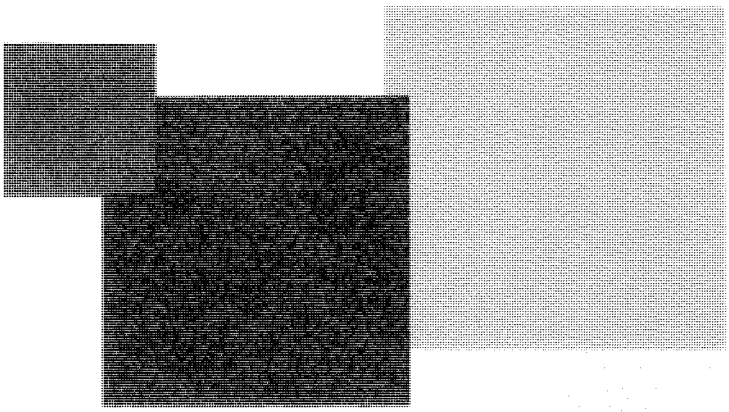
MINISTRY OF THE ENVIRONMENT
OF THE CZECH REPUBLIC

MINERAL COMMODITY SUMMARIES OF THE CZECH REPUBLIC



GEOFOND OF THE CZECH REPUBLIC
JUNE 1999

MINERAL COMMODITY SUMMARIES OF THE CZECH REPUBLIC

STATE TO DECEMBER 31, 1998

(Special data deadline: June 15, 1999)

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ABBREVIATIONS, SYMBOLS AND TECHNICAL UNITS

API	American Petroleum Institute
ATPC	Association of Tin Producing Countries
Btu	British thermal unit
ČBÚ	Czech Mining Office
CFR	Cost and Freight (named port of destination)
ČGÚ	Czech Geological Office
CHKO	Protected landscape area
CHLÚ	Protected deposit area
CIF	Cost, Insurance and Freight (named port of destination)
ČNR	Czech National Council
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 %
PÚ	exploration area
VAT	value-added tax
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 seventh 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 in line with both 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 exploitation, 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 investment activities when considering mining of minerals.
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 assessed classification and conditions of their utilization. The basic data come from calculations of mineral reserves which were approved or verified in the past by the Commission for Classification of Mineral Resources and/or reserves approved by the Board of Minerals, Exploration and Mining of the former Ministry of Economy of the Czech Republic or those approved by former commissions for control and utilization of mineral reserves of individual mining and processing industries. Recently there are reserves approved by the Comission for Projects and Final Reports of the MŽP ČR or by bodies ordering geological works.
Geological reserves on reserved deposits of reserved and non-reserved minerals - as of December 31, 1998 - exceeded 48,000 mill. tons with majority of mineral fuels and building materials. The Ministry of the Environment together with the Ministry of Industry and Trade have 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. That's why many changes have occurred in volume of reserves or deposits of many minerals (especially ores) in comparisn with recent years.

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 consisting 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 and basins 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 is given in this paragraph. The historically significant deposits are given in some maps although they have been eliminated from registers.
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. **Prices** - gives prices of orientation on domestic production and import prices. Domestic prices are without VAT.

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 ČR.

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, i.e. top five (or top ten) producers in the world market.

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, especially data from journals and last editions of statistical yearbooks (for example Welt Bergbau Daten, Mineral Commodity Summaries 1998).

MINERAL PROSPECTING, EXPLORATION AND MINING OUTPUT IN THE CZECH REPUBLIC

Minerals defined in Act No. 44/1988 Sb. on mineral protection and exploitation amended by the Czech National Council Act No. 541/1991 Sb. (The Mining Law) are divided into reserved and non-reserved. Natural aggregate of reserved minerals gives reserved mineral deposits. They constitute the mineral wealth of the country and are owned by the Czech Republic. Deposits of non-reserved minerals (especially gravel, stone, sand, brick clay) are constituent part of the land (§ 7 of the Mining Act) and the Mining Act is not applicable to them. Amendment of the Mining Act dated 1991 cancelled the possibility to state some deposits of non-reserved minerals as reserved and state them as mineral wealth. Decisions of the state administration bodies in this matter which had been issued before the amendment came into force remain valid according to the transient enactment (§ 43a par. 1 of the Mining Act). Deposits stated by these decisions are deposits reserved, i.e. owned by the state, detached from the land.

The prospecting of reserved minerals deposits and their exploration are regulated by the Czech National Council Act No. 62/1988 Sb. On geological works and the Czech Geological Office (The Geological Act), amended in Act No. 543/1991 Sb, Prospecting and exploration can be carried out by a natural or legal person (organization), but it is expected that the works are managed by person who is responsible for them and who has the certificate of qualification.(responsible manager). The organization which is going to realize survey and exploration of deposits of these minerals, verification of reserves and processing of geological documents for their exploitation and protection has to ask for approval to realize these works at the Ministry of the Environment. Before granting the licence it is necessary to ask for the standpoint of a municapality in which cadaster the prospecting and exploration are going to be carried out. The administrative procedure is a subject to administrative regulations. It results in the decision to issue a permit of works. The permit includes the borders of the „exploration area", determination of mineral which prospecting and exploration is approved, the conditions of geological operations and the time of licence valiidity. It is possible to grant the extension of the licence validity when the organization applies for it. The permit is not a territorial determination, but with regard to the risk and financial costs it creates for the enterpreneur the reservation of rights to operate. The enterpreneur is obliged to pay a tax from the exploration area CZK 1,000 per any opened square kilometer of the exploration area in the first year. This tax increases CZK 1,000 per any next year. This taxes are an income of municipalities.

In the frame of working plans and operation works for reserved mineral deposits prospecting and exploration the organization must consider conditions and respect protected interests according to special regulations (§ 22 of the Geological Act). In the first place there are laws for landscape and nature protection, agriculture and forest land protection laws, water and mining laws and the like. If the organization repeatedly breaks the obligations given by the Geological Act, the Ministry of the Environment could withdraw the licence from them.

The above mentioned regulations could be applied to prospecting and exploration of non-reserved mineral deposits (building stone, sand and gravel, brick clay) only in the case that they were sooner declared as reserved deposits according to the transient enactment (§ 43). An organization could realize any new prospecting and exploration of non-reserved minerals after agreement with the land owner.

When the reserved mineral is found during prospecting and exploration in quality and volume that it could be an aggregate then the organization asks the Ministry of the Environment for the reserved deposit certificate issue. This certificate declares the reserved deposit as mineral wealth owned by the state. It also ensures the protection of reserved deposit against

aggravation of its mining or making the mining impossible. The protected deposit area (CHLÚ) is determined (§16 of the Mining Law).
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. During the administrative procedure clashes of interests are solved and also the influence to the environment (EIA). The decision on Mining claim determination is the decision about an area exploitation.
The enterpreneur who obtained the determined mining claim can start mining operations after issue mining activities licence only. This licence issues the authorised 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 after 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 is up to 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	1994	1995	1996	1997	1998
registered tasks of geological exploration	506	492	464	370	347
protected deposit areas	828	841	902	969	1046
mining claims - total number	1080	1073	1066	1066	1053
- area in square km	1660	1650	1704	1649	1642
number of exploited deposits	.	.	632	594	588
mining output, mill.t a)	147	145	150	152	136
organizations managing the deposits	345	344	364	378	377
organizations mining the deposits	.	260	262	287	260

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 1998 and exploration licences issued during 1998:

Exploration areas in 1998

Prospecting and exploration works paid by companies

Mineral code	Mineral	Valid EA (min.1)	Valid EA (min.2)	New issues in 1998	Start of validity in 1998
AG	Silver		1		
ZR	Gold *	11			
RP	Crude oil	37		1	2
ZP	Natural gas	28	37	2	2
PD	Gemstones	6			
(tm)			1		
KN	Kaolin	10	1	4	4
JL	Clays	11	1	3	3
BT	Bentonite		4		
ZS and feldspar substitutes	Feldspar and f. substitutes	3		1	1
PI	Gl., foundry sands	1	1		
AB	Abbrazives	3			
SU	Staurolite		1		
VA	Limestones	4		1	1
SA	Gypsum	3			
KA	Dimension stone	7		3	3
Total number		124	47	15	16

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

Exploration areas in 1998

Prospecting and exploration works paid from the state budget

Mineral code	Mineral	Valid EA (min.1)	Valid EA (min.2)	New issues in 1998	Start of validity in 1998
RP	Crude oil	1		1	1
ZP	Natural gas		1		
KN	Kaolin	9	1	1	1
JL	Clays	5	1		
BT	Bentonite	1			
ZS and feldspar substitutes	Feldspar and f. substitues	2		1	1
PI	Gl., f. sands	1	1		
Total number		19	4	3	3

Min. 1 - primary mineral
Min. 2 - secondary mineral

Geological survey and exploration paid from the state budget in 1998

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 86%) is given to exploration of crude oil and natural gas including carboniferous gas adsorbed to coal. 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 energetic and mineral 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

1993	CZK 248 716 006
1994	CZK 249 841 345
1995	CZK 242 293 906
1996	CZK 163 029 555
1997	CZK 113 230 640
1998	CZK 114 212 711

Mining output of minerals in the Czech economics

Ratio/Year	1994	1995	1996	1997	1998
Share of mining in GDP, %	2.8	2.6	2.0	2.2.	2.1
Share of mining in industrial production, %	5.9	6.7	6,7	4.0	N

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

Group/Year	1994	1995	1996	1997	1998
Ores c)	28 731	28 731	28 731	32	32
Mineral fuels a)	4 360 159	4 552 487	4 237 488	3 962 830	3 738 617
Industrial minerals	3 112 171	3 101 888	2 885 542	3 081 258	3 033 301
Building materials b)	5 895 318	5 887 848	5 796 308	5 781 186	5 757 833

Note:

a) during 1994-1998 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

c) only metals Pb, Z, Sn were stated in 1997-1998

Basic legal regulations on mineral prospecting and exploration in force as of December 31, 1998

Legal standards on mining

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.
Act No. 61/1988 Sb. on mining operations, explosives and state mining administration in the wording of the CNR Act No. 425/1990 Sb., the CNR Act No. 542/1991 Sb. And the Act No. 169/1993 Sb.
Act No. 62/1988 Sb. on geological works and the Czech Geological Office amended in Act No. 543/1991 Sb.
Decree of the ČBÚ No. 56/1982 Sb. which determines districts of range of the District Mining Offices in the wording of the ČBÚ decree No. 120/1993 Sb.

Regulations on exploitation of deposits

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 415/1991 Sb. on construction, elaboration of documentation and determination of safety pillars, rods and zones of protection of underground and surface objects in wording of the CBU Decree No. 340/1992 Sb.
Decree of the ČBÚ No. 172/1992 Sb. on mining claims
Decree of the ČBÚ No. 175/1992 Sb. on conditions of non-reserved mineral deposit usage
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
Decree of the ČBÚ No. 435/1992 Sb., on mine surveying documentation during mining and some other operations that use mining methods in the wording of the Decre of the ČBÚ No 158/1997 Sb.
Decree of the MH ČR No. 617/1992 Sb. on details of mining claims and extracted reserved minerals tax payment

Geological and coherent regulations

Decree of the ČGÚ No. 85/1988 Sb. on reserved deposit survey and exploration procedure with respect to a protection and rational use of mineral wealth and on information about mineral deposit occurence, its rewards and cost payments in wording of the Act of the ČNR No. 541/1991 Sb.
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 in the wording of the Decree No. 363/1992 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 in the wording of the CNR Act No. 543/1991 Sb.
Decree of the MHPR ČR No. 497/1992 Sb. on evidence of reserves of reserved mineral deposits
Decree of the ÚBÚ and ÚGÚ No. 1000/1962 on administration and completion of geological documentation reg. in the volume No. 42/1962 Sb.

Regulations on licencing of mining operations and on verification of qualification

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 and about changes of some regulations issued by the ČBÚ to secure the health safety and protection during the work and to secure safety of processes during mining operations and other operations that use mining methods

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

Decree of the MHPR ČR No. 412/1992 Sb. on certificate of qualification to project, carry out and evaluate geological works

METALLIC ORES - GEOLOGICAL RESERVES

Geological reserves of metallic ores as of December 31, 1997 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 with gold Zlaté Hory discontinued ore mining in the territory of the Czech Republic in 1994. State grants for damping programs directed at social costs, technical liquidations, savings (maintenance) and reclaimings reached CZK 1,960 mill. in 1990-1998.

Mining output - metal content

Metal	Unit	1994	1995	1996	1997	1998
Iron	t	0	0	0	0	0
Copper	t	0	0	0	0	0
Lead	t	0	0	0	0	0
Zinc	t	100	0	0	0	0
Antimony	t	0	0	0	0	0
Silver	kg	100	0	0	0	0
Gold	kg	75	0	0	0	0

IRON ORE

1. Characteristics and use

The highest concentrations of iron are connected with the occurrence of Precambrian sedimentary formations - the largest world source of hematite and magnetite ores. Deposits of magnetite also originate either by segregation of magnetite in mafic magmatic bodies or through contact metasomatic processes. Iron ores mostly 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 72 % Fe. Over 90 % of mining output have been obtained by surface mining. World reserves are estimated at 800,000 mill. tonnes of ores..

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 Barrandian 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 and high SiO_2 content characterize 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 and about 30 % SiO_2 .
- 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

Recently only 8 deposits are registered mostly with subeconomic reserves.

Sedimentary iron ores::
1 Mníšek pod Brdy
2 Zdice

Magnetite:
3 Kovářská
4 Kovářská-Orpus
5 Měděnec – north
6 Přísečnice
7 Vlastějovice
8 Županovice

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

Year		1994	1995	1996	1997	1998
Deposits - total number		28	27	27	9	8
Exploited		0	0	0	0	0
Total reserves, kt		492490	488566	488566	32284	32284
economic proven		519	519	519	-	0
economic probable		12232	12232	12232	11520	11520
subeconomic		479739	475815	475815	20764	20764
Mining output, kt		0	0	0	0	0
Imports, kt	a)	7283	9146	8255	7383	7396
Exports, kt	a)	2	1	2	3	1

Note:
a) item 2601 of the customs tariff

5. Prices

7.4 million tons of Fe-ores were imported on average price CZK 958 per ton in 1998. Also 42 t of crude iron were imported on average price CZK 5063 per ton and 161 kt of crude iron were exported on average price CZK 5231 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998

In 1998 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 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Mining output, mill. t	964	1020	1049	1030	1000

Main producers (1997):

China	25.2 %	(crude ores - average 35 % Fe content)
Brazil	18.4 %	
Australia	14.6 %	
Russia	6.8 %	
India	6.8 %	
USA	6.0 %	
Ukraine	4.4 %	

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	1994	1995	1996	1997	1998 e
A	28.38	28.38	30.00	30.00	30.00
B	33.38	33.38	35.25	35.25	35.25
C	49.19	49.14	52.40	52.40	52.40

Costs for imports of iron ores from Western Australia and Brazil to Europe depend on cargo volume. With 200,000 ton cargo they fluctuate between 3.7 and 6.5 USD per ton, with cargo from 60,000 to 65,000 tons costs increase USD 1.5-3 per ton.

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

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 hausmannite. Manganese world reserves are estimated at 805 mill. tons.

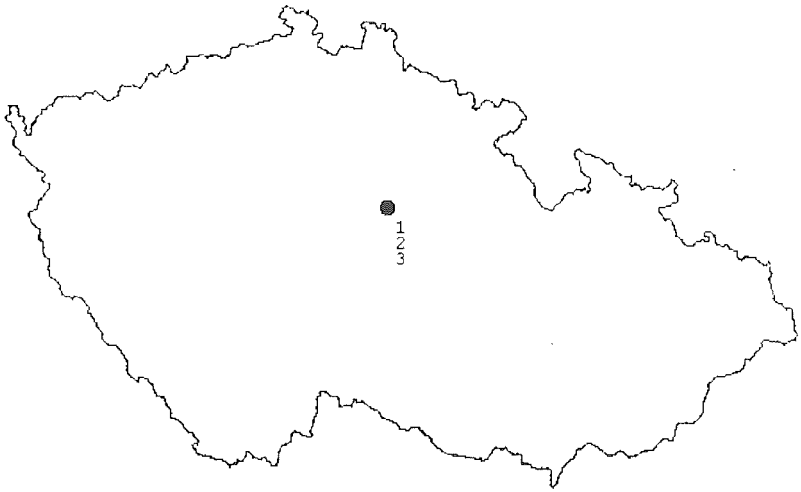
More than 90 % of manganese is used on production of manganese ferro-alloys for the iron industry both in production of pig iron and particularly in the steel industry as a desulphurizing and deoxidizing agent and as an important alloying metal. Average world consumption of manganese is 10 kgs in 1 ton 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

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%).

