MINERAL COMMODITY SUMMARIES OF THE CZECH REPUBLIC

(STATE TO 2007)

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Ministry of the Environment
Czech Geological Survey – Geofond

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CONTENTS

EXPLANATORY NOTES

List of abbreviations, symbols and technical units

AOPK ČR	Agency for Nature Conservation and Landscape Protection (Nature Conservation Authority) of the Czech Republic (Agentura ochrany přírody a krajiny České republiky)
API	American Petroleum Institute
API degrees	Degrees of crude oil specific gravity defined by the API (°API) API gravity formulas: $°\text{API gravity} = \frac{141.5}{\text{SG at } 60° \text{ F}} - 131.5$ $\text{SG at } 60° \text{ F} = \frac{141.5}{°\text{API gravity} + 131.5}$ SG = specific gravity (t/m^3) 60° F = 15,6° C
APT	Ammonium Paratungstate, formula $(NH_4)_{10}[H_2W_{12}O_{42}]\cdot 4H_2O$
ARSM	(Czech) Association for recycling of building materials development (Asociace pro rozvoj recyklace stavebních materiálů)
a. s.	initials after a Czech company name indicate that it is a joint stock company (akciová společnost)
ATPC	Association of Tin Producing Countries
bbl	barrel of crude petroleum, 158.99 dm^3; 1 tonne of crude petroleum is approximately 7 bbl (6.76–7.35 bbl for crude petroleum extracted in the Czech Republic)
bill	billion, 10^9
BP	British Petroleum, British multinational petrochemical company
Btu	British thermal unit, 252 cal, 1,055.06 J
carat	abbreviated as ct – (metric carat), weight unit for gemstones, equal to 0.2 g – unit of gold content (purity) in its alloys equal to 4.167 %; 24 carats = 100 % for fine gold
CBM	Coal Bed Methane
ČBÚ	Czech Mining Office (Český báňský úřad)
ČEZ, a.s.	the biggest Czech producer of electricity
CFR	Cost and Freight (named port of destination)
CHKO	Protected landscape area (Chráněná krajinná oblast)
CHLÚ	Protected deposit area (Chráněné ložiskové území)
CI	Coal Information, mineral (coal) yearbook of the IEA
CIF	Cost, Insurance and Freight (named port of destination)
ČNB	Czech National Bank (Česká národní banka)
ČNR	Czech National Council (Česká národní rada)

COCHILCO	Comisión Chilena del Cobre, Chilean Copper Commission
COREX®	smelting reduction process that allows for the production of hot metal in blast furnace from non-coking coal and ore (concentrate) of various quality
ČR	Czech Republic (Česká republika)
CSK	Czechoslovak Koruna (československá koruna)
ČSÚ	Czech Statistical Office (Český statistický úřad)
CZK	Czech Koruna (česká koruna)
DRI	Direct Reduction of Iron, this method makes iron from high-grade ore without the use of a blast furnace, coke, or limestone
DU	depleted uranium (mostly within the range of 0.2–0.3 % ^{235}U)
e	estimate
ECFIN	Directorate General for Economic and Financial Affairs of the European Commission
ECU	European Currency Unit
EFTA	European Free Trade Association
EIA	Environmental Impact Assessment
	Energy Information Administration, section of the Department of Energy of the USA providing energy statistics, data, analysis
EIU	Economist Intelligence Unit, world's provider of country, industry and management analysis, based in London
ESA	Euratom Supply Agency, European agency for common supply policy on the principle of regular and equitable supply of nuclear fuels for European Community users
EU	European Union
EU-15	EU members since 1995: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom
EU-25	EU members since 2004: EU-15 + Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia
EU-27	EU members since 2007: EU-25 + Bulgaria, Romania
EUR	Euro, currency of Eurozone countries of the European Union
EXW	Ex Works (named place)
FAS	Free Alongside Ship (named port of shipment)
FISIM	an abbreviation for financial intermediation services indirectly measured, their income is given by the difference between the interest which they pay to lenders and interest they receive from borrowers for provided loans
FMPE	Federal Ministry of Fuels and Power (Federální ministerstvo paliv a energetiky)
FOB	Free on Board (named port of shipment)
FOL	Free on Lorry (named place) (United Kingdom)
FOT	Free on Truck (named place) (USA)
Ga	billion of years
GBP	British pound (Great Britain pound, pound sterling)

GBp British pence
GCC Ground Calcium Carbonate
GDP Gross Domestic Product
HEU highly-enriched uranium (above 20 % ^{235}U)
IAEA International Atomic Energy Agency
ICSG International Copper Study Group
IEA International Energy Agency
IISI International Iron and Steel Institute
ILZSG International Lead and Zinc Study Group
IMF International Monetary Fund
IPE International Petroleum Exchange (London, UK)
ISL In Situ Leaching (leaching of U ores in their deposit)
k. s. initials after a Czech company name indicate that it is a limited partnership company (komanditní společnost)
kt kilotonne, 1,000 t
lb pound, 0.4536 kg
LEU low-enriched uranium (up to 20 % ^{235}U, mostly 3–5 %)
LME London Metal Exchange
Ma million of years
MCS Mineral Commodity Summaries, mineral yearbook of the US Geological Survey
mesh to designate screen size as the number of openings per linear inch (including screen wire diameter)
Metals Economic Group a leading worldwide minerals information and consulting company based in Canadian Halifax, founded in 1981
MF Ministry of Finance (of the Czech Republic) (Ministerstvo financí)
MH ČR Ministry of Economy of the Czech Republic (Ministerstvo hospodářství České republiky)
MHPR ČR Ministry of Economic Policy and Development of the Czech Republic (Ministerstvo pro hospodářskou politiku a rozvoj České republiky)
MJ megajoule, 10^6 J
mill million, 10^6
MOX mixed oxide fuel (mixture of plutonium and oxides of uranium from reprocessed burned nuclear fuel, where ^{235}U is replaced by ^{239}Pu as main energy source)
MPO ČR Ministry of Industry and Trade of the Czech Republic (Ministerstvo průmyslu a obchodu České republiky)
mtu metric tonne unit, 10 kg, in concentrates (1 % by weight of useful component content in 1 tonne of concentrate or ore purchased by smelter)
MŽP ČR Ministry of the Environment of the Czech Republic (Ministerstvo životního prostředí České republiky)
N not available or not reliable data

NP	Natural park (Národní park)
NPP	nuclear power plant
NYMEX	New York Mercantile Exchange
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of Petroleum Exporting Countries
PCC	Precipitated Calcium Carbonate
PCE	Pyrometric cone equivalent
PET	Polyethylene Terephthalate, used mainly for manufacture of beverage bottles and (mainly) synthetic fibers ("polyester" in textile)
ppm	parts per million, 0.0001 %
PÚ	exploration area (průzkumné území)
Sb.	Collection of Laws (abbreviated as Coll.) of the Czech Republic
s. p.	initials after a Czech company name indicate that it is a state public enterprise (státní podnik)
spol. s r. o.	initials after a Czech company name indicate that it is a limited liability company (společnost s ručením omezeným), ditto initials s.r.o.
s. r. o.	initials after a Czech company name indicate that it is a limited liability company (společnost s ručením omezeným), ditto initials spol. s r.o.
SEU	slightly enriched uranium (0,9–2 % ^{235}U)
st	short ton, 907.2 kg
t	metric tonne, 1,000 kg, 1,000,000 g
ths	thousand, 10^3
troy oz	Troy ounce (t oz), 31.103 g
T/C	Treatment Charge, the amount per tonne of ore or concentrate (Sn, Pb, Zn, Cu, etc.), charged by the smelter for converting ore or concentrate to metal; it is incorporated into price at which the smelter buys 1 % by weight of useful component content in concentrate or ore (mtu)
UI	Uranium Institute
UNCTAD	United Nations Conference on Trade and Development
USBM	United States Bureau of Mines (disbanded in 1995–1996)
USD	United States Dollar
USc	United States cent
USGS	United States Geological Survey
VAT	value added tax
v. o. s.	initials after a company name indicate that it is an unlimited company (general partnership) (veřejná obchodní společnost)
WBD	Welt Bergbau Daten, mineral yearbook of Austrian Federal Ministry for Economy and Labour
WMMR	World Metals & Mineral Review 2007, mineral yearbook of the Metal Bulletin Plc
WMP	World Mineral Production, mineral yearbook of the British Geological Survey since 2005

WMS	World Mineral Statistics, mineral yearbook of the British Geological Survey till 2004
WNA	World Nuclear Association
WOGR	World Oil and Gas Review, mineral (petroleum, natural gas) yearbook of the Italian multinational petrochemical company ENI (Ente Nazionale Idrocarburi) S.p.A.
ZCHÚ	Specially protected area (Zvláště chráněné území)

Exchange and inflation rates of currencies in which minerals are priced

Annual inflation rates in the USA (US), United Kingdom (UK), Euro Area (EUR) and Czech Republic (CZ)

	US	UK	EUR	CZ
1991	4.2	7.4		56.6
1992	3.0	4.3		11.1
1993	3.0	2.5		20.8
1994	2.6	2.1		10.0
1995	2.8	2.6		9.2
1996	2.9	2.4		8.8
1997	2.3	1.8		8.4
1998	1.5	1.6		10.6
1999	2.2	1.3	1.1	2.3
2000	3.4	0.9	2.1	3.8
2001	2.8	1.2	2.4	4.7
2002	1.6	1.3	2.3	1.8
2003	2.3	1.4	2.1	0.1
2004	2.7	1.3	2.1	2.8
2005	3.4	2.0	2.2	1.8
2006	3.2	2.3	2.2	2.5
2007	2.9	2.3	2.1	2.8

Notes:

- source – IMF. World Economic Outlook Database. October 2008
- inflation rates based on average annual changes of consumer price indices (index, 2000 = 100)

Average yearly exchange rates of CZK against EUR, USD and GBP

	EUR	USD	GBP
1991		29.5	52.0
1992		28.3	49.9
1993		29.2	43.8
1994		28.8	44.0
1995		26.5	41.9
1996		27.1	42.3
1997		31.7	51.9
1998		32.3	53.4
1999	36.9	34.6	56.0
2000	35.6	38.6	58.4
2001	34.1	38.0	54.8
2002	30.8	32.7	49.0
2003	31.8	28.2	46.0
2004	31.9	25.7	47.1
2005	29.8	23.9	43.6
2006	28.3	22.6	41.6
2007	27.8	20.3	40.6

Source: Czech National Bank

Mineral reserve and resource classification in the Czech Republic

The Czech classification

After 1948 the reserve classification of the USSR was progressively adopted in Czechoslovakia, of which the Czech Republic formed part. A Commission for Classification of Mineral Reserves *(Komise pro klasifikaci zásob – KKZ)* was established in 1952, as a state agency to review the categorisation and estimation of reserves of all types of minerals, except radioactive ores.

Initially geological reserves (all reserves in their original state in the deposit without subtracting losses from mining, beneficiation and processing) were classified into subdivisions of groups and categories (slightly simplified).

Groups of geologic reserves according to industrial utilisation:

nebilanční potentially economic – currently unminable due to a low mineral content, small deposit thickness, particularly complicated mining conditions, or due to the unfamiliarity with economic processing methods for the given mineral type, yet which may be considered as exploitable in the future

bilanční economic – minable, suitable for industrial utilisation and for the technical mining conditions for extraction

Categories of geological reserves according to the degree of deposit exploration:

A – explored in detail and delimited by mining works or boreholes, or by a combination of these. Geological setting, distribution of quality mineral types in the deposit and the technological properties of the mineral are known to such a degree that allow for the development of a method for beneficiation and processing of the mineral. Natural and industrial types of minerals are given. Reserves A include those parts of the deposit, where the geological setting, hydrogeological conditions and mining conditions are known to such a degree that a deposit development method can be developed**.**

B – explored and delimited by mining works or boreholes, or by a combination of these in a sparser network than in category A. It further includes reserves of deposits adjoining blocks of category A, verified by exploration works. The manner of geological setting, natural and industrial types of minerals are determined without knowing their detailed distribution in the deposit. The quality and technological characteristics of the minerals are given within a range allowing for a basic choice of a processing method. Hydrogeological conditions and general principles of deposit development are sufficiently clarified.

C_1 – determined by a sparse network of boreholes or mining works, or by a combination of these, as well as reserves which adjoin the reserves of categories A and B, if they are justified from a geological perspective. They also include the reserves of relatively complex deposits with a very irregular distribution of the mineral, even though these deposits were explored in detail. Included here are the deposit reserves partially mined-out with low recovery methods. The setting conditions, quality, industrial types and processing technology of the mineral are defined based on analyses or laboratory tests of samples, or based on analogy with explored deposits of a similar type. The hydrogeological conditions and the principles of deposit development are defined quite in general.

C_2 – are assumed based on geological and geophysical data, confirmed by sampling of the mineral deposit from outcrops, isolated boreholes or mining works. Also, reserves adjoining the reserves of categories A, B, C_1, where geological conditions for this exist.

It is further defined that project development and investment amounts for the construction of mining facilities are permitted on the basis of the economic mineral reserves in categories A+B+C_1, which are therefore reserves eligible for industrial utilisation. That is why, in practice, the economic reserves of categories A, B, C_1, or their total A+B+C_1 was designated by the term industrial reserves.

In 1963, KKZ established the projected reserves *(prognózní zásoby)* category in an amendment of its Principles for the classification of solid minerals (hereinafter Principles) *(Zásad pro klasifikaci zásob pevných nerostných surovin)*. They were defined as unexplored mineral reserves, assumed on the basis of the formation patterns and the distribution of mineral deposits, and investigations, dealing with the geological structure and the history of geological evolution of the evaluated locality. The parameters for the evaluation of projected reserves (strike length, thickness, average mineral content and the like) are determined according to geological assumptions or they are derived. According to the Principles, projected reserves are not listed in the national Register of Reserves *(bilance zásob)*. They serve only as a basis for future planning of geological exploration.

In 1968, KKZ innovated the definition of projected reserves. In the amended Principles for reserve classification, it established the division of reserves into proved (by exploration or mining) and assumed, or projected. Projected geological reserves are unverified reserves, however they are assumed based on geological, geophysical and other scientific knowledge and material. They are predominantly the reserves of larger localities and formations, and, in isolated cases, the reserves of unexplored parts of large structures or deposits.

Due to the establishment of the projected reserve category, geological reserves *(geologické zásoby)* can, with regard to contents, be translated into English as total resources. However up to 1989, the term resources did not appear in Czech or Czechoslovak classifications. But up to now, reserves also represent mineral accumulations, which meet the reserves criteria due to being explored, but which do not meet them due to technical and economic reasons (potentially economic reserves *nebilanční zásoby*). They are therefore mineral resources.

In 1981, the Czech Geological Office issued Directive no. 3 [24], where the present projected reserves *(prognózní zásoby)* were divided into categories D_1, D_2, D_3. They are defined as follows:

D_1 – relate to verified mineral deposit reserves, with which they form one whole deposit. Determined in delimited areas and quantifiable based on positive detection of an existing mineral and its basic quality characteristics.

D_2 – territorially independent. They are determined in a delimited area based on positive detection of an existing mineral and its basic quality characteristic. Analogies are also used for their determination.

D_3 – determined on the basis of regional investigation. So far, mineral existence has not been proven in such a way, in order to be able to delimit the area of their occurrence and to quantify the prognosis.

In October 1989, the Czech Geological Office issued Decree no. 121/1989 Coll., which redefined the projected reserve categories, changed their designation, and for the first time in the Czech Republic established the term resources. The term projected resources has been used instead of the term projected reserves ever since. The categories P_1, P_2, P_3 were as follows:

P_1 – assumed due to the continuation of an already investigated deposit beyond the reserve outline of category C_2 or due to the discovery of new deposit parts (bodies). The basis for this category are the results of geological mapping, geophysical, geochemical and other work in the area of possibly occurring projected resources: geological extrapolation of data results from the investigation, or the verification of part of the deposit. In justified cases this category also includes areas with isolated technical works which do not fulfill the requirements in order to be included in the reserves category C_2. The quantity and quality of the projected resources of this category is estimated according to the given deposit type and its part with detected reserves.

P_2 – assumed in basins districts and geological regions, where deposits of the same formation and generation type were detected. It is based on a positive evaluation of deposit indications and anomalies observed during geological mapping and geophysical, geochemical and other work, whose prospect is, if necessary, confirmed by a borehole or surface excavation work. The projected resource estimate of assumed deposits and the concept of the shape and dimensions of the bodies, their composition and quality, are derived by analogy with known deposits of the same type.

P_3 – assumed solely on the basis of conclusions concerning the formation possibilities of the deposit types under consideration with regard to favourable stratographic, lithological, tectonic and paleogeographic conditions detected while evaluating the locality during geological mapping, and during analysis of geophysical and geochemical data. The quantity and quality of projected resources is estimated according to assumed parameters of the deposit development by analogy with more closely explored localities, where deposits of the same genetical type were detected or verified. The projected resources of minerals in category P_3 can only be displayed by a surface projection.

The amendment of Mining Act no. 541/1991 Coll. divided the classification of reserves (reserved deposits) according to exploration into the categories of prospected reserves (*vyhledané zásoby)* and explored reserves *(prozkoumané zásoby)*, and, according to exploitability conditions, into economic reserves *(zásoby bilanční)* and potentially economic reserves *(zásoby nebilanční)* **.**

Economic – reserves suitable for existing technical and economic conditions in exploiting a reserved deposit.

Potentially economic reserves – currently unexploitable due to being unsuitable for existing technical and economic conditions of exploitation, yet assumed to be exploitable in the future in consideration of expected technical and economic development.

Neither this amendment nor any other regulation defined the content of the terms **prospected** and **explored** reserves. In practice, these categories are identified with the categories of reserve exploration, as they were in effect before the amendement of Mining Act no. 541/1991 Coll., in the following manner: explored reserves = sum of reserve categories A + B + C_1 (also called industrial), prospected reserves = reserves of category C_2**.**

Decree no. 369/2004 Coll., on the planning, execution, and evaluation of geological work, on announcing geohazards**, and on the procedure for estimating reserves of reserved deposits** redefined the categories of projected resources as follows:

P (for reserved minerals) = **R** (for non-reserved minerals) – projected resources, for which existing knowledge of the geological structure of the projected resource area and of the mineral existence and quality has been proven based on technical works.

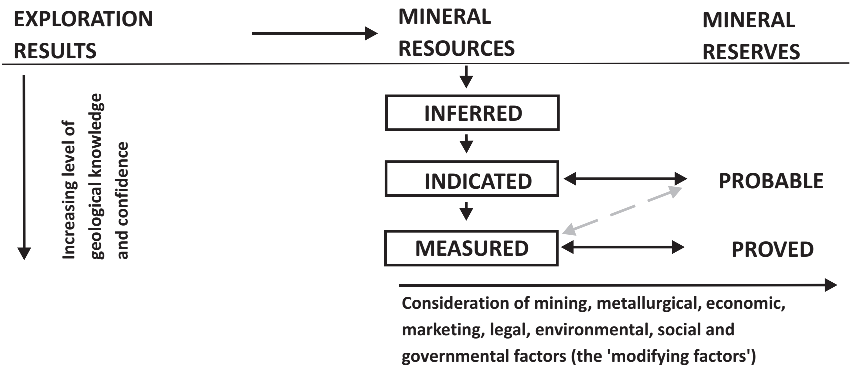
Q – projected resources delimited separately beyond the existing mineral deposit, detected during geological mapping in suitable geological conditions based on justified analogy with another deposit, without proof of existence based on technical works.

International classifications

International systems of classifying reserves and resources developed most rapidly in the last quarter of the twentieth century. In 2001, the European Code for Reporting of Mineral Exploration Results, Mineral Resources and Mineral Reserves was published. This corresponds to the reporting standards of the Australian, Canadian, South African and other organisations grouped in the Combined Reserves International Reporting Standards Committee (now called Committee for Mineral Reserves International Reporting Standards) – CRIRSCO. It is summarized as follows:

Relations between mineral reserves and resources, their definitions

Chart of the relations [27]



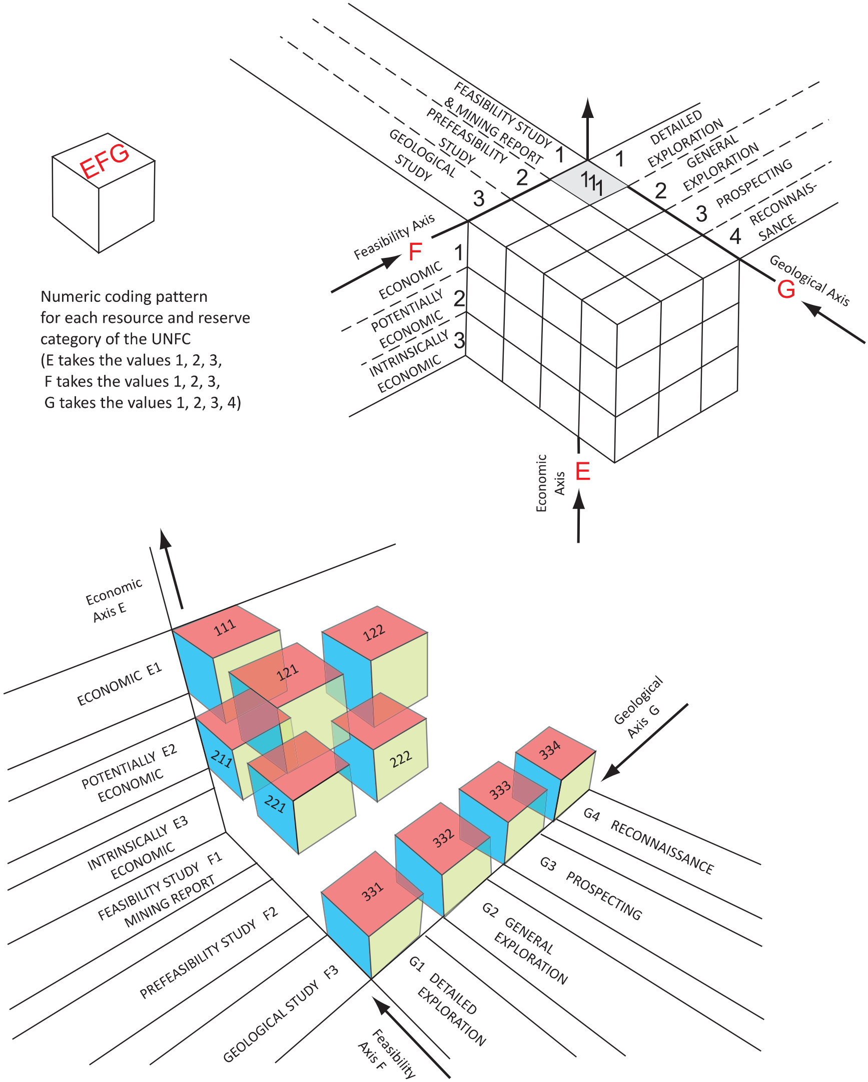
The given definitions are in accordance with the definitions of the UNFC (United Nations Framework Classification) classification of the UN, published by UN-ECE in 1997 [28]. This classification divides (just as, for example, the classification of the USA [15]) its categories according to economic feasibility (quantity and quality of the mineral in situ) in one direction into 3 groups. For the division according to the level of geological knowledge it does not use one direction, one criterion (verification according to technical work carried out), as is common, but two directions, two criteria: 1) According to which of the 4 phases of exploration (from geological to mining) and 2) according to which study (from geological to mining) the given mineral accumulation was prospected or verified. Thus in the area between the axes E (economic), F (feasibility) and G (geological), a total of 36 categories can be established mechanically, out of which only 10 actually exist. The categories are marked with a three-digit code and a priori do not have designations (although recommended designations exist).

(Notice: In the course of discovery and verification of mineral deposits and their estimations of mineral resources and reserves two fundamental stages connect at each other: prospecting and exploration.

Prospecting is a set of geological activities aiming at discovery a mineral accumulation (mineral accumulations) which could be a mineral deposit (mineral deposits) and to express in numbers its (their) mineral resources.

Exploration is to decide if a mineral accumulation (prospective mineral deposit) is a mineral deposit or not and if it is, to estimate its mineral reserves.)

Two presentation ways of UNO spatial mineral resource – reserve classification system (United Nations Framework Classification)



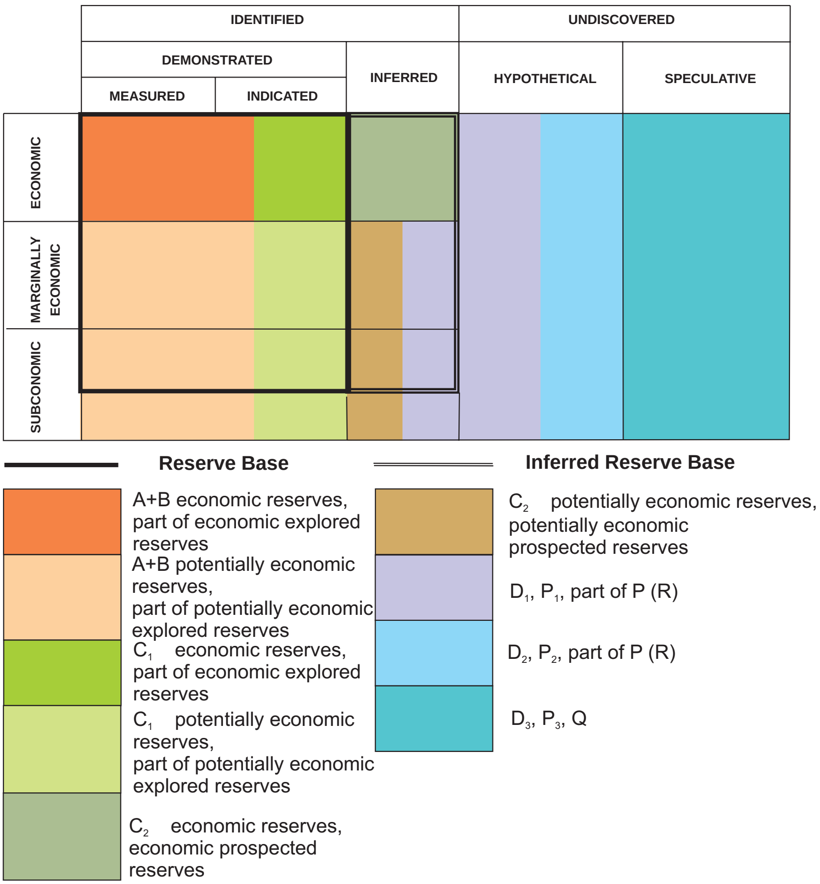
An important aspect of the European and similar reporting codes is the concept of the "competent person". He is responsible for the calculation of reserves and its categories, is a member of an acknowledged professional society (which sees to the expertise and ethics of its members via sanctions), and has expert and moral qualities. His estimates are accepted as reliable by banks and securities exchanges. Competent persons are members of Recognized Overseas Professional Organizations (ROPO), a list of organisations is compiled by the Australasian Joint Ore Reserves Committee (JORC).

Although some national and international classifications are relatively complicated, the mining industry frequently still makes do with only the categories of proved and probable reserves. If it is seeking funds from banks or share flotations on securities exchanges, it must respect the regulations for reporting its mineral reserves. The securities exchanges have reporting requirements which are particularly strict or even provided by law. In general they require adherence to the reporting codes of the international organizations such as those that cooperate in framing the European Code.

Comparison of Czech and international systems of classification

The following scheme and table compare the reserve and resource classifications of the Czech Republic with the international classifications discussed above.

Comparison of the mineral resource classification valid in the USA from 1980 [15] with the reserve and resource classifications valid in the territory of the Czech Republic from 1956



Comparison of UNFC with the reserve and resource classifications of the Council of Mining and Metallurgical Industries (CMMI) [28] and of the Czech Republic

Code of the UNFC category	**Proposed designation of the UNFC category**	**CMMI category**	**Czech categories up to 1991**	**Czech categories in 1991–2004**	**Czech categories after 2004**
111	Proved Mineral Reserve	Proved Mineral Reserve	economic reserves – parts A+B	explored economic reserves	explored economic reserves
121 + 122	Probable Mineral Reserve	Probable Mineral Reserve	economic reserves – parts B + C_1	explored economic reserves	explored + prospected economic reserves
211	Feasibility Mineral Resource	Measured Mineral Resource	potentially economic reserves – parts A+B	explored potentially economic reserves	explored potentially economic reserves
221 + 222	Prefeasibility Mineral Resource	Indicated Mineral Resource	potentially economic reserves- parts B + C_1	explored potentially economic reserves	explored + prospected potentially economic reserves
331	Measured Mineral Resource	Measured Mineral Resource	potentially economic reserves – parts A+B	explored potentially economic reserves	prospected potentially economic reserves + related part P (R)
332	Indicated Mineral Resource	Indicated Mineral Resource	potentially economic reserves – part B + C_1	explored potentially economic reserves	explored potentially economic reserves
333	Inferred Mineral Resource	Inferred Mineral Resource	potentially economic reserves C_2 + parts D_1, P_1	prospected potentially economic reserves + part P_1	prospected potentially economic reserves + part P (R)
334	Reconnaissance Mineral Resource	not available	parts D_1, P_1+ D_2, P_2+D_3, P_3	parts P_1+ P_2+ P_3	parts P (R)+Q

Conclusions

If they are to be of practical use national and international classifications have to respect the information base given by the reserve estimations of mining enterprises. It may be unsuitable to overly expand the classification requirements or expectations beyond the realistic means of this base. Combining a classification with a study (project), which classifies given resources or reserves, or with a prospecting and exploration phase, in which mineral resources and reserves were estimated, causes problems. For economic (acquiring financial means, taxes, market position) or political reasons, a prospector or a mining company developer may be led, for example, to move their exploration phase higher or lower in comparison with its actual position. In socialist (communist) Czechoslovakia with its completely nationalised industry, commerce and services, results of geological prospecting and exploration were judged**,** not according to the mineral reserves prospected or verified by exploration, but according to the fulfillment of exploration work plans, whether planned investments in exploration were completely spent on "drilling and digging", or not. The wage of the employees of exploration and mining organisations depended on the fullfilment of plans. That is why at all levels**,** there was also an interest, that prospecting and exploration constantly continue. Consequently, prospecting strictly speaking and general exploration were the most frequent type of prospecting, and verified reserves were possibly never categorised under A. They were commonly only inserted into categories C_1 and C_2. That enabled their permanent verification. On the other hand, many mining organisations mined the reserves of category C_2 which however could have been ranked factually higher; they were over-explored.

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INTRODUCTION

The *Mineral Commodity Summaries of the Czech Republic*, published for the sixteenth time, is intended to inform professional and particularly business communities, and to assist in the expansion of the minerals industry in line with valid legislation and the interests of mining organisations.

Work of the author team, which was enlarged again this year, has been revised by a team of domestic and foreign reviewers. The reviewer team was made up of prominent experts in their respective fields. There was no change in the reviewer group.

Suggestions of the reviewers and readers are being incorporated into the yearbook gradually depending on the author team‘s availability and time constraints resulting from the preparation schedule of the yearbook.

This publication covers the most important minerals of the Czech Republic, which are or have recently been of industrial importance. It includes basic data on the status and changes in the mineral reserves of the Czech Republic taken from the Register of Mineral Deposit Reserves (hereinafter the Register), which is published for a limited number of state administration agencies.

Additional information on prices of minerals, their technological parameters and use, imports and exports, major mining companies, and the location of mineral deposits is intended to assist in understanding the mineral potential of the Czech Republic and to stimulate investment in the minerals industry.

The publication is being updated by relevant statistical data in relation to the development of the national information system, international cooperation, and readers' comments.

The mineral reserves presented are geological reserves, also called *total reserves,* i.e. original reserves (in situ) within individual deposits, estimated according to the given classification and technical-economic conditions of their exploitability. The initial data come from mineral reserve estimates, which were approved or verified in the past by the Commission for Classification of Mineral Reserves and/or by the Commission for Exploration and Mining of Reserved Minerals of the former MHPR ČR and MH ČR, or by former commissions for management of mineral reserves of individual mining and processing industries. Uranium reserves and reserve estimates were approved by the Commission for Classification of Radioactive Mineral Reserves of the former Federal Ministry of Fuels and Energy. Currently, mineral reserves are approved by the Commission for Projects and Final Reports of the Ministry of the Environment of the Czech Republic or by agencies authorising geological work.

There are reserved and non-reserved minerals and deposits as defined by the Mining Act no. 44/1988 Coll., as amended. Reserved minerals always form reserved deposits which are owned by the Czech Republic. Non-reserved deposits are owned by landowners. Non-reserved minerals (construction minerals) can form both reserved and non-reserved deposits. Until 1991, reserved deposits of sufficient mineral quantity and quality were proclaimed "suitable for the needs and development of the national economy" as defined by the Mining Act at that time. Since 1991, the newly recognised and explored deposits of non-reserved minerals form non-reserved deposits.

As of 31 December 2007, geological reserves of reserved deposits of reserved and non-reserved minerals had reached 47.9 billion tonnes of predominantly energy and construction minerals. In 1993–2001, the Ministry of the Environment along with the Ministry of Industry and Trade undertook a fundamental economic revaluation of the mineral wealth of the Czech Republic**.** In 2003–2006, the task has continued to a smaller extent. Therefore compared to past years, many considerable changes have occurred in the number of deposits and registered reserves of many minerals (especially metallic ores).

The *Mineral Commodity Summaries of the Czech Republic* includes selected minerals, i.e. mineral fuels, industrial and construction minerals, and metallic ores, which are of economic importance and of substantial reserves (as with most ores in the past) in the territory of the Czech Republic. Each mineral is presented in a separate chapter consisting of eleven parts.

Part 1. Characteristics and use – provides a basic description of the mineral raw material, its natural occurrence, major minerals and general economic use.

Part 2. Mineral resources of the Czech Republic – describes major regions of occurrence, deposit characteristics, ore types, mining and potential use of the given mineral.

Part 3. Registered deposits and other resources of the Czech Republic – is based on the Register of Mineral Deposits of the Czech Republic and, for the majority of minerals, includes a list of deposits and their location. The names of exploited deposits are given in bold. As for energy minerals and some industrial minerals, only regions and basins rather than single deposits are given. As for dimension stone and construction minerals, which are scattered in hundreds of deposits over the whole territory of the Czech Republic, their groupings are located in the subdivisions of reserved, non-reserved, exploited and unexploited deposits.

Part 4. Basic statistical data of the Czech Republic as of December 31 – are extracted from the Register. There are 3 groups of minerals (ores, energy minerals, and reserved industrial and construction minerals) registered in the Czech Republic. Mine production of non-reserved deposits has been monitored since 1999.

NOTE: **The *Register* presents the *reserves* data in the catagories on exploration (prospected, explored) and economic use (economic, potentially economic), as stipulated by relevant statutes starting with the Mining Act. *Reserves* include *potentially economic reserves*, i.e. reserves which are currently not recoverable and which are, therefore, *potentially economic resources.* Consequently, *total mineral reserves* are in reality *total mineral resources*. The term *reserves* as used, by contrast, in standard international classifications represents only the parts of explored resources which are available for immediate extraction. All other registered parts are resources, not reserves, of a given mineral.** The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter of this yearbook ***"Mineral reserve and resource classification in the Czech Republic".***

Part 5. Foreign trade – provides import and export information on important tariff items of the given raw material. The foreign trade data are the latest (continuously reviewed) data of the ČSÚ.

Part 6. Domestic market and foreign trade prices – provides indicative prices on domestic production, import and export prices. Domestic prices do not include VAT.

Part 7. Mining companies in the Czech Republic as of December 2006 – provides a list of companies mining the given mineral in the territory of the Czech Republic. The companies are listed according to production level. Their addresses are available from the Czech Geological Survey – Geofond.

Part 8. World production – provides data on mining and production of commercial products for the last 5 years, and lists significant world producers, i.e. the top 5–10 countries in world production.

Part 9. World market prices – provides a summary of world prices and their evolution in the last five years as well as current quoted or negotiated prices.

Part 10. Recycling – provides a brief description of possible recycling methods in worldwide use.

Part 11. Substitutes – provides an appraisal and a list of possible material substitutes in worldwide use.

Numerous domestic and foreign data, used in compiling the present yearbook, came from journals, expert literature and the latest editions of various international statistical yearbooks (e.g. Welt Bergbau Daten 2008 (WBD), Mineral Commodity Summaries 2007 (MCS), World Mineral Statistics (WMS), World Mineral Production 2002–2006 (WMP), World Oil and Gas Review 2008 (WOGR), Coal Information (CI), World Metals & Mineral Review 2006 (WMMR), BP Statistical Review of World Energy 2008, Estadísticas del Cobre y Otros Minerales 1987–2006 de Comisión Chilena del Cobre).

MINERAL BASE OF THE CZECH REPUBLIC AND ITS DEVELOPMENT IN 2007

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Ministry of the Environment

The minerals defined in Act No. 44/1988 Coll., on the Protection and Use of Mineral Resources (the Mining Act) as amended, are classified as being reserved and non-reserved. Natural accumulations of reserved minerals form reserved mineral deposits which constitute the mineral wealth of the country and are owned by the Czech Republic. Deposits of non-reserved minerals (especially sand and gravel, crushed stone and brick clay) are a constituent part of the land as stipulated in § 7 of the Mining Act. The former option, declaring significant non-reserved mineral deposits as reserved deposits, was cancelled by the amendment of the Mining Act in 1991. Decisions of administrative agencies in this matter, which had been issued before the amendment went into effect, remain valid based on transitional provisions (§43 and 43a par. 1 of the Mining Act). The deposits specified by these decisions are still reserved deposits, i.e. owned by the state, separated from the land itself.

Prospecting and exploration for reserved mineral deposits, by virtue of the ČNR Act No. 62/1988 Coll., on Geological Work (the Geological Act) as amended, may be conducted by an individual or organisation, providing that the work is managed and guaranteed by a qualified and certified person (responsible manager for the geological work). An organisation seeking to prospect for and explore these mineral deposits, to verify their reserves, and to process geological documents for their exploitation and protection, must make a request to the Ministry of the Environment to establish an exploration area. The proceedings, subject to administrative rules, are concluded by the establishment or non-establishment of an 'exploration area' (exploration permit). In the former case, the following must be determined: the survey area, the mineral to be prospected and explored for which the exploration area is being established, the conditions for the execution of the work, and the period of validity of the exploration area. The exploration area is not a territorial decision, but provides the entrepreneur or organisation (hereinafter entrepreneur) with the exclusive privilege to prospect for the mineral in a given exploration area. In the first year, the entrepreneur is obliged by law to pay a tax of CZK 2,000 per km^2 or km^2 piece of exploration area, which increases annually by CZK 1,000 per km^2 and its piece. These taxes represent an income for the municipalities, in whose cadastral areas the exploration area is established.

Within the scope of planning and conducting the prospecting for and exploration of reserved mineral deposits, the organisation must consider the conditions and interests protected by special regulations (§ 22 of the Act on Geological Work). These primarily refer to laws for the protection of landscape and nature, agricultural and forest land; to the Water and Mining Acts etc. The Ministry of the Environment can cancel the established exploration area, if the organisation repeatedly or severely violates the obligations set by the Geological Act.

The above-mentioned enactments apply to prospecting and exploration for non-reserved mineral deposits, only, if they were previously declared as reserved deposits according to the transitional provisions of the Mining Act. In other cases, an organisation can prospect and explore for non-reserved minerals only upon agreement with the landowner. The provision under § 22 of the Act on Geological Work is also valid in these cases. The mining of reserved deposits is considered to be a mining operation and the mining of non-reserved deposits, which constitute a part of the land, an operation conducted according to the mining methods set by Act No. 61/1988 Coll., on Mining Operations, Explosives and the State Mining Administration, as amended.

If, during prospecting and exploration, a reserved mineral is found to be of quality and quantity indicative of its accumulation (supported by a partial deposit reserve estimate given in the category of prospected reserves), the organisation must report it to the MŽP, which issues a certificate for the reserved deposit owned by the state. At the same time, this certificate ensures the deposit against actions rendering its mining difficult or impossible by the establishment of a protected deposit area (CHLÚ) according to § 17 of the Mining Act.

The entrepreneur's right to mine the reserved deposit is provided by the grant of a mining lease. The submittal of a proposal for the grant of a mining lease must be preceded by an approval from the MŽP, which may depend on the fulfilment of limiting conditions accounting for the interests of the state mineral policy, and on covering expenses of geological work already funded by the state. The organisation, on whose behalf the exploration was carried out, has priority in receiving the approval for the grant of the mining lease. If it fails to assert its mining lease, precedence is then given to the organisation which participated financially in the exploration. Somewhat different rules apply to cases concerning crude oil and natural gas based on a transposed EU directive.

The mining lease is only granted to an entrepreneur possessing a *Certificate of Mining Operations* issued by an authorised Regional Mining Office. This grant procedure takes place in cooperation with relevant administrative agencies, mainly in agreement with environmental, land use planning and building authorities. The entrepreneur‘s proposal for the grant of a mining lease must be furnished with documentation as stipulated by law. The procedure deals with landowner relations and settlement of conflicts of interests, which are protected by special regulations. The environmental impact assessment (EIA) represents a part of the documentation, too. The grant of a mining lease represents a mining as well as land use authorisation.

The entrepreneur, who has been granted a mining lease, may start mining operations only after obtaining a mining permit from the authorised Regional Mining Office. Issue of this permit is subject to an administrative procedure assessing the plans of opening, the preparation and the mining of the deposit, and the plans for rehabilitation and reclamation after termination of mining. In justified cases, the Regional Mining Office may combine the grant of a mining lease and of a mining permit into one administrative procedure.

The entrepreneur is obliged to pay royalties on the mining lease and the extracted reserved minerals. An annual lease payment of CZK 100-1,000 is assessed on every hectare opened within the mining lease area, which is marked off on the surface. The payment is graded with respect to the degree of environmental protection of the affected area, the type of activity conducted in the mining lease, and its environmental impact. The Regional Mining Office fully transfers this payment to the municipalities, in whose territories the mining lease is located, according to the lease proportions in each municipal territory.

An annual royalty on minerals extracted in mining leases is given by the MPO Decrees No. 426/2001 Coll., and 63/2005 Coll., which amend the Decree No. 617/1992 Coll., detailing the payment of royalties on mining leases and extracted minerals.

The royalty on extracted minerals is calculated as

$$U = \frac{Nd}{Nc} \cdot T \cdot \frac{S}{100},$$

whereby

Nd = costs of mineral extraction (ths CZK)
Nc = total costs of the enterprise for manufacture of products (ths CZK)
T = sales (ths CZK)
S = royalty rate (%)
U = royalty total (ths CZK)

The Regional Mining Office transfers 25 % of the yielded royalty to the state budget of the Czech Republic to be purposefully used in remediation of environmental damage caused by the mining of reserved and non-reserved deposits, and the remaining 75 % to the budget of the relevant municipalities.

During the course of mining, the entrepreneur is required to generate sufficient financial reserves for mine damages and for reclamation of areas affected by the deposit exploitation. Generating of the financial reserves is approved by the Regional Mining Office during the mining permit procedure regarding the opening and extraction of the deposit. Drawing on the reserves is permitted by the Regional Mining Office upon agreement with the Ministry of the Environment and upon notification by the relevant municipality. In the case of (partially) state-owned enterprises, the Regional Mining Office decides in agreement with the Ministry of Industry and Trade.

Selected statistical data on exploration and mining on the territory of the Czech Republic

Statistical data/Year	2003	2004	2005	2006	2007
registered geological works	2 680	2 850	2 631	2 563	2 940
protected deposit areas	1 018	1 052	1 048	1 060	1 048
mining leases – total number	1 008	1 004	998	986	988
number of exploited reserved deposits	540	513	517	508	512
number of exploited non-reserved deposits	252	220	224	219	220
mine production of reserved deposits, mill t [a)]	133	134	135	138	151
mine production of non-reserved deposits, mill t [a)]	12	13	14	15	16
organizations managing reserved deposits	387	314	335	328	338
organizations mining reserved deposits	231	227	215	204	205
organizations mining non-reserved deposits	195	167	190	165	188

Note:
[a)] conversions: natural gas 1 mill m^3 = 1 kt, dimension and crushed stones 1,000 m^3 = 2.7 kt, sand and gravel and brick clays and related minerals 1,000 m^3 = 1.8 kt

Significance of mining in the Czech economy

Ratio/Year	2003	2004	2005	2006	2007
Real annual GDP growth, %	3.6	4.6	6.5	6.4	6.6
Share of mining and quarrying in GDP, %	1.1	1.4	1.2	N	1.1*
Share of mining and quarrying in industrial production, %	2.8	2.6	2.6	2.5	2.0*

Note:
* preliminary data

Trends of reserves of minerals (economic explored disposable reserves)

Totals in mill t (if not otherwise stated)

Group/Year		2003	2004	2005	2006	2007
Metallic ores	a)	26	26	26	26	26
Energy minerals	b)	3 076	3 015	2 972	2 830	2 778
of which: uranium (U)(kt)		2	2	2	2	2
crude oil		13	13	13	12	15
natural gas	b)	42	42	47	47	46
Industrial minerals		2 735	2 726	2 705	2 669	2 779
Construction minerals	c)	5 395	5 316	5 350	5 220	5 200

Note:
a) metals in ores total, in 2003 only Au (25 642 kt) and Sn-W (709 kt) ores, since 2004 only Au ores (25 642 kt)
b) natural gas – conversion into kt: 1 mill m^3 = 1 kt
c) including dimension stone, conversion into kt – dimension and crushed stones 1,000 m^3 = 2.7 kt, sand and gravel and brick clays and related minerals 1,000 m^3 = 1.8 kt

Summary of exploration licences valid in 2007 and newly issued in 2007 (listed according to minerals)

Exploration areas (EA) in 2007

Prospecting and exploration works financed by companies

Minerals	Number of valid EA (min. 1)	Number of valid EA (min. 2)	Number of new issues in 2007	Start of validity in 2007
Hard coal	1	0	0	0
Crude oil and natural gas	37	0	0	0
Gemstones	1	1	1	1
Kaolin	5	0	0	0
Clays	4	0	2	2
Bentonite	3	0	0	0
Feldspar and feldspar substitutes	4	3	2	2

Minerals	Number of valid EA (min. 1)	Number of valid EA (min. 2)	Number of new issues in 2007	Start of validity in 2007
Silica raw materials	3	0	0	0
Crushed stone	0	0	0	0
Sand and gravel	2	0	0	0
Total	**61**	**4**	**5**	**5**

Mineral 1 (min. 1) – in case that the raw material is the major one
Mineral 2 (min. 2) – in case that the raw materials is a by-product

Prospecting and exploration works financed from the state budget

In 2007, the Ministry of Environment conducted state-funded geological work related to the reevaluation, prospecting, exploration and protection of reserved deposits in the amount of CZK 3.111 mill. For instance, exploration of new deposits of reserved minerals was carried out in order to safeguard them for future use. This concerns the exploration of bentonite, glass and foundry sands, kaoline, clays and feldspar deposits.

The Central Geological Authority of the state administration fulfils the duty involving the state register of reserved deposits – state property (§ 29 of the Mining Act). Accordingly, it issues the register as one of the main sources for

- land use planning
- the raw material policy
- the energy policy
- the environmental policy
- the structural policy
- the employment policy

The register lists the **latest status of the deposits as documented in the reserves estimate.** The reserves estimate is prepared **with respect to the conditions of exploitability** expressing

- the state of the market, prices, business economy,
- the mining and technical conditions of exploitation,
- the conflicts of interests arising from the deposit exploitation (primarily environmental protection and other conflicts)

It is altogether entirely unstable factors reflecting political, economic and social change (in the largest sense).

Reevaluation of deposits not allocated for entrepreneurial exploitation continued.

A portion of funds from the state budget was allocated to rectify the consequences of mineral exploration and mining.

Some technical workings which were carried out during geological explorations in the past and which started to endanger the environment, had to be liquidated. In 2006, CZK 10.257 mill were spent on the liquidation of these workings.

A partial programme continued aimed at reevaluating heaps, dumps and tailings after termination of mineral mining from two fundamental standpoints:

a) which of the existing heaps, dumps and tailings represent a mineral accumulation potentially exploitable in the future, and should therefore be considered as such;

b) what is the biotope status in the heaps, dumps and tailings, and which of them pose a hazard from a perspective of environmental management.

The results of work in this area are also used to evaluate the impact of former mining operations in individual localities. CZK 1.5 mill were spent on this work in 2007.

Expenditures for state-funded exploration work related to economic geology

(rounded values)

1993	CZK 248.7 mill
1994	CZK 249.8 mill
1995	CZK 242.3 mill
1996	CZK 163.0 mill
1997	CZK 113.2 mill
1998	CZK 114.2 mill
1999	CZK 110.8 mill
2000	CZK 26.3 mill
2001	CZK 21.5 mill
2002	CZK 17.0 mill
2003	CZK 7.0 mill
2004	CZK 26.2 mill
2005	CZK 12.0 mill
2006	CZK 1.7 mill
2007	CZK 3.0 mill

Mainly geological work of a *non-deposit* character was funded by the state. Individual projects were publicly commissioned in order to implement the following partial programmes:

- rectify the consequences of past geological (non-deposit) work financed by the state (mine workings not yet liquidated, boreholes)
- geological informatics
- geological mapping
- geohazards of the environment
- hydrogeology
- engineering geology
- comprehensive geological studies

CZK 58.1 mill in total were spent on these geological works in 2007.

Summary of selected legal regulations on mineral prospecting and exploration in force as of June 30, 2007

Acts

Act No. 44/1988 Coll., on Mineral Protection and Use (the Mining Act) – as amended by the Acts No. 541/1991 Coll., No. 10/1993 Coll., No. 168/1993 Coll., No. 132/2000 Coll., No. 258/2000 Coll., No. 366/2000 Coll., No. 315/2001 Coll., No. 61/2002 Coll., No. 320/2002 Coll., No. 150/2003 Coll., 3/2005 Coll., No. 386/2005 Coll., No. 186/2006 Coll. and No. 313/2006 Coll.

Act No. 61/1988 Coll., on Mining Operations, Explosives and the State Mining Administration as amended by the Acts No. 425/1990 Coll., No. 542/1991 Coll., No. 169/1993 Coll., No. 128/1999 Coll., No. 71/2000 Coll., No. 124/2000 Coll., No. 315/2001 Coll., No. 206/2002 Coll., No. 320/2002 Coll., No. 226/2004 Coll., No. 3/2005 Coll., No. 386/2005 Coll., No.186/2006 Coll., No. 313/2006 Coll. and No. 342/2006 Coll.

Act No. 62/1988 Coll., on Geological Work, as amended by the Acts No. 543/1991 Coll., No. 366/2000 Coll., No. 320/2002 Coll., No. 18/2004 Coll., No. 3/2005 Coll., No. 444/2005 Coll. and No. 186/2006 Coll.

Other legal regulations

Mineral deposits exploitation

Decree of the ČBÚ No. 306/2002 Coll., that determines the **operation districts of the Regional Mining Offices.**

Decree of the ČBÚ No. 104/1988 Coll., **on efficient use of reserved deposits, on permits and notification of mining operations and other activities employing mining methods,** as amended by the Decree No. 242/1993 Coll., No. 434/2000 Coll., and No. 299/2005 Coll.

Decree of the ČBÚ No. 415/1991 Coll., **on construction, the elaboration of documentation and the determination of safety pillars, rods and zones for the protection of underground and surface sites** in the wording of the Decree of the ČBÚ No. 340/1992 Coll., and No. 331/2002 Coll.

Decree of the ČBÚ No. 172/1992 Coll., **on mining leases** in the wording of the Decree No. 351/2000 Coll.

Decree of the ČBÚ No. 175/1992 Coll., **on the conditions of non-reserved mineral deposit exploitation** in the wording of the Decree No. 298/2005 Coll.

Decree of the MŽP ČR No. 363/1992 Coll., **on the survey and registry of old mine workings** in the wording of the Decree of the MŽP No. 368/2004 Coll.

Decree of the MŽP ČR No. 364/1992 Coll., **on protected deposit areas**

Decree of the ČBÚ No. 435/1992 Coll., **on mine surveying documentation during mining and during some operations employing mining methods** in the wording of the Decree of the ČBÚ No. 158/1997 Coll. and the Decree No. 298/2005 Coll.

Decree of the MH ČR No. 617/1992 Coll., **detailing the payment of royalties on mining leases and extracted minerals**, in the wording of the Decree of the MPO No. 426/2001 Coll. and No. 63/2005 Coll.

Decree of the MHPR ČR No. 497/1992 Coll., **on the registration of reserves of reserved mineral deposits**

Geological work

Decree of the MŽP No. 282/2001 Coll., **on the registration of geological work**, in the wording of the Decree of the MŽP No. 368/2004 Coll.

Decree of the MŽP No. 368/2004 Coll., **on geological documentation**

Decree of the MŽP No. 369/2004 Coll., **on the planning, execution and evaluation of geological work, on announcing geohazards, and on the procedure for estimating reserves of reserved deposits**

Regulations on licensing of mining operations and verification of qualification

Decree of the ČBÚ No. 298/2005 Coll., **on the requirements for professional qualification and competence in mining or operations employing mining methods, and on some legal regulation changes,** in the wording of the Decree No. 240/2006 Coll.

Decree of the ČBÚ No. 15/1995 Coll., **on the licensing of mining operations and operations employing mining methods as well as on the development of sites and installations, which constitute these operations,** in the wording of the Decree No. 298/2005 Coll.

Decree of the MŽP ČR No. 206/2001 Coll., **on the certificate of qualification for planning, executing and evaluating geological work**

ECONOMY AND MINERALS

Development of the Czech and world economy and importance of raw materials

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1. Growth performance of the Czech economy

The 2005–2007 period belongs to the most favourable ones for the Czech economy in the history of the Czech Republic. The real growth of the gross domestic product (GDP) **[1]**[1] reached 6.4 % and, compared to the preceding years, the economic growth rate not only increased considerably but the growth also became healthier in terms of growth factors on both the supply and demand sides. Remarkable is that the growth rate increase was not accompanied by deteriorating macroeconomical balance, by contrast with majority of new Member States from Central and Eastern Europe. On the contrary, compared to the preceding three years, the balance of trade became positive, deficit of the current account balance as well as deficit of public finance decreased and situation on the labour market improved significantly.

Restructuring and modernization on the supply side **[2]** were accelerated by a strong inflow of foreign direct investment and by an increasing importance of corporations under foreign control with markedly higher productivity. Easier accessible financial sources from the banks, low interest rates and expansive fiscal policy assisted the growth, too. The entry of the Czech Republic into the EU, which cultivated the institutional environment and increased possibilities of free movement of goods, services, capital and labour, represented undoubtedly a positive impulse. Economic recovery in Western Europe (first of all in Germany, the major trade partner of the Czech Republic), increase of non-financial enterprise profitability or increase of credits provided to enterprises and households belong to other positive effects.

Faster economic growth of the Czech Republic compared to the growth of developed countries of the EU (EU-15), where the average annual GDP growth in 2001–2007 reached only 2 %, manifested itself in acceleration of the real convergence (approximation to the level of the average per capita income of EU citizens). The GDP per capita in the Czech Republic in purchasing power parity **[13]**) in relation to the average level of the EU-27 increased from 68.6 % in 2000 to 81.3 % in 2007, i.e. by whole 12.7 per cent points. The Czech Republic overcame this way lost of its position from the 1990´ and reached the 16th position in the GDP per capita in the EU-27. Of the new Member States of the Central and Eastern Europe, the Czech Republic belongs to the most developed ones after Slovenia. The convergence process of the Czech economy was the quickest from the Central European new Member States of the EU after Slovakia.

The growth on the **supply side** in 2007 was markedly influenced especially by a strong growth of the gross value added (GVA) **[4]** in industry and services (see Tab. 1). The ro-

[1] Note: Numbers in square brackets **[ ]** refer to following chapter *Glossary to selected economic term*

Tab. 1: Gross value added (GVA) by economic activity (annual percentage change)

	2001	2002	2003	2004	2005	2006	2007
Agriculture, fishing and forestry	-2.8	3.3	4.0	7.8	11.0	-16.4	-14.3
Industry	-1.2	4.0	-1.2	12.9	10.1	13.6	10.8
Out of that: Mining and quarrying	-6.5	2.7	-10.9	14.4	-12.4	3.0	-13.7
Manufacturing	-0.5	5.4	-1.0	13.2	11.9	14.3	13.9
Electricity, gas and water supply	-4.4	-7.5	1.6	9.1	2.9	9.7	-14.1
Construction	-5.0	-1.9	2.6	5.7	-1.2	4.6	2.7
Services	5.7	2.3	4.9	0.1	6.5	5.9	7.6
Total GVA	2.5	2.5	2.9	4.5	6.6	7.1	6.5

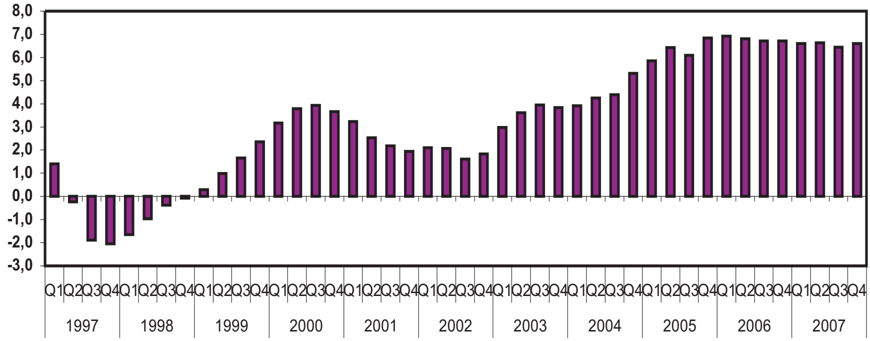
Source: ČSÚ – quarterly national accounts (June 2008), own calculations.

bust, more than two-digit growth of the GVA in **industry** continues for the fourth year and it has become a driving force on the supply side. The tendency to strengthen the position of manufacturing industry continued; the GVA of this industry increased by 13.9 % in 2007 especially thanks to the enlargement of the production of corporations under foreign control. Production of cars, electrotechnics, production of rubber, plastics and machinery and equipment represented four main industries covering together almost one half of the industrial production. Agriculture, mining and quarrying and electricity, gas and water supply showed a strong decrease of the GVA[2]. The GVA increase in the construction industry increased by 2.7 %. **Services** displayed a solid growth rate of the GVA (7.6 %) and in regard to its high share in the total GVA in the national economy they contributed significantly to the growth of the economy. The development in the individual branches of the services was different. The highest GVA growth rates were registered in transport and telecommunications, banking, insurance and real estates.

In the quarterly time division, the economic growth rate in the Czech Republic has been increasing significantly since 2003. The high quarterly year-on-year dynamics, exceeding 6 %, were maintained in all 11 quarters starting the second quarter of 2005 (see Fig. 1). In 2008, however, the growth rate has decreased and the GDP has increased by 5.3 % in the first quarter. Marked decrease of the consumer demand of households caused namely by increase of the inflation represented the major reason for the decrease of GDP dynamics.

Automotive industry with growth of 15.7 % and about 20 % share in the industrial production contributed the most to the growth of the industrial production. The fact that corporations under foreign control gradually replace imported components by domestic production of car components contributes to the accelerating growth of car production, too. On a long term, the increasing importance of automotive industry in the Czech economy can represent a certain risk owing to a cyclic character of demand for cars. Production of electric and optical instruments and equipment (17.3 %), rubber and plastics production (18.6 %) and machinery and equipment (21 %) showed double-digit growth in 2007. All

[2] According to the index of the industrial production, however, production decrease in mining and quarrying was moderate (-1.7 %) and in electricity, gas and water supply the production even slightly increased (1.7 %).



Source: ČSÚ – quarterly national accounts (June 2008).

Fig. 1: Quarterly real GDP in 1997–2007 (constant prices of previous year, in per cent)

these rapidly growing industries have two common denominators: a high share of sales from direct export and a high penetration of corporations under foreign control.

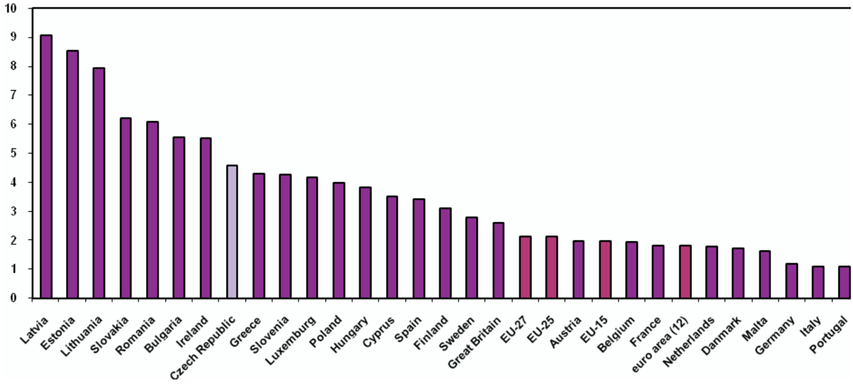
On the **domestic demand side [3]**, the growth of final demand of households (consumption and investment) represented the basic factor of the GDP growth in 2001–2007. The year 2005, when foreign trade (pure export) contributed the most to the GDP growth, represented the only exception. Marked increase of the Czech export in 2004–2007 resulted in the positive and increasing values of the balance of foreign trade in goods and services **[12]** and the foreign trade became an important growth factor. On the domestic demand side, growth rate of the final household consumption increased in 2007. This reflected relatively rapid growth of real disposable income of households, whose evolution was influenced first of all by increase of employment and real wages. Gross capital formation kept a high dynamics as well. The development of the basic demand components is shown in Tab. 2).

In the **international comparison**, the Czech Republic with annual growth dynamics of 4.6 % in the years 2001–2007 reached the eight position in the EU-27 chart. The Baltic

Tab. 2: Growth of real GDP and final demand components (percentage annual change)

	GDP [1]	Final consum-ption [6]	Private consum-ption [7]	Public consum-ption [8]	Gross capital formation [9]	Gross fixed capital formation [10]	Domestic demand [11]	Export	Import
2001	2.5	2.6	2.3	3.6	6.6	6.6	3.7	11.2	12.8
2002	1.9	3.5	2.2	6.7	4.6	5.1	3.8	2.1	5.0
2003	3.6	6.3	6.0	7.1	-1.4	0.4	4.0	7.2	8.0
2004	4.5	0.9	2.9	-3.5	9.1	3.9	3.2	20.7	17.9
2005	6.3	2.6	2.5	2.9	-0.8	1.8	1.6	11.6	5.0
2006	6.8	3.5	5.4	-0.7	10.5	6.5	5.5	15.8	14.2
2007	6.6	4.2	5.9	0.5	9.6	5.8	5.8	14.6	13.8

Source: ČSÚ – quarterly national accounts (June 2008), own calculations..



Source: EUROSTAT, Structural Indicators (June 2008), own calculations

Fig. 2: Real GDP (percentage average annual change in 2001–2007)

States, leading the chart, are followed by Slovakia, Romania and Bulgaria. Ireland was the only developed western state that reached a higher GDP growth than the Czech Republic (see Fig. 2). Portugal, Italy and Germany, where the average annual GDP in 2001–2007 was slighly above 1 %, were countries with the lowest growth. The Czech economic growth outgained that of EU-27, where the average annual GDP growth in 2001–2007 was only 2.1 % This speeded up the real convergence process.

Forecasts of the development of the Czech economy for the years 2008 and 2009 are for a more significant decrease of the economic growth rate. Decrease in consumer demand due to a higher inflation and lower real wages rise, more moderate expansion of credits and impacts of the governmental fiscal reform will belong to the main domestic factors. Investments could keep a high growth dynamics due to the higher inflow of the financial means form the EU funds and inflow of foreign direct investment (FDI). On the other hand, investment increase can be negatively influenced by aggravated expectations of the future development and higher interest rates. As for the external factors, the Czech economy will be negatively influenced by lower growth of the world economy, namely in the EU countries, which will influence first of all Czech exports. Differing forecasts reflect a considerable uncertainty related to the world economy development. Projection of the International Monetary Fund from spring 2008[3] predicts a marked decrease of growth to 4.2 % in 2008 and 4.6 % in 2009. This projection seems pessimistic compared to the Ministry of Finance prediction from April 2008[4], which counts with 4.9 % GDP growth in 2008 and a slight growth increase to 5.1 % in 2009. OECD prediction from April 2008 is close to that of the Czech Ministry of Finance and gives 4.5 % in 2008 and 5 % in 2009. According to the European Commission[5], the exceptional growth from 2005-2007 should decrease to 4.7 % in 2008 and 5 % in 2008. The projected growth rate of the Czech economy is, however, more than double the prognosis for EU-27 (about 2 %), which will result in further narrowing of the income gap compared with EU-27. Risks for the future lay primarily in the external environment, which will influence exports, the inflow of foreign direct investment and the

[3] IMF: World Economic Outlook, April 2008.
[4] OECD: Economic Survey of the Czech Republic, 2008.
[5] ECFIN: Economic Forecast, Spring 2008.

prosperity of corporations under foreign control. There is a need to continue in the reform of public finance and of the labour market to maintain a high growth, which is indispensable for a rapid process of real convergence. Due to tougher competition on the world market, the transition from the competitive strength based on expenditures and prices to an advantage based on qualitative factors, namely on the use of new technologies and high qualifications, improvement of the innovation effectiveness and institutional environment will have to be speeded up.

2. Structural changes of the Czech economy

The structure of the Czech national economy has gone through marked changes since 1989. These were related to changing domestic and foreign demand, price and foreign trade liberalization and extensive privatization. The biggest structural changes took place in 1990–1995, when the so-called industrialization structure with a high share of industry, first of all heavy industry, had to be overcome. This was reflected also in a decrease of the importance and share of industries mining and processing raw materials. In the period 1995 to 2007, the structure of the Czech economy changed only gradually (see Tab. 3). The share of agriculture continued to decrease (from 5 % in 1995 to 2.7 % in 2007). Industry retained its almost one-third share and even increased (from 31.6 % in 2000 to 32.4 % in 2007) thanks to the rapid growth of the manufacturing industry. Construction industry retains its share of about 6.5 %. Share of services remains low in the international comparison (it is even the lowest of all the EU countries after Romania) and it stabilized on the level of 58.6 % in 2007. The share of mining and quarrying continued to decrease reaching only 1.2 % and 0.8 % of the total GVA and total employment, respectively.

The Czech Republic has a relatively low share of services and a high share of industry within the EU. The high share of industry is given by the country's long industrial tradition amongst other factors. A very steep drop in industrial production occurred in the beginning of the transformation as a result of loss of the eastern markets, changed domestic and foreign demand and strong foreign competition after the liberalization of foreign trade.

Tab. 3: Structure of the gross value added (current prices) and employment (in %)

	Gross value added			Employment		
	1995	2000	2007	1995	2000	2007
Agriculture, fishing and forestry	5.0	3.9	2.7	6.0	4.7	3.4
Industry	31.7	31.6	32.4	29.9	29.8	29.5
Mining and quarrying	2.2	1.5	1.2	1.8	1.3	0.8
Construction	6.6	6.5	6.3	10.1	8.7	8.7
Services	56.7	58.0	58.6	54.0	56.8	58.4

Source: ČSÚ – quarterly national accounts (June 2007), own calculations

Only the last years have seen a marked revival of industrial production, as an influx of foreign direct investment and the influence of corporations under foreign control start to show themselves more distinctly. The real growth of gross value added **[14]** in industry was enormously high in 2003–2007 (annual average almost 12 %), whereas the GVA in industry practically stagnated in the preceding three years. Employment decreased on a long term in agriculture, mining and quarrying and electricity, gas and water production. Manufacturing industry showed annual average employment increase by 1 % in the last four years.

Individual branches of industry developed very differently in 2007. The greatest growth was in production of transport equipment (growth by 21 %), followed by production of rubber and plastics (growth by 18.6 %) and of electric and optical instruments (growth by 17.3 %). Mining and quarrying, coke production, refinery oil processing and production of basic metals and fabricated metal products showed a decrease, **The importance of raw materials** measured by the share of this industry in the gross value added and employment in the whole national economy of the Czech Republic is rather small and it has been declining. The share of the mining and quarrying in total GVA decreased from 2.2 % in 1995 to 1.2 % in 2007. The share of mining and quarrying in the industrial production is higher, its decrease is however considerable. This branch had a share (according to the national accounts) of 6.9 % in total industrial production in 1995 and only 3.8 % in 2007. The employment in this branch decreased by more than one half between 1995 and 2007 (from 98 thousand to 43.5 thousand persons, respectively), and share of this branch on the total employment in the national economy decreased from 1.8 % to 0.8 %, respectively. The lower share in the employment than in the GVA shows that labour productivity in this branch is relatively higher compared to the average productivity in whole national economy.

According to the index of industrial production **[15]** based on the statistics of the production of selected products, mining and quarrying practically stagnated in the 2001–2007 period (the index of industrial production 2007/2000 equalled 103.7). Production of energy-raw materials decreased on a long term (index 2007/2000 = 93.9) and only production of other raw materials showed more than 4 % annual increase in 2001–2007. As for energy-producing raw materials, mine production of coal, lignite and peat decreased (index 2007/2000 = 92.6) and oil and gas mine production increased (index 143.5). Increasing mine production of oil and gas however weights just a little in the whole branch of the mining and quarrying, and the future development of coal mining will depend on solving the question of ecological territorial limits in northern Bohemia.

The small and decreasing importance of mining and quarrying from the macroeconomic point of view **[16]** is caused by the Czech Republic's relative poverty in raw materials (except coal and construction minerals) and dependence on import of important energy and other minerals (especially oil and gas). Ongoing structural changes with decreasing importance of industry depending on the raw materials add to it. According to tables of interindustry relations **[17]** for the year 2005, the decisive part of the resources (domestic production and import) of the mining and quarrying industry is used for intermediate consumption. According to the OKEČ (Classification of industries by economic activity) **[18],** two industries, coke, refined petroleum products and nuclear fuel (DF) and electricity, gas and water supply (E) – represent the largest consumers of the subindustry CA (coal, lignite and peat; oil and gas; uranium and thorium ores – uranium ores only in the Czech Republic). Three industries – production of other non-metallic mineral products (DI), production of basic metals and fabricated metal products (DJ) and construction (F) – represent the main consumers in the subindustry CB (other minerals). The weight of the DI and DJ subindustries in total industry is rather large (20 % of the industrial production) and the importance of domestic raw materials have to be assessed also by the weight of manufacturing branches in the national economy which use them. Environmental aspects represent an indispensable factor, as the mining industry in the main has a negative influence on the environment.

On the other hand, relatively rapid growth of the world economy and increasing prices of energy and other raw materials can result in enhancement of the mining sector or even renewal of production in enterprises which were formerly unprofitable.

The position of the industry of raw material mining in the whole national economy is shown in Tab. 4.

Tab. 4: Gross value added in current prices (CZK billion)

	2003	2004	2005	2006	2007
Agriculture, fishing and forestry	72.7	82.8	80.4	73.5	86.4
Mining and quarrying	26.5	34.2	36.4	37.9	39.3
Manufacturing	577.7	677.5	704.9	762.8	866.1
Electricity, gas and water supply	86.8	99.4	103.8	127.7	135.4
Construction	149.2	164.5	168.0	179.8	200.9
Services	1 429.5	1 470.2	1 581.1	1 718.0	1 877.5
GVA total in basic prices	2 343.1	2 529.7	2 675.3	2 900.3	3 206.3

Source: ČSÚ – quarterly national accounts

Calculated in current prices the GVA of the mining and quarrying industry increased in 2004-2007. This was caused also by a marked increase of prices (price deflator **[19]** of GVA in the mining and quarrying industry increased by 12.7 % in 2004, by 21.5 % in 2005 and by 19.9 % in 2007).

3. World economy trends

Subsequent to a strong expansion, the world economy entered an uncertain and difficult period, which started by the crisis of the mortgage market in the USA in mid-2007. This gradually expanded into the whole financial system not only in the USA but also in other countries. Many financial institutions registered big losses and they are becoming more careful in credit granting. It remains in question if a more significant credit crunch, which would suppress still more the economic activity, is approaching. In any case, credit conditions are becoming stricter and the US and European banks complete the reduced capital bases. The financial crisis, which started in August 2007 and affected the USA and other developed countries, is considered the worst since the Great Depression in 1929[6]. Other risks, such as decrease of real estate and asset prices, increase of prices of commodities like oil, foods and agricultural raw materials, depreciation of the US dollar and lasting global macroeconomical disbalance aligned with financial sector.

Uncertainty persists concerning the future development of the US economy, where the mortgage market crisis is spreading to the whole financial system and deterioration on the real estate market is more serious than previously expected. The US economy probably entered the recession period and it will register a negative growth at least for two quarters of the year. Another serious problem is, how strongly deceleration of the US economy will influence the development in other regions of the world. Impacts on the world economy can be significant and the IMF estimates of the expected growth for Europe and many developing economies have been reduced.

6 Situation in the world financial system is evaluated in detail in IMF report: Global Financial Stability Report, April 2008.

Structure of the world economic growth

The strong expansion of the world economy of the recent years has finished and global GDP growth in 2008 should reach only 3.7 % compared to 4.9 % in 2007 (see Tab. 5). This growth will be to a certain extent driven by the rapid growth of Asian countries (China, India), oil-exporting countries (OPEC, Russia) as well as developing countries. Considerable **differences between individual regions**, like the USA, EU or Asian countries, pertain. Marked deceleration of the US economy to 0.5 % and 0.6 % in 2008 and 2009, respectively, is expected. Economic growth in the EU countries and Japan should also decelerate; it would however become more balanced in relation to the USA. The EU started to overtake the US economy in 2006. High growth rates should stay with **emerging and developing economies**. These countries determined global growth in the last five years. They contributed two thirds to the world GDP growth. They were successful in export diversification, domestic economy strengthening and institutional environment improvement. Their total growth was 7.9 % in 2007; deceleration to 6.7 % is expected in 2008. This is still a high rate, which contributes significantly to the world economy growth, and supports exports from developed countries. The Chinese economy registered growth 11.4 % and it became a country which contributes the most to the world growth (calculated both in purchasing power parity and in market exchange rate). The expected growth of 9.3 % at 10 % share of China in the world product will increase the global GDP growth by 0.93 percentage point, which represents one fourth of the world product growth. India grew by a rate of more than 9 % and it will decelerate to roughly 8 %. Russia reached a high dynamics of 8 % in 2007. This should decrease to less than 7 % in 2008. Brazil, China, India and Russia became countries which contributed by nearly one half to the global economic growth.

Unbalanced development of the world economy shows itself in increasing current account deficits in one group of countries and increasing surpluses in other countries. Current account balances rather rapidly adapted to the oil shocks by the way of increases of interest rates, and by slowing down of demand and economical growth in the past. In addition, the exchange rate channel **[20]** functioned, too. Sufficiency of financial sources and financial system enabled to transfer rather smoothly sources from countries with savings surplus into countries with savings deficit. Considerably high deficits of the USA on one side and

Tab. 5: Main indicators of world economy trends (annual percentage change)

	2006	2007	2008	2009
GDP – world	5.0	4.9	3.7	3.8
USA	2.9	2.2	0.5	0.6
EU	3.3	3.1	1.8	1.7
Japan	2.4	2.1	1.4	1.5
China	11.1	11.4	9.3	9.5
India	9.7	9.2	7.9	8.0
Russia	7.4	8.1	6.8	6.3
World trade	9.2	6.8	5.6	5.8

Note: the country's weight is based on purchasing power parity aggregates, which increase the importance of less developed economies in total world growth. By using real GDP growth calculated at current exchange rates, the real GDP growth of the world economy would decrease by about 1 percentage point. The growth of the world real GDP would be 3.7 % in 2007 and 2.6 % in 2008 (exchange rates). Source: MMF – World Economic Outlook, April 2008, p. 2.

large surpluses of China, Japan and oil-exporting countries on the other side are the most serious aspects of the world economy. Insufficient national savings **[21]** in relation to the investments represent the basic reason for the high current account deficit of the USA. The consequences of this disequilibrium can be very serious, because willingness of the foreign investors and central banks (especially in Japan and oil-exporting countries) to buy dollar assets **[22]** can weaken. This can result in further depreciation of dollar **[23]**, dollar assets freezing and a decrease of demand and economic growth in the USA. Also Central and Eastern European countries and many developing countries can have difficulties with the current account deficit financing at present turbulences in financial markets. For the **Czech Republic**, the development in the EU, where 85 % of its export is directed and from where it acquires predominant part of the foreign investment, is important. The EU increased its growth dynamics in 2006 and 2007 and real GDP growth in the EU-27 reached 2.8 % in 2007 in contrast to 3.1 % in 2006. The Eurozone countries recorded GDP growth of 2.6 % in 2007, which is just slightly lower than in the preceding year (2.8 %). The growth decelerated to 2.2 just in the fourth quarter due to turbulences on financial markets and oil price rise. Expectations of entrepreneurs and consumers worsened and the growth prospects further worsened due to the ongoing euro appreciation and weaker export. In addition, question remains, to which extent will be the EU activity influenced by the US economy stagnation. Business relationships are still important[7], even though the weight of the US marked in the EU trade decreased. It seems, however, that overflow of the financial sector difficulties, leading to the tightening of credit conditions with a negative impact on the domestic demand, will be more important. Many west European banks have already registered losses which stem from the US mortgage market crisis. Projection of the European Commission from April 2008[8] counts with a decrease of growth dynamics in EU-27 from 2.8 % in 2007 to 2 % in 2008 and 1.8 % in 2009. Growth in the Eurozone countries should be by 0.3 percentage point lower (1.7 % in 2007 and 1.5 % in 2009)[9]. A higher growth in EU-27 is given by substantially higher GDP growth in newly accepted countries which are not members of the Eurozone. Their weight on the total GDP of the EU is, however, relatively small. ECFIN has decreased the predicted GDP growth by almost 0.5 percentage point compared to the autumn prospect. Even though the EU is probably more resistant to the coming shocks thanks to the last structural reforms and relative macroeconomic stability, it cannot avoid them and impacts of the financial crisis on the first place can be worse than it is expected. ECFIN takes as an alternative scenario the impact of a harder credit conditions – according to this scenario, the growth in 2008 would further decrease by 0.5 percentage point.

Evolution in the west European developed countries varies considerably. There is a group of mainly small countries with a reasonable growth dynamics (Ireland, Luxembourg, Finland, the Netherlands, Austria) on one side and Italy and Portugal, with the average annual GDP growth of only 1.6 % in 2006 and 2007, on the other side. Development in the neighbouring Germany, which is in addition our biggest trade partner, is important for the Czech Republic. After a poor year 2005 (0.8 % growth), the GDP growth increased to 2.9 and 2.5 % in 2006 and 2007, respectively. IMF predicts a significant growth deceleration to 1.4 and 1.0 % in 2008, resp. 2009. This could of course influence Czech exports.

7 Share of the USA in EU-27 foreign trade with goods was only 7.6 % in 2006. Relatively high share showed only Ireland (18.8 %), Malta and Great Britain.

8 European Commission, Directorate-General for Economic and Financial Affairs: Economic Forecast, Spring 2008, Brussels.

9 IMF projection from April 2008 is more pessimistic and predicts that the Eurozone growth will decelerate to 1.4 % in 2008 and 1.2 % in 2009.

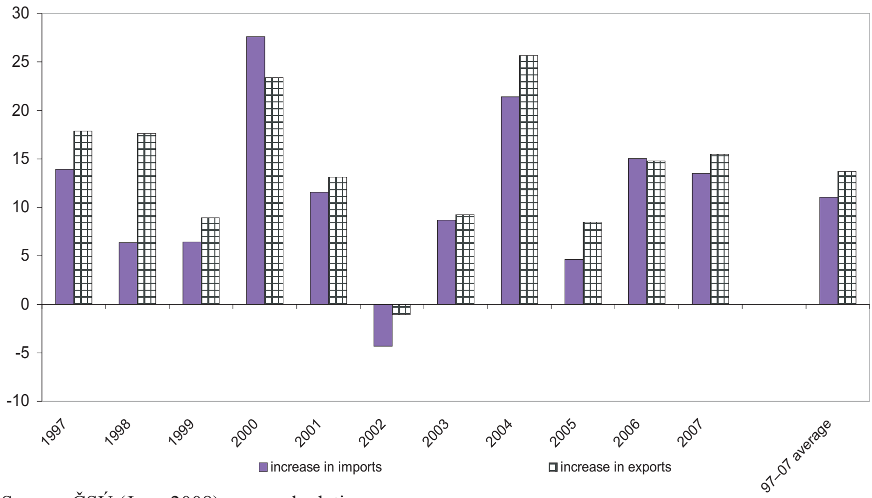
Growing **inflation pressures** still represent a serious problem of Europe. Year-on-year inflation, measured by consumer price index, increase by 3.7 % in Eurozone in 2008. It was therefore considerably higher than the 2 % limit, which European Central Bank considers to be a determinant for price stability evaluation. Energy and food price increase represented the main reason. Moderate price rise and euro appreciation represented damping factors of the inflation increase. IMF predicts price rise of 2.8 % for 2008 and 1.9 % for 2009. Harder conditions for credit acquisition, lower pressure on resources and no effect of administrative price regulations would contribute to renewed price stability. Question remains if higher pressure on wages increase will not appear. ECB has been holding rates on the stable level of 4 % since June 2007.

4. Foreign trade and external economic balance [24] in the Czech Republic

Development of the foreign trade has started to play a dominant role in the development of the Czech economy. This is because the Czech economy is considerably open and important changes have occurred in foreign trade as a result of a strong inflow of foreign capital as well as the entry to the EU – exports rapidly increase, their structure, technical level as well as prices change and considerable changes of terms of trade take place. The high importance of foreign trade for the Czech Republic results from the high share of the value of exports of goods and services in the GDP, which reached 79.6 % for exports and 74.6 % for imports in current prices in 2007. Very good results for the Czech foreign trade during the last years show that the competitive strength of our production, which gains ground on difficult markets, has been growing – despite the recession of economic activity in the old EU countries and especially in Germany in 2001–2005, our main trading partner. From the macroeconomic point of view it is also important that foreign trade (with goods and services) in 2004–2007 strongly contributed to the GDP growth and became an important driving force of the GDP growth on the demand side.

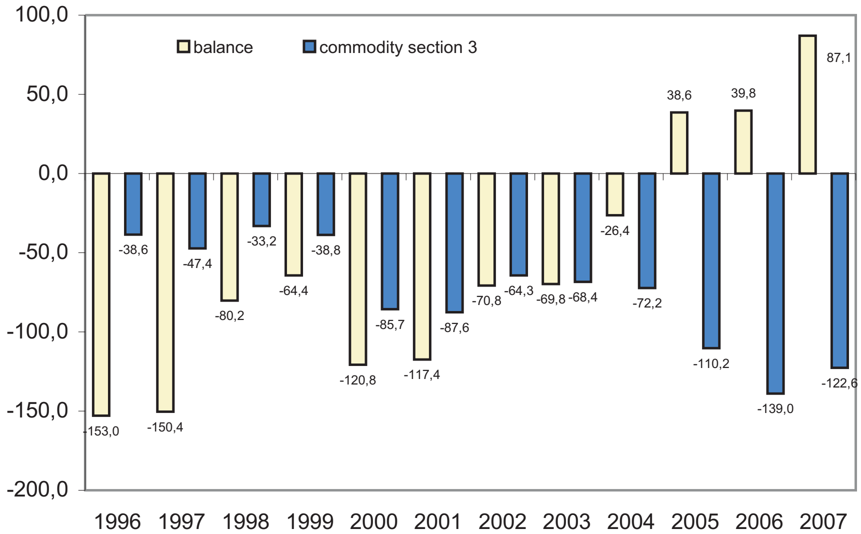
A strong growth of goods export and import continued in 2007. Whereas exports of goods increased by 15.5 % and overtook the growth of imports (13.5 %) in 2007, growth rate of the export and import was relatively high and almost identical – 14.8 and 15.0 % – in 2006 (see Fig. 3). Growth rate of the Czech goods export is higher than its import also on a long term (1997–2007) – 13.7 and 11.0 %, respectively. Surplus of the trade balance significantly increased to CZK 87.1 billion in 2007 and it was by CZK 43.7 billion higher than in 2006 (CZK 39.8 billion). The year 2007 was therefore on only the third year in Czech history when the country reached a positive balance of foreign trade in goods, but also when the positive balance further increased. Entry of the Czech Republic into the EU contributed to the very favourable foreign trade results. First of all, however, it was the previous strong inflow of the foreign direct investment directed into branches with a high share of exports, such as production of transport equipment, telecommunication equipment, consumer electronics and computer technique as well as the revival of boom in the main business partner countries (Germany). Successful penetration of demanding markets in the EU and in the world, despite ongoing Czech crown appreciation, represents another positive contribution.

As the commodity structure is concerned, the highest deficit creates group 3 (mineral fuels, lubricants and related materials – see Fig. 4). As regards the destination, export to the Commonwealth of Independent States and European transition economies (by more than



Source: ČSÚ (June 2008), own calculations

Fig. 3: Growth of exports and imports (percentage annual change)



Note: commodity group 3 in SITC Rev. 3 includes mineral fuels, lubricants and related materials. Data for 2007 are preliminary. Source: ČSÚ (2008), foreign trade statistics (6. 6. 2008)

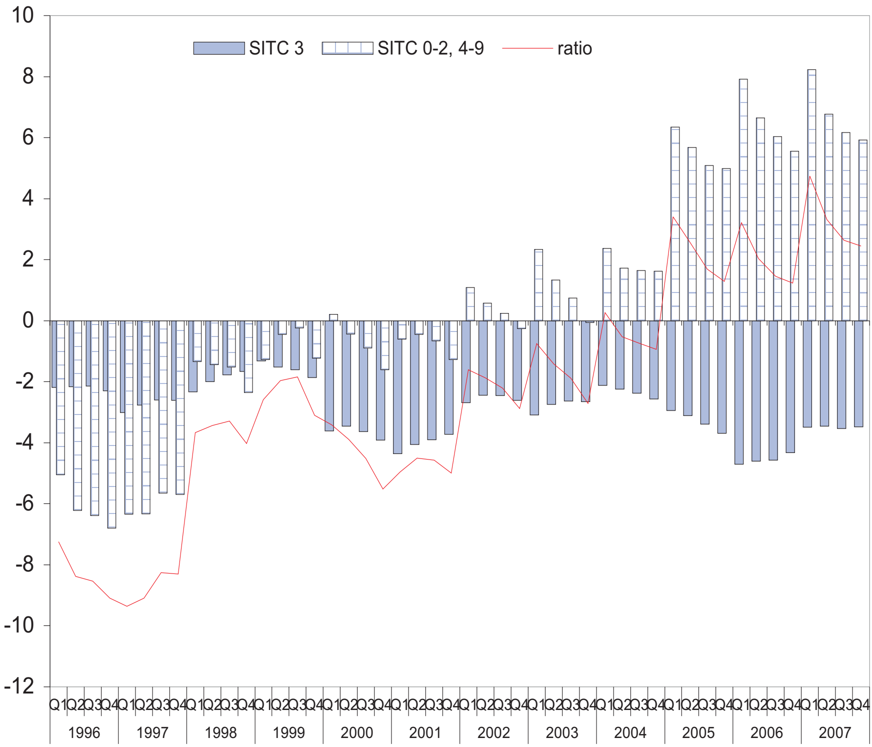
Fig. 4: Balance of foreign trade, 1996–2007 (CZK billion)

26 %) and developing economies (more than 22 %) increased the most. However, this was at a small share in aggregate trade, where the EU-27 countries retain the dominant position (more than 85 % of the Czech export and more than 70 % share of the Czech import).

Germany (about 31 % of the Czech export and 28 % of the Czech import) remains the major trade partner of the Czech Republic, although its share has been slightly decrease in recent years. . The share of Slovakia keeps approximately constant for several years already (9 % of export and more than 5 % of import). Share of Poland, UK and Sweden has been increasing, which represents the desirable diversification of the Czech export structure and restriction of the relatively high dependence on the only (German) market.

Development of the goods balance of foreign trade (without balance of services) is shown in Fig. 5. Whereas SITC 3 group shows relatively stable deficit value in whole period of interest, which changes mostly by influence of prices of imported raw materials and exchange rate fluctuations, a gradual improvement of export abilities of the Czech Republic can be observed in other groups.

Total foreign trade balances improved again by 47.3 % in 2007, but the evolution of individual commodity groups was different. The trade deficit in the mineral fuels and lubricants import decreased thanks to the Czech crown hardening (from CZK 139.0 billion in 2006 to



Note: commodity group 3 in SITC Rev. 3 includes mineral fuels, lubricants and related materials. Data for 2007 are preliminary. Ratio = SITC 3 balance / GDP. Source: ČSÚ (2008), foreign trade statistics (6. 6. 2008), quarterly national accounts (17. 6. 2008), own calculations

Fig. 5: Balance of foreign trade, 1996–2007 (% of GDP, 12M moving total)

CZK 122.6 billion in 2007) decreased. On the other hand, deficit in case of chemicals increased (from CZK 89.5 billion to CZK 112.6 billion) and deficit for food and live animals stagnated (CZK 29.3 billion and CZK 30 billion). Group 2 (raw materials, inedible, except fuels) reached a surplus (CZK 9.6 billion from the deficit of CZK 2.3 billion) and therefore it shows a considerable variability (this group was mostly in deficit since 2000; the deficit was permanent in 2001–2006, with the largest deficit in 2004 (CZK 5.6 billion). The growing deficit in some commodity groups was more than compensated by the growth of the trade balance surplus in the group of machinery and transport equipment, which markedly increased again (from CZK 271 billion in 2006 to almost CZK 307 billion in 2007).

Two groups dominate in Czech exports: manufactured goods classified chiefly by material (group 6) and first of all machinery and transport equipment (group 7). This group increased its share in total exports from 32.8 % in 1996 to 54.2 % in 2007 (see Tab. 6). On the other hand, the share of all other groups decreased. The share of groups 2 and 3, which are closest to the raw material mining industry, decreased from 9.3 % in 1996 to 5.3 % in 2007. In case of imports, the share of mineral fuels, lubricants and related materials decreased to 8.0 % of total imports in 2007. The highest value of 9.6 % was recorded in 2000, it was however followed by decrease to 7 % limit in 2001-2004 with a high increase in 2005 (9.2 %). This distinct fluctuation of the share was caused primarily by pronounced changes in oil and gas prices in the last few years. . This group has a markedly higher share in imports than in exports, from which results also a markedly negative balance of foreign trade (see Fig. 4 above).

Tab. 6: Commodity structure of foreign trade of the Czech Republic by SITC, Rev. 3 (percentage share)

	Export				Import			
SITC Rev. 3 commodity sections	1996	2000	2005	2007	1996	2000	2005	2007
0, 1 – Food and live animals, beverages and tobacco	5.0	3.7	3.8	3.5	6.6	4.6	5.1	4.9
2 – Raw materials, inedible, except fuels	4.8	3.5	2.5	2.6	3.7	3.2	2.8	2.4
3 – Mineral fuels, lubricants and related materials	4.5	3.1	3.1	2.7	8.7	9.6	9.2	8.0
4 – Animal and vegetable oils, fats and waxes	0.2	0.1	0.1	0.1	0.3	0.2	0.2	0.1
5 – Chemical and related products, n.e.s.	9.0	7.1	6.4	5.8	11.9	11.2	11.0	10.4
6 – Manufactured goods classified chiefly by material	28.6	25.4	21.7	20.4	19.3	20.8	20.5	20.9
7 – Machinery and transport equipment	32.8	44.5	50.8	54.2	38.0	40.0	40.3	43.0
8, 9 – Miscellaneous manufactured articles, commodities and transactions n.e.c. in the SITC	15.1	12.6	11.6	10.6	11.5	10.4	11.0	10.2

Note:
n.e.s. – nowhere else stated
n.e.c. – nowhere else classified
Data for 1996–2000 are in the methodology valid since 1. 7. 2000. Data for 2007 are preliminary after revision from the end of May 2008. Source: ČSÚ – foreign trade (June 2008)

Development of the selected import and export commodities is given in Tab. 7. Whereas export of some traditional raw materials gradually decreases (with an exception of cement, showing year-on-year increase by almost 30 %), energy mineral import registered a moderate (oil) and marked decrease (iron ore).

Tab. 7: Foreign trade – selected commodities (thousands tonnes)

	Export			Import	
	Cement	Kaolin	Calcite	Crude oil	Iron ore
1999	1 559	428	239	5 997	5 357
2000	1 494	443	305	5 819	6 933
2001	866	455	270	6 005	6 891
2002	466	445	212	6 082	6 812
2003	562	442	103	6 344	8 222
2004	747	484	140	6 406	7 639
2005	559	271	124	7 730	6 807
2006	496	261	162	7 752	7 987
2007	644	174	106	7 147	5 256

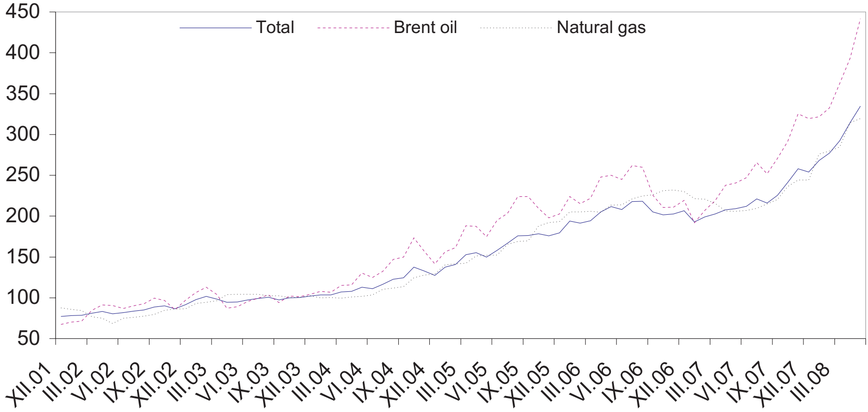
Note: data for 2007 are preliminary. Source: ČSÚ

Development of the trade balance is to a considerable extent influenced by the development of prices of raw materials which are imported into the Czech Republic. The last several years have seen a marked rise in world prices of raw materials and food (see Fig. 6), which already resemble situation from the beginning of the 1970´and the period of the second oil shock[10]. The negative impact on the trade balance was suppressed by movement of the exchange rate [appreciation **[25]** of Czech koruna (CZK) against dollar][11]. Continuously increasing prices decreased only in the second half of 2006, however, the growing tendency renewed in the beginning of 2007 and the oil prices reached maximum values until now. Development of raw material prices is reflected also in the development of exchange ratios. These deteriorated in 2005 and 2006 (decrease by -1.0 % and -1.5 %). After this, they improved by 2.3 % in 2007 (the positive trend was given by improvement in the first quarter of 2007). Ratios of trade exchange were negative in the next months of the year due to raw material price increase. Decrease of export and import prices continued also in the first months of 2008 and exchange ratios slightly improved in the first quarter of the year (100.3 %).

Table 8 summarizes oil prices and index which reflects development of mineral prices except energy minerals. Extremes in 1998–1999, 2000–2001 and a gradual increase after 2002 are this way obvious. Impact on trade balance and implicitly enterprises can be estimated based on the development of the index in CZK, which apart from oil prices reflects

[10] Taking the highest price for barrel of oil (Brent, quoted on the New York Mercantile Exchange), during the second oil crisis (1979) of USD 39.5 from April 1980, barrel of oil should cost approximately USD 103.76 re-calculated to the present money value (1 USD from 1980 has today a value of 2.61 USD). Oil price increased from about USD 3 to USD 12 for barrel (1974 – the first oil crisis), it represents however only USD 52.29 in today´s prices. The record from 1990 caused by the war in the Gulf (USD 40.42 for barrel) represents only USD 66.44 for barrel, recalculated in today´s prices. The maximum value until nowadays was reached during June (16.6.2008) – USD 139.89 for barrel.

[11] However, persisting high demand on energy of the Czech economy, which shows itself among others also by increase of raw material import, is problematic.



Source: ČSÚ (2008), own calculations

Fig. 6: World prices of industrial raw materials and foodstuffs, December 2001–May 2007 (indices, 2000 = 100)

also development of the exchange rate of Czech crown to USD. The impact was more pronounced in some years (2000, when the USD reached historical values to CZK) or unfavourable development of prices was alternatively suppressed by CZK strengthening (this tendency is notable after 2004). Index of non-financial commodity prices is influenced by a marked increase of food and raw material prices, which however became an investment instrument for international investors – apart from increasing consumption in many world economies (e,g, China, India). As a result, price fluctuations are more remarkable.

Tab. 8: Changes of world average commodity prices

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Brent oil	USD/barrel	15.8	17.1	20.5	19.1	12.7	17.8	28.3	24.4	25.0	28.8	38.3	54.4	65.4	72.7
	SOPR = 100	*92.9*	*107.8*	*119.9*	*93.5*	*66.5*	*140.0*	*159.0*	*86.2*	*102.5*	*115.3*	*133.0*	*142.0*	*120.2*	*111.2*
Index in CZK	2000 = 100	..	41.5	50.8	55.5	37.6	56.1	100.0	85.0	74.9	74.5	90.2	119.3	135.3	135.1
	SOPR = 100	..	..	*122.5*	*109.3*	*67.7*	*149.2*	*178.3*	*85.0*	*88.1*	*99.5*	*121.1*	*132.3*	*113.4*	*99.9*
Index NFC [1)]	2000 = 100	117.5	126.5	124.9	120.4	104.6	95.9	100.0	95.2	97.1	102.8	118.4	125.6	154.8	176.5
	SOPR = 100	*110.4*	*107.6*	*98.8*	*96.4*	*86.9*	*91.7*	*104.2*	*95.2*	*101.9*	*105.9*	*115.2*	*106.1*	*123.2*	*114.0*
Index NFC [2)]	2000 = 100	..	86.6	86.9	98.4	85.8	85.8	100.0	94.6	81.8	75.6	81.5	83.8	101.6	108.0
	SOPR = 100	..	..	*100.4*	*113.2*	*87.2*	*100.0*	*116.6*	*94.6*	*86.5*	*92.4*	*107.8*	*102.8*	*121.2*	*106.3*

Note: average is calculated on basis of spot prices. SOPR = previous year = 100. NFC – Nonfuel commodities (commodities except oil). Values are annual averages. [1)] on USD basis, [2)] on CZK basis.
Source: MF ČR Macroeconomic Prediction (various issues), own calculations.

External economic balance evaluated based on trade balance and current account balance recorded a marked improvement in 2005–2007. This was caused primarily by surplus of trade balance with goods and services. This changed from the deficit exceeding 2 % of the GDP in 2001–2003 to increasing surplus, which reach a record value of 4.7 % GDP.

Inflow of foreign direct investment in the preceding years as well as the entry of the Czech Republic in the EU had a favourable influence on the strong increase of the Czech export.

The structure of the current account markedly changed and balance of incomes instead of the balance of trade became the main source of the current account deficit in 2004. Payment balance in 2007 was this way influenced by a marked increase of surplus of balance of trade and by deepening of balance of incomes deficit. Pure outflow of primary incomes abroad in 2007 in form of wages, reinvested or repatriated profits and interests represented 7.1 % of the GDP and lowered considerably the national income of the Czech Republic. This is the amount by which the gross national income of the Czech Republic is lower than the GDP. The Czech Republic along with some other countries, like Ireland of Hungary, becomes a country which looses a significant part of the created value, which cannot be used for consumption or investment. Reinvestment and repatriation of profit will represent the main source of current account deficit also in future. Current account deficit of the Czech Republic reached an average annual value of 2.5 % GDP during the last three years (see Tab. 9). This is much more than the average deficit in developed countries of EU-15. This unbalance is however acceptable for the economy on a lower economic level, which is gaining on the income in developed countries. The Czech Republic had the lowest current account deficit of the twelve new Member States of the EU in 2007. As for the national economy, the current account deficit results from insufficient national savings in their relation to investments. This gap has to be financed by foreign sources. Whereas the entrepreneur sector increased considerably its ability to create savings and improved its return, creation of savings of the households decreased considerably. Their measure of savings is on a very low level compared to developed EU countries. Negative gap between savings and investments is thus created by government institution and household sectors.

Tab. 9: Current account balance (% of GDP)

	Current account	Balance of trade	Balance of services	Balance of incomes	Current transfers
2001	-5.3	-5.0	2.5	-3.6	0.8
2002	-5.5	-2.9	0.9	-4.7	1.2
2003	-6.2	-2.7	0.5	-4.6	0.6
2004	-5.2	-0.5	0.6	-5.6	0.2
2005	-1.6	2.0	1.2	-5.2	0.4
2006	-3.1	2.0	1.3	-6.3	-0.2
2007	-2.5	3.3	1.6	-7.1	-0.2

Source: ČNB, 2008, own calculations.

Foreign direct investments (FDI), the inflow of which intensified after the year 1998 in relation to the acceptance of investment incentives and to continuing privatization and restructuring of corporations, became an important factor in the Czech economy growth. The Czech Republic occupied the fourth position amongst 10 new member countries of the EU (after Bulgaria, Estonia and Hungary) in the cumulative net value of FDI in % of GDP (50.2 % in 2007)[12]. Major part of these FDI – about 40 % – was directed into the Czech

[12] Czech Republic was in the third place (after Estonia and Hungary) in 2007 in the relation of cumulated amount of FDI (inward) per capita (nearly 8.5 ths USD) among new member countries of the EU without Cyprus and Malta [based on FDI WIIW (Wiener Institut für Internationale Wirtschaftvergleiche) database, see Havlik, Hozner, et al., 2008: WIIW Current Analyse and Forecasts, 1, WIIW, Vienna, February 2008].

manufacturing industry, The influence of corporations under foreign control increased with the inflow of FDI, too. These corporations accounted for more than 60 % of the total income of non-financial corporations in 2007 and it reached 45 % share in employment (enterprises with more than 20 employees).

Structure of FDI directed to the Czech economy has changed qualitatively during the last two years. Major part of investments represent reinvested profits, i.e. means generated by enterprises themselves in the Czech economy and not the real influx of capital from abroad. The onset of reinvestment in the Czech Republic started in 1998 and its extent and importance for total investment activity of foreign companies varied considerably in individual years. Primarily its importance was marginal; however, it increased gradually with profit creation in enterprises under foreign control (in accordance with the so-called investment life cycle). Reinvestments represented practically the only source of FDI inflow in 2003; they reach almost CZK 80 billion in 2004 and 2005 and they represented an important source of financing investment of enterprises under foreign control. Reinvestments dominated strongly over own FDI influx into the equity capital in 2006-2007 (they represented already 70 % of the FDI volume in 2007 – the highest value since the foundation of the Czech Republic). This tendency is obvious also in the mining and quarrying sector.

The importance of foreign capital measured by cumulative inflow of foreign direct investment in the mining industry corresponded roughly to the share of this industry in GDP (see Tab. 10). In the year 2007, however, the investment into the branches – both direct (new) capital and reinvested profit – increased. After the investment influx in 2006, which represented more than CZK 5.208 billion in absolute values (even though less in relation to the total volume – 3.9 % of total FDI), investment into the equity capital reached one of the highest values and increased more than three time on year-by-year basis, to CZK 4,175.8 mil, i.e. 8.2 % from the FDI influx. Volume of reinvested income increased as well to CZK 4,061.4 mil, i.e. 3.1 % of the FDI influx. The main investors in this branch come from the surrounding states (Germany and Austria) but also from the Netherlands or France.

Tab. 10: Stock of foreign direct investment in the Czech Republic as of December 31, 2007 (CZK mill)

	Equity capital	Reinvested profit	Other capital	Total
Total stock	1 030 040.6	655 529.0	166 465.5	1 852 035.1
Mining and quarrying	33 103.8	16 875.4	-210.4	49 768.8
Share of mining and quarrying (in per cent)	3.2	2.6	*x*	2.7

Note: data for 2007 are preliminary. Source: ČNB (2008), Balance of Payments Statistics, own calculations

The outflow of the Czech foreign direct investment to foreign countries also in view of the structure of the economy is substantially lower (see Tab. 11); during recent years though Czech capital is successfully involved also on foreign markets and in foreign companies (coal mining in Poland and exploration and mining of oil and gas realized abroad by the Moravské naftové doly company). However, there these companies meet a strong competition from big (state-owned and disposing with strong capital) companies e.g. from Russia. Outflow of the Czech FDI abroad in the mining industry reached its maximum in 2007, as its total volume exceeded CZK 2 billion (however, it represented only less than 8 % of the total FDI). Volume of reinvested profit dominated, and about one third of the flow was represented by investment into the equity capital. (Until now, the boom was in 2003, almost CZK 1 billion and more than 17 % from the total FDI outflow). The year 2007 represented a continuation of the growth from 2006, when an important increase resulted from another period of interest of the Czech companies in foreign acquisitions (at that time, however, it concerned exclusively reinvested profit). As for the volume, mining and quarrying is comparable to the manufacturing branch of the industry dealing with chemical products.

Tab. 11: Stock of Czech foreign direct investment abroad as of December 31, 2007 (CZK mill)

	Equity capital	Reinvested profit	Other capital	Total
Total stock	77 461.8	35 320.2	19 050.1	131 832.1
Mining and quarrying	1 650.4	1 961.8	329.7	3 941.9
Share of mining and quarrying (in per cent)	2.1	5.6	1.7	3.0

Note: data for 2007 are preliminary. Source: ČNB (2008), Balance of Payments Statistics, own calculations

Glossary to selected economic terms

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[1] Gross domestic product (GDP) is the most often used indicator of the total economic performance of the economy. It can be defined either as a sum of the gross value added **[4]** of various sectors and branches of the national economy or as a value of the domestic final demand (final consumption **[6]** and gross capital formation **[9]**) increased by exports and reduced by imports.

[2] Supply side of the economy relates to the basic factors of economic activity (labour, capital and total factor productivity) and to the main branches of activity (agriculture, industry, construction, services).

[3] Demand side explores the basic components of the demand which determine economic activity (personal consumption, public consumption, investment and foreign trade).
(Both demand and supply sides refer to levels of activity even more than growth!)

[4] Gross value added (GVA) is a widely used indicator of the total economic performance of each branch. It is an indicator corresponding to the GDP in the whole national economy. It is calculated by subtraction of the intermediate consumption (consumption of the raw materials, energy, materials) from the total value of the production.

[5] FISIM is an abbreviation for financial intermediation services indirectly measured. Their income is given by the difference between the interest which they pay to lenders and interest they receive from borrowers for provided loans.

[6] Final consumption includes personal and public consumption, it determines the growth of standard of living and it represents the largest component of the final utilization of the production.

[7] Private consumption contains consumption of products and services for final use, which is covered from the disposable income of households.

[8] Public consumption is the part of final consumption which is covered from the disposable income of government institutions.

[9] Gross capital formation (total investments) includes gross fixed capital formation, changes in inventories and net acquisitions of assets.

[10] **Gross fixed capital formation** is a basic component of investment and it includes acquisitions of fixed assets (esp. machinery, equipment, buildings and constructions) during a certain period.

[11] **Domestic demand** is a sum of final consumption and gross capital formation.

[12] **Balance of foreign trade** is the difference between the value of exports and imports. When exports exceed imports, a surplus is formed, and in the opposite case there is a deficit .

[13] **Purchasing power parity** is a notional, artificially calculated currency exchange rate, which corresponds to its purchasing power. It is a rate at which we would obtain the same amount of goods and services at home as well as in the country with which we compare ourselves. It is used in the international comparisons of the real magnitudes as for instance the GDP per capita, for which the market exchange rates are not useful.

[14] **Real growth of gross value added** is growth calculated in constant prices, which excludes the influence of price changes.

[15] **Index of industrial production** is calculated in agreement with the international standards and it is based on statistics of selected products and a two-stage weighting system. It is a selective index representing the weighted arithmetic average of the indexes of selected indicators, which is used to characterize the industrial production growth.

[16] **Macroeconomic point of view** is a viewpoint which is based on the view of whole national economy and takes into account mutual linkages and connections.

[17] **Tables of inter-industry relations** (input-output tables) are chessboard tables (in form of matrices), which show flows of the production of individual industries. Use of the production of the industry in the intermediate consumption (according to individual industries) and in final use is given in the lines. Costs of the industry according to the supplier industries are given in the columns.

[18] **OKEČ** (Odvětvová klasifikace ekonomických činností - Classification of industries by economic activity) is the internationally standardized classification of the economic activities according to the viewpoint of a similar economic utilization of the production. OKEČ divides the national economy into 16 basic groups (sections). Industry is divided into three sections (mining and quarrying, manufacturing and electricity, gas and water supply). More detailed division of industry then includes 17 branches.

[19] **Price deflator** is a price index mostly indirectly measured. Deflator of the gross value added has to be calculated from the changes of the total production and intermediate consumption prices. It equals a ratio of the GVA in current prices to the GVA in constant prices.

[20] Exchange rate channel expresses influence of the exchange rate changes on other economic magnitudes. In case of the foreign trade and current account deficit, the exchange rate change (weakening of strengthening of the currency) influences exports and imports of the country and by that also the external economic balance.

[21] National savings are a basic source of financing the investments. They represent that part of the disposable (final) incomes which is not used for final consumption. When investments are higher than savings, foreign savings have to be used for their financing.

[22] Dollar assets are financial assets denominated in USD.

[23] Depreciation means weakening of the exchange rate of one currency to another depending on the demand and supply on the foreign exchange market.

[24] External economic balance is given by the relationship of the total income of the country from abroad (incomes from the export of goods and services and inflow of primary incomes and transfers) and expenses to foreign countries (import of goods and services, outflow of primary incomes and transfers). It can be assessed from the current account balance.

[25] Appreciation means valuation (strengthening) of the currency exchange rate of one country against the other depending on the demand and supply on the foreign exchange market.

[26] Terms of trade express the movement of prices in foreign trade (the ratio of changes of the prices of exports to prices of imports). They are calculated by division of an index of the prices of exports by an index of the prices of imports. Where prices of exports grow more quickly than those of imports, the country can import a higher physical volume of imports for the same physical volume of exports.

[27] Gross national income is an indicator based on the gross domestic product which takes into account inflow and outflow of primary incomes (incomes from labour, capital and ownership). Primary income balance towards the foreign countries influences the so-called disposable incomes of the country, on which depend final consumption and savings. In case that the outflow of incomes is higher than inflow, possibilities to increase standard of living are reduced. This indicator is therefore more appropriate for characterising the growth of the country's welfare than GDP.

Mineral facts: Metal raw materials – retrospective, fundamentals, prospects

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1. Introduction

We propose to examine four items: known reserves (reserves), inbound (demand) and outbound flows (production), consequences of these flows (foreign trade, organisation and coordination of transport) and, finally, outlook (worldwide "super cycle" and its limits).

2. Reserves

This issue has been controversial for a long time. The media repeat that the reserves of this or that metal will be depleted in x number of years. Let us start to analyse the facts.

The controversy was brought about by ignoring two facts: the concept of reserves is dynamic, and not static; each mining company developer is also an explorer.

2.1. Is the state of worldwide reserves alarming?

Geological reserves identified by geologists represent a physical quantity of which a certain amount of useful substances is more or less precisely determined. Knowledge on how to appraise them is assumed, but the costs of this appraisal compared with the expected market price are not defined at this stage.

Reserves represent an economic quantity oscillating around an optimum which is a result of economic and financial analysis of plans whether to mine or not to mine these or those observed geological reserves. These two concepts are often confused and what is forgotten is that, if reduced due to mining, reserves are renewed by mining exploration. Reality demonstrates that deposits which were considered to be unminable for lack of corresponding beneficiation or metallurgical processes or which are economically unprofitable in one era, may become minable reserves some decades later.

An analysis demonstrates that the majority of current reserves are of the same quantity as the reserves from 1975; even though in a third of a century, the world consumed more than the reserves registered in 1975. That is the result of the dynamics of exploration, which are too often underestimated or ignored. In 1975, a profitable processing process did not exist for certain gold and copper ores (designated as "refractory"); now, these ores are mined.

This demonstrates the vital importance of exploration, and beneficiation and metallurgical innovations, too. It is also essential for exploration to be financeable (see paragraph 2.3).

Tab. 1. Dynamism of reserves, their consumption and exploration 1975–2007

	reserves in 1975	production 1976–2000	reserves deduced in 2000	**real reserves in 2000**	*exploration contribution 1976–2000*	production 2001–2005	reserves deduced in 2005	**real reserves in 2005**	*exploration contribution 2001–2005*	**reserves in 2007**
	A	B	C=A-B	**D**	*E=D-C*	G	H=D-G	**I**	*J=I-H*	
copper, mill t	**450**	280	170	**340**	*170*	70.45	269.55	**470**	*200.45*	**490**
tin, mill t	**10.2**	5.9	4.3	**9.6**	*5.3*	1.40	8.20	**6.1**	*-2.11*	**6.1**
lead, mill t*	**160**	144	16	**64**	*48*	15.68	48.32	**67**	*18.68*	**79**
zinc, mill t	**150**	178	-28	**190**	*218*	58.33	131.67	**220**	*88.33*	**180**
iron ore, mill t	**259 000**	23 263	235 737	**140 000**	*-95737*	6 250	133 750	**160 000**	*26 250*	**150 000**
molybdenum, kt	**6 000**	2 767	3 233	**5 500**	*2 267*	729	4 771	**8 600**	*3 829*	**8 600**
nickel, kt	**54 044**	21 104	32 940	**49 000**	*16 060*	6.75	48 993.25	**62 000**	*13 006.75*	**67 000**
tungsten, kt	**3 900**	474.07	3 425.93	**2 000**	*-1 425.93*	373.6	1 626.4	**2 900**	*1 273.6*	**2 900**
gold, kt	**41.985**	23.3	18.685	**48**	*29.315*	12.477	35.523	**42**	*6.477*	**42**

* primary lead only

Sources: for reserves *Commodity Data Summaries 1976* (USBM) and *Mineral Commodity Summaries 2000, 2006 & 2008* (USGS); for productions *World Mining & Metals Yearbook.*

Yet today however, major reserves are not in the same regions as in 1975 or 1990. A relay existed between regions and, consequently, their "geopolitical weight" evolved. Let us go further… The reserves, which are calculated by the US Geological Survey – the sole agency which still possesses the capacity to execute such world summaries – are determined based on research conducted during times of generally "normal" prices. Several other major mining countries also calculate their reserves (Brazil, Canada, Russia, India, China?) and either publish them or not. However, they do not conduct international research (and if they do so, for example due to strategic reasons, they do not publish the results).

Currently, with historically high prices of all metals, capable of remaining at these levels for 10 to 20 years (super cycles – Chinese, Indian, Brazilian, Russian, Middle Eastern, etc. – successive and intermediate), is it not neccessary to double the amount of certain published reserves? The explored deposits whose cubature was calculated 10 years ago and which were then considered inexploitable are or may be now becoming economically exploitable.

However, is it also not suitable to weigh the "life span" of deposits with the growth in demand? Namely, to convert from a static economic life of reserves (share of reserves in 2006 and of demand in 2006) to a dynamic and more realistic one, taking into consideration the growth in consumption (share of reserves and of consumption increasing by 3 %, 5 % or 8 % annually as per metal).

Tab. 2. Static and dynamic lifetime of world copper reserves

copper reserves 2005	470	mill t
copper mine production 2005	14.98	mill t
> static lifetime of reserves 2005	*31*	*years*
copper mine production 1995	10.06	mill t
copper mine production 2005	14.98	mill t
average yearly growth 1995–2005	0.492	mill t, thus + 4.06 %/year
> dynamic lifetime of reserves 2005	*20*	*years*

The example of copper reserves is instructive: the static economic life of reserves is 31 years, whereas the dynamic economic life of mine production, increasing at an average annual rate of 4 %, is 20 years. The exploration effort must be intensive in order to maintain this rate of growth. From 2001 to 2007, exploration, revived due to high-priced copper, created 150 million tonnes of new reserves, however, the cumulative mine production was 101 million tonnes!

2.2. Reserves are less and less present in places where they are consumed

What is up for discussion, despite technical and economic uncertainties based on the range – static or dynamic – of existing data on reserves in the earth (and with their unreliability and gaps, inevitable and sometimes evitable anomalies – e.g. Cuban nickel …) is "where are the metals for the future?", as Prof. Pierre Routhier wrote more than three decades ago.

An increasing disproportion is perceived between regions of mine and metallurgical production, new countries which treat ores and export metals or their intermediate products, and final consumer countries which transform crude metals into industrial products.

Some examples:

Aluminium is probably an atypical example. The industry, ranging from bauxite to extruded aluminum profiles, is extremely fragmented: several countries dominate the production of bauxite and aluminium oxide, other countries import them for the production of metal or its alloys, and finally others carry out industrial reprocessing and production of intermediate or final products. In isolated cases, there are few countries which sustain an integrated industry (e.g. Russia).

