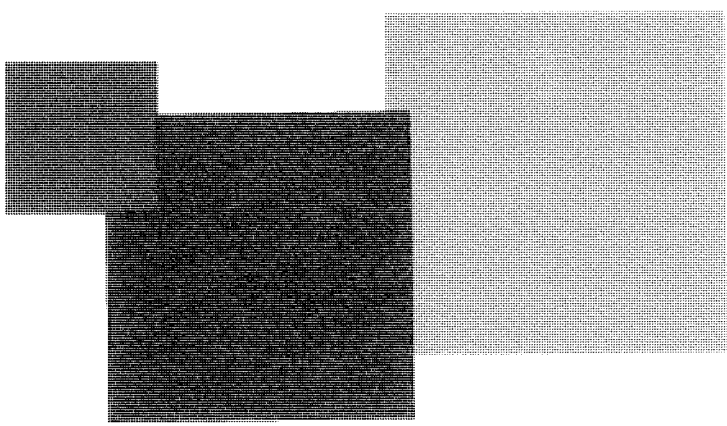
MINISTRY OF ENVIRONMENT
OF THE CZECH REPUBLIC

MINERAL COMMODITY SUMMARIES OF THE CZECH REPUBLIC



GEOFOND OF THE CZECH REPUBLIC
JUNE 1997

MINERAL COMMODITY SUMMARIES OF THE CZECH REPUBLIC

STATE TO DECEMBER 31, 1996

(Special data deadline: May 15, 1997)

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ABBREVIATIONS, SYMBOLS AND TECHNICAL UNITS

API	American Petroleum Institute
ATPC	Association of Tin Producing Countries
Btu	British thermal unit
CFR	Cost and Freight (named port of destination)
CIF	Cost, Insurance and Freight (named port of destination)
ČR	Czech Republic
CSK	Czechoslovakian Koruna
ČSÚ	Czech Statistical Office
CZK	Czech Koruna
DEM	Deutsche Mark
DRI	Direct Reduction of Iron
e	estimate
ECU	European Currency Unit
EFTA	European Free Trade Association
EU	European Union
EXW	Ex Works (named place)
FAS	Free Alongside Ship (named port of shipment)
FOB	Free on Board (named port of shipment)
FOT	Free on Truck (named place)
GATT	General Agreement on Tariffs and Trade
GBP	Great Britain Pound
GBp	Great Britain pence
GDP	Gross Domestic Product
IPE	International Petroleum Exchange (London, UK)
kt	kiloton, 1000 t
lb	pound, 0.4536 kg
LME	London Metal Exchange
mesh	to designate screen size as the number of openings per linear inch
MH ČR	Ministry of Economy of the Czech Republic
MHPR ČR	Ministry of Economic Policy and Development of the Czech Republic
MJ	megajoule, 10^6 J
MPO ČR	Ministry of Industry and Trade of the Czech Republic
mtu	metric ton unit, 10 kg
MŽP ČR	Ministry of Environment of the Czech Republic
N	not available or not reliable data
NYMEX	New York Mercantile Exchange
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of Petroleum Exporting Countries
PCE	Pyrometric cone equivalent
ppm	parts per million, 0.0001 %
Sb.	Act Digest of the Czech Republic
st	short ton, 907.2 kg
troy oz	troy ounce, 31.103 g
T/C	Treatment Charge, the amount per ton charged by a smelter for converting ore to metal
UNCTAD	United Nations Conference on Trade and Development
USBM	United States Bureau of Mines
USD	United States Dollar
USc	United States cent
ZO	Foreign Trade

INTRODUCTION

The handbook "Mineral Commodity Summaries of the Czech Republic", published for the fifth time, is intended to provide information for professionals and particularly for businessmen in order to assist them in developing small and medium size enterprises in mineral exploration and mining and, at the same time, to avoid violating relevant legislation and interests of mining organizations.
The publication also includes basic data extracted from the "Register of Reserves of Mineral Deposits", which is further elaborated for only a limited number of Governmental Departments. Information on prices of minerals, their technological parameters and uses, imports and exports, major mining companies and locations of mineral deposits is intended to assist in understanding the mineral potential of the Czech Republic and to stimulate and influence investment activities. Based upon progress in the national information system and international cooperation, the publication is thoroughly supplied with appropriate statistical data and comments from readers will be taken into consideration when publishing further issues.
The term mineral reserves refers to geological and/or total reserves which means original reserves within individual deposits, calculated according to a valid classification and conditions of their utilization. The basic data come from calculations of mineral reserves which were approved or verified by the former Commission for Classification of Mineral Resources and/or reserves approved by the Board of Minerals, Exploration and Mining of the Ministry of Economy of the Czech Republic (formerly Commission for Projects and Final Reports) or those approved by former commissions for control and utilization of mineral reserves of individual mining and processing industries or by newly introduced mining companies.
Geological reserves of reserved minerals - as of December 31, 1995 - exceeded 60,000 mill. tons with majority of mineral fuels.
The Ministry of Environment together with the Ministry of Industry and Commerce recently announced a project of recalculation of reserves of regale minerals which will lead to a fundamental economic revaluation of the mineral wealth of the Czech Republic.

The year-book "Mineral Commodity Summaries of the Czech Republic" includes all minerals, i.e. metallic ores, mineral fuels, industrial minerals and building materials which are of economic importance and reserves on the territory of the Czech Republic. Each mineral is presented in an individual chapter which consists of ten parts.
Part 1. **Characteristics and uses** - provides a basic description of the mineral raw material, its abundance in nature, major minerals and general use.
Part 2. **Mineral resources of the Czech Republic** - describes major regions of their occurrence, characteristics of their deposits, types, production and potential use.
Part 3. **Registered deposits of the Czech Republic** - is based upon the register of mineral deposits of the Czech Republic and for the majority of minerals it includes a summary of individual deposits and their location. As for mineral fuels and some industrial minerals only regions are shown rather than single deposits. As for dimension stone and building materials, hundreds of these deposits are scattered over the whole territory of the Czech Republic. Consequently, no summary or location are given in this paragraph.
Part 4. **Basic statistical data of the Czech Republic as of December 31,** are extracted from the "Reserves register" and from the ČSÚ statistical data on mineral imports and exports.There are 3 groups of minerals (ores, mineral fuels and reserved industrial minerals) balanced in the Czech Republic. Statistical data has not covered up data of the Register of Reserves of Non-reserved Mineral Deposits yet. Data on foreign trade are the latest (continuously reviewed) data of the ČSÚ.

Part 5. **Tariff rates** - show corresponding codes of the customs tariff and tariffs in force according to the government Decree No. 301/1996 Sb.
Part 6. **Mining companies in the Czech Republic.** This part gives a list of companies which are mining the given mineral on the territory of the Czech Republic. The companies are arranged according to the level of production. Their addresses are at disposal in Geofond of the CR.
Part 7. **World production** gives data on mining and production of commercial products for the last 5 years. There are also quoted significant world producers with share exceeding 5% in a last statistically closed year.
Part 8. **World prices** - gives a summary of prices and their evolution in the last five years as well as prices based upon quotations or prices negotiated in contracts.
Part 9. **Recycling** - gives a brief description of possible recycling methods known in the world.
Part 10. **Substitutes** - this paragraph provides an appraisal of materials which can substitute for the given mineral (worldwide).

Numerous domestic data and foreign materials were used when compiling the present yearbook.

MINERAL PROSPECTING, EXPLORATION AND MINING OUTPUT IN THE CZECH REPUBLIC

Minerals given in Act No. 44/1988 Sb. on minerals protection and use amended by the Czech National Council in Act No. 541/1991 Sb. (The Mining Law) are reserved minerals. The aggregate of these minerals utilizable for industry gives reserved mineral deposits. They constitute the mineral wealth of the country and are owned by the Czech Republic. The prospecting of reserved mineral deposits and thier exploration are regulated by Czech National Council Act No. 62/1988 Sb. on geological works and the Czech Geological Office amended in Act No. 543/1991 Sb. (The Geological Act). Prospecting and exploration can be carried out by a natural or legal person (organization) in the territory, shape and time given with a prospecting and exploration licence. This licence is granted by the Ministry of Environment of the Czech Republic (Ministry of Economy was abolished by the Act No. 272/1996 Sb.; its function in the field of mineral policy and mineral utilization passed to the Ministry of Industry and Trade of the Czech Republic and its function in the field of geological exploration to the Ministry of Environment). Before granting the licence the Ministry of Environment asks (by the law) the standpoint of a municipality in which cadaster the prospecting and exploration is going to be carried out. The Ministry of Environment of the Czech Republic gives the conditions of geological operations, the time of licence validity and the borders of the "exploration area", where the applicant acquires the right to carry out prospecting and exploration provided by the exploration licence. An enterpreneur could ask the issue of the reserved mineral exploration licence on the Ministry of Environment directly or within the framework of a tender advertised by the Ministry of Environment of the Czech Republic. The enterpreneur should have the geological operations licence and a person with the certificate on qualification to project, carry out and evaluate geological works. This certificate is issued by the Ministry of Environment.

The enterpreneur is obliged to pay a tax from the exploration area CZK 1,000 for any opened square kilometer of the exploration area in the first year. This tax increases CZK 1,000 for any next year. The taxes go to municipalities in which cadastral territories the exploration area is found. An evaluation of reserved deposit reserves is a foundation for the reserved deposit certificate issue. This certificate declares the mineral aggregate to be a deposit. In that case the deposit is liable to the Mining Law range. The reserved deposit protection against aggravation of its mining or making the mining impossible is ensured by the protected deposit area determination.

The enterpreneurs right to mine the reserved deposit originates in the mining claim allocation. An application for the determination of a claim has to be agreed in advance by the Ministry of Environment of the Czech Republic. The Ministry could limit a precedent approval for the determination of a mining claim by fulfiling qualifications taking into consideration state mineral policy interests. The priority over others for precedent approval for the determination of a mining claims enjoys the enterpreneur who operated the exploration or who participated financially.

The mining claim is allocated to the enterpreneur only who is in possesion of a "Certificate on mining operations" issued by the authorised Regional Mining Office. The local authorised Regional Mining Office determines the mining claim in cooperation with other state administration bodies, mainly in agreement with environmental and territorial planning authorities and with the Building Office. The enterpreneur must support the application for the determination of a claim by documentation and documents given in law.

The enterpreneur who obtained the determined mining claim can start mining operations after issue mining activities licence only. This licence issues the authorises Regional Mining Office. Before the mining activities licence issue an administrative procedure takes place where the plans of opening, preparation and mining of the deposit are discussed together with advanced funding

height proposal (asked by law) for covering the mining effects up to finishing the output of the deposit.
The enterpreneur is obliged to pay taxes from the claims and extracted reserved minerals. Yearly tax from the claim amounts CZK 10,000 for every even opened square kilometer of the mining claim in the area demarcated on the surface. With smal claims (up to 0.02 square km) the yearly tax amounts CZK 2,000. Every Regional Mining Office fully transfers this tax to the municipalities in which territories the claim is found. The ratio answers to claim proportions in the territory of every municipality. Yearly tax (royalty) is given by the Ministry of Economy Decree No. 617/1992 Sb. on details of mining claim and extracted reserved minerals tax payment. The rate depends on grade of extracted mineral and balances from 0.5 to 10 % of its trade price. The Regional Mining Office transfers 50 % of the profit of extracted mineral tax to the state budget and 50 % to the budget of the interested municipalities.

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

Statistical data/Year	1992	1993	1994	1995	1996
registered tasks of geological exploration	379	726	506	492	464
protected deposit areas	703	787	828	841	1030
mining claims - total number	1034	1048	1080	1073	1066
- area in square km	2162	1678	1660	1650	1704
number of exploited deposits	.	.	.	.	632
mining output, mill.t a)	165	159	147	145	150
organizations managing the deposits	352	321	345	344	364
organizations mining the deposits	.	.	.	260	262

Note:
a) without radioactive minerals; conversion to tons: natural gas - $1000m^3$ = 1 t, dimension and building stones - $1000m^3$ = 2700 t, gravelsand and brick clays - $1000m^3$ = 1800 t

Summary of exploration licences valid in 1996 and exploration licences issued during 1996:

Exploration areas in 1996

Prospecting and exploration works paid by companies

Mineral code	Mineral	Valid EA (min.1)	Valid EA (min.2)	New issues in 1996	Start of validity in 1996
PL	Polymetallic ores	1			0
AG	Silver	0	1		
ZR	Gold +	12			
RP	Crude oil	28		3	3
ZP	Natural gas	32	28	2	2
PD	Gemstones	5		2	1
KN	Kaolin	27	3	1	1
JL	Clays	20	16	3	3
BT	Bentonite	1	16		
ZS and feldspar substitutes	Feldspar and f. substitutes	3		3	2
PI	Gl., foundry sands	2	6		
SU	Staurolite	0	1		
CT	Fusible basalt	2		1	1
VA	Limestones	5		2	2
SA	Gypsum	3		2	2
KA	Dimension stone	8		6	4
Total number		149	71	25	21

+ Within several EA issues of licences were held up
Min. 1 - primary mineral
Min. 2 - secondary mineral

Exploration areas in 1996

Prospecting and exploration works paid from the state budget

Mineral code	Mineral	Valid EA (min.1)	Valid EA (min.2)	New issues in 1996	Start of validity in 1996
RP	Crude oil	1			
ZP	Natural gas	1	1		
PD	Gemstones	12			
KN	Kaolin	8			
JL	Clays	11	1	3	
BT	Bentonite	0	1		
ZS and feldspar substitutes	Feldspar and f. substitutes	2		2	
PI	Gl., foundry sands	1	1		
WL	Wollastonite	1			
CK	Cem. correctives	1			
KA	Dimension stone	3		1	1
Total number		41	4	6	1

Geological survey and exploration

Geological survey and exploration of reserved mineral deposits which are paid from the state budget are realized continuously by means of individual projects. After approval of these projects there are made contracts for works on them.
The objective of the works is:

- to ensure pre-project and project arrangements
- to carry out survey and exploration
- to evaluate results and approve a report.

When the deposit is verified a calculation of reserves of the deposit is approved and an certificate on deposit is issued. Then a protection proposal is prepared. From the state budget there are paid the most risky opening operations, i.e. especially prospecting. Their results cover largely the state administration, municipalities, enterpreneurs and land owners information needs for:

- protection of nonrenewable resources
- design of territorial planning schemes on all scales
- strategic planning and specification of a state mineral policy
- preparation of entrepreneurial designs
- decision of land owners to use the land optimally.

Main amount of finance (about 80%) is given to exploration of crude oil and natural gas including carboniferous gas adsorbed to coal. The objective is to find environmentally clear domestic energetic sources. Operations on ore exploration were finished in 1992. Exploration of industrial minerals was carried out in the frame of the "Domectic Resources Development Program". The objective of the Program has been to secure data on mineral potential and its accesibility for perspective domestic industries, in the first place ceramic industry, and to facilitate works on strategic development plans. Deposit exploration works are financed as recoverable expenditures, i.e. an enterpreneur refunds the state all operation costs during deposit exploitation. The volume of works concerning industrial minerals continuously declines.

There is further program of deposit works - a continuous re-balance of all reserved deposits without exploration or mining licences. The objective of this re-balance is to reassess deposits surveyed in the past (sometimes even 30 years ago) according to the up-to-date technological and economic criteria and to eliminate from the state balance all deposits, which are explicitly non-usable presently and in the future. Thus their protection will be cancelled and areas unblocked for contingent construction activities. Then only a better view of state mineral potential will be obtained. It should facilitate to design the territorial plans in a new way and to accept relevant designs for economic and ecological policy of the country. A trend of costs for exploration works on deposits has been as follows:

Costs for exploration works on deposits paid from the state budget

1992	CZK 186 562 860
1993	CZK 248 716 006
1994	CZK 249 841 345
1995	CZK 242 293 906
1996	CZK 163 029 555

Mining output of minerals in the Czech economics

Ratio/Year	1992	1993	1994	1995	1996
Share of mining in GDP, %	N	3.7	2.8	2.6	N
Share of mining in industrial production, %	7.1	6.9	5.9	6.7	N

Trends of mineral industrial reserves (economic proven free reserves)
total numbers according groups, kt

Group/Year	1992	1993	1994	1995	1996
Ores	31 369	28 731	28 731	28 731	28 731
Mineral fuels a)	5 182 287	4 484 926	4 360 159	4 552 487	4 237 488
Industrial minerals	3 125 709	3 106 652	3 112 171	3 101 888	4 365 345
Building materials b)	6 126 921	5 965 482	5 895 318	5 887 848	5 796 308

Note:
a) without radioactive minerals, conversion into kt - natural gas 1 mil. m^3 = 1 kt
b) including dimension stone, conversion into kt - dimension and building stones 1000 m^3 = 2.7 kt, gravelsand and brick clays 1000 m^3 = 1.8 kt

Basic legal regulations on mineral prospecting and exploration in the territory of the Czech republic which have been in force as of January 1, 1997:

- Act No. 62/1988 Sb. on geological works and the Czech Geological Office amended in Act No. 543/1991 Sb.
- Decree of the ČGÚ No. 121/1989 Sb. on projects, carrying out and evaluation of geological works, and on granting the certificate on qualification to carry them out
- Decree of the ČGÚ No. 8/1989 Sb. on geological work registration, on passing over and accessibility of geological work results, and on survey of old workings and old workings register management
- Decree of the MŽP ČR No. 363/1992 Sb. on survey of old workings and old workings register management
- Decree of the MŽP ČR No. 364/1992 Sb. on protected deposit areas
- Act No. 439/1992 Sb. on minerals protection and use (Mining Law) - the complete wording with jurisdiction for the Czech Republic with amendments and supplements instituted through Czech National Council Act No. 541/1991 Sb.
- Decree of the MHPR ČR No. 412/1992 Sb. on certificate of qualification to project, carry out and evaluate geological works
- Decree of the ČBÚ No. 172/1992 Sb. on mining claims
- Decree of the ČBÚ No. 340/1992 Sb. on qualification requirements, and on verification the specialists of mining operations and other operations that use mining methods
- Act No. 440/1992 Sb. on mining operations and state mining administration (the complete wording as follows of later amendments and supplements)
- Decree of the MHPR ČR No. 497/1992 Sb. on evidence of reserves of reserved mineral deposits
- Decree of the MH ČR No. 617/1992 Sb. on details of mining claims and extracted reserved minerals tax payment
- Decree of the ČBÚ No. 104/1988 Sb. on efficient use of reserved deposits, on permits and notification of mining operations and other operations that use mining methods amended in Decree No. 242/1993 Sb.
- Decree of the ČBÚ No. 15/1995 Sb. on licence of mining operations and other operations that use mining methods as well as of project development of objects and installations which are a constituent part of these operations

METALLIC ORES - GEOLOGICAL RESERVES AND MINING OUTPUT

Geological reserves of metallic ores as of December 31, 1996 were mostly subeconomic. More significant volume of economic reserves was presented with goldbearing, polymetallic and tin-tungsten ores only.

Ore mining has got very old tradition in the territory of the Czech Republic. The oldest archaeological evidence on gold wash originates in the 9th century B.C. In the Middle Ages Bohemia became the centre of European gold and silver mining. Long mining activity was the cause of the fact that the territory of the Czech Republic became rich in poor ores only. Mining met with its last large boom in the cold war period after 1948 when the ore deposits were exploited even at considerable economic loss to ensure an independence of mineral imports from the western countries. After 1989 a large exploitation damping came and a close of mining in the polymetallic deposit Zlaté Hory discontinued ore mining in the territory of the Czech Republic. State grants for damping programs directed at social costs, technical liquidations, savings(maintenance) and reclaimings reached CZK 1,700 mil. in 1990-1996.

Mining output - metal content

Metal	Unit	1992	1993	1994	1995	1996
Iron	t	20608	0	0	0	0
Copper	t	500	200	0	0	0
Lead	t	1100	100	0	0	0
Zinc	t	4400	1500	100	0	0
Antimony	t	224	0	0	0	0
Silver	kg	6200	500	100	0	0
Gold	kg	521	512	75	0	0

IRON ORE

1. Characteristics and use

Iron is a grey, highly malleable metal having specific density of 7.87 t/m^3 and a melting point of 1,536° C. It is the 4th rock-forming element. The highest concentrations of iron are connected with the occurrence of Precambrian sedimentary formations which are the largest world source of hematite. Another important source of iron is deposits of magnetite which originated either by segregation of magnetite in mafic magmatic bodies or through pyrometasomatic processes. Iron ores occur in the form of oxides, silicates and carbonates. In general, two types of iron oxides are mined worldwide - hematite Fe_2O_3 and magnetite Fe_3O_4 having up to 70 % Fe. Over 90 % of mining output have been obtained by surface mining. World reserves are estimated at 150,000 mill. tons.

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 is used for other than metallurgical processes, such as heavy media, and the manufacture of cement, ferrites, feed-stuffs, coloring agents, etc.

2. Mineral resources of the Czech Republic

- Sedimentary deposits of iron ores occur in the Barrandien zone. These ores are of marine origin and of Ordovician age.

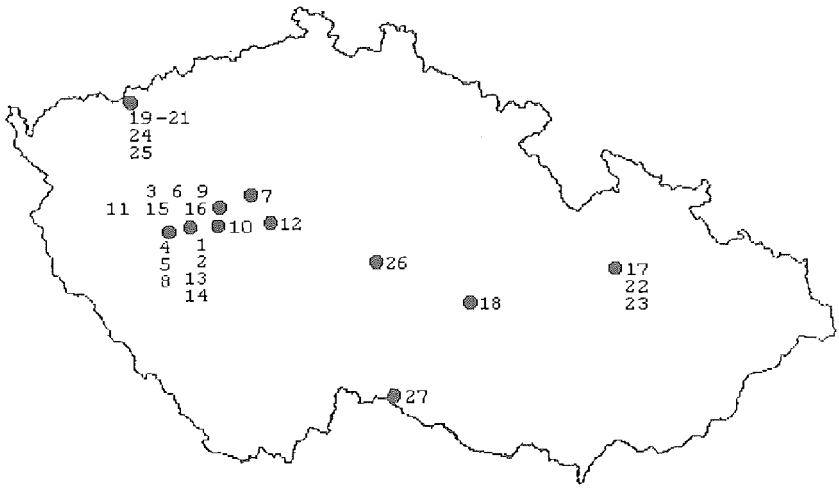
The ore forms mostly lenses. Early Ordovician ores contain mostly hematite (hematite-siderite ores). The content of iron is on average 25 to 30 %. Oolitic texture is characteristic of these ores.

- Deposits of the Lahn-Dill type related to the submarine volcanic activities occur in the Moravian-Silesian Devonian. Most abundant is hematite, less abundant is magnetite and Fe-silicates. Magnetite of the Medlov deposit which was still mined in the sixties, similarly to the sedimentary deposits of the Barrandien zone, contained on average 38 % Fe.
- Pyrometasomatic deposits of magnetite are characteristic of skarns of the Moldanubicum crystalline unit and the Krušné hory unit. The content of Fe in ore of Měděnec and Přísečnice, which were mined as late as in 1992, was on average 33 %.

Deposits of the above mentioned three genetic types were mined in the past 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 Barrandien zone which were thermally treated through the Krupp-Renn process. Magnetite was mostly used for other than metallurgic processes, such as for production of cement (heavy concrete), as a heavy medium of jigs in coal preparation plants, etc.

The availability of higher-grade and relatively cheaper imported iron ores led to the gradual closing of iron mines on the territory of the Czech Republic.

3. Registered deposits and their location in the Czech Republic



Sedimentary iron ores:

1 Bechlov
2 Březina
3 Dlouhá Skála-Petrovka
4 Ejpovice-Anton De Padua
5 Ejpovice
6 Chlustina
7 Chrbina
8 Klabava
9 Knížkovice
10 Komárov
11 Krušná Hora
12 Mníšek pod Brdy
13 Mýto-Cheznovice
14 Rač
15 Velíz
16 Zdice

Magnetite:

17 Benkov-west
18 Budeč
19 Horní Halže
20 Kovářská
21 Kovářská-Orpus
22 Králová
23 Medlov-Lazce
24 Měděnec-north
25 Přísečnice
26 Vlastějovice
27 Županovice

3. Registered deposits and their location in the Czech Republic

Year		1992	1993	1994	1995	1996
Deposits - total number		29	28	28	27	27
exploited		2	0	0	0	0
Total reserves, kt		492490	492490	492490	488566	488566
economic proven		519	519	519	519	519
economic probable		12232	12231	12232	12232	12232
subeconomic		479739	479739	479739	475815	475815
Mining output, kt		64	0	0	0	0
Imports, kt	a)	5131	7550	7283	9146	8255
Exports, kt	a)	0	0	2	1	2

Note:
a) item 2601 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2601	Iron ores and concentrates incl. roasted iron pyrites	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

In 1996 no mining companies were operating in the Czech Republic to extract iron ores.

7. World production

World production of iron ores has been generally on the rise since the nineteen-thirties with an average annual output of approx. 100 million tons, reaching its probable last peak in 1995. The important iron ore - producing countries are as follows (according to UNCTAD):

Year	1992	1993	1994	1995	1996 e
Mining output, mill. t	916	938	964	1020	1050

Main producers (1995):

Brazil	17.4 %
Australia	14.2 %
China	24.6 % (crude ores)
CIS	13.2 %
India	6.2 %
USA	6.5 %

Brazil and Australia reached also high share in world export of iron ores (60% in 1995).

8. World market prices

Prices of the European market are quoted in FOB for calendar year in USc/mtu. Prices FOB are being established with regard to shipping costs of the major consumers 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.

Quoted prices of staple traded iron ores according to their grade (Brazil) in USc/mtu FOB are as follows:

A Fine ore CJF (Carajás Fines)
B Lump ore CJL (Carajás Lump)
C Pellets BFP (Blast Furnace Pellets)

Commodity / Year	1992	1993	1994	1995	1996
A	33.10	29.09	28.38	28.38	30.00
B	37.10	33.09	33.38	33.38	35.25
C	48.47	43.64	49.19	49.14	52.40

9. Recycling

Metal recycling is widely used. Iron scrap (steel scrap and cast iron scrap) are 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 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 whose availability continues to decrease with increasing portion of continuous steel casting. Processing and particularly the still increasing consumer's share of iron scrap does not meet specific requirements of the steel industry. Electric furnaces have the major share consumption of iron scrap allowing as much as 100 % charge of iron scrap.

10. 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.

MANGANESE

1. Characteristics and use

Manganese is a hard, brittle, grey metal melting at 1,244°C and with a specific density of 7.4 t/m^3. There are two principal types of manganese deposits - marine chemical sediments and deposits of oxidation zone enriched in manganese. The former type represents the majority of known reserves of manganese. Reserves occurring in the Earth's crust are equal to 3,630 mill. tons, of which reserves of high grade ore having over 44 % Mn represent 500 to 600 mill. tons. Inferred reserves confined to deep-sea nodules having an average content of 25 % Mn represent about 358 million tons of metal. Among 300 known manganese minerals only 12 are principal constituents of economic deposits. The following are the most important: pyrolusite, psilomelane, manganite, braunite and rhodochrosite. Manganese world reserves are estimated at 805 mill. tons. More than 90 % of manganese is used on 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. Average world consumption of manganese is 10 kgs in 1 ton of crude steel and in up-to-date steel foundries is minimum 6 kgs. Manganese is also used in alloys of non-ferrous metals (Al, Cu, Ti, Ag, Au, Bi). Another applications are in the manufacture of dry batteries, coloring matters, soft ferrites, fertilizers, feed for animals, fuel additives, welding electrodes, water treatment, etc.

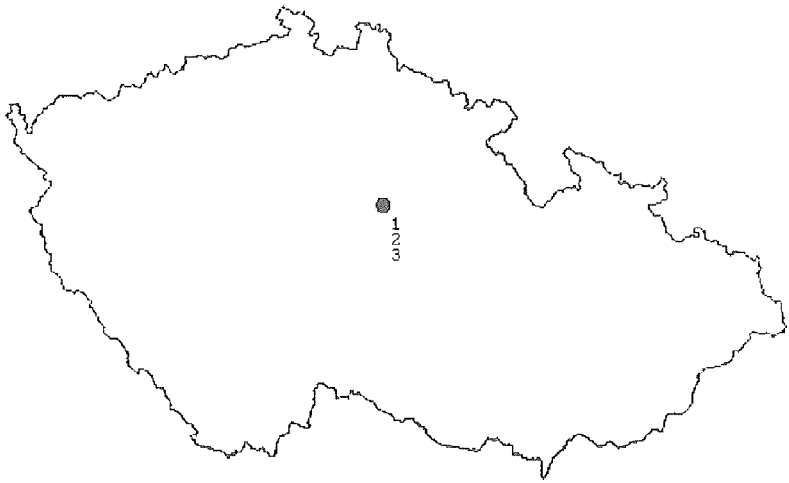
2. Mineral resources of the Czech Republic

Accumulations of Mn ores are known from the Železné hory mountains area where they are confined to volcaniclastic deposits of the Proterozoic. The mineralization is confined to a horizon of graphitic-pyritic slates which are 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 Chvaletice. Fe-Mn ores of the gossan type were mined in the past on the outcrops. Pyrite was mined in the fifties and sixties 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 tailings ponds at the former mineral processing plant (average Mn content of the ore is 9,8%).

Other Mn occurrences within the Czech Republic are insignificant. Among them the following can be quoted: hydrothermal veins with Mn oxides at Horní Blatná and Narysov near Příbram and residual ores at Maršov in west Moravia.

3. Registered deposits and their location in the Czech Republic



1 Chvaletice
2 Chvaletice - tailings ponds 1 and 2
3 Řečany - tailings pond 3

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

Year		1992	1993	1994	1995	1996
Deposits - total number		2	2	3	3	3
exploited		0	0	0	0	0
Total reserves, kt		134405	134405	138801	138801	138801
economic proven		0	0	0	0	0
economic probable		0	0	0	0	0
subeconomic		134405	134405	138801	138801	138801
Mining output, kt		0	0	0	0	0
Imports, kt	a)	42	13	13	47	19
Exports, kt	a)	0	0	0	0	0

Note:
a) item 2602 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2602	Manganese ores and concentrates including Mn-Fe ores and concentrates with 20 wt% Mn or more (calculated on dry substance)	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

In 1996 no mining companies were operating in the Czech Republic to extract manganese ores.

7. World production

Production of manganese ores is actually copying the production of iron ores because their consumption is connected with the production of pig iron and steel. So far the highest peak of production of manganese ores with regard to metal content was reached in 1990 - 11096 kt. The major producers of Mn ores were as follows (mining output according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt Mn	7667	6741	7125	7200	7200

Main producers (1994):

South Africa	17.2%
Ukraine	14.0%
Australia	13.4%
China	13.4%
Brazil	13.0%
Gabon	11.7%
India	8.8%

Operating technologies of manganese nodules offshore mining were at disposal in France, Japan, Germany, USA and India at the end of 1995.

8. World market prices

Basically three types of manganese ore are traded on the world market - metallurgical ore (38 to 55 % Mn) 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 a USD/mtu basis CFR Europe. The price in the eighties fluctuated on average around USD 1.5 per mtu until 1988. Then a rise in prices came and reached its peak in 1990 and 1991 (USD 4 per mtu). Since this period the prices have been falling again. The main cause was decline in market demand owing to a world economic recession and continuous reduction of Mn content in pig iron. Average prices of the said manganese ore grade at yearend (commodity A):

Commodity / Year	1992	1993	1994	1995	1996
A	3.45	2.20	2.20	2.00	2.14

Most of manganese raw materials in the world market - 85% in 1993 - originate in five states: South Africa - 21.1%, Australia - 20.4%, Gabon - 20%, Brazil - 12.7% and Ukraine -10.7%.

9. 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 high in Mn as MnO and MnS are recycled to a certain extent. Manganese from used dry cells is also recycled to certain extent.

10. Possible substitutes

No substitute for manganese has yet been found in principal processes. In steel-manufacture, it can be substituted to a certain extent - determined by economic parameters - by other deoxidizing additives - silica, aluminium, complex alloys and rare earth oxides.

NICKEL

1. Characteristics and use

Nickel is a white, malleable and very hard metal melting at 1,455° C and with a specific density of 8.9 t/m^3. The majority of nickel deposits are confined to ultramafic rocks such as peridotite and serpentinite. Economic deposits are represented by sulphide mineral assemblages (40 % of world reserves) and by lateritic deposits (60 % of world reserves). Sulphide deposits are of magmatic or metamorphic origin. Major nickel minerals are pentlandite and nickel bearing pyrrhotite. Both minerals are usually accompanied by Cu minerals which are extracted as a by-product. Proved reserves with an average grade 1 % and higher are equal to 130 mill.tons of nickel metal. Lateritic deposits originated through weathering processes of ultramafic rocks (having max. 0.3 % Ni) exposed to extreme climatic conditions of subtropical and tropical zones with torrential rains. Weathering processes led to enrichment of Ni up to 3.5%. The major Ni mineral of these lateritic deposits is a hydrosilicate of Ni - garnierite $H_2(Ni,Mg)Si0_4$. Some nickel also occurs in the manganese ocean crust and deep sea nodules, particularly in the Pacific Ocean. Steel mills and iron foundries account for 65 % of total nickel use worldwide (particularly stainless and heat-resisting steels having 7-12 % Ni). Other applications are in the production of common and special alloys (superalloys) used in machine and electrotechnical industries, for nickel electroplating, etc.

