MINISTRY OF ECONOMY OF THE CZECH REPUBLIC

MINERAL COMMODITY SUMARIES OF THE CZECH REPUBLIC

NATIONAL INFORMATION CENTRE OF THE CZECH REPUBLIC
DEPARTMENT GEOFOND
JUNE 1995

MINERAL COMMODITY SUMMARIES OF THE CZECH REPUBLIC

STATE TO DECEMBER 31, 1994

MINISTRY OF ECONOMY OF THE CZECH REPUBLIC
DEPARTMENT OF MINERAL RESOURCES AND GEOLOGY

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ABBREVIATIONS, SYMBOLS AND TECHNICAL UNITS

API	American Petroleum Institute
ATPC	Association of Tin Producing Countries
Btu	British thermal unit
CFR	Cost and Freight (named port of destination)
CIF	Cost, Insurance and Freight (named port of destination)
ČSÚ	Czech Statistical Office
DEM	Deutsche Mark
DRI	Direct Reduction of Iron
e	estimate
EC	European Community
EFTA	European Free Trade Association
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
IPE	International Petroleum Exchange (London, UK)
ITGE	Instituto Tecnologico Geominero de Espana
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
MJ	megajoule, 10^6 J
mtu	metric ton unit, 10 kg
N	not available or not reliable data
NYMEX	New York Mercantile Exchange
OPEC	Organization of Petroleum Exporting Countries
ppm	parts per million, 0.0001 %
Sb.	Act Digest of the Czech Republic
st	short ton, 907.2 kg
troy oz	troy ounce, 31.103 g
T/C	Treatment Charge, the amount per ton charged by a smelter for converting ore to metal
UNCTAD	United Nations Conference on Trade and Development
USBM	United States Bureau of Mines
USD	United States Dollar
USc	United States cent

INTRODUCTION

The handbook "Mineral Commodity Summaries of the Czech Republic", published for the third time in more extended form, is intended to provide information for professionals and particularly for businessmen in order to assist them in developing small and medium size enterprises in mineral exploration and mining and, at the same time, to avoid violating relevant legislation and interests of mining organizations.
The publication also includes basic data extracted from the "Register of Reserves of Mineral Deposits" and "Register of Reserves of Non-reserved Mineral Deposits" which are further elaborated for only a limited number of Governmental Departments.
Information on prices of minerals, their technological parameters and uses, imports and exports, major mining companies and locations of mineral deposits is intended to assist in understanding the mineral potential of the Czech Republic and to stimulate and influence investment activities. The annually updated publication "Mineral Commodity Summaries of the Czech Republic" thus becomes an integral part of the whole information system focused on mineral policy of the Ministry of Economy of the Czech Republic.
Based upon progress in the national information system and international cooperation, the publication will be thoroughly supplied with appropriate statistical data and comments from readers will be taken into consideration when publishing further issues. Consequently, the authors would appreciate any comments on the subject.
The term mineral reserves refers to geological and/or total reserves which means original reserves within individual deposits, calculated according to a valid classification of reserves and conditions of their utilization. The basic data come from calculations of mineral reserves which were approved or verified by the former Commission for Classification of Mineral Resources and/or reserves approved by the Board of Minerals, Exploration and Mining of the Ministry of Economy of the Czech Republic (formerly Commission for Projects and Final Reports) or those approved by former commissions for control and utilization of mineral reserves of individual mining and processing industries or by newly introduced mining companies.
Geological reserves of minerals - as of December 31, 1994 - exceeded 60,000 mill. tons (without natural gas) with majority of mineral fuels. As of Decemberr 31, 1994 the total area of mining claims represented 1,659.9 km^2 (inter-annual 1994/1993 area decrease index was 98.9 and 1994/1992 index was 76.8).
The Ministry of Economy together with the Ministry of Industry and Commerce recently announced a project of recalculation of reserves of regale minerals which will lead in the next 2-3 years to a fundamental economic revaluation of the mineral wealth of the Czech Republic.

The year-book "Mineral Commodity Summaries of the Czech Republic" includes all minerals, i.e. metallic ores, mineral fuels, industrial minerals and building materials which are of economic importance and reserves on the territory of the Czech Republic. Each mineral is presented in an individual chapter which consists of ten parts.
Part 1. **Characteristics and uses** - provides a basic description of the mineral raw material, its abundance in nature, major minerals and general use.
Part 2. **Mineral resources of the Czech Republic** - describes major regions of their occurrence, characteristics of their deposits, types, production and potential use.
Part 3. **Registered deposits of the Czech Republic** - is based upon the register of mineral deposits of the Czech Republic and for the majority of minerals it includes a summary of individual deposits and their location. As for mineral fuels and some industrial minerals only regions are shown rather than single deposits. As for dimension stone and building materials, hundreds of these deposits are scattered over the whole territory of the Czech Republic. Consequently, no summary or location are given in this paragraph.

Part 4. **Basic statistical data of the Czech Republic as of December 31,** are extracted from the "Reserves register" and from the ČSÚ statistical data on mineral imports and exports.There are 3 groups of minerals (ores, mineral fuels and reserved industrial minerals) balanced in the Czech Republic. Outstanding inter-annual changes in number of deposits of some minerals (for example hard coal, kaolin, clays, limestones and other) were effected by administrative and statement methodology changes. In 1991 the Czech republic changed the customs tariff statistics of the foreign trade; therefore the import and export statistical data up to 1991 are of orientation only.
Part 5. **Tariff rates** - show corresponding entries of the customs tariff of ÚCS and tariffs in force according to the government Decree No. 265/1994 Sb.
Part 6. **Mining companies in the Czech Republic.** This part gives a list of companies which are mining the given mineral on the territory of the Czech Republic. The companies are arranged according to the level of production.
Part 7. **World production** gives data on mining and production of commercial products for the last 5 years. Leading world producers and their share of world production are also quoted.
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, foreign publications and even unpublished reports of NIS ČR Geofond were used when compiling the present yearbook.

METALLIC ORES - GEOLOGICAL RESERVES AND MINING OUTPUT

Ore mining has got very old tradition in the territory of the Czech Republic. The oldest archaeological evidence on gold wash originates in the 9^{th} century B.C. In the Middle Ages Bohemia became the centre of European gold and silver mining. Long mining activity was the cause of the fact that the territory of the Czech Republic became rich in poor ores only. Mining met with its last large boom in the cold war period after 1948 when the ore deposits were exploited even at considerable economic loss to ensure an independence of mineral imports from the western countries. After 1989 a large exploitation damping came and a close of mining in the polymetallic deposit Zlaté Hory discontinued ore mining in the territory of the Czech Republic.
Geological reserves of metallic ores as of December 31, 1994 were mostly subeconomic. More significant volume of economic reserves was presented with goldbearing, polymetallic and tin-tungsten ores only. The hope for re-opening of ore mining is connected with continuous geological survey of gold deposits.

Mining output - metal content

Metal	Unit	1990	1991	1992	1993	1994
Iron	t	29946	32844	20608	0	0
Tungsten	t	84	12	0	0	0
Copper	t	800	600	500	200	0
Lead	t	2300	2100	1100	100	0
Zinc	t	7500	8500	4400	1500	100
Tin	t	590	15	0	0	0
Antimony	t	216	384	224	0	0
Silver	kg	16200	8900	6200	500	100
Gold	kg	187	564	521	512	75

IRON ORE

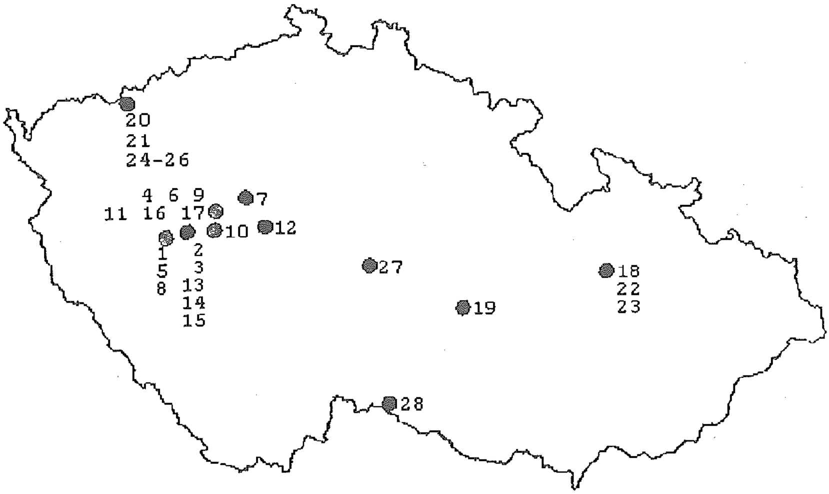
1. Characteristics and use

Iron is a grey, highly malleable metal having specific density of 7.87 t/m^3 and a melting point of 1,536° C. It is the 4th rock-forming element. The highest concentrations of iron are connected with the occurrence of Precambrian sedimentary formations which are the largest world source of hematite. Another important source of iron is deposits of magnetite which originated either by segregation of magnetite in mafic magmatic bodies or through pyrometasomatic processes. Iron ores occur in the form of oxides, silicates and carbonates. In general, two types of iron oxides are mined worldwide - hematite Fe_2O_3 and magnetite Fe_3O_4 having up to 70 % Fe. World reserves are estimated at 150,000 mill. tons.
Iron ores are used for the production of pig iron either in the form of crude lump ore or in the form of fines or sintered or pelletized concentrates. Modern technologies of iron manufacturing such as DRI process, Corex, etc. enable the use of fines and concentrates without sintering or pelletization.
A very small amount of iron is used for other than metallurgical processes, such as heavy media, and the manufacture of cement, ferrites, feed-stuffs, coloring agents, etc.

2. Mineral resources of the Czech Republic

▪ Sedimentary deposits of iron ores occur in the Barrandien zone. These ores are of marine origin and of Ordovician age.
The ore forms mostly lenses. Early Ordovician ores contain mostly hematite (hematite-siderite ores). The content of iron is on average 25 to 30 %. Oolitic texture is characteristic of these ores.
▪ Deposits of the Lahn-Dill type related to the submarine volcanic activities occur in the Moravian-Silesian Devonian. Most abundant is hematite, less abundant is magnetite and Fe-silicates. Magnetite of the Medlov deposit which was still mined in the sixties, similarly to the sedimentary deposits of the Barrandien zone, contained on average 38 % Fe.
▪ Pyrometasomatic deposits of magnetite are characteristic of skarns of the Moldanubicum crystalline unit and the Krušné hory unit. The content of Fe in ore of Měděnec and Přísečnice, which were mined as late as in 1992, was on average 33 %.
Deposits of the above mentioned three genetic types were mined in the past on a large scale and the ore was dressed at high cost and used mostly for pig iron production. This applies particularly for low grade and siliceous sedimentary ores of the Barrandien zone which were thermally treated through the Krupp-Renn process. Magnetite was mostly used for other than metallurgic processes, such as for production of cement (heavy concrete), as a heavy medium of jigs in coal preparation plants, etc.
The availability of higher-grade and relatively cheaper imported iron ores led to the gradual closing of iron mines on the territory of the Czech Republic.

3. Registered deposits and their location in the Czech Republic



Sedimentary iron ores:

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

Magnetite:

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

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

Year		1990	1991	1992	1993	1994
Deposits - total number		29	29	29	28	28
exploited		2	2	2	0	0
Total reserves, kt		493266	492801	492490	492490	492490
economic proven		1270	738	519	519	519
economic probable		12861	12324	12232	12231	12232
subeconomic		479135	479739	479739	479739	479739
Mining output, kt		93	102	64	0	0
Imports, kt	a)	1349	2071	5131	7550	7282
Exports, kt	a)	0	0	0	0	2

Note:
a) item 2601 of the customs tariff

5. Customs tariffs

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

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

In 1994 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 last peak in 1989 - 986 mill. tons. Afterwards the output fell again in connection with world economic recession. A growth of metallurgic production in China was the cause of output revival after 1992. The important iron ore - producing countries are as follows (according to UNCTAD):

Year		1990	1991	1992	1993	1994
Mining output, mill. t		976	950	918	942	956
Main producers, %:						
China	b)	17	18	22	24	24
CIS	a)	24	21	18	16	14
Brazil		16	16	16	17	17
Australia		11	13	13	13	13

Note:
a) USSR before 1992
b) mining of poor ore grading 35 % Fe (world average grades 60 % Fe)

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	1990	1991	1992	1993	1994
A	32.50	34.76	33.10	29.09	26.47
B	N	N	37.10	33.09	26.47
C	51.60	52.15	48.47	43.64	43.64

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 63 % worldwide in 1990 whereas in the former Czechoslovakia it was only 40 %. The reason for the high recycling ratio is in particular the reduction of fuels and energy consumption by as much as 80 % versus energy consumption when using pig iron as a charge in steel-making furnaces. Production of steel requires mostly chemically pure and high grade iron scrap, i.e. scrap whose availability continues to decrease with increasing portion of continuous steel casting. Processing and particularly the still increasing consumer's share of iron scrap does not meet specific requirements of the steel industry. Electric furnaces have the major share consumption of iron scrap allowing as much as 100 % charge of iron scrap.

10. Possible substitutes

Iron ore in pig iron production can be substituted by iron scrap up to 7 % of the charge. Steel products can be substituted to a certain extent by products of other metals, alloys, glass, ceramics and composite materials.

MANGANESE

1. Characteristics and use

Manganese is a hard, brittle, grey metal melting at 1,244°C and with a specific density of 7.4 t/m^3. There are two principal types of manganese deposits - marine chemical sediments and deposits of oxidation zone enriched in manganese. The former type represents the majority of known reserves of manganese. Proven economic 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, hausmannite and rhodochrosite. Manganese world reserves are estimated at 800 mill. tons.

More than 90 % of manganese is used on production of manganese ferro-alloys for the iron industry both in production of pig iron and particularly in the steel industry as a desulphurizing and deoxidizing agent and as an important alloying metal. Average world consumption of manganese is 10 kgs in 1 ton of crude steel and in up-to-date steel foundries is minimum 6 kgs. Manganese is also used in alloys of non-ferrous metals (Al, Cu, Ti, Ag, Au, Bi). Another applications are in the manufacture of dry batteries, coloring matters, soft ferrites, fertilizers, feed for animals, fuel additives, welding electrodes, water treatment, etc.

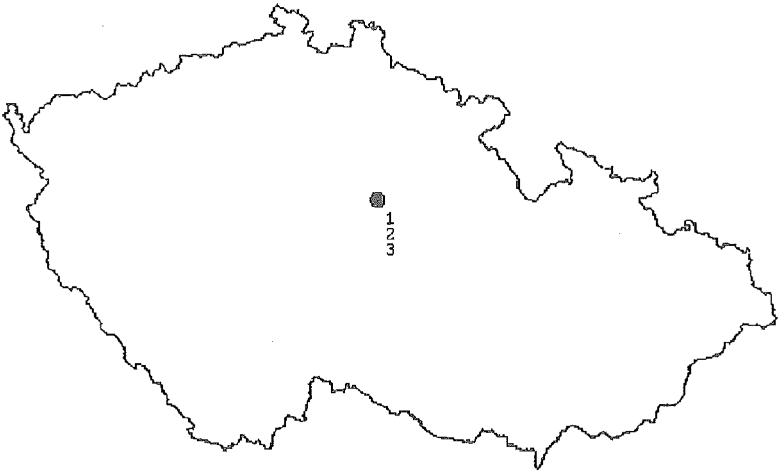
2. Mineral resources of the Czech Republic

Accumulations of Mn ores are known from the Železné hory mountains area where they are confined to volcaniclastic deposits of the Proterozoic. The mineralization is confined to a horizon of graphitic-pyritic slates which are metamorphosed together with neighbouring rocks. The ore horizon extending from Chvaletice to Sovolusky is composed of a mixture of Mn and Fe carbonates (mainly Fe-rhodochrosite), quartz, graphite and Fe-sulphides. Silicates of Mn originated during the regional metamorphic processes. The ore contains up to 13 % Mn.

Major mining operations were executed at Chvaletice. Fe-Mn ores of the gossan type were mined in the past on the outcrops. Pyrite was mined in the fifties and sixties as a raw material for the chemical industry. Mn ores were extracted along with pyrite but due to incomplete technology were not processed and were deposited in tailings ponds at the former mineral processing plant (average Mn content of the ore is 9,8%).

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

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total number		2	2	2	2	3
exploited		0	0	0	0	0
Total reserves, kt		134405	134405	134405	134405	138801
economic proven		0	0	0	0	0
economic probable		0	0	0	0	0
subeconomic		134405	134405	134405	134405	138801
Mining output, kt		0	0	0	0	0
Imports, kt	a)	N	16	42	13	13
Exports, kt	a)	0	0	0	0	0

Note:
a) item 2602 of the customs tariff

5. Customs tariffs

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

6. Mining companies in the Czech Republic as of December 31, 1994
In 1994 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 was reached in 1989 - 25.5 mill. tons, but with regard to metal content in 1990. The major producers of Mn ores and their share on world production were as follows (mining output in Mn content according to the Welt-Bergbau-Daten):

Year		1990	1991	1992	1993 e	1994 e
Mining output, kt Mn		11096	9613	7542	7300	7400
Main producers, %:						
CIS	a)	39	43	38	35	32
South Afrika		16	13	13	13	13
Australia		8	7	8	10	12
China		9	8	9	9	10
Gabon		11	11	9	9	9
India		5	6	9	9	9
Brazil		8	8	9	8	7

Note:
a) USSR before 1992

Operating technologies of manganese nodules offshore mining were at disposal in France, Japan, Germany and USA at the end of 1994. In 1995 India joined these countries.

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 prices are 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. 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 following manganese ore grade at yearend (commodity A):

Commodity / Year	1990	1991	1992	1993	1994
A	4.00	4.00	3.45	2.20	2.00

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 CIS -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 data -by other deoxidizing additives - silica, aluminium, complex alloys and rare earth oxides.

NICKEL

1. Characteristics and use

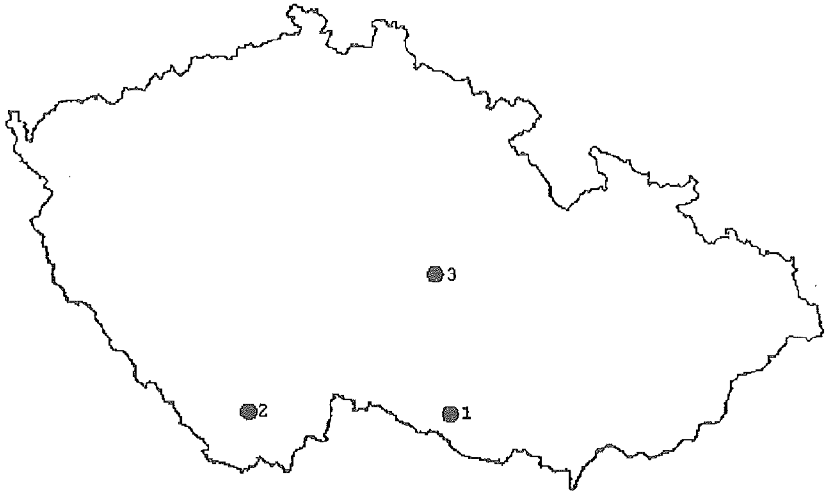
Nickel is a white, malleable and very hard metal melting at 1,455° C and with a specific density of 8.9 t/m^3. The majority of nickel deposits are confined to ultramafic rocks such as peridotite and serpentinite. Economic deposits are represented by sulphide mineral assemblages (40 % of world reserves) and by lateritic deposits (60 % of world reserves). Sulphide deposits are of magmatic or metamorphic origin. Major nickel minerals are pentlandite and nickel bearing pyrrhotite. Both minerals are usually accompanied by Cu minerals which are extracted as a by-product. Proved reserves with an average grade 1 % and higher are equal to 130 mill.tons of nickel metal. Lateritic deposits originated through weathering processes of ultramafic rocks (having max. 0.3 % Ni) exposed to extreme climatic conditions of subtropical and tropical zones with torrential rains. Weathering processes led to enrichment of Ni up to 3.5%. The major Ni mineral of these lateritic deposits is a hydrosilicate of Ni - garnierite $H_2(Ni,Mg)Si0_4$. Some nickel also occurs in the manganese ocean crust and deep sea nodules, particularly in the Pacific Ocean. Steel mills and iron foundries account for 61 % of total nickel use worldwide (particularly stainless and heat-resisting steels having 7-12 % Ni). Other applications are in the production of common and special alloys (superalloys) used in machine and electrotechnical industries, for nickel electroplating, etc.

2. Mineral resources of the Czech Republic

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

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

3. Registered deposits and their location in the Czech Republic



1 Bojanovice
2 Křemže
3 Staré Ransko

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

Year		1990	1991	1992	1993	1994
Deposits - total number		3	3	3	3	3
exploited		0	0	0	0	0
Total reserves, t Ni		111816	111816	111816	111816	111816
economic proven		0	0	0	0	0
economic probable		62397	62397	62397	62397	62397
subeconomic		49419	49419	49419	49419	49419
Mining output, t Ni		0	0	0	0	0
Exports, t	a)	875	0	50	5749	7222
Imports, t	a)	0	0	0	0	287

Note:
a) item 2604 of the customs tariff

5. Customs tariffs

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

6. Mining companies in the Czech Republic as of December 31, 1994
In 1994 no mining companies were operating in the Czech Republic to extract nickel ores.