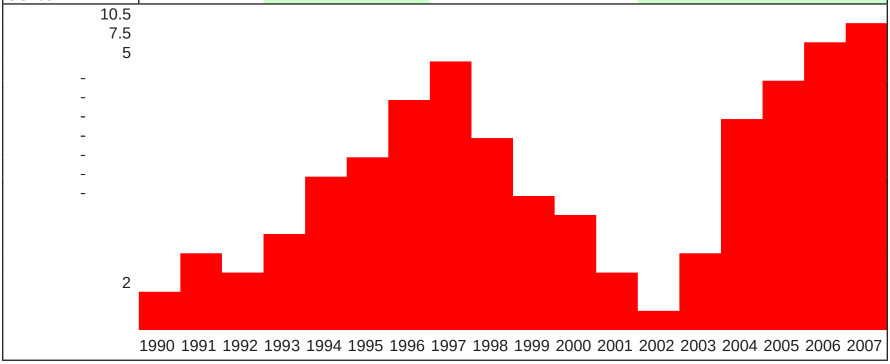
Copper is a different example of this kind. Mine production is dominated by Chile; the metal production is located in major consumer and processing countries; consumption, until recently lead by Europe, Japan and North America, is now lead primarily by China.

2.3. Exploration was dormant for a long time… We are paying for it

It is quite natural that exploration lies dormant at the time of low prices: who would explore, when earnings fluctuate around poor levels? Who would search for new deposits of lead, when it costs 400 USD/t? That would be considered poor company management…, however, it would be strategic for those possessing a good market prognosis.

Currently, exploration is at a gallop, in more or less unworked (“grassroots”) regions or on the periphery of well-known mining districts (“brownroots”), yet without a doubt a bit too late because the supply crisis has taken hold and for a long time… Lagging investment in mines and metallurgical works, just as the already started-up demand, are the causes of the increase in prices at the beginning of the 21st century.

exploration costs, bill USD	2.0	2.3	2.2	2.5	2.9	3.5	**4.6**	**5.2**	3.7	2.8	2.6	2.2	1.9	2.4	3.8	5.1	**7.5**	**10.5**
copper price, USD/t	2 690	2 381	2 337	1 985	2 426	**3 021**	2 381	2 337	1 698	1 654	1 918	1 654	1 632	1 852	2 933	3 793	**6 902**	**7 210**
gold price, USD/oz	384	362	344	360	384	384	**388**	331	294	279	279	271	310	364	409	445	**604**	**697**



* Non-ferrous metals and diamond, iron ores excluded. ** Gold and copper absorb substantial exploration costs.

Source: Exploration budgets after *Metals Economics Group* and *Prospectors and Developpers Association of Canada.* Prices *World Mining & Metals Yearbook.*

Fig. 1. Correlation between world exploration costs* and world prices of gold and copper**

This revival of exploration has several causes:

– basic knowledge (economic geology, metallogeny) and technical knowledge (geophysical methods) have advanced a great deal; better targeted exploration is more successful;
– prices and rates of metals, historically very high, are providing mining enterprises with sufficient means for exploration;
– the organisation of exploration has evolved: It is now conducted mostly via small companies (“junior companies”), flexible and efficient, whose discoveries are purchased in stages by large mining and metallurgical enterprises (“major companies”). Exploration has become a distinct field, the “majors” externalised the risk of failure and its costs. This development limited the dire effect of mergers and acquisitions which multiplied over two decades: the reduction in the exploration budget after a consolidation. Metals Economics Group demonstrated that the exploration budget was nearly always lower after a merger or an incorporation than the total budget prior to a merger or purchase: financial directors implemented economies of scale at the expense of uncertain exploration and preferred the purchase of well-verified reserves of a competitor;

– the laws are more favourable in the majority of mining countries. Exploration flourishes in places where legal, social, fiscal conditions etc. are favourable: it does not matter if it is a traditional or a developing mining country, and it suffices that exploration and subsequent mining may be managed well and clearly for the medium and long term. Exploration is inactive or stagnates in places where discouraging regulations or repeated changes in trends persist.

However after decades, effective exploration is still not used in certain regions of the world: this is the case of Western China, even though measures for assistance are introduced by governments composed mainly of engineers. Many small and intermediate mines are carelessly managed for the medium-term. Is this the fault of geostatisticians?

The situation is not better in, for example, certain regions of Africa and Central Asia. The state of geological and economic-geology knowledge there is often several decades out of date… Since, knowledge and technical methods have advanced considerably during this period. Abandoned mining projects are being revised, and in some archives crowds wait for the possibility to consult "feasibility studies" which are 30 or more years old.

3. Production and consumption by regions, countries, enterprises

3.1. Who produces what, who consumes what, by countries and regions?

Countries which produce ores and metals, and consumer countries to a smaller extent, are fairly concentrated. Numerous mining and metallurgical enterprises remain despite mergers and acquisitions which, in two decades, have multiplied.

3.2. Which deviations are significant?

Industrial and developing countries coexist in worldwide supply and demand. The "China – India dipole" has a key role, but it is not the only one. Certainly, this duo has a substantial part in the industrial growth of the world in terms of nearly all minerals. However, others are also committed to this course: Brazil and Russia, but also other less known countries. We shall discuss this later on.

Shall we proceed further with a more detailed analysis? In computing the consumption of metal in the raw state, we will hardly consolidate the results for the whole industry up to the final marketable product. Developed countries, which seemingly consume less crude metals, in reality import them in the form of goods; developing countries, which seemingly import a lot of crude metals, in reality consume less goods: they reexport goods.

What do we really measure with consumption of metals?

In statistical yearbooks, the data on production, trade and consumption are given in tonnes of crude metal. This is certainly logical, but incomplete. Because trade, which is often important, is based not only on (unwrought) metal but also on intermediate products or even on finished products. Let us take an example from Europe. Denmark no longer consumes tin, lead, stainless steel, magnesium in their raw states, has not produced steel since 2003, and did not consume more than 300 t of nickel and 100 t of copper in 2005. Is it possible to say that it no longer uses these metals? Certainly not. It imports tin in the form of ready-to-use solder, lead in batteries, magnesium in the wheels of imported vehicles, and copper in the form of pipes and wire.

Analysing the industry in its entirety is extremely time consuming and complex, sometimes even impossible because statistical gaps exist. For example, how can the chrome industry be analysed in detail, when statistics list only the chrome content in ferroalloys of individual deliveries? Or the lead industry, when the amount of metal contained in batteries is not statistically known… Or the copper industry, when all of the copper or brass contained in imported or exported electrical materials is not known.

It seems that this type of study was solely conducted by the American Iron & Steel Institute for steel in the USA. The results are informative. This study measures the steel content in 8 product groups, which the USA import from or export to 11 major foreign partners, in million tonnes.

Tab. 3. Steel production and consumption in the USA (mill t)

	2001	2002	2003	2004	2005	2006
Raw steel production	90.1	91.6	93.7	99.7	94.9	98.6
Raw steel consumption	103.8	102.7	100.5	115.6	107.1	119.6
Derived imports of raw steel	13.7	11.1	6.8	16.9	12.2	21.0
Indirect steel imports	N	36.2	N	34.0	36.9	39.8
Indirect steel exports	N	16.3	N	18.1	20.2	20.6
Indirect net imports	17.7	19.9	15.0	15.9	16.7	19.2 *
Real steel consumption	121.5	122.6	115.5	131.5	123.8	138.8

(*) of which 5.5 mil. t are from China and 5.4 mil. t from Japan. In 2006, automobiles represent 9.5 mil. t of these indirect imports.

This is undoubtedly the same in other cases. Thus, does the apparent steel consumption of the Republic of Korea not partly end up in the export of automobiles, merchant ships, and consumer goods? Its apparent consumption exceeds its actual domestic consumption. This is evidently the same regarding China´s apparent consumption of metals.

However, this must not conceal the impact of 2nd and 3rd tier developing countries (emerging economies) which are outsiders from Latin America (Brazil, Mexico, etc.), the Middle East (Iran, countries of the Gulf Cooperation Council) as well as Slavonic (Russia, Kazachstan, Ukraine) and African (South Africa, Namibia, undoubtedly soon Mauretania) countries. Some are developing as producers-exporters, others as consumers for their own domestic market or for export. What role will they play in the world mineral trade in 10, 15 or 20 years? Undoubtedly, a significant one.

Tab. 4. Few emerging mining and industrial countries

IRAN		**1984**	**1990**	**2003**	**2006**	
bauxite production	kt	0	92	366	500	
aluminium production	kt	42	65	103	240	
aluminium consumption	kt	67	120	150	N	
copper mine production	kt	43	75	146	210	
copper production, metal	kt	5	48	145.7	201	became exporter

copper consumption	kt	10	43	110	130	_
lead mine production	kt	17	9	16	24	
lead production, metal	kt	7	10	54	75	2/3 by recycling
lead consumption	kt	20	30	72	65	became exporter
zinc mine production	kt	27	15	111	164	
zinc production, metal	kt	0	0	84	140	became exporter
zinc consumption	kt	13	20	70	80	_
silver production	t	20	38	23	25	underestimated?
gold production	t	N	0.5	0.5	0.25	
molybdenum production	t	500	542	2200	2200	
tin consumption	t	0	0	1400	N	(1995 = 400 t)
iron ore production	mill t	N	12.4*	16	18.I	*2000
direct reduced iron production	mill t	N	4.54*	5.6	6.85	
steel production	mill t	N	6.6*	7.9	9.8	(just like Poland)
steel consumption	mill t	N	9.6*	14.7	17.9	(France = 16.4 mill t)
foreign trade surplus	mill USD		6 817	******	*****	

PERU		**1984**	**1990**	**2000**	**2006**	
copper mine production	kt	364	302	554	1050	
copper production, metal	kt	219	183	452	508	
copper consumption	kt	26.5	29.8	45.3	52.9	
lead mine production	kt	196	210	271	313	world‘s n°3
lead production, metal	kt	71.2	69.7	116.4	120.3	
zinc mine production	kt	553	598	910	1 202	world‘s n°3
zinc production, metal	kt	148	120.1	200.2	175.3	
silver production	t	1 657	1 761	2 438	3 471	world‘s n°1 (17.5 %)
gold production	t	5.8	9.1	132.6	203	world‘s n°5
molybdenum production	kt	3.1	2.51	7.19	17.5	world‘s n°5
tin consumption	kt	2.2	4.8	37.4	38.5	world‘s n°3
tin production, metal	kt	0	0	17.4	40.5	world‘s n°3
iron ore production	mill t	N	N	4.1	7.6	
foreign trade surplus	mill USD		-2 241	-411	5 163	

KAZAKHSTAN		**1995**	**2000**	**2006**	
zinc mine production	kt	162	322	450	
zinc production, metal	kt	169	263	349	
silver production	t	371	895	810	
gold production	t	14.9	27.4	21.8	
uranium mine production	t	1 630	1 740	5 279	world‘s n°3
molybdenum production	t	75	215	400	

chromite production	mill t		**?**	2.4	*3.58*	*world's n°2 (2005)*
ferrochrome production	kt		**?**	589	*1156*	*world's n°2 (2005)*
iron ore production	mill t		**?**	14.9	18.6	
foreign trade surplus	mill USD		114	2 168	*10 322*	*(2005)*

INDONESIA		**1984**	**1990**	**2000**	**2006**	
copper mine production	kt	86	164	1012	817	
copper production, metal	kt	0	0	158.4	217.6	
copper consumption	kt	17.5	49.4	70	220	
nickel mine production	kt	45.7	68.6	98.2	150	world's n°3
nickel production, metal	kt	4.8	5	10.1	14.5	
silver production	t	35	66	314	261	
gold production	t	2.3	11	124.6	86.3	
tin mine production	kt	23.2	30.2	51.6	117.5	world's n°1 in 2006
tin production, metal	kt	22.5	30.4	46.4	80.9	world's n°2
foreign trade surplus	mill USD		**?**	25 042	22 368	

Aluminium production from imported alumina…		**1984**	**1990**	**2000**	**2006**
South Africa	kt	167	160	676	895
Bahrein	kt	177	212	509	872
Dubai	kt	155	174	536	789
Indonesie	kt	199	192	192	250
Island	kt	82	89	226	325
Mozambique	kt	0	0	54	536
Total	**kt**	**780**	**827**	**2 193**	**3 667**
primary world supply	*%*	*4.6*	*4.2*	*9*	*10.8*

Note:11 % of world alumina are imported by non-producing countries, however, disposing of abundant low cost energy (gas, hydroelectricity). These countries are going to be manufacturers-exporters of a metal.

Sources : *World Mining & Metals Yearbook* (productions, consumptions), Annuaire du Fonds monétaire international (foreign trade).

These observations lead to proposing a typology of major regional and national vulnerabilities, which specifies:

– very dependent import countries, which will become more and more dependent, unless a highly unlikely strategic reversal occurs: the European Union, the USA, Japan, Korea, etc. The last two seem to be less vulnerable due to the economic life of their export industry which generates a significant foreign trade surplus;
– export countries which are far too dependent on their exports, they risk becoming so more and more: Australia, Brazil, Russia, a part of Africa and Asia, even Canada. The boom is exceptionally favourable for them for another decade or two, however, produc-

tion often remains an export monoculture linked to the demand of clients. But then? Besides that – is the accumulated wealth distributed rationally throughout the whole society of these countries?
– opportunist countries, including developing or even already prosperous manufacturers generally subsidised with energy resources at a very low purchase price, which process imported minerals in their territories and export metals. This is the case of the countries of the Gulf Cooperation Council as well as Iceland, Norway, Canada too in the case of aluminium: its production is a large consumer of energy, bauxite (or preferably alumina) can be imported for the production of metal at low cost.

3.3. Consequences of these deviations

Several results of these are:

– exponential increase in international traffic, in terms of volume as well as distance, which is worsened by the price increase of bunker fuel for ships. Currently, there is a shortage of freight ships for bulk cargo despite intense shipyard activity, so that even old ships are sold at prices of new ones;
– congestion in Asian ports and networks of heavy mine railways filled to capacity. Since waiting periods are expensive… In order to resolve the blockage of ports, a new category of "China size" ships with a tonnage in the range of 400 000 tonnes has emerged;
– an outflow of heavy industry from industrial countries and a surge of new integrated centres (raw material "hubs", integrating mines or the metal industry, energy sources, a port and a rail network) in China, the Arabic-Persian Gulf, Brazil, Australia, India, etc.
– In this manner, two of the more important aluminium producing units in the world are located in the Middle East (Bahrain, Dubai), near ports next to sources of natural gas and of intermediate products (petroleum coke for electrodes) at very low costs. These two countries import aluminium oxide from Australia for the supply of more than 1.5 million tonnes of metal to the Middle East, Asia and Europe.
This is the spiral of expanding indirect consumption of energy and costs.

3.4. The concentration of manufacturing countries conflicts with the dispersal of manufacturing enterprises

Acquisitions and mergers between large groups conceal reality: the majority of mine production to date comes from medium-sized enterprises. Not only in cases of "small metals", such as gold. In metallurgy, the concentration still remains quite weak, although the takeover of Arcelor by Mittal spilled a lot of ink. Similarities may be observed regarding lead, zinc and nickel metallurgy etc.

Large groups, known through the media, are repeatedly diversifying, and are less and less narrowly specified. This is a change in strategy, which is quite general.

Ironically, the development is mostly contradictory precisely in the sector of "small metals": The majority of metallurgical production comes from a small number of industrial enterprises (sometimes creating oligopolies), while most of the mine production is extremely dispersed, being carried out by small and medium-size enterprises, and even by "enterprises" of illegal (craft) production.

Tab. 5a. Cumulative proportion of the most important production countries in world metal production

	Aluminium			Copper		Lead		Zinc		Nickel		Tin	
Rank	**bauxite**	**alumina**	**metal**	**mine**	**metal**	**mine**	**metal**	**mine**	**metal**	**mine**	**metal**	**mine**	**metal**
First country	33.7	25.1	28.0	35.6	17.3	35.3	55.7	28	29.I	20.I	20.3	36.3	35.6
2 first countries	46.0	44.1	38.5		33.5	54.7	61.1	40.7	36.7	35.7	31.7	71.5	57.9
3 first countries	57.0	53.3	47.5	50.7		67.5	65.8	52	42.9	48.1	43.1	83.4	69.0
4 first countries	67.0	60.2	54.2		49.5	76.3	69.8	58.8	48.6	58.1	53.0	88.9	76.6
5 first countries	75.0	65.7	60.0	62.5		80.0	73.5	64.7	53.2	65.0	61.9	93.0	82.9
6 first countries	82.0	70.2	64.6	68			77.1	69.5	57.5	71.3	68.0	95.1	86.6
7 first countries		74.5					80.1	74.0	61.4	76.3	71.9	96.6	89.9
8 first countries				76.5	65.7			78.2	64.6	81.0	75.4		
9 first countries								82.1	67.8		79.0		
10 first countries									71.0		82.0		

Notes:
Bauxite production is very concentrated, alumina one less: nonintegrated bauxite producers export crude ore (e.g. Guinea). Production of metal, except China (no 1) is even less concentrated: alumina producers export to manufacturers (e.g. Persian Gulf, Iceland)
Copper mine production is strictly concentrated, production of metal is much less concentrated. Ore concentrates are exported as some of producers either are not integrated or have not a metallurgical capacity matching their extractive capacity.
Lead mine production is very strictly concentrated. Concentration of metal production is higher, however, differentiating with a giant (China) overtaking by far a ruck of smelters from which no one attains one tenth of Chinese production.
Productions of zinc are less concentrated than in the case of lead, especially in metallurgy. With exception of China consuming all its concentrates, the metallurgy remains more dispersed.
Nickel mine production is unambiguously concentrated, but principal producing countries keep small distance. Production of metal is less concentrated as many of mattes are processed out of mine production countries, often from historical reasons.
Tin mine and metallurgy productions are extremely concentrated: 3 mine producers and 5 metallurgy producers ensure 83 % of supply.

3.5. The status of "small metals"

In the financial, mining or economic media, everyone worries (industrial users-manufacturers), or rejoices (producers) in the rate rise of ferrous and non-ferrous "large metals". The situation regarding "small metals" is worse.

The rise in prices or rates is indisputable, but their instability complicates management most of all. The managers of mining and metallurgical groups as well as of small and medium-sized enterprises which produce metals are particularly alarmed by severe fluctuations: managing that, which is costly but stable, is less complex than that, which is affected by crises and repeated instability…

The role of "small metals" is exceedingly underestimated, and even ignored. Certainly, worldwide volumes are weak, however, prices are astronomical. World markets of "small metals" have a value of several billion or tens of billions of dollars each.

Tab. 5b. Cumulative proportion of the most important production countries in world metal production – small metals

	Platinoides			Gold	Silver	Antimony	Cadmium	Mercury	Magnesium	Cobalt		Molybdenum
Rank	platine	palladium	others	mine	mine	mine	metal	metal	metal	mine	metal	mine
First country	77.7	44.4	71.6	11.6	17.4	87.0	21.7	64.0	74.1	36.3	23.6	33.9
2 first countries	90,9	82.8	93.1	22.2	30.9	89.7	37.4	86.2	80.5	47.7	39.6	56.9
3 first countries		89.3		32.7	43.9	92.4	48.2	98.5	86.2	59.2	49.3	78.6
4 first countries		94.5		43.0	52.6	95.0	58.1		91.1	67.1	58.5	91.1
5 first countries	99.0			51.7	60.6		67.6		95.7	74.6	67.3	92.8
6 first countries				58.5	67.0		75.6			81.6	75.8	
7 first countries				63.0	72.7		78.9			88.2	83.2	
8 first countries				66.6	78.2		82.0				88.5	
9 first countries				70.2	83.1						91.1	
10 first countries				73.0	87.2						93.3	
11 first countries				75.5								
12 first countries				77.7								
13 first countries				79.5								
14 first countries				81.1								
15 first countries				82.8								
16 first countries				84.4								
17 first countries				85.9								

Notes:
Gold is a scarce example of production dispersion. In 1984 South Africa covered 47 % of world supply (682 t), followed proximately USSR (269 t), Canada (83.4 t), USA (64.8 t) and Brasil (61.1 t). In 2006 South Africa fell to 272 t (12 % of world supply), followed by China and Australia (247 t) and USA (242 t). Presently there are 86 producing countries (65 in 1984) 19 of which realize more than 1 % of the world supply (12 in 1984).
Platinum: Strong South-African hegemony. Palladium: Well-balanced duo South Africa and Russia. Other platinoids: Net predominance of South Africa.
Silver productions are distributed well enough among dominating producers. Silver is particularly byproduct of gold with the exception of Mexico.
Antimony has most concentrated mine productions: there is a total hegemony of China, undoubtedly irreversible.
Cadmium metallurgy production is quite little concentrated. By contrast cadmium consumption is concentrated very strictly: 54.6 % duo China-Japan, 78.6 % trio China-Japan-Belgium.
After ending of mercury production in Spain and Algeria, there is a strictly Asiatic producer duo.
Magnesium also has extremely concentrated production. Predominance of China more recently same as in the case of antimony.
Cobalt mine production becomes more concentrated again (Congo), however, other producing countries become more numerous by reason of an oxide Ni-Co ore hydrometalurgy processing extension. Metal production is less concentrated: mattes, ore concentrates from small mines and intermediate Ni-Co products are exported.
Molybdenum: Very closely concentrated market. For that reason present crisis: Mine supply and roasting capacity insufficient.

Tab. 6. Value classification of few metals world markets (values in mill USD = world production times world prices)

	value 2000	rank, 2000	**value 2007**	rank, 2007	*2007/2000*
Iron (ore)	29 885.0	2	160 800.0	1	*5.4*
Copper	26 797.0	3	128 394.0	2	*4.8*
Aluminium	37 829.7	1	92 323.0	3	*2.4*
Gold	23 019.7	4	52 656.6	4	*2.3*
Nickel	9 490.3	5	51 382.8	5	*5.4*
Zinc	9 346.8	6	36 919.4	6	*4.0*
Molybdenum	745.3	14	11 865.9	7	*15.9*
Lead (primary)	1 513.6	10	10 001.0	8	*6.6*
Platinum	2 791.0	9	9 439.9	9	*3.4*
Silver	2 922.0	8	8 626.8	10	*3.0*
Tin	1 465.2	11	5 301.6	11	*3.6*
Cobalt (metal)	1 205.3	12	3 607.5	12	*3.0*
Palladium	3 328.8	7	2 623.2	13	*0.8*
Magnesium	950.8	13	2 138.8	14	*2.2*
Antimony	166.9	15	927.1	15	*5.6*
Cadmium	9.8	16	189.3	16	*19.3*
Mercury	6.0	17	40.0	17	*6.7*
Total	**151 467.7**		**577 196.8**		***3.8***

Note: In 2007 Ni and Zn caught „Four Grands“ from 2000 (Al, Fe, Cu and Au) up. Lead stood molybdenum back but ahead of platinum and silver; palladium is far beyond cobalt.

The crises there are more severe than in the case of classic “large metals“ listed by LME or NYMEX. “Small metals“ are at the rear of the whole industrial innovation. We do not telephone, or work with a computer without tantalum, tin, platinoids; the petroleum consumption of an airliner will not be reduced without rhenium or ruthenium, and neither a diesel or classic engine can be finished without platinoids (catalytic converter), nor an electromobile without lithium and cobalt (battery).

For example, the purchase of a telephone or a notebook most frequently represents the purchase of a silicon processor made in the USA or Asia, of Australian condensers with tantalum, of screens with indium (Canadian or Chinese, refined in Belgium or Japan) or with Chinese rare earths processed in French La Rochelle. Everything is soldered with Chinese tin in an envelope of polymers (synthesised in Asia, the Gulf, the European Union or the USA), and assembled in Finland… All of that went around the world several times in Korean, Cypriot or Panamanian container ships…

It is necessary to be a realist: This industrial and trade globalization maintains growth in energy consumption.

4. Super cycle of expansion? Its limits?

4.1. Super cycle?

First of all, what is a “super cycle“? The common cycle of industrial or commercial growth or decline most often lasts for half a decade. A super cycle may last for a fourth or a third of a century, as those “well-known 30“ (1944–1974). In order for it to occur, diverse causes must converge in several regions of the world, and political and social factors, which may sometimes be of a diverse nature, must combine simultaneously in the world. We are in that situation.

At the end of the 20th century, one convergence crystallised. China´s political leaders urged its fellow citizens to“become wealthier“; India´s scientific and industrial elite left its domestic market and is again returning to foreign markets; Brazil, where European ironworks (Arbed, Sacilor, etc.) invested more than 30 years ago, became a huge producer of ore, but pig iron and steel too which repaid a then enormous debt; Russia and some of its former satellites once again became industrial powers, and member countries of the Gulf Cooperation Council invested in “energy-consuming“ industry and are now gaining ground in some heavy industry sectors (aluminium, steel, fertilisers), or services. The super cycle gate was opened at the dawn of the 21st century, undoubtedly for a long time.

A super cycle of minerals and even of all mineral, energy, plant and animal commodities? A hypothesis or reality? In my opinion, that is how things stand, a worldwide supercycle is now launched, all the commodities being concerned. We can expect a long period of high prices. That is unavoidable. It is necessary to come to a resolution, to prepare ourselves quickly (if it is not already late), to restore industrial politics without doubt or delay. To set it aside until tomorrow means being dependent on more and more distant suppliers, some of which may experience a demographic collapse after one generation, and others political crises… This then means risking to pay twice for the same incompetence.

4.2. Limits?

Even a worldwide super cycle may have limits, manifesting themselves sometimes very severely. We have a fairly recent example of this: The “thirty well-known“ years of 1944–1974. Before the “oil crisis“ of 1974, a crisis in all raw material prices unfolded very quickly, marked in this period by the prevalence of producer cartels, the beginnings of which appeared in 1971–1972; precursors indicating the end of the “well-known 30“. At that time, they were not perceived by practically anyone that way.

The super cycle, which is currently under way, will have limits and brakes, though certainly of a different nature. The world is evidently not structured the same way as in the 70s.

One of the brakes lies in profession demographics. During lean years, mining enterprises invested little in exploration and, as a result, employed less people; consequently, universities abandoned this stricken industry.

It was logical, but placed a burden on the future. And the now revived exploration cannot find enough experienced practitioners: the 40–50 age group is nearly vacant. The 60–70 one has vanished, and novices are only beginning to be brought forth once more, but they lack the knowledge of x number of crises which can only forge an experienced economist.

Currently therefore, there may be less of a lack in sources to explore than competent practitioners for exploration of new regions, even simply for reevaluation of regions known to be inexploitable 20–30 years ago, but with technical and economic knowledge of our era. In too many countries, our knowledge of mineral deposits date back 30 to 40 years.

The whole expansion has other limits: in China and India as well as in Japan, they are demographic, yet of a different nature. In China and India, there is an imbalance between men and women, which is creating a society of childless old men, with a strong risk of social collapse in 10 to 15 years. Being forbidden to have a second child around 1990 and favouring only male children, are leading to the absence of grandchildren in 2015 to compensate the retirement of aging adults. These two large Asian countries are in such a situation. This situaion is irreversible. In Japan – and maybe also in Korea? – there appears to be an inescapable aging process and a collapsing society, whose future expenses are not covered at all…

In 20 years, the dominant position of these countries will be seized by demographically more dynamic and orderly countries, which are currently developing (Brazil, Malaysia, Thailand, Indonesia, etc.), or which are reviving (Russia, Ukraine, etc.). The analysis of demographic and industrial statistics does not leave any doubts at all.

Finally let us recall that transport congestion and inflation of its unit costs is another drastic limit.

Conclusions: Currently, there is a number of developments underway; a part of the world is experiencing growth, which another part (Europe, then the USA, then Japan) experienced between 1840–1972, in several diverse phases.

This course will indirectly or directly bring about a nearly complete integrity of the world within several decades and that cannot be ignored. It will create expanding trenches between those on board the “train of development“ and those who risk being left behind.

Many governments have long ignored these facts, these tendencies and these changes.

Political decisions, on a long-term basis, determine the future for the next10, 25, or often for 50 years… Our future around 2020, 2025, or 2050 hinges on today´s decision, or their absence. Looking forward, on a long-term basis, makes sense!

The economic situation of domestic mining enterprises

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Tab. 1: Mining total

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		207	230	224	221	209	151
Registered number of employees		96 507	93 114	103 682	101 712	98 340	85 309
Sales	mill CZK	142 736	154 762	196 583	208 614	218 522	218 203
Value added (VA)	mill CZK	52 896	57 453	72 082	74 677	79 108	76 348
Acquisition of land and deposits	ths CZK	832 228	855 526	564 534	608 115	1 181 289	358 967
Sales per employee	ths CZK/ employee	1 479	1 662	1 896	2 051	2 222	2 558
Labour productivity based on VA	CZK/ employee	548 103	617 011	695 224	734 193	804 436	894 966
Hourly labour productivity	CZK/ working hour	330	368	410	436	476	530
Average salary	CZK/ employee	18 142	19 256	20 639	21 777	23 413	25 034
(Value added – salaries) per employee	CZK/ employee	529 962	597 755	674 585	712 416	781 023	869 932

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	-27%	11%	-2%	-2%	-5%	-28%
Registered number of employees	-12%	-4%	11%	-2%	-3%	-13%
Sales	53%	8%	27%	6%	5%	0%
Value added (VA)	44%	9%	25%	4%	6%	-3%
Acquisition of land and deposits	-57%	3%	-34%	8%	94%	-70%
Sales per employee	73%	12%	14%	8%	8%	15%
Labour productivity based on VA	63%	13%	13%	6%	10%	11%
Hourly labour productivity	61%	12%	12%	6%	9%	11%
Average salary	38%	6%	7%	6%	8%	7%
(Value added – salaries) per employee	64%	13%	13%	6%	10%	11%

There are five specific circumstances of the data for mining enterprises (Tab. 1: Mining total) discussed in this yearbook:

1. It is impossible to distinguish pure mining from other activities. All data are for the enterprise as a whole, such as, for example, the production of bricks and the trade activity together.
2. The enterprises belong not only to the group OKEČ (CZ-NACE)* C mining and quarrying, but also to CZ-NACE D manufacture of other non-metallic mineral products (glass and construction minerals) and few enterprises belong to other groups (mining is one of the activities).
3. Sampling is influenced by the accessibility of data. In the case of sales and book value added, the sample corresponds to 95 % of the whole, but it covers a much lower proportion of the number of enterprises. Data for very small enterprises are not available.
4. It is possible to collect a lot of data (for example from annual reports) for the large enterprises, but in the case of small ones data are not available. This affects the selection of indexes.
5. In view of secret individual data, it was necessary to group the mining enterprises into bigger aggregates.

The selection of indicators is as follows:

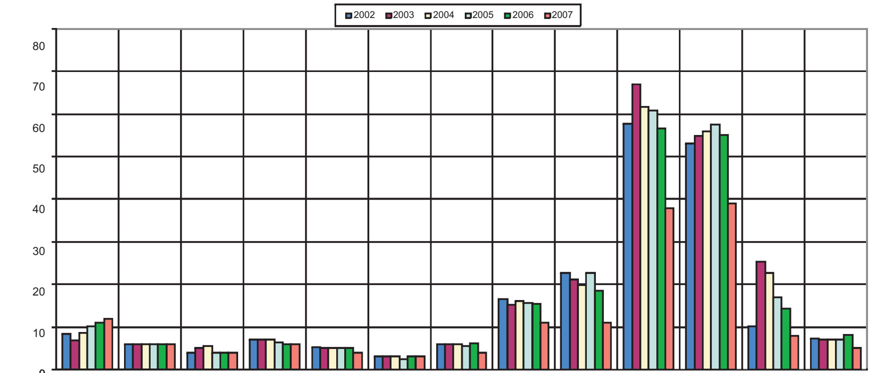
- number of enterprises
- registered average number of employees
- sales (sales of goods and sales of own goods and services)
- book value added (VA) [(sales + change of stocks of own production + capitalization (production of an enterprise for own consumption)) – purchased goods – intermediate consumption (consumption of supplies and raw materials, energy and services)]
- acquisition of land and mineral deposits (investment in new land and mineral deposits)
- sales per employee (labour productivity based on sales, i.e. sales per registered employee)
- book value added per employee (labour productivity based on book value added, i.e. book value added per registered employee)
- hourly labour productivity (book value added per working hour)
- average salary
- (the book value added – salaries) per employee, i.e. book value added after deduction of salaries.

Data have been collected in 2002–2007. Indicators for time series are supplied by chain indices. Comparable indices are compared with data for Mining total (Mining total = 100 %).

* *Translator's note:* OKEČ (Odvětvová klasifikace ekonomických činností) is the same as CZ-NACE – Czech adoption of the General Industrial Classification of Economic Activities within the European Communities (Nomenclature générale des Activités économiques dans les Communautés Européennes)

Fig. 1. Number of enterprises

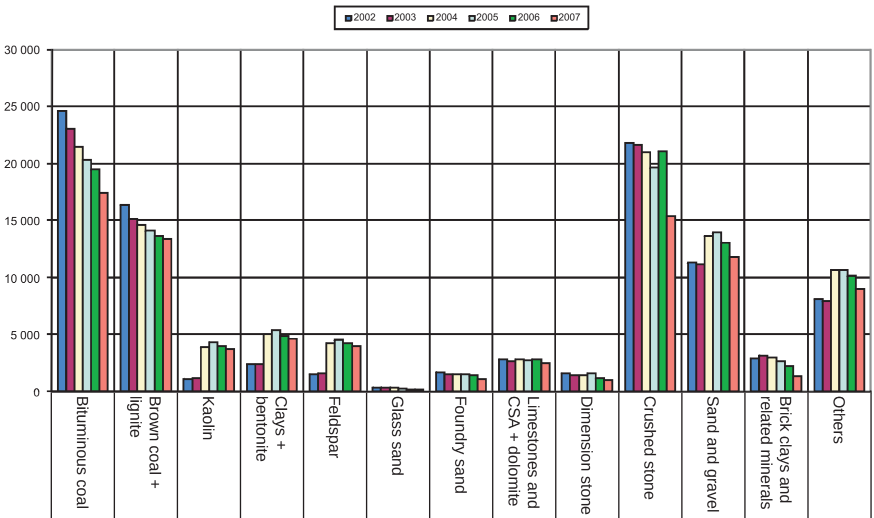
(CSA in this and following figures means "Corrective sialic additives for cement production")



	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA* + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	8	6	4	7	5	3	6	17	23	58	53	10	7
2003	7	6	5	7	5	3	6	15	21	67	55	25	7
2004	9	6	5	7	5	3	6	16	20	62	56	23	7
2005	10	6	4	7	5	3	6	16	23	61	58	17	7
2006	11	6	4	6	5	3	6	15	18	57	55	14	8
2007	12	6	4	6	4	3	4	11	11	38	39	8	5

The number of enterprises (Fig. 1) has been generally stable in the years 2002 to 2006. Changes are connected with mergers of enterprises (reductions) and with acquisition of data for new enterprises. The number of enterprises in 2007 is lower due to a different data collection. In 2002–2006, data were collected for enterprises with 20 or more employees and, in 2007, for enterprises with 50 or more employees. Foundry sand, dimension stone, crushed stone, sand and gravel, and brick clays were affected by this difference in the data collection. We will treat this topic in more detail in the following figures.

Fig. 2. Number of employees



	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	24 648	16 366	1 093	2 422	1 513	369	1 650	2 782	1 567	21 789	11 318	2 854	8 136
2003	23 059	15 126	1 183	2 357	1 560	328	1 527	2 678	1 438	21 643	11 181	3 138	7 896
2004	21 464	14 667	3 901	5 020	4 223	296	1 485	2 835	1 432	21 008	13 677	3 003	10 672
2005	20 360	14 138	4 259	5 375	4 584	227	1 450	2 752	1 551	19 700	13 978	2 656	10 682
2006	19 523	13 657	3 977	4 910	4 251	163	1 402	2 797	1 197	21 061	13 030	2 209	10 165
2007	17 423	13 366	3 685	4 626	3 978	124	1 099	2 467	989	15 404	11 801	1 319	9 028

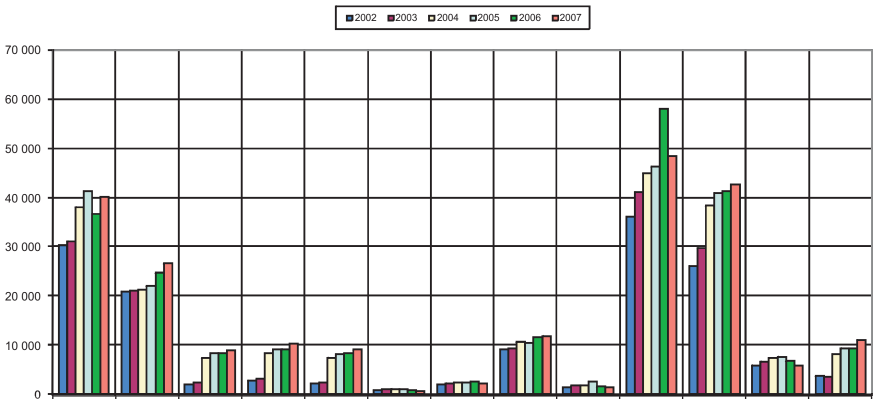
The recalculated number of employees (Fig. 2) is higher in 2004 and 2005 than in 2002 and 2003. A decrease in the number of employees began in 2006 and continued in 2007. There are, of course, several causes for this development and they have to be considered separately in terms of individual minerals.

There is a stable decrease in the number of employees in “classical” mining branches such as, for example, coal mining. In the case of kaolin, clays, and feldspar, the reason for the development in the number of employees is not so much an increase of employees working in mining, as an increase of employees working in consecutive manufacture and trade. The biggest problem in evaluating economic results stems from the influence of mergers of mining and manufacturing activities.

In the case of foundry sand, dimension stone and crushed stone, the considerable decrease in the number of employees in 2007 poses a problem, and there is an obvious effect caused by a different list of enterprises in 2007 compared to 2006. We have estimated this effect. We know the 2007/2006 year-on-year index of the enterprises selected in 2007. Its application to data from 2006 would generate the following employee numbers: 1 197 for foundry sand, 1 243 for dimension stone, and 15 663 for crushed stone. The total for Mining total would amount to 85 920. This represents a negligible difference in mining (plus 0.72 % compared to the value given for 2007), however, a considerable difference in the case of selected minerals – foundry sand 8.93 %, dimension stone 25.66 %, and crushed stone 1.68 %.

It can be expected that the number of employees working directly in mining will decrease in the future.

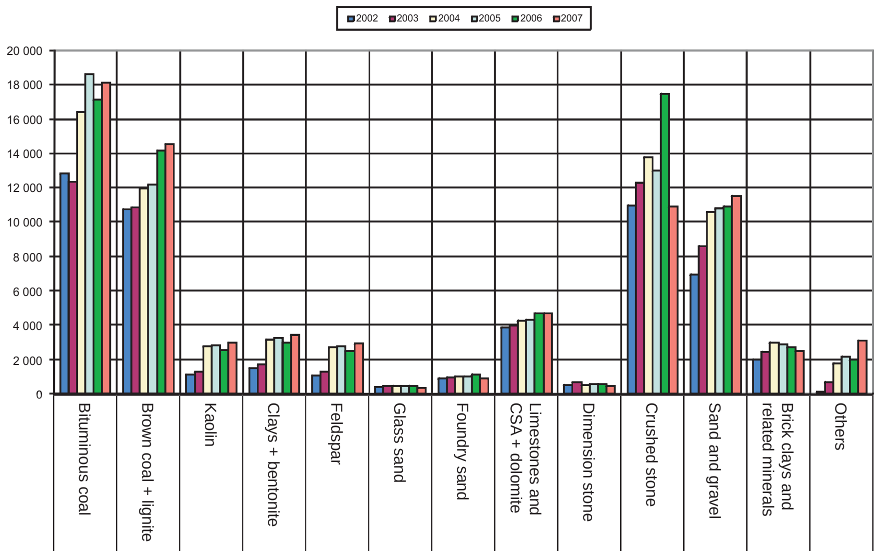
Fig. 3. Sales (mill CZK)



	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	30 315	20 814	1 916	2 785	2 074	856	1 949	9 113	1 429	36 063	25 965	5 737	3 722
2003	30 988	21 067	2 287	3 164	2 310	919	2 060	9 253	1 707	41 136	29 781	6 643	3 446
2004	38 048	21 259	7 365	8 267	7 279	960	2 285	10 648	1 713	44 914	38 336	7 412	8 096
2005	41 260	21 920	8 266	9 124	8 164	881	2 229	10 341	2 525	46 290	40 818	7 600	9 197
2006	36 599	24 613	8 222	9 122	8 221	860	2 439	11 545	1 625	58 074	41 228	6 684	9 292
2007	40 021	26 609	8 913	10 163	8 977	661	2 177	11 711	1 282	48 311	42 607	5 732	11 039

Sales (Fig. 3) are growing over time not only because of the connection with subsequent manufacture (as in the case of kaolin, clays and feldspar). Sales are also increasing in coal mining enterprises where the influence of subsequent manufacture is minimal. Sales growth in 2002–2006 has been healthily high. In 2007, somewhat of a stagnation occurred. Again in this case there is an effect caused by a different list of enterprises in 2007 compared to 2006. We estimated this effect again, this time in terms of the amount of sales. In 2007, sales regarding Mining total would be CZK 19 911 million higher, i.e. 9% higher compared to the state shown in 2007. This is a maximum estimate and, in reality, the value will evidently be lower, because growth tends to be lower in the case of small enterprises than in the case of large ones. It will probably hover close to the 2006 growth rate.

Fig. 4. Book value added (mill CZK)

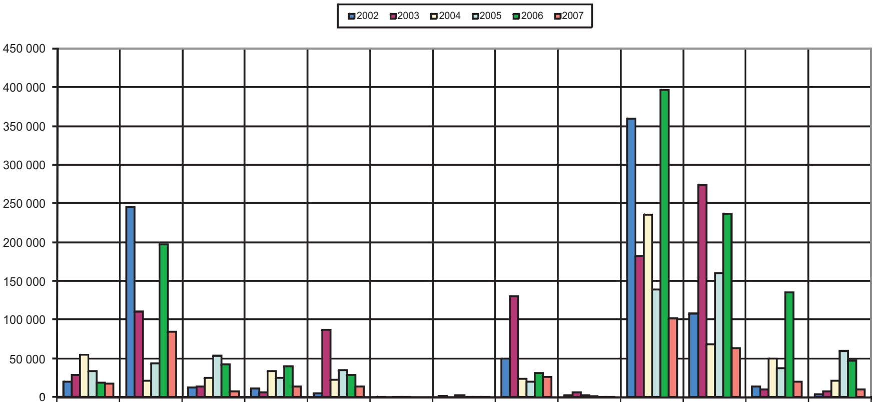


	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	12 857	10 771	1 105	1 460	1 073	389	870	3 882	516	10 949	6 916	1 974	134
2003	12 363	10 857	1 276	1 731	1 285	422	932	3 965	669	12 294	8 569	2 422	668
2004	16 446	11 949	2 735	3 127	2 689	425	983	4 224	469	13 759	10 582	2 948	1 744
2005	18 637	12 166	2 812	3 247	2 772	425	1 007	4 275	532	13 022	10 773	2 880	2 129
2006	17 153	14 135	2 522	2 953	2 498	430	1 099	4 660	547	17 479	10 924	2 722	1 988
2007	18 145	14 561	2 965	3 408	2 941	321	865	4 704	453	10 892	11 513	2 486	3 096

The situation in book value added (Fig. 4) is similar to that of sales, especially as the chain indices concerns. Value added does not change in consequence of enterprise disintegrations and mergers, which represents its advantage over sales. Indices of the book value added are from this viewpoint more predicative than those in sales.

After a period of constant growth, the value was lower in 2007 than in 2006, which may again be affected by a different list of enterprises in 2007 compared to 2006. We estimated this effect and calculated the Mining total at CZK 10 391 million. In other words, the book value added would be CZK 89 500 million, i.e. 13 % higher than in 2006.

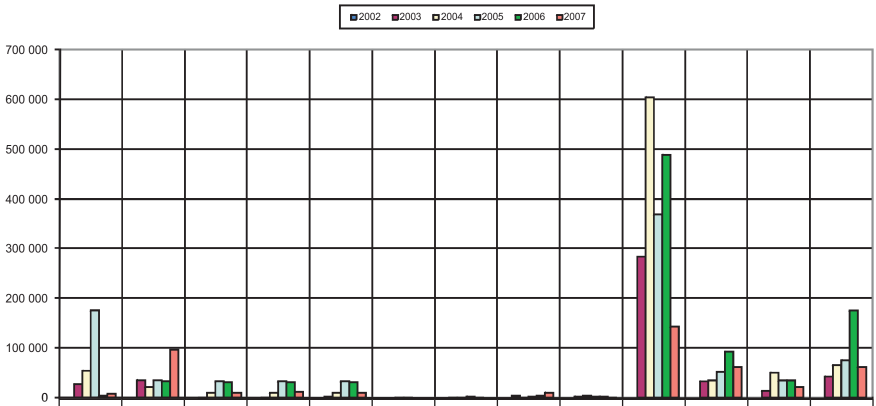
Fig. 5. Acquisition of land and mineral deposits (ths CZK)



	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	20 337	245 737	12 238	11 465	4 510	79	1 225	49 453	3 053	359 382	107 464	13 684	3 601
2003	28 087	110 799	14 078	5 716	86 917	0	0	129 739	6 399	182 194	273 503	10 305	7 790
2004	55 473	21 978	25 153	34 042	22 361	548	3 051	23 513	2 505	235 638	69 010	49 752	21 510
2005	33 496	44 106	52 848	25 240	34 611	123	647	19 971	1 375	139 468	159 652	36 740	59 839
2006	19 214	197 748	43 331	40 242	28 918	0	946	31 613	1 422	396 754	236 847	136 091	48 163
2007	17 417	84 730	7 374	13 690	13 967	0	110	26 622	41	101 245	63 039	20 370	10 362

The data on acquisition of land and deposits (Fig. 5) include investment into new land for manufacture as well as for mining purposes (it is impossible to distinguish). The total sums of investments into land were markedly higher in 2002–2003 than in 2004–2005, and exceeded those in 2002–2003 in 2006. A considerable decrease occurred in 2007.

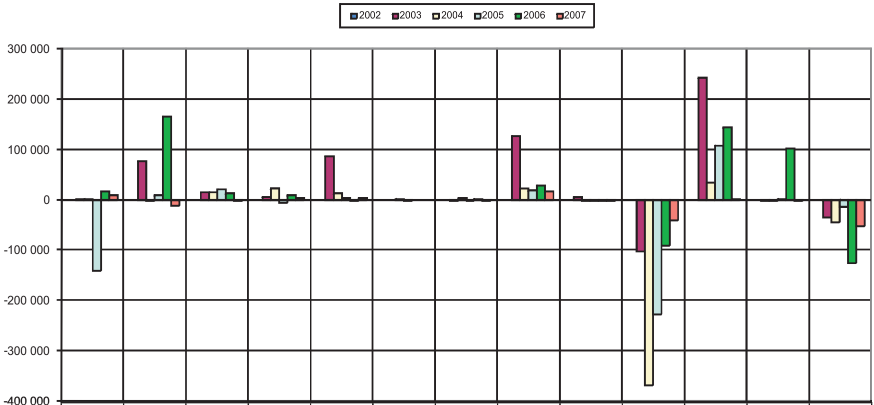
Fig. 6. Sale of land and mineral deposits (ths CZK)



	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	–	–	–	–	–	–	–	–	–	–	–	–	–
2003	26 955	34 275	27	146	1 492	0	21	3 599	1 580	284 337	31 954	12 828	43 407
2004	53 930	22 408	9 910	10 790	9 910	256	259	416	4 637	604 238	35 140	50 257	65 774
2005	175 597	34 886	32 152	32 452	32 152	300	1 447	1 712	1 738	368 172	51 837	35 895	75 050
2006	3 267	33 028	30 980	31 352	30 980	0	73	3 293	2 816	487 383	92 118	34 176	175 157
2007	8 658	96 779	10 508	11 455	10 508	0	0	9 792	112	142 934	61 958	21 169	62 391

It is necessary to supplement data on the acquisition of land and deposits by information concerning their sale.

Fig. 7. Balance acquisition – sale of land and mineral deposits (ths CZK)

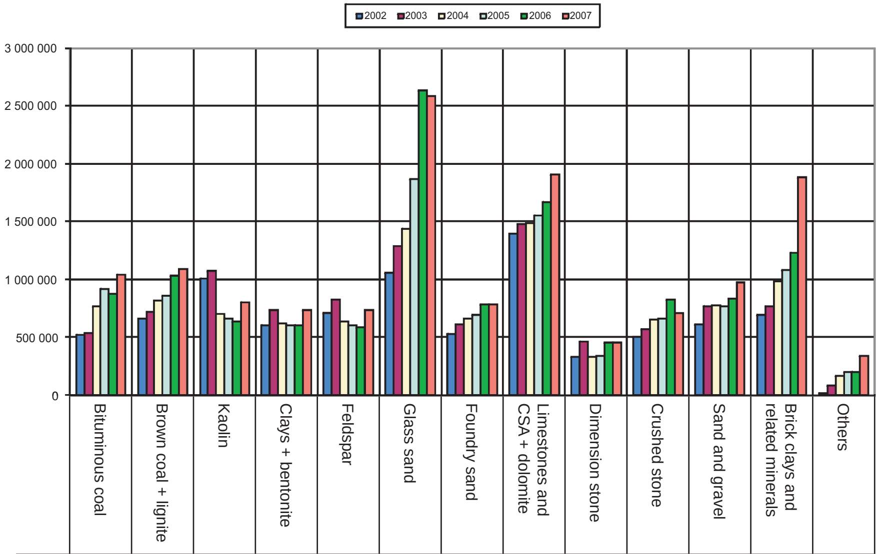


	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	–	–	–	–	–	–	–	–	–	–	–	–	–
2003	1 132	76 524	14 051	5 570	85 425	0	-21	126 140	4 819	-102 143	241 549	-2 523	-35 617
2004	1 543	-430	15 243	23 252	12 451	292	2 792	23 097	-2 132	-368 600	33 870	-505	-44 264
2005	-142 101	9 220	20 696	-7 212	2 459	-177	-800	18 259	-363	-228 704	107 815	845	-15 211
2006	15 947	164 720	12 351	8 890	-2 062	0	873	28 320	-1 394	-90 629	144 729	101 915	-126 995
2007	8 759	-12 049	-3 134	2 235	3 459	0	110	16 830	-71	-41 689	1 081	-799	-52 029

The summary information to Fig. 5 and 6 is given through the balance of acquisitions and sales of land and deposits (Fig. 7). This balance was CZK 415 mill in 2003, CZK -304 mill in 2004, CZK -235 mill in 2005, CZK 256 mill in 2006, and CZK -77 mill in 2007.

The positive balance probably reflects acquisition of land for potential mining. Negative balance is given first of all by sale of unnecessary land and also by sale of mined-out deposits. However, interpretation of balance is equivocal, as we do not dispose any information on the deposits themselves.

Fig. 8. Labour productivity based on book value added (CZK/employee)



	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	521 618	658 141	1 011 088	602 979	709 279	1 054 497	527 468	1 395 223	329 435	502 504	611 051	691 512	16 445
2003	536 165	717 790	1 078 092	734 565	823 936	1 285 959	610 296	1 480 309	465 032	568 048	766 386	771 617	84 572
2004	766 212	814 684	701 211	622 834	636 862	1 439 824	662 379	1 490 063	327 448	654 960	773 718	981 717	163 424
2005	915 357	860 557	660 293	604 200	604 713	1 871 185	694 188	1 553 192	342 669	660 984	770 719	1 084 344	199 317
2006	878 606	1 034 945	634 189	601 502	587 632	2 635 394	784 288	1 666 071	456 865	829 901	838 354	1 232 195	195 582
2007	1 041 427	1 089 399	804 661	739 276	739 276	2 586 412	787 376	1 906 767	458 621	707 076	975 543	1 884 091	342 952

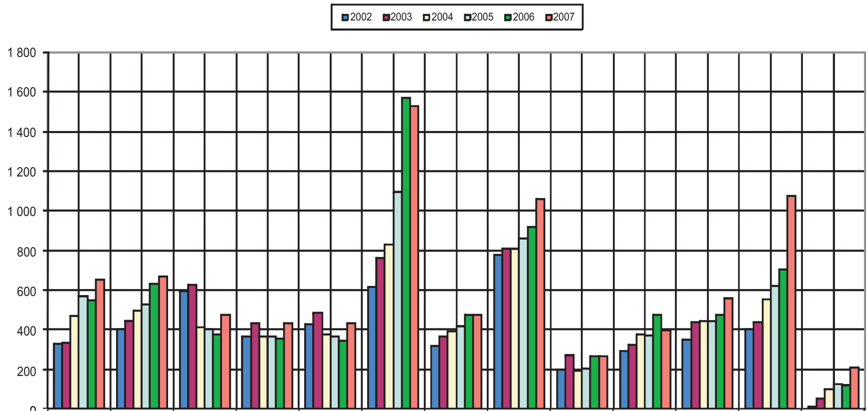
The book value added labour productivity is one of the main indicators for evaluating the enterprises in our sample of indicators. It can be seen from the Fig. 8 that big differences exist between different minerals. Minerals for glass manufacture, limestone, cement raw materials, dolomites and brick clays seem to be excellent. On the opposite side, there are other minerals *Others* (uranium, crude oil, graphite, gemstones, silica minerals and gypsum), where indices are low probably due to high mining costs of uranium.

Since in this case it is a comparative indicator, the effect of a different list of enterprises in 2007 compared with 2006 is not as pronounced. The only perceptible effect is that larger enterprises, which have a higher labour productivity than smaller enterprises, remain on the 2007 list.

Since it is a comparative indicator, a comparison of each mineral with Mining total is possible as well as a comparison of Mining total with bigger units which are CZ-NACE aggregates. In comparison with total industry, labour productivity in Mining total is about 9 % higher. Industry is composed of mining (included in our sample), of manufacture (partly included in our selection) and of energy. Mining total has book value added labour productivity lower than mineral extraction (by about 15 %), higher than manufacturing industry (by about 11 %) and higher than the manufacturing industry (by about 22 %). Our sample is partly connected with manufacture (for example kaolin and ceramics), which is the reason for the labour productivity decrease. In comparison with the whole non-financial sectors, i.e. with the whole economy without the financial sector, our sample of the mining enterprises has a higher productivity of about 24 %.

In the non-financial sectors of enterprises the book value added labour productivity of mining is in the second place after energy. It is specific for mining because the consumption of materials is very low – there are not manufactured products from purchased supplies.

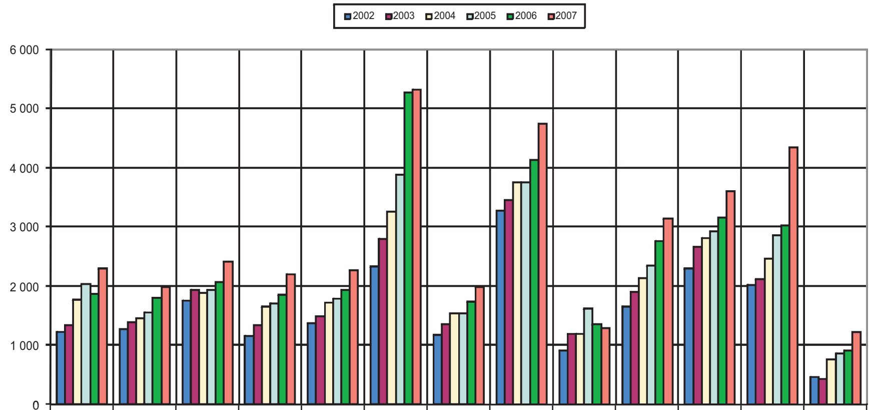
Fig. 9. Hourly labour productivity (CZK/working hour)



	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	328	404	595	364	425	615	317	776	197	291	350	399	10
2003	335	443	625	433	487	764	366	809	272	323	438	440	53
2004	470	495	411	368	374	831	391	811	191	375	441	553	100
2005	567	525	399	366	365	1 095	420	859	201	372	443	619	123
2006	549	630	373	357	347	1 571	477	916	269	473	474	707	120
2007	651	668	473	436	435	1 530	472	1 060	267	397	557	1 077	209

Hourly book value added labour productivity (Fig. 9) has similar characteristics to book value added per employee (Fig. 8). It is a more precise expression of productivity, because it shows the book value added per working hour.

Fig. 10. Sales per employee (ths CZK/employee)

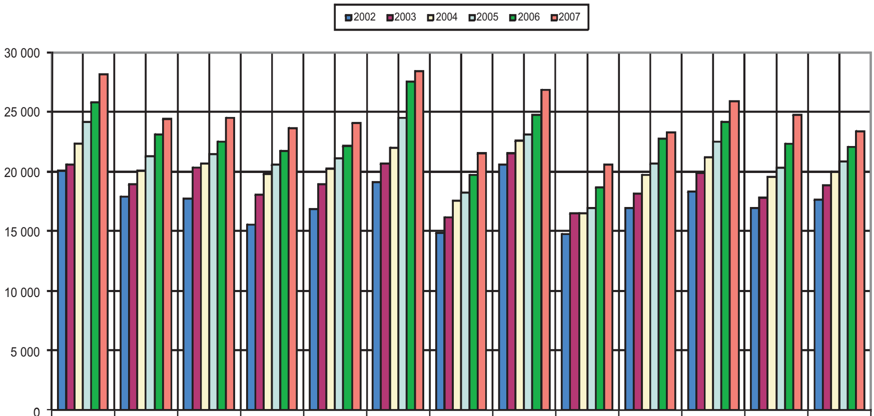


	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	1 230	1 272	1 753	1 150	1 371	2 323	1 181	3 275	912	1 655	2 294	2 010	457
2003	1 344	1 393	1 932	1 343	1 481	2 799	1 350	3 455	1 187	1 901	2 664	2 117	436
2004	1 773	1 449	1 888	1 647	1 724	3 248	1 539	3 756	1 197	2 138	2 803	2 468	759
2005	2 027	1 550	1 941	1 698	1 781	3 881	1 537	3 757	1 628	2 350	2 920	2 861	861
2006	1 875	1 802	2 067	1 858	1 934	5 269	1 740	4 128	1 358	2 757	3 164	3 026	914
2007	2 297	1 991	2 419	2 197	2 257	5 327	1 981	4 748	1 296	3 136	3 610	4 345	1 223

Compared with other aggregates in our sample, sales per employee (Fig. 10) resulte oppositely to the book value added labour productivity. In our sample there are higher sales per employee than in statewide aggregated mining (by about 19 %), but lower than in the manufacturing industry, energy industry, in industry total and in the non-financial sectors enterprises. Higher sales per employee than in statewide aggregated mining are once more connected with including of a part of manufacture into our sample.

Mining takes the last position in sales per employee in comparison with industry and non-financial sphere total aggregates. This can be expected, as e.g. in manufacturing industry, the enterprises supply each other with intermediate products which are then added to sales. This addition does not operate in value added, as stated above.

Fig. 11. Average salary (CZK/employee)

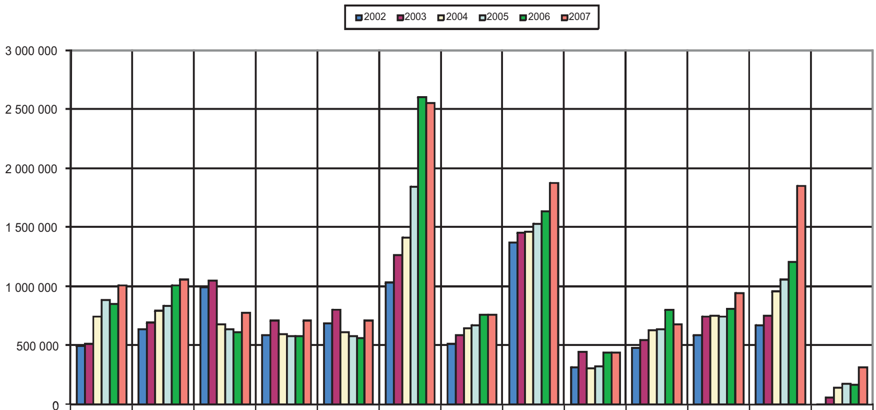


	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	20 074	17 935	17 707	15 561	16 845	19 150	14 839	20 618	14 763	16 928	18 311	16 988	17 618
2003	20 646	18 933	20 391	18 102	18 983	20 675	16 199	21 602	16 481	18 199	19 893	17 857	18 838
2004	22 378	20 120	20 669	19 814	20 285	21 972	17 554	22 617	16 546	19 760	21 247	19 588	20 029
2005	24 181	21 315	21 517	20 638	21 105	24 553	18 275	23 126	16 996	20 712	22 512	20 335	20 894
2006	25 787	23 099	22 533	21 755	22 145	27 575	19 726	24 789	18 659	22 788	24 201	22 385	22 076
2007	28 157	24 478	24 542	23 632	24 081	28 478	21 544	26 869	20574	23 284	25 899	24 784	23 423

The average salary (Fig. 11) is more or less equal despite relatively big differences in labour productivity between individual minerals. Compared to industrial aggregates, our average salary is 2 % higher than in the statewide aggregate of mining, 19 % higher than in the statewide aggregate of industry, 22 % higher than in manufacturing industry, and 16 % higher than in the non-financial sphere in total.

The comparison corresponds to the fact that mining occupies the second position after the energy production as salaries concerns. This represents again a specificity of mining given by the employees' structure.

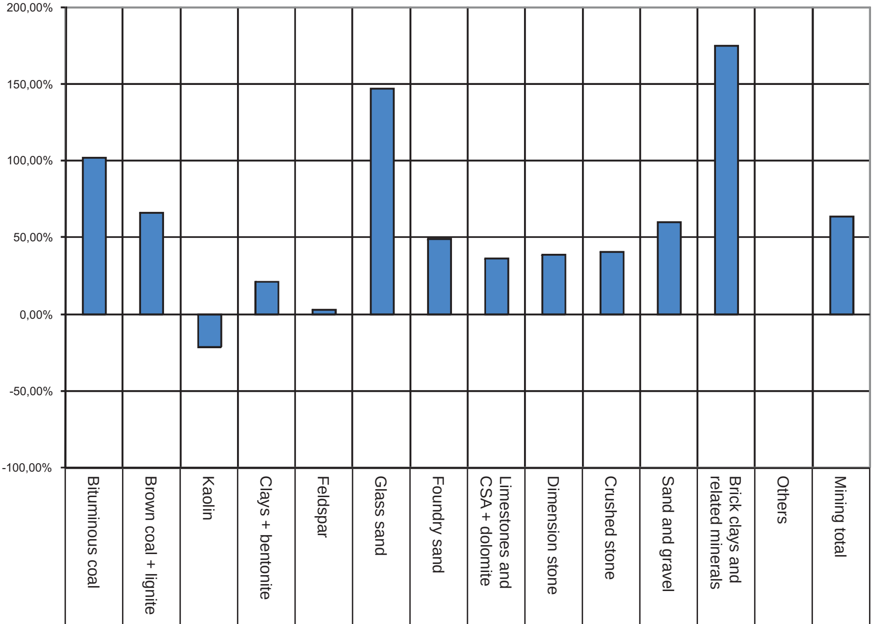
Fig. 12. (Book value added – salaries) per employee (CZK/employee)



	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others
2002	501 544	640 206	993 381	587 418	692 434	1 035 346	512 629	1 374 604	314 672	485 576	592 740	674 524	-1 172
2003	515 519	698 856	1 057 700	716 463	804 954	1 265 284	594 097	1 458 707	448 551	549 849	746 493	753 759	65 734
2004	743 834	794 564	680 541	603 020	616 577	1 417 852	644 824	1 467 446	310 902	635 200	752 471	962 129	143 395
2005	891 175	839 242	638 776	583 562	583 608	1 846 632	675 912	1 530 066	325 674	640 272	748 207	1 064 009	178 423
2006	852 819	1 011 846	611 655	579 746	565 487	2 607 819	764 562	1 641 282	438 206	807 113	814 153	1 209 810	173 506
2007	1 013 270	1 064 921	780 119	713 048	715 195	2 557 934	765 832	1 879 898	438 047	683 792	949 644	1 859 307	319 530

The difference between book value added labour productivity and average salary (Fig. 12) is a deciding indicator for the evaluation of an enterprise‘s productivity (in our selection of indices). The higher the value, the better, i.e. it leaves more money for covering other costs (depreciations, social taxes, financial costs etc.) and for profit creation. In view of the fact that average salaries are not too variable, the result is due to differences in the book value added labour productivity.

Fig. 13. Index 2007/2002 (book value added – salaries) per employee



	Bituminous coal	Brown coal + lignite	Kaolin	Clays + bentonite	Feldspar	Glass sand	Foundry sand	Limestones and CSA + dolomite	Dimension stone	Crushed stone	Sand and gravel	Brick clays and related minerals	Others	Mining total
%	102.03	66.34	-21.47	21.39	3.29	147.06	49.39	36.76	39.21	40.82	60.21	175.65	-27 354.12	64.15

The index 2007/2002 (Fig. 13) was calculated to orientate better in the index (book value added – salaries) per employee. Positive feature is that total mining showed growth of 64 %. In other words, mining business paid more in 2007 than in 2002. The mining of brick clays, glass sand and bituminous coal is excellent. In contrast, kaolin shows an interesting development, probably reflecting connection with ceramics production.

An examination of different minerals follows.

Tab. 2: Bituminous coal

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		8	7	9	10	11	12
Registered number of employees		24 648	23 059	21 464	20 360	19 523	17 423
Sales	mill CZK	30 315	30 988	38 048	41 260	36 599	40 021
Value added (VA)	mill CZK	12 857	12 363	16 446	18 637	17 153	18 145
Acquisition of land and deposits	ths CZK	20 337	28 087	55 473	33 496	19 214	17 417
Sales per employee	ths CZK/ employee	1 230	1 344	1 773	2 027	1 875	2 297
Mining total = 100%	%	*83%*	*81%*	*93%*	*99%*	*84%*	*90%*
Labour productivity based on VA	CZK/ employee	521 618	536 165	766 212	915 357	878 606	1 041 427
Mining total = 100%	%	*95%*	*87%*	*110%*	*125%*	*109%*	*116%*
Hourly labour productivity	CZK/ working hour	328	335	470	567	549	651
Mining total = 100%	%	*99%*	*91%*	*115%*	*130%*	*115%*	*123%*
Average salary	CZK/ employee	20 074	20 646	22 378	24 181	25 787	28 157
Mining total = 100%	%	*111%*	*107%*	*108%*	*111%*	*110%*	*112%*
(Value added – salaries) per employee	CZK/ employee	501 544	515 519	743 834	891 175	852 819	1 013 270
Mining total = 100%	%	*95%*	*86%*	*110%*	*125%*	*109%*	*116%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	42%	-20%	28%	17%	9%	9%
Registered number of employees	-29%	-6%	-7%	-5%	-4%	-11%
Sales	32%	2%	23%	8%	-11%	9%
Value added (VA)	41%	-4%	33%	13%	-8%	6%
Acquisition of land and deposits	-14%	38%	98%	-40%	-43%	-9%
Sales per employee	87%	9%	32%	14%	-7%	23%
Labour productivity based on VA	100%	3%	43%	19%	-4%	19%
Hourly labour productivity	99%	2%	41%	21%	-3%	19%
Average salary	40%	3%	8%	8%	7%	9%
(Value added – salaries) per employee	102%	3%	44%	20%	-4%	19%

There are not many bituminous coal (Tab. 2) extracting enterprises (around 8 % of enterprises in our sample), but it is one of the most significant parts of mining for sales (18.3 %), employee numbers (20.4 %) and book value added (23.8 %). In the relative indices bituminous coal has excellent growth and in comparison with Mining total it is an outstanding mineral from the economic point of view.

Tab. 3: Brown coal and lignite

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		6	6	6	6	6	6
Registered number of employees		16 366	15 126	14 667	14 138	13 657	13 366
Sales	mill CZK	20 814	21 067	21 259	21 920	24 613	26 609
Value added (VA)	mill CZK	10 771	10 857	11 949	12 166	14 135	14 561
Acquisition of land and deposits	ths CZK	245 737	110 799	21 978	44 106	197 748	84 730
Sales per employee	ths CZK/ employee	1 272	1 393	1 449	1 550	1 802	1 991
Mining total = 100%	%	*86%*	*84%*	*76%*	*76%*	*81%*	*78%*
Labour productivity based on VA	CZK/ employee	658 141	717 790	814 684	860 557	1 034 945	1 089 399
Mining total = 100%	%	*120%*	*116%*	*117%*	*117%*	*129%*	*122%*
Hourly labour productivity	CZK/ working hour	404	443	495	525	630	668
Mining total = 100%	%	*123%*	*120%*	*121%*	*120%*	*132%*	*126%*
Average salary	CZK/ employee	17 935	18 933	20 120	21 315	23 099	24 478
Mining total = 100%	%	*99%*	*98%*	*97%*	*98%*	*99%*	*98%*
(Value added – salaries) per employee	CZK/ employee	640 206	698 856	794 564	839 242	1 011 846	1 064 921
Mining total = 100%	%	*121%*	*117%*	*118%*	*118%*	*130%*	*122%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	0%	0%	0%	0%	0%	0%
Registered number of employees	-18%	-8%	-3%	-4%	-3%	-2%
Sales	28%	1%	1%	3%	12%	8%
Value added (VA)	35%	1%	10%	2%	16%	3%
Acquisition of land and deposits	-66%	-55%	-80%	101%	348%	-57%
Sales per employee	57%	10%	4%	7%	16%	10%
Labour productivity based on VA	66%	9%	13%	6%	20%	5%
Hourly labour productivity	65%	10%	12%	6%	20%	6%
Average salary	36%	6%	6%	6%	8%	6%
(Value added – salaries) per employee	66%	9%	14%	6%	21%	5%

There are also few brown coal and lignite (Tab. 3) extracting enterprises (4.0 % of enterprises), but they have a higher share in terms of sales (12.2 %), employee numbers (15.7 %) and book value added (17.9 %). It is one of the most important minerals. Compared to Mining total, the mineral is above-average regarding labour productivity based on value added, hourly labour productivity and the difference (value added – salaries) per employee.

Tab. 4: Kaolin

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		4	5	5	4	4	4
Registered number of employees		1 093	1 183	3 901	4 259	3 977	3 685
Sales	mill CZK	1 916	2 287	7 365	8 266	8 222	8 913
Value added (VA)	mill CZK	1 105	1 276	2 735	2 812	2 522	2 965
Acquisition of land and deposits	ths CZK	12 238	14 078	25 153	52 848	43 331	7 374
Sales per employee	ths CZK/ employee	1 753	1 932	1 888	1 941	2 067	2 419
Mining total = 100%	%	*119%*	*116%*	*100%*	*95%*	*93%*	*95%*
Labour productivity based on VA	CZK/ employee	1 011 088	1 078 092	701 211	660 293	634 189	804 661
Mining total = 100%	%	*184%*	*175%*	*101%*	*90%*	*79%*	*90%*
Hourly labour productivity	CZK/ working hour	595	625	411	399	373	473
Mining total = 100%	%	*180%*	*170%*	*100%*	*92%*	*78%*	*89%*
Average salary	CZK/ employee	17 707	20 391	20 669	21 517	22 533	24 542
Mining total = 100%	%	*98%*	*106%*	*100%*	*99%*	*96%*	*98%*
(Value added – salaries) per employee	CZK/ employee	993 381	1 057 700	680 541	638 776	611 655	780 119
Mining total = 100%	%	*187%*	*177%*	*101%*	*90%*	*78%*	*90%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	0%	25%	0%	-20%	0%	0%
Registered number of employees	237%	8%	230%	9%	-7%	-7%
Sales	365%	19%	222%	12%	-1%	8%
Value added (VA)	168%	15%	114%	3%	-10%	18%
Acquisition of land and deposits	-40%	15%	79%	110%	-18%	-83%
Sales per employee	38%	10%	-2%	3%	7%	17%
Labour productivity based on VA	-20%	7%	-35%	-6%	-4%	27%
Hourly labour productivity	-21%	5%	-34%	-3%	-7%	27%
Average salary	39%	15%	1%	4%	5%	9%
(Value added – salaries) per employee	-21%	6%	-36%	-6%	-4%	28%

In the case of kaolin (Tab. 4), a marked jump in employee numbers, sales and book value added in 2004 is influenced by organizational changes, primarily by the merging of extraction of kaolin with manufacture of kaolin products. This unification can be seen also in the relative indices. In 2002 and 2003 it was an outstanding mineral, with its book value added labour productivity higher than Mining total by 84 % and 75 % respectively. In 2007, the labour productivity was 10 % lower than Mining total.

Tab. 5: Clays and bentonite

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		7	7	7	7	6	6
Registered number of employees		2 422	2 357	5 020	5 375	4 910	4 626
Sales	mill CZK	2 785	3 164	8 267	9 124	9 122	10 163
Value added (VA)	mill CZK	1 460	1 731	3 127	3 247	2 953	3 408
Acquisition of land and deposits	ths CZK	11 465	5 716	34 042	25 240	40 242	13 690
Sales per employee	ths CZK/ employee	1 150	1 343	1 647	1 698	1 858	2 197
Mining total = 100%	*%*	*78%*	*81%*	*87%*	*83%*	*84%*	*86%*
Labour productivity based on VA	CZK/ employee	602 979	734 565	622 834	604 200	601 502	736 680
Mining total = 100%	*%*	*110%*	*119%*	*90%*	*82%*	*75%*	*82%*
Hourly labour productivity	CZK/ working hour	364	433	368	366	357	436
Mining total = 100%	*%*	*110%*	*118%*	*90%*	*84%*	*75%*	*82%*
Average salary	CZK/ employee	15 561	18 102	19 814	20 638	21 755	23 632
Mining total = 100%	*%*	*86%*	*94%*	*96%*	*95%*	*93%*	*94%*
(Value added – salaries) per employee	CZK/ employee	587 418	716 463	603 020	583 562	579 746	713 048
Mining total = 100%	*%*	*111%*	*120%*	*89%*	*82%*	*74%*	*82%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	-14%	0%	0%	-7%	-8%	0%
Registered number of employees	91%	-3%	113%	7%	-9%	-6%
Sales	265%	14%	161%	10%	0%	11%
Value added (VA)	133%	19%	81%	4%	-9%	15%
Acquisition of land and deposits	19%	-50%	496%	-26%	59%	-66%
Sales per employee	91%	17%	23%	3%	9%	18%
Labour productivity based on VA	22%	22%	-15%	-3%	0%	22%
Hourly labour productivity	20%	19%	-15%	0%	-3%	22%
Average salary	52%	16%	9%	4%	5%	9%
(Value added – salaries) per employee	21%	22%	-16%	-3%	-1%	23%

The performance of clays and bentonite (Tab. 5) seems to be similar to that of kaolin. In 2004 merging with manufacture changed the financial situation.

Tab. 6: Feldspar

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		5	5	5	5	5	4
Registered number of employees		1 513	1 560	4 223	4 584	4 251	3 978
Sales	mill CZK	2 074	2 310	7 279	8 164	8 221	8 977
Value added (VA)	mill CZK	1 073	1 285	2 689	2 772	2 498	2 941
Acquisition of land and deposits	ths CZK	4 510	86 917	22 361	34 611	28 918	13 967
Sales per employee	ths CZK/ employee	1 371	1 481	1 724	1 781	1 934	2 257
Mining total = 100%	%	*93%*	*89%*	*91%*	*87%*	*87%*	*88%*
Labour productivity based on VA	CZK/ employee	709 279	823 936	636 862	604 713	587 632	739 276
Mining total = 100%	%	*129%*	*134%*	*92%*	*82%*	*73%*	*83%*
Hourly labour productivity	CZK/ working hour	425	487	374	365	347	435
Mining total = 100%	%	*129%*	*133%*	*91%*	*84%*	*73%*	*82%*
Average salary	CZK/ employee	16 845	18 983	20 285	21 105	22 145	24 081
Mining total = 100%	%	*93%*	*99%*	*98%*	*97%*	*95%*	*96%*
(Value added – salaries) per employee	CZK/ employee	692 434	804 954	616 577	583 608	565 487	715 195
Mining total = 100%	%	*131%*	*135%*	*91%*	*82%*	*72%*	*82%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	-23%	-2%	-1%	1%	1%	-22%
Registered number of employees	163%	3%	171%	9%	-7%	-6%
Sales	333%	11%	215%	12%	1%	9%
Value added (VA)	174%	20%	109%	3%	-10%	18%
Acquisition of land and deposits	210%	1827%	-74%	55%	-16%	-52%
Sales per employee	65%	8%	16%	3%	9%	17%
Labour productivity based on VA	4%	16%	-23%	-5%	-3%	26%
Hourly labour productivity	2%	15%	-23%	-2%	-5%	25%
Average salary	43%	13%	7%	4%	5%	9%
(Value added – salaries) per employee	3%	16%	-23%	-5%	-3%	26%

In the case of feldspar (Tab. 6), the unification with manufacture in 2004 is reflected in the index values, similar to kaolin, clays and bentonite.

Tab. 7: Glass sand

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		3	3	3	3	3	3
Registered number of employees		369	328	296	227	163	124
Sales	mill CZK	856	919	960	881	860	661
Value added (VA)	mill CZK	389	422	425	425	430	321
Acquisition of land and deposits	ths CZK	79	0	548	123	0	0
Sales per employee	ths CZK/ employee	2 323	2 799	3 248	3 881	5 269	5 327
Mining total = 100%	*%*	*157%*	*168%*	*171%*	*189%*	*237%*	*208%*
Labour productivity based on VA	CZK/ employee	1 054 497	1 285 959	1 439 824	1 871 185	2 635 394	2 586 412
Mining total = 100%	*%*	*192%*	*208%*	*207%*	*255%*	*328%*	*289%*
Hourly labour productivity	CZK/ working hour	615	764	831	1 095	1 571	1 530
Mining total = 100%	*%*	*186%*	*208%*	*202%*	*251%*	*330%*	*289%*
Average salary	CZK/ employee	19 150	20 675	21 972	24 553	27 575	28 478
Mining total = 100%	*%*	*106%*	*107%*	*106%*	*113%*	*118%*	*114%*
(Value added – salaries) per employee	CZK/ employee	1 035 346	1 265 284	1 417 852	1 846 632	2 607 819	2 557 934
Mining total = 100%	*%*	*195%*	*212%*	*210%*	*259%*	*334%*	*294%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	0%	0%	0%	-17%	20%	0%
Registered number of employees	-66%	-11%	-10%	-23%	-28%	-24%
Sales	-23%	7%	4%	-8%	-2%	-23%
Value added (VA)	-17%	9%	1%	0%	1%	-25%
Acquisition of land and deposits	-100%	-100%		-78%	-100%	
Sales per employee	129%	20%	16%	20%	36%	1%
Labour productivity based on VA	145%	22%	12%	30%	41%	-2%
Hourly labour productivity	149%	24%	9%	32%	44%	-3%
Average salary	49%	8%	6%	12%	12%	3%
(Value added – salaries) per employee	147%	22%	12%	30%	41%	-2%

Glass sand (Tab. 7) is the smallest mineral, based on employee numbers, sales and book value added, but a star performer in labour productivity – its productivity is 189 % higher than the total. The smallest, but the most effective mineral.

Tab. 8: Foundry sand

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		6	6	6	6	6	4
Registered number of employees		1 650	1 527	1 485	1 450	1 402	1 099
Sales	mill CZK	1 949	2 060	2 285	2 229	2 439	2 177
Value added (VA)	mill CZK	870	932	983	1 007	1 099	865
Acquisition of land and deposits	ths CZK	1 225	0	3 051	647	946	110
Sales per employee	ths CZK/ employee	1 181	1 350	1 539	1 537	1 740	1 981
Mining total = 100%	*%*	*80%*	*81%*	*81%*	*75%*	*78%*	*77%*
Labour productivity based on VA	CZK/ employee	527 468	610 296	662 379	694 188	784 288	787 376
Mining total = 100%	*%*	*96%*	*99%*	*95%*	*95%*	*97%*	*88%*
Hourly labour productivity	CZK/ working hour	317	366	391	420	477	472
Mining total = 100%	*%*	*96%*	*100%*	*95%*	*96%*	*100%*	*89%*
Average salary	CZK/ employee	14 839	16 199	17 554	18 275	19 726	21 544
Mining total = 100%	*%*	*82%*	*84%*	*85%*	*84%*	*84%*	*86%*
(Value added – salaries) per employee	CZK/ employee	512 629	594 097	644 824	675 912	764 562	765 832
Mining total = 100%	*%*	*97%*	*99%*	*96%*	*95%*	*98%*	*88%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	-33%	0%	0%	0%	0%	-35%
Registered number of employees	-33%	-7%	-3%	-2%	-3%	-22%
Sales	12%	6%	11%	-2%	9%	-11%
Value added (VA)	-1%	7%	6%	2%	9%	-21%
Acquisition of land and deposits	-91%	-100%		-79%	46%	-88%
Sales per employee	68%	14%	14%	0%	13%	14%
Labour productivity based on VA	49%	16%	9%	5%	13%	0%
Hourly labour productivity	49%	15%	7%	7%	14%	-1%
Average salary	45%	9%	8%	4%	8%	9%
(Value added – salaries) per employee	49%	16%	9%	5%	13%	0%

Foundry sand (Tab. 8) is a small mineral (has low value of a number of indicators) similar to glass sand. However, it shows below-average performance (labour productivity) compared to glass sand. The different selection of enterprises in 2007 has had an effect on essential indicators.

Tab. 9: Limestones and corrective sialic additives for cement production and dolomite

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		17	15	16	16	15	11
Registered number of employees		2 782	2 678	2 835	2 752	2 797	2 467
Sales	mill CZK	9 113	9 253	10 648	10 341	11 545	11 711
Value added (VA)	mill CZK	3 882	3 965	4 224	4 275	4 660	4 704
Acquisition of land and deposits	ths CZK	49 453	129 739	23 513	19 971	31 613	26 622
Sales per employee	ths CZK/ employee	3 275	3 455	3 756	3 757	4 128	4 748
Mining total = 100%	%	*221%*	*208%*	*198%*	*183%*	*186%*	*186%*
Labour productivity based on VA	CZK/ employee	1 395 223	1 480 309	1 490 063	1 553 192	1 666 071	1 906 767
Mining total = 100%	%	*255%*	*240%*	*214%*	*212%*	*207%*	*213%*
Hourly labour productivity	CZK/ working hour	776	809	811	859	916	1 060
Mining total = 100%	%	*235%*	*220%*	*198%*	*197%*	*192%*	*200%*
Average salary	CZK/ employee	20 618	21 602	22 617	23 126	24 789	26 869
Mining total = 100%	%	*114%*	*112%*	*110%*	*106%*	*106%*	*107%*
(Value added – salaries) per employee	CZK/ employee	1 374 604	1 458 707	1 467 446	1 530 066	1 641 282	1 879 898
Mining total = 100%	%	*259%*	*244%*	*218%*	*215%*	*210%*	*88%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	-34%	-8%	6%	0%	-3%	-28%
Registered number of employees	-11%	-4%	6%	-3%	2%	-12%
Sales	29%	2%	15%	-3%	12%	1%
Value added (VA)	21%	2%	7%	1%	9%	1%
Acquisition of land and deposits	-46%	162%	-82%	-15%	58%	-16%
Sales per employee	45%	5%	9%	0%	10%	15%
Labour productivity based on VA	37%	6%	1%	4%	7%	14%
Hourly labour productivity	37%	4%	0%	6%	7%	16%
Average salary	30%	5%	5%	2%	7%	8%
(Value added – salaries) per employee	37%	6%	1%	4%	7%	15%

Limestone, corrective sialic additives for cement production and dolomites (Tab. 9) are minerals which have about 7.3 % of enterprises, 2.9 % of employees, 5.4 % of sales and 6.2 % of book value added of the Mining total sample. They are also stars for labour productivity, with the productivity more than twice higher than the whole. On the downside is their continuously decreasing share of productivity in the Mining total.

Tab. 10: Dimension stone

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		23	21	20	23	18	11
Registered number of employees		1 567	1 438	1 432	1 551	1 197	989
Sales	mill CZK	1 429	1 707	1 713	2 525	1 625	1 282
Value added (VA)	mill CZK	516	669	469	532	547	453
Acquisition of land and deposits	ths CZK	3 053	6 399	2 505	1 375	1 422	41
Sales per employee	ths CZK/ employee	912	1 187	1 197	1 628	1 358	1 296
Mining total = 100%	%	*62%*	*71%*	*63%*	*79%*	*61%*	*51%*
Labour productivity based on VA	CZK/ employee	329 435	465 032	327 448	342 669	456 865	458 621
Mining total = 100%	%	*60%*	*75%*	*47%*	*47%*	*57%*	*51%*
Hourly labour productivity	CZK/ working hour	197	272	191	201	269	267
Mining total = 100%	%	*60%*	*74%*	*47%*	*46%*	*56%*	*50%*
Average salary	CZK/ employee	14 763	16 481	16 546	16 996	18 659	20 574
Mining total = 100%	%	*81%*	*86%*	*80%*	*78%*	*80%*	*82%*
(Value added – salaries) per employee	CZK/ employee	314 672	448 551	310 902	325 674	438 206	438 047
Mining total = 100%	%	*59%*	*75%*	*46%*	*46%*	*56%*	*50%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	-51%	-6%	-7%	14%	-18%	-40%
Registered number of employees	-37%	-8%	0%	8%	-23%	-17%
Sales	-10%	19%	0%	47%	-36%	-21%
Value added (VA)	-12%	30%	-30%	13%	3%	-17%
Acquisition of land and deposits	-99%	110%	-61%	-45%	3%	-97%
Sales per employee	42%	30%	1%	36%	-17%	-5%
Labour productivity based on VA	39%	41%	-30%	5%	33%	0%
Hourly labour productivity	35%	38%	-30%	5%	33%	-1%
Average salary	39%	12%	0%	3%	10%	10%
(Value added – salaries) per employee	39%	43%	-31%	5%	35%	0%

Dimension stone (Tab. 10) is a small mineral with a very low labour productivity and average salaries, and is affected by the lower number of enterprises in the 2007 selection.

Tab. 11: Crushed stone

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		58	67	62	61	57	38
Registered number of employees		21 789	21 643	21 008	19 700	21 061	15 404
Sales	mill CZK	36 063	41 136	44 914	46 290	58 074	48 311
Value added (VA)	mill CZK	10 949	12 294	13 759	13 022	17 479	10 892
Acquisition of land and deposits	ths CZK	359 382	182 194	235 638	139 468	396 754	101 245
Sales per employee	ths CZK/ employee	1 655	1 901	2 138	2 350	2 757	3 136
Mining total = 100%	%	*112%*	*114%*	*113%*	*115%*	*124%*	*123%*
Labour productivity based on VA	CZK/ employee	502 504	568 048	654 960	660 984	829 901	707 076
Mining total = 100%	%	*92%*	*92%*	*94%*	*90%*	*103%*	*79%*
Hourly labour productivity	CZK/ working hour	291	323	375	372	473	397
Mining total = 100%	%	*88%*	*88%*	*91%*	*85%*	*99%*	*75%*
Average salary	CZK/ employee	16 928	18 199	19 760	20 712	22 788	23 284
Mining total = 100%	%	*93%*	*95%*	*96%*	*95%*	*97%*	*93%*
(Value added – salaries) per employee	CZK/ employee	485 576	549 849	635 200	640 272	807 113	683 792
Mining total = 100%	%	*92%*	*92%*	*94%*	*90%*	*103%*	*79%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	-34%	16%	-8%	-1%	-7%	-33%
Registered number of employees	-29%	-1%	-3%	-6%	7%	-27%
Sales	-34%	14%	9%	3%	25%	-17%
Value added (VA)	-1%	12%	12%	-5%	34%	-38%
Acquisition of land and deposits	-72%	-49%	29%	-41%	184%	-74%
Sales per employee	89%	15%	12%	10%	17%	14%
Labour productivity based on VA	41%	13%	15%	1%	26%	-15%
Hourly labour productivity	36%	11%	16%	-1%	27%	-16%
Average salary	38%	8%	9%	5%	10%	2%
(Value added – salaries) per employee	41%	13%	16%	1%	26%	-15%

Crushed stone (Tab. 11) is another mineral affected by the change in the number of registered enterprises in 2007 as reflected in essential indicators. It is the second most important mineral with 25.1 % of the total number of enterprises in 2007 compared to 2006, when it was the most important mineral with 27.1 %. It is the most important mineral with a 22.1 % share in sales in 2007 (26.6 % in 2006). It is the second most important mineral with a 18.1 % share of the total number of employees (21.4 % in 2006, i.e. the biggest mineral). In terms of book value added, it is the fourth most important mineral in 2007 and ranked first in 2006. It is probably the most important mineral in 2007, when “taking into account” the effect caused by the change in the number of enterprises in 2007.

Tab. 12: Sand and gravel

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		58	67	62	61	57	39
Registered number of employees		11 318	11 181	13 677	13 978	13 030	11 801
Sales	mill CZK	25 965	29 781	38 336	40 818	41 228	42 607
Value added (VA)	mill CZK	6 916	8 569	10 582	10 773	10 924	11 513
Acquisition of land and deposits	ths CZK	107 464	273 503	69 010	159 652	236 847	63 039
Sales per employee	ths CZK/ employee	2 294	2 664	2 803	2 920	3 164	3 610
Mining total = 100%	*%*	*155%*	*160%*	*148%*	*142%*	*142%*	*141%*
Labour productivity based on VA	CZK/ employee	611 051	766 386	773 718	770 719	838 354	975 543
Mining total = 100%	*%*	*111%*	*124%*	*111%*	*105%*	*104%*	*109%*
Hourly labour productivity	CZK/ working hour	350	438	441	443	474	557
Mining total = 100%	*%*	*106%*	*119%*	*108%*	*102%*	*100%*	*105%*
Average salary	CZK/ employee	18 311	19 893	21 247	22 512	24 201	25 899
Mining total = 100%	*%*	*101%*	*103%*	*103%*	*103%*	*103%*	*103%*
(Value added – salaries) per employee	CZK/ employee	592 740	746 493	752 471	748 207	814 153	949 644
Mining total = 100%	*%*	*112%*	*125%*	*112%*	*105%*	*104%*	*109%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	-27%	3%	2%	3%	-4%	-29%
Registered number of employees	4%	-1%	22%	2%	-7%	-9%
Sales	64%	15%	29%	6%	1%	3%
Value added (VA)	66%	24%	23%	2%	1%	5%
Acquisition of land and deposits	-41%	155%	-75%	131%	48%	-73%
Sales per employee	57%	16%	5%	4%	8%	14%
Labour productivity based on VA	60%	25%	1%	0%	9%	16%
Hourly labour productivity	59%	25%	1%	0%	7%	18%
Average salary	41%	9%	7%	6%	8%	7%
(Value added – salaries) per employee	60%	26%	1%	-1%	9%	17%

A similar situation in terms of the effect caused by the change in the selection of enterprises in 2007 compared to 2006 exists in the case of sand and gravel (Tab. 12), as in the case of crushed stone.

Tab. 13: Brick clays and related minerals

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		10	25	23	17	14	8
Registered number of employees		2 854	3 138	3 003	2 656	2 209	1 319
Sales	mill CZK	5 737	6 643	7 412	7 600	6 684	5 732
Value added (VA)	mill CZK	1 974	2 422	2 948	2 880	2 722	2 486
Acquisition of land and deposits	ths CZK	13 684	10 305	49 752	36 740	136 091	20 370
Sales per employee	ths CZK/ employee	2 010	2 117	2 468	2 861	3 026	4 345
Mining total = 100%	*%*	*136%*	*127%*	*130%*	*140%*	*136%*	*170%*
Labour productivity based on VA	CZK/ employee	691 512	771 617	981 717	1 084 344	1 232 195	1 884 091
Mining total = 100%	*%*	*126%*	*125%*	*141%*	*148%*	*153%*	*211%*
Hourly labour productivity	CZK/ working hour	399	440	553	619	707	1 077
Mining total = 100%	*%*	*121%*	*120%*	*135%*	*142%*	*148%*	*203%*
Average salary	CZK/ employee	16 988	17 857	19 588	20 335	22 385	24 784
Mining total = 100%	*%*	*94%*	*93%*	*95%*	*93%*	*96%*	*99%*
(Value added – salaries) per employee	CZK/ employee	674 524	753 759	962 129	1 064 009	1 209 810	1 859 307
Mining total = 100%	*%*	*127%*	*126%*	*143%*	*149%*	*155%*	*214%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	-21%	150%	-10%	-25%	-15%	-44%
Registered number of employees	-54%	10%	-4%	-12%	-17%	-40%
Sales	0%	16%	12%	3%	-12%	-14%
Value added (VA)	26%	23%	22%	-2%	-5%	-9%
Acquisition of land and deposits	49%	-25%	383%	-26%	270%	-85%
Sales per employee	116%	5%	17%	16%	6%	44%
Labour productivity based on VA	172%	12%	27%	10%	14%	53%
Hourly labour productivity	170%	10%	26%	12%	14%	52%
Average salary	46%	5%	10%	4%	10%	11%
(Value added – salaries) per employee	176%	12%	28%	11%	14%	54%

Brick clays and related minerals (Tab. 13) most likely belong among small minerals (2.6 % of sales, etc.) with an outstanding and growing labour productivity.

Tab. 14: Other minerals (uranium + crude oil + graphite + gemstones + silica minerals + gypsum)

Indicator	Unit	2002	2003	2004	2005	2006	2007
Number of enterprises		7	7	7	7	8	5
Registered number of employees		8 136	7 896	10 672	10 682	10 165	9 028
Sales	mill CZK	3 722	3 446	8 096	9 197	9 292	11 039
Value added (VA)	mill CZK	134	668	1 744	2 129	1 988	3 096
Acquisition of land and deposits	ths CZK	3 601	7 790	21 510	59 839	48 163	10 362
Sales per employee	ths CZK/ employee	457	436	759	861	914	1 223
Mining total = 100%	%	*31%*	*26%*	*40%*	*42%*	*41%*	*48%*
Labour productivity based on VA	CZK/ employee	16 445	84 572	163 424	199 317	195 582	342 952
Mining total = 100%	%	*3%*	*14%*	*24%*	*27%*	*24%*	*38%*
Hourly labour productivity	CZK/ working hour	10	53	100	123	120	209
Mining total = 100%	%	*3%*	*14%*	*24%*	*28%*	*25%*	*39%*
Average salary	CZK/ employee	17 618	18 838	20 029	20 894	22 076	23 423
Mining total = 100%	%	*97%*	*98%*	*97%*	*96%*	*94%*	*94%*
(Value added – salaries) per employee	CZK/ employee	-1 172	65 734	143 395	178 423	173 506	319 530
Mining total = 100%	%	*0%*	*11%*	*21%*	*25%*	*22%*	*37%*

Indexes	07/02	03/02	04/03	05/04	06/05	07/06
Number of enterprises	-31%	0%	0%	0%	0%	-39%
Registered number of employees	11%	-3%	35%	0%	-5%	-11%
Sales	197%	-7%	135%	14%	1%	19%
Value added (VA)	2 214%	399%	161%	22%	-7%	56%
Acquisition of land and deposits	188%	116%	176%	178%	-20%	-78%
Sales per employee	167%	-5%	74%	13%	6%	34%
Labour productivity based on VA	1 985%	414%	93%	22%	-2%	75%
Hourly labour productivity	1 904%	430%	89%	23%	-2%	74%
Average salary	33%	7%	6%	4%	6%	6%
(Value added – salaries) per employee	-27 354%	-5 707%	118%	24%	-3%	84%

Because there were only few enterprises in the other mineral sectors, it is impossible to publish data on them. Therefore they were aggregated into one group called Other minerals (Tab. 14). It includes extraction of uranium, natural gas, graphite, precious stones, diatomite, quartz and gypsum. To write any commentary on such mixture is too problematic. They embrace both very effective minerals (petroleum, natural gas), but also, in connection with a very low production, the very problematic ones.

We have tried to compile selected accessible economic data concerning the mining enterprises in this sector. There are too little data, but in view of their accessibility for small enterprises, this is the maximum available.

Outline of domestic mine production

		2003	2004	2005	2006	2007
Energy minerals						
Uranium	t U	458	435	420	383	322
	Concentrate production, t U*	452	412	409	358	291
Bituminous coal	kt	13 382	14 648	12 778	13 017	12 462
Brown coal	kt**	49 920	47 840	48 658	48 915	49 134
Lignite	kt	470	450	467	459	437
Crude oil	kt	310	299	306	259	240
Natural gas	mil m^3 = kt	131	175	356	148	148
Industrial minerals						
Graphite	kt	9	5	3	5	3
Pyrope (garnet) bearing rock	kt	53	42	43	39	34
Moldavite (tectite) bearing rock	ths m^3	36	114	74	95	114
	kt (1 m^3 = 1.8 t)	65	205	133	171	205
Kaolin	Raw, kt ***	4 155	3 862	3 882	3 768	3 604
	Beneficiated, kt	591	596	649	673	682
Clays	kt	554	649	671	561	679
Bentonite	kt	199	224	216	267	335
Diatomite	kt	41	33	38	53	19
Feldspar	kt	421	488	472	487	514
Feldspar substitutes	kt	27	26	23	31	25
Silica minerals	kt	0	0	0	0	19
Glass sand	kt	904	828	920	963	942
Foundry sand	kt	712	831	807	773	850
Limestones and corrective additives for cement production	kt	10 437	10 800	10 190	10 441	11 670
Dolomite	kt	416	345	419	409	385
Gypsum	kt	76	68	24	19	66
Construction minerals						
Dimension stone	Mine production in reserved deposits, ths m^3 ****	244	273	288	242	242
	Mine production in reserved deposits, kt (1m^3 = 2.7 t) ****	659	737	778	653	653
	Mine production in non-reserved deposits, ths m^3 *****	60	65	55	55	48
	Mine production in non-reserved deposits, kt (1m^3 = 2.7 t) *****	162	176	149	149	130

Crushed stone	Mine production in reserved deposits, ths m^3 ****	11 210	11 966	12 822	14 093	14 655
	Mine production in reserved deposits, kt ($1m^3$ = 2.7 t) ****	30 267	32 308	34 619	38 051	39 569
	Mine production in non-reserved deposits, ths m^3 *****	960	960	1 270	1 300	1 350
	Mine production in non-reserved deposits, kt ($1m^3$ = 2.7 t) *****	2 592	2 592	3 429	3 510	3 645
Sand and gravel	Mine production in reserved deposits, ths m^3 ****	9 105	8 859	9 075	9 110	9 185
	Mine production in reserved deposits, kt ($1m^3$ = 1.8 t) ****	16 389	15 946	16 335	16 398	16 533
	Mine production in non-reserved deposits, ths m^3 *****	4 500	4 900	5 100	6 000	6 450
	Mine production in non-reserved deposits, kt ($1m^3$ = 1.8 t)*****	8 100	8 820	9 180	10 800	11 610
Brick clays and related minerals	Mine production in reserved deposits, ths m^3 ****	1 626	1 554	1 543	1 268	1433
	Mine production in reserved deposits, kt ($1m^3$ = 1.8 t)****	2 927	2 797	2 777	2 282	2 579
	Mine production in non-reserved deposits, ths m^3 *****	180	330	220	300	300
	Mine production in non-reserved deposits, kt ($1m^3$ = 1.8 t)*****	324	594	396	522	540
Metallic ores (not mined)						

* corresponds to sales production (without beneficiation losses)

** ČSÚ presents so-called sales mining production which is production of marketable brown coal and reaches on average about 95 % of given mine production

*** raw kaolin, total production of all technological grades

**** including mining of montmorillonite clays overburden of kaolins since 2004

***** decrease of mineral reserves by mining production

****** estimate

MINERALS IN THE CZECH FOREIGN TRADE

Minerals and mineral products represent an important group in the Czech foreign trade. However, the foreign trade balance of minerals and mineral products has been permanently negative owing to the large import volume of mineral fuels (crude oil and natural gas), iron ores and materials for mineral fertilizers production. The following 38 items of the Customs tariff nomenclature HS-4 and HS-6 are the most important minerals and products of Czech foreign trade at the present time:

Definition of selected customs tariff items

Raw material	Code [1)]	Specification of item according to the customs tariff
Fe-ores and concentrates	2601	Iron ores and concentrates incl. roasted iron pyrites
Mn-ores and concentrates	2602	Manganese ores and concentrates including Mn-Fe ores and concentrates with 20 wt% Mn or more (calculated on dry substance)
Ni-ores and concentrates	2604	Nickel ores and concentrates
Cu-ores and concentrates	2603	Copper ores and concentrates
Pb-ores and concentrates	2607	Lead ores and concentrates
Zn-ores and concentrates	2608	Zinc ores and concentrates
Sn-ores and concentrates	2609	Tin ores and concentrates
W-ores and concentrates	2611	Tungsten ores and concentrates
Ag-ores and concentrates	261610	Silver ores and concentrates
Au-ores and concentrates	7108 261690	Gold in unwrought or semimanufactured form, gold powder Other precious metal ores and concentrates
U-ores and concentrates	261210	Uranium ores and concentrates
Crude oil	2709	Petroleum oils and oils obtained from bituminous minerals, crude
Natural gas	271121	Natural gas
Hard coal	2701	Hard coal, briquets and similar solid fuels made of bituminous coal
Brown coal	2702	Lignite, also agglomerated, except jet
Fluorspar	252921 252922	Fluorspar, containing 97 wt % or less of calcium fluoride Fluorspar, containing more than 97 wt % of calcium fluoride
Barite	251010	Natural barium sulphate (barite)
Graphite	2504	Natural graphite
Kaolin	2507	Kaolin and other kaolinitic clays, also calcined
Clays	2508	Other clays (except expanded clays No. 6806), andalusite, kyanite, sillimanite, also baked, mullite, chamotte or dinas earths
Bentonite	250810	Bentonite

Feldspar Feldspar substitute	252910 252930	Feldspar Leucite, nepheline and nepheline syenite
Silica minerals	2506	Quartz (except natural sand), crude quartzite, also dressed
Glass and foundry sand	250510	Silica sand and quartz sand
Limestones	2521	Limestone flux, limestone and other calcareous stone for lime or cement manufacturing
Dolomite	2518	Dolomite, dolomite calcined, roughly worked or cut, agglomerated
Gypsum	252010	Gypsum, anhydrite
Dimension stone	2514 2515 2516 6801 6802 6803	Slate, also roughly worked or cut by saw or other way only into blocks or rectangular slabs Marble, travertine, ecaussine and other calcareous monumental or crushed stone, density 2.5 or higher, and alabaster, also roughly worked or cut by saw or other way cut only into blocks or rectangular slabs Granite, porphyry, basalt, sandstone and other monumental or crushed stone, also roughly trimmed or cut into blocks or rectangular slabs Setts, curbstones and flagstones of natural stone (except slate) Worked monumental and crushed stone (except slate and slate products, except products No. 6801; little stones for mosaics or tasselated pavements or similar objects, also on beds; artificially coloured granules, chippings and dust of natural stone (including slate) Worked slate and articles of slate or of agglomerated slate
Crushed stone	251710*	Pebbles, gravel, broken or crushed stone in general used for concreting and gravelling of roads, railroads etc., flint and hard head also heat-treated
Sand and gravel	250590 251710*	Other sand (natural sand of all kinds, also coloured, except sand containing metals and except silica sand and quartz sand) Pebbles, gravel, broken or crushed stone in general used for concreting and gravelling of roads, railroads etc., flint and hard head also heat-treated

[1)] *Code of the customs tariff; * item included in one commodity only*

Definition of other important customs tariff items

Raw material	Code [1)]	Specification of item according to the customs tariff
Al-ores and concentrates	2606	Aluminium ores and concentrates
Ti-ores and concentrates	2614	Titanium ores and concentrates
Nb, Ta, V and Zr-ores and concentrates	2515	Niobium, tantalum, vanadium or zirconium ores and concentrates
Coke	2704	Coke and semi-coke of coal, lignite or peat; agglomerated; retort carbon
Salt	2501	Salt (inclusive table and denatured salt), pure sodium chloride; also in water solution
Sulphur	2503	Sulphur of all kinds, other than sublimed, precipitated and colloidal
	2802	Sulphur, sublimed or precipitated colloidal sulphur
Sulphuric acid oleum	2807	Sulphuric acid
Natural phosphates	2510	Natural calcium phosphates, aluminium calcium phosphates, etc., unground
Phosphoric substances	2809	Diphosphorus pentaoxide, phosphoric acid and polyphosphoric acids
Nitrogenous fertilizers	3102	Mineral or chemical fertilizers, nitrogenous
Phosphatic fertilizers	3103	Mineral or chemical fertilizers, phosphatic
Potassic fertilizers	3104	Mineral or chemical fertilizers, potassic
Fertilizers of more elements	3105	Mineral or chemical fertilizers of 2–3 of elements
Magnesite	251910	Natural magnesium carbonate (magnesite)
	251990	Magnesia, fused, dead-burned, magnesium oxides
Talc	2526	Natural steatite, also roughly worked or cut etc., talc
Quicklime	2522	Quicklime, slaked and hydraulic, other than calcium oxide and calcium hydroxide of 2825
Cement	2523	Portland, aluminous cement, slag, supersulfate and other hydraulic cement

[1)] *Code of the customs tariff*

Main export and import countries of minerals and intermediate products made from them (in % share of FOB current prices):

	Country / year	2003	2004	2005	2006	2007
Export	Germany	34.5	28.5	24.6	22.3	24.1
	Slovakia	24.9	24.3	24.4	24.3	23.0
	Austria	23.4	26.5	29.6	23.9	21.9
	Poland	5.1	7.7	5.8	5.9	17.5
	Hungary	5.4	4.7	8.9	14.7	5.2
	Italy	1.1	1.1	1.2	1.3	1.1
	Finland	0.5	0.4	0.0	0.8	1.1
	Others	5.1	6.8	5.5	6.8	6.1
Import	Russia	57.3	54.2	61.7	62.7	62.4
	Azerbaijan	7.2	6.7	9.7	12.6	13.5
	Poland	4.4	9.2	4.1	4.4	6.0
	Ukraine	6.0	7.6	5.1	4.4	4.5
	Norway	11.1	8.0	7.8	6.2	3.2
	Slovakia	3.0	2.6	2.0	1.7	2.0
	Algeria	0.0	1.3	1.0	0.1	2.0
	Germany	2.0	2.3	1.8	1.8	1.9
	Kazakhstan	0.5	1.6	1.8	2.7	1.7
	Libya	1.5	1.6	1.9	1.2	0.3
	Syria	4.2	1.8	0.2	0.0	0.0
	Others	2.8	3.1	3.9	2.2	2.5

A significant change in the structure of import by country of origin in current prices occurred in the period of 1999–2000. The reasons were the radical price increase of crude oil and the simultaneous weakening of CZK against USD (the most important items of mineral raw materials – crude oil, natural gas – are purchased for USD). A big share of countries, from which Czech Republic imports crude oil and natural gas, was manifested also in the continuing years 2001 to 2007 with regard to high world prices of both commodities, and regardless of a repeated strengthening of CZK against USD. The importance of import from Norway has been decreasing during the recent years – this is caused by decrease of the imported Norwegian natural gas volume (9 % share in 2007 compared to 18 % in 2006). Norway has therefore fallen down from the third to the fifth position.

Czech foreign trade with raw materials is thus characterized by a high dependence on the import of strategic natural fuels, especially oil and gas. A fact that predominant part of raw material import comes from countries outside the EU represents another characteristic feature. The import of raw materials from the EU-15 oscillates between only 2 and 4 % in current prices of the import on a long term. When new member countries are included, this proportion has been slightly increasing (thanks to Poland and Slovakia), amounting to 15.7 % in 2004, 9.1 % in 2005 and 2006, and 11.4 % in 2007. About 85–90 % of commodities is nevertheless imported from the territories outside the EU. Foreign trade in raw materials between the Czech Republic and the brand new EU members Bulgaria and Romania is surprisingly almost zero.

About 15 % of total Czech import of minerals in value was imported from EU-15 and almost 54 % from EU-25 in 2007 when crude oil and natural gas are not included. The territorial structure of import would in such a case be: Poland 28.2 %, Ukraine 21.6 %, Russia 18.9 %, Slovakia 9.4 %, Germany 9.1 %.

The situation on the side of the Czech raw material export is completely different. Predominant part of the Czech export is directed traditionally to western and central European markets. Export to three most important customer countries (Germany, Austria and Slovakia) exceeds 70 % of the value of total Czech export of raw materials and intermediate products made of these on a long term. In addition, the proportion of export to Poland has been dynamically increasing since 2005; it increased from less than 5 % in 2004 to 17.5 % in 2007.

Share of EU-15 resp. EU-25 (27) countries on the Czech foreign trade with raw materials (% of FOB current prices)

Group of countries/year	2003	2004	2005	2006	2007
Import from EU-15 (%)	3.6	3.7	2.7	2.7	3.0
Import from EU-25 (%)	11.2	15.7	9.1	9.1	11.4
Import from EU-27 (%)	–	–	–	–	11.4
Export to EU-15 (%)	62.4	58.4	56.7	49.6	49.4
Export to EU-25 (%)	96.9	96.1	96.8	95.2	96.0
Export to EU-27 (%)	–	–	–	–	96.4

Note:
EU-15: *Belgium, Denmark, Finland, France, Italy, Ireland, Luxembourg, Germany, the Netherlands, Portugal, Austria, Greece, Spain, Sweden, Great Britain*
EU-25: *EU-15 + CR, Estonia, Cyprus, Lithuania, Latvia, Hungary, Malta, Poland, Slovakia, Slovenia*
EU-27: *EU-25 + Bulgary, Romania*

The most important commodities of the Czech export of mineral substances in 2007 were as follows: bituminous coal – 49.3 %, coke – 14.4 %, natural gas – 7.1 %, brown coal – 4.3 %, and cement – 2.1 %. Main import commodities were in the same year: crude oil – 46.8 %, natural gas – 32.4 %, and iron ore – 7.9 % (% of raw material import, resp. export in current prices). Detailed data are given in the following tables.

Export and import of selected raw materials registered in Raw Material Policy *
(in mill CZK)

Raw material		Customs tariff code	2003	2004	2005	2006	2007*
Ores and concentrates – total	import		8 195	13 419	12 787	13 805	12 291
	export		0	5	2	1	2
Fe-ores and concentrates	import	2601	8 125	13 352	12 704	13 707	12208
	export		0	0	0	0	0
Mn-ores and concentrates	import	2602	63	64	79	71	73
	export		0	3	1	0	1
Ni-ores and concentrates	import	2604	2	3	3	5	8
	export		0	2	1	1	1
Cu-ores and concentrates	import	2603	1	0	0	0	0
	export		0	0	0	0	0
Pb-ores and concentrates	import	2607	2	0	0	20	0
	export		0	0	0	0	0
Zn-ores and concentrates	import	2608	0	0	0	1	1
	export		0	0	0	0	0
Sn-ores and concentrates	import	2609	0	0	0	1	1
	export		0	0	0	0	0
W-ores and concentrates	import	2611	0	0	1	0	0
	export		0	0	0	0	0
Ag-ores and concentrates	import	261610	2	0	0	0	0
	export		0	0	0	0	0
Au-ores and concentrates	import	261690	0	0	0	0	0
	export		0	0	0	0	0
Fuels – total	import		73 865	76 887	116 608	145 854	126 989
	export		10 742	13 667	15 457	16 913	19 157
Uranium-ores and concentrates	import	261210	N	N	N	N	N
	export		N	N	N	N	N
Crude oil	import	2709	36 361	41 865	68 287	82 534	72031
	export		675	437	516	422	165
Natural gas	import	271121	35 972	31 838	45 560	59 429	49808
	export		172	389	428	815	2224
Bituminous coal	import	2701	1 531	3 175	2 757	3 821	5103
	export		8 706	11 628	13 109	13997	15424
Brown coal	import	2702	1	9	4	70	47
	export		1 189	1 213	1 404	1 679	1344

Industrial minerals and construction minerals – total	import		1 163	1 514	1 507	2 157	2 374
	export		2 608	2 941	2 442	2 483	2451
Fluorspar	import	252921 252922	64	127	111	116	140
	export		61	64	61	73	92
Baryte	import	251110	42	47	55	43	38
	export		4	4	8	5	5
Graphite	import	2504	42	73	116	130	126
	export		68	87	85	101	107
Kaolin	import	2507	52	58	69	87	105
	export		1 026	1 140	654	626	485
Clays	import	2508	148	195	193	217	284
	export		382	557	525	458	487
Bentonite	import	250810	47	64	71	70	124
	export		164	199	211	204	225
Feldspars	import	252910	22	24	33	39	35
	export		135	142	161	129	159
Glass and foundry sand	import	250510	95	127	136	180	195
	export		208	262	271	298	282
Limestones	import	2521	90	97	40	39	93
	export		52	67	62	70	42
Gypsum	import	252010	20	42	36	84	152
	export		25	27	12	19	19
Dimension stone	import	2514-6 6801-3	530	571	558	731	854
	export		580	531	520	559	651
Crushed stone	import	251710	36	133	136	150	93
	export		64	56	80	133	103
Sand and gravel	import	250590 251710	58	153	160	182	135
	export		67	60	83	145	122
Raw materials – total	import		83 223	91 820	130 902	161 507	141 437
	export		13 350	16 613	17 901	19 397	21610

Note:
* *data for 2007 are preliminary according to the Czech Statistical Office information*

Export and import of other selected customs tariff items from the class V. – mineral products (in mill CZK)

Raw material		Customs tariff code	2003	2004	2005	2006	2007*
Al-ores and concentrates	import	2606	39	62	68	79	93
	export		3	14	0	0	3
Alumina oxide	import	281820	256	303	300	316	380
	export		5	4	5	3	5
Alumina hydroxide	import	281830	105	98	98	70	62
	export		10	4	2	1	1
Ti-ores and concentrates	import	2614	176	189	421	458	513
	export		4	13	6	9	12
Nb, Ta, V a Zr-ores and concentrates	import	2615	37	30	18	44	43
	export		1	1	0	0	0
Coke	import	2704	1 844	4 358	2 295	2 788	2 993
	export		3 221	5 324	6 005	4 557	4 492
Rock salt	import	2501	775	1 070	995	1 469	800
	export		36	41	43	84	65
Azbestos	import	2524	7	13	0	0	0
	export		0	0	8	0	0
Magnesite	import	251910	22	26	24	14	47
	export		10	8	10	1	2
Talc	import	2526	80	73	71	78	88
	export		2	2	2	2	3
Perlite	import	25301010	15	13	12	13	26
	export		1	1	2	0	1
Sulphur	import	2503, 2802	205	232	217	237	244
	export		23	24	22	19	13
Sulphuric acid	import	2807	33	39	48	53	64
	export		58	60	54	70	79
Natural phosphates	import	2510	49	51	63	85	83
	export		27	1	19	23	24
Phosphorous substances	import	2809	146	105	170	148	111
	export		321	421	657	647	545
Nitrogenous fertilizers	import	3102	1 387	1 815	2 040	2 195	2 291
	export		1 617	1 717	1 870	2 110	2 500
Phosphatic fertilizers	import	3103	45	50	51	50	135
	export		4	6	15	9	10
Potassic fertilizers	import	3104	324	476	459	506	575
	export		16	31	44	48	44
Fertilizers of more elements	import	3105	597	772	709	714	1 112
	export		202	182	197	161	266
Quicklime	import	2522	130	144	135	173	190
	export		303	272	244	238	261
Cement	import	2523	1 948	1 953	1 921	1 873	1 857
	export		586	782	677	590	912
Total	import		8 220	11 872	10 115	11 363	11 707
	export		6 450	8 908	9 882	8 572	9 238

*Note: * data for 2007 are preliminary according to the Czech Statistical Offic*

ENVIRONMENT AND MINERALS

Mining and nature protection

1,499 reserved and 786 non-reserved mineral deposits were registered in the Czech Republic as of December 31, 2007. The number of exploited deposits was markedly lower – 502 reserved and 215 non-reserved. Only 47 reserved and 16 non-reserved deposits were mined in the specially nature protected areas, which represents 9.4 % and 7.4 % of the total number, respectively.

Act No 114/1992 Sb. on nature and landscape protection in its present wording regulates activities in specially protected areas (ZCHÚ) of the Czech Republic (national parks – NP (Národní park), protected landscape areas – CHKO (Chráněná krajinná oblast), national nature reserves, nature reserves, national nature monuments and nature monuments). According to this Act, all mineral mining (section 16) in national parks (with exception of crushed stone and sand mining for construction in the territory of the national park), in the first zone of protected landscape areas (section 26) and in national nature reserves (section 29) is prohibited. Although the mining of mineral resources is not prohibited by law in other areas (2nd to 4th zones of the CHKO, nature reserves, national nature monuments and nature monuments), it is very difficult to obtain authorization. Legal regulations which mention prohibition of the "permanent damage of the soil surface" are the main reason – and they practically exclude mineral mining. A further reason is the civil activity in the field of environmental protection.