2. Mineral resources of the Czech Republic

Lateritic residual deposits of nickel originated by weathering of serpentinite bodies in the Bohemian (Křemže) and Moravian (Bojanovice) parts of the Moldanubicum. Ni mineralization at Křemže occurs in the lower, locally up to 18 m thick, layer of the lateritic body. Ni content of the ore, being on average 0.4 - 0.7 %, is confined to Ni-hydrosilicates, particularly garnierite with an admixture of pimelite, schuchardtite and others. The deposit was mined during and for a short period after World War II. Moravian lateritic deposits have little or no garnierite and nickel contents ranging on average between 0.6 and 1.0 % are confined to Ni-chlorites, Ni-montmorillonite and Ni-nontronite.

Sulphide type of Ni-mineralization is represented by Cu-Ni liquid magmatic deposit of Staré Ransko in gabbroid rocks of the Ransko Massif. Disseminated ore having about 0.16 % Ni and 0.2 % Cu consists mostly of pyrrhotite and less abundant chalcopyrite and pentlandite.

3. Registered deposits and their location in the Czech Republic

1 Bojanovice
2 Křemže
3 Staré Ransko

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

Year		1992	1993	1994	1995	1996
Deposits - total number		3	3	3	3	3
exploited		0	0	0	0	0
Total reserves, t Ni		111816	111816	111816	111816	111816
economic proven		0	0	0	0	0
economic probable		62397	62397	62397	62397	62397
subeconomic		49419	49419	49419	49419	49419
Mining output, t Ni		0	0	0	0	0
Imports, t	a)	50	5749	7222	34	30
Exports, t	a)	0	0	287	17	1

Note:
a) item 2604 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2604	Nickel ore and concentrates	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

In 1996 no mining companies were operating in the Czech Republic to extract nickel ores.

7. World production

World production of Ni ores shows a similar progress to that of iron ores because its major use is in steel manufacture. So far the highest production in metal content was reached in 1990 - 970 kt of Ni. The major producing countries of Ni ores were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt Ni	900	827	784	800	850

Main producers (1994):

Russia	27.4%
Canada	13.4%
New Caledonia	12.2%
Australia	10.5%
Indonesia	5.9%

8. World market prices

Nickel ores are not quoted on the world market, and sales are based upon negotiated prices. Prices of 99.8 % Ni metal are commonly quoted at LME. The highest peak price to date was in 1988 - USD 13,797 per t. Since then the price has been decreasing. The decline in prices is due to a decrease in demand because of the decrease in steel production and due to a higher proportion of metal recycling. A market revival occured in 1994 only. Average annual metal price (commodity A) at LME in USD per ton (Cash) was as follows:

Commodity / Year	1992	1993	1994	1995	1996
A	6998	5281	6341	8234	7497

9. Recycling

The proportion of recycled metal of its total consumption continues to increase and according to UNCTAD it has reached up to 40 %.

10. Possible substitutes

An effort to find a substitute for nickel was stimulated by its high price and other economic reasons. Present and future possible substitutes include aluminum, metal coated steel and plastics in the building and transport industries, special nickel-free steels in power plants and the petroleum chemical industry, plastics in corrosive environments and platinum, cobalt and copper for catalysts.

COPPER

1. Characteristics and use

Copper is a soft and malleable metal of golden red color, melting at 1,083° C and with a specific density of 8.96 t/m^3. Copper deposits can be divided in six groups, according to their origin - porphyry copper deposits, liquid magmatic, contact pneumatolitic, hydrothermal, sedimentary and metamorphic. About 59 % Cu comes from porphyry copper deposits and 24 % from deposits of sedimentary origin. Among 300 known Cu minerals only a few sulphides are of economic importance - chalcopyrite, covellite, Cu-pyrite, chalcocite, bornite, enargite and tetrahedrite, and to certain extent even some oxides (carbonates and silicates). World reserves of Cu in the Earth's crust are estimated at 1.6 billion tons, reserves of Cu in deep sea nodules are estimated at 0.7 billion tons.

Much copper is used in electrotechnics (50 %), in the machine (20 %) and building industries. Majority of copper are used in alloys, particularly in brass and bronze.

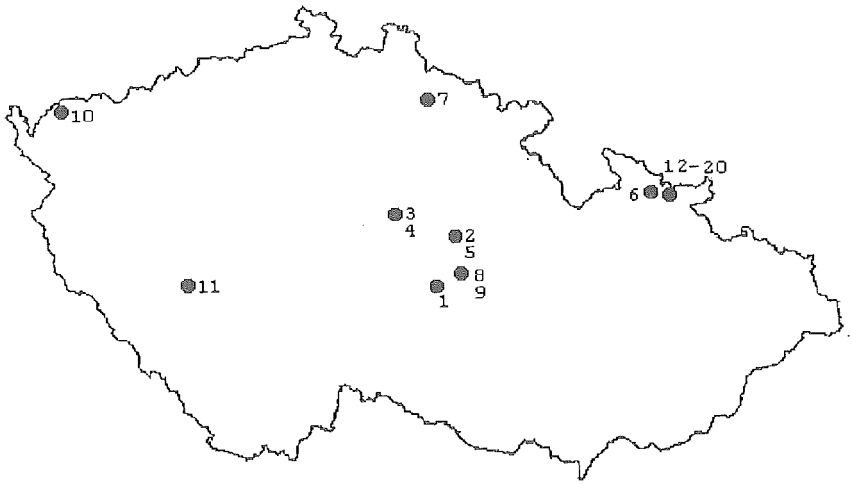
2. Mineral resources of the Czech Republic

Copper deposits of various origin occur in the Czech Republic and were mined in the past.

- Major mining activities were focused on volcaniclastic pyrite deposits of the Zlaté Hory mining district. The mineralization is related to the initial spilite-keratophyre volcanism and is confined to volcaniclastic complex of the Vrbno Formation of the Devonian. Single types of local ores - Cu monometallic, complex Cu-Pb-Zn and Pb-Zn occur separately and show a certain zonation. Out of the total proved reserves about 50 % are 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 0.6 % Cu. Mining of these ores at the Zlaté Hory deposit was terminated in 1990.
- Stratabound monometallic Cu ores (chalcopyrite) confined to a low-grade metamorphic volcaniclastic complex were discovered and their reserves evaluated and proved in the deposit of Tisová near Kraslice. Mining of local ores, having as much as 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 was temporarily flooded.
- Less important Cu mineralizations and/or Cu-Zn-Pb ores of stratabound type and pyrite formation are known at numerous localities of the Bohemian Massif (e.g. Staré Ransko, Křižanovice, Svržno).
- Hydrothermal (vein) Cu deposits of the Czech Republic are of historical importance only. Similar role plays Cu mineralization confined to Permocarboniferous sediments of the Krkonoše piedmont basin, Lower Silesian basin and the Blanice furrow.

Mining of Cu ores in the Czech Republic was gradually terminated. Last small volume of Cu was extracted from complex ores of the Zlaté Hory deposit in 1993.

3. Registered deposits and their location in the Czech Republic



1 Dlouhá Ves
2 Křižanovice
3 Kutná Hora
4 Kutná Hora, Old Bohemian zone
5 Liboběřice
6 Rejvíz
7 Rybnice
8 Staré Ransko-Obrázek
9 Staré Ransko-exploration project
10 Tisová near Kraslice
11 Újezd near Kasejovice
12 Zlaté Hory-Heřmanovice - Cu, Pb, Zn
13 Zlaté Hory-Heřmanovice - Pb, Zn
14 Zlaté Hory-Heřmanovice - Cu
15 Zlaté Hory-Hornické skály
16 Zlaté Hory-Kozlín zone
17 Zlaté Hory-Kozlín above 3rd level
18 Zlaté Hory-east
19 Zlaté Hory-west
20 Zlaté Hory-west-550 m

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	23	21	19	20	20
exploited		3	1	0	0	0
Total reserves, kt Cu		248	239	239	245	245
economic proven		2	0	0	2	2
economic probable		54	41	41	41	41
subeconomic		192	198	198	202	202
Mining output, t Cu		500	200	0	0	0
Imports, t	b)	45	20	11	10	0
Exports, t	b)	0	24	160	15	163

Note:
a) deposits with balanced Cu content
b) item 2603 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in %	
		General	Concessionary
2603	Copper ore and concentrates	free	free

6. Mining companies in the Czech Republic as of December 31, 1996
In 1996 no companies were operating in the Czech Republic to extract Cu ores.

7. World production
Production of Cu ores continues to rise and it conforms to an increasing world consumption (industrial countries show a growth in copper consumption 3% in average every year in the last decade). The major producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt Cu	9446	9993	8993	9600	9800

Main producers (1994):
Chile 24.7%
USA 14.7%
Canada 6.1%
Russia 6.1%

8. World market prices

Copper ores 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 LME. So far reached price peak was recorded in 1989 GBP 1,734.14 per ton (Cash). The next temporary decline in prices was due to a surplus production, particularly due to supplies from the East European countries and because of the decline in consumption resulting from the global economic recession. Average annual metal price (commodity A) at LME in GBP/USD per ton (Cash) was as follows:

Commodity / Year		1992	1993	1994	1995	1996
A	GBP	1297	1358	-	-	-
	USD	-	1789	2312	2936	2289

9. Recycling

Copper belongs to metals which are recycled on a large scale. The volume of recycled copper reached about 18 % of total world metal production in 1994. Copper is recovered mainly through pyrometallurgical processes, to lesser extent through hydrometallurgy.

10. Possible substitutes

Aluminium replaces copper in electrotechnics, in the manufacture of car radiators and refrigerators. Titanium and steel substitute for copper in the manufacture of heat exchangers regardless of their worse conductivity. Steel substitutes for copper in the manufacture of ammunition. Other substitutes are represented by optical fibres in telecommunication and plastics in water distribution and the building industry.

LEAD

1. Characteristics and use

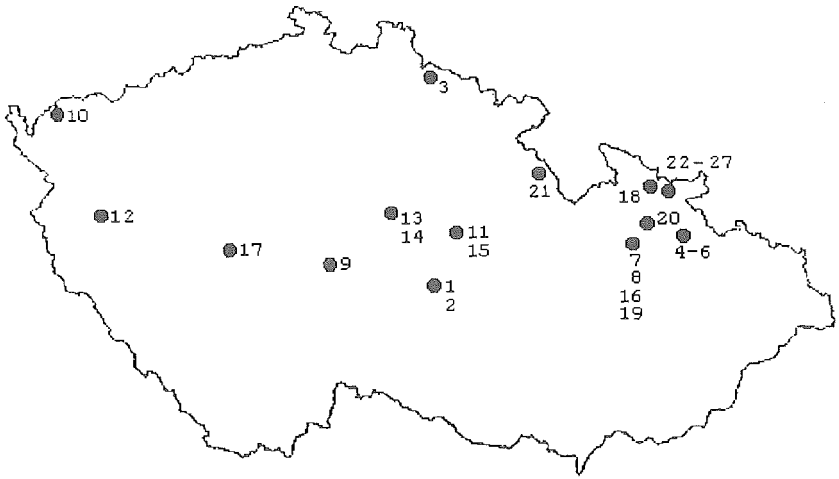
Lead is a soft, silvery lustrous metal melting at 327.4° C and with a specific gravity of 11.34 t/m^3. Lead deposits are of four genetic types - sedimentary, metasomatic, contact metamorphic and hydrothermal (veins). Major part of the world production comes from the first type. The principal economic mineral is galena, usually accompanied by sphalerite, pyrite and chalcopyrite. Extracted ores are mostly of polymetallic character with various contents of minor metals - Cd, Ge, Ga, In, Tl, Ag and Au. The ore is marked as lead ore providing the Pb:Zn ratio is >4. Economic demonstrated reserves of Pb metal in the world are estimated at 63 mill.tons, occurring in Australia, USA, China and Canada. Much lead is used in manufacture of batteries (70 %) and lead pigments and chemicals (13 %). Lead is also used in rolled and extruded products, in shielded cables, in alloys, in ammunition, as anti-nock additive in gasoline. High toxicity of lead leads to a reduction of its consumption in some industries; e.g. consumption index in gasoline production 1990/1985 was equal to 0.64.

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, the glory was due to silver occurring in these ores which were later in 16th century used for extraction of lead and then even for zinc. After World War II, new exploration projects turned the attention to volcaniclastic deposits of the pyrite formation.

- Hydrothermal base metal mineralizations are abundant in the Bohemian Massif. Besides medieval ore districts of Jihlava, Havlíčkův Brod, the Blanice furrow and others, the mining districts of Příbram, Stříbro and Kutná Hora maintained their significance till the 20th century. The major Pb mineral is galena (more or less Ag-bearing) which represents the principal compound 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 occurs at Harrachov where galena is accompanied by barite and fluorite.
- Stratabound base metal ores of volcaniclastic 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 and some deposits of the Zlaté Hory ore district. Contents of lead varying around 0.5 % are confined to galena accompanied by banded sphalerite. Mining of some other base metal deposits of similar origin has not started because of reduction of ore mining.

3. Registered deposits and their location in the Czech Republic



1 Bartoušov
2 Bleigrund
3 Dlouhá Ves
4 Harrachov
5 Horní Benešov
6 Horní Benešov 11th-13th levels
7 Horní Benešov-revision
8 Horní Město
9 Horní Město-Šibenice
10 Hříva near Louňovice
11 Křižanovice
12 Kšice
13 Kutná Hora
14 Kutná Hora - the Grunta zone
15 Liboměřice
16 Oskava
17 Příbram - base metals
18 Rejvíz
19 Ruda-north
20 Soukenná
21 Zdobnice-Čertův Důl
22 Zlaté Hory-Heřmanovice-Cu,Pb,Zn
23 Zlaté Hory-Heřmanovice-Pb,Zn
24 Zlaté Hory-Heřmanovice-Cu
25 Zlaté Hory-east
26 Zlaté Hory-west
27 Zlaté Hory-west -550m

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	31	30	26	27	27
exploited		3	1	0	0	0
Total reserves, kt Pb		272	257	257	270	270
economic proven		18	15	15	17	17
economic probable		90	62	62	62	62
subeconomic		164	180	180	191	191
Mining output, t Pb		1100	100	0	0	0
Imports, t	b)	0	0	0	0	1
Exports, t	b)	393	156	0	110	0

Note:
a) deposits with balanced Pb content
b) item 2607 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2607	Lead ores and concentrates	free	free

6. Mining companies in the Czech Republic as of December 31, 1996
In 1996 no companies were operating in the Czech Republic to extract ores with Pb content.

7. World production
The world output exceeded in 1968 the level of 3 mill.tons of metal content. So far the largest production was recorded in 1977 - 3,657 kt. The major producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt Pb	3224	2752	2698	2800	2800

Main producers (1994):

Australia	18.7%
USA	13.5%
China	13.0%
Peru	7.8%
Mexico	6.5%
Canada	6.4%

8. World market prices

On the world market, the price of lead concentrate of grade 70/80 % Pb is quoted in USD/t, CIF Europe (commodity A) and on T/C basis. The price of concentrate exceeded a limit of USD 100 per ton at the end of 1987 and since then it has been kept above this level. Metal price at LME (commodity B, refined metal having min. 99.97 % Pb) reached its peak in 1979 - GBP 556 per ton (Cash). The price was quoted by June 1993 in GBP/t and in the next period in USD/t.

An average price of commodity A at yearend and an average annual price of commodity B per ton:

Commodity / Year		1992	1993	1994	1995	1996
A		175	175	140	140	168
B	GBP	306	274	-	-	-
	USD	-	399	549	630	774

9. Recycling

The share of recycled lead in world production of Pb metal continues to increase. This trend leads to a decrease in demand for lead concentrates and also affects their prices. Due to much lead consumption in the battery production, batteries thus 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. In recycling shared USA with Germany, France, United Kingdom, Japan and Canada in the main.

10. 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. Lead in the manufacture of pigments is also efficiently replaced by other agents. The volume of lead substitutes continues to increase and will include even the manufacture of batteries. Lead in solders is being replaced by tin.

ZINC

1. Characteristics and use

Zinc is a grey, soft and malleable metal melting at 419.5°C, and with a specific gravity of 7.14 t/m^3. 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 >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 origin which are similar to those of lead. Economic demonstrated reserves of Zn content in the world are estimated at 144 mill.tons. Potential source of zinc may be also zinc bearing coal in which the content of zinc is estimated at an order of a few millions of tons. Much zinc is used in zinc plating (47 %), in alloys (particularly brass - 19 %), in castings (14 %), in rolled materials for the building industry and manufacture of batteries (7 %), etc. As for the volume, zinc represents the 3rd mostly used non-ferrous metal after aluminium and copper.

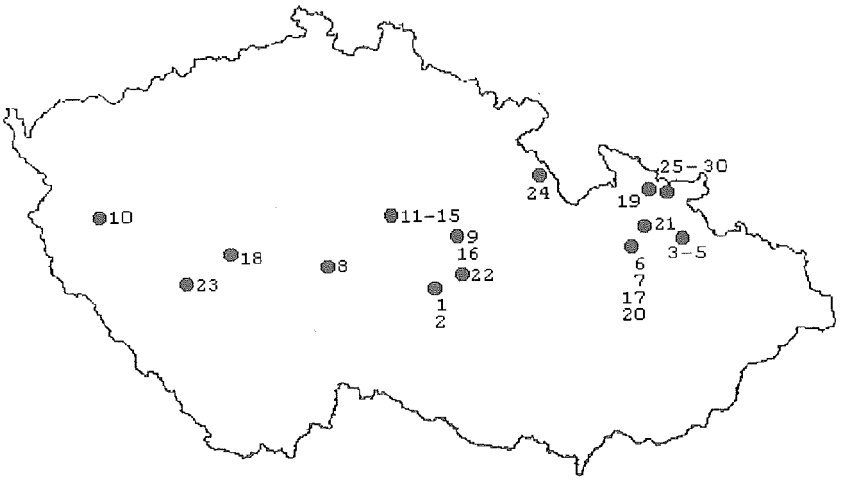
2. Mineral resources of the Czech Republic

Zinc ores almost exclusively occur as a part of base metal ores Pb-Zn±Ag (±Cu) of hydrothermal or volcaniclastic origin.

- Large volume of zinc ores represented mostly by sphalerite was extracted from the base metal deposits of the Březové Hory, Bohutín and Vrančice ore districts in the vicinity of Příbram. Zinc ores were also verified in historical as well as in newly explored vein type deposits. The grade of these ores varied between 1.0 and 2.9 %.
- The most important deposits of volcaniclastic origin occur in the Jeseníky mountains. Disseminated sulphide ores grading 0.7-1.4 % Zn were mined in the deposits of Horní Město (till 1970) and Horní Benešov (till 1992). Mining operations in the Zlaté Hory ore district were terminated in 1993.
- The deposit of Staré Ransko - Obrázek is of enigmatic origin. A sphalerite-barite ore, having up to 2 % Zn was mined until 1990. The Křižanovice deposit of Pb-Zn-Cu ores with barite is classified as volcaniclastic mineralization. The ore contained about 6-7 % Zn. The deposit was discovered during execution of an exploration project in the eighties.

The extraction of Zn ores in the Czech Republic was terminated according to the policy of gradual reduction of ore mining adopted by the Government. A composite Pb-Zn concentrate was the final product when mining the base metal ores. The concentrate was exported because there was no smelter in the Czech Republic.

3. Registered deposits and their location in the Czech Republic



1 Bartoušov
2 Dlouhá Ves
3 Horní Benešov
4 Horní Benešov, 11th-13th levels
5 Horní Benešov-revision
6 Horní Město
7 Horní Město-Šibenice
8 Hříva near Louňovice
9 Křižanovice
10 Kšice
11 Kutná Hora
12 Kutná Hora, the Grunta zone
13 Kutná Hora, the Hlouška zone
14 Kutná Hora, Old Bohemian zone
15 Kutná Hora, the Turkaňk zone
16 Liboměřice
17 Oskava
18 Příbram - base metals
19 Rejvíz
20 Ruda-north
21 Soukenná
22 Staré Ransko-Obrázek
23 Újezd near Kasejovice
24 Zdobnice-Čertův Důl
25 Zlaté Hory-Heřmanovice - Cu, Pb, Zn
26 Zlaté Hory-Heřmanovice - Pb, Zn
27 Zlaté Hory-Heřmanovice - Cu
28 Zlaté Hory-east
29 Zlaté Hory-west
30 Zlaté Hory-west-550 m

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	35	33	29	30	30
exploited		3	1	0	0	0
Total reserves, kt Zn		968	924	924	1036	1036
economic proven		70	44	44	75	75
economic probable		406	234	234	234	234
subeconomic		492	646	646	727	727
Mining output, t Zn	b)	4400	1500	100	0	0
Imports, t	c)	26	0	4	0	1
Exports, t	c)	9841	0	0	1800	0

Note:
a) deposits with balanced Zn content
b) mining output in the course of liquidation works of the Zlaté Hory deposit in 1994
c) item 2608 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2608	Zinc ores and concentrates	free	free

6. Mining companies in the Czech Republic as of December 31, 1996
In 1996 no companies were operating in the Czech Republic to extract Zn ores.

7. World production
Production of zinc ores in metal content exceeded 7 mill. tons in 1985. Increase in production stopped in 1992 and in the next years mine output has been declining. Large increase in stock and raise of recycled metal share in the total production which covered raise in demand were the cause of the above mentioned decline. The major producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt Zn	7257	6855	6307	6500	7000

Main producers (1994):

Australia	15.1%
China	12.0%
Canada	10.9%
Peru	10.8%
USA	9.0%
Mexico	5.7%

In 1996 there was a surplus of zinc concentrates in the world market as their production exceeded smelter capacities.

8. World market prices

Since 1992 two grades of zinc concentrate have been quoted on the world market - sulphide concentrate grade 49/55 % Zn (commodity A) and sulphide concentrate grade 56/61 % Zn (commodity B) in USD/t of dry substance, in transport parity CIF main European ports and on the T/C basis. The price of pure metal grading 99.995 % Zn (commodity C) is quoted at LME in USD/t. The price of sulphide concentrates (different in quality than above mentioned) and pure metal reached its peak in 1989. Later on an expressive fall in prices occured owing to a continuous increase in stock. A trend in average prices of the commodities (A and B - yearend, C - annual) was as follows:

Commodity / Year	1992	1993	1994	1995	1996
A	189	209	172	172	189
B	192	212	173	173	190
C	1239	960	998	1030	1025

9. Recycling

Zinc scrap - metal scrap, galvanized plate, 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.

10. Possible substitutes

Zinc in foundries is replaced by aluminium, plastics and magnesium. Galvanic zinc plating is replaced by coatings of aluminium alloys, pigments, plastics and cadmium. Zinc plates are completely replaced by other materials like stainless steel, aluminium, plastics etc. Aluminium alloys substitute for brass. Zinc is also successfully replaced by other materials in the manufacture of chemicals, electronic devices and pigments.

TIN

1. Characteristics and use

Tin is a soft, silvery white metal melting at 231.9° C and with specific density of 7.3 t/m^3. Tin was concentrated at the end of the magma differentiation and its deposits are related to granitic rocks and their effusive equivalents. The only economic mineral of tin is cassiterite which contains as much as 78 % Sn. The majority of tin come from placer deposits whereas hard rock 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 flowing water over the river bed are most important and the richest ones among the secondary deposits. World economic reserves are estimated at 8 mill.tons of metal.

The majority of tin are used in solders (35 %), tin plates (25 %) and production of chemicals (15 %), then in alloys (bronze) etc.

2. Mineral resources of the Czech Republic

Tin deposits of the Czech Republic are almost exclusively concentrated in the Krušné hory mountains region where they were mined since 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 granits high in lithium and topaz. The major Sn mineral is cassiterite which is disseminated in the greisen bodies and usually accompanied by wolframite and zinwaldite. The Krupka ore district is also characteristic of abundant hydrothermal quartz veins with cassiterite, wolframite and/or Bi and Mo minerals. Sn-W ores with 0.2 - 0.5 % Sn were mined in greisen type deposits.
- An interesting type of Sn mineralization occurs at Zlatý Kopec near Boží Dar where tin minerals are confined to a complex skarn consisting of major magnetite accompanied by minor cassiterite, sphalerite and chalcopyrite. The complex ore shows 0.95 % Sn.
- Basically, the only deposit of primary Sn ores outside the Krušné hory 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 showed an average content of 0.23 % Sn in the ore. Sn mineralization consisting of stannite was found to occur at the Old Bohemian zone of the Kutná Hora mining district. Due to the complex character of the ore, the Sn mineralization is of rather scientific importance, particularly from the viewpoint of metallogeny and specific mineral assemblage.

Placer deposits near the primary ores of the Krušné hory region are exhausted. Only some Sn-W placers in the Slavkovský les area have been preserved and appear to be still economic and mineable.

3. Registered deposits and their location in the Czech Republic

1 Boží Dar-Zlatý Kopec
2 Cínovec-south
3 Cínovec-north-open pit
4 Cínovec-old shaft
5 Čistá-Jeroným
6 Horní Slavkov-the Hány elevation
7 Krásno
8 Krásno-Horní Slavkov
9 Krásno-Koník
10 Krupka 1
11 Krupka 4
12 Nové Město pod Smrkem
13 Přebuz 1
14 Rolava-east

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	14	13	13	14	14
exploited		0	0	0	0	0
Total reserves, t Sn		203087	203087	203087	234913	234913
economic proven		3757	3757	3757	3757	3757
economic probable		37266	37266	37266	37266	37266
subeconomic		162064	162064	162064	193890	193890
Mining output, t Sn		0	0	0	0	0
Imports, t	b)	1998	0	0	0	1
Exports, t	b)	0	5	0	0	0

Note:
a) Sn-W ore deposits
b) item 2609 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2609	Tin ores and concentrates	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

There were no mining companies operating on the territory of the Czech Republic to extract ores with Sn content.

7. World production

The world production of tin concentrates continues to be in long run around 200 kt of Sn metal per year. According to statistical data the production reached its peak in 1981 - 238.9 kt. The major producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Concentrate prod., kt Sn	179	177	173	170	170

Main producers (1994):

China	31.3%
Indonesia	17.7%
Brazil	14.5%
Peru	11.6%
Bolivia	9.3%

Tin concentrate production and its export quotas are rather affected by ATPC - members are Indonesia, Bolivia, Malaysia, Australia, Thailand, Nigeria, Zaire, China and since 1995 also Brazil. ATPC originated one year after the tin world market crisis in autumn 1985. A program of voluntary restricted export was prolonged in 1995 up to July 1996.

8. World market prices

Three grades of tin concentrate are quoted on the world market: 40/60 % Sn (30/50 % up to 1994 - commodity A), 60/70 % Sn (50/65 % up to 1994 - commodity B), and 70/75 % Sn (65/75 % up to 1994 - commodity C) in GBP/t CIF Europe on the T/C basis - and pure metal grading 99.85 % Sn (A Grade) quoted at LME in USD/t Cash (commodity D). Prices of tin concentrates at yearend and an average annual price of pure metal were as follows:

Commodity / Year	1992	1993	1994	1995	1996
A	425	425	425	375	525
B	450	450	450	338	375
C	462	462	462	275	345
D	6105	5147	5462	6217	6167

9. Recycling

Only a small quantity of tin is recycled, particularly that of tin removed from tin plate (by the process economically pretentious). According to the UNCTAD data 10 % of the tin world consumption has supplied the recycled metal only.

10. Possible substitutes

Aluminium, glass, stainless steel, paper and plastic foils are the major substitutes for tin in the food industry. Multicomponent epoxy resins continue to be largely used instead of solders. Tin alloys are replaced by Cu and Al alloys or by plastics. Some chemicals are replaced by Pb and Na compounds.

TUNGSTEN

1. Characteristics and use

Tungsten is a silvery grey and very hard metal exhibiting the highest melting point of all metals - 3,410°C and with a specific density of 19.3 t/m^3. It also shows the highest tensible streght of all metals at temperatures over 1,650°C. High concentrations of tungsten are always related to granites. Tungsten ores are confined to pegmatite, greisen and pneumatolitic deposits related to acid granitoid intrusions. Tungsten ores often occur together with Sn, Mo, Cu and Bi ores. Among the known tungsten minerals, only wolframite (having as much as 75 % WO_3) and scheelite (up to 80 % 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 economic reserves of tungsten ores are estimated at 40 mill. tons, of which 40 % occur in China.

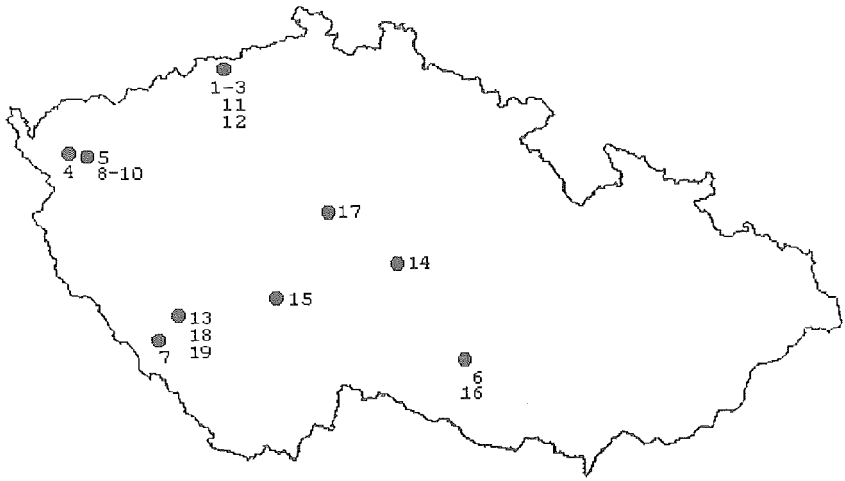
Tungsten ores and concentrates are processed to obtain intermediate products - ammonium paratungstate (APT),tungstic acid, sodium tungstate, metal powder and powder tungsten carbide. Much tungsten is consumed in alloyed steels used in heavy machine industry, particularly in the armament industry. Much tungsten is also used in the manufacture of cutting tools and tools for oil and gas exploitation and mining of solid minerals (drilling bits made of tungsten carbide). About 80 % W is consumed in the afore mentioned fields. Some tungsten is used in electrotechnics and electronics.

2. Mineral resources of the Czech Repnblic

Wolframite concentrate was obtained as a by-product during the mining and processing of greisen Sn-W ores of the Cínovec and Krásno mining districts of the Czech Republic. Besides that, numerous occurrences of scheelite and wolframite mineralizations were found and verified in various places of the Bohemian Massif, particularly during the last few years.

- Greisens rich in Sn (Krásno, Cínovec) as well as 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 Krupka 4 deposit showed up to 0.1 - 0.2 % W. A tungsten mineralization is known from quartz veins and stringers at Rotava and disseminated scheelite in erlans of Vykmanov near Perštejn.
- Typical contact metasomatic scheelite mineralization occurs in the exocontact of the Krkonoše-Jizerské hory and Žulová plutons. However, known localities of Obří důl and Vápenná are of no economic importance.
- Numerous localities of W-ores were found in the Moldanubicum of the Bohemian Massif. They are represented by quartz veins with wolframite and/or scheelite which mostly occur along the exocontacts of the Variscan granitoids and disseminated or vein scheelite confined to erlans. Some localities represent rather larger strataboud deposits of scheelite bearing crystalline schists and/or skarns. So far the most important stratabound deposit of Au-W ores is located at Kašperské Hory. Disseminated and banded scheelite occurs there in silicified layers overlying gold bearing quartz veins. An average W content of the ore is 1.32 %.
- Introduction of more sophisticated exploration methods allowed to discover numerous localities of W ores in the Czech Republic, mostly of enigmatic origin. In contrast to previous 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.

3. Registered deposits and their location in the Czech Republic



1 Cínovec-south
2 Cínovec-north-open pit
3 Cínovec-old shaft
4 Čistá-Jeroným
5 the Hány elevation
6 Hostákov
7 Kašperské Hory
8 Krásno
9 Krásno-Horní Slavkov
10 Krásno-Koník
11 Krupka 1
12 Krupka 4
13 Malý Bor-k.462
14 Nezdín
15 Sepekov
16 Slavice
17 Tehov
18 Týnec-Hliněný Újezd-E
19 Týnec-Hliněný Újezd-W

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	17	18	18	19	19
exploited		0	0	0	0	0
Total reserves, t W		50723	92298	92298	95120	95120
economic proven		127	127	127	127	127
economic probable		10913	52488	52488	52488	52488
subeconomic		39683	39683	39683	42505	42505
Mining output, t W		0	0	0	0	0
Imports, t	b)	47	0	0	0	11
Exports, t	b)	0	34	119	94	128

Note:
a) Sn-W and W ore deposits
b) item 2611 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2611	Tungsten ores and concentrates	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

In 1996 there were no mining companies on territory of the Czech Republic to extract ores with W content.