7. World production
World production of Ni ores shows a similar progress to that of iron ores because its major use is in steel manufacture. So far the highest production was reached in 1990 - 1,046 kt of nickel metal. The major producing countries of Ni ores and their share of world production were as follows (according to the Welt-Bergbau-Daten):

Year		1990	1991	1992	1993 e	1994 e
Mining output, kt Ni		970	937	914	827	850
Main producers, %:						
CIS	a)	30	26	30	28	26
Canada		20	20	22	22	22
New Caledonia		9	11	11	11	12
Indonesia		6	7	8	8	8
Australia		7	7	6	7	7

Note:
a) USSR before 1992

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

Commodity / Year	1990	1991	1992	1993	1994
A	8863	8157	6998	5281	6341

9. Recycling
The proportion of recycled metal of its total consumption continues to increase. It reaches up to 30 % of consumption in some countries.

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

COPPER

1. Characteristics and use

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

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

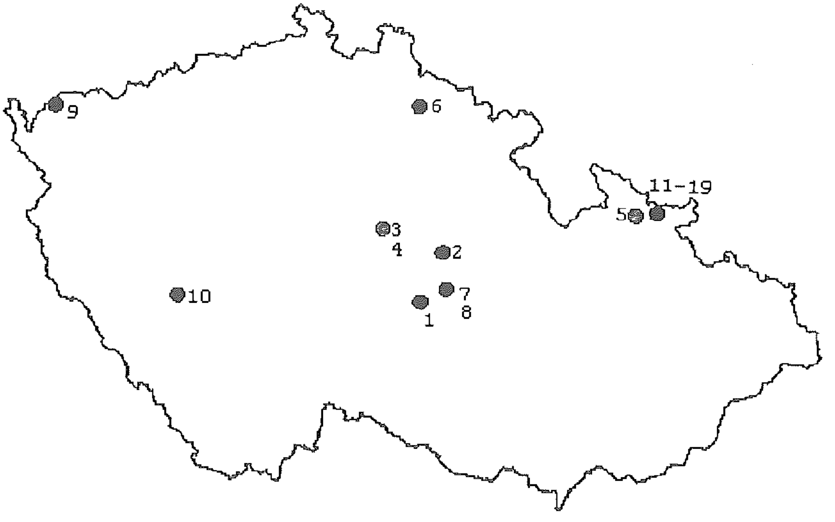
2. Mineral resources of the Czech Republic

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

- Major mining activities were focused on volcaniclastic pyrite deposits of the Zlaté Hory mining district. The mineralization is related to the initial spilite-keratophyre volcanism and is confined to volcaniclastic complex of the Vrbno Formation of the Devonian. Single types of local ores - Cu monometallic, complex Cu-Pb-Zn and Pb-Zn occur separately and show a certain zonation. Out of the total proved reserves about 50 % are confined to complex ores, 25 % to monometallic, and 25-30 % to Pb-Zn ores. Monometallic ores consist of chalcopyrite with varying admixture of pyrite or pyrrhotite. Their grade ranges between 0.4 and 0.6 % Cu. Mining of these ores at the Zlaté Hory deposit was terminated in 1990.
- Stratabound monometallic Cu ores (chalcopyrite) confined to a low-grade metamorphic volcaniclastic complex were discovered and their reserves evaluated and proved in the deposit of Tisová near Kraslice. Mining of local ores, having as much as 1 % Cu, was terminated in 1973. A mineral exploration project was then executed in the ore district in the eighties but mining was not resumed and the deposit was temporarily flooded.
- Less important Cu mineralizations and/or Cu-Zn-Pb ores of stratabound type and pyrite formation are known at numerous localities of the Bohemian Massif (e.g. Staré Ransko, Křižanovice, Svržno).
- Hydrothermal (vein) Cu deposits of the Czech Republic are of historical importance only. Similar role plays Cu mineralization confined to Permocarboniferous sediments of the Krkonoše piedmont basin, Lower Silesian basin and the Blanice furrow.

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

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total	a)	27	23	23	21	19
exploited		6	4	3	1	0
Total reserves, kt Cu		259	249	248	239	239
economic proven		40	39	2	0	0
economic probable		67	61	54	41	41
subeconomic		152	149	192	198	198
Mining output, t Cu		800	600	500	200	0
Imports, t	b)	N	4480	45	20	11
Exports, t	b)	N	0	0	24	160

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

5. Customs tariffs

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

6. Mining companies in the Czech Republic as of December 31, 1994
In 1994 no companies were operating in the Czech Republic to extract Cu ores.

7. World production
Production of Cu ores continues to rise consistently 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 and their share of the world production are as follows (according to the Welt-Bergbau-Daten):

Year		1990	1991	1992	1993 e	1994 e
Mining output, kt Cu		9089	9312	9350	9450	9600
Main producers, %:						
Chile		18	20	21	20	21
USA		17	18	19	20	20
CIS	a)	10	10	9	9	8
Canada		8	8	8	7	7
Zambia		6	6	5	5	6

Note:
a) USSR before 1992

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 1988 GBP 1,706.75 per ton (Cash). The 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. Metal price (commodity A) averaged at LME in GBP/USD per ton (Cash) as follows:

Commodity / Year		1990	1991	1992	1993	1994
A	GBP	1496	1325	1297	1358	-
	USD	-	-	-	1789	2312

9. Recycling

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

10. Possible substitutes

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

LEAD

1. Characteristics and use

Lead is a soft, silvery lustrous metal melting at 327.4° C and with a specific gravity of 11.34 t/m^3. Lead deposits are of four genetic types - sedimentary, metasomatic, contact metamorphic and hydrothermal (veins). Major part of the world production comes from the first type. The principal economic mineral is galena, usually accompanied by sphalerite, pyrite and chalcopyrite. Extracted ores are mostly of polymetallic character with various contents of minor metals - Cd, Ge, Ga, In, Tl, Ag and Au. The ore is marked as lead ore providing the Pb:Zn ratio is >4. Economic demonstrated reserves of Pb metal in the world are estimated at 63 mill.tons, occurring in Australia, USA, China, Canada and former USSR. Much lead is used in manufacture of batteries (63 %) and lead pigments and chemicals (13 %). About 7 % of lead are used in rolled and extruded products, 4 % in shielded cables, 3 % in alloys, 2 % in ammunition, 2 % as anti-nock additive in gasoline. High toxicity of lead leads to a reduction of its consumption in some industries; e.g. consumption index in gasoline production 1990/1985 was equal to 0.64.

2. Mineral resources of the Czech Republic

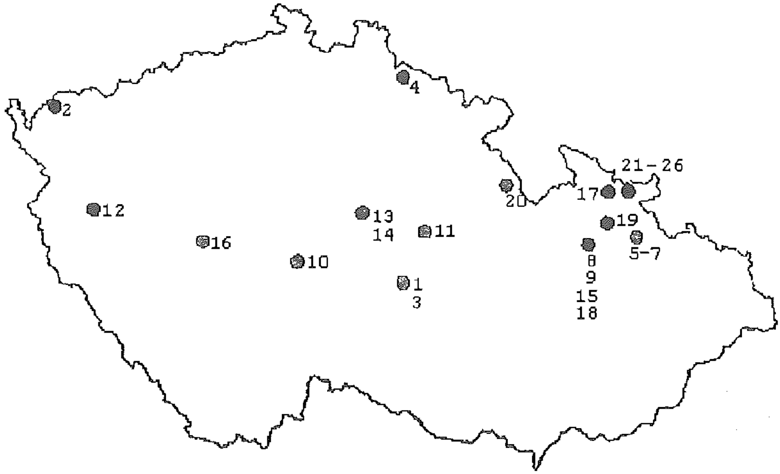
Mining of vein type hydrothermal base metal deposits brought fame and glory to the medieval ore mining in Bohemia. Originally, the glory was due to silver occurring in these ores which were later in 16th century used for extraction of lead and then even for zinc. After World War II, new exploration projects turned the attention to volcaniclastic deposits of the pyrite formation.

■ Hydrothermal base metal mineralizations are abundant in the Bohemian Massif. Besides medieval ore districts of Jihlava, Havlíčkův Brod, the Blanice furrow and others, the mining districts of Příbram, Stříbro and Kutná Hora maintained their significance till the 20th century. The major Pb mineral is galena (more or less Ag-bearing) which represents the principal compound in the majority of Pb-Zn deposit. Only the Kutná Hora ore district shows considerably lesser contents of galena relative to sphalerite in the majority of veins.

■ A distinct type of hydrothermal vein mineralization occurs at Harrachov where galena is accompanied by barite and fluorite.

■ Stratabound base metal ores of volcaniclastic origin related to Devonian volcanism were explored in the fifties through to eighties in northern Moravia. Extensive mining was focused on the deposits of Horní Město, Horní Benešov and some deposits of the Zlaté Hory ore district. Contents of lead varying around 0.5 % are confined to galena accompanied by banded sphalerite. Mining of some other base metal deposits of similar origin has not started because of reduction of ore mining.

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total	a)	34	30	31	30	26
exploited		9	7	3	1	0
Total reserves, kt Pb		265	257	272	257	257
economic proven		87	72	18	15	15
economic probable		121	111	90	62	62
subeconomic		57	74	164	180	180
Mining output, t Pb		2300	2100	1100	100	0
Imports, t	b)	0	0	0	0	0
Exports, t	b)	1021	2934	393	156	0

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

5. Customs tariffs

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

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

In 1994 no companies were operating in the Czech Republic to extract ores with Pb content.

7. World production

The world output since 1968, when the level of 3 mill.tons of metal was exceeded, has been maintained at an average of 3.3 mill. tons a year. So far the largest production was recorded in 1977 - 3.657 mill. tons. The major producing countries and their share of the world production were as follows (according to the Welt-Bergbau-Daten):

Year		1990	1991	1992	1993 e	1994 e
Mining output, kt Pb		3357	3305	3563	3500	3500
Main producers, %:						
China		11	11	19	22	23
Australia		15	18	16	14	14
USA		14	14	11	11	11
CIS	a)	15	14	10	9	8

Note:
a) USSR before 1992

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). The price is quoted 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. Since 1992, the price stagnates at USD 170-180 per ton. 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. The reason for drop in price of pure metal has been the world economic recession and a large surplus and supplies from the East European countries in particular.

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

Commodity / Year		1990	1991	1992	1993	1994
A		135	155	175	175	140
B	GBP	459	315	306	274	-
	USD	-	-	-	399	549

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 comsumer's and manufacture industries. Recycled lead supplied presently about 50 % of the metal world production in 1994. 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

Zinc is a grey, soft and malleable metal melting at 419.5° C, and with a specific gravity of 7.14 t/m^3. The major economic mineral of zinc is sphalerite which is usually accompanied by galena, pyrite and chalcopyrite in base metal deposits. The ore is marked as zinc ore providing the Zn:Pb ratio is >4. Sphalerite usually contains cadmium whose concentrations vary from traces up to 2 %, then germanium, gallium, indium and thallium. Zinc ores occur mostly in base metal deposits of various origin which are similar to those of lead. Economic demonstrated reserves of Zn content in the world are estimated at 140 mill.tons. Potential source of zinc may be also zinc bearing coal in which the content of zinc is estimated at an order of a few millions of tons. Much zinc is used in zinc plating (47 %), in alloys (particularly brass - 19 %), in castings (14 %), in rolled materials for the building industry and manufacture of batteries (7 %), etc. As for the volume, zinc represents the 3rd mostly used non-ferrous metal after aluminium and copper.

2. Mineral resources of the Czech Republic

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

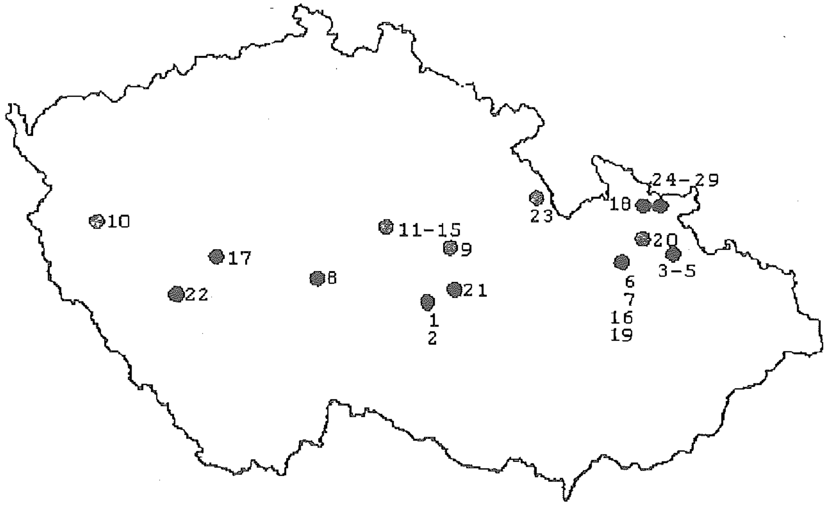
▩ Large volume of zinc ores represented mostly by sphalerite was extracted from the base metal deposits of the Březové Hory, Bohutín and Vrančice ore districts in the vicinity of Příbram. Zinc ores were also verified in historical as well as in newly explored vein type deposits. The grade of these ores varied between 1.0 and 2.9 %.

▩ The most important deposits of volcaniclastic origin occur in the Jeseníky mountains. Disseminated sulphide ores grading 0.7-1.4 % Zn were mined in the deposits of Horní Město (till 1970) and Horní Benešov (till 1992). Mining operations in the Zlaté Hory ore district were terminated in 1993.

▩ The deposit of Staré Ransko - Obrázek is of enigmatic origin. A sphalerite-barite ore, having up to 2 % Zn was mined until 1990. The Křižanovice deposit of Pb-Zn-Cu ores with barite is classified as volcaniclastic mineralization. The ore contained about 6-7 % Zn. The deposit was discovered during execution of an exploration project in the eighties.

The extraction of Zn ores in the Czech Republic was terminated according to the policy of gradual reduction of ore mining adopted by the Government. A composite Pb-Zn concentrate was the final product when mining the base metal ores. The concentrate was exported because there was no smelter in the Czech Republic. Long lasting preparation works and construction of a hydrometallurgical plant at Bruntál which was intended to smelt all base metal complex ores and concentrates of domestic provenience was not completed. Only a pilot plant was finished and some trial tests were done.

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total	a)	38	35	35	33	29
exploited		9	6	3	1	0
Total reserves, kt Zn		982	972	968	924	924
economic proven		275	230	70	44	44
economic probable		519	461	406	234	234
subeconomic		188	281	492	646	646
Mining output, t Zn	b)	7500	8500	4400	1500	100
Imports, t	c)	0	126	26	0	4
Exports, t	c)	6110	13586	9841	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. Customs tariffs

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

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

In 1994 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 last two years mine output has been declining. Large increase in stock and raise of recycled metal share in the total production which covered raise in demand were the cause of the above mentioned decline. The major producing countries and their share of world production are as follows (according to the Welt-Bergbau-Daten):

Year	1990	1991	1992	1993	1994 e
Mining output, kt Zn	7434	7468	7366	6895	6700
Main producers, %:					
Canada	16	15	12	15	15
Australia	11	14	11	15	15
China	10	10	8	12	12
Peru	8	8	6	10	10

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	1990	1991	1992	1993	1994
A	N	N	189	209	172
B	N	N	192	212	173
C	1519	1115	1239	960	998

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 exceeded 28 % of the whole consumption in the world in 1992.

10. Possible substitutes

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

TIN

1. Characteristics and use

Tin is a soft, silvery white metal melting at 231.9°C and with specific density of 7.3 t/m^3. Tin was concentrated at the end of the magma differentiation and its deposits are related to granitic rocks and their effusive equivalents. The only economic mineral of tin is cassiterite which contains as much as 78 % Sn. The majority of tin come from placer deposits whereas hard rock tin is mined rather exceptionally. More than 50 % of placer deposits occur in SE Asia. River (alluvial) placers where heavy minerals were naturally sorted by flowing water over the river bed are most important and the richest ones among the secondary deposits. World economic reserves are estimated at 8 mill.tons of metal.

The majority of tin are used in solders (31 %) and chemicals (7 %), then in alloys (bronze), tin plate and pipes, etc.

2. Mineral resources of the Czech Republic

Tin deposits of the Czech Republic are almost exclusively concentrated in the Krušné hory mountains region where they were mined since medieval times.

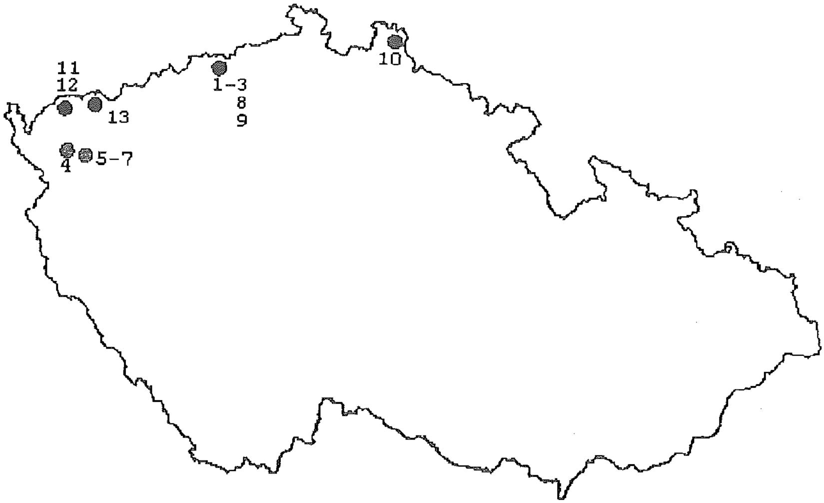
▪ The most important type of tin mineralization is represented by greisen deposits of Sn-W-(Li). These deposits occur in both the eastern part (Cínovec, Krupka) and the western part (Rolava, Přebuz) of the Krušné hory Mts as well as in the Slavkovský les area (Krásno - Horní Slavkov). The origin of these deposits is connected with greisenization and silicification of the Late Variscan domes of granits high in lithium and topaz. The major Sn mineral is cassiterite which is disseminated in the greisen bodies and usually accompanied by wolframite and zinwaldite. The Krupka ore district is also characteristic of abundant hydrothermal quartz veins with cassiterite, wolframite and/or Bi and Mo minerals. Sn-W ores with 0.2 - 0.5 % Sn were mined in greisen type deposits.

▪ An interesting type of Sn mineralization occurs at Zlatý Kopec near Boží Dar where tin minerals are confined to a complex skarn consisting of major magnetite accompanied by minor cassiterite, sphalerite and chalcopyrite. The complex ore shows 0.95 % Sn.

▪ Basically, the only deposit of primary Sn ores outside the Krušné hory region is a stratabound mineralization of cassiterite and sulphides at Nové Město pod Smrkem. An exploration project was carried out after World War II which showed an average content of 0.23 % Sn in the ore. Sn mineralization consisting of stannite was found to occur at the Old Bohemian zone of the Kutná Hora mining district. Due to the complex character of the ore, the Sn mineralization is of rather scientific importance, particularly from the viewpoint of metallogeny and specific mineral assemblage.

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

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total	a)	14	14	14	13	13
exploited		2	2	0	0	0
Total reserves, t Sn		203736	203087	203087	203087	203087
economic proven		29131	3813	3757	3757	3757
economic probable		43550	37266	37266	37266	37266
subeconomic		131055	162008	162064	162064	162064
Mining output, t Sn		510	15	0	0	0
Imports, t	b)	N	13000	1998	0	0
Exports, t	b)	N	114000	0	5	0

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

5. Customs tariffs

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

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

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 and their share of the world production were as follows (according to the Welt-Bergbau-Daten):

Year	1990	1991	1992	1993	1994 e
Concentrate prod., kt Sn	216	189	175	182	180
Main producers, %:					
China	20	22	24	25	25
Indonesia	14	16	17	15	15
Brazil	18	15	16	18	17
Bolivia	8	9	9	10	11
Malaysia	13	11	8	6	5

Tin concentrate production and its export quotas are rather affected by ATPC - members are Indonesia, Bolivia, Malaysia, Australia, Thailand, Nigeria, Zaire and since 1993 also China. Membership of China in ATPC could reduce tin over-production; it is expected that annual production of concentrate in metal content will not exceed 50 kt in China.

8. World market prices

Four grades of tin concentrate are quoted on the world market: 20/30 % Sn (commodity A), 30/50 % Sn (commodity B), 50/65 % Sn (commodity C) and 65/75 % Sn (commodity D) 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 E). Prices of tin concentrates at yearend and an average annual price of pure metal were as follows:

Commodity / Year	1990	1991	1992	1993	1994
A	465	465	465	490	465
B	425	425	425	425	425
C	450	450	450	450	450
D	462	462	462	462	462
E	6203	5593	6105	5147	5462

The increase in export from China affecting prices up to 1993 (when China became member of ATPC) should stabilize.

9. Recycling

Only a small quantity of tin is recycled, particularly that of tin removed from tin plate (by the process economically pretentious). About 25 % of the tin world production is estimated to be recycled.