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		1994	1995	1996	1997	1998
Deposits - total number		3	3	3	3	3
exploited		0	0	0	0	0
Total reserves, kt		138801	138801	138801	138801	138801
economic proven		0	0	0	0	0
economic probable		0	0	0	0	0
subeconomic		138801	138801	138801	138801	138801
Mining output, kt		0	0	0	0	0
Imports, kt	a)	13	47	19	18	4
Exports, kt	a)	0	0	0	0	0

Note:
a) item 2602 of the customs tariff

5. Prices
In 1998 average import prices of Mn and Mn-Fe concentrates were CZK 7373 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998
In 1998 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 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Mining output, kt Mn	7036	7923	8120	7680	7550

Main producers (1997):

South Africa	17.6%
China	16.0%
Australia	13.3%
Gabon	12.4%
Ukraine	12.4%
Brazil	11.4%
India	8.4%

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	1994	1995	1996	1997	1998
A	1.97	1.99	1.93	1.85	1.10

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.

COPPER

1. Characteristics and use

Copper deposits can be divided in five groups, according to their origin - porphyry copper deposits with Mo, stratabound, pyrite in greenschists, magmatic with Ni (Pt) and hydrothermal (vein) deposits. About one half of known mined Cu deposits belongs to porphyry type. Among 300 known Cu minerals only a few sulphides are of economic importance - chalcopyrite, covellite, Cu-pyrite, chalcocite, bornite and enargite. Economic world reserves of Cu in ore are estimated at 310 million tons, reserves of Cu in deep sea nodules are estimated at 0.7 billion tons.

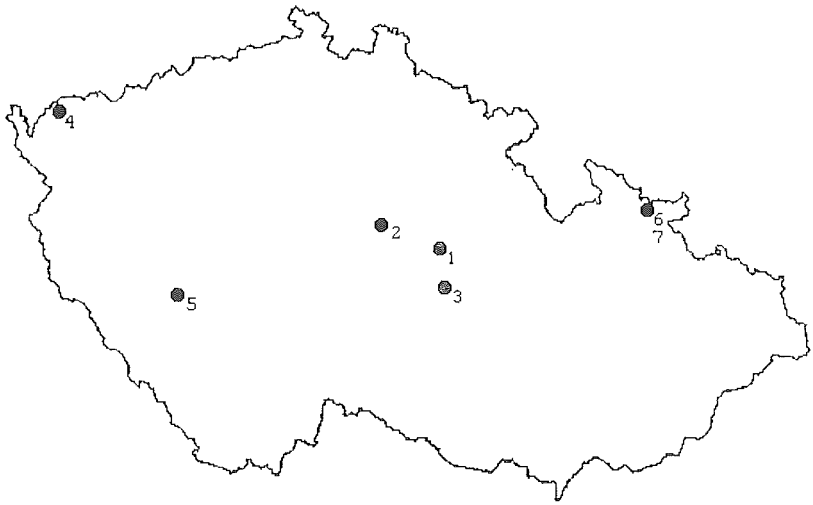
Much copper is used in electrotechnics (50 %), in the machine (20 %) and building industries. Majority of copper is used in alloys, particularly in brass and bronze.

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 with Au and Pb-Zn occur separately and show a certain zonation. Out of the total proved reserves about 50 % have been confined to complex ores, 25 % to monometallic, and 25 % to Pb-Zn ores. Monometallic ores consist of chalcopyrite with varying admixture of pyrite or pyrrhotite. Their grade ranges between 0.4 and 0.6 % 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 about 1 % Cu, was terminated in 1973. A mineral exploration project was then executed in the ore district in the eighties but mining was not resumed and the deposit 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. Mining of Cu ores in the Czech Republic was gradually terminated. Last small volume of Cu was extracted from complex ores with gold of the Zlaté Hory deposit in 1993.

3. Registered deposits and their location in the Czech Republic



15 deposits with prevailing subeconomic reserves have been registered recently. The most important of them are given in the map.

1 Křižanovice
2 Kutná Hora
3 Staré Ransko
4 Tisová u Kraslic
5 Újezd u Kasejovic
6 Zlaté Hory-east
7 Zlaté Hory-west

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

Year		1994	1995	1996	1997	1998
Deposits - total	a)	19	20	20	15	15
exploited		0	0	0	0	0
Total reserves, kt Cu		239	245	245	185	181
economic proven		0	2	2	0	0
economic probable		41	41	41	5	5
subeconomic		198	202	202	180	176
Mining output, t Cu		0	0	0	0	0
Imports, t	b)	11	10	0	0	0
Exports, t	b)	160	15	163	69	128

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

5. Prices
In 1998 no Cu-ore was imported. There were imported 14 kt of refined Cu and copper-base alloys in the Czech Republic. Average price was CZK 58,771 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998
In 1998 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 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Mining output, kt Cu	9020	9605	11000	11300	11860

Main producers (1997):

Chile	29.9%
USA	17.0%
Canada	5.8%
Peru	5.1%
Australia	4.6%
Indonesia	4.6%
Russia	4.6%

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 USD per ton (Cash) was as follows:

Commodity / Year		1994	1995	1996	1997	1998
A	USD	2312	2936	2304	2256	1596

9. Reecycling
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

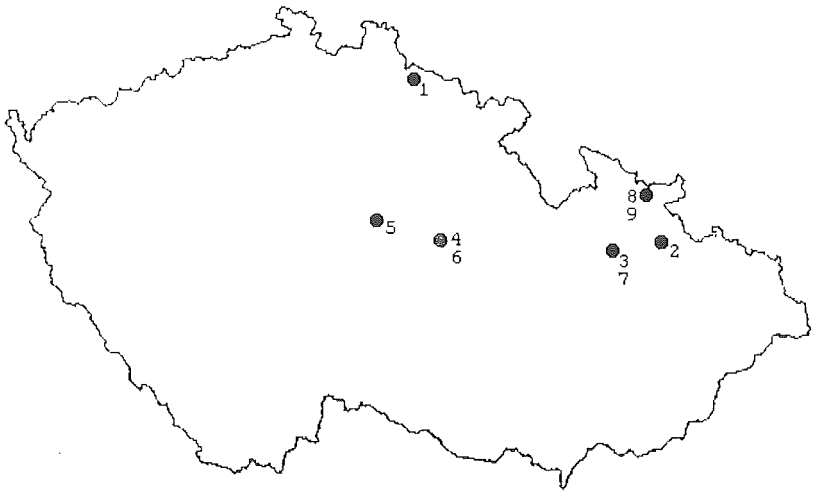
Lead deposits are of five genetic types - sedimentary, volcaniclastic, metasomatic, contact metamorphic and hydrothermal (veins). Major part of the world production comes from the first type. The principal economic mineral is galena, usually accompanied by sphalerite, pyrite and chalcopyrite. Extracted 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 69 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 mineralization is 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 up to 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



Reserves of Pb in ore are registered in 17 deposits. The most important of them are given in the map.

1 Harrachov
2 Horní Benešov
3 Horní Město
4 Křižanovice
5 Kutná Hora
6 Liboměřice
7 Oskava
8 Zlaté Hory-east
9 Zlaté Hory-west

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

Year		1994	1995	1996	1997	1998
Deposits – total	a)	26	27	27	18	17
Exploited		0	0	0	0	0
Total reserves, kt Pb		257	270	270	208	195
Economic proven		15	17	17	13	13
Economic probable		62	62	62	53	43
Subeconomic		180	191	191	142	139
Mining output, t Pb		0	0	0	0	0
Imports, kt	b)	0	0	1	0	0
Exports, kt	b)	0	110	0	50	263

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

5. Prices

30,1 kt of crude lead were imported in 1998. Average price was CZK 19,804 per ton. Pb-ore was not imported in the Czech Republic in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998

In 1998 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 and Mineral Commodity Summaries):

Year	1994	1995	1996e	1997	1998 e
Mining output, kt Pb	2730	2784	3000	2900	3000

Main producers (1997):

Australia	18.3%
China	15.5%
USA	15.5%
Canada	8.6%
Peru	6.6%
Mexico	5.7%

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	1994	1995	1996	1997	1998
A	140	140	168	170	195
B	549	633	775	626	516

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, Great Britain, 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

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.

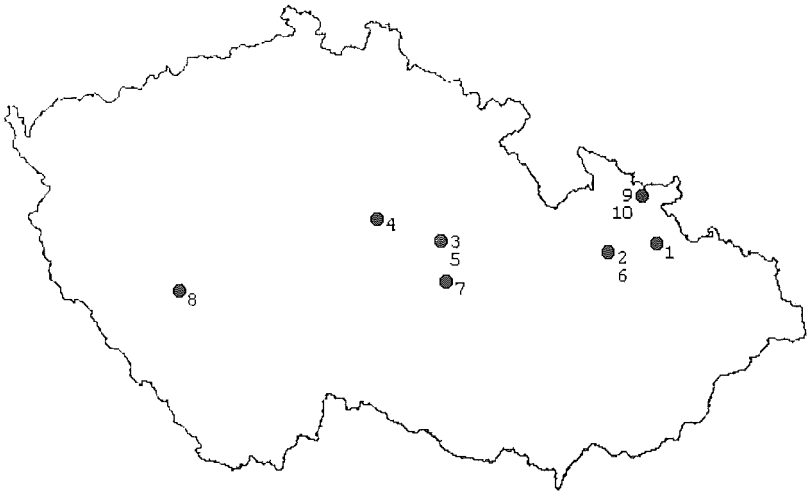
2. Mineral resources of the Czech Republic

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 0.7-2.6 % 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 1.8 % Zn was mined until 1990. The Křižanovice deposit of Pb-Zn-Cu ores with barite is classified as volcaniclastic mineralization. The ore contained about 4-6 % 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



Reserves of Zn in ores are registered in 18 deposits. The most important of them are given in the map.

1 Horní Benešov
2 Horní Město
3 Křižanovice
4 Kutná Hora
5 Liboměřice
6 Oskava
7 Staré Ransko-Obrázek
8 Újezd u Kasejovic
9 Zlaté Hory-east
10 Zlaté Hory-west

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

Year		1994	1995	1996	1997	1998
Deposits – total	a)	29	30	30	22	18
Exploited		0	0	0	0	0
Total reserves, kt Zn		924	1036	1036	882	802
Economic proven		44	75	75	41	41
Economic probable		234	234	234	220	146
Subeconomic		646	727	727	621	615
Mining output, t Zn	b)	100	0	0	0	0
Imports, kt	c)	4	0	1	0	1
Exports, kt	c)	0	1800	0	0	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. Prices

More than 22 kt of crude zinc were imported in 1998. The average price was CZK 37,608 per ton. There was also imported 1 t of Zn-ores.

6. Mining companies in the Czech Republic as of December 31, 1998

In 1998 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 production has increased again since 1995. The major producing countries were as follows (according to the Welt-Bergbau-Daten and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Mining output, kt Zn	6212	6835	7300	7800	8200

Main producers (1997):

Canada	15.4 %
Australia	14.1 %
China	12.8 %
Peru	10.0 %
USA	8.1 %

In 1997 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	1994	1995	1996	1997	1998
A	172	172	189	171	187
B	173	173	190	172	188
C	998	1030	1026	1332	991

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 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.

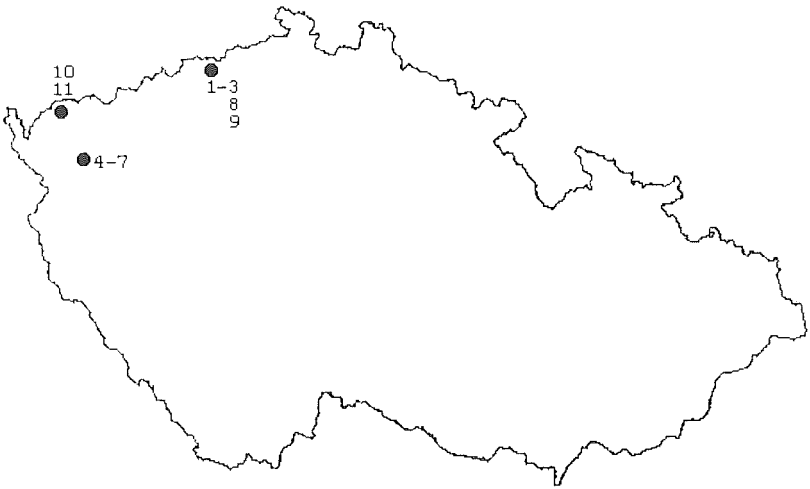
2. Mineral resources of the Czech Republic

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 in deeper levels 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 Cínovec-south
2 Cínovec-north-open pit
3 Cínovec-old shaft
4 Horní Slavkov-the Hány elevation
5 Krásno
6 Krásno-Horní Slavkov
7 Krásno-Koník
8 Krupka 1
9 Krupka 4
10 Přebuz
11 Rolava-east

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

Year		1994	1995	1996	1997	1998
Deposits - total	a)	13	14	14	11	11
Exploited		0	0	0	0	0
Total reserves, t Sn		203087	234913	234913	208077	208076
Economic proven		3757	3757	3757	3014	3014
Economic probable		37266	37266	37266	12425	12425
Subeconomic		162064	193890	193890	192638	192637
Mining output, t Sn		0	0	0	0	0
Imports, t	b)	0	0	1	0	0
Exports, t	b)	0	0	0	0	0

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

5. Prices

436 tons of crude tin were imported in 1998. Average price was CZK 189,075 per ton. No tin ores were imported in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998

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 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Concentrate prod., kt Sn	171	186	196	201	210

Main producers (1997):

China	29.9 %
Indonesia	19.9 %
Peru	14.4 %
Brazil	10.0 %
Bolivia	8.0 %

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	1994	1995	1996	1997	1998
A	425	375	525	525	525
B	450	338	375	375	375
C	462	275	345	345	345
D	5462	6271	6171	5661	5503

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

High concentrations of tungsten are always related to granites. Primary tungsten ores are confined to pegmatite and greisen deposits related to acid granitoid intrusions and to scheelite skarn deposits. 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.

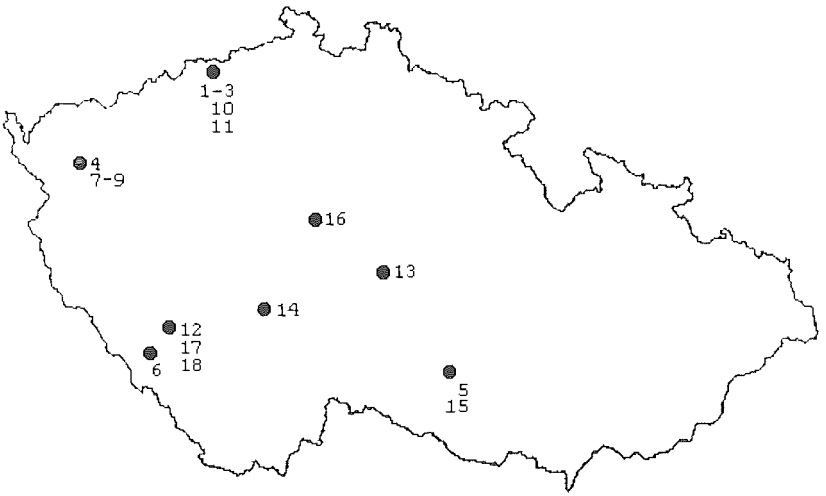
Tungsten ores and concentrates are processed to obtain intermediate products - ammonium paratungstate (APT), tungstic acid, sodium tungstate, metal powder and powder tungsten carbide. Much tungsten is consumed in alloyed steels used in heavy machine industry, particularly in the armament industry. Much 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 Republic

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

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

Year		1994	1995	1996	1997	1998
Deposits - total	a)	18	19	19	18	18
Exploited		0	0	0	0	0
Total reserves, t W		92298	95120	95120	93948	93948
Economic proven		127	127	127	0	0
Economic probable		52488	52488	52488	53373	53373
Subeconomic		39683	42505	42505	40575	40575
Mining output, t W		0	0	0	0	0
Imports, t	b)	0	0	11	14	52
Exports, t	b)	119	94	128	137	105

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

5. Prices

89 t of tungsten were imported in the Czech Republic in 1998. Average price was CZK 445,107 per ton. Also 52 t of tungsten ores were imported – average price was CZK 215,571 per ton. There were exported 105 t of tungsten ores, average price was CZK 125,397 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998

In 1998 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	1994	1995	1996	1997	1998 e
Production, kt W	21	28	32	30	30

Main producers (1997):

China	80.3 %
Austria	6.4 %
Portugal	3.4 %
Bolivia	2.2 %
Russia	1.7 %
Korea, Dem.P.R. of	1.5 %
Uzbekistan	1.0 %

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	1994	1995	1996	1997	1998
A	54	58	48	47	37
B	66	84	67	64	52

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.

SILVER

1. Characteristics and use

Silver is an element of chalcophile character which during the magmatic differentiation tends to concentrate in minerals of late stages or hydrothermal fluids. About 2/3 of the silver world reserves occur in 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

Reserves of silver are registered in 22 deposits of polymetallic ores. The most importand deposits are given in the map.

1 Horní Benešov
2 Horní Město
3 Křižanovice
4 Kutná Hora
5 Liboměřice
6 Oskava
7 Roudný – Aleška
8 Újezd u Kasejovic
9 Zlaté Hory-east
10 Zlaté Hory-west

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

Year		1994	1995	1996	1997	1998
Deposits - total	a)	32	33	32	22	22
Exploited		0	0	0	0	0
Total reserves, t Ag		1090	1115	1035	772	590
Economic proven		8	13	8	0	0
Economic probable		403	403	344	308	175
Subeconomic		679	699	683	464	415
Mining output, kg Ag	b)	100	0	0	0	0
Imports, t	c)	0	0	0	0	0
Exports, t	c)	0	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. Prices

90 t of crude silver were imported in 1998. Average price was CZK 6071 per ton. There were imported no ores containing silver.