7. World production

World production of tungsten metal in ores and concentrates exceeded 40 kt/year in 1970 and reached the peak in 1989 - 52 kt . Afterwards a drop in prices occured connected with a limitation in demand on the world market arising from the economic recession and from structural changes in main consumer branches. The major W-ore and W-concentrate producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Production, kt W	34	28	21	23	25

Main producers (1994):

China 77.6%

Russia 9.7%

8. World market prices

Among all on the world market traded W raw materials (ores, concentrates, oxides, hydroxides, tungstenites, FeW, tungsten carbide and raw W), the ores and concentrates represented the major share of the trade. The price of wolframite - standard, grading min. 65 % WO_3 - on the world market was quoted in USD/mtu WO_3, CIF Europe (commodity A). Quotation of scheelite was abandoned in 1992 due to small scope of trade. Quoted price now includes both types of ore. The price peak was reached in 1977 - USD 180 per mtu WO_3. The subsequent drop in price is assumed to have been caused by global economic recession and particularly by a surplus of cheep Chinese wolframite whose import was restricted in some countries which imposed high antidumping import taxes. Of other W raw materials ammonium paratungstate (APT) powder (commodity B) - quoted on the European free market in USD/mtu W - has been achieving a significant position. The average prices of both commodities (wolframite at yearend and APT in annual average) are as follows:

Commodity / Year	1992	1993	1994	1995	1996
A	45	33	54	58	48
B	56	38	66	84	67

9. Recycling

Recycling of W is carried out only in the USA, Japan and Western Europe. According to incomplete data, recycling accounts for 20-30 % of the total metal production.

10. 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 electrotechnics. Some attempts were made during the period of the tungsten price rise to replace W by molybdenum 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 particularly in less exposed fields where the price of tungsten and tungsten carbide plays a decisive role.

ANTIMONY

1. Characteristics and use

Antimony is a silvery white metal characteristic of poor electric and heat conductivity, melting at 630° C, and with a specific density of 6.68 t/m^3. Its behavior is chalcophile and it occurs mostly together with sulphur, copper, lead and silver in hydrothermal low temperature sulphide deposits. Among more than 100 known antimony minerals only stibnite Sb_2S_3 is of economic importance. The minerals occurs either separately or in complex deposits together with pyrite, arsenopyrite, cinnabar, scheelite, antimony sulphosalts and sulphides of Cu, Pb, Zn and Ag. Complex ores are mined particularly for Au, Ag, Pb, Zn and W. The content of Sb in extracted ores is as much as 60 %. World economic reserves are estimated at 5 mill. tons and their largest volume is in China.

Much antimony is used in the manufacture of compounds for production of plastics where it acts as stabilizing agent and self-extinguishing additive (10 % of total consumption). Another application of antimony is in alloys with lead which are used in batteries, ammunition, solders, building materials, cables, bearings, type metal, ceramics and glass.

2. Mineral resources of the Czech Republic

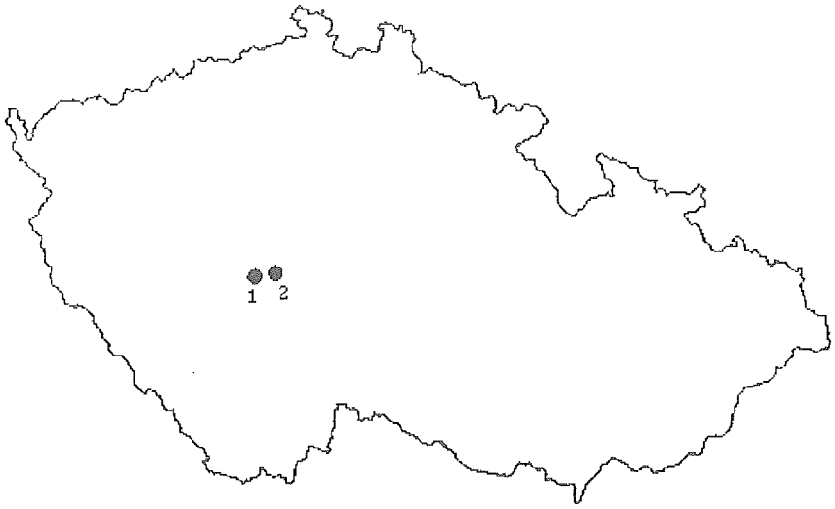
Occurrences of Sb ores in the Bohemian Massif are spatially bound to the Central Bohemian pluton. Hydrothermal Sb mineralization is confined to quartz veins or silicified mylonite zones or eventually forms fillings in fractures of lamprophyric dike rocks.

▩ Quartz veins with massive stibnite, accompanied with native gold and aurostibite occur in the Krásná Hora-Milešov ore district. The ore contains about 2.2 % Sb and 4 ppm Au. The content of Au varies considerably and appears to be increasing with depth whereas the content of Sb decreases. Medieval mining for gold was followed by extraction of Sb-Au ores which started in the second half of 18th century and which continued, with some breaks, until 1992.

▩ Poor mineralization (0.3 % Sb) is known from the neighboring Příčov ore district (the Deštno deposit) which was mined in the previous century. Economic and important concentrations of Sb occurred in the Klement vein of the abandoned deposit of Bohutín near Příbram. Other Sb occurrences of the Bohemian Massif are subeconomic and represent rather mineral indications.

Antimony ores in the Czech Republic are not mined anymore, following the termination of mining activities at Krásná Hora. The only potential source of antimony is represented by the Deštno deposit which was explored in 1983.

3. Registered deposits and their location in the Czech Republic



1 Krásná Hora
2 Deštno

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

Year		1992	1993	1994	1995	1996
Deposits - total number		2	2	2	2	2
exploited		1	0	0	0	0
Total reserves, t Sb		4009	4009	4009	4009	4009
economic proven		0	0	0	0	0
economic probable		153	153	153	153	153
subeconomic		3856	3856	3856	3856	3856
Mining output, t Sb		224	0	0	0	0
Imports, t	a)	0	13	2	0	0
Exports, t	a)	3326	0	0	48	0

Note:
a) item 2617 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2617 10	Antimony ores and concentrates	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

No mining companies were operating on the territory of the Czech Republic to extract antimony ores in 1996.

7. World production

The world output of Sb metal in ores and concentrates, reached so far its highest peak in 1988 and 1989, when it exeeded 75 kt Sb. Later on a drop in mining output occured in most producing countries. The major producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt Sb	44	48	52	54	55
Main producers (1994):					
China 47.9%					
Bolivia 13.5%					
Russia 13.4%					
South Africa 8.7%					

World mining capacity reached about 100 kt Sb in 1995.

8. World market prices

Three grades of antimony ores are quoted on the world market - pure sulphide concentrate 60 % Sb (commodity A), lump sulphide ore 60 % Sb (commodity B) and Chinese concentrate 60 % Sb (Se 60 ppm, Hg 30 ppm max. commodity C). Prices are quoted in USD/mtu Sb, CIF Europe. Also a price of pure metal (Regulus 99.6 % Sb) was quoted on the European free market in USD/t of stock. The average prices at yearend (pure metal annual average) were as follows:

Commodity / Year	1992	1993	1994	1995	1996
A	14.75	14.50	35.00	30.00	19.50
B	15.25	15.00	37.50	33.00	20.50
C	12.50	12.00	27.50	26.50	18.50
D	1708.00	1624.00	3830.00	4039.27	2831.07

9. Recycling

Mostly antimonial lead used in the manufacture of batteries, type metal and antifriction metal are recycled.

10. Possible substitutes

Antimony can be replaced by compounds of titanium, zinc, tin, chrome, zircon, lead and strontium in production of chemicals, pigments, fritted glass and glazes. Combinations of calcium, strontium, tin, copper, selenium, sulphur and cadmium can be used for hardening of lead instead of antimony. Selected organic compounds, asbestos, borates, bromine, chromite, diatomite, magnesite, pearlite, phosphates, pumice, vermiculite and hydrated alumina can be used to replace antimony in the manufacture of self-extinguishing additives.

SILVER

1. Characteristics and use

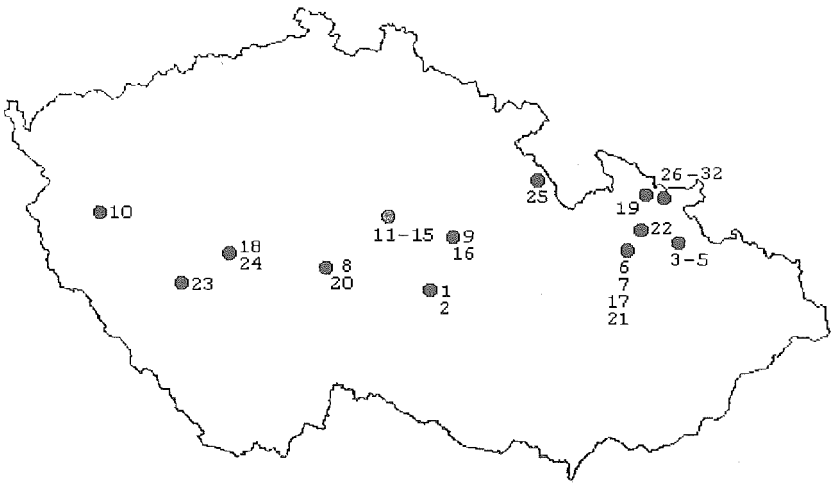
Silver is a white, glossy, relatively soft metal melting at 960° C and with specific density of 10.5 t/m^3. It exhibits the highest heat and electric conductivity among all metals and it is extra resistant against atmospheric oxidation and against corrosion in diluted acids. Silver is an element of chalcophile 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 Cu and Pb-Zn deposits of various origin. Remaining 1/3 of Ag occurs in hydrothermal vein deposits where it is the major economic element. The major silver bearing minerals are argentite, hessite, Ag-galena, kerargyrite, polybasite, pyrargyrite, stromeyerite, sylvanite and tetrahedrite (freibergite). Silver fineness is expressed in thousands of total metal; sterling silver, its commenest alloy, consist of 95.5% silver (fineness of 925/1000). World economic reserves of silver metal are estimated at 300 kt. Majority of silver was used (1995) in photography (29 %), in jewelry and table plate ware (30 %), in electrotechnics and electronics (15-17 %), in mints (3 %), in alloys for brazing (5 %), in batteries, mirrors and special reflecting surface coatings (to absorb solar energy), in catalysts (for production of formaldehyde from methanol and conversion of ethylene to ethylenoxide). Silver is also used in medicine and in nuclear power generation to produce control rods 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 prosperity of old mining towns.

- The major portion of silver reserves in the Czech Republic occurs in base metal sulphide deposits where it forms an isomorphous admixture particularly in galena. Minimum Ag grade was found to occur in all base metal deposits, e.g. 8-20 ppm Ag in base metal ores of the Horní Benešov deposit, 15 ppm Ag at Zlaté Hory - east, 15-22 ppm Ag at Horní Město, 30-50 ppm at Kutná Hora, etc. Some Ag was extracted as a by-product when mining for high grade base metal 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-base metal deposit until the mining operations were reduced or ceased completely in the early nineties.
- Numerous recently abandoned deposits of Pb-Zn-Ag and deposits of so-called five element assemblage in medieval mining districts of Kutná Hora, Jihlava, Příbram, Jáchymov and Stříbro were an important source of European silver in the past. The deposits represent classic types of base metal and other metallic deposits.

3. Registered deposits and their location in the Czech Republic



1 Bartoušov
2 Dlouhá Ves
3 Horní Benešov
4 Horní Benešov 11th-13th level
5 Horní Benešov-revision
6 Horní Město
7 Horní Město-Šibenice
8 Hříva u Louňovic
9 Křižanovice
10 Kšice
11 Kutná Hora
12 Kutná Hora-Gruntecké zone
13 Kutná Hora-Hloušecké zone
14 Kutná Hora-Staročeské zone
15 Kutná Hora-Turkaňské zone
16 Liboměřice
17 Oskava
18 Příbram - base metals
19 Rejvíz
20 Roudný-Aleška
21 Ruda-north
22 Soukenná
23 Újezd near Kasejovice
24 Vrančice
25 Zdobnice-Čertův Důl
26 Zlaté Hory-Heřmanovice-Cu,Pb,Zn
27 Zlaté Hory-Heřmanovice-Pb,Zn
28 Zlaté Hory-Heřmanovice-Cu
29 Zlaté Hory-Kozlín
30 Zlaté Hory-east
31 Zlaté Hory-west
32 Zlaté Hory-west 550m

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	39	36	32	33	32
exploited		3	1	0	0	0
Total reserves, t Ag		1111	1090	1090	1115	1035
economic proven		19	8	8	13	8
economic probable		433	403	403	403	344
subeconomic		659	679	679	699	683
Mining output, kg Ag	b)	6200	500	100	0	0
Imports, t	c)	107	0	0	0	0
Exports, t	c)	4	0	0	0	0

Note:
a) deposits with balanced Ag content
b) mining output in the course of liquidation works of the Zlaté Hory deposit in 1994
c) item 2616 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2616 10	Silver ores and concentrates	free	free

6. Mining companies in the Czech Republic as of December 31, 1996
In 1996 there were no mining companies operating on the territory of the Czech Republic to extract ores with Ag content.

7. World production
The world output exceeded 10,000 t per year in 1976. Since then it was increasing and reached its peak in 1989 - 15,835 t. The major producing countries were as follows (according to the Welt-Bergbau-Daten and Gold Fields Mineral Services 1995):

Year	1992	1993	1994	1995	1996 e
Mining output, t Ag	14236	13983	13800	14581	14600

Main producers:

Mexico	15.9%
Peru	13.1%
USA	10.6%
Canada	8.3%
Chile	7.1%
Poland	6.7%
Australia	6.3%

Only about 17% of silver was obtained by mining and silver ore dressing. Majority of silver was a byproduct of dressing of copper (27%), lead-zinc (41%) and gold bearing (15%) ores. Extracted silver covered about 60% of consumption. Mining output should increase 4% a year up to 1999 according to the 1996 Silver Institute Prognosis.

8. 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. An average annual price trend in GBp per troy oz (commodity A) is given in a summary as follows:

Commodity / Year	1992	1993	1994	1995	1996
A	224	333	345	329	334

Fluctuations in silver world prices reflect among others political situation and speculations on the market identical with other precious metals.

9. Recycling

Recycling of silver which is technologically a very simple operation, dramatically dropped in the early nineties to about one half of recycled Ag in the same period of the eighties. The drop in recycling is attributed to low prices of silver, its lower content in secondary raw materials and restrictive measures in stockpile policy.

10. Possible substitutes

Silver is efficiently replaced in numerous fields. Photomaterials are produced with lower content of silver or without silver at all. Photography continues to be largely replaced by xerography and electronic displays. 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 dental alloys are replaced by ceramic materials. Sterling silver was, except memorial mints and several exceptions (i.e. Mexico put again in circulation silver coins in 1992), replaced by common metals, particularly by Cu alloys.

GOLD

1. Characteristics and use

Gold is a yellow, malleable metal melting at 1,063°C and having a specific density of 19.3 t/m^3. It exhibits an excellent electric conductivity and resistance against atmospheric corrosion. Gold tends to concentrate in late magmatic products during the magmatic evolution. It occurs in hydrothermal, hydrothermal-metamorphic, metamorphic and metasomatic deposits. Secondary deposits - recent and fossil placers - resulted from chemical and physical weathering processes. Gold occurs in the form of native metal, in a natural alloy with silver (electrum) and other metals and/or in the form of tellurides. It occurs in sulphides of antimony, arsenic, copper, iron and silver. During their processing and smelting, gold is recovered as a by-product. The grade or fineness of gold is given in carats or in 1000 units (fine gold 24 carats = 1000, 10 carats = 10/24 = 41.7 % = 417/1000). Total economic world reserves are estimated at 75 kt of Au, of which 15 to 20 % occur as a minor constituent in other ore deposits. The majority of reserves (50 %) are concentrated in South Africa.

Much gold (1993) is used in jewelry (84 %), then in electrotechnics (6 %), in medals and coins (5 %), in dentistry (2 %), in special alloys for the aircraft (particularly armament) industry, in reflectors of infrared radiation, 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.

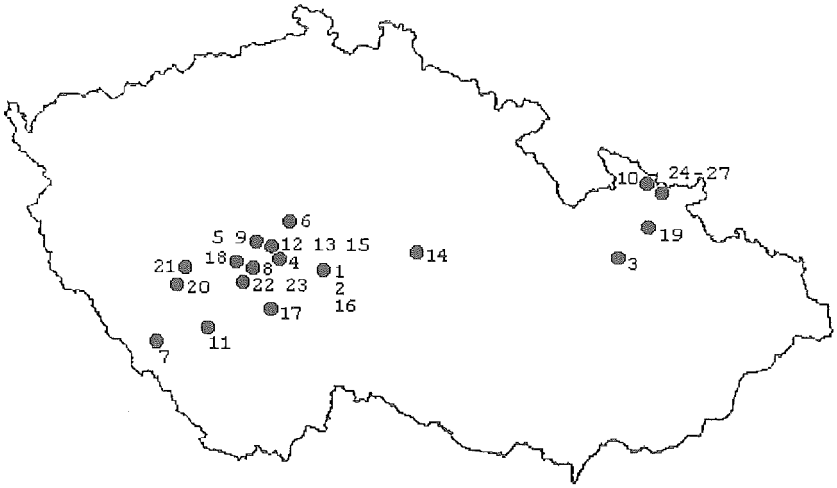
- The major part of gold mineralization is confined to regionally metamorphosed volcaniclastic complexes locally penetrated by Variscan granitoids. Such a complex in the central Bohemian region is represented by the Jílové zone of the Proterozoic age. The zone is characteristic of abundant gold-quartz mineralization which occurs in the 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-west).
- Some hydrothermal quartz veins with gold as well as stratabound gold mineralization with scheelite (Kašperské Hory) and quartz veins and stringers with Ag (Roudný) occur in the crystalline complex of the Moldanubicum.
- Placer gold deposits are close to the primary gold deposits. Permocarboniferous paleoplacers occur in western Bohemia (Křivce) as well as in the Krkonoše piedmont and in tbe Intrasudeten basins. The largest areas of Quaternary placers are located in the foothills of the Šumava mountains and in northern Moravia. 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 termination of mining operations at the Krásná Hora Au-Sb deposit in 1992 and at the Zlaté Hory-west base metal deposit in 1993.

In 1994 an international invitation to tender "Exploration for Gold in the Czech Republic" was realized. Six companies win with their bids to explore 17 areas with the total area 2,093 km^2.

For several years a geological exploration has been accompanied by protest activities of individuals, municipalities and civil associations with the aim to stop mining of primary deposits and following cyanide leaching. In 1996 protests were during the Kašperské Hory deposit exploration. There appeared the chance of dressing the relatively rich goldbearing ore by gravity dressing and flotation.

3. Registered deposits and their location in the Czech Republic



1 Bořkovice-Roudný-Aleška
2 Bořkovice-Roudný-Danica
3 Břevenec
4 Deštno
5 Dražetice-adit no.IV
6 Jílové near Prahy
7 Kašperské Hory
8 Krásná Hora
9 Libčice
10 Mikulovice
11 Modlešovice
12 Mokrsko
13 Mokrsko-east
14 Podmoky
15 Prostřední Lhota-Čelina
16 Roudný-Zvěstov
17 Sepekov
18 Smolotely-Horní Líšnice
19 Suchá Rudná-central part
20 Újezd near Kasejovice
21 Vacíkov
22 Voltýřov
23 Voltýřov-placer
24 Zlaté Hory-east
25 Zlaté Hory-west
26 Zlaté Hory-west 550m
27 Zlaté Hory-Zlatý Potok

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

Year	1992	1993	1994	1995	1996
Deposits - total number	20	21	20	27	27
exploited	3	1	0	0	0
Total reserves, kg Au	172569	214482	214407	253166	249660
economic proven	51146	48740	48740	52139	48740
economic probable	51528	84751	84751	84751	86600
subeconomic	69895	80991	80916	116276	114320
Mining output, kg Au a)	521	512	75	0	0
Imports, kg b)	1066	10979	2312	2463	3388
Exports, kg b)	7	8605	1671	2329	4693

Note:
a) deposits with balanced Au content
b) item 7108 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2616	Precious metal ores and concentrates		
2616 90	- Others	free	free
7108	Gold in unwrought or in semi-manufactured form, gold powder	0 - 5	0 - 3.6

6. Mining companies in the Czech Republic as of December 31, 1996

In 1996 there were no mining companies operating on the territory of the Czech Republic to extract ores with Au content.

7. 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 1993 with an output of 2290 tons of metal. The major producing countries were as follows (according to Gold Fields Mineral Services Ltd):

Year	1992	1993	1994	1995	1996 e
Mining output, t Au	2233	2290	2280	2272	2328

Main producers (1995):

South Africa	23.0%
USA	14.5%
Australia	11.2%
Canada	6.6%
Russia	6.3%
China	6.0%

Mining output should increase according to a 1996 Gold Institute prognosis up to 1999 4% a year.

8. World market prices

As for prices, gold represents a special metal in this respect. Its price is affected by many factors among which speculative trade and global political climate are the most important. Gold is very sensitive to the global political situation. Consequently, the major world stock exchanges 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 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, peak inflation and the onset of the Iraqi Iranian war. The average annual prices fluctuated down to USD 400 per troy oz in London in last 5 years (average p.m. fixing):

Commodity / Year	1992	1993	1994	1995	1996
Gold	343.95	359.82	384.15	384.05	387.70

9. Recycling

Gold is also widely recycled from jewelry and other industries. Recycling may reach as much as 50 % worldwide, even though the data on recycling are rather difficult to obtain.

10. Possible substitutes

The consumption of gold and its alloys in jewelry and electrotechnics is decreasing due to the introduction of parts made of common but gilded metals. Gold can be replaced by palladium, platinum and silver. Gold for monetary storage can be replaced by rhodium which is the most valuable metal. In classic jewelry, however, gold and its alloys are indispensable.

MINERAL FUELS - GEOLOGICAL RESERVES AND MINING OUTPUT

Significant geological reserves of mineral fuels can be found in uranium ores, hard coal and brown coal in the territory of the Czech Republic. Geological reserves of these raw materials have reached a share in percents of the world reserves.

Coal production originated in the Czech countries in the 19th century in the beginning of an industrial revolution. After the 2nd World War uranium ore mining developed. Production of mineral fuels as a whole reached its peak in the second half of eighties and after that a recession came connected with the decline of U-ore and all kinds of coal mining. State grants for damping programs directed at social costs, technical liquidations, savings and reclaimings reached CZK 14,000 mill. in coal industry and CZK 14,400 mill. in uranium industry in 1990-1996. High grants for coal industry damping will continue also in 1997, when the total granted amount will be CZK 5,075 mill. Of mineral fuels the quickest decline affected the uranium ore mining. As to U-ore and coal all requirements of the Czech Republic are secured by the domestic production (hard coal and brown coal are also exported) but the dependence upon oil and gas import reaches nearly hundred-per-cent.

Mining of mineral fuels

Raw material	Unit	1992	1993	1994	1995	1996
Uranium ore	t U	1631	1018	537	611	589
Hard coal	kt	24691	23862	20910	21309	21784
Brown coal	kt	68100	66891	59811	57954	59539
High volat. lignite	kt	1419	1263	913	775	902
Crude oil	kt	80	107	131	149	155
Natural gas	mill.m^3	132	106	154	165	146

Life of industrial reserves (economic proven mineable reserves) consequent the decrease of reserves by output, losses and depreciations in mined deposits per year 1996 (A) and the average annual decrement of reserves in period 1992-1996 (B) was as follows:

Raw material	Life, years	
	A	B
Uranium ore	4	1
Hard coal	21	20
Brown coal	15	12
High volatile lignite	25	12
Crude oil	105	59
Natural gas	11	11

URANIUM

1. Characteristics and use

Uranium with its atomic weight of 238.03 represents the heaviest natural element of the periodic table. It is radioactive with a half-life period of decay equal to 4.5 x 10^9 years. Pure uranium is a white, lustrous metal melting at 1,133° C and exhibiting a specific density of 19.05 t/m^3. Its characteristic property is natural radioactivity of all its isotopes. Relative proportions of single isotopes are as follows: U^{238} = 92.2739 %, U^{235} = 0.7204, U^{234} = 0.057 %. Uranium constitutes several tens of minerals (exclusively oxidic compounds) of which economically most important are oxides (uraninite - pitchblende), phosphates (torbernite, autunite), silicates (coffinite) and organic compounds (anthraxolite). The most important uranium deposits occur in Canada, USA, Zaire, South Africa and Australia. World reserves are estimated at 2.1 mill.tons of uranium metal.

Ores grading 0.1 - 0.002 % U_3O_8 are the minimum metal content of ore which are mined. It depends on the deposit type, volume of reserves and the method of mining. Processed products of U-ore are concentrates of 70 - 90 percentage by weight of uranim oxides.

Uranium concentrates were used primary in dyes, ceramics and glass production. Nowadays uranium is used in fuel elements production, in preparation of radioisotopes for medicine, in crack detection etc. A lot of extracted uranium is stored as nuclear weapon charges.

About 17 % of world electric energy production was generated in nuclear power stations in 1995.

2. Mineral resources of the Czech Republic

Two major periods of the origin of uranium deposits can be distinguished in the Bohemian Massif - Late Variscan and Alpine. The deposits can be classified in 6 morphogenetic types:

- crushed zones with graphite and disseminated uranium ores in crystalline rocks of the Bohemian Massif (Rožná, Zadní Chodov),
- veins and vein systems - hydrothermal deposits related to Variscan granitoids (Jáchymov, Slavkov, Příbram),
- metasomatic mineralization in chloritized granitoids of the Borek massif (Vítkov II, Lhota) and Central Bohemian pluton (Nahošín),
- stratabound mineralization confined to the Late Paleozoic sediments- in coal seams of the Intrasudeten and Kladno-Rakovník basins,
- uranium mineralization in Cretaceous sediments - ore bodies confined to Cenomanian sediments of the Laussicum development of the Bohemian Cretaceous basin,
- stratabound mineralization in Tertiary basins - small deposits in sediments high in organic matter in the broader vicinity of Karlovy Vary.

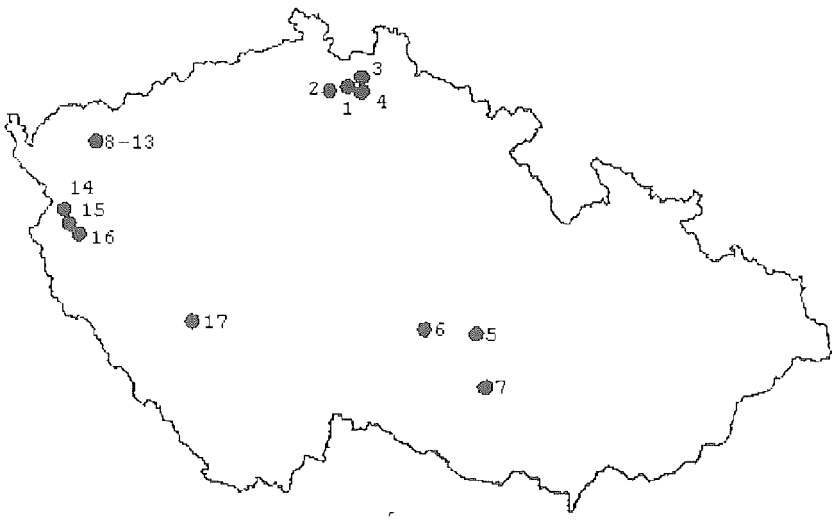
Deposits of economic grade and/or historical important deposits are concentrated in the following regions, including brief characteristics of the mineralization:

- north Bohemian region - mineralization in Cretaceous sediments,
- Moravian region - mineralized fracture zones and hydrothermal veins,
- Krušné hory region - mineralization in Tertiary sediments and exhausted hydrothermal veins (Jáchymov, Slavkov),
- west Bohemian region - metasomatic mineralization,
- central Bohemian - metasomatic and already exhausted hydrothermal veins (Příbram).

Of the balanced deposits the mined deposits were Hamr and Stráž in the Bohemian Cretaceous basin and mineralized fracture zone at Rožná in 1995. Underground mining takes place at Rožná (in average grading 0.202 % U in proven reserves) whereas the Stráž deposit (in average grading 0.037 % U in proven reserves) has been extracted by means of in situ leaching (liquidation of operation from April 1, 1996). All extracted ore was chemically processed to provide chemical concentrate (yellow cake). The only customer to buy U-concentrates were Czech Power Plants.

Tailing pond in Stráž pod Ralskem, where waste leach of deposit with 0.030-0.063% of rare earths was accumulated for 30 years, is a potential source not only of rare earths (lanthanum - gadolinium) but also scandium, yttrium and niobium. Reserves have not been evaluated yet. Contemporary uranium consumption (in nuclear power station Dukovany) reaches 330 t per year. A surplus of production was deposited as state material reserves. Annual consumption should increase into 690 t after starting two blocks of the nuclear power station Temelín.

3. Registered deposits and their location in the Czech Republic



1 Hamr
2 Stráž
3 Břevniště
4 Osečná-Kotel
5 Rožná
6 Brzkov
7 Jasenice-Pucov
8 Hájek
9 Hájek-S
10 Hroznětín
11 Kocourek
12 Mezirolí
13 Ruprechtov 1
14 Zadní Chodov
15 Vítkov 2
16 Lhota u Tachova
17 Nahošín

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

Year		1992	1993	1994	1995	1996
Deposits - total number		17	17	17	17	16
exploited		4	3	3	2	1
Total reserves, t U		143741	143322	142835	141534	141069
economic proven		47767	47136	46744	45300	22615
economic probable		50819	50576	50480	50012	34800
subeconomic		45155	45610	45611	46222	83654
Mining output, t U		1631	1018	537	611	589
Imports, t	a)	0	0	0	0	0
Exports, t	a)	0	0	0	0	0

Note:
a) item 2612 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2612 10	Uranium ores and concentrates	free	free

6. Mining companies in the Czech Republic as of December 31, 1996
DIAMO, s.p. (Stráž pod Ralskem)

7. World production
Large increase in world production of uranium ores began in the fifties due to nuclear arms race and later due to large development in nuclear energy facilities which followed the first "oil shock" in 1973. A record production 45,646 tons of uranium was reached in 1990. Major uranium producing countries were as follows (according to the Welt-Bergbau Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, t U	34224	32868	29845	30000	31000

Main producers (1994):

Canada	27.6%
Kazakhstan	9.1%
Uzbekistan	8.5%
Russia	8.5%
Niger	8.4%
Australia	7.4%
Namibia	7.1%
South Africa	5.4%

In 1994 90 % of uranium were obtained by U-ores mining (42 % by surface mining, 29 % by underground mining and 19 % by in situ leaching) and 10 % was obtained as a by-product within the Au- V- and Cu- ores extraction. According to the 1996 prognoses production should increase in contradistinction to foregoing prognoses; an interannual 2000/1996 increase index should

amount 1.23. The main share of the increase should have Canada with 100% production increase (to 19.500 t U). Production increase will be the result of continuous exhaustion of reserves, which have covered about 50% of consumption in the last five years.

8. World market prices

There are two categories of uranium prices: prices for spot sales and future delivery prices (negotiated). Prices of spot sales in the seventies were still higher than those of future delivery contracts. Recently, however, the ratio is reversed and majority of sales is materialized in spot prices. Until 1992, only two companies - Nuexco and Nukem were revealing the spot prices. Since then the source of information on prices has increased. Prices for spot sales of ores and concentrates are given in USD/lb U_3O separately as restricted and unrestricted exchange value. Detached quotations for restricted and unrestricted exchange value were introduced in November 1992 regarding large raw material supplies from the former USSR. So far the highest price was reached in 1978 - USD 43 per lb U_8O (Nuexco). Since then there was a drop in prices, and starting 1989 the average prices of spot sales continued to be about USD 10 per lb U_3O_8. The fall in prices accounted for a close of a number of mines. The prices increased only in 1996. Average prices of uranium concentrate in USD per lb U_3O_8 fluctuated as follows (up to 1994 annual average, 1995 at yearend):

A Nuexco, restricted exchange value
B Nuexco, unrestricted exchange value
C Nukem, restricted exchange value
D Nukem, unrestricted exchange value

Commodity / Year	1992	1993	1994	1995	1996
A	7.90	9.90	9.30	11.85	14.70
B	7.85	6.90	7.05	10.00	13.75
C	10.12	10.00	9.45	11.85	15.60
D	7.95	7.05	7.22	9.72	15.22

Prices for spot sales and future deliveries are different for US and European markets (market of the Euroatom member countries) particularly after 1989 when US market prices dropped down to 50 % of those of the European market. Prices for the European market are treble the prices for spot sales.

General low level in prices has been due to global political relaxation and economic changes. Up to 1995 there was a surplus of uranium due to nuclear disarmament (large supplies from Russia for USD 7.00 - 7.20 per lb U_3O_8), reduction of consumers stockpiles and declining nuclear energy generation, etc. The era of low prices ended in 1996 (during some sales the price per lb U_3O_8 exceeded USD 16) and according to prognoses the prices should fluctuate between USD 14 and 16 per lb U_3O_8) up to 2010.

9. Recycling

Theoretically, the burned-up fuel elements of nuclear reactors which still contain 80 % of uranium could be reprocessed. However, due to hygienic and economic reasons, burned-up fuel elements are not recycled but stored.

10. Possible substitutes

Problems related to nuclear power generation vs. energy generation from fossil fuels are widely discussed worldwide. Replacement of U^{235} by Th^{232} or U^{238} cannot be materialized because of the Treaty for non-proliferation of nuclear weapons. When using so-called reactors with fast neutrons (i.e. in case of Th and U^{238}), the fission products could be misused for the production of nuclear weapons.

HARD COAL

1. Characteristics and use

Hard coal is a phytokaustobiolite exhibiting a higher degree of coalification, i.e. more than 73.4 % carbon, less than 50 % volatile matter and dry (ash free) caloric value exceeding 24 MJ/kg. The internationally recognized boundary between lignite and hard coal is the value of vitrinite reflectance (R=0.5 %) which in the case of hard coal is higher than 0.5 %.