10. Possible substitutes

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

TUNGSTEN

1. Characteristics and use

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

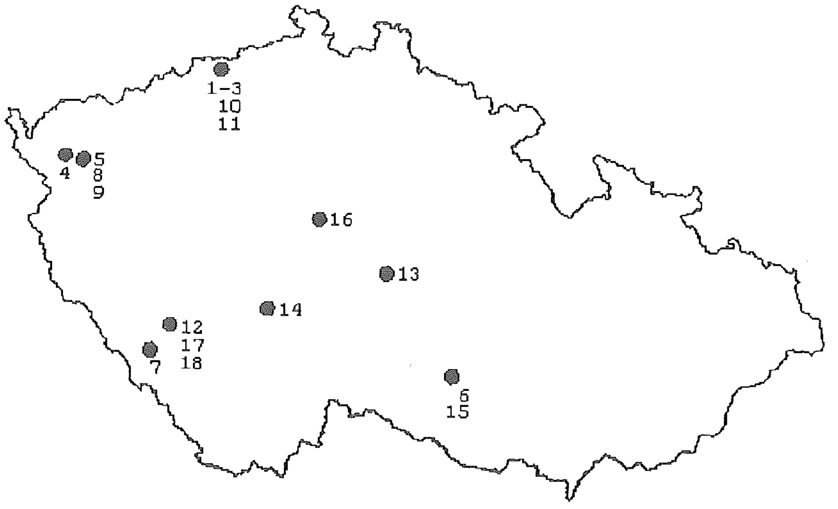
Tungsten ores and concentrates are processed to obtain intermediate products - ammonium paratungstate (APT),tungstic acid, sodium tungstate, metal powder and powder tungsten carbide. Much tungsten is consumed in alloyed steels used in heavy machine industry, particularly in the armament industry. Much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

2. Mineral resources of the Czech 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 mineralizations were found and verified in various places of the Bohemian Massif, particularly during the last few years.

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

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total	a)	12	14	17	18	18
exploited		2	2	0	0	0
Total reserves, t W		48406	48326	50723	92298	92298
economic proven		3669	231	127	127	127
economic probable		12038	10922	10913	52488	52488
subeconomic		32699	37173	39683	39683	39683
Mining output, t W		84	12	0	0	0
Imports, t	b)	N	498000	47	0	0
Exports, t	b)	N	0	0	34	119

Note:

a) Sn-W and W ore deposits

b) item 2611 of the customs tariff

5. Customs tariffs

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

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

In 1994 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 and 1990. 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 and their share of world production were as follows (according to the Welt-Bergbau-Daten):

Year		1990	1991	1992	1993 e	1994 e
Production, kt W		52	48	36	30	30
Main producers, %:						
China		63	66	55	58	59
CIS	a)	15	17	18	19	18

Note:
a) USSR before 1992

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	1990	1991	1992	1993	1994
A	43	63	45	33	54
B	54	61	56	38	66

9. Recycling

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

10. Possible substitutes

The metal remains irreplaceable in the steel-making industry as an alloying additive, in the manufacture of armament, cutting and drilling tools and electrotechnics. Some attempts were made during the period of the tungsten price rise to replace W by molybdenum or even by depleted uranium showing large surplus worldwide. Replacement of W by ceramic materials is reasonable in some fields and replacement of W by Mo in automobile industry is more than equivalent. Sintered tungsten carbide used in the manufacture of cutting and drilling tools can be partly replaced by carbides of other metals or by nitrides and oxides and/or new composite materials particularly in less exposed fields where the price of tungsten and tungsten carbide plays a decisive role.

ANTIMONY

1. Characteristics and use

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

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

2. Mineral resources of the Czech Republic

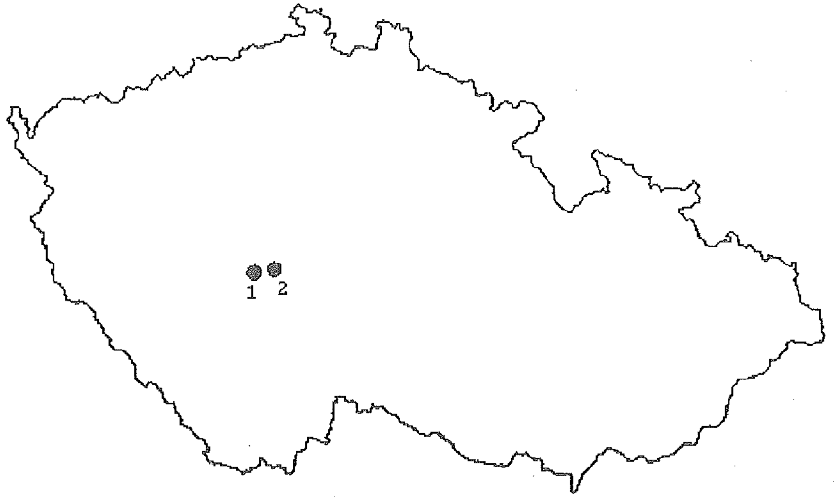
Occurrences of Sb ores in the Bohemian Massif are spatially bound to the Central Bohemian pluton. Hydrothermal Sb mineralization is confined to quartz veins or silicified mylonite zones or eventually forms fillings in fractures of lamprophyric dike rocks.

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

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

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

3. Registered deposits and their location in the Czech Republic



1 Krásná Hora
2 Deštno

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

Year		1990	1991	1992	1993	1994
Deposits - total number		2	2	2	2	2
exploited		1	1	1	0	0
Total reserves, t Sb		4847	3973	4009	4009	4009
economic proven		4304	3430	0	0	0
economic probable		316	316	153	153	153
subeconomic		227	227	3856	3856	3856
Mining output, t Sb		216	384	224	0	0
Imports, t	a)	0	0	0	13	2
Exports, t	a)	N	2322	3326	0	0

Note:
a) item 2617 10 of the customs tariff

5. Customs tariffs

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

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

No mining companies were operating on the territory of the Czech Republic to extract antimony ores in 1993.

7. World production

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

Year		1990	1991	1992	1993 e	1994
Mining output, kt Sb		62	59	44	40	N
Main producers, %:						
China		54	60	52	50	N
Bolivia		14	12	14	15	N
CIS	a)	9	8	11	10	N
South Africa		8	7	9	8	N

Note:

a) USSR before 1992

8. World market prices

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

Commodity / Year	1990	1991	1992	1993	1994
A	16.00	15.50	14.75	14.50	35.00
B	16.50	16.00	15.25	15.00	37.50
C	12.75	12.65	12.50	12.00	27.50
D	1708.00	1631.00	1708.00	1624.00	3830.00

9. Recycling

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

10. Possible substitutes

Antimony can be replaced by compounds of titanium, zinc, tin and strontium in production of chemicals, pigments, fritted glass and glazes. Combinations of calcium, strontium, tin, copper, selenium, sulphur and cadmium can be used for hardening of lead instead of antimony. Selected organic compounds and hydrated alumina can be used to replace antimony in the manufacture of self-extinguishing additives.

SILVER

1. Characteristics and use

Silver is a white, relatively soft metal melting at 960° C and with specific density of 10.5 t/m^3. It exhibits the highest heat and electric conductivity among all metals and it is extra resistant against atmospheric oxidation and against corrosion in diluted acids. Silver is an element of chalcophile character which during the magmatic differentiation tends to concentrate in minerals of late stages or hydrothermal fluids. About 2/3 of the silver world reserves occur in Cu and Pb-Zn deposits of various origin. About 80 % of primary silver is recovered as a by product in processing and smelting of base metal ores. 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). World economic reserves of silver metal are estimated at 280 kt at present prices. Majority of silver are used in photography (43 %), in jewelry and table plate ware (18 %), in electrotechnics and electronics (15-17 %), in mints, in alloys for brazing, in batteries, mirrors and special reflecting surface coatings (to absorb solar energy), in catalysts (for production of formaldehyde from methanol and conversion of ethylene to ethylenoxide). Silver is also used in medicine and in nuclear power generation to produce control rods for water reactors (an alloy consisting of 80 % Ag, 15 % In and 5 % Cd).

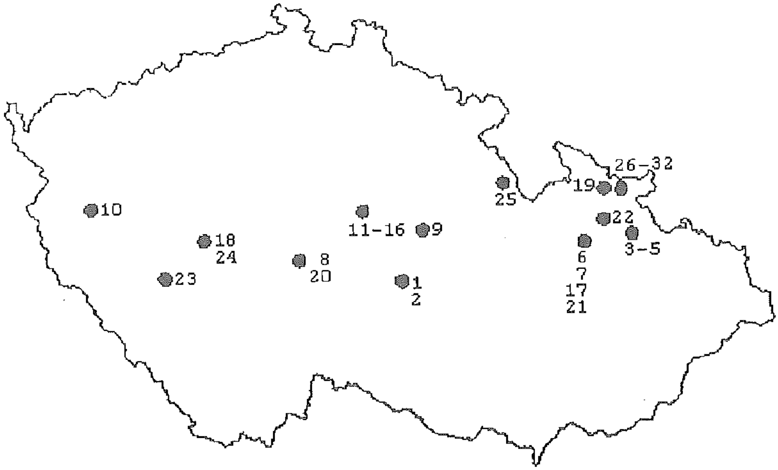
2. Mineral resources of the Czech Republic

Mining for silver played a decisive role in medieval ore mining in Bohemia and in prosperity of old mining towns.

▩ The major portion of silver reserves in the Czech Republic occurs in base metal sulphide deposits where it forms an isomorphous admixture particularly in galena. Minimum Ag grade was found to occur in all base metal deposits, e.g. 8-20 ppm Ag in base metal ores of the Horní Benešov deposit, 15 ppm Ag at Zlaté Hory - east, 15-22 ppm Ag at Horní Město, 30-50 ppm at Kutná Hora, etc. Some Ag was extracted as a by-product when mining for high grade base metal ores (58-70 ppm Ag) and U-Ag ores (high grade Ag ores with native silver and Ag minerals exhibiting around 480 ppm Ag) of the Příbram uranium-base metal deposit until the mining operations were reduced or ceased completely in the early nineties.

▩ Numerous recently abandoned deposits of Pb-Zn-Ag and deposits of so-called five element assemblage in medieval mining districts of Kutná Hora, Jihlava, Příbram, Jáchymov and Stříbro were an important source of European silver in the past. The deposits represent classic types of base metal and other metallic deposits.

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total	a)	43	38	39	36	32
exploited		10	7	3	1	0
Total reserves, t Ag		1002	1016	1111	1090	1090
economic proven		118	86	19	8	8
economic probable		626	601	433	403	403
subeconomic		258	329	659	679	679
Mining output, kg Ag	b)	16200	8900	6200	500	100
Imports, t	c)	167	12	107	0	0
Exports, t	c)	0	2	4	0	0

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

5. Customs tariffs

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

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

In 1994 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 kt per year in 1976. Since then it was increasing and reached its peak in 1989 - 15.835 kt. The major producing countries and their share of the world production were as follows (according to the Welt-Bergbau-Daten):

Year	1990	1991	1992	1993 e	1994 e
Mining output, t Ag	15480	14881	14301	14200	14000
Main producers, %:					
Mexico	15	15	16	16	16
USA	14	12	13	13	12
Peru	11	12	11	11	11
Australia	7	8	9	8	7
Canada	9	8	8	6	5

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

Commodity / Year	1990	1991	1992	1993	1994
A	273	230	224	333	345

Fluctuations in silver world prices reflect among others political situation and speculations on the market identical with other precious metals. An increase in price of silver in 1994 depended on an 2 % increase in Ag consumption (index of inter-annual increase in consumption was 1.02 in 1994/1993) close upon a revival of industrial production. The consumption should go up 3 % approximately in 1995.

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. In average 59 % of the total Ag production have been assumed to come from recycling worldwide during last three years.

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, replaced by common metals, particularly by Cu alloys.

GOLD

1. Characteristics and use

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

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

2. Mineral resources of the Czech Republic

The tradition of mining for primary and secondary gold in the Bohemian Massif dates back almost three millennia. Bohemia used to be one of the most important producers of gold in Europe in the Middle Ages.

■ The major part of gold mineralization is confined to regionally metamorphosed volcaniclastic complexes locally penetrated by Variscan granitoids. Such a complex in the central Bohemian region is represented by the Jílové zone of the Proterozoic age. The zone is characteristic of abundant gold-quartz mineralization which occurs in the deposits of Jílové, Mokrsko, Čelina and some others. Gold mineralization in the Jeseníky mountains area is confined to stratabound base metal deposits related to Devonian volcanism (Zlaté Hory-west).

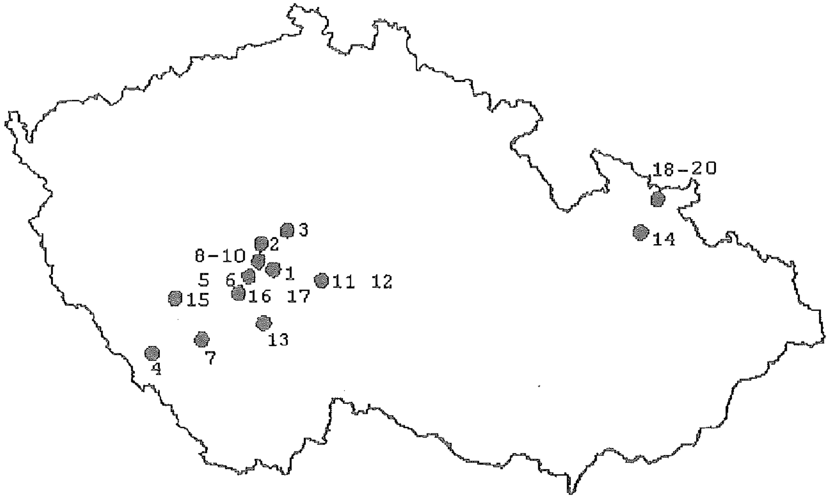
■ Some hydrothermal quartz veins with gold as well as stratabound gold mineralization with scheelite (Kašperské Hory) and quartz veins and stringers with Ag (Roudný) occur in the crystalline complex of the Moldanubicum.

■ Placer gold deposits are close to the primary gold deposits. Permocarboniferous paleoplacers occur in western Bohemia (Křivce) as well as in the Krkonoše piedmont and in the Intrasudeten basins. The largest areas of Quaternary placers are located in the foothills of the Šumava mountains and in northern Moravia. Still recognizable remnants of placer gold panning indicate extensive mining for gold which goes back to Celtic times.

No gold mining is currently taking place in the Czech Republic, following the termination of mining operations at the Krásná Hora Au-Sb deposit in 1992 and at the Zlaté Hory-west base metal deposit in 1993.

In 1994 an international invitation to tender "Exploration for Gold in the Czech Republic" was realized. Six companies win with their bids to explore 17 areas with the total area 2,093 km^2. Ministry of Economy initiated the administration process to licence geological operations in the 4th quarter of the year 1994. Preconditions to re-open Au-ore mines in the territory of the Czech Republic should be prepared in this extensive geological exploration.

3. Registered deposits and their location in the Czech Republic



1 Deštno
2 Dražetice-adit no. IV
3 Jílové near Praha
4 Kašperské Hory
5 Krásná Hora
6 Libčice
7 Modlešovice
8 Mokrsko
9 Mokrsko-east
10 Prostřední Lhota-Čelina
11 Roudný-Aleška
12 Roudný
13 Sepekov
14 Suchá Rudná-central part
15 Újezd near Kasejovice
16 Voltýřov
17 Voltýřov-placer
18 Zlaté Hory-east
19 Zlaté Hory-west
20 Zlaté Hory-west-550 m

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

Year		1990	1991	1992	1993	1994
Deposits - total number		20	19	20	21	20
exploited		4	3	3	1	0
Total reserves, kg Au		98157	100556	172569	214482	214407
economic proven		6992	3694	51146	48740	48740
economic probable		80865	72331	51528	84751	84751
subeconomic		10300	24531	69895	80991	80916
Mining output, kg Au	a)	187	564	521	512	75
Imports, kg	b)	3029	1133	992	10979	2299
Exports, kg	b)	N	13	4	8605	5565

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

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Tariff rates in % Concessionary
2616	Precious metal ores and concentrates		
2616 90	- Others	free	free
7108	Gold in unwrought or in semi-manufactured form, gold powder	0 - 5	0 - 3.9

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

In 1994 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 2,280 tons of metal. The major producing countries and their share in world production were as follows (according to Gold Fields Mineral Services Ltd):

Year		1990	1991	1992	1993	1994
Mining output, t Au		2133	2161	2237	2280	2296
Main producers, %:						
South Africa		28	28	27	27	25
USA		14	14	15	14	14
Australia		11	11	11	11	10
CIS	a)	13	12	11	11	10
Canada		8	8	7	7	6
China		4	5	5	5	6

Note:
a) USSR before 1992

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, tbe 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 - actual price USD 614.63 per troy oz, real price USD 1,077.45 per troy oz (constant USD 1993 = 1). 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 at LME in last 5 years (up to 1992 average a.m. and p.m. fixing, since 1993 average p.m. fixing):

Commodity / Year	1990	1991	1992	1993	1994
Gold	383.66	362.30	343.91	359.82	384.15

9. Recycling

About 60 tons of gold in the USA comes from the reworking of gold fractions which accounts for about 60 % of the total domestic production. Gold in other countries 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

Coal production originated in the Czech countries in the 19th century in the beginning of an industrial revolution. Oil and gas output were and till the present time have been insignificant. 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. 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 output of mineral fuels

Mineral fuel	Unit	1990	1991	1992	1993	1994
Uranium ore	t U	2243	1827	1631	1018	537
Hard coal	kt	30714	25769	24691	23862	20910
Brown coal	kt	78391	75988	68100	66891	59811
High volat. lignite	kt	1814	1500	1419	1263	913
Crude oil	kt	47	64	80	107	131
Natural gas	mill.m^3	125	125	132	106	154

URANIUM

1. Characteristics and use

Uranium with its atomic weight of 238.03 represents the heaviest natural element of the periodic table. It is radioactive with a half-life period of decay equal to 4.5 x 10^9 years. Pure uranium is a white, lustrous metal melting at 1,133°C and exhibiting a specific density of 19.05 t/m^3. Its characteristic property is natural radioactivity of all its isotopes. Relative proportions of single isotopes are as follows: U^{238} = 92.2739 %, U^{235} = 0.7204, U^{234} = 0.057 %. The average abundance of uranium in the Earth's crust is 4 x 10^{-4} %. Uranium constitutes several tens of minerals (exclusively oxidic compounds) of which economically most important are oxides (uraninite - pitchblende), phosphates (torbernite, autunite), silicates (coffinite) and organic compounds (anthraxolite). The most important uranium deposits occur in Canada, USA, Zaire, South Africa and Australia. World reserves are estimated at 2.1 mill.tons of uranium metal.

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

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

About 17 % of world electric energy production was generated in atomic power stations in 1994.

2. Mineral resources of the Czech Republic

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

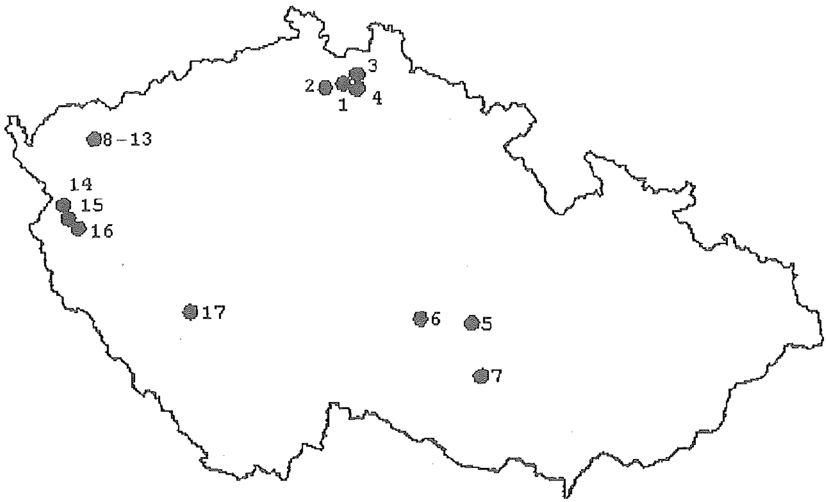
- crushed zones with graphite and disseminated uranium ores in crystalline rocks of the Bohemian Massif (Rožná, Zadní Chodov),
- veins and vein systems - hydrothermal deposits related to Variscan granitoids (Jáchymov, Slavkov, Příbram),
- metasomatic mineralization in chloritized granitoids of the Borek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

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

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

A total of 17 uranium deposits were registered on the territory of the Czech Republic as of December 31, 1994. Currently mined deposits are only the deposits Hamr and Stráž in the Bohemian Cretaceous basin and mineralized fracture zone at Rožná. Underground mining takes place at Hamr (in average grading 0.084 % U in proven reserves) and 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 underground in situ leaching. All extracted ore was chemically processed to provide chemical concentrate (yellow cake). The only customer to buy U-concentrates were Czech Power Plants (ČEZ).

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total number		17	17	17	17	17
exploited		4	4	4	3	3
Total reserves, t U		145341	145341	143741	143322	142835
economic proven		44574	44574	47767	47136	46744
economic probable		54374	54374	50819	50576	50480
subeconomic		46393	46393	45155	45610	45611
Mining output, t U		2243	1827	1631	1018	53
Imports, t	a)	0	0	0	0	0
Exports, t	a)	0	0	0	0	0

Note:
a) item 2612 10 of the customs tariff; ČSÚ presented imports 1kg per year in 1993 and 1994

5. Customs tariffs

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

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

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 exceeding 44,000 tons of uranium was reached in 1980. Major uranium producing countries and their share of the world production were as follows (according to the Mining Magazine and the Welt-Bergbau Daten):

Year		1990	1991	1992	1993	1994 e
Mining output, t U		44696	37486	33414	32532	31695
Main producers, %:						
Canada		22	22	27	28	28
CIS	a)	25	24	23	25	25
Niger		6	8	9	9	9
France		7	7	9	5	5
Australia		8	10	7	7	7

Note:
a) USSR before 1992

In 1994 90 % of uranium were obtained by U-ores mining (42 % by surface mining, 29 % by underground mining and 19 % by in situ leaching) and 10 % was obtained as a by-product within the Au- V- and Cu- ores extraction.