Mineral deposits are mined, and were in the past mined, in the CHKO in majority of cases where the mining claims were already determined before these CHKO were established. Mining in the CHKO declined after 1989 till 2002, after it certain change comes to, which follows from the data in the table "Mining of reserved and non-reserved mineral deposits in CHKO" and also from the fact that reserved deposits were mined in 19 from 25 CHKO in 2007 (see the table "Mining of reserved and non-reserved mineral deposits in individual CHKO") compared to 17 from 25 CHKO in 2006.

Specially protected areas (ZCHÚ) in the Czech Republic

Amount/Year	2003	2004	2005	2006	2007
Total number	2 170	2 202	2 210	2 217	2221
national parks (NP)	4	4	4	4	4
protected landscape areas (CHKO)	24	24	25	25	25
others	2 142	2 174	2 181	2 188	2192

Source: AOPK ČR (2007)

Notes: ⇨

- *conversion to kt: natural gas (1,000,000 m^3 = 1 kt), dimension and crushed stone (1,000m^3 = 2.7 kt), sand and gravel and brick clays (1,000 m^3 = 1.8 kt)*
- *since 2002, mine production in deposits located within 1km zone outside the protected landscape area (CHKO) is not included, i.e. the data represent the real mine production in the territory of the CHKO itself*

Structure of ZCHÚ in 2007

Category of specially protected areas	Number	Area (km 2)	Proportion on the territory of the Czech Republic 78 864 km2 (%)
LARGE-EXTENT ZCHÚ:			
national parks (NP) – mining explicitly prohibited	4	1 195	1.52
protected landscape areas (CHKO)	25	10 867	13.78
– (in them the 1st zones of CHKO where mining is explicitly prohibited)	25	881	1.12
ZCHÚ with mining explicitly prohibited by the Act No. 114/1992 Sb.	29	2 076	2.64
SMALL-EXTENT ZCHÚ:			
national nature monuments (NPP)	105	28	0.04
national nature reserve (NPR)	112	287	0.36
nature monuments (PP)	1 195	274	0.35
nature reserves (PR)	780	368	0.47
NPP, NPR, PP, PR	2 192	950	1.21
– (from them NPP, NPR, PP, PR on the area of NP, CHKO)	694	531	0.67
LARGE-EXTENT AND SMALL-EXTENT ZCHÚ – total	2 221	12 489	15.84

Source: AOPK ČR (2007)

Mining of reserved and non-reserved mineral deposits in CHKO, kt

	Reserved deposits					Non-reserved deposits				
mineral	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
Gemstones*	38	31	32	31	21	–	–	–	–	–
Graphite	0,5	0	0	0	0	–	–	–	–	–
Bituminous coal	0	0	0	0	0	–	–	–	–	–
Crude oil	1,2	1,5	1,1	0,9	0	–	–	–	–	–
Natural gas	3,1	3,0	4,9	14,1	13,8	–	–	–	–	–
Quartz sand	0,4	0,4	0	1,5	0,8	–	–	–	–	–
Feldspar	269	296	296	290	306	–	–	–	–	–
Limestone	3 382	3 427	3 096	3 111	3 171	–	–	–	–	–
Dimension stone	43	37	37	39	31	4,5	3,8	2,8	3,6	3,2
Crushed stone	3 040	2 797	3 171	3 739	3 604	63	45	82	51	32
Sand and gravel	1 740	1 755	1 649	1 737	1 735	89	91	81	116	51
Brick clay	63	31	99	0	23	0	4	4	3,6	3,6
Total	8 582	8 377	8 386	8 963	8906	157	143	169	174	90
Index, 1990=100	53	52	52	56	55	–	–	–	–	–
Index, 2000=100	–	–	–	–	–	51	47	55	57	29

** pyrope bearing rocks*

Mining of reserved and non-reserved mineral deposits in individual CHKO, kt

CHKO/year *	2003	2004	2005	2006	2007
Beskydy Mts.	48	38	74	68	46
Bílé Karpaty Mts.	40	21	28	28	31
Blaník	0	0	0	0	0
Blanský les	600	583	483	761	632
Broumov region	128	123	110	137	133
České středohoří Mts.	1 471	1 400	1 736	1 876	1 736
Český kras (Bohemian Karst)	3 426	3 346	3 239	3 353	3 338
Český les Mts.	0	0	0,2	0,2	0,2
Český ráj	0	0	0	0	0
Jeseníky Mts.	119	135	105	173	162
Jizerské hory Mts.	4	0	0	0	0
Kokořín region	0	4	4	4	4
Křivoklát region	312	269	274	324	402
Labské pískovce (Elbe sandstones)	0	0	0	0	0
Litovelské Pomoraví region	191	83	58	49	92
Lužické hory Mts.	0	0	5	9	10
Moravský kras (Moravian Karst)	185	222	175	143	154
Orlické hory Mts.	0	0	0	0	0
Pálava region	64	71	0	0	0
Poodří region	63	27	99	0	23
Slavkovský les region	170	165	188	181	204
Šumava Mts.	38	30	57	70	51
Třeboň region	1 594	1 737	1 713	1 813	1 760
Žďárské vrchy Mts.	51	49	38	68	91
Železné hory Mts.	78	76	167	81	127
Total mine production (rounded)	8 582	8 377	8 545	9 138	8 996

* till 2004 only mine production of reserved deposits was given, starting from 2005 mine production both reserved and non-reserved deposits is stated

As far as the impact of mining on the area is concerned, the CHKO Český kras (Bohemian Karst – limestone mining) is especially unfavourably affected. The impact on some other CHKO, especially CHKO Třeboň region, Poodří, České středohoří Mts. and Blanský les, is still rather high (see Tab. “Impact of mining of reserved deposits in CHKO”).

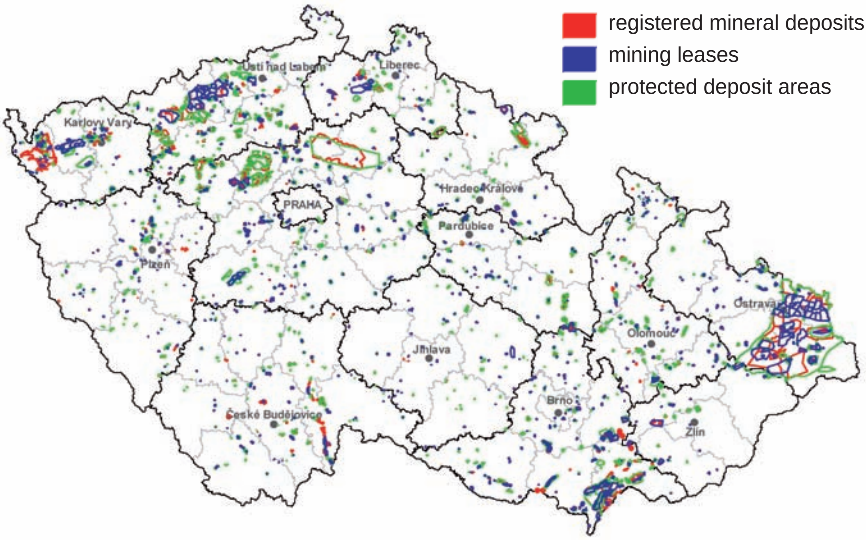
Impact of mining of reserved deposits in CHKO, t/km² in a year
(areas of CHKO as of December 31)

CHKO/year	area km² in 2006	2003	2004	2005	2006	2007
Beskydy Mts.	1 160	40	32	62	59	40
Bílé Karpaty Mts.	715	54	28	38	39	43
Blaník	40	0	0	0	0	0
Blanský les	212	2 729	2 653	2 199	3 592	2 981
Broumov region	410	296	286	233	334	324
České středohoří Mts.	1 070	1 378	1 311	1 626	1 753	1 622
Český kras (Bohemian Karst)	**132**	**25 905**	**25 301**	**24 495**	**25 402**	**25 288**
Český les Mts.	473	0	0	0	0	0
Český ráj	182	0	0	0	0	0
Jeseníky Mts.	740	160	182	142	234	219
Jizerské hory Mts.	350	12	0	0	0	0
Kokořín region	270	0	13	13	13	15
Křivoklát region	630	498	430	439	514	638
Labské pískovce (Elbe sandstones)	245	0	0	0	0	0
Litovelské Pomoraví	96	2 045	887	617	506	958
Lužické hory Mts.	270	0	0	19	34	37
Moravský kras (Moravian Karst)	92	2 032	2 437	1 918	1 559	1 674
Orlické hory Mts.	200	0	0	0	0	0
Pálava region	70	750	832	0	0	0
Poodří region	82	781	335	1 228	0	280
Slavkovský les	640	278	269	307	283	319
Šumava Mts. (CHKO + NP)	1 684	23	18	34	42	30
Třeboň region	700	2 318	2 526	2 492	2 589	2 514
Žďárské vrchy Mts.	715	72	69	53	95	127
Železné hory Mts.	380	273	264	585	213	334
TOTAL(total mining/total area)	10 867	741	723	738	841	828

Note: an impact exceeding 10,000 t/km² in a year is concerned critical

It is possible to get a clearer picture of mining activities in the Czech Republic from following map.

Mining activities charge of the Czech Republic territory



As well as the Act No 114/1992 Sb. on nature and landscape protection, Act No 100/2001 Sb. on environmental impact assessment and the Decree of the MŽP No 175/2006 Sb. (formerly 395/1992 Sb.), by which some provisions of the Act No. 114/1992 Sb. are applied, have a fundamental influence on permission for exploration and mining.

The Mining Act No. 44/1988 Sb. obliges the mining companies by its section 31 to reclaim the areas with mining impacts and to create financial means for this reclamation. These are considered as mining costs from the viewpoint of the profit tax. Table "Development of reclamations after mining" shows that the areas with mining impact decreased and those reclaimed increased in 2003–2007.

Methods of reclamation used in 2007 are shown in another table below.

Development of reclamations after mining

km^2		2003	2004	2005	2006	2007
Reserved deposits	Area with manifestation of mining, not yet reclaimed	806	822	760	697	663
	Reclamations in process	95	111	96	110	113
	Reclamations finished since the start of mining	160	169	170	178	181
	Reclamations finished in the given year	4	4	9	11	7,6
Non-reserved deposits	Area with manifestation of mining, not yet reclaimed	14	16	16	17	16
	Reclamations in process	3	3	3	3	3
	Reclamations finished since the start of mining	2	2	2	2	2
	Reclamations finished in the given year	0,7	0,6	0,5	0,5	0,5

Reclamation after mining of reserved minerals in 2007

(ranked according to regions and way of reclamation; DP = mining claim (in = within, out = outside), areas in hectares (1 km^2 = 100 ha))

Region	Reclamations in process								Reclamations finished							
	agricultural		forest		water		other		agricultural		forest		water		other	
	in DP	out DP	in DP	out DP	in DP	out DP	in DP	out DP	in DP	out DP	in DP	out DP	in DP	out DP	in DP	out DP
Prague	1	0	0	0	0	0	1	3	2	1	0	0	0	0	0	4
Central Bohemia	204	0	162	11	73	0	116	5	380	69	50	7	112	23	33	16
South Bohemia	10	0	40	3	6	0	13	0	70	55	147	1	275	0	29	1
Plzeň	8	0	19	0	0	0	33	1	41	36	47	61	3	0	0	0
Karlovy Vary	135	88	800	1155	508	1	32	36	282	1035	678	1170	58	26	144	18
Ústí nad Labem	624	297	1706	1504	43	29	850	879	899	2024	1431	2901	348	205	447	1319
Liberec	32	0	85	22	0	0	0	0	65	45	167	13	5	0	0	0
Hradec Králové	34	0	44	5	2	0	12	0	40	7	65	2	57	39	6	14
Pardubice	7	0	22	7	89	0	1	2	46	0	1	7	1	0	8	2
Vysočina	0	1	1	0	0	0	6	0	0	0	28	3	0	0	2	2
South Moravia	148	13	55	0	1	0	29	0	319	28	146	8	6	0	12	8
Olomouc	15	2	45	54	86	0	4	0	22	26	1	2	0	0	4	5
Zlín	25	0	0	0	3	0	2	0	48	2	31	0	130	6	98	4
Moravia and Silesia	46	7	674	35	108	1	171	16	994	65	630	36	232	5	132	14
ČR in total	1 289	408	3 653	2 796	919	31	1 270	942	3 208	3 393	3 422	4 211	1 227	304	915	1 407

Mining influences the environment, changes the character of the landscape, and alters ecological conditions for flora and fauna. In some areas mining activities can last several human generations. This way the impact of mining persists and a more permanent new arrangement of natural conditions and relationships in its area is not quickly evident. The new arrangement can be equal to or even better than the original one, of course on a different level. Examples include artificial lakes formed e.g. in south Bohemia by sand and gravel mining, constructions and sport grounds in former quarries or specially protected nature areas proclaimed paradoxically in the territory of former quarries, and also 35 hectares of new vineyards planted as agricultural reclamation of a closed brown coal mine in the north of Bohemia in the Most wine region. They represent by their area almost 6.5 % of the total 550 hectares of productive vineyards of the Czech wine region.

Eliminating negative consequences of mining in the Czech Republic – main methods and financial resources

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Introduction

The process of restructuring coal and ore mining, and of eliminating negative environmental consequences of mining in the landscape and erasing these consequences in affected areas of the Czech Republic, is executed in several ways and with various financial resources. It specifically involves:

1. Use of funds from a financial reserve generated by mining companies for remediation, reclamation and mining damages
2. Use of funds from annual royalties paid by mining companies on mining leases and on extracted reserved minerals pursuant to the Mining Act
3. Phase-out of mining activities and erasing consequences of coal, ore and uranium mining funded by the state
4. Use of proceeds from privatisation of state assets in eliminating old ecological burdens caused by mining, existing prior to privatisation of mining companies
5. A programme which deals with ecological damage caused prior to privatisation of brown coal mining companies in the Ústí nad Labem Region and Karlovy Vary Region, with ecological revitalisation upon termination of mining operations in the Moravia and Silesia Region, and with reducing the impacts caused by the termination of coal mining in the Kladno Region based on Government resolutions in 2002. Funds are provided by proceeds from privatisation of state assets.

1. Use of funds from a financial reserve generated by mining companies for remediation, reclamation and mining damages

Financial reserve for remediation and reclamation

The most important source for funding the elimination of the consequences of mining operations in the Czech Republic is the financial reserve for remediation and reclamation, generated by mining companies during the exploitation of reserved mineral deposits.

An amendment of Mining Act No. 541/1991 Coll., under article 31 section 6, imposes an obligation on the mining company to generate a financial reserve in order to meet the obligation established under article 31 section 5 of the Mining Act, thus guaranteeing the remediation and reclamation of all plots of land affected by mining (hereinafter “reserves”). The reserves are part of the company´s expenses. Pursuant to article 32 section 2 of the Mining Act, the determination of anticipated expenses for remediation and reclamation is part of the plan for opening, preparation and exploitation of reserved deposits (hereinafter “POPD”), and the POPD must also contain a proposal regarding the amount of, and the method for, generating the required financial reserve. However, the anticipated amount of financial costs for remediation and reclamation must for the first time already be included, pursuant to the provision under article 2 section 3 letter k) item 4 of Decree No. 172/1992 Coll., as amended, in the application for the grant of a mining lease. An interim provision of Act No. 541/1991 Coll. established that the required reserve amount should be provided in 10 years (i.e. by 20 December 2001) in the case of existing mines. In a subsequent amendment of the Mining Act by Act No. 168/1993 Coll., the time period for generating the reserve was changed to last for the duration of the economic life of the mine, quarry or their sections. However, that did not apply to companies with an announced or approved phase-out programme (ores, coal).

According to the provision under article 37a section 2 of the Mining Act, the generating of reserves is subject to approval by Regional Mining Authorities (OBÚ). Upon the request of a company, these also permit the drawing on funds from the generated reserve upon agreement with the Ministry of the Environment and upon notification by the relevant municipality. In the case of public enterprises, the OBÚ makes a decision regarding the drawing on the reserve upon agreement with the Ministry of Industry and Trade.

The issues mentioned are further regulated by FMF (Federal Ministry of Finance) Measure No. ref. V/20 100/1992 Coll., on the chart of accounts and on accounting procedures, which lays down the rules regarding the generating and use of financial reserves by companies with permitted mining operations. At the end of each accounting period, companies execute closings of books and carry out document inventories, which verify the balancing of books (Act No. 593/1992 Coll. and No. 563/1991 Coll.).

Related internal regulations of the Czech Mining Office in Prague (ČBÚ):

- Measure No. 14/1994 of the ČBÚ chairman, which consolidates the verification procedure regarding the generating of and the drawing on financial reserves for remediation and reclamation;
- Measure No. 11/1995 of the ČBÚ chairman, which establishes the method principles for generating financial reserves for remediation and reclamation;
- ČBÚ Guidance Note No. ref. 2116/V/93 – V-37 for the supervision of the generating and use of financial reserves by mining companies, executed by the State Mining Authority.

Financial reserve for mining damages

Pursuant to article 37a section 1 of the Mining Act, a mining company is obliged to generate a financial reserve to ensure settlement of mining damages. The reserve amount generated and charged to expenses must correspond to the needs for settling mining damages in the course of time depending on their creation, or prior to their creation (article 37 section 4).

Generating of reserves is subject to approval by the relevant Regional Mining Authority, which also approves the drawing on these reserves upon agreement with the Ministry of the Environment. Prior to making a decision on the drawing on theses reserves, the Regional Mining Authority requests a statement from the relevant municipality. In the case of public enterprises, the OBÚ decides in agreement with the Ministry of Industry and Trade.

A company´s request to draw on the financial reserve for mining damages must be furnished with a list of mining damages, an expense estimate for their elimination and a time table of resource expenses for the elimination of mining damages.

Generated and drawn reserves for remediation and reclamation (in CZK thousand)

Year	Bituminous coal		Brown coal		Crude oil and natural gas		Ores		Industrial minerals		Radioactive raw materials		Total	
	generated	drawn	generated	drawn	generated	drawn	generated	drawn	generated	drawn	generated	drawn	generated	drawn
1993	118 500	0	1 341 769	65 615	12 722	0	0	0	97 438	8 236	0	0	1 570 429	73 851
1994	123 750	18 600	573 242	259 929	6 836	0	0	0	255 155	30 335	0	0	958 983	308 864
1995	85 895	136 064	3 845 935	265 856	22 414	370	0	0	276 724	24 230	0	0	4 230 968	426 520
1996	143 500	97 993	1 436 957	831 817	25 811	113	0	0	270 432	31 829	0	0	1 876 700	961 752
1997	108 000	42 108	1 302 735	1 087 993	62 618	5 569	0	0	484 420	53 262	0	0	1 957 773	1 188 932
1998	51 594	48 033	1 226 036	994 133	22 112	9 541	0	0	466 649	59 913	0	0	1 766 391	1 111 620
1999	132 143	56 236	1 199 633	704 199	26 181	7 473	0	0	318 852	141 530	0	0	1 676 809	909 438
2000	42 747	52 029	1 119 474	683 179	23 487	600	0	0	307 433	140 225	0	0	1 493 141	876 033
2001	876 194	77 458	1 267 431	678 515	23 184	2 750	390	0	215 379	53 893	0	0	2 382 578	812 616
2002	887 250	129 600	1 007 561	653 557	100	250	0	0	157 721	50 604	0	0	2 001 946	822 491
2003	1 800	498	5 199 919	4 844 371	11 782	1 050	0	0	179 763	57 848	0	0	5 393 264	4 903 767
2004	65 002	54 162	1 031 828	720 168	4 770	0	0	0	160 102	73 177	0	0	1 261 702	847 507
2005	66 504	54 204	964 222	547 883	17 524	9 409	0	0	228 713	113 743	0	0	1 254 884	766 460
2006	74 178	113 691	845 008	663 055	17 893	3 300	0	0	144 665	92 489	0	0	1 081 744	872 535

Generated and drawn reserves for mining damages (in CZK thousand)

Year	Bituminous coal		Brown coal		Crude oil and natural gas		Ores		Industrial minerals		Radioactive raw materials		Total	
	generated	drawn	generated	drawn	generated	drawn	generated	drawn	generated	drawn	generated	drawn	generated	drawn
1993	400 721	4 093	150 548	42 957	0	0	0	0	28 462	0	0	0	579 731	47 050
1994	105 650	38 813	50 000	32 223	0	0	0	0	9 328	28 852	0	0	164 978	99 888
1995	204 785	86 001	209 207	37 748	0	0	0	0	10 673	9 394	0	0	424 665	133 143
1996	151 643	74 952	259 779	84 258	0	0	0	0	13 100	3 407	0	0	424 522	162 617
1997	77 900	142 512	318 981	127 715	0	0	0	0	5 733	683	0	0	402 614	270 910
1998	185 723	174 640	252 920	112 852	0	0	0	0	16 043	3 638	0	0	457 686	291 130
1999	111 588	174 640	212 722	40 448	0	0	0	0	10 803	6 844	0	0	335 113	221 932
2000	110 088	107 852	240 655	188 685	0	0	0	0	11 414	1 020	0	0	362 157	297 557
2001	145 750	188 073	105 513	217 306	192	0	100	0	35 877	6 628	0	0	286 872	412 007
2002	102 750	168 531	102 700	510 200	0	0	0	0	2 327	2 338	0	0	207 777	681 069
2003	0	0	816 197	999 271	90	0	0	0	12 576	2 263	0	0	828 863	1 001 534
2004	187 700	139 714	164 700	315 321	0	0	0	0	3 007	4 560	0	0	355 407	459 595
2005	191 700	143 974	97 433	279 955	0	0	0	0	6 597	4 273	0	0	295 730	428 202
2006	N	N	N	N	N	N	N	N	N	N	N	N	N	N

2. Use of funds from annual royalties paid by mining companies on mining leases and on extracted reserved minerals pursuant to the Mining Act

Royalties on mining leases

The amendment of Act No. 541/1991 Coll., which modifies and supplements Act No. 44/1988 Coll., on the protection and use of the mineral resources (the Mining Act), imposes an obligation on mining companies, under article 32a), to pay to the account of the relevant Regional Mining Authority an annual royalty, pursuant to section 1, on the mining lease and, pursuant to section 2, on extracted reserved minerals or on reserved minerals upon their processing and beneficiation.

The royalty obligation for companies was introduced for the first time regarding reserved minerals extracted in 1993. The annual royalty on the mining lease amounts to CZK 10 000 per km^2 opened within the mining lease area marked off on the surface. The annual royalty amounts to CZK 2 000 in the case of small mining leases of up to 2 hectares.

The ultimate recipient of the mining lease royalties are the municipalities, in whose territory the mining lease is located. These resources are used, in large measure, as compensation for negative impacts of mining on the municipalities in question. As shown in the following table, a total of CZK 333.2 million was paid out to municipalities in 1993–2007 since the inception of royalty payments on mining leases.

Royalties from mining lease areas paid out to municipalities (in CZK thousand) pursuant to article 32a) section 1 of the Mining Act

Year	Number of municipalities	Total
1993	1 327	25 929
1994	1 194	22 752
1995	1 168	24 114
1996	1 225	24 032
1997	1 191	23 446
1998	1 269	22 885
1999	1 208	23 629
2000	1 178	23 780
2001	1 171	23 728
2002	1 168	22 899
2003	1 158	21 740
2004	1 161	21 511
2005	1 138	21 077
2006	1 127	16 178
2007	1 118	15 512
Total		**333 212**

Royalties on extracted reserved minerals

The royalty on extracted minerals established under article 32a) section 2 of Act No. 541/1991 Coll., amounts to 10 % of the market price of extracted minerals at the most and, pursuant to section 4, from the royalty yield, pursuant to section 2, the Regional Mining Authority transfers 50 % to the state budget of the Czech Republic and 50 % to the budget of the municipality in whose territory the mining lease is situated. If the mining lease is located in the territory of several municipalities, the Regional Mining Authority distributes the revenue according to the share in mining, similarly to the royalty on a mining lease.

Amendment No. 10/1993 Coll. of the Mining Act established that 50 % of the royalties transferred to the state budget will be used for the purpose of remediation of environmental damage caused by the mining of reserved deposits.

In 2000 a change occurred and article 32a) section 4 of Act No. 366/2000 Coll. established that, of the royalty pursuant to section 2, the Regional Mining Authority shall transfer only 25 % to the state budget of the Czech Republic, from which these funds will be used for the purpose of remediating environmental damage caused by the mining of reserved as well as non-reserved deposits, and that the Regional Mining Authority shall transfer the remaining 75 % to the municipality´s budget. Simultaneously, Government Resolution No. 906/2001 and, again, Government Resolution No. 69/2008 approved to divide the 25% of royalty transferred to the state budget into 12.5 % for use by the Ministry of Industry and Trade in remediation of environmental damage caused by the mining of reserved as well as non-reserved deposits, and into 12.5 % for use by the Ministry of the Environment in liquidation of old mine workings.

The following table clearly shows the payment and use of funds for the 1993-2007 period. In 15 years mining companies paid a total of CZK 7.5 billion., of which municipalities received CZK 4.65 billion, and, for remediation of environmental damage caused by the mining of reserved as well as non-reserved minerals, Regional Mining Authority transferred to the state budget a total of CZK 2.84 billion which was subsequently released from the state budget and of which CZK 2.4 billion went to the Ministry of Industry and Trade and CZK 0.44 billion to the Ministry of the Environment.

Distribution of royalties on extracted reserved minerals pursuant to article 32a) section 4 of the Mining Act (in CZK thousand)

Year	50 % SR (State budget)		50 % Municipalities	Total
1993	230 400		230 526	460 926
1994	245 762		245 276	496 961
1995	221 909		221 566	458 005
1996	229 703		229 703	460 588
1997	228 874		228 874	473 400
1998	220 885		220 886	442 577
1999	219 938		219 938	429 603
2000	227 778		227 859	463 648
Σ	**1 825 249**		**1 824 628**	**3 685 708**

	12.5 % MPO (Ministry of Industry and Trade)	12.5 % MŽP (Ministry of the Environment)	75 % Municipalities	Total
2001	153 166	12 500	302 221	472 492
2002	55 000	59 500	356 724	475 632
2003	61 713	61 800	371 827	495 582
2004	70 000	69 500	393 695	532 750
2005	76 398	76 700	449 135	602 509
2006	76 305	76 400	455 947	608 614
2007	82 716	82 300	494 737	659 288
Σ	**575 298**	**438 700**	**2 824 286**	**3 846 867**
Total	**2 400 547**	**438 700**	**4 649 314**	**7 532 575**

3. Phase-out of mining activities and erasing consequences of coal, ore and uranium mining funded by the state

The restructuring of industry in the Czech Republic, specifically of metallurgy and engineering, initiated after 1989, had an immediate impact on the mining sector. Uneconomic ore, coal and uranium mining, and a lower raw material demand were the decisive reasons for the restructuring and subsequent privatisation of mining companies. Part of the restructuring of the mining industry was the announcement of a phase-out of mining activities in uneconomic underground mines and quarries.

The essential method of funding the restructuring of the mining sector is provided by subsidies from the state budget, in accordance with relevant Government resolutions, for the phase-out and to erase the consequences of mining operations.

In the initial phase, the phase-out in individual branches of mining occurred independently, mainly because mining companies reported to various departments.

The phase-out of uranium mining was already decided upon in 1989, as based on documents processed by the Federal Ministry of Fuel and Energy, which was approved by ČSSR (Czechoslovak Socialist Republic) Cabinet Resolution No. 94/1989 on the concept of lowering the unprofitability of uranium mining in the ČSSR in 1990, in the 9th and 10th five-year plans by phasing it out. This Cabinet resolution from 1990 was subsequently amended by the Government of the ČSFR (Czechoslovak Federal Republic) with new Government Resolution No. 894/1990 regarding the modification of the phase-out concept for uranium mining in the ČSFR.

In 1990, ore mining fell under the Federal Ministry of Metallurgy, Engineering and Electric Engineering which, for the purpose of dealing with ore mining and the announcement of a phase-out programme for the ore mining industry as of 1 July 1990, processed documents for Government proceedings and Government Resolution No. 440/1990 was adopted.

The phase-out of coal mining was announced at the end of 1992 based on Government Resolution No. 691/1992 concerning the programme for restructuring the coal industry, and documents for Government proceedings were processed by the Ministry of Industry and Trade.

Even though the phase-out of ore mining was not completed, a merger of Rudné doly Příbram state enterprise with DIAMO state enterprise occurred as of 1 January 2001, thereby ending the industry-by-industry monitoring of the phase-out, i.e. ore and uranium mining.

Another modification of the reporting method concerning the drawing on state budget funds occurred in 2003, when, in addition to the proposed state participation in the completion of the restructuring of coal mining, Government Resolution No. 395/2003 authorised the transfer of the Barbora locality from OKD, a. s. company to DIAMO state enterprise, and the localities of Ležáky, Kohinoor and of Kladenské doly to Palivový kombinát Ústí state enterprise.

Since the initiation of the phase-out of mining in 1992, a total of CZK 65.3 billion, i.e. an annual average of CZK 4.08 billion, was released from the state budget for the phase-out of mining and to erase the consequences of mining. As shown in the following table, CZK 39.1 billion were spent on technical work related to the phase-out of mining and on erasing the consequences of mining operations, and CZK 26.2 billion on social health benefits for miners.

Use of state budget subsidies for the phase-out of mining and to erase consequences of mining and mandatory social health expenses (in CZK million)

Year	Mining in total			Coal mining			Ore mining			Uranium mining		
	TÚ	MSZN	Total	TÚ	MSZN	Total	TÚ	MSZN	Total	TÚ	MSZN	Total
1992	1 100.3	0	1 100.3	555.7	0	555.7	248.0	0	248.0	296.6	0	296.6
1993	2 555.1	1 436.3	3 991.4	1 816.1	949.7	2 765.8	43.2	189.0	232.2	695.8	297.6	993.4
1994	3 940.1	1 528.0	5 468.1	2 333.4	1 011.7	3 345.1	35.1	179.6	214.7	1 571.5	336.7	1 908.2
1995	3 861.1	1 678.1	5 539.2	1 956.8	1 329.9	3 286.7	198.8	36.4	235.2	1 759.3	346.4	2 105.7
1996	3 755.5	1 823.2	5 578.7	2 168.3	1 422.7	3,591,0	126.7	33	159.7	1 486.9	367.0	1 853.9
1997	2 305.9	1 811.1	4 117.0	1 364.6	1 362.8	2 727.4	100.1	34.9	135.0	836.6	413.4	1 250.0
1998	2 571.7	1 862.9	4 434.6	1 690.2	1 403.7	3 093.9	94.8	30.2	125.0	979.7	422.9	1 402.6
1999	2 073.5	1 955.8	4 029.3	1 206.1	1 475.9	2 682.0	79.2	37.6	116.8	787.9	442.2	1 230.1
2000	2 064.2	1 986.1	4 050.3	1 193.8	1 475.2	2 669.0	158.0	30.2	188.2	712.3	474.9	1 187.2
2001	2 296.2	1 955.6	4 251.8	1 118.4	1 451.0	2 569.4	part of uranium mining			1 174.6	500.4	1 675.0
2002	1 729.9	1 913.8	3 643.7	574.9	1 359.2	1 934.1				1 154.8	553.3	1 708.1
2003	2 148.5	1 751.1	3 899.6	654.4	1 294.2	1 948.6				1 494.1	455.5	1 949.6
2004	2 576.1	1 713.2	4 289.3	With the merger of s. p. Rudné doly Příbram with s. p. DIAMO and the takeover of phased out areas of OKD, a. s., monitoring on an industry-by-industry basis was terminated								
2005	2 110.3	1 669.1	3 779.4									
2006	2 069.8	1609.3	3 679.1									
2007	1 917.9	1 574.1	3 492.0									
Total	39 076.1	26 267.7	65 343.8	16 632.7	14 536.0	31 168.7	1 083.9	570.9	1 654.8	12 950.1	4 610.3	17 560.4

TÚ – technical work related to phase-out and erasing consequences of mining operations
MSZN – mandatory social health expenses

4. Use of proceeds from privatisation of state assets in eliminating old ecological burdens caused by mining prior to privatisation of mining companies

Based on a decision by the Czech Republic Government, the former National Property Fund of the Czech Republic (as of 1 January 2006 the Ministry of Finance, based on Act No. 179/2005 Coll.) pledged, by virtue of "ecological contracts" entered into with individual assignees of assets from privatisation, to eliminate, with its privatisation proceeds, old ecological burdens created prior to privatisation.

The procedures and process principles for implementing measures leading to remediation of old ecological burdens created prior to privatisation are established in accordance with Government Resolution No. 51 from 10 January 2001.

The process adheres primarily to the following Acts and Resolutions of the Czech Republic Government:

a) Act No. 92/1991 Coll., on the terms and conditions regarding the transfer of state assets to other persons, as amended;
b) Act No. 171/1991 Coll., on the responsibility of Czech Republic authorities in cases of transfer of state assets to other persons, and on the National Property Fund of the Czech Republic, as amended;
c) Government Resolution No. 51 from 10 January 2001, which contains the appendix entitled *Principles for Settlement of Ecological Obligations Arising during Privatisation* (hereinafter Principles), as amended;
d) Government Resolution No. 212/1997 on the procedure principles during privatisation pursuant to Act No. 92/1991 Coll. and Act No. 171/1991 Coll., which substituted prior Government Resolutions No. 568/1993, No. 393/1994, No. 178/1995, No. 773/1995 and No. 20/1997;
e) Act No. 137/2006 Coll., on public contracts.

The processing of the programme is always provided by the Ministry of Finance. The Ministry of the Environment provides guaranteed expertise in the process and issues binding opinions on individual process steps. Mutual collaboration of both authorities in this process is regulated by the "Rules for Mutual Collaboration of the Ministry of the Environment and the Ministry of Finance in the Awarding of 'Ecological Contracts' to Eliminate Old Ecological Damage".

The elimination of old ecological damage created prior to privatisation proceeds for the most part according to priorities established by the MŽP.

Overview of entities with which "ecological contracts" were entered into, including guaranteed financial sums and their actual amount drawn (in CZK)

Name of mining company	Amount of guarantee	Drawn from guarantee	Amount available for drawing
DIAMO, státní podnik	1 948 000 000	229 870 378	1 718 129 622
OKD, a.s.	27 800 000 000	2 560 660 237	25 239 339 763
Sokolovská uhelná, a.s.	214 000 000	70 290 576	143 709 424
Severočeské doly, a.s.	172 265 000	2 094 077	170 170 923
Pískovny Hrádek, a.s.	16 931 678	1 142 703	15 788 975
GRANITOL akciová společnost	282 473 000	9 814 821	272 658 179

5. A programme which deals with ecological damage caused prior to privatisation of brown coal mining companies in the Ústí Region and the Karlovy Vary Region, with ecological revitalisation upon termination of mining in the Moravia and Silesia Region, and with reducing impacts caused by the termination of coal mining in the Kladno Region based on Government resolutions in 2002. Funds are provided by proceeds from privatisation of state assets.

After the privatisation of mining companies, the financial settlement of related ecological damage was not resolved in an appropriate manner, within the scope of privatisation projects. However within the scope of privatisation, companies took over not only mining localities but also extensive areas from the state, which were designated for revitalisation and for which a required financial reserve was not generated in the past.

Mining companies are only obliged to generate a financial reserve for remediation and reclamation of areas affected by mining since 1994, and that on the basis of Amendment (No. 168/1993 Coll.) of the Mining Act.

In 2002, the Czech Republic Government being aware of this fact began to intervene financially in the ecological and partially economic revitalisation of regions with active or terminated mining operations. The goal was to eliminate environmental damage caused by mining operations prior to implemented legal regulation.

For this purpose it earmarked, from the proceeds from sale of assets designated for privatisation and from the profits of public enterprises, CZK 15 billion to deal with ecological damage created prior to privatisation of brown coal mining companies in the Ústí Region and Karlovy Vary Region, CZK 20 billion to deal with ecological damage caused by mineral mining, primarily underground mining of bituminous coal in the Moravia and Silesia Region, and CZK 1.177 billion to deal with reducing the impacts caused by the termination of coal mining in the Kladno Region.

The funds from the proceeds from privatisation are released in accordance with Government decisions to cover the expenses of eliminating environmental damage caused by present operations of mining companies, to cover the expenses of and support investment and non-investment activities connected with the remediation of environmental damage caused by mineral mining and to revitalise affected areas, and for financial support of development projects in areas designated for industrial use approved by the Government.

Dealing with ecological damage created prior to privatisation of brown coal mining companies in the Ústí nad Labem Region and the Karlovy Vary Region

For more than 150 years, the character of the landscape was affected significantly by intensive opencast and underground mining of brown coal in the Krušné Hory Mts. piedmont area of northwestern Bohemia. Undergroung mining primarily affected the territory with the deepest seams (up to 450m below the surface) in the central, Most-Bílina area of the basin as well as the Teplice area of the North Bohemian Basin. Opencast mining occurred primarily in areas of coal seam outcrops southwest of Chomutov, west and east of the City of Most, north of the City of Bílina, northwest of the City of Teplice, southwest and north of the City of Ústí nad Labem.

In 2002, the then National Property Fund of the Czech Republic was bound by resolutions of the Czech Republic Government to eliminate ecological damage caused by the activities of coal mining companies in the Ústí nad Labem Region and the Karlovy Vary Region, and to revitalise affected areas. The process was initiated that same year.

In accordance with a relevant resolution of the Czech Republic Government, the process dealing with ecological damage created prior to privatisation of brown coal mining companies in the Ústí nad Labem Region and the Karlovy Vary Region includes both of the Krušné hory Mts Basin situated in the territory of the Districts of Sokolov, Chomutov, Most, Teplice and of Ústí nad Labem, i.e. the Sokolov Basin and the North Bohemian Basin, or the mining leases of Sokolovská uhelná, a.s., Severočeské doly, a.s., Mostecká uhelná společnost, a.s., Kohinoor, a.s., and Palivový kombinát Ústí, s. p.

The programme mentioned specifies a group of projects aimed primarily at creating and renewing:
- forest stands,
- agricultural land,
- bodies of water,
- landscape vegetation,
- biocorridors and biocentres,
- areas for recreation,
- areas designated for ecology and natural science,
- building sites.

The funds actually spent on **76** concluded projects amount to **CZK 1.739 billion**, and on **58** projects in progress they amount to **CZK 1.993 billion** as of the specified date. The remaining financial amount required to secure additional money for the projects in progress amounts to ca. **CZK 1.156 billion** according to contracts.

List of companies included in the programme plan:

Sokolovská uhelná, legal successor, a.s. (SU)

Severočeské doly, a.s. (SD)

Mostecká uhelná společnost, a.s. (MUS)

Palivový kombinát Ústí based in Ústí nad Labem (PKÚ)

List of regions (projects of cities and municipalities) included in the programme plan:

Karlovy Vary Region - KK

Ústí Region – ÚK

Projects concluded and projects in progress (in CZK)

Coal Companies	Projects concluded		Projects in progress		
	Number of projects	Project costs	Number of projects	Project prices	Amount drawn as of 31 March 2008
SU	1	73 877 440	14	1 333 743 849	825 140 429
SD	7	256 466 070	5	532 066 099	24 994 027
MUS	26	225 370 672	12	895 657 515	710 287 697
PKÚ	14	958 723 302	16	538 544 066	385 966 197
Total	**48**	**1 514 437 484**	**47**	**3 300 011 529**	**1 946 388 350**

Municipalities Total	Projects concluded		Projects in progress		
	Number of projects	Project costs	Number of projects	Project prices	Amount drawn as of 31 March 2008
KK	9	190 840 190	5	54 446 064	12 819 735
ÚK	1	21 337 708	6	95 076 964	34 485 917
Total	**10**	**212 177 898**	**11**	**149 523 028**	**47 305 652**

Project plan	18	12 617 372

Total	76	1 739 232 754	58		1 993 694 002

Revitalisation of the Moravia and Silesia Region

Currently, the revitalisation of the Moravia and Silesia Region is aimed primarily at eliminating the consequences of ecological burden caused by bituminous coal mining.

As of 31 March 2008, the funds actually spent on **15** concluded projects amount to ca **CZK 0.22 billion**, and on **26** projects in progress they amount to ca **CZK 0.63 billion** as of the specified date**.** The remaining financial amount required to secure additional money for the projects in progress amounts to ca **CZK 0.541 billion** according to contracts**.**

Categories of priority projects, approved by the Government, which deal with eliminating environmental damage caused by mineral mining in the Moravia and Silesia Region

1. Reclamation work
2. Reducing thermal activity
3. Comprehensive site development
4. Comprehensive reduction of uncontrolled methane emissions
5. Eliminating old ecological burdens in OKD, a. s.
6. Land development upon termination of mining

Projects concluded (in CZK)

Project name	Project costs
Reducing thermal activity	
Survey and monitoring of thermal activity in the Heřmanice waste dump	4 962 696
Survey and monitoring of thermal activity in the Hedvika waste dump	6 506 627
Total	**11 469 323**
Comprehensive site development	
Height measurement in areas with phased out mining operations	1 094 800
Examiner´s report - Height measurement in areas with phased out mining operations	44 140
Total	**1 138 940**
Comprehensive development of sites with uncontrolled methane emissions	
Comprehensive analysis of the methane problem in connection with old mine workings - study	7 602 000
Examiner´s report on the conceptual solution of the methane problem	35 000
Measures for removing emergency measures regarding methane emissions in the City of Orlová	62 873 211
Processing individual methodical procedures of basic activities	1 856 400
Survey of mine gas emissions in areas with phased out coal mining and related health and environmental risks	2 344 300
Total	**74 710 911**
Eliminating old ecological burdens in OKD, a.s.	
Remediation and reclamation of the Křemenec area	113 929 281
Processing the “Remediation and reclamation of the Kašpárkovice lands“ project	809 200
Processing the “Remediation of the Solca tailing ponds“ project	1 224 510
Processing the “Development of lands including Karvinský Creek in the area of Špluchov – section 3“ project	1 860 565
Total	**117 823 556**
Land development upon termination of mining	
Demolition KOBLOV	6 914 609
Demolition HRUŠOV	6 845 432
Total	**13 760 041**
Total	**218 902 771**

Projects in progress (in CZK)

Project name	Project price	Project costs thus far
Reclamation work		
Rudná land reclamation, structure 5 (along Polanecká street)	5 711 866	2 692 494
Remediation and reclamation of reservoirs and lands below the Stachanov reservoirs	45 316 473	0
Reclamation of the Žofie waste dump	1 980 932	1 950 601
Drainage of lands south of Kuboň Pond – site A and B	2 379 151	2 001 798
Reclamation of NP 1 lands	116 095 818	33 365 163
Remediation SALMA	7 110 595	8 390
Reclamation of the Oskar waste dump	6 074 753	71 953
Development along Orlovská Stream	6 519 187	0
Total	191 188 775	**40 090 399**
Reducing thermal activity		
Survey and monitoring of thermal activity in the Heřmanice waste dump – site II	4 224 595	3 400 536
Survey and monitoring of thermal activity in the Ema waste dump	1 495 848	566 522
Total	5 720 443	**3 967 058**
Comprehensive land development		
Height measurement in areas with phased out mining operations managed by DIAMO (ODRA)	4 709 500	0
Total	4 709 500	**0**
Comprehensive development of sites with uncontrolled methane emissions		
Reducing verified methane emissions in the City of Orlová – Project Orlová 2	34 575 450	7 560 860
Land categorisation map OKR	2 249 100	610 470
Economics of filling underground spaces	2 261 000	1 392 300
Geophysical and borehole survey	1 707 650	1 006 740
Scientific-research support for significant safety improvements regarding uncontrolled mine gas emissions from old workings, as a result of dealing with residual coal gas capacity and gas bearing capacity of phased out and abandoned mine sections	2 261 000	1 392 300
Total	43 054 200	**11 962 670**

Eliminating old ecological burdens in OKD, a.s.		
Decontamination and reclamation of sludge tanks – phase III., IV. and V.	260 993 363	158 608 605
Darkov land reclamation, phase I, locality C2	394 939 113	310 229 897
Expert report on the legitimacy of OKD, a.s. request for approval of Method Changes No. 3 – Křemenec	40 000	39 668
Louky land reclamation – structure 8	62 491 957	55 290 421
Reclamation of waste dump D – reclamation of waste dump D1 and D2	57 386 059	48 462 727
Expert witness verification of the accuracy in establishing the share of state and OKD funding of submitted partial projects	30 000	0
Total	775 880 492	**572 631 318**
Land development upon termination of mining		
Ostravice Dam – Hrabová km 12.05, no. st. 237	53 428 967	0
Project documents regarding land development within the scope of eliminating environmental damage upon termination of mining – executed in areas no.1 and 3 of project no. 45	1 604 400	1 543 500
František premises, phase 1	11 695 637	0
Reclamation of lands of the former František – Horní Suchá mine	79 982 231	0
Total	146 711 235	**1 543 500**
Total		**630 194 945**

Reducing impacts caused by the termination of coal mining in the Kladno Region

In the middle of 2002, the Czech Republic Government decided to phase out underground mining of bituminous coal in the Kladno Region due to the economic ineffectiveness of mining. This hasty closure of mines in this region brought about, similarly as in the preceding coal districts, the need to deal with eliminating environmental damage caused by past mining operations in a special way.

In consideration of the situation which developed in the Kladno Region, the Czech Republic Government noted the need to reduce the impacts caused by the termination of coal mining in the Kladno Region, by issuing Resolution No**. 552** on 4 June 2003, dealing with the reduction of impacts caused by the termination of coal mining in the Kladenský Region. It agreed with the idea of gradually releasing, according to the means of the National Property Fund of the Czech Republic, an amount of up to **CZK 1.177 billion** from FNM resources starting in 2004 in order to deal with ecological impacts caused by coal mining in the past and with land reclamation. Considering the shortage of funds in order to carry out the "Reclamation of the Tuchlovice Mine Waste Dump" contract, the Czech Republic Government modified the above-mentioned resolution with Resolution No. **1467** on 20 December 2006, and **agreed** with the idea of gradually releasing, according to the means of the MF, funds in the amount of up to **CZK 1.427 billion** starting in 2004 from a special account managed by the MF pursuant to article 4 of Act No. 178/2005 Coll., on the termination of the National Property Fund, in order to deal with ecological burdens caused in the past and with land reclamation.

The following projects are considered essential:

- eliminating the dangerous conditions at the V Němcích Schöeller mine waste dump
- reclamation of the Tuchlovice mine waste dump

The funds actually spent on **3** concluded projects amount to **CZK 0.360 billion** and on **1** project in progress they amount to **CZK 0.280 billion** as of the date specified**.** The remaining financial amount required to secure additional money for projects in progress amount to ca **CZK 0.782 billion** according to contracts**.**

Projects concluded (in CZK thousand)

Project name	Project costs
V Němcích Schoeller mine waste dump – eliminating dangerous conditions	210 986
Eliminating the dangerous conditions at the V Němcích Schoeller mine waste dump – stage 2, western section	106 862
Eliminating the dangerous conditions at the V Němcích Schoeller mine waste dump – additional construction work	41 947
Total	**359 795**

Projects in progress (in CZK thousand)

Project name	Project price	Project costs thus far
Reclamation of the Tuchlovice mine waste dump	1 023 419	279 872
Total	**1 023 419**	**279 872**

GEOLOGY AND MINERALS

Geological evolution of the area of the Czech Republic

Arnošt Dudek

The Czech Republic is located in the very centre of Europe at the limit between the Hercynian Meso-Europe and the Neo-Europe (Fig. 1). There is hardly any country with such a variegated geological structure in such a small area and with such a complex geological evolution. Practically all known rocks and the majority of geological formations and known types of ores and industrial minerals occur on the state territory. Even though most ore deposits are interesting mainly from a scientific and mineral collectors' point of view, a number were of European importance during the Middle Ages and the beginning of modern time. The interesting and complex history of this area attracted attention of researchers already in early times and it strongly influenced the evolution of the mining and geological sciences. It was on this territory where one of the oldest mining laws, the Jihlava Mining Law (1260), and slightly later the mining law of the King Wenceslas II "Ius regale montanorum" (1300), which became basis of many mining laws in other states of the world especially in South America, came into being. The origin of the world-known works of Georgius Agricola, especially his book "Bermannus sive de re metallica dialogus" (1530), is also linked to the territory of the Bohemian Massif.

Three main structural complexes form the geological structure of Czech territory. The oldest one, consolidated already during the Precambrian orogenies, is **Brunovistulicum**, taking basically the area of Moravia. This segment of the Earth's crust probably represents an extremity of the East European platform, even though some researchers consider it as a part of the African plate. The influence of the younger – Paleozoic and Alpine – orogenies was only minor and it served as a foreland of the nappe structures which were thrust over it. The **Hercynian-consolidated Bohemian Massif**, overlapping to the area of the neighbouring Austria, Germany and Poland in the south, west and north, forms the major part of the state territory. Bohemian Massif belongs to the Paleo-Europe. The Hercynian orogeny in the end of the Carboniferous put the finishing touches on it, even though it also contains older building elements. It already behaved as a consolidated block after the Hercynian orogeny, only sometimes flooded by epi-continental sea and affected only by fault tectonics. As a crustal block rising from young sedimentary formations, it broke up only during the younger mountain-building processes, morphologically only in the end of the Neogene and in the Quaternary. Geological continuation of the Hercynides towards the west is indicated by other crustal blocks which were created later – Schwarzwald, Vosges Mountains, the French Massif Central and Iberian Meseta, in the northern branch then the Armorican Massif and massifs in southern England and Ireland. The eastern margin of the Bohemian Massif was thrust over the Cadomian unit of the Brunovistulicum during the Hercynian orogeny. The **Outer Flysh Carpathians** – part of the Alpine-Carpathian orogeny (the Alpides), formed mainly by the Mesozoic and Tertiary mountain-building processes – extend to the eastern part of the Czech state. Horizontal nappes thrust over the Brunovistulian basement and its sedimentary cover over a distance of tens of kilometres only in the Neogene are characteristic of this unit.

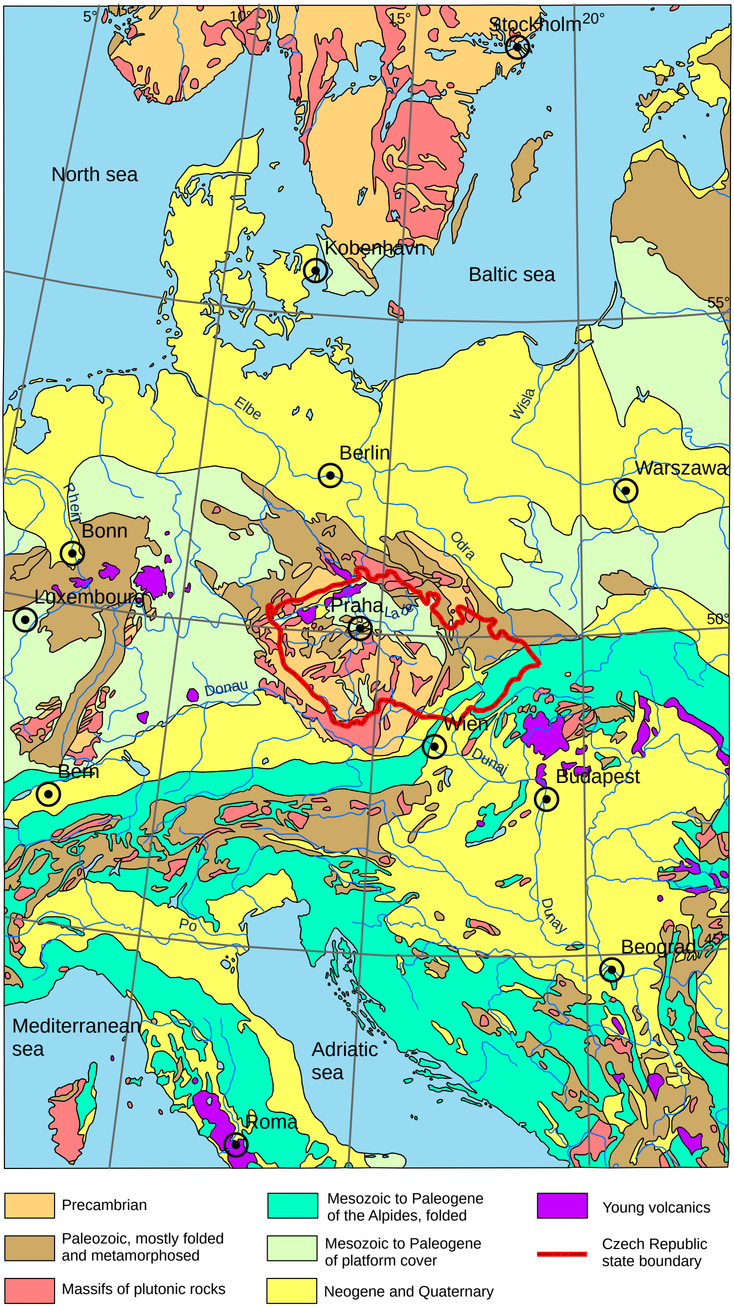


Fig. 1. Geological position of the Czech Republic in Europe

As in the study of the history of mankind, there is little information on the oldest periods of the evolution of the Earth we live on, and our findings are accompanied by a large number of uncertainties. This of course applies also for the Czech territory, even though it belongs to the areas where systematic geological research was in progress since the beginning of the 19th century.

Complexes of the **Brunovistulicum** crop out on the surface only in the western Moravia, but they reach far to the east below the overthrust nappes of the Outer Flysh Carpathians. They are formed by metamorphic rocks – mainly monotonous biotite paragneisses – which were altered during the Proterozoic orogenies, and intruded by huge massifs of abyssal magmatic rocks of about 550 Ma age at the boundary between the Proterozoic and Paleozoic. The Brno and Dyje Massifs represent the exposures of these rocks. Granitoid plutons covering large areas as well as smaller basic massifs of gabbros and norites compacted this unit and prevented its later reworking by younger mountain-building processes, which formed the Bohemian Massif. Western parts of the Brunovistulicum are built by variegated volcano-sedimentary complexes (involving limestones, graphitic rocks, quartzites, amphibolites and orthogneisses). These parts were strongly affected by the Hercynian tectonometamorphic processes. They crop out from beneath of the overthrust Hercynian complexes of the Moldanubicum and Lugicum in tectonic windows of the Dyje and Svratka Domes of the **Moravicum** and Desná Dome of the **Silesicum**. Their appurtenance to the Brunovistulicum has not been commonly accepted yet and these units are by some authors ranked to the Lower Paleozoic and to the Hercynian Bohemian Massif. Platform sediments – the Cambrian conglomerates and sandstones in limited areas, marine Silurian shales sporadically and extensive and important sediments of the Devonian, Lower Carboniferous and continental sediments of the coal-bearing Upper Carboniferous – are deposited on the Cadomian basement. The younger platform cover is represented by sediments of the Jurassic, Cretaceous, Paleogene and the Neogene of the Carpathian Foredeep. This consolidated basement was overthrust by nappes of the Outer Flysh Carpathians from the east (Fig. 2).

The lower level (basement) of the **Bohemian Massif** – the epi-Variscan platform – is built by metamorphic rocks intruded by numerous and very large granitoids massifs, and by only weakly metamorphosed or unmetamorphosed but Hercynian-folded Lower Paleozoic. Regionally it is divided (Fig. 3) into the core, formed by the highly metamorphosed **Moldanubicum** and mostly only weakly metamorphosed **Bohemicum**. This core is rimmed by the **Saxothuringicum** (Krušné hory Mts.) on the NW, **Lugicum** (Krkonoše Mts., Orlické hory Mts., Králický Sněžník) on the north and **Moravo-Silesicum** (Jeseníky Mts., eastern part of the Českomoravská vrchovina Highlands) on the east (see Fig. 3). These marginal complexes are metamorphosed mostly less intensively than the central Moldanubicum.

The ***Moldanubicum*** is formed by rocks metamorphosed mainly in the amphibolite facies – sillimanite and cordierite gneisses and migmatites with intercalations of orthogneisses, marbles, quartzites, graphitic rocks and amphibolites. Bodies of high-temperature and high-pressure metamorphic rocks – granulites and garnet peridotites with eclogites – are numerous, too. Their occurrences mark course of old tectonic zones, along which these rocks were exhumed from depth. They are exposed mainly in southern Bohemia (Blanský les, Prachatice, Křišťanov and Lišov granulite massifs) and western Moravia (Bory and Náměšť granulite massifs). The age of the protolith of Moldanubian complexes is probably Upper Proterozoic; their metamorphism under the amphibolite, granulite and eclogite facies conditions is linked to the Hercynian orogeny. Pre-Paleozoic, Cadomian metamor-

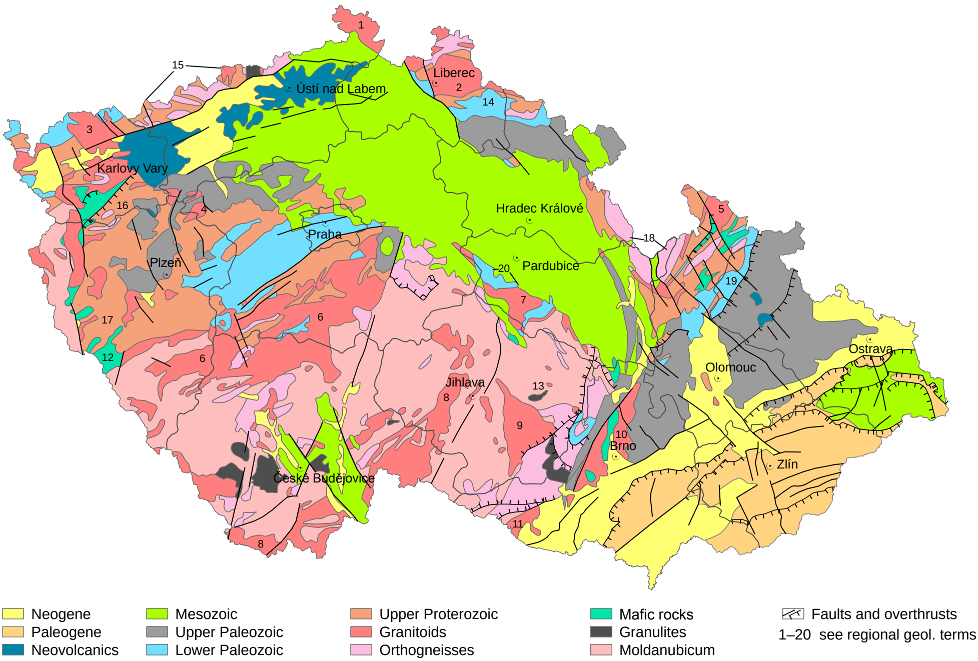
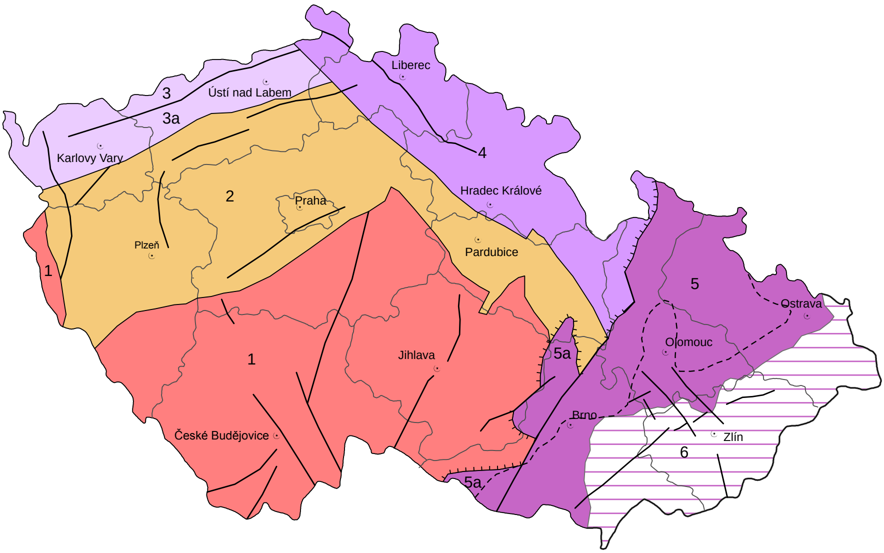


Fig. 2. Geology of the Czech Republic

phism of regional extent, mostly overprinted by the Hercynian processes, is nevertheless documented. Minor bodies of old orthogneisses exhumed along deep-reaching faults in the southern Bohemia, the radiometric age of which is even 2.1 Ga, represent a single exception. They document the existence of the Lower Proterozoic in the deeper crustal structure of the Bohemian Massif. Some Moldanubian rocks, especially gneisses, granulites and amphibolites, represent common resources of building stone.

The metamorphic rock complexes of the central Bohemian ***Bohemicum*** as well as the marginal complexes of the Saxothuringicum, Lugicum and Moravo-Silesicum developed by regional metamorphism of mainly Upper Proterozoic protoliths (1,000–545 Ma). During this period, the area of today's Bohemian Massif was covered by a deep sea, in which sandy and clayey rocks were deposited. Surrounding continents, probably rather distant in the mainland formed by very old rocks, represented the source area of the deposited material. Some clastic minerals from metamorphic rocks of the southern Bohemia (up to 2.7 Ga old, in the neighbouring Bavaria even 3.8 Ga) were at least in part derived from the Archaic of the African shield. They were of course deposited much later. The sedimentation was accompanied by submarine volcanism of tholeiitic basalts, which formed linear structures tens of kilometres long, maybe in some cases standing out above the sea level (*island arcs*) as well as much less extensive acid volcanism. The volcanic activity was accompanied by deposition of black shales with abundant pyrite and of siliceous sediments – lydites. Finely banded structures resembling organogenic stromatolites, which would belong to the oldest organic remnants on the Czech territory, were found rarely in the latter. A set of these sediments and volcanic rocks was intensively folded and mostly also metamorphosed in the end of the Proterozoic. Very weakly metamorphosed Proterozoic rocks are nowadays exposed only in central Bohemia between Prague and Plzeň (in the so-called *Barrandian*). The intensity of their alteration increases towards the marginal mountains. A continuous succession of thin metamorphic zones of Barrovian type up to gneisses with kyanite and sillimanite developed especially towards the W and SW. Proterozoic rocks are altered into gneisses and amphibolites also in the Krušné hory Mts., Krkonoše Mts., Orlické hory Mts. and Hrubý Jeseník Mts. These complexes were intruded by numerous massifs of granites (especially Stod, Čistá-Jesenice and Lužice massifs) and gabbros (Kdyně and Poběžovice massifs) in the end of the tectonometamorphic processes especially in the western and northern Bohemia. The Pre-Paleozoic ***Cadomian orogeny*** represents one of the most important magmatogennic and tectonometamorphic processes in the evolution of the Bohemian Massif.



1 – Moldanubian area (Moldanubicum), 2 – Central Bohemian area (Bohemicum), 3 – Erzgebirge area (Saxothuringicum), a – Ohře (Eger) rift, 4 – Lusatian area (Lugicum), 5 – Moravosilesian area (Moravosilesicum) including Brunovistulicum, a – Moravicum, 6 – assumed continuation of Brunovistulicum beneath the Western Carpathians. - - - - border of Western Carpathians, overthrusts and faults.

Fig. 3. Regional basement division of the Bohemian Massif on the territory of the Czech Republic

The Earth's crust in Czech territory was not completely solid after the Cadomian orogeny and it gradually broke into a number of smaller blocks, which moved away from each other and were partly flooded by sea again during the ***Lower Paleozoic*** (Cambrian, Ordovician, Silurian, Devonian to Lower Carboniferous). Unaltered sediments were preserved especially in central Bohemia, in the area between Prague and Plzeň (Pilsen), named Barrandian, to a lesser extent also in other parts of the Bohemian Massif. In its marginal parts (excluding Brunovistulicum), Paleozoic complexes experienced strong metamorphism and therefore their identification and dating is commonly very difficult. In the Barrandian, sedimentation started already in the ***Lower***

Cambrian, represented by a formation of conglomerates and sandstones up to several hundred to thousand meters thick. Sporadic occurrences of shales of fresh-water or brackish origin, in which the oldest fossils of arthropods in Bohemia were found, are known here. Sea penetrated to central Bohemia in the Middle Cambrian and deposited sandstones and especially shales, which are world-known for their occurrences of trilobite fauna. The evolution of the Cambrian was terminated by extensive rhyolites and andesite terrestrial volcanism.

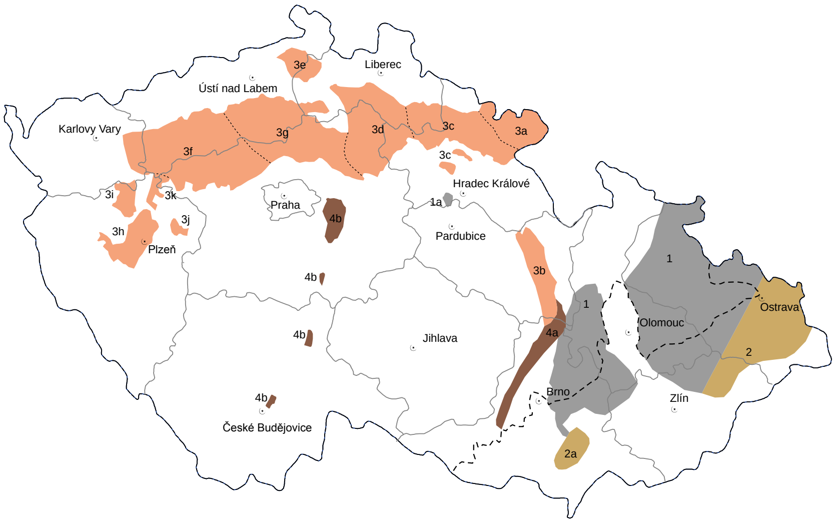
The ***Ordovician*** started by the sea again transgressing in central Bohemia and by the formation of the so-called ***Prague Basin***, the evolution of which continued until the Middle Devonian. The Ordovician rocks are represented mainly by clastic sediments, mostly various types of shales with thick quartzite intercalations), the deposition of which was accompanied by intensive basaltic volcanism. Deposits of sedimentary iron ores (e.g. Nučice, Ejpovice etc.) which were of a high importance in the 19th and beginning of the 20th century originated in relation to the volcanic activity. The Bohemian Massif was located close to the southern polar circle in the Ordovician and sedimentation of rocks as well as volcanic activity proceeded in the sub-polar climate. This crustal segment moved rather rapidly to the north, into warmer waters of the tropic of Capricorn in the end of the Ordovician.

The change of the climate and by this also conditions of development of organisms and sedimentation during the ***Silurian*** resulted in formation of fine-grained black shales with abundant graptolite fauna, accompanied also by intensive volcanic activity and intrusions of numerous diabase sills. Mass development of organisms with carbonate shells occurred in its upper parts with regard to the increasing temperature and massive limestone formations were formed.

Continuous carbonate sedimentation in the Prague Basin lasted until the ***Devonian***, whereas in the surrounding parts of Europe as well as more distant areas the rock deposition was interrupted by the ***Caledonian orogeny***. Gradual unaffected evolution of both the sediments and organisms and their long-lasting detailed study by several generations of Czech paleontologists was a prerequisite for the determination of the first, globally valid ***stratotype*** between two systems (Silurian and Devonian) in Klonk u Suchomast SW of Prague. The limestone sedimentation in the Prague Basin terminated in the Middle Devonian and sandstones with terrestrial flora ended the Devonian sedimentation in this area.

Sedimentation of the Devonian rocks continued in the Upper Devonian only in the area of the Krkonoše Mts. (on Ještěd Mt.) and especially in Moravia in the Jeseníky Mts. and in the Moravian Karst. Evolution of the Devonian in Moravia differed from that on the Bohemian territory. Transgressive complex of the siliciclastic and volcanic rocks with stratiform deposits of Fe, Cu, Au, Zn and Pb overlie the old Brunovistulian basement in its western, more mobile part. This clastic sedimentation continues also in the Lower Carboniferous. The Devonian rocks on the more stable Brunovistulian basement in the south and east begin by clastic rocks, which in places reach over 1,000 m in thickness. Limestones appear only in the Upper Devonian and their evolution continues until the Lower Carboniferous. There is therefore no manifestation that the sedimentation was interrupted by the Hercynian orogeny in Moravia. Sedimentation spaces just moved to the east to Ostrava region and to today's Carpathian basement. Limestones of the Upper Devonian form important deposits especially in central Moravia (e.g. Mokrá, Líšeň, Hranice etc.).

A change in the character of the sedimentation in the end of the Devonian is an expression of the ***Hercynian orogeny***, which affected (about 340–310 Ma ago) the majority of the Czech lands with a high intensity and expressed itself by the development of the nappe structure



1 – Marine Lower Carboniferous (Culm); a – occurrence near Hradec Králové, 2 – Upper Carboniferous of the Upper Silesian Basin; a – occurrence in South Moravia, 3 – Limnic Permo-Carboniferous; partial basins: a – Intrasudetic B.; b – Orlice B.; c – Krkonoše Piedmont B.; d – Mnichovo Hradiště B.; e – Česká Kamenice B.; f – Kladno-Rakovník B.; g – Mšeno-Roudnice B. (Mělník B.); h – Plzeň B.; i – Manětín B.; j – Radnice B.; k – Žihle B.
4 – Permo-Carboniferous of the grabens: a – Boskovice G., b – Blanice G. – – – border of the Western Carpathians, ········ boundary of basins

Fig. 4. Carboniferous and Permian in the Bohemian Massif and in the basement of the Western Carpathians on the territory of the Czech Republic

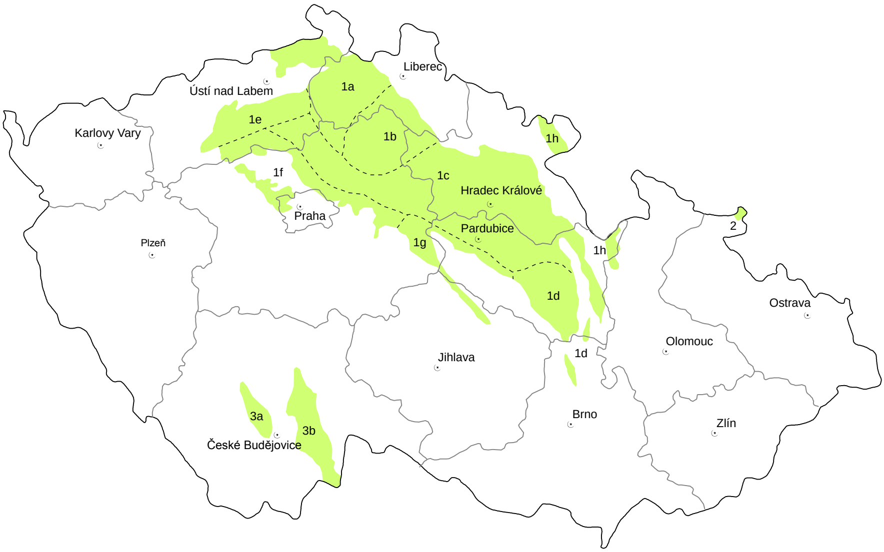
and a very strong metamorphism of large areas. Even the crystalline complexes formed during the Cadomian orogeny were metamorphosed again. Vast massifs of granitoid magmatic rocks of several thousand km^2 extent, not yet completely uncovered by denudation, formed practically simultaneously. Their intrusions were accompanied also by extensive surface volcanic activity and the development of very numerous deposits of variable genetic types (e.g. Krušné Hory Mts. massifs and Sn, W, Li, Ag, U, Co, Ni mineralization in the Saxothuringicum or Central Bohemian and Moldanubian Plutons in the Moldanubicum and Au, Sb, Ag, Pb, Zn, U mineralization). Granitoid massifs represent an important resource of building and dimension stone as well as feldspar raw materials. Weathered crusts of granitoids (e.g. Krušné hory Mts. massifs, Dyje Massif) are an important source of kaolin, too.

There are two different types of the ***Carboniferous*** and its rocks in the Bohemian Massif as a result of the Hercynian orogeny. The Lower Carboniferous is missing in Bohemia and sedimentation of the continental type begins in the intra-mountain basins only in the Upper Carboniferous (Westphalian) and continues in the Permian. Basins with partly individual evolution extend in the Plzeň (Pilsen) surroundings towards the south and southwest as far as the Broumov area in the SE tip of the Czech Republic (Fig. 4), where their stratigraphic extent is the largest and the sedimentation finishes as late as the Lower Triasic. They are to a large extent overlain by sediments of the Bohemian Cretaceous Basin. River and lake deposits – conglomerates, arkoses and shales with layers of tuffs and tuffites – are in many places accompanied also by formation of coal seams, which were and still are of a high economic importance. Some seams show an elevated U content making them even potential deposits. The Carboniferous arkoses in the Plzeň (Pilsen) and Podbořany regions gave rise to important deposits of kaolin. Carboniferous mainly refractory clay and claystone are important, too. The Bohemian Massif reached the equator on its way to the north and coal formation reflects the dominating tropical climate.

In Moravosilesian area, which was just weakly influenced by the Hercynian orogeny thanks to the solid Brunovistulian basement, the Devonian sedimentation was continuous until the Lower Carboniferous, when the formation of limestones terminated. It was followed by flyshoid sedimentation of conglomerates, greywackes and shales in multiple alternation of individual layers (Culm development). The Lower Carboniferous greywackes represent a resource of a high-quality building stone. Depositional environment gradually changed from marine to fresh-water during the Upper Carboniferous and important deposits of bituminous coal (paralic basins of the Ostrava region) formed in the coastal marshes. The Czech part of the Upper Silesian Basin represents the most important bituminous coal mining district in the Czech Republic. The Carboniferous system in the Czech Republic was and remains not only an important energy base of the state but also a world-known classical area of Carboniferous flora and fauna.

The Hercynian mountains were rapidly lowered by erosion and denudation in the ***Permian***, and thick formations of red-brown conglomerates, sandstones, arkoses and shales formed. Sedimentation was accompanied also by basaltoid volcanism of the intra-plate type and sedimentation of clastic rocks with elevated Cu content. A substantial change of climate, caused by the shift of the lithospheric plate with the Bohemian Massif further north, into the belt between the equator and tropic of Cancer, resulted in the formation of deserts, which covered most of Europe. These sediments are today preserved in the Bohemian Massif only in relics. They reach the highest thickness – up to 3 km – in tectonic troughs of roughly N-S direction, so-called grabens (Boskovice and Blanice grabens). Coal seams (today already mined out) occur locally on the basis of the Permian in these grabens and higher horizons contain restricted lake and river calcareous sediments. These are commonly overfilled by relics of stegocephalians and especially of the Permian insects, which made the Boskovice Graben famous.

The Bohemian Massif was slowly uplifted as a compact block after the Hercynian consolidation and it remained mainly land almost until the end of Mesozoic. White lake sandstones of the ***Triassic*** are represented only to minor extent in NE Bohemia in the Krkonoše Mts. Piedmont and Intra-Sudetic Basins. Sea penetrated from the Carpathian area to northern Germany by a narrow channel across northern Bohemia (roughly between Brno and Dresden) in the ***uppermost Jurassic***. This channel linked the deep Tethys on the SE with the shallow shelf sea to the north from the Bohemian Massif. Limestones (Oxfordian–Kimmeridgian) are exposed only in small islands along the Lužice Fault. Transgression of the ***Upper Cretaceous*** sea, which flooded all the northern and partly also the central part of the Bohemian Massif, was of much higher importance. Several hundreds meters thick strata of the Upper Cretaceous claystones, marlites, sandy marlites and sandstones (the Bohemian Cretaceous Basin – Fig. 5) developed there. The Bohemian Cretaceous Basin is divided into facies areas (developments) shown in Fig. 5 based on character of sedimentation in particular parts of the Basin. Rock complexes of the Basin represent the most important underground water reservoir in the Czech Republic and also an important raw material resource (ceramic and refractory clay, glass, foundry and mortar sand, cement raw materials, building and sculpture stone but also uranium). Smaller, but fresh-water Upper Cretaceous basins formed also in southern Bohemia. It is the České Budějovice Basin localized more westward and the Třeboň Basin localized more eastward.



1. Bohemian Cretaceous Basin and its facies areas (developments): a – Lužice a., b – Jizera a., c – Labe (Elbe) a., d – Orlice-Žďár a., e – Ohře (Eger) a., f – Vltava-Beroun a., g – Kolín a., h – Hejšovina and Bystřice a. 2. Cretaceous in environs of Osoblaha. 3. South Bohemian basins: a – České Budějovice b., b – Třeboň b. - - - - boundary of facies areas (developments)

Fig. 5. Upper Cretaceous in the Bohemian Massif on the territory of the Czech Republic

The evolution in Moravia was different. The Triassic is not represented at all, whereas in the ***Jurassic*** the sea penetrated from the Mediterranean area far to the NW and flooded the eastern margin of the Bohemian Massif. Jurassic sediments are nowadays to a large extent covered by rocks of the Neogene or the Outer Flysh Carpathian nappes. Tectonic blocks of the Jurassic limestones, exhumed from depth in front of the Carpathian nappes and forming isolated klippen by Štramberk and in the Pavlovské vrchy Hills, represent an important land-forming element and also an important resource of very pure carbonate raw material.

The character of the sedimentation in the Outer Carpathians markedly changed in the ***Cretaceous***. Sediments formed in deeper sea from submarine slides and turbidite currents, transporting clastic material far from the land. They are characterized by multiple alternations of sandy and clayey layers of a low thickness (dm to m) and infrequently also sandstone benches, which are collectively called **flysh**. The sediments reach even many thousand meters in thickness. The flysh sedimentation continued in this area also in the Paleogene (Fig. 6).

The Bohemian Massif remained land which was only occasionally flooded in the east by shallow epicontinental sea from the Carpathian area. Nevertheless, several depressions with intensive freshwater sedimentation were formed as a result of strong tectonic movements in the Alpine and Carpathian space in the end of the ***Paleogene and in the Neogene***. This is the area of the South Bohemian basins (the České Budějovice Basin and the Třeboň Basin) with lignite, clay and diatomite deposits and also a marked tectonic trough of the SSW-NNE direction (Ohře Rift) in north-western Bohemia, where the Krušné Hory Piedmont basins (Cheb, Sokolov, North Bohemian and Zittau) formed – see Fig. 6. Sandstones and especially clays and claystones with thick (locally up to 60 m) brown coal seams sedimented in these basins. Brown coal deposits in the North Bohemian and Sokolov basins represent the most important

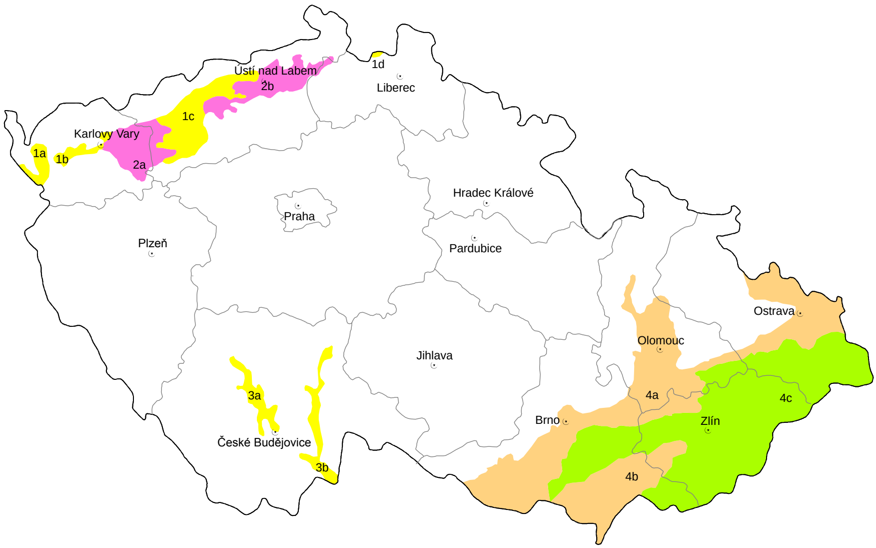
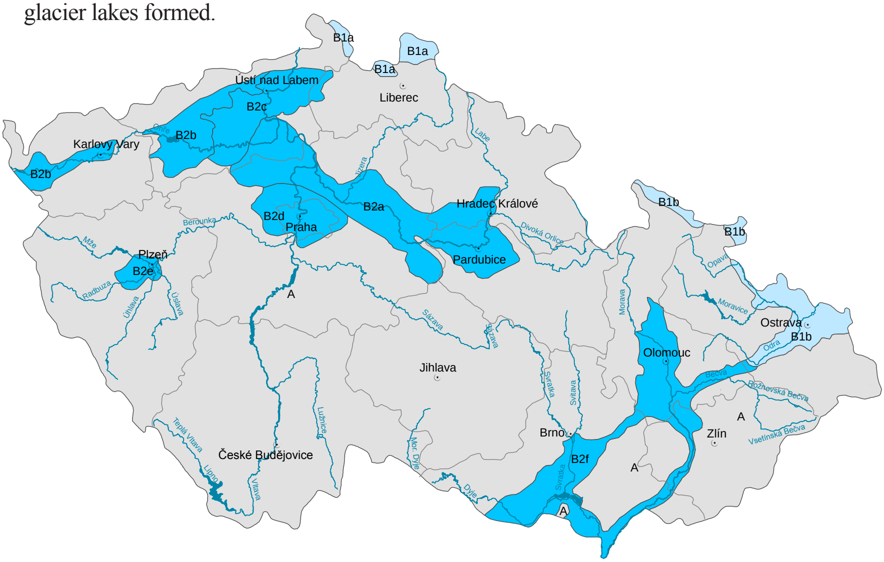


Fig. 6. Tertiary in the Bohemian Massif and Western Carpathians on the territory of the Czech Republic

brown coal deposits in the Czech Republic. Important deposits of Neogene clays then occur in the Cheb Basin. Formation of basins was accompanied by very intensive **volcanic activity** and a large accumulation of lavas and pyroclastics (the Doupovské hory Mts. Volcanic Complex, České středohoří). The rocks are mainly various types of olivine basalts and alkaline basaltic rocks, to lesser extent also more acid phonolites. Volcanic conduits and necks give today's landscape a beautiful character. The main volcanic activity took place 35–17 Ma ago, a younger phase 8 Ma ago and the last minor volcanoes are just several thousand years old (Komorní and Železná hůrka). The area represents a classical example of alkaline volcanism and it played an important role in the evolution of geosciences. The rocks are important not only as a building stone but also as a raw material for manufacture of molten basalt products. Deposits of the Bohemian garnets at the southern margin of České středohoří are related to the volcanic activity, too (pyropes were carried up by volcanic necks from the ultrabasic rocks in the crystalline basement). Weathering and decomposition of tuffs of the Doupovské hory and České středohoří Mts. resulted in the formation of important bentonite deposits.

The flysh complexes of the Carpathian area were folded and thrust in the form of nappes (verified by exploration) over a distance of several tens of kilometres towards the west and southwest over the Bohemian Massif in the end of the ***Paleogene***. The Carpathian Foredeep, partly still covered by the arriving nappes, formed in front of the thrust nappes in the ***Neogene*** (Miocene). The sediments of the Vienna Basin (of up to 5 km in thickness) were subsequently hardly folded. These are represented mainly by marine clay, marl and sand, just partially diagenetically consolidated, which contain smaller deposits of oil and gas. The depositional setting of the younger formations became progressively fresh-water. The youngest ones contain deposits of lignite.

Important tectonic processes expressing themselves by marked vertical movements of individual crustal segments operated in the Bohemian Massif in the end of the Tertiary and beginning of the Quaternary. In this way, the marginal mountains – Šumava Mts., Český les Mts., Krušné hory Mts., Krkonoše Mts., Orlické hory Mts. as well as Hrubý Jeseník Mts. – were uplifted by up to 1,000 m and the Bohemian basin was formed. This is sometimes considered as being formed by the impact of a large meteorite, but this is a nonsense resulting from the interpretation of satellite images without knowledge of the real structure of the massif. The Bohemian Massif was influenced by several phases of continental and mountain **glaciations** during the ***Quaternary***. A periglacial climate dominated here, which resulted in the formation of massive stony debris and block-seas, terrace system of the rivers (Fig. 7) as well as really extensive loesses. Terrace sediments of rivers especially form important deposits of sand and gravel and feldspar raw materials, and loesses of brick clays. The continental ice sheet reached as far as the northern margin of the massif and left sediments of frontal moraines in the Ostrava region, on the northern piedmont of the Hrubý Jeseník Mts. and in the Šluknov and Frýdlant extremities. Mountain glaciers modified morphology of the marginal mountains, especially the Krkonoše Mts., to a lesser extent also the Jeseníky Mts. and Šumava Mts., where even minor glacier lakes formed.



A – Quaternary of the denudation areas, B1 – Quaternary areas of the continental glaciation: a – North Bohemian Area, b – North Moravian Area, B2 – Quaternary of the extra glacial areas: a – Labe (Elbe) A., b – Krušné hory (Erzgebirge) piedmont basins, c – České středohoří Mts., d – Praha Plain, e – Plzeň Basin, f – Moravian dales.

Fig. 7. Quaternary division on the territory of the Czech Republic

Figures in this chapter were adapted by the author from:

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Geologie České republiky, postcard – ČGÚ;

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Zpráva Československé stratigrafické komise (1992): Regionálně geologické dělení Českého masivu na území České republiky. – Časopis min. geol., 37, 257–276, Praha.

Regional geological terms

(used in sub-chapter 2. Mineral resources of the Czech Republic)

Arnošt Dudek

Bíteš orthogneiss – mostly muscovitic orthogneiss of the Cadomian age, characteristic of the Moravicum of the Dyje and Svratka domes between Krems in Austria and Svojanov in the Czech Republic (opal, kaolin, crushed stone) – Fig. 3 – unit 5a

Blanice Graben – fault system of the NNE-SSW direction in central and southern Bohemia, marked also by downthrown islands of the uppermost Carboniferous and Permian with bituminous coal seams. It continues as Rodel line in Austria (Au-Ag-ores) – Fig. 4 – unit 4b

Bohemian Cretaceous Basin **–** sediments of the Upper Cretaceous (Cenomanian to Santonian), overlying crystalline rocks in the northern part of the Bohemian Massif. Based on the lithological character, it has been regionally classified into facial developments as follows:

- *Lužice* (U-Zr-ores, glass and foundry sand) – Fig. 5 – unit 1a
- *Jizera* (glass and foundry sand, dimension stone) – Fig. 5 – unit 1b
- *Orlice-Žďár* (foundry sand) and its *east Bohemian* (clays) and *Moravian parts* (clay) Fig. 5 – unit 1d
- *Ohře (Eger)* – the Most, Teplice (quartzite, corrective additives for cement production) and Louny part (clay) Fig. 5 – unit 1e
- *Vltava-Beroun* including Prague surroundings (clay, dimension stone) Fig. 5 – unit 1f

Boskovice Graben – tectonic trench of the NNE-SSW direction in western Moravia filled with sediments of the uppermost Carboniferous and Permian (bituminous coal) Fig. 4 – unit 4a

Bory granulite massif – a small granulite body in the Moldanubicum N of Velké Meziříčí in western Moravia (feldspar, crushed stone) – Fig. 4 – unit 4a

Brno Massif **–** a large massif in western Moravia built by a variable series of both acid and basic plutonic rocks of the Cadomian age (feldspar, crushed stone) – Fig. 2 – unit 10

Carpathian Flysh – a part of the Outer Carpathians in eastern Moravia built by clayey and sandy Cretaceous and Paleogene sediments, with a marked nappe structure of the pre-Miocene age. It composes the Chřiby Mts. and the Ždánice Forest and mountain ranges on the border with Slovakia – the Beskydy, Javorníky and Bílé Karpaty Mts. (natural gas) – Fig. 6 – unit 4c

Carpathian Foredeep – the external part of the Carpathian mountain chain in eastern Moravia, which was formed in front of the Outer Carpathian nappes and overlies the south-eastern slope of the Bohemian Massif. It is filled with the Miocene sediments of the Egerian to Badenian (oil, natural gas, clay, bentonite, gypsum in the Opava Basin) – Fig. 6 – unit 4a

Central Bohemian Pluton – an extensive Hercynian granitoids pluton on the border between Bohemicum and Moldanubicum, more basic than the massifs of the Krušné hory Mts. and in Českomoravská vrchovina Highlands (granodiorites, tonalite, diorite). Important deposits in the exocontact (U, Au, Ag-Pb-Zn-ores, feldspar, quartz, dimension and building stone) – Fig. 2 – unit 6

Cheb Basin – the westernmost of the Tertiary basins, at the crossing of the Ohře rift and the Tachov Graben. Sedimentation continued until Pliocene (brown coal, kaolin, clay, diatomite, glass and foundry sand – numerous conflicts of interest) – Fig. 6 – unit 1a

České Budějovice Basin – a smaller, western subbasin of South Bohemian basin, filled with fresh-water sediments of the Upper Cretaceous and to a minor extent Neogene and Quaternary. Episodic ingressions of the sea from the Alpine foredeep (lignite, tectites, diatomite, sand and gravel) – Fig. 6 – unit 3a

České středohoří Mts. – a classical area of the Tertiary alkaline volcanic rocks (olivine basalts to phonolites) exposed in the Ohře (Eger) rift between Chomutov and Nový Bor, with the main volcanic centre in Roztoky nad Labem (pyrope, diatomite, feldspar substitutes, crushed stone) – Fig. 6 – unit 2b

Čistá-Jesenice Massif – a minor granitoid massif in western Bohemia composed of both Cadomian and Hercynian bodies. It is covered from a large part by Carboniferous and Permian sediments (feldspar, dimension and building stone) – Fig. 2 – unit 4

Domažlice Crystalline Complex – south-western part of the upper Proterozoic of the Bohemicum in the Šumava piedmont, metamorphosed during both Cadomian and Hercynian orogeny, with minor massifs of granitoids and gabbroic rocks and abundant pegmatites (feldspar) – Fig. 2 - unit 17

Doupov Mts. – a volcanic complex of the Tertiary age at the crossing of the Ohře rift with the Jáchymov fault, between Karlovy Vary and Kadaň. Alkaline volcanic rocks are represented mainly by olivine basalt, "leucitic" tephrite and abundant tuffs. Phonolites are missing (bentonite, crushed stone) – Fig. 6 – unit 2a

Dyje Massif – a massif of the Cadomian granitoids in the Dyje Dome of the Moravicum in SW Moravia, extending from the northern vicinity of Znojmo almost to Danube. It was affected by a strong tropical weathering in the Jurassic and Neogene and from a large part covered by sediments of the Carpathian foredeep (kaolin, feldspar, building stone) – Fig. 2 – unit 11

Hroznětín Basin – the northern extremity of the Sokolov Basin N of Karlovy Vary (bentonite) – Fig. 6 – unit 1b

Intra-Sudetic Basin – Permocarboniferous basin in the NW tip of Bohemia with sedimentary fill from the Lower Carboniferous to Upper Cretaceous about 3,000 meters in thickness and Permian volcanites. Southern extremity of the Lower Silesian Basin (bituminous coal) Fig. 4 – unit 3a

Islet zone of the Central Bohemian Pluton – a number of both large and minor blocks of the contact metamorphosed Proterozoic and Lower Paleozoic rocks from the mantle of the pluton, downthrown into granitoids (Au, building stone, barite, limestone) – Fig. 2 – unit 6

Jílové Belt – a belt of the Upper Proterozoic volcanic (basalt, andesite, boninite and rhyolites), subvolcanic and acid plutonic rocks extending over 120 km in NNE-SSW direction south of Prague, from a major part enclosed in granitoids of the Central Bohemian Pluton (Au-ores, building stone) – Fig. 2 – unit 6

Kdyně Massif – a complex of metabasic, gabbroic and dioritic rocks in the Domažlice Crystalline Complex on the border of Šumava and Bohemian Forest (dimension and building stone) – Fig. 2 – unit 12

Kladno-Rakovník Basin – one of the basins of the Central Bohemian limnic Permocarboniferous, partly covered by Cretaceous sediments (bituminous coal, kaolin, claystone) – Fig. 2 – unit 12

Krkonoše-Jizera Crystalline Complex – western part of the Lužice area built by metamorphic rocks of the Proterozoic and Lower Paleozoic age (limestone, dolomite) and intruded by plutons of the Cadomian (Lužice) and Hercynian (Krkonoše-Jizera) age (feldspar, dimension and building stone). Fe-bearing skarns, Sn and W-ores, fluorite and barite occur in the exocontact of the plutons – Fig. 2 – unit 14

Krkonoše-Jizera Massif – Hercynian granitoid massif building the border range with Poland (excellent dimension stone, feldspar) – Fig. 2 – unit 2

Krkonoše Mts. piedmont basin – one of the Central Bohemian Permocarboniferous basins partially covered with Cretaceous sediments. Formations encompass whole Permian and extend up to the lowermost Trias (Cu-ores, Au paleoplacers, bituminous coal, pyrope) – Fig. 4 – unit 3c

Krušné hory Mts. Piedmont basins – a group of limnic Tertiary basins associated with the Ohře Rift SE of the Krušné hory Mts. From WSW to ESE, these are: Cheb, Sokolov, north Bohemian and Zittau basins. – Fig. 6 – unit 1

Krušné hory Mts. Pluton – a large Hercynian granitoid pluton underlying metamorphic rocks of the Krušné Hory and Smrčiny Mts., exposed by erosion only in numerous partial massifs (Sn-W-ores, kaolin, feldspar, quartz, building stone) – Fig. 2 – unit 3

Krušné hory Mts. Crystalline Complex – a part of the Saxothuringicum built by metamorphic complexes mostly of the Proterozoic, subordinately also of the Lower Paleozoic age (U, Ag, Bi, Co, As-ores, Cu-ores, Sn-skarns, fluorite, barite, kaolin) and intruded by Hercynian granitoids. – Fig. 3 – unit 3 (Fig. 2 – unit 15)

Lužice Massif – an extensive Cadomian granitoids massif predominantly on the German territory, extending into the Jizera Mts. (quartz, dimension and building stone) – Fig. 2 – unit 1

Moldanubian Pluton – the largest Hercynian granitoids complex in the Bohemian Massif in Českomoravská vrchovina Highlands, Šumava and Waldviertel (dimension and building stone; Au-W and U-ores and Ag-Pb-Zn-ores in the exocontact) – Fig. 2 – unit 8

Moravian-Silesian Devonian – weakly metamorphosed volcano-sedimentary unites in the Jeseníky Mts. – *Vrbno Strata, Šternberk-Benešov Belt* (Fe-ores, Cu-ores, Pb-Zn-ores, barite, quartzite, dolomite) – Fig. 2 – unit 19

Moravian-Silesian Carboniferous – marine flyshoid Lower Carboniferous of the Nízký Jeseník Mts. and Drahany Highlands (slate, quartz) and paralic to limnic Upper Carboniferous of the Ostrava region (Upper Silesian Basin – bituminous coal, natural gas) – Fig. 4 – unit 1, 2

Mšeno-Roudnice Basin – one of the Central Bohemian Permocarboniferous basins, completely overlain by the Bohemian Cretaceous Basin (bituminous coal) – Fig. 4 – unit 3g

Nasavrky Massif – a minor however very complex Hercynian granitoid body exposed in the Železné hory Mts. (pyrite, dimension and building stone; fluorite and barite in the exocontact) – Fig. 2 – unit 7

North Bohemian Basin – the largest Tertiary basin of the Ohře Rift between the Doupov Mts. and České středohoří Mts. (brown coal, clay, bentonite, diatomite, quartzite) – Fig. 6 – unit 1c

Ohře rift – a prominent fault structure in the south-eastern piedmont of the Krušné hory Mts. and Litoměřice Fault, delimited by the Krušné hory and Litoměřice faults and their directional continuations. Tertiary alkaline volcanites, coal-bearing basins and mineral as well as thermal waters are associated with the rift – Fig. 3 – unit 3a

Orlické hory Mts.-Kłodzko Crystalline Complex – metamorphic complexes of probably Proterozoic age in the eastern part of the Lužice area in the Orlické hory and Rychleby Mts. and in Kłodzko - Fig. 2 – unit 18

Outer klippen zone of the Western Carpathians – extensive fragments of Jurassic and Cretaceous sediments brought up from depth in front of the flysh nappes – Štramberk, Pavlovské vrchy (limestone) – Fig. 2 and 6 – unit 4c

Plzeň Basin – an independent basin at the SW margin of the Central Bohemian Permocarboniferous (bituminous coal, kaolin, clay) – Fig. 4 – unit 3a

Quaternary alluvia – alluvia and terraces of majority of larger water courses (feldspar, sand and gravel, in south Bohemia and SW Moravia also tectites) – Fig. 7 – units B2a, B2b, B2f

Quaternary placers – in piedmont of the Šumava and Jeseníky Mts. (Au), Krušné Hory Mts. (Sn), southern piedmont of the České středohoří Mts. (pyrope)

Sokolov Basin – the smallest Tertiary basin of the Ohře Rift WSW of the Doupov Mts. with important deposits of energy minerals (brown coal, U, clay, bentonite) – Fig. 6 – unit 1b

South Bohemian Basins – freshwater sedimentation space of the Upper Cretaceous and Tertiary age, where the Rudolfov horst separates the smaller České Budějovice Basin in the west from the larger Třeboň Basin in the east – Fig. 6 – unit 3

Svratka Dome of the Moravicum – the northern of the domes built by metamorphic rocks of the Moravicum W of Brno (graphite, feldspar, limestone, building stone) – Fig. 3 – unit 5a

Syrovice-Ivaň terrace – a higher located Quaternary terrace between the Jihlava and Svratka rivers S of Brno (feldspar) – Fig. 7 – unit B2f

Teplá Crystalline Complex – the NW part of the Proterozoic of the Central Bohemian area (Bohemicum) with a rapid succession of metamorphic zones from SE to NW into the Slavkov les Forest (feldspar) – Fig. 2 – unit 16

Tertiary relics of the Plzeň region – relics of the formerly more extensive Tertiary sediments on the site of a river paleostream discharging into the North Bohemian Basin (clay, bentonite) – not shown on scale of the maps

Třebíč Massif – an extensive massif of the Hercynian melanocratic granitoids and syenitoids (durbachites) in the Českomoravská vrchovina Highlands (amethyst, morion, feldspar, dimension stone) – Fig. 2 – unit 9

Třeboň Basin – a larger, eastern subbasin of South Bohemian basin with continental Cretaceous and Teriary sediments (kaolin, clay, bentonite, diatomite) – Fig. 6 – unit 3b

Upper Silesian Basin – an Upper Carboniferous basin situated predominantly in Poland and extending to the Czech Republic only by its SW part. It is formed by volcanoclastic sediments with numerous bituminous coal seams. On the Czech territory, it is further subdivided into i) western, more mobile paralic Ostrava part, ii) eastern, platform limnic Karviná part and iii) southern Beskydy part (bituminous coal, natural gas) – Fig. 4 – unit 2

Variegated Group of the Moldanubicum – metamorphic complexes of paragneisses and migmatites with numerous intercalations of amphibolites, marbles, quartzites, graphitic rocks and skarns (Fe-skarns, graphite, feldspar, limestone, dolomite, fluorite, building stone) – part of the Modanubian unit, in Fig. 2 (and 3)

Vienna Basin – an extensive Tertiary Neogene basin with marine sedimentary fill gradually becoming freshwater, of more than 5,000 m in thickness (lignite, oil, natural gas) – Fig. 6 – unit 4b

Železné hory Mts. area – part of Bohemicum built by weakly metamorphosed volcanosedimentary series of the Upper Proterozoic and sediments of the Lower Paleozoic (Mn-Fe-carbonates, pyrite, fluorite, barite, limestone) and the Hercynian granitoid Nasavrky Massif – Fig. 2 – unit 20

Zittau Basin – a Tertiary basin in the continuation of the Ohře Rift, extending only by a negligible south-eastern extremity into the Czech territory (brown coal, lignite, clay) – Fig. 6 – unit 1d

Žulová Massif – a minor Hercynian granitoid massif in the northern tip of the Moravian-Silesian area (kaolin, quartz, dimension and building stone) – Fig. 2 – unit 5

ENERGY MINERALS
– geological reserves and mine production

Significant geological reserves of energy minerals on the territory of the Czech Republic can be found only for uranium ores, bituminous (hard) coal and brown coal (subbituminous coal or lignite). Geological reserves of these raw materials take a share of the order of some percent in the world resources. Brown coal deposits are concentrated in the Krušné Hory Mts. Piedmont Basins. About 60 % of domestic electric energy and heat (heating plant) production is covered by coal from these basins. All the bituminous coal mining is at present concentrated in the Czech part of the Upper Silesian Basin. At still increasing world prices of uranium, the Czech territory is perspective also as resources of these energy mineral concerns. Prospective use of these resources can be however complicated and limited, first of all due to conflicts of interest with the environment protection.

Coal production started to thrive on the Czech territory in the 19th century in the beginning of the industrial revolution. After the World War II, uranium ore mining developed. Production of energy minerals as a whole reached its peak in the second half of the 1980' and after that a recession came connected with the decline of U-ore and all kinds of coal mining. Out of mineral fuels, the quickest decline affected the uranium ore mining; however, this process has been re-valuated with regard to the marked increase of uranium world prices. State subventions for closure programs directed towards social costs, technical liquidations, health and safety activities (maintenance) and reclamation in 1990–2007 are the object of the chapter *Eliminating negative consequences of mining in the Czech Republic – main methods and financial resources* in this yearbook.

In the past, all uranium needs of the Czech Republic were covered from domestic production. This coverage from domestic sources has been continuously decreasing to the level of about one third of the total needs in 2007. The Czech Republic's needs for coal are totally met from domestic production, and bituminous coal is also exported, but nearly all the oil and gas needed is imported. The world prices of crude oil and natural gas started to increase significantly in 2000. The Czech Republic then purchased both strategic raw materials for CZK 82.3 billion (in 1999 it was only 41 billion). This amount represented 90 % of all finances used for purchase of primary mineral raw materials. High sums were paid for purchase of crude oil and natural gas in 2001 (more than CZK 86 billion), 2002 (67 billion), 2003 (72 billion), 2004 (74 billion) and 2005 (116 billion). CZK 142 billion in 2006 represented twice as much than in 2003 at comparable volume. This enormous charge of Czech foreign trade balance was slightly anually lowered to CZK 122 billion in 2007.

Also other energy minerals i.e. all other coal types show an important increase of the world prices. Increase of uranium prices is, however, enormous. Its price has been rapidly increasing since a long period of stability until the year 2003 and it reached already multiple of the starting value from the end of 2003. During 2007 it came to a slight price correction, the price seeked for balanced position at levels around USD 60/lb in the closing date of this publication.

Mining of energy minerals

Raw material	Unit	2003	2004	2005	2006	2007
Uranium	t U	458	435	420	383	322
Bituminous coal	kt	13 382	14 648	12 778	13 017	12 462
Brown coal	kt	49 920	47 840	48 658	48 915	49 134
Lignite	kt	470	450	467	459	437
Crude oil	kt	310	299	306	259	240
Natural gas	mill m^3	131	175	356	148	148

Lifetime of industrial reserves

(economic explored disposable reserves) and so-called exploitable (recoverable) reserves, after the decrease of reserves by production incl. losses of registered deposits per year 2007 (A) and as the average annual decrement of reserves in period 2003–2007 (B) was as follows:

Raw material	Lifetime – A (years)		Lifetime – B (years)	
Reserves	industrial	exploitable	industrial	exploitable
Uranium ore	12	2	13	2
Bituminous coal	62	9	67	10
Brown coal [a)]	28	18	28	18
Brown coal [b)]	45	–	45	–
Lignite [c)]	> 100	3	> 100	2
Crude oil	61	7	52	6
Natural gas	16	> 100	13	> 100

a) except reserves blocked by territorial limits
b) including reserves blocked by territorial limits (partly even potentially economic)
c) (Czech) variety of brown coal with the lowest degree of coalification

1. Characteristics and use

Uranium, with its average abundance in the Earth's crust of about 2.7 ppm, is rather common element like tin or zinc. Some rocks such as granites or shales contain concentrations substantially higher – from 5 to 25 ppm. Natural uranium has a lithophile character and it occurs in form of oxides and other compounds. It is a mixture of three isotopes: 99.2836 % of ^{238}U, 0.711 % of ^{235}U and 0.0054% of ^{234}U. Natural uranium has to be enriched, which means that contents of ^{235}U, which is in contrast to ^{238}U fissionable, has to be increased for most of the industrial purposes. Fuel for majority of commercial nuclear reactors contains 3–5 % of ^{235}U (LEU), for nuclear weapons over 90 % (HEU). On the contrary, depleted uranium (DU), i.e. U with reduced proportion of ^{235}U, mostly below 0.3 %, is suitable for other use (e.g. conventional weapons).

The uranium ores of various genetic types represent raw material for fuel production in the nuclear power plants. Uranium is present in several tens of minerals (exclusively oxygen-bearing compounds), economically most important of which are oxides (uraninite – pitchblende), phosphates (torbernite, autunite), silicates (coffinite, uranophane), titanates (brannerite, davidite), vanadates (carnotite) and organic compounds (anthraxolite).

IAEA distinguishes 15 main categories of uranium deposits according to the geological position. Unconformity-related (the most important Canadian deposits, e.g. McArthur River), sandstone-hosted (majority of deposits in Kazakhstan and the USA), of breccia complexes (Olympic Dam), volcanogenic (Krasnokamensk) and intrusive (Rössing) deposit types are of the highest economic importance. The mined grades vary strongly depending on the deposit type, amount of reserves and way of mining. Average U contents range usually between 0.05 and 0.4 %. Extremely rich "unconformity" type deposits, where average grade reaches even several per cent (even 20 %), represent an exception.

Products of U-ore processing are chemical concentrates containing 72–86 weight percent of uranium. World Identified Resources of U in ores (primary resources) consist of Reasonably Assured Resources (RAR) and Inferred Resources (IR). These are reported as amounting at 3.8 to 5.1 mill t (according to WNA and IAEA) (5.47 mill t according to the Red Book 2007) recoverable at costs ≤ USD 80/kg U to ≤ USD 130/kg U, respectively. The largest resources are concentrated in Australia (above 24 %), Kazakhstan (17 %), Canada (9 %), South Africa and the USA (7 % each), further in Namibia and Brazil (6 % each), Niger (almost 5 %), Russia (almost 4 %) and Uzbekistan (above 2 %).

History of uranium utilization started only about 150 years ago, when small quantities of uranium compounds were used in dyes for ceramics and glass production. Main demand started at the end of World War II for military purposes, which was replaced by energetic use (1 tonne of uranium can produce 40 gigawatt-hours of electric energy. This is comparable with burning of 16 thousand tonnes of coal or 80 thousand barrels of oil) in the late 60s. All this history can be tracked today via inventories of depleted uranium from the enrichment process (uranium missing a substantial part of isotope ^{235}U). Approximately 2.3 million tonnes of uranium have been mined worldwide since 1945 for all uses. The main usage of uranium is in power reactors, much less in research reactors (and e.g., for preparation of radioisotopes for medicine and detectors), as fuel in nuclear propulsion in navy, icebreakers, submarines; depleted uranium is used in shielding, counterweights (boats, planes) and special ammunition manufacture. Negligible quantities of uranium salts are used for colouring stained glass. A lot of extracted and enriched uranium is still stored as nuclear weapon charges.

2. Mineral resources of the Czech Republic

Czech Republic belonged to the most important uranium world producers. Historically it occupies 9th position in the world with total production of over 110 thousand tonnes of uranium in the years 1946–2007 in form of sorted ores and chemical concentrate. The main period of uranium mining in the Czech Republic lasted from the late 1940s to the beginning of 1990s, when the mining of all to day mined vein deposits (except the Rožná deposit) was terminated. Mining at the Hamr deposit was terminated in 1995 and at the Stráž deposit a year later, by which also the sandstone type deposit mining was terminated. Annual mine production of uranium amounted at 2,000–2,900 t (max. slightly above 3,000 t in 1960) in the period of the highest mining boom (1955–1990). Czech Republic now occupies 12th or 13th position with actual production of about 320 t per year, which represents less than 1 % share of the world production.

Exploitable uranium deposits were found both in the crystalline basement and in the cover formations of the Bohemian Massif. Two major periods of the formation of uranium accumulations can be distinguished: Late Variscan and Alpine.

Practically only two types of deposits according to the IAEA classification occurred on the Czech territory – the vein type (meant including the "zone" ones) and the sandstone type. Hydrothermal vein deposits (veins in metamorphic rocks, zone deposits in metamorphic rocks and along big dislocations in granitoids) were of the highest importance as the metal production concerns. Total mine production of U metal from these deposit types reached almost 80 kt. Deposits of uranium-bearing sandstones of the Bohemian Cretaceous Basin with 29.5 kt of U in total occupy the second position. Remaining almost 0.9 kt of U comes from deposits in Carboniferous to Permian and Tertiary sediments (mainly of coal and lignite type, respectively, according to IEAE classification). Major part of the exploited uranium – about 85 % – was mined by the classic underground mining. Underground leaching from boreholes (in-situ leaching, ISL), which produced almost 15 % of uranium, represented an important mining method, too. Open-pit mining produced only about 400 t of uranium, which represents about 0.3 % of the total amount.

Vein uranium deposit type in the Czech Republic was divided into 3 subtypes:

- Veins and vein systems of hydrothermal origin in metamorphic rocks. Predominant uraninite – pitchblende mineralization is very inhomogeneous, contrasting and it is spatially and genetically associated with Variscan granitoid massifs. Usually steeply dipping ore bodies (veins) have several cm to 1 m in thickness, rarely more. U content in these deposits was mostly from 0.1 to 0.X %, exceptionally up to about 1 %. To this type belonged the largest Czech and one of the largest world hydrothermal vein deposits Příbram, and other formerly important deposits of Jáchymov, Horní Slavkov and some smaller deposits, e.g. Licoměřice-Březinka, Zálesí u Javorníka, Přebořice, Chotěboř, Slavkovice, Lázně Kynžvart-Kladská, Planá u Mariánských Lázní-Svatá Anna et al.
- Graphitised and chloritised or solely chloritised ore-bearing crushed zones in metamorphic rocks with diffuse boundaries of mainly steep dip. The mineralization is irregularly

distributed, mainly disseminated, with main minerals uraninite, coffinite and brannerite. Tabular ore bodies are X m to 10 m thick. U contents were between 0.09 and 0.3 %. The only still mined deposit Rožná, and also Zadní Chodov, Olší, Dyleň, Okrouhlá Radouň, Jasenice-Pucov et al. belong to this type.

- Metasomatic mineralization associated with chloritized tectonic zones in Variscan granitoids predominantly with uraninite-coffinite-brannerite mineralization. This mineralization is relatively uniform and forms mostly steeply-dipping pipe-like or lenticular ore bodies. Uranium content in deposits was mainly between 0.07–0.13 % (Vítkov 2, Lhota u Tachova, Nahošín).

Deposits of uranium-bearing sandstones:

- Predominantly stratabound mineralization in the Cretaceous sediments – ore bodies formed mainly by uraninite and U-blacks, locally with zircon, confined to the water-bearing Cenomanian sediments of the Laussicum development of the Bohemian Cretaceous Basin. Ore bodies are flat-lying or subhorizontal, and they have stratabound, tabular, less often lenticular shape with thickness from several decimetres to several meters. Mineralization makes part of the matrix and it is relatively uniformly disseminated. Uranium content in deposits varies in average from 0.03 % up to 0.14 %. Deposits in Stráž pod Ralskem surroundings, where both classical underground mining (e.g. Hamr, Křižany, Břevniště) and ore leaching from boreholes (Stráž) took place, were of crucial importance. Other explored deposits (Osečná-Kotel) and prognostic resources (Hvězdov, Mimoň, Heřmánky and others) have not been mined yet. More than 98 % of registered reserves in the Czech Republic (mostly potentially economic, i.e. irrecoverable resources in fact) are associated with this type of deposits. Uranium reserves (resources, better said) would be recoverable (economically) mainly by in situ leaching (ISL or ISR – in situ recovery), however, this is excluded now for ecological reasons. If uranium prices held their present level in the long term, respectively over USD 100 per lb U_3O_8, then even conventional underground mining would not be entirely excluded in terms of economy.

Other deposits:

- Stratabound mineralization confined to the Late Paleozoic sediments, formed by uranium-bearing coal seams and surrounding rocks of the Upper Carboniferous and Lower Permian in the Intra-Sudetic Basin (e.g. Radvanice, Rybníček, Svatoňovice) and Kladno-Rakovník Basin (Jedomělice, Rynholec). Mineralization of mainly uraninite was in form of small moderately dipping irregular lenses, resp. slabs of maximum thickness in decimeters. Average U contents in the deposits ranged between 0.1 and 0.3 %.
- Stratabound mineralization in the eastern part of the Sokolov Basin (e.g. Mezirolí, Podlesí) and its Hroznětín part (e.g. Hájek, Ruprechtov, Hroznětín). Irregular mineralization in sediments enriched in organic material (including coal), formed mainly by uranium blacks, had usually a shape of smaller slabs and lenses from tens cm to several meters in thickness. U content was between 0.1 and 0.2 % on average.

Deposits of economic importance, which were intensively exploited especially in the past, are concentrated into five regions. Their list with type of mineralization and the most important deposits is given below. The regions are ordered according to their importance, given by the amount of the obtained uranium. The share of the individual region on bulk mining production in per cent is given in parentheses.

- Central Bohemian region – mineralization of the vein type: e.g. Příbram, Předbořice (almost 40 % of the total U mine production)
- North Bohemian region – mineralization in the Cretaceous sediments: e. g. Stráž pod Ralskem, Hamr, Břevniště (more than 23 %)
- Moravian region – mineralized fracture zones and hydrothermal veins – Rožná, Olší (about 17 %)
- West Bohemian region – mineralization of the zone and vein type: e.g. Zadní Chodov, Vítkov 2, Horní Slavkov, Dyleň (10 %)
- Krušné hory Mts. region – vein deposits and mineralization in Tertiary sediments: e.g. Jáchymov, Hájek (less than 7 %).

Other small deposits and occurrences scattered in remaining parts of the Bohemian Massif such as in Železné hory Mts., Rychlebské hory Mts., Krkonoše Mts., and Okrouhlá Radouň deposit contributed by remaining 3 % to the total post-World War II production of 110,150 t U.

Two registered uranium ore deposits produced uranium in concentrate in 2007.

Only one of them was mined – deposit of the zone type Rožná. The other one – Stráž pod Ralskem in the Bohemian Cretaceous Basin – produced uranium within the frame of liquidation works. At the Rožná, underground mining took place (average grade 0.2–0.3 % U in economic reserves). The Stráž deposit (average grade 0.03 % U in economic reserves) has been exploited by means of in situ leaching till April 1, 1996. Since this date, uranium has been recovered as a byproduct from the treatment of underground waters and technological solutions within the scope of mine liquidation and reclamation work. However, the trend has been decreasing from 150 tonnes of U per year to the current amount of less than 40 tonnes.

All extracted ore was chemically processed to provide chemical concentrate (yellow cake). It was exported for further processing (conversion and enrichment) abroad. The main portion of domestic production was purchased by the Czech energy enterprise ČEZ, a. s. in the last 15 years. The present consumption of uranium in the nuclear power plants (NPP) Dukovany and Temelín is about 690 t U per year. The surplus of production from the beginning of the 1990's was deposited in the State Material Reserves and after 2002 more than 2,300 tonnes was sold in the world market.

Tailing pond in Stráž pod Ralskem, where waste from leaching of the deposit containing 0.030–0.063 % of rare earths accumulated for 30 years, is a potential source not only of rare earths (lanthanum–gadolinium) but also of scandium, yttrium, niobium, zirconium and hafnium. With an exception of Zr, reserves of these metals have not been evaluated yet.

