

TECHNOLOGY OF EXPLORATION AND MANAGEMENT OF NATURAL RESOURCES

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Summary

Humankind's security of natural resources is one of the fundamental problems faced by the civilized community. Classification of natural resources is described in brief. Measures aimed at conservation of natural resources are specified. The stages of investigation and development of land, water, energy, and other resources are described from the Neolithic epoch to the late twentieth century. The estimates of the state-of-the-art of natural resource management, use, and conservation are given in correlation with the principles of sustainable development of nature and people (Earth Summit, 1992). The factor that has negatively affected primary materials supply in every country of the former USSR is disclosed. Estimates of the share of Russia in the total explored reserves of oil, natural gas, coal, iron ores, bauxite, copper, phosphate, nickel, tin, diamonds, and other useful minerals are given. Detailed description of primary material, fuel, and energy resources of Russia in the late twentieth century, and mining methods used for their development are presented. Output statistics are provided on ferrous and non-ferrous metals, gold, diamond, oil, natural gas, and coal. Forecast estimates of the country's mineral reserves and resources of the twenty-first century are shown. Directions and objectives of the research into the mineral wealth of Russia are shown in the paper. Promising methods for comprehensive development of mineral resources and a strategy for mutual development of natural resources and people are discussed.

1. Introduction

Meeting the demand of humankind in natural resources is one of fundamental problems

faced by the civilized community. Enjoying the achievements of scientific and technological progress people do not get free from the necessity of developing the natural wealth. Just on the contrary, people's dependence on natural resources is ever growing.

Natural resources can be divided arbitrarily into two categories: renewable (water, land, and biological resources, etc) and non-renewable (mineral) resources. Broad-scale development of natural resources, growing rates of the biosphere pollution with non-recycled production wastes, and the refuse resulting from human activities make the problem of reasonable nature management, and conservation of global and regional ecological equilibrium particularly pressing. Protection of the environment constituents and natural resources is a task, which cannot be realized by any country solely. It dictates the necessity for coordinated efforts of various countries and a common global strategy.

2. Stages of Development of Natural Resources

At the early stages of human history major importance was attached to hunting and fishing. It was accompanied by limited-scale use of mineral resources (application of rock and minerals as tool materials by people of the Paleolithic and the Neolithic epochs) and nearly complete recycling of wastes in natural ecological systems. However, first broader-scale attempts of high-grade silicon mining date back to the Neolithic epoch. For over 40 000 subsequent years, with the progress of agriculture and cattle breeding, wider use has been made of land resources, vegetation, irrigation water, and some energy sources (wind, water streams, and traction force of animals). Along with this, the culture of metals and alloys (copper, bronze, gold, iron, etc), ceramics, natural stone (cult buildings, roads, engineering structures, sculptures and jewelry) has been developed.

According to Academician V. I. Vernadsky's estimates, the ancient people used nineteen chemical elements; on the eve of the twentieth century use was made of fifty-nine elements, and natural resources were used by far more intensively. In 1985, all discovered chemical elements of the Earth's crust were used.

In the 1920s–1980s the development of natural resources envisaged the assessment, exploration, and cadastral valuation by types (forest estimation, land and water cadastres, quantitative assessment of mineral resources, etc.), application proper, conservation, and prevention of the depletion of natural resources. Work was initiated on the productivity maintaining and rehabilitation of resources (reclamation of lands and soils, restoration and consolidation of seashores, and large water-pool banks, soil development, and afforestation, etc.). At all the stages of the above mentioned period top priority was attached to economic and social justification of the development of natural resources, both from the global and from the regional/local viewpoints.

Studying of natural resources is steadily advancing and expanding. People successfully use the most effective R&D findings and developments (remote sensing of the Earth's surface by satellites and aircraft, geophysical research systems, and super-long borehole drilling, etc.). Scientifically grounded evaluation of natural resources (cadastral,

technological, economic, and social) is becoming a mandatory condition of the most efficient use of natural resources, with due account for all negative effects such use may have on people and environment. The volume of annually extracted natural materials and products for this period are roughly estimated at 35×10^9 to 40×10^9 MT with the share of the former USSR in the total volume of annually mined rock alone amounting to 15×10^9 MT.