According to prognoses the world U-ore production should decline; an interannual 1998/1994 decrease index should result 0.86 whilst an interannual 1998/1994 consumption increase index prognosis amounts 1.02. Consumption should be fairly covered by dissolution of military and civil reserves.

8. World market prices

There are two categories of uranium prices: prices for spot sales and future delivery prices (negotiated). Prices of spot sales in the seventies were still higher than those of future delivery contracts. Recently, however, the ratio is reversed and majority of sales is materialized in spot prices. Until 1992, only two companies - Nuexco and Nukem were revealing the spot prices. Since then the source of information on prices has increased. Prices for spot sales of ores and concentrates are given in USD/lb U_30 separately as restricted and unrestricted exchange value. So far the highest price was reached in 1978 - USD 43 per lb U_8O (Nuexco). Since then there was a drop in prices, and starting 1989 the average prices of spot sales continued to be under

USD 10 per lb U_3O_8. Average prices of uranium concentrate in USD per lb U_3O_8 fluctuated as follows:

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

Commodity / Year	1990	1991	1992	1993	1994
A	N	N	7.90	9.90	9.30
B	N	N	7.85	6.90	7.05
C	N	N	10.12	10.00	9.45
D	N	N	7.95	7.05	7.22

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

General fall in prices is due to global political relaxation and economic changes. There is a surplus of uranium due to nuclear disarmament (large supplies from CIS - the former USSR for USD 7.00 - 7.20 per lb U_3O_8), reduction of consumers stockpiles and declining nuclear energy generation, etc.

Uranium consumption was higher then its production in 1994 and it reached about 56 t (index of interannual decrease in consumpmtion 1994/1993 = 0.982). It is expected that the consumption up to 2010 will be approximately the same.

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^{238} or U^{238} cannot be materialized because of the Treaty for non-proliferation of nuclear weapons. When using so-called reactors with fast neutrons (i.e. in case of Th and U^{238}), the fission products could be misused for the production of nuclear weapons.

HARD COAL

1. Characteristics and use

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

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

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

2. Mineral resources of the Czech Republic

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

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

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

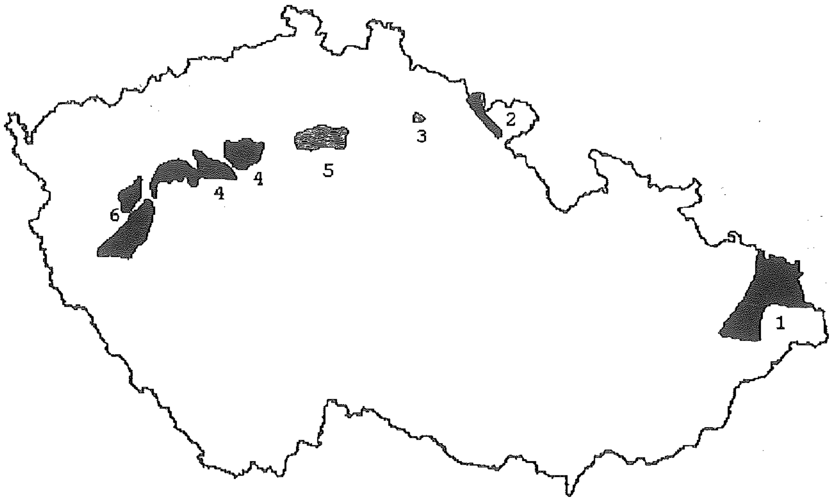
Relatively large reserves of coal were verified south of the original Upper Silesian basin, particularly near Frenštát pod Radhoštěm where Carboniferous sediments are buried under Miocene sediments and the Beskydy nappes. Here, the coal would be extracted from the depths of 800 to 1,300 m under difficult geological and mining conditions.

▪ Another area with reserves of hard coal occurs in central Bohemia, west of Prague. The majority of coal reserves of the Kladno-Rakovník basin (steam coal) were already mined and remaining two mines, still in operation, have limited volume of mineable reserves. Another deposit of coking coal was discovered and explored in the fifties and sixties near Slaný. It extends NE from the Kladno basin and has about 223 mill. tons of coal which occurs at depths of 1,000 to 1,300 m. The deposit was developed by two main shafts which were later closed.

▪ NE of Prague, there has been explored the so-called Mšeno (Mělník) basin having 1,268 mill.tons of reserves of steam coal. However, conflicts of interest prevent to develop this deposit (overlying Cretaceous sandstones represent a source of potable water for central Bohemia).

▪ Some other deposits of hard coal in the Plzeň (Pilsen) and Trutnov regions and near Brno are either almost exhausted or due to anticipated mining cost become 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		1990	1991	1992	1993	1994
Deposits - total number		100	100	98	97	74
exploited		38	29	26	26	25
Total reserves, kt		12951167	13096406	13084836	13511433	13573064
economic proven		3069226	2838652	2761374	2322931	2309614
economic probable		6808792	6566497	6402537	6098169	5962804
subeconomic		3073149	3691257	3920925	5090333	5300646
Mining output, kt		30714	25769	24691	23862	20910
Imports, kt	a)	1825	3714	3112	1940	1721
Exports, kt	a)	1532	2500	2788	5137	6499

Note:
a) item 2701 of the customs tariff

5. Customs tariffs

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

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

OKD, a.s. - Důl 9.květen (Stonava)
OKD, a.s. - Důl Dukla (Havířov-D.Suchá)
OKD, a.s. - Důl Doubrava
OKD, a.s. - Důl J.Fučík (Petřvald)
ČMD, a.s. - Důl Kladno o.z. (Libušín)
OKD, a.s. - Důl František (Havířov-H.Suchá)
ČMD, a.s. - Důl Tuchlovice
ZUD, a.s. - Zbůch
OKD, a.s. - Důl Odra (Ostrava-Přívoz)

7. World production

World production of hard coal exceeded 3,000 mill. tons in 1985 and reached its peak in 1990. 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 and their share of world production were as follows (according to the Welt-Bergbau-Daten):

Year		1990	1991	1992	1993	1994 e
Mining output, mill.t		3615	3525	3576	3627	3500
Main producers, %:						
China		29	29	30	35	34
USA		24	23	23	21	18
CIS	a)	15	13	14	13	12
India		6	6	7	7	8
Australia		6	6	6	6	6
South Africa		5	5	6	6	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 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 (according to the Coal Week International) or FAS (according to the Coal). 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:
A Coking coal
B Steam coal

Commodity / Year	1990	1991	1992	1993	1994
A	N	46.20	45.20	44.10	43.58
B	N	36.70	35.70	36.00	34.69

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 (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 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 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.

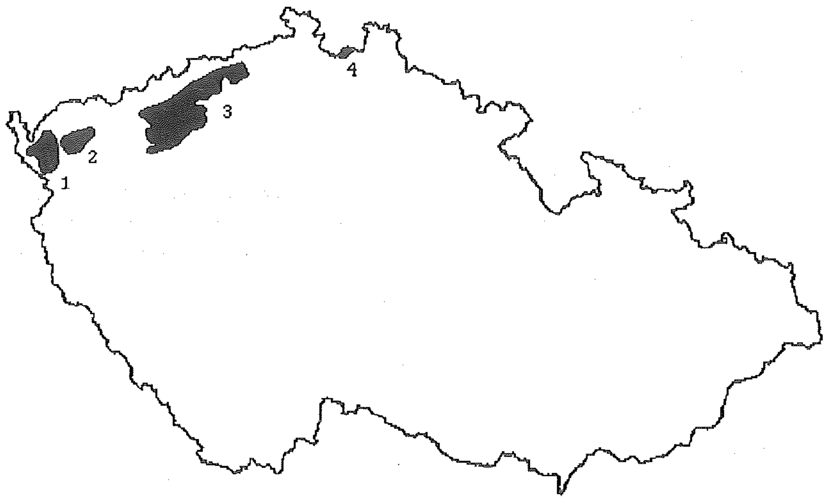
▪ Shallow parts of the Teplice partial basin were already mined. Remaining reserves of almost sulphur free brown coal located under the Chabařovice township are likely to be abandoned because of the conflicts of interest. Similar conflicts may occur even in other parts of the basin.

▪ The Sokolov basin west of Karlovy Vary has two brown coal seams. The major reserves are confined to the thickest and the uppermost seam called Antonín. The brown coal is of xylitic character, it is high in water and relatively low in sulphur. The seam is extracted by open pit mining and is used in power generation (sorted brown coal, burning in power plants, lighting gas production).

▪ The Cheb basin has about one billion of reserves of stratigraphically latest lignite characteristic of high content of water (about 50 to 55 %), high in liptodetrite, and consequently high in mineral tar. It is a brown coal suitable for chemical processing. Mining operations in this basin were not allowed because they are likely to affect sources of mineral water for nearby Františkovy Lázně spa.

▪ The Zittau basin extends into the Czech Republic from Poland and Germany. The upper seam was already mined. Remaining two lower seams are difficult to be mined underground because of overlying quicksand and tectonic problems.

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total number		80	80	83	79	80
exploited		23	22	21	19	17
Total reserves, kt		11100310	11004316	11247919	11115499	10713071
economic proven		5653195	5610526	4553475	4200406	3965192
economic probable		2254125	2212437	2208560	1930676	1922642
subeconomic		3192990	3181353	4485884	4984417	4825237
Mining output, kt		78391	75988	68100	66891	59811
Imports, kt	a)	0	2	0	29	7
Exports, kt	a)	2158	2267	3147	5008	5282

Note:

a) item 2702 of the customs tariff

5. Customs tariffs

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

6. Mining companies in the Czech Republic as of December 31, 1995

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

7. World production

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

Year		1990	1991	1992	1993	1994 e
Mining output, mil.t		1179	1086	1014	920	950
Main producers, %:						
USA		7	7	8	8	8
Germany	a)	30	26	24	24	23
CIS	b)	13	14	13	13	12
Czech Republic		7	7	7	7	6
Poland		6	6	7	7	7

Note:
a) including GDR in 1990
b) USSR before 1992

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 international 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 lignite 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 high volatile lignite. 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 lignite. In the Czech Republic, however, is treated separately.

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

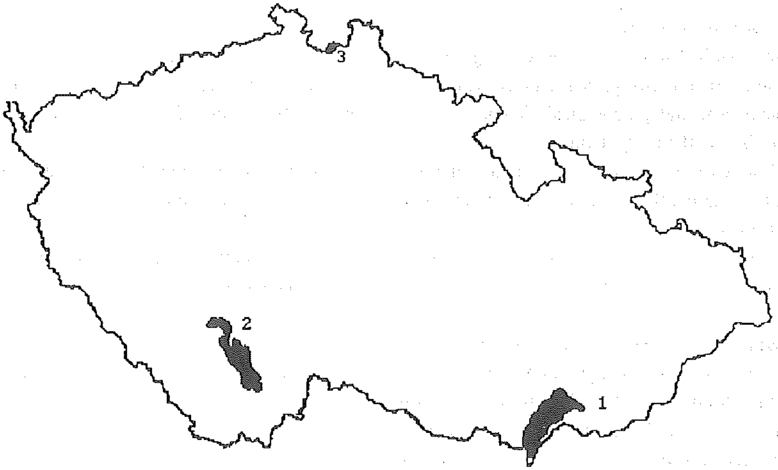
2. Mineral resources of the Czech Republic

■ Largest deposits of high volatile lignite occur along the northern margin of the Vienna basin which extends from Austria into southern Moravia. There are two lignite seams in the latest sediments of the Pannonian and Pliocene age. Reserves of the northern Kyjov seam are already exhausted whereas reserves of the southern Dubňany seam are currently mined by two shafts. Economic reserves are registered at another deposits but their extraction is not anticipated. South Moravian high volatile lignite is of xylodetrital character with numerous tree trunks. It is high in water (45-50 %) and its caloric value is less than 10 MJ. The content of sulphur is about 3-4 % which is above the ecological norm. The lignite is burnt in the Hodonín power plant. Regardless of relatively large reserves of high volatile lignite in the basin, further development of mining operations is unlikely due to various reasons.

■ There are seven deposits of high volatile lignite in southern Bohemia which are registered. They occur in narrow lobate extensions of the České Budějovice basin. These deposits are not mineable because of very low grade of the local lignite. Moreover, the Mydlovary power plant, the major consumer of the local lignite, was closed.

■ Isolated occurrences of lignite are in the vicinity of Liberec in northern Bohemia. It is a Pliocene xylite.

3. Registered deposits and their location in the Czech Republic



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

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

Year	1990	1991	1992	1993	1994
Deposits - total number	20	20	20	20	20
exploited	3	3	3	2	2
Total reserves, kt	807537	805371	792470	787635	772571
economic proven	248743	246533	227729	180690	149190
economic probable	370819	370819	370819	359145	359145
subeconomic	187975	188019	193922	247800	264236
Mining output, kt	1814	1500	1419	1263	913

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

6. Mining companies in the Czech Republic as of December 31, 1994
Jihomoravské lignitové doly, s.p. (Hodonín)

7. World production

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

8. World market prices

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

9. Recycling

High volatile lignite is not recycled.

10. Possible substitutes

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

CRUDE OIL

1. Characteristics and use

Oil (petroleum)is a natural mixture of gaseous, liquid and dissolved solid hydrocarbons and their derivatives. Its specific gravity fluctuates between 0.75 and 1.0 t/m^3, the average content of carbon is between 80.0 and 87.5 %, hydrogen between 10.0 - 15.0 % and its calorific value ranges between 38.0 and 42.0 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 60.0 and 140.0° C in pelitic oil-bearing sediments at depths between 1,300 and 5,000 m. From these sediments it subsequently migrates and accumulates in permeable and porous reservoir rocks. Principally 4 types of crude oil can be recognized based upon its chemical composition - paraffin-base petroleum, asphalt-base petroleum, naphtene petroleum, and mixed bases (aromatic) petroleum.

Total deposit reserves of crude oil in the world are estimated at 136.000 mill. tons of which about 75 % have been found in OPEC member countries.

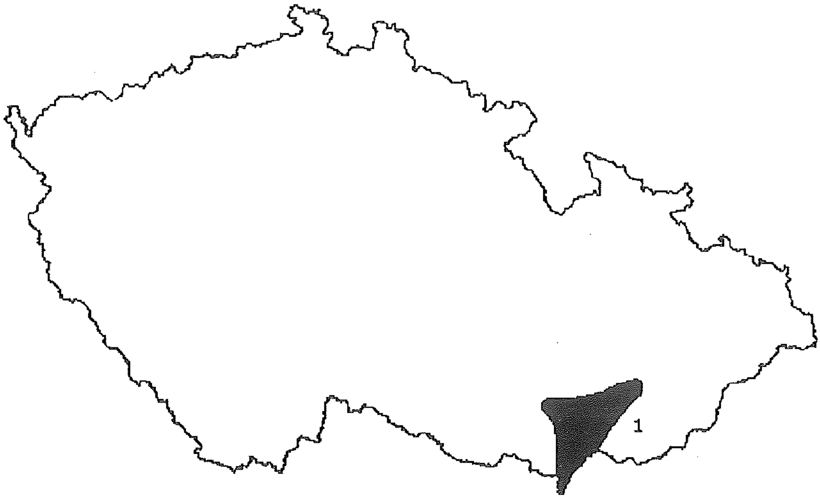
All-round oil industrial use is evident and new applications are still under way. Nevertheless, power generation, petrochemical and chemical industries are the principal oil consumers.

2. Oil resources of the Czech Republic

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

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

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		1990	1991	1992	1993	1994
Deposits - total number		15	16	19	20	23
exploited		8	8	11	11	14
Total reserves, kt		64917	64863	63474	63371	65876
economic proven		12285	12029	11224	10745	12586
economic probable		44675	44675	44090	44090	44323
subeconomic		7957	8159	8160	8536	8967
Mining output, kt		47	64	80	107	131
Imports, kt	a)	6475	6510	7049	5610	6493
Exports, kt	a)	0	0	9	66	76

Note:

a) item 2709 00 of the customs tariff

5. Customs tariffs

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

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

Moravské naftové doly, a.s. (Hodonín)

7. World oil production

World crude oil output was relatively stable during the last few years being 66.5 mill. barrels a day (1 barrel = 158.984 litres). Production was more or less controlled or affected by the OPEC quotas. However, these quotas were exceeded tenaciously by some OPEC members. The OPEC members accounted for more than 40 % of the world crude oil output. A production fall in continued in the CIS (the former USSR) 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		1990	1991	1992	1993	1994 e
Mining output, mill.t	a)	3101	3093	3112	3163	3150
Main producers, %:						
Saudi Arabia		10	14	14	13	14
CIS	b)	18	17	14	13	13
USA		12	13	12	11	12
Iran		5	5	5	6	6

Note:

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

b) the former USSR before 1992

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 38.0°, WTI 34.5°, Arab Light 34.0°, Dubai Fateh 32.0°, Russia Export blend 32.0°).

Average price quotations of direct sales in the last 5 years in USD per barrel, CIF Rotterdam (1993 and 1994 as of 31st December) were as follows:

A Brent crude oil

B OPEC basket crude oil

Commodity / Year	1990	1991	1992	1993	1994
A	N	20.10	19.30	13.15	16.48
B	N	18.66	18.41	12.95	16.34

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 reserves are estimated at 7 trillions of m^3.

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

2. Natural gas resources of the Czech Republic

▧ Natural gas deposits are in reservoirs that contain oil. The deposits are mostly located in south Moravian part of the Vienna basin. Northern part of the basin contains rather oil deposits. Natural gas contains more than 93.0 % of methane , up to 5.0 % of higher weight hydrocarbons and max. 1.0 % of hydrogen and carbon dioxide . 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		1990	1991	1992	1993	1994
Deposits - total number		42	44	44	45	49
exploited		14	13	17	20	22
Total reserves, mill.m^3		36078	35958	23376	23777	22804
economic proven		5598	5437	4439	4702	4835
economic probable		29234	29234	17699	17789	16475
subeconomic		1246	1287	1238	1286	1494
Mining output, mill.m^3		125	125	132	106	154
Imports, mill.m^3	a)	6361	6787	6850	6804	7322
Exports, mill.m^3	a)	N	N	N	1	2

Note:
a) item 2711 21 of the customs tariff

5. Customs tariffs

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

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

Moravské naftové doly, a.s. (Hodonín)
Důlní průzkum a bezpečnost Paskov, a.s.
UNIGEO, a.s. (Ostrava-Hrabová)

7. World production

World natural gas production continues to rise and it is not expected to be affected by the decrease in production in the former USSR, 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 and their share of world production were as follows (according to the Gas World International):

Year		1990	1991	1992	1993	1994
Mining output, bill.m^3		2067	2118	2106	2158	2181
Main producers, %:						
CIS	a)	39	38	37	35	32
USA		24	24	24	24	26
Canada		5	5	6	6	8

Note:
a) USSR before 1992

The gas of Carboniferous origin emitted during extraction of coal seams reached about 25 mill. t per year. It represented from 4 to 6 % of all methane emissions from both natural and man-made sources of methane in the world. Of given 25 mill. t about 1.6 mill. t of gas - i.e. approximately 6 % - were used for industrial purposes. A remainder went to the atmosphere. According to 1994 data 8 countries used the carboniferous gas - China, CIS, Czech Rep., Germany, Poland, Great Britain, USA and Australia.

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 4.0 per mill. Btu in 1985, had decreased down to USD 2.0 - 2.5 per mill.Btu in 1990. The American natural gas price was USD 1.98 per mill. Btu (Spot) in 1993, according to prognossis it should reach up to 3.50 USD per mill. Btu by 2010.

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 with total geological reserves exceeding 12,000 mill. t as of December 31, 1994. Of the reserves shares have namely limestones - 52 %, kaolin - 11 %, clays - 11 % and glass and foundry sands - 6 %. Other industrial minerals - fluorspar, barite, graphite, bentonite, feldspar and feldspar substitutes, quartz, gemstones (pyropes and moldavites), wollastonite, fusible basalt, diatomite, gypsum and dimension stone represent smaller nevertheless important raw material potential of the national economy. Kaolin, sands, clays and limestones are also important export commodities.

Mining output of industrial minerals

Raw material	Unit	1990	1991	1992	1993	1994
Fluorspar	kt	19	32	22	22	10
Barite	kt	1	1	0	0	0
Graphite	kt	39	47	20	27	25
Pyrope-bearing rock	kt	55	31	45	34	33
Moldavite-bearing rock	m^3	0	0	6480	0	0
Kaolin	kt	3455	2913	2530	2336	2706
Clays	kt	1409	947	903	1018	823
Bentonite	kt	159	125	135	63	65
Feldspar	kt	115	130	152	203	170
Feldspar substitutes (phonolite)	kt	15	16	16	20	25
Silica raw materials	kt	169	65	46	23	2
Natural sands	kt	2758	1837	1963	1735	1955
Fusible basalt	kt	142	72	107	134	85
Diatomite	kt	82	68	57	39	40
Limestones	kt	15449	11472	11134	10498	10205
Corrective sialic components	kt	796	650	741	616	655
Gypsum	kt	661	569	660	560	591
Dimension stone	thous.m^3	182	198	177	187	223

FLUORSPAR

1. Characteristics and use

Fluorspar - CaF_2 is by far the most common natural compound of fluorine. Fluorspar (also fluorite) is a transparent or translucent, glossy mineral, varying in color from white, amber, green, black, and blue to purple. The wide range of colors is caused by minor impurities and displacements in the crystal structure. The color can be changed when exposed to X-rays, UV radiation, heat, and pressure. The mineral crystallizes in the cubic system. Tiny inclusions of gas and liquids, pyrite, muscovite, chalcopyrite and other minerals are relatively common in fluorite. It occurs in the form of crystalline, massive or rodlike aggregates and also well developed crystals in fractures and cavities. It is rated as 4 on Mohs' scale of hardness. Majority of fluorspar deposits are of hydrothermal origin and may be further classified as low, medium and high temperature hydrothermal systems. Fluorspar deposits which originated by infiltration or residual, pegmatite and sedimentary deposits are much less abundant.