3. Registered deposits and other resources in the Czech Republic

(see map)

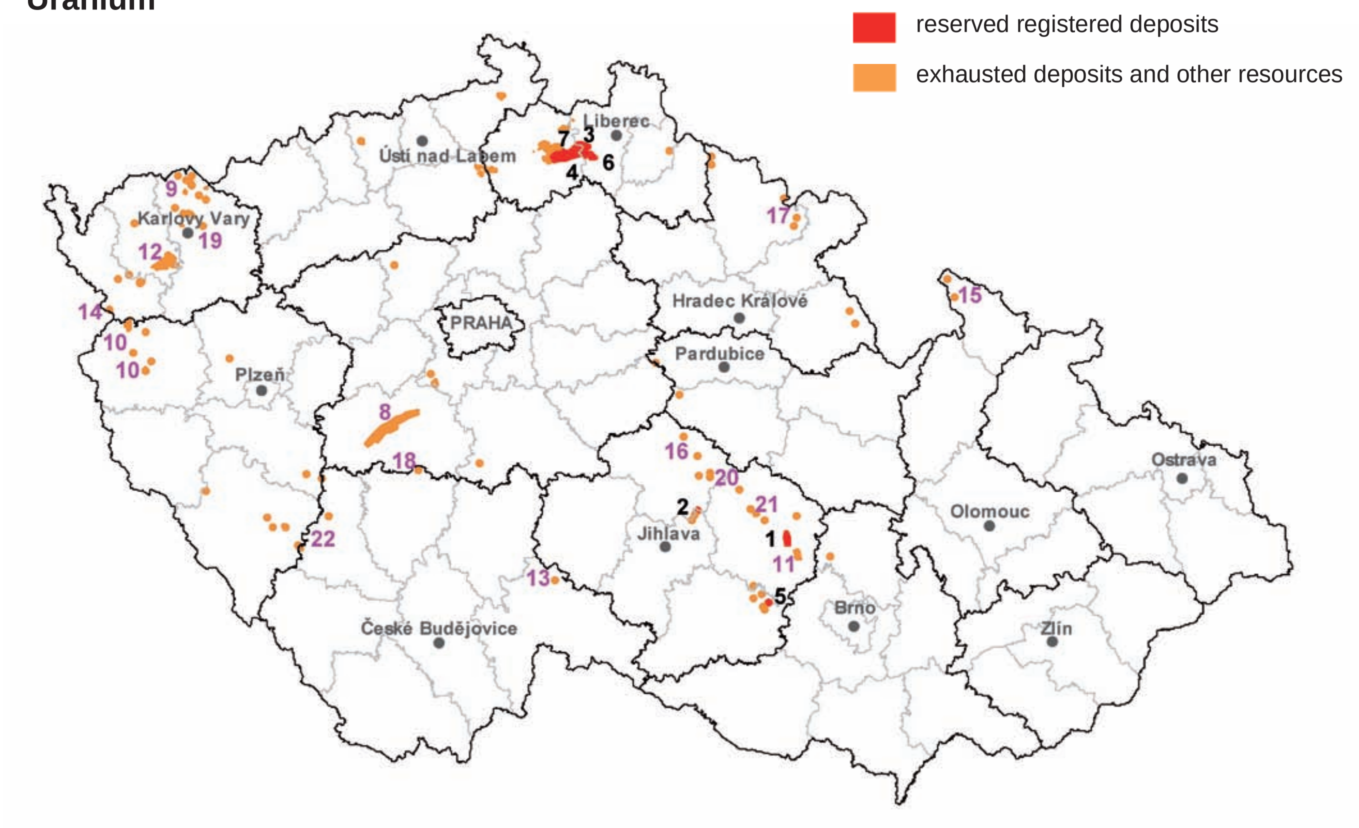
Reserved registered deposits

(Names of mined deposits are indicated in **bold type**)

1 **Rožná**	3 Břevniště pod Ralskem	5 Jasenice-Pucov	7 Stráž pod Ralskem*
2 Brzkov	4 Hamr pod Ralskem	6 Osečná-Kotel	

* uranium is extracted only as secondary effect of underground waters and technological solutions treatment within the framework of mine liquidation and reclamation works after in situ leaching (ISL) of uranium ores

Uranium



reserved registered deposits
exhausted deposits and other resources
Liberec
Ústí nad Labem
Karlovy Vary
PRAHA
Hradec Králové
Pardubice
Plzeň
Jihlava
České Budějovice
Brno
Olomouc
Ostrava
Zlín
1
2
3
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Exhausted deposits and other resources

8 Příbram	13 Okrouhlá Radouň	18 Předbořice
9 Jáchymov	14 Dyleň	19 Hájek + Ruprechtov
10 Zadní Chodov + Vítkov 2	15 Javorník	20 Chotěboř
11 Olší	16 Licoměřice-Březinka	21 Slavkovice
12 Horní Slavkov	17 Radvanice + Rybníček + Svatoňovice	22 Mečichov-Nahošín

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	7	7	7	7	7
exploited	1	1	1	1	1
Total mineral * reserves, t U	136 409	136 044	135 990	135 812	135 729
economic explored reserves	1 710	1 622	1 655	1 671	1 677
economic prospected reserves	19 448	19 418	19 411	19 476	19 435
potentially economic reserves	115 251	115 004	114 924	114 665	114 617
exploitable (recoverable) reserves	688	570	596	677	643
Mine production, t U	458	435	420	383	322
Production of concentrate, t U **	452	412	409	358	291

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

** sales production (without ore milling losses)

5. Foreign trade

28441030 – Natural uranium – wrought

	2003	2004	2005	2006	2007
Import, t U	N	N	N	N	N
Export, t U	1 016	665	867	529	316

Imports of uranium are withheld due to the protection of confidential data of private companies. Approximately 80 tonnes of enriched and processed uranium per year has been imported by ČEZ, a.s., in a form of nuclear fuel.

In the period 2000–2005, all domestic production of uranium was bought by the Czech energy utility ČEZ, a. s., and exported for processing and fuel fabrication to cover fuel needs of the nuclear power plant (NPP) Dukovany and the NPP Temelín (with the exception of sales from the State Material Reserves). This covered approximately 93 % of domestic needs in 2000–2002, however, approximately only one third of the needs in 2007.

The remaining portion of uranium was purchased in the world market and imported as enriched uranium equivalent in fabricated fuel in case of the Russian supplier – TVEL Company, which delivers fuel elements for Dukovany nuclear power station. Fuel elements for Temelín nuclear power station are delivered by Westinghouse Company at present; TVEL Company will become its supplier in 2010.

According to the governement decision from October 2005, the last Czech uranium mine Rožná was scheduled to close in 2008. In May 2007 the government decided on a possibility to continue in mining at Rožná mine provided that it is economically effective (which will be assessed by the government every year).

6. Prices of domestic market and foreign trade

28441030 – Natural uranium – wrought

	2003	2004	2005	2006	2007
Average import prices (CZK/kg U)	N	N	N	N	N
Average export prices (CZK/kg U)	806	844	1 445	1 345	2 344

7. Mining companies in the Czech Republic as of December 31, 2007

DIAMO, s.p., Stráž pod Ralskem

8. World production

According to IAEA, the world consumption of uranium as nuclear plant fuel was about 67–68 kt per year (65–66 kt according to WNA) (data for 2005). This amount was covered from primary sources only by 55–60 %. Remaining 40–45 % of uranium consumption was covered from secondary sources such as strategic reserves of natural and enriched uranium, mainly the USA and Russia, uranium from dismantling of Russian nuclear warheads (so-called “HEU” source), reprocessed burned fuel including MOX, and uranium obtained by re-enrichment of depleted uranium from earlier processing.

In 2006, after 2 years of growth, a year-on-year (definitely temporary) decrease of uranium production by 5 % took place to 39,429 tonnes U, i.e. even below the 2004 level. This decrease was caused by both manufacturing difficulties and mined ore grades inferior to expected ones of the main producers at Canadian and Australian deposits.

Approximately 2.3 mill t of uranium has been exploited in the world for all uses since 1945. Large increase in world production of uranium ores began in the 1950s as a result of the nuclear military programmes, and successively also due to civil power station demand, especially after the first “oil shock” in 1973. A record production of 45.6 kt of uranium was reached in 1990. Subsequently, the mine production fell due to surplus of supply in the world market. It has been slowly increasing again in the two recent years, especially in Australia, Kazakhstan, Uzbekistan and Russia. As European countries concerns, uranium is mined in Ukraine and in the Czech Republic, in small amount in Romania and within liquidation works in Germany. Share of the Czech Republic in the world production was less than % in 2006. Following states took part in uranium mine production (according to The Uranium Institute/World Nuclear Association, World Mineral Statistics and Welt Bergbau Daten):

Year	2003	2004	2005	2006	2007 e
Mine production, t U (UI/WNA)	35 613	40 251	41 702	39 429	41 279
Mine production, t U_3O_8 (dle WBD)	42 240	47 458	49 571	46 563	N

Main producers' share in the world mine output (2006; according to WBD):

Canada	25.0 %	Uzbekistan	5.7 %
Australia	19.3 %	USA	4.2 %
Kazakhstan	13.4 %	Ukraine	e2.0 %
Niger	8.7 %	China	e1.9 %
Russia	e8.3 %	South Africa	1.4 %
Namibia	7.8 %	Czech Republic	0.9 %

24 % of the primary production of uranium was obtained by open-pit mining, 41 % by underground mining, over 26 % was exploited by in-situ leaching (ISL or ISR) or by leaching from dumps and around 9 % represented by-product of processing of other ores (mainly Au and Cu) in 2006. Important uranium mining companies-founders merged in the nineties. Only 8 biggest world-mining companies (with the output volume of more than 1,000 tonnes per year) covered 85.5 % of the world production in 2006. These were the following companies: Cameco, Rio-Tinto, Areva (former Cogema), KatAtomProm, TVEL, BHP Billiton, Navoi, Uranium One (according to the WNA). McArthur River (Canada): 7,199 t U, Ranger (Australia): 4,589 t U, Rossing (Namibia): 2,583 t U, Krasnokamensk (Russia): 3,037 t U, Olympic Dam (Australia): 3,388 t U as by-product of Cu mining and Arlitt (Niger): 1,750 t U represented the most important world deposits in 2007.

9. World market prices

Unlike other raw materials, uranium was not traded on any commodity exchange until recently. New-York commodity exchange NYMEX launched newly uranium trading, however, only in form of futures contracts, not physical supplies. However, this has not been used by primary consumers – electrical companies – due to small realized volumes. World market prices are quoted in USD/lb U_3O_8. For the purpose of this report, they have been recalculated to USD/kg U (multiplying index of 2.6 has been used).

Uranium price history was influenced by three main periods of uranium usage: (1) the weapons procurement era (1940–1969), (2) the inventory accumulation – commercial era (1970–1989) and (3) the inventory liquidation era (1990–2005). While the first period was characterized by subsidized production, or prices settled by governments as a customer, in the second one prices were derived from costs of already existing deposits. Prices had been also driven up by expectations of rapid development of nuclear energy in the late 1970's, and reached their historic maximum of 112.8 USD/kg (43.4 USD/lb U_3O_8) in 1978, which would be almost 300 USD/kg in constant 2005 USD. Significant exploration boom appeared worldwide. However, expectations of rapid development of nuclear energy were frozen after the Three-Mile Island and Chernobyl accidents. Overflow of cheap uranium from the former Soviet Union countries caused drop in the world price in the beginning of 1990's. Pertaining surplus of uranium from secondary sources further depressed prices of uranium in the market for many years, which lead to severe phasing out programmes and closures of uranium mines in many countries (e.g., France, the USA, Spain, Gabon, Czechoslovakia, Eastern Germany, South Africa) and caused delaying the next exploration cycle, as there was little economic incentive to invest in new developments.

Despite the common long-term perception that the price should rise, this happened only after several warning market disruptions of production. This in combination with other negative events in the marked in the period 2003–2004 proved its high vulnerability:

- Flooding at McArthur River mine (Canada)
- Fire at Olympic Dam mill (Australia)
- Gaseous UF leakage problems in ConverDyn's conversion facility and temporary termination of production (the USA)
- Weakness of USD relative to currencies of major uranium-producing and exporting countries
- Strike at Cameco's in conversion facility at Port Hope (Canada)
- Cutting US trader GNSS (Globe Nuclear Services and Supply Ltd) from sources of Russian uranium by Russian governmental company TENEX (Техснабэкспорт)

In 2006, ongoing steep price growth was heavily influenced by additional problems:

- Partial production cuts in consequence of temporary flooding at Ranger Mine (Australia)
- Flooding at developed Cigar Lake mine (Canada) with minimum 3 years´ delay in mining initiation
- Technical difficulties forced number of producers to buy uranium to perform their supplier obligations, which motivated on prices to grow. In comparison with a situation 5–10 years ago, availability of uranium from strategic reserves markedly declined; on the contrary, consumers´ policy prevailed to enlarge and to hold the reserves in the long term.

In the situation when 4 main mining companies with capacity of only 4–5 mines contribute roughly 50 % to the world production, the main concern is not about adequacy of uranium resources, but about the ability of the mining industry to meet near-future supply requirements and especially its supplier vulnerability. As a result, the market is facing a shortage of uranium, since power enterprises were increasing inventories before the steep price rise in 2007. In addition to that, the price has been also driven up by speculative purchases made by investment companies since 2005. In 2005, the World Nuclear Association declared nuclear renaissance in relation to energy scarcity in countries like China and India and of a general growth of prices of all energy sources. For instance, only China plans to build 40 new nuclear power stations in future 15 years. Russia has similarly ambitious plans. In recent years, other countries such as the USA have announced a shift towards or a return to nuclear energy. In Europe these were e.g. Great Britain, Poland and Italy. Interest of many of former developing countries (Indonesia, Vietnam, Egypt, Bangladesh, Turkey e.o.) to join the nuclear club represents a new trend, too.

The average prices of uranium concentrate in USD per kg of uranium (U) fluctuated as follows:

Price/Year	2003	2004	2005	2006	2007
Annual average spot (TradeTech)	30.05	48.49	74.92	129.84	N
End of the year spot (Ux Weekly)	37.70	53.82	94.25	187.20	234.00
End of the year long-term Indicator (TradeTech) [1)]	40.30	65.00	93.60	179.40	247.00
Long-term average in EU15 [2)]	34.50	36.32	41.76	48.23	56.16

Notes:

1) the price indicator shows the base price level for which it was possible to conclude long-term (multi-annual) supply contracts at that time

2) ESA average prices for deliveries under long-term (multi-annual) contracts in a respective year

10. Recycling

Majority of present-day reactors is operated in strategy of the so-called "opened fuel cycle", i.e. that only approximately 5 % of total energy contained in the uranium fuel is consumed. Spent fuel is in this case stored (for 40–50 years) in in-process stores with the perspective of final disposal at permanent repositories constructed in suitable geological environment. Only a small portion (for economic as well as sanitary reasons) of world nuclear spent fuel is reprocessed within so-called "closed fuel cycle". The aim of this process is to lower amounts of highly radioactive waste; at the same time, unburned fissile material (^{235}U and ^{239}Pu) is used again as a fuel, which increases the efficiency of uranium utilization by up to 30 %, compared to the closed cycle. Reactors with fast neutrons, resp. their advanced form using other types of fuel than today water reactors, represent a perspective for considerably higher energy use of uranium.

11. Possible substitutes

Thermal and atomic propulsion reactors are designed for usage of specific fuel and form of processed uranium (low enriched or natural uranium in thermal reactors, or highly enriched uranium in navy reactors). From this point of view, there is no substitute for uranium in this type of reactors. Thorium (Th) is other primary element which can be used as fuel in specifically designed nuclear reactors. Only India has been currently considering future exploitation of Th due to a shortage of domestic uranium resources for feeding its ambitious nuclear energy program, and also due to existing restrictions of other states on uranium import to India, as India has not signed the Non-proliferation treaty yet. Within the framework of the total energy balance, the substitution is possible by another energy sources, e.g. fossil fuels, however, these produce greenhouse gases. Positive and negative sides of nuclear power supply have been broadly discussed in the world, in particular in relation to electricity production from classical fuels – coal, oil and gas and their substitutes.

1. Characteristics and use

Bituminous, hard or black coal and anthracite are caustobiolites exhibiting a higher degree of coalification, i.e. more than 75.5 % carbon (in the US use between 69 to 86 % for bituminous coal and 86 % for anthracite), less than 50 % volatile matter and calorific value on an ash-free but moist basis exceeding 24 MJ/kg. The internationally recognized boundary between lignite and bituminous coal is the value of vitrinite reflectance (R_{vi} = 0.6 %), which in the case of bituminous coal is higher than 0.6 %.

According to the IEA 2006, the world proved recoverable reserves of bituminous coal reach about 479 bill t. Predominant part of these reserves is located on the territory of the USA (23 %), India (19 %), China (13 %), Russia and South Africa (each 10 %), further Australia (8 %), Kazakhstan (6 %), Ukraine and Poland (roughly 3 % each).

Coking coal by definition is a bituminous coal, which allows producing coke for blast-furnace production of pig iron and/or for heating. Other coal is classified as steam coal and it is used predominantly for electric energy production (40 % of electric energy in the world is generated by coal burning).

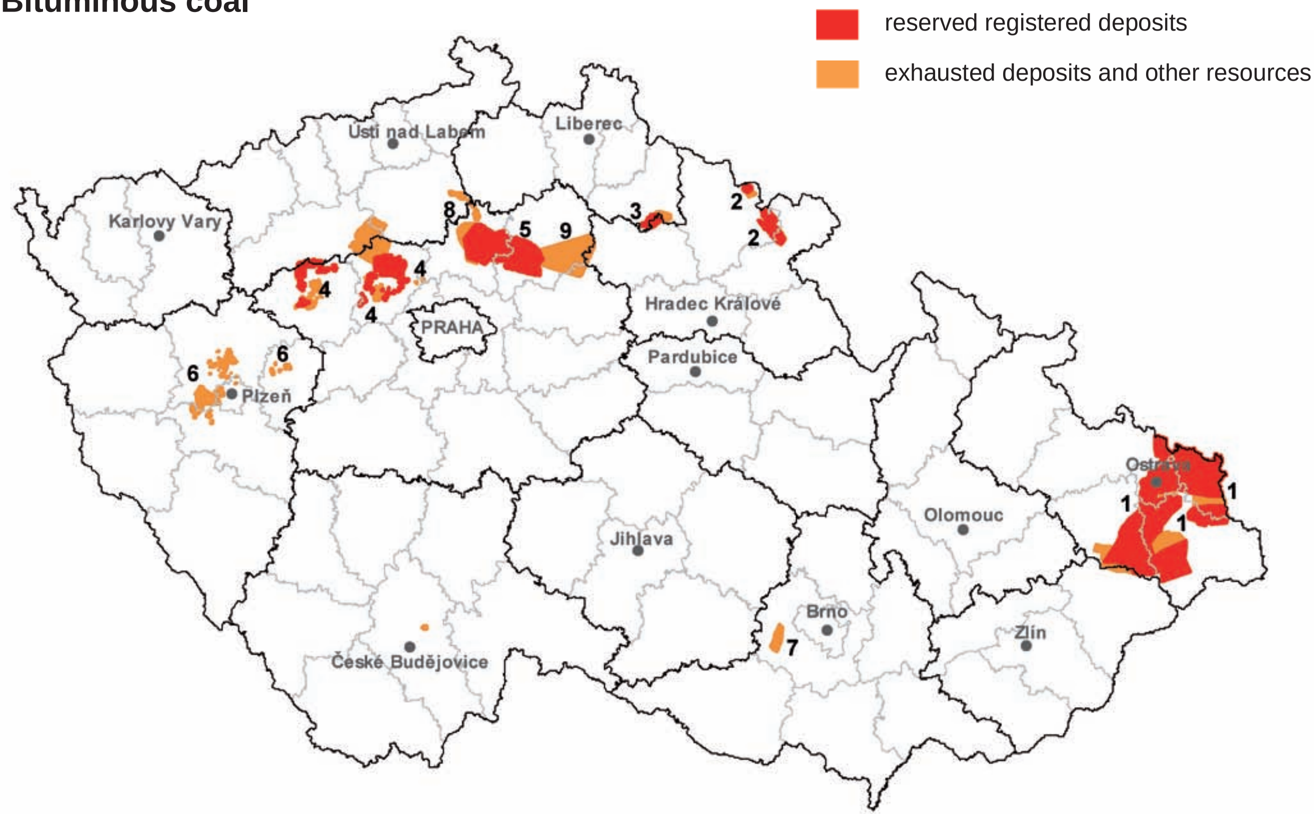
2. Mineral resources of the Czech Republic

Both the coking coal and the steam coal deposits occur on the territory of the Czech Republic. Czech part of the Upper Silesian Basin with an area of about 1,550 km^2 (about 30 % of coal reserves is in the Czech Republic and 70 % in Poland), is of a decisive importance. This part called the Ostrava-Karviná Coalfield containing an important portion of coking coal, represents essentially the only area with bituminous coal mining in the Czech Republic at present.

- The Bludovice fault divides the Czech part of the Upper Silesian Basin into two sections: the northern Ostrava-Karviná and the southern Beskydy Mts. Piedmont sub-basins. A major fault (the so-called Orlová structure) separates the western (Ostrava) and eastern (Karviná) part of the Ostrava-Karviná coalfield. The former is filled with older sediments heavily affected by tectonics, of paralic character of sediments. The latter, less complex, exhibits both paralic and limnic character of the sediments as well as of coal. The western part consists of several tens of high-grade coking coal seams of relatively low thickness (about 0.7 m on average), whereas the eastern part is characterised by abundant seams of medium thickness (about 1.8 m on average) in mineable depths containing mixed coking coal and high volatile steam coal. 4 mines with 7 deposits (mining leases Darkov, Doubrava, Karviná-Doly I and II, Lazy, Louky, Stonava) in the Karviná part of the basin supply roughly 92 % of the basin production at present (mining of Dolní Suchá deposit was terminated in mid-2006). The calorific value of mined coal Q_i^r is mostly 23–30 MJ/kg and ash content A^d between 10 and 30 %. A long-term intensive mining activity resulted in that the mining in the Ostrava part of the basin reached deeper and deeper levels (even above 1,000 m), which together with complex and unfavourable mining and geological conditions increased the mining costs. Consequently, the Ostrava mines became unprofitable and they were gradually closed and liquidated. The majority of mines in the eastern part have enough reserves with a less complex geological structure, which makes their extraction less expensive. This coal is, however, of a lower grade because of its poor coking properties.

- One deposit of predominantly coking coal in the Ostrava Formation are still extracted by a single mine in the northern part of the Beskydy piedmont part of the basin (mining lease Staříč). The calorific value of mined coal Q_i^r is mostly 28–29 MJ/kg and ash content A^d between 11 and 19 %. Relatively large reserves of coal were verified south of the original Upper Silesian Basin, particularly near Frenštát pod Radhoštěm, where Carboniferous sediments are buried under Miocene sediments and the Beskydy nappes. Here, the coal would be extracted from the depths of 800 to 1,300 m under difficult geological and mining conditions. Besides, a part of the deposit extends into the Protected Landscape Area (CHKO) Beskydy Mts. and this is why its exploitation is not considered in the meantime.
- Kladno-Rakovník Basin in central Bohemia, west of Prague, part of the Central Bohemian Basins, represented the second most important area with bituminous coal reserves until the mining in the three last mining leases (Kačice, Srby, Tuchlovice) was definitely terminated. The major part of the coal reserves (steam coal) were already mined out and the remaining ones lost their economic importance. The calorific value of mined coal Q_i^r was 18–20 MJ/kg in average and ash content A^d between 20 and 35 %. Another deposit with a small share of coking coal of a rather high quality was discovered and explored in the 1950s and 1960s near Slaný. It is the north-eastern extension of the Kladno Basin and has about 342 mill tonnes of coal. In addition to a high depth of 700 to 1,300 m, the hydrogeological and gas situation is complicated, too. The average calorific value of the coal Q_i^r is mostly 18–22 MJ/kg and ash content A^d between 20 and 40 %. The development of the deposit was terminated in the beginning of the 1990s after two shafts were put down.
- The so-called Mšeno part of Mšeno-Roudnice Basin, having more than 1.1 bill tonnes of reserves of steam coal, has been explored northeast of Prague. The calorific value Q_i^r is between 16–20 MJ/kg in average and ash content A^d between 24 and 40 %. However, economic aspects and conflicts of interest – the overlying Cretaceous sandstones represent a source of potable water for central Bohemia – obstruct exploitation of this deposit. The neighbouring Roudnice part of the Basin and the eastward neighbouring Mnichovo Hradiště Basin appear to be completely unprospective at present.
- A deposit of low-quality steam bituminous coal of a low prospectivity has been evaluated in the Krkonoše Mts. Piedmont Basin.
- The underground mining of mainly steam coal in the Intra-Sudetic (Lower Silesian) Basin was definitely terminated in the beginning of the 1990s. A surface mining of a very restricted extent has been taking place since 1998 on the Žacléř deposit.
- The bituminous coal mining in the Plzeň (Pilsen) region (Plzeň and Radnice Basins) was definitely terminated in the first half of the 1990s, too. The remaining reserves were eliminated from The Register in 2002. Negligible short-time mining in adjacent Manětín and Žihle Basins and isolated relics in the Carboniferous by Mirošov, Merklín, Tlustice, Malé Přílepy etc. were of a limited local importance.
- Steam coal mining in the Boskovice Graben (Rosice-Oslavany District) west of Brno was definitely terminated early in 1992.
- Minor isolated relics of bituminous coal to anthracite in the Blanice Graben were locally mined, e.g., by Lhotice NE of České Budějovice and W of Vlašim in the past.
- Neither the negligible anthracite mining in a small basin by Brandov in the Krušné Hory Mts. was of a higher importance.

Bituminous coal



3. Registered deposits and other resources in the Czech Republic

(see map)

Coal basins:

1 Upper-Silesian Basin
2 Intra-Sudetic Basin
3 Krkonoše Mts. Piedmont Basin
4 Central Bohemian Basins (namely Kladno-Rakovník Basin)
5 Mšeno Part of Mšeno-Roudnice Basin
6 Plzeň Basin and Radnice Basin
7 Boskovice Graben
8 Roudnice Part of Mšeno-Roudnice Basin
9 Mnichovo Hradiště Basin

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	62	62	63	63	63
Exploited	11	11	11	10	9
Total mineral *reserves, kt	16 110 431	16 093 442	16 094 030	16 063 718	16 159 327
economic explored reserves	1 688 785	1 670 133	1 672 651	1 587 320	1 566 771
economic prospected reserves	5 891 179	5 891 506	5 880 437	5 869 966	5 876 191
potentially economic reserves	8 530 467	8 531 803	8 540 942	8 606 432	8 716 365
exploitable (recoverable) reserves	279 310	271 120	269 198	134 060	182 165
Mine production, kt	13 382	14 648	12 778	13 017	12 462

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Domestic production of selected intermediate products

Year/ kt	2003	2004	2005	2006	2007
coke	3 556	3 548	3 412	3 428	3 258

Coke production

Mittal Steel Ostrava a.s. – enterprise No 10 coking plant

OKD, OKK a.s.

Třinecké železárny, a.s.

Coking plant of the Mittal Steel Ostrava a.s. represents the biggest coke producer in the Czech Republic. It disposes three coking batteries, two of which are filled with compacted coal prism and the third, so-called large-volume, is filled by dumping. The coking plant produces up to 1.5 mill tonnes of coke, 90 % of which represents the high-quality blast-furnace coke with grain size over 30 mm. Coke gas, which is subsequently used within the metallurgical complex, is purified in the chemical part of the coking plant. Chemical products – crude coal tar, crude coking benzol and liquid sulphur – are produced by this process; they find successfully their place even on foreign market.

OKD, OKK, a.s. produces mainly coke, using practically all types of coal useful for coking mined in the OKD, a.s. Metallurgical coke (foundry coke, blast-furnace coke), heating coke and coke for technological purposes are produced. Coke chemical products (coke gas, tar, benzol, ammonium sulphate and liquid and solid sulphur), which form at the high-temperature coal carbonization, represent by-products.

Třinecké železárny a.s. uses two coking batteries with yearly capacity of 700 ths tonnes. Coal for blast-furnace coke production is transported on railway from the close bituminous-coal Ostrava-Karviná Region. Coking batteries are equipped with mechanism for wet coke quenching.

5. Foreign trade

2701 – Bituminous coal, briquettes and similar solid fuels made of bituminous coal

	2003	2004	2005	2006	2007
Import, kt	1 281	1 696	1 264	1 981	2 539
Export, kt	5 669	5 705	5 261	6 515	6 693

Detailed data on bituminous coal imports (kt)

Country	2003	2004	2005	2006	2007
Poland	1 202	1 630	1 225	1 923	2 379
Russia	48	53	32	51	90
others	31	13	7	7	70

Detailed data on bituminous coal exports (kt)

Country	2003	2004	2005	2006	2007
Slovakia	2 197	2 013	1 757	1 822	1 866
Russia	1 809	2 170	1 974	1 748	1 820
Poland	500	621	637	1 570	2 015
Germany	710	587	525	551	281
Hungary	452	304	251	516	559
Bosnia and Herzegovina	0	1	108	307	150
others	1	9	9	3	2

2704 – Coke and semi-coke from bituminous coal, lignite or peat, agglomerated retort coal

	2003	2004	2005	2006	2007
Import, kt	701	756	510	768	772
Export, kt	944	958	980	971	798

Detailed data on coke imports (kt)

Country	2003	2004	2005	2006	2007
Poland	633	686	423	704	670
Slovakia	62	38	75	56	45
others	6	32	12	8	57

Detailed data on coke exports (kt)

Country	2003	2004	2005	2006	2007
Germany	442	437	409	372	319
Russia	340	323	344	280	233
Slovakia	65	42	34	103	28
Poland	12	46	99	73	68
Finland	51	31	0	50	73
others	34	79	94	93	77

Bituminous coal represents one of the most important items of the Czech mineral export expressed both in volume and financially. The export volume oscillated traditionally around 5.5 mill tonnes. It increased to 6.7 mill tonnes in 2006, which represents more than one half of the domestic mine production. The Czech export volume in 2007 was high again. The bituminous coal import is roughly three times lower and it comes almost exclusively from Poland. Foreign trade with coke is more balanced. Whereas 500–800 kt has been traditionally imported almost exclusively from Poland, Czech export has been slightly below 1 mill tonnes and is directed to neighbouring countries, mainly Germany and Austria and also to Russia.

6. Prices of domestic market and foreign trade

2701 – Bituminous coal, briquettes and similar solid fuels made of bituminous coal

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	1 195	1 872	2 181	1 949	2 010
Average export prices (CZK/t)	1 536	2 038	2 492	2 168	2 305

2704 – Coke and semi-coke from bituminous coal, lignite or peat, agglomerated retort coal

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	2 631	5 765	4 498	3 560	4 145
Average export prices (CZK/t)	3 413	5 558	6 131	4 969	5 630

Bituminous coal prices are on agreement and the OKD a.s. mining company considers them to be commercially confidential. It can be, however, assumed that the prices considerably increased in 2003–2005. This increase roughly copies the increase of import and export prices.

7. Mining companies in the Czech Republic as of December 31, 2007

OKD a.s., Ostrava

GEMEC – UNION a.s., Jívka

8. World production

World production of bituminous coal exceeded 3,000 million tonnes in 1985. Despite the prognoses of the UNO European Economic Commission, the world mine production exceeded the limit of 4,000 mill tonnes already in 2003 (not after 2010 as forecasted by the Commission). Rise of the mine production has been accelerating recently: the limit of 5,000 mill t was reached in 2005, which represented an increase by almost 20 % in two years. Year-on-year mine production in 2006/2005 increased by additional 8 %. Mine production of steam coal markedly exceeds that of coking coal. A long-term decrease of the mine production in Europe is being replaced by mine production in Asia and South America. The Asian continent has a share of about 60 % in the world mine production of steam coal and of about 50 % in that of coking coal. Increase of mine production in China, India, but also in Indonesia, Colombia and Kazakhstan is especially dynamic. The world mine production has been developing as follows in the last five years:

World bituminous coal mine production

Year	2003	2004	2005	2006	2007 e
Mine production, mill t (IEA/OECD)	4 038	4 629	4 973	5 370	N
Mine production, mill t (WBD)	4 268	4 679	4 983	5 395	N

Welt Bergbau Daten statistics give in addition classification of mine production according to the main technological type of bituminous coal:

World bituminous coal mine production according to its grades

Mine production, mill t	2003	2004	2005	2006	2007 e
Steam coal	3 755	4 132	4 348	4 706	N
Coking coal	513	547	635	689	N

Main producers' share in the world mine output (2006; according to WBD):

Steam coal		Coking coal	
China	45.9 %	China	46.8 %
USA	20.1 %	Australia	19.1 %
India	8.6 %	Russia	9.3 %
South Africa	5.2 %	USA	6.5 %
Australia	3.8 %	Canada	3.6 %
Indonesia	3.8 %	Ukraine	3.4 %
Russia	3.6 %	India	3.4 %
Poland	1.7 %	Poland	2.1 %
Kazakhstan	1.7 %	Germany	1.9 %
Colombia	1.4 %	Kazakhstan	1.8 %
Vietnam	0.8 %	Czech Republic	1.0 %
Ukraine	0.8 %	New Zealand	0.4 %

According to the World Coal Institute, about 16 % of the bituminous coal production (approximately 750 mill t) is traded in international market. Australia (231 mill t), Indonesia (129 mill t), Russia (92 mill t) and South Africa (69 mill t) belong to the world largest exporters. Japan (178 mill t), followed by South Korea (80 mill t), Taiwan (64 mill t), Great Britain (51 mill t), Germany (41 mill t), India (41 mill t) and China (38 mill t) were the largest coal importers.

9. World market prices

Prices for spot sales and future delivery prices are quoted on the coal world market. Prices of both major technological types of coal (coking and steam coal) are further divided according to the calorific value and the contents of volatile constituents, sulphur and ash. According to IEA, roughly 750 mill t of bituminous coal was traded in 2004, of which 540 mill t was steam coal and roughly 210 mill t coking coal.

Prices of the Australian and US coal have been traditionally representative, as their share in the world trade has been historically important. Prices are quoted in USD/t FOB, FAS or CIF. Prices of overseas coal on the European market (CIF) during the last decade were fluctuating between USD 34 and 100 per tonne of steam coal and between USD 48 to 120 per tonne of coking coal. Price variations were due to fluctuation in supplies and demands and also due to oscillations in sea transport costs. Lower prices of overseas coal lead in the last third of the 20th century to a gradual reduction of coal mining in European countries, where mining costs were considerably higher. Since 2004 strong growth of bituminous coal (both coking and steam grades) world market prices takes place.

The average annual prices of bituminous coal in USD per tonne CIF EU (according to the International IEA Statistics):

Commodity/Year		2003	2004	2005	2006	2007
Coking bituminous coal, American, CIF EU	USD/t	64.18	84.75	110.91	123.44	N
Coking bituminous coal, Australian, CIF EU	USD/t	58.03	73.63	114.89	135.52	N
Coking bituminous coal, South African, CIF EU	USD/t	39.20	61.31	71.77	66.18	N
Coking bituminous coal, Polish, CIF EU	USD/t	62.24	108.71	138.92	118.82	N
Steam bituminous coal, American, CIF EU	USD/t	47.37	61.50	86.75	82.08	N
Steam bituminous coal, Australian, CIF EU	USD/t	46.83	69.05	106.40	109.71	N
Steam bituminous coal, South African, CIF EU	USD/t	39.10	58.00	67.64	66.24	N
Steam bituminous coal, Chinese, CIF EU	USD/t	51.38	60.61	93.41	150.20	N
Steam bituminous coal, Russian, CIF EU	USD/t	42.22	65.14	68.46	67.93	N
Steam bituminous coal, Polish, CIF EU	USD/t	43.26	68.95	78.34	75.65	N
Steam bituminous coal, Columbian, CIF EU	USD/t	41.65	61.54	67.98	66.07	N
Steam bituminous coal, Indonesian, CIF EU	USD/t	39.29	52.56	N	N	N
Steam bituminous coal, Czech, CIF EU	USD/t	64.04	83.24	N	N	N

Note:
Calorific value of coal and its other qualities differ tremendously between mines, let alone between countries, so that the differences in price partly reflect such disparities

Important rise in all types of bituminous coal occurred in 2004. Year-on-year increase was 20–75 %. This was unequivocally caused by a break in raw material consumption in the third world countries. Number of these countries used to supply large volumes of bituminous coal to developed countries until recently and their own domestic consumption was negligible. Domestic consumption of these countries (often) increases dramatically and raw materials are therefore in still larger volumes consumed already in the mother country. This however concerns nominal prices the rise of which reflects also long-term weakening of the US dollar. This rise continued and even forced sometimes in 2005 when namely prices of American and Australian coking bituminous coal and South African and American steam bituminous coal rose. In 2006 trend in prices differed by country: prices of American and Australian coking bituminous coal grew on and especially prices of Chinese coal grew due to demand excess (anually by 60 %). Others price quotations rather stagnated.

10. Recycling

Coal cannot be recycled once its energy is consumed.

11. Possible substitutes

Coking coal can be replaced by steam coal or natural gas due to introduction of new technologies in production of pig iron (e.g. COREX®). Other energy minerals can replace coal in energy generation.

1. Characteristics and use

Brown coal (sub-bituminous coal and lignite, brown coal) is a caustobiolite showing lower degree of coalification, i.e. having about 65 to 73.5 % carbon, more than 50 % volatile matter and calorific value on an ash-free but moist basis lower than 24 MJ/kg. Limit between sub-bituminous coal and lignite has not been internationally determined. Usually a raw material with carbon content in combustible matter below 65 % and calorific value below 17 MJ/kg (below about 19 MJ/kg in the USA) is considered as lignite. The coal terminology is not unified in the international practice. The English term lignite sometimes designates both coal of Czech (Central European) brown coal grade and Czech lignite grade whereas the latter is registered separately in the Czech Republic.

World proved recoverable reserves of sub-bituminous coal and lignite are estimated between 420 and 430 bill t, resp. (EIA 2006). About 250 bill t of this amount represent sub-bituminous coal and about 170 bill t lignite. Major part of these reserves is located on the territory of the USA (31 %), Russia (25 %), further China (12 %) and Australia (9 %). Rather large reserves are also on the territory of Ukraine (4 %), Serbia and Montenegro (4 %),Brazil and Germany (roughly 2 % each).

Brown coal is used mainly in the production of energy and to a smaller extent in chemical industry.

2. Mineral resources of the Czech Republic

The majority of brown coal in the Czech Republic has been used for energy generation. The major Bohemian brown coal basins originated and are located in the graben along the Krušné hory Mts, which follows the Hercynian direction and the NW boundary of the Czech Republic. The total area of the coal-bearing sediments is 1,900 km^2 large. The underlying sediments are of the Eocene age. The brown coal seams and overlying sediments, of 400 m thickness or even more, are of the Early Miocene age. The sedimentation in the Cheb Basin was terminated as late as in the Pliocene. The following independent basins are recognized in the whole area of the Krušné hory Mts. Basin (from NE to SW): North Bohemian, Sokolov and Cheb Basins. The largest North Bohemian Basin is then divided into three parts. The share of the North Bohemian Basin on the total mine production of the brown coal in the Czech Republic is about 79 %, the remaining 21 % comes from the Sokolov Basin. The coal is exploited with one exception only by open-pit mining operations.

- In the Chomutov part of the North Bohemian Basin, the coal seam is divided into 3 benches. These become connected or are close to each other towards the north-western part of the basin, which allows their common open-pit mining. The raw material represents less calorific steam coal with a low degree of coalification. Its major use is burning in power plants. The problem with the elevated sulphur content in this coal (S^d of about 2.6 %) was solved by desulphurization of power plants exhaust gases. The ash content in general increases from NW to SE, where it can reach up to 50% (being about 35 % on average). The average thickness of the mined seam is about 23 meters and the calorific value of the coal

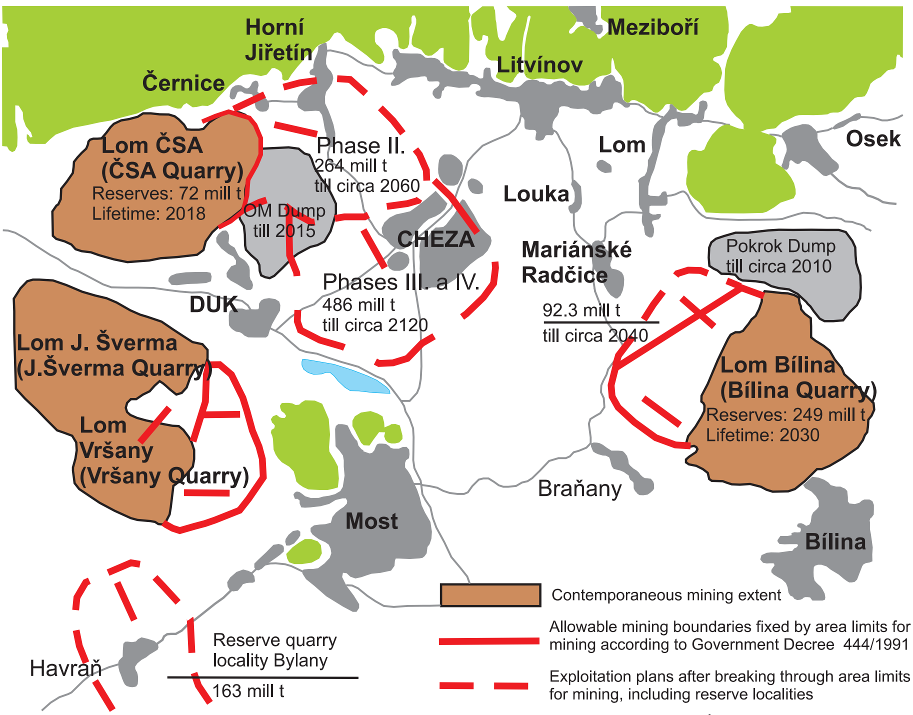
Q_i^r is 10–11 MJ/kg. The coal in this part of the basin is extracted by one large open-pit mine Tušimice-Libouš (mining lease Tušimice).

- Brown coal in the Most part of the North Bohemian Basin shows higher degree of coalification and a lower content of ash (10–34 %). The coal is used in energy generation; sorted types for small customers are produced, too. Locally, however, it is very rich in sulphur (S^d between 1 and 1.5 % on average) and arsenic. The average thickness of the mined seam is between 20–30 meters, the calorific value of the coal Q_i^r is 10–17 MJ/kg. The depth of open-pit mines continues to increase, being currently at about 150 m in some parts. The extraction takes place in four large open-pit mines (mining leases Bílina, Ervěnice, Holešice, Vršany) and one underground mine (mining lease Dolní Jiřetín u Mostu) at present.
- Mine production of the Teplice part of the North Bohemian Basin was terminated in 1997 by closure of the Chabařovice open-pit mine. The remaining reserves of high-quality almost sulphur- and ash-free brown coal located under the Chabařovice municipality cannot be mined out because of the conflicts of interests and complex hydrogeological conditions. Similar conflicts will probably block extraction of the other reserves of the high-quality coal also in other parts of the basin. Minor isolated occurrences of small sub-bituminous coal seams in the České středohoří area were from a large part mined out in the past.
- The Sokolov Basin west of Karlovy Vary has two main groups of strata – Antonín and Josef. The major reserves are confined to the thickest and the uppermost seam called Antonín, which is separated into 2 to 3 thin benches in its western part. The steam coal is of a lower to medium coalification, relatively poor in sulphur (S^d of about 1 %) and rich in water compared to the coal of the North Bohemian Basin. Only the east of the central part of the basin has been mined since 2001. The seam is extracted by two large open-pit mines Jiří (mining lease Alberov) and Družba (mining lease Nové Sedlo) and one smaller open-pit mine Marie (mining lease Královské Poříčí). The calorific value Q_i^r is 12–13 MJ/kg and ash content A^d between 20 and 23 %. The coal is used mainly in energy generation (sorted brown coal, burning in power plants, gas and briquette production) but also in some carbochemical products. Coal of the lower Josef seam with higher degree of coalification but at the same time higher ash, Ge, sulphur and other impurities (As, Be) contents, is not used anymore. It was mined at isolated relics s. from Karlovy Vary in a smaller extent in the past.
- The Cheb Basin has more than 1.7 billion tonnes of reserves of brown coal of a low coalification (the calorific value Q_i^r is about 10 MJ/kg). The coal is characterised by a high content of water, ash (20–40 %), sulphur (2-4 %) and other impurities. It might be suitable for chemical processing due to its locally high content of liptodetrite (an organic coal component) and therefore also mineral tar. It was shortly mined in a small extent in the Pochlovice part of the basin on the E in the past. Renewal of the mining operations in this basin is though excluded for the time being as major part of the reserves is blocked by protection of the mineral water sources of the Františkovy Lázně Spa.
- The Zittau (Žitava) Basin extends into the Czech Republic by a minor part from Poland and Germany. The upper seam was already mined out by surface mining. Remaining two lower seams are difficult to be mined underground because of both technical and economical problems associated with overlying quicksand.
- Minor occurrences of low-quality brown coal in the Bohemian Cretaceous Basin were in a negligible amount occassionally mined, e.g., near Moravská Třebová, Svitavy and others in the past.

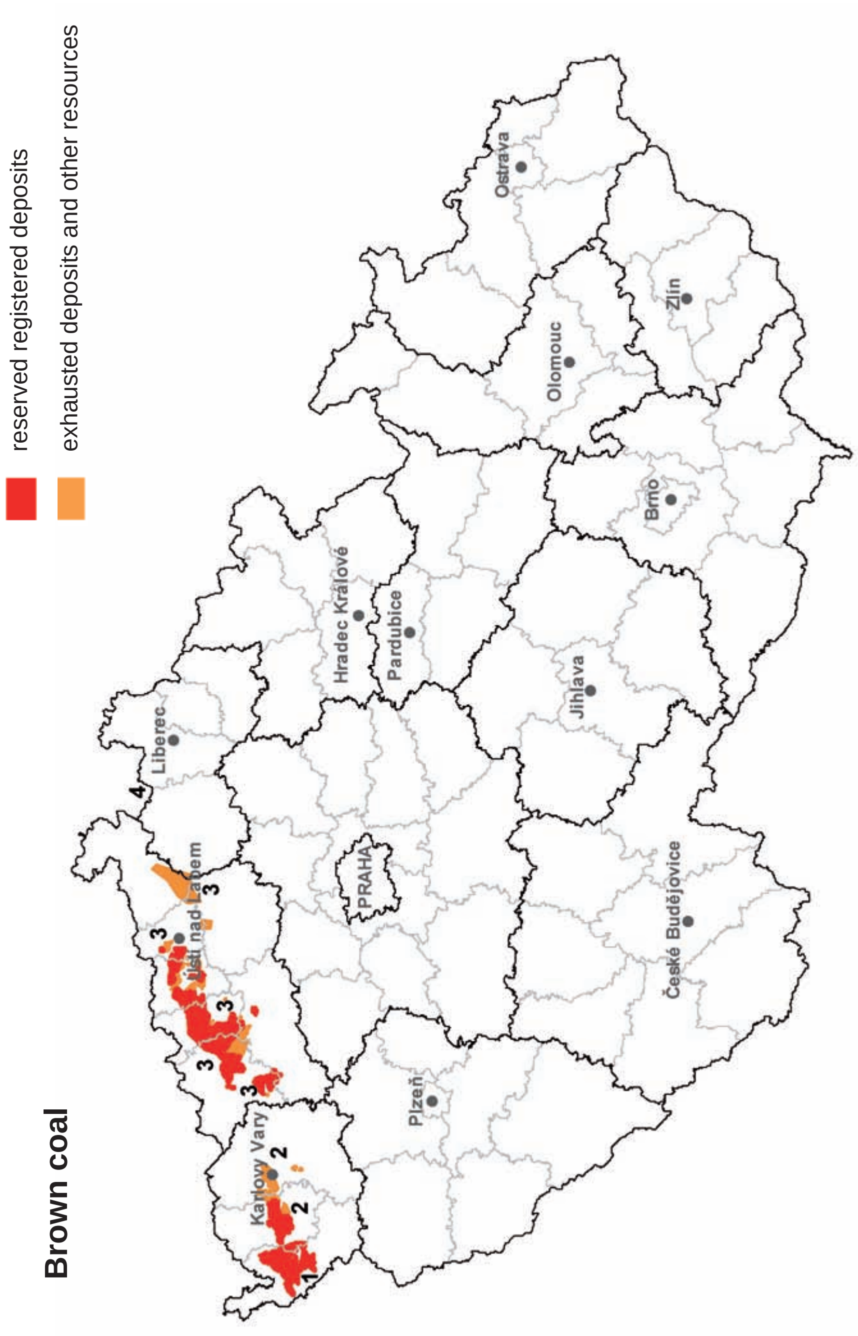
Ecological territorial limits

Rather large brown coal reserves in northern Bohemia (in North-Bohemian Basin) are blocked based on the announcement of the so-called ecological territoria limits of brown coal mining in northern Bohemia. These were established by the Czech Republic Government Resolution No. 444 from 1991, which was accepted upon suggestion of the former Minister of the Environment Ivan Dejmal. The resolution of the government defines mining leases and areas which should remain unexploited. Environmental and landscape protection in the area of northern Bohemia was the main reason for their establishment. Lifetime of reserves beyond the ecological territorial limits represents about 18-year mining and concerns namely the ČSA, Bílina and Vršany quarries. Reserves of about 0.9 billion tonnes are bound by these so-called ecological territorial limits. There is an increasing pressure on revaluation or correction of the original decision from 1991 in relation to decreasing brown coal reserves in the mined localities. It remains a fact that brown coal is, along with nuclear power stations, a single relevant raw material for the Czech energy production. Brown call represents also an essential raw material for the Czech heating industry. In terms of energy security, domestic raw material resources are also gaining in importance.

Area distribution of ecological territorial limits



Brown coal



reserved registered deposits
exhausted deposits and other resources
Ostrava
Zlín
Olomouc
Brno
Hradec Králové
Pardubice
Jihlava
Liberec
Ústí nad Labem
PRAHA
České Budějovice
Plzeň
Karlovy Vary
1
2
3
4

3. Registered deposits and other resources in the Czech Republic

(see map)

Coal basins:

1 Cheb Basin
2 Sokolov Basin
3 North-Bohemian Basin
4 Zittau (Žítava) Basin

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	58	57	55	54	54
exploited	9	9	9	9	9
Total mineral *reserves, kt	9 501 242	9 873 178	9 423 625	9 192 305	9 140 769
economic explored reserves	2 989 071	3 088 277	2 616 759	2 562 306	2 516 982
economic prospected reserves	1 942 506	2 334 200	2 305 437	2 305 437	2 305 437
potentially economic reserves	4 569 665	4 450 701	4 501 429	4 324 562	4 318 350
exploitable (recoverable) reserves	1 365 406	1 091 284	1 045 968	978 839	931 488
Mine production, kt	49 920	47 840	48 658	48 915	49 134

Notes:

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook
• After MPO ČR report "A. Bufka: Uhlí, koks a brikety v České republice v roce 2006" (A. Bufka: Coal, coke and briquettes in the Czech Republic in 2006) mine production after treatment of coal was 48,600 kt inclusive 3,692 kt sorted and 44,908 kt industrial brown coal in 2006.

Domestic production of selected intermediate products

Year / kt	2003	2004	2005	2006	2007
Briquettes	314	301	301	345	247

5. Foreign trade

2702 – Lignite, also agglomerated, except jet

	2003	2004	2005	2006	2007
Import, kt	0	4	2	25	34
Export, kt	1 274	1 233	1 475	1 563	1 187

Note: jet is a compact black variety of brown coal used in (mourning) jewelry

Detailed data on brown coal exports (kt)

Country	2003	2004	2005	2006	2007
Slovakia	803	743	862	938	801
Germany	169	158	174	223	130
Hungary	276	272	347	366	157
others	26	60	92	36	99

Brown coal belongs to raw materials the domestic production of which covers fully the domestic consumption. The raw material therefore does not represent an import item and volume of import is relatively small compared to the volume of mine production. Exports have been oscillating between 1 and 2 mill tonnes per year and directed mainly to the neighbouring Slovakia. Export to Germany decreased markedly during the last five years – it amounted at about 2 mill tonnes still in 1999–2001.

6. Prices of domestic market and foreign trade

2702 – Lignite, also agglomerated, except jet

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	NA	NA	NA	NA	N
Average export prices (CZK/t)	933	983	952	1 111	1 132

Brown coal prices depend on calorific value and granularity. Severočeské doly a.s. offers sorted coal of the average calorific value of 17.6 MJ/kg in category small lump II for CZK 1,700–2,050 per tonne, in the category cube I for CZK 1,620–1,940 per tonne and cube II for CZK 1,320–1,590 per tonne. Brown coal rough powder prices fluctuate between CZK 700 and 1,020 per tonne, prices of brown coal mixtures used in industry (calorific value of 11.4 to 15.6 MJ/kg) between CZK 620 and 850 per tonne. Brown coal mixture from the mine Nástup Tušimice (calorific value of 10.5–11.5 MJ/kg) was offered for CZK 478 per tonne. Mostecká uhelná společnost a.s. offers sorted coal in category small lump for about CZK 1,870 per tonne, in category cube I for about CZK 1,780 per tonne and cube II for about CZK 1,180 per tonne. Sokolovská uhelná used to offer small lump for CZK 860–1,010 per tonne and cube for CZK 800–920 per tonne in 2006. Dried brown coal powder was sold at prices fluctuating between CZK 1,150 and 1,480 per tonne. Prices of brown coal briquettes fluctuate from CZK 1,400/t (fragments) up to CZK 3,800/t (prisms in packages). The price list was not published in the last years.

Domestic brown coal prices

Product specification	2006	2007
sorted; cube II; 17,6 MJ/kg; Severočeské doly	1460–1600	1707–2045
sorted; cube I; 17,6 MJ/kg; Severočeské doly	1380–1660	1619–1942
sorted; cube II; 17,6 MJ/kg; Severočeské doly	1120–1340	1325–1586
coarse coal powder I, II; Severočeské doly	660–960	708 –1023
industrial mixture; 10,5-11,5 MJ/kg; Severočeské doly	600–815	627–855
sorted; cobble; Mostecká uhelná	1450–1750	1869
sorted; cube I; Mostecká uhelná	1380–1660	1780
sorted; cube II; Mostecká uhelná	850–1030	1181
sorted; cobble; Sokolovská uhelná	860–1010	N
sorted; cube; Sokolovská uhelná	800–920	N
dried brown coal powder; Sokolovská uhelná	1150–1480	N

Average export prices have increased since 2003, when they exceeded CZK 900 per tonne. In 2006, they increased to more than 1,100 CZK/t. It is not representative to follow import prices as the volume of the trade is negligible.

7. Mining companies in the Czech Republic as of December 31, 2007

Severočeské doly a.s., Chomutov

Mostecká uhelná společnost, a.s., Most

Sokolovská uhelná, legal successor, a.s., Sokolov

Důl Kohinoor a.s., Dolní Jiřetín

8. World production

World production (including lignite) exceeded 1,000 mill tonnes in 1980. It reached its peak probably in 1989 – 1,273 mill t, and then a decline came. The world production stagnated on the level of about 850 mill t per year in the second part of 1990s. Mine production in Germany (the most important world producer) has been rather stable – around 180 mill t – in the last years. Mine production in Greece has been 60–70 mill tonnes per year. Poland, another important European brown coal producer, produces about 60 mill tonnes per year. Mine production in Russia increased significantly in 2006 (90 mill t).

Years	2003	2004	2005	2006	2007 e
Mine production, mill t (WBD)	909	924	931	940	N
Mine production, mill t (IEA/OECD)	883	884	906	914	N

Main producers’ share in the world mine output (2006; according to WBD):

Germany	18.8 %	Turkey	6.6 %
Russia	9.6 %	Poland	6.5 %
USA	8.1 %	Czech Republic	5.2 %
Australia	7.6 %	China	4.8 %
Greece	6.7 %	Serbia and Montenegro	4.1 %

9. World market prices

Brown coal does not represent important volume of the world trade and its sales are usually materialized only between neighbouring countries based upon individual contracts and negotiated prices considering the grade and transport costs. Data on these prices are not available.

10. Recycling

Brown coal cannot be recycled once its energy is consumed.

11. Possible substitutes

Possible substitutes differ according to the type of brown coal and its use. In energy generation, other fuels, particularly nuclear fuel, can replace it. This substitution, however, represents a big investment and it usually meets environmental and other problems. Use of brown coal in energy production is hampered by the fact that it represents a source of emissions, similarly to bituminous coal, natural gas, fuel gas and biomass.

Lignite

1. Characteristics and use

Lignite in the Czech terminology is a variety of brown coal, which exhibits the lowest degree of coalification, is mostly of xylitic character with large or small fragments of wood and tree trunks with preserved growth rings. Lignite is usually comprised in the term brown coal in the world use, whereas it has been traded separately in the Czech Republic. From the petrological viewpoints, it is a brown coal hemitype. Its calorific value on an ash-free but moist basis is lower than 17 MJ/kg (in the US use below about 19 MJ/kg).

However, no strong boundary between brown coal grade and lignite grade of coal has been internationally established and term lignite can designate both Czech brown coal grade and lignite grade of coal which are marketed separately in the Czech Republic.

World proved recoverable reserves of lignite are estimated at about 170 bill tonnes. Their predominant part is located on the territory of Australia (22 %), the USA (19 %), China (11%), Serbia and Montenegro (9 %) and Russia (6 %).

Lignite is used in energy generation and for heating. It represents the lowest quality mineral fuel, consumption of which gradually decreases.

2. Mineral resources of the Czech Republic

- Largest deposits of lignite occur along the northern margin of the Vienna Basin, which extends from Austria into southern Moravia. There are two lignite seams in the youngest sediments of the Pannonian and Pliocene age. Reserves of the northern Kyjov seam are already exhausted (the last mine Šardice was closed in the end of 1992). Those of the southern Dubňany seam have been mined by only one underground mine Hodonín-Mikulčice since 1994, when the mining at Dubňany deposit was terminated. The last mine was supposed to closed in 2004, nevertheless negotiations on prolongation of the contract with ČEZ, a.s. and by that also continuation of the mining are in progress. Practically all production is burned in the Hodonín power station owned by ČEZ, a.s. Economic reserves are registered at six other deposits, but their exploitation is not anticipated. South Moravian lignite is of a xylodetrital character with numerous tree trunks. It is rich in water (45–49 %), ash content A^d is between 23 and 26 %, average content of sulphur S^d is 1.5–2.2 % and its calorific value Q_i^r is 8–10 MJ/kg. Recently, local lignite has also been used in other ways than as a fuel. So-called teraclean for soil fertilization is produced after lignite processing by crushing and grinding.
- Other deposits of low-quality lignite occur in narrow lobe-shaped extremities of the České Budějovice Basin. Major part of the reserves has been mined out and the remaining ones are not of any economic importance.
- Smaller isolated occurrences of lignite (Miocene) in the Zittau (Žitava) Basin were to a large extent mined out, too, and the remaining reserves are not of any economic importance.

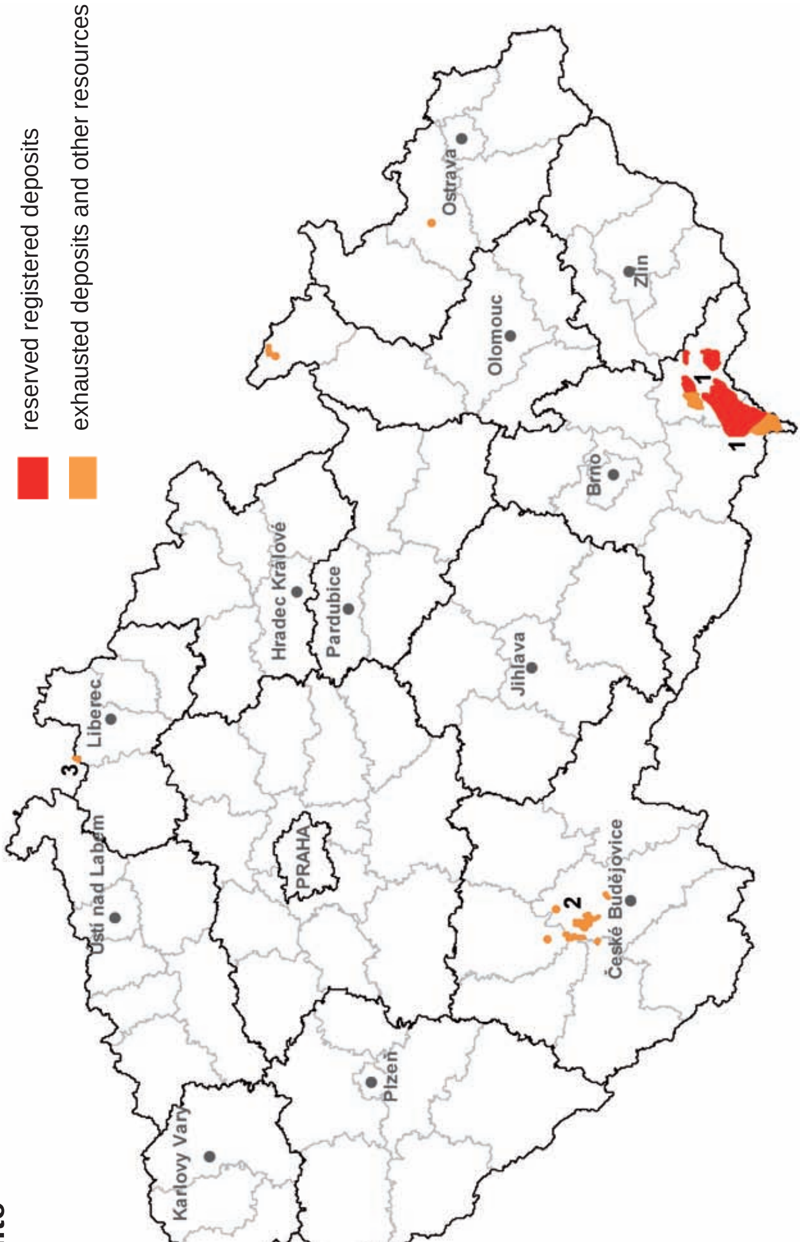
3. Registered deposits and other resources in the Czech Republic

(see map)

Principal areas of deposits presence:

1 Vienna Basin   2 České Budějovice Basin   3 Zittau (Žitava) Basin

Lignite


reserved registered deposits
exhausted deposits and other resources
Ostrava
Zlín
Olomouc
Brno
Hradec Králové
Pardubice
Jihlava
Liberec
Ústí nad Labem
PRAHA
České Budějovice
Plzeň
Karlovy Vary
1
1
2
3

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	11	11	11	9	9
exploited	1	1	1	1	1
Total mineral reserves*, kt	1 011 865	1 010 123	1 007 933	976 985	976 367
economic explored reserves	214 270	212 982	210 792	205 030	204 412
economic prospected reserves	619 978	622 534	622 534	615 273	615 273
potentially economic reserves	177 617	174 607	174 607	156 682	156 682
exploitable (recoverable)	3 443	3 065	3 003	2 544	2 107
Mine production, kt	470	450	467	459	437

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

5. Foreign trade

No separate customs tariff item exists for lignite.

6. Prices of domestic market and foreign trade

Prices of South Moravian lignite for energy production (predominant part of the mine production) have been ranging between CZK 500 and 600 per tonne during the last years. Sorted lignite was offerred in the category small lump at CZK 570 per tonne, in the category cube at CZK 580 per tonne in 2006. Calorific value of the offered lignite fluctuates between 8.0 and 10.0 MJ/kg.

7. Mining companies in the Czech Republic as of December 31, 2007

Lignit Hodonín s.r.o., Mikulčice

8. World production

Production of lignite in the world is included in the brown coal (lignite) production. Mine production of lignite itself (in the Czech terminology) has been traditionally stated especially in central and south-east Europe (e.g. in Austria, Hungary, Bulgaria, Serbia, Slovenia, Bosnia and Herzegovina, Macedonia).

9. World market prices

Lignite is generally not traded outside a producing country.

10. Recycling

Lignite is not recycled.

11. Possible substitutes

Other energy minerals can replace lignite exclusively used as a fuel.

1. Characteristics and use

Oil (crude oil, petroleum) is a natural mixture of gaseous, liquid and solid chemical compounds, predominantly hydrocarbons. Its specific gravity fluctuates between 0.75 and 1 t/m^3, the average content of carbon is between 80 and 87.5 %, hydrogen between 10–15 % and its calorific value ranges between 38 and 42 MJ/kg. Hydrocarbons are derived from an organic matter originating from subaqueous biochemical decomposition of biomass under specific conditions. The crude oil originates at temperatures between 60 and 140°C in pelitic oil-bearing sediments at depths between 1,300 and 5,000 m. From these sediments it subsequently migrates and accumulates in permeable, porous reservoirs or fractured collector rocks. The extracted oil is called crude oil and it has highly variable properties such as colour, viscosity, molecular mass and specific gravity.

Crude oil is classified as light, medium or heavy according to its measured API degrees of gravity. At 60° F (15.6° C) light has a gravity higher than 31.1° API, medium has gravity between 22.3–31.1° API, heavy has gravity below 22.3° API.

Principally 4 types of crude oil can be distinguished, based upon its chemical composition – paraffin-base petroleum, asphalt-base petroleum, naphtene petroleum, and mixed bases (aromatic) petroleum.

Sweet and sour crude oil is also distinguished after its sulphur content (sweet below 0.5 wt. % S, sour above this limit).

Total world proved reserves are estimated at 165,000 mill tonnes (more than 1.2 trillion barrels), about 75 % of which are located in the OPEC member countries. The highest amount of the proved reserves is found on the territory of Saudi Arabia (22 %), Iran (11 %), Iraq (almost 10 %), Kuwait and United Arab Emirates (8 % each), Russia and Venezuela (almost 7 % each).

Tar sands, also called to as oil or bituminous sands, resources of which are estimated at 3.5 trillion barrels (472.5 billion tonnes) represent a prospective petroleum source. The largest world deposits and resources are in Venezuela and Canada (Alberta). They are mined in a large amount only by open-pits in Canada as their extraction is economically and technically demanding. The content of bitumen (8–14° API) in sands ranges usually between 10 and 12 %. Tar sands are mined to extract the oil-like bitumen which is upgraded into synthetic crude oil or refined directly into petroleum products by specialized refineries.

Crude oil is processed mainly by distillation (refining) so that its individual fractions are separated: gasoline, petrol, kerosene, oil, and lubricating oil, asphalt. Higher carbohydrates (long carbohydrate chains) are processed (shortened) by cracking. Oil is widely used in industry and new applications are still under way. Nevertheless, use as energy in automotive systems, energy generation in general, petrochemical (feeding the transport sector) and chemical industries are the principal oil consumers.

2. Oil resources of the Czech Republic

In contrast to coal, the Czech Republic does not possess sufficient resources of oil or gas. Reserves and deposits of oil are concentrated mainly in southern Moravia and they are associated with geological units of the Western Carpathians and the south-eastern slopes of the Bohemian Massif. Even though the domestic mine production of crude oil has been increasing in recent years, it covers only roughly 5 % of domestic consumption.

- The deposits of the Vienna Basin (Moravian part) are distributed over a great number of individual oil-bearing structures and producing horizons situated at the depth going down to 2,000 m. Sandstones of the Middle and the Upper Badenian represent the most productive oil-bearing rocks. The Hrušky deposit, major part of which has been already extracted, represents the largest deposit of this area. Prospecting in this area however still continues. A new oil deposit with a gas cap has been discovered and exploited (approximately 6 % of the total) in the area of Poštorná.
- Another region with oil deposits lies in the Moravian part of the Carpathian Foredeep and on the south-eastern slope of the Bohemian Massif. The most important accumulations occur particularly in the collectors in the Miocene, Jurassic and jointed and weathered portions of the crystalline rocks. The Dambořice deposit represents the largest and most important deposit at present. Other important deposits – Žarošice and Uhřice-jih – have been discovered by a systematic exploration based on the 3D interpretation of the seismics. Oil is accumulated in the Jurassic sediments – the so-called Vranovice carbonates in the Žarošice deposit and sandstones of Gresten Formation In the Uhřice-jih deposit. These deposits are intensively exploited at present – they take a share of roughly 88 % in the total crude oil mine production in the Czech Republic. Technology of horizontal drilling has been used at the mining in order to reach the highest possible yield. Gas is moreover injected into the apical parts of the deposits to maintain the deposit pressure in case of the Uhřice-jih and Dambořice deposits. This method does not have to be applied in Žarošice deposit yet as the gas cap along with the active bedding water represent here an important source of pressure.

Oil and gas deposits are mutually genetically related. Oil deposits of the Vienna Basin are concentrated in the Badenian and Lower Miocene sediments, whereas in the Sarmatian only gas deposits occur. The light, sulphur-free paraffin to paraffin-naphtene oil prevails in the Czech Republic. Three grades of oil with specific gravity from 856 to 930 kg/m^3 at 20°C, which corresponds to 20–33° API or 6.76–7.35 bbl/t, with sulphur content of 0.08–0.32 wt %, were extracted in 2007.

3. Registered deposits and other resources in the Czech Republic

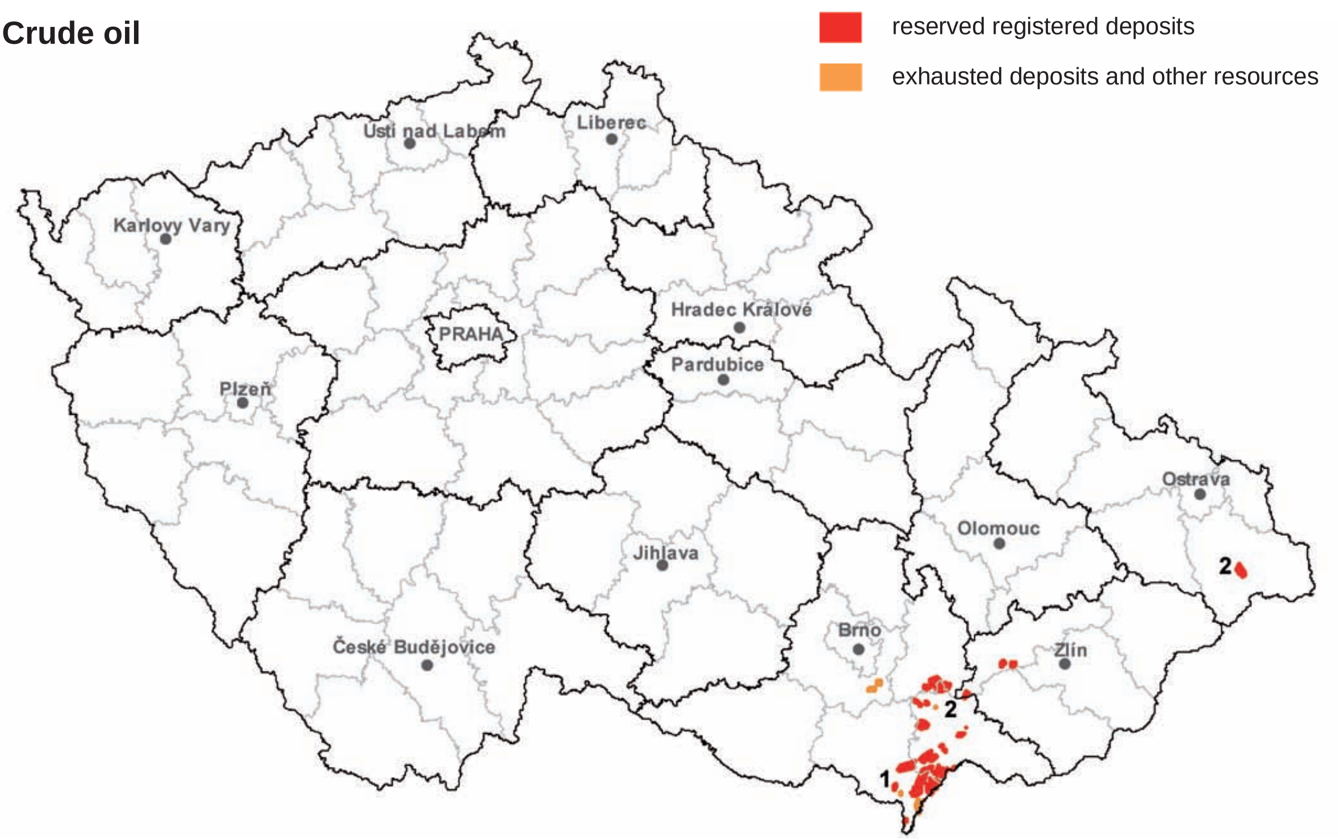
(see map)

Principal areas of deposits presence:

1 Vienna Basin

2 West-Carpathian Foredeep

Crude oil


reserved registered deposits
exhausted deposits and other resources
Ústí nad Labem
Liberec
Karlovy Vary
Hradec Králové
PRAHA
Pardubice
Plzeň
Ostrava
Olomouc
Jihlava
2
Brno
Zlín
České Budějovice
2
1

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	28	28	28	28	28
exploited	18	19	19	21	22
Total mineral *reserves, kt	32 443	32 790	32 536	32 277	31 118
economic explored reserves	12 484	12 824	12 526	12 315	14 602
economic prospected reserves	8 557	8 567	8 613	8 609	5 163
potentially economic reserves	11 402	11 399	11 397	11 353	11 353
exploitable (recoverable) reserves	2 331	3 065	2 325	2 135	1 793
Mine production, kt	310	299	306	259	240

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Crude oil refineries:

Česká Rafinérská, a.s. – refineries Kralupy nad Vltavou and Litvínov

PARAMO, a.s. – refineries Pardubice and Kolín

Česká Rafinérská, a.s. represents the largest crude oil processing and oil producing company in the Czech Republic. This company operates crude oil refineries in Litvínov and Kralupy nad Vltavou. Both these refineries produce fuel. Refinery in Litvínov processes the Russian oil mixture REB (oils with medium sulphur content imported from the Russian Federation namely by Družba pipeline), refinery in Kralupy processes so-called sweet oil, i.e. oil with a low sulphur content imported to the Czech Republic by IKL (Ingolstadt – Kralupy – Litvínov) pipeline, and oil of domestic origin mined by Moravské naftové doly a.s. Company. The Česká Rafinérská, a.s. is owned by three shareholders: refinery-petrochemical holding Unipetrol (51.23 %), and the foreign companies ENI (32.44 %) and Shell (16.33 %). The Česká Rafinérská a.s. works in the so-called reprocessing mode, which means that it is not trading anymore but it deals only with oil processing to a variety of oil products and intermediate products which is defined in advance by the dealership of share-holders. Oil is purchased by the dealership itself.

PARAMO, a.s. is an important Czech producer of oil products which are fuels (petrol, Diesel oil, light heating oil, heating oil), mineral lubricating fuels, plastic lubricants, asphalts. PARAMO, a.s. operates refinery in Pardubice and a branch office in Kolín. The former converts Russian oil primarily into fuels, lubricating oils and asphalts, The latter does not process crude oil but it is an oil refinery equipped with a modern unit of re-distilling of oil hydrogenates (raw material from the Litvínov refinery) producing lubricating oil. Unipetrol Company with 88.03 % share is the main share-holder of the PARAMO a.s.

5. Foreign trade

2709 – Petroleum oils and oils obtained from bituminous minerals, crude

	2003	2004	2005	2006	2007
Import, kt	6 344	6 406	7 730	7 752	7 147
Export, kt	133	64	58	42	17

Detailed data on crude oil imports (t)

Country	2003	2004	2005	2006	2007
Russia	4 318	4 440	5 458	5 187	4 611
Azerbaijan	1 000	983	1 455	1 951	1 963
Algeria	0	188	178	20	279
Kazakhstan	71	218	249	413	232
Libya	217	236	270	175	51
Syria	636	316	49	6	0
Norway	87	0	0	0	0
others	15	25	71	0	11

271011 – Petrol (Gasoline)

Commodity	2003	2004	2005	2006	2007
Import, kt	1 161	1 235	1 055	732	N
Export, kt	195	200	172	311	N

Detailed data on petrol imports (t)

Country	2003	2004	2005	2006	2007
Slovakia	543	554	457	377	N
Germany	244	275	294	190	N
Poland	230	240	175	65	N
Austria	133	145	113	85	N
others	11	21	16	15	N

As the domestic mine production covers only negligible part of the domestic crude oil consumption (about 4–5 %), predominant part of the raw material has to be imported. Total import volume has been increasing systematically – it increased by 27.5 % during the period 2002–2006, which represents an increase by 5.5 % per year. The imports were slightly lower, the reason however was not decrease of consumption but by the unplanned outage of a part of the Litvínov-Záluží refinery. The largest part of the imported oil comes traditionally from Russia – it makes roughly two thirds of total import. Azerbaijan with a share which increased from about 15 % in 2002 to about 25 % in 2006 and to about 27 % in 2007 is the second most important country from which oil is imported. Kazakhstan, Algeria and Libya rank to other more significant lasting oil importing countries to the Czech Republic. Spectrum of the other countries is variable.

In addition to oil, also oil derivates, especially petrol, are imported in the Czech Republic. Volume of the imported petrol fluctuates between 0.7 and 1.2 mill tonnes and its major part is imported from Slovakia and Germany. These data are not made public since 2007 as the importing company concerns them as its individual data. The only data available is that petrol for CZK 11.7 billion (EUR 423 mill) was imported and petrol for CZK 3.1 billion (EUR 112 mill) was exported.

6. Prices of domestic market and foreign trade

2709 – Petroleum oils and oils obtained from bituminous minerals, crude

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	5 732	6 536	8 834	10 646	10 078
Average export prices (CZK/t)	5 057	6 776	8 952	10 103	9 984

271011 – Petrol (Gasoline)

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	8 608	10 705	13 015	14 636	N
Average export prices (CZK/t)	8 551	9 915	12 938	14 519	N

Average import prices of oil in the Czech Republic have increased steeply in relation to a marked increase of crude oil world prices during recent years. In comparison with the year 1999, when crude oil was imported at average price of CZK 3,680 per tonne, the import prices were two times higher in 2000 (CZK 7,486 per tonne). That was caused by a violent increase of crude oil prices on the world market and by a significant weakening of the CZK against USD. Also in 2001, the import price of crude oil was still relatively high (CZK 6,808 per tonne) with regard to the situation on the world markets, irrespective of a repeated strengthening of the CZK against USD. This unfavourable trend did not improve until 2002, when the average import price of CZK 5,501 per tonne was reached thanks to the lower oil prices on the world market and the long-term increase of the CZK rate to USD. Average import price increased again up to CZK 5,732 per tonne in 2003 due to the evolution on the world market and this trend continued in 2004, too. The average import price reached CZK 6,536/t (34.7 USD/bbl). Steep rise of the crude oil prices continued also in 2006, when even the limit of CZK 10 ths per tonne was overstepped. Average import price of oil oscillated around USD 66/bbl. The annual average reached CZK 10,000 in 2007 thanks to the temporary oil price decrease in the first quarter of the year. The import prices were nevertheless increasing again for the rest of the year. Strengthening of the CZK against USD protects domestic economy against even more serious impacts.

7. Mining companies in the Czech Republic as of December 31, 2007

Moravské naftové doly a.s., Hodonín

Česká naftařská spol. s.r.o., Hodonín

MND Production a.s., Hodonín

UNIMASTER s.r.o., Ostrava-Hrabová

8. World production

World crude oil production fluctuated between 3.5 and 3.9 billion tonnes in the last years. In the 1990s Russia's production decreased significantly. The production volume was greatly influenced by cartel OPEC, whose members agreed on a production reduction of 1.7 mill bbl a day in 1999 to confront the record low prices of that time (1 barrel = 158.987 litres, 1 tonne of crude oil corresponds approximately to 7 barrels). The fall in crude oil production of OPEC together with other four non-OPEC members represented 2.1 mill bbl a day. The cartel influenced significantly the world market also in 2000, when a deficiency of the raw material supply in the market resulted in the steep crude oil prices rise. OPEC influence did not decrease in 2007 as its member countries shared 43.0 % in the world crude oil production. On the contrary, Angola newly joined the OPEC and Ecuador renewed its membership in 2007. Sudan considers joining of the OPEC and similar considerations appear also in case of Brazil, near whose shore potentially large deposits of the raw material have been found recently. In contrast, Indonesia leaves the cartel, as it changes from the pure exporter into the pure importer due to a high domestic consumption increase.

Crude oil production of Saudi Arabia, Russia, Algeria, Brazil, Angola and Canada has been increasing, while that of Iraq, Great Britain, Norway and Indonesia has been decreasing during recent years. A big disproportion between producing and consuming regions is characteristic for crude oil: for instance, share of the USA in the world production is 8.0 %, whereas its share in the world consumption is 24.1 %. Share of EU 25 countries in the mine production and consumption is only 2.9 % and 17.8 %, respectively. China produced 4.8 % whereas it consumed 9.3 % of the world production. Japan represents one of a few countries which manage to decrease crude oil consumption on a long term. Data of individual international statistics differ from each other; for instance, according to International Energy Outlook 2004, world mine production reached about 83 mill barrels per day already in 2002. Data given by OPEC cartel in the Annual Statistical Bulletin 2006 are in contrast substantially lower. Ten most important producing countries mined almost 62 % of the world mine production in 2006. Angola and Azerbaijan showed a marked year-on-year increase in 2007/2006.

World crude oil extraction

Year	2003	2004	2005	2006	2007 e
Mine production, ths bbl/day (BP)	77 031	80 326	81 255	81 659	81 533
Mine production ths bbl/day (OPEC)	67 305	70 556	71 612	71 996	N
Mine production, mill t (WBD)	3 597	3 689	3 806	3 818	N

Main producers' share in the world mine output (2006; according to WBD):

Saudi Arabia	13.8 %	Mexico	4.9 %
Russia	12.6 %	United Arab Emirates	3.6 %
USA	8.2 %	Kuwait	3.5 %
Iran	5.2 %	Norway	3.4 %
China	4.9 %	Nigeria	3.1 %

9. World market prices

Crude oil is a commodity that is extremely sensitive to the global political and economic conditions. Until recently the highest prices were reached in 1990 at over USD 40/barrel in consequence of the Gulf War. In 1991–1995, the crude oil price markedly decreased to USD 15–20/bbl. The price increased by about USD 24/bbl in 1996. However, the prices were decreasing since the end of 1996 in consequence of uncontrollable growth of production. The crude oil price hit twelve-year minimum (USD 10/bbl) in December 1998. Therefore the OPEC members signed an agreement on the significant reduction in production in spring 1999, which was joined by some important producers – non-OPEC members (Mexico, Oman, Russia, Norway). A surprising respect of the production limits by the member states led to the considerable growth of prices. During 1999 the prices increased about three times and they settled in a range between USD 24 (Dubai) and USD 27 (Brent) per barrel by the end of the year. The OPEC influenced significantly the crude oil world prices also in 2000, when the prices were increasing even if the OPEC production increased several times and even if at year-end the total mine production of this cartel was higher than during of the price crisis at the beginning of 1999. The OPEC succeeded to drain a considerable part of crude oil stockpiles in particular countries by which it provoked impression of the raw material deficiency. At the beginning of September 2000, price of Brent was around USD 37 and of Dubai USD 31–32 per barrel. Also in 2001, the OPEC succeeded in ruling the world prices according to its ideas – price of Dubai was between USD 16 and 27 per barrel, of Brent USD 17–29 per barrel. In 2002 the oil prices on the world market were 18–30 USD per barrel (Brent) and 17–28 USD per barrel (Dubai), respectively. The year 2003 has seen a further increase of the world oil prices. Its major cause was a conflict in the Middle East, due to which the uncertainty concerning supply of the world market by this strategic raw material increased. Oil prices oscillated between 23 and 34 USD per barrel (Brent) and 22 and 31 USD per barrel (Dubai), respectively, as a result of the international situation.

World price of oil experienced a dramatic evolution in 2004. The uncertainty of deliveries from the Persian Gulf area all the time shaken by violence was combined with an even more important factor – steeply increasing oil consumption in rapidly developing economies of the emerging countries (China, India, Indonesia, Brazil etc.). Indonesia, until recently an important world producer of oil, represents an example: it has left the OPEC cartel as it has become a pure oil importer during the last 2–3 years. In consequence of these factors, the oil price Brent increased systematically for whole ten months from value of USD 29 per barrel (January 2004) up to USD 52 per barrel (October 2004). The price evolution of oil Dubai followed a similar scenario in 2004; just the interval of the prices was narrower (USD 27 to 41 per barrel). Crude oil prices followed similar trends in 2005. The oil price Brent more or less gradually increased from 40 USD/bbl to 68 USD/bbl. Price interval of the oil Dubai fluctuated between 34 and 60 USD/bbl with a similar marked increase during January – September and a small correction and stagnation until the end of the year. World prices of oil remained on a high level in 2006, too – oil price Brent fluctuated in a large range of 58–78 USD/bbl. Almost continual price rise up to the nominal historical maximum of about USD 78/bbl in the first decade of August was characteristic of January–August 2006. The prices decreased down to the level of USD 60/bbl in August–October 2006. World crude oil prices continued to rise also in 2007. They increased practically continually up to 80 USD/bbl and, after a short correction, up to 95 USD/bbl until the end of the year. In addition to the existing causes (consumption increase in the rapidly modernizing economies, stable consumption in developed countries, political instability in some producing regions), the oil prices was more and more influenced by depreciation of US dollar. The magical limit of USD 100/t was broken at the beginning of March 2008. World oil prices increased up to USD 140/bbl in the second half of 2008. With regard to the fact that the cause of the growth trend will not cease to exist, we can expect further and further until recently hardly credible price maxima.

The major world commodity exchanges (IPE, NYMEX) quote prices of direct sales (spot) and prices of long-term contracts in USD per barrel, FOB. Daily quotations regularly include prices of the North Sea Brent, the American West Texas Intermediate (WTI) and the OPEC basket of crude oils (7 types of oils – Saharan Blend of Algeria, Minas of Indonesia, Bonny Light of Nigeria, Arab Light of Saudi Arabia, Dubai Fateh of Dubai, Tia Juana of Venezuela and Isthmus of Mexico). Different crude oil prices reflect its grade, which is expressed in degrees of API (Brent 38°, WTI 34.5°, Arab Light 34°, Dubai Fateh 32°, Russia Export blend 32°).

The average spot price quotations (according to IEA and BP)

Commodity/Year		2003	2004	2005	2006	2007
Brent crude oil, CIF Rotterdam	USD/barrel	28.85	38.26	54.57	65.14	72.39
OPEC basket crude oil, CIF Rotterdam	USD/barrel	26.75	33.43	49.40	61.50	68.19
West Texas Intermediate (WTI) oil, CIF Rotterdam	USD/barrel	31.08	41.51	56.64	66.02	72.20
Nigerian Forcados, CIF Rotterdam	USD/barrel	28.66	38.13	55.69	67.07	74.48

10. Recycling

Crude oil cannot be recycled once its energy is consumed. Some products made of oil can be nevertheless recycled, especially plastics. The Czech Republic belongs among important producers of plastic products. Domestic production of plastics increased by 93 %

in 2000–2004, the most in whole EU. Development of the branch is related especially to the increase of car production in the Czech Republic, as there is 100 to 200 kg of plastic products on a car. Demand of the wrapping industry has been rising, too – it represents a dominant plastics consumer in the Czech Republic (47 %). Average consumption of plastics per capita is about 60–70 kg in the Czech Republic, the most of the countries of central and Eastern Europe. Average of the EU countries is between 90 and 100 kg per capita.

The Czech Republic occupies the second place after Germany among the EU countries as plastics recycling concerns. 38 % of sorted plastics were recycled in 2004 in the Czech Republic; it was already 42 % in 2005 and 52 % in 2007. Fibres, which can be used as sleeping bag or winter jacket filling and can be added also in loaded carpets, can be made of recycled PETE bottles. Litter bags, waste baskets or garden furniture can be made by recycling of other plastics.

11. Possible substitutes

Oil may be successfully substituted to certain extent by other types of fuels in energy generation. As for gasoline or other oil derivatives, these can be substituted to a certain degree by fuels based on plants.

1. Characteristics and use

There are two types of natural gas: natural gas more or less associated with crude oil and natural gas from coal. Natural gas is a mixture of gaseous hydrocarbons, principally methane (CH_4), with other gases (nitrogen, carbon dioxide, hydrogen sulphide, hydrogen, inert gases). Methane dominates in the mixture from more than 50 %. There is also some natural blending with crude oil, water and sand when exploiting natural gas. Three principal grades of natural gas are recognized in the Czech Republic: dry gas (containing 96–99 % of methane), wet gas (85–95 % of methane plus admixture of other hydrocarbons) and gas containing higher portion of inert components (50–65 % of methane, more than 10 % of nitrogen – N_2 and more than 20 % of carbon dioxide – CO_2).

The world´s economic reserves of natural gas were estimated at about than 181,5 trillion cubic meters. The greatest part of economic reserves is situated in the territories of Russia (almost 27 %), Iran (almost 16 %) and Qatar (14 %). Rather large reserves are also on the territory of Saudi Arabia (almost 4 %), United Arabian Emirates and the USA (above 3 % each), , Niger (almost 3 %), Algeria and Venezuela (roughly 2.5 % each).

Solid methane in form of the so-called gas hydrate could represent a perspective resource. Usually it occurs in sediments of the ocean floor or in permafrost. However, its extraction has not been completely technologically and economically solved.

Gas of usually Carboniferous age emitted out of coal seams (Coal Bed Methane – CBM) may be classified as natural gas, too. The Carboniferous gas contains 90–95 % of methane. Its volume varies from 0 to 25 m^3 per tonne of coal. It depends on a degree of carbonification and on the depth of occurrence.

Natural gas is along with crude oil and coal one of the main world natural fuels. It is a universal energy source – the most often it is used for heating and electric energy production.

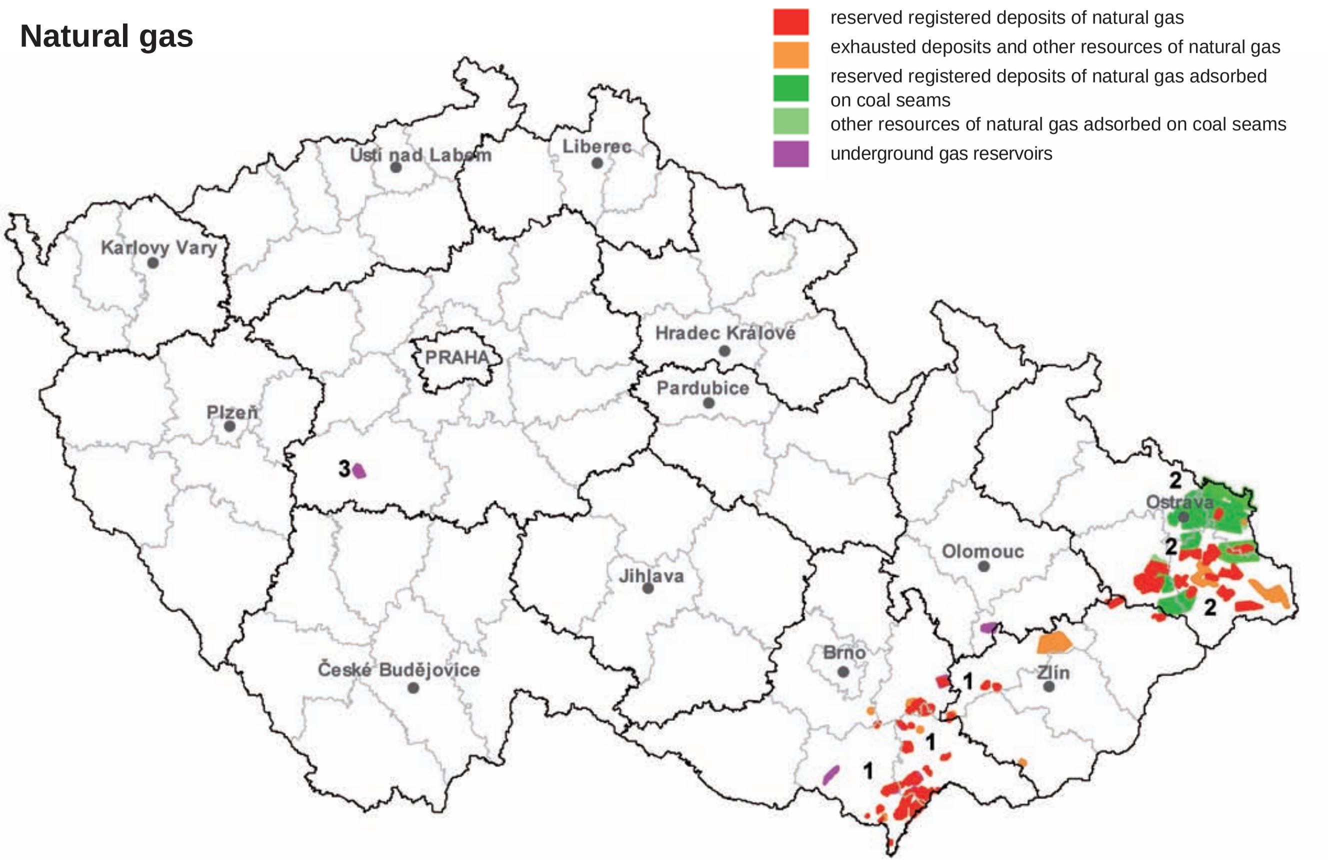
2. Natural gas resources of the Czech Republic

As with crude oil, the Czech Republic is not endowed with sufficient reserves of natural gas either. Deposits and reserves are accumulated in southern and northern Moravia. They are associated with geological units of the Western Carpathians and the south-eastern slopes of the Bohemian Massif, where they usually occur together with crude oil. In northern Moravia they are also associated with coal seams of the Upper Silesian Basin. Extraction of natural gas in the Czech Republic has been rather stable on a long term and it covers roughly 1–2 % of domestic consumption. The exploatation has violently increased in 2005 due to a single-phase exhaust of recoverable reserves of gas cushion of the underground gas storage Dolní Bojanovice (Poddvorov deposit).

- Natural gas deposits, genetically associated with formation of oil, occur in the Moravian part of the Vienna Basin. Crude oil deposits are concentrated mainly in the central part of the Basin, natural gas deposits prevail in peripheral areas. They occur in the Badenian sediments along with oil deposits either as independent natural gas deposits or in form of gas caps of the oil deposits or gas dissolved in the oil. The overlying Sarmatian sediments contain almost exclusively only natural gas deposits. Exploited natural gas contains 87.2–98.8 % volume of CH_4, its calorific value is 35.6–37.7 MJ/m^3 (dry natural gas at 0°C), specific gravity is 0.72–0.85 kg/m^3 (at 0°C) and H_2S content is under l mg/m^3. New natural gas resources have been discovered especially in the Prušánky area during exploration mostly using the 3D seismics. Based on these positive results, further exploration will focus on analogical types of deposit structures. The largest mined-out natural gas deposits from the Hrušky and Poddvorov fields have been used as underground gas storages Tvrdonice and Dolní Bojanovice.

- The Carpathian Foredeep and south-eastern slopes of the Bohemian Massif represent another area with common oil and gas occurrences. Dolní Dunajovice, Uhřice and Horní Žukov (gas deposits converted into underground storages) and Lubná-Kostelany (today almost mined out) belong to the largest deposits. The most important accumulations are confined mainly to collectors in the Miocene, Jurassic and jointed and weathered portions of the crystalline rocks. The deepest exploited deposit is Karlín, where natural gas (and gas condensate) was mined from depth of more than 3,900 m. The composition of local gas deposits varies considerably. The Dolní Dunajovice deposit is characterized by high content of methane (98 %), whereas the deposit Kostelany–západ contains only 70 % methane and is rich in helium and argon, which can be extracted on industrial scale. Considerable reserves are bound in gas caps of the heavy crude oil deposits Ždánice-Miocene and Kloboučky. Mining technology which would enable to extract economically not only the natural gas bound in gas caps but also a part of heavy oil reserves has been intensively searched for. New natural gas resources have been discovered especially in the Poštorná area during exploration mostly using the 3D seismics. Based on these positive results, further exploration will focus on analogical types of deposit structures. Gas deposits Dolní Dunajovice and Uhřice are secondarily used as underground gas storages. In northern Moravia, specifically between Příbor and Český Těšín, the gas deposits are mostly associated with the weathered and tectonically affected Carboniferous paleorelief, or with the directly overlying clastic rocks of the Miocene. Several natural gas deposits have been opened in this area during the last years, with the most important deposit Janovice. The origin of gas in these deposits developed in the apical parts of the Carboniferous morphological elevations has not been explained yet – either the gas is formed during the coalification of coal deposits, or it is related to crude oil formation. This concerns especially Bruzovice and Příbor deposits. Part of the Příbor gas deposit or already mined-out Žukov deposit is used as underground gas reservoir.
- Natural gas of obviously Carboniferous origin and age is extracted during so-called degassing (extraction from already closed underground mines) of coal seams of the Czech part of the Upper Silesian coal basin. Mine gases are diluted by air and the resulting concentration of such gases reaches about 50–55 % CH_4. O_2, N_2, CO and CO_2 are present, too. The natural gas quality varies considerably depending on the method of extraction and technical limitations related to degassing. CH_4 content in non-diluted Carboniferous gas is 94–95 %. Gas from individual localities is delivered by more than 100 km long network of gas pipelines to local consumers (e.g. Mittal Steel). Natural gas adsorbed on coal seams makes almost 22 % of the total present production in the Czech Republic. However, its proportion represents almost 88 % of the approximate total of 28 billion m^3 of recoverable reserves. Natural gas from the mines Dukla, Lazy and Doubrava goes by 22 km long pipeline to the steel works Nová Huť in Ostrava.

Natural gas


reserved registered deposits of natural gas
exhausted deposits and other resources of natural gas
reserved registered deposits of natural gas adsorbed on coal seams
other resources of natural gas adsorbed on coal seams
underground gas reservoirs
Ústí nad Labem
Liberec
Karlovy Vary
Hradec Králové
PRAHA
Pardubice
Plzeň
3
2
Ostrava
2
Olomouc
2
Jihlava
Brno
1
Zlín
České Budějovice
1
1

- Numerous occurrences of natural carbohydrates both on the terrain surface and in boreholes were found in the area of the Carpathian flysh nappes. Extraction of several deposits (e.g. Hluk) of restricted extent took place in the past.

3. Registered deposits and other resources in the Czech Republic

(see map)

Principal areas of deposits and underground gas reservoir Háje:

1 South-Moravian region 2 North-Moravian region 3 underground gas reservoir Háje

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	82	83	84	84	85
exploited	35	35	38	40	39
Total mineral *reserves, mill m^3	41 699	41 731	46 542	46 811	45 989
economic explored reserves	3 996	4 097	3 848	4 109	4 139
economic prospected reserves	35 675	35 606	40 643	40 593	39 765
potentially economic reserves	2 028	2 028	2 051	2 109	2 085
exploitable (recoverable) reserves	24 987	24 933	27 982	28 160	27 819
Mine production, mill m^3	131	175	356	148	148

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

5. Foreign trade

271121 – Natural gas

	2003	2004	2005	2006	2007 e
Import, mill m^3	9 786	9 169	9 759	9 761	8 400
Export, mill m^3	29	63	N	86	N

Territorial classification of import is paradoxically considered as confidential. However, in principle roughly 75 % of natural gas is imported from Russia and the remaining about one forth from Norway. Czech natural gas is exported in volume lower in order than the import to Austria, Poland and Germany. The import was assured by RWE Transgas (97 %) and Vemex (3 %).

6. Prices of domestic market and foreign trade

271121 – Natural gas

	2003	2004	2005	2006	2007 e
Average import prices (CZK/ths m^3)	3 676	3 472	4 668	6 088	5 929

As in case of crude oil, the import prices multiplied twice in 2000 (CZK 2,063 for thousand m^3 in 1999; CZK 4,059 on thousand m^3 in 2000). Import prices of natural gas remained high also in the following years. A slight decrease of the average import price in 2004 was due to strengthening of the CZK against USD. Average import prices of natural gas continued to rise in 2006 by full 30 % in between the years. Import prices were still high in 2007, reaching almost CZK 6,000/ths cubic meters. Total consumption of crude oil reached about 8.653 billion cubic meters, which is by 7 % less than in 2006. The decrease is caused namely by high prices of the commodity, due to which a part of consumers changed the energy medium.

7. Mining companies in the Czech Republic as of December 31, 2006

Moravské naftové doly a.s., Hodonín

Green Gas DPG, a.s. (se sídlem Paskov)

UNIMASTER s.r.o., Ostrava-Hrabová

Česká naftařská spol. s.r.o., Hodonín

Eight underground storage facilities of natural gas operated by three companies exist in the Czech Republic. Their total capacity represents about one third of the natural gas consumption in the Czech Republic. Company RWE Transgas, a.s. (a subsidiary of the German company RWE AG) – specifically its daughter company RWE Gas Storage s.r.o. – owns six underground storage facilities on the territory of the Czech Republic (Dolní Dunajovice, Tvrdonice, Štramberk, Lobodice, Háje u Příbrami and Třanovice) with capacity of about 2.321 billion cubic meters. The company has foreseen enlargement of the capacity of the storage facilites by additional 0.77 billion cubic meters.

Moravské naftové doly a.s. operates the underground storage facility Uhřice with capactiy of 180 mill cubic meters, which was opened in 2001. The company has been planning construction of another storage facility with capacity of 570 mill cubic meters along with VEMEX Company.

Storage in Dolní Bojanovice with capacity of 570 mill cubic meters is owned and operated by SPP Bohemia a.s. However, this underground storage facility of natural gas has been used only for needs of the Slovak Republic.

8. World production

World natural gas production persisted in the range of about 2,400 up to 2,800 billion m^3 a year during the last five years. It was unaffected by the decrease in production in Russia, the major world producer of natural gas, because that was offset by increased production in other countries, particularly in Canada, the Middle East countries, and elsewhere. Regional disproportion between natural gas producers and consumers is lower than in the case of crude oil. The share of the USA in the world production is 18.8 %, on the consumption 22.6 %. China contributes by 2.4 % to the world production and consumes almost equal portion of 2.3 %. The share of EU members is 6.5 % and 16.4 % of production and consumption, respectively. World production was as follows (according to the British Petroleum and Welt Bergbau Daten):

World natural gas extraction

Year	2003	2004	2005	2006	2007 e
Mine production, bill. m^3 (BP)	2 619	2 704	2 776	2 872	2 940
Mine production, bill. m^3 (WBD)	2 570	2 606	2 647	2 731	N

Main producers' share in the world mine output (2006; according to WBD):

Russia	22.7 %	Great Britain	3.0 %
USA	19.3 %	Indonesia	3.0 %
Canada	7.0 %	Algeria	2.9 %
Norway	3.4 %	The Netherlands	2.7 %
Iran	3.2 %	Saudi Arabia	2.5 %

Note:
Russian natural gas production has been reported under the standard pressure of 0.1 MPa and temperature of 20 °C. To compare it with western standards it is necessary to multiply the values by a factor of 0.9315.

The gas of Carboniferous origin emitted during extraction of coal seams reached about 25 billion m^3 per year. It represented 4–6 % of all methane emissions from both natural and artificial sources of methane in the world. About 1.6 billion m^3 of gas, i.e. approximately 6 % of the given 25 billion m^3, were used for industrial purposes. The remainder went to the atmosphere. According to 1996 data, 10 countries used the Carboniferous gas – China, Russia, Czech Rep., Germany, Poland, Great Britain, the USA, Australia, France and Ukraine.

9. World market prices

Most of the natural gas contract prices are linked to crude oil market prices as there are not internationally quoted world natural gas prices but there are bilateral long-term supply contracts.

General increase in natural gas consumption was accompanied by decrease in costs of transport paid by consumers for imported gas (approximately 75 % of gas is transported through pipelines and about 25 % in tankers in liquefied state). Natural gas prices are negotiated and are quoted in USD per mill Btu. Natural gas price for customer in Europe that had been still fluctuating between USD 3.6 and 4 per mill Btu in 1985 fluctuated around USD 2.25 per mill Btu in 1996. Prices fell down to USD 1.7–2.0 per mill Btu in 1998. Natural gas prices fluctuated between 1.8 and 2.9 per mill Btu in 1999. Natural gas prices increased significantly in connection with increase of crude oil prices during 2000. In autumn 2000, natural gas prices were for the first time in history higher than USD 5 per mill Btu. In 2001, the prices were oscillating between USD 1.9 and 3.4 mill Btu, in 2002 in a relatively broad range of 2.0–5.3 USD/mill Btu. The local maxima were reached in 2003, when natural gas was traded shortly in the end of February for 9.5 USD/mill Btu. The prices fluctuated mainly between 4.5 and 7.2 USD/mill Btu for the rest of the year, with the annual average of 5.5 USD/mill Btu. High prices of the natural gas in 2003 copied the record-breaking prices of the crude oil. Natural gas price remained rather high in 2004 in relation to the still record crude oil prices. The price oscillated between 4.5 and 9.0 USD/mill Btu and the annual average was 6.17 USD/mill Btu. World prices of natural gas oscillated in a wide range between USD 5.5/mill Btu and USD 15.5/mill Btu. High prices of the natural gas in 2003 copied the record-breaking prices of the crude oil. Natural gas price remained rather high in 2004 in relation to the still record crude oil prices. The price oscillated between 4.5 and 9.0 USD/mill Btu and the annual average was 6.17 USD/mill Btu. World prices of natural gas oscillated in a wide range between USD 5.5/mill Btu and USD 15.5./mill Btu in 2005. Prices markedly rose especially in the second half of the year, when they reached very high values. In 2006 natural gas prices ranged between 5.5 and 11.0 USD/mill Btu with predominating decrease in the first and reincrease in the second half of the year. The prices oscillated between 6 and 9 USD/mill Btu in 2007. They increased more markedly from 8 to 13 USD/mill Btu in the first half of 2008 Increase of the world natural gas prices is due to the fact that this energy mineral represents an alternative to the other mineral fuels. As with oil and other minerals, the stated prices are nominal the rise of which is apart from fundamental factors partly influenced also by long-term decrease of the US dollar.

10. Recycling

Natural gas is not recycled.

11. Possible substitutes

Natural gas can be successfully substituted to a certain extent by other types of fuel in energy generation. However, natural gas itself represents economically and ecologically effective substitute for all other mineral fuels (it emits the least amount of CO_2 per unit of energy produced).

INDUSTRIAL MINERALS
– geological reserves and mine production

In addition to energy minerals, industrial minerals represent the most important group of minerals on the territory of the Czech Republic. Raw materials for ceramic and glass industry are traditionally important as their geological reserves as well as mining concerns. Kaolin of the Plzeň (Pilsen) and Karlovy Vary regions as well as Kadaň and Podbořany regions is the most significant one. Other important raw materials are glass sand from Střeleč and Provodín surroundings, feldspar from Halámky and Krásno and clay from the Cheb Basin and central Bohemia. Reserves of limestone and raw materials for cement production are large and their mine production reaches high volume.

Kaolin, quartz sand, limestone, clays, feldspar and dimension stone are also important export commodities in mineral sector.

On the other hand, the production of formerly important graphite, pyrite, fluorite, barite and some other industrial minerals was already terminated, most likely definitively.

Mining of industrial minerals – reserved deposits

Raw material	Unit	2003	2004	2005	2006	2007
Graphite	kt	9	5	3	5	3
Pyrope-bearing rock	kt	53	42	43	39	34
Kaolin	kt	4 155	3 862	3 882	3 768	3 604
Clays	kt	554	649	671	561	679
Bentonite	kt	199	201	186	220	284
Feldspar	kt	421	488	472	487	514
Feldspar substitute (phonolite)	kt	27	26	23	31	25
Glass and foundry sand	kt	1 616	1 659	1 727	1 736	1792
Fusible basalt	kt	13	12	14	19	16
Diatomite	kt	41	33	38	53	19
Limestones (total)	kt	10 236	10 568	9 912	10 193	11 280
high percentage limestones	kt	4 573	4 629	4 199	4 386	4 885
other limestones	kt	4 444	4 666	4 500	4 643	5 138
Dolomites	kt	416	345	419	409	385
Corrective additives for cement production	kt	201	232	278	248	391
Gypsum	kt	104	71	25	16	66

Lifetime of industrial reserves

(economic explored disposable reserves) based on the decrease of reserves by mine production incl. losses in registered deposits per year 2007 (A) and on the average annual decrement of reserves in period 2003–2007 (B) is as follows:

Raw material	Lifetime – A (years)	Lifetime – B (years)
Graphite	> 100	> 100
Pyrope-bearing rock	52	48
Kaolin	46	45
Clays	> 100	> 100
Bentonite	> 100	> 100
Feldspar	55	58
Glass and foundry sand	98	44
Fusible basalt	> 100	> 100
Diatomite	> 100	85
Limestones (total)	> 100	> 100
high percentage limestones	> 100	> 100
other limestones	> 100	> 100
Dolomites	> 100	> 100
Corrective additive for cement production	> 100	> 100
Gypsum	> 100	> 100

Fluorspar

1. Characteristics and use

Fluorspar is the commercial term of the mineral fluorite. Most fluorspar deposits are veins of hydrothermal origin. Fluorspar deposits which originated by infiltration, metasomatism and sedimentation are much less abundant. Other minerals like quartz, barite, calcite, etc. usually accompany fluorspar. According to the USGS (MCS), world economic reserves of fluorspar are given at 480 mill t (reserve base), about 230 mill t of which represent reserves. The largest part of the reserves is located on the territory of China (23 %), South Africa (17 %) and Mexico (more than 8 %). Phosphate rock deposits containing about 3 % of fluorine on average could represent a potential fluorine source in future.

Three basic grades of fluorspar can be distinguished according to their quality and specification:

a) metallurgical grade (min. 85 % CaF_2, max. 15 % SiO_2);
b) acid grade (min. 97 % CaF_2, up to 1.5 % SiO_2, 0.1–0.3 % S);
c) ceramic grade (80–96 % of CaF_2, up to 3 % SiO_2).

More than half of the mined fluorspar is used in chemical industry for production of fluorine (F), hydrofluoric acid (HF), NaF and synthetic cryolite. Fluorine is contained in teflon and refrigerants (Freons). Metallurgical steel and aluminium industry also consumes relatively large volumes of fluorspar (1/3 of the total fluorspar production) as flux to reduce melting temperatures. Other applications are for example in cement production, in glass industry (glass with 10 to 30 % CaF_2 is milky, opaque and opalescent), in enamels, etc. Complex chemicals with fluorine and bromine are used in fire extinguishers and anaesthetics.

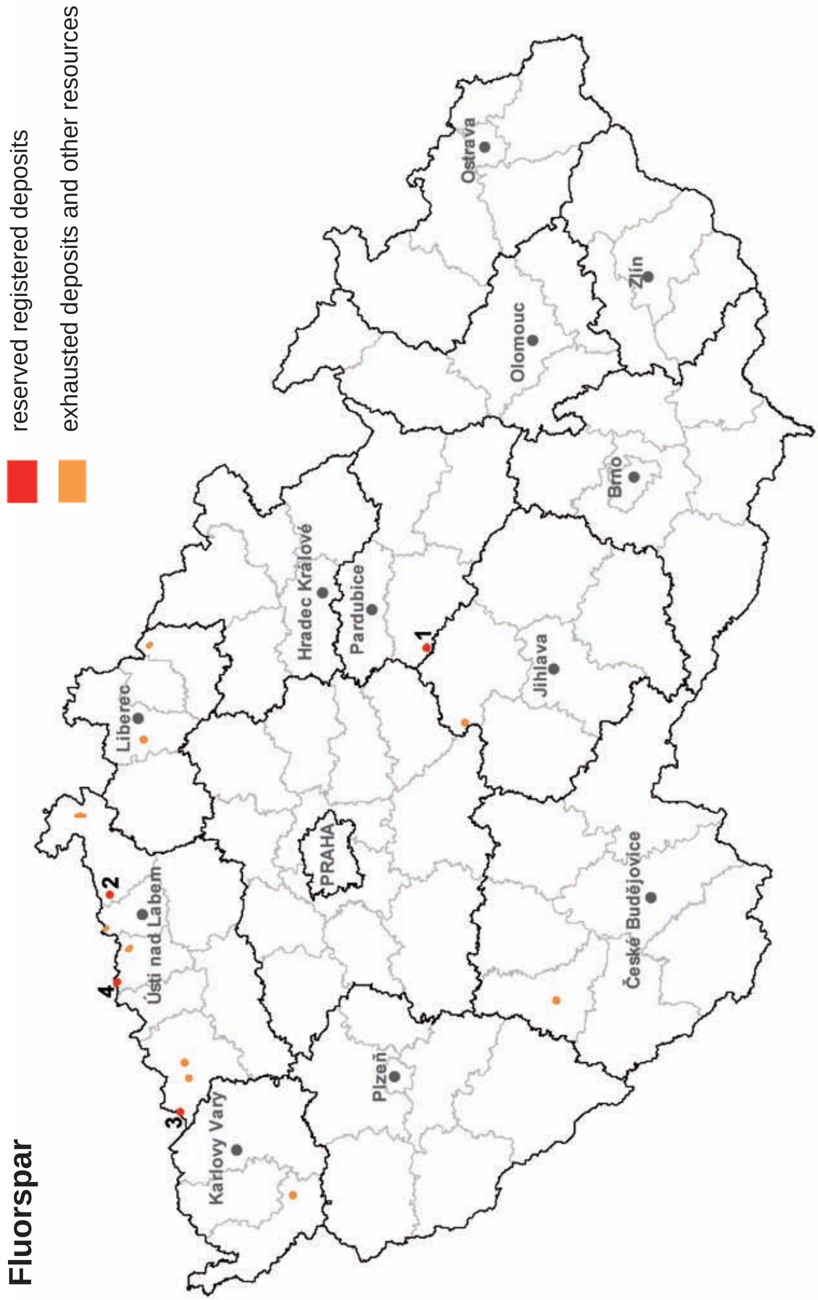
2. Mineral resources of the Czech Republic

All Czech fluorspar deposits are of hydrothermal origin, i.e. vein, stockwork and rarely even impregnation or metasomatic types. They are mostly located in marginal parts of the Bohemian Massif, associated with major fault zones of the Krušné hory Mts. (NE-SW) and the Labe-Lužice (NW-SE) lineaments direction. The most important deposits are located in the Krušné Hory Mts. (e.g. Moldava, Kovářská), less important ones in the Lužice area of the Bohemian Cretaceous Basin (Jílové u Děčína), Železné hory Mts. (Běstvina). Smaller deposits and occurrences are also in other parts of the Bohemian Massif (e.g. Krkonoše Mts. – Harrachov, Ještěd Mts. piedmont – Křižany et al.)

- Fluorite accumulations are most often associated with a considerable proportion of barite (for instance registered deposits Běstvina, Kovářská, and mined out deposits Krásná Lípa, Hradiště u Vernéřova, Harrachov, Křižany u Liberce et al.).
- Smaller part of fluorite accumulations contains almost no barite (e.g. registered deposit Jílové u Děčína and mined out deposits Blahuňov u Chomutova, Kožlí u Ledče et al.) or there are just subordinate barite contents (e.g. registered deposit Moldava, mined-out deposit Vrchoslav et al.).

Industrial mining of fluorite in the Czech Republic started in the beginning of the 1950s (apart from a small mine in Kožlí u Ledče nad Sázavou during both of the world wars) and continued until the first quarter of 1994, when extraction from Jílové, Běstvina and Moldava deposits was terminated. Resumption of mining is not foreseen, as there is sufficient

Fluorspar


reserved registered deposits
exhausted deposits and other resources
Karlovy Vary
Plzeň
Ústí nad Labem
Liberec
PRAHA
Hradec Králové
Pardubice
Jihlava
České Budějovice
Brno
Olomouc
Zlín
Ostrava
1
2
3
4

amount of raw material of higher quality and lower price especially from China. Czech deposits are of no economic use at present.

3. Registered deposits and other resources in the Czech Republic

(see map)

Registered deposits and other resources are not mined

1 Běstvina
2 Jílové u Děčína
3 Kovářská
4 Moldava

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number [a)]	4	4	4	4	4
exploited	0	0	0	0	0
Total mineral *reserves, kt	2 033	2 033	2 033	2 033	2 033
economic explored reserves	0	0	0	0	0
economic prospected reserves	0	0	0	0	0
potentially economic reserves	2 033	2 033	2 033	2 033	2 033
Mine production, kt	0	0	0	0	0

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

a) Deposits with registered fluorspar reserves

Fluorspar processing, production of fluorspar concentrate

FLUORIT Teplice s.r.o.

FLUORIT Teplice s.r.o. started its activity in 1954, when the flotation lines for fluorite concentrate production for chemical industry in Teplické rudné doly in Sobědruhy went into operation. Fluorit Teplice s.r.o. founded in 1992 became a successor in fluorite and fluorite concentrates production in Sobědruhy. After the domestic fluorite exploitation was terminated in 1994, the company re-oriented to processing of imported mineral. Drying, grinding and sorting of the flotation fluorite concentrate represents the basic process of the production. The company produces various concentrates and also metallurgical fluorite. Almost half of the production is exported, especially to Slovakia, Germany, Hungary and Bulgaria.

5. Foreign trade

252921 – Fluorspar, containing 97 wt % or less of calcium fluoride

	2003	2004	2005	2006	2007
Import, t	7 206	8 342	8 487	8 879	13 384
Export, t	16 613	3 620	1 641	1 578	2 253

Detailed data on metallurgical fluorspar (252921) imports (t)

Country	2003	2004	2005	2006	2007
Mexico	6 841	2 917	1 617	1 259	5 236
China	347	198	0	1 052	3 305
Germany	2	5 597	6 665	6 403	2 690
Slovakia	0	0	120	85	349
others	16	4	85	80	1 805

252922 – Fluorspar, containing more than 97 wt % of calcium fluoride

	2003	2004	2005	2006	2007
Import, t	9 422	19 516	15 891	15 759	13 765
Export, t	6 858	6 454	7 036	8 566	8 087

Detailed data on chemical fluorspar (252922) imports (t)

Country	2003	2004	2005	2006	2007
Germany	50	1 352	6 122	10 207	7 527
South Africa	0	0	7 708	0	3 657
Mexico	0	1 002	0	0	1 844
China	9 311	17 253	2 014	5 553	624
others	61	108	47	0	112

Metallurgical fluorspar (customs item 252921) has been imported in a rather stable volume of between 7 and 9 kt per year. Almost twice as much was imported in 2007. This raw material type was imported traditionally almost exclusively from Mexico; since 2004, however, its major part has been imported from Germany and since 2006 also from China. Chemical fluorspar (customs item 252922) represents a similar case – the original Chinese raw material has been newly imported via Germany. Volume of import of the chemical fluorspar is more fluctuating, roughly between 10 and 20 kt per year during the last five years. Major part of the exported fluorspar is a product of the Fluorit Teplice, s.r.o. which deals with processing of imported mineral.