6. Mining companies in the Czech Republic as of December 31, 1998

In 1998 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, Gold Fields Mineral Services 1995 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Mining output, t Ag	13088	14159	15200	15300	16000

Main producers (1997):

Mexico	16.3 %
Peru	13.1 %
USA	10.5 %
Canada	7.8 %
Australia	7.2 %

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 USc per troy oz (commodity A) is given in a summary as follows:

Commodity / Year	1994	1995	1996	1997	1998
A	529	519	575	489	508

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

According to their origin primary gold deposits can be divided into two large groups: volcanic sedimentary and volcanic-plutonic. Secondary deposits - recent and fossil placers - resulted from physical weathering processes. Gold occurs in the form of native metal, in a natural alloy with silver (electrum) 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 46 kt of Au, of which 15 to 20 % occur as a minor constituent in other ore deposits. 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.

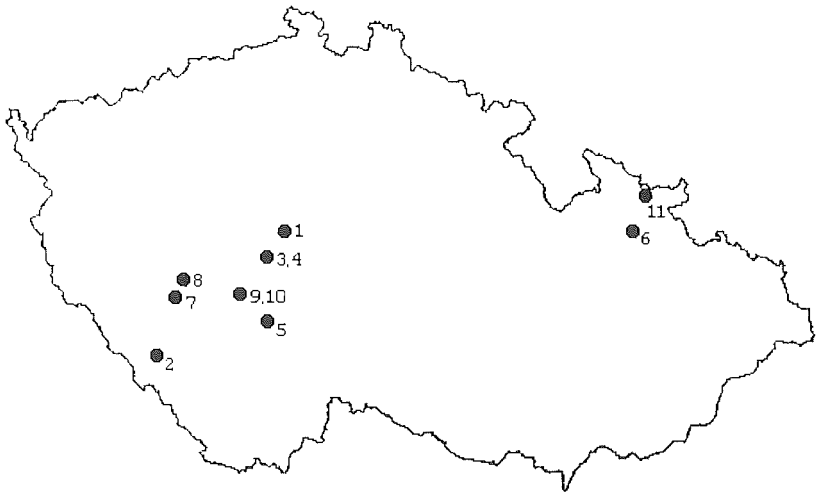
2. Mineral resources of the Czech Republic

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 the Intra-Sudetic basin. The largest areas of Quaternary placers are located in the foothills of the Šumava mountains and in northern Moravia and Silesia. Still recognizable remnants of placer gold panning indicate extensive mining for gold which goes back to Celtic times.

No gold mining is currently taking place in the Czech Republic, following the 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.

3. Registered deposits and their location in the Czech Republic



27 occurences of gold are registered in balance of reserves. In eight localities only the accumulation is higher and has a deposit importance.

1 Jílové u Prahy
2 Kašperské Hory
3 Mokrsko
4 Mokrsko-east
5 Sepekov
6 Suchá Rudná-central part
7 Újezd u Kasejovic
8 Vacíkov
9 Voltýřov
10 Voltýřov-placer
11 Zlaté Hory-west

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

Year		1994	1995	1996	1997	1998
Deposits - total number		20	27	27	27	27
Exploited		0	0	0	0	0
Total reserves, kg Au		214407	253166	249660	249660	249660
Economic proven		48740	52139	48740	48740	48740
Economic probable		84751	84751	86600	86600	86600
Subeconomic		80916	116276	114320	114320	114320
Mining output, kg Au	a)	75	0	0	0	0
Imports, kg	b)	2312	2463	3388	2346	2415
Exports, kg	b)	1671	2329	4693	2489	2806

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

5. Prices

2,415 t of crude gold were imported in 1998. Average price was CZK 180462 per kgs. No ores containing gold were imported in 1998..

6. Mining companies in the Czech Republic as of December 31, 1998

In 1998 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 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Mining output, t Au	2197	2213	2263	2472	2529

Main producers (1997):

South Africa	21.3 %
USA	14.1 %
Australia	12.6 %
Canada	6.5 %
Russia	5.9 %
China	5.4 %

The first three countries produce nearly 50% of all world production. In their territories more than 60% of world reserves is concentrated.

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) and fell under USD 300 per Troy oz in the end 1997.

Commodity / Year	1994	1995	1996	1997	1998
Gold	384.15	384.05	387.70	331.00	291.00

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 19,800 mill. in coal industry and CZK 17,000 mill. in uranium industry in 1990-1998. High grants for coal industry damping will continue also in 1999, when the total granted amount will be CZK 4,020 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	1994	1995	1996	1997	1998
Uranium ore	t U	537	611	589	624	611
Hard coal	kt	20910	21309	21784	20847	19521
Brown coal	kt	59811	57954	59539	57395	51283
High volat. Lignite	kt	913	775	902	747	652
Crude oil	kt	131	149	155	159	172
Natural gas	mill.m^3	154	165	146	118	137

Life of industrial reserves (economic proven mineable reserves) consequent the decrease of reserves by output incl. losses of balanced deposits per year 1998 (A) and the average annual decrement of reserves in period 1994-1998 (B) was as follows:

Raw material	Life, years	
	A	B
Uranium ore	33	35
Hard coal	68	65
Brown coal 1)	38	33
High volatile lignite	132	105
Crude oil	66	74
Natural gas	12	12

1) including reserves blocked by area limits

URANIUM

1. Characteristics and use

The most frequent genetic types of uranium depostis are hydrotermal (mostly vein), sedimentary, infiltration, metamorphogenic and albitite ones. 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 about 0.1% 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.

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 Intra-Sudetic 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 of high-grade ore 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 1997. 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 I

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

Year		1994	1995	1996	1997	1998
Deposits - total number		17	17	16	13	13
Exploited		3	2	1	1	1
Total reserves, t U		142835	141534	141069	139396	139528
economic proven		46744	45300	22615	21527	21229
economic probable		50480	50012	34800	21946	21685
subeconomic		45611	46222	83654	95923	96614
Mining output, t U		537	611	589	624	611
Imports, t	a)	0	0	0	0	N
Exports, t	a)	N	N	N	N	N

Note:
a) item 2612 10 of the customs tariff

5. Prices
Neither import nor export prices of uranium have been published.

6. Mining companies in the Czech Republic as of December 31, 1998
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 '99 and Engineering and Mining Journal):

Year	1994	1995	1996	1997	1998e
Mining output, t U	33040	37434	40142	42500	40500

Main producers (1997):

Canada	32.1 %
Australia	16.3 %
Niger	9.8 %
Namibia	9.6 %
USA	6.1 %
Uzbekistan	5.5 %
South Africa	3.7 %

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.

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. So far the highest price was reached in 1978 - USD 95 per kg 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 22 per kg 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 kg U_3O_8 fluctuated as follows (up to 1994 annual average, 1995 at yearend):
A Nuexco

Commodity / Year	1994	1995	1996	1997	1998
A	14.7	17.5	27.2	23.7	19.9

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 15.4 - 15.9 per kg U_3O_8), reduction of consumers stockpiles and declining nuclear energy generation, etc.

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 Upper Silesian basin. About 15% of reserves are in the Czech Republic and about 85% in the territory of Poland.

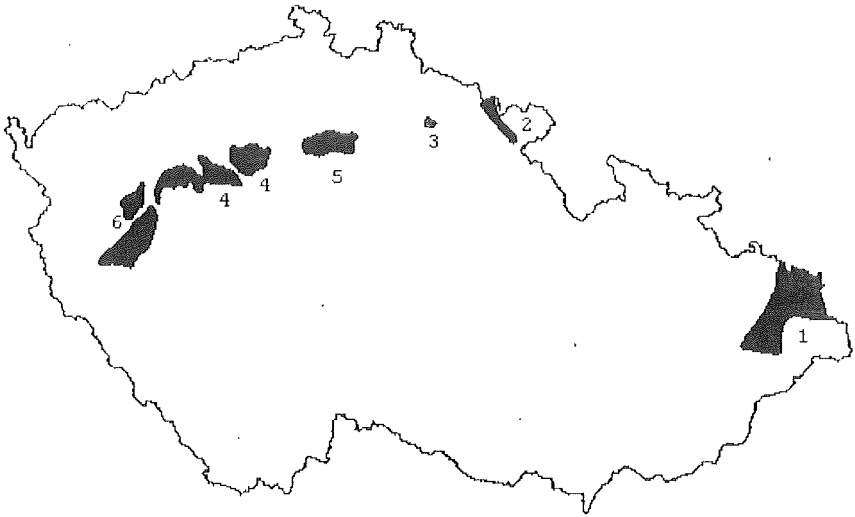
The major fault, called the Orlová fault, divides the Moravian part of the Upper Silesian basin into the western section (the Ostrava part) which is older and of paralic character of sediments and coal seams and the eastern section (the Karviná part) which exhibits limnic character of the sediments as well as of coal. The western part consists of several tens of thin coal seams kf high grade coking coal whereas the eastern part is characteristic of abundant thick seams consisting of mixed coking coal 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. As the deposit is situated on the border of protected landscape area there can come conflicts of interests with Beskydy protection in the case of its mining.

- 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		1994	1995	1996	1997	1998
Deposits - total number		74	73	72	68	67
exploited		25	21	17	20	18
Total reserves, kt		13573064	13932934	13942239	13954950	13941612
Economic proven		2309614	2696681	2612865	2417365	2355800
Economic probable		5962804	6402625	6401303	6147991	6045714
Subeconomic		5300646	4833628	4928071	5389594	5540098
Mining output, kt		20910	21309	21784	20847	19521
a) Imports, kt	b)	1721	2676	3211	2274	1578
Exports, kt	b)	6499	7022	6738	6609	6726

Note:
a) ČSÚ returns so-called sale output, which presents production of marketable hard coal and reaches in average 78.8% of above mentioned mining output
b) item 2701 of the customs tariff
1193743 kt of reserves are presented as mineable, i.e. 8.56% of all reserves and 14.21% of economic reserves.

5. Prices

Prices of sized coal from the Oskava-Karviná district fluctuate between CZK 1710-1720 per ton. Prices of metallurgical coke are CZK 3300-3800 per ton, prices of heating coke are CZK 2900-3050 per ton and prices of coke breeze and coke dust (i.e. undersizes under 20 mm) are CZK 2050-2350 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998

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
ČMD, a.s. - Důl ČSM o.z., Stonava
OKD, a.s. - Důl Paskov, o.z.
ČMD, a.s. - Kladno
OKD, a.s. - Ostrava
Gemec, s.r.o. - Ostrava

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	1994	1995	1996	1997	1998e
Mining output, mill.t	3567	3688	3866	3875	3600

Main producers (1997):

China	35.1 %
USA	23.4 %
India	7.6 %
Australia	5.7 %
South Africa	5.6 %

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	1994	1995	1996	1997	1998
A	43.58	44.05	43.55	45.89	45.45
B	34.69	34.21	34.33	32.81	30.47

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.

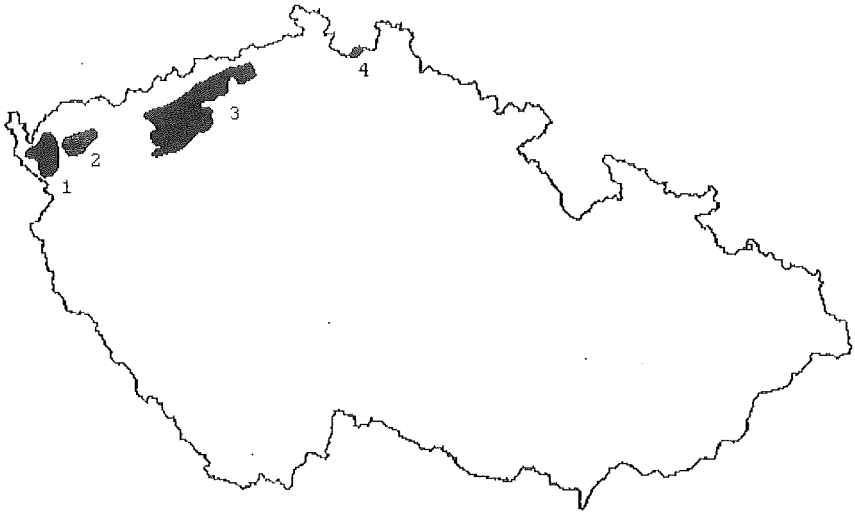
Brown coal is used in the main in energetics and to a smaller extent in chemical industry.

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 Žitava 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 Žitava basin

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

Year		1994	1995	1996	1997	1998
Deposits – total number		80	72	71	66	62
Exploited		17	17	16	14	13
Total reserves, kt		10713071	10443206	10376959	9893368	9741936
economic proven		3965192	3825418	3417784	3456447	3648979
economic probable		1922642	1889287	1956191	1910604	2078570
subeconomic		4825237	4728501	5002984	4526317	4014387
Mining output, kt		59811	57954	59539	57395	51283
Imports, kt	a)	7	0	5	3	2
Exports, kt	a)	5282	6903	6173	5000	3930

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
1568448 kt of reserves are presented as mineable, i.e. 16.1% of all reserves and 27.4% of economic reserves.

5. Prices

Brown coal prices depend on caloricity and granularity. Prices of ranks with caloricity 11 MJ per kg fluctuate between CZK 315-413 per ton, with caloricity 15 MJ/kg between CZK 455-563 per ton and with caloricity 20 MJ/kg between CZK 605-750 per ton (without VAT). Prices of brown coal briquettes of E230 quality fluctuate from CZK 1148 per ton (fragments) up to CZK 2888 per ton (packages).

6. Mining companies in the Czech Republic as of December 31, 1998

Severočeské doly, a.s. (Chomutov)
Mostecká uhelná společnost, a.s.
Sokolovská uhelná, a.s. (Vřesová)

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	1994	1995	1996	1997	1998 e
Mining output, mill.t	889	852	850	850	820

Main producers (1997):

Germany	20.9 %	Greece	6.9 %
Russia	9.8 %	Turkey	6.6 %
USA	9.3 %	Czech Republic	6.3 %
Poland	7.4 %	China	3.5 %
Australia	7.2 %	Romania	3.4 %

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 one shaft. 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 Žitava basin

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

Year	1994	1995	1996	1997	1998
Deposits – total number	20	20	20	13	15
Exploited	2	1	1	1	1
Total reserves, kt	772571	771489	1017621	1023455	1025720
economic proven	149190	147244	145940	124920	142117
economic probable	359145	359145	590960	564590	606825
subeconomic	264236	265100	280721	333945	276778
Mining output, kt	912	784	902	747	652

25893 kt of reserves are presented as mineable, i.e. 11.8% of all reserves and 23.3% of economic reserves.

5. Prices

Prices of Southmoravian high volatile lignite fluctuate between CZK 430 and 470 per ton (according to granularity).

6. Mining companies in the Czech Republic as of December 31, 1998

Lignit Hodonín 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 foreign 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 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, porous reservoir or broken up 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.

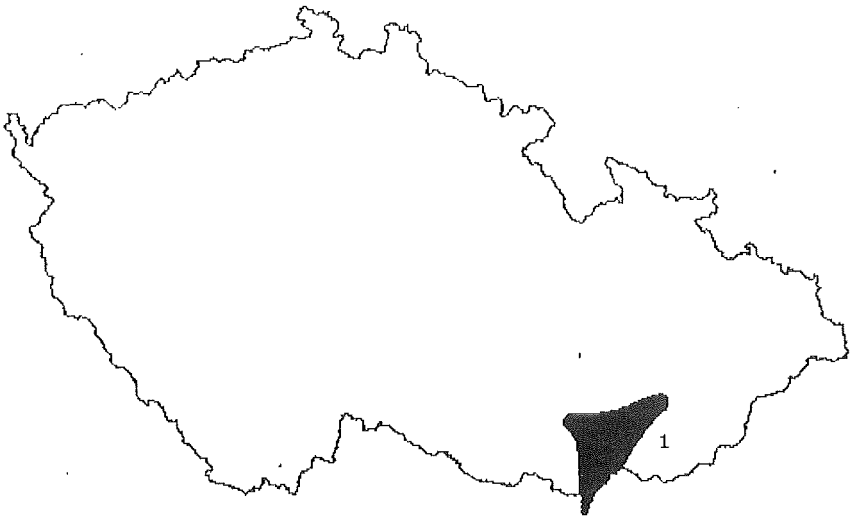
All-round oil industrial use is evident and new applications are still under way. Nevertheless, power generation, petrochemical and chemical industries are the principal oil consumers.

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 sandstones 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	1994	1995	1996	1997	1998
Deposits – total number	23	26	25	25	22
Exploited	14	18	16	16	17
Total reserves, kt	65876	48771	48430	47942	37846
economic proven	12586	12333	12048	11584	11403
economic probable	44323	23677	23588	23400	13499
subeconomic	8967	12761	12794	12958	12944
Mining output, kt	131	149	155	159	172
Imports, kt a)b)	6493	7052	7671	7050	6948
Exports, kt a)	76	108	84	90	104

Note:
a) item 2709 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)
3887 kt of reserves are presented as mineable, i.e. 10.3% of all reserves and 15.6% of economic reserves.