Coking coal by definition is a hard coal which allows to produce coke for blast-furnace production of pig iron and/or for heating. Other coal is marked as steam coal (40 % of electric energy is generated by burning of coal).

Total world deposit reserves of the hard coal were estimated at 521,000 mill. tons in 1994.

2. Mineral resources of the Czech Republic

Both the coking coal and the steam coal occur on territory of the Czech Republic.

- Coking coal occurs mostly in the Bohemian (Moravian) part of the Upper Silesian basin.

The major fault, called the Orlová fault, divides the Moravian part of the Upper Silesian basin into the western section (the Ostrava part) which is older and of paralic character of sediments and coal seams and the eastern section (the Karviná part) which exhibits limnic character of the sediments as well as of coal. The western part consists of several tens of thin coal seams of high grade coking coal whereas the eastern part is characteristic of abundant thick seams consisting of mixed and high volatile steam coal.

Mining in the Ostrava part reached the depth of about 1,000 m which together with complex and unfavorable mining and geological conditions makes economic mining extremely difficult. Consequently, the Ostrava mines continue to be gradually abandoned. Some mines in the eastern part have enough reserves which can be extracted with much lower costs. However, this coal is of lower grade, as far as coking properties are concerned.

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.

- Another area with reserves of hard coal occurs in central Bohemia, west of Prague. The majority of coal reserves of the Kladno-Rakovník basin (steam coal) were already mined and remaining two mines, still in operation, have limited volume of mineable reserves. Another deposit of coking coal was discovered and explored in the fifties and sixties near Slaný. It extends NE from the Kladno basin and has about 223 mill. tons of coal which occurs at depths of 1,000 to 1,300 m. The deposit was developed by two main shafts which were later closed.
- NE of Prague, there has been explored the so-called Mšeno (Mělník) basin having 1,268 mill.tons of reserves of steam coal. However, conflicts of interest prevent to develop this deposit (overlying Cretaceous sandstones represent a source of potable water for central Bohemia).
- Some other deposits of hard coal in the Plzeň (Pilsen) and Trutnov regions and near Brno became subeconomic.

3. Registered deposits and their location in the Czech Republic

1 the Upper Silesian basin
2 the Intrasudeten basin
3 the Krkonoše piedmont basin
4 the Central Bohemian basin
5 the Mělník basin
6 the Plzeň and Radnice basin

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

Year		1992	1993	1994	1995	1996
Deposits - total number		98	97	74	73	72
exploited		26	26	25	21	17
Total reserves, kt		13084836	13511433	13573064	13932934	13942239
economic proven		2761374	2322931	2309614	2696681	2612865
economic probable		6402537	6098169	5962804	6402625	6401303
subeconomic		3920925	5090333	5300646	4833628	4928071
Mining output, kt	a)	24691	23862	20910	21309	21784
Imports, kt	b)	3112	1940	1721	2676	3211
Exports, kt	b)	2788	5137	6499	7022	6738

Note:
a) ČSÚ returns so-called sale output, which presents production of marketable hard coal and reaches in average 77% of above mentioned mining output
b) item 2701 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2701	Hard coal, briquets and similar solid fuels made of hard coal	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

OKD, a.s. - Důl Darkov o.z., Karviná
OKD, a.s. - Důl Lazy o.z., Lázy
OKD, a.s. - Důl ČSA o.z., z. ČSA, Karviná
OKD, a.s. - Důl Paskov, o.z.
ČMD, a.s. - Důl ČSM o.z., Stonava
OKD, a.s. - Důl ČSA o.z., z. Doubrava
ČMD, a.s. - Kladenské doly o.z., Libušín
OKD, a.s. - Důl J.Fučík o.z., Petřvald

7. World production

World production of hard coal exceeded 3,000 mill. tons in 1985. According to the 1995 prognosis of the UNO European Economic Commission the world production should not exceed 4000 mill. t per year by 2010. An expected decrease of production in Europe should be exceeded expresively by production in Asia and Latin America. The output of steam coal exceeds presently the production of coking coal and production ratio of both types of coal is expected to be 2:1 in favor of steam coal in near future. The major producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, mill.t	3572	3625	3485	3500	3600

Main producers (1994):

China	33.0%
USA	24.6%
India	7.4%
Australia	6.5%
South Africa	5.6%
Russia	5.2%

In 1996 there was an outstanding surplus of hard coal in the european market. A difficult access of the Czech coal producers to the European market became worse owing to a bulky hard coal export from Poland. Continuous import of the cheap Polish coal to the Czech Republic made also sales of the Czech coal difficult.

8. 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 heating value and the contents of volatile constituents, sulphur and ash.

Decisive prices are those of the Australian and US coal since this coal represents 55 % of the world sales. 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 33 and 52 per ton of steam coal and between USD 50 and 80 per ton of coking coal. Price variations were due to fluctuation in supplies and demands and also due to oscillations in sea transport costs. Low prices of overseas coal lead to a gradual reduction of coal mining in Europe where mining cost is considerably higher.

Average annual prices of US coal in USD per ton FAS (according to Coal Age):

A Coking coal

B Steam coal

Commodity / Year	1992	1993	1994	1995	1996
A	45.19	44.11	43.58	44.05	43.55
B	35.72	36.03	34.69	34.21	34.33

According to prognoses hard coal prices should increase by 2005, prices of coking coal should increase 34% and steam coal 40% against the price level reached in 1996. This increase in prices should be evoked by higher consupmtion especially in Europe and Asia.

9. Recycling

Coal is not recycled.

10. Possible substitutes

Coking coal is possible to replace by steam coal due to introduction of new technologies in production of pig iron e.g. (Corex). Coal can be replaced by other mineral fuels in power generation.

BROWN COAL

1. Characteristics and use

Brown coal is a phytokaustobiolite showing lower degree of coalification, i.e. having less than 73.5 % carbon, more than 50 % volatile matter and dry (ash free) caloric value less than 24 MJ/kg. Internationally recognized boundary between brown coal and hard coal is the reflectance value of vitrinite (R=0.5 %) which in case of brown coal is lower than 0.5 %. The boundary between brown coal and high volatile lignite is usually not recognized because, in practical terms, brown coal generally includes high volatile lignite. However, in the Czech Republic both types are treated separately.

Total world deposit reserves of the brown coal (incl. high volatile lignite) were estimated at 518,000 mill. tons in 1994.

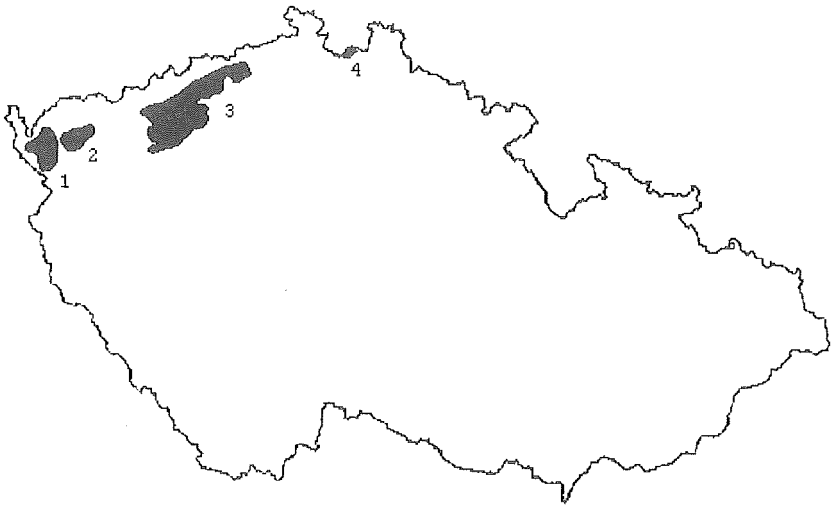
Brown coal is used in the main in energetics and to a smaller extent in chemical industry.

2. Mineral resources of the Czech Republic

The majority of brown coal in the Czech Republic are still used for power generation. The major Bohemian brown coal basins originated and are located in the furrow along the Krušné hory Mts which follow NW boundary of the Czech Republic. The total area of the coal-bearing sedimentation is 1,900 km^2 large. Underlying sediments are of the Oligocene to Early Miocene age. The brown coal seams are mostly of the Middle Miocene age whereas overlying sediments which are as much as 400 m thick and even more, are of the Late Miocene age. The sedimentation in the Cheb basin was terminated as late as in the Pliocene. The following single basins are recognized in the whole area of the Krušné hory furrow (from NE to SW): North Bohemian, Sokolov and Cheb basins. The largest North Bohemian basin is then divided in three partial basins. It used to be a still is the major source of brown coal which is now extracted by huge open pit mining operations.

- In one part of the North Bohemian basin, in the so-called Chomutov basin, there are several coal seams which, in the major part of the basin, are close to each other to allow open pit mining for all of them. Lignite shows a low degree of coalification and high content of ash (up to 50 %). Burning of this brown coal in large power plants inflicts environmental problems because it is high in sulphur and arsenic. Due to low caloric value, a part of reserves exceeds the earlier used norm specifying the amount of sulphur in grams related to a unit of net caloric value.
- Brown coal in the Most partial basin of the North Bohemian basin shows higher degree of coalification and a lower content of ash. Locally, however, is very high in sulphur and arsenic. The depth of open pit mines continues to increase being currently about 150 m.
- Shallow parts of the Teplice partial basin of the North Bohemian were already mined. Remaining reserves of almost sulphur free brown coal located under the Chabařovice township are likely to be abandoned because of the conflicts of interest. Similar conflicts may occur even in other parts of the basin.
- The Sokolov basin west of Karlovy Vary has two brown coal seams. The major reserves are confined to the thickest and the uppermost seam called Antonín. The brown coal is of xylitic character, it is high in water and relatively low in sulphur. The seam is extracted by open pit mining and is used in power generation (sorted brown coal, burning in power plants, lighting gas production).
- The Cheb basin has about one billion of reserves of stratigraphically latest lignite characteristic of high content of water (about 50 to 55 %), high in liptodetrite, and consequently high in mineral tar. It is a brown coal suitable for chemical processing. Mining operations in this basin were not allowed because they are likely to affect sources of mineral water for nearby Františkovy Lázně spa.
- The Zittau basin extends into the Czech Republic from Poland and Germany. The upper seam was already mined. Remaining two lower seams are difficult to be mined underground because of overlying quicksand and tectonic problems.

3. Registered deposits and their location in the Czech Republic



1 the Cheb basin
2 the Sokolov basin
3 North Bohemian basin
4 the Zittau basin

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

Year		1992	1993	1994	1995	1996
Deposits - total number		83	79	80	72	71
exploited		21	19	17	17	16
Total reserves, kt		11247919	11115499	10713071	10443206	10376959
economic proven		4553475	4200406	3965192	3825418	3417784
economic probable		2208560	1930676	1922642	1889287	1956191
subeconomic		4485884	4984417	4825237	4728501	5002984
Mining output, kt		68100	66891	59811	57954	59539
Imports, kt	a)	0	29	7	0	5
Exports, kt	a)	3147	5008	5282	6903	6173

Note:
a) ČSÚ returns so-called sale output, which presents production of marketable brown coal and reaches in average 99.6% of above mentioned mining output
b) item 2702 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2702	Lignite, whether or not agglomerated	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

Severočeské doly, a.s. (Chomutov)
Mostecká uhelná společnost, a.s.
Sokolovská uhelná, a.s. (Vřesová)
Palivový kombinát, s.p. (Ústí nad Labem)

7. World production

World production (including high volatile lignite) exceeded 1,000 mill. tons in 1980. It reached its peak probably in 1989 - 1,273 mill. t, and then a decline came. World production data showed differences up to 30 % in the last five years. The major producers of brown coal were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, mill.t	1022	924	886	850	800

Main producers (1994):

Germany	23.4%
Russia	10.2%
USA	9.0%
Poland	7.5%
Czech Republic	6.9%
Greece	6.5%
Turkey	5.8%
Australia	5.5%

8. World market prices

Brown coal sales represent only negligible volume of the total world trade and are usually materialized only between neighbouring countries based upon individual contracts and negotiated prices considering the grade and transport costs. Data on prices on world market are not available.

9. Recycling

Brown coal is not recycled.

10. Possible substitutes

Possible substitutes differ according to the type of brown coal and its use. In power generation, it can be replaced by other fuels, particularly by nuclear fuel. This substitution, however, is connected with large investment, environmental and other problems.

HIGH VOLATILE LIGNITE

1. Characteristics and use

High volatile lignite is a variety of brown coal which exhibits the least degree of coalification, is of xylitic character with preserved tree trunks and with large or small fragments of wood. From the geochemical and petrological viewpoints, it is a brown coal hemitype. Its dry (ash free) caloric value is less than 17 MJ/kg.

No boundary between brown coal and high volatile lignite has been established and high volatile lignite is generally included in regular brown coal. In the Czech Republic, however, is treated separately.

High volatile lignite is used in power generation and for heating. Among mineral fuels it represents the least quality fuel whose consumption gradually declines.

2. Mineral resources of the Czech Republic

- Largest deposits of high volatile lignite occur along the northern margin of the Vienna basin which extends from Austria into southern Moravia. There are two lignite seams in the latest sediments of the Pannonian and Pliocene age. Reserves of the northern Kyjov seam are already exhausted whereas reserves of the southern Dubňany seam are currently mined by two shafts. Economic reserves are registered at another deposits but their extraction is not anticipated. South Moravian high volatile lignite is of xylodetrital character with numerous tree trunks. It is high in water (45-49 %), average content of S 1.5-2.2 % and its caloric value is 8-10 MJ. The lignite is burnt in the Hodonín power plant.
- There are seven deposits of high volatile lignite of low quality in southern Bohemia which are registered.
- Isolated occurrences of high volatile lignite (Pliocene xylite) are in the vicinity of Liberec in northern Bohemia.

3. Registered deposits and their location in the Czech Republic

1 the Vienna basin
2 South Bohemian basin
3 the Zittau basin

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

Year	1992	1993	1994	1995	1996
Deposits - total number	20	20	20	20	20
exploited	3	2	2	1	1
Total reserves, kt	792470	787635	772571	771489	1017621
economic proven	227729	180690	149190	147244	145940
economic probable	370819	359145	359145	359145	590960
subeconomic	193922	247800	264236	265100	280721
Mining output, kt	1419	1263	913	775	902

5. Customs tariffs

High volatile lignite is not mentioned in the customs tariff of rates and its export (since 1992 approximately 4 % of the total production) was evidently included in item 2702 of the customs tariff.

6. Mining companies in the Czech Republic as of December 31, 1996
Lignit s.r.o., Důl Mír Mikulčice

7. World production
World output of high volatile lignite is included in the brown coal production.

8. World market prices
High volatile lignite is generally not traded on the world market.

9. Recycling
High volatile lignite is not recycled.

10. Possible substitutes
High volatile lignite exclusively used as a fuel can be replaced by other mineral fuels.

CRUDE OIL

1. Characteristics and use

Oil (petroleum)is a natural mixture of gaseous, liquid and dissolved solid hydrocarbons and their derivatives. 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. Principal source of hydrocarbons is represented by an organic material originating from subaqual anaerobic decaying of plants and/or animals 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 and porous reservoir rocks. Principally 4 types of crude oil can be recognized based upon its chemical composition - paraffin-base petroleum, asphalt-base petroleum, naphtene petroleum, and mixed bases (aromatic) petroleum.

Total deposit reserves of crude oil in the world are estimated at 137,000 mill. tons of which about 75 % have been found in OPEC member countries.

All-round oil industrial use is evident and new applications are still under way. Nevertheless, power generation, petrochemical and chemical industries are the principal oil consumers.

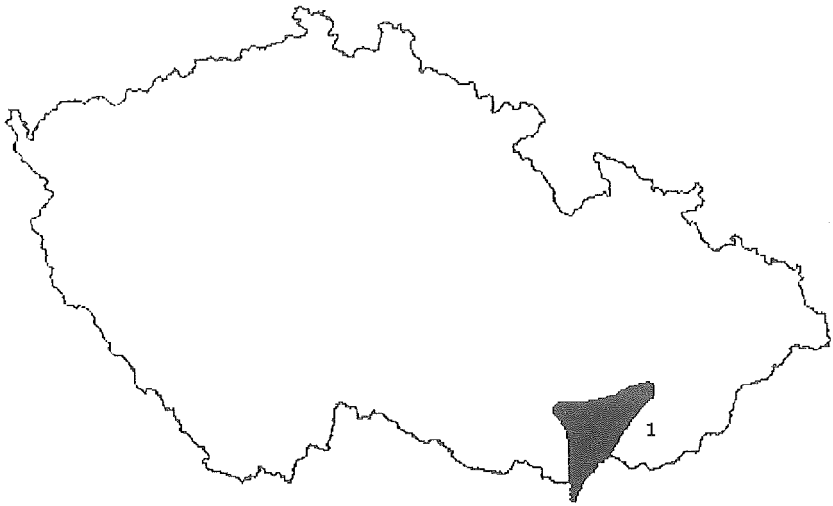
2. Oil resources of the Czech Republic

Oil deposits of the Czech Republic are confined to the Vienna - Moravia oil and gas-bearing province. The deposits are distributed over a great number of individual oil-bearing structures and producing horizons situated at the depth going down to 2,800 m. The most productive oil-bearing rocks are represented by sands of the Middle and/or the Upper Badenian. The largest deposit of this area (Hrušky) whose major part has already been extracted, serves as an underground gas storage.

Another region in which oil is anticipated to occur lies in the Moravian part of the Carpathian foredeep where oil exploration still continues. The most important accumulations occur particularly in the weathered crystalline and Paleozoic rocks. Light, sulphur free, paraffin to paraffin - naphtene oil prevail in this field. Uhřice and Kloboučky (in the Ždánice region) are the only oil deposits in this area.

Five grades of oil were extracted in 1996 with specific gravity from 856 to 930 kg/m^3 at 20 °C, 20-33 ° API and with content of sulphur 0.08-0.32 % by weight.

3. Registered deposits and their location in the Czech Republic



1 the Vienna basin and Carpathian foredeep

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

Year		1992	1993	1994	1995	1996
Deposits - total number		19	20	23	26	25
exploited		11	11	14	18	16
Total reserves, kt		63474	63371	65876	48771	48430
economic proven		11224	10745	12586	12333	12048
economic probable		44090	44090	44323	23677	23588
subeconomic		8160	8536	8967	12761	12794
Mining output, kt		80	107	131	149	155
Imports, kt	a)b)	7049	5610	6493	7052	76717671
Exports, kt	a)	9	66	76	108	8484

Note:

a) item 2709 00 of the customs tariff

b) in 1996 81% were transfered by the pipe line Družba and 19% by the pipe line IKL (Ingolstadt-Kralupy nad Vltavou)

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2709 00	Petroleum oils and oils obtained from bituminous minerals, crude		
2709 00 10	- Condensates of natural gas	free	free
2709 00 90	- Others	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

Moravské naftové doly, a.s. Hodonín
Flachs-Union, s.r.o. Hodonín

7. World oil production

World crude oil output was relatively stable during the last few years being 60 mill. barrels a day (1 barrel = 0.143 t). Production was more or less controlled or affected by the OPEC quotas; official quota has been advanced in the 1st half-year 1996 into 25 mill. bbl a day, but anyhow it was exceeded. A production fall in continued in Russia and this reduced a non-OPEC members share of the world production. The following countries represented the major producers of crude oil (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, mill.t a)	3111	3185	3155	3180	3200

Main producers (1994):

Saudi Arabia	12.8%
USA	11.0%
Russia	10.0%
Iran	5.8%

Note:

a) in statistics crude oil production is given including natural gas condensates and natural gas liquids in a number of cases

Oil output increase of non-OPEC members should raise rapidly in 1996 owing to starting production in 16 new oil fields in the North Sea. This should increase the output capacity by 1 mill. bbl a day.

8. World crude oil market price

Crude oil represents a commodity which is extremely sensitive to the global political climate and development. The last considerable increase in prices occurred in 1990 , during the Gulf war. The crude oil price then exceeded USD 40/bbl .The major world exchange stock exchanges (IPE,

NYMEX) quote prices of direct sales (Spot) and prices of long termed 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°).

Average price quotations of direct sales in the last 5 years in USD per barrel, CIF Rotterdam (from 1993 as of 31st December) were as follows:

A Brent crude oil

B OPEC basket crude oil

Commodity / Year	1992	1993	1994	1995	1996
A	19.30	13.15	16.48	18.70	23.66
B	18.41	12.95	16.34	18.44	24.13

9. Oil recycling

Crude oil is not recycled.

10. Oil substitutes

Oil may be successfully substituted to certain extent by other types of fuels in power generation. As for gasoline or other oil derivatives, these can be substituted by fuel based on plants.

NATURAL GAS

1. Characteristics and use

Natural gas is a mixture of low-molecular-weight paraffin series hydrocarbons, principally methane, ethane, propane, and butane, with small amounts of higher weight hydrocarbons. Natural gas also frequently contains nitrogene, carbon dioxide, and hydrogene sulfide. Methane (CH_4) is normally the major constituent. There is also some admixture of crude oil, water and sand when extracting natural gas. Three principal grades of natural gas are recognized in the Czech Republic: dry gas (containing 98 - 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).

Natural gas world proven reserves were estimated at 141 trillions of m^3 at yearend 1994. The greatest part of proven reserves is situated in the territories of Russia - 32.2 % and Iran - 14.9 %.

Also gas of Carboniferous origin emitted out of coal seams may be classified as natural gas. The carboniferous gas contains from 90 to 95 % of methane. Its volume varies from 0 to 25 litres per ton of coal. It depends on a degree of carbonisation and on the depth of occurence.

2. Natural gas resources of the Czech Republic

- Natural gas deposits are in reservoirs that contain oil. The deposits are mostly located in south Moravian part of the Vienna basin. Northern part of the basin contains rather oil deposits. Extracted natural gas contains from 87.2 to 98.8 % of CH_4, its caloric 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 content H_2S is under 1 mg/m^3. The Carpathian foredeep is considered as a promising area for the occurrence of natural gas. The composition of local gas deposits varies considerably. The Dolní Dunajovice deposit is characteristic of high content of methane (98 %) whereas the deposit Kostelany-west contains only 70 % methane and is high in helium and argon which can be extracted on industrial scale.
- In northern Moravia, specifically between Příbor and Český Těšín, the gas deposits are mostly confined to the weathered and tectonically affected Carboniferous paleorelief. The origin of these gas deposits being developed close to the top of the Carboniferous morphological elevations has not been deciphered yet. Ideas about the gas to have originated during coalification of the local coal seams has little support and its origin is considered to be connected with the neoid movements which led to the origin of natural hydrocarbons. This applies particularly to the gas deposits of Žukov, Bruzovice and Příbor. Part of the Příbor gas deposit is used as an underground gas storage .
- Natural gas of obviously Carboniferous origin and age is extracted during so-called degasification of coal seams of the Czech part of the Upper Silesian coal basin. Its quality varies considerably depending on the method of extraction and technical limitations related to degasification.

3. Registered deposits and their location in the Czech Republic

1 South Moravian region
2 North Moravian region

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

Year	1992	1993	1994	1995	1996
Deposits - total number	44	45	49	34	54
exploited	17	20	22	14	29
Total reserves, mill.m^3	23376	23777	22804	23186	17083
economic proven	4439	4702	4835	4482	4252
economic probable	17699	17789	16475	16922	10743
subeconomic	1238	1286	1494	1782	2088
Mining output, mill.m^3	132	106	154	165	146
Imports, mill.m^3 a)	6850	6804	7322	8049	9499
Exports, mill.m^3 a)	N	1	2	2	1

Note:
a) item 2711 21 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2711	Natural gas and other gaseous hydrocarbons		
2711 21	Natural gas in gaseous state	15	free
2711 29	Petroleum gases and other gaseous hydrocarbons n.e.s., in gaseous state	15	free

6. Mining companies in the Czech Republic as of December 31, 1996
Moravské naftové doly, a.s. Hodonín
Důlní průzkum a bezpečnost Paskov, a.s.
UNIGEO, a.s. Ostrava

Besides natural gas output there was another main activity of Moravské naftové doly - construction of underground storage. Underground storage in Uhřice with capacity of 180 mill. m^3 should operate in 1999. Another underground storage will be built in Dambořice with capacity about 200 mill. m^3. A construction of next underground storages is planned to reach a world standard in storage 25-30% of the year natural gas consupmtion. As the expected consumption is 13.5 bill. m^3 in the Czech Republic in 2010, the capacity of storages should reach approximately 4 bill. m^3. The capacity of storages was 1.7 bill. m^3 in the territory of the Czech Republic at yearend 1996. The Czech import company Transgas has used also a rented capacity in Germany (0.9 bill. m^3).

7. World production
World natural gas production kept up on the level about 2,200 bill. m^3 a year during the last five years and it is not expected to be affected by the decrease in production in Russia, the major world producer of natural gas because it is compensated by increased output in other countries, particularly in Canada, the Middle East countries, and elsewhere. The major producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, bill.m^3	2128	2193	2273	2300	2350

Main producers (1994):
USA 29.5%
Russia 24.9%
Canada 6.3%

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 there 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 mill. t per year. It represented from 4 to 6 % of all methane emissions from both natural and man-made sources of methane in the world. Of given 25 mill. t about 1.6 mill. t of gas - i.e. approximately 6 % - were used for industrial purposes. A remainder went to the atmosphere. According to 1996 data 10 countries used the carboniferous gas - China, Russia, Czech Rep., Germany, Poland, United Kingdom, USA, Australia, France and Ukraine.

8. World market prices

General increase in natural gas consumption was accompanied by decrease in costs of transport payed by consumers for imported gas (approximately 75 % of gas is transported through pipelines and about 25 % in tankers in liquified state). Natural gas prices are negotiated and are quoted in USD per mill. Btu. Natural gas price at a customer in Europe that had been still fluctuating between USD 3.6 and 4 per mill. Btu in 1985, fluctuated round USD 2.25 per mill.Btu in 1995.

9. Recycling

Natural gas is not recycled.

10. Natural gas substitutes

Natural gas can be successfully substituted to a certain extent by other types of fuel in energetics. However, natural gas itself represents economically and ecologically effective substitute for all other mineral fuels.

INDUSTRIAL MINERALS - GEOLOGICAL RESERVES AND MINING OUTPUT

Industrial minerals represent - after mineral fuels - the most important group of raw materials in the territory of the Czech Republic. In this group the largest reserves are of limestones, kaolin, clays and natural sands. Other industrial minerals represent smaller nevertheless important raw material potential of the national economy. Kaolin, natural sands, clays and limestones are also important export commodities.

Mining of industrial minerals

Raw material	Unit	1992	1993	1994	1995	1996
Fluorspar	kt	22	22	10	0	0
Graphite	kt	20	27	25	27	30
Pyrope-bearing rock	kt	45	34	33	24	39
Moldavite-bearing rock	m^3	6480	0	0	0	0
Kaolin	kt	2530	2336	2706	2800	2798
Clays	kt	903	1018	823	915	738
Bentonite	kt	135	65	65	54	59
Feldspar	kt	152	203	170	183	211
Feldspar substitute (phonolite)	kt	16	20	25	35	38
Silica raw materials	kt	46	23	2	3	4
Natural sands	kt	1963	1735	1955	1990	2209
Wollastonite	kt	0	0	0	1	1
Mica	kt	0	0	0	4	0
Fusible basalt	kt	107	134	85	108	90
Diatomite	kt	57	39	40	29	35
Limestones	kt	11134	10498	10205	10092	10610
Corrective sialic additives	kt	741	616	655	658	643
Gypsum	kt	660	560	591	542	443
Dimension stone	thous.m^3	177	187	225	210	190

Life of industrial reserves (economic proven mineable reserves) consequent the decrease of reserves by output, losses and depreciations in mined deposits per year 1996 (A) and the average annual decrement of reserves in period 1992-1996 (B) was as follows:

Raw material	Life, years	
	A	B
Graphite	24	30
Pyrope-bearing rock	12	14
Kaolin	25	30
Clays	66	48
Bentonite	383	312
Feldspar	76	70
Feldspar substitute (phonolite)	N	N
Silica raw materials	245	86
Natural sands	25	35
Wollastonite	N	N
Mica	N	N
Fusible basalt	59	51
Diatomite	114	105
Limestones	116	59
Corrective sialic additives	437	432
Gypsum	14	11
Dimension stone	230	230

FLUORSPAR

1. Characteristics and use

Fluorspar - CaF_2 is by far the most common natural compound of fluorine. Fluorspar (also fluorite) is a transparent or translucent, glossy mineral, varying in color from white, amber, green, black, and blue to purple. The wide range of colors is caused by minor impurities and displacements in the crystal structure. The color can be changed when exposed to X-rays, UV radiation, heat, and pressure. The mineral crystallizes in the cubic system. Tiny inclusions of gas and liquids, pyrite, muscovite, chalcopyrite and other minerals are relatively common in fluorite. It occurs in the form of crystalline, massive or rodlike aggregates and also well developed crystals in fractures and cavities. It is rated as 4 on Mohs' scale of hardness. Majority of fluorspar deposits are of hydrothermal origin and may be further classified as low, medium and high temperature hydrothermal systems. Fluorspar deposits which originated by infiltration or residual, pegmatite and sedimentary deposits are much less abundant. Fluorspar is accompanied usually by other minerals like quartz, barite, calcite, etc. World economic reserves are estimated at 209 mil.t.

More than half of the fluorspar output is used in chemical industry for production of fluorine (F), hydrofluoric acid (HF), NaF and synthetic cryolite. Fluorine is an important component of chloroflourocarbons and other chemicals used in refrigerants and other agents. Metallurgical industry of alumina also consumes relatively large volumes of fluorspar (1/3 of the total fluorspar output). Another applications are in cement production, in glass industry (glass with 10 to 30 % CaF_2 is milky, opaque and opalescent) for enamels, etc. Complex chemicals with fluorine and bromine are used in fire extinguishers and anaesthetics.

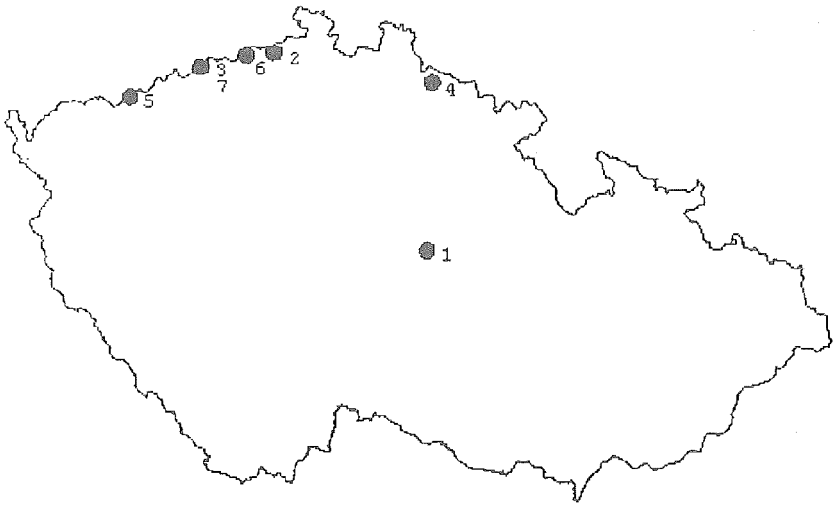
2. Mineral resources of the Czech Republic

All Czech fluorspar deposits are of hydrothermal origin, i.e. vein, stockwork and rarely even metasomatic types. They are mostly located in marginal parts of the Bohemian Massif occuring along major fault zones of the Krušné hory (NE-SW) and the Labe-Lužice (NW-SW) lineaments. Based on the principal mineral assemblages, these deposits can be divided into the following types: hematite-quartz-fluorspar, quartz-fluorspar, barite-fluorspar, barite-fluorspar with sulphides and barite-fluorspar-carbonates.

However, relative proportions of single minerals are changing considerably in individual deposits and even within single veins.

Majority of fluorspar deposits exhibit vertical zonation. Primary zonation is characteristic of abundant barite in upper parts and increasing content of fluorite with depth. However, this primary zoning is preserved only in relatively small layers or bodies because it is overlapped by secondary zonation which exhibits a pulsation character. The secondary zonation is due to an influx of fluids along fractures and faults and after re-opening of the old vein filling. Secondary zonation results in upgrading or reduction of the vein filling as far as the content of fluorite is concerned. The Moldava deposit, for instance, shows considerable enrichment in fluorspar.

3. Registered deposits and their location in the Czech Republic



1 Běstvina
2 Jílové near Děčín
3 Moldava
4 Harrachov
5 Kovářská
6 Krásný Les-Špičák
7 Moldava-Vápenice

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	7	7	7	7	7
exploited		4	3	3	0	0
Total reserves, kt		3629	3570	3558	3476	3477
economic proven		957	887	68	48	35
economic probable		2389	2400	2089	1003	997
subeconomic		283	283	1401	2425	2425
Mining output, kt		22	22	10	0	0
Imports, t	b)	2401	19616	26642	67720	42437
Exports, t	b)	5894	14144	20667	26011	17172

Note:
a) deposits with balanced fluorspar content
b) items 2529 21 and 2529 22 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2529 21	Fluorspar, containing by weight 97 % or less of calcium fluoride	free	free
2529 22	Fluorspar, containing by weight more than 97 % of calcium fluoride	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

No mining companies were operating on the territory of the Czech Republic to extract fluorspar in 1996.