6. Prices of domestic market and foreign trade

252921 – Fluorspar, containing 97 wt % or less of calcium fluoride

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	3 736	4 014	4 192	4 173	4 283
Average export prices (CZK/t)	945	4 469	5 958	6 311	6 376

252922 – Fluorspar, containing more than 97 wt % of calcium fluoride

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	3 901	4 690	4 762	5 017	4 600
Average export prices (CZK/t)	6 625	7 416	7 343	7 398	7 778

7. Mining companies in the Czech Republic as of December 31, 2007

No mining companies were extracting fluorspar on the territory of the Czech Republic in 2007.

8. World production

The world production was increasing until 1989 when 5,925 kt of fluorspar were extracted. Since then, there was a sharp fall in the production due to reduction of fluorspar consumption in steel and aluminium production and in chemical industry (reduction of Freon production). World mine production gradually increased from the minimum of 4,031 kt in 1993 to 4,670 kt in 1998. World production increased slowly from 4.4 to 5.3 mill tonnes during the last five years. In addition to China and Mexico, mine production has increased also in Mongolia and Iran. Production of South Africa has been rather stagnating, whereas mine production in Russia has been decreasing recently. In Europe, Spain, Italy and Great Britain show rather stable mine productions; by contrast, mine production in Germany markedly increased in 2006. Data according to Mineral Commodity Summaries (MCS) and the Welt Bergbau Daten (WBD):

World fluorspar mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt (MCS)	4 750	5 060	5 260	5 330	5 310
Mine production, kt (WBD)	4 712	5 199	5 210	5 393	N

Main producers' share in the world mine output (2006; according to MCS):

China	51.6 %	Spain	2.5 %
Mexico	17.6 %	Namibia	2.4 %
Mongolia	7.3 %	Morocco	1.8 %
South Africa	5.1 %	Kenya	1.6 %
Russia	3.9 %	France	0.8 %

9. World market prices

Fluorspar prices were recently affected not only by fall in demand but also by supplies of cheap Chinese fluorspar on the world market. Prices of majority of quoted types significantly increased in 2004. Price rise continued also during the year 2005 (by roughly 20 % year-on-year in case of the African and Chinese mineral; on the other hand, prices of the Mexican fluorspar declined). Prices of the Mexican fluorspar increased in 2006 and the prices of the South African raw material increased as well. In 2007, the decreasing US dollar value influenced mostly the prices of the Chinese fluorspar, which increased year-on-year by nearly one third. Fluorspar prices valid for various fluorspar grades and place of origin are monthly quoted in the Industrial Minerals magazine in GBP/t or in USD/t and at different transport rates.

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
chemical quality, South Africa, dry, bulk, FOB Durban	USD/t	115.00	137.00	162.00	182.00	189.50
chemical quality, Mexico, filtration cake, FOB Tampico	USD/t	115.00	173.00	140.00	190.00	190.00
chemical quality, China, dry, CIF US Gulf Port	USD/t	167.50	200.00	235.00	235.00	307.50

10. Recycling

In chemical industry where fluorspar consumption prevails, fluorspar recycling is virtually impossible because of its dissociation during acid leaching. However, maximum effort is evident to recycle or reduce the consumption of saturated fluorohydrocarbons (freons) due to their negative environmental impacts. Not too much fluorspar is recycled in metallurgy when producing aluminium.

11. Possible substitutes

Fluorspar is virtually an unique source of fluorine for chemical industry and thus irreplaceable. However, an extensive replacement of fluorohydrocarbon derivatives is under way when using new agents and methods in cosmetics and refrigerants (fluorine and its compounds are replaced by carbon dioxide, nitrogen, air, mechanical sprays, etc.). Fluorohydrocarbons are replaced by hydrocarbons in production of foamed plastics. Fluorspar can be to a certain extent substituted by cryolite (incl. synthetic) in metallurgy when producing aluminium. Fluorspar can also be substituted by dolomite, limestone and/or olivine in ferrous metallurgy.

Barite

1. Characteristics and use

Barium, which is the major constituent of barite, occurs in igneous rocks. It is released during their weathering and transferred into sediments and residual rocks. Barite deposits, in general, can be divided in fissure veins, metasomatic, residual and volcanosedimentary (stratabound) deposits. According to the USGS, world barite reserves are given at 740 mill t (reserve base), about 200 mill t of which represent reserves. Almost half of reserves is located in China (48 %), further in India (11 %) and the USA (more than 7 %).

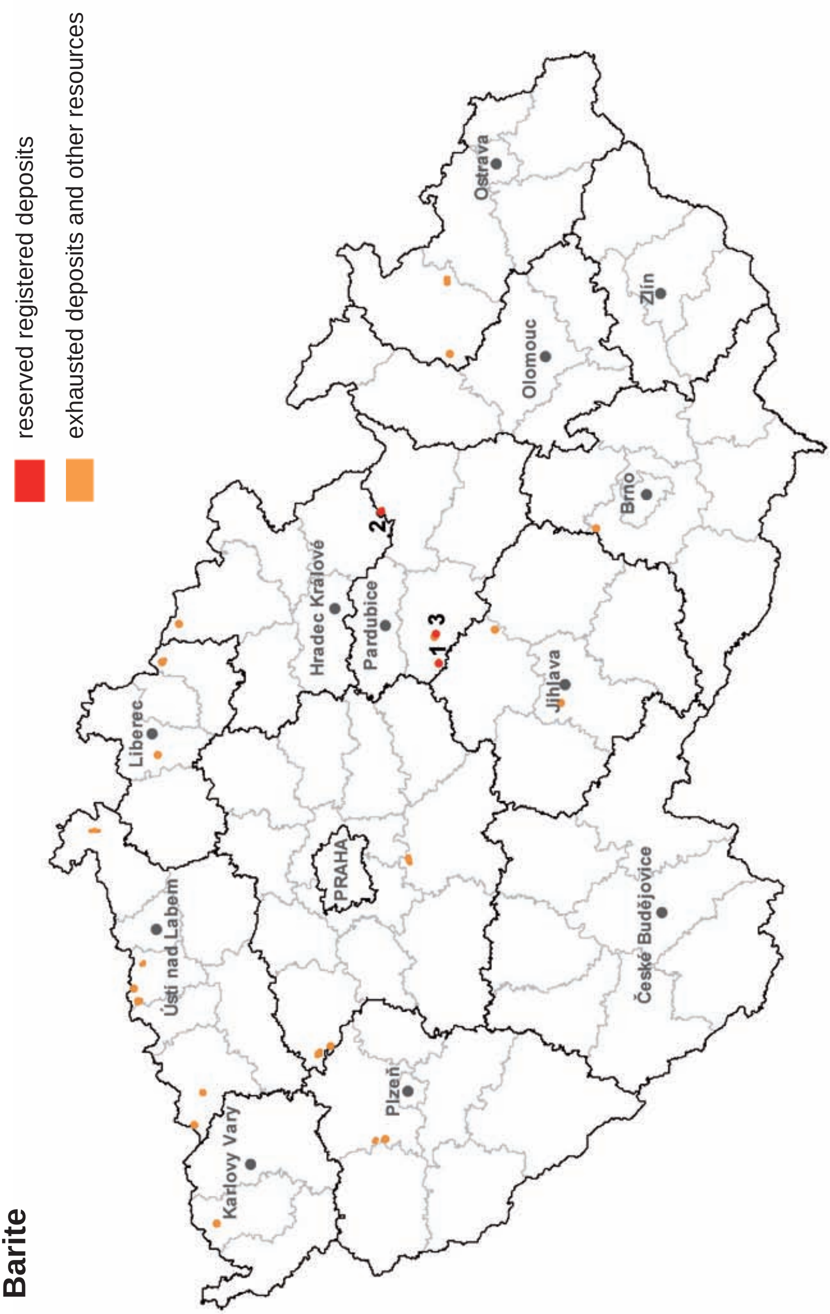
Barite is widely used because of its specific properties such as whiteness, high density, chemical resistance, absorption of X-rays and gamma radiation, etc. Barite is used in glassmaking to produce special glass, in ceramic glazes, porcelain enamels, paints, plastics, fireworks (signal flares, detonators, etc.), for radiation shielding, in insecticides, etc. The major use of barite, however, is as high-weight mud for petroleum and natural gas exploration drilling.

2. Mineral resources of the Czech Republic

Barite deposits of the Czech Republic are of hydrothermal origin, mainly of the vein or stockwork type, to a lesser extent of the metasomatic or stratabound types. These deposits are randomly distributed over the Bohemian Massif, which is caused by a great number of barite-bearing formations of various age and origin. The most important deposits were located in the Krušné hory Mts. (e.g. Kovářská, Mackov), Železné hory Mts. (e.g. Běstvina), Krkonoše Mts. (e.g. Harrachov); smaller deposits and occurrences are known from the Jeseníky Mts. (e.g. Horní Benešov), from the Proterozoic of the western (e.g. Pernárec) and central Bohemia (e.g. Krhanice), Orlické hory Mts. (e.g. Bohousová), Čistá-Jesenice Massif (e.g. Otěvěky) etc.

- Hydrothermal veins, locally with base metals, are tens to hundreds metres, exceptionally even 1 km, long, and have thickness between a few decimetres to several meters. The vein filling consisting of barite is in the form of lenses or columns. These veins are mostly confined to regional faults or faults of lower order trending mostly NW-SE and NNW-SSE. Younger polymetallic (base metal) and the latest quartz mineralization, which downgrades the vein fillers in deeper parts, are common, too (e.g. the Mackov and Bohousová deposits). Mined out deposit of Pernárec (1924–1960), further the deposits and occurrences Mackov, Bohousová etc., belong to the deposit type where barite is sole or predominating mineral. Fluorite is present in substantial amount along with barite at deposits Běstvina, Moldava, Kovářská, Harrachov etc. A barite mineralization is known from the Květnice deposit near Tišnov in the Moravicum, where barite was mined in 1905–1908 and during World War II.
- Stratabound barite deposits originated from submarine hydrothermal solutions ascending along the faults at sea floor. These deposit types are in the Bohemian Massif represented by layers and lenses in the Proterozoic sediments of the islet zone (Krhanice nad Sázavou), Železné hory Mts. (Křižanovice) and in the Devonian of the Jeseníky Mountains (Horní Město-Skály, Horní Benešov, where barite was mined as a by-product in 1902–1914 and 1955–1960).

Barite


reserved registered deposits
exhausted deposits and other resources
Karlovy Vary
Ústí nad Labem
Liberec
Hradec Králové
Pardubice
PRAHA
Plzeň
České Budějovice
Jihlava
Brno
Olomouc
Zlín
Ostrava
1
2
3

Barite was exploited in Czech Republic until 1990 from Běstvina deposit and, until 1991, from Harrachov deposit. Renewal of mining is not foreseen in the near future. The deposits lost their industrial importance; their remaining reserves are gradually revaluated and in majority of the cases written off from The Register. Also, as with fluorite, there is a sufficient amount of higher-quality and less expensive raw material, first of all from China.

3. Registered deposits and other resources in the Czech Republic

(see map)

Registered deposits and other resources are not mined

1 Běstvina 2 Bohousová 3 Křižanovice

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number [a)]	3	3	3	3	3
exploited	0	0	0	0	0
Total mineral *reserves, kt	569	569	569	569	569
economic explored reserves	0	0	0	0	0
economic prospected reserves	0	0	0	0	0
potentially economic reserves	569	569	569	569	569
Mine production, kt	0	0	0	0	0

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

a) Deposits with registered barite reserves

5. Foreign trade

251110 – Natural barium sulphate (barite)

	2003	2004	2005	2006	2007
Import, t	8 090	7 386	8 552	7 536	6 358
Export, t	452	405	512	277	284

251120 – Natural barium carbonate (witherite)

	2003	2004	2005	2006	2007
Import, t	358	1 399	0	0	0
Export, t	443	211	49	0	0

Volume of the imported barite has been ranging roughly between 6 and 10 kt on a long term, only a negligible amount has been re-exported. Import in the Czech Republic comes traditionally from Germany, Slovakia, Great Britain and China.

6. Prices of domestic market and foreign trade

251110 – Natural barium sulphate (barite)

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	5 218	6 403	6 392	5 649	5 905
Average export prices (CZK/t)	N	N	N	N	N

Average import prices have been ranging between about CZK 5,000 and 6,400 per tonne, i.e. about USD 150–270 per tonne. Import price of barite increased during the first half of the year 2007 and it reached roughly 290 USD/t. In the second half of the year, it oscillated between 297 and 312 USD/t.

7. Mining companies in the Czech Republic as of December 31, 2007

No mining companies were extracting barite on the territory of the Czech Republic in 2007.

8. World production

World production of barite was gradually increasing until 1990 (8,209 kt). It then dropped down, mainly because of global economic recession, which affected not only major barite consuming sectors (both crude oil and natural gas exploration), but also chemical industry. Then the barite production was increasing till 1997 (6,930 kt). Since 1999, the world production is increasing again. The increase of the world production is caused particularly by the increase of the Chinese mine production. Mine production in Mexico, Thailand and the USA has been increasing in recent years, too. Preliminary production data for the year 2007 already reaches the almost historically highest production of 1990, which shows evidence of the actual world boom in the mineral sector. Data on the world mine production according to Mineral Commodity Summaries (MCS) and Welt Bergbau Daten (WBD):

World barite mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt (MCS)	6 700	7 240	7 870	7 960	8 000
Mine production, kt (WBD)	7 478	7 358	7 742	7 941	N

Main producers´ share in the world mine output (2006; according to MCS):

China	55.3 %	Mexico	2.6 %
India	11.9 %	Turkey	2.3 %
USA	7.4 %	Vietnam	1.5 %
Morocco	4.4 %	Thailand	1.5 %
Iran	3.6 %	Kazakhstan	1.5 %

9. World market prices

Barite prices were in the past under pressure of oversupply, particularly of cheap Chinese and Indian barite. Chinese barite acquired the leading position on the world market already in the seventies, being used not only in drilling mud but also in other sectors of various industries. As in the case of fluorite, world prices of barite of Asian provenance increased significantly in 2004. Prices of barite from China and India increased also in 2006, and markedly also during the year 2007. Prices of various grade and origin are quoted monthly in the Industrial Minerals magazine in GBP/t or USD/t.

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
API, Chinese lump, CIF Gulf Coast	USD/t	44.50	63.50	59.00	72.50	115.00
API, Indian lump, CIF Gulf Coast	USD/t	48.00	70.00	70.00	83.50	143.00
API, Moroccan lump, CIF Gulf Coast	USD/t	51.00	63.50	68.00	68.00	N
Micro-ground white < 20 microns, paint grade, min. 99 %, UK	GBP/t	145.00	145.00	145.00	145.00	145.00

10. Recycling

Barite is actually continuously recycled when used in drilling mud. In other applications (chemicals, paints, enamels, glass, rubber etc.) it is not recycled because in its use is too dispersed to be economically recyclable.

11. Possible substitutes

Magnetite, hematite (incl. synthetic), ilmenite, celestite and other heavy minerals can be alternatively used instead of barite in drilling mud. Barite can be replaced by other fillers (e.g. by limestone, dolomite, soot) in production of rubber, in glassmaking partly by strontium salts, in lithopone by other whites (e.g. zinc white) etc. However, none of these substitutes is as good as barite.

Graphite

1. Characteristics and use

Graphite represents one of the forms of carbon (C) occurring in the nature. Graphite is an important technical mineral exhibiting perfect basal cleavage, very good electric and heat conductivity, high refractoriness (crucibles and furnace lining, e.g.) and resistance to acids, alkalies, molten metals, etc.

All rocks, which contain considerable amount of graphite that can be recovered, are considered as a graphite raw material. Graphite is graded primarily on the size of flakes – “crystalline” flake graphite with flakes exceeding 0.1 mm and “amorphous” graphite with flakes smaller than 0.1 mm, which appears like a massive material. The latter looks like a dull solid matter. There are no general rules about the division of crystalline graphite into large, medium, and small flake, and individual producers have different criteria.

Graphite deposits can be divided into early magmatic, contact metasomatic, metamorphogenic (metamorphic and metamorphosed) and residual deposits. According to the USGS, world reserves of graphite are given at 290 mill tonnes (reserve base), out of which about 86 mill t represent reserves. More than three quarters of reserves are located on the territory of China (76 %), more important reserves are also on the territory of India, Mexico, Sri Lanka and the Czech Republic (where the deposits are though largely sub-economic).

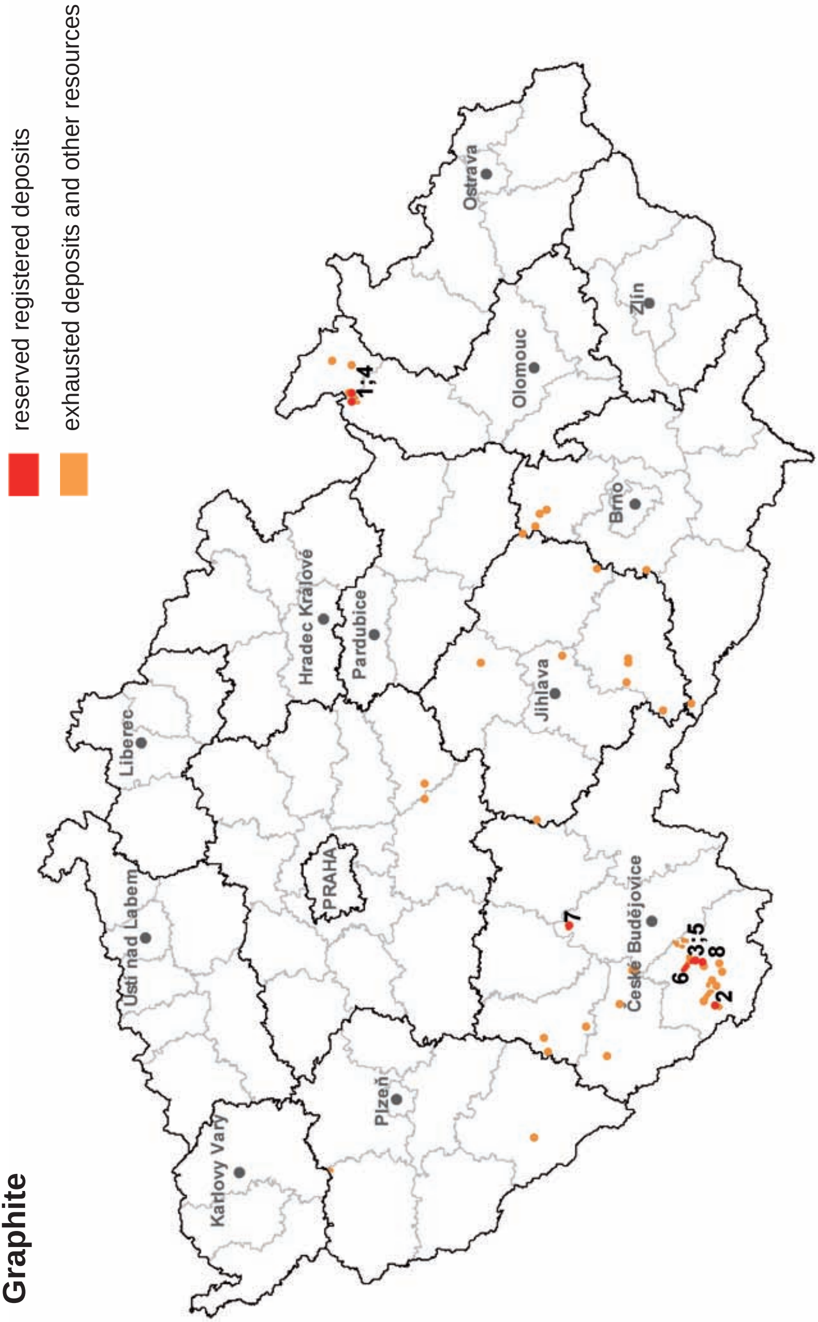
Use of graphite is based upon its physical and chemical properties. It is used in foundry industry, electricity and electronics uses, electrochemistry, chemical, rocket, armament and nuclear industries, in manufacture of refractory materials, lubricants, protective coatings, pencils, threads, production of synthetic diamonds etc.

2. Mineral resources of the Czech Republic

All graphite deposits in the Czech Republic belong to the metamorphogenic type. They originated during regional metamorphism of clayey sandy sediments high in organic matter, which is also indicated by higher concentrations of S, P, V and abundant limestones. The deposits occur in the Bohemian Massif in the Moldanubicum, Moravicum and Silesicum regional geological units.

- The most important deposits occur in the Modanubicum, particularly in the so-called Varied Group of Český Krumlov (deposits: Český Krumlov-Městský vrch, Lazec, where the mining was terminated in the middle of the year 2003; further deposits: Bližná, Spolí, Český Krumlov-Rybářská ulice). Other less important deposits occur in the Votice-Sušice Varied Group (a single, until 1967 mined deposit at Koloděje nad Lužnicí-Hosty) and in the Chýnov mica schists (Černovice – mined-out former deposit). South Bohemian graphitic rocks have a character of graphite-rich gneisses, quartzites and carbonates. Smaller occurrences, which are of no economic importance at present, are known also from the Moravian part of Moldanubicum (e.g. Lesná, Lubnice, Louka, Římov et al.).
- Deposits in the Moravian-Silesian region occur in an area affected by lower grade metamorphism. Graphite shows lower degree of crystallization and contains much more sulphur, which is confined to pyrite and pyrrhotite. The whole region is characterized by higher contents of combustibles and lower sulphur content in graphitic layers in lime-

Graphite



reserved registered deposits
exhausted deposits and other resources
Karlovy Vary
Ústí nad Labem
Liberec
Plzeň
PRAHA
Hradec Králové
Pardubice
Jihlava
České Budějovice
Brno
Olomouc
Zlín
Ostrava
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stones than those in graphitic schists and phyllites. The deposit Tresné, already mined out, was considered the largest graphite deposit of the Moravicum. It is located in the Olešnice group of the Svratka dome. The major deposit in the Silesicum is Velké Vrbno-Konstantin, which makes a part of a graphitic zone at the western margin of the Velké Vrbno dome. Since the second half of the year 2003, this deposit remains the only one to be mined in the Czech Republic. Other 8 small deposits in Branná and Velké Vrbno surroundings were registered until 2006, of which only 1 has remained after revaluation.

Underground mining of graphite deposits in the Czech Republic is economically unprofitable and it is on decline, as there is a sufficient supply of cheaper, especially Chinese mineral, similarly to fluorite and barite. On the other hand, open-pit mining in Velké Vrbno surroundings still continues and its mine production is rather stable.

3. Registered deposits and other resources in the Czech Republic

(see map)

Names of mined deposits are indicated in **bold type**

Amorphous graphite:

1 **Velké Vrbno-Konstantin**
2 Bližná-Černá v Pošumaví
3 Český Krumlov-Rybářská ulice
4 Velké Vrbno-Luční hora 2

Crystalline graphite:

5 Český Krumlov-Městský vrch
6 Lazec-Křenov
7 Koloděje nad Lužnicí-Hosty

Mixed (from amorphous to crystalline) graphite:

8 Spolí

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	15	15	15	8	8
exploited [b)]	1	1	1	1	1
Total mineral *reserves, kt [a)]	14 355	14 350	14 347	14 165	14 162
economic explored reserves	1 344	1 339	1 336	1 327	1 324
economic prospected reserves	4 154	4 154	4 154	4 041	4 041
potentially economic reserves	8 857	8 857	8 857	8 797	8 797
Mine production, kt [a)]	9	5	3	5	3

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

a) Reserves and mine production are given for crude graphite (graphite "ore"); average graphite contents in the raw material range between 15 and 20 % (crystalline grade) and 25–35 % (amorphous grade), respectively

b) Mining at crystalline graphite deposits Český Krumlov-Městský vrch and Lazec-Křenov was terminated in the course of the year 2003

Processing of graphite

Graphite Týn, spol. s r.o.

Graphite Týn s.r.o. (before March 2007 Maziva Týn s.r.o.) produces highly refined natural graphite, micro-ground graphite, expandable graphite, graphite dispersions and pressed graphite. The tradition of graphite processing in Týn nad Vltavou dates back to 1965. The company has been a member of the international concern Graphit Kropfmühl AG since 1999.

5. Foreign trade

2504 – Natural graphite

	2003	2004	2005	2006	2007
Import, t	2 765	3 668	4 858	3 601	5 301
Export, t	4 058	3 924	3 614	3 518	4 029

Detailed data on territorial structure of graphite import in volume (t)

Country	2003	2004	2005	2006	2007
Germany	807	1 098	2 027	1 177	2 686
China	1 429	1 862	2 265	1 912	2 349
Great Britain	311	373	382	177	53
others	218	335	184	335	213

Detailed data on territorial structure of graphite export in volume (t)

Country	2003	2004	2005	2006	2007
Germany	2 572	2 179	2 017	2 272	2725
Italy	653	719	601	381	418
Poland	261	553	481	265	284
Hungary	211	185	196	227	281
Slovakia	194	166	172	211	162
others	167	122	147	162	159

3801 – Synthetic graphite and graphite products; colloidal, semicolloidal graphite

	2003	2004	2005	2006	2007
Import, t	1 397	2 740	3 799	2 780	4 364
Export, t	703	829	673	369	563

6903 – Refractory ceramics products

	2003	2004	2005	2006	2007
Import, t	4 985	5 707	5 767	7 744	11 196
Export, t	10 158	12 186	12 470	14 062	16 379

After the domestic mining at south Bohemian deposits was terminated in mid-2003, the volume of imported graphite increased up to 5 kt in 2005 and in 2007. Graphite is imported to the Czech Republic first of all from China; imports reported as from Germany often contain Chinese raw material from deposits run in China by German companies. On the other hand, volume of exported graphite has been rather stable, oscillating between 3.5 and 4 kt per year. The raw material is directed mainly to neighbouring countries. Products made of the Czech refractory graphite ceramics were exported to more than 65 countries in and outside Europe in 2007.

6. Prices of domestic market and foreign trade

2504 – Natural graphite

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	15 295	19 849	23 849	36 198	23 699
Average export prices (CZK/t)	16 793	22 121	23 520	28 638	26 672

Prices of domestic flotation concentrates of natural graphite oscillated between CZK 12 and 16 thousands per tonne depending on the content of combustion matters, sulphur and moisture. Flotated crystalline flake graphite is sold for CZK 20,000 per tonne, flotated crystalline graphite with synthetic flake for CZK 15,000 per tonne. Graphite product (petroleum coke powder) has been offered for approximately CZK 12,000 per tonne in 2004. A wide spectrum of final graphite products, including chemically treated, micro-ground, expandable, pressed graphite and graphite lubricants, is offered by Graphite Týn, s.r.o. (formerly Maziva Týn nad Vltavou, s.r.o.). Prices of chemically treated graphite (purity above 99.5 % C) oscillate between CZK 54,000 and CZK 100,000 per tonne (according to the granular composition). Prices of further processed micro-ground graphites start from CZK 62,000 per tonne.

7. Mining companies in the Czech Republic as of December 31, 2006

Grafitové doly Staré Město, s.r.o.

8. World production

World production of graphite remained consistently around 1 mill t/year till 1992, then it markedly decreased. Graphite mine production has been increasing again in the last five years, during which many changes on the world market occurred: the Chinese dominant role was further strengthened whereas the mine production on Madagascar decreased significantly and that of Mexico, Zimbabwe and India. Mine production of Brazil has been increasing during the last two years. In Europe, graphite is mined only in Ukraiine, Norway, Czech Republic and in negligible amounts in Romania. Mine production in the Czech Republic reached 16 kt in 2002, i. e. around 2 % of the world production, about 1.2 % in 2003, and it can represent 0.5–1 % nowadays. Data in individual international yearbooks are variable and they are often backward-corrected. Data according to Mineral Commodity Summaries (MCS) and the Welt Bergbau Daten (WBD):

World graphite mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt (MCS)	742	982	1 060	1 030	1 030
Mine production, kt (WBD)	540	582	676	752	N

Main producers' share in the world mine output (2006; according to MCS):

China	70.0 %	Canada	2.7 %
India	11.7 %	Madagascar	1.5 %
Brazil	7.4 %	Mexico	1.3 %
North Korea	3.1 %	Ukraine	0.8 %

9. World market prices

Prices of graphite were at the end of eighties influenced by its surplus on the world market. Prices of graphite of majority of grades dropped in 1993 down to 50 % of those in 1990. Prices were affected particularly by supplies of cheap Chinese graphite and by introduction of Russian graphite on the world market. World prices of graphite stagnate since the second half of the 1990s until 2004. The situation changed just during the year 2005, when prices of individual quotations increased by 10–20 %. Prices of the high-quality raw material continued to rise in 2006–2007. Prices of natural graphite are published monthly in the Industrial Minerals magazine and quoted in USD/t, CIF UK ports.

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
Crystalline large flake, 94–97 % C, + 80 mesh, CIF UK ports	USD/t	660	660	728	875	935
Crystalline medium flake, 94–97 % C, + 100–80 mesh, CIF UK ports	USD/t	600	600	670	770	850
Crystalline small flake, 94–97 % C, + 100 mesh, CIF UK ports	USD/t	525	525	583	675	725
Crystalline large flake, 90 % C, + 80 mesh, CIF UK ports	USD/t	515	515	613	613	613
Crystalline medium flake, 90 %, + 100–80 mesh, CIF UK ports	USD/t	390	390	468	468	468
Cystalline small flake, 90 % C, –100 mesh, CIF UK ports	USD/t	375	375	443	443	443
Amorphous powder, 80/85 % C, CIF UK ports	USD/t	–	–	250	250	250

In 1993–2001, the magazine Industrial Minerals has quoted also synthetic graphite with 99.93 % content of C, later with 99, 95 % content of C. Its price was USD 2.23 per kg at year-end 1993; it was continuously increasing and reached USD 2.55 per kg FOB Swiss border at year-end 1996. In the following years, the price oscillated between USD 2.23–2.55 per kg FOB Swiss border. Synthetic graphite was traded for USD 1.94 per kg at year-end 2000 and for USD 2.07 per kg at year-end 2001. Price quoting was reintroduced in the end of 2005 at price of USD 2.07 per kg. The price oscillated in a large interval of 3–10 USD/kg in 2006. Prices increased up to 3.5 and 12.5 USD/kg in 2007.

10. Recycling

Recycling of graphite in major fields of its use is virtually impossible (refractory materials, break lining, foundry industry, lubricants). Recycling of graphite electrodes is rather an exception of a limited importance.

11. Possible substitutes

Natural graphite is replaced by synthetic graphite in the foundry industry (artificial soot and/or oil coke mixed with olivine or staurolite), by lithium, mica, talc and molybdenite in lubricants, by calcined petroleum coke, anthracite coal, used carbon electrodes and magnesite in steel production. All alternative materials, however, have only limited use.

Gemstones

Jaroslav Hyršl

(subchapters 1., 2., 6. – except tables, 8. – except data on world mine production of diamonds and garnets, 9. – Range of prices of the most important gemstones, 10., 11.)

1. Characteristics and use

The designation "gemstone" refers to such natural materials, which can be used in jewellery. These can be minerals, rocks, natural glasses as well as organic material (e.g. pearls, amber, jet or ivory). Beauty (mainly an interesting colour, type of cutting, etc.), durability (hardness, toughness) and rarity represent their main properties. Gemstones were formerly classified according to their hardness (diamond, corundum, chrysoberyl, beryl, spinel, topaz, etc), because hardness of 7 and more is ideal for use in jewellery. Mineralogical system based on chemical composition is used at present. The most important gemstones belong to elements (diamond), oxides (corundum, spinel, chrysoberyl, quartz e.o.), and silicates (beryl, tourmaline, topaz e.o.). As gemstone formation and geological environment concerns, they occur in volcanic rocks (diamond, corundum, olivine, amethyste in geods), pegmatites (beryl, tourmaline, topaz, chrysoberyl, rose quartz), hydrothermal veins (emerald, quartz), metamorphic rocks (corundum, spinel, emerald) as well as sediments (almost all given above).

Gemstones represent raw material differing completely from the others presented in these Summaries. This is given by an extreme range of their price depending on quality. The old precious and semi-precious stone classification has not been used in scientific literature anymore, because e.g. high-quality amethyst can be more expensive than low-quality ruby or emerald. For the most part, precious (used in jewellery when cut) and decorative (or ornamental) stone classifications (e.g. agates, malachite etc., primarily used only when polished) are used. Waste after gemstone processing can be in some cases (mainly garnets and corundum) used as an abrasive.

Technically speaking, stones used in jewellery must be classified into four categories as follows:

1. natural stones, only polished
2. natural stones treated by man (burning at high temperatures, irradiation, filling of cracks by a foreign material, artificial colouring and many others)
3. synthetic stones (they have similar properties as natural ones)
4. imitation stones (e.g. glass, they have different properties than natural stones)

The correct identification of the gemstone and its classification in these categories is however possible only by an experienced expert disposing a very good instrumentation. Moreover, new processing methods appear every year. Differences in price (hereinafter, approximate wholesale prices in spring 2007 are presented) are huge. A red transparent cut ruby of about 2 carats (i.e. about 9 times 7 mm in size) can serve as an example. Its glass imitation is practically valueless. Synthetic stone can cost USD 2–400 depending on the method of synthesis. Processed natural stone can cost USD 20–5 000 depending on the processing method and its intensity. Completely unprocessed natural ruby of a top quality and weight of 2 carats can however cost up to USD 25,000!

Diamond, by far the best known gemstone financially representing major part of gemstone market, can serve as another example. Diamonds are evaluated according to four C´s: carat (weight in carats), colour (from the most expensive completely colourless to cheap yellowish and brown stones), clarity (judged by a 10x loupe), and cut (quality of the cut). Depending on these parameters, a diamond of 1 carat in weight (in case of a round brilliant cut it has 6.4 mm in diameter) can cost several hundred to USD 17 000, intensively coloured natural diamonds even much more. However, a number of treatments, which improve markedly an appearance of the stone, is known for diamond as well as almost all other gemstones. This logically has to result in a lower price than that of the similar natural stones. Synthetic cut diamonds are common as well on market nowadays (so far mainly coloured, as it is much more difficult to produce the colourless ones) and their proportion will rapidly increase in future.

It has to be pointed out once more that both examples given above represent stones which can appear very similar to a non-specialist. For this reason, statistical data which follow have to be taken with caution, as they do not say anything about quality of the stones.

2. Mineral resources of the Czech Republic

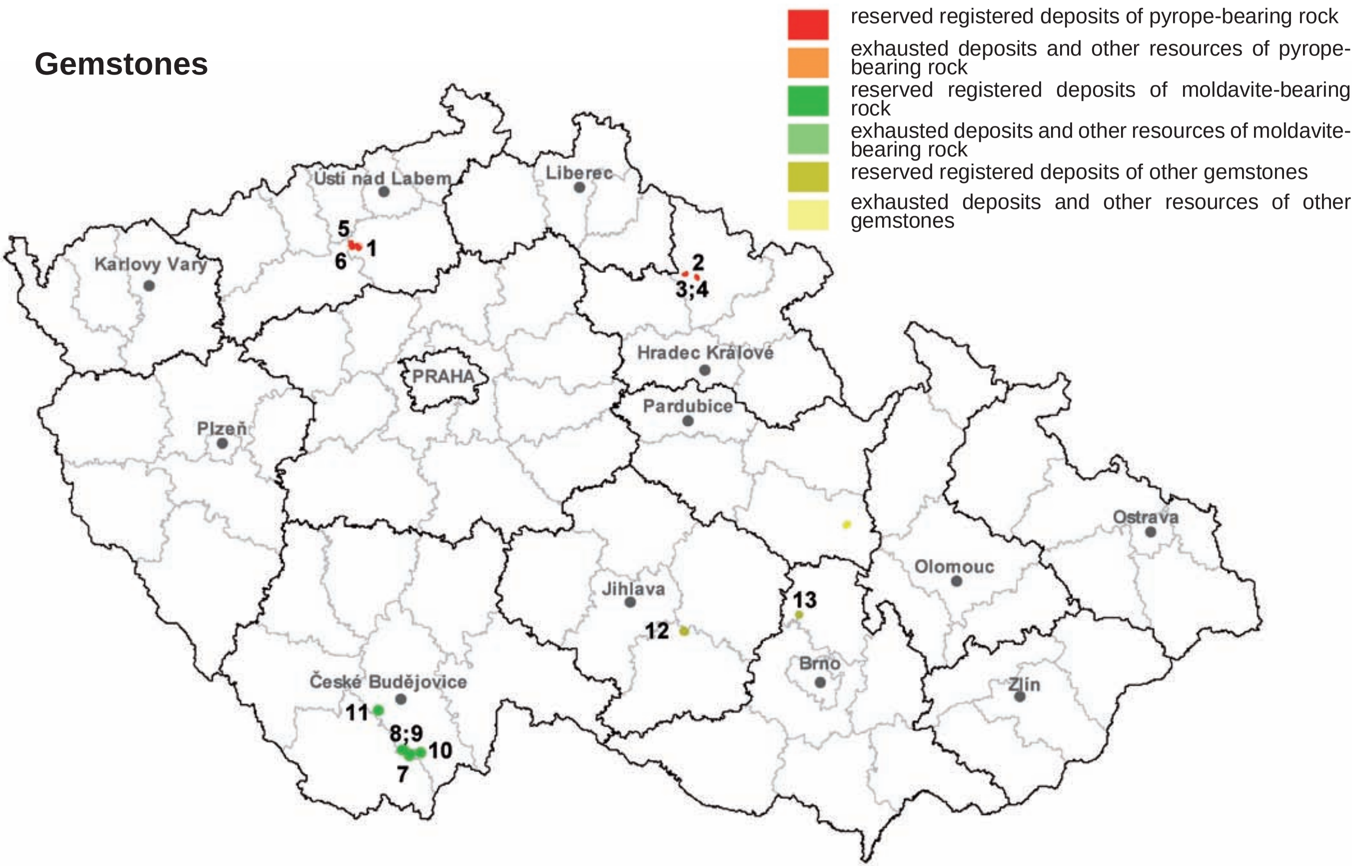
The Czech Republic is very poor in gemstone occurrences, despite its complex geology and abundance of various types of deposits. Only pyrope (Bohemian garnet) and moldavite deposits are of an international importance. Occurrences of some types of decorative quartz (rock crystal and smoky quartz in pegmatites in Velké Meziříčí and Liberec surroundings), agates in the Krkonoše Mts. piedmont, amethyst and jasper in the Krušné hory Mts., so-called porcelanite (original clay minerals burned at the contact with basalt) in southern Moravia, opals from Křemže surroundings in southern Bohemia e.o. have no economic importance.

Pyrope is a mineral from garnet group having the composition $Mg_3Al_2[SiO_4]O_3$, but always with a Fe admixture and coloured by Cr. The so-called Bohemian garnet, world-known bloody-red pyrope, has been mined for several centuries in Quaternary sand and gravel at the České středohoří Mts. piedmont. Xenoliths of ultrabasic rocks enclosed in Tertiary volcanics represent their parent rock.

The Podsedice deposit in the České středohoří piedmont is exploited at present. Mining of a small Vestřev deposit in the Krkonoše Mts. piedmont was terminated in the end of 2007. Contents of pyrope of more than 2 mm in diameter are not stable, they fluctuate between 20 and 100 g per one tonne of the rock. Genuine Bohemian garnets are always small; raw stones of more than 5–7 mm in diameter are rare. Much larger and more abundant almandine imported from abroad, which have however a brownish or violet shade, has been therefore used as a central stone in jewels.

Moldavite represents an unique Czech gemstone. It belongs to tectites, i.e. natural glasses, which occur in several places in the world. Their origin was always enigmatic; a theory that these are terrestrial rocks, molten in the course of a large meteorite impact with the melt sprayed over a large distance, predominates at present. A crater after the meteorite impact has been identified for majority of the world tectite occurrences, too. Czech moldavites come from the Ries crater by German town Nördlingen in Bavaria and were formed about 15 million years ago. They occur in southern Bohemia in Tertiary and Quaternary placers, mainly in southern vicinity of České Budějovice. They typically have a green colour and

Gemstones



reserved registered deposits of pyrope-bearing rock
exhausted deposits and other resources of pyrope-bearing rock
reserved registered deposits of moldavite-bearing rock
exhausted deposits and other resources of moldavite-bearing rock
reserved registered deposits of other gemstones
exhausted deposits and other resources of other gemstones
Ústí nad Labem
Liberec
Karlovy Vary
PRAHA
Plzeň
Hradec Králové
Pardubice
Jihlava
České Budějovice
Brno
Olomouc
Ostrava
Zlín
1
2
3;4
5
6
7
8;9
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13

uneven surface with many corrugations, which were formed by natural etching. Moldavites usually reach 1–3 cm in size, larger ones are rare. They are used in jewels either in natural state, faceted or as engraving. Smaller moldavite occurrences can be found in southern Moravia in Třebíč surroundings; these however have an unattractive brown-green colour and cannot be used as gemstones. Several small deposits were exploited in south Bohemia until recently. Of these, Besednice deposit was closed in 2007, and Ločenice deposit (with sand and gravel as major and moldavites as minor raw materials) is mined at present. Moldavite contents in the deposits are very variable, ranging mostly between 8 and 15 g per 1m^3 (5–8 g per one tonne) of the rock.

3. Registered deposits and other resources in the Czech Republic

(see map)

Names of mined deposits are indicated in **bold type**

Pyrope-bearing rock:
1 **Podsedice-Dřemčice**
2 **Vestřev**
3 Horní Olešnice 1
4 Horní Olešnice 2
5 Linhorka-Staré
6 Třebívlice

Moldavite-bearing rock:
7 **Besednice**
8 **Ločenice**
9 Chlum nad Malší-východ
10 Slavče-sever
11 Vrábče-Nová Hospoda

Other gemstones:
12 Bochovice *
13 Rašov **

* amethyst, ** opal

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number [a]	11	11	11	13	13
exploited [b]	4	4	4	4	4
Total mineral *reserves, kt [a]	19 231	19 198	19 162	19 196	19 155
economic explored reserves	3 492	3 469	3 444	3 412	3 384
economic prospected reserves	12 850	12 840	12 829	12 895	12 882
potentially economic reserves	2 889	2 889	2 889	2 889	2 889
Mine production, kt [a]	53	42	43	39	34
Mine production, ths m^3 [c]	36	114	74	95	63
Mine production, kt [c] (1 m^3 = 1.8 t)	65	205	133	171	205

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

a) pyrope-bearing rock

b) two deposits of pyrope, two deposits of moldavite in 2003–2007

c) moldavite-bearing rock

5. Foreign trade

7102 – Diamonds, also finished but unassembled, unmounted

	2003	2004	2005	2006	2007
Import, kg	121	138	140	175	317
Export, kg	34	26	44	43	185

7103 – Precious (other than diamond) and semi-precious stones, also finished, sized but unstrung, unassembled, unmounted

	2003	2004	2005	2006	2007
Import, kg	47 232	51 882	95 925	45 963	147 541
Export, kg	6 765	2 965	3 960	1 925	2 230

251320 – Emery, natural corundum, garnet and other natural abrasives

	2003	2004	2005	2006	2007
Import, t	1 375	3 089	2 882	2 662	4 037
Export, t	141	1 063	354	246	347

Detailed data on territorial structure of diamond import in volume (kg)

	2003	2004	2005	2006	2007
Belgium	8	14	14	26	158
South Africa	69	51	63	110	105
Germany	2	23	26	8	11
Israel	25	18	12	8	10
United Kingdom	5	21	8	3	8
Thailand	1	4	5	6	7
USA	1	1	5	5	7
India	1	4	4	4	5
others	9	2	3	5	4

Detailed data on geographical origin of precious (other than diamond) and semi-precious stone import in volume (kg)

	2003	2004	2005	2006	2007
Brazil	18 142	19 581	16 492	33 102	125 096
South Africa	18 279	30 422	71 072	5 677	10 323
China	194	89	427	2 979	5 951
Uruguay	100	0	0	405	2 137
Tanzania	748	1 026	985	301	1 134
India	46	6	1 560	29	735
Mozambique	0	0	920	90	601
Hong Kong	209	147	1 561	1 781	591
Morocco	0	0	0	204	438
Thailand	41	102	169	189	210
Nigeria	297	197	277	288	110
USA	309	3	732	23	90
Russia	558	0	62	451	81
Germany	533	45	216	206	19
Pakistan	423	0	102	183	0
Namibia	6 980	0	1 220	0	0
Mongolia	232	29	0	0	0
others	141	235	130	55	25

Detailed data on territorial structure of emery, natural corundum and garnet import in volume (t)

	2003	2004	2005	2006	2007
Australia	840	2 543	2 206	1 822	2 845
India	522	527	568	561	1 021
Germany	10	10	8	274	111
others	3	9	100	5	60

The customs item 7103 includes a large spectrum of precious stones (ruby, sapphire, emerald etc.), imported from many countries, such as South Africa, Brazil, Namibia, Tanzania, Hong Kong, China, Germany, Niger, Russia etc. Export is by order lower and is directed to Germany, Poland and the USA. Emery, natural corundum and garnets are imported especially from Australia and India.

6. Prices of domestic market and foreign trade

International trade with gemstones has been so globalized recently, that no substantial differences in their prices wherever in the world including the Czech Republic exist. The only difference is that imported are rather gemstones of a lower quality due to the lower purchasing power as well as lower knowledge of both jewellers and customers; stones of a high quality are rare.

7102 – Diamonds, also finished but unassembled, unmounted

	2003	2004	2005	2006	2007
Average import prices (CZK/kg)	517 868	284 370	439 379	442 023	410 814
Average export prices (CZK/kg)	448 794	294 077	354 886	452 209	109 135

7103 – Precious (other than diamond) and semi-precious stones, also finished, sized but unstrung, unassembled, unmounted

	2003	2004	2005	2006	2007
Average import prices (CZK/kg)	217	243	233	508	199
Average export prices (CZK/kg)	1 413	3 363	1 635	3 391	4 060

251320 – Emery, natural corundum, garnet and other natural abrasives

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	5 532	4 455	3 784	5 773	5 513
Average export prices (CZK/t)	9 114	5 362	6 767	11 490	7 858

7. Mining companies in the Czech Republic as of December 31, 2007

Granát – družstvo umělecké výroby, Turnov

FONSUS první těžební a.s., Praha

Bohemia Deposits a.s., Besednice

8. World production

Diamond represents the only gemstone for which relatively reliable data on annual production exist. There are practically no estimates for any other gemstone. This is mainly because mostly small deposits mined by primitive methods are concerned, as well as a large range of prices as explained above. On each locality in general major proportion of the extracted material is of a low quality; stones that can be cut commonly make up only several percent of the total mine production and financially only one top-quality stone can represent major part of the annual profit.

The most important gemstones and mining countries are as follows:

diamond – Botswana, Russia, Canada, Australia, South Africa, Congo (former Zaire)
ruby – Myanmar (Burma), Madagascar, Kenya, Pakistan
sapphire – Sri Lanka, Madagascar, Tanzania, Australia, Thailand
emerald – Columbia, Brazil, Zambia, Zimbabwe, Pakistan
alexandrite – Brazil, Russia, Zimbabwe
aquamarin – Brazil, Madagascar, Mozambique, Pakistan
tanzanite – Tanzania (the only known deposit)
topaz – Brazil, Pakistan
tourmaline – Brazil, Madagascar, Pakistan, Afghanistan, Mozambique
olivine – USA, Pakistan
amethyst – Brazil, Uruguay, Zambia

World production of industrial diamonds (with reference to MCS) reached about 75 mill carats in 2007. The main producer was Congo D.R. (former Zaire) – 31 %, followed by Russia – 20 %, Australia – 21 %, South Africa – 12 % and Botswana – 11 %. These countries covered roughly 95 % of the world production.

World production of gem-quality diamonds (with reference to WBD) was estimated at about 102 mill carats in 2006. In this case it was Russia – 30 % - in the first place, followed by Botswana – 24 %, Canada – 13 %, Australia – 12 %, South Africa – 6 %, Congo D.R. (former Zaire) – 6 % and Angola – 6 %. These seven countries covered roughly 97 % of the world production.

World mine production of garnet (mostly for industrial use) was about 325 kt in 2007 (with reference to MCS). The largest mining capacity was in Australia – 49 %, other producers were India – 20 %, the USA – 11 % and China – 9 %.

World diamond mine production

Industrial diamonds	2003	2004	2005	2006	2007 e
Mine production, ths carats (MCS)	69 500	67 000	81 000	80 000	75 000
Mine production, ths carats (WBD)	69 622	65 608	83 766	93 291	N

Gem-quality diamonds	2003	2004	2005	2006	2007 e
Mine production, ths carats (WBD)	78 564	74 106	85 211	101 520	N

World industrial garnet mine production

Industrial garnets	2003	2004	2005	2006	2007 e
Mine production, ths carats (MCS)	277	302	324	325	325

9. World market prices

Market prices of gemstones depend on their type, size and quality. Garnet (almandine) used as abrasive is quoted in the Industrial Minerals magazine monthly as 8–250 mesh class, FOB mine Idaho, USA. The average prices in USD/t for minimum 20 t lots at the end of the year were as follows:

The average prices of traded garnet commodity at year-end

Commodity/Year		2003	2004	2005	2006	2007
Garnet (almandine), 8–250 mesh, FOB mine Idaho, USA	USD/t	210	210	210	210	210

Range of prices of the most important gemstones

(spring 2007, in all cases cut stones of 2 carats in weight, whole-market price per piece in USD):

aquamarine	10–1 000
alexandrite	100–12 000
amethyst	5–30
diamond colourless	1 000–61 000
diamond pink	50 000–400 000
emerald	20–12 000
garnet almandine	5–60
olivine	10–150
ruby	20–25 000
sapphire blue	10–6 000
tanzanite	200–1 000
topaz blue	5–30
topaz orange	30–1 000
tourmaline red	50–400
tourmaline green	20–300

10. Recycling

Gemstones retain their value; those from older jewel are therefore often used in a new one. The stone has to be re-cut in some cases, especially when the cut is damaged. Technical stones are commonly recycled – this concerns first of all abrasives.

11. Possible substitutes

Imitation stones exist since the oldest times. Either similarly coloured natural stones (e.g. garnet or red spinel as a ruby imitation) or synthetic stones (e.g. green or light blue synthetic spinel as olivine and aquamarine imitation or changeable synthetic corundum as an alexandrite imitation) are used. Synthetic gemstones are common on market. Approximate dates of the first syntheses are as follows: alexandrite – 1973, diamond – technical 1955, gemmy – 1971, ruby – 1891, sapphire – 1910, emerald – 1956, spinel – 1930. On global scale, synthetic gemstones and imitations even predominate over the natural stones, and untreated natural stones are very rare.

Kaolin

1. Characteristics and use

Kaolin is mostly a residual (primary), less often a sedimentary (secondary) white or whitish rock, containing substantial amount of the kaolinite group clay minerals. It always contains quartz and it may contain other clay minerals, micas, feldspars, and other minerals, depending on the nature of the parent rock.

Kaolin originated mostly through weathering or hydrothermal alteration of various rocks, rich in feldspar, as granitoids, rhyolites, arkoses, gneisses, etc. These so-called residual (primary) kaolins can be transported, thus forming sedimentary (secondary) kaolins. The deposits are concentrated in areas with feldspar rocks presence in where the kaolinization had occurred. World economic reserves (resources) of kaolin are estimated at about 12,000 – 14,000 mill tonnes. They are concentrated in the U.S.A. (53 %), Brasil (28 %), Ukraine and India (7 % each).

A most of the crude kaolin is processed in dry (air-float) or wet (water-wash) way to increase the kaolinite content and produce a saleable product (refined kaolin). Kaolin is used for various purposes and the required grade depends on the use. A mayor amount (about 45 %) of kaolin is used in paper industry (coating and filling) and as a raw material in the ceramic industry – in production of porcelain and other whiteware (about 20 %). Kaolin is being used also as a filler in the production of rubber, plastics, paint and pigments, manufacture of reinforcing fibreglass, in production of refractory materials, and in cosmetics, pharmaceutical and food industries. Kaolin is also used in the production of synthetic zeolites. Production of kaolin is often classified among the production of clays and vice versa.

2. Mineral resources of the Czech Republic

Technological suitability of kaolin is assessed according to properties of the refined (water-washed) kaolin. In the Czech Republic, kaolins are classified according to their use:

- Kaolin for production of porcelain and fine ceramics (KJ) – the highest quality kaolin with high requirements on purity, rheological properties, strength after drying, pure white-fired colour (content of $Fe_2O_3 + TiO_2$ without high-intensity electromagnetic separation up to 1.2 %), refractoriness min. 33 PCE (1,730 °C).
- Kaolin for other ceramics manufacturing (KK) has no specifically defined parameters and is used in many ceramic recipes. Specially appreciated are white-fired colours, low content of colorant oxides, etc.
- Kaolin used in paper industry (KP) is employed both for fillers and coatings. Required properties are high whiteness and low content of abrasive particles. It is also used as filler in the production of rubber (requires minimum content of the so-called “rubber poisons” – Mn max. 0.002 %, Cu max. 0.001 % and Fe max. 0.15 %), in plastics, paints, fibreglass etc.
- Titanium-bearing kaolin (KT) contains over 0.5% TiO_2 and this type of kaolin occurs only in the Karlovy Vary region, where it formed from granites with high content of Ti-minerals. Both tests and experience proved that in some cases TiO_2 content can be reduced by high-intensity electromagnetic separation, after which part of these kaolins can be used as KJ or KK and even KP grades.

- Feldspar-bearing kaolin (KZ) contains higher amount of non-kaolinized feldspars and has been used mostly in ceramics for production of sanitary and technical ceramics.

All kaolin deposits in the Czech Republic originated by kaolinitic weathering of feldspar rocks. Decrease of kaolinization with increasing depth and transition into non-weathered parent rock are characteristic of these deposits. Kaolinite is a strongly predominant clay mineral. The major regions with kaolin deposits are as follows:

- The Karlovy Vary region – parent rocks are represented by autometamorphosed and younger granites of the Karlovy Vary massif. This is the most important source of the top quality kaolins for the production of porcelain (KJ) or their eventual substitutes (KT). There are also deposits of the KK, less of the KP grades. The most important deposits are Božičany, Jimlíkov, Mírová and in 2005 opened deposit Ruprechtov, where the KJ, KT and KK are mined together. KP is mined at the Otovice-Katzenholz deposit.
- The Kadaň region – kaolins of this area originated from granulite gneiss of the Krušné hory Mts. crystalline complex. This kaolin is of the KK and KP grades. Kralupy u Chomutova-Merkur (KP) deposit was mined out in 2003, other deposits were mined out already earlier (e.g. Kadaň, Prahly). KP at the large Rokle deposit, where bentonite has been mined for a long time, has been exploited since 2003.
- The Podbořany region – parent rock is subarkose of the Líně formation belonging to the Central Bohemian Permocarboniferous. All grades of kaolin given above occur here. However, some of the kaolins classified as KJ have a lower quality (rather KK even KZ grade) and their use as an additive into the Karlovy Vary kaolins in production of porcelain is rather restricted due to their rheological properties. Large Krásný Dvůr-Podbořany deposit of the KJ kaolin grade represents the most important deposit.
- The Plzeň region – parent rock is represented by Carboniferous arkoses of the Plzeň Basin. Kaolins of this area are of the KP grade (the largest reserves of the best quality kaolin) and the KK grade, and only a negligible part of the reserves is of the KZ and KJ grades. Horní Bříza, Kaznějov-jih and Lomnička-Kaznějov deposits north of Plzeň and Chlumčany-Dnešice south of Plzeň represent the most important large mined deposits of KP and KK. The major portion of the KP grade was converted into KK grade due to revaluation in 2005.
- The Znojmo region – these kaolins originated mostly from granitoids of the Dyje massif, to a lesser extent from the Bíteš orthogneiss of the Dyje dome of the Moravicum. These kaolins are of the KZ grade and less of the KP grade. A small deposit of KP Únanov-sever was mined out in 2007.
- The Cheb Basin – these kaolins originated from granites of the Smrčiny massif. A single deposit in this area – Plesná-Velký Luh (KK, KP) – has not been mined yet.
- The Třeboň Basin – less important deposits, local kaolins originated from granites and biotite paragneisses of the Moldanubicum. Only ceramic kaolins (KK) at two small deposits Kolenec and Klikov are evaluated here. The raw material is not mined and its exploitation is not foreseen due to its low quality.
- Vidnava – kaolins formed from granites of the Žulová Massif. The raw material of a single, until now not mined deposit Vidnava has been alternatively evaluated as KP and KK. In The Register it is however listed under refractory clays for grog production to ensure its best use.
- The other smaller kaolin occurrences have been either mined out (Lažánky) or not explored yet (Žlutice, Toužim, Javorník areas).

The kaolin deposits of the Czech Republic are important also on a world scale, the most important areas being Plzeň, Karlovy Vary, Podbořany and Kadaň. All Czech kaolin deposits are extracted by open-pit mining operations at present.

3. Registered deposits and other resources in the Czech Republic

(see map)

Principal areas of deposits presence:

1 Karlovy Vary region
2 Kadaň region
3 Podbořany region
4 Plzeň region
5 Znojmo region
6 Cheb Basin
7 Třeboň Basin
8 Vidnava

4. Basic statistical data of the Czech Republic as of December 31

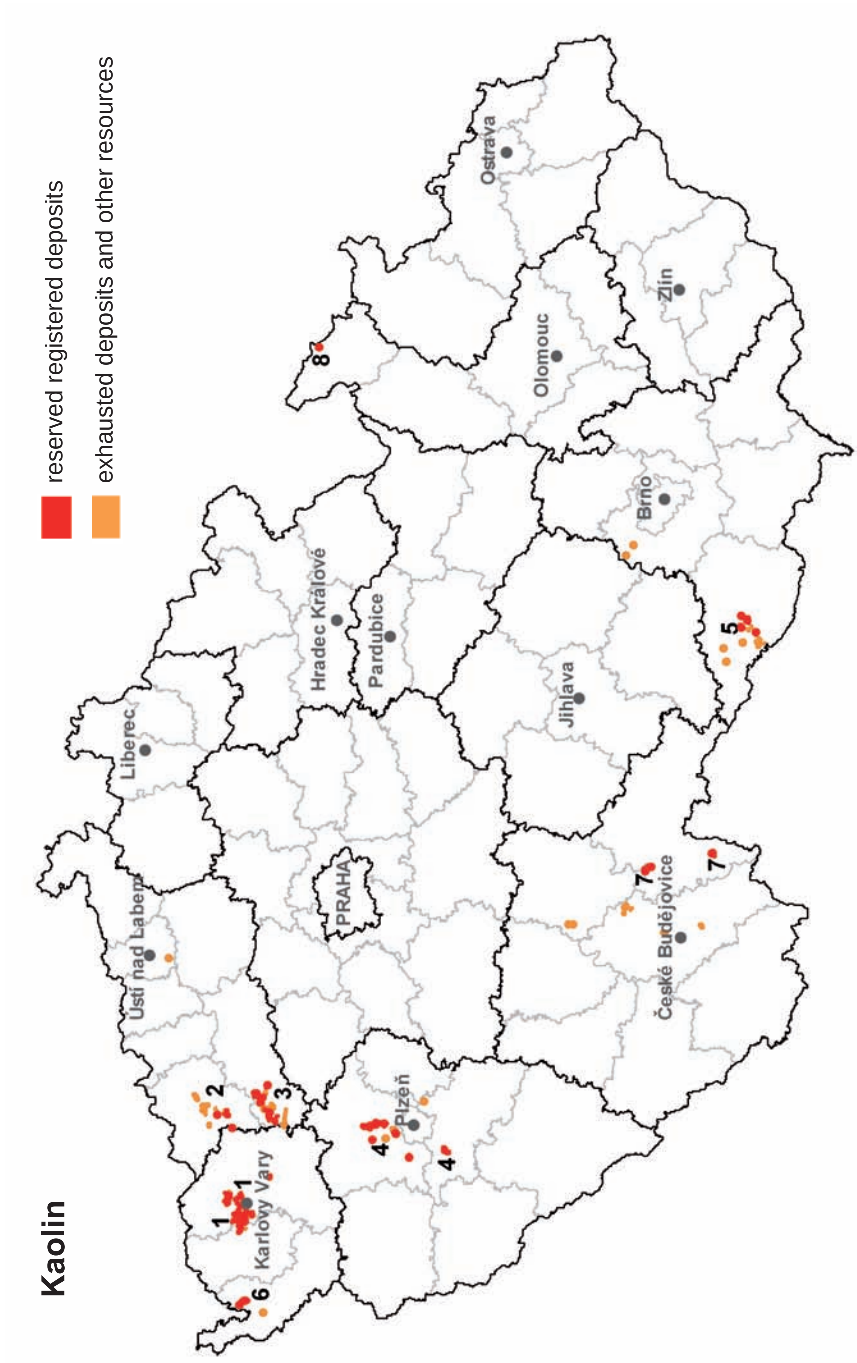
Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	65	65	66	67	69
exploited	15	15	14	14	14
Total mineral *reserves, kt	1 121 045	1 120 869	1 104 330	1 204 349	1 220 325
economic explored reserves	221 695	215 787	195 550	191 326	249 703
economic prospected reserves	488 404	494 164	486 686	567 110	497 185
potentially economic reserves	410 946	410 918	422 094	445 913	473 437
Mine production, kt [a)]	4 155	3 862	3 882	3 768	3 604
Beneficiated (water-washed) kaolin production, kt	591	596	649	673	682

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

a) Raw kaolin, total production of all technological grades;

The data of kaolin for production of porcelain and fine ceramics (KJ) and kaolin used as fillers in paper industry (KP) have been stated separately due to great varieties of end use and prices of the individual kaolin types.


Kaolin
reserved registered deposits
exhausted deposits and other resources
Karlovy Vary
Ústí nad Labem
Liberec
Hradec Králové
Pardubice
PRAHA
Plzeň
České Budějovice
Jihlava
Brno
Olomouc
Zlín
Ostrava
1
1
2
3
4
4
5
6
7
7
8

Number of deposits; reserves; mine production

Kaolin for production of porcelain and fine ceramics (KJ)	2003	2004	2005	2006	2007
Deposits – total number	29	29	29	29	30
exploited [a)]	7	7	7	7	6
Total mineral *reserves, kt	258 622	257 119	256 232	255 331	259 416
economic explored reserves	56 541	56 008	55 491	54 965	54 054
economic prospected reserves	108 362	107 762	107 762	107 762	111 858
potentially economic reserves	93 719	93 349	92 979	92 604	93 504
Mine production, kt	402	448	429	449	383

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

a) Exploited deposits of KJ: Božičany-Osmosa-jih, Jimlíkov, Krásný Dvůr-Podbořany, Mírová, Podlesí 2, Ruprechtov

Number of deposits; reserves; mine production

Kaolin for paper industry (KP)	2003	2004	2005	2006	2007
Deposits – total number	22	22	22	23	23
exploited [a)]	8	8	7	7	7
Total mineral *reserves, kt	376 722	365 127	266 832	349 689	312 105
economic explored reserves	82 513	77 365	32 462	31 228	57 019
economic prospected reserves	186 149	185 975	176 074	231 906	185 205
potentially economic reserves	108 060	101 787	58 296	86 555	69 881
Mine production, kt	3 401	3 181	1 023	1 013	1 021

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

a) Exploited deposits of KP: Horní Bříza-Trnová, Chlumčany-Dnešice, Kaznějov-jih, Lomnička-Kaznějov, Otovice-Katzenholz, Rokle, Únanov-sever 3

Porcelain production

Karlovarský porcelán a.s.
Český porcelán a.s. Dubí
Porcelánová manufaktura Royal Dux Bohemia a.s.
Leander, Porcelán Loučky s.r.o.
G. Benedikt Karlovy Vary
Haas & Czjzek, První porcelánová manufaktura v Čechách, s.r.o.
Starorolský porcelán Moritz Zdekauer a.s.

Industrial production of special ceramic materials

Glazura s.r.o, Roudnice nad Labem
Elektroporcelán Louny a.s. – výroba keramických izolátorů
Technická keramika a.s.
Jizerská porcelánka s.r.o.

Karlovarský porcelán a.s. is the biggest Czech producer of household porcelain. It comprises the following plants: Concordia a.s. (yearly production of 1,000 tonnes of porcelain), Chodov (traditional pink china production, about 100 tonnes per year), Klášterec (production of 4,500 tonnes per year), Nová Role (production of 4,000 tonnes of china per year) and Thun Studio. Český porcelán a.s. Dubí is one of the producers of known china with onion décor. Apart from this, it produces other white china types, decorated china and hotel china. Český porcelain a.s. is the major share-holder of the Porcelánová manufaktura Royal Dux Bohemia in Duchcov, the traditional producer of figural and decorative china. Fine white ornamental and household china and a big assortment are produced by the Leander, Porcelán Loučky s.r.o. G. Benedikt Karlovy Vary Company specializes in the china production for hotels and gastronomy. Haas & Czjzek, První porcelánová manufaktura v Čechách, s.r.o. operates a plant in Horní Slavkov, which produces hand-painted china dining sets. Starorolský porcelán Moritz Zdekauer a.s. is engaged in household, hotel and ornamental porcelain as well.

Glazura s.r.o. from Roudnice nad Labem is an important producer of ceramic frits and fluxing agents. It produces namely a large variety of ceramic glazes which improve the surface of ceramic products by primarily ensuring their impermeability, increasing their chemical resistance and mechanical resistance and improving their aesthetic properties (colouring, lustre etc.). Elektroporcelán Louny a.s. specializes in the production of porcelain insulators and products from special ceramic materials which show extraordinary resistance to abrasion and mechanical and thermal stress. The assortment offered by Technická keramika a.s. includes production of technical oxide ceramics for the electrotechnical industry. Laboratory and technical porcelain is produced e.g. by Jizerská porcelánka s.r.o. seated in Desné in Jizerské hory Mts.

5. Foreign trade

2507 – Kaolin and other kaolinitic clays, also calcined

	2003	2004	2005	2006	2007
Import, t	15 466	14 046	16 901	23 023	23 474
Export, t [a)]	441 500	483 720	268 715	261 065	173 107

[a)] *Export of kaolin of the highest quality Sedlec Ia was limited by Ministry of Industry and Trade*

As kaolin is a very important Czech export commodity, foreign trade numbers are given in detail below:

25070020 – Kaolin

	2003	2004	2005	2006	2007
Import, t	5 626	6 888	11 697	12 289	14 557
Export, t [a)]	438 441	482 251	265 195	259 395	171 511

[a)] *Export of kaolin of the highest quality Sedlec Ia was limited by Ministry of Industry and Trade*

25070080 – Kaolinic clay (other than kaolin)

	2003	2004	2005	2006	2007
Import, t	9 840	7 158	5 203	10 735	8 917
Export, t	3 059	1 469	3 520	1 670	1 597

Detailed data on kaolin imports (t)

Country	2003	2004	2005	2006	2007
Ukraine	2 208	3 278	7 193	5 690	9 713
Great Britain	10 546	7 585	5 122	11 270	8 036
Germany	2 063	2 162	3 334	4 201	4 103
others	629	1 021	1 252	1 862	1 622

Detailed data on kaolin exports (t)

Country	2003	2004	2005	2006	2007
Germany	142 970	152 135	60 803	50 801	44 738
Slovakia	65 807	75 045	80 819	82 555	22 784
Italy	27 431	30 834	23 098	22 391	22 647
Poland	23 846	27 895	26 027	29 056	15 583
Austria	48 534	44 543	16 542	14 226	9 970
United Arab Emirates	7 826	7 612	6 986	8 406	8 351
Romania	18 376	14 610	13 425	12 200	7 944
Slovenia	6 614	7 525	6 952	5 992	7 146
Iran	3 302	2 528	0	4 209	6 673
Turkey	0	0	0	1 924	5 558
Serbia	0	0	1 556	2 755	3 183
Hungary	9 510	10 005	8 564	5 745	2 002
the Netherlands	34 692	40 310	0	49	45
Belgium	34 689	50 356	271	0	0
others	17 902	20 322	16 124	20 758	16 683

Kaolin belongs traditionally to the most attractive items of the Czech foreign trade with raw materials – the fact that Czech kaolin was exported to more than 40 European and non-European countries during the last five years documents this. Both the neighbouring countries (Germany, Slovakia, Austria, Poland or Italy) and distant and exotic ones (United Arab Emirates, Iran, Bangladesh, Malaysia etc.) represent the traditional and large consumers. During the last 3 years, however, the export volume of Czech kaolin decreased markedly; this concerns especially exports to Germany, Austria, Belgium and the Netherlands. The fall in export to Slovakia, Austria and Poland continued in 2007. By contrast, Czech kaolin found new markets in Serbia and Turkey.

The Czech export drop is primarily caused by strong competition of cheaper Chinese kaolin. At present, China produces approximately one half of the world production of chinaware. By contrast, production of many European countries is decreasing. Secondarily, the interest of better situated classes has gradually shifted to other values (electronics, real properties) at the expense of luxurious porcelain sets. Cheap competition manifests itself also in the case of electroporcelain, whose production is much cheaper in India and China thanks to energy prices subventions.

Import volumes are significantly lower; however, they have been increasing slightly every year. A minor part of the imported raw material is represented by high-quality British and German kaolins.

6. Prices of domestic market and foreign trade

The average prices of ceramic grade on the domestic market oscillated depending on quality, between CZK 2,000–3,500 per tonne. The average export prices were CZK 3,600–3,900 per tonne. Paper-filling kaolin has been sold at CZK 1,400–2,200 per tonne. Only a small part exceeded the price of CZK 2,500 per tonne (bulk kaolin). Prices above CZK 3,000 per tonne were attained only for products for the chemical industry, produced by grinding of paper kaolin. Crude kaolin for building ceramics was sold for CZK 200–300 per tonne. Beneficiated (water-washed) kaolin from Podbořany was sold on the domestic market at CZK 1,500 per tonne, kaolin for fine porcelain and glazes production roughly at CZK 2,000 per tonne and activated kaolin at CZK 2,400 per tonne.

The average prices of traded kaolin on the domestic market

Product specification	2006	2007
kaolin of ceramic grade, CZK/t	2000–3500	2000–3500
paper-filling kaolin, CZK/t	1400–2200	1500–2200
kaolin for chemical industry, microground, CZK/t	above 3000	above 3000
kaolín for porcelain production from Sedlec, CZK/t	3000–3300	3000–3500
beneficiated kaolin from Podbořany KD, CZK/t	1500	1640
kaolin for porcelain and glazes production from Podbořany, CZK/t	2000	2100
activated kaolin from Podbořany, CZK/t	2400	2500

25070020 – Kaolin

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	5 159	5 278	4 085	4 456	4 958
Average export prices (CZK/t)	2 230	2 352	2 426	2 393	2 765

Average import prices have been about twice as high as the export prices especially because high-quality British and German kaolin for the most demanding use has been imported into the Czech Republic. Average export prices for Czech kaolin have been rather stable, between 2,300 and 2,700 CZK/t.

7. Mining companies in the Czech Republic as of December 31, 2006

LB MINERALS a.s., Horní Bříza

Sedlecký kaolín a.s., Božičany

Kaolin Hlubany a.s., Podbořany

KERAMOST, a.s., Most

KSB s.r.o., Božičany

8. World production

Data on world production of kaolin vary considerably; the statistics quote alternately dry or wet weight, raw or refined (floated) kaolin, exact figures on mined and produced volumes of saleable product or their estimates. Considerably different numbers are quoted also in single year's volumes of the same publications. Despite of these facts it can be estimated that world production since 1984 ranged above 20 mill tonnes per year, and in 1990 according to the Welt Bergbau Daten (WBD), it reached its top (27.7 mill t). After a fall to 21 mill t in 1993, world production of kaolin has been slowly increasing again. Numbers in World Mineral Statistics (WMS) are somewhat higher, and those in the Mineral Commodity Summaries (MCS) are markedly higher as they include some types of clays. In general, an increase of kaolin mining production in rapidly emerging countries (China, Brazil, Republic of Korea, Malaysia) and stagnation or decrease of mine production in developed countries (Great Britain, the USA) can be observed. Mine production of Australia, Turkey, Argentina and Jordan and in Europe of Spain and Bulgaria increased markedly during the last three years; by contrast, it decreased in Iran, Russia and Mexico.

World kaolin mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt (MCS)	41 000	44 500	44 700	37 500	37 800
Mine production, kt (WBD)	26 565	26 620	26 763	26 564	N

Main producers' share in the world mine output (2006; according to the WBD):

USA	28.1 %	Russia	3.8 %
Germany	14.4 %	Czech Republic	3.1 %
China	10.5 %	Spain	2.8 %
Brazil	9.2 %	Republic of Korea	2.8 %
Great Britain	6.6 %	Turkey	2.2 %

Note:

Data on production share of the Czech Republic vary between the yearbooks. Welt Bergbau Daten gives about 3.2 % for 2005, while World Mineral Production gives 2.8 % for year 2004. The Industrial Minerals HandyBook quotes 8 % as the Czech share on the world production for 1997.

9. World market prices

Prices of kaolin on the world market – in spite of a lasting surplus of supply – kept at a steady level. The Industrial Minerals magazine quotes each month the prices of British and US kaolin. However, the range of quotations was changed in 2002 and the prices of the British Cornwall kaolin have ceased to be published.

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
Kaolin refined, filler, Ex Georgia plant, USA	USD/st	90.00	90.00	90.00	90.00	90.00
Kaolin refined, coating, Ex Georgia plant, USA	USD/st	135.00	135.00	135.00	135.00	135.00
Kaolin refined, calcined, Ex Georgia plant, USA	USD/st	348.00	348.00	348.00	348.00	348.00
Kaolin refined (water-washed), ceramic grade, bulk, EXW France	GBP/t, since 2005 EUR/t	70.00	70.00	116.50	116.50	116.50
Kaolin refined (water-washed), ceramic grade, bulk, FOB Rotterdam	GBP/t	80.00	80.00	80.00	80.00	80.00

10. Recycling

In ceramic production, a part of the shards is recycled. Increasing recycling of paper has little influence on kaolin consumption, since recycled mineral fillers and coating pigments are separated and slurry is discarded. The recycled paper – used mainly for newsprint and wrapping – uses little if any kaolin.

11. Possible substitutes

Depending on the use, the following holds:

- In production of porcelain, kaolin is irreplaceable.
- In ceramic formulations, kaolin can in some cases be partially substituted by clays, talc, wollastonite or mullite (also synthetic mullite), but in most cases these substitutes are uncompetitive.
- In production of paper (which consumes almost half of total production of kaolin), the possibilities for substitution are the highest – kaolin as a filler can be replaced by extra finely pulverized limestone, dolomite (also synthetic – precipitated), mica (muscovite), talc, wollastonite, etc.
- In other cases, where kaolin is used as filler (insulation materials, pigments, glass fibres), the situation is analogous.
- In production of refractory materials and applications in the building industry, other materials with adequate properties can successfully substitute kaolin.

Clays

1. Characteristics and use

Clays are sedimentary or residual unconsolidated rocks consisting of more than 50 % of clay fraction (particle size less than 0.002 mm), containing as the major constituent clay minerals, particularly those of the kaolinite group, but also hydromicas (illite) and montmorillonite (see bentonite). Depending on the composition of clay minerals, clays are divided into monomineral (e.g. kaolinite, illite, etc.) and polymineral clays (composed of more clay minerals). Clays can contain various admixtures, e.g. quartz, micas, carbonates, organic matter, oxides and hydroxides of Fe, etc. Their colour depends on admixtures and can be white, grey, yellow, brown, violet and commonly green, etc. They can be also secondarily consolidated (claystones) or recrystallized unmetamorphosed (shales or clay shales).

From the point of view of deposits and further technological processing, this category includes a wide selection of rocks rich in clay minerals. Abroad, bentonite, brick-clays and even kaolins are often included in this category. Clays can be found in virtually all sedimentary formations all over the world. They are mostly used in production of ceramics, as refractory and sealing materials, fillers, in paper industry and for filtration of oils, etc.

2. Mineral resources of the Czech Republic

According to the technological properties and use, the clays in the Czech Republic are classified as follows:

- Whiteware clays (JP) – they are used as a raw material for the production of ceramics with white- or light-burning colour, sintering at temperatures over 1,200 °C. The clay minerals are represented mostly by kaolinite; the content of clastic particles is low.
- Refractory clays for grog (fireclays) (JZ) – after firing, these clays are suitable as grog for production of fireclay products. The material is required to contain maximum Al_2O_3 and a minimum Fe_2O_3; other required parameters are very high refractoriness and the lowest possible absorption capacity after firing. The major clay mineral is again kaolinite (and/or dickite).
- The other refractory (ball) clays (JO) – used as binding (plastic) clays in the production of mainly refractory products. Besides high binding properties they should contain as low amount of Fe_2O_3 and clasts as possible.
- Non-refractory ceramic clays (JN) – clay minerals of wide technological properties and uses (production of floor and wall tiles, additives, etc.) range.
- Aluminous underlying clays (JA) – kaolinite clays underlying the coal seams near Most in the North Bohemian Basin, containing about 40 % Al_2O_3, locally 3–7 % TiO_2 and usually a large amount of siderite. These clays were considered as a possible source of Al in the past. They are of no importance today due to the energy-intensive processing. They are moreover overlain by waste dumps of coal mines.

Clay deposits in the Czech Republic are concentrated in the following major areas:

- The Kladno-Rakovník Permo-Carboniferous – the deposits contain mostly high-grade refractory claystones (shales or schistose clays) (JZ), which are used in the production of refractory grogs. Less common are deposits of red-burning tile clays and grey non-refractory claystones (JN). A large Rynholec-Hořkovec 2 deposit and a smaller Lubná-Marta deposit represent the most important deposits.

- Moravian and east Bohemian Cretaceous sediments – this is the area of the largest clay reserves (JZ grade), with the same use as the ones from the previous area (but of a slightly lower quality). A single deposit Březinka is mined at present.
- Cretaceous sediments in the Prague surroundings – these clays are suitable as a highly refractory (non-plastics) grog (JZ) and refractory binding clays (JO), as well as whiteware clays (JP). The most important are deposits of JZ Vyšehořovice and Brník.
- The Louny Cretaceous – these clays are suitable as whiteware clays (JP) and other refractory clays (JO), but particularly as ceramic clays (JN). A medium-sized Líšťany deposit (JN) is the only deposit mined at present.
- South Bohemian Basins – medium or high-grade refractory clays, suitable for use namely as binding clays (JO), whiteware clays (JP) and non-refractory clays (JN). Borovany-Ledenice (JO, diatomite is mined here, too) and Zahájí-Blana represent the main deposits.
- The Plzeň Basin and Tertiary relics of Central and Western Bohemia – mostly medium grade refractory clays, classified as binding clays (JO) and ceramic clays for production of floor and wall tiles, as well as for stoneware (JN). The large Kyšice-Ejpovice deposit (JO) is the most important deposit here.
- The Cheb and Sokolov Basins – more significant is the Cheb Basin containing important binding clays (JO), whiteware clays (JP), refractory and sintering clays (JO, JN), etc. Nová Ves u Křižovatky 2 represents the significant exploited deposit of JO.
- North Bohemian and the Žitava (Zittau) Basins – apart from high aluminous underlying clays (JA), there are also overlaying ceramic (mostly sintering and tile) clays (JN). Only a medium-sized deposit of JN Tvršice in the North Bohemian Basin is mined.
- Tertiary and Quaternary sediments in Moravia – mostly ceramic (sintering and tile) clays (JN). The mining in this region was terminated in 1997 (Poštorná, Šatov).

The most important areas with clay deposits in the Czech Republic are nowadays Cheb Basin, south Bohemian Basins, Cretaceous in the Prague surroundings, Permo-Carboniferous of Rakovník region and less Cretaceous of Moravia and eastern Bohemia. Clays and claystones in the Czech Republic are extracted by open-pit mining and only locally by underground operations (Lubná, Březinka).

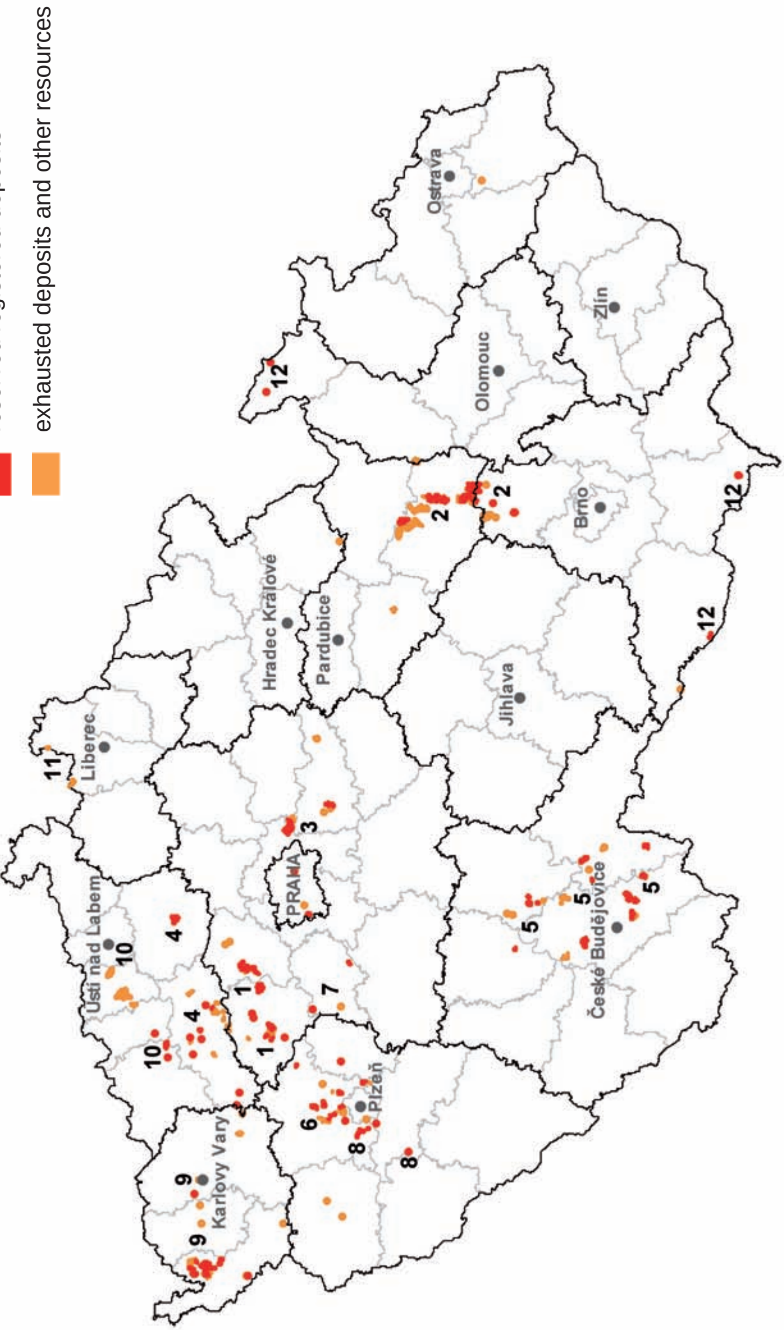
3. Registered deposits and other resources in the Czech Republic

(see map)

Principal areas of deposits presence:

1 Kladno-Rakovník Permo-Carboniferous
2 Moravian and East-Bohemian Cretaceous
3 Cretaceous in the Prague surroundings
4 Louny Cretaceous
5 South-Bohemian Basins
6 Plzeň Basin
7 Tertiary relics of Central Bohemia
8 Tertiary relics of Western Bohemia
9 Cheb Basin and Sokolov Basin
10 North-Bohemian Basin
11 Zittau Basin
12 Tertiary and Quaternary in Moravia

Clays



reserved registered deposits
exhausted deposits and other resources
Liberec
Ústí nad Labem
Karlovy Vary
Plzeň
PRAHA
Hradec Králové
Pardubice
Jihlava
České Budějovice
Brno
Olomouc
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4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	112	111	111	110	106
exploited	26	25	25	22	21
Total mineral *reserves, kt	960 604	959 285	956 937	944 607	927 520
economic explored reserves	194 480	193 861	193 230	188 102	185 168
economic prospected reserves	416 399	416 348	414 014	411 630	396 645
potentially economic reserves	349 729	349 076	349 693	344 875	345 707
Mine production, kt	554	649	661	561	679

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Domestic production of selected intermediate products

Year / kt	2003	2004	2005	2006	2007
Fire-clay	24.1	26.1	24.9	23.8	27.2
Non-shaped refractories	62.4	82.0	96.1	85.6	96.1
Other refractories	37.7	67.0	66.2	68.4	101.0

5. Foreign trade

2508 – Other clays (except expanded clays), andalusite, kyanite, sillimanite, also baked, mullite, fire-clay or ganister earths

	2003	2004	2005	2006	2007
Import, t	41 954	59 004	57 634	64 285	69 376
Export, t	145 597	230 108	209 718	189 026	193 281

As the item 2508 includes various raw materials (often with a different way of application), also numbers on foreign trade on chosen sub-items are given below:

250830 – Refractory (fire) clay

	2003	2004	2005	2006	2007
Import, t	9 388	11 937	11 294	18 087	23 275
Export, t	46 678	41 722	35 140	36 623	31 839

Detailed data on refractory clay imports (t)

Country	2003	2004	2005	2006	2007
Poland	6 973	9 869	8 421	14 655	14 022
Germany	462	767	1 891	1 531	5 905
Ukraine	1 902	1 236	893	1 720	3 109
others	51	65	89	181	239

Detailed data on refractory clay exports (t)

Country	2003	2004	2005	2006	2007
Germany	17 395	13 787	21 509	23 729	20 053
Slovakia	9 852	8 074	5 800	5 507	3 910
Italy	5 313	2 452	1 413	1 148	970
Austria	8 224	11 558	201	234	910
others	5 894	5 851	6 237	6 005	5 996

Refractory clays belong to the most important items of clay foreign trade. The volume of imports roughly doubled between 2003 and 2006 as a result of increased imports from Poland. In contrast, traditionally high export has been gradually decreasing during the last years. Czech refractory clays are exported mainly to Germany and Slovakia. Whereas the volume of exports to Germany has been increasing, exports to Slovakia decreased to one half during the period 2002–2006 and decreased also in 2007.

250840 – Other clays

	2003	2004	2005	2006	2007
Import, t	6 494	16 892	23 955	17 655	13 969
Export, t	35 827	44 383	6 979	8 940	2 800

250870 – Fire-clay or ganister earths

	2003	2004	2005	2006	2007
Import, t	9 755	5 889	2 235	2 168	2 862
Export, t	45 597	81 891	82 246	56 556	61 124

6. Prices of domestic market and foreign trade

250830 – Refractory (fire) clay

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	1 017	1 264	1 625	1 896	1 932
Average export prices (CZK/t)	1 361	1 766	1 402	1 249	1 332

250840 – Other clays

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	3 589	2 906	1 920	1 985	3 046
Average export prices (CZK/t)	821	834	1 863	1 815	3 748

250870 – Fire-clay or ganister earths

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	2 172	3 214	5 847	5 309	4 618
Average export prices (CZK/t)	2 720	3 009	3 035	3 300	3 405

Different qualities of clay and schistose clay have different market prices. For example, crude refractory clay is delivered at CZK 450–830 per tonne, average price is roughly CZK 600 per tonne, dried refractory clay reaches CZK 860–2,000 per tonne, and average prices are about CZK 1,400 per tonne. Kaolinic clay with high plasticity and refractoriness of about 1,700 ^{o}C were sold for CZK 450–1,050 in crude state and for CZK 2,500–5,000 dried.

Prices of crude sintering clay oscillate between CZK 200–800 per tonne, average price is CZK 400 per tonne. Dried sintering clay is sold at CZK 1,150 per tonne. Prices of crude bleaching clay oscillate between CZK 420 and CZK 1,700 per tonne, average price is about CZK 1,300 per tonne, prices of dried bleaching clay reach CZK 1,400–3,000 per tonne, and average price is about CZK 2,200 per tonne. The average prices of other crude clays are CZK 300 per tonne; prices of dried ones are about CZK 1,450 per tonne.

Prices of crude schistose clay on the domestic market oscillate between CZK 400–600 per tonne. Calcined schistose clay is sold at CZK 2,600–4,000 per tonne.

7. Mining organizations in the Czech Republic as of December 31, 2007

LB Minerals a.s., Horní Bříza

KERAMOST a.s., Most

České lupkové závody a.s., Nové Strašecí

P-D Refractories CZ a.s., Velké Opatovice

RAKO – Lupky s.r.o., Lubná u Rakovníka

Kaolin Hlubany a.s., Podbořany

8. World production

Overall data on the world production of clays are not available. There are some partial statistics on certain grades of clays; according to these, the production of clays has been slowly but steadily growing. Total yearly production of clays in the USA (which includes, however, also kaolin, bentonite and Fuller´s earth production) has been approximately 40 mill tonnes in the last years. Germany, Canada, Ukraine, Thailand and Austria belong to important refractory clay producers.

9. World market prices

The average prices of most of the clays were steadily growing. Prices of some of the clays were quoted each month in the Industrial Minerals magazine.

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
Refractory clay, 45 % Al_2O_3, FOB China	USD/t	67.50	67.50	84.00	84.00	84.00
Calcined kaolinic clay, 47 % Al_2O_3, FOB EU	USD/t	120.00	140.00	140.00	140.00	140.00

10. Recycling

The material is not recycled.

11. Possible substitutes

A majority of the clays are used in various fields of ceramics production. Depending on the use, the following substitutes are possible:

- Whiteware clays used in ceramic recipes – here the clays are irreplaceable. On the contrary, the selection of clays used is still wider, depending on local resources and new recipes.
- Clays for grogs – especially in production of fire-clay and similar materials, the clays can be successfully substituted by a number of refractory materials – andalusite, mullite (recently even synthetic mullite), etc. – depending on the use and local availability.
- The same applies to clays used in production of other refractory products; there are a number of possible substitutes, which depend on the purpose and use of these products, economic limits, and local resources.
- Clays for non-refractory ceramic products (earthenware pipes, tanks for acids, floor and wall tiles, jars, etc.) – besides natural mineral substitutes (such as halloysite for floor tiles, mineral pigments instead of colour-burning clays, cast basalt), other possible substitutes can be glass (tiles), artificial stoneware (floor tiles, paving bricks, slabs), metals, plastics, etc. However, in the ceramic production itself, the clays are irreplaceable.
- Titanium-bearing and aluminous clays are a potential source of titanium and aluminium and as such represent a substitute for traditional metallic ores of these elements.

Bentonite

1. Characteristics and use

Bentonite is a soft, very fine-grained heterogeneous rock of various colours, composed mostly of clay mineral montmorillonite, which originated mostly by submarine or atmospheric weathering of basic (to a smaller extent also of acid) volcanic rocks (mainly tuffs). Montmorillonite gives to bentonite its typical properties – high sorption capacity, characterized by a high value of cation exchange (the ability to receive certain cations from solutions, and replace them with its own molecules – Mg, and in some cases also Ca and alkalies); internal swelling after contact with water (some bentonites do not swell, but have a high absorptive capacity as bleaching clays, especially when they are activated); high plasticity and binding ability. Bentonite also contains other clay minerals (kaolinite, illite, beidellite), Fe compounds, quartz, feldspars, volcanic glass, etc., which represent impurities and if possible they are removed during the mineral processing.

World economic reserves of bentonite are estimated at more than 1,400 mill t.

Bentonite has many uses, which depend upon its mineralogical composition and technological properties. It is mostly used in the foundry industry, for pelletizing of iron ores (4–10 kg per tonne of pellets), as an adsorbent (decolourization, catalysis, refining, filtration, drying, waste water treatment, pesticide carrier), in drilling mud, as a filler (dyes, varnishes, pharmaceutical and cosmetic products), a suspension (lubricating oils), in the building industry (sealing material), in agriculture, etc. Bentonite use as a bedding (cat litter) and a granulated food binder has been increasing recently.

2. Mineral resources of the Czech Republic

All bentonite deposits in the Czech Republic were formed by clay weathering of volcanic rocks. Bentonite deposits and reserves in the Czech Republic are almost exclusively concentrated in the area of the Doupovské hory Mts. and the České středohoří Mountains. A large portion of bentonite from these deposits is of the highest grade, suitable especially for the foundry industry (bonding agent for moulding sand) – both activated (Ca^{2+} and Mg^{2+} ions replaced by Na^{+} ions) and non-activated bentonites are used for this purpose.

Mining, mineral processing and use of bentonite in the Czech Republic started only in the late 1950s, particularly due to its use in the foundry industry. The mining culminated first at the beginning and end of the 1980s (207 kt in 1987). Decreased demand from the foundry industry in the first half of the 1990s resulted in reduced mine production (54 kt in 1995). Mine production increased substantially in 1996–2000 especially due to the higher demand for non-traditional bentonite use (bedding, use in animal food, insulation materials etc.). This trend still continues.

- The eastern margin of the Doupovské hory Mts. at the contact with the North Bohemian Basin represents the most important area with bentonite deposits. A major part of the reserves and the largest bentonite deposits are concentrated in Kadaň and Podbořany surroundings. Rokle is the most important deposit mined at present.
- Bentonite deposits of the western margin of the Doupovské hory Mts. at the contact with the Hroznětín Basin are concentrated mainly in Hroznětín surroundings. Mining and

processing activity at Hroznětín-Velký Rybník deposit was terminated in 1993 for economic reasons. Large reserves were evaluated at several deposits at the end of the 1990s. A majority of these deposits (except Všeborovice deposit) have however unfavourable stripping conditions, they are less explored and in some cases also the raw material is of a lower quality than that of the Podbořany, Kadaň and Most regions deposits.

- Deposits of the Most region at the contact of the south – eastern margin of the North Bohemian Basin and the České středohoří Mts. represent the second most significant bentonite area of the Czech Republic at present. Braňany-Černý vrch, Stránce and Střimice deposits belong to the most important ones.
- Tertiary basins of the Plzeň region (Dnešice) and south Bohemian basins (Maršov, Rybova Lhota) represent the less important bentonite areas. Local raw material – mostly montmorillonite clay – is mostly of a lower quality. It is suitable mainly for agriculture or as a sealing material, to a lesser extent also for bedding production. Bentonites occur also in the Sokolov Basin, where the raw material suitable for bedding production (montmorillonite clay) mostly from the Božičany-Osmóza-jih deposit has been processed since 2004.
- Montmorillonite clays predominate in the Miocene sediments of the Carpathian Neogene in southern Moravia. The material is, with some exceptions (Ivančice-Réna), of a lower quality, suitable mainly for agriculture or as a sealing material. Two small deposits have been evaluated here (Ivančice-Réna, Poštorná).

Bentonite has been defined as a single raw material in The Register since 2006 – the foundry and other bentonite were therefore merged.

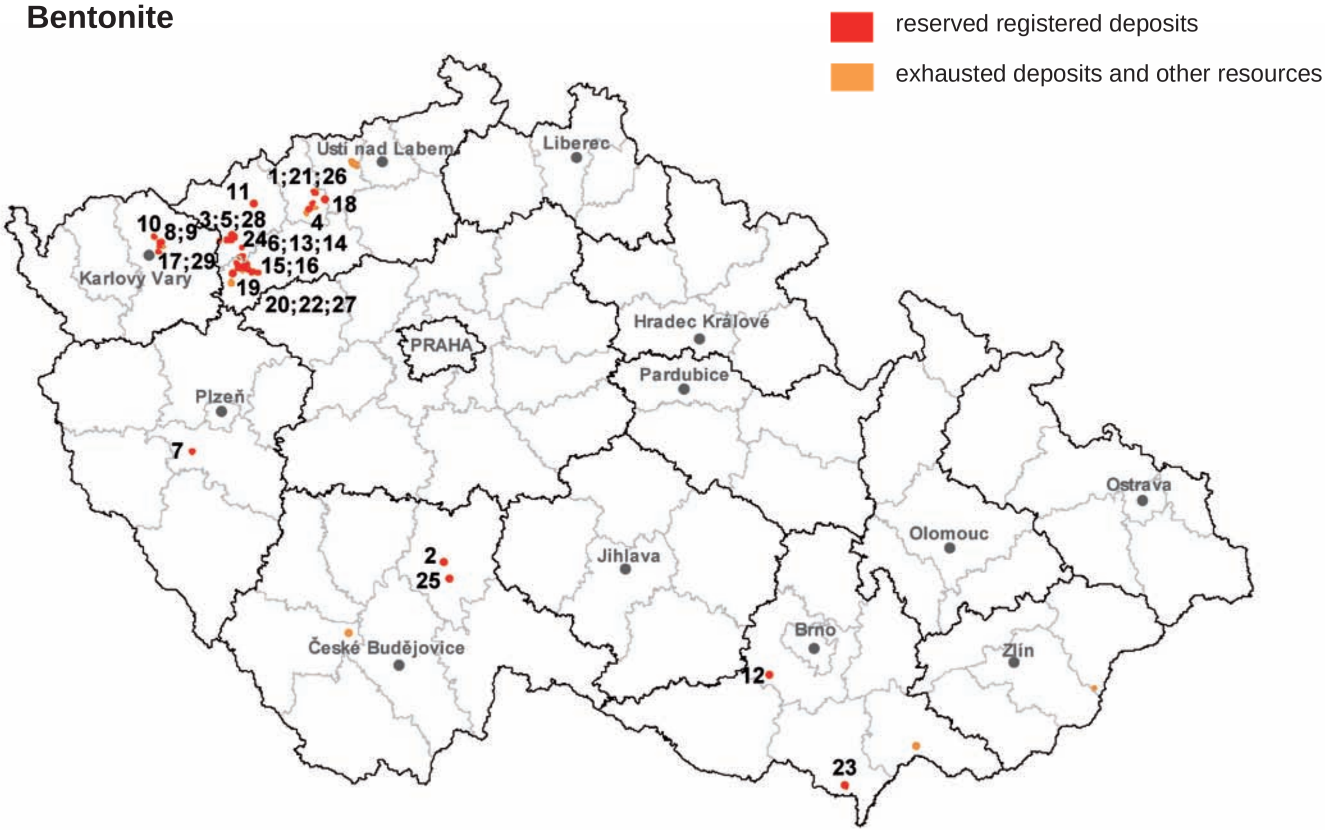
3. Registered deposits and other resources in the Czech Republic

(see map)

Names of mined deposits are indicated in **bold type**

1 **Braňany-Černý vrch**
2 **Maršov u Tábora**
3 **Rokle**
4 **Stránce**
5 Blov-Krásný Dvoreček
6 Blšany 2
7 Dnešice-Plzeňsko-jih
8 Hájek 1
9 Hájek 2
10 Hroznětín-Velký Rybník
11 Chomutov-Horní Ves
12 Ivančice-Réna
13 Krásný Dvůr-Brody
14 Krásný Dvůr-Podbořany
15 Krásný Dvůr-VysokéTřebušice 1
16 Krásný Dvůr-VysokéTřebušice
17 Lesov
18 Liběšice
19 Nepomyšl
20 Nepomyšl-Velká
21 Obrnice-Vtelno
22 Podbořany-Letov
23 Poštorná
24 Račetice
25 Rybova Lhota
26 Střimice 1
27 Veliká Ves-Nové Třebčice
28 Vlkaň
29 Všeborovice

Bentonite


reserved registered deposits
exhausted deposits and other resources
Ústí nad Labem
Liberec
1;21;26
11
18
4
10
8;9
3;5;28
246;13;14
17;29
15;16
Karlovy Vary
19
20;22;27
Hradec Králové
PRAHA
Pardubice
Plzeň
7
Ostrava
Olomouc
Jihlava
2
25
České Budějovice
Brno
Zlín
12
23

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	28	28	28	29	29
exploited	4	4	4	4	4
Total mineral *reserves, kt	317 390	315 256	315 413	327 155	317 813
economic explored reserves	54 201	54 035	53 997	53 893	50 895
economic prospected reserves	168 982	168 104	168 104	177 893	162 625
potentially economic reserves	94 207	93 117	93 312	95 369	104 293
Mine production, kt**	199	224	216	267	335

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

** Including montmorillonite clays from kaolin deposits overburden

5. Foreign trade

250810 – Bentonite

	2003	2004	2005	2006	2007
Import, t	11 795	19 944	15 084	18 521	23 666
Export, t	17 458	62 012	85 146	86 298	97 405

250820 – Decolourizing earths and Fuller's earth

	2003	2004	2005	2006	2007
Import, t	702	564	1 333	1 104	0
Export, t	32	27	0	1	0

Detailed data on bentonite imports (t)

Country	2003	2004	2005	2006	2007
Slovakia	8 598	13 721	8 409	12 046	14 392
Germany	2 080	4 115	4 267	4 016	6 159
Italy	395	623	995	1 329	1 839
others	722	1 485	1 413	1 130	1 276

Detailed data on bentonite exports (t)

Country	2003	2004	2005	2006	2007
Germany	10 388	44 032	60 129	60 754	53 204
Austria	554	8 247	13 447	12 700	15 135
France	0	0	0	0	10 761
Poland	3 094	3 703	4 967	5 838	7 709
Slovakia	2 686	3 317	4 052	4 048	3 053
others	736	2 713	2 551	2 958	7 543

Bentonite belongs to minerals the export of which is several times higher than import (about four to five times in the last years). It has been traditionally imported mainly from Slovakia, from where also the high-quality raw material from the Stará Kremnička-Jelšový potok deposit is imported, and from Germany. The volume of import from Italy has been increasing recently. Czech bentonite is exported mainly to Germany (three-fold increase between 2002 and 2005) and to Austria, since 2007 newly also to France.

6. Prices of domestic market and foreign trade

250810 – Bentonite

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	3 956	3 192	4 688	3 782	5 223
Average export prices (CZK/t)	9 409	3 216	2 481	2 365	2 307

Technical bentonite, which can be used as sealing and backfilling material or as an additive in fertilizers, has been sold on domestic market for prices from CZK 3,000 per tonne. Import prices have been fluctuating between 3,200 and 5,200 CZK/t (140-250 USD/t) during the last five years. Export prices show much larger variations. However, they have decreased recently significantly in consequence of the marked increase of the volume of export to Germany. The average export prices oscillated between 105 and 115 USD/t between 2005 and 2007.

7. Mining companies in the Czech Republic as of December 31, 2007

KERAMOST a.s., Most

LITH s.r.o., Malé Chvojno

8. World production

Annual world production of bentonite is about 12 mill tonnes. World production oscillated between 10 and 13 mill tonnes in the last 5 years. Data of the individual statistical reviews differ considerably. The amount of mine production of the biggest producers (the USA, Greece, and Germany) does not show large fluctuations. Mining production in Great Britain, Italy and Russia markedly decreased whereas that of Mexico increased during the last five years. World production of the so-called Fuller´s earth (Ca-bentonite in fact) has been oscillating between 4 and 5.6 mill t during the recent years (according to the Mineral Commodity Summaries).

World bentonite mine production

Year	2003	2004	2005	2006	2007
Mine production, kt (MCS)	10 200	10 500	11 700	11 700	11 800
Mine production, kt (WBD)	10 261	10 790	10 789	11 208	N

Main producers' share in the world mine output (2006; according to WBD):

USA	44.1 %	Mexico	4.0 %
Greece	10.4 %	Japan	3.8 %
Russia	7.4 %	Germany	3.5 %
Turkey	5.1 %	Argentina	2.3 %
Italy	4.2 %	Brazil	2.1 %

The share of the Czech Republic for 2006 is about 2.0 % (11th place) as given by WBD.

Important European bentonite producers are united in the European Bentonite Producers Association (EUBA), which is a member of the European Industrial Minerals Association (IMA). In 2007, the EUBA members were as follows: Bentonite Performance Minerals, Cebo Holland, Cetco Europe Ltd., Damolin A/S, Laviosa Chimica Mineraria Spa, Oil Dri, Peletico Ltd., Rockwood Additives Ltd., S&B Industrial Minerals S.A., Steetley Bentonite & Absorbents Ltd., Süd Chemie and Tolsa S.A.

9. World market prices

Bentonite prices showed short-term fluctuations in the last few years. The higher increase in price of some types of bentonite came in 2000. The prices of a majority of the mentioned categories continued to increase in 2001 and stagnated in 2002–2004. The price of the foundry bentonite of Indian provenance rose markedly in 2005. Subsequently prices of American bentonite from Wyoming increased by 7–40 % in 2006. There was no further price increase in 2007. According to quotations in the Industrial Minerals magazine, the average prices at year-end were as follows:

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
Wyoming, crude, bulk, rail hopper cars, FOB ex-works	USD/st	44.50	44.50	46.50	59.00	59.00
Wyoming, foundry grade, bagged, rail cars, FOB ex-works	USD/st	63.00	63.00	63.00	67.50	67.50
Wyoming, API, bagged, rail cars, FOB ex-works	USD/st	48.00	48.00	48.00	67.50	67.50
Indian bentonite, cat litter grade, crushed, dried, bulk, FOB Kandla	USD/t	36.00	36.00	36.00	36.00	36.00
Indian bentonite, foundry grade, crushed, dried, bulk, FOB Kandla	USD/t	42.50	42.50	67.50	67.50	67.50
Cat litter grade, 1–5 mm, bulk, FOB main European port	EUR/t	43.50	40.00	43.50	43.50	43.50

10. Recycling

Bentonite can be recycled on a very limited scale only.

11. Possible substitutes

In moulding sand, bentonite can be replaced by bonding agents containing graphite, synthetic polymers, or other clay minerals. Drilling mud can use similar substitutes; fillers can use chalk, dolomite, limestone, etc., in ecological applications bentonite can be replaced by zeolites. Bentonite begins to be replaced by cheap chalk or silica-based litter for cats. In production of iron ore pellets, burnt lime, polymers and other binders can replace bentonite.

Diatomite

1. Characteristics and use

Diatomite is a sedimentary rock, consisting mainly of the microscopic cells of fresh-water or marine diatoms. This rock shows various degrees of consolidation – it is either loose (diatomaceous earth) or consolidated (diatomaceous shale or chert). Loose rock has a character of very fine-grained sediment. Shells are partly dissolved during diagenesis and the sediment is impregnated by released opal, which leads to consolidation and schistosity development. Polishable and absorbing shales, sometimes even opal cherts are distinguished depending on the degree of porosity. Chemically, diatomite is dominated by $SiO_{2,}$ the content of which should be the highest possible. From the technological point of view, important parameters are porosity, resistance against acids, refractoriness, thermal and electric conductivity, density, moisture, chemical composition et al. Clastic, clayey and organic particles (sponges) and higher Al_2O_3, Fe_2O_3 and CaO contents are contaminants. Deposits originate in water basins with low content of $CaCO_3$ and suspended aluminosilicate material. The most favourable conditions are in cool water near volcanic areas. The world economic reserves are estimated at 800 mill t, about 250 mill t of which occurs in the USA.

The material is used for filtration purposes (the highest grades), in production of fillers (rubber, paper, cosmetics), as abrasives, as carrier for catalysts, and in building industry for manufacturing of thermal and sound insulating materials.

2. Mineral resources of the Czech Republic

Diatomite accumulations in the Czech Republic are confined to areas with Tertiary and Quaternary lake sediments, first of all to the Tertiary sediments of the South Bohemian basins and volcanic rocks of the České středohoří Mts. Smaller occurrences are known from other areas of the Bohemian Massif and in the Neogene of the Carpathian Foredeep and flysh.

- The biggest accumulations of diatomite in Bohemia are situated in the south Bohemian basins. Spongy diatomites and diatomaceous clays (low-grade building diatomites) occur together with lignite. The only registered and also mined deposit in the Czech Republic – Borovany-Ledenice – is located in the Třeboň Basin. Tertiary sediments were deposited in tectonically confined space on the Moldanubian basement. Deposit layer of diatomites, diatomite clays and spongy diatomites occur in the upper part of the Mydlovary Formation. Diatomites are in subhorizontal position, of whitish grey to ochre colour, unconsolidated with average thickness about 8.5 m (15 m at maximum). High-grade diatomite is used after processing for filtration purposes or as filler in food, chemical, pharmaceutical industries, etc. The highest-grade (extra pure) diatomite is used in wine, spirits, beer, edible oil or fat filtration. Diatomite of lower grade is suitable mostly for building and insulation materials production. It is partly used for cat litter production at present.
- Many diatomite outcrops, which were occasionally mined already in the first half of the 19th century as a raw material for abrasives and polishing materials production, are known in the České středohoří Mts. The most significant deposit Kučlín was mined out in 1966. These occurrences are of no importance at present.

- Lens-shaped occurrences of diatomites in the Carpathian flysh south of Brno (Pouzdřany) were prospected, with a negative result.
- Quaternary diatomites are known from the Most (together with lake mud rich in organic matter) and Františkovy Lázně surroundings (deposit Hájek – earlier mined together with peat, nowadays a natural preserved area Soos).

3. Registered deposits and other resources in the Czech Republic

(see map)

Mined deposit:

1 **Borovany-Ledenice**

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	1	1	1	1	1
exploited	1	1	1	1	1
Total mineral *reserves, kt	4 607	4 562	4 519	4 361	4 342
economic explored reserves	4 279	4 234	4 191	4 123	4 104
economic prospected reserves	328	328	328	328	328
potentially economic reserves	0	0	0	0	0
Mine production, kt	41	33	38	53	19

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

5. Foreign trade

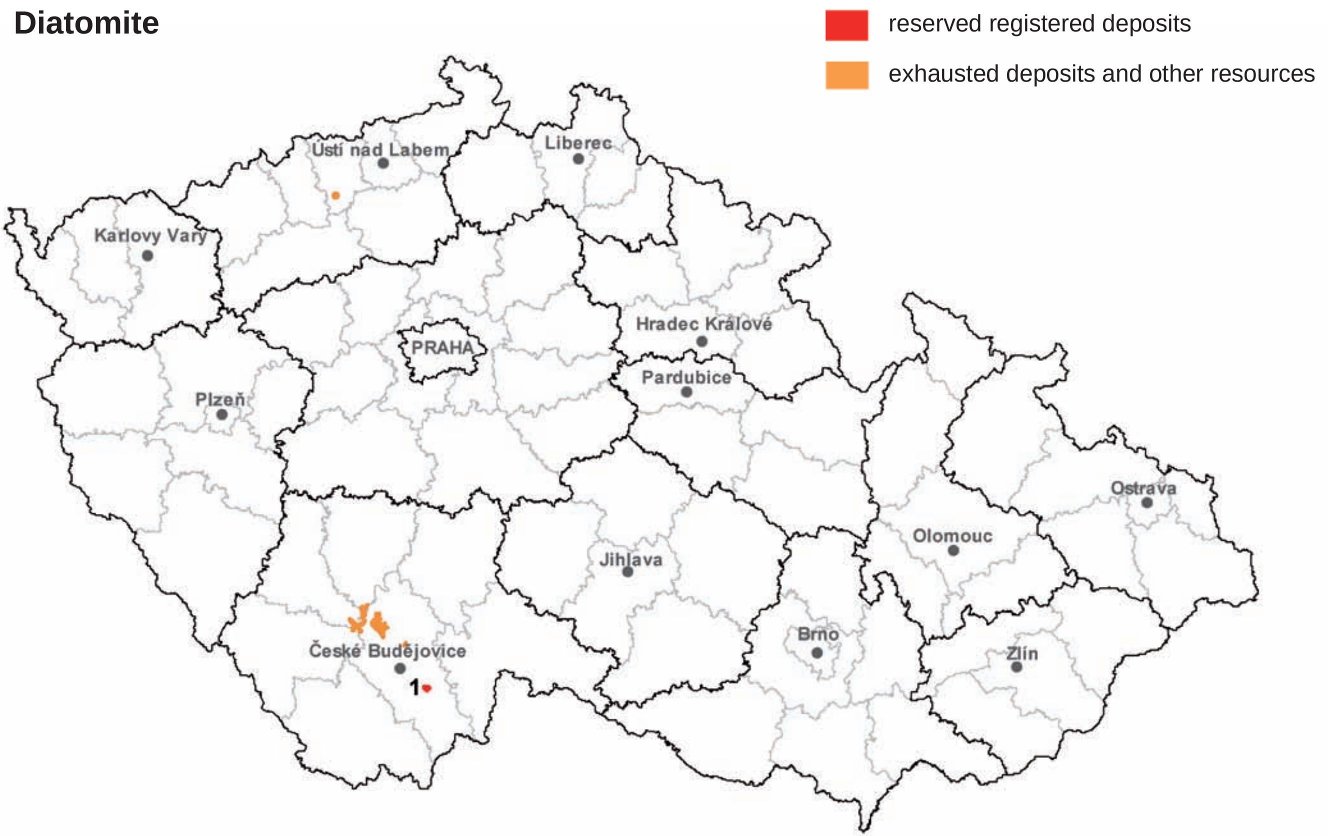
2512 – Siliceous fossil meal, siliceous earth

	2003	2004	2005	2006	2007
Import, t	1 562	1 969	2 267	2 262	3 310
Export, t	5 081	4 734	4 274	4 566	1 152

Detailed data on diatomite imports (t)

Country	2003	2004	2005	2006	2007
France	722	674	675	438	749
Denmark	287	310	479	567	633
Mexico	6	2	22	22	596
USA	433	767	843	996	481
others	114	216	268	259	851

Diatomite



reserved registered deposits
exhausted deposits and other resources
Ústí nad Labem
Liberec
Karlovy Vary
Hradec Králové
PRAHA
Pardubice
Plzeň
Ostrava
Olomouc
Jihlava
Brno
Zlín
České Budějovice
1

Detailed data on diatomite exports (t)

Country	2003	2004	2005	2006	2007
Switzerland	199	261	400	554	522
Germany	1 493	1 389	1 337	1 817	197
Austria	1 970	1 811	1 461	1 180	155
others	1 419	1 273	1 076	1 015	278

6901 – Bricks, blocks etc. and other ceramic goods of siliceous fossil meals

	2003	2004	2005	2006	2007
Import, t	1 900	1 612	1 839	3 938	3 696
Export, t	820	215	978	3 303	4 682

The import volume has been oscillating between 1.5 and 3.3 kt of high-quality raw material per year with gradually increasing trend in the last years. The volume of the Czech export has been traditionally two to three times higher. In 2007, the Czech export decreased to 1 kt. Diatomite is imported to the Czech Republic traditionally from France, the USA and Denmark, not so high-quality Czech diatomite is exported mainly to neighbouring countries.

6. Prices of domestic market and foreign trade

2512 – Siliceous fossil meal, siliceous earth

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	12 689	12 391	10 864	12 945	10 731
Average export prices (CZK/t)	8 092	8 661	8 427	8 520	9 393

Diatomite for filtration purposes of variable parameters (filtration velocity, pouring mass, pH) is sold for CZK 13–15 thousand per tonne on domestic market. Diatomite absorbent, used as pet litter, or to remove bad smells were accessible for prices of about CZK 40 per kg. Markedly higher import prices, reflecting difference in quality, are typical for the foreign trade prices.

7. Mining companies in the Czech Republic as of December 31, 2007

LB Minerals a.s., Horní Bříza

8. World production

World production of diatomite oscillated between about 1 and 2 mill t per year. Data of the individual statistical reviews differ considerably; the yearbook Welt Bergbau Daten (WBD) gives traditionally lower values, mine production in China is however not included in the totals. According to the Mineral Commodity Summaries (MCS), world production during the last 5 years has been oscillating between 1.9 and 2.2 mill t per year with a slightly increasing tendency; according to the Welt Bergbau Daten, it oscillated between 1.4 and 1.6 mill t per year.

World diatomite mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt (MCS)	1 950	1 930	2 020	2 160	2 200
Mine production, kt (WBD)	1 400	1 351	1 373	1 590	N

Main producers' share in the world mine output (2005; according to MCS):

USA	37.0 %	France	3.5 %
China	19.4 %	Mexico	2.8 %
Denmark	10.9 %	Germany	2.5 %
Japan	6.0 %	Czech Republic	1.9 %
Countries of the former USSR	3.7 %	Spain	1.6 %

9. World market prices

Only prices of the American diatomite are published on the world market. Average prices on the American market ex-works oscillated between USD 220 and 270 per tonne. Diatomite is quoted in the renowned magazine Industrial Minerals monthly as CIF, UK. World prices of both diatomite sorts have been very stable.

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
Diatomite calcined, filtration, CIF UK	GBP/t	390.00	390.00	390.00	390.00	390.00
Diatomite calcined, burned, filtration, CIF UK	GBP/t	400.00	400.00	400.00	400.00	400.00

10. Recycling

Diatomite can be recycled only on a very restricted scale.