5. Prices

Average import prices of crude oil reached up to CZK 2870 per ton in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998

Moravské naftové doly, a.s. Hodonín

7. World oil production

World crude oil output was relatively stable during the last few years being 3150 mill. 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	1994	1995	1996	1997	1998 e
Mining output, mill.t	3162	3264	3237	3474	3200

Main producers (1997):

Saudi Arabia	12.0 %	Venezuela	4.7 %
USA	11.5 %	China	4.7 %
Russia	10.0 %	Norway	4.6 %
Iran	5.5 %	Canada	3.5 %
Mexico	4.9 %	Great Britain	3.4 %

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, where the main producers are Norway and Great Britain. 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	1994	1995	1996	1997	1998
A	16.48	18.70	23.66	19.06	11.86
B	16.34	18.44	24.13	18.68	12.04

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 carbonification 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	1994	1995	1996	1997	1998
Deposits – total number	49	34	54	67	59
Exploited	22	14	29	31	30
Total reserves, mill.m^3	22804	23186	17083	21141	20888
economic proven	4835	4482	4252	4146	4005
economic probable	16475	16922	10743	14908	14789
subeconomic	1494	1782	2088	2087	2094
Mining output, mill.m^3	154	165	146	118	137
Imports, mill.m^3 a)	7322	8049	9499	9524	9573
Exports, mill.m^3 a)	2	2	1	1	0

Note:

a) item 2711 21 of the customs tariff

12894 mill. m^3 of reserves are presented as mineable, i.e. 61.7% of all reserves and 68.6% of economic reserves.

5. Prices

Average import prices reached up to CZK 2225 per 1000 m^3 in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998
Moravské naftové doly, a.s. Hodonín
Důlní průzkum a bezpečnost Paskov, a.s.
Důlní průzkum Stonava s.r.o., Ostrava
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	1994	1995	1996	1997	1998 e
Mining output, bill.m^3	2273	2365	2352	2311	2300

Main producers (1997):

Russia	24.7 %
USA	23.3 %
Canada	6.8 %
Great Britain	4.0 %
Indonesia	3.9 %
Netherlands	3.5 %

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 25000 mill. m^3 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 25,000 mill. m^3 about 1,600 mill. m^3 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 1996 and between USD 1.7 and 2.0 per mill. Btu in 1998.

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	1994	1995	1996	1997	1998
Fluorspar	kt	10	0	0	0	0
Graphite	kt	25	27	30	25	28
Pyrope-bearing rock	kt	33	24	39	49	43
Kaolin	kt	2706	2800	2798	2982	3049
Clays	kt	823	915	738	759	1030
Bentonite	kt	65	54	59	110	125
Feldspar	kt	170	183	211	243	266
Feldspar substitute (phonolite)	kt	25	35	38	33	33
Silica raw materials	kt	2	3	4	13	1
Natural sands	kt	1955	1990	2209	1763	1642
Fusible basalt	kt	85	108	90	103	96
Diatomite	kt	40	29	35	42	35
Limestones	kt	10205	10092	10610	11010	11169
of them:						
high percentage limest.	kt				4536	4526
other limestones	kt				6474	5216
dolomites	kt				294	389
Corrective sialic additives	kt	655	658	643	540	260
Gypsum	kt	591	542	443	241	222
Dimension stone	thous.m^3	225	210	190	258	305

Life of industrial reserves (economic proven mineable reserves) consequent the decrease of reserves by output incl. lossesi in balanced deposits per year 1998 (A) and the average annual decrement of reserves in period 1994-1998 (B) was as follows:

Raw material	Life, years	
	A	B
Graphite	43	45
Pyrope-bearing rock	42	49
Kaolin	60	65
Clays	145	168
Bentonite	349	536
Feldspar	72	98
Silica raw materials	not mined	513
Natural sands	87	90
Fusible basalt	74	73
Diatomite	91	106
High percentage limestones	141	148
Other limestones	173	175
Dolomite*	217	248*
Gypsum	473	223
Dimension stone	251	323

* of average decrease in 1997 and 1998

FLUORSPAR

1. Characteristics and use

Most fluorspar deposits are veins of hydrothermal origin. Fluorspar deposits which originated by infiltration, metasomatism and sedimentation are much less abundant. Fluorspar is accompanied usually by other minerals like quartz, barite, calcite, etc. World economic reserves are estimated at 400 mil.t.

We can distinguish three basic grades of fluorspar according to their quality and specification:

a) metallurgical grade (min. 85% CaF_2, max. 15% SiO_2);
b) acid grade (min. 97% CaF_2, up to 1.5% 0.1-0.3% S);
c) ceramic grade (80-96% of CaF_2, up to 3% SiO_2).

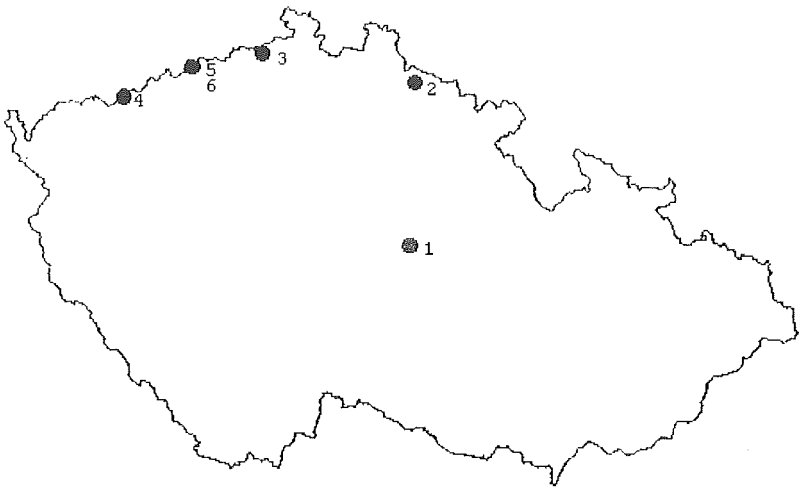
More than half of the fluorspar output is used in chemical industry for production of fluorine (F), hydrofluoric acid (HF), NaF and synthetic cryolite. Fluorine is an important component of chlorofluorocarbons and other chemicals used in refrigerants and other agents. Metallurgical industry of alumina 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. However, relative proportions of single minerals are changing considerably in individual deposits and even within single veins.

Majority of fluorspar deposits exhibits 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 guest minerals which exhibit a pulsation character. Such a 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 Harrachov
3 Jílové u Děčína
4 Kovářská
5 Moldava
6 Moldava-Vápenice

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

Year		1994	1995	1996	1997	1998
Deposits – total	a)	7	7	7	6	6
Exploited		3	0	0	0	0
Total reserves, kt		3558	3476	3477	3078	3078
economic proven		68	48	35	0	0
economic probable		2089	1003	997	584	584
subeconomic		1401	2425	2425	2494	2494
Mining output, kt		10	0	0	0	0
Imports, t	b)	26642	67720	42437	51530	41943
Exports, t	b)	20667	26011	17172	22688	24827

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

5. Prices

In 1998 average import prices of acid-grade fluorspar (over 97% CaF_2) were CZK 3896 per ton, average import prices of metallurgical and ceramic grades were CZK 3901 per ton. Average export prices fluctuated between CZK 5713 and 6338 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998

No mining companies were operating on the territory of the Czech Republic to extract fluorspar in 1998.

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 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Mining output, kt	4252	4427	4140	4110	4100

Main producers (1997):

China	53.5%
Mexico	11.7%
South Africa	5.6%
France	2.6%
Spain	2.6%

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. 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	1994	1995	1996	1997	1998
A	92.50	105.00	112.50	112.50	112.50
B	162.50	157.50	167.50	180.00	*180.00
C	141.00	152.50	150.00	135.00	135.00
D	90.00	90.00	92.50	92.50	95.00
E	117.50	117.50	125.00	120.00	120.00

* *the last available data are from January 1998*

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 also be substituted by dolomite, limestone and/or olivine in ferrous metallurgy.

BARITE

1. Characteristics and use

Barium which is the major constituent of barite occurs in igneous rocks. It is released during their weathering and transferred 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.

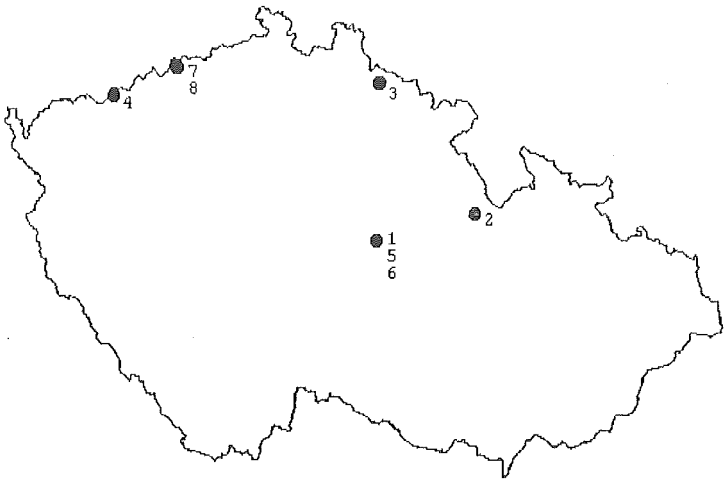
Barite is widely used because of its specific properties such as whiteness, high density, chemical resistance, absorption of X-rays and gamma radiation, etc. Barite is used in glassmaking to produce special glass, in ceramic glazes, porcelain enamels, paints, plastics, fireworks (signal flares, detonators, 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 mineralization which downgrade the vein fillers 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.

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		1994	1995	1996	1997	1998
Deposits - total	a)	7	8	8	9	9
Exploited		0	0	0	0	0
Total reserves, kt		3328	2920	2920	2920	2920
Economic proven		44	44	44	44	44
Economic probable		2373	1407	1407	947	947
Subeconomic		911	14669	1469	1929	1929
Mining output, kt		0	0	0	0	0
Imports, t	b)	30596	39964	14692	10828	7993
Exports, t	b)	118	12	10	50	70

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

5. Prices

Average import price of barite reached CZK 4647 per ton in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998

No mining companies were operating on the territory of the Czech Republic to extract barite in 1998.

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 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Mining output, kt	4653	5052	4460	7031	6000

Main producers (1997):

China	49.8%
USA	10.0%
India	7.8%
Morocco	4.9%
Kazakhstan	3.8%

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	1994	1995	1996	1997	1998
A	42.50	46.50	53.50	51.50	45.00
B	37.50	47.50	52.50	53.50	51.00
C	207.50	207.50	207.50	207.50	207.50
D	38.50	40.00	41.00	41.00	41.00
E	80.00	77.50	77.50	77.50	80.00

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 an important technical mineral exhibiting perfect basal cleavage, fair electric and heat conductivity, refractoriness and resistance to acids.

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.

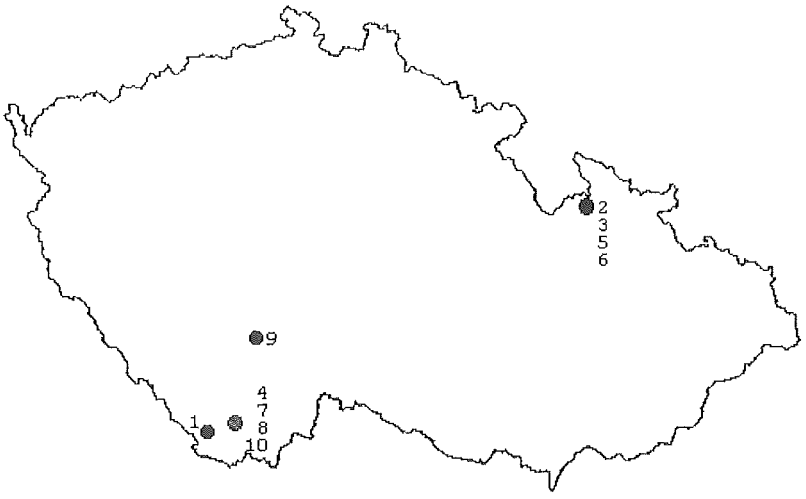
Graphite deposits can be divided into early magmatic, contact metasomatic, metamorphogenic (metamorphic and metamorphosed) and residual deposits. World reserves of graphite are estimated at 21 mill. tons. Uses of graphite are based upon its physical and chemical properties. It is used in foundry industry, 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 Bohemian Massif in the Southbohemian Moldanubicum, then in the Moravicum and Silesicum.

- The most important deposits occur in the Southbohemian Modanubicum, particularly in the so-called Varied Group 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 Varied Group (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



Amorpous graphite
1 Bližná
2 Velké Vrbno-Konstantin
3 Branná-Medvědí důl
4 Český Krumlov-Rybářská street.
5 Malé Vrbno
6 Velké Vrbno

Crystalline graphite:
7 Český Krumlov-Městský vrch
8 Lazec
9 Kolodějе n. Luž.-Hosty

Combined graphite:
10 Spolí

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

Year		1994	1995	1996	1997	1998
Deposits - total number		17	17	17	16	16
Exploited		4	4	4	4	4
Total reserves, kt		15287	15247	15201	14378	14926
Economic proven		2178	2138	2092	2054	2012
Economic probable		4369	4369	4369	3780	4370
Subeconomic		8740	8740	8740	8544	8544
Mining output, kt		25	27	30	25	28
Imports, t	a)	737	977	1176	634	839
Exports, t	a)	2294	2691	2722	2831	2670

Note:
a) item 2504 of the customs tariff

5. Prices

Average import prices reached CZK 29367 per ton, average import prices were CZK 23395 per ton in 1998. Average domestic prices of foundry graphite fluctuated according to their quality between CZK 7560 and 12415 per ton (without VAT). Prices of domestic flotation graphite fluctuate between CZK 11,900 and 36,100 per ton (without VAT). Prices of chemically treated graphite (purity 99.5-99.9% C) fluctuate from CZK 50,300 to CZK 93,100 per ton. Prices of microground graphite (purity 99.5-99.9% C) fluctuate between CZK 58,200 and 73,300 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998

Grafit, a.s. Netolice
Grafitové doly Staré Město, 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 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Mining output, kt	791	610	800	750	750

Main producers (1997):

China	37.5%
India	15.0%
Mexico	6.0%
Brazil	5.4%
Canada	3.3%

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	1994	1995	1996	1997	1998
A	750	750	750	750	650
B	500	500	500	515	515
C	400	415	415	390	390
D	375	385	385	385	385
E	260	260	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 ruby, 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.

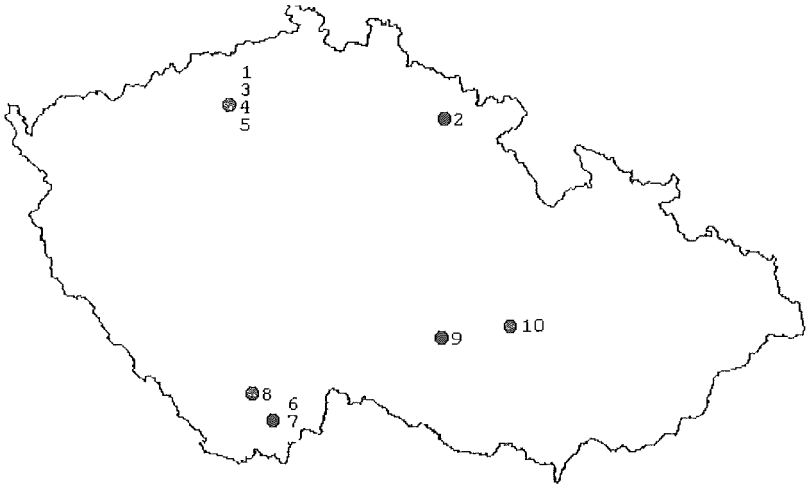
2. Mineral resources of the Czech Republic

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).

- 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 deposit Vestřev in the Krkonoše piedmont basin only. Stones of large size are used as 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 Vodňany to České Budějovice and the Kaplice region. Green-brownish (coloured) 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 has small extent and will never play any important role in economy.

3. Registered deposits and their location in the Czech Republic



Pyrope-bearing rock:	Moldavite-bearing rock:	Other gemstones:
1 Podsedice	6 Ločenice	9 Bochovice
2 Vestřev	7 Besednice	10 Rašov
3 Linhorka-Staré	8 Vrábče-Nová Hospoda	
4 Podsedice-Dřemčice		
5 Třebívlice		

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

Year		1994	1995	1996	1997	1998
Deposits - total	a)	5	5	5	5	5
Exploited		2	2	2	2	2
Total reserves, kt	a)	23133	23109	23072	23019	22900
Economic proven		3759	3660	3630	3583	3501
Economic probable		12930	12927	12920	12914	12910
Subeconomic		6444	6522	6522	6522	6489
Mining output, kt	a)	33	24	39	49	43
Imports, kg	b)	20355	31631	38025	31496	22995
Exports, kg	b)	7347	3609	4959	2846	2341

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

5. Prices

22995 kgs of gemstones were imported in the Czech Republic in 1998, average price was CZK 799 per kg. In the same time 2341 kgs of gemstones were exported. Average export price was CZK 2256 per kg. In these numbers diamonds are not included.

