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## 9. MEDZINÁRODNÁ BANÍCKA KONFERENCIA 9th INTERNATIONAL MINING CONFERENCE

### MINERAL INDUSTRY AND THE ENVIRONMENT AT THE CROSSING POINT TO THE THIRD MILLENIUM

#### NEROSTNÝ SUROVINOVÝ PRŮMYSL A ŽIVOTNÍ PROSTŘEDÍ NA PRAHU TŘETÍHO TISÍCILETÍ

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**Abstrakt:** Současnost a budoucnost průzkumu, těžby a spotřeby nerostných surovin je určována základními trendy vývoje lidské společnosti, rozsáhlými změnami výrobních technologií a požadavky na ochranu životního prostředí. V posledních desetiletích evropské hornictví prochází útlumem. To se týká i České republiky. Těžba rud skončila, těžba ostatních nerostných surovin poklesla o 30 až 40 %. Přesto bude těžba uhlí a nerudných a stavebních surovin i nadále velmi významná v důsledku rozvoje nových zpracovatelských technologií. To vše vyžaduje rozpracování nerostné surovinové politiky odvozené od přijatého národohospodářského scénáře.

Velmi závažným problémem spojeným s těžbou a využíváním nerostných surovin je péče o životní prostředí. To vyžaduje systémový přístup k řešení koexistence lidských aktivit s přírodou. Míra poznání chování globálních geosystémů není z prostorových, časových a kauzálních aspektů dobrá, což dokládá např. rozporuplná diskuse o skleníkovém efektu, uhlíkovém cyklu či biodiverzitě. Drastický útlum hornictví spojený s technickou likvidací dolů vyžaduje individuální řešení revitalizace pohornické krajiny ve vztahu s regionálním územním plánováním.

#### 1. Introduction

Solving relations between the mining and the environment requires a complex system approach. Unfortunately, we often meet the wholly opposite approach. The practice appears to take events out of connections and to emphasize them excessively. It can be even said that hardly anywhere we can see so many unqualified, or even demagogic attitudes as in the sphere of environmental care. Primarily opinions presented to the general public in the press can be often described as irrational and dictated not by professional, but political and individual interests. This surely cannot contribute to solving these complicated problems.

According to many authorities, we are undergoing a period of significant changes on the local and global levels. Since the 70's, a lot of research institutions have already been concerned with considerations on future ways of the evolution of humankind. Various conceptions have been formed ranging from catastrophic, presented with pleasure by science-fiction writers and representatives of deep ecology through pessimistic ideas of the Roman Club up to realistic considerations. They rest upon the conception of sustainable development. The demand for mineral and especially energy raw materials creates a key point of these conceptions.

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## 2. Humankind and mineral industry

It is evident that the human society is necessarily in need of mineral raw materials to its living. Our considerations about mineral resources are limited by several fundamental facts:

- World population is growing rapidly. This growth is very uneven and appears above all in developing countries.
- World population is fully dependent on the comprehensive supply with mineral raw materials.
- Energy resources are of the first-rate importance and their structure will be changed in the future.
- Protection of the environment calls for essential changes in technologies economizing both the raw materials and energy requirements.
- The extensive modification of technologies is predicted in next decade. Consequently great changes in mineral raw materials are possible to be expected, maybe up to 70 %.
- Mineral resources are located very heterogenously on the Earth. That is why practically no country is self-supporting in minerals (Fig. 2).

Then we must admit the geological exploration, exploitation and processing of mineral raw materials. In addition, we must agree with negative impacts accompanying these activities. However, what we must try is to reduce and eliminate these negative effects by suitable methods. The reengineering of the flow of materials in society, especially the identification of substitutes and the recycling of materials has a key role. The understanding of dynamics of the substitutions requires the consideration of all phases of the materials cycles and all commodities that are used for material purposes (Fig. 3).