11. Possible substitutes

Diatomite, which has a number of applications due to its unique properties, can be replaced by a number of materials. In filtration – the dominant area of use – it can be replaced by expanded perlite or quartz sand, respectively by various types of membranes. Substitutes are, however, seldom as effective as diatomite. As filler, diatomite can be replaced by talc, ground quartz sand, crushed mica, some clay types, perlite, vermiculite or ground limestone. As a heat insulating material, it can be replaced also by various types of clay and bricks, mineral wool, expanded perlite or vermiculite. As friction material, it can be replaced by asbestos, barite, bauxite, alumina, clays, graphite, gypsum, mica, pumice, pyrophyllite, silica, slate, vermiculite and zircon.

Feldspar

1. Characteristics and use

Feldspar is economic geological term for rocks with the predominance of some mineral of the feldspar group or feldspar mixture in such a form, quantity and quality, which allow their industrial extracting. Feldspars are a group of monoclinic (orthoclase, sanidine) and triclinic (microcline, plagioclases) potassium and sodium-calcium alumosilicates, and together with quartz they represent the most common rock-forming minerals, which create 60 % of the Earth's crust. Potassium feldspars (orthoclase, microcline) and acid plagioclases (Na > Ca; albite, oligoclase, andesine) are suitable for industrial use. Basic plagioclases (Ca > Na; labradorite, bytownite, anorthite) are of a marginal importance. Suitable feldspar resources are dike rocks (pegmatites, aplites), igneous rocks (granites) and sediments (feldspar-bearing sand and sand and gravel), eventually also residues of incompletely kaolinized rocks and metamorphic rocks. The major impurity represents higher content of iron in the feldspar structure (unremoveable) or in the form of admixtures (removeable).

Because of their low melting point, feldspars are used as a melting agent in ceramic mixtures, glass batches, glazes, enamels and recently also as casting powders. Almost 90 % of feldspars are consumed by the glass and ceramic industry. A small amount is used as filler, especially in colours and plastic materials.

Rocks containing alkalies in other mineral than feldspar (mostly nepheline – anhydrous sodium-potassium alumosilicate) can be used as substitutes for feldspar raw materials. Particularly nepheline syenites, to a lesser extent nepheline phonolites, are used for this purpose in the world.

2. Mineral resources of the Czech Republic

Deposits of feldspar raw materials in the Czech Republic are first of all associated with primary sources, formed mainly by leucocratic granitoids and pegmatite bodies. Nevertheless, the importance of secondary sources, represented by feldspar sand and gravel, has been increasing.

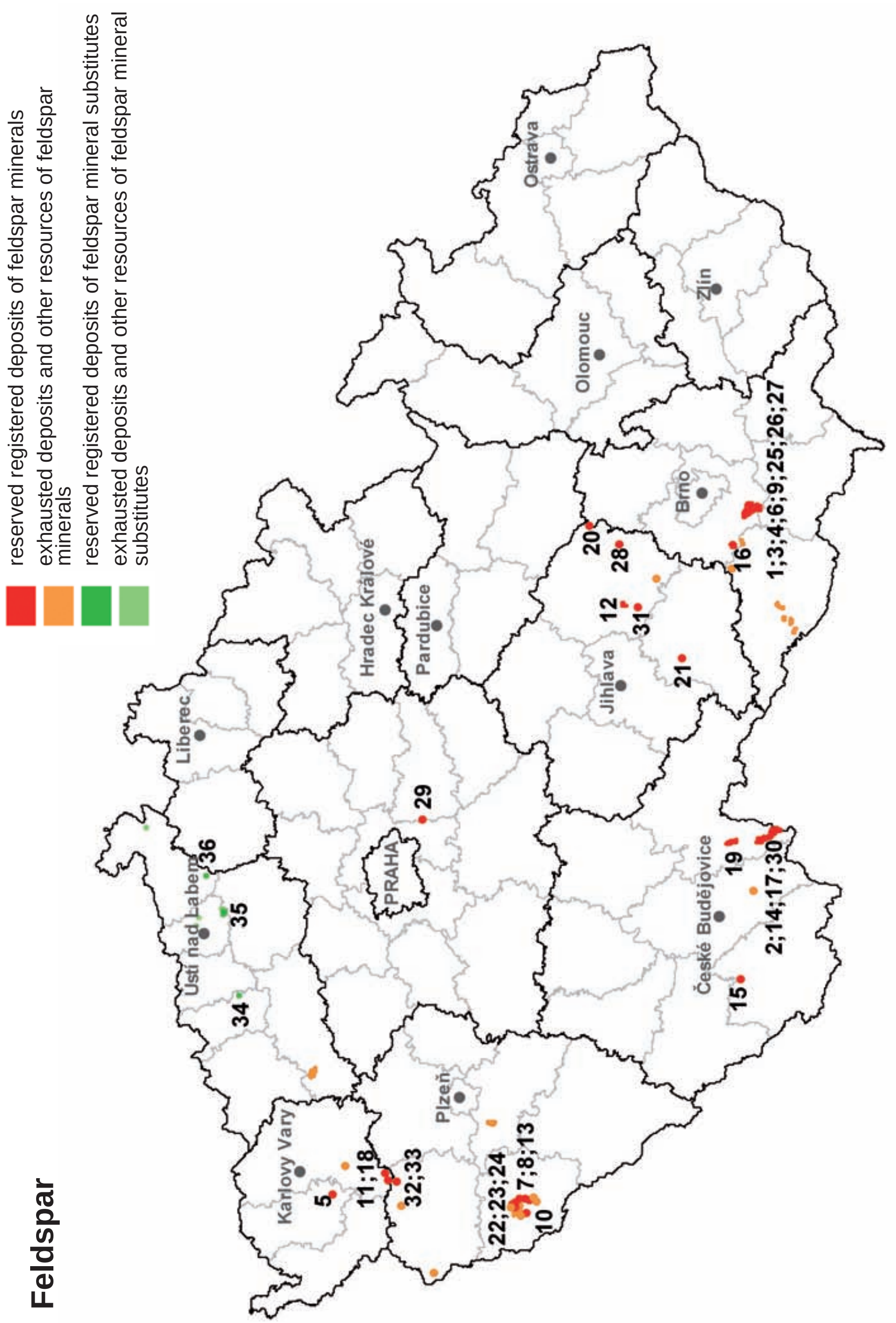
- Fluvial Quaternary feldspar placer deposits represent at present the most important feldspar resource. They were formed by deposition of disintegrated granitic rocks with a high content of mainly potassium feldspar phenocrysts. The major deposits are concentrated into two regions.
  1. the upper course of the Lužnice River with the crucial exploited deposit Halámky, mined from water. Other deposits of the region – Tušť, Dvory nad Lužnicí and Majdalena – are not mined yet. A large part of reserves of these deposits is blocked by conflicts of interests with nature protection, especially with the Protected Landscape Area (CHKO) Třeboňsko.
  2. the area south of Brno with sediments of the Jihlava River – the so-called Syrovice-Ivaň terrace with deposits Bratčice, Žabčice-Smolín, Hrušovany, Ledce, etc. Quality of feldspar is slightly lower, as it has higher Fe contents. A major part of the local raw material is used only as a construction sand and gravel at present. Only a portion – size fraction 4–8 mm – has been stored in depots for later use as feldspar raw material

since 2000. Similar deposits of feldspar accumulations of the Jihlava River are located in the Ivančice area southwest of Brno.

Feldspar sand and gravel with a predominance of potassium feldspar over plagioclase represents the raw material of fluvial deposits. It is suitable for production of utility china, sanitary ceramics, glass and to a limited extent also glazes.

- Fine to medium-grained leucocratic granitoids (granites and granite aplites, quartz diorites) represent another important feldspar raw material. Feldspar deposits are developed for instance in the Krušné hory Mts. Pluton (with the fundamental deposit Krásno mined by open pit: albite-bearing aplitic granite), Mračnice Granitoid Massif (Mračnice: quartz diorite-trondhjemite), Třebíč Massif (Velké Meziříčí-Lavičky: aplitic granite). Prospecting was carried out also in other massifs such as the Brno Massif (Moravský Krumlov), Dyje Massif (Přímětice), Chvaletice Massif, Babylon, Blatná and other individual massifs of the Central Bohemian Pluton (all granites and granodiorites). Mineral consists mainly of sodium-potassium feldspars and it is used for sanitary ceramics, coloured glass, china and abrasive disc production.
- Coarse-grained to porphyric leucocratic granitoids could represent an important resource of the feldspar raw material in future. Such rocks occur in the Říčany Massif (Štíhlice), in the Čistá-Jesenice and Bory massifs, the Krkonoše-Jizera (Izera-Karkonosze) Pluton (Liberec granite) etc. Raw material consists mainly of sodium-potassium feldspars, which mostly require high-intensity magnetic separation to decrease the Fe content.
- Deposits of feldspar materials forming lenses in metamorphosed rocks have recently been the subjects of new prospecting. Deposit of orthoclasite to microclinite Markvartice by Třebíč is located in the western branch of the Varied Group of the Moldanubicum in Moravia. The albitite deposit Malé Tresné is situated at the north-western margin of the Svratka dome at the contact of the Micaschist Zone and Olešnice Unit. A small deposit of anorthosite to gabbro Chvalšiny occurs within amphibolites of the Český Krumlov Varied Group of the Moldanubicum in Šumava.
- Pegmatite deposits known from several regions represented the only source of the raw material used mainly for ceramic production in the past. Pegmatites of medium to lower quality occur in south-west Bohemia in the Poběžovice-Domažlice region (e.g. Luženičky, Meclov, Otov). These pegmatites contain equal proportions of sodium and potassium feldspars and an admixture of dark minerals. In this region there are also deposits of high-quality sodium and sodium-calcium feldspars, used for glazes and pellucid glass (Ždánov). K-feldspars are dominant in pegmatites in the other regions. Abundant occurrences of relatively high-quality feldspar with low contents of impurities (Beroun, Křepkovice, Zhořec) occurs in the Teplá region in western Bohemia. The Písek region with its pegmatites appears to be promising but has not been well explored yet. Some smaller deposits of feldspar are known from the Humpolec, Tábor and Rozvadov (Česká Ves) areas, from western Moravia (Smrček) etc. Feldspars from pegmatites do not represent too perspective feldspar resource anymore at present due to irregular shape of deposit bodies, small and to a large extent mined-out reserves and also conflicts of interests. Large amount of the highest-quality raw material of the pegmatite deposits (mainly from the Poběžovice-Domažlice and Písek regions) has been to a large extent exhausted by mining in the past – this involves especially the more easily accessible subsurface parts. This holds true also for the area of the Bory Granulite Massif with a small deposit Bory-Olší, linked to a classical but mined-out deposit Dolní Bory.

Feldspar



reserved registered deposits of feldspar minerals
exhausted deposits and other resources of feldspar minerals
reserved registered deposits of feldspar mineral substitutes
exhausted deposits and other resources of feldspar mineral substitutes
Liberec
Ústí nad Labem
Karlovy Vary
Plzeň
PRAHA
Hradec Králové
Pardubice
Jihlava
České Budějovice
Brno
Olomouc
Zlín
Ostrava
5
11;18
32;33
22;23;24
7;8;13
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36
29
15
2;14;17;30
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28
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16
1;3;4;6;9;25;26;27

- Kaolinized feldspar materials with unaltered or imperfectly altered feldspars can represent another promising resource of the feldspar. This concerns most of all arkoses of the Plzeň and Podbořany regions and gneisses and granitoids of the Znojmo region (see Kaolin – KZ).
- Tertiary volcanic rocks – nepheline phonolites from České středohoří (Želenice deposit) – are used as feldspar substitutes in the Czech Republic. They can be used in the glass and ceramic industry only as a melting agent in coloured materials, due to high contents of colouring oxides. A high content of alkalis (10–10.5 % Na_2O and 3.5–5 % K_2O) results in a lower melting temperature and a shorter burning time.

3. Registered deposits and other resources in the Czech Republic

(see map)

Names of mined deposits are indicated in **bold type**

Feldspar minerals:

1 **Bratčice**
2 **Halámky**
3 **Hrušovany u Brna**
4 **Hrušovany u Brna-Protlas**
5 **Krásno-žula**
6 **Ledce-Hrušovany u Brna**
7 **Luženičky**
8 **Mračnice**
9 **Žabčice-Smolín**
10 **Ždánov**
11 Beroun-Tepelsko
12 Bory-Olší
13 Bozdíš
14 Dvory nad Lužnicí-Tušť
15 Chvalšiny
16 Ivančice-Němčice
17 Krabonoš
18 Křepkovice
19 Majdalena
20 Malé Tresné
21 Markvartice u Třebíče
22 Meclov 2
23 Meclov-Letiště
24 Meclov-západ
25 Medlov
26 Medlov-Smolín
27 Smolín-Žabčice
28 Smrček
29 Štíhlice
30 Tušť-Halámky
31 Velké Meziříčí-Lavičky
32 Zhořec 1
33 Zhořec 2-Hanovské pásmo

Feldspar mineral substitutes:

34 **Želenice**
35 Tašov-Rovný
36 Valkeřice-Zaječí vrch

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Feldspar

Year	2003	2004	2005	2006	2007
Deposits – total number	33	33	34	33	33
exploited	8	8	10	10	10
Total mineral *reserves, kt	83 372	68 093	67 610	65 497	71 092
economic explored reserves	35 367	25 432	24 979	24 518	30 126
economic prospected reserves	40 670	35 516	35 590	27 566	27 220
potentially economic reserves	7 335	7 145	7 041	13 413	13 746
Mine production, kt	421	466	472	487	514

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship

of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Number of deposits; reserves; mine production

Feldspar substitutes (nepheline phonolites)

Year	2003	2004	2005	2006	2007
Deposits – total number	3	3	3	3	3
exploited	1	1	1	1	1
Total mineral *reserves, kt	200 110	200 084	200 061	200 030	200 005
economic explored reserves	0	0	0	0	0
economic prospected reserves	200 110	200 084	200 061	200 030	200 005
potentially economic reserves	0	0	0	0	0
Mine production, kt	27	26	23	31	25

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

5. Foreign trade

252910 – Feldspar

	2003	2004	2005	2006	2007
Import, t	7 388	8 785	13 315	16 035	14 213
Export, t	133 862	143 941	160 490	154 671	168 328

Detailed data on feldspar imports (kt)

Country	2003	2004	2005	2006	2007
Germany	6 189	6 284	9 800	12 414	10 174
Austria	24	1 169	2 211	2 563	1 927
Turkey	19	597	870	625	812
Finland	595	313	431	384	383
others	561	422	3	49	917

Detailed data on feldspar exports (kt)

Country	2003	2004	2005	2006	2007
Poland	97 139	109 724	121 856	111 854	137 804
Germany	3 050	4 252	8 955	11 677	15 765
Hungary	15 422	15 732	19 250	17 295	7 020
Slovakia	11 958	8 956	6 990	10 594	3 187
Russia	908	354	1 142	1 290	2 496
Croatia	806	832	730	614	883
Austria	4 046	3 495	658	18	0
others	533	596	609	1 329	1 173

252930 – Leucite, nepheline and nepheline syenite

	2003	2004	2005	2006	2007
Import, t	736	916	1 089	1 321	1 742
Export, t	0	0	0	1	4

Feldspars rank among the Czech minerals which are successfully traded on foreign markets. As the west European markets are dominated by Italian and Turkish feldspar, the Czech feldspar traditionally found its place almost exclusively in the central European region. Poland, followed after a big gap by Hungary, Germany and Slovakia, are the biggest importers of the Czech feldspar. Total volume of feldspar export has increased twice between 1999 and 2000 and since 2005 it represents 150 kt per year. Low order import has been gradually increasing, oscillating around 10 % of the export volume in the last years. Cheap Turkish feldspar started to appear more systematically on domestic market since 2002, the traded amounts are though still negligible. Nepheline syenite is imported to the Czech Republic traditionally from Norway, since 2004 also from Spain.

6. Prices of domestic market and foreign trade

Potassium feldspar, which can be used for flat and utility glass and package glassware production, is sold on domestic market for CZK 950–1,150; feldspar for special utility glass, lights and TV-screens production for CZK 1,100–1,250. Potassium feldspar, which can be used for ceramics, china, glazes and electroporcelain production, was offered for 1,350–1,700 CZK in 2003. Sodium-potassium feldspar used as fluxing agent and grog in ceramic materials is offered on domestic market for CZK 500 per tonne. The material is delivered crushed down to a size 0–5 mm. Feldspars from Krásno were offered at CZK 560–580 per tonne, ground and bagged feldspar for CZK 2,350/t on domestic market.

The average prices of traded feldspar on the domestic market

Product specification	2006	2007
feldspar Krásno, ŽK 05 Ž 55 NaK 60, CZK/t	560	560
feldspar Krásno, Ž 55 NaK 60, CZK/t	582	582
feldspar Krásno, Ž 55 NaK 60 – ground, CZK/t	2 350	2 350

252910 – Feldspar

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	2 943	2 733	2 514	2 442	2 474
Average export prices (CZK/t)	1 010	989	1 005	834	945

252930 – Leucite, nepheline and nepheline syenite

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	7 918	8 913	8 884	7 346	7 131
Average export prices (CZK/t)	–	32 823	–	3 529	29 858

Decrease of the average import prices of feldspar has been caused by strengthening of the Czech crown against foreign currencies. Special feldspar types imported from Finland are the most expensive, Austrian mineral is the cheapest. German and Turkish feldspar are as a rule slightly less expensive than the annual averages. Export prices of Czech feldspar oscillate on average around CZK 1 000 per tonne. Export prices to Poland, the biggest importer of Czech feldspar, are usually by 10–15 % lower than the annual price averages.

7. Mining companies in the Czech Republic as of December 31, 2007

LB MINERALS a.s., Horní Bříza
KMK Granit s.r.o., Sokolov
Ing. František Čtverák, Tišnov
Družstvo DRUMAPO, Němčičky
AGRO Brno-Tuřany, a.s.
Brněnské papírny s.p., Předklášteří
KERAMOST a.s., Most (feldspar substitutes)

8. World production

Annual world production (including nepheline syenite and aplite) is about 15-20 mill tonnes. The production continues to rise owing to an increase of use in metallurgy and other industrial branches. Mine production increased rather rapidly in Turkey, Thailand, Iran, Argentine, Korea, Germany and the Czech Republic and slightly in France and Spain during the last five years. Feldspar production stagnated in the USA and Mexico. Mine production in Italy decreased until 2002, though it has increased during three recent years. Data from various sources often considerably differ. For instance, the last issue of Welt Bergbau Daten gives Germany as the largest world producer with a huge increase of mine production in the last three years. Data on the mine production come from Mineral Commodity Summaries (MCS) and Welt Bergbau Daten (WBD). Overall lower values given formerly by MCS are probably because Chinese production (about 2 mill tonnes) is not included.

World feldspar mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt (MCS)	10 800	11 100	12 900	15 400	16 000
Mine production, kt (WBD)	11 020	12 650	14 629	14 850	N

Main producers' share in the world mine output (2006; according to MCS):

Italy	19.5 %	the USA	4.9 %
Turkey	14.9 %	France	4.2 %
China	12.3 %	Spain	3.8 %
Japan	6.5 %	Czech Republic	3.1 %
Thailand	6.5 %	Mexico	2.9 %

According to the yearbook Mineral Commodity Summaries, the Czech Republic occupies the 9th position in the world with a share of 3.1 %. Statistical summary Welt Bergbau Daten presents the Czech Republic on the 8th place with a share of 3.3 %. On the European scale, it occupies the 4th–5th place.

The largest producers of nepheline syenite were Canada, Norway and Russia. Nepheline phonolite was mined in France, Germany and in the Czech Republic.

9. World market prices

The average indicative prices of sales quoted in the Industrial Minerals magazine were constant during the period 1990–1992. Feldspar prices were increasing in 1993 and in 1995 in consequence of the recovery of demand. Feldspar prices stagnated until 2006. The prices of a part of the Turkish feldspar increase in 2007 (40–70 %).

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
Feldspar, ceramic grade, bagged, FOB Durban, South Africa	USD/t	140.00	138.50	138.50	138.50	138.50
Feldspar, micronised, bagged, FOB Durban, South Africa	USD/t	205.00	205.00	205.00	205.00	205.00
Sodium feldspar, crude, max. 10 mm, bulk, FOB Gulluk, Turkey	USD/t	13.50	13.50	13.50	13.50	22.50
Sodium feldspar, ground, max. 63 microns, bagged, FOB Gulluk, Turkey	USD/t	77.50	77.50	77.50	77.50	77.50
Sodium feldspar, glass grade, max. 500 microns, bagged, FOB Gulluk, Turkey	USD/t	55.00	55.00	55.00	55.00	70.00
Potassium feldspar, ceramic grade, bulk, FOB India	USD/t	26.00	26.00	26.00	26.00	26.00
Nepheline syenite, Norwegian; glass grade, 0.5 mm, bulk, FOL UK port	GBP/t	97.00	97.00	97.00	97.00	97.00
Nepheline syenite, Norwegian; ceramic grade, 45 microns, bulk, FOL UK port	GBP/t	146.00	146.00	146.00	146.00	146.00

10. Recycling

The recycling of glass reduces the consumption of virgin materials, including feldspar in glass production. The recycling rate is about 33 % in the USA and as high as 90 % in some European countries like Switzerland.

11. Possible substitutes

Feldspar substitutes are materials having alkali metals bound in other minerals than feldspars, like nepheline syenites or – in the case of the Czech Republic – nepheline phonolites. These materials replace feldspars used as a melting agent. In other applications (fine abrasives, filler in rubber, plastics and paints), feldspars can be replaced by bauxite, corundum, diatomite, garnet, magnetite, nepheline syenite, olivine, perlite, pumice, silica sand, staurolite, ilmenite, barite, kaolin, mica, wollastonite, calcined alumina, clays, talc, spodumene, pyrophyllite or their mixtures.

Silica minerals

1. Characteristics and use

Silica minerals are represented by various rocks high in SiO_2 (usually min. 96 %). These are various quartzites (sedimentary or metamorphosed rocks, consisting mostly of quartz and originated through silicification of sandstones or by cementing of silica sand by siliceous cement), silicified sandstones, siliceous rocks, quartz sands and pebbles, and vein and pegmatite quartz. The grade is established by various standards. The observed parameters are the content of SiO_2 and refractoriness. High Al_2O_3, Fe_2O_3 and possibly other oxides represent impurities.

Silica minerals are used in production of ferroalloys for the metallurgical industry, silicon metal (in metallurgy, in semiconductors as well as for solar photovoltaic panels), refractory building materials (silica - bricks, mortars, ramming masses), porcelain and ceramics. Vein quartz, rock crystal and quartz pebbles are used in production of pure silica glass, UV glass and optical glass (fibre).

2. Mineral resources of the Czech Republic

In the Czech Republic, silica raw materials are classified into two groups: common silica minerals, and silica minerals for production of special glass. Silica mineral deposits are formed especially by the occurrences of the Tertiary “amorphous” quartz, Cretaceous “crystalline” quartz and Ordovician quartz, to lesser extent by the occurrences of vein quartz and lydites of the Upper Proterozoic. These minerals are practically not mined in the Czech Republic anymore with the exception of the Vrábče-Boršov deposit. They are mostly replaced by quartz sand (that completely replaced the previous materials in ceramic and glass industry), of which there is a sufficient amount at the market and which are moreover less variable and cheaper.

- Vein quartz deposits can be found almost all over the territory of the Czech Republic. The raw material is suitable for ferrosilicon and silicon production and for ceramics and glass. Vein quartz accumulations are not economic at present due to their low and variable quality and they are gradually eliminated from The Register. Deposits and occurrences can be divided into the following genetic groups:
    1. Deposits of a very pure quartz in pegmatites (Dolní Bory) – of no significance at present
    2. Quartz dikes (silicified fault zones) in Tachov region (Tachov-Světecká hora), in northern (Rumburk) and southern (Římov-Velešín) Bohemia and in the Jeseníky Mts. (Bílý Potok-Vrbno, Žárová)
    3. Quartz veins related to granitoid massifs (the Žulová Massif – Velká Kraš, the Karlovy Vary Massif – Černava-Tatrovice, the Lužice Massif – Rumburk et al.)
- Deposits of “amorphous” quartzite (quartz grains are cemented by a very fine quartz matrix) originated through silicification of Tertiary and Upper Cretaceous sediments in the Most region (Lužice u Mostu-Dobrčice, Stránce, Skršín) and Chomutov region (Chomutov-Horní Ves). In the Podbořany (Skytaly, Vroutek) and Žlutice regions this quartzite occurs only as relic boulders. Quartzite is a traditional material for production of silica

bricks and the quartzite of the highest purity is suitable even for silicon metal production. Quartzites in the Podbořany region were used also for ceramic manufacture.

- Tertiary silicification of Cretaceous sandstones gave origin to important deposits of "crystalline" quartzites (isometric grains of quartz) in the Teplice (mined deposit of Jeníkov-Lahošť, Střelná) and Most (Bečov) regions. Quartzites are suitable mostly for metallurgy and partly also for production of silica bricks and silicon metal.
- The Ordovician quartzites of the Barrandian zone (Kublov, Mníšek pod Brdy, Drahoňův Újezd-Bechlov, Sklená Huť, Železná) were the most important of the Paleozoic quartzites. They are usually classified as of a lower grade for production of ferrosilicon and to a lesser extent silica bricks. Other larger accumulations of quartzites occur in the Devonian rocks of the Silesicum (Vikýřovice) et al. These quartzites are of a low grade and they are suitable after processing for production of silica bricks of a lower quality.
- Deposits of the Upper Proterozoic silicites (lydites) might be promising for future industrial use because of their reserves and quality. This concerns especially the Rokycany (Litohlavy, Kyšice-Pohodnice) and Přeštice (Kaliště, Kbelnice) regions. Tests showed that the material might be suitable for production of siliceous alloys, and to a lesser extent perhaps for production of silica bricks.
- Quartz pebbles from sand and gravel mined in alluvial deposits of the Labe and Dyje rivers and in the Cheb region used to be considered as a potential source of silica, too. Fraction 16–50 mm at Vrábče-Boršov deposit in the České Budějovice Basin is used this way at present. This fraction is formed almost exclusively just by quartz pebbles; other rocks, limonitized pebbles and other impurities are taken out by hand. Gravel is exported to Germany (about 20–30 kt per year) as a silica mineral for ferrosilicon production.
- Only milky white vein quartz (after mineral processing) is suitable for production of special glass. It is associated with the Central Bohemian Pluton in the Příbram region (Krašovice in the metamorphosed islet zone) and with hydrothermal veins, which were metamorphosed together with the country rocks (phyllites) in the Prostějov region (Dětkovice).

3. Registered deposits and other resources in the Czech Republic

(see map)

Names of mined deposits are indicated in **bold type**

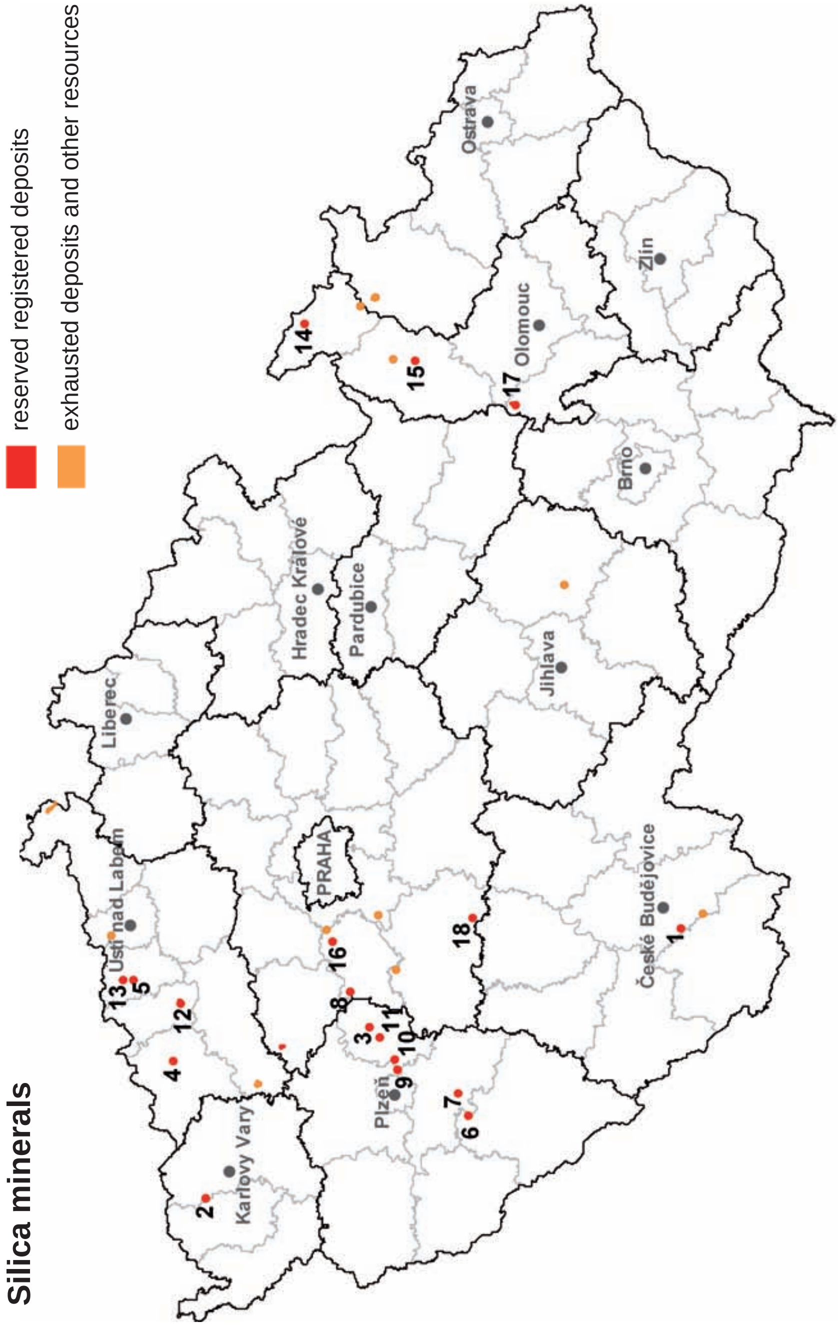
Quartz – quartzites:

1 Vrábče-Boršov	7 Kbelnice	13 Střelná
2 Černava-Tatrovice	8 Kublov-Dlouhá Skála	14 Velká Kraš
3 Drahoňův Újezd-Bechlov	9 Kyšice-Pohodnice	15 Vikýřovice
4 Chomutov-Horní Ves	10 Litohlavy-Smrkový vrch	16 Železná
5 Jeníkov-Lahošť	11 Sklená Huť	
6 Kaliště	12 Stránce	

Quartz for special glass:

17 Dětkovice	18 Krašovice

Silica minerals



4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	20	19	18	18	18
exploited	2	1	1	1	1
Total mineral *reserves, kt	35 361	31 379	28 455	28 455	28 673
economic explored reserves	5 479	4 607	4 463	4 463	907
economic prospected reserves	26 063	26 063	23 283	23 283	23 014
potentially economic reserves	3 819	709	709	709	4 752
Mine production, kt	0	10	15	17	19

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Production of ground quartz

Minorit s.r.o.

Since 2000, quartz powder has been produced by Minorit s.r.o. Company, which is a daughter company of Provodínské písky a.s. and Fluorit Teplice s.r.o. Companies, based in Teplice, Quartz powders are produced by silica sand grinding in non-ferrous environment and subsequent air sorting. Their SiO_2 content is above 98 %.

Domestic production of selected intermediate products

year / kt	2003	2004	2005	2006	2007
ganister	8.4	8.7	8.8	10.5	11.3

Ganister production

P-D Refractories CZ a.s.

Ganister producing plant with annual capacity of up to 30 ths tonnes was founded in 1985 in Svitavy. Refractory products of high quality and complex shape can be produced in this modern factory.

Company Dinas Banská Belá, a.s. in Slovakia, which has been mining its own deposit Šobov, belong to important Central European producers of ganister and other refractory materials.

5. Foreign trade

2506 – Quartz (except natural sand), crude quartzite, also dressed

	2003	2004	2005	2006	2007
Import, t	14 686	18 329	19 352	14 372	16 544
Export, t	259	384	653	36	26

Detailed data on quartz and quartzites imports (t)

Country	2003	2004	2005	2006	2007
Slovenia	7 074	8 874	9 828	7 360	8 604
Germany	3 886	3 808	4 146	4 218	5 090
Poland	3 187	4 986	4 785	2 217	1 799
others	539	661	593	577	1 051

720221 – Ferrosilicon

	2003	2004	2005	2006	2007
Import, t	24 652	30 471	31 682	34 114	39 481
Export, t	5 810	7 120	5 157	6 233	8 198

Detailed data on ferrosilicon imports (t)

Country	2003	2004	2005	2006	2007
Poland	9 410	10 852	10 179	5 020	11 204
Slovakia	1 951	7 027	8 839	8 970	8 532
China	32	270	203	1 030	4 342
Russia	1 037	1 006	1 395	3 586	3 416
Ukraine	7 080	3 637	1 579	3 938	2 216
Macedonia	1 285	3 075	4 827	6 525	2 091
others	3 857	4 604	4 660	5 045	7 680

6. Prices of domestic market and foreign trade

2506 – Quartz (except natural sand), crude quartzite, also dressed

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	2 339	2 713	2 411	2 722	2 838

720221 – Ferrosilicon

	2003	2004	2005	2006	2007
Average export prices (CZK/t)	17 233	20 281	18 561	19 570	22 370

Lump quartz has been sold at CZK 50–200 per tonne on domestic market. Import prices of quartzites oscillate in a rather narrow interval of 2,300–2,800 CZK/t. The average import prices of ferrosilicon oscillated between 17 and 22 ths CZK/t in period 2003–2007. Ferrosilicon imported from Macedonia and Poland is cheaper than that from Slovakia.

7. Mining companies in the Czech Republic as of December 31, 2007

Budějovické štěrkopísky spol. s r.o., Vrábče

8. World production

Among many known silica raw materials (except sand), special attention is paid to materials for production of synthetic quartz crystals for use in electronics and optics, and then to mining for (finding) natural quartz crystals for direct use in industrial applications. Mining for natural crystals is limited (Brazil, China, Namibia, Madagascar and the USA) and that is why number of countries have built plants for production of synthetic crystals – the largest factories are in the USA and Japan, smaller ones are in Belgium, Brazil, Bulgaria, France, Germany, South Africa and Great Britain. Among the largest exporters of raw material for production of synthetic crystals were Brazil and Namibia. Production in the USA reached its peak 778 t in 1992; in 1993 the production decreased to 500 t. The production in the USA became stabilized in the following years: 1995 – 435 t, 1996 – 435 t, 1997 – 450 t. During the last years, the production was not published in the international reviews. World production of silicon (combined totals of silicon content of ferrosilicon and silicon metal) is described in the following table:

World silicon production

Year	2003	2004	2005	2006	2007 e
Production, kt (MCS)	4 390	4 900	4 720	4 970	5 100

Main producers' share in the world mine output (2006; according to MCS):

China	56.7 %	France	3.3 %
Russia	10.6 %	Norway	3.1 %
Brazil	4.5 %	the USA	3.1 %

9. World market prices

Silica materials (except for glass and foundry sand) are not quoted. Prices of raw material for production of synthetic quartz crystals dropped in the USA from USD 1.43 per kg in 1988 to USD 0.85 per kg in 1990. The price stagnated on a level of USD 1.20 per kg. The magazine Industrial Minerals has been publishing quotations of silicon carbide since 2002.

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
Silicon carbide, 99 % SiC, grade 1, CIF UK	GBP/t	825	825	825	825	825
Silicon carbide, min. 98 % SiC, refractory grade, CIF UK	USD/t; EUR/t since 2005	745	745	1000	1000	1000
Silicon carbide, min. 95 % SiC, refractory grade, CIF UK	USD/t; EUR/t since 2005	540	540	875	790	790

10. Recycling

Silica material is not recycled.

11. Possible substitutes

Natural quartz had been, as a strategic mineral, irreplaceable until the fifties. At present it is being more and more replaced, both in electronics and optics, by synthetic crystals. Synthetic quartz competes with natural quartz also in production of clear silica glass. More accessible glass sand represents the major source of quartz for ceramics and pellucid quartz glass production at present. Other types of lining can replace silica bricks.

Glass sand

1. Characteristics and use

Glass sand is granular, light or even white-coloured rock (quartz sand or sandstone), which is used, after processing, as a raw material for production of glass. Required parameters (grain size, mineral and chemical composition) vary according to the type of glass. Sand of required grade does not usually occur in nature; therefore the sand has to be processed by crushing, washing (to remove floating particles) and grading (to reach the required grain size). To obtain high grade glass sand, it is necessary to apply more sophisticated methods of mineral processing (electromagnetic separation, flotation, etc.); it is of utmost importance to reduce the content of colouring oxides (Fe_2O_3, TiO_2, Al_2O_3) in order to meet rigid specifications with respect to purity of silica and its maximum content. Sand for glass melting is used for making of glass batches for production of flat glass, package glassware and some technical glasses (max. content of Fe_2O_3 0.023–0.040 %), and utility glass (up to 0.021 % Fe_2O_3); glass sand of higher grade is used for production of non-transparent silica glass (max. 0.020 % Fe_2O_3) and the top quality sand (max. 0.012 % and 0.015 % Fe_2O_3) are used for production of crystal glass, semi-optical glass and some special technical glasses.

Natural quartz sand is after washing, separation and drying often coloured by inorganic pigments and used for plasters, as gunite sand and for other decorative purposes.

2. Mineral resources of the Czech Republic

The largest and most important deposits of glass sand in the Czech Republic are located in the Bohemian Cretaceous Basin, smaller ones occur in the Cheb Basin. Some potentially interesting areas of the Bohemian Cretaceous Basin are of no perspective especially due to nature protection reasons – this concerns for instance Lužické hory Mts., Český ráj (The Bohemian Paradise), Adršpašsko-teplické skály (Adršpach-Teplice Rocks) etc.

- The Střeleč deposit in the Jizera facies development area of the Bohemian Cretaceous Basin represents the most important deposit of the Czech Republic. The mined raw material consists of weakly consolidated quartz sandstone of the Coniacian age and its quality meets world specifications. A reserve deposit Mladějov v Čechách has been evaluated in its southern foreland.
- Southern surroundings of Česká Lípa in the Lužice facies development area of the Bohemian Cretaceous Basin represent the second most significant deposit area. The raw material consists of weakly consolidated quartz sandstone of the Middle Turonian age. Srní 2-Veselí and Provodín deposits which are exploited at present will be soon mined out and they are gradually replaced by Srní-Okřešice deposit, opened in 2004.
- Non-traditional deposit of Velký Luh consists of the Pliocene sand and gravel of the Cheb Basin (redeposited material from kaolinic weathered Smrčiny granite). The raw material is used in technical, ceramic and filtering sand for water-plants, most of the potentially economic raw material as building sand. No glass sand is produced here, as it would require a complex processing (abrasion, electromagnetic separation, grinding).

3. Registered deposits and other resources in the Czech Republic

(see map)

Names of mined deposits are indicated in **bold type**

1 **Provodín***	3 **Srní-Okřešice***	5 **Velký Luh***
2 **Srní 2-Veselí***	4 **Střeleč***	6 Mladějov v Čechách*

* Deposits of glass and foundry sands

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	6	6	6	6	6
exploited	4	4	5	5	5
Total mineral* reserves, kt	270 935	268 876	265 673	260 917	254 871
economic explored reserves	97 282	96 595	93 283	92 382	91 391
economic prospected reserves	15 375	15 305	26 077	25 947	25 892
potentially economic reserves	158 278	156 976	146 313	142 588	137 588
Mine production, kt	904	828	920	963	942

✦ See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Industrial glass production

Glaverbel Czech a.s.

Speglass s.r.o

Sklárna Heřmanova huť

Sklárny Kavalier a.s.

Sklárna Slavia s.r.o.

Nižborská sklárna RÜCKL CRYSTAL a.s.

VITRUM, s.r.o. Sklárna Janov

Glaverbel Czech a.s. produces flat glass, a large assortment of security glass both glued and toughened, sun glass, thermal insulating glass, metallized glass, antifire glass etc. Special, primarily bent glass and various types of security glass are produced by Speglass s.r.o. Glass works Heřmanova Huť produces among others glass for beverages. Glass works Kavalier produces boiling glassware, technical and laboratory glass and borosilicate glass.

There is a number of traditional glass works in the Czech Republic, products of which are commonly renowned in many countries. Glass works Slavia in Nový Bor specializes in

Glass sand


reserved registered deposits
exhausted deposits and other resources
Ústí nad Labem
Liberec
Karlovy Vary
Hradec Králové
PRAHA
Pardubice
Plzeň
Ostrava
Olomouc
Jihlava
Brno
České Budějovice
Zlín
1
2;3
4;6
5

hand glass production, glass works RÜCKL CRYSTAL in Nižbor produces cut lead crystal, Sklárna Janov of the Vitrum s.r.o. focuses on pressed, hollow and hand-painted glass.

5. Foreign trade

250510 – Silica sand and quartz sand

	2003	2004	2005	2006	2007
Import, t	189 130	245 139	263 151	360 174	276 339
Export, t	490 218	555 118	516 770	564 608	342 056

Detailed data on silica sand and quartz sand imports (t)

Country	2003	2004	2005	2006	2007
Slovakia	98 610	124 302	147 997	150 434	129 081
Poland	40 351	48 413	52 427	95 842	98 320
Germany	12 686	16 332	17 181	18 526	33 056
Austria	34 319	53 496	41 568	88 439	5 135
others	3 164	2 596	3 978	6 933	10 474

Detailed data on silica sand and quartz sand exports (t)

Country	2003	2004	2005	2006	2007
Slovakia	90 104	96 014	99 366	115 553	115 321
Germany	91 679	100 032	87 853	111 690	77 334
Croatia	56 933	66 836	67 889	67 584	66 203
Austria	218 250	261 065	4 790	230 075	36 436
Slovenia	26 899	23 950	27 150	31 000	35 650
others	6 353	7 221	3 288	8 706	11 112

7001 – Cullet and other waste and scrap of glass; massive glass in pieces

	2003	2004	2005	2006	2007
Import, t	65 942	77 588	79 321	71 259	75 965
Export, t	18 110	11 959	3 485	8 542	12 706

Unfortunately, it is evident that the customs tariff item 250510 combines glass and foundry sand and also a part of sand and gravel. In general, data of the ČSÚ on foreign trade with items sand and construction minerals have to be taken only as information on the main trends in this field, not as precise data. For instance, atypical numbers for export in 2005 and 2007 document, that the remaining volume of export to Austria was shown only under a different item of the customs tariff than usual.

Roughly half of silica sand and quartz sand import shown is declared as import from Slovakia. Import from Poland and Austria markedly increased in 2003–2007, too. Czech quartz sand was exported to more than 50 countries in 2003–2007. The largest volume of export is directed logically to neighbouring countries (Austria, Slovakia, Germany), but also to the area of Balkan etc. Whereas in case of export to Austria and especially to Germany sand and gravel is concerned, glass or foundry sand is exported to Slovakia and Slovenia. Financially, the export value has been oscillating between CZK 200 and 300 mill per year.

Volume of cullet import has been oscillating between 65 and 80 kt per year since 2003. Valuable secondary raw material has been imported mainly from Germany, Austria, Hungary, but also from Great Britain, France and China. The fact that this material is not exported in large amounts - unlike many other secondary raw materials – is positive since its recycling in the Czech Republic represents significant energy savings.

6. Prices of domestic market and foreign trade

Prices of glass sands are differentiated according to their properties and their quality. Domestic prices of wet glass sand oscillate between CZK 300 and 1,000 per tonne. Prices of dry glass sand (not bagged) are about CZK 750–1,500 per tonne, of the bagged ones at CZK 1,100–1,850. Prices of very finely milled sand oscillate between CZK 2,950 and 4,600 depending on the quality. Prices of filtration sand are as follows: wet CZK 375–550 per tonne; dry CZK 740–910 per tonne.

Average import prices of silica and quartz sand have been very stable on a long term – they oscillated in a narrow interval of 500–520 CZK/t between 2003 and 2006. In 2007, the average import price increased to approximately 700 CZK/t especially due to high import prices of the German, Indian and Turkish mineral. The average export price of the Czech sand increased slowly between 2003 and 2006. In 2007, the price jumped due to export of the high-quality quartz sand to Slovakia, Slovenia, Hungary and the United Arabian Emirates. Both import and export prices of cullet and waste and scrap of glass increased in 2004; the atypical average export price in 2005 was caused by a small volume of trade.

250510 – Silica sand and quartz sand

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	500	518	517	501	706
Average export prices (CZK/t)	424	472	524	528	823

7001 – Cullet and other waste and scrap of glass; massive glass in pieces

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	1 290	1 740	1 736	1 640	2 806
Average export prices (CZK/t)	2 116	2 676	4 174	2 360	1 768

7. Mining companies in the Czech Republic as of December 31, 2007

Sklopísek Střeleč, a.s., Mladějov

Provodínské písky, a.s., Provodín

LB Minerals a.s., Horní Bříza

8. World production

World statistics provide data only on total production of sand for industrial use (glass production, foundry industry, abrasives etc.). These numbers are incomplete by the fact that they are not available for all countries. The world mine production had been rising until 1988 (119 mill t). Since then the production was decreasing due to general economic recession. The volume of production returned back to the level of about 120 mill t in 1995. World production slowly increased between 1996 and 2002. The change did not arrive until 2003 when world production increased again to about 110 mill tonnes. Mine production continued to rise up to the limit of 120 mill tonnes in 2004–2006 in relation to the worldwide economic growth. Numbers on world mine production according to Mineral Commodity Summaries (MCS):

World silica sand for industrial use mine production

Year	2003	2004	2005	2006	2007
Mine production, mill t (MCS)	110	115	118	118	120

Main producers' share in the world mine output (2006; according to MCS):

USA	26.9 %	Spain	4.3 %
Slovenia	8.5 %	Great Britain	4.2 %
Germany	6.5 %	Japan	3.9 %
Austria	5.8 %	Australia	3.1 %
France	5.5 %	South Africa	2.7 %

9. World market prices

Quartz sand for industrial use was traded on European market at average price GBP 11.00 per tonne at the first half of the 1990s. The price increased to GBP 13.50 per tonne in 1995. The prices increased again to GBP 15.00 per tonne in 2000 and to GBP 16.00 per tonne in 2001. The price stagnates since 2001. Prices of sand quoted by the Industrial Minerals magazine in GBP/t EXW GB at year-end were as follows:

The average prices of traded commodity at year-end

Commodity/Year		2003	2004	2005	2006	2007
Glass sand, flint, container, EXW GB	GBP/t	16.00	16.00	16.00	16.00	16.00

10. Recycling

Glass sand, for obvious reasons, cannot be recycled; however, it is possible to use sorted glass waste in a glass batch, which is being done on a long term. However, demand of glass works on the input quality of glass scrap has been increasing recently. Another problem is, that there is a demand first of all for scrap of separated colours (white, green, brown) in glass industry. Interest in mixed cullet is minimal. Surplus of supply of mixed processed cullet from foreign recycling companies (first of all from Germany and Austria where glass recycling is strongly supported) over demand results in permanent pressure on decrease of sale price of recycled glass on the territory of the Czech Republic. Price of mixed unprocessed glass on the territory of the Czech Republic has been oscillating between CZK 650 and 1,100 per tonne (EUR 22–37) including transport to the recycling facilities. At these prices on the input on the recycling line, the output price is unfortunately markedly higher than in the EU countries. Glass works ask from the Czech processing companies for a price comparable with that paid abroad. They refuse to take all the mixed glass collected on the territory of the Czech Republic and they prefer to buy a substantial part abroad.

The highest proportion of recycling of sorted glass scrap in 2005 was reported in Switzerland (96 %), Sweden (93 %), Germany and Belgium (88 % each), Austria and Norway (both 86 %). Contrastingly, the proportion was very low in Turkey (22 %), Greece (29 %), Great Britain (32 %), Spain and Portugal (38 % each). The largest volume of collected glass was in 2003 in Germany, France and Italy. Average production of glass scrap on citizen reaches roughly 77 kg in the Czech Republic. 65 % of the sorted glass scrap was used again (recycled) in 2004; in 2005 it was already 68 % and in 2006 almost 70 %.

11. Possible substitutes

In glass production, the sand is in fact only a source of SiO_2, therefore it can be replaced by sorted vein quartz, waste glass, synthetic SiO_2, etc.

Foundry sand

1. Characteristics and use

Foundry sand is granular, light-coloured rock, being used directly or after mineral dressing for production of foundry moulds and cores. The main required properties include sufficient resistance to high temperatures and strength (depends on quality and quantity of the binding component), and suitable grain size (the average grain size and its regularity). Because of its variability, natural foundry sand is more and more often being replaced by synthetic sand, i.e. quartz sand mixed with appropriate amount of binding agents (mostly bentonite).

Natural quartz sand is after washing, separation and drying often coloured by inorganic pigments and used for plasters, as gunite sand and for other decorative purposes.

2. Mineral resources of the Czech Republic

Foundry sand (material of lower grade) deposits always accompany glass sand, but they can occur also separately. Deposits in the Provodín and Střeleč surroundings are of a highest importance, the same way as in case of glass sand.

- Orlice-Žďár facies area of the Bohemian Cretaceous Basin represents the third most important area. The material consists of weakly consolidated Cenomanian quartz or glauconitic (so-called natural sand) sandstones. The mining operations are concentrated in Blansko, Voděrady and Svitavy surroundings.
- There is no interest in glacial sand of the northern Moravia (Palhanec-Vávrovice, Polanka nad Odrou), aeolian sand in the Labe River area (Zvěřínek, Kluk) and southern Moravia (Bzenec, Strážnice, Břeclav), fluvial terrace sand of the central (Tetín, Srbsko, mined-out Kobylisy-Dolní Chabry), southern (Lžín) and western Bohemia (Kyšice) and other at present. The reasons are a low quality which demands processing of the raw material and sufficient amount of a higher-quality raw material from other sources. The same holds for sand of the Carpathian Neogene basins (Nový Šaldorf) etc.
- Pliocene sand of the Cheb Basin (Velký Luh) is of a local importance.
- In addition, sand representing a waste product of kaolin processing (e.g., Krásný Dvůr) is used in foundry industry, too.

Glass and foundry sand deposits in the Czech Republic are extracted by open pits. Lower-quality sand is used in the building industry.

3. Registered deposits and other resources in the Czech Republic

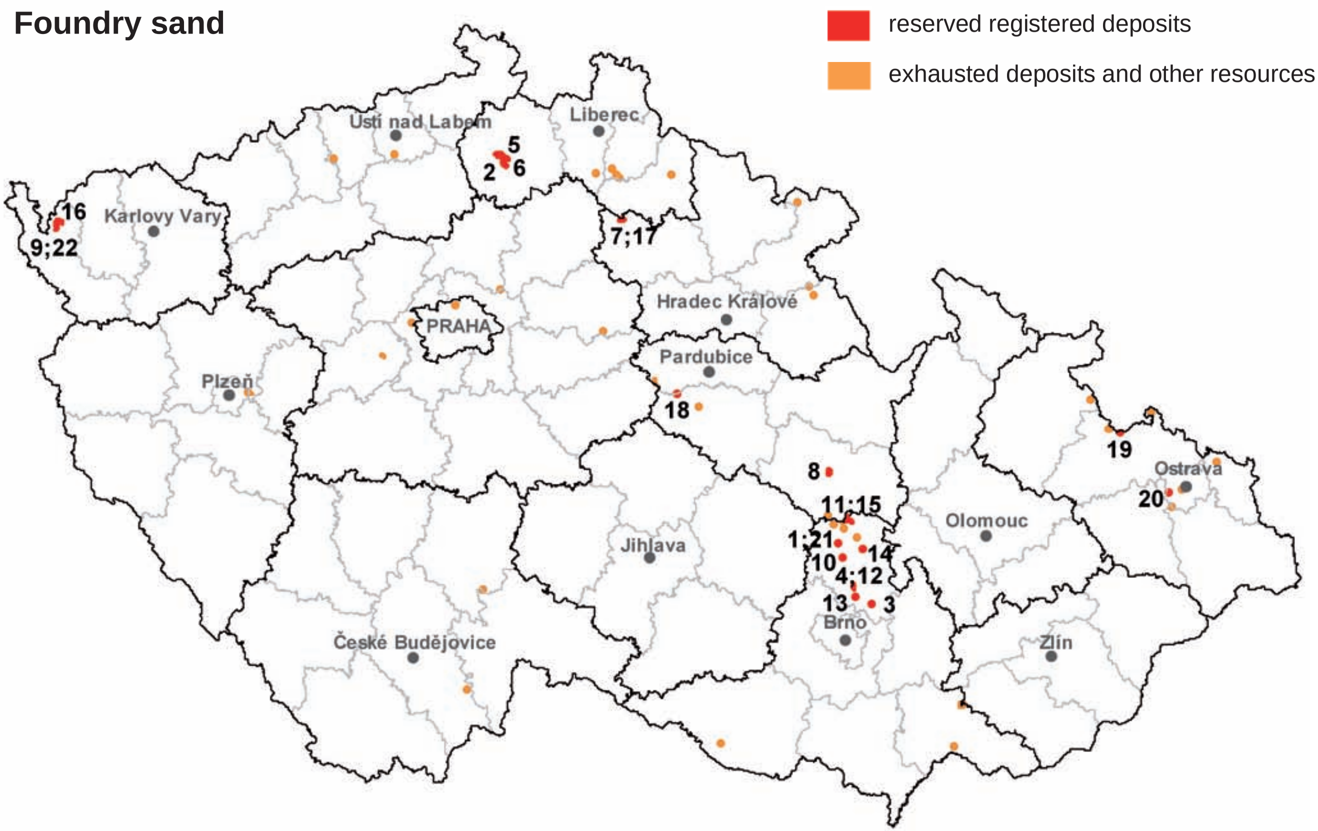
(see map)

Names of mined deposits are indicated in **bold type**

1	**Nýrov**	8	**Svitavy-Vendolí**	15	Deštná-Dolní Smržov
2	**Provodín ***	9	**Velký Luh ***	16	Lomnička u Plesné
3	**Rudice-Seč**	10	**Voděrady**	17	Mladějov v Čechách *
4	**Spešov-Dolní Lhota**	11	Babolky	18	Načinešice
5	**Srní-Okřešice ***	12	Blansko 1-Jezírka	19	Palhanec-Vávrovice
6	**Srní 2-Veselí ***	13	Blansko 2-Mošna	20	Polanka nad Odrou
7	**Střeleč ***	14	Boskovice-Chrudichromy	21	Rudka-Kunštát
				22	Velký Luh 1

* deposits of glass and foundry sands

Foundry sand



4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	29	29	29	26	22
exploited	11	12	12	10	10
Total mineral *reserves, kt	444 218	442 305	418 304	387 667	378 201
economic explored reserves	158 574	142 134	138 820	137 955	134 964
economic prospected reserves	96 230	85 786	81 956	81 907	80 465
potentially economic reserves	189 414	214 385	197 528	167 805	162 772
Mine production, kt	712	831	807	773	850

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

5. Foreign trade

Item 250510 (Silica sand and quartz sand) of the customs tariff unfortunately clearly includes both glass and foundry sand, and also a part of sand and gravel. The data below therefore correspond to those presented in chapter on glass sand, in which also a more detailed classification of export and import according to countries.

250510 – Silica sand and quartz sand

	2003	2004	2005	2006	2007
Import, t	189 130	245 139	263 151	360 174	276 339
Export, t	490 218	555 118	516 770	564 608	342 056

6. Prices of domestic market and foreign trade

250510 – Silica sand and quartz sand

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	500	518	517	501	706
Average export prices (CZK/t)	424	472	524	528	823

Average import prices of quartz sand (customs tariff item 250510) were around 500 CZK/t and they were comparable with average export prices (420–530 CZK/t). The average import and export prices increased markedly in 2007. This was caused in general by an increase in world prices of quartz sand due to an energy price rise as well as by a higher demand in Central Europe, where the smelting industry is being strongly revitalized.

Prices of foundry sand are lower than prices of glass sand. Wet sand was sold at CZK 250–400 per tonne, dry (not bagged) at CZK 700–800 per tonne, in bags for CZK 1,200 to 1,800 per tonne.

7. Mining companies in the Czech Republic as of December 31, 2007

Provodínské písky a.s., Provodín

Sklopísek Střeleč a.s., Mladějov

Moravské keramické závody a.s., Rájec-Jestřebí

PEDOP s.r.o., Lipovec

Jaroslav Sedláček – SEDOS, Drnovice

LB Minerals a.s., Horní Bříza

P-D Refractories CZ a.s., Velké Opatovice

SETRA s.r.o., Brno

8. World production

World statistics provide only data on total production of sand for industrial use (glass production, foundry industry, abrasives etc.). Therefore the data given below are identical to those presented in the chapter on glass sand. These numbers are moreover distorted by that they are not available for all countries.

The production had been rising until 1988 (119 mill t). Since then the production was decreasing due to general economic recession. The volume of production returned back to the level of about 120 mill t in 1995. World mine production slowly increased between 1996 and 2002. The change did not arrive until 2003, when the production increased again to about 110 mill tonnes. The increase continued during the last three years. Numbers of world production volume according to Mineral Commodity Summaries (MCS):

World silica sand for industrial use mine production

Year	2003	2004	2005	2006	2007 e
Mine production, mill t (MCS)	110	115	118	118	120

Main producers’ share in the world mine output (2006; according to MCS):

USA	26.9 %	Spain	4.3 %
Slovenia	8.5 %	Great Britain	4.2 %
Germany	6.5 %	Japan	3.9 %
Austria	5.8 %	Australia	3.1 %
France	5.5 %	South Africa	2.7 %

9. World market prices

The average price of foundry sand for industrial use on the European market was steady (around 10 GBP/t) in the first half of the 1990s. It slowly increased in the period 1995–2001. Between 2002 and 2005, foundry sand world prices stagnated. In 2006, the US foundry sand price increase approximately by 60 % due to energy price rise as well as the continuous weakening of the US currency. World prices remain stable since 2002. Prices of foundry sand quoted by the Industrial Minerals magazine at year-end were as follows:

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
Foundry sand, dry, bulk, EXW UK	GBP/t	16.00	16.00	16.00	16.00	16.00
Foundry sand, dry, bulk, EXW USA	USD/t	19.50	19.50	19.50	27.00	27.00

10. Recycling

Foundry sand used in moulding is mixed with bentonites, water glass, etc; having been exposed to high temperatures, their properties change to such extent, which makes their full recycling impossible. A research with an objective to increase a share of recycled sand in new mixtures is carried out in many countries, also in the Czech Republic.

11. Possible substitutes

Foundry sand for moulding mixtures, especially in precision casting and few other uses, can be replaced by crushed olivine, staurolite or chromite with graphite binder.

Limestones and corrective additives for cement production

1. Characteristics and use

Limestones as a mineral are sedimentary (limestones) and metamorphic rocks (crystalline limestone or marble) containing $CaCO_3$ (calcite or aragonite). Limestones originated through chemical, biogenic and mechanical processes or their combination. Primary and secondary admixtures in limestones are dolomite, silicates, phosphates, etc. Limestones of different origin show variations in physical characteristics, texture, hardness, colour, weight, and porosity, ranging from loosely consolidated marls through chalk to compact limestones. Their colour depends on sort of admixture (pyrite and organic substance – black, pure – light to white). Calcitic marble (crystalline limestone) is a metamorphic rock formed of limestone under increased temperature and pressure. Limestones occur in practically all the sedimentary geological formations and their metamorphosed equivalents worldwide.

Limestones are used for production of building materials (lime, cement, mortar mixtures, granulated gravel, dimension and crushed stone, etc.), in the metallurgical, chemical and food industries, recently also for desulphurization of industrial flue gas (e.g. in thermal power stations), in agriculture, glass and ceramic industries, etc.

This group of minerals also includes corrective additives for cement production (CK), e.g. shales, clays, loess, loams, sand, etc., which correct the content of SiO_2, Al_2O_3 and Fe_2O_3 in the basic raw material for clinker mix. These corrective materials mostly occur directly in deposits of portland limestones or separately in their close neighbourhood.

2. Mineral resources of the Czech Republic

According to use, the limestones in the Czech Republic are classified in the following grades:

- Limestones with very high percentage of $CaCO_3$ (VV), containing at least 96 % of carbonate component (with max. 2 % $MgCO_3$). These limestones are used mostly in chemical, glass, ceramics, rubber, food and metallurgical industries, for desulphurization, and for production of the top quality lime (quick lime);
- Other limestones (VO) – with carbonate content at least 80 % – are used mostly for production of cement, further for production of lime, desulphurization, etc. Also dolomites and dolomitic limestones were included in this group in the Czech Republic until 1997.
- Clayey limestones (VJ) – with $CaCO_3$ content over 70 % and higher content of SiO_2 and Al_2O_3. These limestones are used for production of cement, all kinds of lime, and for desulphurization;
- Carbonates for use in agriculture (VZ) – with the content of carbonates at least 70–75%. They are used for agricultural land and forest soils conditioning;

  Above this limestones are suitable for dimension stones and crushed stone (see this chapters below).

Limestone deposits in the Czech Republic are concentrated in the following main areas:

- The Devonian of the Barrandian area – the most important and the largest mining district in Bohemian part of the Czech Republic. Almost all types of limestones occur there, particularly those of VV and VO grades, but also VZ and CK grades. Limestone deposits are hosted by sediments of mostly Lower Devonian age, and consist usually of several lithological types. The Upper Koněprusy limestones are of the highest grade (average content of $CaCO_3$ is about 98 %). A considerable part of reserves and hypothetical resources is however located in Protected Landscape Area Český kras, hence cannot be accessed. The most important deposits are Koněprusy (VV), Kozolupy-Čeřinka (VV+VO), Kosoř-Hvížďalka (VO), Loděnice (VO), Radotín-Špička (VO) and Tetín (VV+VO).
- The Paleozoic of Chrudim region (of the Železné hory Mts.) – relatively small surface area with important deposits. They are composed of the Podolí crystalline limestones (VV grade, 95 % $CaCO_3$) and less pure darker marbles of VO grade (90 % $CaCO_3$). Mined deposit Prachovice (VV+VO) represents the only and decisive deposit.
- Central Bohemian metamorphosed "islands" (Islet Zone) – small isolated areas with rather pure metamorphosed limestones (mostly VV a VO grades). Skoupý deposit (VV) is the most important one.
- Crystalline complex of the Krkonoše–Jizerské hory Mts. – medium and small-size deposits, mostly in the form of lenses within phyllitic and mica schistous rocks. Limestones are crystalline, often with variable contents of $MgCO_3$ (dolomitic limestones to calcitic dolomites) and SiO_2 (mostly VO and VZ grades). Apart from dolomite deposit Lánov, the almost exhausted Černý důl deposit (VO) is the only exploited deposit.
- Moldanubicum – small-size deposits of crystalline limestones, forming bands or lenses in metamorphic rocks. Dolomitic limestones or dolomites usually accompany the limestones here. The majority of local limestones are of VZ and VO grades. The highest number of deposits and amount of reserves is concentrated in the Šumava part of the Moldanubicum, with an important exploited deposit Velké Hydčice-Hejná (VO).
- The Moravian Devonian – represents the most important and very large region with limestone deposits of various sizes in Moravian part of the Czech Republic. The Vilémovice limestones (VV grade, 96–97 % $CaCO_3$) represent the major mineral in almost all deposits. Further types represented are the Křtiny, Hády and Lažánky limestones (VO). They are mostly registered as corrective additives for cement production. The largest and the most important deposits are concentrated in particular areas of the Moravian Karst with a large mined deposit Mokrá u Brna (VV+VO+CK) and of the Hranice Devonian with a large mined deposit Hranice-Černotín (VO+CK). Other mostly not mined deposits occur in the Konice-Mladeč Devonian, Čelechovice-Přerov Devonian and in the Devonian of the Boskovice Graben.
- The Silesicum (the Branná Group), the Zábřeh Group and the Orlické hory Mts.–Kłodzko Crystalline Complex – smaller deposits of crystalline limestones forming bands in metamorphic rocks. Limestones are often of high grade (VV grade, up to 98 % $CaCO_3$, less of VO grade) and in the northern part of the area there are limestones suitable for dimension stones (KA). Horní and Dolní Lipová (VV+VO) in the Silesicum and Vitošov (VV), located at the border of the Desná Dome and the Zábřeh Group, represent the most important mined deposits of this type.
- The Bohemian Cretaceous Basin (the Ohře and Kolín regions) – large and medium-size deposits. Deposits contain clayey limestones and marls with content of $CaCO_3$ ranging between 80 and 60 % (the most important deposits of clayey limestones – VJ). Exploited deposit Úpohlavy-Chotěšov (VJ) is of a fundamental importance.

- Outer Klippen Belt of the Western Carpathians – limestones form tectonically isolated blocks in surrounding rocks (so-called “klippen”). The limestones – Štramberk limestones in the NE and Ernstbrunn limestones in the SW – are of a very high grade, with an average content of $CaCO_3$ 95.0–98.0 %, and $MgCO_3$ about 1.0 % (VV). Štramberk (VV+VO) is the most important mined deposit of this type. It has been the only mined deposit since 2005, when the operation of the Mikulov deposit was terminated.

Other regions with carbonate rocks occurrences, such as Krušné hory Mts. Crystalline Complex, the Culm of the Nízký Jeseník Mts., Moravicum, the Tertiary of the southern and central Moravia etc. are mostly of just local interest. Deposits of limestones, additives for cement production and dolomites are extracted by open-pit mines.

3. Registered deposits and other resources in the Czech Republic

(see map)

Principal areas of deposits presence:

1 Devonian of the Barrandian area
2 Paleozoic of the Železné hory Mts.
3 Central Bohemian Islet Zone
4 Krkonoše Mts.-Jizerské hory Mts. Crystalline Complex
5 South-Bohemian and Moravian Moldanubicum
6 Moravian Devonian
7 Silesicum (Branná Group), Orlické hory Mts.-Kłodzko Crystalline Complex and Zábřeh Group
8 Bohemian Cretaceous Basin
9 Outer Klippen Belt of the Western Carpathians

4. Basic statistical data of the Czech Republic as of December 31

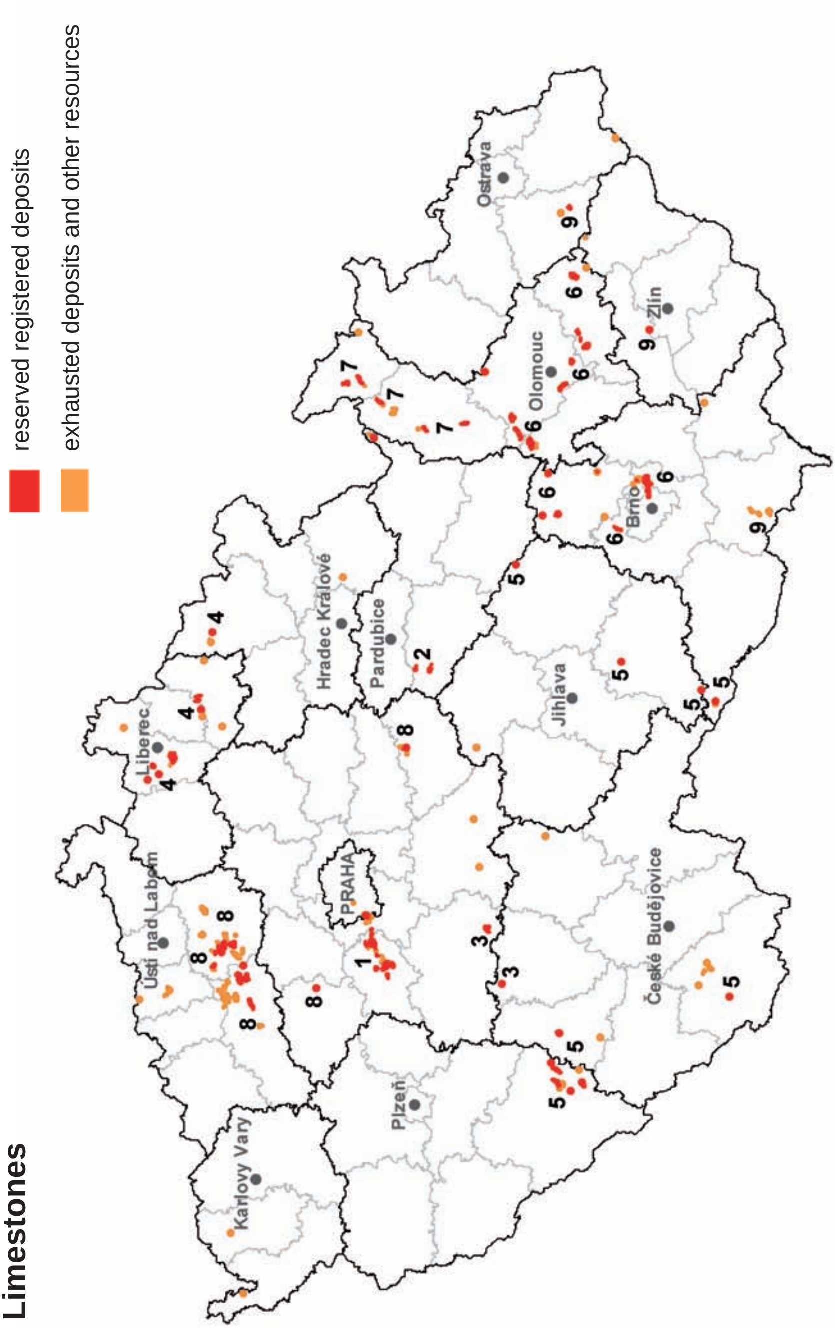
Number of deposits; reserves; mine production

Limestones – total number

Year	2003	2004	2005	2006	2007
Deposits – total number	99	95	91	88	87
exploited	24	25	25	23	22
Total mineral *reserves, kt	4 525 784	4 447 004	4 453 558	4 295 554	4 279 084
economic explored reserves	1 815 869	1 845 807	1 709 724	1 699 360	1 755 091
economic prospected reserves	2 039 737	1 931 626	1 912 168	1 804 009	1 778 279
potentially economic reserves	670 178	669 571	831 666	792 185	745 714
Mine production, kt	10 236	10 568	9 912	10 193	11 279

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Limestones



reserved registered deposits
exhausted deposits and other resources
Ostrava
Olomouc
Zlín
Brno
Hradec Králové
Pardubice
Liberec
Ústí nad Labem
PRAHA
Jihlava
Plzeň
Karlovy Vary
České Budějovice

Owing to the importance and considerable differences in technological use and prices, high-percentage limestones (VV), corrective additives for cement production (CK) and other limestones (VO) are monitored separately.

High-percentage limestones containing 96 % or more of $CaCO_3$ (VV)
Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	30	30	30	28	28
exploited	12	12	11	11	11
Total mineral *reserves, kt	1 431 653	1 426 550	1 423 616	1 388 433	1 355 031
economic explored reserves	690 135	685 191	648 966	626 781	622 492
economic prospected reserves	572 168	572 009	565 040	553 972	546 162
potentially economic reserves	169 350	169 350	209 610	207 680	186 377
Mine production, kt	4 573	4 629	4 199	4 386	4 885

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Other limestones (VO)
Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	50	50	46	47	47
exploited	14	15	15	14	14
Total mineral *reserves, kt	2 437 066	2 362 640	2 375 637	2 258 386	2 283 330
economic explored reserves	1 007 595	993 551	894 967	908 015	970 282
economic prospected reserves	981 106	919 718	907 242	814 494	796 574
potentially economic reserves	448 365	449 371	573 428	535 877	516 474
Mine production, kt	4 444	4 666	4 500	4 643	5 138

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Corrective additives for cement production (CK)
Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	16	16	16	15	15
exploited	5	5	5	5	4
Total mineral *reserves, kt	778 630	778 372	778 089	628 591	628 191
economic explored reserves	342 980	342 722	342 439	342 187	341 787
economic prospected reserves	224 300	224 300	224 300	159 688	159 688
potentially economic reserves	211 350	211 350	211 350	126 716	126 716
Mine production, kt	201	232	278	248	391

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

In many limestone deposits, VV and VO are extracted together. Six out of fifteen CK deposits make part of VO deposits.

Domestic production of selected intermediate products

Year / kt	2003	2004	2005	2006	2007
Cement	3 465	3 709	3 978	4 105	4 767
Quicklime	1 055	1 084	1 049	1 016	1 083
Lime hydrate	195	180	162	170	194

Source: Svaz výrobců cementu (Union of cement producers), Svaz výrobců vápna (Union of lime production)

Cement production:

Cementárna Praha-Radotín

Cementárna Mokrá

Cementárna Prachovice

Cementárna Čížkovice

Cementárna Hranice

Cementárna (cement works) Praha-Radotín and cementárna Mokrá produce Portland cement, Portland slag cement and so-called cement with modified properties. Cementárna Prachovice and cementárna Čížkovice produce Portland cement, Portland slag cement and Portland mixed cement. The assortment of the Hranice cement works involves Portland cement, Portland slag cement and Portland cement with limestone.

Lime production:

Vápenka Čertovy schody a.s.

Vápenka Vitošov s.r.o.

Vápenka Vitoul s.r.o.

KOTOUČ ŠTRAMBERK, spol. s r. o.

CARMEUSE CZECH REPUBLIC s.r.o.

HASIT Šumavské vápenice a omítkárny, a.s.

Krkonošské vápenky Kunčice, a.s.

The assortment of the vápenka (lime works) Čertovy schody involves apart from natural products (lump and ground limestone and lump and grinded dolomite) also burnt products (lump and ground lime, lime hydrate) and special products. Vápenka Vitošov produces lump lime, lime briquettes (used for iron production), lime hydrate and also mortar and plaster mixtures SALITH®. Vápenka Vitoul produces ground and finely ground limestones, used for instance at desulphurization of flue gases from thermal power stations, as a filler in rubber-making industry or at production of plastics. KOTOUČ ŠTRAMBERK, spol. s r. o. produces a large variety of products, e.g. lump sorted limestone, ground limestone, lump lime, ground lime, lime hydrate. HASIT Šumavské vápenice a omítkárny, a.s. produces e.g. lime hydrate, magnesium-lime fertilizers, fillers, plaster mixtures etc. The assortment of Krkonošské vápenky Kunčice includes e.g. dry mortar and plaster mixtures, maintenance plaster, masonry mortar.

5. Foreign trade

2521 – Limestone flux, limestone and other calcareous stone, for lime or cement manufacturing

	2003	2004	2005	2006	2007
Import, t	524 152	398 670	170 303	215 210	583 085
Export, t	103 111	133 184	123 299	161 380	104 811

2522 – Quicklime, slaked and hydraulic lime

	2003	2004	2005	2006	2007
Import, t	104 552	104 807	95 014	123 068	124 148
Export, t	198 479	171 160	155 322	145 260	149 991

2523 – Portland, aluminous, slag, supersulphate and similar hydraulic cements also coloured or in the form of clinkers

	2003	2004	2005	2006	2007
Import, t	1 148 584	1 308 919	1 206 097	1 163 105	1 064 655
Export, t	562 474	674 149	554 803	495 128	641 678

Detailed data on limestone imports (kt)

Country	2003	2004	2005	2006	2007
Slovakia	520 008	394 663	168 669	214 175	581 891
Germany	231	310	214	408	592
Poland	2 969	2 871	948	371	10
others	944	826	472	256	592

Detailed data on limestone exports (kt)

Country	2003	2004	2005	2006	2007
Poland	47 035	96 564	85 303	102 145	67 610
Germany	53 725	21 604	31 097	44 826	22 514
Austria	0	1 077	2 064	14 110	13 397
Slovakia	2 351	1 667	1 061	299	690
others	0	12 272	3 774	0	600

Volume of foreign trade with cement (more than 1 million tonnes per year imported since 2003) has been the most important. About two thirds are imported from Slovakia, the rest namely from Germany and Poland. Czech cement export has been ranging between 0.45 and 0.7 million tonnes and is directed in Germany and other neighbouring countries. The long-term trend of the Czech export being several times higher than the import turned into a completely opposite situation in 2002 and since than the foreign trade balance has been unfavourable for the Czech Republic.

Natural limestone has been imported to the Czech Republic almost exclusively from Slovakia. The imported volume has been gradually decreasing before 2006 (to almost one half during 2004-2006), as the trade was shifting rather to intermediate products. Almost 0.6 mill tonnes of mainly Slovak limestone was imported again in 2007. The Czech limestone export has been fluctuating between 100 and 200 kt per year; the export to Poland at the expense of Germany has increased in recent years. Trade with lime represents the smallest volume – import has been oscillating around 100 kt on a long term and it comes traditionally mainly from Slovakia. The lime export decreased from 225 kt in 2001 to 145 kt in 2006 and approximately 150 kt in 2007.

6. Prices of domestic market and foreign trade

Prices are influenced by quality requirements. Prices of high percentage limestones used especially in metallurgy and in chemical and sugar industries are the highest. The average prices of lump high-purity limestone oscillated between CZK 200-500 per tonne during the last years. Prices of bulk cement oscillated, depending on the quality, between CZK 2,100–2,600 per tonne, cement on pallets between CZK 2,300 and 2,800 per tonne. Prices of ground lime were CZK 1,300–2,800 per tonne, lump lime CZK 2,300–2,500 per tonne. Lime hydrate was sold at CZK 2,300–2,830 per tonne. Prices of crushed limestone were CZK 150–250 per tonne depending on $CaCO_3$ content. Prices of ground limestones were CZK 400–1,200 depending on the way of use and grain fraction.

The average prices of traded commodities on the domestic market

Product specification	2006	2007
cement CEM I, 42,5 R, on pallets, CZK/t	N	2560
cement CEM I, 42,5 R, on pallets, covered with foil , CZK/t	N	2640
cement CEM III A, 32,5 R, on pallets, CZK/t	N	2260
cement CEM III A, 32,5 R, on pallets, covered with foil, CZK/t	N	2340
lime hydrate dolomitic, CZK/t	N	2300–2565
quicklime, ground, CZK/t	N	1290

2521 – Limestone flux, limestone and other calcareous stone, for lime or cement manufacturing

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	172	243	237	182	162
Average export prices (CZK/t)	501	507	506	437	520

2522 – Quicklime, slaked and hydraulic lime

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	1 242	1 371	1 419	1 403	1 529
Average export prices (CZK/t)	1 529	1 588	1 571	1 640	1 660

2523 – Portland, aluminous, slag, supersulphate and similar hydraulic cements also coloured or in the form of clinkers

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	1 696	1 492	1 593	1 639	1 744
Average export prices (CZK/t)	1 042	1 161	1 219	1 191	1 422

7. Mining companies in the Czech Republic as of December 31, 2007

Limestones:

Českomoravský cement a.s., nástupnická společnost, Mokrá

Holcim (Česko), a.s., člen koncernu, Prachovice

Velkolom Čertovy schody a.s., Tmaň

Cement Hranice, a.s.

Lafarge Cement, a.s., Čížkovice

Vápenka Vitošov s.r.o., Leština

Lomy Mořina, s.r.o., Mořina

OMYA CZ s.r.o.

HASIT Šumavské vápenice a omítkárny, a.s., Velké Hydčice

Lom Skalka, s.r.o., Ochoz u Brna

Krkonošské vápenky Kunčice, a.s.

Vápenka Vitoul s.r.o., Mladeč

Kalcit, s.r.o., Brno

LB Cemix a.s., Borovany

AGIR s.r.o., Petrovice

Agrostav Znojmo, a.s.

Kamenolom a vápenka Malá dohoda, s.r.o., Holštejn

Corrective additives for cement production:

Českomoravský cement a.s., nástupnická společnost (succession company), Mokrá

Cement Hranice, a.s.

Holcim (Česko), a.s., člen koncernu (trust member), Prachovice

8. World production

Overall data on production of limestones in the world are not available. Accessible are data on mine production in some of the neighbouring countries – the average annual mine production in Slovakia (high-percentage limestones and other limestones) oscillated between 6.5 and 7.5 mill t in the last years. The annual mine production in Poland (including limestones used as crushed stone) has been roughly between 33 and 42 mill t. The major producing areas can be indirectly traced based on production of cement and lime, which consumes most of the mined limestone. In the last five years, the largest world producers were China then, India, the USA, Japan, Rep. of Korea, Spain, Russia, Brazil, Turkey and Italy, which together produced almost 70 % of the world production of cement. China, the USA, Russia, Japan, Germany, Brazil and Mexico produced about two thirds of the world lime production (64 % in 2006).

World production of cement

Year	2003	2004	2005	2006	2007 e
Production, mill t (MCS)	1 950	2 130	2 310	2 550	2 600

World production of lime

Year	2003	2004	2005	2006	2007 e
Production, mill t (MCS)*	120	126	127	271	277

* compilers of the MCS yearbook revaluated radically lime production in China and increased the originally given volume of approximately 25 mill tonnes to approximately 160–170 mill tonnes.

9. World market prices

Prices of limestone are not quoted. Prices of lime on the US market oscillated between USD 61 and 84 per tonne in 2003–2007, prices of lime hydrate were between USD 85 and 105 per tonne. The Industrial Minerals magazine has been publishing prices of calcium carbonate of various grades.

The average prices of traded commodities at year-end

Commodity/Year		2003	2004	2005	2006	2007
Calcium carbonate ground (GCC), coated fine grade, EXW UK	GBP/t	91.50	91.50	91.50	91.50	91.50
Calcium carbonate precipitated (PCC), coated fine grade, EXW UK	GBP/t	358.50	358.50	358.50	385.00	385.00
Calcium carbonate precipitated (PCC), fine (0.4–1.0 microns), FOB USA	USD/st	260.00	260.00	260.00	260.00	260.00
Calcium carbonate precipitated (PCC), very fine (0.02–0.36 microns), FOB USA	USD/st	562.50	562.50	562.50	562.50	562.50

10. Recycling

The material is not recycled. Recycled are just some products of glass industry, construction materials, etc.

11. Possible substitutes

Limestones of all grades have various uses. Limestones can be replaced in many applications. Limestones, dolomites and variously burnt lime are often mutually replaceable (e.g. in agriculture). Also in the desulphurization, various mixtures of carbonates can replace limestones. Limestone and products made of limestone (lime, hydrated lime) used for acid neutralization can be replaced by MgO minerals, natural and synthetic zeolites and anaerobic bacteria; biological technologies are successfully used in acid rain effects suppression and acid mine water neutralization.

Yet the limestone are irreplaceable in many of their uses – for instance in production of cement and lime, or in the metallurgical industry (melting agent for production of pig iron and steelmaking too).

Dolomite

1. Characteristics and use

In the Czech Republic, carbonates containing at least 27.5% of $MgCO_3$ and more than 80 % of $MgCO_3$ + $CaCO_3$ are classified as dolomites.

Pure dolomite is important material for glass, ceramic and chemical industries. Dolomitic rocks are used in production of dolomitic lime, hydrated lime, magnesium cements, and magnesia refractories for metallurgy, in desulphurization of power station waste gases. They are also used as dimension stone, in production of fertilizers and fillers and often also for crushed stone production and other building purposes. And as acid soil correctives.

2. Mineral resources of the Czech Republic

Dolomite and calcitic dolomite deposits and occurrences are located in the following main regions of the Czech Republic:

- Crystalline Complex of the Krkonoše–Jizerské hory Mts. – crystalline calcitic dolomite and dolomite deposits in the form of lenses in host rocks. This region is the most important in the Czech Republic, because it has the highest number of deposits and the largest volume of reserves. The largest and the most important deposit of dolomites in the Czech Republic Horní Lánov contains raw material with 32 % of CaO and nearly 19 % of MgO on average.
- Šumava Mts. and Bohemian Moldanubicum – it contains several smaller pure dolomite deposits (mined deposit Bohdaneč, abandoned deposit Jaroškov) and calcitic dolomite deposits (Podmokly, Krty).
- Crystalline Complex of the Krušné hory Mts. – several small deposits near Kovářská and Přísečnice (for instance mined-out deposit of pure dolomite Vykmanov).
- Moravian branch of the Moldanubicum with small but often high-quality dolomite occurrences (mined-out deposit Dolní Rožínka) and little explored prognostic resources (Lukov at Moravské Budějovice, Číchov et al.).
- Devonian of the Barrandian – a typical dolomite deposit (Velká Chuchle) already mined out.
- The Orlické hory Mts.–Kłodzko crystalline complex and Silesicum (Velké Vrbno group) – several smaller deposits (Bílá Voda).
- Moravian (Čelechovice–Přerov) Devonian near Olomouc – with two larger deposits of Lažánky calcitic dolomites (Hněvotín, Bystročice), associated here with Vilémovice limestones (VO). The average content of Mg in both deposits is 17 %. Another medium-sized deposit of Lažánky calcitic dolomites occurs near Čelechovice. The reserves are blocked by the spa protection zone.

Krkonoše–Jizerské hory Mts. Crystalline Complex and Moravian Devonian are the most important regions where dolomites partly occur in some deposits (Lánov, Hněvotín), but these are mainly calcitic dolomites. Deposits of the Šumava branch of the Moldanubicum are usually smaller or formed by impure calcitic dolomites. In the other regions, dolomites form only smaller lenses and they are often not enough explored (especially in the western Moravia).

3. Registered deposits and other resources in the Czech Republic

(see map)

Names of mined deposits are indicated in **bold type**

1	**Bohdaneč**	5	Hněvotín	9	Kryštofovo Údolí
2	**Lánov**	6	Horní Rokytnice	10	Křížlice
3	Bystročice	7	Jesenný-Skalka	11	Machnín-Karlov pod Ještědem
4	Čelechovice na Hané	8	Koberovy	12	Podmokly

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	12	12	12	12	12
exploited	2	2	2	2	2
Total mineral *reserves, kt	511 469	515 382	514 963	514 554	514 168
economic explored reserves	80 601	80 255	79 836	79 427	79 041
economic prospected reserves	336 584	340 843	340 843	340 843	340 843
potentially economic reserves	94 284	94 284	94 284	94 284	94 284
Mine production, kt	416	345	419	409	385

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

5. Foreign trade

2518 – Dolomite calcined, roughly worked or cut; agglomerated

	2003	2004	2005	2006	2007
Import, t	578 828	463 601	364 125	447 424	493 955
Export, t	14 245	14 403	13 164	19 047	19 908

Predominant part of dolomite (and dolomitic limestones in form of crushed stone) comes from the neighbouring Slovakia. In contrast, predominant part of the Czech export is directed to Poland. High-quality white dolomite is exported for markedly higher export prices.

6. Prices of domestic market and foreign trade

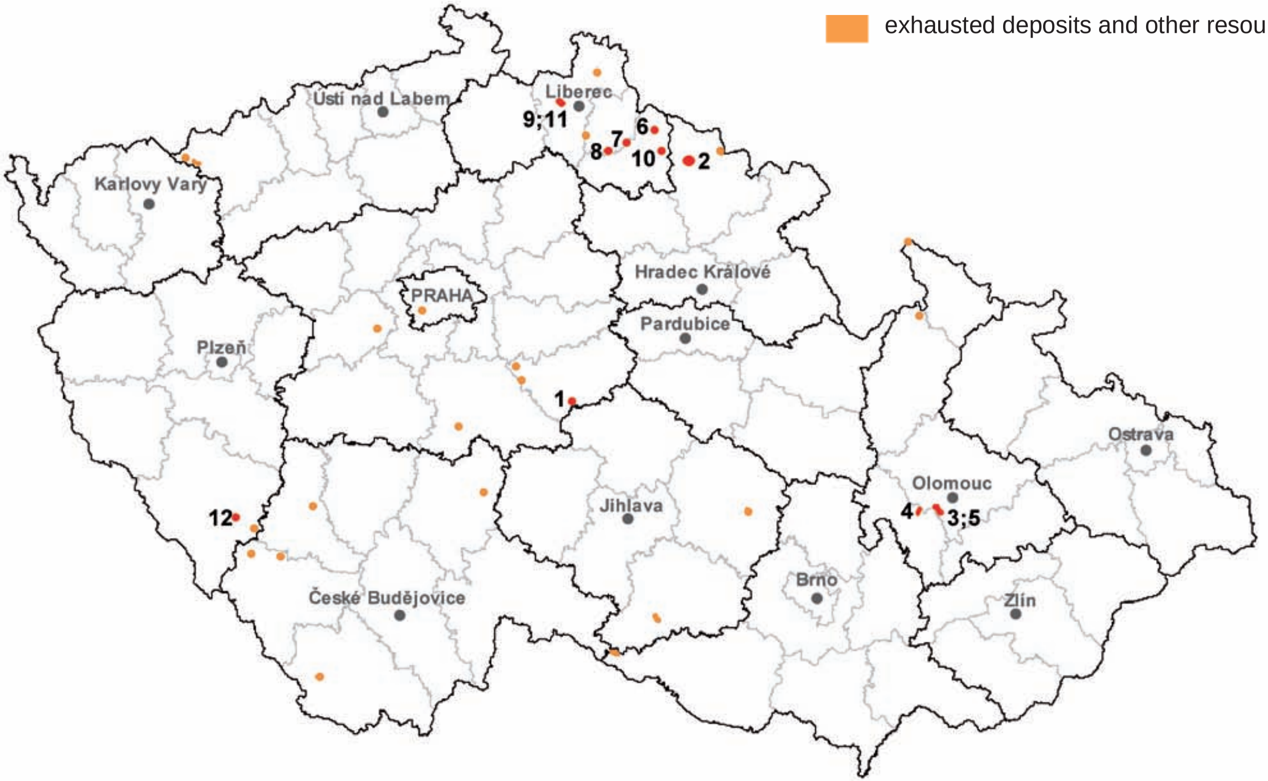
2518 – Dolomite calcined, roughly worked or cut; agglomerated

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	196	288	261	214	228
Average export prices (CZK/t)	2 051	2 205	2 863	2 587	2 389

Dolomite

reserved registered deposits

exhausted deposits and other resources



Prices of lump dolomite are CZK 75 per tonne; prices of dolomite aggregates reach CZK 210–350 per tonne depending on granularity. Ground calcitic dolomite is sold in bulk at CZK 540–640 per tonne, on pallets at CZK 1,580 per tonne. Crushed white dolomite is offered from 950 CZK/t (0–2 mm) to 1,330 CZK/t (2–5, 5–8, 8–16 mm).

The average prices of traded commodities on the domestic market

Product specification	2006	2007
Dolomite aggregates, CZK/t	190–330	210–350
Ground calcitic dolomite bulk, CZK/t	510–610	540–640
Ground calcitic dolomite on pallets, CZK/t	1580	1580

7. Mining companies in the Czech Republic as of December 31, 2007

Krkonošské vápenky Kunčice a.s.

UNIKOM a.s., Kutná Hora

8. World production

The dolomite production and consumption are not statistically followed in the world market. Annual market production in Slovakia has been oscillating roughly between 1.7 and 2.0 mill t during the last five years. The Polish annual mine production of dolomite has been between 5 and 6 mill tonnes. The USA production of dolomite crushed stone was 91 mil t in 2004 and 95 mill t in 2005, and it decreased to 87.7 mill tonnes in 2006.

9. World market prices

World market prices are not given in the international statistical surveys. In 2006, average price of dolomite used as crushed stone in the US market was 7.55 USD/t.

10. Recycling

Dolomite is not recycled.

11. Possible substitutes

Dolomite as source of Mg is substituted by magnesite, by Mg obtained from seawater and salt brines and by brucite.

1. Characteristics and use

Gypsum is a sedimentary rock, consisting mostly or completely of monoclinic mineral gypsum ($CaSO_4.2H_2O$), which is usually colourless or white. The rock often contains impurities (clay minerals, quartz, iron oxides, limestone, dolomite, anhydrite, etc.). The majority of gypsum deposits was formed as evaporites from marine or lake water in arid areas. Deposits of different origin (weathering and decomposition of sulphides, hydration of anhydrite, metasomatic processes, etc.) are of no economic importance. Anhydrous $CaSO_4$ (anhydrite) is often classified in the gypsum group. It is usually transformed to gypsum by wet grinding. Present world reserves of gypsum are estimated at 2,600 mill tonnes.

Gypsum is used mostly for production of building materials (calcined gypsum, cement, plasters, prefabricated elements) and small amount for other purposes (in agriculture, glass and paper manufacturing, in pharmacy, also as a filler, etc.).

2. Mineral resources of the Czech Republic

Gypsum deposits in the Czech Republic are confined to the Miocene (Badenian-Wieliczkien) sediments of the Opava Basin (marginal part of the Carpathian Foredeep). Larger part of the productive Badenian is on the Polish side of the basin. The average content of gypsum in the rock is 70–80 %. The impurities are mostly clay and to a smaller extent sand. Close to surface deposit parts are often karstified. The mining for gypsum (in the past there were also underground mines) in the Opava region has been going on continuously since the second half of the 19th century. At present, there is only one open-pit mine at Kobeřice ve Slezsku-jih deposit.

3. Registered deposits and other resources in the Czech Republic

(see map)

Names of mined deposits are indicated in **bold type**

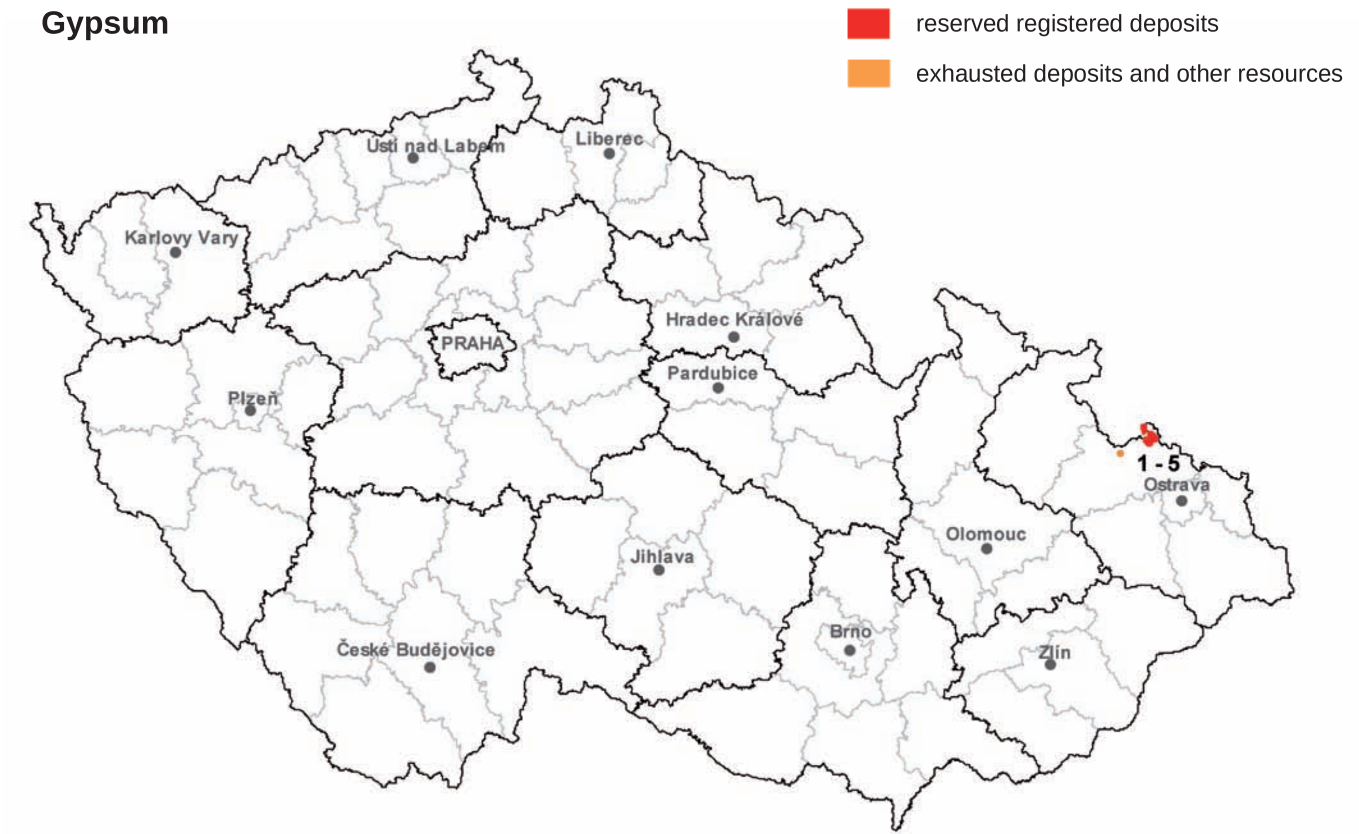
1	**Kobeřice ve Slezsku-jih**	3	Rohov-Strahovice	5	Třebom
2	Kobeřice ve Slezsku-sever	4	Sudice		

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	5	5	5	5	5
exploited	1	1	1	1	1
Total mineral *reserves, kt	504 597	504 527	504 502	504 470	504 349
economic explored reserves	119 470	119 400	119 375	119 343	119 222
economic prospected reserves	302 990	302 990	302 990	302 990	302 990
potentially economic reserves	82 137	82 137	82 137	82 137	82 137
Mine production, kt	76	68	24	16	66

Gypsum


reserved registered deposits
exhausted deposits and other resources
Ústí nad Labem
Liberec
Karlovy Vary
Hradec Králové
PRAHA
Pardubice
Plzeň
1 - 5
Ostrava
Olomouc
Jihlava
Brno
České Budějovice
Zlín

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Domestic production of selected intermediate products

Year	2003	2004	2005	2006	2007
Plaster boards (ths m^2)	32 109	38 698	36 410	41 793	40660
Gypsum (kt)	128	145	127	163	112

Production of byproduct gypsum

ČEZ, a.s.

Precheza, a.s.

H_2SO_4-bearing waste water formed during titanium white production, which is the main activity of Precheza a.s. Free H_2SO_4 is neutralized by limestone and the remaining sulphates by lime. White gypsum PREGIPS, used in the construction industry for cement or plaster production, and brown gypsum PRESTAB – granulate added for technical reclamation result from this process. 60–80 kt of the white and roughly the same amount of the brown gypsum are produced per year.

Production of plasterboards

KNAUF (závod Počerady)

Rigips, s.r.o. (závod Horní Počaply)

KNAUF s.r.o. has been active on the Czech market in the branch of plasterboard construction systems and materials since 1992. The construction plasterboards and supporting sections have been produced since 1994 in KNAUF Počerady plant. Rigips s.r.o. operates a plant for the plasterboard production in Horní Počaply by Mělník. The plant has a yearly capacity of 20 mill m^2 of plasterboards.

5. Foreign trade

252010 – Gypsum, anhydrite

	2003	2004	2005	2006	2007
Import, t	20 266	29 194	19 619	39 679	70 814
Export, t	92 133	90 803	33 306	46 837	105 385

Detailed data on gypsum imports (t)

Country	2003	2004	2005	2006	2007
Germany	19 764	28 653	19 305	38 752	69 048
others	502	541	314	927	1 766

Detailed data on gypsum exports (t)

Country	2003	2004	2005	2006	2007
Poland	0	0	0	5 230	87 272
Slovakia	92 104	90 803	33 305	41 606	18 087
others	29	0	1	1	26

Gypsum foreign trade, the same way as domestic production of natural gypsum, has been significantly influenced by over-production of synthetic, waste gypsum, which originates as a desulphurization by-product of flue gas in thermal power stations. Surplus of the waste gypsum on Central European market resulted in a pronounced decrease of the domestic mine production of natural gypsum and of volume of gypsum exported from the Czech Republic, especially in 2005 and 2006. Czech gypsum from Kobeřice has been exported traditionally especially to Slovakia. Export to Poland started in 2005 and its volume increased steeply in 2007. Gypsum import has been oscillating between 20 and 70 kt per year and imported raw material comes predominantly from Germany.

6. Prices of domestic market and foreign trade

252010 – Gypsum, anhydrite

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	977	1 441	1 814	2 118	2 147
Average export prices (CZK/t)	273	296	361	416	183

As an unusually high amount of gypsum was exported to Poland at 117 CZK/t, the average gypsum export prices decreased significantly in 2007. This resulted in decrease of the average annual price of all contracts. The average export price of a standard contract to Slovakia was approximately 500 CZK/t.

The average prices of traded commodities on the domestic market

Product specification	2006	2007
gypsum mined out, CZK/t	300	300
plaster binder grey, packages of 30 kg, pallets, CZK/t	2600	2700
plaster binder white, packages of 30 kg, pallets, CZK/t	4400	4500

In 2007, the average price of domestically mined gypsum fluctuated around CZK 300 per tonne depending on the quantity purchased. Gypstrend s.r.o. offers also plaster binder the prices of which differ according to the quantity and colour of the material. Price of grey plaster binder in packages of 30 kg on pallets with foil oscillated around CZK 2,700 per tonne and price of white one was about CZK 4,500 per tonne in 2007. Gypsum blocks represent a new product, which can substitute plasterboard at construction of internal partition walls. Their advantage compared to gypsum plasterboards is a higher surface rigidity. Their prices oscillate around CZK 370 and 480 per m^2.

7. Mining companies in the Czech Republic as of December 31, 2007

GYPSTREND, s.r.o., Kobeřice

8. World production

World production of gypsum (including anhydrite) has been for a long time in the range of 80–100 million tonnes. The highest mine production was in the year 2005 (105 mill tonnes), according to the yearbook Welt Bergbau Daten. The production is closely related to building activities, the reduction of which caused also a temporary reduction of mining for gypsum after 1989. There appeared a big competitor of natural gypsum, so-called "synthetic gypsum", in some countries in the last years. It originates as a byproduct of desulphurizing (flue gas desulphurisation – FGD) of thermal power stations. Mining production as recorded in USGS yearbooks Mineral Commodity Summaries (MCS) are higher than those of the Welt Bergbau Daten (WBD).

World gypsum mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt (MCS)	104 000	109 000	118 000	125 000	127 000
Mine production, kt (WBD)	95 349	99 838	105 016	115 280	N

Main producers' share in the world mine output (2006; according to MCS):

USA	16.9 %	China	6.0 %
Spain	10.6 %	Mexico	5.6 %
Iran	10.4 %	Japan	4.8 %
Canada	7.6 %	France	3.8 %
Thailand	6.7 %	Australia	3.2 %

9. World market prices

Prices of natural gypsum have been steady in the last years. Even in times of more extensive building activities, the prices were stable, which was also caused by a supply of waste gypsum (desulphurization byproduct of flue gas in thermal power stations, chemical industry), production of which highly exceeded the demand. Crude gypsum prices were quoted by the Industrial Minerals magazine until 2001 and it oscillated around 9.00 GBP/t EXW UK. Crude gypsum prices oscillated between 7 and 9 USD/t on the US market in 2003–2007.

10. Recycling

Waste gypsum wallboards from construction sites are recycled in a limited volume.

11. Possible substitutes

Natural gypsum is replaceable to some extent by byproduct gypsum for example from production of phosphoric acid, titanium dioxide and flue gas desulphurisation (FGD). The latter is the main type of by-product gypsum used (wallboards, cement production).

CONSTRUCTION MINERALS
– geological reserves and mine production

There are very high geological reserves of construction minerals – dimension stone, crushed stone, sand and gravel and brick clays and related minerals (brick minerals) – in the Czech Republic. The volume of mine production of construction minerals decreased significantly – to about one half – in the beginning of the 1990s and remained very stable (typically for dimension stone and sand and gravel) in the years afterwards. The change did not arrive until 2003, when the demand for construction minerals increased in relation to reparation of damages after the destructive flood which affected a substantial part of the Czech Republic in August 2002. In connection with the economic growth of the country, mine production stayed at a high level also in 2004–2007. A higher consumption (especially of crushed stone) has been mainly used at the renovation of infrastructure and road and railway constructions.

Mining of construction minerals in reserved deposits (decrease of mineral reserves volume by mining)

Mineral	Unit	2003	2004	2005	2006	2007
Dimension stone	ths m^3	244	273	288	242	242
Crushed stone	ths m^3	11 210	11 966	12 822	14 093	14 655
Sand and gravel	ths m^3	9 105	8 859	9 075	9 110	9 185
Brick minerals	ths m^3	1 626	1 554	1 543	1 286	1 433

Thousands of m^3 converted to kt:

- dimension and crushed stone 1,000 m^3 = 2.7 kt
- sand and gravel and brick minerals 1,000 m^3 = 1.8 kt

Mineral	Unit	2003	2004	2005	2006	2007
Dimension stone	kt	659	737	778	653	653
Crushed stone	kt	30 267	32 308	34 619	38 051	39 569
Sand and gravel	kt	16 389	15 946	16 335	16 398	16 533
Brick minerals	kt	2 927	2 797	2 777	2 315	2 579

Lifetime of industrial reserves

(economic explored disposable reserves) based on the decrease of reserves by mining including losses in registered deposits per year 2007 (A) and on the average annual decrement of reserves in period 2003–2007 (B) was as follows:

Mineral	Lifetime A (years)	Lifetime B (years)
Dimension stone	> 100	> 100
Crushed stone	69	81
Sand and gravel	95	99
Brick minerals	> 100	> 100

Data on construction mineral production presented by the Czech Geological Survey – Geofond were distorted to a certain extent before 1999 due to the classification of deposits as reserved and non-reserved. Producers were not obliged to submit the state statistical statement Geo (MŽP) V3-01 when non-reserved deposit was exploited and therefore their production could not be recorded. The actual production of construction minerals was therefore higher than data presented.

Since 1999, the non-reserved deposit production has been recorded by means of the state statistical statements Hor (MPO) 1-01. These data give a much more precise idea on total building material production (dimension stone included) in the Czech Republic. As the response rate was about 90 to 95 % until 2006, the actual mine output of non-reserved deposits is about 5 to 10 % higher than shown in the table. The response rate has been close to 100 % since 2007.

Mine production of construction minerals in non-reserved deposits is as follows:

Mineral	Unit	2003	2004	2005	2006	2007
Dimension stone	ths m^3	60	65	55	55	50
Crushed stone	ths m^3	960	1000	1 270	1 300	1 350
Sand and gravel	ths m^3	4 500	4 900	5 100	6 000	6 500
Brick minerals	ths m^3	180	330	220	300	300

Thousands of m^3 converted to kt:

- dimension and crushed stone 1,000 m^3 = 2.7 kt
- sand and gravel and brick minerals 1,000 m^3 = 1.8 kt

Mineral	Unit	2003	2004	2005	2006	2007
Dimension stone	kt	162	176	149	149	135
Crushed stone	kt	2 600	2 700	3 500	3 510	3 645
Sand and gravel	kt	8100	8 800	9 100	10 800	11 700
Brick minerals	kt	324	594	396	540	540

1. Characteristics and use

Rock, which has been specially cut or shaped for use in buildings, curbing or other construction or special use, is termed “dimension stone” or “decorative stone”. Architectural specifications for dimension stone concern primarily aesthetic qualities such as design, surface appearance, etc. Important requirements include mineralogical composition, strength, weather resistance, colourfastness, porosity, texture, structure, etc. Dimension stone includes all kinds of solid rocks of magmatic, sedimentary or metamorphic origin which can be quarried in the form of blocks and which are suitable for cutting to specific dimensions. A weathered surface, altered or crushed zones or intercalation of unsuitable rocks represent undesirable imperfections.

2. Mineral resources in the Czech Republic

Mostly deep-seated igneous rocks (predominantly granitoids), forming about 70 % of exploited reserved deposits, are used as dimension stone in the Czech Republic at present. Their share of the total geological reserves is higher than 50 %. Their share of the total mine production of dimension stone is 65 % at reserved and 60 % at non-reserved deposits of dimension stone. Higher than 20 % share of the mine production at reserved deposits have shales and slates and about 8 % sandstones. In the case of non-reserved deposits, more than 30 % of the mine production is represented by sandstone. The share of marbles is low – around 1 %.

- Dimension stone used in buildings, curbing and other applications (paving cubes, curb stones, guard stones, stairs etc.) mostly involves igneous rocks, much less other rocks (basalt columns, dike rocks). Deposits, similarly to those of crushed and broken stone, are bounded to the Central Bohemian Pluton and Moldanubian Pluton, the Nasavrky Massif, eventually other plutonic bodies of the Bohemian Massif (Štěnovice massif, Žulová Pluton, etc.).
- Mostly marbles and plutonic rocks are exploited for architectural and sculpture dimension stone production. Light granites and granodiorites, which occur in the Central Bohemian and Central Moldanubian plutons, the Štěnovice, the Krkonoše Mts.-Jizerské hory Mts., the Jeseníky Mts. and Nasavrky massifs in Bohemia, and in Třebíč and Žulová massifs in Moravia, are mostly used. Less important are dark igneous rocks – diabase, diorite and gabbro, which also occur in the Central Bohemian Pluton, further in the Kdyně and the Lužice massifs. These rocks are used for wall lining (also polished), paving, for building of monuments and in sculpture, etc.
- Neovolcanic rocks are not very suitable, apart from some trachytes of the České středohoří Mts. and Doupovské hory Mts., which are used in sculpture and as a polished lining.
- Among sedimentary rocks in Bohemia, the most important are Cenomanian sandstones from the area east of Prague and from Hořice and Broumov regions. Less important are Triassic and red Permian sandstones from the Krkonoše Mts. Piedmont Basin. In Moravia, there are the Cretaceous Těšín sandstones or red Permian sandstones of the Tišnov region. Sandstones are used for production of cut and polished wall linings. Very suitable are also Devonian limestones of the Barrandian area and of the Moravian Karst (wall lining, terrazzo, etc.). Pleistocene travertines, used for interior wall lining, terazzo

and conglomerates, were quarried in the Přerov region. Slates of the Moravian–Silesian Paleozoic are used as lining, covering and paving material, and as expanded materials. Greywackes of the Culm were often used, too.

- Crystalline limestones and dolomites – marbles – are the most widely used metamorphic rocks (polished wall linings, paving materials, terrazzo, conglomerates, and sculptures). Large deposits are in the Šumava region and the Czech part of the Moldanubicum, in the Krkonoše Mts.-Jizerské hory Mts. Crystalline Complex and the Orlické hory Mts.-Kłodzko Crystalline Complex, the Svratka Anticline, in the Silesicum, and in the Branná Group (Silesia). Proterozoic phyllites (slates) of the western Bohemia (the Střela valley) and the Železný Brod Crystalline Complex are used for roofing and wall lining (the waste as a filler). Serpentinites of Moravia and Western Bohemia are used, too.

3. Registered deposits in the Czech Republic

(see map)

There are many registered dimension stone deposits in the Czech Republic and therefore they are not listed.

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	165	164	163	162	163
exploited	75	72	73	72	70
Total mineral *reserves, ths m^3	198 263	197 503	192 984	191 821	190 993
economic explored reserves	84 656	84 537	84 287	83 667	83 262
economic prospected reserves	69 081	68 440	68 249	67 998	66 778
potentially economic reserves	44 527	44 527	40 448	40 156	40 954
Mine production in reserved deposits, ths m^3 [a)]	244	273	288	242	242
Mine production in non-reserved deposits, ths m^3 [b)]	60	65	55	55	50

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

a) decrease of mineral reserves by mine production

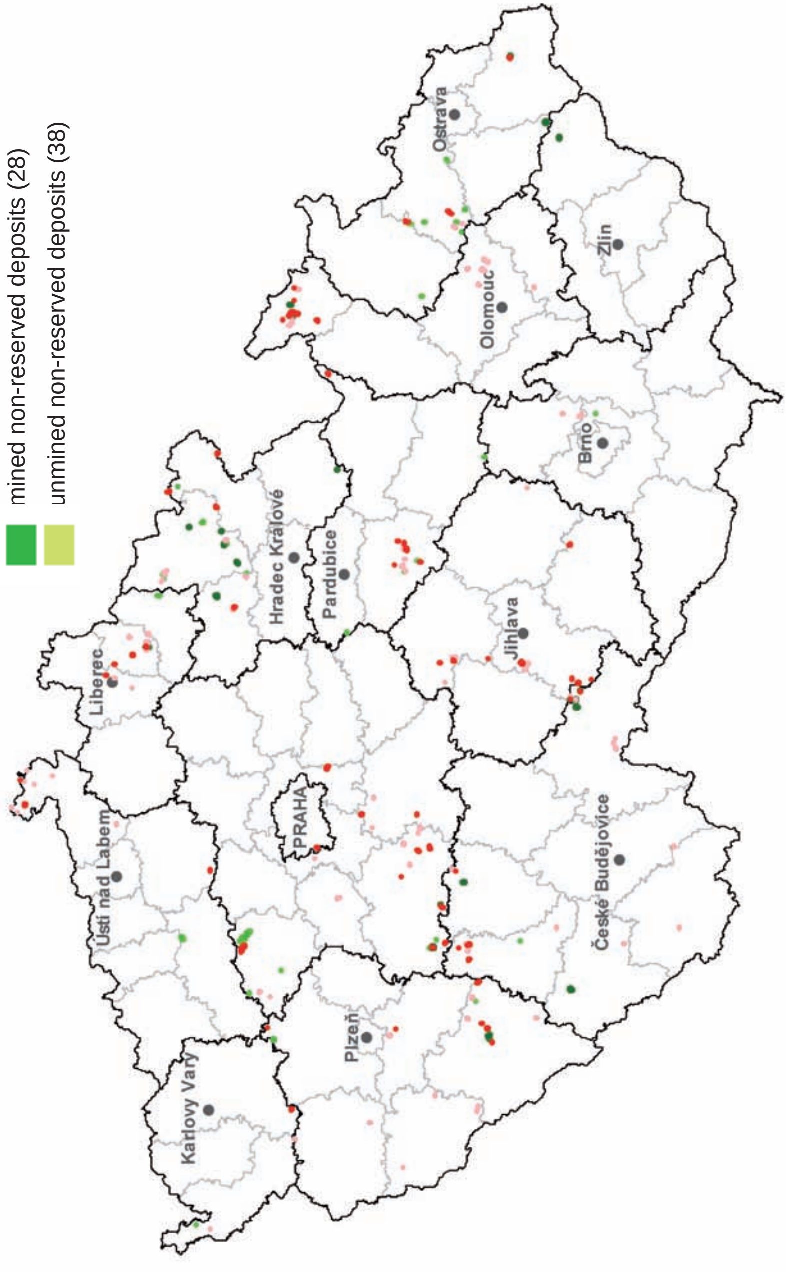
b) estimate

5. Foreign trade

2514 – Slate, also roughly worked or cut

	2003	2004	2005	2006	2007
Import, t	1 528	836	2 094	5 376	5 025
Export, t	26 414	50 134	50 694	56 668	59 005

Dimension stone



Detailed data on slate exports (t)

Country	2003	2004	2005	2006	2007
Poland	13 791	20 058	29 378	39 252	38 591
Ukraine	3 622	12 672	13 334	10 291	12 143
Lithuania	165	4 664	2 956	3 745	5 609
Russia	6 211	11 182	4 166	2 530	2 098
others	2 625	1 558	860	850	564

2515 – Marble, travertine, ecaussine and other calcareous stone

	2003	2004	2005	2006	2007
Import, t	1 038	1 203	1 168	1 521	2 625
Export, t	60	34	21	6	4

Detailed data on marble imports (t)

Country	2003	2004	2005	2006	2007
Germany	76	36	63	79	899
Italy	193	358	517	536	848
Croatia	79	43	138	312	257
Spain	0	168	113	165	28
Greece	380	250	43	10	0
others	310	348	294	419	593

2516 – Granite, porphyry, basalt, sandstone and other stone

	2003	2004	2005	2006	2007
Import, t	12 693	7 423	8 640	8 015	11 590
Export, t	11 486	10 043	11 392	7 704	9 431

Detailed data on granite and rocks like that imports (t)

Country	2003	2004	2005	2006	2007
Italy	2 148	1 387	1 150	1 413	5 389
India	1 627	1 296	1 485	1 118	768
South Africa	827	1 357	1 535	911	713
others	8 091	3 383	4 470	4 573	4 720

Detailed data on granite and rocks like that exports (t)

Country	2003	2004	2005	2006	2007
Germany	8 008	8 315	10 241	6 776	6 939
Slovakia	1 431	580	537	512	1 733
Poland	980	345	359	200	283
others	1 067	803	255	216	476

6801 – Setts, curbstones and flagstones of natural stone (except slate)

	2003	2004	2005	2006	2007
Import, t	5 344	3 919	4 487	2 366	3 038
Export, t	166 184	125 789	123 759	116 169	106 485

6802 – Worked monumental and crushed stone (except slate) and stonework

	2003	2004	2005	2006	2007
Import, t	22 408	22 895	26 428	29 898	35 475
Export, t	48 520	46 004	54 381	73 529	89 315

6803 – Worked slate and articles of slate or of agglomerated slate

	2003	2004	2005	2006	2007
Import, t	1 235	1 738	1 817	2 098	2 294
Export, t	328	136	384	548	254

Dimension stone represents a typical raw material which can be in some cases sold in the entire world for its mutual difference, uniqueness and inimitability. Foreign trade with dimension stone is divided into many customs tariff items, which however do not respect the common petrographic classification of the rocks. The Czech export of slate experienced a big grow, for rough items in 2002–2004 (item 2514) and a grow again in 2005–2006 after a marked decline in 2004 for worked slate (item 6803); export goes mainly to Eastern Europe. Various types of marble are imported to the Czech Republic from traditional producer countries like Italy, Greece, Spain, but also Croatia, Macedonia, Portugal or Albania. Large spectrum, covered by the customs tariff item 2516 (granite, porphyry, basalt, sandstone etc.), is imported to the Czech Republic from many countries. Export of the Czech dimension stone goes mainly to neighbouring countries, especially Germany. It declined sharply for both marbles (item 2515) and granites (2516) in 2006. Customs tariff items 6801, 6802 and 6803 include worked dimension stone. Various types of setts, are exported to about 20 countries annually, especially to Germany, Austria and Slovakia. Worked stones for artistic or construction purposes are imported to the Czech Republic especially from Italy and China, on the contrary Czech stones are exported mainly to Central European countries

(Poland, Slovakia, Russia, Lithuania, Ukraine). Worked slate is imported to the Czech Republic mainly from Spain, Italy, India and China.