6. Mining companies in the Czech Republic as of December 31, 1998

Granát - družstvo umělecké výroby Turnov
TRL s.r.o, Kutná Hora

7. World production

World production of industrial diamonds reached about 62 mill. carats in 1997. The main producer was Australia – 37.5%, next were Zaire – 24.2%, Russia 14.5%, South Africa – 8.9% and Botswana – 8.1%.

World production of gem-quality diamonds was estimated to 53 mill. carats in 1997. Also in this case in the first place was Australia – 31.8%, next were Botswana - 23.5%, Russia - 17.0%, Zaire - 8.4% and South Africa 7.5%.

World capacity of garnet output (mostly for industrial application) was 130 kt in 1996. The largest mining capacity was in the USA - 41.5 %, further producers were Australia - 23.5%, India - 11.5% and China - 11.5%.

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	1994	1995	1996	1997	1998 e
A	210	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 the kaolinite group 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 mill. tons 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 fillers in paper industry (KP) is used both for fillers and coatings. Required properties are high whiteness and low content of abrasive particles. It is also used as fillers 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 kaolinitic weathering of feldspar rocks. The major kaolin deposits are located in the following areas:

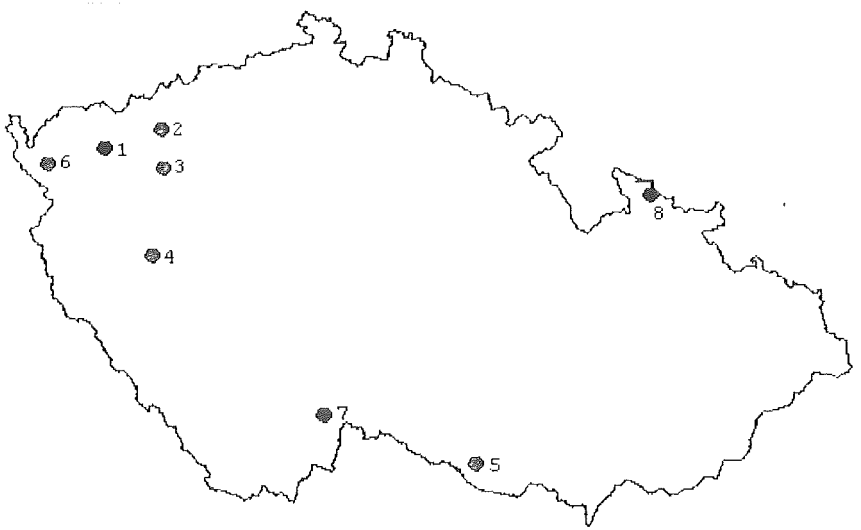
- The Karlovy Vary region - parent rocks are represented by autometamorphosed and younger granites of the Karlovy Vary massif. This is the most important source of the top quality kaolins for the production of porcelain (KJ) or their eventual substitutes (KT). There are also deposits of the KK, less 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 feldspathic 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		1994	1995	1996	1997	1998
Deposits - total	a)	75	71	71	74	66
exploited		11	10	11	11	12
Total reserves, kt		1346588	1347694	1236135	1213915	1148848
economic proven		253955	252740	282252	279722	276537
economic probable		690155	696312	575381	567527	529649
subeconomic		402478	398642	378502	366666	342662
Mining output, kt	a)	2706	2800	2798	2982	3049
Imports, t	b)	3963	3825	5846	10087	16028
Exports, t	b)	345423	383498	361858	397720	418948

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. Prices

Average prices of ceramic grade according to quality fluctuated between CZK 2000-3500 per ton in the domestic market. Average export prices were CZK 3600-3900 per ton. Paper filling kaolin has been sold at CZK 1600-1850 per ton and average export price has been CZK 3000 per ton. Average import price of kaolin and other kaolinitic clays (item 2507 of the customs tariff) was CZK 4292 per ton in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998

Keramika Horní Bříza, a.s.
Sedlecký kaolín, a.s. Božičany
Kaolin Hlubany, a.s. Podbořany
Chlumčanské keramické závody, a.s.
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	1994	1995	1996	1997	1998 e
Production, kt	22970	23168	24800	24500	25000

Main producers (1997):

USA	36.9 %	China	4.0 %
United Kingdom	9.9 %	Iran	3.5 %
Germany	7.4 %	Colombia	3.3 %
Russia	6.2 %	Czech Rep..	3.2 %
Brazil	5.3 %	India	.2.2 %

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	1994	1995	1996	1997	1998
A	65.00	62.50	62.50	62.50	62.50
B	97.50	97.50	97.50	97.50	100.00
C	60.00	60.00	60.00	60.00	60.00
D	102.50	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 elasts 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).

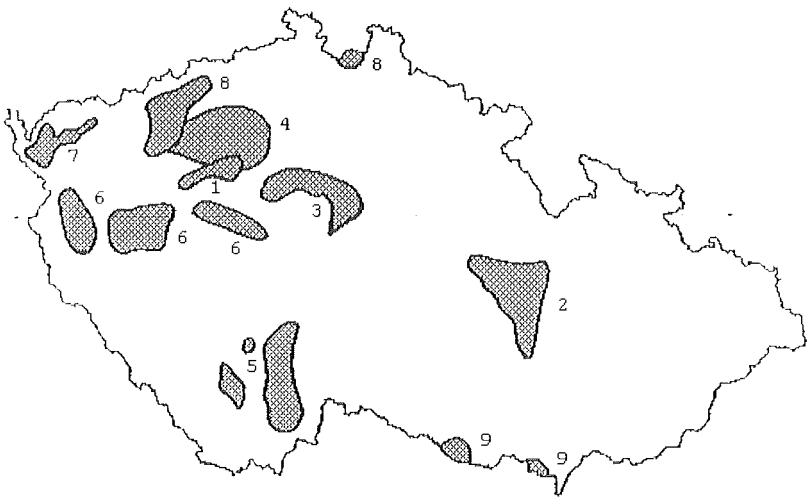
- South Bohemian basins - medium or high grade refractory clays, suitable for use as bond

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 Žitava 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).

Clays and claystones 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 Žitava basins
9 Tertiary and Quaternary sediments in Moravia

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

Year		1994	1995	1996	1997	1998
Deposits - total number		136	136	136	134	113
exploited		31	31	30	29	26
Total reserves, kt		1324985	1335424	981614	1239926	1035854
economic proven		267586	266573	257861	258133	247216
economic probable		800113	810416	697642	696792	512483
subeconomic		257286	258435	268111	285001	276155
Mining output, kt		823	915	738	759	1030
Imports, t	a)	6914	7001	8513	14896	23250
Exports, t	a)	203707	199891	98397	203922	188540

Note:
a) item 2508 of the customs tariff

5. Prices

Different quality of clay and schistose clay in the market gives varicoloured prices. For example crude refractory clay is delivered at CZK 170 - 750 per ton, average price is CZK 540 per ton, dried refractory clay reaches CZK 860 - 1840 per ton, average prices are about CZK 1200 per ton. 3047 tons of refractory clay were imported in 1998. Average import price was CZK 1678 per ton. In the same time 47013 tons of refractory clay were exported, average price was CZK 1877 per ton. Prices of crude sintering clay fluctuate between CZK 170 - 665 per ton, average price is CZK 400 per ton. Dry sintering clay is sold at CZK 1000 per ton. Prices of crude bleaching clay fluctuate from CZK 350 to CZK 1630 per ton, average price is about CZK 1300 per ton if they are crude, prices of dry bleaching clay reach up to CZK 1375 - 2950 per ton, average price is about CZK 2160 per ton. Average prices of other crude clays are CZK 230 per ton, prices of dry ones are about CZK 1300 per ton. 1226 tons of other clays were imported in 1998 at average price CZK 4827 per ton. 73635 tons of other clays were exported, average export price was CZK 695 per ton. 5886 t of fire clay were imported at average price CZK 1768 per ton. Export was realized at CZK 2487 per ton, its volume was 44586 tons. Prices of crude schistose clay in the domestic market fluctuate between CZK 400 - 551 per ton. Calcined schistose clay is sold at CZK 1150 - 3450 per ton. 256 tons of mullite were imported in 1998. Average price was CZK 18000 per ton.

6. Mining organizations in the Czech Republic as of December 31, 1998

Palivový kombinát Ústí n. Labem, s.p.
KEMAT Skalná, s.p.
KERAMOST a.s., Most
České lupkové závody a.s., Nové Strašecí
Calofrig a.s., Borovany
Rakovnické keramické závody, a.s.
Moravské šamotové a lupkové závody a.s., Velké Opatovice
Keramika Horní Bříza a.s.
Mostecká uhelná společnost, a.s.
RAKO - Lupky s.r.o., Lubná u Rakovníka
Kaolin Hlubany a.s., Podbořany

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	1994	1995	1996	1997	1998
A	109.00	109.00	97.50	106.50	-
B	77.50	86.00	86.00	86.00	88.00
C	45.00	45.00	45.00	45.00	45.00
D	95.00	100.00	100.00	100.00	105.00
E	150.00	162.50	162.50	162.50	184.80

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

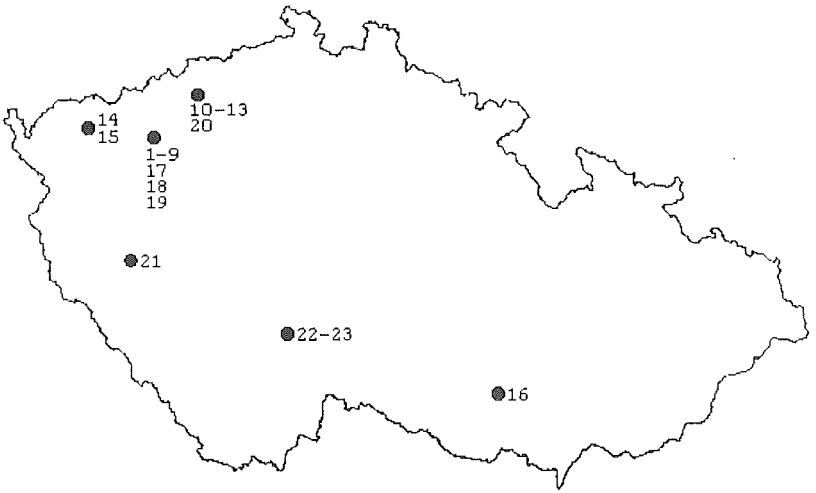
Bentonite is a soft, very fine-grained heterogeneous rock of various colours, composed mostly of clay mineral montmorillonite which originated mostly by submarine or atmospheric weathering of basic (to a smaller extent also of acid) volcanic rocks (mainly tuffs). Montmorillonite gives to bentonite its 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
4 Krásný Dvůr-Vys.Třebušice
5 Nepomyšl
6 Nepomyšl-Velká
7 Podbořany-Letov
8 Rokle
9 Vlkaň
10 Braňany-Černý vrch
11 Liběšice
12 Stránce
13 Střimice 1
14 Hroznětín-Velký Rybník 2
15 Všeborovice
16 Ivančice-Réna

Other bentonite:

17 Chomutov-Horní Ves
18 Krásný Dvůr-Vys. Třebušice
19 Račetice
20 Obrnice-Vtelno-Rudolice
21 Dnešice-Plzeňsko-south
22 Maršov
23 Rybova Lhota

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

Year		1994	1995	1996	1997	1998
Deposits - total number		25	25	23	24	24
exploited		4	3	4	4	3
Total reserves, kt		275593	185991	231184	231110	248273
economic proven		49429	51096	51611	51460	51378
economic probable		189173	119365	160171	160162	143594
subeconomic		36991	15530	19402	19488	53301
Mining output, kt		65	54	59	110	125
Imports, t	a)	3329	3065	5394	7162	9271
Exports, t	a)	19317	18048	21633	20608	23305

Note:
a) item 2508 10 of the customs tariff

5. Prices
Average import prices were CZK 4007 per ton in 1998. Average export prices wer CZK 3501 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998
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 1996 (10,010 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	1994	1995	1996	1997	1998 e
Production, kt	9191	9581	10010	9852	10000

Main producers (1997):

USA	37.6 %
Russia	13.2 %
Greece	9.6 %
Turkey	5.3 %
Germany	5.2 %
Italy	5.2 %

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	1994	1995	1996	1997	1998
A	135.00	135.00	135.00	135.00	120.00
B	32.50	32.50	32.50	32.50	42.50
C	35.00	35.00	35.00	35.00	50.00
D	35.00	35.00	35.00	35.00	38.50

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

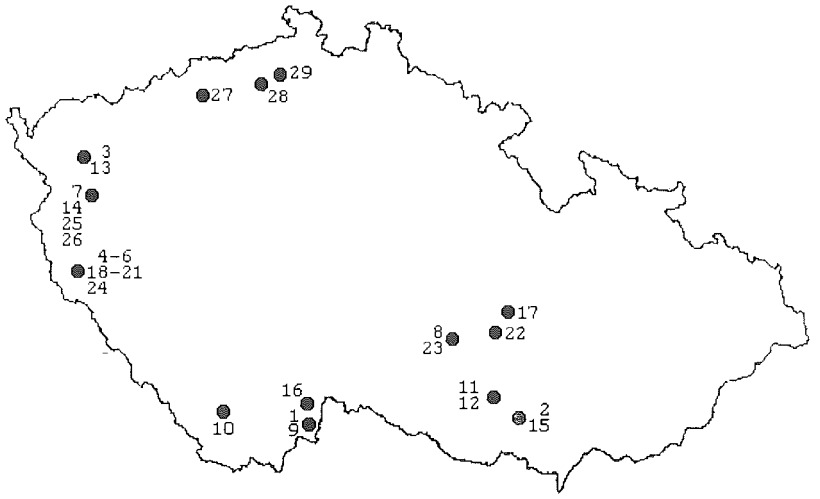
For the same purposes there are also used feldspar substitutes, which are rocks with alkali metals confined to some other minerals (mostly nepheline - anhydrous sodium-potassium alumo-silicate). Nepheline syenites are particularly used abroad to substitute for feldspar raw materials.

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 Halámky-Tušť
10 Chvalšiny
11 Ivančice-Letovisko
12 Ivančice-Němčice
13 Krásno-Vysoký Kámen
14 Křepkovice
15 Ledce-Hrušovany near Brno
16 Majdaléna
17 Malé Tresné
18 Meclov 2
19 Meclov-airfield
20 Meclov-west
21 Otov-Červený vrch
22 Smrček
23 Velké Meziříčí-Lavičky
24 Zámělíč
25 Zhořec 1
26 Zhořec 2-the Hanov zone

Feldspar substitutes:

27 Želenice
28 Tašov-Rovný
29 Valkeřice-Zaječí vrch

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

Year		1994	1995	1996	1997	1998
Deposits - total	a)	36	36	36	36	29
Exploited		5	6	6	6	6
Total reserves, kt	a)	86217	85910	87207	86872	*282155
economic proven		39724	39417	40373	40038	37921
economic probable		40726	40726	41857	41857	*240610
subeconomic		5767	5767	4977	4977	3624
Mining output, kt	a)	170	183	211	243	*299
Imports, t	b)	431	620	3923	5685	5474
Exports, t	b)	66583	74181	67515	54474	57546

Note:
a) feldspars
b) item 2529 10 of the customs tariff
** including feldspar substitutes*

5. Prices

Average feldspar import prices reached up to CZK 3321 per ton in 1998. Export price was CZK 1361 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998

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 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997	1998 e
Mining output, kt	6731	7780	6750	6800	7000

Main producers (1997):

Italy	26.5 %
USA	13.7 %
Thailand	9.6 %
France	8.8 %
Turkey	7.4 %

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	1994	1995	1996	1997	1998
A	160.00	160.00	182.50	182.50	182.50
B	85.00	85.00	99.00	99.00	99.00
C	140.00	140.00	140.00	140.00	150.00
D	235.00	235.00	235.00	235.00	205.00

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.

SILICA MINERALS

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 silica sands by siliceous cement; 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 metallurgy,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:

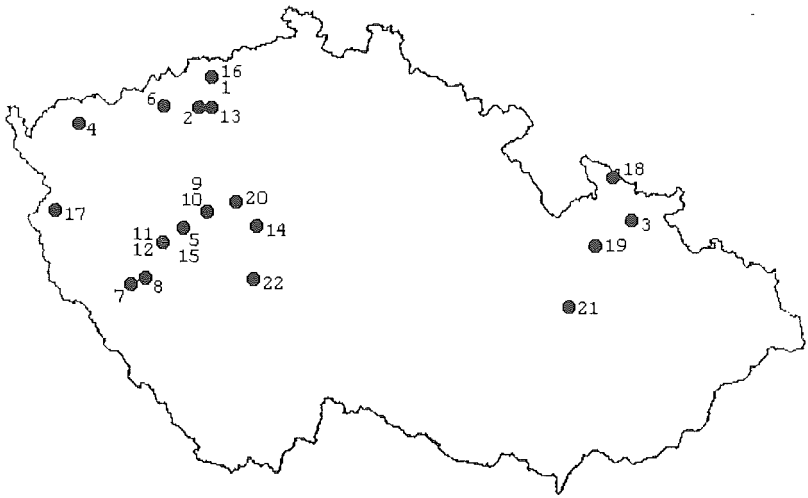
  Quartz deposits in pegmatites (N. Moravia) - suitable for production of porcelain, ferrosilicon, silicon.