During the last tens of years, European mining has undergone an extensive damping in coal and ore productions. In most of the countries of Western Europe, and in the Czech Republic too, the mining industry becomes a dark side of history. Mines are being closed, some of them are changed to specific, and it is necessary to say that attractive tourist places. Reasons for this evolution are economical, political, ecological and technological. Their importance is different in various countries depending upon geological preconditions, economic orientation and maturity of the country and, in a considerable degree, upon environmental understanding of the society. This process concerns also the Czech Republic. Although it began by completing the exploitation of iron and gold ores in the sixties, it was intensified after the velvet revolution in 1989. Transition to the principles of market economy has manifested itself:

- in decreasing the consumption of raw materials due to restructuring related branches (energetics, metallurgy, machine industry) and also owing to the division of former Czechoslovakia,
- then in removing so-called limit prices of mineral raw materials supported by the state,
- and as a result of this, in damping uneconomical mines.

country	year	annual (t)			life (t)		
		total	of which		total	of which	
			constr.	energ.		constr.	energ.
Czech R.	1993	16.71	6.35	9.77	1220	463	713
Germany	1987	16.86	8.53	6.55	1180	597	459
USA	1987	17.82	9.05	7.65	1336	679	574

Fig. 1: Mineral raw materials consumption per person.

The production of mineral raw materials cut down to 30-40 %. The decrease in production has appeared with all types of mineral raw materials; the exceptions being oil and natural gas, whose productions are virtually negligible. So, our ore mining and production are in the situation equal to that in Japan. Nevertheless, in 1993 more than 2000t of raw materials per 1 square kilometer were exploited, or over 15t per head. If we take this number as the certain "average" and consider the import of raw materials, then any inhabitant of our country consumes 1220 t of mineral raw materials within 73 years, which represents the average lifetime. This amount is comparable with another countries. We can expect that these numbers will change and diminish as a result of technological progress. Nevertheless, we must seriously concern with questions regarding the future supply of needed mineral raw materials under the existing damping of mining industry. If we look at the structure of production (Fig. 1), we can observe that a wholly prevailing part is formed by energy and building raw materials. It is rather interesting that, in this context, a term "The Modern Stone Age" often appears. Just energetics and building industry are not decisively numbered among the branches that should be damped down. Their role will be certainly even of greater and greater importance. Of course, we can expect changes in technologies leading to decreasing the specific consumption. The evolution in the sphere of

coal utilization can be given as an example. Coal must still create one energy strategy. The world's development of Clean Coal