7. World production

The world production has been increasing since 1987 till 1989 when 5,529 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 freons production). The major producers were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt	4376	4031	4118	4000	4000

Main producers (1994):

China 58.3%
Mexico 7.9%

World mining capacity reached 7700 kt in 1995.

8. 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. The Chinese supplies caused economic losses to traditional western producers and consequently led to reduction of their production capacities. Most countries applied antidumping measures in 1993. 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. Average prices of traded commodities at yearend were as follows:

A Metallurgical, min. 70 % CaF_2 (since 1995 min. 85 % CaF_2), GBP/t, ex-UK mine
B Acidspar, dry basis, 97 % CaF_2, bagged, GBP/t, EXW UK
C Acidspar, Chinese dry bulk, USD/t, CIF Rotterdam (since 1994 wet filtercake)
D Metallurgical, Mexican, USD/t, FOB Tampico
E Acidspar, Mexico, filtercake, USD/t, FOB Tampico

Commodity / Year	1992	1993	1994	1995	1996
A	87.50	92.50	92.50	105.00	112.50
B	145.00	165.00	162.50	157.50	167.50
C	105.00	111.00	141.00	152.50	150.00
D	92.50	87.50	90.00	90.00	92.50
E	124.50	111.00	117.50	117.50	125.00

Fluorspar prices of metallurgical and chemical qualities were affected by sales of US stockpile in the last period.

9. 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.

10. Possible substitutes

Fluorspar is virtually a 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, nitrogene, air, mechanical sprays, etc.). Fluorohydrocarbons are replaced by hydrocarbons in production of foamed plastics. Fluorspar can be substituted by cryolite (incl. synthetic) to certain extent in metallurgy when producing aluminium. Fluorspar can be also substituted by dolomite, limestone and/or olivine in ferrous metallurgy.

BARITE

1. Characteristics and use

Barite, chemically barium sulphate - $BaSO_4$, is the most common and abundant orthorhombic mineral exhibiting shades of white to dark grey and black depending on impurities and having a specific gravity of 4.3 - 4.7 t/m^3. Minor to trace amounts of other metals occur in barite crystal structure (Sr, Ca, Ra and Pb). Barite can be also contaminated by heterogenous iron oxides or clay minerals and organic matter.

Barium which is the major constituent of barite occurs in igneous rocks. It is released during their weathering and transferred in sediments and residual rocks. Barite deposits, in general, can be divided in fissure veins, replacement, residual and volcaniclastic (stratabound) deposits. World barite reserves are estimated at 303 mill. t.

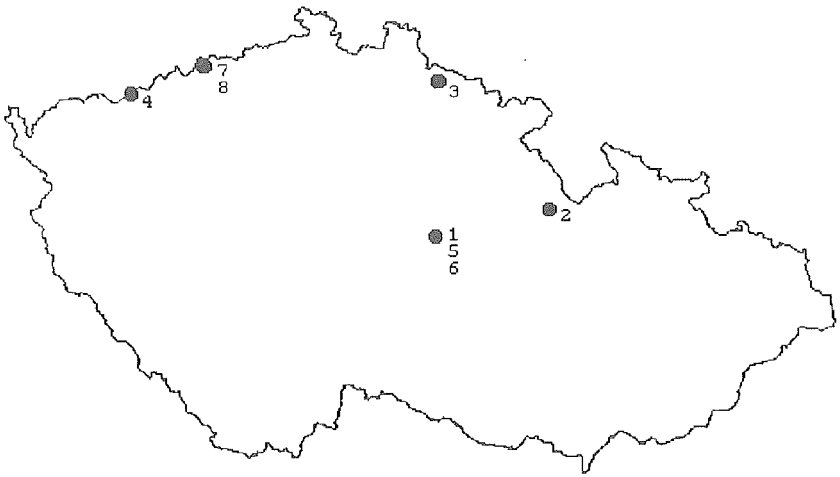
Barite is widely used because of its specific properties such as whiteness, high density, chemical resistance, absorption of X-rays and gamma radiation, etc. Barite is used in glassmaking to produce special glass, in ceramic glazes, porcelain enamels, paints, plastics, fireworks (signal flares, detonators, etc.), for radiation shielding, in insecticides, etc. The major use of barite, however, is as weighting agent in well-drilling muds.

2. Mineral resources of the Czech Republic

Barite deposits of the Czech Republic belong to the vein, stockwork, metasomatic or stratabound types. These deposits are randomly distributed over the Bohemian Massif depending on a great number of barite-bearing formations of various age and origin.

- Hydrothermal veins, locally with base metals, are tens to hundreds metres, exceptionally even 1 km, long, and having 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 orders trending mostly NW-SE and NWN-SES which are often filled with an older quartz or quartz-hematite mineral assemblage. Locally occur younger polymetallic (base metal) and the latests quartz mineralizations which downgrade the vein filling in deeper parts (e.g. the Mackov and Bohosouvá deposits). The deposits are mostly of the early Alpine or Variscan age and to much lesser extent of Precambrian or late Alpine age. Earlier mined deposit of Pernárec (1924-1960), then the deposits Mackov, Moldava-Vápenice and Kovářská in the Krušné hory mountains, Bohousová, Harrachov and Běstvina belong to the above mentioned type of the deposit.
- Stratabound barite deposits originated from submarine hydrothermal solutions ascending along the faults at sea floor. These stratiform deposits in the Bohemian Massif are represented by layers and lenses in sediments of the Barrandien zone and the Železné hory Proterozoic (Krhanice in the Sázava river basin, Křižanovice) and in the Devonian of the Jeseníky mountains (Horní Benešov, Horní Město-Skály).
- A barite mineralization is known from the Květnice deposit near Tišnov in the Moravicum where barite was mined during World War II. Calcite - barite veins also occur in granites of the Svratka Dome and in the Květnice limestones. The filling of the major vein consists of calcite whereas barite is much less abundant.

3. Registered deposits and their location in the Czech Republic



1 Běstvina
2 Bohousová
3 Harrachov
4 Kovářská
5 Křižanovice
6 Liboměřice
7 Mackov
8 Moldava-Vápenice

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	7	7	7	8	8
exploited		2	1	0	0	0
Total reserves, kt		3328	3328	3328	2920	2920
economic proven		44	44	44	44	44
economic probable		2373	2373	2373	1407	1407
subeconomic		911	911	911	14669	1469
Mining output, kt		0	0	0	0	0
Imports, t	b)	23699	31752	30596	39964	14692
Exports, t	b)	0	588	118	12	10

Note:
a) deposits with balanced barite content
b) item 2511 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2511 10	Natural baryum sulphate (barites)	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

No mining companies were operating on the territory of the Czech Republic to extract barite in 1996.

7. World production

The world barite production was gradually increasing till 1990 (8,209 kt). Then the barite output declined mostly due to global economic recession which affected not only major barite consuming sectors (both crude oil and natural gas exploration) but also chemical industry. The major producers of barite were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt	6922	4626	4298	4500	4500

Main producers (1994):

China	41.9%
India	11.9%
Morocco	6.2%
Germany	5.4%
Iran	5.2%

8. World market prices

Barite prices were under pressure of surplus offer, particularly regarding the offer of cheap Chinese and Indian barite. Chinese barite acquired the leading position in world production already in the seventies being used not only in drilling muds but also in other sectors of various industries. Prices of barite of various grade and origin are quoted monthly in the Industrial Minerals magazine in GBP/t or USD/t. Average prices of traded commodities at yearend were as follows:

A API, Chinese lump, USD/t, CIF Gulf Coast
B API, Indian lump, USD/t, CIF Gulf Coast
C Ground, white, paint grade, 96 - 98 $BaSO_4$, 99 % 350 mesh, GBP/t, del UK
D Unground, OCMA/API bulk, SG 4.2, USD/t, FOB Morocco
E Ground, bagged, USD/t, FOB Morocco

Commodity / Year	1992	1993	1994	1995	1996
A	N	42.50	42.50	46.50	53.50
B	N	37.50	37.50	47.50	52.50
C	170.00	190.00	207.50	207.50	207.50
D	40.00	43.50	38.50	40.00	41.00
E	N	85.00	80.00	77.50	77.50

9. Recycling

Barite is actually continuously recycled in drilling muds. In other applications (chemicals, paints, enamels, glass, rubber etc.) is not recycled.

10. Possible substitutes

Magnetite, hematite (incl. synthetic), ilmenite, celestite and other heavy minerals can be alternatively used instead of barite in drilling muds. However, it is just a marginal alternative only. Barite can be replaced by other fillers (e.g. by limestone, dolomite, soot) in production of rubber and in glassmaking partly by strontium salts, in lithopone by other whites (e.g. zinc white) etc. However, all these substitutes were found not as good as barite.

GRAPHITE

1. Characteristics and use

Graphite is one of two polymorphs of natural carbon. Graphite is an important technical mineral exhibiting perfect basal cleavage, fair electric and heat conductivity, refractoriness and resistance to acids. Graphite occurs in two polymorphs - hexagonal and rare rhombohedral. Graphite forms hexagonal flakes of light or dark steel grey color, occasionally completely black with metallic or dull lustre.

All rocks which contain considerable amounts of graphite that can be recovered are be 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. The latter looks like a dull solid matter. A division of crystalline graphite into large, medium and small flake is a business division without any general rules. It differs in accordance with particular producers.

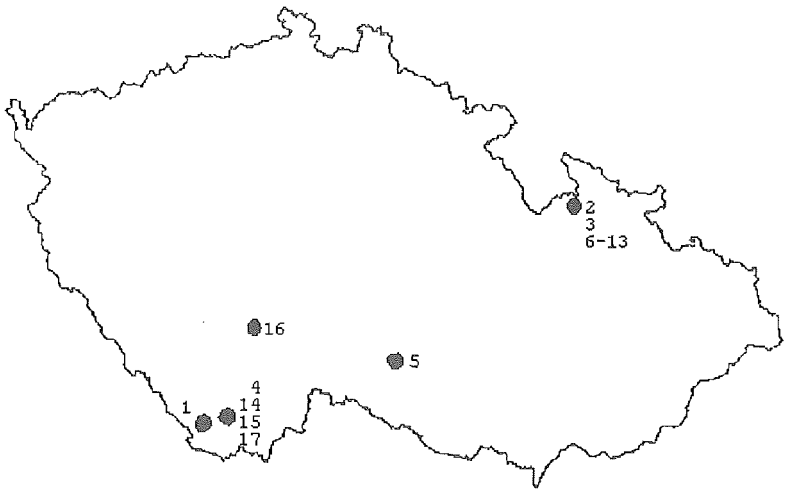
Graphite deposits can be divided into early magmatic, contact metasomatic - skarns, vein type deposits, metamorphogenic (metamorphic and metamorphosed) and residual. World reserves of graphite are estimated at 21 mill. tons. Uses of graphite are based upon its physical and chemical properties. It is used in foundry industry, electrotechnics, chemical and nuclear industries, in manufacture of refractory materials, lubricants, protective coatings, pencils, ammunition production and production of synthetic diamonds.

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 western part of the Bohemian Massif in Moldanubicum, then in the Moravicum and Silesicum.

- The most important deposits occur in the western part of Modanubicum, particularly in the so-called variegated series of Český Krumlov (mined deposits: Bližná, Český Krumlov-Městský vrch, Lazec, not mined deposits: Spolí, Český Krumlov-Rybářská street). Other less important deposits occur in the Votice-Sušice variegated series (not mined deposit at Koloděje nad Lužnicí-Hosty) and in the Chýnov mica schists (Černovice subeconomic deposit). South Bohemian graphitic rocks have a character of graphite rich gneisses, quartzites and carbonates.
- Deposits in the Moravian-Silesian region occur in an area affected by lower grade metamorphism. Local graphite shows lower degree of crystallization and contains much more sulphur which is confined to pyrite and pyrrhotite. The whole region is characteristic of higher contents of volatile constituents and less sulphur in graphitic layers in limestones than those in schists and phyllites. The major deposit of graphite in the Moravicum is Velké Tresné which was abandoned in 1966. It occurs in the Olešnice group of the Svratka dome. The major deposit in the Silesicum is Velké Vrbno-Konstantin which is a part of a graphitic zone belonging to the western margin of the Velké Vrbno dome.

3. Registered deposits and their location in the Czech Republic



Amorphous graphite:

1 Bližná
2 Konstantin
3 Branná-Medvědí důl
4 Český Krumlov-Rybářská street
5 Lesná
6 Malé Vrbno
7 Velké Vrbno-Adamov
8 Velké Vrbno-Adamov-south 1
9 Velké Vrbno-Adamov-south 2
10 Velké Vrbno-Luční hora 1
11 Velké Vrbno-Luční hora 2
12 Velké Vrbno-Ostružník
13 Velké Vrbno-U Milíře

Crystalline graphite:

14 Český Krumlov-Městský vrch
15 Lazec
16 Koloděje n. Luž.-Hosty

Combined graphite:

17 Spolí

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

Year		1992	1993	1994	1995	1996
Deposits - total number		10	10	17	17	17
exploited		4	5	4	4	4
Total reserves, kt		14559	14508	15287	15247	15201
economic proven		2198	2213	2178	2138	2092
economic probable		3725	3615	4369	4369	4369
subeconomic		8636	8680	8740	8740	8740
Mining output, kt		20	27	25	27	30
Imports, t	a)	200	654	737	977	1176
Exports, t	a)	896	2120	2294	2691	2722

Note:
a) item 2504 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in %	
		General	Concessionary
2504	Natural graphite	free	free

6. Mining companies in the Czech Republic as of December 31, 1995
Grafit, a.s. Netolice
Rudné doly Staré Město - F, s.r.o.

7. World production
World production of graphite remained stable around 1 mill. t/year up to 1992 and then has declined. World major graphite producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt	1022	863	782	800	800

Main producers (1994):
China 63.9%
India 8.9%

8. 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 Russia graphite on the world market. Prices of natural graphite are published monthly in the Industrial Minerals magazine and quoted in USD/t CIF UK ports. Average prices of traded grades of graphite at yearend were as follows:

A Crystalline lump, 92/95 % C
B Crystalline large flake, 85/90 % C
C Crystalline medium flake, 85/90 % C
D Crystalline small flake, 80/95 % C
E Amorphous powder, 80/85 % C

Commodity / Year	1992	1993	1994	1995	1996
A	1125	750	750	750	750
B	600	500	500	500	500
C	550	400	400	415	415
D	425	375	375	385	385
E	330	330	260	260	260

Since 1993 the magazine Industrial Minerals has quoted also synthetic graphite with 99.93% content of C. Its price was USD 2.23 per kg at yearend 1993; it continued to rise and reached USD 2.55 per kg FOB Swiss border at yearend 1996.

9. Recycling

Recycling of graphite in major fields of its use is virtually impossible (refractory materials, break lining, foundry industry, lubricants). Little recycling of graphite electrodes is rather an exception.

10. Possible substitutes

Natural graphite is replaced by artificial 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 limited use.

GEMSTONES

1. Characteristics and use

The designation "gemstone" refers to such minerals or rocks which are mostly used for personal adornment. The most important qualities of gemstones are beauty, durability, color, transparency, high lustre, brilliance, attractiveness, rarity, etc. The price of gemstones depends on their quality, size, rarity and also last fashion may strongly affect the price of individual gemstones. Gemstones and gem materials occur in a large variety of rocks and mineral deposits. Among gemstones are elements, oxides, silicates, alumosilicates, borosilicates and other compounds.

Some low-quality gemstones are used in various sectors of industry, mostly as abrasives and in instruments requiring precision elements - knife edges for balances, jewel bearings in timing devices, etc.

Recently, there is relatively large production of synthetic crystals, particularly those of corundum, spinels, emeralds and diamonds. The latter are rather dark and are being used as abrasives. Manufactured crystals, in general, include applications in transistors, infrared optics, bearings, lasers, etc.

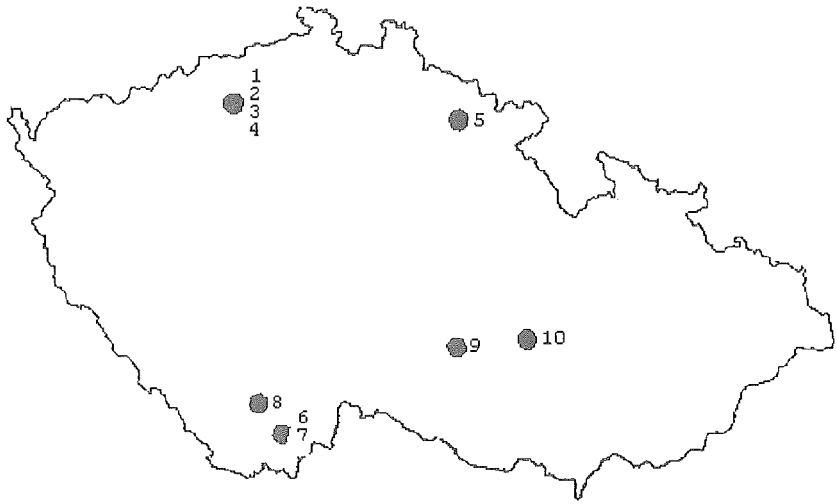
2. Mineral resources of the Czech Republic

Complex and varying geology of the Czech Republic is suitable for the occurrence of large selection of gemstones which were known and mined for since time immemorial. At present, the most significant gemstones in the Czech Republic are represented by so-called Bohemian garnet (pyrope) and tectite called moldavite.

- Pyrope, the most famous Czech gemstone is relatively complex Mg and Al silicate of varying chemistry, always containing low concentrations of Fe and Cr. Primary source of pyrope are ultramafic rocks, but there are mined pyrope-bearing placers on the southern slopes of the České středohoří - the deposit Podsedice and the deopsit Vestřev in the Krkonoše piedmont basin only. Stones of large size are used as a semi-precious gemstones, smaller grain sizes as abbrazives.
- The moldavites seem to represent an example to what extent the fashion trends may influence the popularity of certain gemstones. The moldavites are tectites whose origin is still enigmatic. They occur in loose Tertiary and Quaternary alluvial sands in southern Bohemia, in a belt which extends from Písek to České Budějovice and the Kaplice region. Brown moldatives occur in southern Moravia, along the Jihlava river, in a belt extending from Telč to Třebíč and further to Moravský Krumlov. Moldavites, particularly those from southern Bohemia, due to their attractiveness, are used in jewelry (mostly in their natural form). Industrial accumulations were verified at Besednice, Ločenice and Vrábče in southern Bohemia. Moldavites weren't mined systematically (during last five years the mining was realized in 1992 only).
- Increasing interest and demand for gemstones initiated some survey aimed at search for some other gemstones (varieties of SiO_2) in the Czech Republic. Amethyst was found to occur in relatively large volumes in some quartz veins penetrating a porphyry syenite of the Třebíč massif, particularly at the Bochovice and Hostákov localities. Geodes with crystals of amethyst and morion occur in these veins. The crystals exhibit zonal structure which is particularly well developed at Bochovice where the vein quartz envelopes so-called barrier amethyst. An opal deposit has been discovered in a fault zone NE of Rašov. A lenticular body of opal, about 60 m long occurs in a tectonic breccia confined to the Bíteš gneiss which shows some hydrothermal alteration.

It seems to be obvious that industrial mining for gemstones will never play any important role in economy of the Czech Republic but it may bring some profit on local scale.

3. Registered deposits and their location in the Czech Republic



Pyrope-bearing rock:
1 Podsedice
2 Linhorka-Staré
3 Podsedice-Dřemčice
4 Třebívlice
5 Vestřev

Moldavite-bearing rock:
6 Besednice
7 Ločenice
8 Vrábče-Nová Hospoda

Other gemstones:
9 Bochovice
10 Rašov

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	5	5	5	5	5
exploited		1	1	2	2	2
Total reserves, kt	a)	18967	23171	23133	23109	23072
economic proven		3836	3793	3759	3660	3630
economic probable		12934	12934	12930	12927	12920
subeconomic		2197	6444	6444	6522	6522
Mining output, kt	a)	45	34	33	24	39
Imports, kg	b)	61028	16830	20355	31631	38025
Exports, kg	b)	494	1262	7347	3609	4959

Note:
a) pyrope-bearing rock
b) item 7103 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
7103	Precious and semi-precious stones (o/t diamonds) incl. worked or sorted		
7103 10	- Unworked or simply cut or roughly shaped	5.0	free

6. Mining companies in the Czech Republic as of December 31, 1996

Granát - družstvo umělecké výroby Turnov
TRL, s.r.o. Praha 4

7. World production

World production of gemstones is not recorded. World capacity of garnet output (mostly for industrial application) was 150 kt in 1991 with utilization 95 %. The largest mining capacity was in the USA - 43 %, further producers were India - 19%, Australia - 17 % and China - 13 %.

8. 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, FOT mine Idaho, USA (Commodity A). Average prices in USD/t with minimum 20 t at yearend were as follows:

Commodity / Year	1992	1993	1994	1995	1996
A	190	210	210	210	210

9. Recycling

Gemstones in jewelry are not recycled. Recycling is basically possible in some sectors of their industrial applications (garnet as an abrasive can be recovered, cleaned, resized, and reused several times).

10. Possible substitutes

Generally, individual gem stones in jewelry can be combined and replaced. Pyropes can be replaced by almandines, amethysts and similar looking minerals. Many minerals and products can alternate garnet used as abrasive: especially natural or synthetic corundum, silicon carbide, silica sand, perlite, pumice, etc.

KAOLIN

1. Characteristics and use

Kaolin is mostly residual (primary), less often sedimentary (secondary) whitish rock, containing substantial amount of kaolinite minerals. It always contains quartz, and it may contain 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, like granitoids, arkoses, gneisses, etc. These so-called residual kaolins could then be transported, thus originating sedimentary kaolins. The deposits are concentrated in feldspar rocks in which the kaolinization had occurred. The titanium-bearing kaolin originated of autometamorphic granites with high Ti-minerals content. World economic reserves of kaolin were estimated at 12050 mil.t in 1983.

Kaolin is used for various purposes and the required grade depends on the use. Most often it is used as a raw material in the ceramic industry - in production of porcelain and other clay ware, then as a filler in the production of paper, rubber, plastics and pigments, in production of refractory materials, and in cosmetics, pharmaceutical, food. Kaolin is also used in production of synthetic zeolites. Production of kaolin is often classified among production of clays.

2. Mineral resources of the Czech Republic

Technological suitability of kaolin is assessed according to properties of the water washed kaolin. In the Czech Republic, kaolins are classified according to their use:

- Kaolin for production of porcelain and fine ceramics (KJ); requirements: purity, rheological properties, strength after drying, pure white-fired colour (content of $Fe_2O_3+TiO_2$ max. 1.6 %), refractoriness min. 33 PCE (1,730° C), screen residue on the screen 0.063 mm max. 2 %.
- Kaolin for ceramics manufacturing (KK) has no specifically defined parameters and is used according to many ceramic recipes. Specially appreciated are white-fired colour, low content of colorant oxides, etc.
- Kaolin used as a filling in paper industry (KP) is used both as a filling and for coating. Required properties are high whiteness and low content of abrasive particles. It is also used as a filling in 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 %) and in plastics.
- Titanium-bearing kaolin (KT) - contains over 0.5 % TiO_2 and this type of kaolin occurs only in the Karlovy Vary region. Tests have proven in some cases a possibility to reduce TiO_2 content by high intensity electromagnetic separation after which most of these kaolins can be used as KJ or KK 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 weathering (kaolinization) of feldspar rocks. The major kaolin deposits are located in the following areas:

- 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 Kadaň region - kaolins of this area originated from granulite orthogneiss of the Krušné hory crystalline complex. This kaolin is of the KK and KP grades.

▨ The Podbořany region - parent rock is feldšpathic sandstone of the Líně formation belonging to the Central Bohemian Permocarboniferous. There occur all aforesaid grades of kaolin here. The KJ kaolins are used as an additive into the Karlovy Vary kaolins in production of porcelain because of their rheological properties.

▨ 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), less of the KK grade, and only negligible part of the reserves is of the KZ and KJ grades.

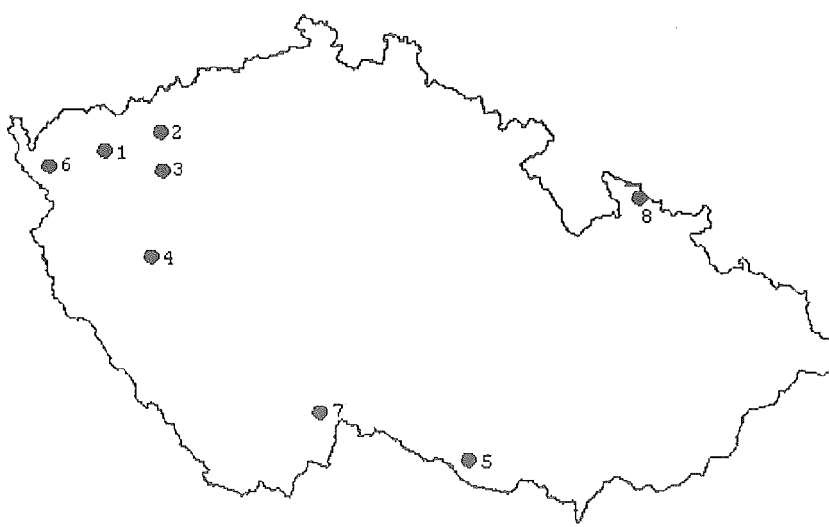
▨ The Znojmo region - these kaolins originated mostly from granitoids of the Dyje massif, less from the Bíteš orthogneiss of the Dyje dome of the Moravicum. These kaolins are of the KZ grade and less of the KP grade.

▨ The Cheb basin - these kaolins originated through kaolinization of granites of the Smrčiny massif. There is only one deposit here (KK, KP).

▨ The Třeboň basin - less important deposits, local kaolins originated from granites and biotite paragneisses of the Moldanubicum. Only ceramic kaolins (KK) are present.

All kaolin deposits of the Czech Republic are extracted by open-pit mining operations.

3. Registered deposits and their location in the Czech Republic



1 The Karlovy Vary region
2 The Kadaň region
3 The Podbořany region
4 The Plzeň region
5 The Znojmo region
6 The Cheb basin
7 The Třeboň basin
8 Vidnava

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	130	135	75	71	71
exploited		19	18	11	10	11
Total reserves, kt		1324969	1348057	1346588	1347694	1236135
economic proven		234787	255279	253955	252740	282252
economic probable		711743	691037	690155	696312	575381
subeconomic		378439	401741	402478	398642	378502
Mining output, kt	a)	2530	2336	2706	2800	2798
Imports, t	b)	1385	1353	3963	3825	5846
Exports, t	b)	439997	426488	345423	383498	361858

Note:

a) raw kaolin, total output of all technological grades;
kaolin refined - water-washed - represents about 25% of above mentioned mining output

b) item 2507 of the customs tariff

c) exports of high quality kaolin Sedlec Ia have been limited by MPO quotas

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2507	Kaolin and other kaolinitic clays, whether or not calcined	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

Západočeské kaolinové a keramické závody, a.s. Horní Bříza
Sedlecký kaolín, a.s. Božičany
Chlumčanské keramické závody, a.s.
Kaolin Hlubany, a.s. Podbořany
Severočeské doly, a.s. Chomutov
Poštorenské keramické závody, a.s.

7. World production

Data on the world production of kaolin vary considerably; the statistics quote alternately dry or wet weight, raw or refined kaolin, exact figures on mined and produced volumes of saleable product or their estimates. In spite of these misleading facts we can estimate that the world production since 1984 in the range of 20 mill. tons per year, and in 1990 it obviously reached its top (27,760 kt). The major producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Production, kt	22970	21003	22499	23000	24000

Main producers (1994):

USA	37.0%
United Kingdom	11.2%
Germany	7.2%
Colombia	6.0%

World production capacity reached about 27000 kt in 1995.

8. World market prices

Prices of kaolin on the world market - in spite of the lasting surplus of the supply - kept at the generally steady level. The Industrial Minerals magazine quotes each month prices of British and US kaolin. Average prices of traded commodities in GBP/t FOT ex-Cornwall, UK at yearend were as follows:

A Kaolin refined, filler
B Kaolin refined, coating
C Kaolin refined, ceramic grade
D Kaolin refined, porcelain grade

Commodity / Year	1992	1993	1994	1995	1996
A	75.00	62.50	65.00	62.50	62.50
B	97.50	97.50	97.50	97.50	97.50
C	80.00	60.00	60.00	60.00	60.00
D	N	102.50	102.50	102.50	102.50

9. Recycling

In ceramic production a part of bodies is recycled. The increased recycling of paper little influences the kaolin consumption; when 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.

10. Possible substitutes

Depending on the use, the situation is as follows:

- In production of porcelain, kaolin is irreplaceable.
- In ceramic recipes, in some cases kaolin can be partially substituted by clays, talc, wollastonite, or mullite (also synthetic mullite), but mostly these substitutions are financially pretentious.
- In production of paper (which consumes almost a half of the 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 a filler (insulation materials, pigments, glass fibres), the situation in analogous.
- In production of refractory materials and applications in the building industry, kaolin can be successfully substituted by other materials with adequate properties.

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, then 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, etc. They can be also secondarily consolidated (claystones) or recrystallized (argillite).

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 virtually in 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 technological properties and use, the clays are classified in the Czech Republic as follows:

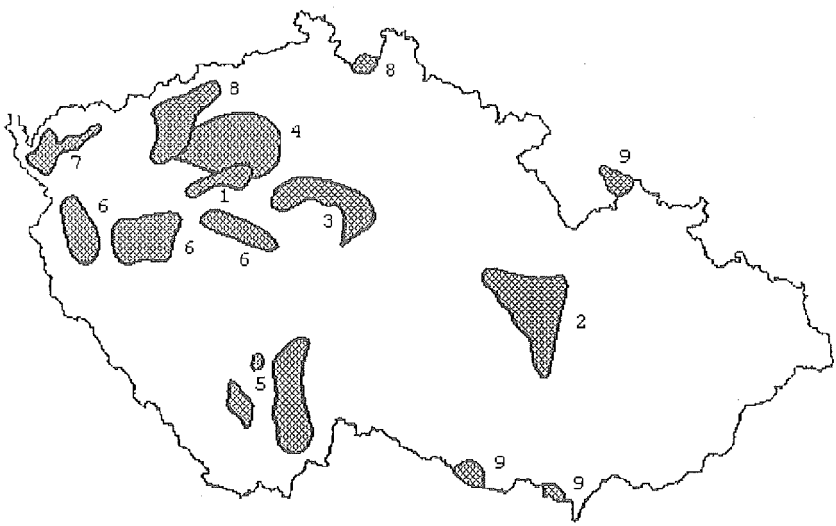
- Whiteware clays (JP) - they are used as a raw material for production of ceramics with white- or light-burning colour, sintering at temperatures over 1,200° C. The clay minerals are represented mostly by kaolinite, the content of clasts is low.
- Refractory clays for grog (JZ) - after firing, these clays are suitable as an opening material for production of fireclay products. The material is required to contain maximum Al_2O_3 and 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).
- Other refractory clays (JO) - used as bond (plastic) clays in production of mainly refractory products. Besides high binding properties they should contain a minimum of Fe_2O_3 and clasts.
- Non-refractory ceramic clays (JN) - the raw material of wide spectrum of technological properties and uses (production of floor and wall tiles, additives, etc.).
- Aluminous underlaying 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.

Clay deposits in the Czech Republic are concentrated in the following major areas:

- The Kladno-Rakovník Permocarboniferous - the deposits contain mostly high grade refractory claystones (shales) (JZ), which are used in production of refractory opening materials. Less common are deposits of red-burning tile clays and grey non-refractory claystones (JN).
- 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 with slightly lower quality).
- Cretaceous sediments in the vicinity of Prague - these clays are suitable as a highly refractory opening material (JZ) and refractory bond clays (JO), as well as whiteware clays (JP).
- The Louny Cretaceous - these clays are suitable as whiteware clays (JP) and other refractory clays (JO), but particularly as ceramic clays (JN).
- South Bohemian basins - medium or high grade refractory clays, suitable for use as bond clays (JO), whiteware clays (JP) and non-refractory clays (JN).

▪ The Plzeň basin and Tertiary relics of Central and Western Bohemia - mostly medium grade refractory clays, classified as bond clays (JO) and ceramic clays for production of floor and wall tiles, as well as for stoneware (JN).
▪ The Cheb and Sokolov basins - more significant is the Cheb basin containing important bond clays (JO), whiteware clays (JP), refractory and sintering clays (JO, JN), etc.
▪ North Bohemian and the Zittau basins - apart from high aluminous underlaying clays (JA), there are also overlaying ceramic (mostly sintering and tile) clays (JN).
▪ Tertiary and Quaternary sediments in Moravia - mostly ceramic (sintering and tile) clays (JN).
A very special position has the kaolin deposit at Vidnava classified as a clay deposit of JZ grade. Other deposits are of only local importance.
Clays in the Czech Republic are extracted by open-pit mining operations.