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

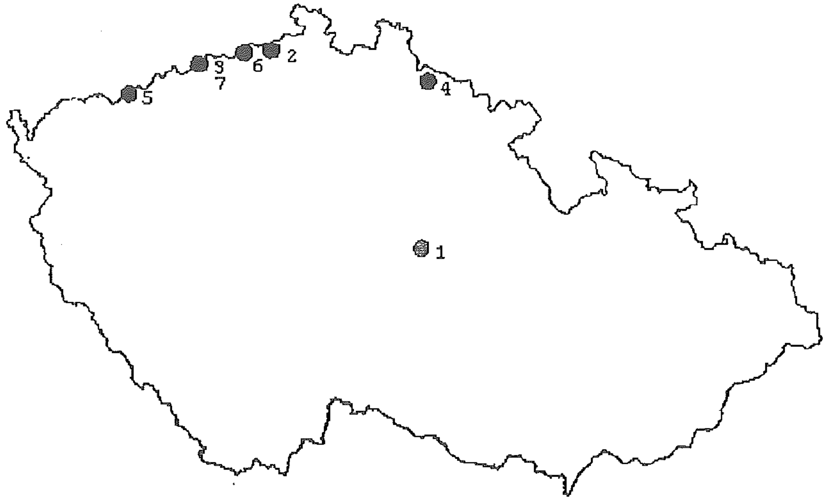
2. Mineral resources of the Czech Republic

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

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

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

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total	a)	7	7	7	7	7
exploited		4	4	4	3	3
Total reserves, kt		3744	3653	3629	3570	3558
economic proven		1038	1031	957	887	68
economic probable		2508	2508	2389	2400	2089
subeconomic		198	114	283	283	1401
Mining output, kt		19	32	22	22	10
Imports, t	b)	N	19792	2401	19616	26642
Exports, t	b)	N	1075	5894	14144	20667

Note:

a) deposits with balanced fluorspar content

a) items No. 2529 21 and 2529 22 of the customs tariff

5. **Customs tariffs**

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

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

Rudné doly Příbram, s.p.

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 and their share of world production were as follows (according to the Welt-Bergbau-Daten):

Year		1990	1991	1992	1993	1994
Mining output, kt		5641	4542	4456	4392	N
Main producers, %:						
China		29	37	47	48	N
Mongolia		16	11	8	12	N
Mexico		11	8	6	6	N
CIS	a)	8	9	9	7	N

Note:
a) USSR before 1992

8. **World market prices**

Fluorspar prices were recently affected not only by fall in demand but also by supplies of cheap Chinese fluorspar on the world market. The Chinese supplies caused economic losses to traditional western producers and consequently led to reduction of their production capacities. Most countries applied antidumping measures in 1993. Fluorspar prices valid for various fluorspar grades and place of origin are monthly quoted in the Industrial Minerals magazine in GBP/t or in USD/t and at different transport rates. Average prices of traded commodities at yearend were as follows:

A Metallurgical, min. 70 % CaF_2, 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
(in 1994 wet filtercake)
D Metallurgical, Mexican, USD/t, FOB Tampico
E Acidspar, Mexico, filtercake, USD/t, FOB Tampico

Commodity / Year	1990	1991	1992	1993	1994
A	50.00	87.50	87.50	92.50	92.50
B	127.50	145.00	145.00	165.00	162.50
C	N	108.00	105.00	111.00	141.00
D	92.50	92.50	92.50	87.50	90.00
E	135.00	124.50	124.50	111.00	117.50

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. Substitutes

Fluorspar is virtually a unique source of fluorine for chemical industry and thus irreplaceable. However, an extensive replacement of fluorohydrocarbon derivatives is under way when using new agents and methods in cosmetics and refrigerants (fluorine and its compounds are replaced by carbon dioxide, nitrogene, air, mechanical sprays, etc.). Fluorohydrocarbons are replaced by hydrocarbons in production of foamed plastics. Fluorspar can be substituted by cryolite (incl. synthetic) to certain extent in metallurgy when producing aluminium. Fluorspar can be also substituted by dolomite, limestone and/or olivine in ferrous metallurgy.

BARITE

1. Characteristics and use

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

Barium which is the major constituent of barite occurs in igneous rocks. It is released during their weathering and transferred in sediments and residual rocks. Barite deposits, in general, can be divided in fissure veins, replacement, residual and volcaniclastic (stratabound) deposits. World barite reserves are estimated at 210 mill. t.

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

2. Mineral resources of the Czech Republic

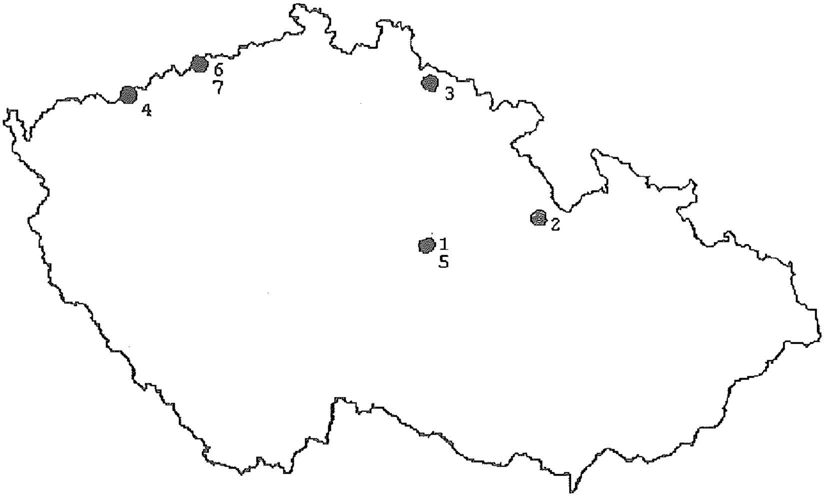
Barite deposits of the Czech Republic belong to the vein, stockwork, metasomatic or stratabound types. These deposits are randomly distributed over the Bohemian Massif depending on a great number of barite-bearing formations of various age and origin.

▩ Hydrothermal veins, locally with base metals, are tens to hundreds metres, exceptionally even 1 km, long, and having thickness between a few decimetres to several meters. The vein filling consisting of barite is in the form of lenses or columns. These veins are mostly confined to regional faults or faults of lower orders trending mostly NW-SE and NWN-SES which are often filled with an older quartz or quartz-hematite mineral assemblage. Locally occur younger polymetallic (base metal) and the latests quartz mineralizations which downgrade the vein filling in deeper parts (e.g. the Mackov and Bohosouvá deposits). The deposits are mostly of the early Alpine or Variscan age and to much lesser extent of Precambrian or late Alpine age. Earlier mined deposit of Pernárec (1924-1960), then the deposits Mackov, Moldava-Vápenice and Kovářská in the Krušné hory mountains or Bohousová, Harrachov,and Běstvina belong to the above mentioned type of the deposit.

▩ Stratabound barite deposits originated from submarine hydrothermal solutions ascending along the faults at sea floor. These stratiform deposits in the Bohemian Massif are represented by layers and lenses in sediments of the Barrandien zone and the Železné hory Proterozoic (Krhanice in the Sázava river basin, Křižanovice) and in the Devonian of the Jeseníky mountains (Horní Benešov, Horní Město-Skály).

▩ A barite mineralization is known from the Květnice deposit near Tišnov in the Moravicum where barite was mined during World War II. Calcite - barite veins also occur in granites of the Svratka Dome and in the Květnice limestones. The filling of the major vein consists of calcite whereas barite is much less abundant.

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total	a)	7	7	7	7	7
exploited		2	2	2	1	0
Total reserves, kt		3400	3140	3328	3328	3328
economic proven		279	44	44	44	44
economic probable		2600	2373	2373	2373	2373
subeconomic		521	723	911	911	911
Mining output, kt		1	1	0	0	0
Imports, t	b)	N	0	23699	31752	30596
Exports, t	b)	N	20	0	588	118

Note:

a) deposits with balanced barite content

b) item 2511 10 of the customs tariff

5. Customs tariffs

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

6. Mining companies in the Czech Republic

No mining companies were operating on the territory of the Czech Republic to extract barite in 1994.

7. World production

The world barite production was gradually increasing till 1990. 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 and their share of world output were as follows (according to the Welt-Bergbau-Daten):

Year		1990	1991	1992	1993	1994 e
Mining output, kt		8209	7687	6932	4626	7000
Main producers, %:						
China		24	23	27	41	32
CIS	a)	27	27	27	25	24
Mexico		4	3	6	3	6
India		8	9	6	12	5
Morocco		4	6	6	8	5

Note:
a) USSR before 1992

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 the end of the year 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	1990	1991	1992	1993	1994
A	N	N	N	42.50	42.50
B	N	N	N	37.50	37.50
C	170.00	170.00	170.00	190.00	207.50
D	40.00	40.00	40.00	43.50	38.50
E	N	N	N	85.00	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. Substitutes

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

GRAPHITE

1. Characteristics and use

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

All rocks which contain considerable amounts of graphite that can be recovered are be considered as a graphite raw material. Graphite is graded primarily on the size of flakes -"crystalline" flake graphite with flakes exceeding 0.1 mm and "amorphous" graphite with flakes smaller than 0.1 mm. The latter looks like a dull solid matter.

World deposits can be divided into several types: 1. early magmatic, 2. contact metasomatic - skarns, 3. vein type deposits 4. metamorphogenic - a) metamorphic, b) metamorphosed, 5. residual. World reserves of graphite are estimated at 21 mill. tons. Uses of graphite are based upon its physical and chemical properties. It is used in foundry industry, electrotechnics, chemical and nuclear industries, in manufacture of refractory materials, lubricants, protective coatings and pencils.

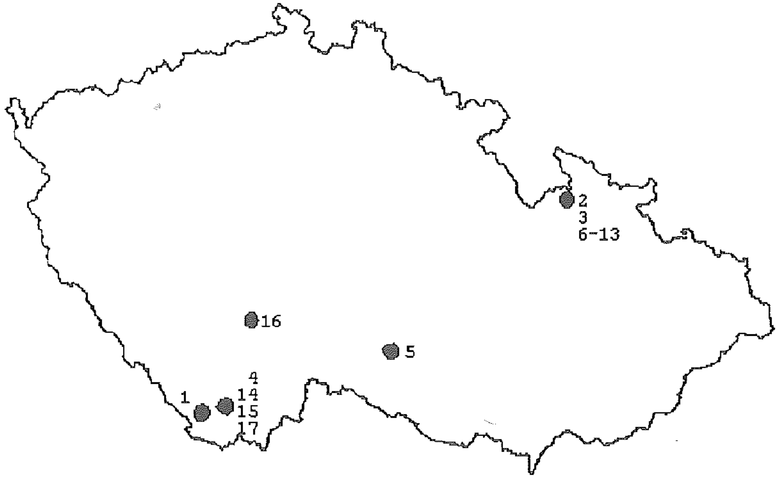
2. Mineral resources of the Czech Republic

All graphite deposits in the Czech Republic belong to the metamorphogenic type. They originated during regional metamorphism of clayey sandy sediments high in organic matter which is also indicated by higher concentrations of S, P, V and abundant limestones. The deposits occur in the western part of the Bohemian Massif in Moldanubicum, then in the Moravicum and Silesicum.

The most important deposits occur in the western part of Modanubicum, particularly in the so-called variegated series of Český Krumlov (mined deposits: Bližná, Český Krumlov-Městský vrch, Lazec, not mined deposits: Spolí, Český Krumlov-Rybářská street). Other less important deposits occur in the Votice-Sušice variegated series (not mined deposit at Koloděje nad Lužnicí-Hosty) and in the Chýnov mica schists (Černovice subeconomic deposit). South Bohemian graphitic rocks have a character of graphite rich gneisses, quartzites and carbonates.

Deposits in the Moravian-Silesian region occur in an area affected by lower grade metamorphism. Local graphite shows lower degree of crystallization and contains much more sulphur which is confined to pyrite and pyrrhotite. The whole region is characteristic of higher contents of volatile constituents and less sulphur in graphitic layers in limestones than those in schists and phyllites. The major deposit of graphite in the Moravicum is Velké Tresné which was abandoned in 1966. It occurs in the Olešnice group of the Svratka dome. The major deposit in the Silesicum is Velké Vrbno-Konstantin which is a part of a graphitic zone belonging to the western margin of the Velké Vrbno dome.

3. Registered deposits and their location in the Czech Republic



Amorphous graphite:

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

Crystalline graphite:

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

Combined graphite:

17 Spolí

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

Year		1990	1991	1992	1993	1994
Deposits - total number		10	10	10	10	17
exploited		4	5	4	5	4
Total reserves, kt		13216	13163	14559	14508	15287
economic proven		1770	1769	2198	2213	2178
economic probable		3611	3559	3725	3615	4369
subeconomic		7835	7835	8636	8680	8740
Mining output, kt		39	47	20	27	25
Imports, t	a)	1409	348	200	654	737
Exports, t	a)	2928	1224	896	2120	2294

Note:
a) item 2504 of the customs tariff

5. Customs tariffs

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

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

Grafit, a.s. (Netolice)
TREFIL, s.r.o. (Praha 5)

7. World production

World production of graphite remains stable for long time and is around 1 mill. t/year. World major graphite producing countries and their share of the world production were as follows (according to the Welt-Bergbau-Daten):

Year		1990	1991	1992	1993	1994 e
Mining output, kt		1029	1070	1031	893	950
Main producers, %:						
China		53	55	63	62	55
CIS	a)	8	8	8	7	6
India		6	7	7	9	8
Korean Republic		10	7	1	4	1

Note:
a) USSR before 1992

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 the CIS graphite on the world market. Prices of natural graphite are published monthly in the Industrial Minerals magazine and quoted in USD/t CIF UK port. 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	1990	1991	1992	1993	1994
A	N	N	1125	750	750
B	1060	925	600	500	500
C	945	725	550	400	400
D	720	500	425	375	375
E	330	330	330	330	260

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 MoS_2 in lubricants, partly by magnesite in steel production. All alternative materials, however, have limited use.

GEMSTONES

1. Characteristics and use

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

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

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

2. Mineral resources of the Czech Republic

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

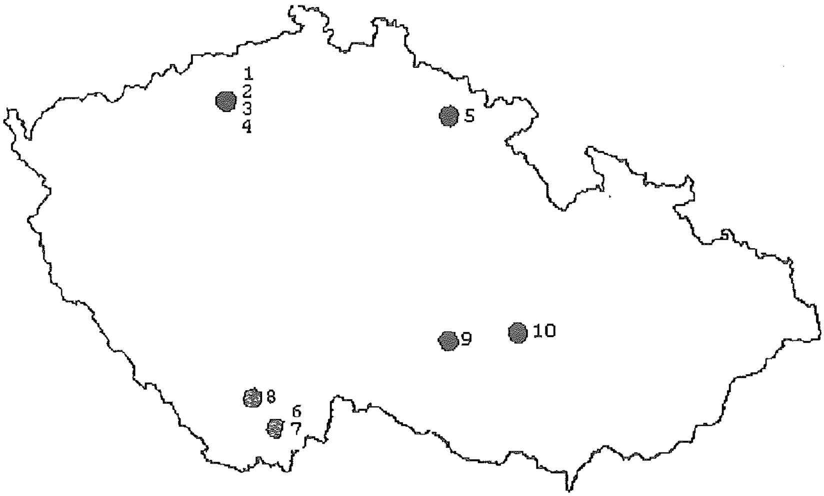
▪ Pyrope, the most famous Czech gemstone is relatively complex Mg and Al silicate of varying chemistry, always containing low concentrations of Fe and Cr. Primary source of pyrope are ultramafic rocks, but there are mined pyrope-bearing placers on the southern slopes of the České středohoří - the deposit Podsedice and the deopsit Vestřev in the Krkonoše piedmont basin only.

▪ The moldavites seem to represent an example to what extent the fashion trends may influence the popularity of certain gemstones. The moldavites are tectites whose origin is still enigmatic. They occur in loose Tertiary and Quaternary alluvial sands in southern Bohemia, in a belt which extends from Písek to České Budějovice and the Kaplice region. Brown moldatives occur in southern Moravia, along the Jihlava river, in a belt extending from Telč to Třebíč and further to Moravský Krumlov. Moldavites, particularly those from southern Bohemia, due to their attractiveness, are used in jewelry (mostly in their natural form). Industrial accumulations were verified at Besedice, Ločenice and Vrábče in southern Bohemia. Moldavites weren't mined systematically (during last five years the mining was realized in 1992 only).

▪ Increasing interest and demand for gemstones initiated some survey aimed at search for some other gemstones (varieties of SiO_2) in the Czech Republic. Amethyst was found to occur in relatively large volumes in some quartz veins penetrating a porphyry syenite of the Třebíč massif, particularly at the Bochovice and Hostákov localities. Geodes with crystals of amethyst and morion occur in these veins. The crystals exhibit zonal structure which is particularly well developed at Bochovice where the vein quartz envelopes so-called barrier amethyst. An opal deposit has been discovered in a fault zone NE of Rašov. A lenticular body of opal, about 60 m long occurs in a tectonic breccia confined to the Bíteš gneiss which shows some hydrothermal alteration.

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

3. Registered deposits and their location in the Czech Republic



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

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

Other gemstones:
9 Bochovice
10 Rašov

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

Year		1990	1991	1992	1993	1994
Deposits - total	a)	5	5	5	5	5
exploited		1	1	1	1	2
Total reserves, kt	a)	19049	19013	18967	23171	23133
economic proven		3918	3882	3836	3793	3759
economic probable		12934	12934	12934	12934	12930
subeconomic		2197	2197	2197	6444	6444
Mining output, kt	a)	55	31	45	34	33
Imports, kg	b)	4022	9488	61028	16830	20355
Exports, kg	b)	7268	18	494	1262	7347

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

5. Customs tariffs

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

6. Mining companies in the Czech Republic as of December 31, 1994
Rudné doly Příbram, s.p.
TRL, s.r.o. (Praha 4 - Modřany)

7. World production
World production of gemstones is not recorded except diamonds.

8. World market prices
Market prices of gemstones depend on their type, size and quality.

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. Substitutes
Generally, individual gem stones in jewelry can be combined and replaced. Pyropes can be replaced by almandines, amethysts and similar looking minerals.

KAOLIN

1. Characteristics and use

Kaolin is mostly residual (primary), less often sedimentary (secondary) whitish rock, containing substantial amount of kaolinite minerals. It always contains quartz, and it may contain clay minerals, micas, feldspars, and other minerals, depending on the nature of the parent rock.

Kaolin originated mostly through weathering or hydrothermal alteration of various rocks, rich in feldspar, like granitoids, arkoses, gneisses, etc. These so-called residual kaolins could then be transported, thus originating sedimentary kaolins. The deposits are concentrated in feldspar rocks in which the kaolinization had occurred. The titanium-bearing kaolin originated of autometamorphic granites with high Ti-minerals content.

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, and other industries. 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:

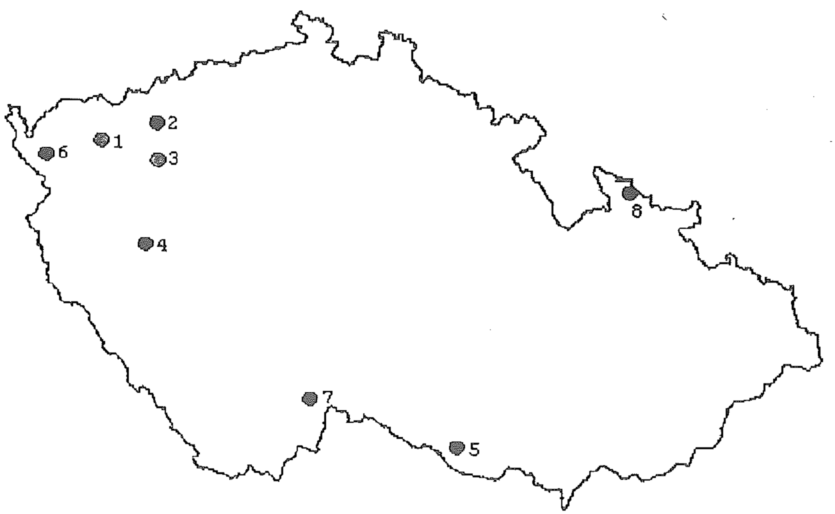
- Kaolin for production of porcelain and fine ceramics (KJ); requirements: purity, rheological properties, strength after drying, pure white-fired colour (content of $Fe_2O_3+TiO_2$ max. 1.6 %), refractoriness min. 33 P.C.E. (1730° C), screen residue on the screen 0.063 mm max. 2 %;
- Kaolin for ceramics manufacturing (KK) has no specifically defined parameters and is used according to many ceramic recipes. Specially appreciated are white-fired colour, low content of colorant oxides, etc;
- Kaolin used as a filling in paper industry (KP) is used both as a filling and for coating. Required properties are high whiteness and low content of abrasive particles. It is also used as a filling in production of rubber (requires minimum content of the so-called "rubber poisons" - Mn max. 0.002 %, Cu max. 0.001 % and Fe max. 0.15 %) and in plastics;
- Titanium-bearing kaolin (KT) - contains over 0.5 % TiO_2 and this type of kaolin occurs only in the Karlovy Vary region. Tests have proven in some cases a possibility to reduce TiO_2 content by high intensity electromagnetic separation after which most of these kaolins can be used as KJ or KK grades;
- Feldspar-bearing kaolin (KZ) contains higher amount of non-kaolinized feldspars and has been used mostly in ceramics for production of sanitary and technical ceramics.