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

  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 Chomutov-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 Sklená Huť
16 Střelná
17 Tachov-Světecká Hora
18 Velká Kraš
19 Vikýřovice
20 Železná

Quartz for special glass:

21 Dětkovice
22 Krašovice

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

Year		1994	1995	1996	1997	1998
Deposits - total number		23	23	23	23	22
exploited		2	2	2	2	2
Total reserves, kt		55146	55143	54025	54012	49170
economic proven		7320	7319	7565	7552	5365
economic probable		31630	31628	30285	30285	27168
subeconomic		16196	16196	16175	16175	16637
Mining output, kt		2	3	4	13	1
Imports, t	a)	2694	8781	21339	30250	40966
Exports, t	a)	112	191	270	172	119

Note:
a) item 2506 of the customs tariff

5. Prices
Average import prices of quartz and quartzite (item 2506 of the customs tariff) were CZK 4032 per ton in 1998. Average export prices wer CZK 8200 per ton. Lump quartz was sold at CZK 45 - 177 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998
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 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.

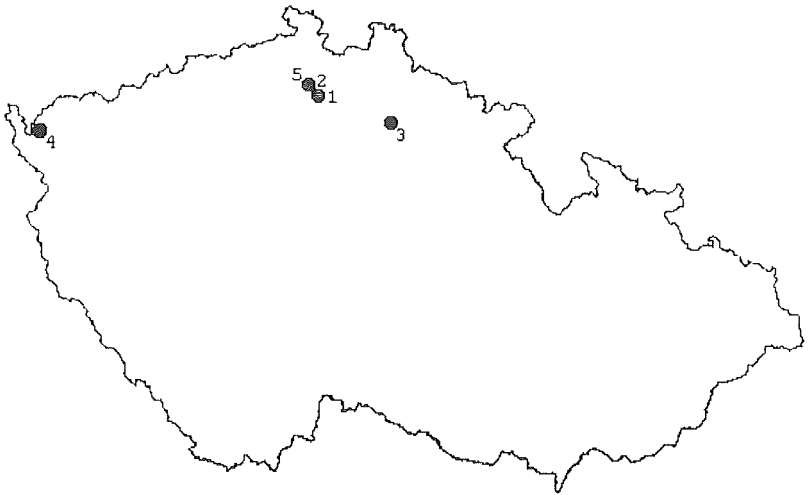
Natural quartz sands are after washing, separation and drying often coloured by inorganic pigments and used for plasters, as gunite sand and in other decorations.

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.).

All deposits of glass 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 *

* glass and foundry sands deposits

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

Year		1994	1995	1996	1997	1998
Deposits – total number		5	5	5	5	5
exploited		4	4	4	4	4
Total reserves, kt		269159	267437	242397	241190	239739
economic proven		90737	89731	96497	95730	94912
economic probable		83000	82965	28968	28938	28855
subeconomic		95422	94741	116932	116522	115972
Mining output, kt		862	1026	1130	994	827
Imports, t	a)	149142	159946	127952	67188	57967
Exports, t	a)	545622	661142	692336	436931	763007

Note:
a) item 2505 10 of the customs tariff

5. Prices

Technological point of view and quality needs both specify mineral prices. Domestic prices of glass sands – wet fluctuate between CZK 220 and 678 per ton. Glass sands - dry prices are about CZK 635 - 1145 per ton. Prices of filtration sands were: wet CZK 423 - 620 per ton, dry CZK 545 - 1980 per ton. Average import prices of silica sands (item 2505 10 of the customs tariff) were CZK 420 per ton, average export prices were CZK 285 per ton in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998

Sklopísek Střeleč - EXIMOS, a.s.
Provodínské písky, a.s.
KEMAT Skalná, s.p.

7. World production

World statistics provides only 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 volume of production returned back to the level about 120 mill.t in 1995. The major world producers were:

Year	1994 e	1995 e	1996 e	1997 e	1998 e
Mining output, mill.t	105	120	120	120	120

Main producers (1996):

USA	23.8%
Netherlands	18.3%
Germany	8.6%
Austria	6.5%
France	5.6%

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 Glass sand, flint, container

Commodity / Year	1994	1995	1996	1997	1998
A	11.00	13.50	13.50	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.

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

1. Characteristics and use

Foundry sands are granular, pale coloured rocks, 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 synthetic sands, i.e. quartz sands mixed with suitable amount of binding agents (mostly bentonite).

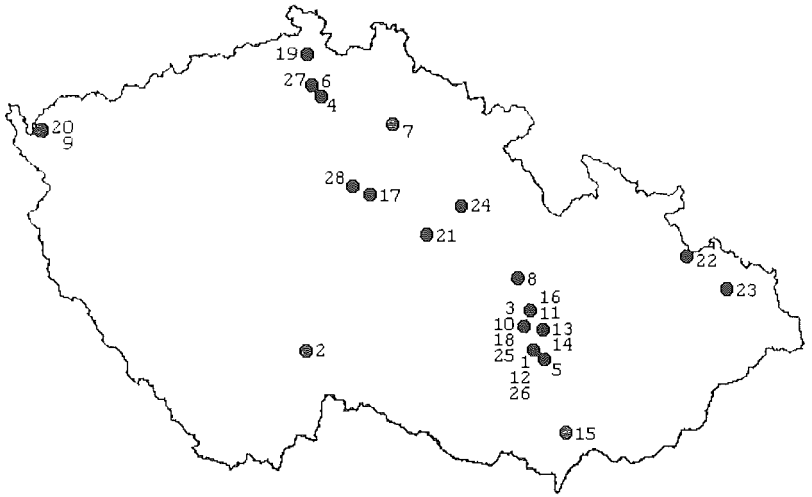
Natural quartz sands are after washing, separation and drying often coloured by inorganic pigments and used for plasters, as gunite sand and in other decorations.

2. Mineral resources of the Czech Republic

Foundry sand deposits 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 foundry sands in the Czech Republic are extracted by open-pit mining operations.

3. Registered deposits and their location in the Czech Republic



Foundry sands:

1 Blansko 1-Jezírka
2 Lžín
3 Nýrov
4 Provodín *
5 Rudice-Seč
6 Srní 2 *
7 Střeleč *
8 Svitavy
9 Velký Luh *
10 Voděrady
11 Babolky
12 Blansko 2-Mošná
13 Boskovice
14 Boskovice-Chrudichromy
15 Čejč-Hovorany
16 Deštná-Dolní Smržov
17 Kluk-Mostkový Les
18 Kunštát-Zbraslavec
19 Kytlické Mlýny
20 Lomnička
21 Načešice
22 Palhanec-Vávrovice
23 Polanka nad Odrou
24 Rokytno-Bohumileč
25 Rudka u Kunštátu
16 Spešov-Dolní Lhota
27 Srní *
28 Zvěřínek-Polabí

* glass and foundry sands deposits

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

Year		1994	1995	1996	1997	1998
Deposits – total number		37	37	37	37	32
Exploited		13	13	13	12	14
Total reserves, kt		498715	498115	485745	488212	469370
economic proven		162725	162281	163208	166207	160409
economic probable		123649	123827	106421	105849	97335
subeconomic		212341	212007	216116	216156	211626
Mining output, kt		1093	964	1079	769	815
Imports, t	a)	149142	159946	127952	67188	57967
Exports, t	a)	545622	661142	692336	436931	763007

Note:
a) item 2505 10 of the customs tariff

5. Prices

Prices of foundry sands were lower than prices of glass sands, they reached: wet CZK 160 - 245 per ton, dry CZK 110 - 650 per ton. Average import prices of silica sands (item 2505 10 of the customs tariff) were CZK 431 per ton, average export prices were CZK 288 per ton in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998

Provodínské písky, a.s.
Sklopísek Střeleč - EXIMOS, a.s.
Moravské keramické závody a.s., Rájec
Moravské šamotové a lupkové závody a.s., Velké Opatovice
KEMAT Skalná, s.p.
SEDOS - těžba písků, Drnovice
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 volume of production returned back to the level of about 120 mill.t. The major world producers were:

Year	1994 e	1995 e	1996 e	1997 e	1998 e
Mining output, mill.t	105	120	120	120	120

Main producers (1996):

USA	23.8 %
Netherlands	18.3 %
Germany	8.6 %
Austria	6.5 %
France	5.6 %

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

Commodity / Year	1994	1995	1996	1997	1998
A	9.75	11.50	11.50	11.50	11.50

9. Recycling

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. A research with an objective to increase a share of recycled sand in new mixtures is realized in many countries, also in the Czech Republic,.

10. Possible substitutes

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.

LIMESTONES AND CORRECTIVE SIALIC ADDITIVES FOR CEMENT PRODUCTION

1. Characteristics and use

Limestones are sedimentary and metamorphic 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 variations 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.

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 were included in this group in the Czech Republic up to 1997.

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

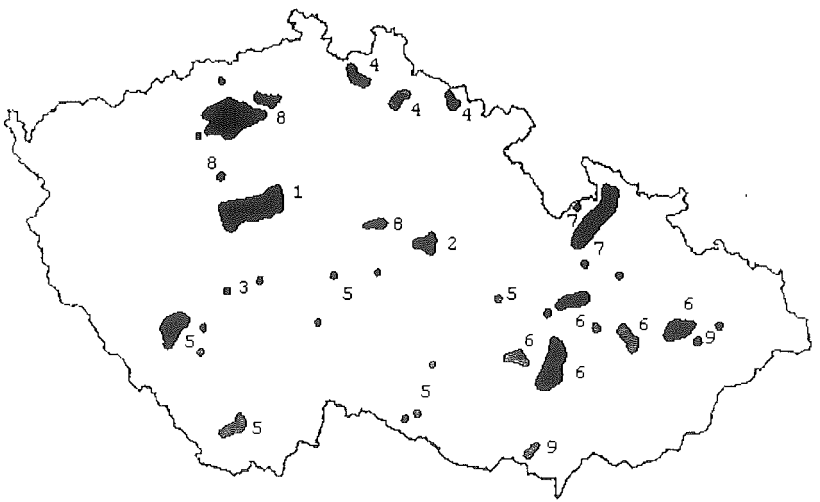
- The Barrandien zone Devonian - the most important and largest deposits are located in this area. Almost all types of limestones occur there,particularly those of VV and VO grades but also VZ and CK grades. Limestone deposits are confined to sediments of mostly Lower Devonian age, and consist of several 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		1994	1995	1996	1997	1998
Deposits - total number		117	116	116	103	108
exploited		30	28	28	26	29
Total reserves, kt	a)	6244117	6201001	6066998	4865893	4896250
economic proven		2054979	2034624	2074634	1926060	1895614
economic probable		3469784	3424478	3416250	2446023	2504844
subeconomic		719354	741899	576114	493810	495792
Mining output, kt	a)	10205	10092	10610	11010	11169
Imports, kt	b)	781	623	512	623	411
Exports, kt	b)	53	72	88	151	200

Note:
a) limestones without corrective sialic additives for cement production
b) item 2521 of the customs tariff

Regarding great varieties of technological use and prices there have been stated both high percentage limestones (VV) and other limestones (VO) separately since 1997. Separately are also given clay limestones, carbonates for agriculture and dolomites.

	1998	
	VV	VO
Deposits - total number	27	74
Total reserves, kt	1705246	2468225
economic proven	756699	1012422
economic probable	804900	1167489
Subeconomic	143647	288314
Mining output, kt	4526	5216

In many limestone deposits VV and VO are extracted at the same time. That's why number of deposits in operation is not given.

5. Prices

Price relations are influenced by quality requirements. The highest are prices of high percentage limestones used especially in metallurgy and in chemical and sugar industries. Average prices of lump high percentage limestone fluctuated between CZK 150 - 190 per ton in 1998. Prices of bulk cement fluctuated according to the quality between CZK 1610 - 2130 per ton. Prices of bulk lime were CZK 550 - 1100 per ton, lime hydrate CZK 1200 - 1670 per ton. Ground limestone was sold according to $CaCO_3$ content at CZK 190 - 340 per ton. Average import price of limestones for cement and lime production was CZK 140 per ton, but their average export price was CZK 482 per ton. 416 kt of lime were imported at CZK 421 per ton in 1998. At the same time 432 kt of cement were imported at average price CZK 1555 per ton. 173 kt of lime were exported, average price was CZK 1387 per ton, also 1482 kt of cement were exported, average price was CZK 1281 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998

Limestones:

Českomoravský cement a.s., Beroun
Velkolom Čertovy schody a.s., Tmaň
Lafarge cement-Čížkovická cementárna, a.s.
Cement Hranice, a.s.
Cementárny a vápenky Prachovice, a.s.
Lomy Mořina, s.r.o.
Kotouč Štramberk, s.r.o.
Vápenka Vitošov s.r.o., Leština
HASIT a.s. - ŠVO, Velké Hydčice
Lom Skalka, s.r.o., Ochoz u Brna
Krkonošské vápenky Kunčice, a.s.
Vitoul v.o.s., Měrotín
Kamenolom a vápenka Malá dohoda, s.r.o.
AGIR s.r.o., lom Skoupý
JHF Heřmanovice, s.r.o.
OMYA a.s, Vápenná
Agrostav Znojmo, a.s.

Corrective sialic additives for cement production:

Cement Hranice, a.s.
Českomoravský cement a.s. Beroun
Velkolom Čertovy schody a.s., Tmaň
The company Českomoravský cement a.s., Beroun has arisen from the companies Cementárny a vápenky Mokrá, a.s. and Cement Bohemia Praha, a.s.

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 and lime, which consumes most of the mined limestone. In the last five years the largest world producers then were China, Japan, USA, Russia, Rep. of Korea, India and Germany which together produced more than 70 % of the world production of cement. China, USA, Germany, Japan, Mexico and Brazil have produced more than 55% of the world lime production.

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, 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).

DOLOMITE

1. Characteristics and use

Dolomite minerals include dolomite containing at least 90% of CaMg $(CO_3)_2$ and calcitic dolomite with CaMg $(CO_3)_2$ content higher than 50%. Pure dolomite is important material for glass, ceramic and chemical industries. Dolomitic rocks are used in production of dolomitic lime, hydrates, magnesium cements, magnesia refractories; in desulphurization of power station waste gases. They are also used as dimension stone and in production of fertilizers and fillers.

2. Mineral resources of the Czech Republic

Dolomite and calcitic dolomite deposits are located in the following regions of the Czech Republic:

- Cristalline complex of the Krkonoše-Jizerské hory mountains - crystalline dolomite and calcitic dolomite deposits in the form of flags and lenses. The largest deposit Horní Lánov contains in average 32% of Cao and nearly 19% of MgO.
- South Bohemian Moldanubicum - it contains several smaller deposits in the Sušice-Votice group near Šumava.
- Crystalline complex of the Krušné hory mountains - several deposits near Kovářská and Přísečnice.
- Moravian Devonian near Olomouc and Přerov - its dolomites form group of beds on the carbonate group basis near Čelechovice of Haná.
- Moravian branch of Moldanubicum with small but high quality dolomite occurences.
- The Orlické hory - Kladsko crystalline complex and Velké Vrbno group - several smaller occurences of dolomitic rocks.

3. Registered deposits and their location in the Czech Republic

Dolomite occurence is given in the map of limestone deposits.

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

Year		1997	1998
Deposits - total number		13	13
exploited		2	2
Total reserves, kt		582578	517635
economic proven		84868	84276
economic probable		410307	347802
subeconomici		87403	85557
Mining output, kt		294	389
Imports, kt	a)	647	584
Exports, kt	a)	20	12

a) item 2518 of the customs tariff

5. Prices

Prices of lump dolomite are CZK 150 per ton, prices of dolomite aggregates reach according to granularity CZK 90 - 180 per ton. Ground lime dolomite with 39.40% $MgCO_3$ content are sold in bulk at CZK 280 - 340 per ton. Import prices were CZK 175 per ton in 1998, the export ones were CZK 50 per ton.

6. Mining companies in the Czech Republic as of December 31, 1998
Krkonošské vápenky Kunčice, a.s.
UNIKOM a.s., Kutná Hora

7. World production
Dolomite production and concumption are not statisticali observed in the world market.

8. World market prices
World market prices are not given in the international statistical surveys.

9. Recycling
Dolomite is not recycled with exception of scrap glass.

10. Possible substitutes
Dolomite as source of Mg is substituted by magnezite, by Mg obtained from the sea water and salt brines and by brucite.