6. Prices of domestic market and foreign trade

Prices of dimension stone products depend on mineral quality and on the level of processing. For example: prices of granite blocks oscillate between CZK 5,600 and 20,000 per m^3 depending on block volume; prices of granite paving stones oscillate between CZK 2,000 and CZK 3,200 per tonne (average price is CZK 2,500 per tonne); prices of granite curbs reach CZK 900–3,000 per linear meter (average price is CZK 1,800 per linear m). Crude sandstone blocks are sold at CZK 4,300–15,000 per m^3 (average price is CZK 10,000 per m^3).

Prices of polished slabs of granite, syenite or other igneous rocks oscillate between CZK 1,500–9,000 per m^2 depending on thickness of the slab. Slabs with sand blasted finish made of the same material reach up to CZK 1,150–6,650 per m^2. Sandstone slabs with rubbed finish are sold at CZK 1,1190–3,850 per m^2 depending on their thickness and colour; the price of cut sandstone panels (30 cm thick) reach up to CZK 4,900 per m^2. In contrast, sandstone prisms are sold at CZK 950 per tonne.

Domestic marble (from Supíkovice and Lipová) is sold at CZK 1,210–2,300 per m^2 as polished panels or paving slabs. Prices of imported marble (for instance Carrara) reach up to CZK 1,800–2,600 per m^2. Polished granite parapets are sold at CZK 447–790 per linear meter; marble parapets at CZK 390–760 per linear meter. Price of polished benchtop slabs made of granite and other igneous rocks is CZK 3,500–5,000 per m^2. Marble benchtop slabs are sold at CZK 2,700–6,700 per m^2.

Prices of slate products differ. For instance, roofing shingles are sold at CZK 560–1,100 per m^2 depending on shingle size. The price of slate revetment is about CZK 300 per m^2; slate pavement is sold at about CZK 350 per m^2.

2514 – Slate, also roughly worked or cut

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	8 827	5 339	3 120	2 423	2 310
Average export prices (CZK/t)	1 206	1 362	1 063	1 032	1 078

2515 – Marble, travertine, ecaussine and other calcareous stone

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	13 120	17 347	12 907	16 203	10 344
Average export prices (CZK/t)	6 290	11091	28 848	19 240	13 510

2516 – Granite, porphyry, basalt, sandstone and other stone

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	4 522	6 875	7 896	7 068	6 418
Average export prices (CZK/t)	3 533	2 727	2 921	2 557	2 661

7. Mining companies in the Czech Republic (reserved deposits) as of December 31, 2007

REVLAN s.r.o., Horní Benešov
Slezský kámen a.s., Jeseník
Granit Lipnice s.r.o., Dolní Město
Průmysl kamene a.s., Příbram
HERLIN s.r.o., Příbram
Bohumil Vejvoda, obchodní činnost VEDA CS, Krakovany v Čechách
MEDIGRAN s.r.o., Plzeň
Česká žula s.r.o., Strakonice
DCK – Družstvo cementářů a kameníků Holoubkov Bohemia, a.s.
Jindřich Zedníček, Kamenná
COMING PLUS a.s., Praha 4
GRANIO s.r.o., Chomutov
SLEZSKÁ ŽULA s.r.o., Javorník
Josef Máca, Třešť
RALUX s.r.o., Uhelná
Kámen Ostroměř s.r.o.
Q – GRANIT s.r.o., Blatná
Ligranit a.s., Liberec
Pražský kamenoservis s.r.o., Praha 10
Granit Málkov s.r.o., Blatná
Kámen Hudčice s.r.o.
Kamenolom Nová Červená Voda s.r.o., Praha
Granit – Zach s.r.o., Prosetín
Kamenoprůmyslové závody s.r.o., Šluknov
Obec Studená
Krákorka a.s., Červený Kostelec
Lom Matula Hlinsko a.s.
Anna Mrázová, Mukařov
Těžba nerostů a.s., Plzeň
M.& H. Granit s.r.o., Plzeň
CHARLTON a.s., Praha
Ladislav Peller – Těžba a úprava surovin, Praha 4
JIHOKÁMEN, výrobní družstvo, Písek
CZECH – TRADING s.r.o., Rychnov nad Kněžnou
Lucie Salavcová Babická, Vrchotovy Janovice
BÖGL & KRÝSL, k.s., Praha
Mšenské pískovce s.r.o., Mšené-lázně
K – Granit s.r.o., Jeseník

The most important mining organizations in non-reserved deposits as of December 31, 2007

HERLIN s.r.o., Příbram
RENO Šumava a.s., Prachatice
KOKAM s.r.o., Kocbeře
K – Granit s.r.o., Jeseník
Lom Horní Dvorce s.r.o., Strmilov
Profistav s.r.o., Litomyšl
Obec Studená
Josef Máca, Třešť
Jiří Sršeň – TEKAM, Záměl
HERKU – kamenolomy s.r.o., Sušice
Lesostavby Frýdek - Místek, a.s.
Alfonz Dovičovič, Hořice
Kamenolom Javorka s.r.o., Lázně Bělohrad
Lom Studená, s.r.o., Kolín
Žula, spol. s r.o., Praha
Ing. Danuše Plandorová, Hážovice
JIHOKÁMEN, výrobní družstvo, Písek
KAJA – TRADING, spol. s r.o., Praha
Krákorka a.s., Červený Kostelec
Kamenolom Dubenec s.r.o., Všestary

8. World production

Precise statistics on a worldwide basis are lacking, since often producers are not required to record dimension stone production. Data when available are either given in tonnes or in m^3. According to the USGS Mineral Yearbook, world production was estimated at 103 mill t in 2006. Main producers were China, India, Italy, Iran and Turkey. These countries produced about 69 % of the world production. Annual production of the USA has been approximately 1.3–1,5 mill tonnes in the recent years. Carbonate represents 42 %, granite 32 %, sandstone 15 %, marble 4 %, slate 1 % and other types 6 % of the total amount. Annual production of the architectural and sculpture dimension stone in Poland has been oscillating between 600 and 1,100 ths m^3. Mining production in Slovakia fluctuates between only 10 and 20 ths m^3 per year (the only mined deposit Spišské Podhradie – travertine).

9. World market prices

Prices of dimension stone in international market depend on mineral quality and degree of working. In general they are not officially published.

10. Recycling

The material is recycled to a limited extent (setts, worked slate, worked building stone etc.).

11. Possible substitutes

Individual types of dimension stone are mutually replaceable. Synthetic materials, ceramics, metals, glass, etc can replace all types. However, an opposite tendency has been evident recently – a growing interest in natural materials.

Crushed stone

Thomas Heise, Günter Tiess
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(subchapters 8., 9.)

1. Characteristics and use

Crushed stone involve all kinds of solid magmatic, sedimentary, or metamorphic rocks, which have suitable technical properties to be used in construction works. They must have certain physical and mechanical properties based on their origin, mineralogical and petrographic composition, structure, texture, secondary alterations, etc. The rocks are used in the form of quarried stone or mostly in the form of crushed and broken aggregates. Impurities are represented by fractured, crushed, weathered or altered zones, inclusions of technically unsuitable rocks, higher content of sulphur, amorphous SiO_2, etc. The world resources are virtually inexhaustible.

2. Mineral resources in the Czech Republic

Commercially usable deposits of stone suitable for crushing can be found throughout the Bohemian Massif, but much less frequently in its basin regions. Western Carpathians are rather poor in stone suitable for crushing.

- Volcanic rocks represent the major source of stone for production of crushed aggregates in the Czech Republic. Deposits of paleovolcanic rocks (pre-Tertiary volcanites) occur only in the Barrandian area (consolidated pyroclastics are also suitable), in the Krkonoše Mts. Piedmont Basin and in the Intra-Sudetic Depression. They locally enclose also layers or bodies of pyroclastic or altered rocks. Especially important are deposits of mafic rocks – spilites, diabases, etc. Among neovolcanic rocks (post-Cretaceous volcanites), mafic (especially basaltic) varieties appear to be the most important, too. They are most abundant in the České středohoří and Doupovské hory Mountains, less abundant in the neovolcanic area of the Bohemian Cretaceous Basin, eastern Sudetes and in the Železný Brod region. Share of basic volcanic rocks in the total mine production of crushed stone in the Czech Republic is about 25 %.
- Igneous rocks (particularly granites and quartz-diorites) represent an important source of crushed stone. Various types of igneous rocks (including accompanying swarms of dike rocks) are quarried at many localities in the Central Bohemian Pluton, Central Moldanubian Pluton, the Železné hory Mts. Pluton (the Nasavrky Massif), the Brno Massif and in other plutonic bodies. Single deposits of dike rocks are of small importance. Share of deep-seated igneous rocks in the total mine production of crushed stone in the Czech Republic is about 22 %.
- Deposits of consolidated clastic sediments (siltstones, greywackes, etc.) predominate in the sedimentary rock deposits. Culmian greywackes of the Nízký Jeseník Mountains and the Drahanská vrchovina Highlands represent the most important source of crushed stone. Similar rocks also occur in the Proterozoic of the Barrandian area, Moravian Dev-

onian and the flysh belt of the Western Carpathians. Clastic sedimentary rocks (mainly greywackes) make about 27 % of the crushed stone production in the Czech Republic.

- Carbonates (the Lower Paleozoic of the Barrandian area, the Moravian–Silesian Devonian) and siliceous rocks (lydites or cherts in the Upper Proterozoic of the Plzeň region) represent deposits of chemical and biogenic origin. They constitute approximately 3 % of the total crushed stone production in the Czech Republic.
- Regionally metamorphosed rock deposits, represented by crystalline schists or gneisses, which occur exclusively in crystalline complexes of the Bohemian Massif in Moldanubicum, Moravicum, Silesicum, crystalline areas of the Slavkovský les, West Sudetes etc. are of a high importance, too. Besides technologically very suitable rocks (orthogneisses, granulites, amphibolites, serpentinites, crystalline limestones, etc.) there occur also some less suitable rocks (mica-schists, paragneisses, quartzites).
- Less important are deposits of contact metamorphosed rocks (hornfelses, schists) occurring along the contact of the Central Bohemian and the Nasavrky Plutons with Late Proterozoic and Paleozoic sediments. Metamorphosed (both regionally and contact) rocks contribute to more than 23 % in the total mine production of crushed stone.
- A small proportion of suitable clays of the Cypris formation, representing the overburden of the Sokolov coal basin, have been used for expanded stone production (commercial name LIAPOR).

3. Registered deposits in the Czech Republic

(see map)

Because of the large number of crushed stone deposits in the Czech Republic, they are not listed.

4. Basic statistical data of the Czech Republic as of December 31

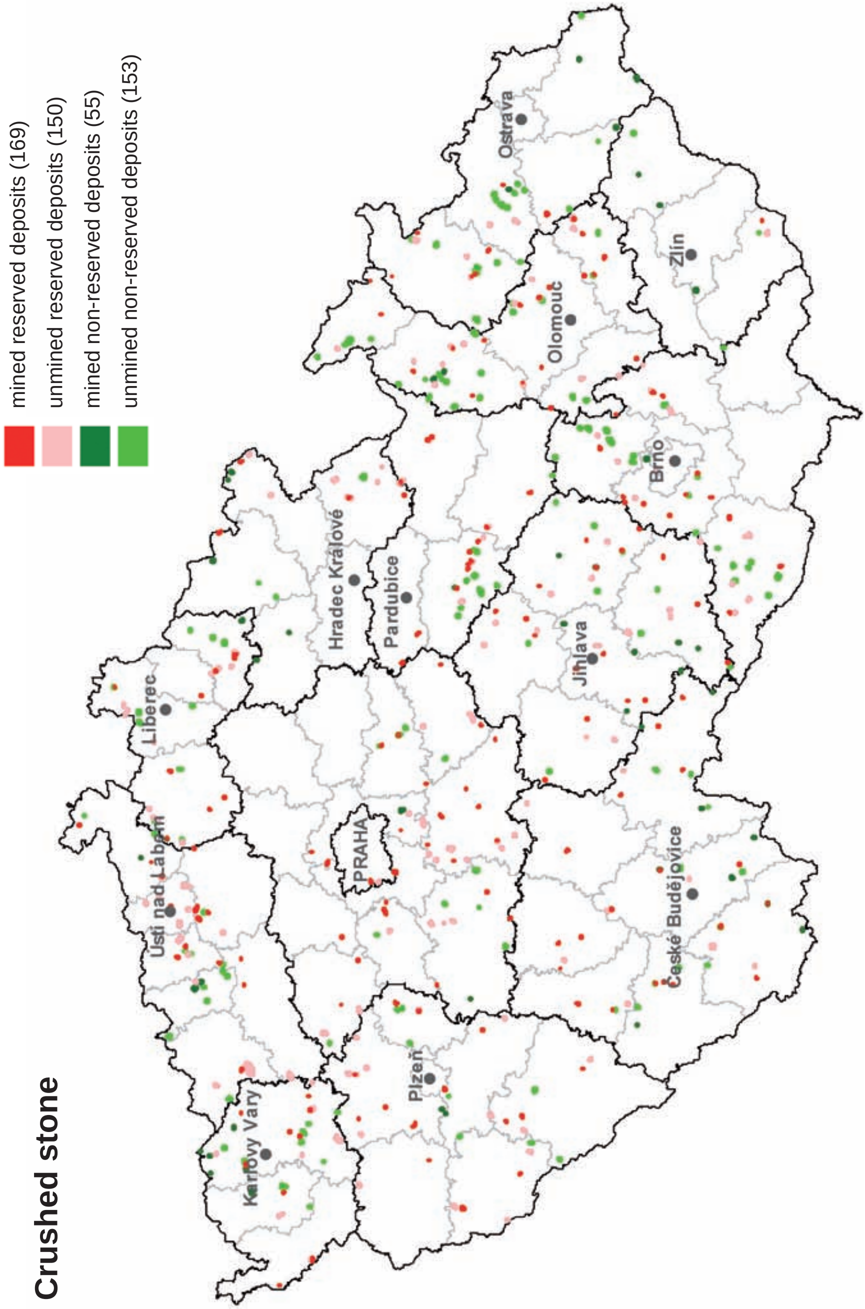
Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	329	324	319	319	319
exploited	169	168	169	170	169
Total mineral *reserves, ths m^3	2 338 034	2 281 082	2 315 902	2 254 873	2 266 643
economic explored reserves	1 158 022	1 142 528	1 166 229	1 130 527	1 129 149
economic prospected reserves	1 028 320	983 239	1 014 798	996 531	1 005 144
potentially economic reserves	151 692	155 315	134 875	127 815	132 350
Mine production in reserved deposits, ths m^3	11 210	11 966	12 822	14 093	14 655
Mine production in non-reserved deposits, ths m^3; [a)]	960	960	1 270	1 300	1 350

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

[a)] estimate

Crushed stone



5. Foreign trade

251710 – Pebbles, gravel, broken or crushed stone

	2003	2004	2005	2006	2007
Import, kt	144	455	480	632	246
Export, kt	324	210	340	599	471

Definition of the item 251710 of the customs tariff clearly shows that not only crushed stone but also sand and gravel and other sand types are included in this item. However, especially in case of Slovakia the import does not concern crushed stone s.s. Customs tariff items in the group of construction materials characteristically overlap or they are not unequivocally specified. Given data, as well as the territorial structure of foreign trade, should be understood rather as information on trends rather than exact numbers.

Detailed data on crushed stone imports (kt)

Country	2003	2004	2005	2006	2007
Slovakia	117	397	397	553	158
Germany	6	26	62	38	49
Poland	17	19	16	31	27
other	4	13	5	10	12

Detailed data on crushed stone exports (kt)

Country	2003	2004	2005	2006	2007
Austria	281	190	196	254	209
Slovakia	2	2	138	322	184
Germany	39	16	6	18	55
other	2	2	0	5	23

6. Prices of domestic market and foreign trade

251710 – Pebbles, gravel, broken or crushed stone

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	246	293	284	237	378
Average export prices (CZK/t)	197	266	234	221	220

Crushed stone prices oscillate depending on the rock quality, grain size and also on availability of the mineral in certain region. Size fraction 4–8 mm was offered at following prices in CZK/t: spilite – approximately 325, amphibolite – approximately 310, granite – approximately 303, gneiss and porphyry – approximately 300, granodiorite – approximately 295, greywacke – approximately 288, basalt – approximately 275, chert – approximately 260, limestone – approximately 230. In size fraction 8–16 mm, the prices in CZK/t were as a whole lower: spilite – approximately 292, amphibolite – approximately 255, basalt – 253, chert and gneiss – approximately 242, granodiorites – 237, greywacke – 235, granite – 236, porphyry – 220, limestone – approximately 195. Prices of crushed stone in size fraction 16–32 mm were still lower (in CZK/t): spilite – approximately 260, basalt – approximately 245, amphibolite – approximately 240, gneiss – approximately 230, chert and porphyry – approximately 225, granodiorite – 215, greywacke – approximately 200, granite – 190, limestone – approximately 185. Prices of crushed stone in size fraction 32–63 mm as a whole were between 170 and 230 CZK/t in 2007; the cheapest was again limestone and the most expensive spilite.

As classification according to the region concerns, prices of crushed stone have been higher in Liberec, South Bohemian and Pilsen Regions. Relatively low prices were noted in Moravian-Silesian, Olomouc and Karlovy Vary Regions.

Domestic prices of crushed stone

Product specification	2006	2007
crushed stone, spilite, fraction 4–8mm, CZK/t	310	325
crushed stone, amphibolite, fraction 4–8 mm, CZK/t	295	310
crushed stone, granite, fraction 4–8 mm, CZK/t	290	303
crushed stone, gneiss and porphyry, fraction 4–8 mm, CZK/t	288	300
crushed stone, granodiorite, fraction 4–8 mm, CZK/t	282	295
crushed stone, greywacke, fraction 4–8 mm, CZK/t	270	288
crushed stone, basalt, fraction 4–8 mm, CZK/t	260	275
crushed stone, chert, fraction 4–8 mm, CZK/t	250	260
crushed stone, limestones, fraction 4–8 mm, CZK/t	215	230
crushed stone, spilite, fraction 8–16 mm, CZK/t	280	292
crushed stone, amphibolite, fraction 8–16 mm, CZK/t	245	255
crushed stone, granite, fraction 8–16 mm, Kč/t	222	236
crushed stone, gneiss, fraction 8–16 mm, Kč/t	230	242
crushed stone, granodiorites, fraction 8–16 mm, Kč/t	227	237
crushed stone, greywacke, fraction 8–16 mm, Kč/t	224	235
crushed stone, basalt, fraction 8–16 mm, Kč/t	240	253
crushed stone, chert, fraction 8–16 mm, Kč/t	230	242
crushed stone, limestones, fraction 8–16 mm, Kč/t	185	195

7. Mining companies in the Czech Republic (reserved deposits) as of December 31, 2007

Českomoravský štěrk a.s., Mokrá
TARMAC CZ a.s., Liberec

KAMENOLOMY ČR s.r.o., Ostrava – Svinov
EUROVIA Lom Jakubčice s.r.o.
Hanson ČR a.s., Veselí nad Lužnicí
Kámen a písek s.r.o., Český Krumlov
COLAS CZ a.s., Praha
KÁMEN Zbraslav, spol. s.r.o.
Lomy s.r.o., Brno
M – SILNICE a.s., Pardubice
Berger Bohemia a.s., Plzeň
BÖGL & KRÝSL k.s., Praha
Štěrkovny spol. s r.o., Dolní Benešov
DOBET s.r.o., Ostrožská Nová Ves
Kamenolom Císařský a.s., Brno
Granita s.r.o., Skuteč
Kámen Brno, s.r.o.
Stavby silnic a železnic a.s., Praha 1
Basalt s.r.o., Zabrušany
Stone s.r.o., kamenolom Všechlapy
ZAPA beton a.s., Praha 4
SHB s.r.o., Bernartice
PIKASO s.r.o., Praha 4
Lom Klecany, s.r.o., Praha 9
Žula Rácov s.r.o., Batelov
LOMY MOŘINA spol. s.r.o., Mořina
ROSA s.r.o., Drásov
RENO Šumava s.r.o., Prachatice
Silnice Čáslav – Holding, a.s.
Stavební recyklace s.r.o., Sokolov
Formanservis s.r.o., Nebřenice
Železniční průmyslová stavební výroba Uherský Ostroh, a.s.
ATS – Silnice s.r.o., Štěnovice
BES s.r.o., Benešov
HUTIRA – OMICE, s.r.o., Omice
IS-VPAS s.r.o., Ústí nad Labem
ZD Šonov u Broumova
PETRA – lom Číměř, s.r.o.
EKOZIS, spol. s.r.o., Zábřeh
František Matlák, Mochov
VH PROSPEKT Olomouc s.r.o.
PEDOP s.r.o., Lipovec
Froněk s.r.o., Rakovník
OLZ a.s., Olomouc

Kozákov – družstvo, Záhoří
Weiss s.r.o., Děčín
Agrostav Znojmo, a.s.
Thorssen s.r.o., Kamenolom Mladecko
NATRIX a.s., Bojkovice
CZ Lom Družec s.r.o., Kladno
Josef Žirovnický, Vlašim
Pavel Dragoun, Cheb
Kamenolom KUBO s.r.o., Malé Žernoseky
JHF Heřmanovice spol. s.r.o.
Jan Hamáček – Stavby Prunéřov
KATORGA s.r.o., Praha
EKOSTAVBY Louny s.r.o.
CEFEUS s.r.o., Praha 2

The most impotrant mining organizations in non-reserved deposits as of December 31, 2007

Sokolovská uhelná, právní nástupce, a.s., Sokolov
LOMY MOŘINA spol. s.r.o., Mořina
BÖGL & KRÝSL – SILNICE MORAVA s.r.o., Krnov
COLAS CZ a.s., Praha
KÁMEN Zbraslav, spol. s.r.o.
Kamenolom Žlutava s.r.o.
Mostecká uhelná a.s., Most
SENECO, s.r.o., Polná
ZUD, a.s., Zbůch
ZETKA Strážník a.s., Studenec
Granita, s.r.o., Skuteč
RENO Šumava s.r.o., Prachatice
TS služby, s.r.o., Nové Město na Moravě
BAK a.s., Trutnov
LB, s.r.o., Mezirolí
Stavoka Kosice, a.s.
KAMENOLOMY ČR s.r.o., Ostrava-Svinov
Jihočeské lesy České Budějovice, a.s.
Valašské lesotechnické meliorace, a.s.
EKOZIS spol. s.r.o., Zábřeh
Kalcit s.r.o., Brno
Grafitové doly Staré Město a.s.
Vojenské lesy a statky ČR, s.p., Praha 6
Lesy České republiky, s.p., Hradec Králové
Obec Hošťálková

Lesostavby Frýdek Místek, a.s.
Petr Vaněk – Lomstav, Horní Maršov
Zemní a dopravní stavby Hrdý Milan, s.r.o., Dobrná
KATORGA s.r.o., Praha
Kamena, výrobní družstvo Brno
TATI s.r.o., Praha 6

8. World production

Mine production of the crushed stone is frequently reported together with sand and gravel under the term aggregates. In Europe Spain and France are the biggest producers of aggregates, representing about one third of the European Union production. Germany is on the third place with nearly the same production as France (in percent). The following tables show up the production of crushed stone.

Production of crushed stone in European Union in 2006 (t)

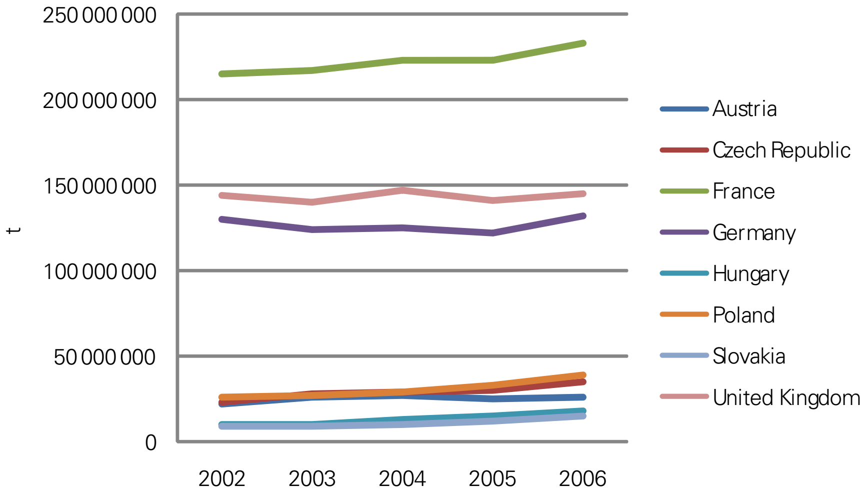
Rank	Country	Production [t]
1	Germany	266 000 000
2	Italy	177 625 321
3	France	174 360 000
4	Spain	120 000 000
5	United Kingdom	92 107 000
6	Poland	90 000 000
7	Netherlands	72 200 000
8	Denmark	72 060 000
9	Irish Republic	64 000 000
10	Finland	54 000 000
11	Switzerland	50 000 000
12	Hungary	46 458 296
13	Austria	27 589 904
14	Sweden	21 488 963
15	Slovenia	17 873 000
16	Czech Republic	16 931 536
17	Norway	13 380 000
18	Bulgaria	11 698 613
19	Belgium	8 636 966
20	Lithuania	7 633 311
21	Slovakia	7 522 034
22	Latvia	5 202 061
23	Estonia	4 210 280
24	Romania	1 600 000
25	others	N
	Sum	1 422 577 285
		Source: British Geological Survey

Production of crushed stone in the USA in 2006 (t)

West	172 900 000
Midwest	439 000 000
South	855 000 000
Northeast	251 800 000
Sum	1 718 000 000

Source: USGS

Production of crushed stone in Central Europe, France and United Kingdon in 2002–2006

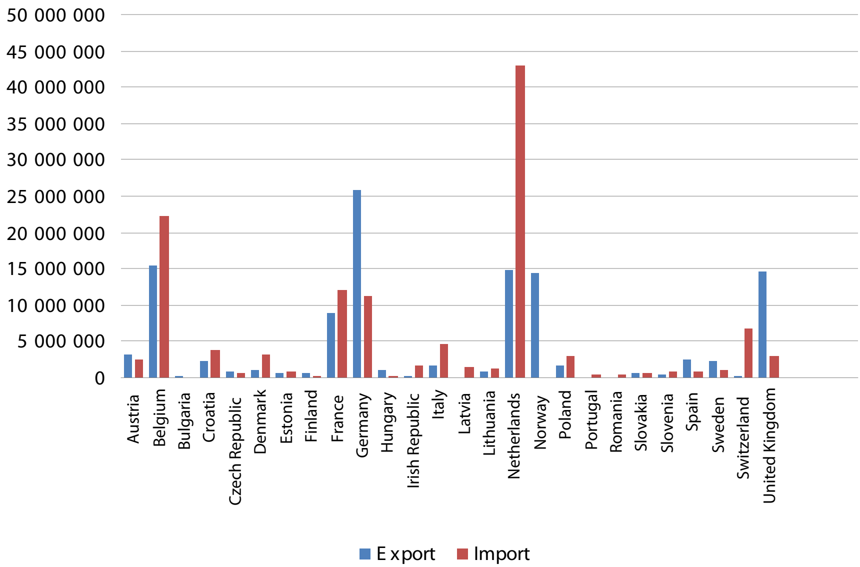


Data source: British Geological Survey

9. World market prices

Crushed stone prices are not formed on the international market. Neither indicative regional prices are quoted. Foreign trade exchange takes place mostly between neighbouring countries. The prices of aggregates are different all over Europe and can even alternate locally for some percent of the average price. For example a ton of crushed stone will be much cheaper in the south than in the north of Germany because of the existence of hard rock deposits in the southern mountainous areas and the lack of them in the flat parts of Germany.

European export and import of aggregates in 2006 (t)

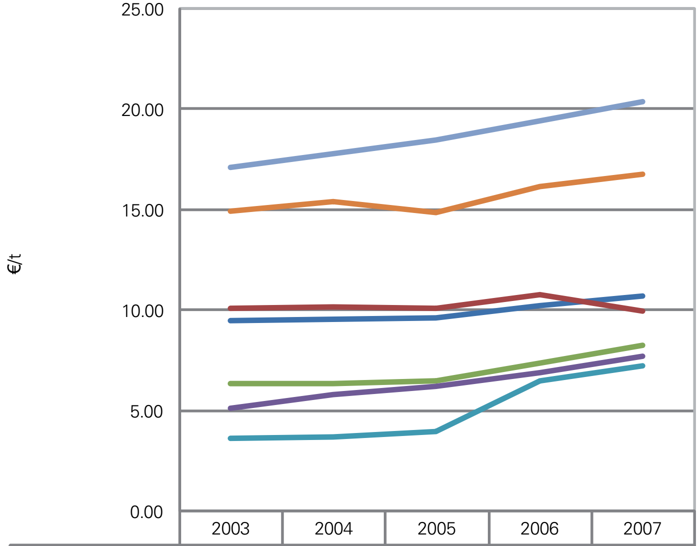


Data source: British Geological Survey

As far as crushed stone is concerned there was not a single long-time decrease of prices. The highest change of price took place in Austria 2006–2007 when the crushed stone price raised by 24.3 %. The long-term increases 2003–2007 were:

- Austria: 47.8 %
- Germany: 11.9 %
- Poland: 23.1 %
- Slovakia: 23.8 %
- Hungary: 9.0 %
- France: 2.8 %
- United Kingdom: 20.4 %
- USA (2003–2006): 34.6 %

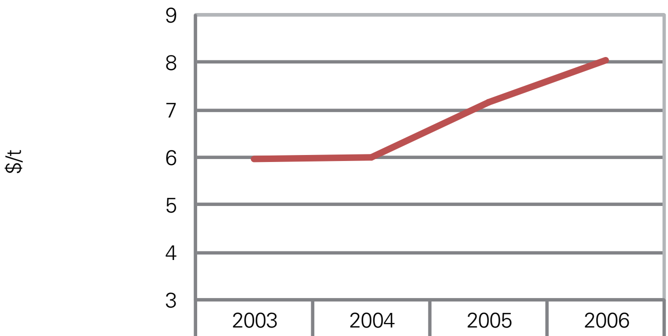
Average crushed stone prices in Central Europe, France and United Kingdom



	2003	2004	2005	2006	2007
Austria	9.47	9.53	9.60	10.21	10.71
Germany	10.05	10.15	10.10	10.80	9.94
Poland	6.38	6.38	6.54	7.37	8.27
Slovakia	5.11	5.81	6.24	6.90	7.73
Hungary	3.65	3.74	4.01	6.48	7.23
France	14.89	15.42	14.85	16.14	16.79
United Kingdom	17.09	17.78	18.48	19.43	20.39

Based on collected data

Average crushed stone prices in the USA



	2003	2004	2005	2006
Crushed Stone	5.98	6.01	7.18	8.05

Source: USGS

The collected European price lists have been converted into Euro. The historic exchange values have not been considered. For the comparison of the European aggregate prices the unity Euro per tone was used. The Hungarian, Polish, British and Slovak prices had to be converted into euro. The exchange rates resulted from the daily information of the Austrian National Bank, September 4, 2008:

Exchange rates

1 Euro	238.73 Hungarian Forint
1 Euro	3.3860 Polish Zloty
1 Euro	0.8130 British Pound
1 Euro	30.278 Slovak Koruna

10 Recycling

Because of low prices of the mineral, recycling has been of minimum importance Construction waste can be recycled following crushing up, sorting and/or screening and washing The "Association for Recycling of Building Materials Development" (Asociace pro rozvoj recyklace stavebních materiálů – ARSM) is active in the Czech Republic, which associates persons and organizations dealing with problems in waste building materials processing Apart from other activities, the association regularly organizes expert seminars and popularises usage of recycled building materials

11 Possible substitutes

Crushed stone can be replaced, depending on their use and grade, by gravel sand, synthetic aggregates, slag and various waste materials

Sand and gravel

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(subchapters 8., 9.)

1. Characteristics and use

Sand and gravel belong to the principal construction minerals worldwide. Sand and gravel represent loose sediments originated by transport and deposition of more or less reworked rock fragments of certain size (gravel e.g. 2 to 128 mm, sand e.g. 0.063 to 2 mm), which are products of the weathering of rocks. They consist mostly of pebbles and boulders of resistant rocks and minerals (quartz, feldspar, quartzite, granite, etc.), to a smaller extent of less resistant rocks and minerals (mostly of crystalline or metamorphic and sedimentary rocks). Sand and gravel also contain silty and clayey fractions. Major impurities are humus, clay intercalations, higher content of floatable particles and sulphur, high content of unsuitable (as shape concerns) or weathered grains. Other impurities are opal, chalcedony, chert and diatomite – hydrous compounds of silicon react with alkalies from feldspars to form a siliceous gel, which adsorbs water and causes fracturing of concrete.

Gravel and sand deposits are common all over the world.

The ultimate use of sand and gravel is determined by gravel particles size, their shape and type and composition of particle forming minerals and rocks. Sand and gravel are used mostly in the building industry in concrete mixtures, as drainage and filtration layers, road base, fill, etc. Sand is used in the building industry in mortar and concrete mixtures, as a filler material in production of bricks, in plasters, as a backfill of abandoned stopes in mines, etc.

2. Mineral resources of the Czech Republic

Most of the deposits in the Czech Republic are of the Quaternary age mainly of fluvial origin, less often of fluviolacustrine, fluvioglacial, glaciolacustrine and eolian origin. Industrially exploitable deposits occur particularly in large river basins.

- The Labe (Elbe) River basin – deposits along the right bank of the middle course (important deposits for central and eastern Bohemia) and lower course are characterised by well rounded pebbles and boulders, varying ratio of gravel and sand and suitability for concrete mixtures. Other important deposits are in basins of the rivers Orlice and Ohře, along the lower course of the rivers Cidlina and Jizera, and along the middle course of the Ploučnice River. The material requires processing when used for concrete.
- The Vltava River basin – important deposits are at lower course but there are common conflicts of interests. Important deposits are along the Berounka River, too. Major deposits in the southern Bohemia occur along the Lužnice River. The right bank of the Nežárka River shows good prospects for extraction of sand and gravel.
- The Morava River basin – along the upper and middle course of the Morava River there are deposits of gravel and sand with prevailing coarse fraction, which are after process-

ing suitable for concrete mixtures. Deposits in the Hornomoravský úval (Upper Moravian Depression) contain abundant fine fractions. Reserves are parts of the flood plains; the material is suitable for road construction and for mortar mixtures. Important deposits of sand and gravel in southern Moravia occur along the middle and lower course of the Dyje River and its tributaries, particularly the Dyje–Svratka Depression and area around Brno (Svitava, Svratka).

- The Odra River basin – important deposits of sand and gravel are at the middle course of the Opava River and near confluence of rivers Opava and Odra. The material is suitable for reinforcing of road shoulders and stabilization.

Less important are deposits of glacial origin in northern Bohemia (the Frýdlant region) and in the Ostrava and Opava regions. Eolian sand of the Labe River basin and those located in southern Moravia are used mostly in mortar mixtures. Proluvial sediments of northern Bohemia, the Ostrava region, the Olomouc region, etc., are only of local importance. Variable facies of Tertiary sand in the Cheb region, in north Bohemian and south Bohemian basins, in the Plzeň region (mortar sands), and particularly in Moravia (e.g. the Prostějov and Opava regions) is exploited more often. Weathered sandstones of the Bohemian and Moravian Cretaceous sediments and sand from washing of kaolin are used in construction works.

3. Registered deposits in the Czech Republic

(see map)

Because of their large number, deposits of sand and gravel are not listed.

4. Basic statistical data of the Czech Republic as of December 31

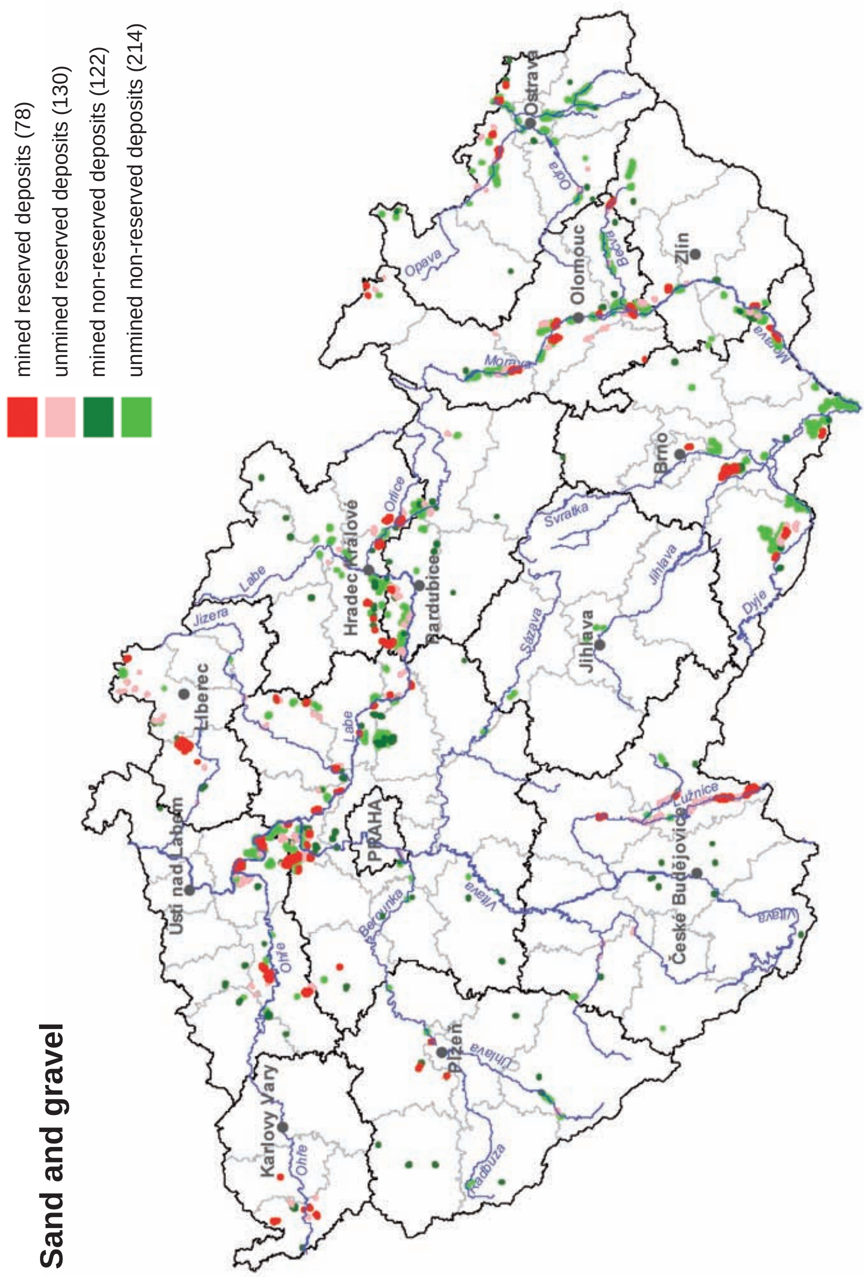
Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	211	210	211	209	208
exploited	80	77	78	79	78
Total mineral *reserves, ths m^3	2 202 415	2 201 697	2 180 635	2 151 237	2 145 835
economic explored reserves	1 187 283	1 178 495	1 165 983	1 150 463	1 141 041
economic prospected reserves	780 157	792 129	783 676	772 580	777 699
potentially economic reserves	234 975	231 073	230 976	228 194	227 095
Mine production in reserved deposits, ths m^3	9 105	8 859	9 075	9 110	9 185
Mine production in non-reserved deposits, ths m^3 [a)]	4 500	4 900	5 100	6 000	6 450

* See ***<u>NOTE</u>*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

[a)] estimate

Sand and gravel



5. Foreign trade

250590 – Other sand (natural sand of all kinds, also coloured, except sand containing metals and except silica sand and quartz sand)

	2003	2004	2005	2006	2007
Import, kt	44	42	73	52	50
Export, kt	6	1	0	0	1

251710 – Pebbles, gravel, broken or crushed stone

	2003	2004	2005	2006	2007
Import, kt	144	455	480	632	246
Export, kt	324	210	340	599	471

Detailed data on the territorial structure of import and export of the customs tariff item 251710 are given in chapter crushed stone. Volume of trade with item 250590 is negligible. But imports and exports of 251710 item know a large increase.

6. Prices of domestic market and foreign trade

Sorted products of gravel-pits are markedly cheaper than washed products. Regional prices of sorted products are very stable and do not show bigger differences (e.g. size fraction 0–4 mm: state average 92 CZK/t, average of South Moravian Region 94 CZK/t, average of Central Bohemian Region 93 CZK/t in 2007). By contrast, prices of washed products differ quite a lot depending on the region. Average price of the mined stone in size fraction 4–8 mm was about 220 CZK/t, size fraction 8–16 mm cost 205 CZK/t in 2006. The lowest prices were reached for instance in Central Bohemia, the highest in the Zlín region, where there is a deficit of construction materials resources.

7. Mining companies in the Czech Republic (reserved deposits) as of December 31, 2007

Českomoravský štěrk a.s., Mokrá
KÁMEN Zbraslav, spol. s.r.o.
LB Minerals, a.s., Horní Bříza
Holcim (Česko) a.s. člen koncernu, Prachovice
TARMAC CZ a.s., Liberec
GZ – SAND s.r.o., Napajedla
Hanson ČR a.s., Veselí nad Lužnicí
Družstvo DRUMAPO, Němčičky
František Jampílek, Lázně Toušeň
Ing. František Čtverák, Tišnov
TVARBET Moravia a.s., Hodonín
Štěrkovny Olomouc a.s.

Václav Maurer, Lužec nad Vltavou
S-MOST s.r.o., Hradec Králové
PIKASO s.r.o., Praha 4
DOBET s.r.o., Ostrožská Nová Ves
Štěrkovny spol. s r.o., Dolní Benešov
ILBAU s.r.o, Praha
Městské lesy Hradec Králové a.s.
Budějovické štěrkopísky spol. s.r.o., Vrábče
Těžba štěrkopísku s.r.o., Brodek
Písky – J. Elsnic s.r.o., Postoloprty
Pískovna Sojovice, s.r.o.
Zemědělské obchodní družstvo Zálabí, Ovčáry
Jana Lobová, Pardubice
BUILDING SP s.r.o., Sadská
Lubomír Kruncl, Travčice
KAMENOLOMY ČR s.r.o., Ostrava-Svinov
KM Beta Moravia s.r.o., Hodonín
Zechmeister s.r.o., Valtice
Pískovna Černovice s.r.o., Brno
NZPK s.r.o., Podbořany
Oldřich Psotka, Mikulovice u Jeseníka
Kaolin Hlubany, a.s.
Best Písek s.r.o.
Ladislav Šeda, Turnov
Zemědělské obchodní družstvo Brniště
TEKAZ s.r.o., Cheb
BÖGL & KRÝSL, k.s., Praha
Písník Smiřice, a.s., Heřmanův Městec
Brněnské papírny s.p., Předklášteří
František Dvořák, Dolní Dunajovice

The most important mining companies in non-reserved deposits as of December 31, 2007

České štěrkopísky spol. s r.o., Praha
Vltavské štěrkopísky s.r.o., Chlumín
Pískovny Hrádek, a.s., Hrádek nad Nisou
GZ – Sand s.r.o., Napajedla
ROBA štěrkovny Nové Sedlo, s.r.o.
ZEPIKO,spol. s .r.o., Brno
Písek Žabčice, s.r.o.
realma-pískovna dolany s.r.o., Zlín
Písek – Beton a.s., Veltruby-Hradištko

Plzeňské štěrkopísky s.r.o., Plzeň
Lubomír Kruncl, Travčice
AGRO Brno-Tuřany, a.s.
Rovina Písek a.s., Písek u Chlumce nad Cidlinou
SABIA s.r.o., Bohušovice nad Ohří
Obec Konětopy
Dopravní a zemní služby s.r.o., Nová Bystřice
Agropodnik Humburky, a.s.
BEST a.s., Rybnice
Písník Kinský, s.r.o., Kostelec nad Orlicí
MPC s.r.o., pískovna Račiněves
ACHP s.r.o., Hradec Králové
BÖGL & KRÝSL, k.s., Praha
Sušárna a.s., Kratonohy
Luděk Měchura, Kyjov
AG Skořenice, a.s.
TAPAS Borek, s.r.o., Stará Boleslav
Ladislav Šeda, Turnov
TEZZAV spol. s r.o., Praha
Brněnské písky a.s., Němčičky
Hradecký písek a.s., Brno
Lenka Kratochvílová, Žďár nad Orlicí
Ing. Milan Tichý – Inženýrské stavby VOKA, Zahrádky
Agrodružstvo Klas, Staré Ždánice
Ing. Václav Luka, Český Brod
Silnice Klatovy, a.s.
Ladislav Mazura, Písty
ZEPOS a.s., Radovesice
Vlastimil Beran, Daleké Dušníky
Kobra Údlice, s.r.o.
STAVOKA Kosice a.s.
STAVOKA Hradec Králové, a.s.
Vratislav Matoušek, Tursko
AGROSPOL Hrádek, spol. s.r.o.
Štěrkovna Zaječí s.r.o., Velké Pavlovice
JF TAKO s.r.o., Tatce
Pískovna Klíčany HBH s.r.o.
LIKOD s.r.o., Boršice u Buchlovic
Obecní lesy Bludov s.r.o.
UNIGEO a.s., Ostrava-Hrabová
Ing. František Klika, Kladno
META Servis s.r.o., Černošice

ZS Kratonohy a.s.
Pražské vodovody a kanalizace a.s.
Technické služby města Strakonice s.r.o.
Mgr. Milan Roček, Turnov
Ing. Josef Novák – NOBI, Praha 5
Václav Merhulík, prodej a těžba písku, Lety
Jiří Zach, Markvartice
Obec Polešovice
Ilona Hejzlarová, Jetřichov
Obec Malhotice
Lesy České republiky, s.p., Hradec Králové
Písky – Skviřín, s.r.o. Tachov
Štěrkopísky Milhostov s.r.o., Sokolov
Obec Senomaty
MORAS a.s., Moravany
STAKUS – písek s.r.o., Tachov
Obec Police
Václav Mašek, Hýskov
Obec Rabštejnská Lhota
Jiří Bartoš, Dolní Újezd
Městské lesy Jaroměř s.r.o., Proruby
ZD v Pňovicích
Zemědělské družstvo Kokory
Správa a údržba silnic Jihočeského kraje, České Budějovice
TOP – PLYN s.r.o., Bohušov
NPKZ s.r.o., Podbořany
Radomír Kopecký, Suchdol nad Odrou
HYDROSPOL spol. s.r.o., Staré Město u Bruntálu
II. severočeská stavební spol. s.r.o., Okounov
Jiří Řezáček, Postřekov
Vladislav Durczok – pískovna Petrovice
Stavby silnic a železnic a.s., Praha 1
Technické služby města Úpice

8. World production

The world production of sand and gravel is not statistically monitored. Mine production of the crushed stone is frequently reported together with sand and gravel under the term aggregates. The following tables show up the production of sand and gravel.

Production of sand and gravel in the European Union in 2006 (t)

Rank	Country	Production [t]
1	Germany	266 000 000
2	Italy	177 625 321
3	France	174 360 000
4	Spain	120 000 000
5	United Kingdom	92 107 000
6	Poland	90 000 000
7	Netherlands	72 200 000
8	Denmark	72 060 000
9	Irish Republic	64 000 000
10	Finland	54 000 000
11	Switzerland	50 000 000
12	Hungary	46 458 296
13	Austria	27 589 904
14	Sweden	21 488 963
15	Slovenia	17 873 000
16	Czech Republic	16 931 536
17	Norway	13 380 000
18	Bulgaria	11 698 613
19	Belgium	8 636 966
20	Lithuania	7 633 311
21	Slovakia	7 522 034
22	Latvia	5 202 061
23	Estonia	4 210 280
24	Romania	1 600 000
25	others	n.a.
	Sum	1 422 577 285

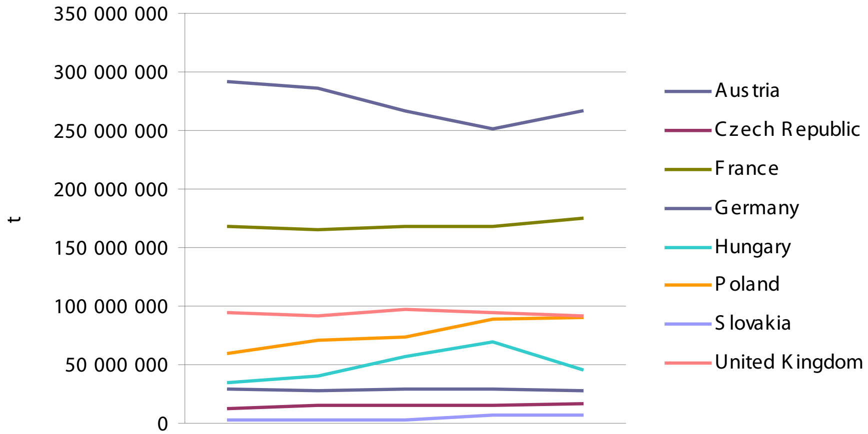
Source: British Geological Survey

Production of sand and gravel in the USA in 2006 (t)

West	541 900 000
Midwest	339 000 000
South	313 000 000
Northeast	129 800 000
Sum	1 322 000 000

Source: USGS

Production of sand and gravel in Central Europe, France and United Kingdon in 2002–2006

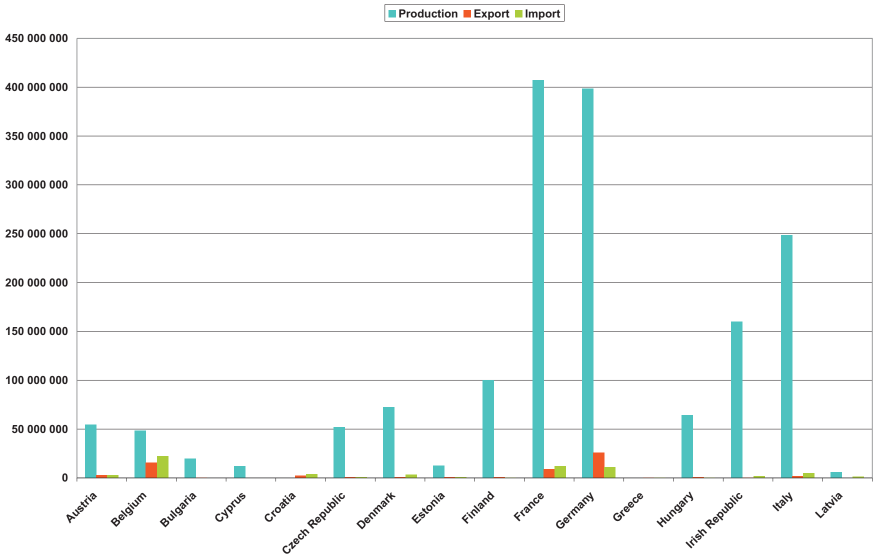


Data source: British Geological Survey

9. World market prices

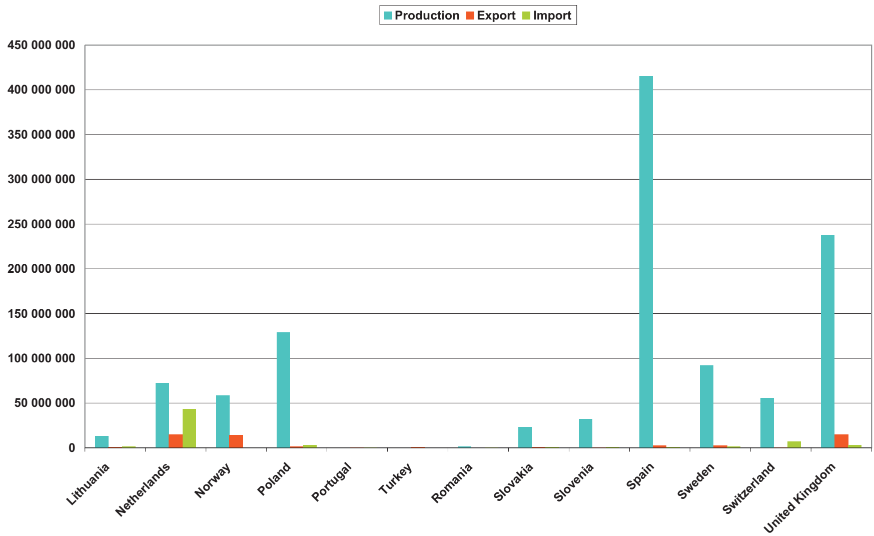
Sand and gravel prices are not formed on the international market. Neither indicative regional prices are quoted. Trade exchange takes place mostly between neighbouring countries. For example a ton of sand will be much cheaper in the north of Germany where big sand deposits can be found as in the south of Germany where less sand deposits can be extracted. In Austria a difference can be observed in a less distant dimension. The production of sand and gravel in the flat parts of Austria (e.g. Lower Austria) can be executed in a more extensive way like in the mountainous regions of Salzburg, Tyrol, Vorarlberg and parts of Carinthia and Styria. The method of the production of sand and gravel gives important information and effects on the product. The production below ground water table bears several advantages to sand and gravel mining on the surface. The next economic factor considers the transportation of the produced material. Normally the transportation radius is 30 kilometers before the transportation costs raises over the product return. In several cases of products with special chemical or physical attributes this radius may increase. To summarize the mentioned affects on the prices it is important to notice that average prices of a country may differ in an enormous scale from local prices. The bigger the country the more the prices may fluctuate.

European export and import of aggregates in 2006 (t) – part I



Data source: British Geological Survey

European export and import of aggregates in 2006 (t) – part II

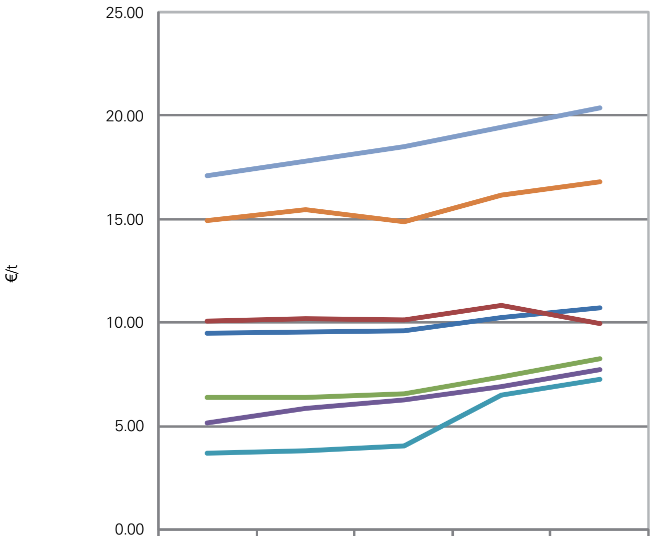


Data source: British Geological Survey

There was a general increase of the sand and gravel prices in Central Europe and the USA during the relevant period. There were only two exceptions, France and Germany. While in France the prices on sand and gravel dropped in the period 2004–2005 by 3.7 % they increased by 8.7 % in the next year which was one of the biggest raises in the period in the aggregate sector of Central Europe in the period under consideration. The biggest raise of sand and gravel prices took place in Hungary in 2005 to 2006 with a raise of 61.9 %. A long-term raise of prices can be observed in many cases. The raises from 2003 to 2007 appointed:

- Austria: 13.1 %
- Germany: -1.1 %
- Poland: 29.6 %
- Slovakia: 51.3 %
- Hungary: 98.0 %
- France: 12.8 %
- United Kingdom: 19.3 %
- United States (2003–2006): 25.2 %

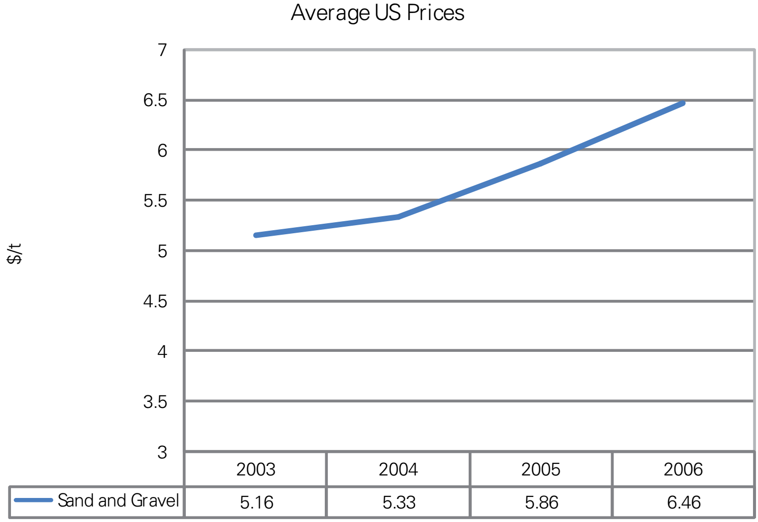
Average sand and gravel prices in Central Europe, France and United Kingdom



	2003	2004	2005	2006	2007
Austria	9.47	9.53	9.60	10.21	10.71
Germany	10.05	10.15	10.10	10.80	9.94
Poland	6.38	6.38	6.54	7.37	8.27
Slovakia	5.11	5.81	6.24	6.90	7.73
Hungary	3.65	3.74	4.01	6.48	7.23
France	14.89	15.42	14.85	16.14	16.79
United Kingdom	17.09	17.78	18.48	19.43	20.39

Based on collected data

Average sand and gravel prices in the USA



Source: USGS

The collected European price lists have been converted into Euro. The historic exchange values have not been considered. For the comparison of the European aggregate prices the unity Euro per tone was used. The Hungarian, Polish, British and Slovak prices had to be converted into euro. The exchange rates resulted from the daily information of the Austrian National Bank, September 4, 2008:

Exchange rates

1 Euro	238.73 Hungarian Forint
1 Euro	3.3860 Polish Zloty
1 Euro	0.8130 British Pound
1 Euro	30.278 Slovak Koruna

10. Recycling

Similar to all construction minerals, recycling is economically problematic and is significant in case of concrete only.

11. Possible substitutes

Crushed aggregate, artificial aggregate, slags, etc can replace coarser fractions of sand and gravel. Finer fractions, i.e. sand, cannot be replaced because of reduced strength of the final products. Substitution of sand and gravel on large scale is questionable also from the economic point of view.

Brick clays and related minerals

1. Characteristics and use

Minerals for production of bricks are all varieties of minerals applicable to a brick manufacturing separately or in a mixture. For this purpose following types of rocks are used: loess, loams, clays and claystones, marls, weathered shales, etc. The brick manufacturing material itself (under common term “brick clay”) contains two main components – plastic and non-plastic (grog) in correct proportions either directly in the material, or alternatively their optimum ratio can be reached by their mixing. The prevailing component in the mixture forms the base whereas the complementary component, which is correcting the properties of the base, serves as a plasticizing agent or a non-plastic component. Harmful substances in brick minerals are mostly carbonates, gypsum, siderite, organic matter, larger fragments of rocks, etc.

Deposits of brick minerals are common all over the world and usually they are not registered.

2. Mineral resources of the Czech Republic

Quaternary loams of various origins prevail among brick minerals in the Czech Republic. Mostly pre-Quaternary sediments represent the source of corrective minerals.

- Deposits of Quaternary brick minerals (loess and loess-loam, loam, sand, sandy-clayey residues) are common all over the country and they are mined extensively. The most important of them are formed by sediments of aeolian, deluvio-aeolian or glacial origin (northern Bohemia and Silesia). Impurities in aeolian sediments are represented by buried soil horizons, clastics and calcareous nodules, in deluvial sediments by detritus of hard rocks. Aeolian materials are suitable (usually in a mixture) for production of exacting thin-walled elements. Deluvial materials can be used as corrective components for more plastic soils, or directly for production of thick-walled brick elements.
- Neogene pelites are a common pre-Quaternary brick mineral in the Bohemian limnic basins and in the Vienna Basin. They are characterized by sandy intercalations and locally also by a higher content of montmorillonite or clastics, in the Vienna Basin and the Carpathian Foredeep also by a higher content of soluble salts. They have been exploited for a very long period of time. They are suitable also for production of exacting thin-walled bearing and shaped elements.
- Paleogene claystones (also calcareous) are exploited in eastern and south-eastern Moravia. They represent weathered parts of flysh layers of outer nappes of the Western Carpathians. Efflorescence-forming salts and layers of sandstones are their major harmful substances. They are used for production of solid or perforated bricks.
- Upper Cretaceous clays and claystones (often calcareous) are used as the base in brick manufacturing material in areas of the Bohemian Cretaceous Basin and in South Bohemian Basins. Marl, marlstone and sand are used as corrective materials. The material is suitable for production of the most demanding perforated bricks and ceiling elements. In southern Bohemia, because of contamination by limonitized sandstone, it can be used only for production of less demanding building elements.

- Permocarboniferous pelites and aleuropelites are used for brick production in Permocarboniferous basins and grabens of Bohemia and Moravia. These deposits are characterized by the occurrence of sandstones and by complex structure. The minerals can be used also for production of roof tiles and thin-walled elements.
- The Late Proterozoic and Early Paleozoic weakly weathered slates and their residues are used around Prague, in the Plzeň and Rokycany regions, etc. Harmful substances are clastics and pyrite. They are not suitable for production of exacting bricks.

3. Registered deposits in the Czech Republic

(see map)

There are large numbers of brick mineral deposits registered in the Czech Republic and thus they are not listed in this overview. Their distribution over the Czech territory is rather uneven and consequently in some regions there is a shortage of these minerals (e.g. Českomoravská vrchovina Highlands).

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	144	143	144	141	142
exploited	41	40	39	33	37
Total mineral *reserves, ths m^3	584 108	567 069	571 144	566 217	559 324
economic explored reserves	248 444	238 408	232 879	229 270	220 955
economic prospected reserves	246 312	241 152	241 390	240 315	238 341
potentially economic reserves	89 352	87 509	96 875	96 632	100 028
Mine production in reserved deposits, ths m^3	1 626	1 554	1 543	1 286	1 433
Mine production in non-reserved deposits, ths m^3 [a)]	180	330	220	290	300

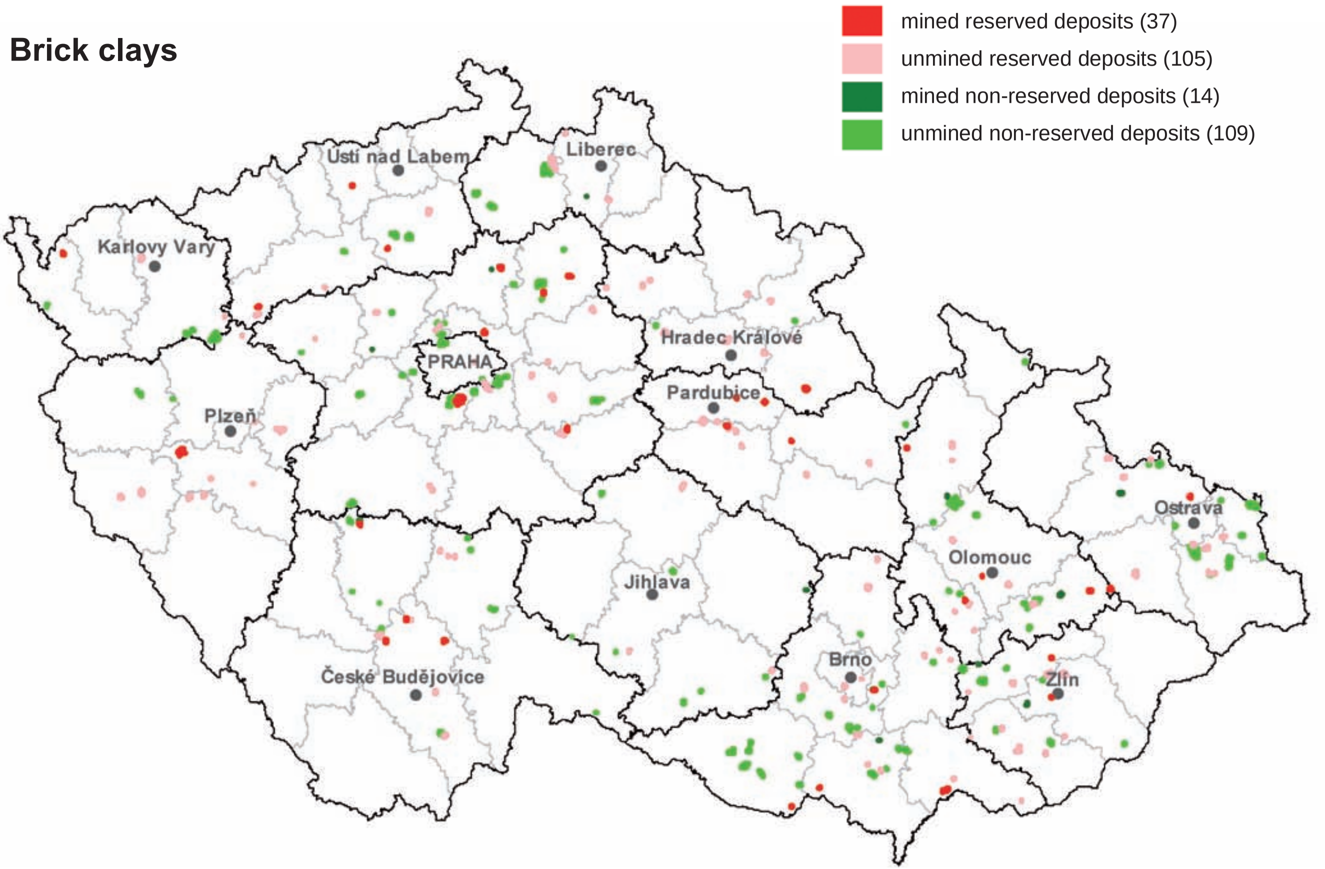
* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

[a)] estimate

Domestic production of selected intermediate products

Year	2003	2004	2005	2006	2007
Burnt bricks (kt)	1 320	1 379	1 450	1 317	N
Burnt roof tiles (kt)	226	204	242	N	N

Brick clays


mined reserved deposits (37)
unmined reserved deposits (105)
mined non-reserved deposits (14)
unmined non-reserved deposits (109)
Ústí nad Labem
Liberec
Karlovy Vary
Hradec Králové
PRAHA
Pardubice
Plzeň
Ostrava
Olomouc
Jihlava
Brno
Zlín
České Budějovice

5. Foreign trade

690410 – Building bricks

	2003	2004	2005	2006	2007
Import, t	95 712	213 831	174 275	209 194	N*
Export, t	89 643	23 262	6 487	25 185	N*

** individual datum*

Detailed data on building bricks imports (t)

Country	2003	2004	2005	2006	2007
Germany	40 629	108 238	61 819	144 588	N*
Austria	7 457	62 915	84 095	40 795	N*
Poland	40 339	27 264	15 737	9 491	N*
Belgium	4 552	7 283	7 879	7 900	N*
others	2 735	8 131	4 745	6 420	N*

** individual datum*

690510 – Roof tiles

	2003	2004	2005	2006	2007
Import, t	7 291	12 087	10 890	12 964	15 451
Export, t	112 245	102 697	93 578	82 148	76 692

Detailed data on roof tiles exports (t)

Country	2003	2004	2005	2006	2007
Germany	50 767	38 079	29 168	24 776	18 106
Slovakia	24 365	31 741	37 113	29 981	27 561
Poland	24 957	20 234	17 208	19 490	29 643
Austria	8 163	7 853	7 582	6 851	143
others	3 993	4 790	2 507	1 050	1 239

They are not the brick minerals, which are traded on foreign market, but goods with higher value added, i.e. final products (bricks, roof tiles). Trading partners are nevertheless mainly neighbouring countries. A typical feature of foreign trade with bricks is that the Czech Republic turned into a pure importer from exporter in 2002–2004. Contrastingly, roof tiles export has been roughly 7 (in 2006) to 12 (in 2003) times higher then their import.

6. Prices of domestic market and foreign trade

Domestic prices of brick products

Product specification	2006	2007
Full brick; CZK/piece	5.00–10.00	6.00–12.00
Honeycomb brick; CZK/piece	6.00–12.00	6.50–14.00
Facing bricks; CZK/piece	N	10.00–16.00
Brick blocks Porotherm; CZK/piece	35.00–110.00	40.00–130.00

Price of brick clays on domestic market has been about CZK 500/t. Clay (for tennis courts) is offered at CZK 1,050–1,800 per tonne. Prices of full bricks oscillate between CZK 6.00 and 12.00 apiece, depending on their quality (especially resistance against frost) and producer. The average price is CZK 7.00.20/piece. Lightened full bricks were sold at about CZK 5.00 apiece. Honeycomb bricks were sold at CZK 6.50–14.00 apiece, on average for CZK 12.00 apiece. The average price of drain tiles was CZK 5.40–11.50/piece according to diameter; the average price of ceiling drain tiles was CZK 14.70–18.80/piece. Roof tiles are sold at CZK 13.00–27.50 apiece. Brick blocks "Porotherm" are offered at CZK 40.00 to 130 apiece. Evolution of the average import and export prices are contained in the following tables.

690410 – Building bricks

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	1 414	1 460	1 858	1 472	N*
Average export prices (CZK/t)	974	1 350	1 545	1 216	N*

** individual datum*

690510 – Roof tiles

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	6 626	4 637	4 329	5 687	6 973
Average export prices (CZK/t)	4 707	4 717	4 574	4 558	5 054

7. Mining companies in the Czech Republic (reserved deposits) as of December 31, 2007

WIENERBERGER Cihlářský průmysl a.s., České Budějovice
TONDACH Česká republika s.r.o., Hranice
HELUZ cihlářský průmysl, v.o.s., Dolní Bukovsko
Cihelna Hodonín s.r.o.
Cihelna Kinský s.r.o., Kostelec nad Orlicí
Sofron Trade a.s., Plzeň
Cihelna Vysoké Mýto s.r.o.
Cihelny KRYRY a.s., Plzeň

PARALAX a.s., Praha 8
Otčenášek – Mikulka s.r.o., Prostějov
Cihelna Hlučín s.r.o., Ostrava
Zlínské cihelny s.r.o., Zlín
Bratři Řehounkové – cihelna Časy s.r.o.
LB Minerals a.s., Horní Bříza
Cihlářský závod v Horkách nad Jizerou, s.r.o.

The most important mining organization in non-reserved deposits as of December 31, 2007

WIENERBERGER Cihlářský průmysl, a.s., České Budějovice
WIENERBERGER cihelna Jezernice, spol. s.r.o.
GEOPOS spol. s.r.o., Dřínov
STAMP s.r.o, Náchod
Vlastimil Bělák, cihelna Bořinov
PARALAX a.s., Praha 8
Ing. Jiří Hercl, cihelna Bratronice, Kyšice

8. World production

Production of brick clays is not recorded on the global scale. The annual mine production in Slovakia oscillates roughly between 300 and 600 ths m^3, in Poland it has been between 2.5 and 3.5 mill m^3 during the last five years.

9. World market prices

Brick clays and related minerals are not subjects of the world trade.

10. Recycling

Brick clays and related minerals cannot be recycled, but the final products – bricks, tiles and blocks – can be reused. It is possible to recycle construction detritus and mixed construction waste (for instance recycled material “Remexit”).

11. Possible substitutes

In production of conventional brick elements, brick minerals are irreplaceable. Other types of bricks can be produced from other materials (e.g. calcareous-acid bricks, sintered light ashes, foamed concrete), of course. In such a case, various natural and artificial materials (quartz, lime, powder aluminium, artificial aggregates, cinder and flue ashes of thermal power plants, tailings, etc.) can be used as substitutes.

METALLIC ORES
– geological reserves and mine production

Deposits of Mn, Cu, Pb, Zn, Ag, Sn, W, Li, Au and Ge were registered in the Register to 31. 12. 2007 on the Czech territory. Geological reserves of metallic ores represent mostly potentially economic resources. More significant volume of economic reserves was presented only for gold bearing ores. As the most common metal ores concerns, there were no deposits of Al, Ti and Cr ores mined in the history and no deposits occurred on the Czech territory.

There is a very old tradition of ore mining on the territory of the Czech Republic. The oldest archaeological evidence on gold panning dates back to the 9th century B.C. In the Middle Ages Bohemia became the centre of European gold, silver and tin mining. Continued mining activities have nearly exhausted the resources. With a few exceptions (e.g. the Au-W deposit of Kašperské Hory), only low-grade ores remain on the territory of the Czech Republic. The mining industry´s last boom occurred in the cold war period after 1948, when ore deposits were exploited, even at considerable economic loss, to ensure the independence of the communist state from mineral imports from western countries. After 1989 there were many closures and cutbacks; with the closure of mining in the polymetallic deposit with gold Zlaté Hory, the mining of metallic ores on the territory of the Czech Republic terminated in 1994. State subventions for closure programs directed towards social costs, technical liquidations, health and safety activities (maintenance) and reclamation in 1990–2007 are the object of the chapter *Eliminating negative cosequences of mining in the Czech Republic – main methods and financial resources* in this yearbook.

All deposits of Fe ores, Ni ores and Sb ores, majority of Ge ores deposits, a large number of Cu ore, base metal (Pb, Zn, Ag) and Sn-W ores deposits were revaluated and gradually eliminated from The Register in the course of the revaluation carried out since 1993. Majority of small deposits of scheelite W ores was eliminated from the Register in 2006.

A steady increase in prices of base metals (Cu, Pb, Zn, Sn, Ni and Al) and Ag has been observed since 2003. Prices of Fe and W have been increasing since 2004 and 2005, respectively. The most important rise show prices of Cu, W, Pb and Zn, to a lesser extent Fe (Fe price has changed now, e.g. iron ore price is at its highest level, in constant USD, in October 2008), Pb, Al, Ag, Sn, Mn and Ni. Prices of rare metals such as Pt and Au have increased significantly, too. Aside the trend stands Pd, the price of which steeply increased more than three times by the end of 2000. Its price decreased back to the original level the next year and has been rather stable since then. During 2007 prices of most metal commodities did not grow on – either they relatively maintained their higher levels or slightly decreased. More remarkable metal prices decline came in connection with commencing global economic crisis and slump of stock markets in summer and autumn 2008.

The Au-W ores deposit Kašperské Hory, from the European viewpoint exceptionally large and rich, is the most important and perspective ore deposit in the Czech Republic. Large deposits mineable by open pits like e.g. Mokrsko or Vacíkov are very promising at present high Au prices, too. Exploitation of all these deposits is however excluded at present time due to the unsolvable conflicts with the nature protection.

Iron

1. Characteristics and use

Precambrian ferruginous quartzites (event. jaspillites, itabirites, taconites), commonly enriched as a result of supergene processes, represent the dominant type of industrial iron deposits as their mine production as well as reserves concerns. Magmatic deposits, to which belong titanomagnetites and ilmenite-titanomagnetite ores, are another important industrial deposit type. Iron ores are mostly formed by hematite Fe_2O_3 and magnetite Fe_3O_4 containing up to 72 % Fe, in less extent by limonite $Fe_2O_3.nH_2O$ (48–63 % Fe), eventually siderite $FeCO_3$ (48,3 % Fe) and sometimes also by other minerals such as Fe-silicates (27–38 % Fe). Over 90 % of mining production has been obtained by surface mining. World resources exceed 800,000 billion tonnes of ore containing more than 230 billion tonnes of iron.

Iron ores are used for the production of pig iron either in the form of crude lump ore or in the form of fines or sintered or pelletized concentrates. Modern technologies of iron manufacturing such as DRI process, COREX®, etc. enable the use of fines and concentrates without sintering or pelletization.

A very small amount of iron (approximately 2 %) is used for other than metallurgical purposes, such as heavy media, and the manufacture of special (underwater works, e.g.) cement, ferrites, animal feed, colouring agents, etc.

2. Mineral resources of the Czech Republic

There are no economically exploitable iron ore deposits in the Czech Republic. Ores occurring on the territory of the republic are of a low grade, altogether having Fe contents below 40 % and in the majority of cases workable by underground mining. Deposits of much richer ores with Fe contents around 50 % and more are exploited mainly by open pit mining in the world at present. The average grade of iron ores traded on the world market is 60 % and more. The availability of much higher-quality and relatively cheaper iron ores from import led to gradual cessation of iron ore mining on the territory of the Czech Republic. At the same time, reserves of these ores were gradually eliminated from The Register as completely non-economic.

- Sedimentary iron ores occur in the Barrandian. These are Paleozoic ores of marine origin in sediments of the Ordovician age. The deposits have mostly a form of rather extensive lenses. The ores consist mainly of hematite, siderite and Fe-silicates (leptochlorites). The content of iron is on average 25 to 30 %. Oolitic texture and high SiO_2 content characterize these ores. These ores were intensively mined on many sites (e.g. Nučice, Ejpovice, Mníšek pod Brdy, Zdice etc.) mainly in the 19th and the first half of the 20th century. The mining was definitely terminated in the beginning of the 1960s and the remaining reserves of all the sedimentary deposits of Fe in the Czech Republic were written off from the Register in 1997–1999.
- Volcano-sedimentary former deposits of the Lahn-Dill type occur in the Moravian-Silesian Devonian. The ores, containing mainly hematite, magnetite and to a lesser extent Fe-silicates, form smaller lense-shaped bodies, which are often intensively folded. Magnetite ores had average Fe contents around 35 to 40 % Fe; ores with predominance of hematite slightly lower (about 30 %). The ores were mined on many places (Medlov,

Benkov, Králová, Horní Město etc.). Mining activity reached its climax in the 19th century and it was definitely terminated in the mid-sixties of the 20th century. All remaining reserves of deposits of the Lahn-Dill type were written off the Register in 1997–1999.

- Small magnetite lenses are typical of skarns of the Moldanubicum (Vlastějovice, Županovice, Malešov, Budeč etc.) and Saxothuringicum (Měděněc, Přísečnice, Kovářská) of the Bohemian Massif, Krkonoše Mts.-Jizerské hory Mts. crystalline unit etc. Fe contents of the ores were mainly about 33 to 38 %. The mining activity was terminated largely already in the sixties, at Přísečnice and Měděnec deposits in 1992. The remaining reserves of these deposits were to a large extent cancelled before the 1990s.
- Other genetic types of Fe mineralization were of only a marginal importance. This concerned for instance banded ores of Sydvaranger type (Sobotín et al.), hydrothermal ores (Krušné hory Mts. et al.), stratabound (Hraničná et al.), sedimentary (except the Ordovician ones), residual, metasomatic ores etc.

Iron ore deposits were mined in the past (peak in the 19th and beginning of the 20th century) on a large scale and the ore was dressed at high cost and used mostly for pig iron production. This applies particularly for low-grade and siliceous sedimentary ores of the Barrandian, which were thermally treated through the Krupp-Renn process. Magnetite was mostly – and in 1970s to 1990s almost exclusively – used for other than metallurgic purposes, such as for production of cement (heavy concrete), as a heavy medium of jigs in coal processing plants, etc.

3. Registered deposits and other resources in the Czech Republic

(see map)

Principal areas of deposits presence:

1 Barrandian

2 Silesicum + Moravo-Silesian Devonian

3 Krušné hory Mts. (Erzgebirge Mts.) Crystalline Complex

4 Moldanubicum

4. Basic statistical data of the Czech Republic as of December 31

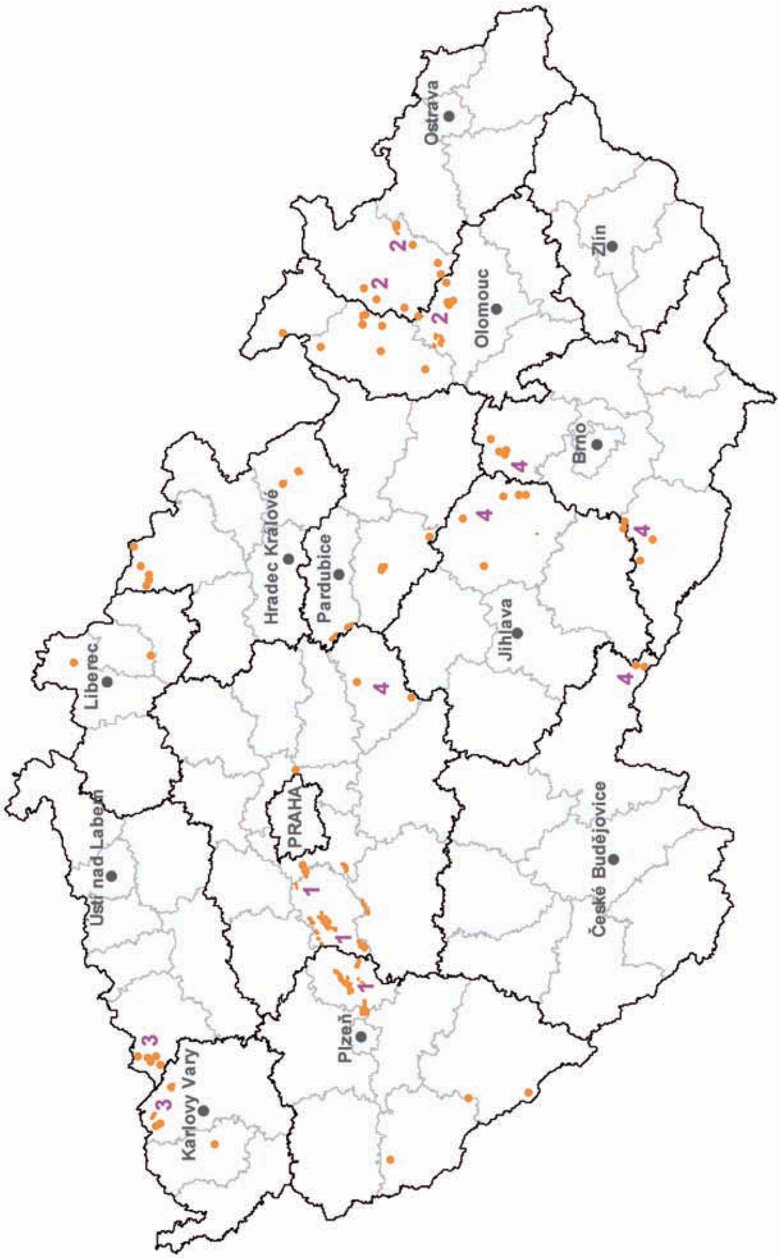
Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	1	0	0	0	0
exploited	0	0	0	0	0
Total mineral *reserves, kt ores	14 770	0	0	0	0
economic explored reserves	0	0	0	0	0
economic prospected reserves	11 520	0	0	0	0
potentially economic reserves	3 250	0	0	0	0
Mine production, kt Fe	0	0	0	0	0

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

Iron

exhausted deposits and other resources



Domestic production of selected intermediate products

Year/ths t	2003	2004	2005	2006	2007
Pig iron	5 207	5 385	4 627	5 192	5 287
Crude steel	6 783	7 033	6 189	6 862	7 059
Rolled stock	6 261	6 395	5 782	6 273	6 123
Tubes	704	706	707	786	761

Source: HUTNICTVÍ ŽELEZA a.s.

Iron ore consumption in the Czech Republic (only blast furnaces)

Year/ths t	2003	2004	2005	2006	2007
consumption	7 607	7 872	6 914	7 775	7 888

Source: Hutnictví železa, a. s.

Crude iron production

Arcelor Mittal Ostrava a.s.

Třinecké železárny, a.s.

Steel production and processing

Arcelor Mittal Ostrava a.s. (Ispat – Nová huť)

Třinecké železárny, a.s.

Vítkovické železárny – EVRAZ Vítkovice Steel a.s.

FERROMET GROUP s.r.o. (železárny Hrádek, Veselí a Chomutov)

Vítkovice Heavy Mashinery a.s.

ŠKODA TVC s.r.o.

ŽDB a.s.

Arcelor Mittal Ostrava a.s. represents the largest metallurgical enterprise in the Czech Republic. Its production includes long products, flat products, tubes and engineering products. Steel works of the Mittal Steel a.s. produce about 3 million tonnes of steel per year. Třinecké železárny a.s. makes crude iron and steel long rolled products. It was founded already in 1839. It has about one-third share in present steel production in the Czech Republic. EVRAZ Vítkovice Steel a.s. produces namely crude steel both noble and not, long products, thick plates, iron bars and rolled material. This company represents the biggest Czech producer of thick plates.

FERROMET GROUP s.r.o. operates three steel works which re-process iron scrap – Železárny Hrádek a.s. (rolled and drawn steel), Železárny Veselí a.s. (drawn steel) and Železárny Chomutov a.s. (drawn steel). Vítkovice Heavy Machinery a.s. produces castings, ingots, steel constructions, machines, equipment and investment units of heavy engineering. ŠKODA TVC s.r.o. (Škoda Plzeň) is engaged in metal working and metal components production. ŽDB a.s. produces shaped iron and iron bars, ingots, steel wire ropes, steel lining of tyres and wire netting. This company represents an important central European producer of high-C and low-C wires.

5. Foreign trade

2601 – Iron ores and concentrates

	2003	2004	2005	2006	2007
Import, kt	8 222	7 638	6 803	7 985	5 254
Export, kt	0	0	0	0	0

Detailed data on iron ore imports

Country	2003	2004	2005	2006	2007
Ukraine	5 265	4 622	3 700	3 852	2 950
Russia	2 466	2 552	2 437	3 597	1 853
others	491	464	666	536	451

7201 – Pig iron

	2003	2004	2005	2006	2007
Import, kt	72	88	89	150	109
Export, kt	50	56	16	18	31

7204 – Ferrous waste and scrap, remelted scrap ingots or iron or steel

	2003	2004	2005	2006	2007
Import, kt	506	549	385	559	522
Export, kt	1 179	1 447	1 738	1 498	1 691

Detailed data on ferrous waste and scrap imports (kt)

Country	2003	2004	2005	2006	2007
Poland	288	293	204	338	332
Slovakia	214	235	143	191	178
others	4	21	38	30	12

Detailed data on ferrous waste and scrap exports (kt)

Country	2003	2004	2005	2006	2007
Germany	523	804	1 133	831	889
Austria	500	345	276	342	348
Poland	82	195	172	208	229
Slovakia	61	58	27	29	69
Italy	1	18	85	68	128
others	12	27	45	19	28

The Czech Republic imports 7–8 mill t of iron ores per year, mainly from Ukraine and Russia. Whereas volume of import from Ukraine predominated in the past, the ratio was more or less balanced in 2006. Only 5.3 mill t of iron ores was imported in 2007. Ferrous waste and scrap represents the second most important item. Export of this item is 2–4 times higher than import, which shows that in this case the secondary raw material in not economically used as to the energy balance of the Czech Republic. That is to say that iron production from ferrous waste and scrap represents savings of about 60 % of energy compared to production from iron ore. Iron waste and scrap for CZK 12.2 billion (EUR 440 mill) was exported from the Czech Republic in 2007. Ferrous waste and scrap is exported mainly to Germany and Austria, and imported namely from Poland and Slovakia.

6. Prices of domestic market and foreign trade

2601 – Iron ores and concentrates

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	988	1 748	1 867	1 717	1894
Average export prices (CZK/t)	N	N	N	N	N

7204 – Ferrous waste and scrap, remelted scrap ingots or iron or steel

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	3 475	5 671	5 476	5 603	6 160
Average export prices (CZK/t)	4 086	6 119	4 261	6 458	7 243

Import prices of iron ore increased significantly during the year 2004, when the average nominal import prices almost doubled from 30–40 USD/t to 70–90 USD/t. Import price increase reflected the rise of iron ore world prices.

7. Mining and processing companies in the Czech Republic as of December 31, 2007

As in the preceding years, no mining companies were extracting iron ores in the Czech Republic in 2007.

8. World production

World production of iron ores rose since the 1930s' average of approx. 100 million tonnes to exceed the 1 bill t level by the mid 1990s. It stagnated for the next ten years and has recently increased sharply. The increase is related to an important increase of pig iron and steel consumption in populated, rapidly developing countries (China, India, Brazil et al.). The limit of 1.5 billion tonnes was overstepped according to some sources in 2005. Based on preliminary data, world production increased by about 10 % between the years 2005 and 2006. Asian production of iron ores doubled in 2002-2006, that of China itself almost tripled. World mine production has been still rising during the last two years; it reached 1.8 billion t in 2006 according to MCS. Mine capacities for iron ore increased by 70 mill t only during 2006 (UNSTAD sources). The International Iron and Steel Institute (IISI) predicts that world demand for iron ore will increase by another 236 mill t between 2006 and 2009.

World mine production of iron ores

Year	2003	2004	2005	2006	2007 e
Mine production, mill t (according to MCS)	1 160	1 340	1 540	1 690	1 900
Mine production, mill t (according to WMS)	1 075	1 184	1 320	1 483	N

Main producers' share in the world mine output (2006, according to MCS):

China	32.7 %	Russia	5.7 %
Brazil	17.7 %	Ukraine	4.1 %
Australia	15.3 %	USA	2.9 %
India	7.8 %	South Africa	2.3 %

Brazil and Australia reached also high share in the world export of iron ores.

World production of pig iron

Year	2003	2004	2005	2006	2007 e
Production, mill t (according to MCS)	647	712	825	865	940
Production, mill t (according to IISI)	670	724	792	871	N

Main producers of pig iron (2006, according to MCS):

China	46.7 %	USA	4.4 %
Japan	9.7 %	Brazil	4.1 %
Russia	6.0 %	Ukraine	3.8 %
Germany	5.4 %	South Korea	3.2 %

World production of steel

Year	2003	2004	2005	2006	2007 e
Production, mill t (according to MCS)	962	1 050	1 130	1 170	1 320
Production, mill t (according to IISI)	969	1 067	1 132	1 250	1 344

Main producers of crude steel (2006, according to MCS):

China	35.8 %	South Korea	4.1 %
Japan	9.9 %	Germany	4.0 %
the USA	6.1 %	Brazil	2.8 %
USA	8.4 %		

According to the International Iron and Steel Institute (IISI), following companies ranked among the ten biggest world producers of crude steel in 2006: Arcelor Mittal, Nippon Steel, JFE, POSCO, Baosteel, US Steel, Nucor, Tangshan, Corus Group and Riva Group. These 10 companies covered about 25 % of the world production of crude steel.

9. World market prices

Prices of iron ore on the European market are quoted in FOB for calendar year in USc/mtu. The final price of 1 tonne of the ore is a multiple of the unit price in mtu and the metal content in the relevant ore. Prices FOB are being established with regard to shipping costs of the major importers in order to maintain similar prices of ores having a similar grade in CFR North Sea ports. This is why the FOB prices of ores of similar grade of suppliers from various regions differ from each other.

A steep increase in world iron ore prices occurred in 2004, as a result of an elevated demand from the side of China, which, though the biggest world producer, has become an important iron ore importer recently, too. Companhia Vale do Rio Dolce (CVDR) company, the biggest world producer of iron ores, announced in February 2005, that it concluded an agreement on raw material supply for Japan (Nippon Steel Corporation), Taiwan and Australia at prices by 71.5 % higher than those of the year 2004. Prices reached 79.58 USc/mtu (Carajás Lump) and even 115.51 USc/mtu (Blast Furnace Pellets) in the first half of the year 2005. Total year-on-year rise in iron ore prices was 70–90 %. Iron ore prices were high also in 2006-2007 and in some cases they continued to rise. The price increase was related to a huge increase in steel production, which roughly represented a 10 % year-on-year increase in 2006/2005 and 2007/2006. Prices of input raw materials – iron ore – increased of course as well due to the high demand. Nominal prices of the “fines” and “lump” types increased on average by 10 %, prices of Brazilian iron-ore pellets on average by 5 % in 2007.

Quoted prices of staple traded iron ores:

Commodity/Year		2003	2004	2005	2006	2007
Brazilian fine ore CJF (Carajás Fines)	USc/mtu	31.95	37.90	65.00	77.35	84.70
Brazilian lump ore CJL (Carajás Lump)	USc/mtu	37.36	44.46	79.58	94.70	103.70
Australian fine ore (Mt. Newman Fines)	USc/mtu	30.83	35.99	61.72	73.45	81.95
Mauretanian fine ore TXF (Tazadit Fines)	USc/mtu	30.30	41.35	70.92	78.15	84.57
Brazilian pellets BFP (Tubarão Blast Furnace Pellets)	USc/mtu	52.00	61.88	115.51	112.04	117.96
Brazilian pellets DRP (Tubarão Direct Reduction Pellets)	USc/mtu	55.90	66.52	126.06	123.25	129.76

Costs for imports of iron ores from Western Australia and Brazil to Europe depend on cargo volume. In case of 100 to 150 ths tonnes cargo they are about 12 USD per tonne at present.

10. Recycling

Metal recycling is widely used. Iron scrap (steel scrap and cast iron scrap) is widely used in production of crude steel but very little in production of pig iron. The share of iron scrap in production of crude steel was 40 % worldwide in the last twenty years (according to UNCTAD) and the same share of iron scrap has been reached in the Czech Republic. The reason for the high recycling ratio is in particular the reduction of fuels and energy consumption by as much as 80 % versus energy consumption when using pig iron as a charge in steel-making furnaces. Production of steel requires mostly chemically pure and high-grade iron scrap, i.e. scrap availability of which continues to decrease with increasing proportion of continuous steel casting. Processing scrap and particularly the increasing proportion of consumer's iron scrap does not meet specific requirements of the steel industry. Electric furnaces have the major share in consumption of iron scrap, allowing as much as 100 % charge of iron scrap.

11. Possible substitutes

Iron ore in pig iron production can be substituted by iron scrap up to 7 % of the charge. Steel products can be substituted to a certain extent by products of other metals, alloys, glass, ceramics and composite materials. Prices of substitutes are nevertheless higher, and therefore, such a substitution has to be justified by better properties of new material (e.g. lower weight of aluminum compounds used in cars helps fuel saving).

1. Characteristics and use

Manganese is one of the most abundant elements in the Earth´s crust and it forms easily various compounds in nature due to its chemical character. There are basically two types of manganese deposits as their industrial use concerns: of sedimentary or volcano-sedimentary and of metamorphic origin, enriched as a result of weathering or hydrothermally, Projected resources confined to deep-sea nodules having an average content of 25 % Mn represent about 358 million tonnes of metal. Among 300 known manganese minerals only 12 are principal constituents of economic deposits. are Out of these, pyrolusite, psilomelane, manganite, braunite and hausmannite are the most important. Known reserves on continents exceed 5 billion tonnes of metal in ores. Additional huge amounts of Mn are bound to deep sea nodules, occurring at the bottom of oceans. It is estimated that these nodules contain roughly 2.5 x 10^{12} tonnes of manganese.More than 90 % of manganese is used for production of manganese ferro-alloys for the iron industry, both in production of pig iron and particularly in the steel industry as a desulphurizing and deoxidizing agent, and as an important alloying metal. The average world consumption of manganese is 10 kg in 1 tonne of crude steel, in up-to-date steelworks the minimum is 6 kg. Manganese is also used in alloys with non-ferrous metals (Al, Cu, Ti, Ag, Au, Bi). Another applications are in the manufacture of dry batteries, colouring agents, soft ferrites, fertilizers, feed for animals, fuel additives, welding electrodes, water treatment, etc. Manganese raw materials are classified into metallurgical, chemical and batteries grades, based on the quality of ores or concentrates required in the main uses.

2. Mineral resources of the Czech Republic

The Czech Republic has no Mn ore reserves other than the Chvaletice deposit with low-grade ores, exploitation of which is problematic. Mn contents in currently mined ores in the world are about 30–50 % in primary, mainly metamorphic ores, and significantly over 10 % in sedimentary ores.

- The most significant accumulations of Mn ores are known from the Železné hory Mts. area, where they are confined to volcano-sedimentary deposits of the Proterozoic. The mineralization is associated with a horizon of graphitic-pyritic slates, which have been metamorphosed together with neighbouring rocks. The ore horizon extending from Chvaletice to Sovolusky is composed of a mixture of Mn and Fe carbonates (mainly Fe-rhodochrosite), quartz, graphite and Fe-sulphides. Silicates of Mn originated during the regional metamorphic processes. The ore contains up to 13 % Mn.
- Major mining operations were executed at the Chvaletice deposit. First, only Fe ores of the gossan type (since the 17^{th} century) and since World War I also experimentally Mn ores were mined on the outcrops. Pyrite was mined from the 1950s until the termination of mining operations in 1975 as a raw material for the chemical industry. Mn ores were extracted along with pyrite but due to incomplete technology were not processed and were deposited in tailing ponds at the former mineral processing plant. An average Mn content in the tailing pond No 3 is 9–11 % and in the tailing ponds No 2 and 3 between 5 and 8 %. Desulphurization of combustion products could represent a potential use of these ores.

- Other occurrences of Mn ores in the Czech Republic (e.g. Horní Blatná, Arnoštov, Maršov near Veverská Bítýška et al.) were not of any economic importance.

3. Registered deposits and other resources in the Czech Republic

(see map)

Registered deposits and other resources are not mined

1 Chvaletice 2 Chvaletice-tailing ponds Nos 1 & 2 3 Řečany-tailing pond No 3

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	3	3	3	3	3
exploited	0	0	0	0	0
Total mineral *reserves, kt ores	138 801	138 801	138 801	138 801	138 801
economic explored reserves	0	0	0	0	0
economic prospected reserves	0	0	0	0	0
potentially economic reserves	138 801	138 801	138 801	138 801	138 801
Mine production, kt Mn	0	0	0	0	0

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

No ferro-alloys were produced in the Czech Republic in 2007. The most important producer of ferro-alloys in the central European region is OFZ a.s., formerly Oravské ferozliatinárske závody Istebné, in Slovakia. This company produces a large assortment of ferro-alloys on the basis of manganese, silicon and chromium – FeMnC, FeSiMn, FeSi 45%, FeSi 65%, FeSi 75%, FeSiCa, FeCrC.

Huta Łaziska S.A. in Poland (ferrosilicium, ferrosilicomanganese) and Treibacher Industrie AG in Austria (ferrovanadium, ferromolybdene) belong to important ferro-alloys producers in the Central Europe region.

5. Foreign trade

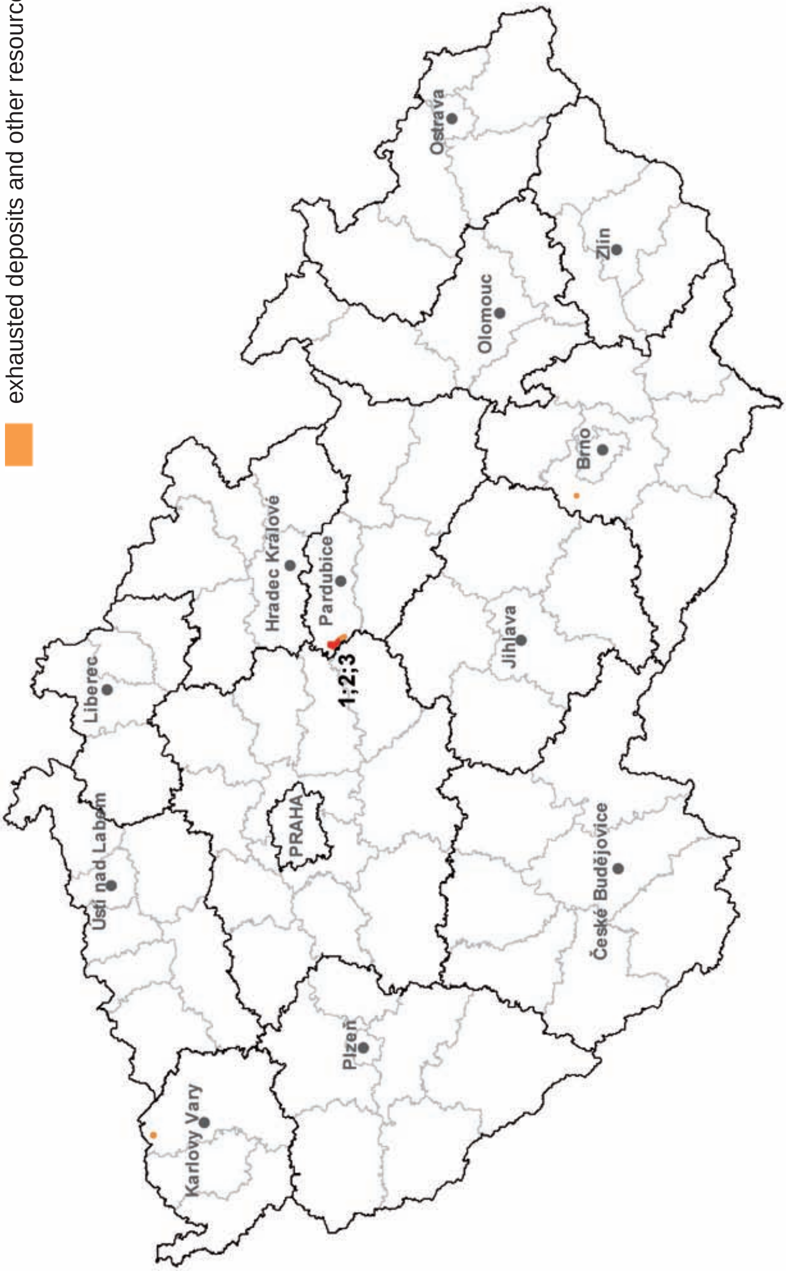
2602 – Manganese ores and concentrates

	2003	2004	2005	2006	2007
Import, t	11 966	11 665	13 846	14 375	16 079
Export, t	33	558	54	45	43

Manganese

reserved registered deposits

exhausted deposits and other resources



Detailed data on manganese ore imports (t)

Country	2003	2004	2005	2006	2007
Ukraine	6 483	2 642	9 721	4 559	13 458
Georgia	1 583	6 292	510	5 673	0
the Netherlands	2 538	2 154	3 432	1 978	2 531
Australia	610	48	5	11	4
South Africa	0	0	7	1 881	0
others	752	529	171	273	86

720211; 720219 – Ferro-manganese

	2003	2004	2005	2006	2007
Import, t	24 154	27 028	31 728	32 371	35 480
Export, t	533	2 032	4 089	4 113	2 996

720230 – Ferrosilicomanganese

	2003	2004	2005	2006	2007
Import, t	55 989	59 361	58 142	57 855	52 153
Export, t	50	2 040	9 320	9 122	2 722

Detailed data on ferrosilicomanganese imports (t)

Country	2003	2004	2005	2006	2007
Slovakia	31 610	30 624	27 852	33 491	33 765
Ukraine	12 053	10 769	20 026	12 355	11 388
Norway	1 986	2 020	1 815	2 134	1 237
Romania	5 166	6 950	1 095	0	0
Poland	0	7 324	4 579	1 017	1 923
others	5 174	1 674	2 775	8 864	3 840

8111 – Manganese and articles thereof, including waste and scrap

	2003	2004	2005	2006	2007
Import, t	386	593	629	674	780
Export, t	4	9	24	5	138

2820 – Manganese oxides

	2003	2004	2005	2006	2007
Import, t	1 386	888	787	1 316	1 058
Export, t	238	318	294	413	668

Ferrosilicomanganese import, oscillating steadily between 5-05 and 60 t per year in the last years, represents the most important volume. Ferrosilicomanganese has been imported namely from Slovakia, Ukraine and Norway. Ferromanganese is imported to the Czech Republic in about a half offerrosilicomanganese import volume of c. 30 kt per year. Manganese ores represent a traditionally important item; between 12 and 16 kt per year is imported, mainly from Ukraine and the Netherlands; import from other countries is irregular.

6. Prices of domestic market and foreign trade

2602 – Manganese ores and concentrates

	2003	2004	2005	2006	2007
Average import prices	5 289	5 504	5 702	4 960	4 533

7. Mining companies in the Czech Republic as of December 31, 2007

No mining companies were extracting manganese ores in the Czech Republic in 2007.

8. World production

Production of manganese ores moves in line with the production of iron ores, because their consumption is connected with the production of pig iron, steel and ferroalloys. The individual yearbooks differ significantly as the estimates of the world production concerns: whereas mine production of about 8–12 mill tonnes was given in Mineral Commodity Summaries (MCS), the mine production was considerably higher in individual years according to the Welt Bergbau Daten (WBD). In the past five years, manganese production has been decreasing in the RSA, Ukraine and surprisingly also in China. By contrast, it has been increasing significantly in Australia, Gabon, India, Kazakhstan and Mexico.

World manganese mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt Mn (MCS)	8 200	9 350	10 500	11 900	11 600
Mine production, kt Mn (WBD)	12 621	13 264	13 916	13 431	N

Main producers' share in the world mine output (2006; according to MCS):

South Africa	19.3 %	Gabon	11.3 %
Australia	19.3 %	Ukraine	6.9 %
China	13.4 %	India	6.8 %
Brazil	11.5 %		

Operating technologies of manganese nodules offshore mining were by the end of the 2007 at disposal in France, Japan, Germany, the USA, Russia, Republic of Korea, India and China. Czech Republic as a member of the international Interoceanmetal (IOM), established in 1987 with the main aim to utilize mineral resources from the seabed, has one fifth share in about 75,000 km^2 IOM lease of the ocean bottom in the north-eastern part of the tectonic zone Clarion–Clipperton in the subtropical part of the northern Pacific, where nodules with promising contents of Mn, Cu, Co, Ni but also Zn, Pb, Mo et al. occur. Currently, a second stage of the geological survey is being conducted, which aims to predict really perspecive locations in the area of interest.

9. World market prices

Basically three types of manganese ore are traded on the world market – metallurgical ore (38 to 55 % Mn), raw material with a content of 48–50 % Mn as a standard for production of manganese ferro-alloys, and chemical and battery grade ores with 70 to 85 % Mn. Only metallurgical ore of grade 48–50 % Mn with maximum 0.1 % P is quoted on a long-term basis on the world market. The price is quoted on an USD/mtu basis CFR Europe. Final price of 1 tonne of ore is a multiple of the unit price in mtu and the metal content in the relevant ore. E.g. at price of 2.03 USD/mtu for 48 % manganese ore of metallurgical grade the final price is 97.44 USD/t. The price in the eighties fluctuated on average around USD 1.5 per mtu until 1988. Then price increased and reached its peak in 1990 and 1991 (USD 4 per mtu). Since this period the prices had been decreasing for a number of years. The major cause was decline in market demand owing to a world economic recession and continuous reduction of Mn content in pig iron. The change didn't come until during the year 2005 in relation to price rise of iron ores and other metal commodities. Prices continued to rise also during the following years. World prices doubled from 6 to 16 USD per mtu only in the period June 2007–June 2008. This was caused primarily by a high demand of the Asian steel sector. Whereas the world steel production in 2007 decreased by 2.9 %, production of the Asian continent increased by 6.3 % and production of China even by as much as 36 %. Nowadays, 60 % of the world steel production comes from Asia.

The average prices of the given manganese ore grade at year-end

Commodity/Year		2003	2004	2005	2006	2007
metallurgical ore of grade 48–50 % Mn with maximum 0.1 % P, CFR Europe	USD/mtu	1.99	1.97	2.40	2.60	8.00

10. Recycling

Recycling of manganese is of only minor importance because of easy availability and relatively low price of primary manganese raw materials. Only scrap from iron and non-ferrous metals production and particularly steel slag rich in Mn in form of MnO and MnS are recycled to a certain extent. Manganese from used electric dry batteries is also recycled to a lesser extent.

11. Possible substitutes

No substitute for manganese in principal areas of use exists. In steel manufacture, other deoxidising additives – silicon, aluminium, complex alloys and rare earth elements – can substitute it to a certain extent, conditioned by economic parameters.

Copper

1. Characteristics and use

Copper deposits can be divided into five main groups (according to their origin) – porphyry copper deposits with Mo, stratiform, stratabound (sulphides in greenschists), magmatic with Ni (Pt) and deposits of massif ores formed by veinlets, stockworks and lenticular bodies. Only a few sulphides out of 300 known Cu minerals are of economic importance: chalcopyrite, covellite, Cu-pyrite, chalcosine, bornite and enargite. Economic world reserves of Cu in ore are estimated at more than 3 billion tonnes (MCS 2008), whereas additional approximately 700 mill tonnes of resources are estimated in deep-sea nodules.

According to the Copper Development Association, 37 % of copper was used in building industry, 26 % in electronics, 15 % in the engineering industry, 11 % in consumer goods production and 11 % in transport in 2003. Important amount of copper is used in alloys, particularly in brass and bronze.

2. Mineral resources of the Czech Republic

There are no economically exploitable Cu ore deposits in the Czech Republic. Cu ores of various genetic types occur here and were exploited in the past.

- Major mining activities were focused on volcanosedimentary sulphide deposits of the Zlaté Hory mining district. The mineralization is associated with the spilite-keratophyre volcanism and is localized in volcanosedimentary complex of the Vrbno Formation of the Devonian. Individual types of local ores – Cu monometallic, complex Cu-Pb-Zn with Au and Pb-Zn – occur separately in space and show a certain zonation. About 50 % of the economic reserves have been confined to complex ores, 25 % to monometallic, and 25 % to Pb-Zn ores. Monometallic ores consist of chalcopyrite with varying admixture of pyrite or pyrrhotite. Their grade ranges between 0.4 % and 0.7 % Cu. These ores were mined at deposits Zlaté Hory-jih and Zlaté Hory-Hornické skály. Mining of these ores at the Zlaté Hory deposit was terminated in 1990. 5,808 kt of ore containing 34,741 t of copper were mined in 1965–1990 period.
- Stratabound monometallic Cu ores (chalcopyrite) confined to a low-grade metamorphosed volcanosedimentary complex were discovered and their reserves evaluated and explored in the former deposit of Tisová near Kraslice. Mining of local ores, having about 1 % Cu, was terminated in 1973. A mineral exploration project was then executed in the ore district in the eighties, but mining was not resumed and the deposit (mine) was temporarily flooded.
- Less important Cu mineralizations and/or Cu-Zn-Pb ores of stratabound type pyrite formation are known at numerous localities of the Bohemian Massif (e.g. Staré Ransko, Křižanovice, Svržno).
- Hydrothermal (vein) Cu abandoned deposits (Rybnice, Rožany, Tři Sekery) and sedimentary Cu ores (Krkonoše Mts. Piedmont Basin) were of a historical importance only. A very poor deposit Horní Vernéřovice–Jívka was exploited here in 1958–1965.

Mining of Cu ores in the Czech Republic was terminated in 1990 and the deposits have been gradually eliminated from The Register.

3. Registered deposits and other resources in the Czech Republic

(see map)

Registered deposits and other resources are not mined

Reserved registered deposits:

1 Křižanovice

2 Kutná Hora

3 Zlaté Hory-Hornické Skály

4 Zlaté Hory-východ

Exhausted deposits and other resources:

5 in Krušné hory Mts. (Erzgebirge Mts.) and Tisová

6 Tři Sekery and surroundings

7 in Krkonoše Mts. Piedmont Basin and Intrasudetic Basin

8 Staré Ransko

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number [a)]	5	5	5	5	4
exploited	0	0	0	0	0
Total mineral *reserves, kt Cu	51	51	51	51	49
economic explored reserves	0	0	0	0	0
economic prospected reserves	0	0	0	0	0
potentially economic reserves	51	51	51	51	49
Mine production, kt Cu	0	0	0	0	0

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

[a)] *deposits with registered Cu content*

Copper and copper alloys processing

Měď Povrly, a.s.

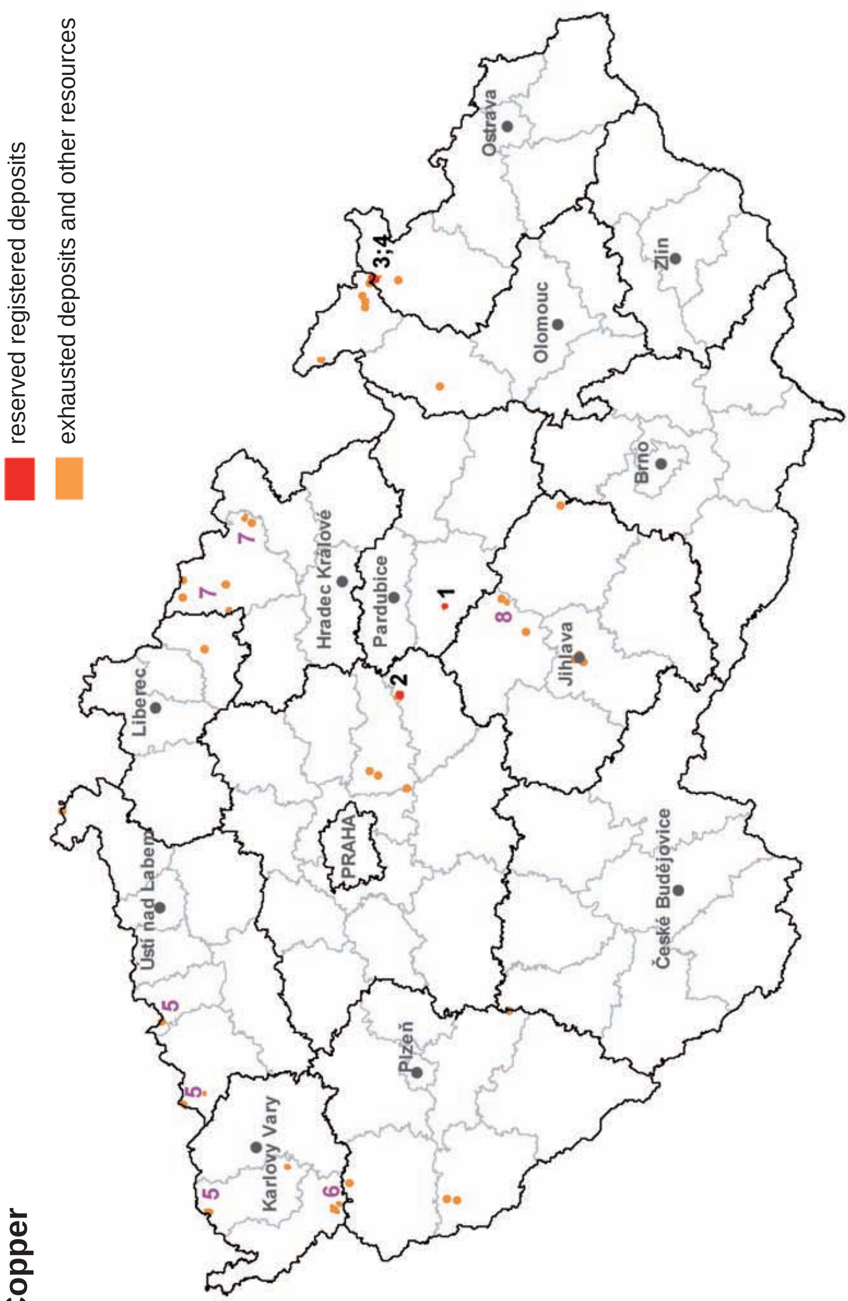
Kovohutě Čelákovice, a.s.

Kovohutě Rokycany, a.s.

Slévárna Vysoké Mýto s.r.o.

Měď Povrly a.s. located in northern Bohemia close to Ústí nad Labem is engaged in copper and brass (copper-zinc base alloys) processing into rolled intermediate products. The

Copper



reserved registered deposits
exhausted deposits and other resources
Ostrava
3;4
Zlín
Olomouc
Brno
7
Hradec Králové
Pardubice
1
8
Jihlava
Liberec
2
PRAHA
Ústí nad Labem
České Budějovice
5
Plzeň
5
Karlovy Vary
5
6

company produces wires, bars, tubes and other products from copper and brass. These products are used e.g. in the production of imitation jewellery and fancy goods, artistic objects, musical instruments, keys and locks, ammunition, electro-technical goods, instruments and machinery, shower hoses and bathroom fixtures, car equipment, lights, in welding or in construction industry in roofing production, drainage of roofs and façades.

Production of metallurgical intermediate products (bars, tubes, wires) of copper and its alloys represents the major activity of Kovohutě Čelákovice, a.s., as well. It produces intermediate products made of pure copper, intermediate products made of copper alloyed with other elements (Ag, Mn, Si, Ni, P, As), intermediate products of brass and of bronze. Apart from the main assortment, the company produces roughly 40 highly sophisticated alloys.