All kaolin deposits in the Czech Republic originated by weathering (kaolinization) of feldspar rocks. The major kaolin deposits are located in the following areas:

- The Karlovy Vary region - parent rocks are represented by autometamorphosed and younger granites of the Karlovy Vary massif. This is the most important source of the top quality kaolins for the production of porcelain (KJ) or their eventual substitutes (KT). There are also deposits of the KK, less of the KP grades;
- The Kadaň region - kaolins of this area originated from granulite orthogneiss of the Krušné hory crystalline complex. This kaolin is of the KK and KP grades;

■ The Podbořany region - parent rock is 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		1990	1991	1992	1993	1994
Deposits - total	a)	127	127	130	135	75
exploited		21	19	19	18	11
Total reserves, kt		1254347	1248534	1324969	1348057	1346588
economic proven		239509	238000	234787	255279	253955
economic probable		643349	634764	711743	691037	690155
subeconomic		371489	375770	378439	401741	402478
Mining output, kt	a)	3455	2913	2530	2336	2706
Imports, t	b)	80	928	1385	1353	3963
Exports, t	b)	487833	374561	439997	426488	345423

Note:
a) raw kaolin, total output of all technological grades
b) item 2507 of the customs tariff

5. Customs tariffs

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

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

Západočeské kaolinové a keramické závody, a.s. (H. Bříza)
KSB, s.r.o. (Božíčany)
Chlumčanské keramické závody, a.s.
Kaolin Hlubany, a.s. (Podbořany)
Severočeské doly, a.s. (Chomutov)
Poštorenské keramické závody, a.s.

7. World production

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

Year		1990	1991	1992	1993	1994 e
Production, kt		27760	26066	22457	20960	22000
Main producers, %:						
USA		35	37	36	43	40
United Kingdom		11	11	12	12	12
CIS	a)	14	13	9	5	7
Korean Republic		5	7	8	3	8

Note:
a) USSR before 1992

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 (since 1993), and during the last five years they either have not changed at all, or shown only minimum fluctuations. Average prices of traded commodities in GBP/t FOT ex-Cornwall, UK at the end of the year were as follows:

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

Commodity / Year	1990	1991	1992	1993	1994
A	55.00	55.00	75.00	62.50	65.00
B	97.50	97.50	97.50	97.50	97.50
C	57.50	60.00	80.00	60.00	60.00
D	N	N	N	102.50	102.50

9. Recycling

In ceramic production a part of bodies is recycled.

10. Possible substitutes

Depending on the use, the situation is as follows:

- In production of porcelain, kaolin is irreplaceable;
- In ceramic recipes, in some cases kaolin can be partially substituted by clays, talc, wollastonite, or mullite (also synthetic mullite), but mostly these substitutions are financially pretentious;
- In production of paper (which consumes almost a half of the total production of kaolin), the possibilities for substitution are the highest - kaolin as a filler can be replaced by extra finely pulverized limestone, dolomite (also synthetic - precipitated), mica (muscovite), talc, wollastonite, etc;
- In other cases, where kaolin is used as a filler (insulation materials, pigments, glass fibres), the situation in analogous;
- In production of refractory materials and applications in the building industry, kaolin can be successfully substituted by other materials with adequate properties.

CLAYS

1. Characteristics and use

Clays are sedimentary or residual unconsolidated rocks consisting of more than 50 % of clay fraction (particle size less than 0.002 mm), containing as the major constituent clay minerals, particularly those of the kaolinite group, then hydromicas (illite) and montmorillonite (see bentonite). Depending on the composition of clay minerals, clays are divided into monomineral (e.g. kaolinite, illite, etc.) and polymineral clays (composed of more clay minerals). Clays can contain various admixtures, e.g. quartz, micas, carbonates, organic matter, oxides and hydroxides of Fe, etc. Their colour depends on admixtures and can be white, grey, yellow, brown, violet, etc. They can be also secondarily consolidated (claystones) or recrystallized (argillite).

From the point of view of deposits and further technological processing, this category includes a wide selection of rocks rich in clay minerals. Abroad, bentonite, brick-clays and even kaolins are often included in this category. Clays can be found virtually in all sedimentary formations all over the world.

They are mostly used in production of ceramics, as refractory and sealing materials, fillers, in paper industry and for filtration of oils, etc.

2. Mineral resources of the Czech Republic

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

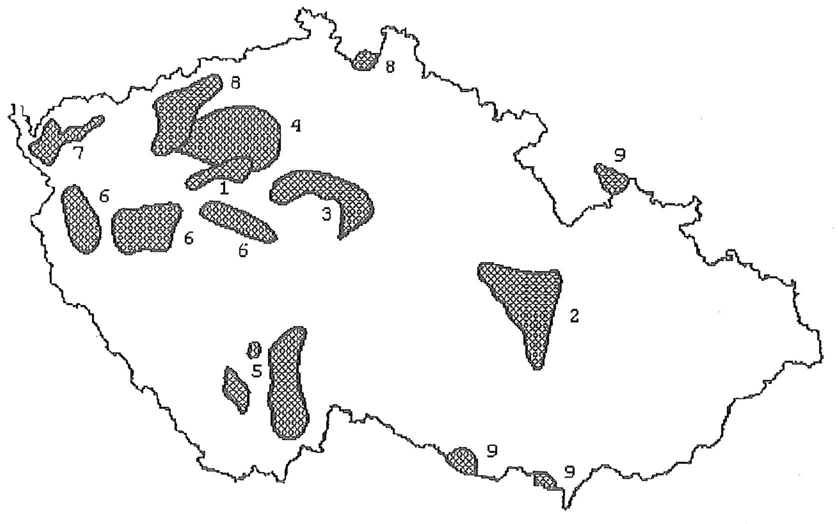
- Whiteware clays (JP) - they are used as a raw material for production of ceramics with white- or light-burning colour, sintering at temperatures over 1,200°C. The clay minerals are represented mostly by kaolinite, the content of clasts is low.
- Refractory clays for grog (JZ) - after firing, these clays are suitable as an opening material for production of fireclay products. The material is required to contain maximum Al_2O_3 and minimum Fe_2O_3, other required parameters are very high refractoriness and the lowest possible absorption capacity after firing. The major clay mineral is again kaolinite (and/or dickite).
- Other refractory clays (JO) - used as bond (plastic) clays in production of mainly refractory products. Besides high binding properties they should contain a minimum of Fe_2O_3 and clasts.
- Non-refractory ceramic clays (JN) - the raw material of wide spectrum of technological properties and uses (production of floor and wall tiles, additives, etc.).
- Aluminous underlaying clays (JA) - kaolinite clays underlying the coal seams near Most in the North Bohemian basin, containing about 40 % Al_2O_3, locally 3-7 % TiO_2 and usually a large amount of siderite.

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

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

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

3. Registered deposits and their location in the Czech Republic



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

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

Year		1990	1991	1992	1993	1994
Deposits - total number		143	143	146	156	136
exploited		34	35	32	34	31
Total reserves, kt		1490776	1374140	1385964	1327259	1324985
economic proven		311874	298331	291254	269133	267586
economic probable		930179	824557	831770	801885	800113
subeconomic		248723	251252	262940	256241	257286
Mining output, kt		1409	947	903	1018	823
Imports, t	a)	N	530	1719	566	6914
Exports, t	a)	N	176519	168643	239423	203707

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

5. Customs tariffs

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

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

KERAMOST, a.s. (Most)
KEMA Skalná, s.p.
Západočeské kaolinové a keramické závody, a.s. (H.Bříza)
České lupkové závody, a.s. (Nové Strašecí)
Calofrig, a.s. (Borovany)
Moravské šamotové a lupkové závody, a.s. (V.Opatovice)
RAKO - Lupky, s.r.o. (Lubná)
Chlumčanské keramické závody, a.s.
Rakovnické keramické závody, a.s.
Kaolin Hlubany, a.s. (Podbořany)
Poštorenské keramické závody, a.s.
Palivový kombinát Ústí n. Labem, s.p.
Moravské keramické závody, a.s. (Rájec)

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, CIF UK
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, bagged, GBP/t, FOB UK
E Westerwald clay, dried & ground, bulk, DEM/t, FOB Germany

Commodity / Year	1990	1991	1992	1993	1994
A	90.00	90.00	90.00	105.50	109.00
B	70.50	70.50	85.00	77.50	77.50
C	30.00	35.00	50.00	45.00	45.00
D	80.00	90.00	95.00	95.00	95.00
E	N	155.00	155.00	150.00	150.00

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

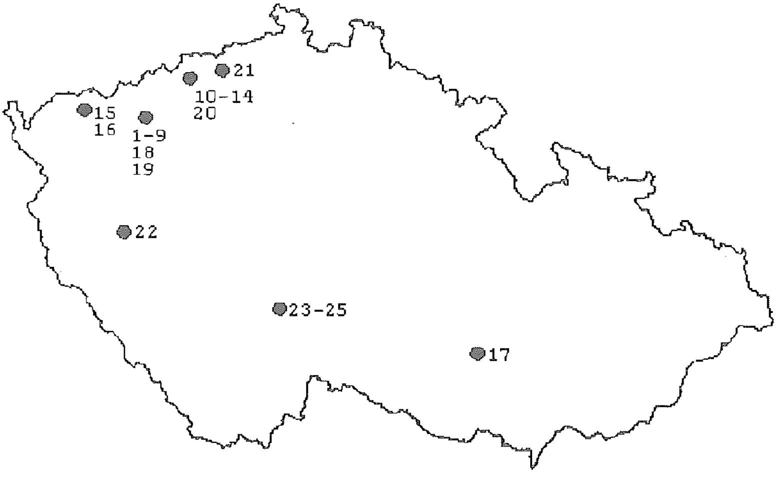
1. Characteristics and use

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. 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, 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").

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

Other bentonite:

18 Račetice
19 Vysoké Třebušice
20 Obrnice-Vtelno-Rudolice
21 Modlany
22 Dnešice-Plzeň-south
23 Maršov
24 Rybova Lhota
25 Skalice

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

Year		1990	1991	1992	1993	1994
Deposits - total number		23	24	26	26	25
exploited		4	5	5	6	4
Total reserves, kt		242678	248302	279303	175263	275593
economic proven		43927	49482	49503	49472	49429
economic probable		164165	164169	192809	110868	189173
subeconomic		34586	34651	36991	14923	36991
Mining output, kt		159	125	135	63	65
Imports, t	a)	N	300	1420	4308	3329
Exports, t	a)	N	9459	10078	13976	19317

Note:
a) item 2508 10 of the customs tariff

5. Customs tariffs

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

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

KERAMOST, a.s. (Most)
DIXALVE CS, s.r.o. (Praha 8)
Calofrig, a.s. (Borovany)

7. World production

Annual world production of bentonite is about 10 mill. tons. The production has been for a long period higher than 9 mill.t/year, and the highest output was in 1989. 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		1990	1991	1992	1993	1994 e
Production, kt		9225	9432	9316	8875	9200
Main producers, %:						
USA		38	36	36	35	37
CIS	a)	22	21	21	18	19
Greece		6	6	6	8	6
Germany		6	6	6	5	6
Japan		6	6	6	6	6

Note:
a) USSR before 1992

8. World market prices

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

A Wyoming, foundry grade, 85 % <200 mesh, bagged, 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	1990	1991	1992	1993	1994
A	125.00	125.00	125.00	135.00	135.00
B	26.50	26.50	26.50	32.50	32.50
C	39.00	39.00	39.00	45.00	35.00
D	34.50	34.50	34.50	35.00	35.00

9. Recycling

Bentonite used as a bonding agent for pelletizing of iron ores cannot be recycled at all, in other uses only on a very limited scale.

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 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. For industrial use are suitable potassium feldspars (orthoclase, microcline) and acic 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

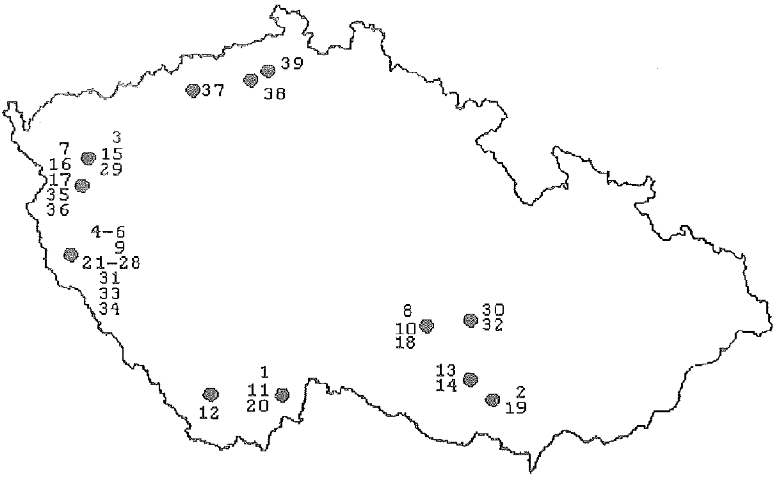
For the same purposes there are also used feldspar substitutes, which are rocks with alkali metals confined to some other minerals (mostly nepheline - anhydrous sodium-potassium alumo-silicate). Nepheline syenites are particularly used abroad to substitute for feldspar raw materials.

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.

3. Registered deposits and their location in the Czech Republic



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

Feldspar substitutes:
37 Želenice
38 Tašov-Rovný
39 Valkeřice-Zaječí vrch

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

Year		1990	1991	1992	1993	1994
Deposits - total	a)	33	35	36	36	36
exploited		5	6	6	6	5
Total reserves, kt	a)	77280	85401	86930	86608	86217
economic proven		22914	29541	40437	40115	39724
economic probable		49184	50678	40726	40726	40726
subeconomic		5182	5182	5767	5767	5767
Mining output, kt	a)	115	130	152	203	170
Imports, t	b)	N	557	2461	529	431
Exports, t	b)	N	27780	43093	63687	66583

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

5. Customs tariffs

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

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

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 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 and their share of the world production were as follows (according to the Welt-Bergbau-Daten and the Industrial Minerals magazine):

Year	1990	1991	1992	1993	1994
Mining output, kt	5610	5517	5965	6562	6410
Main producers, %:					
Italy	28	24	23	23	25
USA	11	11	12	12	12
Thailand	6	7	9	9	9
Germany	6	6	6	6	6
Turkey	3	4	5	8	14

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

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

Commodity / Year	1990	1991	1992	1993	1994
A	140.00	140.00	140.00	160.00	160.00
B	65.00	65.00	65.00	85.00	85.00
C	N	N	N	135.00	140.00
D	N	N	N	225.00	235.00

9. Recycling

The use of cullet or recycled glass is increasing which in turn is reducing the need for virgin raw materials in glass batch. 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 clays, talc, spodumene, pyrophyllite or their mixtures.

QUARTZ

1. Characteristics and use

Silica raw materials are represented by various rocks high in SiO_2 (usually min. 96 %). These are various quartzites (sedimentary or metamorphosed rocks, consisting mostly of quartz and originated through silicification of sandstones or by cementing of quartz sandstones by siliceous cement; the shape of original grains cannot be usually recognized), silicified sandstones, siliceous rocks, quartz sand and gravel, and vein and pegmatite quartz. Vein quartz and rock crystal (abroad) are used for production of special glass. The grade is established by various standards. The observed parameters are the content of SiO_2 and refractoriness. Impurities are represented by high Al_2O_3, Fe_2O_3, and/or other oxides.

Silica raw materials are used in production of ferroalloys in the metallurgical industry, silicon metal (in metalurgy,in semiconductors), refractory building materials (silica - bricks, mortars, ramming masses), porcelain and ceramics. Vein quartz, rock crystal and quartz boulders are used in production of pure silica glass, UV glass and optical glass (fibre).

2. Mineral resources of the Czech Republic

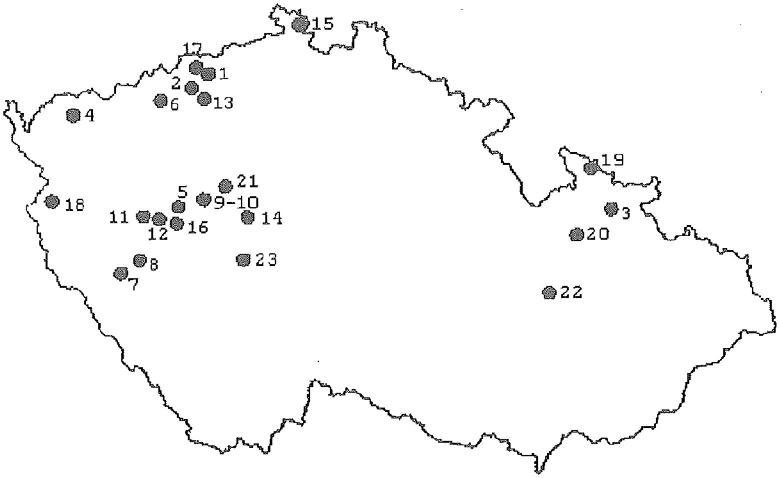
In the Czech Republic, silica raw materials are classified into two groups - silica raw materials, and silica raw materials for production of special glass. Silica deposits are confined especially to the occurrences of the Tertiary "amorphous" quartz, Cretaceous "crystalline" quartz and Ordovician quartz, to lesser extent to the occurrences of vein quartz and lidites of the Upper Proterozoic.

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

1) Quartz deposits in pegmatites (N. Moravia) - suitable for production of porcelain, ferrosilicon, silicon;
2) Quartz dikes (silicified fault zones) - suitable for ceramic industry (the Tachov region, S. Bohemia, the Jeseníky mountains);
3) Quartz veins related to granitoid massifs (the Karlovy Vary massif, the Žulová massif)

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

3. Registered deposits and their location in the Czech Republic



Quartz - Quartzite:

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

Quartz for special glass:

22 Dětkovice
23 Krašovice

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

Year		1990	1991	1992	1993	1994
Deposits - total number		24	24	24	24	23
exploited		2	2	2	2	2
Total reserves, kt		48366	48288	48034	55148	55146
economic proven		7427	7349	7323	7321	7320
economic probable		24515	24515	24515	31631	31630
subeconomic		16424	16424	16196	16196	16196
Mining output, kt		169	65	46	23	2
Imports, t	a)	N	N	N	2498	2694
Exports, t	a)	N	N	N	17397	112

Note:
a) item 2506 of the customs tariff

5. Customs tariffs

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

6. Mining companies in the Czech Republic as of December 31, 1994
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 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 Great Britain. Among the largest exporters of raw material for production of synthetic crystals were Brazil and Namibia. Average production in the USA since 1989 has been 440 t/year.

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 at this level until now.

9. Recycling
Silica material is not recycled.

10. Possible substitutes

Quartz had been, as a strategic mineral, irreplaceable until the fifties. Today it is being still more replaced, both in electronics and optics, by synthetic crystals. Synthetic quartz competes with natural quartz also in production of clear silica glass.

In production of ferrosilicon, the quartz is irreplaceable, but the final product, ferrosilicon, can be replaced by other materials. Also dinas can be replaced by other types of lining.

GLASS AND FOUNDRY SANDS

1. Characteristics and use

Glass sands are granular, pale or even white coloured rocks (quartz sands or sandstones), which are used, after beneficiation, as a raw material for production of glass. Required parameters (grain size, mineral and chemical composition) vary according to the type of glass. Sands of required grade do not usually occur in the nature, therefore the sands have to be dressed by crushing, washing (removes floating particles) and sorting (to reach the required grain size). To obtain high grade glass sands it is necessary to apply more sophisticated methods of mineral dressing (electromagnetic separation, flotation, etc.); it is of utmost importance to reduce the content of colorant oxides (Fe_2O_3, TiO_2, Al_2O_3) in order to meet rigid specifications with respect to purity of silica and its maximum content. Sands for glass melting are used for preparation of glass batches for production of sheet glass, packing glass and some technical glasses (max.content of Fe_2O_3 0.0023 % - 0.0040 %), and utility glass (up to 0.0021 % Fe_2O_3); glass sands of higher grade are used for production of non-transparent silica glass (max. 0.0020 % Fe_2O_3) and the top quality sands (max. 0.0012 % and 0.0015 % Fe_2O_3) are used for production of crystal glass, semi-optical glass and some special technical glasses.

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

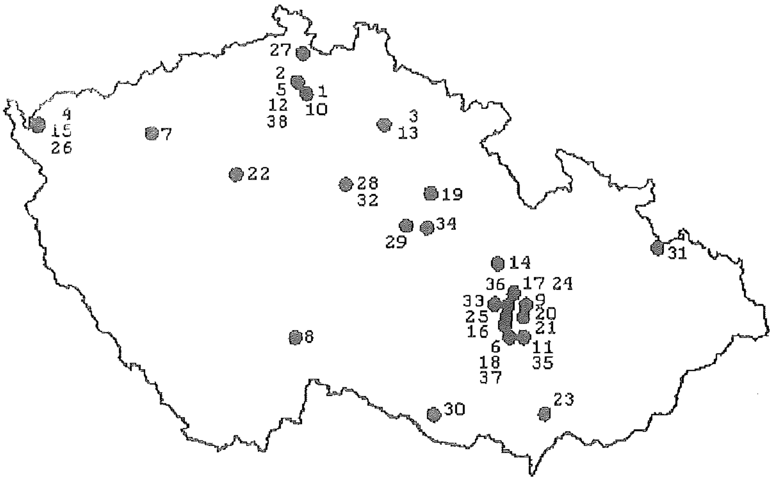
2. Mineral resources of the Czech Republic

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

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

All deposits of glass and foundry sands in the Czech Republic are extracted by open-pit mining operations (in the past exceptionally also by underground mining - Dolní Lhota).