3. Registered deposits and their location in the Czech Republic



1 The Kladno-Rakovník Permocarboniferous
2 Moravian and East Bohemian Cretaceous sediments
3 Cretaceous sediments around Prague
4 The Louny Cretaceous
5 South Bohemian basins
6 The Plzeň basin and Tertiary relics of Central and Western Bohemia
7 The Cheb and Sokolov basins
8 North Bohemian and the Zittau basins
9 Tertiary and Quaternary sediments in Moravia

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

Year		1992	1993	1994	1995	1996
Deposits - total number		146	156	136	136	136
exploited		32	34	31	31	30
Total reserves, kt		1385964	1327259	1324985	1335424	981614
economic proven		291254	269133	267586	266573	257861
economic probable		831770	801885	800113	810416	697642
subeconomic		262940	256241	257286	258435	268111
Mining output, kt		903	1018	823	915	738
Imports, t	a)	1719	566	6914	7001	8513
Exports, t	a)	168643	239423	203707	199891	98397

Note:
a) items of the customs tariff, see paragraph 5

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2508 20	Decolorizing and fuller's earth	free	free
2508 30	Fireclay	free	free
2508 40	Other clays	free	free
2508 50	Andalusite, kyanite and sillimanite	free	free
2508 60	Mullite	free	free
2508 70	Chamotte or dinas earth	free	free

6. Mining organizations in the Czech Republic as of December 31, 1996

KEMAT Skalná, s.p.
KERAMOST a.s., Most
Calofrig a.s., Borovany
Západočeské kaolinové a keramické závody a.s., Horní Bříza
České lupkové závody a.s., Nové Strašecí
Moravské šamotové a lupkové závody a.s., Velké Opatovice
RAKO - Lupky s.r.o., Lubná u Rakovníka
Chlumčanské keramické závody, a.s.
Rakovnické keramické závody, a.s.
Poštorenské keramické závody, a.s.
Kaolin Hlubany a.s., Podbořany
Klinger s.r.o., Šatov
Palivový kombinát Ústí n. Labem, s.p.
Moravské keramické závody a.s., Rájec-Jestřebí

7. 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 is slowly but steadily growing.

8. World market prices

Average prices of most of the clays were steadily growing. Prices of some of the clays are quoted each month in the Industrial Minerals magazine. The overview of average prices of sales at yearend for the following commodities:

A Fuller's earth, soda ash-treated, del UK, foundry grade, bagged, GBP/t
B Calcined refractory, 40-70 % Al_2O_3, GBP/t, CIF UK
C Ball clay, air dried, shredded, bulk, GBP/t, FOB UK
D Ball clay, pulverized, air fluid, bagged, GBP/t, FOB UK
E Westerwald clay, dried & ground, bulk, DEM/t, FOB Germany

Commodity / Year	1992	1993	1994	1995	1996
A	90.00	105.50	109.00	109.00	97.50
B	85.00	77.50	77.50	86.00	86.00
C	50.00	45.00	45.00	45.00	45.00
D	95.00	95.00	95.00	100.00	100.00
E	155.00	150.00	150.00	162.50	162.50

9. Recycling

The material is not recycled.

10. Possible substitutes

Majority of the clays are used in various fields of ceramics production. According to the use, the following substitutes are possible:

- Whiteware clays used in ceramic recipes - here the clays are irreplaceable. On the contrary, the selection of used clays is still wider, depending on local resources and new recipes.
- Clays for opening materials - especially in production of fireclay and similar materials, the clays can be successfully substituted by a number of refractory materials - andalusite, mullite (including synthetic mullite), etc. - depending on the use and local availability.
- The same applies for clays used in production of other refractory products; there are numbers of possible substitutes, which depend on the purpose and use of these products, economic considerations, 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 buff-burning clays, cast basalt), another 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

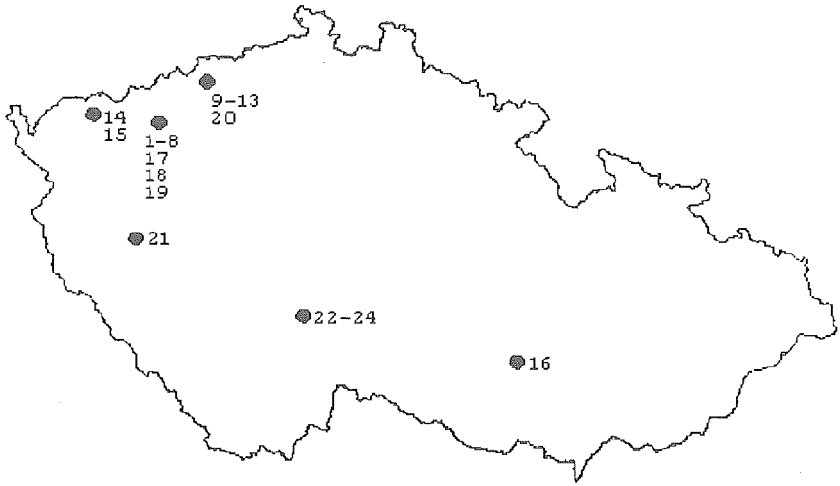
Bentonite is a soft, very fine-grained heterogeneous rock of various colours, composed mostly of clay mineral montmorillonite which originated mostly by submarine or atmospheric weathering of basic (to a smaller extent also of acid) volcanic rocks (mainly tuffs). Montmorillonite gives to bentonite its 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 alkali metals); 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 power. 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 were estimated at 1,410 mil.t in 1993.

Bentonite has many uses, which depend upon its mineralogical composition and technological properties. It is mostly used in foundry industry, for pelletizing of iron ores (4-10 kg are added to one tonne of dry iron ore to form pellets), as an adsorbent (decolorizing mineral, catalysis, refining, filtration, drying, waste water treatment, pesticide carrier), in drilling muds, as a filler (dyes, varnishes, pharmaceutical and cosmetic products), a suspension (lubricating oils), in the building industry (sealing material), in agriculture, etc. In recent years, the bentonite is still more used as a pet waste adsorbent (catlite) and pesticide carrier.

2. Mineral resources of the Czech Republic

The most important bentonite deposits in the Czech Republic are in the eastern (The Kadaň and Podbořany region) and western margin of the Doupovské hory (Hroznětín region) and České středohoří mountains (particularly the Most region). These areas include almost all bentonite deposits and reserves of the Czech Republic. Less important are deposits in Tertiary basins (The Plzeň region, South Bohemian basins, the Cheb and Sokolov basins) and Miocene sediments of the Carpathian Neogene in southern Moravia, with their mostly montmorillonite clays. All bentonite deposits in the Czech Republic originated by weathering of volcanic rocks. Mining, mineral processing and use of bentonite in the Czech Republic started only in the late fifties, particularly due to its use in the foundry industry. The mining culminated at the beginning and end of the eighties, and since then it has a decreasing trend. Large portion of bentonite from deposits of the Doupovské hory and České středohoří mountains 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.

3. Registered deposits and their location in the Czech Republic



Foundry bentonite:

1 Blov-Krásný Dvoreček
2 Blšany 2
3 Krásný Dvůr-Vys.Třebušice
4 Nepomyšl
5 Nepomyšl-Velká
6 Podbořany-Letov
7 Rokle
8 Vlkaň
9 Braňany 1
10 Černý vrch
11 Liběšice
12 Stránce
13 Střimice 1
14 Velký Rybník 2
15 Všeborovice
16 Ivančice-Réna

Other bentonite:

17 Chomutov-Horní Ves
18 Račetice
19 Vysoké Třebušice
20 Obrnice-Vtelno-Rudolice
21 Dnešice-Plzeň-south
22 Maršov
23 Rybova Lhota
24 Skalice

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

Year		1992	1993	1994	1995	1996
Deposits - total number		26	26	25	25	23
exploited		5	6	4	3	4
Total reserves, kt		279303	175263	275593	185991	231184
economic proven		49503	49472	49429	51096	51611
economic probable		192809	110868	189173	119365	160171
subeconomic		36991	14923	36991	15530	19402
Mining output, kt		135	63	65	54	59
Imports, t	a)	1420	4308	3329	3065	5394
Exports, t	a)	10078	13976	19317	18048	21633

Note:
a) item 2508 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2508 10	Bentonite	free	free

6. Mining companies in the Czech Republic as of December 31, 1996
KERAMOST a.s., Most

7. World production
Annual world production of bentonite is about 11 mill. tons. The production has been for a long period higher than 9 mill.t/year, and the highest output was in 1989 (9,590 kt). After 1989 the production slightly decreased due to a lower demand for the drilling mud and for pelletizing of iron ore (drop in production of pig iron since 1990). The world's leading producers were (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Production, kt	8915	8876	8874	8700	8900

Main producers (1994):

USA	37.1%
Russia	16.9%
Greece	7.9%
Germany	5.6%
Japan	5.4%

8. World market prices

Bentonite prices have been slightly fluctuating from time to time in the last few years. According to quotation of the Industrial Minerals magazine there were the following average prices on the world market at yearend:

A Wyoming, foundry grade, 85 % <200 mesh, bagged, 20-ton lots, GBP/t, del UK
B Wyoming, crude, bulk, rail cars, USD/st, FOB ex-works
C Wyoming, foundry grade, bagged, rail cars, USD/st, FOB ex-works
D Wyoming, API, bagged, rail cars, USD/st, FOB ex-works

Commodity / Year	1992	1993	1994	1995	1996
A	125.00	135.00	135.00	135.00	135.00
B	26.50	32.50	32.50	32.50	32.50
C	39.00	45.00	35.00	35.00	35.00
D	34.50	35.00	35.00	35.00	35.00

9. Recycling

Bentonite can be recycled on a very limited scale only.

10. Possible substitutes

In moulding sands, bentonite can be replaced by bonding agents containing graphite, synthetic polymers, or other clay minerals. Drilling muds can use similar substitutes, fillers can use chalk, dolomite, limestone, etc., in ecological applications bentonite can be replaced by zeolites. In production of iron ore pellets, bentonite is replaced by burnt lime, polymers and other binders.

FELDSPAR

1. Characteristics and use

Feldspar raw materials are rocks with the prevalent portion of minerals of the feldspar group or their mixtures in such a form, quantity and quality, which allow their industrial processing. 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. For industrial use are suitable potassium feldspars (orthoclase, microcline) and acid plagioclases (albite, oligoclase, andesite). Suitable feldspar resources are dike rocks (pegmatites, aplites), igneous rocks (granites) and sediments (feldspar bearing sands and gravel), eventually also residues of incompletely kaolinized rocks. The major impurities is high content of iron in the feldspar structure (unremoveable) or in the form of admixture (removeable).

Because of their low melting point, feldspars are used as a melting agent in ceramic mixtures, glass batches, glazes, enamels and also as casting powders in the last years

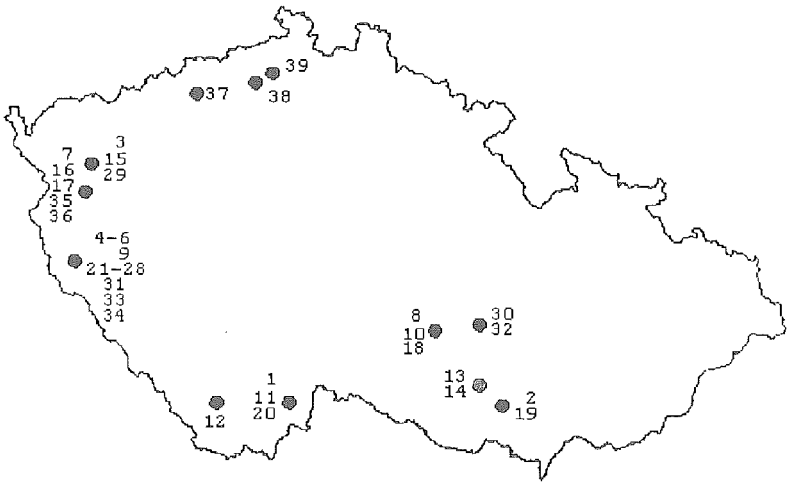
For the same purposes there are also used feldspar substitutes, which are rocks with alkali metals confined to some other minerals (mostly nepheline - anhydrous sodium-potassium alumo-silicate). Nepheline syenites are particularly used abroad to substitute for feldspar raw materials.

2. Mineral resources of the Czech Republic

Feldspar deposits in the Czech Republic are represented mostly by feldspar gravel sands, leucocratic granitoids and pegmatite bodies.

- Recently, the most significant are feldspar deposits originated in source areas of granitic rocks high in feldspar phenocrysts. The most important of them are the area along the upper course of the river Lužnice and the area south of Brno (sediments of the river Jihlava). The sediments are Quaternary fluvial feldspar gravel sands, suitable for production of glazes, household china, sanitary ceramics, glass, etc.
- Very important source of feldspar are leucocratic granitoids (granites and granite porphyries, diorites), mostly fine- to medium-grained. They have been explored at many localities occurring in various granite massifs (Chvaletice, Blanice region, Babylon, Blatno, etc.). Besides potential deposits (western Moravia), this category also includes already mined deposits in western Bohemia. The material is used in production of sanitary ceramics, colored glass, porcelain, grinding wheels, etc.
- In the past, the only source of feldspars used to be pegmatite deposits occurring in many regions. The Poběžovice - Domažlice region is characteristic of pegmatites with an admixture of dark minerals. These pegmatites exhibit a balanced proportion of sodium and potassium feldspars. The material is medium to low grade. But there are also sodium feldspar deposits which can be used in production of glazes and clear glass. In other areas, prevailing minerals in pegmatites are potassium feldspars. The Tepelské vrchy region, with quite large deposits of high grade feldspars and low content of impurities seem to be very promising. Quite promising is also the Písek region, with zoned pegmatites, only slightly affected by metasomatic processes. Smaller deposits are known in the area of Humpolec, in western Moravia, etc.
- As a substitute for feldspars in the Czech Republic, there are used mainly Tertiary volcanic rocks of the České středohoří mountains - nepheline phonolites. Because of high content of coloring oxides they are used in the glass and ceramics industry only as a melting agent for color mixtures. High alkali content (10-10.5% Na_2O and 3.5-5% K_2O) facilitates lowering of melting temperature and shortening of burning period.

3. Registered deposits and their location in the Czech Republic



Feldspar raw materials:

1 Halámky
2 Hrušovany near Brno
3 Krásno-granite
4 Luženičky
5 Mračnice
6 Ždánov
7 Beroun-Tepelsko
8 Bory-Olší
9 Březinka
10 Dolní Bory
11 Halámky-Tušť
12 Chvalšiny
13 Ivančice-Letovisko
14 Ivančice-Němčice
15 Krásno-Vysoký Kámen
16 Křepkovice
17 Kříženec
18 Lavičky
19 Ledce-Hrušovany near Brno
20 Majdaléna
21 Mašovice
22 Meclov 2
23 Meclov-airfield
24 Meclov-west
25 Ohnišťovice
26 Ohnišťovice-west
27 Otov-Červený vrch
28 Otov-east 2
29 Přílezy
30 Smrček
31 Srby
32 Velké Tresné
33 Zámělíč
34 Zámělíč 2
35 Zhořec 1
36 Zhořec 2-the Hanov zone

Feldspar substitutes:

37 Želenice
38 Tašov-Rovný
39 Valkeřice-Zaječí vrch

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

Year		1992	1993	1994	1995	1996
Deposits - total	a)	36	36	36	36	36
exploited		6	6	5	6	6
Total reserves, kt	a)	86930	86608	86217	85910	87207
economic proven		40437	40115	39724	39417	40373
economic probable		40726	40726	40726	40726	41857
subeconomic		5767	5767	5767	5767	4977
Mining output, kt	a)	152	203	170	183	211
Imports, t	b)	2461	529	431	620	3923
Exports, t	b)	43093	63687	66583	74181	67515

Note:
a) feldspars
b) item 2529 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2529 10	Feldspar	free	free

6. Mining companies in the Czech Republic as of December 31, 1996
Calofrig a.s., Borovany
Chlumčanské keramické závody, a.s.
KMK Granit s.r.o., Sokolov

7. World production
Annual world production (including nepheline syenite and aplite) is about 6,9 mill. tons. The output continues to go up owing to an increase of use in metallurgy and other industrial branches. Of statistically closed years the highest output was reached in 1994. The major producing countries were as follows (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt	6005	6457	6776	6800	6850

Main producers (1994):

Italy	26.7%
USA	11.3%
Thailand	7.8%
Turkey	7.4%
France	5.7%
Germany	5.6%

Nepheline phonolites were mined in France, Germany and in the Czech Republic. The largest producers of the nepheline syenite were Canada, Norway and Russia.

8. World market prices

Average prices of sales quoted in the Industrial Minerals magazine were constant during the period 1990-1992. Feldspar prices were increasing in 1993 because of the recovery in demand. Average feldspar prices at yearend were as follows:

A Ceramic grade, powder, 300 mesh, bagged, GBP/t, ex-store UK
B Sand, glass grade, 28 mesh, GBP/t, ex-store UK
C South African, ceramic grade, bagged, USD/t, FOB Durban
D South African, micronised, bagged, USD/t, FOB Durban

Commodity / Year	1992	1993	1994	1995	1996
A	140.00	160.00	160.00	160.00	182.50
B	65.00	85.00	85.00	85.00	99.00
C	N	135.00	140.00	140.00	140.00
D	N	225.00	235.00	235.00	235.00

9. Recycling

Reducing the need for virgin raw materials, reduces the need of feldspar, too. The recycling rate is about 33 % in the USA and as high as 90 % in some European countries like Switzerland.

10.Possible substitutes

Feldspar substitutes are materials having alkali metals confined to other minerals than feldspars, like nepheline syenites or nepheline phonolites in the Czech Republic. These replace feldspars 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 hydrate, clays, talc, spodumene, pyrophyllite or their mixtures.

QUARTZ

1. Characteristics and use

Silica raw materials 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 quartz sandstones by siliceous cement; the shape of original grains cannot be usually recognized), silicified sandstones, siliceous rocks, quartz sand and gravel, and vein and pegmatite quartz. The grade is established by various standards. The observed parameters are the content of SiO_2 and refractoriness. Impurities are represented by high Al_2O_3, Fe_2O_3, and/or other oxides.

Silica raw materials are used in production of ferroalloys in the metallurgical industry, silicon metal (in metalurgy,in semiconductors), refractory building materials (silica - bricks, mortars, ramming masses), porcelain and ceramics. Vein quartz, rock crystal and quartz boulders 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 - silica raw materials, and silica raw materials for production of special glass. Silica deposits are confined especially to the occurrences of the Tertiary "amorphous" quartz, Cretaceous "crystalline" quartz and Ordovician quartz, to lesser extent to the occurrences of vein quartz and lidites of the Upper Proterozoic.

- Vein quartz deposits can be found almost all over the territory of the Czech Republic, and they can be divided into the following genetic groups:

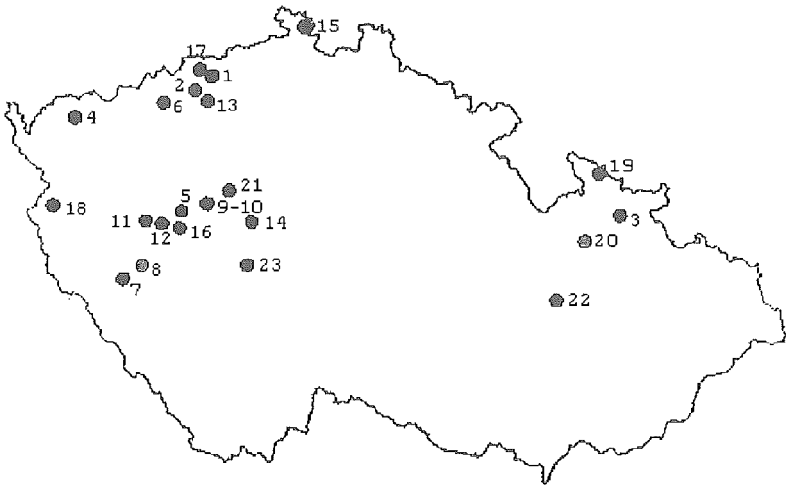
1) Quartz deposits in pegmatites (N. Moravia) - suitable for production of porcelain, ferrosilicon, silicon.

2) Quartz dikes (silicified fault zones) - suitable for ceramic industry (the Tachov region, S. Bohemia, the Jeseníky mountains).

3) Quartz veins related to granitoid massifs (the Karlovy Vary massif, the Žulová massif)

- Deposits of "amorphous" quartzite (quartz grains are cemented by a very fine quartz matrix) originated through silicification of Tertiary and Upper Cretaceous sediments in northern and western Bohemia (The Most region - mined deposit of Stránce, the Chomutov and Podbořany regions). Quartzite is a traditional material for production of dinas and can be also used for production of silicon metal.
- Neoid silicification of Cretaceous sandstones gave origin to important deposits of "crystalline" quartzites (isometric grains of quartz) in the Teplice region (mined deposit of Jeníkov-Lahošť). Quartzites are suitable for metallurgy but also for production of dinas.
- Among Paleozoic quartzites, the Ordovician quartzites of the Barrandien zone appear to be the most important. They are classified as of a lower grade for production of ferrosilicon and dinas.
- Because of their size and grade, very promising seem to be deposits of the Upper Proterozoic lydites, especially in the Rokycany and Přeštice regions. Tests showed the material is suitable for production of siliceous alloys, and to lesser extent for production of dinas.
- As a potential source of silica are considered to be also quartz sands and gravels in alluvial deposits of the Labe and Dyje rivers, and in the Cheb region.
- Only milky white vein quartz (after mineral processing) is considered to be suitable for production of special glass. It occurs in the Central Bohemian pluton (The Příbram region - metamorphosed island zone), and in hydrothermal veins which were metamorphosed together with the country rocks (phyllites) in the Prostějov region.

3. Registered deposits and their location in the Czech Republic



Quartz - Quartzite:

1 Jeníkov-Lahošť
2 Stránce
3 Bílý Potok-Vrbno
4 Černava-Tatrovice
5 Drahoňův Újezd-Bechlov
6 Horní Ves
7 Kaliště
8 Kbelnice
9 Kublov-Dlouhá Skála
10 Kublov-Velíz
11 Kyšice-Pohodnice
12 Litohlavy-Smrkový vrch
13 Lužice-Dobrčice
14 Mníšek pod Brdy
15 Rumburk
16 Sklená Huť
17 Střelná
18 Světecká Hora
19 Velká Kraš
20 Vikýřovice
21 Železná

Quartz for special glass:

22 Dětkovice
23 Krašovice

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

Year		1992	1993	1994	1995	1996
Deposits - total number		24	24	23	23	23
exploited		2	2	2	2	2
Total reserves, kt		48034	55148	55146	55143	54025
economic proven		7323	7321	7320	7319	7565
economic probable		24515	31631	31630	31628	30285
subeconomic		16196	16196	16196	16196	16175
Mining output, kt		46	23	2	3	4
Imports, t	a)	N	2498	2694	8781	21339
Exports, t	a)	N	17397	112	191	270

Note:
a) item 2506 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2506	Quartz (other than natural sands); quartzite, crude or roughly trimmed.	free	free

6. Mining companies in the Czech Republic as of December 31, 1995
KERAMOST a.s., Most

7. World production
Among many known silica raw materials (except sands), special attention is paid to materials for production of synthetic quartz crystals for use in electronics and optics, and then to mining for natural quartz crystals for direct use in industrial applications. Mining for natural crystals is limited (Brazil, China, Namibia, Madagascar) and 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 United Kingdom. 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.

8. World market prices
Silica materials (except for glass and foundry sands) 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 and the price has been probably at this level until now.

9. Recycling
Silica material is not recycled.

10. Possible substitutes
Quartz had been, as a strategic mineral, irreplaceable until the fifties. Today it is being still more replaced, both in electronics and optics, by synthetic crystals. Synthetic quartz competes with natural quartz also in production of clear silica glass.
In production of ferrosilicon, the quartz is irreplaceable, but the final product, ferrosilicon, can be replaced by other materials. Also dinas can be replaced by other types of lining.

GLASS AND FOUNDRY SANDS

1. Characteristics and use

Glass sands are granular, pale or even white coloured rocks (quartz sands or sandstones), which are used, after beneficiation, as a raw material for production of glass. Required parameters (grain size, mineral and chemical composition) vary according to the type of glass. Sands of required grade do not usually occur in the nature, therefore the sands have to be dressed by crushing, washing (removes floating particles) and sorting (to reach the required grain size). To obtain high grade glass sands it is necessary to apply more sophisticated methods of mineral dressing (electromagnetic separation, flotation, etc.); it is of utmost importance to reduce the content of colorant 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. Sands for glass melting are used for preparation of glass batches for production of sheet glass, packing glass and some technical glasses (max.content of Fe_2O_3 0.0023 - 0.0040 %), and utility glass (up to 0.0021 % Fe_2O_3); glass sands of higher grade are used for production of non-transparent silica glass (max. 0.0020 % Fe_2O_3) and the top quality sands (max. 0.0012 % and 0.0015 % Fe_2O_3) are used for production of crystal glass, semi-optical glass and some special technical glasses.

Foundry sands are similar rocks as glass sands, being used directly or after mineral dressing for production of foundry moulds and cores. The required properties include sufficient resistance to high temperatures and strength (depends on quality and quantity of the binding elements), and suitable grain size (the average grain size and its regularity). Because of their variability, natural foundry sands are still more being replaced by quartz sands, mixed with suitable amount of binding agents (mostly bentonite).

Natural quartz sands are after washing, separation and drying often coloured by inorganic pigments and used for plasters, as gunite sand and in other decorations.

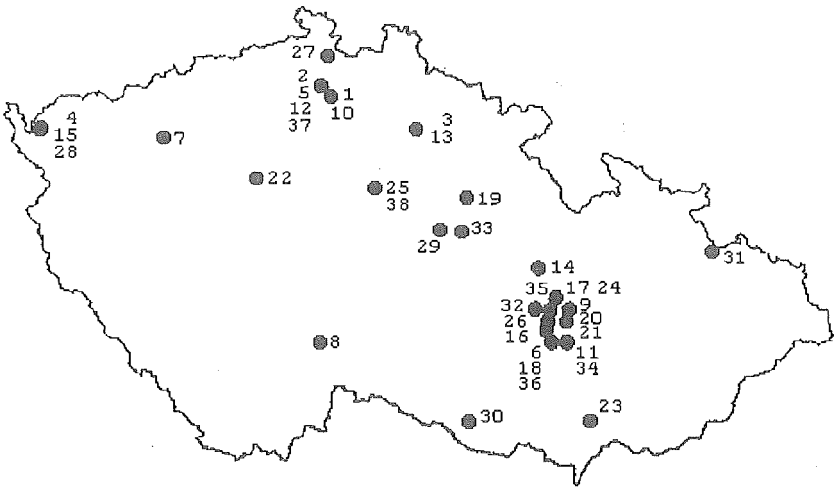
2. Mineral resources of the Czech Republic

The largest and most important deposits of glass sands in the Czech Republic are located in the Lužice (Srní, Provodín) and Jizera (Střeleč) regions of the Bohemian Cretaceous basin. The raw material consists of weakly consolidated quartz sandstones of the Coniacian (Střeleč) and Middle Turonian (Provodín, Srní) age. The Střeleč glass sand is of top world quality. Other deposits within the Bohemian Cretaceous basin are less important, or they are located in areas with special environmental considerations. Unconventional deposit at Velký Luh is composed of Pliocene gravel sands of the Cheb basin (redeposited material from the kaolinized Smrčina granite). Sands from all aforesaid deposits require mineral dressing in order to meet rigid specifications (washing, sorting, electromagnetic separation, flotation, etc.).

Foundry sand deposits are more abundant. They always accompany glass sands (material of lower grade), but they can also form their own deposits in other parts of the Bohemian Cretaceous basin (Cenomanian sandstones of the Orlice-Žďár region which are often glauconitic sands). Less important are wind blown sands (the Labe river basin and the Lower Moravian depresion) and Pliocene sands of the Cheb basin; only of local importance are fluvial sands (Lžín), glacial sands (Palhanec), etc. Foundry industry also uses sands which are a waste product of kaolin refining(Krásný Dvůr).

All deposits of glass and foundry sands in the Czech Republic are extracted by open-pit mining operations.

3. Registered deposits and their location in the Czech Republic



Glass sands:

1 Provodín *
2 Srní 2 *
3 Střeleč *
4 Velký Luh *
5 Srní *

Foundry sands:

6 Blansko 1-Jezírka
7 Krásný Dvůr
8 Lžín
9 Nýrov
10 Provodín *
11 Rudice-Seč
12 Srní 2 *
13 Střeleč *
14 Svitavy
15 Velký Luh *
16 Voděrady
17 Babolky
18 Blansko 2-Mošná
19 Bohumileč-Rokytno
20 Boskovice
21 Boskovice-Chrudichromy
22 Břve
23 Čejč-Hovorany
24 Deštná-Dolní Smržov
25 Kluk-Mostkový Les
26 Kunštát-Zbraslavec
27 Kytlické Mlýny
28 Lomnička
29 Načešice
30 Nový Šaldorf
31 Palhanec-Vávrovice
32 Prostřední Poříčí
33 Rabštejnská Lhota
34 Rudice-Novinky, Na Kalu
35 Rudka u Kunštátu
36 Spešov-Dolní Lhota
37 Srní *
38 Zvěřínek-Polabí

* glass and foundry sands deposits

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

Year		1992	1993	1994	1995	1996
Deposits - total number		32	34	33	33	33
exploited		12	11	11	13	13
Total reserves, kt		769164	769348	767874	765552	730324
economic proven		272210	254991	253462	252012	259705
economic probable		215171	206734	206649	206792	135389
subeconomic		281783	307623	307763	306748	335230
Mining output, kt		1963	1735	1955	1990	2182
Imports, t	a)	1488	102768	149142	159946	127952
Exports, t	a)	297308	540017	545622	661142	692336

Note:
a) item 2505 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2505	Silica sands of all kinds, also colored, except sands containing metals		
2505 10	- Silica sands and quartz sands	35	4.3

6. Mining companies in the Czech Republic as of December 31, 1996
Sklopísek Střeleč - EXIMOS, a.s.
Provodínské písky, a.s.
Moravské keramické závody a.s., Rájec
KEMAT Skalná, s.p.
SEDOS - těžba písků, Drnovice
Kaolin Hlubany a.s., Podbořany
Moravské šamotové a lupkové závody a.s., Velké Opatovice
Písek Lžín, České Budějovice

7. World production
World statistics provides data on production of gravel sands for industrial uses (glass production, foundry industry, abrasives etc.). The production had been rising until 1988 (119 mill.t). Since then the production was decreasing due to general economic recession. The major world producers were (according to USBM):

Year	1992	1993	1994 e	1995 e	1996 e
Mining output, mill.t	105	105	105	105	105

Main producers (1993):

USA	24.9%
Netherlands	19.4%
Germany	10.3%
France	5.9%
Austria	5.7%

8. World market prices

Average price of quartz sand for industrial use on the European market have been steady in the last years, an increase came in 1995. Prices of sands quoted by the Industrial Minerals magazine in GBP/t EXW UK at yearend were as follows:

A Foundry sand, dry, bulk
B Glass sand, flint, container

Commodity / Year	1992	1993	1994	1995	1996
A	9.75	9.75	9.75	11.50	11.50
B	11.00	11.00	11.00	13.50	13.50

9. Recycling

Glass sands, for obvious reasons, cannot be recycled; but it is possible to use sorted glass waste in a glass batch, which is being done.

Foundry sands used in moulding are mixed with bentonites, water glass, etc; having been exposed to high temperatures, their properties change to such extent which makes their full recycling impossible.

10. Possible substitutes

In glass production, the sand is basically the only source of SiO_2, therefore it can be replaced by sorted vein quartz, waste glass, synthetic SiO_2, etc. Foundry sands for moulding mixtures, especially in precision casting and few other uses, can be replaced by crushed olivine, staurolite, or chromite with graphite binder. Further substitutes are being studied.

WOLLASTONITE

1. Characteristics and use

Wollastonite ($CaSiO_3$) is triclinic, acicular mineral with chain structure of SiO_2tetrahedrons, of whitish colour, chemically very stable. Its specific density varies between 2.8 - 2.9 t/m^3, Mohs' hardness is 4.5 - 5, it melts at 1,540° C. It is a typical metamorphic and common mineral occurring particularly in contact metamorphosed limestones and erlans (with acid intrusions). It is associated with garnet (grossular , andradite) and vesuvian, eventually with pyroxenes and amphiboles. These rocks are usually called skarns. Sometimes the wollastonite content in the rock is so high (as much as 90 %) that we can speak of wollastonitite. Wollastonite (concentrate) is extracted from the rock by mineral dressing (grinding, flotation, high intensity electromagnetic separation, etc.), which also removes impurities.

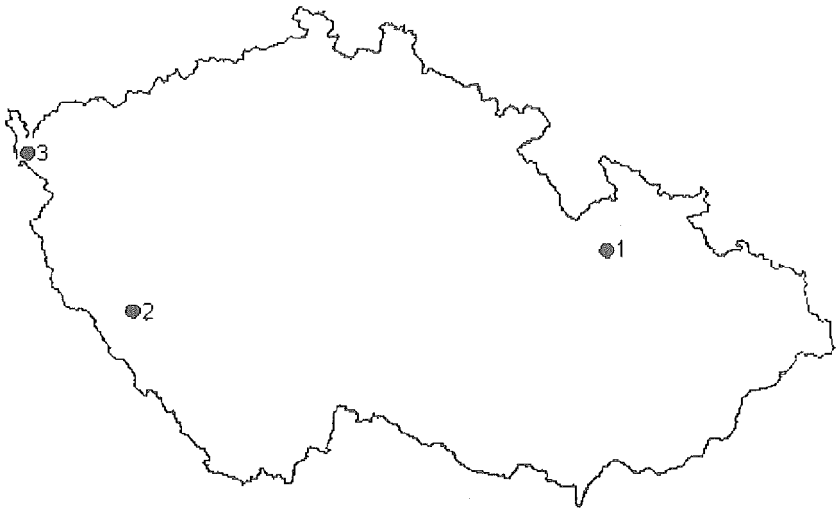
The mineral is a very promising raw material. Wollastonite is used in ceramics to manufacture tiles, sanitary ceramics, etc., both in the bodies and glazes, then as a filler in plastics and paints, as a refractory material, as a substitute for asbestos, in production of mineral fibres, in foundry industry for production of casting powders and slag for continuous casting of steel, etc.