GYPSUM

1. Characteristics and use

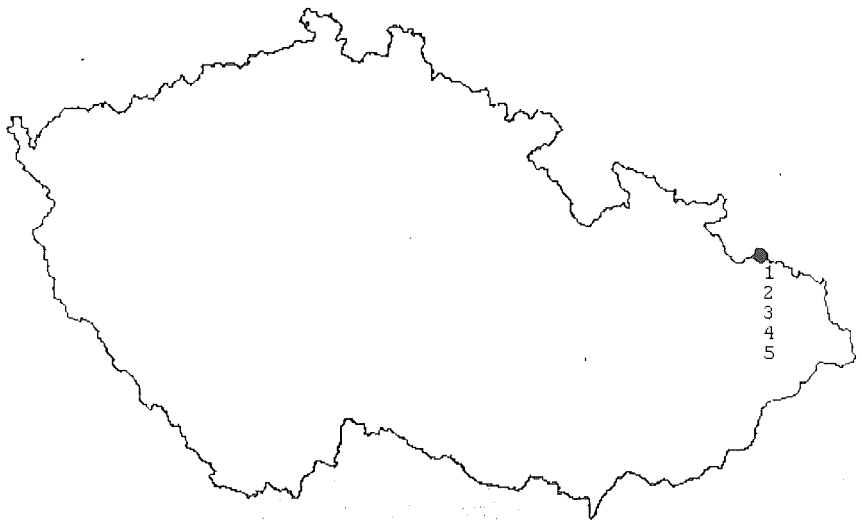
Gypsum is a sedimentary rock, consisting mostly or completely of monoclinic mineral gypsum ($CaSO_4.2H_2O$) which is usually colorless or white. The rock often contains impurities (clay minerals, quartz, iron oxides, limestone, dolomite, anhydrite, etc.). The majority of gypsum deposits were formed as 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		1994	1995	1996	1997	1998
Deposits - total number		5	5	5	5	5
exploited		1	1	1	1	1
Total reserves, kt		506747	506147	505612	505273	505051
economic proven		121620	121020	120485	120146	119924
economic probable		302990	302990	302990	302990	302990
subeconomic		82137	82137	82137	82137	82137
Mining output, kt		591	542	443	241	222
Imports, t	a)	1813	7622	22088	27283	34531
Exports, t	a)	122847	101016	86176	59769	68351

Note:
a) item 2520 10 of the customs tariff

5. Prices
Average price of extracted domestic gypsum was about CZK 250 per ton in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998
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 and Mineral Commodity Summaries):

Year	1994	1995	1996	1997 e	1998 e
Mining output, kt	93363	96141	99700	100000	99000

Main producers (1997):

USA	17.0 %
China	9.0 %
Canada	8.6 %
Iran	8.3 %
Thailand	8.3 %
Spain	8.0 %

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	1994	1995	1996	1997	1998
A	9.00	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". Architectural 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 marbles and abyssal igneous rocks - granites and granodiorites, which occur in the Central Bohemian and Central Moldanubianc plutons, the Štěnovice, the Krkonoše-Jizerské hory, the-Jeseníky and Nasavrky massifs in Bohemia, and in Třebíč 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 - marbles (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 and also of Northern Moravia and Silesia Culm 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	1994	1995	1996	1997	1998
Deposits - total number	180	183	186	188	175
exploited	73	78	74	72	74
Total reserves, thous.m^3	227669	232985	238807	233982	231740
economic proven	92825	93093	97233	96643	94234
economic probable	103458	108181	110164	104136	104315
subeconomic	31386	31711	31410	33203	33191
Min. output, thous.m^3	225	210	190	258	305
a)	413	487	566	172	292
Imports, kt b)	178	266	188	833	573
Exports, kt b)					

Note:
a) decrease of mineral reserves by mining output
b) items of the customs tariff 2514, 2515, 2516, 6801, 6802, 6803

5. Prices

Price relations of dimentsion stone products are dependent on mineral quality and on level of processing. For example: prices of granite blocks fluctuate between CZK 4300 - 15000 per m^3 according to block volume; prices of granite paving cubes fluctuate from CZK 1400 to CZK 3850 per ton (average price is CZK 2500/t); prices of granite curbs reach up to CZK 690 - 1550 per running meter (average price is CZK 1100/running m). Crude sandstone blocks are sold at CZK 4300 - 15000 per m^3 (average price is CZK 10000/m^3).

Prices of polished panel boards made of granite, syenite or other igneous rocks fluctuate between CZK 2000 - 4500 per m^2 according to thickness of the board. Panel boards with blasted finish made of the same material reach up to CZK 1400 - 3000/m^2. Ground finish sandstone boards are sold at CZK 1325 - 3339 per m^2 according to their thickness and rock colour; the price of cut sandstone boards (30 cm thick) reach up to CZK 4900 per m^2. On the opposite side sandstone prisms are sold at CZK 950 per ton. Domestic marble (of Supíkovice and Lipová) is sold at CZK 1200 - 1750 per m^2 as polished panel or pavement boards. Prices of imported marble (for instance Carrara) reach up to CZK 1800 - 2600 per m^2. Polished granite parapets are sold at CZK 429 - 774 per running meter; marble parapets at CZK 382 - 732 per running meter. Price of polished bench top boards made of granite and other igneous rocks is CZK 3500 - 5000 per m^2. Marble bench top boards are sold at CZK 2700 - 6700 per m^2.

Different are prices of schist stone-cutting products. For instance Roofing is sold according to shape-piece size at CZK 200 - 600 per m^2. Price of schist revetment is about CZK 300 per m^2; Schist pavement is sold at about CZK 350/m^2.

813 m^3 of marble were imported in 1998. Average price was CZK 19624 per m^3. Also 23038 m^3 of granite and sandstone were imported; average price was CZK 3533/ m^3. Average price of imported natural stone products (item 6801) was CZK 8309 per m^3 ; average price of cut stone (item 6802 of the customs tariff) was CZK 2776/m^3 . Schist was imported in volume of 15 thous. m^2. Average price was CZK 696/m^3. 262 m^3 of marble were exported, average export price was CZK 22408 per m^3. 27 thous. m^3 of granite and m^3 of other igneous rocks (item 2516) were exported at average price CZK 3756 per ton. 142 thous. m^3 of natural stone products were exported at CZK 2861 per m^3. Export of cut stone reached up to 42 thous. Average export price was CZK 4802 per m^3. Also 72 thous. m^3 of schist were exported at average price CZK 82 per m^3.

6. Mining companies in the Czech Republic as of December 31, 1998

OMYA a.s, Vápenná
MINERAL s.r.o., Horní Benešov
Slezský kámen a.s., Jeseník
Průmysl kamene a.s., Příbram
Stone Group s.r.o., Tábor
GRALOM s.r.o., Drahnětický Málkov
HERLIN, s.r.o., Příbram
Kámen Ostroměř, s.p.
Českomoravský průmysl kamene a.s., Hradec Králové
Česká žula s.r.o., Strakonice
Agroplast a.s., Liberec
LIGRANIT s.r.o., Liberec
Lom Matula Hlinsko, s.r.o.
MUZIKA s.r.o., lom Blatná - Řečice
Completinvest s.r.o. - Břidl. důl Vítkov-Lhotka
VADAMO s.r.o, Nečín
RALUX s.r.o., Uhelná
REKO Renata Kohlová, Přerov
Strabag a.s., České Budějovice
GRANIT - Zach s.r.o, Prosetín
Granit Lipnice s.r.o., Dolní Město
Lesostavby Šumperk, a.s.
Špaček kamenolomy s.r.o., Štěnovice
Kámen Zbraslav, s.r.o.
Medigran s.r.o., Plzeň
Petr Babický, Vrchotovy Janovice
Kamenoprůmyslové závody s.r.o., Šluknov
Bohemia Granit s.r.o., Praha 4
Jihokámen Písek, VD
Mramor Dobřichovice, s.r.o.
Unigranit s.r.o., Písek
COMING s.r.o., Praha
Družstvo cementářů a kameníků Holoubkov
Moravská těžební a.s., Hlubočky
Krákorka a.s., Červený Kostelec
Jindřich Zedníček-zprac.kamene, Kamenná
Josef Krýsl, Sušice
Slate – B.D.S.O. a.s., Staré Oldřůvky

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

Prices of dimension stone in international market depend on mineral quality and degree of working. In international price lists they usually have not been given.

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 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(MŽP)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	1994	1995	1996	1997	1998
Building stone	thous.m^3	8290	9021	9891	10845	9528
Sand and gravel	thous.m^3	11469	10525	12350	11727	9279
Brick clays	thous.m^3	1884	1935	1972	2074	2124

Life of industrial reserves (economic proven mineable reserves) consequent the decrease of reserves by output incl. losses in balanced deposits per year 1998 (A) and the average annual decrement of reserves in period 1994-1997 (B) was as follows:

Raw material	Life, years	
	A	B
Building stone	117	115
Sand and gravel	110	94
Brick clays	132	147

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. 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. 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, Central 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		1994	1995	1996	1997	1998
Deposits - total number		495	348	346	343	342
exploited		180	185	186	182	179
Total reserves, thous.m^3		2415946	2403289	2378271	2367537	2376271
economic proven		1202828	1188114	1186079	1172557	1182970
economic probable		1078055	1074490	1045345	1040769	1038492
subeconomic		135063	140685	146847	154211	154809
Mining output, thous.m^3		8290	9021	9891	10845	9528
Imports, kt	a)	318	377	260	711	429
Exports, kt	a)	1627	1151	1025	805	2703

Note:
a) item 2517 10 of the customs tariff

5. Prices

Prices of crushed aggregates fluctuate according to mineral quality and granularity between CZK 35 - 255 per ton. Average price is CZK 150/t. Current price of quarry stone is CZK 50 - 195 per ton; price of regulation quarry stone is CZK 300 - 320 per ton. Facing stone is sold t CZK 320 - 900 per ton. Average import prices of aggregates (item 251710 of the customs tariff) were CZK 82/t in 1998. Export was realized at CZK 27/t. Extremly low export price of the commodity was caused by large export of building stone to Poland at very low prices in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998

TARMAC Severokámen a.s., Liberec
Spojené štěrkovny a pískovny a.s., Brno
STRABAG a.s., České Budějovice
Západokámen Plzeň, a.s.
Hájek s.r.o., Opava
Silnice a.s., Hradec Králové
Lomy s.r.o., Brno
BERON s.r.o., Čerčany
Kámen a písek s.r.o., Český Krumlov
Pioneer staveb.mater. a.s., Veselí n.Lužnicí
Max Boegl & Josef Krýsl k.s., Dobřany
Kámen Zbraslav, s.r.o.
Silnice Jihlava, a.s.
Basalt Měrunice, s.r.o.
Granita s.r.o., Praha 5
TOSTEIN a.s., Brno
Štěrkovna HEROUS s.r.o., Lhota Rapotina
STONE s.r.o., Kamenolom Všechlapy
Berger Bohemia a.s., Plzeň
IPS a.s., Praha 10
Štěrkovny s.r.o., Dolní Benešov
Palivový kombinát Ústí nad Labem, s.p.
Silnice Nepomuk, a.s.
SHB Bernartice, s.r.o.
Kamenolom Císařský a.s., Šluknov

GOS – Granit Ořechov, s.r.o.
Sokolovská uhelná, a.s.
Formanservis s.r.o., Dobřejovice
Lom Jašek - Výkleky, s.r.o.
MŠLZ a.s., Velké Opatovice
Lafarge Kamenivo s.r.o., Praha 8
ATS - Silnice s.r.o., Libá
Štěrkovna s.r.o., Ostrožská Nová ves
BES s.r.o., Benešov
PIKASO s.r.o., Praha 4
Kamenolom Vlastějovice, s.r.o.
IES Mosty Litice, s.r.o.
Karlovarské silnice a.s., Karlovy Vary
Silnice Znojmo, a.s.
Českomoravský cement a.s., Beroun
Žula – Rácov s.r.o., Batelov
Agroplast a.s., Liberec
Silniční stavitelství Praha, a.s.
EKOZIS Zábřeh, s.r.o.
RENO Šumava s.r.o., Prachatice
ZD Šonov u Broumova
Vojenské stavby a.s., o.z. Baraba, Praha
Stavby silnic a železnic a.s., Praha 1
Froněk s.r.o., Rakovník
ROSA s.r.o., Drásov
SOL-EX s.r.o., Valšov
Weiss s.r.o., Děčín
Ivo Hutira, Omice
ILBAU Stříbro, a.s.
EKOFIM s.r.o., Praha 10
PETRA - lom Číměř, s.r.o.
Lesní společnost Jihomoravské lesy a.s., Prostějov
Stavebniny – Matlák František, Lažánky
CEFEUS s.r.o., Praha 2
KROFIAN – Kamenivo, s.r.o., Ledeč n.Sáz.
Štěrk a písek s.r.o., Praha 7
VIA - VODA s.r.o., Hrubá Voda
Josef Žirovnický, Vlašim
Pavel Dragoun, Cheb
Agrostav Znojmo, a.s.
TS služby, Nové Město na Moravě
NATRIX a.s., Bzenec
Kamenolom Zderaz s.r.o., Proseč
Zábřežská lesní a.s., Zábřeh na Moravě
ZD se sídlem v Libině
Rudolf Vít - Lom Kubo, Malé Žernoseky
Jihočeské lesy České Budějovice, a.s., Nové Hrady
JAMEL s.r.o., Velké Přítočno
Ing.Jan Weiss, Děčín
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. World market prices

Average price of crushed rock aggregates on the world market is not published.

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.

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	1994	1995	1996	1997	1998
Deposits - total number	382	215	215	220	219
exploited	64	69	73	73	80
Total reserves, thous.m^3	2527526	2514531	2421049	2402970	2349188
economic proven	1335872	1327712	1271932	1276994	1259653
economic probable	934818	929824	889269	877106	848248
subeconomic	256836	256995	259848	248870	241287
Mining output, thous.m^3	11465	10525	12350	11727	9279
Imports, kt a)	457	420	316	2372	512
Exports, kt a)	1982	1527	1102	888	1818

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

5. Prices

Prices of extracted aggregate fluctuate according to granularity from CZK 90 to CZK 300 per ton, average price is about CZK 150 per ton. Prices of pitsand have reached up to CZK 60 per ton, prices of washed sand have fluctuated between CZK 60 - 120 per ton.
Import price of sand was CZK 253 per m^3, of aggregate CZK 120 per m^3 in 1998. Average export price of sand was CZK 261 per m^3, of aggregate CZK 40 per m^3. Extremly low export price of the commodity (item 251710 of the customs tariff) was caused by large volume of export to Poland at a very low price in 1998.

6. Mining companies in the Czech Republic as of December 31, 1998

Spojené štěrkovny a pískovny a.s., Brno
Kámen Zbraslav, s.r.o
Tarmac Severokámen a.s., Liberec
Pioneer staveb.mater. a.s., Veselí n.Lužnicí
Calofrig a.s., Borovany
Štěrkovna s.r.o., Ostrožská Nová Ves
Pískovny Dobříň, a.s., Roudnice n.Labem
TVARBET Moravia a.s., Hodonín
Štěrkopískovna Mohelnice, s.r.o.
TEKAZ s.r.o., Cheb
Štěrkovny s.r.o., Dolní Benešov
Družstvo DRUMAPO, Němčičky
Brněnské papírny, s.p.
Prefa Pradubice, a.s.
TAUM - V.Maurer, Lužec nad Vltavou
ILBAU s.r.o, Praha
GZ - SAND s.r.o., Otrokovice
PIKASO s.r.o., Praha 4
Pískovna Černovice, s.r.o.
Písek - Beton a.s., Veltruby-Hradištko
Zemědělská společnost Kratonohy, a.s.
SYSBAU s.r.o., Bohumín
MPC s.r.o., pískovna Račiněves
Pískovna Sojovice, s.r.o.

Dopravně mechanizační podnik a.s., Pardubice
Agropodnik Humburky, a.s.
TAPAS Borek s.r.o., Stará Boleslav
Piskovna Doubrava, s.r.o., Kostomlaty
Těžba štěrkopísku s.r.o., Brodek
Max Boegl & Josef Krýsl k.s., Dobřany
Městské lesy Hradec Králové
ZD Třebechovice p.Orebem – v likvidaci
KEMAT s.r.o., Skalná
Západokámen Plzeň, a.s.
Pískovny Hrádek, s.r.o.
Rovina Písek, a.s.
Sokolovská uhelná, a.s.
Vojenské stavby a.s., o.z. Baraba, Praha
Montage Most, a.s.
KM Beta Moravia s.r.o., Hodonín
Zechmeister s.r.o., Valtice
ZOD Brniště
NZPK s.r.o., Podbořany
ZOD Zálabí, Ovčáry
Silnice Klatovy, a.s.
Kaolin Hlubany, a.s.
Berger Bohemia a.s., Plzeň
1.Stavební a.s., Litoměřice
Stavitelství-Dvořák F., Dolní Dunajovice
AGS Bohemiastone s.r.o., Hradec Králové
STRABAG a.s., České Budějovice

7. World production
Tbe 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 on the world market are not published.

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	1994	1995	1996	1997	1998
Deposits - total number	321	211	210	206	203
exploited	73	88	81	73	69
Total reserves, thous.m^3	722775	709320	706743	700259	686012
economic proven	336345	325842	323574	318599	320053
economic probable	313648	309048	303379	302439	273825
subeconomic	72782	74430	79790	79221	92134
Mining output, thous.m^3	1884	1935	1972	2074	2124

5. Prices

Nor brick clays nor brick products have been stated in the Czech foreign trade statistics. Price of brick clays in the domestic market is about CZK 500/t. En-tout-cas is offered at CZK 1500/t. Prices of full bricks fluctuate according to their quality (expecially frost resistance) and producer. They are sold at CZK 3.90 - 8.50 a piece. Average price is CZK 5.60/piece. Price of perforated bricks is CZK 5.40 - 8.60/piece. Average price of drainage bricks is CZK 5.60 - 12.00/piece. Roofing is sold at CZK 14.60 a piece ("Bobrovka") or at CZK 25.60 a piece ("J10"). Brick blocks "Porotherm" are offered at CZK 50 a piece.