3. Registered deposits and their location in the Czech Republic



Glass sands:

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

Foundry sands:

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

* glass and foundry sands deposits

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

Year		1990	1991	1992	1993	1994
Deposits - total number		32	31	32	34	33
exploited		14	13	12	11	11
Total reserves, kt		760225	757423	769164	769348	767874
economic proven		275535	273062	272210	254991	253462
economic probable		197838	197765	215171	206734	206649
subeconomic		286852	286596	281783	307623	307763
Mining output, kt		2758	1837	1963	1735	1955
Imports, t	a)	N	391	1488	102768	149142
Exports, t	a)	N	242876	297308	540017	545622

Note:
a) item 2505 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Concessionary
2505	Silica sands of all kinds, also colored, except sands containing metals		
2505 10	- Silica sands and quartz sands	35	4.8

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

Sklopísek Střeleč - EXIMOS, a.s.
Provodínské písky, a.s.
Moravské keramické závody, a.s. (Rájec)
KEMA Skalná, s.p.
Kaolin Hlubany, a.s. (Podbořany)
SEDOS - těžba písků (Drnovice)
Moravské šamotové a lupkové závody, a.s. (V. Opatovice)
Písek Lžín, Dr.F.Dusbábek (Č. 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 1989. Since then the production was decreasing due to general economic recession. The major world producers were (according to USBM):

Year	1990	1991	1992	1993 e	1994 e
Mining output, mill.t	117	110	110	100	110
Main producers, %:					
Netherlands	21	23	22	22	22
USA	22	21	21	21	21
Argentina	8	8	8	8	8
Germany	5	6	6	6	6

8. World market prices

Average price of quartz sand for industrial use on the European market have been steady in the last 5 years. Prices of sands quoted by the Industrial Minerals magazine in GBP/t EXW/UK, at the end of the year were as follows:

A Glass sand, flint, container

B Foundry sand, dry, bulk

Commodity / Year	1990	1991	1992	1993	1994
A	9.75	9.75	9.75	9.75	9.75
B	11.00	11.00	11.00	11.00	11.00

9. Recycling

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

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

10. Possible substitutes

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

WOLLASTONITE

1. Characteristics and use

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

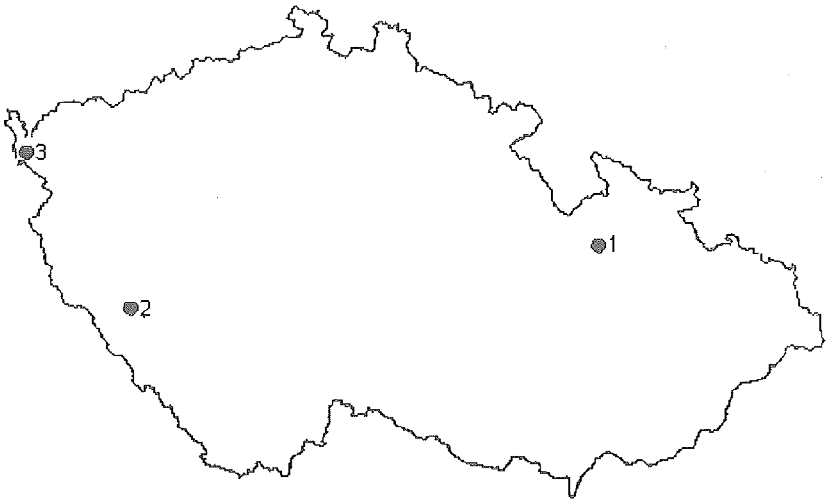
The mineral is a very promising raw material. Wollastonite is used in ceramics to manufacture tiles, sanitary ceramics, etc., both in the bodies and glazes, then as a filler in plastics and paints, as a refractory material, as a substitute for asbestos, in production of mineral fibres, in foundry industry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

2. Mineral resources of the Czech Republic

Three explored and evaluated wollastonite deposits in the Czech Republic are of metamorphic origin and they have not been mined yet.

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

3. Registered deposits and their location in the Czech Republic



1 Bludov
2 Mochtín
3 Skalka

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

Year		1990	1991	1992	1993	1994
Deposits - total number		N	3	3	3	3
exploited		0	0	0	0	0
Total reserves, kt		N	3083	3083	3301	3301
economic proven		N	0	0	0	0
economic probable		N	2688	2688	2906	2906
subeconomic		N	395	395	395	395
Mining output, kt		0	0	0	0	0
Imports, kt	a)	N	N	N	N	N
Exports, kt	a)	N	N	N	N	N

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

5. Customs tariffs

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

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

There were no organizations in the Czech Republic mining for wollastonite in 1994.

7. World production

Until 1976, leading producer of wollastonite were the USA, which produced 85 % of the world output. China started to develop its production in the seventies, and reduced the USA share to 34 % in 1993. The world production in 1982 (without China) was 126 kt/year, in 1985 (including China) 270 kt/year, and in 1992 as much as 385 kt/year. It is expected that in 1995 the world production will reach up to 500 kt/year, and in 2000 even up to 750 kt/year. About 65 % of the wollastonite should be used as a substitute for asbestos. The world production of wollastonite exceeded probably 400 kt. The largest world producers of wollastonite and their share on world production were the USA - 34 % (the largest wollastonite producing company is NYCO Minerals Inc., which is producing high-quality wollastonite of the Lewis deposit in the New York state), China - 33 %, India - 17 %, Mexico - 8 % and Finland - 8 %.

8. World market prices

Larger increase of wollastonite prices was recorded in the eighties. In the last 5 years, the prices fluctuated very little (with both ups and downs). The Industrial Minerals magazine quoted following average prices of selected commodities at yearend:

A Finnish, 325 mesh, GBP/t ex-store UK
B US acicular, minus 200 mesh, USD/st EXW
C US acicular, minus 325 mesh, USD/st EXW
D US acicular, minus 400 mesh, USD/st EXW
E US acicular (15:1 - 20:1 aspect ratio), USD/st EXW

Commodity / Year	1990	1991	1992	1993	1994
A	218	218	253	275	275
B	263	263	170	176	180
C	180	180	212	220	224
D	193	193	234	243	248
E	N	N	286	297	308

9. Recycling

The material is not recycled.

10. Possible substitutes

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

DIATOMITE

1. Characteristics and use

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

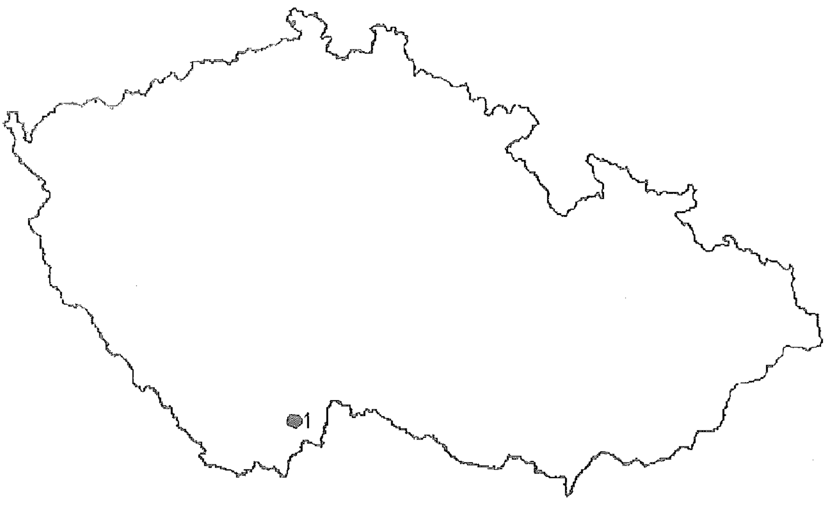
Filtration is the major end use of diatomite (the highest grades); it is used in production of industrial fillers (rubber, paper, cosmetics), as abrasives, as carrier for catalysts, thermal and sound insulating elements or light building elements.

2. Mineral resources of the Czech Republic

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

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

3. Registered deposits and their location in the Czech Republic



1 Borovany

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

Year		1990	1991	1992	1993	1994
Deposits - total number		1	1	1	1	1
exploited		1	1	1	1	1
Total reserves, kt		5288	5213	5152	5108	5066
economic proven		4960	4885	4824	4780	4738
economic probable		328	328	328	328	328
subeconomic		0	0	0	0	0
Mining output, kt		82	68	57	39	40
Imports, t	a)	1528	1012	1538	1506	2090
Exports, t	a)	7322	5629	5950	5827	6591

Note:

a) item 2512 of the customs tariff

5. Customs tariffs

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

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

Calofrig, a.s. (Borovany)

7. World production

Production of diatomite has been at the level over 1 mill. t/year for many years. The highest production was reached in 1988. Leading position had 4 countries, which produced 75 % of the world output (according to the Welt-Bergbau-Daten):

Year		1990	1991	1992	1993	1994 e
Mining output, kt		1345	1389	1259	1082	1200
Main producers, %:						
USA		47	44	47	55	49
CIS	a)	19	16	16	15	14
France		4	7	6	8	6
Korean Republic		4	7	6	6	6

Note:

a) USSR before 1992

8. World market prices

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

A US calcined, filter-aids, GBP/t

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

Commodity / Year	1990	1991	1992	1993	1994
A	322.50	322.50	322.50	337.50	337.50
B	345.00	345.00	345.00	360.00	360.00

9. Recycling

In some filter systems, the filter media can be back flushed and cleaned for re-use.

10. Possible substitutes

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

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

LIMESTONES AND CORRECTIVE SIALIC COMPONENTS FOR CEMENT PRODUCTION

1. Characteristics and use

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

Limestones are used for production of building elements (lime, cement, mortar mixtures, granulated gravel, dimension and building stone, etc.), in the metallurgical, chemical and food processing industries, recently also for desulphurization, in agriculture, glass and ceramic industries, etc.

This group of raw materials also includes corrective sialic additives for production of cement, e.g. shales, clays, loess, loams, sands, etc., which correct the content of SiO_2, Al_2O_3 and Fe_2O_3 in the basic raw material for burning of clinker in production of cement. These corrective materials mostly accompany deposits of portland limestones or occur in their close neighbourhood.

2. Mineral resources of the Czech Republic

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

- Limestones with very high percentage of $CaCO_3$ (VV), containing at least 96 % of carbonate (with max. 2 % $MgCO_3$). These limestones are used mostly in chemical, glass, ceramics, rubber, food processing and metallurgical industries, for desulphurization, and for production of the top quality lime;
- Clayey limestones (VJ) - with $CaCO_3$ content over 70 % and higher content of SiO_2 a Al_2O_3. These limestones are used for production of cement, all kind of lime, and for desulphurization;
- Carbonates for use in agriculture (VZ) - with the content of carbonates at least 70-75 %. They are used for dressing of agricultural land and forest soils;
- Other limestones (VO) - with carbonate content at least 80 % - they are used mostly for production of cement, then for production of lime, desulphurization, etc. Also dolomites and dolomitic limestones are included in this group in the Czech Republic.
- Corrective sialic additives for cement production (CK) - are represented by lithologically various types of rocks (see paragraph 1), which are used for correction of chemical composition of the raw material for cement production.

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

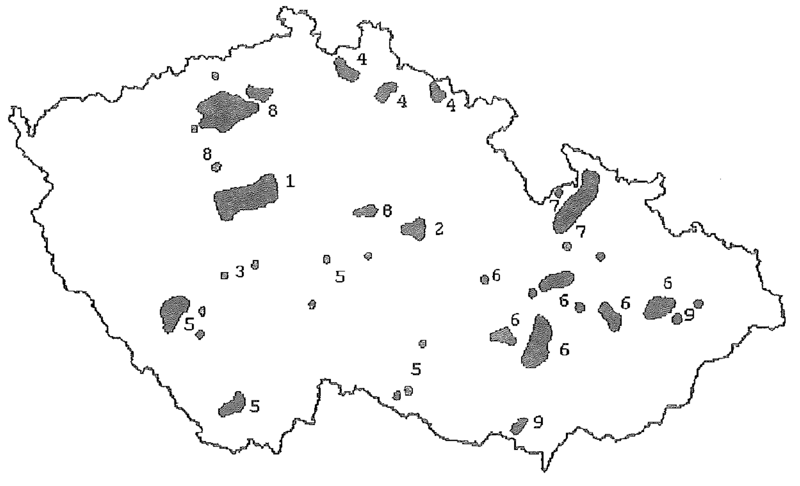
- The Barrandien zone Devonian - the most important and largest deposits are located in this area. Almost all types of limestones occur there,particularly those of VV and VO grades but also VZ and CK grades. Limestone deposits are confined to sediments of mostly Lower Devonian age, and consist of several 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 open-pit mining and quarrying.

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		1990	1991	1992	1993	1994
Deposits - total number		123	120	121	124	117
exploited		35	34	35	36	30
Total reserves, kt	a)	4729054	6256629	6680860	6313734	6244117
economic proven		2111796	2075808	2078431	2074678	2054979
economic probable		1732792	3413293	3600855	3493991	3469784
subeconomic		884466	767528	1001574	745065	719354
Mining output, kt	a)	15449	11472	11134	10498	10205
Imports, kt	b)	N	0	3	16	781
Exports, kt	b)	N	109	143	191	53

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

5. Customs tariffs

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

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

Limestones:
Cementárny a vápenky Mokrá, a.s.
Velkolom Čertovy schody, a.s. (Tmaň)
Cement Hranice, a.s.
Pragocement, a.s. (Praha 5 - Radotín)
Čížkovická cementárna, a.s.
Cementárny a vápenky Prachovice, a.s.
Vápenka Vitošov, s.r.o.
Kotouč Štramberk, s.r.o.
Lomy Mořina, s.r.o.
VITOUL, v.o.s. (Měrotín)
JHF Heřmanovice, s.r.o.
ZD Sloup v Mor. Krasu
TERAMO Vápenná, a.s.
AGIR, s.r.o., lom Skoupý
Agrostav Znojmo, a.s.
GMS, a.s. (Praha 7)

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

7. World production

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

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 limestones on the US market in 1993 was USD 5 per t, sorted limestone (in lumps) for metallurgical works in Germany was sold in 1988 for DEM 12.85 per ton.

9. Recycling

The material is not recycled.

10. Possible substitutes

Limestones of all grades have various uses. Limestones can be replaced in many applications. Limestones, dolomites and various burnt lime are often mutually replaceable (e.g. in agriculture). Also in the desulphurization, the limestones can be replaced by various mixtures of carbonates. Yet the limestones are irreplaceable in many of their uses - for instance in production of cement and lime, or in the metallurgical industry (melting agent for production of pig iron).

GYPSUM

1. Characteristics and use

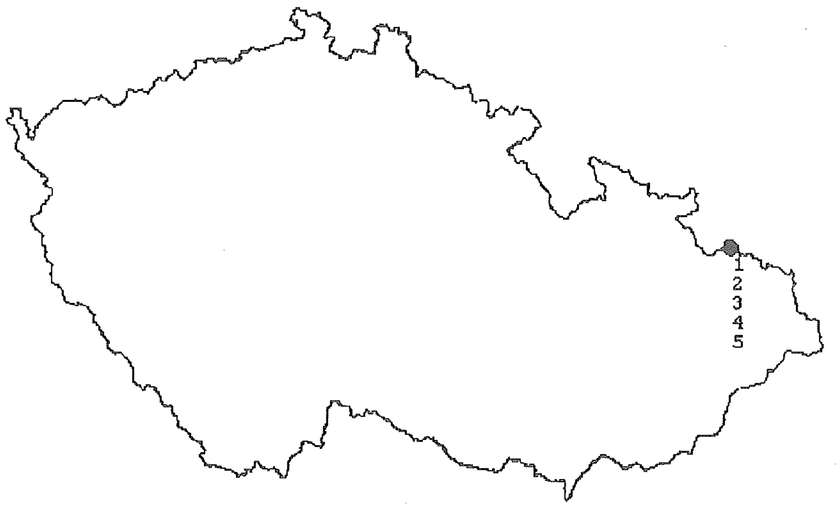
Gypsum is a sedimentary rock, consisting mostly or completely of monoclinic mineral gypsum ($CaSO_4.2H_2O$) which is usually colorless or white. The rock often contains impurities (clay minerals, quartz, iron oxides, limestone, dolomite, anhydrite, etc.). The majority of gypsum deposits were formed as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

Gypsum is used mostly for production of building materials (calcined gypsum, 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. The production is declining. There are 4 other explored and evaluated deposits.

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		1990	1991	1992	1993	1994
Deposits - total number		5	5	5	5	5
exploited		1	1	1	1	1
Total reserves, kt		509394	508775	508057	507401	506747
economic proven		124267	123648	122930	122274	121620
economic probable		302990	302990	302990	302990	302990
subeconomic		82137	82137	82137	82137	82137
Mining output, kt		661	569	660	560	591
Imports, t	a)	N	12272	4457	46	1813
Exports, t	a)	N	53945	10368	112755	122847

Note:
a) item 2520 10 of the customs tariff

5. Customs tariffs

Code	Commodity	Tariff rates in % General	Conces-sionary
2520 10	Gypsum, anhydrite	5	4.8

6. Mining companies in the Czech Republic as of December 31, 1994
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 - 100 mill. t, probably with the highest output in 1989. The production is closely related to building activities and the reduction of construction works after 1989 caused also a reduction of mining for gypsum. The largest world producers were (according to the Welt-Bergbau-Daten):

Year	1990	1991	1992	1993	1994 e
Mining output, kt	92909	86283	88466	89157	89000
Main producers, %:					
USA	16	16	17	18	18
China	10	12	12	12	12
Spain	8	8	9	8	9
Canada	9	8	8	9	8
Thailand	6	8	8	8	8
Iran	10	8	8	10	8

8. World market prices

Prices of natural gypsum was steady in 1994. Even in times of more extensive building activities the prices were stable, which was also caused by a supply of waste gypsum (desulphurization of 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 the end of the year quoted by the Industrial Minerals magazine were as follows:

Commodity / Year	1990	1991	1992	1993	1994
A .	6.50	6.50	6.50	9.00	9.00

9. Recycling

The material is not recycled.

10. Possible substitutes

Used mainly as setting regulator gypsum is irreplaceable as other substitutes are not economical.

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 abyssal igneous rocks - granites and granodiorites, which occur in the Central Bohemian and Moldanubianc plutons,the Štěnovice, the Krkonoše-Jizerské hory, the-Jeseníky and Nasavrky massifs in Bohemia, and in Moldanubian and Žulová massifs in Moravia. Less important are dark igneous rocks - diabases, diorites and gabbros, which also occur in the Central Bohemian Pluton,then in the Kdyně and Lužice massifs, (eventually serpentines in W.Bohemia and Moravia). Aforesaid rocks are used for wall lining (also polished), paving, for building of monuments and in sculpture, etc.);
- Neovolcanic rocks are not very suitable, apart from some trachytes of the České středohoří and Doupovské hory mountains which are used in sculpture and as a polished lining;
- Among sedimentary rocks in Bohemia, the most important are Cenomanian sandstones from the area east of Prague then from Hořice and Broumov regions. Less important are Triassic and red Permian sandstones from the Krkonoše piedmont basin. In Moravia, there are the Těšín Cretaceous sandstones or red Permian sandstones of the Tišnov region. Sandstones are used for production of cut and polished wall linings. Very suitable are also Devonian limestones of the Barrandien zone and of the Moravian karst (wall lining, terrazzo, etc.). Pleistocene travertines, used for interior wall lining, terazzo and conglomerates, are quarried in the Přerov region. Schists of the Moravian-Silesian Paleozoic are used as lining, covering and paving material, and as expanded materials;
- Mostly used metamorphic rocks are crystalline limestones and dolomites (polished wall linings, paving materials, terrazzo, conglomerates, sculptures). Large deposits are in the Šumava region and Czech part of the Moldanubicum, in the Krkonoše-Jizerské hory crystalline complex and Orlické hory-Sněžník crystalline complex,the Svratka anticline,in the Silesicum, and in the Branná group (Silesia). Proterozoic phyllites of western Bohemia (the Střela valley) and the Železný Brod crystalline complex are used for roofing and wall lining (the waste as a filler).

3. Registered deposits in the Czech Republic

There is a vast amount of dimension stone deposits (reserved and non-reserved) in the Czech Republic and therefore they are not listed.

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

Year		1990	1991	1992	1993	1994
Deposits - total number		185	193	197	197	180
exploited		83	84	85	79	73
Total reserves, thous.m^3		234007	240836	241026	241646	241504
economic proven		90199	92557	91222	93352	93227
economic probable		116325	118419	117236	115909	115892
subeconomic		27483	29860	32568	32385	32385
Mining output, thous.m^3		182	198	177	187	223
Imports, kt	a)	N	N	N	296	413
Exports, kt	a)	N	N	N	136	178

Note:
a) items of the customs tariff according to paragraph 5

5. Customs tariffs

Code	Commodity	Tariff rates in %	
		General	Conces-sionary
2514	Slate, whether or not roughly trimmed or merely cutted	free	free
2515	Marble, travertine, ecaussine and other calcareous monumental or building stone	free	free
2516	Granite, porphyry, basalt, sandstone and other monumental or building stone	free	free
2518	Dolomite whether or not calcined, roughly trimmed or sawed, agglomerated dolomite	free	free
2518 10	- Dolomite not calcined	free	free
6801	Setts, curbstones and flagatones of natural stone	32	6
6802	Worked menumental and building stone	30 - 70	7.9 - 9.7
6803	Worked slate and articles of slate or of agglomerated slate	19	4.3

6. Mining companies in the Czech Republic as of December 31, 1994
Slezský kámen, a.s. (Jeseník)
Průmysl kamene, a.s. (Příbram)
TERAMO Vápenná, a.s.
KAVEX Mrákotín, s.r.o.