2. Mineral resources of the Czech Republic

Three explored and evaluated wollastonite deposits in the Czech Republic are of metamorphic origin.

- Deposit at Bludov consits of two lenses of garnet-pyroxene- wollastonite skarn confined to a crystalline complex consisting of paragneisses, mica-schists with bodies of quartzite gneisses of the Branná group at its contact with the Šumperk granodiorite . The wollastonite content in rocks varies between 20 - 50 %. The rock also contains on average 15 - 25 % of garnet (andradite - grossular), which could be also extracted.
- The Mochtín deposit is composed of lenticular body of wollastonite skarn confined to a strongly migmatitized paragneisses of the Šumava Moldanubicum near its contact with granodiorites of the Central Bohemian pluton. Average content of wollastonite is 40 - 50 % (locally even 90 %).
- The Skalka deposit is formed by tectonically sunken block of garnet-pyroxene-wollastonite skarn with vesuvian in neighbouring metamorphic rocks (paragneisses, mica-schists, hornfels) of the Arzberg group near its contact with granites of the Smrčiny massif. Three separate blocks have been discovered showing on average 31 % of wollastonite in the rock (varies between 10 and 90 %).
- There are also known rocks rich in wollastonite (42 - 87 %, almost wollastonitite) at Lazy near Kynžvart but because of conflicts of interest this locality could not have been evaluated.

3. Registered deposits and their location in the Czech Republic



1 Bludov 2 Mochtín 3 Skalka

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

Year		1992	1993	1994	1995	1996
Deposits - total number		3	3	3	3	3
exploited		0	0	0	1	1
Total reserves, kt		3083	3301	3301	3301	3301
economic proven		0	0	0	0	0
economic probable		2688	2906	2906	2906	2906
subeconomic		395	395	395	395	395
Mining output, t		0	0	0	800	800
Imports, kt	a)	N	N	N	N	N
Exports, kt	a)	N	N	N	N	N

Note:
a) within the item 2530 of the customs tariff wollastonite is not presented separatelly

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2530	Mineral substances not listed elsewhere		
2530 90 80	- Others	free	free

6. Mining companies in the Czech Republic as of December 31, 1996
Bludovit s.r.o., Jihlava

7. World production
Until 1976, leading producer of wollastonite were the USA, which produced 85 % of the world output. China started to develop its production in the seventies, and reduced the USA share to 34 % in 1993. The world production was as much as 408 kt/year in 1994. It is expected that the world production capacity could reach even up to 750 kt/year in 2000. The share of the world production capacity was following in 1994: USA - 39 %, China - 29 %, India - 20 %, Finland - 7 % and Mexico - 4 %.

8. World market prices
Larger increase of wollastonite prices was recorded in the eighties. In the last 5 years, the prices fluctuated very little. The Industrial Minerals magazine quoted following average prices of selected commodities at yearend:
A Finnish, 325 mesh, GBP/t ex-store UK
B US acicular, minus 200 mesh, USD/st EXW
C US acicular, minus 325 mesh, USD/st EXW
D US acicular, minus 400 mesh, USD/st EXW
E US acicular (15:1 - 20:1 aspect ratio), USD/st EXW

Commodity / Year	1992	1993	1994	1995	1996
A	253	275	275	275	275
B	170	176	180	180	180
C	212	220	224	224	224
D	234	243	248	248	248
E	286	297	308	308	308

9. Recycling
The material is not recycled.

10. Possible substitutes

Wollastonite itself is often used as a substitute for other materials especially of asbestos; about 65 % of wollastonite production should be used as asbestos substitute. Thus the wollastonite can be replaced by the materials it substitutes. Generally, the wollastonite can be replaced by synthetic $CaSiO_3$, which in refractory products, in spite of some technological differences, can even surpass natural wollastonite. The major producers of the synthetic $CaSiO_3$ are Germany (Rheinische Kalksteinwerke GmbH), Belgium (NV Promat SA) and Brazil (Energyarc).

MICA

1. Characteristics and use

Micas are a group of hydrous aluminosilicates of various chemical composition and physical properties. Muscovite, phlogopite, biotite, lepidolite, zinnwaldite and other minerals of which only muscovite and phlogopite are more important commercially belong to this group. Micas are a common component of most minerals. They originated by crystallisation of migmatite melts, by contact and regional metamorphism and by decomposition of other silicates during hydrothermal and pneumatolytic processes. All micas split perfectly and are elastic. Muscovite and phlogopite have a high mechanical strength, they are chemically resistant and thermally stable (muscovite up to 500° C and phlogopite up to 1000° C). Electrical properties include low conductivity and high resistivity. Although micas are widespread minerals, mineable deposits are not many. Mica is supplied as sheet mica (large crystals), as flake or scrap mica (generally derived from a flotation process). Mica world deposit reserves have not been evaluated.

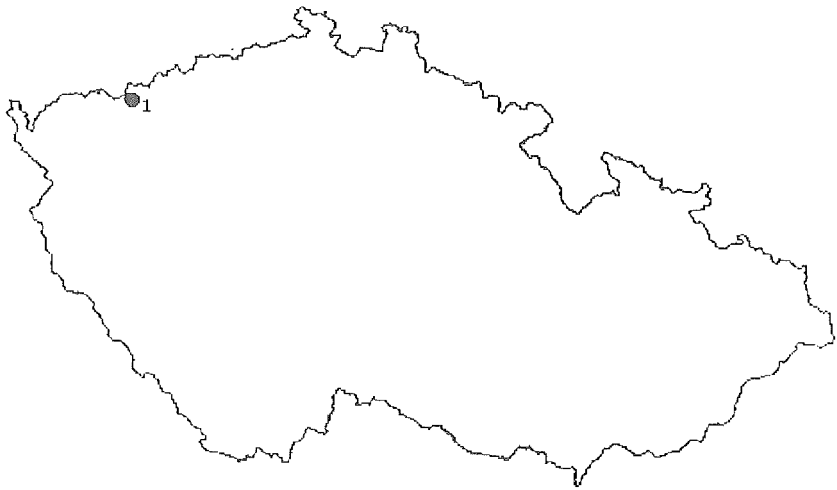
Mica is widely used. The highest world consumption of mica is in cement production (over 50%) and for fillers in paint and plastics productions (over 20%). Micas are components of well-drilling muds and for their characteristic properties are used in electronics, electrotechnics optics and in other fields of industry. Flake and dry-ground mica is used in production of reconstituted mica - micanite, mica paper and glass-bonded mica which substitute for natural sheet mica.

2. Mineral resources of the Czech Republic

Occurences (but not deposits) are numerous regarding the geological structure of the Czech territory with numerous areas of occurences of granites and their pegmatites, mica shists, gneisses, phyllites, greisens, sands, sandstones and other rocks.

- Muscovite occurs largely near Domažlice and in Teplá area, also in Kutná Hora, Krkonoše and Posázaví areas, in Moravia near Rožná, Maršíkov and Dolní Bory, it is also a component of garnet mica shist near Kovářská in Krušné hory Mts., where the only one balanced deposit in the CR is found.
- Phlogopite occurs in Bohemia near Písek and Tábor, in Moravia near Třebíč, Sokolí and Nedvědice.
- Biotite is widespread in Železné hory Mts., Krušné hory Mts. and České středohoří Mts.
- Lepidolite was discovered in Bohemia near Sušice and Křemže, in Moravia near Rožná, Dobrá voda, Jeclov and Ctidružice
- Zinnwaldite accompanies greisen deposits of Sn-W ores in Krušné hory and Slavkovský les regions

3. Registered deposits nad their location in the Czech Republic



1 Kovářská-Dolina 1

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

Year		1992	1993	1994	1995	1996
Deposits - total number		0	0	0	1	1
exploited		0	0	0	1	1
Total reserves, kt		0	0	0	1552797	1547812
economic proven		0	0	0	763691	1232857
economic probable		0	0	0	789106	314955
subeconomic		0	0	0	0	0
Mining output, t		0	0	0	3803	0
Imports, kt	a)	2074	1979	244	404	533
Exports, kt	a)	0	0	46	2	40

Note:
a) item 2525 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2525	Mica including splittings, mica waste	free	free

6. Mining companies in the Czech Republic as of December 31, 1996
GARMICA s.r.o., Měděnec

7. World production
Mica world production data are mostly estimated as China has not returned production (there are known approximate production capacities only). The major world producers were as follows (according to the Industrial Minerals magazine):

Year	1992 e	1993 e	1994 e	1995 e	1996 e
Mining output, mill.t	245	150	260	260	260

Main producers (1995):

USA	40%
China (estimated)	15%
Russia	10%
Canada	7%

World production capacity was 300 kt/year. Production of muscovite dominated; phlogophite was produced in Canada, Finland, India, Russia and Madagascar.

8. World market prices
Mica is quoted in several grades by the Industrial Minerals magazine monthly. Average prices of sales at yearend were constant during the last five years. On the world market there are given four grades of mica as representatives of traded commodities with average prices as follows:
A Indian dry ground, GBP/t CIF Europe
B Indian wet ground, GBP/t (in 1996 USD/t) CIF Europe
C Indian micronized, GBP/t CIF Europe
D Block mica, clear, USD/kg FOB S. Africa

Commodity / Year	1992	1993	1994	1995	1996
A	123	175	175	175	175
B	N	310	310	450	575
C	N	313	313	313	313
D	N	32	32	32	32

9. Recycling

The material is not recycled.

10. Possible substitutes

Sheet mica is substituted by reconstituted mica, by alumina ceramics, fused quartz and organic polymers. In electronics and electrotechnics there is natural mica often replaced by synthetic mica manufactured by heating a properly proportioned mixture of dry, pulverized potash, feldspar, potassium silicofluoride, magnesia, alumina and silica in a furnace at 1,360°C. In other areas of use (carriers, fillers, lubricants) there is a great number of possible substitutes including series of currently accessible minerals.

DIATOMITE

1. Characteristics and use

Diatomite or diatomaceous earth is a sedimentary rock, consisting mostly of the microscopic cells of fresh-water or marine diatoms. This rock shows various degree of consolidation - it is either loose (diatomaceous earth) or consolidated (diatomaceous shales or chert). Loose rocks has a form of a very fine grained sediment. During diagenetic processes there occurs partial dissolving of shells and impregnation of the sediment by released opal which leads to consolidation into a shale. Depending on the degree of porosity we speak of polishable or "absorbing" shales, sometimes even of opal cherts. Chemically, diatomite is essentially amorphous hydrated or opaline silica with varying amounts of contaminants. The silica content of diatomite will range from about 58 to 91 %. From the technological point of view, important parameters are porosity, acid resistance , refractoriness, thermal and electric conductivity, apparent density, moisture content, chemical composition, etc. Contaminants are silica sands, clay minerals, organic particles (sponges) or higher content of Al_2O_3, Fe_2O_3 and CaO. Deposits originated in water basins with low content of $CaCO_3$ and dissolved silica. The most suitable conditions exist in cool, clear, well-lighted water near volcanic areas. The world reserves are estimated at 800 mill. tons, of which 250 mill. t in the USA..

Filtration is the major end use of diatomite (the highest grades); it is used in production of industrial fillers (rubber, paper, cosmetics), as abrasives, as carrier for catalysts, thermal and sound insulating elements or light building elements.

2. Mineral resources of the Czech Republic

Diatomite deposits in the Czech Republic are confined to areas with Tertiary or Quaternary sediments in the South Bohemian basins and to volcanites of the České středohoří mountains. Smaller deposits occur also in other parts of the Bohemian Massif and in the Neogene of the Carpathian foredeep.

- The largest diatomite deposits in Bohemia are in the South Bohemian basins. In the Budějovice basin, there occur spongy diatomites and diatomaceous clays together with lignites. The only evaluated and registered deposit at Borovany is located in the Třeboň basin. Tertiary sediments were deposited in structurally narrow space of the Moldanubicum basement. Diatomites, diatomaceous clays and spongy diatomites occur in the upper layer of the Mydlovary formation. Diatomites are of whitish grey to ochre colour, unconsolidated, and in horizontal position. Average thickness is about 8.5 m (max. 15 m). Mining at this deposit dates back to the beginning of this century. High grade diatomites are used after processing and product preparation, for filtration or as fillers in food, chemical and pharmaceutical industries, etc. Diatomite of lower grade is used in production of building and insulating elements.
- In the České středohoří mountains, there are known many outcrops of diatomites which were occassionally mined even in the first half of the last century as a material for production of abrasives.
- Quaternary diatomites are located around Most (together with lake mud high in organic matter) and Františkovy Lázně (deposit Hájek - earlier extracted together with peat, nowadays it is a natural preserved area).

3. Registered deposits and their location in the Czech Republic

1 Borovany

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

Year		1992	1993	1994	1995	1996
Deposits - total number		1	1	1	1	1
exploited		1	1	1	1	1
Total reserves, kt		5152	5108	5066	5036	4995
economic proven		4824	4780	4738	4708	4667
economic probable		328	328	328	328	328
subeconomic		0	0	0	0	0
Mining output, kt		57	39	40	29	35
Imports, t	a)	1538	1506	2090	2718	5602
Exports, t	a)	5950	5827	6591	7714	7359

Note:

a) item 2512 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2512	Siliceous fossil meal and similar siliceous earths	free	free

6. Mining companies in the Czech Repnblic as of December 31, 1996

Calofrig a.s., Borovany

7. World production

Production of diatomite has been at the level over 1 mill. t/year for many years but a production capacity has been 2 mill. t at the same time. The highest production was reached in 1988 - 1,672 kt. Leading position had 4 countries, which produced 80 % of the world output (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt	1258	1080	1080	1100	1100

Main producers (1994):

USA	56.7%
France	8.3%
Korean Republic	7.7%
Spain	6.5%

8. World market prices

World market quotes only prices of US diatomite. Monthly quotations of the Industrial Minerals magazine (del UK) show continuous increase of prices in the last 5 years. Average prices of commodities at yearend were as follows:

A US calcined, filter-aids, GBP/t

B US flux-calcined filter-aids, GBP/t

Commodity / Year	1992	1993	1994	1995	1996
A	322.50	337.50	337.50	390.00	390.00
B	345.00	360.00	360.00	400.00	400.00

9. Recycling

The material is recycled in a small extent. In some filter systems, the filter media can be back flushed and cleaned for re-use.

10. Possible substitutes

Filtration is the major use of diatomite where it can be replaced by activated carbon, cellulose, pumice, quartz sand, asbestos, expanded perlite, fritted glass, etc. However, in general, the parameters of diatomite have not been reached. In other applications, diatomite can be replaced:

- As a filler by talc, mica, quartz sand, clays, perlite, vermiculite, limestone.
- As an insulating material in building industry by regular bricks, asbestos, diatomite mineral wool, metals, cement, pumice, perlite, zeolites, vermiculite.
- As friction material by asbestos, barite, bauxite, alumina, clays, graphite, gypsum, mica, pumice, pyrophyllite, silica, slate, vermiculite, zircon.

LIMESTONES AND CORRECTIVE SIALIC ADDITIVES FOR CEMENT PRODUCTION

1. Characteristics and use

Limestones are sedimentary rocks containing $CaCO_3$ (calcite or aragonite). Primary and secondary admixtures in limestones are dolomite, silicates, phosphates, etc. Limestones originated through chemical, biological and mechanical processes or their combinations. Limestones of different origins show variaitons in physical characteristics, texture, hardness, color, weight, and porosity, ranging from loosely consolidated marls through chalk to compact limestones and hard crystalline marbles. Limestones originated in sediments of virtually every geologic age, worldwide. However, their volume seems to increase in later periods.

Limestones are used for production of building elements (lime, cement, mortar mixtures, granulated gravel, dimension and building stone, etc.), in the metallurgical, chemical and food processing 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 raw materials also includes corrective sialic additives for production of cement (CK), e.g. shales, clays, loess, loams, sands, etc., which correct the content of SiO_2, Al_2O_3 and Fe_2O_3 in the basic raw material for burning of clinker in production of cement. These corrective materials mostly accompany deposits of portland limestones or occur in their close neighbourhood.

2. Mineral resources of the Czech Republic

According to use, the limestones are classified in the Czech Republic into the following grades:

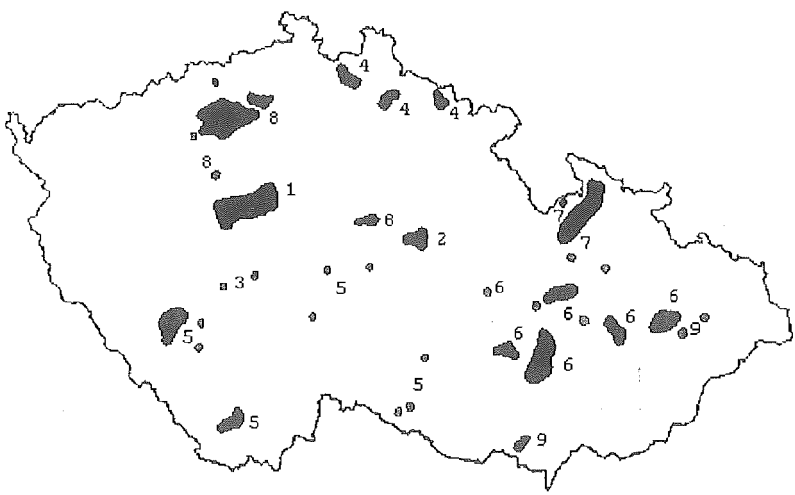
- Limestones with very high percentage of $CaCO_3$ (VV), containing at least 96 % of carbonate (with max. 2 % $MgCO_3$). These limestones are used mostly in chemical, glass, ceramics, rubber, food processing and metallurgical industries, for desulphurization, and for production of the top quality lime;
- Clayey limestones (VJ) - with $CaCO_3$ content over 70 % and higher content of SiO_2 a Al_2O_3. These limestones are used for production of cement, all kind of lime, and for desulphurization;
- Carbonates for use in agriculture (VZ) - with the content of carbonates at least 70-75 %. They are used for dressing of agricultural land and forest soils;
- Other limestones (VO) - with carbonate content at least 80 % - they are used mostly for production of cement, then for production of lime, desulphurization, etc. Also dolomites and dolomitic limestones are included in this group in the Czech Republic.

Limestone deposits in the Czech Republic are concentrated in the following main areas:

- The Barrandien zone Devonian - the most important and largest deposits are located in this area. Almost all types of limestones occur there,particularly those of VV and VO grades but also VZ and CK grades. Limestone deposits are confined to sediments of mostly Lower Devonian age, and consist of several lithological types. The Upper Koněprusy limestones are of the highest grade (average content of $CaCO_3$ is about 98%).
- The Paleozoic of the Železné hory mountains - relatively small area with important deposits. The local material is composed of the Podolí crystalline limestones (VV grade, 95 % $CaCO_3$) and less pure darker marbles of VO grade (90 % $CaCO_3$).
- Central Bohemian metamorphosed "islands" - small isolated areas with quite pure metamorphosed limestones (mostly VV a VO grades).
- Crystalline complex of the Krkonoše-Jizerské hory mountains - medium size deposits, mostly in the form of lenses confined to phyllites and mica-schists. These are crystalline limestones, often with various contents of $MgCO_3$ and SiO_2 (mostly VO and VZ grades).
- Moldanubicum - small size deposits of crystalline limestones, forming bands or lenses in metamorphic rocks. They occur particularly in the Šumava part of the Moldanubicum. Dolomitic limestones or dolomites usually accompany the limestones here. The majority of local limestones are of VZ and VO grades.

■ The Moravian Devonian - represents the most important region with limestone deposits of various size in Moravia. The Vilémovice limestones (VV grade, 96-97 % $CaCO_3$) occur in almost all deposits. Less abundant are the Křtiny, Hády and Lažánky limestones (VO).
■ The Silesicum (the Branná group) and the Zábřeh group - smaller deposits of crystalline limestones forming bands in metamorphic rocks. Local 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).
■ The Bohemian Cretaceous basin (The Ohře and Kolín regions) - large and medium size deposits. Deposits contain clayey limestones and marls with contents of $CaCO_3$ ranging between 80 and 60 % (the most important deposits of clayey limestones - VJ).
■ Outer nappes zone of the West Carpathians - limestones form structurally isolated blocks in surrounding rocks (so-called "clippen").The limestones are very high grade, with an average content of $CaCO_3$ 95-97 %, and $MgCO_3$ less than 1 % (VV). Also clayey limestones (VJ) are mined here.
Other deposits are only of local importance, as far as production and reserves are concerned. All deposits of limestones and raw materials for production of cement are extracted in the Czech Republic by surface mining.

3. Registered deposits and their location in the Czech Republic



1 The Barrandien zone Devonian
2 The Paleozoic of the Železné hory mountains
3 Central Bohemian "islands" zone
4 The Krkonošsko-Jizerské hory crystalline complex
5 Bohemian, Moravian and the Šumava part of the Moldanubicum
6 The Moravian Devonian
7 Silesicum (the Branná group), the Orlické hory-Kladsko crystalline complex and the Zábřeh series.
8 The Bohemian Cretaceous basin
9 Outer nappe zone

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

Year		1992	1993	1994	1995	1996
Deposits - total number		121	124	117	116	116
exploited		35	36	30	28	28
Total reserves, kt	a)	6680860	6313734	6244117	6201001	6066998
economic proven		2078431	2074678	2054979	2034624	2074634
economic probable		3600855	3493991	3469784	3424478	3416250
subeconomic		1001574	745065	719354	741899	576114
Mining output, kt	a)	11134	10498	10205	10092	10610
Imports, kt	b)	3	16	781	623	512
Exports, kt	b)	143	191	53	72	88

Note:

a) limestones without corrective sialic additives for cement production

b) item 2521 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in %	
		General	Concessionary
2521	Limestone flux; limestone and other calcareous stone, for lime or cement manufacturing	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

Limestones:

Cementárny a vápenky Mokrá, a.s.

Cement Hranice, a.s.

Velkolom Čertovy schody a.s., Tmaň

Cementárny a vápenky Prachovice, a.s.

Cement Bohemia Praha, a.s.

Lomy Mořina, s.r.o.

Lafarge cement - Čížkovická cementárna, a.s.

Vápenka Vitošov s.r.o., Leština
Kotouč Štramberk, s.r.o
Krkonošské vápenky Kunčice, a.s.
HASIT a.s. - ŠVO, Velké Hydčice
Lom Skalka s.r.o., Ochoz u Brna
Vitoul v.o.s., Měrotín
OMYA a.s., Vápenná
Kamenolom a vápenka Malá dohoda, s.r.o.
JHF Heřmanovice, s.r.o.
AGIR s.r.o., lom Skoupý
Agrostav Znojmo, a.s.

Corrective sialic additives for cement production:
Cementárny a vápenky Mokrá, a.s.
Cement Hranice, a.s.
Velkolom Čertovy schody a.s., Tmaň
Kotouč Štramberk, s.r.o.

7. World production

Overall data on production of limestones in the world are missing. The major producing areas can be characterized by production of cement, which consumes most of the mined limestone. In the last five years the largest world producers then might be China, Japan, USA and Russia, which together produced more than 40 % of the world production of cement.

8. World market prices

Prices of limestones are not quoted. Since the limestones are generally well available in a wide assortment of grades, prices are set upon agreement. Average price of crushed limestones on the US market in 1993 was USD 5 per t and average price of Austrian limestones exported to EU countries was 3 ECU/t in 1993.

9. Recycling

The material is not recycled. Recycled are some products of glass industry, construction materials, etc. only.

10. Possible substitutes

Limestones of all grades have various uses. Limestones can be replaced in many applications. Limestones, dolomites and various burnt lime are often mutually replaceable (e.g. in agriculture). Also in the desulphurization, the limestones can be replaced by various mixtures of carbonates. 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 neutralization and acid mine water neutralization. Yet the limestones 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).

GYPSUM

1. Characteristics and use

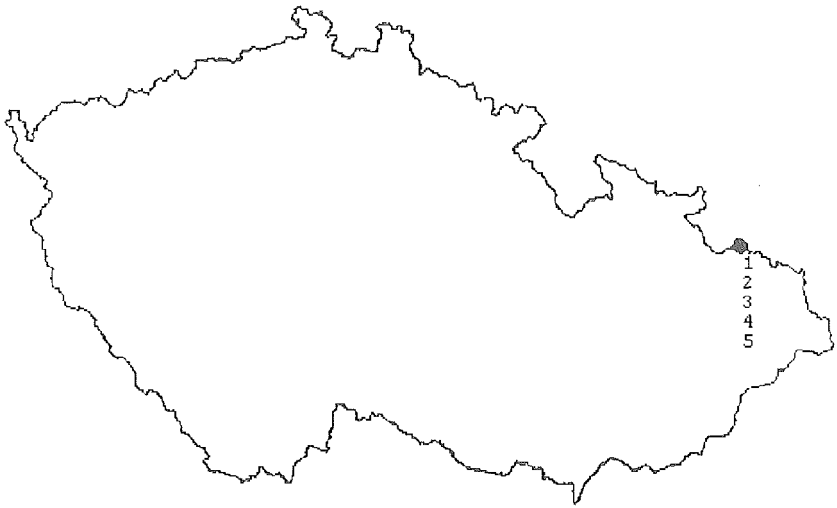
Gypsum is a sedimentary rock, consisting mostly or completely of monoclinic mineral gypsum ($CaSO_4.2H_2O$) which is usually colorless or white. The rock often contains impurities (clay minerals, quartz, iron oxides, limestone, dolomite, anhydrite, etc.). The majority of gypsum deposits were formed as evaporites from marine or lake waters in arid areas. Deposits which have different origin (weathering and decomposition of sulphides, hydration of anhydrite, metasomatic processes, etc.) are of no economic importance. Anhydrite $CaSO_4$ with no water of crystallization is often classified into the gypsum group. It is usually changed into gypsum by wet grinding. Present world reserves of gypsum are estimated at 2,600 mill. tons.

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. Average content of gypsum in the rock is 70-80 %. The impurities are mostly clays and locally sands. Layers near the surface 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-south.

3. Registered deposits and their location in the Czech Republic



1 Kobeřice-south
2 Kobeřice-north
3 Rohov-Strahovice
4 Sudice
5 Třebom

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

Year		1992	1993	1994	1995	1996
Deposits - total number		5	5	5	5	5
exploited		1	1	1	1	1
Total reserves, kt		508057	507401	506747	506147	505612
economic proven		122930	122274	121620	121020	120485
economic probable		302990	302990	302990	302990	302990
subeconomic		82137	82137	82137	82137	82137
Mining output, kt		660	560	591	542	443
Imports, t	a)	4457	46	1813	7622	22088
Exports, t	a)	10368	112755	122847	101016	86176

Note:
a) item 2520 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2520 10	Gypsum, anhydrite	5	4.3

6. Mining companies in the Czech Republic as of December 31, 1996

Gypstrend s.r.o., Kobeřice

7. World production

World production of gypsum (including anhydrite) has been for a long time in the range of 80,000-100,000 kt, with the highest statisticaly closed output in 1994. The production is closely related to building activities and the reduction of construction works after 1989 caused also a temporary reduction of mining for gypsum. The largest world producers were (according to the Welt-Bergbau-Daten):

Year	1992	1993	1994	1995 e	1996 e
Mining output, kt	88633	91495	96373	96500	97000

Main producers (1994):

USA	17.8%
China	11.4%
Canada	8.8%
Iran	8.7%
Thailand	8.4%
Spain	7.6%
France	5.2%
Mexico	5.2%

World mining capacity reached 106 000 kt in 1995.

8. World market prices

Prices of natural gypsum were steady in 1996. Even in times of more extensive building activities the prices were stable, which was also caused by a supply of waste gypsum (desulphurization of flue gas in thermal power stations, chemical industry), production of which highly exceeds the demand. Average prices of crude gypsum (commodity A) in GBP/t EXW UK at yearend quoted by the Industrial Minerals magazine were as follows:

Commodity / Year	1992	1993	1994	1995	1996
A	6.50	9.00	9.00	9.00	9.00

9. Recycling

Waste wallboards from construction sites are recycled in a limited volume.

10. Possible substitutes

Natural gypsum is replaceable to some extent by a waste gypsum for example from production of phosporic acid, titanium dioxide, flue gas desulfurization (FGD). Byprodudt gypsum from FGD is used for wallboards and cement production.

DIMENSION STONE

1. Characteristics and use

Rock which has been specially cut or shaped for use in buildings, curbing or other construction or special uses is termed "dimension stone" and/or "decorative stone". Archictectural specifications for dimension stone apply primarily to esthetic qualities such as design, surface appearance, etc. Important requirements include mineralogical composition, strenght, weather resistance, color fastness, porosity, texture, structure, etc. Dimension stone includes all kind of solid rocks of magmatic, sedimentary or metamorphic origin which can be quarried in the form of blocks suitable for cutting to specific dimensions. Weathered surface, altered or crushed zones or inclusions of unfitting rocks represent undesirable imperfections.

2. Mineral resources in the Czech Republic

▪ Dimension stone used in buildings, curbing and other applications mostly involves igneous rocks, much less other rocks (basalt columns, dike rocks, sandstones). Deposits, similarly as those of crushed and broken stone are confined to the Central Bohemian pluton and Moldanubian pluton, the Nasavrky massif, eventually other plutonic bodies of the Bohemian Massif (Štěnovice massif, Žulová pluton, etc.).

▪ Architectural and sculpture dimension stone also use mostly abyssal igneous rocks - granites and granodiorites, which occur in the Central Bohemian and Moldanubianc plutons,the Štěnovice, the Krkonoše-Jizerské hory, the-Jeseníky and Nasavrky massifs in Bohemia, and in Moldanubian and Žulová massifs in Moravia. Less important are dark igneous rocks - diabases, diorites and gabbros, which also occur in the Central Bohemian Pluton,then in the Kdyně and Lužice massifs, (eventually serpentines in W.Bohemia and Moravia). Aforesaid 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 and Doupovské hory mountains 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 then from Hořice and Broumov regions. Less important are Triassic and red Permian sandstones from the Krkonoše piedmont basin. In Moravia, there are the Těšín Cretaceous 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 Barrandien zone and of the Moravian karst (wall lining, terrazzo, etc.). Pleistocene travertines, used for interior wall lining, terazzo and conglomerates, are quarried in the Přerov region. Schists of the Moravian-Silesian Paleozoic are used as lining, covering and paving material, and as expanded materials.

▪ Mostly used metamorphic rocks are crystalline limestones and dolomites (polished wall linings, paving materials, terrazzo, conglomerates, sculptures). Large deposits are in the Šumava region and Czech part of the Moldanubicum, in the Krkonoše-Jizerské hory crystalline complex and Orlické hory-Sněžník crystalline complex,the Svratka anticline,in the Silesicum, and in the Branná group (Silesia). Proterozoic phyllites of western Bohemia (the Střela valley) and the Železný Brod crystalline complex are used for roofing and wall lining (the waste as a filler).

3. Registered deposits in the Czech Republic

There is a vast amount of 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

Year	1992	1993	1994	1995	1996
Deposits - total number	197	197	180	183	186
exploited	85	79	73	78	74
Total reserves, thous.m^3	220696	223607	227669	232985	238807
economic proven	90302	92950	92825	93093	97233
economic probable	100522	99271	103458	108181	110164
subeconomic	29872	31386	31386	31711	31410
Min. output, thous.m^3 a)	177	187	225	210	190
Imports, kt b)	N	296	413	487	566
Exports, kt b)	N	136	178	266	188

Note:
a) decrease of mineral reserves by mining output
b) items of the customs tariff according to paragraph 5

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2514	Slate, whether or not roughly trimmed or merely cutted	free	free
2515	Marble, travertine, ecaussine and other calcareous monumental or building stone	free	free
2516	Granite, porphyry, basalt, sandstone and other monumental or building stone	free	free
2518	Dolomite whether or not calcined, roughly trimmed or sawed, agglomerated dolomite	free	free
2518 10	- Dolomite not calcined	free	free
6801	Setts, curbstones and flagatones of natural stone	32	6.1
6802	Worked monumental and building stone	30 - 70	7.2 - 8.8
6803	Worked slate and articles of slate or of agglomerated slate	19	4.0

6. Mining companies in the Czech Republic as of December 31, 1996

OMYA a.s, Vápenná
Průmysl kamene a.s., Příbram
Slezský kámen a.s., Jeseník
KAVEX Mrákotín, s.r.o.
MINERAL s.r.o., Horní Benešov
Kámen Ostroměř, s.p.
LIGRANIT s.r.o., Liberec
Českomoravský průmysl kamene a.s., Hradec Králové
Česká žula s.r.o., Strakonice
KAVEX s.r.o., Sedlčany
Agroplast a.s., Liberec
Lom Matula Hlinsko, s.r.o.
Completinvest s.r.o. - Břidl. důl Vítkov-Lhotka
HERLIN, s.r.o., Příbram
MUZIKA s.r.o., lom Blatná - Řečice
GRANIT - Zach s.r.o, Prosetín
Terobet a.s., Říčany
Českomoravský průmysl kamene s.p., Hradec Králové
Kamenoprůmyslové závody s.r.o., Šluknov
REKO Renata Kohlová, Přerov
Beliza s.r.o., Radíč
Silnice Ostrava, a.s.
Špaček kamenolomy s.r.o., Štěnovice
COMING s.r.o., Praha
Petr Babický, Vrchotovy Janovice
Jihokámen Písek, VD
Bohemia Granit s.r.o., Jičín
Kamenoprůmysl Hudčice, s.p.
Družstvo cementářů a kameníků Holoubkov
RALUX s.r.o., Uhelná
Mramor Dobřichovice, s.r.o.
Kamena v.d., Brno
Krákorka a.s., Trutnov
Max Boegl & Josef Krýsl k.s., Dobřany
Plzeňská těžební s.r.o., Plzeň

7. World production

Production of dimension stone hasn't been monitored in a long term. According to the Industrial Minerals magazine world production in 1994 reached 36,346 kt. Main producers were Italy, China, Spain, India and Greece. These countries produced more than 56 % of the world production.