of decisive elements of

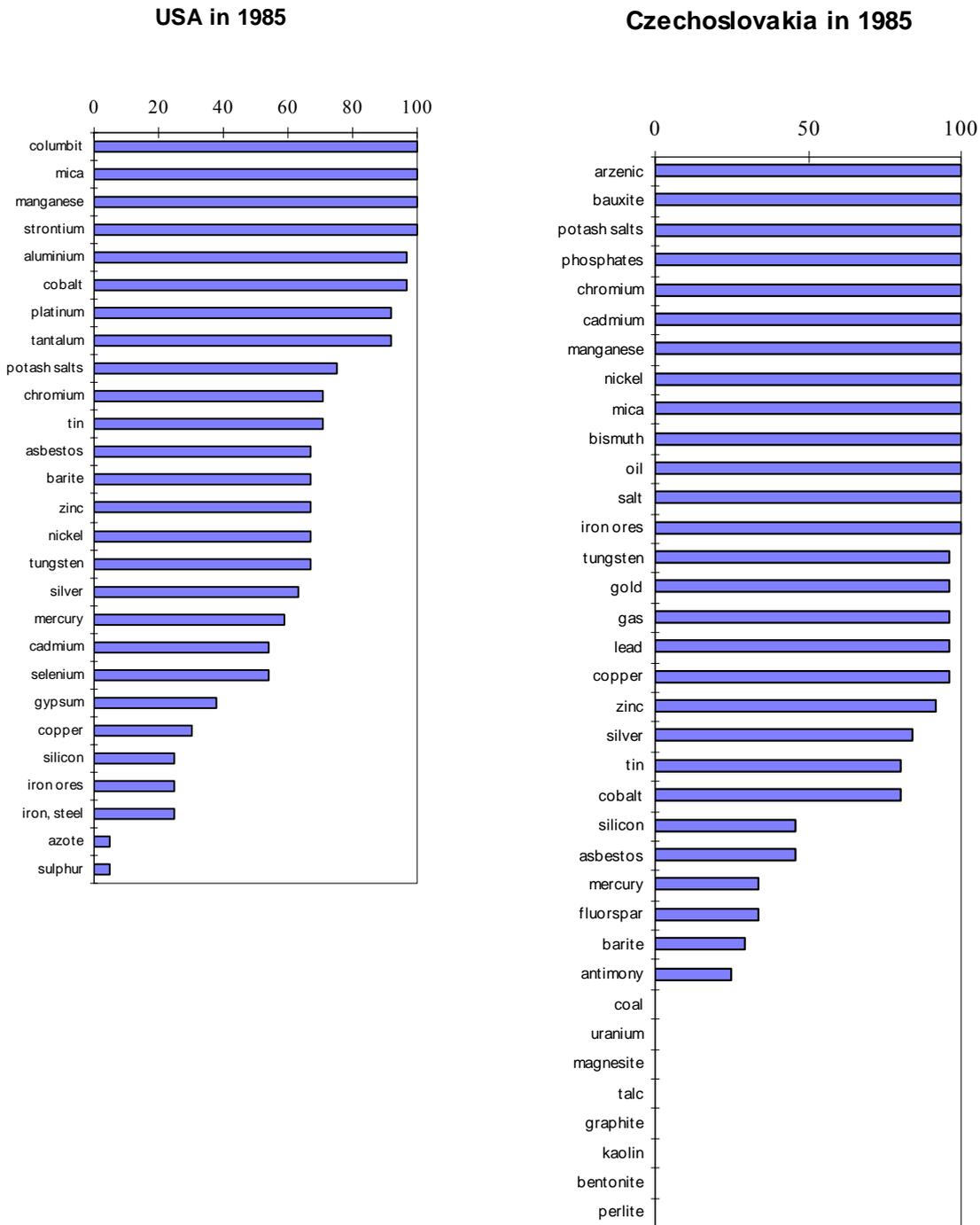


Fig. 2: Dependence on import.

Technology indicates extraordinary attention which will be paid to coal resources in the next millenium. Clean coal technology representing "a new coal era" covers the whole chain of technologies (exploitation, processing, transport and utilization to waste recovery).

The sphere of supply and consumption of mineral raw materials has been radically changed. Legislative and economic conditions, under which these processes take place, have been rearranged. What

is of decisive importance is, similarly to the technologically advanced world, the national raw material policy. We cannot think that this term represents former balances of the type "the X company produces so many and so many and this production is taken by the Y company". What is meant is the system of rules of behaviour of subjects on the raw materials market on the basis of an accepted macroeconomic scenario of economic development. These considerations are essential to supplying strategic and critical mineral raw materials. A principal change has occurred in the market of mineral raw materials as a result of removing all boundaries on the world's market, where each raw material is from the short- or long-term standpoint available, if we have appropriate finances. In general, it is necessary to realize that economically available resources of all kinds of mineral raw materials depend exclusively on the total prices that are still acceptable from the customer's view.