KAVEX GROUP, s.r.o. (Plzeň)
Kámen Ostroměř, s.p.
Českomoravský průmysl kamene, a.s. (Hradec Králové)
LIGRANIT, s.r.o. (Liberec)
Silnice Ostrava, a.s.
Agroplast, a.s. (Liberec)
UNICOM Liberec, s.r.o.
SLATE - B.D.S.O., a.s. (Staré Oldřůvky)
HERLIN, s.r.o. (Příbram)
Česká žula, s.r.o. (Strakonice)
RD Jeseník, s.p.
SKS Kámen Kozárovice, s.r.o.
Jašek Granit Švihov, s.r.o.
Kamenoprůmysl Hudčice, s.p.
Jihokámen Písek, VD
Terobet, a.s. (Říčany)
Družstvo cementářů a kameníků Holoubkov
Kamenoprůmyslové závody, s.r.o. (Šluknov)
Stavba, družstvo Olomouc
Mramor Dobřichovice, s.r.o.
Obecní úřad Leštinka
Průmysl kamene Plzeň, s.p.
GMS, a.s. (Praha 7)
Bratři J. a K. Jaškové a spol. (Přerov)
Kamena, v.d. (Brno)
Max BOEGL & Josef KRÝSL - lom Hamr
Ing. Jiří Zach (Praha)
Lesostavby Šumperk, a.s.

7. World production

Estimated world production in 1990 was 32 mill.t of dimension stone, the largest world producers are (data in mill.t, according to ITGE):

Italy	7.25	i.e.	22.7 %
Spain	4.25		13.3 %
Greece	1.85		5.8 %
USA	1.70		5.3 %
France	1.10		3.4 %
China	1.00		3.1 %
Brazil	0.90		2.8 %
Portugal	0.75		2.3 %
others (less than 2 % share)	13.20		41.3 %
Total	32.00		100.0 %

8. World market prices

Prices of dimension stone are set upon agreement and they are usually not quoted.

9. Recycling

The material is not recycled.

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 reserves of building materials - building stone, sand and gravel and brick clays in the Czech Republic. The reserves accounted 9,490,000 mill. m^3 as of December 31, 1994. Of this volume the share of building stone was 34.7 %, sand and gravel 47.7 % and brick clays 17.6 %. 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 are distorted to a certain extent. The reason is classification of deposits as reserved and non-reserved. During mine output of non-reserved deposits producers are not obliged to submit statistical statement Geo(MH)V3-01 and therefore their output can't be (excepting some of them) recaptured. That's why the actual output of building materials was rather higher than following numbers.

Mining output of building materials

Raw material	Unit	1990	1991	1992	1993	1994
Building stone	thous.m^3	16127	9517	8412	7488	8224
Sand and gravel	thous.m^3	21064	12876	12831	12481	11469
Brick clays	thous.m^3	2637	2167	1913	2062	1884

BUILDING STONE

1. Characteristics and use

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

2. Mineral resources in the Czech Republic

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

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

3. Registered deposits in the Czech Republic

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

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

Year		1990	1991	1992	1993	1994
Deposits - total number		483	488	493	496	495
exploited		207	205	198	181	180
Total reserves, thous.m^3		3201913	3265457	3324664	3301512	3296656
economic proven		1292493	1299967	1297748	1249895	1245610
economic probable		1742491	1808768	1857397	1882330	1875316
subeconomic		166929	156722	169519	169287	175730
Mining output, thous.m^3		16127	9517	8412	7488	8224
Imports, kt	a)	N	2	4	226	318
Exports, kt	a)	N	1215	3023	1874	1627

Note:
a) item 2517 10 of the customs tariff

5. Customs tariffs

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

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

Západokámen Plzeň, a.s.
WIMPEY - Severokámen, a.s. (Liberec)
Silnice Ostrava, a.s.
Silnice, a.s. (Hradec Králové)
Kámen a písek, s.r.o. (Český Krumlov)
Strabag Bohemia, a.s. (České Budějovice)
Železniční průmyslová stavební výroba, a.s. (U.Ostroh)
Kámen Zbraslav, s.r.o.
Pražský průmysl kamene, s.p. (Praha)
BERON, s.r.o. (Čerčany)
Palivový kombinát Ústí nad Labem, s.p.
Štěrkovny a pískovny Olomouc, a.s.
Kamenoprůmysl Skuteč, s.p.
Štěrkovny a pískovny Brno, a.s.
Lomy. s.r.o. (Brno)
Kamenolom Dobkovičky, s.p. (Velemín)
Firma Hájek Josef (Opava)
Silnice Jihlava, a.s.
Basalt Měrunice, s.r.o.
Max BOEGL & Josef KRÝSL - lom Hamr
Štěrkovna Olbramovice, s.p.
Vojenské stavby, a.s. (Praha 2)
Podkrkonošská těžba a úprava kamene, s.p. (Košťálov)

Štěrkovny a pískovny Veselí n.Lužnicí, a.s.
ATS - Silnice, s.r.o. (Cheb)
Berger, a.s. (Plzeň)
Sokolovská uhelná, a.s. (Vřesová)
Štěrkovny a pískovny Brno, s.p.
KROFIAN, a.s. (Hradec Králové)
Štěrkovny Lhota Rapotina, s.p.
Kamenolom Císařský, a.s. (Šluknov)
Karlovarské silnice, a.s.
ILBAU - SIBE, a.s. (Beroun)
GOS Granit Ořechov, s.r.o.
Silnice Nepomuk, a.s.
Povodí Ohře, a.s. (Chomutov)
SHB Bernartice, s.r.o.
Silniční stavitelství Praha, a.s.
Silnice Znojmo, a.s.
Pragocement, a.s. (Praha 5-Radotín)
Lom Jašek, Výkleky, s.r.o.
EKO-BET Jaroslav Vízner (Plaňany)
Sokolovské báňské stavby, a.s.
Štěrkovna, s.r.o. (Ostrožská Nová Ves)
IES Mosty Litice, s.r.o.
Správa a údržba silnic (Prachatice)
KBW, s.r.o. (Dobkovice)
KAVAL, s.r.o. Kamenolom Valšov
Silnice Stříbro, a.s.
Matlák - kamenolom Lažánky
Správa a údržba silnic (Jindřichův Hradec)
EKOZIS Zábřeh, s.r.o.
Agrostav Znojmo, a.s.
Agroplast, a.s. (Liberec)
ROCKAR, s.r.o. (Mladecko)
Cementárny a vápenky Prachovice, a.s.
ZD Šonov u Broumova
Ing. Jan Weiss (Děčín)
Transelba, s.r.o. - kamenolom Rosice
Strabag Uherské Hradiště, a.s.
JAMEL Kladno
TS - kamenolom (Nové Město na Moravě)
VIA - VODA, s.r.o. (Hrubá Voda)
Zábřežská lesní, a.s. (Zábřeh na Moravě)
Lesní společnost Jihomoravské lesy, a.s. (Prostějov)
HUTIRA, p.p. (Omice)
Mydlářka, a.s. (Benešov u Prahy)
Pavel Dragoun (Cheb)
Svoboda A.B. (Hodonín)
ZD Libina
JČL Č.Budějovice, a.s. (d.Milevsko)
Lom Kubo, R.Vít (Malé Žernoseky)
Podnik ekologické výstavby, a.s. (Chomutov)

7. World production

World production of the building stone is not observed.

8. Prices on the world market

Prices of the building stone are set upon agreement and they are rarely quoted (except the USA); average prices of the building stone in the USA in the last 5 years fluctuated between USD 4.39 - 4.83 per ton (crushed stone).

9. Recycling

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

10. Possible substitutes

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

SAND AND GRAVEL

1. Characteristics and use

Sand and gravel has been and will continue to be the principal construction material worldwide. Sand and gravel represent loose sediments originated by transport and deposition of more or less worn rock fragments of certain size (gravel 2 to 128 mm, sand 0.063 to 2 mm) which are products of the weathering of rocks. They mostly consist of pebbles and boulders of resistent rocks and minerals (quartz, feldspar, quartzite, granite, etc.), to a smaller extent of less resistent rocks and minerals (mostly of crystalline or metamorphic and sedimentary rocks). Sand and gravel also contains silty and clayey fractions. Major impurities are humus, clay intercalations, higher content of floatable particles and sulphur, high content of unsuitable (shape wise) or weathered grains. Gravel and sand deposits are common all over the world and they are not registered.
The ultimate use of sand and gravel determines the ratio of combination of sand and gravel size, their shape, rock type and composition. Sand and gravel are used mostly in the building industry in concrete mixtures, as drainage and filtration layers, road base, fill and for foundation stabilization, etc. Sands are used in the building industry in mortar and concrete mixtures, as an opening material in production of bricks, in plasters, as a filling of abandoned stopes in mines, etc.

2. Mineral resources of the Czech Republic

Most of the deposits in the Czech Republic are of fluvial origin and of Quaternary age; less often of fluvio-lacustrine, fluvioglacial, glacio-lacustrine and eolian origin. Industrially usable deposits occur particularly in river basins of large streams.
The Labe river basin - deposits along the right bank of the middle course (important deposits for central and eastern Bohemia) and lower course are characteristic of well rounded pebbles and boulders, varying ratio of gravel and sand and suitability for concrete mixtures. Other important deposits are in basins of the rivers Orlice and Ohře, along the lower course of the rivers Cidlina and Jizera, and along the middle course of the Ploučnice river. The material requires processing when used for concrete.
The Vltava river basin - important deposits are at lower course but there exist conflicts of interest. Major deposits in the southern Bohemia occur along the Lužnice river. The right bank of the Nežárka river shows good prospects for extraction of sand and gravel. The Morava river basin - along the upper and middle course of the Morava river there are deposits of gravel and sand with prevailing coarse fraction which are after processing, suitable for concrete mixtures. Deposits in the Hornomoravský úval (Upper Moravian depression) contain abundant fine fractions. Reserves are confined to the flood plains; the material is suitable for road construction and for mortar mixtures. Important deposits of sand and gravel in southern Moravia occur along the middle and lower course of the Dyje river and its tributaries,particularly the Dyje-Svratka depression and area around Brno (Svitava, Svratka).
The Odra river basin - important deposits of sand and gravel are at the middle course of the Opava river and near confluence of rivers Opava and Odra. The material is suitable for reinforcing of road shoulders and stabilization of soils.
Less important are deposits of glacial origin in northern Bohemia (The Frýdlant region) and in the Ostrava and Opava regions. Wind-blown sands of the Labe river basin and those located in southern Moravia are used mostly in mortar mixtures. Proluvial sediments of northern Bohemia, the Ostrava region, the Olomouc region, etc. are only of local importance. Facially changing Tertiary sands in the Cheb region, in north Bohemian basins, in the Plzeň region (mortar sands), and particularly in Moravia (e.g. the Prostějov and Opava regions) are utilized more often. Weathered sandstones of the Bohemian and Moravian Cretaceous sediments and sands from washing of kaolin are used in construction works.

3. Registered deposits in the Czech Republic

Because of their large number, deposits of sand and gravel are not listed.

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

Year		1990	1991	1992	1993	1994
Deposits - total number		367	374	365	385	382
exploited		83	83	82	70	64
Total reserves, thous.m^3		4504114	4454246	4438684	4522539	4529141
economic proven		1392204	1411501	1421936	1415203	1417277
economic probable		2581936	2518514	2493461	2573666	2617261
subeconomic		529974	524231	523287	533670	494603
Mining output, thous.m^3		21064	12876	12831	12481	11469
Imports, kt	a)	N	3	9	340	457
Exports, kt	a)	N	1466	3257	2174	1982

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

5. Customs tariffs

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

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

Pískovny Bratčice - Hrušovany, s.p.
A.H. Praha, a.s.
Štěrkovny a pískovny Olomouc, a.s.
Štěrkovny a pískovny Veselí nad Lužnicí, a.s.
WIMPEY - Severokámen, a.s. (Liberec)
Calofrig, a.s. (Borovany)
Stavební společnost Praha, s.r.o., Štěrkopískovna Dobříň
Kontakt Moravia, a.s. (Hodonín)
Štěrkovna, s.r.o. (Ostrožská Nová Ves)
TEKAZ, s.r.o. (Cheb)
Hrádecké pískovny, s.p. (Václavice)
Štěrkovny, s.r.o. (Dolní Benešov)
Prefa Pradubice, a.s.

Štěrkovny a pískovny Brno, a.s.
JAPAL, s.r.o. (Mohelnice)
Železniční průmyslová stavební výroba, a.s. (U.Ostroh)
TAUM, V.Maurer (Lužec n.V.)
Pískovna Sojovice, s.r.o.
ZD Skořenice
Pískovna Černovice, s.r.o.
Západokámen Plzeň, a.s.
Pražský průmysl kamene, s.p. (Praha)
Těžba štěrkopísku, s.r.o. (Brodek)
Pískovna Doubrava, s.r.o.
ZD Nové Město n.Cidl se sídlem v Písku
ZD Ovčáry
Dopravně mechanizační podnik, a.s. (Pardubice)
Agrodružstvo Klas (Staré Ždánice)
MPC, s.r.o. (Želetice)
TAPAS Borek, s.r.o.
ZD Humburky
1.Stavební, a.s. (Litoměřice)
Vojenské stavby, a.s. (Praha 2)
Montage Most, s.r.o.
AGS Bohemiastone, a.s. (Hradec Králové)
Sokolovská uhelná, a.s. (Vřesová)
GZ - SAND, s.r.o. (Otrokovice)
Silnice Klatovy, a.s.
Berger, a.s. (Plzeň)
Silnice, a.s. (Rychnov nad Kněžnou)

7. World production

The world production of sand and gravel is not statistically observed.

8. World market prices

Prices of sand and gravel are set upon agreement and they are not (except the USA) quoted; the average price of sand and gravel in the USA in the last 5 years fluctuated between USD 3.39 - 3.64 per ton.

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 but unsuitable for production of roof tiles;
- 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	1990	1991	1992	1993	1994
Deposits - total number	313	313	306	321	321
exploited	108	107	104	90	73
Total reserves, thous.m^3	1627015	1638092	1665091	1672782	1663774
economic proven	481709	495786	477417	469989	463593
economic probable	997615	999436	1046282	1059800	1057826
subeconomic	147691	142870	141392	142993	142355
Mining output, thous.m^3	2637	2167	1913	2062	1884

5. Customs tariffs

Materials for brick production are not listed in the customs tariff and their import and export have not been observed.

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

Jihočeské cihelny, a.s. (České Budějovice)
P.W.S., s.r.o. (Stod)
Wienerberger, M.C.P., a.s. (Novosedly)
Later Chrudim, a.s.
Severočeské cihelny, a.s. (Teplice)
Cihelna Rolný, s.r.o. (Prostějov)
Cihelna Dolní Jirčany, a.s.
Weineberger - Cihelna Hostomice, a.s.
Cihelny Hodonín, s.r.o.
Cihelna Dolní Bukovsko, v.o.s.
Cihelna Šlapanice, a.s.
Hevlínské cihelny, s.r.o.
CIDEM Hranice, a.s.
J.H.D., s.r.o. (Chrást)
Krytina Hranice, s.r.o.
CIOS Osenice, s.r.o.
Cihelna Kinský, s.r.o. (Kostelec n.O.)
Cihlářský závod Horky n.Jizerou, s.r.o.
Cihlářské závody Praha, a.s.
CSAS Cihelna, s.r.o. (Libčice nad Vlt.)
LIBOPOR, s.r.o. (Libochovice)
CIPO, s.r.o. (Hrádek nad Nisou)
Cihelna Žopy, s.r.o. (Holešov)
OBINPRO - BETSY, s.r.o. (Brno)
SEPO Modřice, s.r.o.
Cihelna Čepí, s.r.o.
Ing. Sommer - Cihelna Brázdim, s.r.o.

Koramic Řepov, a.s.
Cihelna Staré Místo, s.p.
Hodonínské cihelny Hodonín, s.p.
Cihelna Huráb, s.r.o. (Boskovice)
Cihelna Klíma, s.r.o. (Vrátkov)
J.Řehounek, Cihelna Časy
Cihelna Chmeliště, s.p.
Cihelna Molitorov
Cihelna Uhříněves, s.p.
Cihelna Pulice, s.r.o.
Cihelna Malenovice, s.r.o.
KEMA Skalná, s.p.
AKPOL, s.r.o. (Polom)
Cihelna Mensdorff-Pouilly, s.r.o. (Boskovice)
Cihelna Osvětimany, s.r.o.
Magma, provoz cihelna (Neplachovice)
Litovelská cihelna, s.r.o. (Chudobín)
Lounské cihelny Louny, s.p.
Cihelna Jeníkovice, s.r.o.
STAMP stavební společnost, 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.

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.

MINERALS IN CZECH FOREIGN TRADE

Minerals and mineral products represent an important group in Czech foreign trade. But a foreign trade balance has been permanently passive owing to large import volume of mineral fuels (crude oil and natural gas) and iron ores. The foreign trade with statistically important (in expression of value) minerals and products after division of Czechoslovakia on January 1, 1993 is manifested in the following table rendering several items of the Customs tariff in nomenclature HS-4:

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

Total export of the Czech Republic amounted to CZK 384,966 mill. FOB in 1993 and CZK 411,457 mill. FOB in 1994; the share of the above mentioned group of minerals was 5.9 % and 5.1 % respectively.
Total import to the Czech Republic amounted to CZK 374,878 mill. FOB in 1993 and CZK 423,964 mill. FOB in 1994; the share of the above mentioned items was 9.8 % and 9.1 % respectively.

A very important volume of minerals and mineral products exports was directed to Slovakia after the division of Czechoslovakia, namely mineral fuels. Their shares were as follows: hard coal 48 %, brown coal 46 % and coke 28 % (of the value expression of export in 1993).

Czech foreing trade with statistically important minerals and mineral products

Code	Unit	1993			1994		
		Export	Import	Balance	Export	Import	Balance
2501	thous.CZK share, %	35329 0	762166 2	- 726837 -	28334 0	627039 2	- 598705 -
2507	thous.CZK share, %	904053 4	10121 0	893932 -	684814 3	19409 0	665405 -
2508	thous.CZK share, %	349743 2	59250 0	290493 -	283090 1	71766 0	211324 -
2517	thous.CZK share, %	1419778 6	103474 0	1316304 -	316680 2	69310 0	247370 -
2523	thous.CZK share, %	2676888 12	97166 0	2579722 -	3028361 15	204750 0	2823611 -
2601	thous.CZK share, %	74 0	4343809 12	- 4343735 -	2463 0	4460981 12	- 4458518 -
2701	thous.CZK share, %	8304066 37	1677847 5	6626219 -	8737618 42	1591212 4	7146406 -
2702	thous.CZK share, %	4722395 21	11930 0	4710465 -	3708114 18	3288 0	3704826 -
2704	thous.CZK share, %	3448709 15	79585 0	3369124 -	3590276 17	429691 1	3160585 -
2709	thous.CZK share, %	247185 1	17686167 48	- 17438982 -	233157 1	19286550 50	- 19053393 -
2711	thous.CZK share, %	208515 1	11731959 32	- 11523444 -	192067 1	11806792 31	- 11614725 -
Total	thous.CZK share, %	22316735 100	36563474 100	- 14246739 -	20804974 100	38570788 100	- 17765814 -

Note:
a) 0 % of export or import indicates that the volume is less than 0.5 %
b) expression of value proceeds out of the declared goods tariff value internationally marked FOB (without foreign trade direct costs)

Conditions of minerals and mineral products import and export were regulated by relevant decrees. The Ministry of Industry and Trade Decree No. 300/1993 Sb. has been in force since January 1, 1994. There was issued, among others, a list of Customs tariff items concerning the field of minerals and mineral products liable to licence procedure of quantity limitation as it is stated in the following summary of selected items:

Item		Import limit, t	Export limit, t
2505	Natural sands	-	1 300 000
2507	Kaolin, Quality Sedlec Ia	-	45 000
2517 10	Gravel, broken or crushed stone except crushed limestone	-	5 050 000
2521	Limestone and other calcareous stone, for lime or micronised limestones manufacturing	-	200 000
2523 29 00	Grey cement	-	1 920 000
2523 90 90			
2612 10	Uranium ores and concentrates	1	-
2701	Steam hard coal	1 200 000	800 000
	Coking hard coal	300 000	3 000 000
2702	Brown coal also agglomerated	500 000	6 000 000
2704	Coke of foundry coking plants	-	850 000
	Coke of mining coking plants	-	1 050 000

Mineral Commodity Summaries of the Czech Republic
1995 Yearbook

Published by Ministry of Economy of the Czech Republic
Edited by NIS ČR – department Geofond
Distributor: NIS ČR – Geofond, Kostelní 26, 170 00 Praha 7, Czech Republic
Praha, June 1995 – 150
Printed by GRAPHIC, Konviktská 5, 110 00 Praha 1
ISBN 80-212 0125-8