6. Mining companies in the Czech Republic as of December 31, 1998

WIENERBERGER CP a.s., České Budějovice
Later Chrudim, a.s.
České cihelny Josef Meindl s.r.o., Stod
CIDEM Hranice, a.s.
Hevlínské cihelny s.r.o., Hevlín
ZGW Gleinstaetten, Krytina Šlapanice, a.s.
Cihelna Flachs Alois - Hurdis, Hodonín
Jirčany, a.s.
SČC a.s., Plzeň
Cihelna Kinský s.r.o., Kostelec n.O.
Cihelna Hodonín, s.r.o.
Cihelna Dolní Bukovsko, v.o.s.
SEPO Modřice, s.r.o.
ZGW Krytina Hranice, s.r.o.
Cihlářské závody Praha, a.s. – v likvidaci
Cihelna Klíma s.r.o., Vrátkov
CIOS HOLDING Osenice, s.r.o.
Abrhámova cihelna s.r.o., Kunovice
Cihelna Řepov, a.s.
Hodonínské cihelny s.p., Hodonín – v likvidaci
Libopor s.r.o., Libochovice

Cihelna Žopy s.r.o., Holešov
Bratři Řehounkové, Cihelna Časy s.r.o.
KEMAT s.r.o., Skalná
Cihelna Huráb s.r.o., Boskovice
Cihelna Staré Místo s.r.o.
Ing. Sommer - Cihelna Brázdim, s.r.o.
Litovelská cihelna, s.r.o.
PARALAX a.s., Praha 8
Cihelna Polom, s.r.o.
ECOMOSYS s.r.o., cihelna Litenčice
Naděžda Veselá, Praha 1
Cihelna Chmeliště, s.p.
Cihelna Malenovice s.r.o.
CIPO s.r.o.- cihelna, Hrádek nad Nisou
STAMP s.r.o., Náchod

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

	1994	1995	1996	1997	1998
total number	1683	1733	1784	1847	1921
national parks (NP)	3	3	3	3	3
protected landscape areas (CHKO)	24	24	24	24	24
others	1656	1706	1757	1820	1948

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 21 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, mining was realized in 18 CHKO only in 1998. As to impact of mining in protected landscape areas there has been unfavourable order in CHKO Český kras (limestone mining).

Mining of reserved mineral deposits in CHKO, kt

Mineral/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	915	764	778	715	426	454	424	512	386
Natural gas	0	0	1	6	2	1	0	0	1
Clays	205	165	141	141	116	105	137	140	0
Natural sand	13	7	2	8	7	8	6	5	2
Feldspar	N	N	N	N	N	N	N	121	174
Limestone	6632	4436	4645	4077	4130	3529	3103	4604	3772
Dimension stone	187	203	218	190	223	185	176	231	52
Building stone	7744	4414	4020	3756	3618	3318	3607	3939	3125
Sand and gravel	6721	3386	3107	3614	2918	2797	2938	2862	1983
Brick clays	293	229	146	140	11	20	16	67	56
Total a)	26219	16570	15824	15237	13877	12878	13797	12513	9551
Index, 1990 = 100	100	63	60	58	53	49	53	48	37

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/Yeart	1990	1991	1992	1993	1994	1995	1996	1997	1998
Beskydy	72	52	44	62	3	4	7	15	30
Bílé Karpaty	123	165	54	43	62	30	41	49	64
Blanský les	1842	1058	737	497	462	478	564	626	493
Broumovsko	490	366	381	355	67	72	102	115	98
České středohoří	3416	2087	2125	1960	1866	1628	1733	1752	1666
Český kras	4436	2669	2771	2677	2858	2345	2715	3223	3549
Český ráj	1660	850	759	725	912	932	1182	212	0
Jeseníky	350	254	195	274	349	409	310	396	179
Jizerské hory	16	17	20	5	14	14	15	13	5
Kokořínsko	29	25	20	16	0	0	0	0	0
Křivoklátsko	1268	1010	964	988	866	745	701	871	848
Litovelské Pomoraví	2942	1508	1021	862	470	453	682	409	572
Moravský kras	470	222	413	412	137	167	254	311	303
Orlické hory	475	238	227	286	246	243	235	437	0
Pálava	32	51	57	39	50	46	64	60	54
Poodří	106	92	45	47	0	0	16	22	18
Slavkovský les	17	28	17	18	26	28	35	42	42
Šumava	9	7	5	4	3	2	0	0	36
Třeboňsko	3971	2043	2327	2853	2560	2329	2459	2470	2115
Žďárské vrchy	340	173	167	115	138	162	143	140	59
Železné hory	1917	1345	1562	1093	1234	1196	1210	1304	98
Total output (round)	26236	16598	15841	15255	13903	12906	13984	12156	10229

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

CHKO	1990	1991	1992	1993	1994	1995	1996	1997	1998
Beskydy	61	44	37	53	3	3	6	13	25
Bílé Karpaty	172	231	76	60	87	42	57	71	89
Blanský les	8674	4982	3471	2340	2176	2251	2656	3064	2325
Broumovsko	1195	893	929	866	163	176	249	290	239
České středohoří	3213	1963	1999	1844	1755	1531	1630	1710	1567
Český kras	**34594**	**20814**	**21610**	**20877**	**22288**	**18286**	**21173**	**25242**	**27726**
Český ráj	**18110**	9273	8281	7910	9950	**10168**	**12895**	2180	0
Jeseníky	474	344	264	371	473	554	420	543	240
Jizerské hory	44	46	55	14	38	38	41	36	13
Kokořínsko	107	92	74	59	0	0	0	0	0
Křivoklátsko	2000	1593	1520	1558	1366	1175	1105	1397	1350
Litovelské Pomoraví	**30646**	**15708**	**10635**	8979	4896	4719	7104	4124	5958
Moravský kras	5109	2413	4489	4478	1489	1815	2761	3380	3223
Orlické hory	2328	1167	1113	1402	1206	1191	1152	2224	0
Pálava	385	614	686	469	602	554	770	723	650
Poodří	1301	1129	552	577	0	0	196	249	219
Slavkovský les	27	44	27	28	41	44	55	66	65
Šumava	9	7	5	4	3	2	0	0	52
Třeboňsko	5603	2882	3283	4025	3612	3286	3469	3342	3021
Žďárské vrchy	482	245	237	163	196	230	203	206	83
Železné hory	6745	4732	5496	3846	4342	4208	4257	4601	345

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), iron ores and materials for mineral fertilizers production. The foreign trade with statistically important (in expression of value) minerals and products is manifested in the following tables rendering group 28 of items of the Customs tariff in nomenclature HS-4:

Definitions of available customs tariff items

Raw material	Code [1)]	Specification of item according to the customs tariff
Fe-ores and concentrates	2601	Iron ores and concentrates incl. roasted iron pyrites
Mn-ores and concentrates	2602	Manganese ores and concentrates including Mn-Fe ores and concentrates with 20 wt% Mn or more (calculated on dry substance)
Ni-ores and concentrates	2604	Nickel ores and concentrates
Cu-ores and concentrates	2603	Copper ores and concentrates
Pb-ores and concentrates	2607	Lead ores and concentrates
Zn-ores and concentrates	2608	Zinc ores and concentrates
Sn-ores and concentrates	2609	Tin ores and concentrates
W-ores and concentrates	2611	Tungsten ores and concentrates
Ag-ores and concentrates	261610	Silver ores and concentrates
Au-ores and concentrates	7108	Gold in unwrought or in semimanufactured form, gold powder
	261690	Other precious metal ores and concentrates
U-ores and concentrates	261210	Uranium ores and concentrates
Crude oil	2709	Petroleum oils and oils obtained form bituminous minerals, crude
Natural gas	271121	Natural gas
Hard coal	2701	Hard coal, briquets and similar solid fuels made of hard coal
Brown coal	2702	Lignite, whether or not agglomerated
Fluorspar	252921	Fluorspar, containing by weight 97 % or less of calcium fluoride
	252922	Fluorspar, containing by weight more than 97 % of calcium fluoride
Barite	251010	Natural baryum sulphate (barites)
Graphite	2504	Natural graphite
Kaolin	2507	Kaolin and other kaolinitic clays, whether or not calcined
Clays	2508	Other clays (except expanded clays No. 6806), andalusite, kyanite, sillimanite, also fireclay, mullite, chamotte or dinas earth
Bentonite	250810	Bentonite
Feldspar	252910	Feldspar
Glass and foundry sands	250510	Silica sands and quartz sands
Limestones	2521	Limesone flux, limestone and other calcareous stone, for lime or cement manufacturing

Gypsum	252010	Gypsum, anhydrite
Dimension stone	2514	Slate, whether or not roughly trimmed or sawed or merely cutted only into blocks or rectangular slabs
	2515	Marble, travertine, ecaussine and other calcareous monumental or building stone, density 2.5 or higher, and alabaster, whether or not roughly trimmed or sawed or merely cutted only into blocks or rectangular slabs
	2516	Granite, porphyry, basalt, sandstone and other monumental or building stone, whether or not roughly trimmed or merely cutted into blocks or rectangular slabs
	6801	Setts, curbstones and flagstones of natural stone (except slate)
	6802	Worked monumental and building stone (except slate and slate products, except products No. 6801; little stones for mosaics or tasselated pavements or similar objects, whether or not on beds; artificially coloured granules, chippings and dust of natural stone (including slate)
	6803	Worked slate and articles of slate or of agglomerated slate
Building stone	251710*	Pebbles, gravel, broken or crushed stone in general use for concreting and gravelling of roads, railroads and others like that, flint and hard head whether or not heat-treted
Sand and gravel	250590	Other sands (natural sands of all kinds, also colored, except sands containing metals and except silica sands and quartz sands)
	251710*	Pebbles, gravel, broken or crushed stone in general use for concreting and gravelling of roads, railroads and others like that, flint and hard head whether or not heat-treted

[1] *Code of the customs tariff*

* *item included in one commodity only*

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

	Country/Year	1994*	1995*	1996*	1997*	1998
Export	Germany	32.8	31.8	37.4	27.8	26.5
	Austria	21.9	23.4	22.1	24.2	21.6
	Slovakia	25.2	23.6	20.2	22.8	23.3
	Poland	4.3	7.6	8.0	8.8	13.7
	Hungary	10.5	8.5	7.7	7.7	9.2
	others	5.3	5.1	4.6	8.7	5.7
Import	Russia	80.4	83.9	79.5	71.8	74.6
	Poland	6.1	6.8	5.9	7.6	3.1
	Ukraine	5.2	5.7	5.4	6.8	8.2
	Germany	2.0	1.0	3.3	3.4	2.0
	Slovakia	1.3	1.5	1.5	1.8	0.5
	others	3.3	1.1	4.4	8.2	11.6

** there was used another methodology of calculation in 1994-1997*

Important commodities of the Czech export were in the last four years: hard coal - 50-60%, brown coal – 15-24%, kaolin – 4-6% and dimension stone – 3-4%.
Main import commodities were at the same time: crude oil - 42%, natural gas - 39% and iron ore - 9% (average % share of import of mineral commodities value). Detailed data are given in the following table.

Export and import of raw materials in mill. CZK

Raw material		Customs tariff code	1994	1995	1996	1997	1998
Ores + concentrates total	import		4 501	5 756	5 137	6 525	7 131
	export		38	45	31	26	19
Fe – ores and concentrates	import	2601	4 461	5 679	5 088	6 469	7 088
	export		3	1	3	5	3
Mn – ores and concentrates	import	2602	37	64	42	52	26
	export		0	1	0	1	1
Ni – ores and concentrates	import	2604	3	8	6	1	6
	export		10	0	0	0	0
Cu – ores and concentrates	import	2603	0	4	0	0	0
	export		2	0	2	1	1
Pb – ores and concentrates	import	2607	0	0	0	0	0
	export		0	0	0	0	1
Zn – ores and concentrates	import	2608	0	0	0	0	0
	export		0	9	0	0	0
Sn – ores and concentrates	import	2609	0	0	0	0	0
	export		0	0	0	0	0
W – ores and concentrates	import	2611	0	0	1	3	11
	export		13	33	26	19	13
Ag – ores and concentrates	import	261610	0	0	0	0	0
	export		0	0	0	0	0
Au – ores and concentrates	import	261690	0	0	0	0	0
	export		10	0	0	0	0
Fuels total	import		32 688	40 584	52 489	57 250	42794
	export		12 871	14 086	14 293	14 405	13722
Uranium- ores and concentrates	import	261210	0	0	0	0	0
	export		N	N	N	N	N
Cruce oil	import	2709	19 287	21 266	28 377	28 454	19 937
	export		233	352	277	327	389
Natural gas	import	271121	11 807	17 038	21 229	26 579	21 300
	export		192	190	220	211	2
Hard coal	import	2701	1 591	2 280	2 882	2 216	1 557
	export		8 738	9 510	9 827	10 586	10 746
Brown coal	import	2702	3	0	1	1	0
	export		3 708	4 033	3 969	3 281	2 585
Industrial m. + build.m. - total	import		758	1 045	1 086	922	1030
	export		2 456	2 597	2 506	2 696	2861
Fluorspar	import	252921 252922	71	217	136	161	164
	export		1	2	11	127	153
Barite	import	251110	69	91	51	45	37
	export		0	0	0	0	0
Graphite	import	2504	17	20	20	20	25
	export		48	54	55	61	62
Kaolin	import	2507	19	22	29	43	69
	export		685	812	793	898	948
Clays	import	2508	72	77	86	79	97
	export		283	305	307	315	332

Bentonite	import	250810	14	13	23	29	37
	export		47	59	69	70	82
Feldspar	import	252910	2	3	14	20	18
	export		64	71	82	67	78
Glass and foundry sands	import	250510	28	36	33	31	25
	export		222	142	184	191	219
Limestone	import	2521	81	60	60	76	58
	export		37	47	46	82	96
Gypsum	import	252010	1	5	12	16	24
	export		48	52	36	30	17
Dimension stone	import	2514-6 6801-3	315	411	520	295	349
	export		496	573	568	633	724
Building stone	import	251710	28	42	43	34	35
	export		230	204	167	105	73
Sand and gravel	import	250590 251710	42	50	60	73	92
	export		296	277	189	117	77
Raw materials total	import		37 946	47 385	58 711	64 697	50 955
	export		15 365	16 728	16 829	17 127	16 602

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)

IMPORTANCE OF MINERALS IN THE CZECH NATIONAL ECONOMY

In the last few years, in connection with structure changes in the Czech economy, especially in industry there have changed both the role and the importance of branches of extracting and processing minerals and materials of mineral origin. Index of mineral output share of the GDP has witness the changes as it has declined from 3.7% in 1993 to 2.1% in 1997. The quota of mineral output within other industrial pruduction has declined from 6.9% in 1993 to 4.0% in 1997.

Market economy affected a restriction or even stoppage of mining of non-economic deposits, where mining continued with the help of state appropriations in the past. All mining was stopped in the deposits of ores, baryte and fluorspar and in smaller coal regions. The mining of coal has been limited in the other regions, too. At the same time the mining of uranium ores (registered in mineral fuels) was limited. On the other side production of some industrial minerals increased in 1998. It concerns the kaolin, clays and also bentonite and feldspar production. The production of limestone increased, too. It has again exceeded 11 mill. t.

Also the production of dimension stone rose significantly in 1998. In connection with decline in building production there has reduced the mining of building stone and sand and gravel.

Importance of minerals is not limited by these numbers only. Minerals and materials of mineral origin are the basis for production of many industries: electricity industry, metallurgical, machine, chemical, brick and tile industries, ceramics, stoneware manufacturing, glass industry, etc. While there are domestic resources for most of given branches at disposal, the Czech Republic depends on imports of important energetic and chemical raw materials, i.e. crude oil, natural gas, ores, metals, sulphur, salts and phosphates. Import of minerals shared 6% of all Czech imports in 1998. Main export commodities among raw materials were black coal, brown coal, kaolin and dimension stone in 1998. We can add export of coke, cement, ceramic and glass products.

Extent of mining largely impacts the environment. That is why output restrictions in many deposits could have a positive effect on atmosphere recovery and on recovery of other forms of polluted environment. Very important is decline of mineral output in protected landscape areas. Mining in these areas has reached the lowest level since 1990. It was 63% lower in 1998. But there have still existed protected landscape areas where restrictions has not been realized. In this category belong: Český kras, Litovelské Pomoraví, Moravský kras and Třeboňsko. Output of minerals has been limited in the main in Český ráj and České středohoří.

We must await a limited life of our most important resources of mineral fuels represented by deposits of brown and hard coal. We can pin-point a short life of brown coal reserves following from area limits. These limits have arisen during the struggle to recover the atmosphere and to stabilize the territory of the North Bohemia. The Czech Republic is not without prospects in deposits of gold. Their exploitation depends on solution of conflicts of interests with nature protectors. As to industrial minerals the Czech Republic is rich in minerals for ceramic and glass industries and in building raw materials.

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