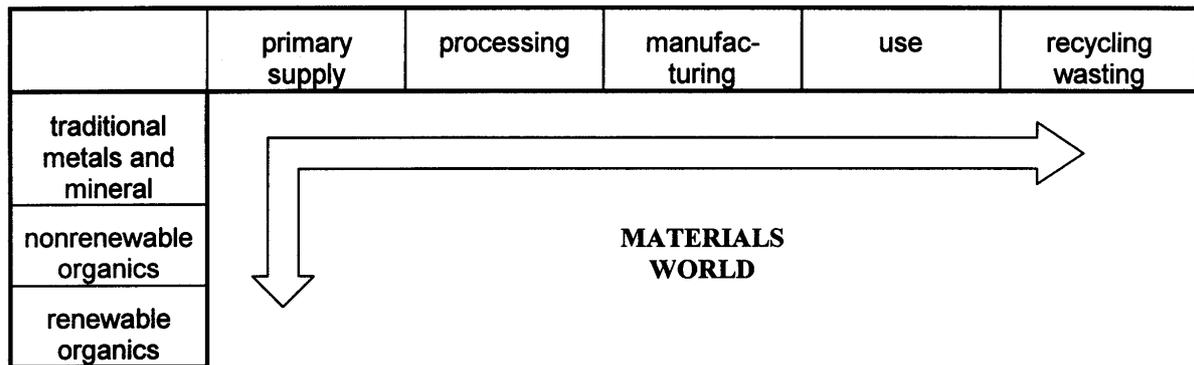


Fig.3 The increasing recognition of material flow (E.B.Amey 1996, modified).

### 3. Mineral industry and the environment

As for environmental problems, I would like to put the stress on connection of geological and mining activities with the care of the environment. In geological exploration, the point is that geology is naturally related to the subject of its interest. Already for many years, the exploitation and consequential branches of processing and treatment of mined mineral raw materials must have been orientated to coexistence with nature as well as the area of anthropogenization. Nevertheless, it is true that an immense increase in energy and material demands of industrial society of this century represents, from the long-standing standpoint, a new phenomenon that can reflect in unexpected changes in ecosystems, especially in the areas of extensive exploitation at synergic acting of heavy and chemical industries.

A precondition to understanding very complex processes being under way in the anthroposphere is a system conception of coexistence of activities of human society and nature. The environmental system of the Earth is enormously complicated. A key role is played by the geological environment and its components that together with the hydrosphere, atmosphere and biosphere form a balanced system with feedbacks, with the balance of great geochemical cycles, which Vernadsky considered to be one of basic conditions to the uninterrupted evolution of life on the Earth. It is a case of understanding interconnections of natural and anthropogenic systems in the whole hierarchic structure, from local to global ones. However, according to this conception we must see a role and significance of humankind in the Earth's evolution in the right light. We are to realize spatial, temporal and causal aspects. We must see limited human experience given by the temporal and spatial factors.

Discussions on the greenhouse effect can be presented as an example, whose discrepancy is evident especially in considerations on the evolution of the geosphere, hydrosphere and atmosphere in geological history. It seems to be still an unclarified problem out of human experience and the stage of knowledge. Besides, we know that the considerable vicissitudes of temperature have occurred without any connection with human activities. In addition, the CO<sub>2</sub> content, e.g. in the Cretaceous, was many times higher. During the last glacial stage, the CO<sub>2</sub> content was also after the latest analyses comparable with that at present.

It is peculiar that the most significant energy source of our lives - the Sun, very often has not been taken into account in considerations like that. There is obvious connection of the integral curve of solar and geomagnetic activity with the curves of temperature, weather situations and rainfall. Common agreement prevails in opinion of broad international expert community that solar - terrestrial impacts (Sun - Earth relations) on climate changes are of first importance. A primary role of the inertial motion of Sun around the centre of mass of the Solar system is indicated by many authors.

We must see that degradation and pollution of the environment that many people assign exclusively

to human acting, is also a natural process occurring in the whole history of our planet in various forms and intensity. For example, the explosion of the Tambora volcano (Indonesia) ejected into the atmosphere an unimaginable amount of minimum 80 km<sup>3</sup> of tephra. Solfataras in the Valley of Thousand Smokes in Alaska bring every year 1.25 million t of hydrogen chloride and 0.3 million t of hydrogen sulphide. The explosion of the Mt. Helena volcano in 1980 destroyed totally the area of more than 500 km<sup>2</sup> and covered a greater part of the USA and southeastern Canada with ash fallouts.