8. World market prices

According to the Roskill Information Service average EU export prices of dimension stone main commodities in ECU/t have fluctuated in the last period as follows:

A Italian marble
B Greek marble
C Italian granite
D Portuguese granite

Commodity / Year	1992	1993	1994	1995	1996
A	298	256	N	N	N
B	255	208	N	N	N
C	506	388	N	N	N
D	193	185	N	N	N

9. Recycling

The material is recycled in a limited extent (setts, worked slate, worked building stone etc.).

10. Possible substitutes

Individual types of dimension stone are mutually replaceable. All types can be replaced by synthetic materials, ceramics, metals, glass, etc. There is an opposite tendency in the last few years - the interest in natural materials is steadily growing.

BUILDING MATERIALS - GEOLOGICAL RESERVES AND MINING OUTPUT

There are extraordinary high geological reserves of building materials - building stone, sand and gravel and brick clays in the Czech Republic. The building stone and the sand and gravel are also important export commodities (of exported raw materials have represented third position next to brown and hard coal for a long time).
Building materials output data presented by NIS ČR - Geofond are distorted to a certain extent. The reason is classification of deposits as reserved and non-reserved. During extraction of non-reserved deposits producers are not obliged to submit statistical statement Geo(MH)V3-01 and therefore their output can't be (excepting some of them) recaptured. That's why the actual output of building materials was rather higher than following numbers.

Mining of building materials (decrease of mineral reserves volume by mining)

Raw material	Unit	1992	1993	1994	1995	1996
Building stone	thous.m^3	8378	8077	8290	9021	9891
Sand and gravel	thous.m^3	12831	12481	11469	10525	12350
Brick clays	thous.m^3	1913	2062	1884	1935	1972

Life of industrial reserves (economic proven mineable reserves) consequent the decrease of reserves by output, losses and depreciations in mined deposits per year 1996 (A) and the average annual decrement of reserves in period 1992-1996 (B) was as follows:

Raw material	Life, years	
	A	B
Building stone	57	33
Sand and gravel	40	39
Brick clays	73	71

BUILDING STONE

1. Characteristics and use

Building stone (also called crushed and broken stone) are all kinds of solid magmatic, sedimentary or metamorphic rocks, which have suitable properties to be used in construction works. They must have certain physical and chemical properties based on their 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. Some basalt and phonolite rocks are used for production of cast basalt or phonolite. Impurities consist of fractured, crushed, weathered or altered zones, inclusions of technologically unsuitable rocks, higher content of sulphur, amorphous SiO_2, etc. The world reserves are virtually inexhaustible.

2. Mineral resources in the Czech Republic

Commercially usable deposits of building stone can be found throughout the whole Bohemian Massif, except its platform cover. The latter, however, includes important deposits of neovolcanic rocks. West Carpathians are rather poor in building stone.

- The major source of building stone are igneous rocks (particularly granites and quartz-diorites). Various types of igneous rocks (including accompanying swarms of dike rocks) are quarried at many localities in the Central Bohemian pluton, Moldanubian pluton, the Železné hory pluton (the Nasavrky massif), the Brno massif and in other plutonic bodies. Single deposits of dike rocks are rather of little importance.
- Volcanic rocks represent the major source of stone for production of crushed aggregates in the Czech Republic. Paleovolcanic deposits occur only in the Barrandien zone (including consolidated pyroclastics), in the Krkonoše piedmont basin and in the Intrasudeten depression. They locally envelope also layers or bodies of pyroclastics or altered rocks. Important are also mafic rocks - spilites, diabases, etc. Among neovolcanic rocks, mafic (especially basaltic) varieties appear to be most important. They are most abundant in the České středohoří and Doupovské hory mountains, less abundant are in the neovolcanic area of the Cretaceous basin and eastern Sudeten or in the Železný Brod region.
- Among the sedimentary rocks there prevail clastic sediments (siltstones, greywackes, etc.) as a suitable building stone. Culmian greywackes of the Nízký Jeseník mountains and the Drahanská vrchovina plateau are the most inportant source of building stone. Similar rocks also occur in the Algonkian of the Barradien zone, Moravian Devonian and the flysh belt of the West Carpathians.
- Deposits of chemical and organic origin are represented by carbonates (the Early Paleozoic of the Barrandien zone, the Moravian-Silesian Devonian) and siliceous rocks (lydites or cherts) in the Algonkian of the Pilsen region).
- Also important from the viewpoint of suitable building stone are metamorphic rocks represented by crystalline schists or gneisses, which are exclusively confined to crystalline complexes of the Bohemian Massif - the so-called Moldanubicum, Moravicum, Silesicum, crystalline series of the Slavkovský les, W. Sudeten, Kutná Hora and Domažlice, granulite massif of southern Bohemia and the Bor granulite massif, etc. Besides technologically very suitable rocks (e.g. orthogneisses, granulites, amphibolites, serpentines, crystalline limestones, etc.) there occur also some less suitable rocks (mica-schists, paragneisses, quartzites).
- Less important are deposits of contact metamorphosed rocks (hornfelds, schists) occurring along the contact of the Central Bohemian and the Nasavrky plutons with Algonkian and Paleozoic sediments.

3. Registered deposits in the Czech Republic

Because of vast number of building stone deposits in the Czech Republic, they are not listed.

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

Year	1992	1993	1994	1995	1996
Deposits - total number	493	496	495	348	346
exploited	198	181	180	185	186
Total reserves, thous.m^3	2483872	2420710	2415946	2403289	2378271
economic proven	1252513	1207021	1202828	1188114	1186079
economic probable	1102789	1085069	1078055	1074490	1045345
subeconomic	128570	128620	135063	140685	146847
Mining output, thous.m^3	8378	8077	8290	9021	9891
Imports, kt a)	4	226	318	377	260
Exports, kt a)	3023	1874	1627	1151	1025

Note:
a) item 2517 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2517 10	Pebbles, gravel, broken or crushed stone	free	free

6. Mining companies in the Czech Republic as of December 31, 1996

Západokámen Plzeň, a.s.
TARMAC Severokámen a.s., Liberec
Silnice Ostrava, a.s.
Štěrkovny a pískovny Brno, a.s.
BERON s.r.o., Čerčany
ŽPSV Štěrkovny a pískovny Uherský Ostroh, a.s.
Kámen a písek s.r.o., Český Krumlov
Silnice a.s., Hradec Králové
Lomy s.r.o., Brno
Štěrkovny a pískovny Olomouc, a.s.
Kámen Zbraslav, s.r.o.
Max Boegl & Josef Krýsl k.s., Dobřany
Strabag Bohemia a.s., České Budějovice
Firma Hájek Josef, Opava
Berger Bohemia a.s., Plzeň
Štěrkovny a pískovny Veselí n.Lužnicí, a.s.
Silnice Jihlava, a.s.
Tostein s.r.o., Štěrkovna Olbramovice
Štěrkovna HEROUS s.r.o., Lhota Rapotina
Čedič Dobkovičky a.s., Velemín
PRO-KATEX a.s., Praha 4
Granita s.r.o., Skuteč

Basalt Měrunice, s.r.o.
Kamenolom Císařský a.s., Šluknov
Cement Bohemia Praha, a.s.
STONE s.r.o., Kamenolom Všechlapy
Sokolovská uhelná, a.s.
ATS - Silnice s.r.o., Cheb
Pražský průmysl kamene s.p., Praha
Kamenolom Vlastějovice, s.r.o.
MŠLZ a.s., Velké Opatovice
SHB Bernartice, s.r.o.
Lafarge Kamenivo s.r.o., Praha 8
GOS - Granit Ořechov, s.r.o.
KAVAL s.r.o., Kamenolom Valšov
Karlovarské silnice a.s., Karlovy Vary
Silnice Znojmo, a.s.
Sokolovské báňské stavby a.s., Sokolov
ILBAU - SIBE a.s., Beroun
IES Mosty Litice, s.r.o.
Palivový kombinát Ústí nad Labem, s.p.
BES s.r.o., Silnice Benešov
Lom Jašek - Výkleky, s.r.o.
Štěrkovna s.r.o., Ostrožská Nová Ves
Jan Hamáček - JH, Prunéřov-Vrbičky
Vojenské stavby a.s., o.z. ETIS, Praha
EKO-BET Jaroslav Vízner, Plaňany
Lesní společnost Jihomoravské lesy a.s., Prostějov
Weiss s.r.o., Děčín
Agroplast a.s., Liberec
ROCKAR s.r.o., Praha 2
Správa a údržba silnic Prachatice
Silnice Stříbro, a.s.
Stavebniny Čelákovice - F.Matlák
Kamenoprůmysl Skuteč, s.p.
PETRA - lom Číměř, s.r.o.
Cementárny a vápenky Prachovice, a.s.
ZD Šonov u Broumova
VIA - VODA s.r.o., Hrubá Voda
ROSA s.r.o., kamenolom Lomnička, Drásov
EKOZIS Zábřeh, s.r.o.
Silnice Nepomuk, a.s.
HUTIRA p.p., Omice
Agrostav Znojmo, a.s.
Pavel Dragoun, Cheb
Silniční stavitelství Praha, a.s.
TS - kamenolom, Nové Město na Moravě
IPS a.s., Praha 10
Firma Hober-K.Beran, Týn nad Vltavou
CEFEUS s.r.o., Praha 2
KROFIAN a.s., Hradec Králové
Strabag Uherské Hradiště, a.s.
Zábřežská lesní a.s., Zábřeh na Moravě

ZD Libina
Jihočeské lesy České Budějovice, a.s.
Mydlářka a.s., Benešov u Prahy
Ing.Jan Weiss, Děčín
Kamenolom Zderaz, s.r.o.
Rudolf Vít - Lom Kubo, Malé Žernoseky
JAMEL Kladno
Podnik ekol. výstavby a.s., Chomutov

7. World production

World production of the building stone is not observed. The highest mining in EU state Germany and France (both cca 170 mill. t per year) for a long time.

8. Prices on the world market

Average price of crushed rock aggregates imported from outside the EU in ECU/t (according to the Roskill Information Services):

A Austrian crushed rock aggregates
B Norwegian crushed rock aggregates

Commodity / Year	1992	1993	1994	1995	1996
A	57	62	N	N	N
B	13	18	N	N	N

9. Recycling

Because of low price of the raw material, recycling is of minimum importance. Construction waste can be recycled following sorting and/or screening and washing.

10. Possible substitutes

Building stone (crushed and broken stone) can be replaced, according to their use and grade, by gravel sands, synthetic aggregates, slags and various waste materials.

SAND AND GRAVEL

1. Characteristics and use

Sand and gravel has been and will continue to be the principal construction material worldwide. Sand and gravel represent loose sediments originated by transport and deposition of more or less worn rock fragments of certain size (gravel 2 to 128 mm, sand 0.063 to 2 mm) which are products of the weathering of rocks. They mostly consist of pebbles and boulders of resistent rocks and minerals (quartz, feldspar, quartzite, granite, etc.), to a smaller extent of less resistent rocks and minerals (mostly of crystalline or metamorphic and sedimentary rocks). Sand and gravel also contains silty and clayey fractions. Major impurities are humus, clay intercalations, higher content of floatable particles and sulphur, high content of unsuitable (shape wise) or weathered grains. Gravel and sand deposits are common all over the world and they are not registered.

The ultimate use of sand and gravel determines the ratio of combination of sand and gravel size, their shape, rock type and composition. Sand and gravel are used mostly in the building industry in concrete mixtures, as drainage and filtration layers, road base, fill and for foundation stabilization, etc. Sands are used in the building industry in mortar and concrete mixtures, as an opening material in production of bricks, in plasters, as a filling of abandoned stopes in mines, etc.

2. Mineral resources of the Czech Republic

Most of the deposits in the Czech Republic are of fluvial origin and of Quaternary age; less often of fluvio-lacustrine, fluvioglacial, glacio-lacustrine and eolian origin. Industrially usable deposits occur particularly in river basins of large streams.

The Labe river basin - deposits along the right bank of the middle course (important deposits for central and eastern Bohemia) and lower course are characteristic of 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 exist conflicts of interest. 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 processing, suitable for concrete mixtures. Deposits in the Hornomoravský úval (Upper Moravian depression) contain abundant fine fractions. Reserves are confined to 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 of soils.

Less important are deposits of glacial origin in northern Bohemia (The Frýdlant region) and in the Ostrava and Opava regions. Wind-blown sands 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. Facially changing Tertiary sands in the Cheb region, in north Bohemian basins, in the Plzeň region (mortar sands), and particularly in Moravia (e.g. the Prostějov and Opava regions) are utilized more often. Weathered sandstones of the Bohemian and Moravian Cretaceous sediments and sands from washing of kaolin are used in construction works.

3. Registered deposits in the Czech Republic
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

Year	1992	1993	1994	1995	1996
Deposits - total number	365	385	382	215	215
exploited	82	70	64	69	73
Total reserves, thous.m^3	2535250	2545318	2527526	2514531	2421049
economic proven	1362667	1356903	1335872	1327712	1271932
economic probable	913577	930095	934818	929824	889269
subeconomic	259006	258320	256836	256995	259848
Mining output, thous.m^3	12831	12481	11465	10525	12350
Imports, kt a)	9	340	457	420	316
Exports, kt a)	3257	2174	1982	1527	1102

Note:
a) items 2505 90 and 2517 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2505	Silica sands of all kinds, also colored, except sands containing metals (c. 26)		
2505 90	- Others	35	free
2517 10	Pebbles, gravel, broken or crushed stone	free	free

6. Mining companies in the Czech Republic as of December 31, 1996
Kámen Zbraslav, s.r.o
Štěrkovny a pískovny Olomouc, a.s.
Štěrkovny a pískovny Veselí nad Lužnicí, a.s.
TEKAZ s.r.o., Cheb
Tarmac Severokámen a.s., Liberec
Štěrkovna s.r.o., Ostrožská Nová Ves
Pískovny Hrádek, s.r.o.
Družstvo DRUMAPO, Němčičky
Štěrkovny s.r.o., Dolní Benešov
TVARBET Moravia a.s., Hodonín
Štěrkopískovna Mohelnice, s.r.o.
Calofrig a.s., Borovany
Prefa Pradubice, a.s.
TAUM - V.Maurer, Lužec nad Vltavou
ŽPSV Štěrkovny a pískovny Uherský Ostroh, a.s.

ILBAU-Bohemia s.r.o, Praha 9
Štěrkovny a pískovny Brno, a.s.
Pískovna Černovice, s.r.o.
Pískovny Dobříň, a.s.
GZ - SAND s.r.o., Otrokovice
MPC s.r.o., Litoměřice
Pražský průmysl kamene s.p., Praha
Těžba štěrkopísku s.r.o., Brodek
Pískovny Bratčice - Hrušovany, s.p.
Západokámen Plzeň, a.s.
Zemědělská společnost Kratonohy, a.s.
KM Beta s.r.o., Hodonín
Agropodnik Humburky, a.s.
Dopravně mechanizační podnik a.s., Pardubice
Pískovna Sojovice, s.r.o.
SYSBAU s.r.o., Bohumín
Pískovna Doubrava, s.r.o.
Písek - Beton a.s., Třemošnice
AG Skořenice, a.s.
ZD Třebechovice p.Orebem
Max Boegl & Josef Krýsl k.s., Dobřany
Rovina Písek, a.s.
TAPAS Borek s.r.o., Stará Boleslav
NZPK s.r.o., Podbořany
Montage Most, a.s.
1.Stavební a.s., Litoměřice
ZOD Brniště
AGS Bohemiastone s.r.o., Hradec Králové
Sokolovská uhelná, a.s.
Vojenské stavby a.s., o.z. ETIS, Praha
Berger Bohemia a.s., Plzeň
Strabag a.s., Rychnov nad Kněžnou
Stavitelství-Dvořák F., Dolní Dunajovice

7. World production

The world production of sand and gravel is not statistically observed. The highest mining in EU states Germany (about 400 mill. t per year).

8. World market prices

Average prices of sand and gravel in ECU/t (according to the Roskill Information Service):

A French sand and gravel, exports outside the EU
B German sand and gravel, exports outside the EU
C Norwegian sand and gravel, imports to the EU
D Polish sand and gravel, imports to the EU

Commodity / Year	1992	1993	1994	1995	1996
A	8.5	10.8	N	N	N
B	6.3	7.2	N	N	N
C	11.8	12.7	N	N	N
D	8.1	7.7	N	N	N

9. Recycling

Similar to all building materials, recycling is problematic and is important for concrete only.

10. Possible substitutes

Coarser fractions of sand and gravel can be replaced by crushed aggregate, artificial aggregate, slags, etc. Finer fractions, i.e. sands, cannot be replaced because of reduced strenght of the final products. Substitution of sand and gravel on large scale is questionable also from the economic point of view.

BRICK CLAYS

1. Characteristics and use

Raw materials for production of bricks include a variety of mostly sedimentary rocks such as loess, loams, clays and claystones, marls, weathered shales, etc. The raw material must contain two main components - plastic and opening - which are proportional in the material itself, or optimum ratio is reached by their mixing. The prevailing component in the mixture forms the base whereas the complementary component, which is correcting the properties of the material,serves as a plasticizing agent or an opening component. Harmful substances in production of bricks are mostly carbonates, gypsum, siderite, organic matter, larger fragments of rocks, etc.

Deposits of materials for brick production are common all over the world and they are not registered.

2. Mineral resources of the Czech Republic

Quaternary loams of various origin represent the basic material for brick production in the Czech Republic. The source of natural corrective materials are mostly pre-Quaternary sediments.

- Deposits of Quaternary raw materials (loess and loess loam, loam, sand, sandy-clayey residues) are common all over the country and they are mined in great numbers. The most important of them are confined to sediments of eolian, deluvio-eolian and/or glacial origin (N.Bohemia and Silesia). Impurities in wind-blown sediments are represented by buried soil horizons, clastics and calcareous nodules, in deluvial sediments detritus of hard rocks. Eolian 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 materials, or directly for production of thick-walled elements.
- Neogene pelites are a common pre-Quaternary material in the Bohemian limnic basins and in the Vienna basin. They are characteristic of sandy admixture and locally also of higher content of montmorillonite or detrital minerals, in the Vienna basin and the Carpathian foredeep also of higher content of soluble salts. They have been utilized 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 utilized in E and SE Moravia. They represent weathered parts of flysch layers of outer nappes of the West Carpathians. Impurities are efflorescence-forming salts and layers of sandstones. They are used for production of solid or perforated bricks.
- Upper Cretaceous clays and claystones (often calcareous) are used as a raw material for brick production in areas of the Bohemian Cretaceous basin and in south Bohemian basins. Marls, marlstones and sands are used as corrective materials. The material is suitable even for production of the most exacting perforated bricks and ceiling elements. In southern Bohemia, because of contamination by limonitized sandstone only for production of less exacting building elements.
- Permocarboniferous pelites and aleuropelites are used for brick production in Permocarboniferous basins and furrows of Bohemia and Moravia. These deposits are characteristic of the occurrence of sandstones and of complex structure. The material can be used also for production of roof tiles and thin-walled elements.
- The Late Proterozoic and Early Paleozoic weathered slates and their residues are used for production of bricks around Prague, in the Plzeň and Rokycany regions, etc. Impurities are solid detritus and pyrite. They are not suitable for production of exacting brick elements.

3. Registered deposits in the Czech Repunblic

There are vast numbers of brick clay deposits registered in the Czech Republic and thus they are not listed in this overview. Their distribution over the Czech territory is rather random and consequently some regions are short of these materials (e.g. Českomoravská vrchovina plateau).

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

Year	1992	1993	1994	1995	1996
Deposits - total number	306	321	321	211	210
exploited	104	90	73	88	81
Total reserves, thous.m^3	751076	732680	722775	709320	706743
economic proven	359022	343426	336345	325842	323574
economic probable	321648	315622	313648	309048	303379
subeconomic	704066	73632	72782	74430	79790
Mining output, thous.m^3	1913	2062	1884	1935	1972

5. Customs tariffs

Materials for brick production are not listed in the customs tariff and their import and export have not been observed (one part of brick clays - clays - can be stated in the item 2508 40 of the customs tariff Other clays).

6. Mining companies in the Czech Republic as of December 31, 1994

WIENERBERGER CP a.s., České Budějovice
Later Chrudim, a.s.
Severočeské cihelny a.s., Teplice
České cihelny Josef Meindl s.r.o., Stod
ZGW Gleinstaetten, Krytina Šlapanice, a.s.
CIDEM Hranice, a.s.
Flachs Alois - Hurdis, Hodonín
Cihelna Kinský s.r.o., Kostelec n.O.
Cihelny Dolní Jirčany, a.s.
Hevlínské cihelny s.r.o., Hevlín
Cihelna Osvětimany, s.r.o.
SEPO Modřice, s.r.o.
Cihelna Dolní Bukovsko, v.o.s.
Cihelna Hodonín, s.r.o.
Cihelna Chrást, s.r.o.
KORAMIC Řepov, a.s.
CIOS Osenice, s.r.o.
Abrhámova cihelna s.r.o., Kunovice
Cihlářský závod Horky n.Jizerou, s.r.o.
Krytina Hranice, s.r.o.
Cihelna Staré Místo s.p., Veliš
Cihelna Klíma s.r.o., Vrátkov
Cihelna Malenovice s.r.o., Zlín
Jan Řehounek, Cihelna Časy
Cihelna Libčice, s.r.o.

Cihelna Žopy s.r.o., Holešov
Hodonínské cihelny s.p., Hodonín
SOSNAR - cihelna s.r.o., Brno, Litenčice
Cihelna Mensdorff-Pouilly s.r.o., Boskovice
Cihelna Čepí, s.r.o.
Cihelna Chmeliště, s.p.
Ing. Sommer - Cihelna Brázdim, s.r.o.
K-KERAMO s.r.o., Zlín
KEMAT s.r.o., Skalná
Cihelna Nebužely, Jaroslav Petrželka
Cihelna Polom, s.r.o.
Molitorov s.r.o., Kouřim
Agrostav Frýdek Místek (v likvidaci)
Lounské cihelny Louny, s.p.
CIPO s.r.o.- cihelna, Hrádek nad Nisou
Milan Král - MAGMA, Neplachovice

7. World production

Output of brick clays is not observed on the global scale.

8. World market prices

Brick clays are not a subject of the world trade.

9. Recycling

Brick clays cannot be recycled, but the final products - bricks, tiles, blocks - can be reused. It is possible to recycle construction detritus and mixed construction waste (for instance recycled material "Remexit").

10. Possible substitutes

In production of conventional brick elements, this material is irreplaceable. Other types of bricks can be produced from other materials (calcareous-acid bricks, agloporite, gas silicates, etc.). Various natural and artificial materials can be used for production of the afore mentioned building elements - quartz, lime, powder aluminium, artificial aggregates, cinder and flue ashes of thermal power plants, tailings, etc.

MINING IN NATURE PROTECTED AREAS

Activities in special protected areas of the Czech Republic (national parks, protected landscape areas, national nature reservations, nature reservations, national nature monuments and nature monuments) regulates Act No 114/1992 Sb. on nature and landscape protection. According to this Act all mining in national parks (with exception of building stone and sand mining for construction in the territory of the national park), in the 1st zone of protected landscape areas and in national nature reservations is prohibited. Although the mineral resources mining is not prohibited by law in other areas (protected landscape area zones) activities connected with mining projects will probably fail. Civil activities in the field of environmental protection are the main reason.

Special protected areas in the Czech Republic

	1992	1993	1994	1995	1996
total number	1567	1639	1683	1733	1784
national parks (NP)	3	3	3	3	3
protected landscape areas (CHKO)	24	24	24	24	24
others	1540	1612	1656	1706	1757

The area of special protected large-scale areas (NP and CHKO) has been 11,535 square kilometers, of which the area of prohibited mining of minerals has amounted 19.3 %. The area of NP and CHKO has amounted 14.6 % of the territory of the Czech Republic (78,864 km^2). Reserved mineral deposits were mined also in the territory of 20 CHKO in the last years, but nearly all mining claims were determinated before establishment of the protected areas. Mining output in CHKO's has declined after 1989. This fact is illustrated in following tables. As to impact of mining in protected landscape areas there has been unfavourable order in CHKO's Český ráj (natural sand mining), Český kras and Moravský kras (limestone mining).
There were 105 mining claims in the CHKO areas in 1996 and their area reached 65.31 square kilometers.

Mining of reserved mineral deposits in CHKO, kt

Mineral/Year	1989	1990	1991	1992	1993	1994	1995	1996
Hard coal	682	915	764	778	715	426	454	424
Natural gas	0	0	0	1	6	2	1	0
Clays	216	205	165	141	141	116	105	137
Natural sand	1091	1165	778	761	609	779	758	997
Limestone	9396	8989	6631	6652	6066	5784	5240	5502
Dimension stone	192	187	203	218	190	223	185	176
Building stone	7044	7744	4414	4020	3756	3618	3318	3607
Sand and gravel	7870	6721	3386	3107	3614	2918	2797	2938
Brick clays	232	293	229	146	140	11	20	16
Total a)	26723	26219	16570	15824	15237	13877	12878	13797
Index, 1989 = 100	100	98	62	59	57	52	48	52

Note:

a) conversion to tons: natural gas (1000000 m^3 = 1 kt), dimension and building stones (1000m^3 = 2.7 kt) gravelsands and brick clays (1000 m^3 = 1.8 kt)

Mining of reserved mineral deposits in CHKO, kt

CHKO/Year	1989	1990	1991	1992	1993	1994	1995	1996
Beskydy	70	72	52	44	62	3	4	7
Bílé Karpaty	132	123	165	54	43	62	30	41
Blanský les	1769	1842	1058	737	497	462	478	564
Broumovsko	476	490	366	381	355	67	72	102
České středohoří	2762	3416	2087	2125	1960	1866	1628	1733
Český kras	4938	4436	2669	2771	2677	2858	2345	2715
Český ráj	1380	1660	850	759	725	912	932	1182
Jeseníky	389	350	254	195	274	349	409	310
Jizerské hory	17	16	17	20	5	14	14	15
Kokořínsko	25	29	25	20	16	0	0	0
Křivoklátsko	1088	1268	1010	964	988	866	745	701
Litovelské Pomoraví	3395	2942	1508	1021	862	470	453	682
Moravský kras	2848	2725	2559	2340	2336	1718	1790	1770
Orlické hory	410	475	238	227	286	246	243	235
Pálava	0	32	51	57	39	50	46	64
Poodří	63	106	92	45	47	0	0	16
Šumava	9	9	7	5	4	3	2	0
Třeboňsko	5009	3971	2043	2327	2853	2560	2329	2459
Žďárské vrchy	327	340	173	167	115	138	162	143
Železné hory	1615	1917	1345	1562	1093	1234	1196	1210
Total output (round)	26723	26219	16570	15824	15237	13877	12878	13949

Impact of mining in CHKO, t/km^2/year

CHKO/Year	1989	1990	1991	1992	1993	1994	1995	1996
Beskydy	59	61	44	37	53	3	3	6
Bílé Karpaty	185	172	231	76	60	87	42	57
Blanský les	8331	8674	4982	3471	2340	2176	2251	2656
Broumovsko	1161	1195	893	929	866	163	176	249
České středohoří	2598	3213	1963	1999	1844	1755	1531	1630
Český kras	**38509**	**34594**	**20814**	**21610**	**20877**	**22288**	**18287**	**21173**
Český ráj	**15056**	**18110**	9273	8281	7910	9950	**10168**	**12895**
Jeseníky	527	474	344	264	371	473	554	420
Jizerské hory	46	44	46	55	14	38	38	41
Kokořínsko	92	107	92	74	59	0	0	0
Křivoklátsko	1716	2000	1593	1520	1558	1366	1175	1105
Litovelské Pomoraví	**35365**	**30646**	**15708**	**10635**	8979	4896	4719	7104
Moravský kras	**29003**	**27751**	**26060**	**23830**	**23789**	**17496**	**18229**	**18025**
Orlické hory	2010	2328	1167	1113	1402	1206	1191	1152
Pálava	0	385	614	686	469	602	554	770
Poodří	773	1301	1129	552	577	0	0	196
Šumava	9	9	7	5	4	3	2	0
Třeboňsko	7057	5603	2882	3283	4025	3612	3286	3469
Žďárské vrchy	464	482	245	237	163	196	230	203
Železné hory	5682	6745	4732	5496	3846	4342	4208	4257

Note: as critical there is considered an impact exceeding 10,000 t/km^2/year

MINERALS IN THE CZECH FOREIGN TRADE

Minerals and mineral products represent an important group in the Czech foreign trade. But a foreign trade balance of minerals and mineral products has been permanently passive owing to large import volume of mineral fuels (crude oil and natural gas) and iron ores. The foreign trade with statistically important (in expression of value) minerals and products is manifested in the following tables rendering group 11 of items of the Customs tariff in nomenclature HS-4:

2501 Salt and pure sodium chloride
2507 Kaolin and other kaolinic clays, whether or not calcined
2508 Other clays
2517 Pebbles, gravel, broken or crushed stone
2523 Cement
2601 Iron ores and concentrates incl. roasted iron pyrites
2701 Hard coal, briquettes, ovoids and similar solid fuels made of hard coal
2702 Lignite, whether or not agglomerated
2704 Coke & semi-coke
2709 Petroleum oils and oils obtained from bituminous minerals, crude
2711 Natural gas and other gaseous hydrocarbons

Main export and import countries of minerals and mineral products statictically significant in % share of FOB expression of value:

	Country/Year	1993	1994	1995	1996
Export	Germany	36.7	32.8	31.8	37.4
	Austria	16.3	21.9	23.4	22.1
	Slovakia	29.9	25.2	23.6	20.2
	Poland	0.6	4.3	7.6	8.0
	Hungary	8.7	10.5	8.5	7.7
	others	7.8	5.3	5.1	4.6
Import	Russia	85.5	80.4	83.9	79.5
	Poland	6.1	6.1	6.8	5.9
	Ukraine	5.8	5.2	5.7	5.4
	Germany	0.9	2.0	1.0	3.3
	Slovakia	1.3	1.3	1.5	1.5
	others	0.4	3.3	1.1	4.4

Important commodities of the Czech export were in the last four years: hard coal - 41%, brown coal - 19%, coke - 16% and cement - 14%.
Main import commodities were in the same time: crude oil - 48%, natural gas - 33% and iron ores - 11% (average % share of FOB expression of value). Detailed data are given in a following table.

Code	Unit	1993		1994		1995		1996	
		Export	Import	Export	Import	Export	Import	Export	Import
2501	mill.CZK	35	762	29	643	41	702	49	862
	%	0	2	0	2	0	1	0	1
2507	mill.CZK	904	10	760	20	812	22	793	29
	%	4	0	4	0	4	0	3	0
2508	mill.CZK	362	59	289	73	305	77	307	86
	%	2	0	1	0	1	0	1	0
2517	mill.CZK	1340	104	320	71	294	87	252	69
	%	6	0	2	0	1	0	1	0
2523	mill.CZK	3034	97	3093	206	2198	323	4145	467
	%	13	0	15	1	10	1	18	1
2601	mill.CZK	0	4344	2	4513	1	5679	3	5088
	%	0	12	0	12	0	12	0	9
2701	mill.CZK	8307	1678	8738	1606	9510	2280	9827	2881
	%	37	5	41	4	44	5	42	5
2702	mill.CZK	4723	12	3840	3	4033	0	3969	1
	%	21	0	18	0	19	0	17	0
2704	mill.CZK	3450	80	3610	434	3703	712	3777	284
	%	15	0	17	1	17	1	16	0
2709	mill.CZK	247	17686	233	19287	352	21266	277	28377
	%	1	48	1	50	2	44	1	48
2711	mill.CZK	209	11732	208	11809	190	17038	220	21230
	%	1	32	1	30	1	35	1	36
Total group	mill.CZK	22611	36564	21122	38656	21439	48186	23619	59374
	%	100	100	100	100	100	100	100	100
Total ZO CR	mill.CZK	384966	374878	410250	430853	453450	554312	594952	755278
Group share	%	6	10	5	9	5	9	4	8

Note:

a) zero data of value report on exports or imports smaller than 0.5 mill. CZK
zero data of share in % express the share smaller than 0.5 %

b) expression of value proceeds out of the declared goods tariff value internationally marked FOB (without foreign trade direct costs)

c) data on exports and imports are round off numbers reported by ČSÚ; data are precised continuously

d) total data on ZO ČR have been reported after new methodology since 1996 (deadline January 16, 1997)

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