Intermediate products made of copper make part of the assortment of Kovohutě Rokycany, a.s., as well. The company produces namely strips and sheets of pure copper and of copper alloys, bars and tubes of bronze, bars and tubes of continually cast copper and wires of copper and its alloys. The company produces in addition wires, strips and sheets of nickel and its alloys.

Vysoké Mýto s.r.o. foundry specializes in castings of copper alloys (brass, bronze) of small size. Monthly production is about 15 tonnes of castings of Cu alloys.

5. Foreign trade

2603 – Copper ores and concentrates

	2003	2004	2005	2006	2007
Import, t	2	0	4	2	0
Export, t	45	21	0	3	0

7402 – Unrefined copper

	2003	2004	2005	2006	2007
Import, t	9	915	210	677	2
Export, t	0	2	0	0	0

7403 – Refined copper and copper alloys

	2003	2004	2005	2006	2007
Import, t	6 209	4 648	4 248	7 573	16 622
Export, t	977	7 804	4 240	12 659	10 269

Detailed data on refined copper and copper alloys imports (t)

Country	2003	2004	2005	2006	2007
Germany	3 191	1 402	1 731	4 115	5 672
Poland	1 947	1 944	1 342	1 017	2 270
Slovakia	112	53	521	1 003	5 398
Austria	567	884	91	114	1 287
Russia	49	0	382	1 200	0
Chile	0	6	1	1	1 512
Italy	136	233	66	26	115
others	207	126	114	101	368

7404 – Copper waste and scrap

	2003	2004	2005	2006	2007
Import, t	2 080	4 027	6 094	8 372	9 137
Export, t	36 874	45 571	54 198	57 417	59 632

Detailed data on copper waste and scrap imports (t)

Country	2003	2004	2005	2006	2007
Slovakia	365	1 380	2 073	4 688	5 464
Poland	1 159	1 621	2 445	1 451	1 861
Germany	428	732	528	484	691
Austria	50	4	212	1 207	44
Hungary	0	191	769	376	768
others	78	99	67	166	309

Detailed data on copper waste and scrap exports (t)

Country	2003	2004	2005	2006	2007
Germany	23 811	24 926	27 094	33 776	33 888
Slovakia	2 727	4 306	5 760	5 349	5 275
Austria	3 579	3 750	3 708	4 098	6 948
Italy	4 065	2 151	1 704	4 559	3 325
Belgium	1 582	2 616	5 390	4 143	2 784
China	254	1 875	3 660	1 758	1 577
others	856	5 947	6882	3 734	5 835

Foreign trade with refined copper, copper alloys and copper waste and scrap is the most important of the above given items of the customs tariff. Unrefined copper has been imported traditionally from Germany and Poland. Copper waste and scrap migrates from the East to the West, similarly to other non-ferrous metals. Amount of the copper waste leaving the Czech Republic is alarming (about 55–60 kt in 2005–2007). Recent years have seen a gradual shift of the main traded volume from unrefined metal and intermediate products to final copper products (wires, sheet metal, rods etc.)

6. Prices of domestic market and foreign trade

740311 – copper cathodes and sections of cathodes unwrought

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	48 221	66 938	81 329	138 886	149 878
Average export prices (CZK/t)	N	70 788	82 123	144 661	155 128

740321 – copper-zinc base alloys, unwrought

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	190 864	82 075	86 257	173 779	37 395
Average export prices (CZK/t)	110 109	59 741	60 702	97 061	37 896

740322 copper-tin base alloys, unwrought

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	667 091	383 785	355 912	233 643	324 831
Average export prices (CZK/t)	156 925	67 120	90 763	113 971	115 645

7404 – copper waste and scrap

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	30 437	43 633	52 967	100 977	105 847
Average export prices (CZK/t)	38 062	45 958	53 974	97 067	101 761

Evolution of the average import and export prices of copper,copper-zinc and copper-tin base alloy and copper waste and scrap in the last five years documents well the recent pronounced rise of non-ferrous metal prices.

7. Mining companies in the Czech Republic as of December 31, 2007

No companies were extracting Cu ores in the Czech Republic in 2007.

8. World production

Production of Cu ores continues to rise and it conforms to the increasing world consumption (industrial countries show an increase in copper consumption by 3 % per year on average in the last decade). World production represents roughly about 15.0 mill tonnes per year at present. Mining production of Chile continued to increase in the last years (from 2.2 mill tonnes in 1994 to about 5.4 mill tonnes in 2004–2006). Mine production of Peru and newly since 1997 in Argentine and since 2004 in Brazil has been increasing with similar dynamics. On the contrary, mine production of the USA has been decreasing. Mine production of Indonesia, which had been dynamically growing in 1995–2000, has been stagnating during the recent years. Mine production of Poland, the European largest producer, has been stable around 450–530 kt per year.

World production data are adopted from Mineral Commodity Summaries (MCS), the International Copper Study Group (ICSG) database and the yearbook Estadísticas del Cobre y otros Minerales published by a renowned institute Comisión Chilena del Cobre (COCHILCO).¨

World copper mine production

Year	2003	2004	2005	2006	2007
Mine production, kt Cu (MCS)	13 600	14 600	15 000	15 100	15 600
Mine production, kt Cu (ICSG)	13 758	14 595	14 925	14 988	15 443
Mine production, kt Cu (COCHILCO)	13 700	14 714	15 180	15 224	N

Main producers' share in the world mine output (2006; according to COCHILCO):

Chile	35.2 %	Russia	5.1 %
USA	8.1 %	China	5.0 %
Peru	6.9 %	Canada	4.0 %
Australia	5.9 %	Zambia	3.7 %
Indonesia	5.4 %	Poland	3.4 %

According to the International Copper Study Group, following world deposits belong to the largest one based on the year mine capacity: Escondida (Chile; 1.311 mill t), Codelco Norte (Chile; 0.957 mill t), Grasberg (Indonesia; 0.75 mill t), Collahuasi (Chile; 0.45 mill t), Morenci (the USA; 0.43 mill t), Taimyr Peninsula (Russia; 0.43 mill t), El Teniente (Chile; 0.418 milů t), Antamina (Peru; 0.4 mill t), Los Palambres (Chile; 0.335 mill t) and Batu Hijau (Indonesia; 0.3 mill t). The first European deposit Rudna in Poland with the yearly capacity of 0.22 mill t, exploited by KGHM Polska Miedź S.A., occupies the 16th position.

The largest metallurgical works in the world are located apart from Chile mainly in Asia. The largest production capacity have following metallurgical works: Birla Copper (India; 0.5 mill t), Norddeutsche Raffinerie (Germany; 0.45 mill t), Saganoseki Ooita (Japan; 0.45 mill t), Codelco Norte (Chile; 0.4 mill t), Guixi (China; 0.4 mill t), Norilsk (Russia; 0.4 mill t), El Teniente (Chile; 0.391 mill t), Besshi Ehime (Japan; 0.365 mill t), Jinchuan (China; 0.350 mill t) and Yunnan (China; 0.350 mill t). Huelva in Spain with the yearly capacity of 0.32 mill t is the only European metallurgical works which classifies among the top twenty ones in the world.

9. World market prices

Copper ore concentrates are not quoted on the world market; sales are based upon negotiated prices only. Prices of Cu metal (Grade A Electrolytic Copper) are commonly quoted at London Metal Exchange (LME). Copper price reached high values in 1973 and 1974 and another local maximum was reached in 1989 (annual average USD 2,847 per tonne). The following temporary decrease in prices was caused by a surplus production, particularly due to supplies from the East European countries and by the decrease in consumption resulting from the global economic recession. The prices hit twelve-year minimum in the first part of the year 1999. This trend has not changed until the second half of the year 2003, by the end of which the prices reached the limit of USD 2,300 per tonne. Prices of all non-ferrous metals on the world market significantly hardened during the year 2004. Copper prices increased up to 3,300 USD/t in this period, the cause being especially a high demand from the side of rapidly growing economies of Asia. For instance, the copper consumption in China increased according to ICSG by 9.3 % in 2004. Continual rise in copper price on the world market during the year 2005 had similar causes: whereas the price was below USD 3,100 per tonne in January 2005, it reached USD 4,650 per tonne in the end of the year. The price rose by about 50 % just during the year 2005. Price of copper, as of a number of other metals, was to a certain extent also under influence of speculators, attracted by the high price rise. The prices slowly decreased back to the limit of 6,000 USD/t in the second half of the year 2006. However, already in April 2007 they increased back to the level of 8,000 USD/t. The price subsequently stabilized between 7,000 and 8,000 USD/t until November 2007. A temporary drop below 7,000 USD/t was followed by another price rise above 8,000 USD/t already in February 2008. The prices have remained above the 8,000 USD/t level, even approaching the 9,000 USD/t limit since February 2008. Historical maxima are still caused mainly by economical growth in the Asian region. Copper consumption in Asia increased from 450 ths tonnes to approximately 8 mill tonnes per year between 1960 and 2006. The last few years have seen the biggest increase of consumption.

The average annual metal price at LME in USD per tonne (Cash) was as follows

Commodity/Year		2003	2004	2005	2006	2007
Cu metal at the LME, Grade A Electrolytic Copper, cash	USD/t	1 779	2 866	3 679	6 709	7 139

10. Recycling

Copper belongs to metals which are recycled on a large scale. The proportion of recycled copper in the metal consumption reaches 30–40 % according to the International Copper Study Group. This proportion is even higher in developed countries, e.g. in Germany it exceeds 50 %. Copper is recovered mainly through pyrometallurgical processes, to lesser extent through hydrometallurgy.

11. Possible substitutes

Aluminium replaces copper in electrical and electronics uses, in the manufacture of car radiators and refrigerators. Titanium and steel despite their worse conductivity substitute for copper in the production of heat exchangers. Steel substitutes for copper in the manufacture of ammunition, too. Optical fibres in telecommunication and plastics in water distribution (lines) and the building industry are other substitutes.

1. Characteristics and use

Lead ores make usually part of base metal ores, formed predominantly by sulphides of Pb, Zn, in places Cu and accompanied by exploitable contents of silver and gold and many trace elements (e.g. In, Cd, Bi etc.). Galenite and sphalerite usually with pyrite and often with chalcopyrite represent major minerals of these ores. Ideas on genesis of many of base metal ore deposits are variable, even contradictory, as even several genetic processes contributed to their formation and final form. As industrial use concerns, deposits of various genesis can be grouped into 6 main types. Large to huge stratified and lenticular concordant bodies in metamorphic rocks, large and medium-sized deposits of disseminated galena-sphalerite ores in limestones and dolomites (stratabound), large and medium-sized massive sulphide deposits, medium-sized deposits of irregular shape with massive and disseminated mineralization, medium-sized and small deposits of skarn ores, medium and small vein deposits of relatively rich ores.

Automotive industry is the main branch which uses lead. Even though lead is to a lesser extent used for production of batteries, it is still essential in various seals, weights on wheels, solders, bearings etc. production. About 20 % of lead consumption covers electrotechnics, electronics, production of explosives, protective coatings etc.

2. Mineral resources of the Czech Republic

Mining of vein-type hydrothermal base metal deposits brought fame and glory to the medieval ore mining in Bohemia. Originally it was due to the silver contents in ores of these deposits; additional extraction of lead and later also zinc ores started in the 16th century. After World War II, new exploration projects turned the attention to volcanosedimentary deposits of the sulphide formation.

- Hydrothermal vein base metal mineralization is abundant in the Bohemian Massif. Besides medieval ore districts of Oloví, Jihlava, Havlíčkův Brod, Stříbro, the Blanice Graben and others, the mining districts of Příbram, Stříbro and Kutná Hora maintained their significance till the 20th century. The major Pb-bearing mineral was galena (more or less Ag-bearing), which can be as abundant as sphalerite in the majority of Pb-Zn deposit. Only the Kutná Hora ore district shows considerably lesser contents of galena relative to sphalerite in the majority of veins.
- A distinct type of hydrothermal vein mineralization occurred at Harrachov, where galena is accompanied by barite and fluorite.
- Stratabound base metal ores of volcanosedimentary origin related to Devonian volcanism were explored in the fifties through to eighties in northern Moravia. Extensive mining was focused on the deposits of Horní Město, Horní Benešov, Zlaté Hory-východ and Zlaté hory-západ. Contents of lead varying up to 0.5 % are bound in galena, accompanied in ore bands by sphalerite. Mining of any other base metal deposits of similar origin has not started because of reduction of ore mining.

Mining of base metal deposits in the Czech Republic was terminated at the beginning of 1994. A complex Pb-Zn concentrate represented a final product of mining. This concentrate was exported, as there was no domestic capacity for its smelting. Reserves of base metal ores have been gradually eliminated from The Register.

3. Registered deposits and other resources in the Czech Republic

(see map)

Registered deposits and other resources are not mined

Reserved registered deposits:

1 Horní Benešov
2 Horní Město
3 Horní Město-Šibenice
4 Křižanovice
5 Kutná Hora
6 Oskava
7 Ruda u Rýmařova-sever
8 Zlaté Hory-východ

Exhausted deposits and other resources:

9 Březové Hory + Příbram-Bohutín
10 Oloví
11 Stříbro
12 Havlíčkův Brod (Dlouhá Ves + Bartoušov + Stříbrné Hory)
13 Ratibořské Hory + Stará Vožice
14 Černovice

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number [a)]	8	8	8	8	8
exploited	0	0	0	0	0
Total mineral *reserves, kt Pb	152	152	152	152	152
economic explored reserves	0	0	0	0	0
economic prospected reserves	0	0	0	0	0
potentially economic reserves	152	152	152	152	152
Mine production, kt Pb	0	0	0	0	0

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

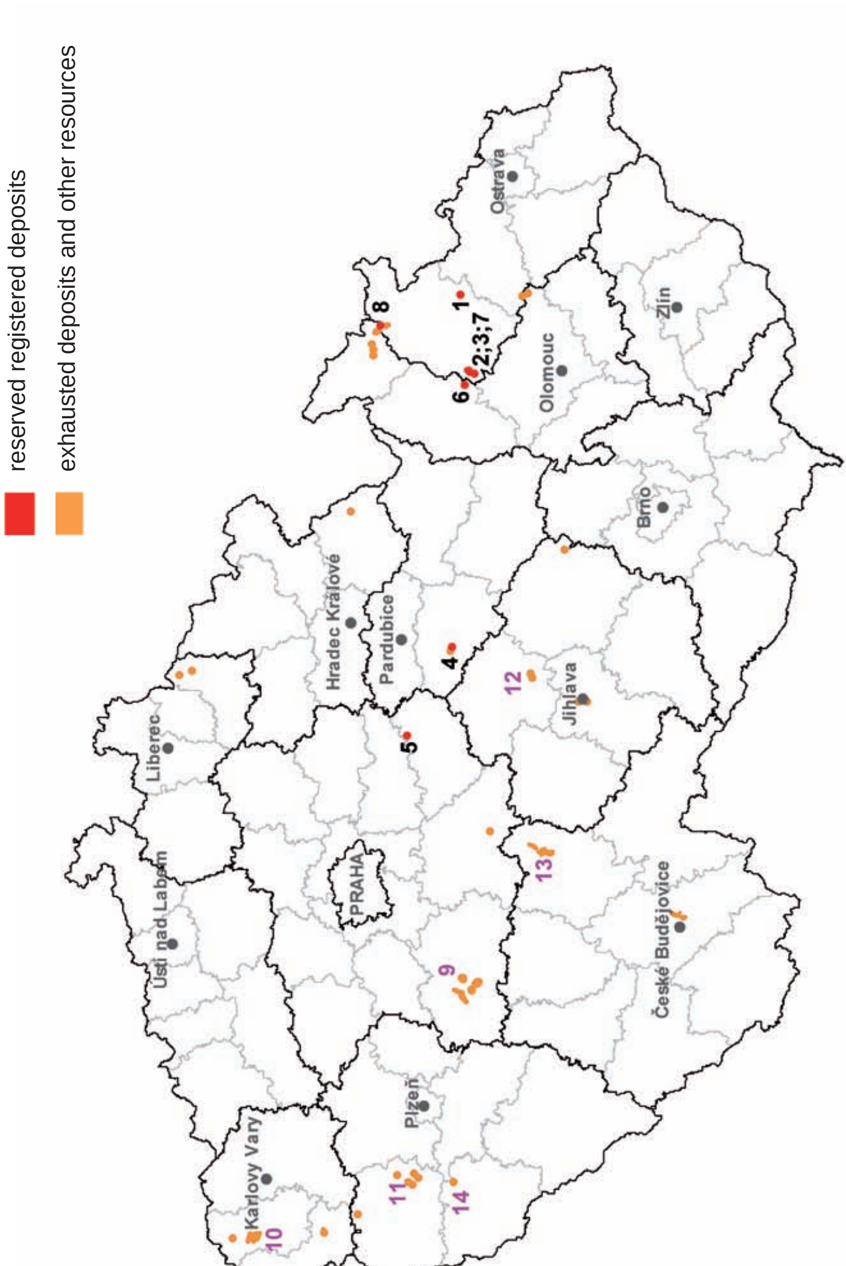
a) Deposits with registered Pb content

Recycling and lead production

Kovohutě Příbram nástupnická a.s.

Activity of Kovohutě Příbram nástupnická a.s. can be divided into four main branches. Recycling division is engaged with bulk buying and recycling of waste and scrap of lead

Lead


reserved registered deposits
exhausted deposits and other resources
Ostrava
Zlín
Olomouc
Brno
Jihlava
Hradec Králové
Pardubice
Liberec
Ústí nad Labem
PRAHA
České Budějovice
Plzeň
Karlovy Vary
1
2;3;7
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and its alloys, 80 % of which represent old scrap lead accumulators. Its production assortment represents lead and its alloys in pigs. Products division is engaged with the production and sale of a large assortment of products on lead, tin and antimony basis. All the assortment of about 2,000 types is used e.g. in construction industry, electro-technics, electronics, chemical industry, health services, engineering in measuring technique and at ammunition production. Lead plates, lead stripes and sections, lead wires and bars, lead seals etc. belong to main products. Electric waste division is engaged with ecological processing of collected electrical equipment and separately collected electric waste. Precious metals division is engaged with bulk buying and ecologically harmless usage and recycling of waste – secondary raw materials containing precious metals.

5. Foreign trade

2607 – Lead ores and concentrates

	2003	2004	2005	2006	2007
Import, t	506	0	0	1 741	0
Export, t	0	0	0	0	0

7801 – Unwrought lead

	2003	2004	2005	2006	2007
Import, t	55 699	73 472	N	67 924	66 088
Export, t	7 112	7 230	8 666	10 430	16 707

Detailed data on unwrought lead imports (t)

Country	2003	2004	2005	2006	2007
Germany	39 068	50 101	N	42 696	35 331
Sweden	7 615	10 976	14 600	16 510	15 913
Poland	3 742	4 899	1 093	809	5 231
Romania	1 324	1 381	2 161	2 740	2 470
Austria	22	2 416	N	3 124	4 762
others	3 928	3 699	N	2 045	2 381

7802 – Lead waste and scrap

	2003	2004	2005	2006	2007
Import, t	908	1 348	4 104	4 411	6 519
Export, t	2 926	3 032	4 948	6 648	6 866

Detailed data on lead waste and scrap imports (t)

Country	2003	2004	2005	2006	2007
Poland	785	391	1 244	1 455	1 444
Germany	100	224	946	934	2 663
Hungary	23	586	732	636	945
Bosnia and Herzegovina	0	0	671	956	736
others	0	146	509	430	731

Detailed data on lead waste and scrap exports (t)

Country	2003	2004	2005	2006	2007
Germany	2 926	3 023	4 948	6 583	6 537
others	0	9	0	65	349

Foreign trade with unwrought lead, the import of which represents 55 to 70 kt per year, i.e. CZK 1.5–3.3 billion, is the most important of the above given customs tariff items. Unwrought lead is imported traditionally from Germany and Sweden. Gradual decrease of unwrought lead import from Poland in favour of lead waste and scrap in 2005 and 2006 is interesting. Import of lead waste and scrap increased more than twenty times in 2002–2005 and the import-export balance equilibrated for the first time in 2006. Export of this item from the Czech Republic is nevertheless still higher. Almost all lead waste and scrap is exported to Germany. Volume of trade with lead ores and concentrates is negligible.

6. Prices of domestic market and foreign trade

7801 – Unwrought lead

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	16 689	21 355	N	30 936	50 426
Average export prices (CZK/t)	18 087	25 728	22 338	34 420	51 072

7802 – Lead waste and scrap

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	12 838	18 540	18 883	24 028	44 543
Average export prices (CZK/t)	8 963	12 294	23 566	23 470	27 829

7. Mining companies in the Czech Republic as of December 31, 2007

In 2007, no companies exploiting ores with Pb content were operating in the Czech Republic.

8. World production

The world production exceeded the level of 3 mill tonnes of metal content first in 1968. The largest production so far was recorded in 1977 – 3,657 kt.

Since the second part of 1990s until 2003, the world mine production had been oscillating around 3,000 kt. The last three years have seen a repeated rise in mine production, especially in case of two largest world producers – Australia and China. The Chinese production increased from 640 kt in 2002 to 950 kt in 2004 and about 1,200 kt in 2006. Data according to Mineral Commodity Summaries (MCS), International Lead and Zinc Study Group (ILZSG) database and yearbook Welt-Bergbau-Daten (WBD):

World lead mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt Pb (MCS)	2 950	3 150	3 270	3 360	3 550
Mine production, kt Pb (ILZSG)	3 111	3 129	3 415	3 492	3 685
Mine production, kt Pb (WBD)	3 265	3 265	3 358	N	N

Main producers' share in the world mine output (2006; according to MCS):

China	34.6 %	Mexico	3.5 %
Australia	19.9 %	Canada	2.4 %
USA	12.4 %	Sweden	1.9 %
Peru	9.0 %	India	1.9 %

Metal production

Year	2003	2004	2005	2006	2007
Metal production, kt Pb (according to ILZSG)	6 763	6 957	7 636	7 948	8 150

9. World market prices

On the world market, mines receive the lead metal price *less* a treatment and refining charge (per unit of contained lead), with some adjustments for their lead concentrates (recoverable byproducts such as Ag, Ge, In). The treatment charge (T/C) for lead concentrate grading 70–80 % Pb is quoted in USD/t, CIF Europe. It exceeded a limit of USD 100 per tonne at the end of 1987 and since then it was gradually increasing by almost 100 %. Then it decreased again and it stabilized at about USD 110 per tonne during the last years.

The metal has been traditionally traded on the London Metal Exchange (LME) in GBP/t until the end of June 1993 and since then in USD/t. Metal price at LME (refined metal having minimum 99.97 % Pb) reached local maximum in 1979 – GBP 556 per tonne. The price of lead was oscillating below the level of USD 500 per tonne in 2000 to 2002. This trend dramatically changed in the second half of the year 2003, during which the prices increased up to the limit of USD 700 per tonne. Prices of all non-ferrous metals on the world market significantly hardened during the year 2004. Lead prices increased up to the extraordinary level of 1,040 USD/t in this period. It was again a high demand from the side of rapidly growing economies of Asia, especially China and India, which caused this increase. The lead prices were high also in 2005, where they ranged between 820 and 1,160 USD/t. World price of lead markedly increased in 2006, especially in its second half, when the price increased to as much as 1,800 USD/t. This rise was caused by continuing high demand especially of the Asian region, which contributed to the low level of the metal reserves on world stock exchanges. Prices continued to rise in the first half of 2007 as well, when the price temporarily increased to a record-breaking value of 3,500 USD/t. In the summer months of 2007, lead prices again levelled off between 3,000 and 3,500 USD/t. The lead price reached a record value of 3,980 USD/t in October 2007, however, it subsequently returned back to the level around 2,500 USD/t due to the increase of stock reserves.

Treatment charge (T/C) of lead concentrates and lead metal LME price

Commodity/Year		2003	2004	2005	2006	2007
Lead concentrate, 70–80 % Pb grade, T/C basis, CIF Europe	* USD/t	110	110	110	110	N
Refined metal, 99.97 % Pb minimum, LME	**USD/t	515	888	976	1 291	2 588

* Average price of commodity at year-end
** Average annual price

10. Recycling

The share of recycled lead in world production of Pb metal has been continuously increasing. This trend leads to a decrease in demand for lead concentrates and it also affects their price. Due to the high lead consumption in the accumulator and battery production, batteries represent the most recycled material. Less recycled is scrap from consumer's and manufacture industries. Recycled lead has supplied 59 % of the metal world production according to the UNCTAD data. Mainly Japan, Germany, France, Great Britain, the USA and Canada took part in the recycling. It is at the same time estimated, that about 85 % of products made of or containing lead were recycled in 2004. According to the Battery Council International, 97 % of lead accumulators are recycled at present in the USA.

11. Possible substitutes

Lead used for piping in the building industry and for electric cables is being replaced by plastics. Aluminium, tin, iron and plastics gradually replace lead in packing and preserving of products. Tetraethyl lead used as anti-knock additive in gasoline is replaced by aromatic hydrocarbons. Other agents are also efficiently replacing lead in the manufacture of pigments. The volume of lead substitutes continues to increase and will include even the manufacture of accumulators and batteries. Lead in solders is being efficiently replaced by tin.

Zinc

1. Characteristics and use

The major economic mineral of zinc is sphalerite, which is usually accompanied by galena, pyrite and chalcopyrite in base metal deposits. The ore is marked as zinc ore providing the Zn:Pb ratio is higher than 4. Sphalerite usually contains cadmium, whose concentrations vary from traces up to 2 %, then germanium, gallium, indium and thallium. Zinc ores occur mostly in base metal deposits of various origins, the same way as lead ores. World reserves of Zn are estimated at 1.9 billion tonnes. Explored and prospected reserves make about 480 mill tonnes of metal. About 21 % of this amount is located in Australia, 19 % in China and 18.8 % in the USA, Approximately 55 % of zinc consumption is used in zinc galvanizing, about 17 % in alloys. Roughly 13 % makes brass and bronze production and about 15 % is used for other purposes.

2. Mineral resources of the Czech Republic

Zinc ores almost exclusively occur as a part of polymetallic ores [Pb-Zn±Ag (±Cu)] of hydrothermal or volcanosedimentary origin.

- A large volume of zinc ores represented mostly by sphalerite was extracted from the vein-type base metal deposits of the Březové Hory, Bohutín and Vrančice ore districts in the vicinity of Příbram (until 1962). The grade of these ores ranges between 1.0 and 2.9 %. Other base metal deposits were explored and partly mined in the period after World War II: in the northern part of the Kutná Hora district (Rejské pásmo, Turkaňské pásmo and Staročeské pásmo zones), in the Havlíčkův Brod district (Stříbrné Hory, Dlouhá Ves, Bartoušov) and in western Bohemia (Stříbro, Kšice).
- The most important base metal deposits of volcanosedimentary origin occur in the Jeseníky Mountains. Disseminated sulphide ores grading 1.1–1.8 % Zn were mined in the deposits of Horní Město (1967–1970) and Horní Benešov (1963–1992). 6,561 kt of ore containing 39,210 t of lead and 90,711 t of zinc were mined from both deposits in 1963–1992. Mining of the Au-Zn ores at Zlaté Hory-východ deposit in the Zlaté Hory ore district was terminated in 1994. 771.6 kt of base metal ores containing 9,111 t Zn, 395 t Pb and 1,559 kg Au were mined at Zlaté Hory-východ and Zlaté Hory-západ deposits in 1988–1994.
- The potential deposit of Staré Ransko-Obrázek is probably of polygenetic origin. Sphalerite-barite ore, having up to 1.8 % Zn, was mined here until 1990. The Křižanovice deposit of Pb-Zn-Cu ores with barite belongs to deposits of unclear genesis, too. The ore contained about 4–6 % Zn. The deposit was discovered during an exploration project in the eighties.

The production of Zn ores in the Czech Republic was terminated at the beginning of 1994, in line with the policy of a gradual reduction of ore mining adopted by the Government. A mixed Pb-Zn concentrate was the final product of the base metal ores mining. The concentrate was exported because there was no smelter in the Czech Republic. Base metal reserves have been gradually eliminated from The Register.

3. Registered deposits and other resources in the Czech Republic

(see map)

Registered deposits and other resources are not mined

Reserved registered deposits:

1 Horní Benešov
2 Horní Město
3 Horní Město-Šibenice
4 Křižanovice
5 Kutná Hora
6 Oskava
7 Ruda u Rýmařova-sever
8 Zlaté Hory-východ

Exhausted deposits and other resources:

9 Březové Hory + Příbram + Bohutín
10 Stříbro
11 Havlíčkův Brod (Dlouhá Ves + Bartoušov + Stříbrné Hory)
12 Staré Ransko

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number [a)]	9	9	9	9	8
exploited	0	0	0	0	0
Total mineral *reserves, kt Zn	477	477	477	477	472
economic explored reserves	0	0	0	0	0
economic prospected reserves	0	0	0	0	0
potentially economic reserves	477	477	477	477	472
Mine production, t Zn	0	0	0	0	0

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

[a)] Deposits with registered Zn content

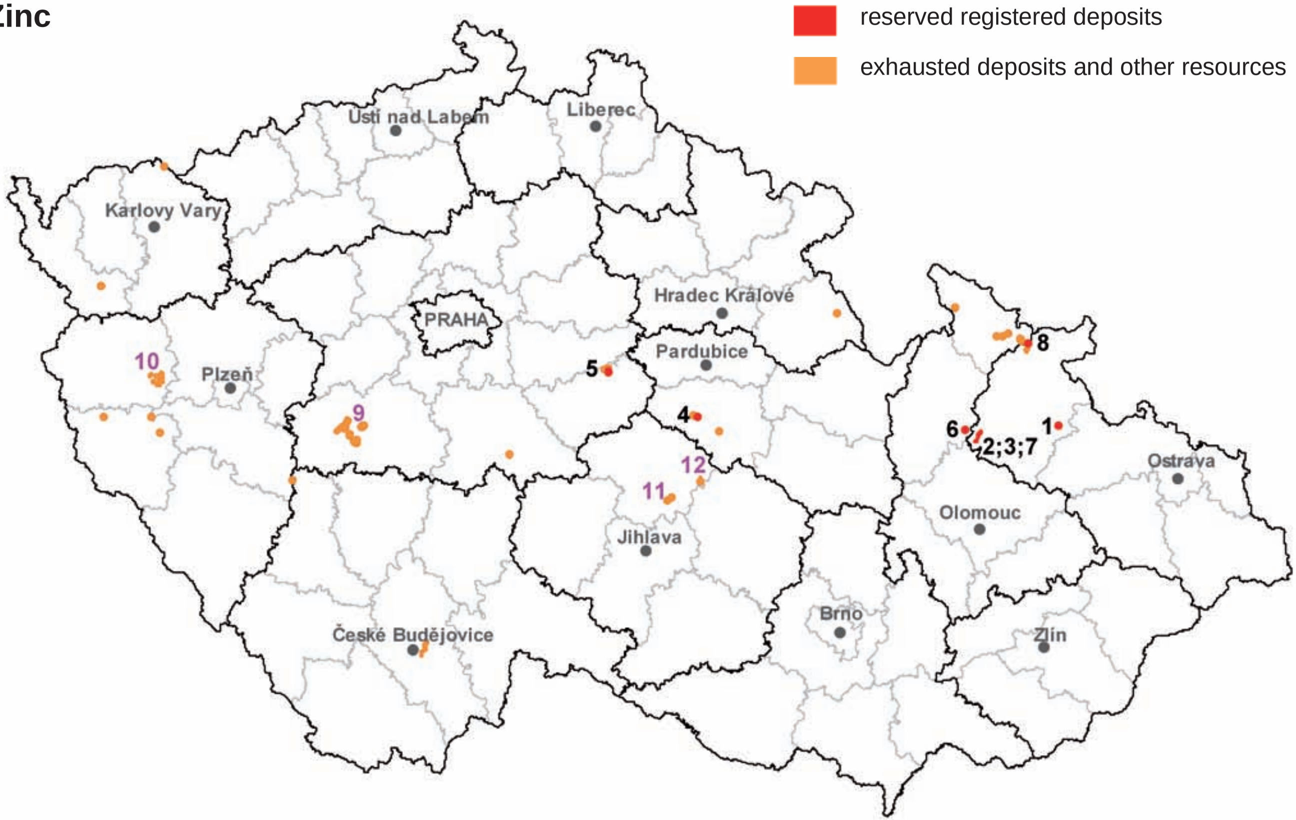
Production of zinc alloys and castings

COMAX, spol. s.r.o.

ALFE Brno, s.r.o.

Casting of both iron and non-ferrous metals, production of painted steel and aluminium stripes, plates and its forming represents the main activity of COMAX s.r.o. (formerly Kovohutě Velvary). Metallurgical part produces various alloys including Zn alloys. These are continually cast intermediate products – bronzes (tin, lead, aluminium, red), brasses (casting, modified), alloys (aluminium, zinc) and master alloys. ALFE Brno, s.r.o. ensures

Zinc



reserved registered deposits
exhausted deposits and other resources
Ústí nad Labem
Liberec
Karlovy Vary
Hradec Králové
PRAHA
Pardubice
Plzeň
10
9
5
4
12
11
6
2;3;7
1
8
Ostrava
Olomouc
Jihlava
Brno
České Budějovice
Zlín

production of precise castings of zinc and modern technology of centrifuge casting in rubber forms apart from classical casting production.

5. Foreign trade

2608 – Zinc ores and concentrates

	2003	2004	2005	2006	2007
Import, t	0	0	1	17	28
Export, t	0	21	0	0	0

7901– Unwrought zinc

	2003	2004	2005	2006	2007
Import, t	28 748	34 205	36 444	40 641	47 755
Export, t	1 670	5 659	8 110	6 382	18 682

Detailed data on unwrought zinc imports (t)

Country	2003	2004	2005	2006	2007
Poland	10 481	17 110	19 115	12 899	10 493
Germany	6 024	5 160	6 785	8 364	7 610
Belgium	3 259	2 925	3 383	4 589	4 741
Slovakia	206	1 566	1 038	4 483	13 937
Romania	1 016	1 773	1 003	1 187	1 333
the Netherlands	520	1 309	1 033	924	1 440
Kazakhstan	317	376	21	2 335	298
Russia	983	49	0	942	55
China	1328	12	0	196	2 385
others	4 614	3 926	4 066	4 822	5 463

7902 – Zinc waste and scrap

	2003	2004	2005	2006	2007
Import, t	25	104	565	334	4 008
Export, t	2 247	2 517	2 739	3 041	2 966

Detailed data on zinc waste and scrap exports (t)

Country	2003	2004	2005	2006	2007
Germany	1 407	846	777	1 006	1 074
Austria	518	625	642	520	700
Belgium	116	286	487	537	421
India	63	261	379	183	21
Poland	88	101	128	412	577
others	55	398	326	383	173

Foreign trade with zinc is materialized through two main commodities – unwrought metal and zinc waste and scrap. Volume of unwrought zinc import has been increasing continuously in recent years and it oscillates around 40 kt in present. Substantial part of unwrought zinc has been traditionally imported from Poland and Germany, share of Belgium has been newly increasing. 15–20 % of zinc is re-exported into other countries. In contrast, zinc waste and scrap has been mostly exported from the Czech Republic in volume of about 2–3 kt per year. Export is directed mainly to Germany, Austria and Belgium, but Poland became a more important buyer in 2006 and 2007. An unusually high amount of zinc waste and scrap was imported from Slovakia in 2007.

6. Prices of domestic market and foreign trade

7901– Unwrought zinc

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	27 410	30 233	35 139	64 717	75 795
Average export prices (CZK/t)	22 571	27 754	31 777	71 185	74 116

7902 – Zinc waste and scrap

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	50 892	20 201	34 229	38 454	72 547
Average export prices (CZK/t)	13 982	16 795	20 004	43 394	47 029

The average import prices of unwrought zinc increased from about 27 ths CZK/t in 2002–2003 to more than twice as much in 2006 and to 2.5 times as much in 2007. This illustrates well the zinc world price increase in recent years.

By contrast, imported prices of zinc decreased from 2002 (CZK 62,500/t) to CZK 38,500/t in 2006 and in the same time exported scrap prices tripled.

7. Mining companies in the Czech Republic as of December 31, 2007

No companies were extracting Zn ores in the Czech Republic in 2007.

8. World production

Production of zinc contained in ores exceeded 7 mill tonnes in 1985. Increase in production terminated in 1992 and in the next years mine production was decreasing. High increase in stock and increase of recycled metal proportion in the total production, covering increase of demand, were the cause of the above mentioned decline. The production has been increasing again since 1994. It was higher than 8 mill t in 1999; the 9 mill tonne limit was according to the international statistics exceeded in the 2002–2003 period. While the Canadian production has been decreasing, mine production of China and Peru has been increasing in the recent years. The most significant increase in mine production was monitored in China (1,000 kt in 1995; 1,476 kt in 1999; 1,700 kt in 2001; 2,200 kt in 2003; 2,550 kt in 2005; 3,000 kt in 2006). Data come from Mineral Commodity Summaries (MCS), International Lead and Zinc Study Group (ILZSG) database and the yearbook Welt Bergbau Daten (WBD).

World zinc mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt Zn (MCS)	9 010	9 600	9 800	10 000	10 500
Mine production, kt Zn (ILZSG)	9 520	9 735	10 156	10 479	11 048
Mine production, kt Zn (WBD)	9 532	9 729	10 152	10 610	N

Main producers' share in the world mine output (2006; according to MCS):

China	26.0 %	Canada	7.1 %
Australia	13.8 %	Mexico	4.8 %
Peru	12. %	Kazakhstan	4.0 %
the USA	7.3 %		

World zinc metal production

Year	2003	2004	2005	2006	2007 e
Metal production, kt Zn (according to ILZSG)	9 913	10 396	10 224	10 645	11 346

9. World market prices

Since 1992 basic treatment charges for two grades of zinc concentrate have been quoted on the world market – sulphide concentrate grade 49–55 % Zn and sulphide concentrate grade 56–61 % Zn in USD/t of dry substance, in transport parity CIF main European ports. However, zinc concentrate quotations do not have a big practical importance. The price of pure metal grading 99.995 % Zn has been quoted at LME in USD/t since September 1988 (before in GBP/t). Zinc mines are paid the price for pure metal less treatment and refining charges (TR-C) under complex formulae which allow for assumed losses during smelting and refining, for the content of by-products and for changes in metal prices from the basis set out in the contracts.

Treatment charges for sulphide concentrates (different in quality than above mentioned) and prices of pure metal reached their local maxima in 1989. Later on, a significant fall in prices occurred owing to a continuous increase in stock. Treatment charges for zinc concentrates decreased below the limit of USD 150 per tonne in the years 2002–2003. The same way, the pure metal prices were very low in the years 2001 and 2002 – about half compared to the year 1997. The world prices of the pure zinc started to increase again only in the second half of the year 2003. Prices of all non-ferrous metals on the world market significantly hardened during the year 2004. Zinc prices oscillated between 940 and 1,220 USD/t in 2004. The increase of prices was caused by an increasing demand from the side of rapidly developing (mainly Asian) economies. World prices of zinc continued to rise also in 2005, especially in its second half, when they continually increased from 1,150 to 1,900 USD/t. The growth trend continued during all the year 2006 and the price increased from the level of about 2,000 USD/t up to the record value of 4,500 USD/t towards the end of the year. The price rise was caused by durable high demand from the Asian economies in combination with low reserves at LME and insufficient smelting capacities (compared with mining capacities) throughout the world. Zinc represented one of a few commodities whose prices gradually decreased during 2007, which is documented also by a lower annual average value. Prices fluctuated between approximately 3,000 and 4,000 USD/t in the first third of 2007, however, they gradually decreased to the 2,500 USD/t level before the end of the year. The limit of 2,000 USD/t was reached in the first half of the year 2008. The relatively low new stable position of the zinc world price was caused by the doubling of the metal stock at LME as well as the increase of production due to the previous high prices of the commodity.

The trend in average prices of the commodities was as follows:

Zinc price at LME

Commodity/Year		2003	2004	2005	2006	2007
* Zn metal, 99.995 % Zn, LME	*USD/t	828	1 047	1 382	3 264	3 041

Note: * annual average

10. Recycling

Zinc scrap – metal scrap, galvanized plates, alloys, flue dust, oxides and chemicals containing zinc – is being reworked by both the pyrometallurgical and hydrometallurgical processes. An increase of share in recycled metal consumption has reached 35 % of the whole consumption in the world according to the UNCTAD data. According to the Zinc Association, the proportion of recovered zinc in the US consumption was about 40 % in 2000.

11. Possible substitutes

Aluminium, plastics and magnesium replace zinc in foundry work. Coatings of aluminium alloys, pigments, plastics and cadmium replace galvanic zinc plating. Zinc plates are completely replaced by other materials like stainless steel, aluminium, plastics etc. Aluminium alloys substitute for brass. Other materials in the manufacture of chemicals, electronic devices and pigments also efficiently replace zinc.

1. Characteristics and use

Tin minerals are concentrated at the end of the magma differentiation and its deposits are related to granitic rocks and their vein and effusive equivalents. Tin mineralization is known also from skarns, developed close to contacts with granitoids. Tin minerals occur often in tin-tungsten, tin-silver and tin-base metal deposits. Cassiterite SnO_2, containing as much as 78 % Sn, represents the major economic mineral of tin. Stanine is a less common component of the tin-bering ores. Cassiterite is resistant to weathering and forms placer deposits. Hydrothermal (vein) tin is mined rather exceptionally. More than 50 % of placer deposits occur in SE Asia. River (alluvial) placers, where heavy minerals were naturally sorted by water flowing over the riverbed, are the most important and the richest ones among the secondary deposits. World economic reserves of tin in ores are estimated at 11 mill tonnes of metal according to MCS 2008.

The majority of tin is used in solders (35 %), tin plates (25 %) and production of chemicals (20-25 %). Tin has been from of old used in alloy (bronze) etc. production. A recent tendency of unleaded solder production has lead to tin consumption increase.

2. Mineral resources of the Czech Republic

Tin deposits of the Czech Republic are almost exclusively concentrated in the Krušné hory Mts., Slavkovský les and their piedmont, where they were mined since the beginning of the medieval times.

- The most important type of tin mineralization is represented by greisen deposits of Sn-W-(Li). These deposits occur in both the eastern part (Cínovec, Krupka) and the western part (Rolava, Přebuz) of the Krušné hory Mts. as well as in the Slavkovský les area (Krásno-Horní Slavkov). The origin of these deposits is connected with greisenization and silicification of the Late Variscan domes of granites high in lithium and topaz. The major Sn mineral is cassiterite, which is disseminated in the greisen bodies and usually accompanied by wolframite and zinnwaldite. The Krupka and Cínovec ore districts are also rich in hydrothermal quartz veins with cassiterite, wolframite, prospectively Bi and Mo minerals. Sn-W ores with 0.2–0.5 % Sn were mined in greisen and vein-type deposits.
- An interesting type of Sn mineralization occurs at Zlatý Kopec near Boží Dar, where tin minerals are constituents of a complex skarn, consisting of major magnetite accompanied by minor cassiterite (with hulsite, schoenfliesite), sphalerite and chalcopyrite. Presumably polygenetic complex ore contains 0.95 % Sn.
- Basically, the only deposit of primary Sn ores outside the Krušné hory Mts. region is a stratabound mineralization of cassiterite and sulphides at Nové Město pod Smrkem. An exploration project was carried out after World War II, which proved an average content of 0.23 % Sn in the ore.
- Sn mineralization consisting of stannite was found in deeper levels at the Staročeské pásmo zone of the historical Kutná Hora mining district. Due to the complex character of the ore and mainly its uneconomic accumulation, the Sn mineralization (occurrence) is of scientific importance only, particularly from the viewpoint of metallogeny and specific mineral assemblage.

The tin mining focused first at secondary (placer) deposits and gradually passed to the primary ones. Placer deposits near the primary ores of the Krušné hory Mts. region and their piedmont are in principle exhausted. Only small primary and secondary accumulations of cassiterite and wolframite in the Slavkovský les area and its piedmont have been preserved. Majority of the reserves of the primary deposits has been mined out, too, the remaining ones do not have any economic significance at present. Sn ores mining in the Czech Republic was terminated in 1991 by closing down the Krásno deposit. Mining at Cínovec deposit was terminated one year earlier. Larger resources of low-grade ores remained just at Krásno and Cínovec deposits. These could represent even a possible source of trace and rare elements (e.g. Li, Rb, Cs, Nb, Ta, Sc etc.) in future.

3. Registered deposits and other resources in the Czech Republic

(see map)

Registered deposits and other resources are not mined

1 Cínovec-jih   2 Krásno   3 Krásno-Horní Slavkov

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number [a]	6	3	3	3	3
exploited	0	0	0	0	0
Total mineral *reserves, t Sn	174 000	163 809	163 809	163 809	163 809
economic explored reserves	3 014	0	0	0	0
economic prospected reserves	6 884	0	0	0	0
potentially economic reserves	164 102	163 809	163 809	163 809	163 809
Mine production, t Sn	0	0	0	0	0

* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

[a] Sn-W ore deposits

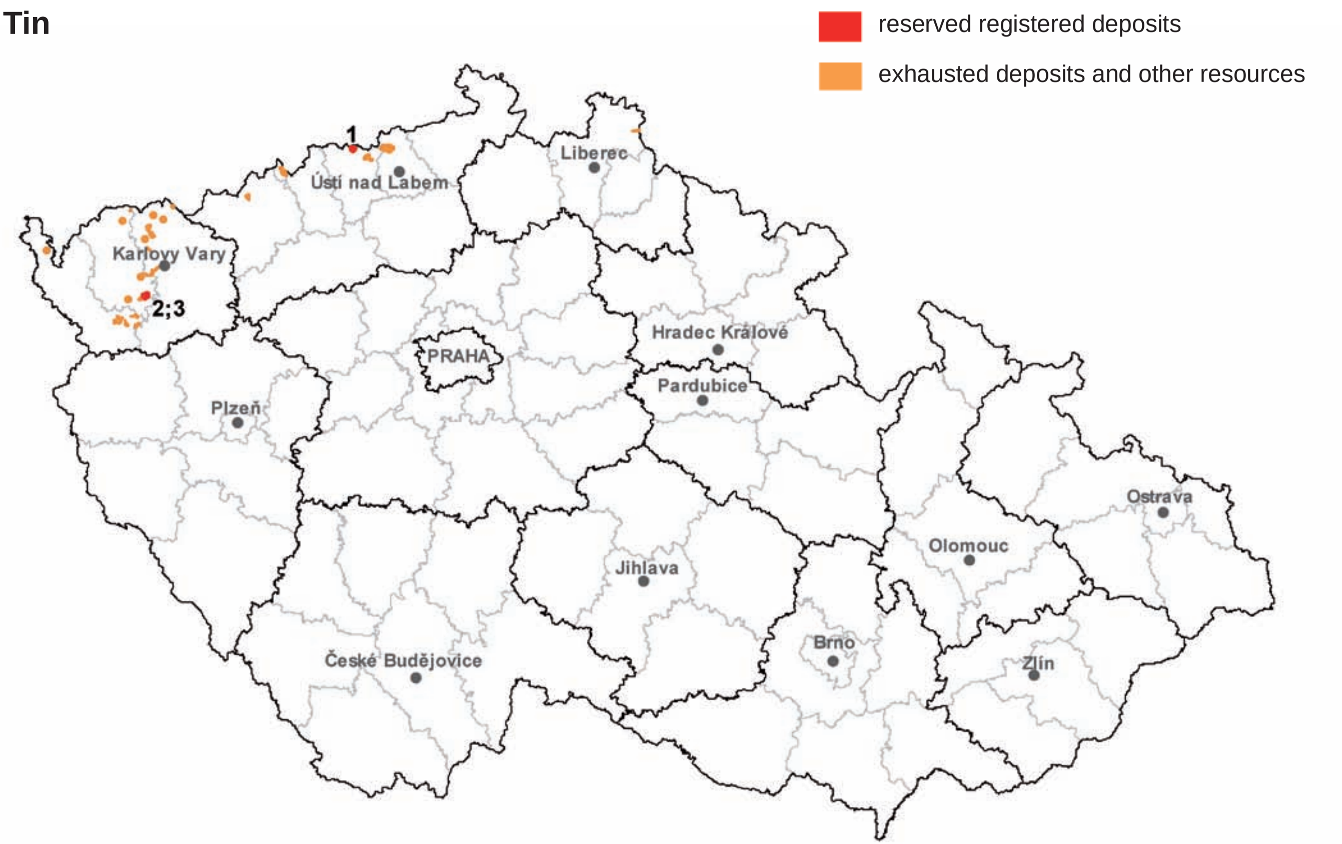
Production of tin intermediate products and tin-bearing alloys

Kovohutě Příbram nástupnická, a. s.

COMAX, spol. s r. o.

Kovohutě Příbram nástupnická a.s. produces tin products and intermediate products, e.g. tin foil, tin plates, pressed tin stripes and pressed tin tubes apart from a number of other products. It produces in addition a big assortment of printing metal of tin, lead and antimony alloy. COMAX, s.r.o. produces among others tin bronzes.

Tin


reserved registered deposits
exhausted deposits and other resources
1
2;3
Liberec
Ústí nad Labem
Karlovy Vary
PRAHA
Hradec Králové
Pardubice
Plzeň
Ostrava
Olomouc
Jihlava
Brno
Zlín
České Budějovice

5. Foreign trade

2609 – Tin ores and concentrates

	2003	2004	2005	2006	2007
Import, t	0	0	1	1	2
Export, t	0	0	0	0	0

8001– Unwrought tin

	2003	2004	2005	2006	2007
Import, t	635	550	634	665	603
Export, t	66	191	242	74	256

Detailed data on unwrought tin imports (t)

Country	2003	2004	2005	2006	2007
China	413	246	235	159	248
Germany	66	155	137	159	141
Peru	0	0	0	0	60
France	7	12	11	3	44
Bolivia	0	0	0	99	25
Indonesia	65	37	145	140	10
Austria	25	3	10	0	1
Thailand	5	80	20	40	0
Malaysia	5	0	20	20	0
Others	49	17	56	45	74

8002 – Tin waste and scrap

	2003	2004	2005	2006	2007
Import, t	37	63	69	75	13
Export, t	25	105	70	249	962

Detailed data on waste and scrap imports (t)

Country	2003	2004	2005	2006	2007
Slovakia	37	63	69	73	12
other	0	0	0	2	1

Detailed data on waste and scrap exports (t)

Country	2003	2004	2005	2006	2007
Belgium	0	47	36	229	125
Germany	15	19	25	18	825
the Netherlands	0	24	0	0	0
Austria	8	5	7	2	2
others	2	10	2	0	10

Unwrought tin import has been rather stable, amounting at roughly 550–650 t per year. Unwrought tin has been imported traditionally from China, Germany and Indonesia, in the recent years also from Bolivia and Peru. An important part of the imported tin was re-exported to third countries in some years. Volume of tin waste and scrap was relatively balanced, however, in 2006 export was three times as high as import and it predominated completely in 2007. Tin waste and scrap has been imported to the Czech Republic almost exclusively from Slovakia, export is directed to western Europe. Foreign trade with the item tin ores and concentrates is negligible.

6. Prices of domestic market and foreign trade

8001– Unwrought tin

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	141 196	194 066	185 732	200 185	292 759
Average export prices (CZK/t)	147 705	193 066	189 772	229 421	265 399

8002 – Tin waste and scrap

	2003	2004	2005	2006	2007
Average import prices (CZK/t)	32 510	115 387	73 018	115 963	104 517
Average export prices (CZK/t)	69 114	141 174	116 025	56 871	12 587

7. Mining companies in the Czech Republic as of December 31, 2007

No mining companies extracted Sn ores on the territory of the Czech Republic in 2007.

8. World production

For a long time the world production of tin concentrates was about 200 kt of Sn metal per year. This level has been significantly overstepped each year since 2000. According to statistical data, the production reached its peak in 2005 – roughly 290 kt. In contrast to decreasing mine production of Brazil, Indonesia and Portugal, production in China, Indonesia and Bolivia has been increasing, whereas that of Brazil and Peru has been stagnating. Yearbook MCS nevertheless substantially corrected its data on the Chinese and Peruvian mine production in 2003. Data according to Mineral Commodity Summaries (MCS) and from Welt Bergbau Daten (WBD):

World lead mine production

Year	2003	2004	2005	2006	2007 e
Mine production, kt Sn (MCS)	207	264	290	273	300
Mine production, kt Sn (WMS)	254	286	301	284	N

Main producers' share in the world mine output (2006; according to MCS):

China	41.4 %	Brazil	4.0 %
Indonesia	29.8 %	Vietnam	1.2 %
Peru	12.6 %	Russia	1.0 %
Bolivia	6.0 %	Malaysia	1.0 %

In the past, tin concentrate production and its export quotas were to a large extent affected by ATPC, the members of which wereIndonesia, Bolivia, Malaysia, Australia, Thailand, Nigeria, Zaire, China and Brazil. ATPC originated one year after the tin world market crisis in autumn 1985. China intervenes in the price evolution significantly recently, influencing the amount of the commodity on world market by means of export licences.

Following companies belonged among 10 most important tin producers in 2007 (according to ITRI – International Tin Research Institute): Yunnan Tin (China), PT Timah (Indonesia), Minsur (Peru), Malaysia Smelting Corp. (Malaysia), EM Vinto (Bolivia), Thaisarco (Thailand), Yunnan Chengfeng (China), Liuzhou China Tin (China), Metallo Chimique (Belgium), Gold Bell Group (China).

World metal production

Year	2003	2004	2005	2006	2007
Smelting production, kt Sn (according to WMS; EIU)	263	308	335	352	337

9. World market prices

Treatment charges (T/C) for three grades of tin concentrates were quoted on the world market in the past: 40–60 % Sn , 60–70 % Sn and 70–75 % Sn in USD/t CIF Europe. Subject to certain adjustments tin mines receive the price for pure tin metal *less* these treatment charges. Pure metal grading 99.85 % Sn (A Grade) Cash has been quoted at London Metal Exchange (LME). The metal was formerly quoted in GBP/t, since 1989 it has been quoted in USD/t. Prices of all non-ferrous metals on the world marked significantly hardened during the year 2004. Tin prices oscillated between 6,200 and 10,200 USD/t, reaching roughly fifteen years´ maxima. The cause of this was again a high demand from the side of rapidly growing Asian economies. Whereas world tin prices decreased from the level of 8,500 USD/t to roughly 6,000 USD/t in 2005, further rise of demand caused a continual price increase as high as the level of 12,000 USD/t. World tin consumption increased to 189 kt only in the first half of the year 2006, which was by 30 kt more than in the preceding year (China has seen a year-by-year consumption increase by 34 %). Price oscillated even between 13,000 and 15,000 USD/t in the first half of the year 2007. The world price increased up to about 17,000 USD/t during the summer months. This record price level was reached also in the end of 2007. The tin prices steeply increased up to 25,000 USD/t in the first half of the year 2008. This was caused by a significant demand increase from the Asian region, the same way as in the case of other non-metallic ores. The world consumption was 120 kt in 2007. The consumption in China increased by 19.5 % whereas the consumption in the USA decrease by full 36 %. Kuala Lumpur Tin Market represents the fundamental platform for the tin marketing and quotations.

Average annual price of metal:

Commodity/Year		2003	2004	2005	2006	2007
99.85 % Sn (LME, A Grade), Cash	USD/t	4 890	8 495	7 370	7 982	13 535

10. Recycling

The last decades have seen a significant increase in the amount of recycled tin. The secondary production of the metal gained by recycling reached about 40,000 tonnes in 2004. Rate of recycling of tinplate scrap oscillates in developed countries between 50 and 75 %; the share of recycled metal in total consumption of the commodity is however considerably lower.

11. Possible substitutes

Aluminium, glass, stainless steel, paper and plastic foils are the major substitutes for tin in the food industry. Multicomponent epoxy resins are more and more used instead of solders. Tin alloys are replaced by Cu and Al alloys or by plastics. Pb and Na compounds replace some Sn chemicals.

Tungsten

1. Characteristics and use

Higher concentrations of tungsten are nearly always associated to granites. Primary tungsten ores are confined the most often to pegmatite and greisen deposits genetically associated with wolframite in acid granitoid intrusions and with scheelite in skarn deposits. Tungsten ores often occur together with Sn, Mo, Cu, Au and Bi ores. Among the known tungsten minerals, only wolframite (having as much as 76.5 % WO_3) and scheelite (up to 80.5 % WO_3) are of economic importance. Wolframite contains besides Fe and Mn also some minor or trace concentrations of Nb and Ta. Tungsten placers occur in close vicinity of primary ores. World reserves of tungsten ores are estimated at more than 6 mill tonnes of metal (according to MCS 2008), more than 66 % of which occur in China.

Tungsten ores and concentrates are processed to obtain intermediate products – ammonium paratungstate (APT), tungstic acid, sodium tungstate, metal powder and powder tungsten carbide. Much tungsten is consumed in steel alloying used in heavy engineering, particularly in the armaments industry, and in the manufacture of metal-cutting tools and tools for oil and gas drilling and for mining of solid minerals (drilling bits made of tungsten carbide). About 80 % W is consumed in the aforementioned fields. Some tungsten-based alloys are used in electricity and electronics.

2. Mineral resources of the Czech Republic

Wolframite concentrate was obtained as a by-product during the mining and processing of vein and greisen Sn-W ores of the Cínovec (where also an important Li mineralization – zinwaldite – occurred) and Krásno mining districts of the Czech Republic. Besides that, numerous occurrences of scheelite and wolframite mineralization were found and verified in various places of the Bohemian Massif, particularly during the last few years. Tungsten ores mining was terminated along with the Sn ores in 1990 at Cínovec deposit and a year later at deposit Krásno. Some small occurrences in the Moldanubicum were mined out during the exploration in the end of 1980s and beginning of 1990s (Malý Bor-Vrbík, Nekvasovy-Chlumy).

- Quartz veins and greisens mainly rich in Sn (Krásno, Cínovec), less frequently rich in W (Krupka 4) occur in the Krušné hory Mts. region. Greisen ores have usually contents ranging between 0.02 and 0.07 % W. Only ores of the former deposit Krupka 4 showed up to 0.1–0.2 % W. A tungsten mineralization is known from quartz veins and stockworks at Rotava and disseminated scheelite in calc-silicate rocks (erlans – Ca-pyroxenic gneisses) of Vykmanov near Perštejn.
- A typical contact metasomatic scheelite mineralization occurs in the exocontact of the Krkonoše Mts.–Jizerské hory and Žulová plutons. However, known localities of Obří důl and Vápenná are of no economic importance.
- A number of mainly small new localities of the W-ores was found in the Moldanubicum. They are represented by both quartz veins with wolframite eventually scheelite which mostly occur along the exocontacts of the Variscan granitoids and disseminated or vein scheelite in calc-silicate rocks (erlans – Ca-pyroxenic gneisses). Some bodies represent bigger stratabound deposits of scheelite-bearing crystalline schist or skarn type. So far the most important stratabound deposit of Au-W ores is located at Kašperské Hory. Dis-

seminated and banded scheelite occurs there in silicified layers underlying gold-bearing quartz veins. The average W content of the ore is as high as 1.32 %. Even though all reserves are subeconomic due to conflicts of interests with nature protection, the Kašperské Hory deposit nowadays represents the only economically exploitable deposit of W ores in the Czech Republic. As a complex Au-W deposit it is large and important even from European viewpoint.

- Introduction of more sophisticated exploration methods allowed discovering numerous localities of W ores in the Czech Republic, mostly of enigmatic origin. In contrast to former ideas about the common occurrence of Sn-W ores, it was proved that wolframite or scheelite ores occur mostly as separate mineralizations, and only a minor part belongs to combined Sn-W assemblages.

After the Sn-W ores mining was terminated in 1991, the remaining reserves have been revaluated and gradually eliminated from The Register. This concerned also 8 small deposits in the Moldanubicum, which were revaluated and eliminated from The Register in 2006.

3. Registered deposits and other resources in the Czech Republic

(see map)

Registered deposits and other resources are not mined

1 Cínovec-jih
2 Kašperské Hory
3 Krásno-Horní Slavkov
4 Krásno-Horní Slavkov

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number [a)]	13	12	12	4	4
exploited	0	0	0	0	0
Total mineral *reserves, t W	73 611	72 740	72 740	70 253	70 253
economic explored reserves	0	0	0	0	0
economic prospected reserves	2 623	1 752	1 752	0	0
potentially economic reserves	70 988	70 988	70 988	70 253	70 253
Mine production, t W	0	0	0	0	0

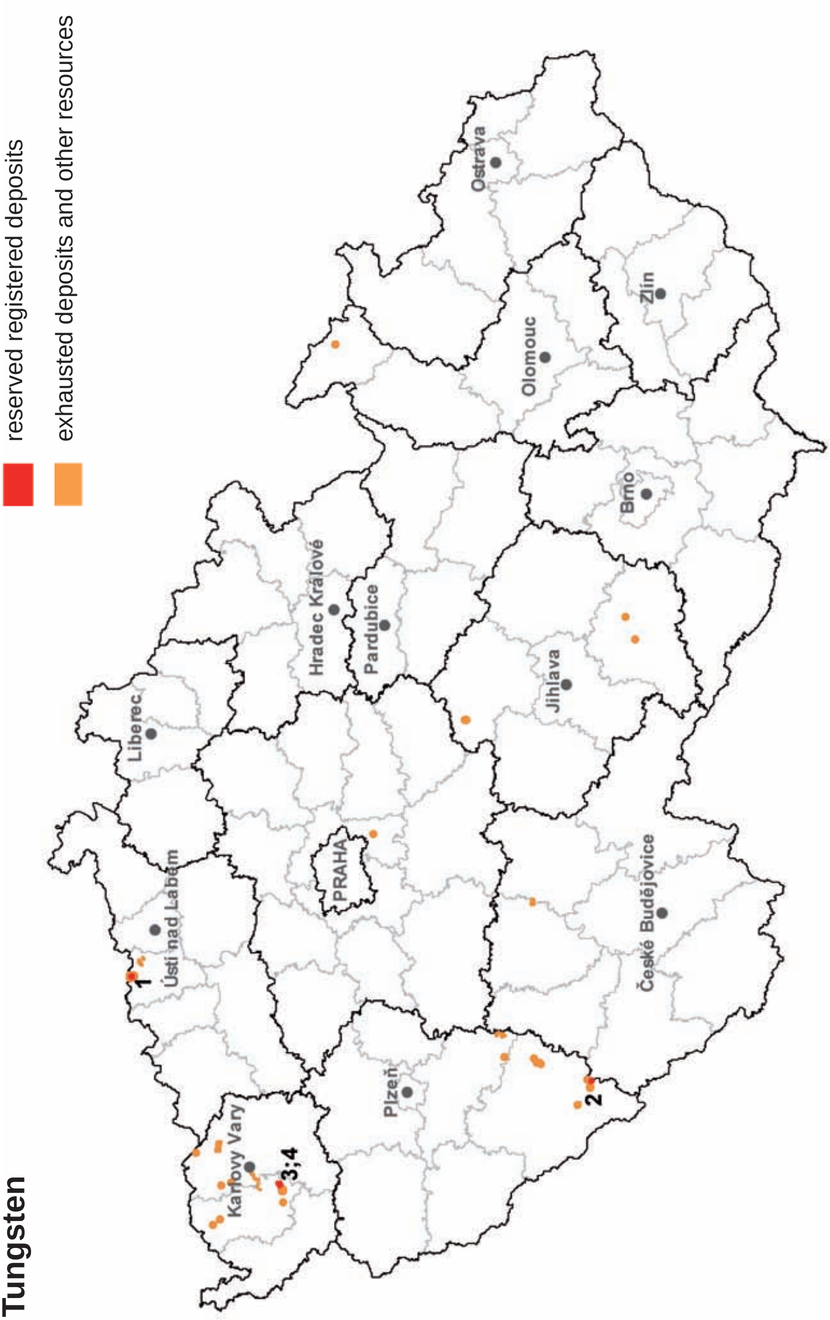
* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

a) Sn-W and W ore deposits

Production of tungsten intermediate products

OSRAM Bruntál spol. s r.o.

Tungsten


reserved registered deposits
exhausted deposits and other resources
Ostrava
Zlín
Olomouc
Brno
Hradec Králové
Pardubice
Liberec
Jihlava
Ústí nad Labem
PRAHA
České Budějovice
Plzeň
Karlovy Vary
1
2
3;4

OSRAM Bruntál s.r.o. produces tungsten powder and powder tungsten carbide, which is used as an intermediate product in the production of instruments of sintered carbides. The company was founded by the transformation of the former Hydrometalurgické závody a.s. (HMZ). New owner of the HMZ Company since October 2000 is the German company OSRAM GmbH, which is a subsidiary of the German concern Siemens A.G. The enterprise in Bruntál became this way the European basis for tungsten and tungsten-carbide powders, fine wires and coils.

5. Foreign trade

2611 – Tungsten ores and concentrates

	2003	2004	2005	2006	2007
Import, t	1	0	2	0	0
Export, t	0	0	0	0	1

8101– Tungsten and its products, including waste and scrap

	2003	2004	2005	2006	2007
Import, t	73	116	175	199	840
Export, t	108	131	179	157	105

720280 – Ferro-tungsten and ferrosilicotungsten

	2003	2004	2005	2006	2007
Import, t	52	56	44	34	32
Export, t	2	8	136	0	2

Detailed data on ferro-tungsten and ferrosilicotungsten imports (kt)

Country	2003	2004	2005	2006	2007
China	52	50	30	28	17
Germany	0	3	4	2	0
Slovakia	0	0	6	0	1
Poland	0	0	3	1	9
others	0	3	1	2	5

6. Prices of domestic market and foreign trade

Tungsten ore and concentrates import from the Netherlands or Germany is negligible. Crude tungsten (including waste and scrap), the import of which increased three times between 2002 and 2006, represents the largest volume. The year 2007 has seen another steep import increase. Tungsten wires, to a lesser extent tungsten powder, make predominant part of the import. Crude tungsten and its intermediate products are imported mainly from Germany, the USA, Spain and China, export goes back to Germany or to Great Britain and Poland. 20-60 tonnes per year of ferro-tungsten and ferro-silico tungsten is imported on a long term. Ferro-alloys are imported mainly from China and Slovakia, recently also from Germany and Poland. Unusual export was directed to the Netherlands in 2005.

810196 – Tungsten wires

	2003	2004	2005	2006	2007
Average import prices (CZK/kg)	3 024	2 557	2 824	1 838	285
Average export prices (CZK/kg)	12 813	10 458	5 053	5 455	5 910

720280 – Ferro-tungsten and ferrosilicotungsten

	2003	2004	2005	2006	2007
Average import prices (CZK/kg)	150	212	441	564	557

Customs tariff item 8101 tungsten and its products, including waste and scrap, covers such variety of goods, that it makes no sense to give import prices of the item as a whole. Only prices of sub-item 810196 tungsten wires are therefore presented. Big difference between import and export prices is given among others by substantially lower volume of export of this sub-item compared to its import. Markedly lower import prices in 2007 are caused by a large amount of the delivered commodity of a lower quality. Average import prices of ferro-tungsten and ferrosilicotungsten document increase of tungsten world prices of the last years.

7. Mining companies in the Czech Republic as of December 31, 2007

No mining companies were extracting W ores on territory of the Czech Republic in 2007.

8. World production

World production of tungsten metal in ores and concentrates exceeded 40 kt in 1970 and reached its peak – 52 kt at the end of 1980s. The subsequent drop in prices was related to restriction of demand on the world market resulting from the economic recession and from structural changes in major consumer branches. The world production has been again slowly increasing since 2000. China is the dominant world producer, and also has the greatest potential for increasing its mine output. The data on the world mining production in individual yearbooks partly differ from each other: According to Mineral Commodity Summaries (MCS), the world production is higher and it has increased significantly in the last four years. The Welt Bergbau Daten places Canada with a share of almost 4 % on the second place after China.

World tungsten metal mine production

Year	2003	2004	2005	2006	2007 e
Mine production, t W (MCS)	62 100	73 700	70 100	90 800	89 600
Mine production, t W (WBD)	49 043	56 720	56 340	65 099	N

Main producers' share in the world mine output (2006; according to MCS):

China	87.0 %	Bolivia	1.0 %
Russia	4.4 %	Portugal	0.9 %
Austria	2.8 %	Korea, D.P.R. of	0.7 %
Portugal	1.4 %		

9. World market prices

Among all W raw materials traded on the world market (ores, concentrates, oxides, hydroxides, tungstates, FeW, tungsten carbide and raw metal), the ores and concentrates represented traditionally the major share of the trade. The price of wolframite – standard, grading min. 65 % WO_3 – on the world market has been quoted in USD/mtu WO_3, CIF Europe. Final price of 1 t of the ore is a multiple of the unit price in mtu and the metal content in the relevant ore. Quotation of scheelite was abandoned in 1992 due to small extent of trade. Quoted price now includes both types of ore. The local maximum of the average wolframite price peak was reached in 1977 – USD 180 per mtu WO_3. The subsequent drop in price was caused by global economic recession and particularly by a surplus of cheap Chinese wolframite, import of which was restricted in some countries, which imposed high antidumping import taxes. Wolframite prices increased again from 42–50 USD/mtu up to 62–64 USD/mtu in the beginning and end of the year 2004, respectively. Prices continued to rise up to the limit of 100 USD/t in 2005 and very high prices were reached in 2006, too. Prices remained high in 2007 as well, when they oscillated around USD 160/mtu.

As other W raw materials concerns, an intermediate product ammonium paratungstate (APT) powder – quoted on the European free market in USD/mtu W – has been achieving more and more significant position. Dramatic price rise can be followed during the last two years. Majority of trading has been based on ATP. The average annual prices of the ore and the average price of the APT at year-end were as follows:

Average annual prices of the tungsten ore and the average price of the APT at year-end

Commodity/year		2003	2004	2005	2006	2007
Ore, grading min. 65 % WO_3, CIF Europe	USD/mtu WO_3	45	55	123	166	165
Ammonium paratungstate (APT) powder, European free market	USD/mtu W	64	92	262	245	255

10. Recycling

Recycling of W (especially alloys containing tungsten) is carried out only in Japan, the USA and Western Europe. According to incomplete data, recycling roughly accounts for 30 % of the total metal production.

11. Possible substitutes

The metal remains irreplaceable in the steel-making industry as an alloying additive, in the manufacture of armament, cutting and drilling tools and electricity and electronics uses. Some attempts were made during the period of the tungsten price rise to replace W by molybdenum in armoured tank ammunitions or even by depleted uranium showing large surplus worldwide. Replacement of W by ceramic materials is reasonable in some fields and replacement of W by Mo in automobile industry is more than equivalent. Sintered tungsten carbide used in the manufacture of cutting and drilling tools can be partly replaced by carbides of other metals or by nitrides and oxides and/or new composite materials or synthetic diamond, particularly in less exposed fields and where the price of tungsten and tungsten carbide plays a decisive role.

Silver

1. Characteristics and use

Silver is an element of chalcophile character, which during the magmatic differentiation tends to concentrate in minerals of late stages or hydrothermal fluids. About 2/3 of the silver world reserves occur in polymetalic (Cu and Pb-Zn) deposits of various origin. The major silver-bearing mineral is Ag-bearing galena, the other ones are mainly sulphides and sulphosalts of Ag, such as e.g. argentite, proustite, kerargyrite, polybasite, pyrargyrite, stromeyerite and tetrahedrite (freibergite). Silver fineness is expressed in thousandths of total alloy; sterling silver, its commonest alloy, contains 92.5 % silver (fineness of 925/1,000). World reserves of silver metal in various deposit types are estimated at 5702 kt of metal (according to MCS 2008).

Although the amount of silver used in photographic industry decreases due to development of digital photograph, its consumption does not decrease substantially. This metal finds a new usage in many industrial and consumer branches like electrotechnics and electronics, colour printing, deodorant production, health care etc. Silver is also used in water purification, battery production, production of glasses and special reflecting surfaces (solar energy acquisition), catalyser production and in nuclear power generation for control rods manufacture for water reactors (an alloy consisting of 80 % Ag, 15 % In and 5 % Cd).

2. Mineral resources of the Czech Republic

Mining for silver played a decisive role in medieval ore mining in Bohemia and in the prosperity of old mining towns.

- The major portion of silver resources in the Czech Republic occurs in polymetalic (Pb-Zn and Cu) deposits, where it forms an isomorphous admixture particularly in galena. Some Ag was extracted as a byproduct when mining high-grade polymetalic ores (58–70 ppm Ag) and U-Ag ores (high grade Ag ores with native silver and Ag minerals exhibiting around 480 ppm Ag) of the Příbram uranium-polymetalic deposit, until the mining operations were reduced and ceased completely in the early nineties. Polymetalic ores of the Horní Benešov and Horní Město deposits contained obtainable amount of Ag, too. The 50 % lead concentrate showed average Ag content of 846 g/t, the 49 % zinc concentrate contained 86.6 g/t Ag on average in 1963–1992. Deposit Zlaté Hory-východ was the one containing silver in polymetalic ores in the Zlaté Hory district. The Pb-Zn concentrate produced from the ores of this deposit in 1988–1992 displayed average Ag content of 0.19 g/t.
- Numerous recently abandoned deposits of Pb-Zn-Ag and deposits of so-called five element assemblage (U-Bi-Co-Ni-Ag) in medieval mining districts of Kutná Hora, Jihlava, Příbram, Jáchymov, Stříbro, Rudolfov, Havlíčkův Brod, Stará Vožice etc. were an important source of European silver in the past. The deposits represent classic deposit types.

Silver reserves have been gradually eliminated from The Register in connection with the revaluation of polymetalic ores.

3. Registered deposits and other resources in the Czech Republic

(see map)

Registered deposits and other resources are not mined

Reserved registered deposits:

1 Horní Benešov
2 Horní Město
3 Horní Město-Šibenice
4 Kutná Hora
5 Oskava
6 Ruda u Rýmařova-sever
7 Zlaté Hory-východ

Exhausted deposits and other resources:

8 Příbram surroundings
9 Jáchymov surroundings
10 Havlíčkův Brod surroundings
11 Jihlava surroundings
12 Ratibořské hory + Stará Vožice
13 Rudolfov
14 Stříbro
15 Hrob + Mikulov
16 Nalžovské hory
17 Vejprty + Hora sv. Kateřiny

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number [a)]	9	8	8	8	7
exploited	0	0	0	0	0
Total mineral *reserves, t Ag	533	533	533	533	532
economic explored reserves	0	0	0	0	0
economic prospected reserves	0	0	0	0	0
potentially economic reserves	533	533	533	533	532
Mine production, t Ag	0	0	0	0	0

* See **_NOTE_** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

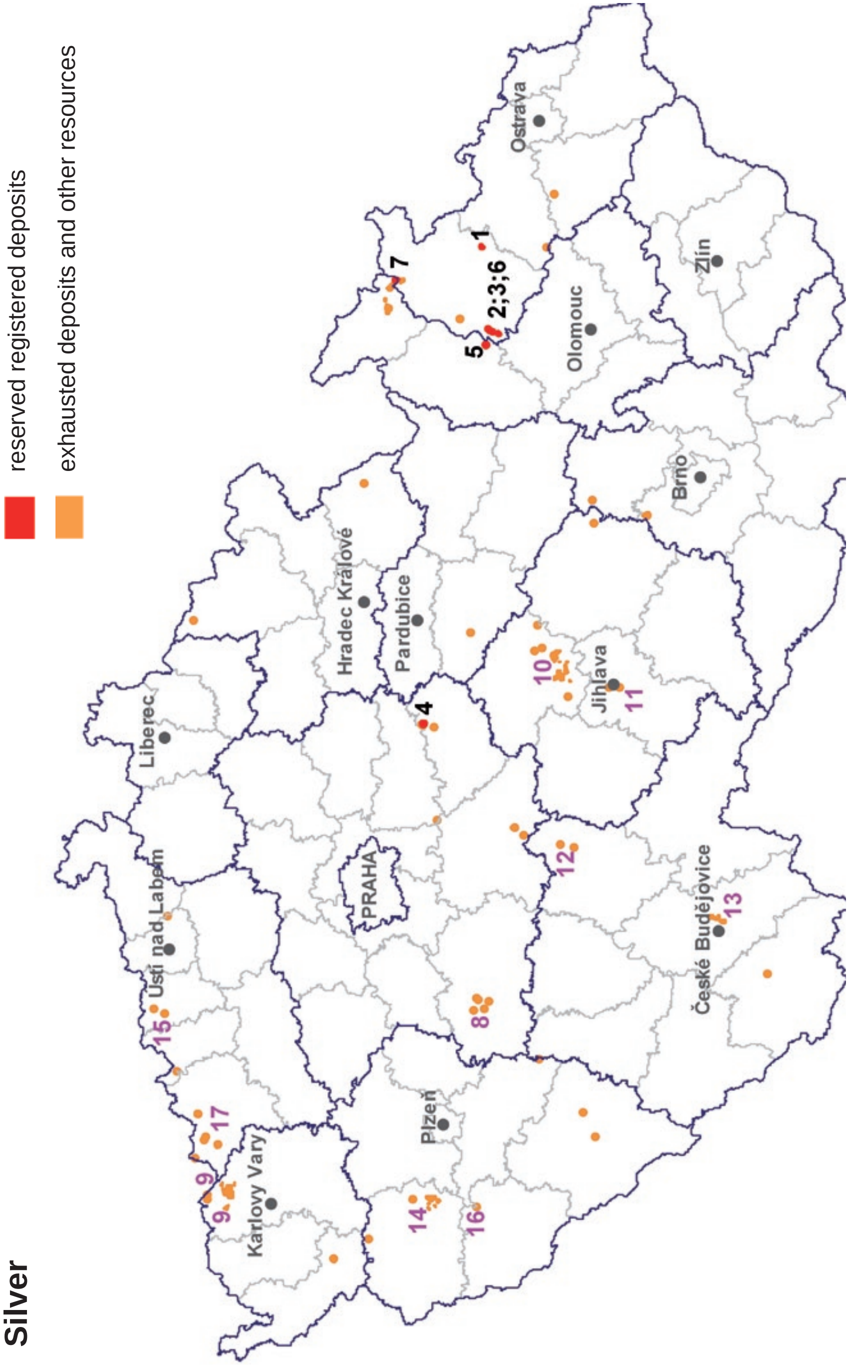
a) Deposits with registered Ag content

Refining and processing of precious metals

SAFINA, a.s.

SAFINA, a.s. is engaged in refining of precious metals [up to 3N (99.9 %) – 4N5 (99.995 %) purity], with production of intermediate products and products of precious metals, production of alloys of precious metals for jewellery and dentistry, production of chemicals containing precious metals, bulk buying and refining of waste containing precious metals and recycling of electric waste.

Silver



reserved registered deposits
exhausted deposits and other resources
Ostrava
Olomouc
Zlín
Brno
Hradec Králové
Pardubice
Jihlava
Liberec
Ústí nad Labem
PRAHA
Karlovy Vary
Plzeň
České Budějovice
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2;3;6
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5. Foreign trade

261610 – Silver ores and concentrates

	2003	2004	2005	2006	2007
Import, kg	115	38	0	0	0
Export, kg	2	5	1	0	2

7106 – Silver, unwrought or in semi-manufactured or powder form

	2003	2004	2005	2006	2007
Import, kg	238 752	257 623	103 373	N	N
Export, kg	171 398	285 526	N	N	N

6. Prices of domestic market and foreign trade

Since data of the Czech Statistical Institute (ČSÚ) are not reliable, neither these data nor import and export prices have been reported since 2005. Foreign trade with silver ores and concentrates was negligible.

7. Mining companies in the Czech Republic as of December 31, 2007

No mining companies were extracting Ag ores on the territory of the Czech Republic in 2007.

8. World production

The world production exceeded 10 kt per year in 1976. Since then it was increasing and reached its peak in 1989 – 15.8 kt. Mining production was gradually decreasing and reached 13.8 kt (1994). Since 1996, the world production of silver has been increasing again and it oscillated between 18.5 and 20 kt in the last five years. The high mine production was one of the causes of low silver prices in 1998–2003. Mine production of silver increased the most in China and Peru during the last five years. Mine production of Mexico and Australia increased significantly, too. Mine production in Chile, Canada and Kazakhstan has not shown big variations. In contrast, mine production of the USA and Poland decreased. In 2006, mainly mine production of Peru and Chile increased; on the contrary, Australian mine production decreased back to the level of 1999. Data on silver production according to Mineral Commodity Summaries (MCS), Silver Institute (SI) and the yearbook Estadísticas del Cobre y otros Minerales published by Comisión Chilena del Cobre (COCHILCO):

World silver mine production

Year	2003	2004	2005	2006	2007 e
Mine production, t Ag (MCS)	18 800	19 700	19 300	19 500	20 500
Mine production, t Ag (COCHILCO)	18 475	18 730	19 258	18 898	19 694
Mine production, t Ag (SI)	18 684	19 352	20 083	20 096	20 858

Main producers´ share in the world mine output (2006; according to COCHILCO):

Peru	17.7 %	Poland	6.6 %
Mexico	15.7 %	USA	5.7 %
China	10.2 %	Canada	4.4 %
Chile	9.8 %	Kazakhstan	4.2 %
Australia	9.5 %	Bolivia	2.7 %

According to the Silver Institute (SI), only 25 % of silver came from the mine production and processing of silver ores in 2007. Majority of silver was a by-product of dressing of lead-zinc (35 %), copper (25 %) and gold-bearing (15 %) ores. Extracted silver covered about 60 % of consumption. Jewellery represents an important consumer of silver.

Following companies belonged to ten most important silver world producers in 2007: BHP Billiton (Australia), Industrias Peñoles (Mexico), KGHM Polska Miedź (Poland), Cia. Minera Volcan (Peru), Kazakhmys (Kazakhstan), Pan American Silver (Canada), Goldcorp (Canada), Cia. de Minas Buenaventura (Peru), Southern Copper Corporation (USA). Following localities ranked among 10 most productive world silver deposits in 2007: Cannington (Australia), Fresnillo (Mexico), Dukat (Russia), Uchucchacua (Peru), Greens Creek (the USA), Arcata (Peru), Imiter (Morocco), Rochester (the USA), Tayahua (Mexico) and La Colarada (Mexico).

9. World market prices

Only price of pure metal 99.9 % Ag is quoted on the world market. It is quoted in GBp or USc/troy oz. The highest price since 1880 (London Brokers' Official Yearly Average Prices) was recorded in 1980 – GBp 905.2 per troy oz (speculative buying into the USA by the Hunt family). World price of silver reached an important maximum exceeding 9 dollars in spring 1987. Silver prices than oscillated basically between USD 4 and 6 per troy oz. Local maximum from February 1998, when the price temporarily increased to USD 7.8 per troy oz, represented the only exception. Qualitative change did not arrive until during the year 2004, when the prices were between 5.5 and 8.5 USD/troy oz. The price almost reached the level of 9 USD/troy oz by the end of the year 2005. Price rise continued also in the first half of 2006, when the prices reached the limit of 15 USD/troy oz. The prices oscillated between 10 and 14 USD/troy oz in the second half of 2006 and between 12 and 14.5 USD/troy oz in the first half of 2007. The price started to increase systematically up to the level of 16 USD/troy oz since September 2007. During the first quarter of 2008, the price continued to rise up to the record values of 21 USD/troy oz (March 2008). High demand from the side of rapidly developing economies of the third world, significantly exceeding supply, caused the price rise. Price fluctuations of silver on the world marked reflect among others political situation and speculations, similarly to the other precious metals. An average annual price trend in USD/troy oz is given in a summary as follows:

Handy & Harman silver price, yearly average

Commodity/Year		2003	2004	2005	2006	2007
Silver, Handy & Harman	USD/t oz	4.88	6.66	7.31	11.55	13.38

10. Recycling

Recycling of silver, which is technologically a very simple operation, dramatically dropped in the early nineties to about one half of Ag recycled during the same period of the eighties. The drop in recycling was attributed to low prices of silver, its lower content in secondary raw materials and restrictive measures in government stockpile policy and changes in the photographic industry (switch to digital cameras etc.). Share of the recycled silver in the offer of the world market was estimated at 20 % in 2004.

11. Possible substitutes

Silver is efficiently replaced in numerous fields. Photo materials are produced with lower content of silver or without silver at all. Photograph continues to be largely replaced by xerography and electronic displays. Digital photograph has marked a violent rise especially during recent years. Aluminium and rhodium substitute for silver in the manufacture of special mirrors and other reflecting surface coatings, tantalum and special steels are now used in surgical tools and artificial joints. Silver is being also replaced in batteries and ceramic materials replace dental alloys. Sterling silver was, except memorial mints and several exceptions (e.g. Mexico put again in circulation silver coins in 1992), replaced by common metals, particularly by Cu alloys.

Gold

1. Characteristics and use

Primary gold deposits can be divided into three large groups according to their origin: volcano-hydrothermal, plutonic-hydrothermal and metamorphic. Secondary deposits – recent and fossil placers – resulted from physical weathering processes. Gold occurs in the form of native metal, in a natural alloy with silver (electrum) or other metals or in some cases in the form of tellurides and selenides too. It occurs in sulphides of antimony, arsenic, copper, iron and silver. During their processing and smelting, gold is recovered as a byproduct. The grade or fineness of gold is given in carats or in 1,000 units (fine gold 24 carats = 1,000, 10 carats = 10/24 = 41.7 % = 417/1,000). Total economic world reserves are estimated at about 90 kt of Au (MCS 2008). 15 % to 20 % of this amount occurs as a minor constituent in ores of other metals (first of all Cu). More than 40 % of the world reserves is located on the territory of South Africa, even though the share of this present largest gold producer in the world gold mining has been decreasing in the reent years.

The major use of gold worldwide has been in jewellery (80 %) and as a hoarded metal. It is further used in electrotechnical industry, in medal and coin stamping, in dentistry, in producing special alloys for the aircraft (especially military) industry, in infrared reflectors etc.

2. Mineral resources of the Czech Republic

The tradition of mining for primary and secondary gold in the Bohemian Massif dates back almost three millennia. Bohemia used to be one of the most important producers of gold in Europe in the Middle Ages.

- The major part of gold mineralization is associated with regionally metamorphosed volcanosedimentary complexes locally penetrated by Variscan granitoids. Such a complex in the central Bohemian region is represented by the Jílové zone of the Proterozoic age, with abundant gold-quartz mineralization (deposits of Jílové, Mokrsko, Čelina and some others). Gold mineralization in the Jeseníky Mountains area is confined to stratabound base metal deposits related to Devonian volcanism (Zlaté Hory-západ). Gold ores mining was terminated in 1994 by closure of the Zlaté Hory-západ deposit. 1,524 kg Au was mined at this deposit in 1990–1994. Mokrsko deposit represents an explored deposit containing substantial Au reserves – 98 t Au in ores exploitable by open pit mining with average content of economic disposable reserves of 1.9 g/t Au and further more than 20 t Au exploitable by underground mining. Other 12.5 t of Au reserves exploitable by underground mining of Au with 1.6 g Au/t has been registered in a near-by deposit Prostřední Lhota-Čelina. There is therefore more than 131 t Au in whole Psí hory district (Čelina, Mokrsko). Vacíkov deposit SW of Příbram, were more than 33 t Au in ores containing 1.1 g Au/t, exploitable by open-pits, is similar.
- Some hydrothermal quartz veins with gold as well as stratabound gold mineralization with scheelite (Kašperské Hory) and quartz veins and stockworks with Ag (Roudný) occur in the crystalline complex of the Moldanubicum. Deposit Kašperské Hory, where the exploration was not completed, contains 189 t Au (officially 55 t of average content 4.7 g Au/t of ore) in potentially economic reserves of average content of 3.44 g/t of ore.
- Placer gold deposits are spatially and genetically linked to the primary gold deposits. Permo-Carboniferous paleoplacers occur in western Bohemia (Křivce) as well as in the

Krkonoše Mts. Piedmont and in the Intra-Sudetic basins. The largest areas of Quaternary placers are located in the foothills of the Šumava Mountains and in northern Moravia and Silesia. Still recognizable remnants of placer gold panning indicate extensive mining for gold, which goes back to Celtic times.

No gold mining is currently taking place in the Czech Republic, following the end of mining operations at the Krásná Hora Au-Sb deposit in 1992 and at the Zlaté Hory-západ base metal deposit in 1994. Unsolved conflicts of interests with nature protection and from the world aspect an unusual prohibition of the cyanide process in mining in the Czech Republic block the use of the explored Au reserves at Mokrsko and Kašperské Hory deposits.

3. Registered deposits and other resources in the Czech Republic

(see map)

Registered deposits and other resources are not mined

1 Břevenec
2 Jílové u Prahy
3 Kašperské Hory
4 Mikulovice u Jeseníka
5 Modlešovice
6 Mokrsko
7 Mokrsko-východ
8 Podmoky
9 Prostřední Lhota-Čelina
10 Sepekov
11 Suchá Rudná-střed
12 Vacíkov
13 Voltýřov
14 Zlaté Hory-východ
15 Zlaté Hory-Zlatý potok

4. Basic statistical data of the Czech Republic as of December 31

Number of deposits; reserves; mine production

Year	2003	2004	2005	2006	2007
Deposits – total number	23	20	20	19	15
exploited	0	0	0	0	0
Total mineral *reserves, kg Au	242 624	240 677	240 677	239 518	238 890
economic explored reserves	48 740	48 740	48 740	48 740	48 740
economic prospected reserves	36 467	35 777	35 777	34 618	28 644
potentially economic reserves	157 417	156 160	156 160	156 160	161 516
Mine production, kg Au	0	0	0	0	0

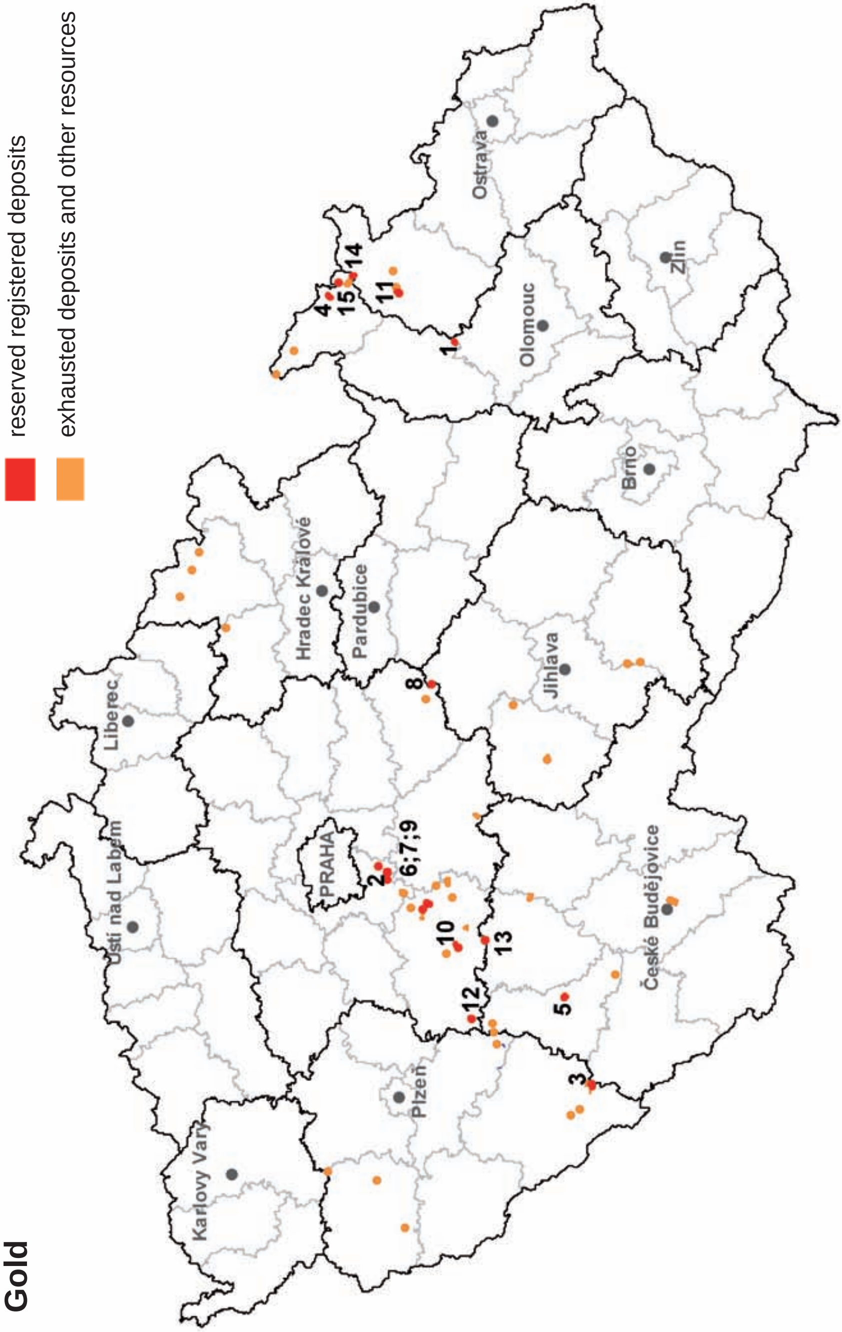
* See ***NOTE*** in the chapter ***Introduction*** above on a terminological difference between Czech official application of the term reserves and standard international application of the term. The relationship of domestic and foreign classifications of mineral reserves and resources is described in the separate chapter ***Mineral reserve and resource classification in the Czech Republic*** of this yearbook

5. Foreign trade

7108 – Gold in unwrought or semi-manufactured form, gold powder

	2003	2004	2005	2006	2007
Import, kg	1 599	1 624	N	N	1 929
Export, kg	5 182	5 831	5 715	4 722	4 631

Gold


reserved registered deposits
exhausted deposits and other resources
Ostrava
Zlín
Olomouc
Brno
Jihlava
Hradec Králové
Pardubice
Liberec
Ústí nad Labem
PRAHA
České Budějovice
Plzeň
Karlovy Vary
1
2
3
4
5
6;7;9
8
10
11
12
13
14
15

Detailed data on gold imports (kg)

Country	2003	2004	2005	2006	2007
Germany	4 375	4 542	4 561	276	308
Switzerland	321	10	785	4 076	3 861
Slovakia	245	190	233	155	208
others	241	1 089	136	215	254

About 1.2–2.2 tonnes of gold per year were traditionally imported in the Czech Republic. Data of the Czech Statistical Institute on gold imports in 2005 and 2006 are not reliable. Gold has been imported mainly from Germany, Austria, Switzerland and Italy. About 4–6 t per year has been exported traditionally to Germany; since 2006, majority goes to Switzerland.Gold-bearing ores are not imported in the Czech Republic.

6. Prices of domestic market and foreign trade

Customs tariff item 7108 include so variable products and intermediate products, that it would be misleading to give average import or export prices.

7. Mining companies in the Czech Republic as of December 31, 2007

No mining companies were extracting Au ores on the territory of the Czech Republic in 2007.

8. World production

World production of gold, following a slight decrease in the early seventies, continued to rise steadily and reached its peak so far in 2001–2003 (about 2,500 to 2,600 t in metal content). According to the statistics of the Gold Survey yearbook, published by renowned company GFMS Limited, world consumption of gold was 3,851 t in 2005. Roughly 64 % of this amount came from the primary metal production and about 22 % was recovered; the remaining came from central banks selling and private disinvestment a stažení soukromých investic. Based on the information from Peter Hambro Mining Company, average world expense on Au production from deposits reach 224 USD/t oz, whereas average expenses on production from deposits in Russia represent only 166 USD/t oz (MBM, Febr. 2004, p. 12). Data on bulk production of Au from mined ores slightly differ depending on the source (according to Mineral Commodity Summaries-MCS and the Welt Bergbau Daten-WBD):

World gold mine production

Year	2003	2004	2005	2006	2007 e
Mine production, t Au (MCS)	2 590	2 430	2 470	2 500	2 500
Mine production, t Au (WBD)	2 528	2 409	2 452	2 353	N

Main producers' share in the world mine output (2006; according to MCS):

South Africa	11.1 %	Peru	8.3 %
the USA	10.2 %	Indonesia	6.7 %
China	10.4 %	Russia	6.5 %
Australia	10.0 %	Canada	4.2 %

The first three countries produce roughly one third of the world production. More than 60 % of world reserves are concentrated on their territories.

According to The Gold Institute, following mines belonged to those with the highest gold mine production in the last years: Grasberg (Indonesia), Yanacocha (Peru), Muruntau (Uzbekistan), Betze Post (USA), Driefontein (South Africa), Twin Creeks (USA), Carlin (USA), Kloof (South Africa), Cortez (USA), Great Noligwa (South Africa), Porgera (Papua New Guinea), Randfontein (South Africa), Pierina (Peru), Meikle (USA), Kalgoorlie Consolidated Gold Mines Pty. Ltd. (Australia), Kumtor (Kyrgizstan), Obuasi (Ghana), Round Mountain (USA), Sadiola (Mali) and Lihir (Papua New Guinea).

Barrick (production in 2006: 268.8 t), Newmont (184.9 t), AngloGold Ashanti (175.3 t), Gold Fields (126.3 t), Harmony (72.9 t), Navoi Metals & Mining (58.2), Freeport McMoran (53.9 t), Gold Corp. (52.7 t), China Nacional Gold Group (49.3 t) and Fujian Zijin Mining (49.3 t) belong to ten most important mining companies (according to USGS).

9. World market prices

As for prices, gold represents a special metal. Its price is affected by many factors, among which speculative trade and global political climate are the most important. Consequently, the major world gold market centres quote gold prices twice a day (morning and afternoon fixing) in USD/troy oz. The price development is observed in actual and real prices using deflator of USD. The highest yearly average price during the last 25 years was reached in 1980 – USD 614.63 per troy oz (actual price). This highest price was due to the global political situation, which reflected the revolution in Iran, the Soviet invasion of Afghanistan, the petroleum shock, high inflation and the onset of the Iraqi–Iranian war. The average annual prices were below USD 400 per troy oz in London in the last 5 years (average p.m. fixing) and fell under USD 300 per troy oz in the end of 1997. Prices of gold hit twenty-years´ minimum in 1999. Low gold prices (along with the attempt of banks to diversify their portfolios) represented one of the reasons why a number of the National Banks began to sell parts of gold reserves, which resulted in further price decrease. No significant price changes followed in 2000. Agreement among the most important national banks about co-ordination and limitation of gold sale of their reserves caused only a short-term price increase. Gold prices remained on a very low level major part of the year. The low prices were characteristic also for 2001, when the metal prices were oscillating between 255 and 295 USD/troy oz. This trend changed during 2002, when the price of gold started to increase from about 280 USD/troy oz up to 350 USD/troy oz in the end of the year. World price oscillated between 320 and 400 USD/troy oz for major part of the year 2003 and it reached its highest level since February 1996, i.e. 411.70 USD/troy oz (1 troy oz = 31.1035 g), in December 2003. In 2004, in line with the increasing trend of other raw materials, a marked increase of gold prices occurred. The prices oscillated between 375 and 455 USD/troy oz, which represented the highest maxima since 1988. Rise of the world gold prices continued also in the year

2005, especially its second half, when prices increased from about 420 to 540 USD/troy oz. Gold price increased also in the first half of 2006, when it reached 725 USD/troy oz. The price fluctuated between 550 and 650 USD/troy oz in the rest of the year. In the first half of 2007, gold prices were still higher, between 610 and 690 USD/troy oz. Gold prices increased significantly by 100 USD/troy oz righ up to the limit of 800 USD/troy oz during September and October 2007. The yearly maximum of 840 USD/troy oz was reached in the first November decade. Gold price increased significantly also in the first quarter of 2008, when the magical limit of 1,000 USD/troy oz (1017 USD/troy oz in mid-March 2008) was broken. Gold price increase is related to price increase of other commodities, however, it has to be evaluated also taking into account continuously falling price of the US dollar, in which gold is quoted. On the other hand, the trend seems to be long-term and a number of mining companies started to revaluate some formerly uneconomic projects.

Gold price, average p.m. London fixing

Commodity/Year		2003	2004	2005	2006	2007
Gold, London, average p.m. fixing	USD/t oz	364	410	445	603	695

10. Recycling

Gold is widely recycled from jewellery and other industries. Recycling may reach as much as 20–25 % worldwide, even though the data on recycling are rather difficult to obtain.

11. Possible substitutes

The consumption of gold and its alloys in jewellery and electricity and electronics uses is decreasing due to the introduction of parts made of common but gold plated metals. Gold can be replaced by palladium, platinum and silver. Gold could be replaced by rhodium or other precious metals only in a very limited extent. In classic jewellery, however, gold and its alloys are indispensable.

BASIC DATA ON SELECTED RAW MATERIALS NOT PRODUCED IN THE CZECH REPUBLIC

Many types of raw materials were not included in this yearbook, as they have not been produced in the Czech Republic. As some of them are though important items in Czech foreign trade of mineral raw materials, at least basic data on the following commodities are given below: aluminium, titanium, rock salt, asbestos, minerals of the sillimanite group, mullite, magnesite, talc, perlite, sulphur, raw materials used in industrial fertilizers production.

Aluminium

Bauxite deposits form industrial exploitable Al-resources. Bauxite is an impure mixture of Al-minerals – gibbsite ($Al_2O_3.3H_2O$), boehmite ($Al_2O_3.H_2O$) and diaspore ($Al_2O_3.H_2O$). From a genetic standpoint bauxite is divided in type “terra rossa” alias genuine bauxite, associated with carbonate rocks weathering (for example Jamaica, Haiti, Dominican Republic, Hungary), and lateritic bauxite, formed by lateritic weathering of various rocks with Al-contents (Guyana, Guinea, Surinam, Brazil, India, Ghana, Australia). Al-clays were registered in the North Bohemian (brown coal) Basin (deposit Ležáky) in the Czech Republic until recently.

World production of primary Al reached almost 34 mill t in 2006. The most important world producers are China (28 %), Russia (11 %), Canada (9 %), the USA (7 %), Australia (6 %), Brazil (4.5 %) and Norway (4 %).

Foreign trade

2606 – Aluminium ores and concentrates

	2003	2004	2005	2006	2007
Import, t	13 871	21 204	25 147	24 840	26 865
Export, t	546	502	13	20	381

281820 – Aluminium oxide (other than synthetic corundum)

	2003	2004	2005	2006	2007
Import, t	23 142	26 908	28 481	24 151	30 543
Export, t	93	126	195	297	136

281830 – Aluminium hydroxide

	2003	2004	2005	2006	2007
Import, t	12 767	17 279	10 997	9 754	7 835
Export, t	205	140	139	61	50

7601 – Raw (unwrought) aluminium

	2003	2004	2005	2006	2007
Import, t	149 570	165 980	166 877	180 599	201 543
Export, t	43 044	48 646	48 077	46 007	54 456

7602 – Aluminium waste and scrap

	2003	2004	2005	2006	2007
Import, t	24 336	27 606	34 049	49 358	63 606
Export, t	33 134	37 746	39 388	54 472	61 078

Titanium

Primary Ti-ores deposits are created by bodies of magmatogenous origin in anorthosites and gabbros (Canada, Russia) and also in alkaline rocks, in which they are enriched by weathering (Brazil, South Africa, India). Placers represent the most important deposit type for industry, especially placers of a beach type (Australia, India). An important share in Ti-ores mine production have Australian beach sands, which represent about one fourth of the world production of ilmenite ($FeTiO_3$) (1.2 mill t) and nearly one half of the world production of rutile (TiO_2) (220 kt) concentrates and practically the total world mine production of leucoxene (mixture of Fe-Ti oxides) (35 kt). South Africa (Richards Bay Minerals Co.) represents another important producer. World production of ilmenite represented about 5.4 mill t in 2006 and it is estimated at 5.6 mill t in 2007. After Australia with 24 % share in ilmenite mine production, South Africa (19 %), Canada (15 %), China (9 %) and Norway (7 %) belong to the largest ilmenite producers. World production of rutile is substantially lower, amounting to approximately 0.5 mill t in 2006 and approximately 0.5 mill t in 2007 (estimate). Australia (50 %) and South Africa (28 %) followed by Ukraine (14 %) and India (4 %) belong to the biggest rutile producers.

Foreign trade

2614 – Titanium ores and concentrates

	2003	2004	2005	2006	2007
Import, t	74 709	75 101	80 407	149 924	179 322
Export, t	177	873	340	492	745

8108 – Titanium and products of it, including waste and scrap

	2003	2004	2005	2006	2007
Import, t	620	800	1 045	1 157	1 090
Export, t	239	191	338	434	147

Rock salt

Rock salt (halite) is a sedimentary rock composed mostly or completely of sodium chloride (NaCl). It usually originates by chemical sedimentation (evaporation) from true solutions. Two genetic types of halite deposits (in solid state) are distinguished: fossil stratified deposits and salt domes. New hypotheses on evaporate sedimentation presume sedimentation both on coastal supratidal mud platforms, or sabkhas and in deep sea basins that did not ever dry up and were not salt basins. Rock salt is used mainly in chemical industry for production of chlorine, soda and some inorganic salts (60 %), in the food industry as preservative (23 %), for roads sprinkling in winter (8 %), in rubber, paints, ceramics and agriculture. Salt is produced in more than 120 countries in the world; world mine production of rock salt reached about 250 mill t in 2006. Leaders in salt production are the China (22 %), the USA (18 %), Germany (8 %), India (6 %) and Canada (6 %).

Foreign trade

2501 – Salt (inclusive table and denaturated salt), and pure sodium chloride; also in water solution

	2003	2004	2005	2006	2007
Import, t	681 134	909 965	840 204	1 152 750	562 842
Export, t	10 490	12 986	15 424	30 656	19 320

Asbestos

Term asbestos is used for technically utilizable solid mineral fibres of variable mineralogical composition. The asbestos of the highest quality is formed by flexible chrysotile fibres, less commonly by amosite and crocidolite. Brittle fibres have usually composition of anthophyllite. Less important is amphibole asbestos formed by tremolite or actinolite.

Asbestos deposits originate by hydrothermal processes connected with metamorphism of ultramafic rocks, dolomitic limestones or ferruginous sedimentary formations.

The asbestos quality is given by length of fibres and their flexibility. The most expensive is so-called textile asbestos; the raw material of the lowest quality is used in production of asbestos-concrete products. The extent of asbestos use (e.g. in brake lining in car industry) has been restricted for health and ecological reasons during the last years. Chrysotile asbestos covers about 90 % of the world production, two thirds of the remaining 10 % are represented by crocidolite and one third by amosite. World mine production of asbestos was estimated at 2,300 kt in 2006. 925 kt of this amount was produced in Russia, approximately 350 kt in Kazakhstan, 350 kt in China, approximately 250 kt in Canada, approximately 240 kt in Brazil and 100 kt in Zimbabwe.

Foreign trade

2524 – Asbestos

	2003	2004	2005	2006	2007
Import, t	1 464	2 891	0	0	1
Export, t	0	248	1	0	0

Andalusite, kyanite, sillimanite, mullite

Andalusite, kyanite (formerly named also disthen) and sillimanite are mutually polymorph minerals with a high Al content. Andalusite is a typical mineral of metamorphosed rocks. Kyanite occurs especially in crystalline schists (micaschists, gneisses) rich in Al, less frequently also on contacts, in granulites and eclogites. Locally, it forms even individually exploitable deposits of the practical importance. Sillimanite occurs in metamorphic rocks and in pegmatites, too. Mullite – the main component of special refractory materials – is formed at temperatures above 1,100 °C. Mullite ($2Al_2O_3.2SiO_2$) is a mineral, which forms by heating of all aluminosilicates. Elongated acicular crystals, which form from small crystals during cooling of the melt, penetrate the melt and strenghten the burnt material. Mullite gives the most important technological properties to a number of refractory products (e.g. fire-clay). Refractoriness, heat resistance, resistance against temperature changes etc. increase with increasing mullite content. All the sillimanite group minerals represent a very valuable raw material appreciated especially for its toughness, resistance against high temperatures, low expansion, and excellent isolation properties as well as resistance against corrosion. It serves for production of special types of porcelain, furnace lining etc. World mine production is estimated at 410 ths tonnes per year. South Africa (andalusite, sillimanite), the USA, France and India represent the main producers.

Foreign trade

250850 – Andalusite, kyanite and sillimanite

	2003	2004	2005	2006	2007
Import, t	3 480	3 333	3 184	5 248	4 570
Export, t	0	0	15	0	0

250860 – Mullite

	2003	2004	2005	2006	2007
Import, t	340	446	549	1 502	1 033
Export, t	5	72	192	608	117

Magnesite

Magnesite ($MgCO_3$) is the most important mineral of magnesium. It occurs in crystalline and massive (crypto-crystalline) form. Crystalline magnesite grain size is below 10 mm. Massive magnesite is characterised by grain size of 0.004 to 0.01 mm and conchoidal fracture resembling porcelain. Magnesite deposits are associated with rocks rich in magnesium – dolomites and serpentinites. Crystalline magnesite originates by hydrothermal Mg influx into carbonate rocks; massive magnesite originates by CO_2 addition to serpentinite, it can be however also of sedimentary origin. Magnesite usually contains various admixtures of CaO, Fe_2O_3, MnO, Al_2O_3, SiO_2 and others, which affect the quality of the material. The mineral is considered as magnesite providing it has MgO content above 40% and CaO content up to 4%. Both magnesite types are used for caustic clinker production for refractory materials, insulations and special cements. Magnesite is also used in chemical industry and in paper and synthetic silk production. Magnesite world mine production fluctuated between 12 and 14 mill t in recent years. The major producer of magnesite is China (35 %), followed by Turkey (18 %), Slovakia (11 %), Russia (7 %), DPR Korea (6 %), and Austria (6 %).

Foreign trade

251910 – Natural magnesium carbonate (magnesite)

	2003	2004	2005	2006	2007
Import, t	5 528	5 973	6 860	5 440	9 688
Export, t	1 569	1 033	1 586	48	39

251990 – Magnesia, fused, dead-burned, other magnesium oxides

	2003	2004	2005	2006	2007
Import, t	34 407	42 411	43 534	51 974	52 469
Export, t	355	2 758	4 695	4 067	4 818

Talc

Talc is a soft, white (without admixtures), flaky magnesium silicate $Mg_3Si_4O_{10}(OH)_2$ of melting-point from 1,200 to 1,500 °C. All admixtures containing Fe^{3+}, pyrite and Mn oxides represent undesirable impurities. Talc is characterised by chemical (acid and lye) resistance, low electric and heat conductivity, high sorption ability, perfect basal cleavage and pure white colour (some high grade varieties). Talc originates by SiO_2 addition to rocks rich in magnesium (dolomites, dolomitic limestones, magnesites and ultrabasic rocks) during the hydrothermal processes and regional metamorphism. Well-workable massive cryptocrystalline talc variety with high electric resistance is called steatite. Also rock mixtures of talc and magnesite, often with high chlorite content, called soapstone, have similar properties like talc. World mine production reached about 8.9 mill t in 2006 according to Mineral Commodity Summaries. The major producer of talc is China (34 % including pyrophyllite), followed with a large gap by Republic of Korea (11 %), the USA (9 %), India (7 %), Brazil (7 %), Finland (6 %), and Japan (4 %).

Otherwise for pure talc, France’s Rio Tinto Luzenac orebody remains one of the biggest producer in the world.

Foreign trade

2526 – Natural steatite; talc

	2003	2004	2005	2006	2007
Import, t	10 278	9 446	10 213	10 898	13 056
Export, t	133	172	292	201	340

Perlite

Perlite is a natural volcanic glass (hyaloclastite) formed largely by SiO_2 (65–78 %), mainly of rhyolite and sometimes andesite composition. It originates by lava disintegration in contact with water. Heating up to temperatures of about 1,000 ^{o}C results in abrupt expansion and formation of glass foam. During this process, the volume increases four to twenty times so that the density reaches values of 0.08 to 0.2 t/m^3. Expanded perlite is used in building industry for its both heat and sound insulation properties, for production of light weight concrete and in adsorption mixtures used for removing of oil slicks on the water surface. Adsorption properties of perlite are used also in production of feeding mixtures and litter. World mine production of perlite was estimated at 1,810 kt for the year 2006. The largest producers are Greece (about 600 kt), the USA (450 kt) followed by Japan (240 kt), Turkey (150 kt) and Mexico (100 kt). Slovakia with its deposit Lehôtka pod Brehy represents an important producer, too.

Foreign trade

25301010 – Perlite

	2003	2004	2005	2006	2007
Import, t	5 388	4 626	5 115	5 615	7 575
Export, t	42	61	73	36	83

Sulphur

Sulphur resources are represented by native sulphur deposits and sulphide (or sulphate) deposits. Sulphur deposits are of volcanic, biogenous, oxidation or thermogenetic origin. Sulphur is mainly extracted as a by-product during crude oil, natural and industrial gas processing. Sulphur world production reached about 66 mill t in 2007. According to MCS, world sulphur leaders in 2007 were the USA (13%), followed by Canada (14 %), China (13 %), Russia (11 %) and Saudi Arabia (5 %). Germany (2.3 mill t in 2007) and Poland (1.2 mill t) are important native sulphur producers as well. In 2006 (MCS) the shares were 14 % each for USA and Canada, 12 % China, 11 % Russia, 2 % Poland, 3 % Germany.

Foreign trade

2503 – Sulphur of all kinds, other than sublimed, precipitated and colloidal

	2003	2004	2005	2006	2007
Import, t	52 784	35 037	17 016	40 147	55 195
Export, t	10 087	10 207	9 296	11 719	5 579

2802 – Sulphur, sublimed or precipitated; colloidal sulphur

	2003	2004	2005	2006	2007
Import, t	49 164	70 158	89 614	70 555	57 410
Export, t	134	1 581	503	113	132

2807 – Sulphuric acid

	2003	2004	2005	2006	2007
Import, t	57 788	52 490	51 004	54 426	46 299
Export, t	52 860	47 490	50 224	62 666	67 033

Other raw materials used in industrial fertilizers production

The raw materials used in production of industrial fertilizers, either singly, or in combination, are divided in nitrogenous, phosphatic and potassic. Also microelements needful for sustenance of organisms (Ca, Mg, B, Cu, Fe, Mn, Mo and Zn) are included into this group. World demand of industrial fertilizers reached about 130 mill t N, 43 mill t P_2O_5 and 29 mill t K_2O in 2007.

Natural nitrates are known as the Chile saltpetre, they form a 100 km long, narrow deposit zone in the Atacama desert in Chile. Production capacity of the Chile saltpetre reaches 1 mill t, whereas world production capacity of synthetic NH_3 is fluctuating around 150 mill t. The most used fertilizers with N contents are $(NH_4)_2HPO_4$ (diammonium hydrogenphosphate), $Ca(NH_2)_2$ (calcium amide) and $CO(NH_2)_2$ (urea).

There are two genetic types of natural phosphorus resources – endogenous and exogenous one. Exogenous deposits in sea sediments (about 80 % of the world production) and endogenous apatite deposits in alkaline igneous rocks (almost the total remaining production) are the most important resources for industrial fertilizer production. World production of P_2O_5 contained in phosphorus-bearing rocks oscillates between 130 and 150 mill t. The most important producers of sedimentary phosphorites are the USA (about 25 %), China (about 20 %) and Morocco (about 20 % including the Western Sahara area). The major world apatite supplier is Russia.

Resources of potassic raw materials are represented almost exclusively by evaporite deposits occurring together with rock salt. There are two chemical types of evaporite deposits: deposits rich in Mg-sulphates (main minerals are carnallite, polyhalite and epsomite) and deposits poor in Mg (main minerals are sylvite and carnallite). World K_2O production reached about 29.1 mill t in 2006. The major producer Canada (28 %) is followed by Russia (20 %), Belarus (16 %) and Germany (12 %).

Foreign trade

3102 – Nitrogenous fertilizers

	2003	2004	2005	2006	2007*
Import, t	431 489	515 058	518 701	522 851	175 393
Export, t	547 624	600 230	533 128	537 115	168 684

2510 – Natural phosphates

	2003	2004	2005	2006	2007
Import, t	24 299	24 282	22 634	28 141	33 954
Export, t	683	33	545	726	732

2809 – Phosphoric oxides and acids

	2003	2004	2005	2006	2007*
Import, t	21 879	15 456	19 712	12 899	7 534
Export, t	33 631	30 520	43 789	43 382	21 623

* *since 2007 in tonnes of* P_2O_5

3103 – Phosphatic fertilizers

	2003	2004	2005	2006	2007*
Import, t	14 736	14 466	14 763	13 575	7 004
Export, t	642	1 074	1 985	2 113	778

* *since 2007 in tonnes of* P_2O_5

3104 – Potassic fertilizers

	2003	2004	2005	2006	2007*
Import, t	14 736	14 466	14 763	13 575	7 004
Export, t	642	1 074	1 985	2 113	778

* *since 2007 in tonnes of* P_2O_5

3105 – Fertilizers containing several elements

	2003	2004	2005	2006	2007
Import, t	99 490	117 648	105 612	118 939	160 565
Export, t	36 089	29 228	32 553	23 895	36 705