As for a very discussed problem of decreasing biodiversity we should remember that in the history of life on the Earth more than 99% of all the types have died out. From the standpoint of present frequently mentioned opinions on harmfulness of radioactive radiation, it is interesting that it was just the influence of increased radioactivity during periods of intensive accumulation of uranium into sediments that was, according to opinions of many scientists, a cause of not only the extinction of many existing kinds, but also the subsequent origin of new kinds by stabilization of dominant mutations. Up to now, no ideas concerning the basic impact of changes in the orientation of the geomagnetic field has not been taken into account yet. In the stage of transition, hard cosmic radiation acted similarly to the radiation of the environment.

It follows from these examples that the system approach helps to see the structural and historical components of the local and global systems under evaluation in proper dimensions, where man plays a rather subordinate role from the global and historical standpoint but certainly an important role from the local point of view. On the whole, there is an agreement in the statement that human activities impact on the environment. Nevertheless, evident tendencies to underevaluating or overevaluating appear. Reasons can be seen especially in the scale of natural systems, which are influenced by past and present human activities relatively little. Therefore it is difficult to quantify impacts on the environment and ability of these systems to absorb undergoing anthropogenic processes. That is just why is right to apply the precautionary principle in the sense of the conference in Bergen in 1990.

What is closely connected with geology and mining is the care of natural resources that must be understood, however, in its broad sense. We must realize that strict programmes on environmental protection applied in relation to the exploitation of mineral raw materials lead to the "export" of negative influencing the environment into producer and exporting countries.

A drastic damping in the European mining showed itself in the need for the technical liquidation of mines and in increasing demands for covering the impacts of mining activities and remediation of post-mining areas. Liquidation of mines is a technically demanding problem with specific safety issues. It is necessary to emphasize that the liquidation of each mine requires an individual approach depending upon local conditions. I would like to comment on the reclamation and reviving of the landscape after mining. Removing effects of mining activities together with subsequent reviving post-mining areas is time-consuming, technically and financially exacting, and often is ecologically disputable. In the areas of mining activities, three stages of the landscape development can be generally defined, namely:

- the pre-mining area, it means an area under the regime of protection of mineral accumulations against other industrial and building activities (in our conception it is a case of a so-called protected deposit area),
- the mining area with degraded functions of the environment,
- the post-mining area asking for removing effects and creating a new landscape.

In principle, it is necessary to analyse the impacts of completing the mining and related industrial activities from the standpoint of regional urban planning and plans of development of towns and villages in the region. Briefly speaking, the aim is to propose such procedures of technical and biological reclamation as form preconditions for reviving the landscape. According to a general opinion, problems of covering effects of mining activities must be an unseparable part of the conceptional programmes of mining companies, or in the case of former exploitation, a part of state ecological programmes.

#### **4. Conclusion**

In 1984 Wolfe stated that what was necessary to the healthy development of humankind was a balanced compromise between the environment and the economy. It is necessary to bear in mind that the healthy environment can be created only under healthy economy. This is given very simply in Paul Hayne's excellent textbook "Economic style of thinking", where we read that economy and ecology are allies, not rivals or opponents. I should like to say, that we need replace a little worn slogan "All what is ecological is also economical" with the buzz-word "all what is economical is also ecological". In conclusion I would like to say that it is technically and ecologically correct liquidation and reviving that reflect our responsibility for future generations. We must have in mind that no country is sufficiently rich to be able to afford wrong solutions.

Although during the 70's and 80's a life of mineral resources was regarded as a limiting standpoint for the future of humankind, at present it is clear from all analyses that this is not true. It is impacts of utilization of resources not only upon human society but also upon whole global geosystems, including the biosphere that must be thought as a determinant viewpoint. What is meant is a fundamental change that

could be designated as a change in professional philosophy and ethics. Putting this change into common practice represents a problem that is difficult, but necessary to keep the sustainable development of humankind.

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