At the modern stage of development people are quite aware of the necessity to establish relations with nature according to the principles of “sustainable development” offered by the United Nations Conference on Environment and Development (Earth Summit) held in Rio de Janeiro in 1992 as the main direction for the development of the world community. In Russia these principles are interpreted as the strategy of sustainable development of nature and people. These principles form a complex system of mutually determined social, economic, political, cultural, ethic, international, ecological, and other issues. The success of future actions to be undertaken at the national and global levels can be achieved only with an application of the comprehensive system approach to the problem.

3. Natural Resource Management, Utilization and Conservation: The State-of-the Art

The approaches to global problems concerning natural resource management, utilization and conservation in modern conditions greatly depend on such very important factors, as war prevention, limitation and decommissioning of arms, conservation and security of the biosphere, energy, mineral feedstock and foodstuff supply, elimination of the backwardness of developing countries.

According to the established legislation, management of natural resources viewed as the state-owned property is aimed at their studying, reproduction and conservation. The system of administrative control of natural resources in Russia includes the Federal agencies, such as structural divisions of the Ministry of Natural Resources of the Russian Federation, and local agencies, such as committees for natural resources of autonomous republics, regions, and territories i.e., managerial bodies for state-owned mineral and water resources.

Great diversity is the most peculiar feature of natural resources, thus the problems concerning each variety are plentiful. In connection with this, below goes the description of these problems with regard to mineral resources.

4. Mineral Resources

Despite the fact that mineral resources are rather irregularly distributed over the former USSR territory, the orientation of Russia towards top-priority development of primary material producing sectors at that time have determined the strategy for the development of the country's own primary material sources. This strategy was based on the conception of establishing an integrated primary material production complex. Actually, plentiful mineral reserves and resources met the national mineral feedstock demand, and from year to year the mining industry accounted for 50 to 70 percent of the total hard-

currency inflows of the country. However, it is the strong dependence of the primary material production complex upon the country's territorial integrity, that after the USSR disintegration has negatively affected primary materials supply in every country of the former Soviet Union, even in Russia, which possesses the most plentiful mineral resources. Thus the share of Russia in the total explored reserves of the former USSR accounts for the following: 87 percent of oil and gas; 70 percent of coal; 60 percent of iron ores; 85 percent of bauxite, 53 percent of copper; 50 percent of natural phosphates; and 90 to 100 percent of nickel, tin, vanadium, platinumoid elements, diamonds, and mica.

Mineral resources of Russia are traditionally divided into two groups: primary material resources and fuel and energy sources.

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Biographical Sketch

Kliment N. Trubetskoy, Dr. Sc. (Eng.), professor, member of the Russian Academy of Sciences (RAS), member of the RAS Presidium, Director of the RAS Research Institute of Comprehensive Exploitation of Mineral Resources, a researcher of the Earth's mineral wealth and ecologist, the author of 400 works published in Russia and abroad, including 40 monographs and 55 patents, a winner of the USSR and Russian State Prizes and an awardee of N. V. Melnikov Commemorative Gold Medal of the RAS. The professor has elaborated scientific grounds for a new insight into the modern contents of mining sciences as a body of knowledge about laws and methods of the controlled technogenic transformation of the Earth's bowels. He has also identified scientific grounds for the development of high resource-saving (resource-reproducing) surface mining technologies. Rather great is his contribution to the development and commercial application of novel mining equipment and technogenic primary material processing and utilization technologies. His fruitful efforts in environmental control research are highly appreciated. K.N. Trubetskoy heads a leading research school for comprehensive exploitation and conservation of mineral reserves and resources supported by the Government. The professor has trained 26 doctors of science. For many years he has been a deputy academician-secretary of the RAS Division of geology, geochemistry, geophysics and mining sciences. Great are his efforts aimed at the co-ordination of geosciences research in Russia. Prof. Trubetskoy is a deputy Chairman of the Geosciences Section of the Committee on State Prizes with the RF President, deputy Editor-in-Chief and a member of the editorial board of well-known scientific Russian magazines. In 1997, for his activity as a member (since 1992) of the International Organizing Committee of the World Mining Congress (IOC WMC) Prof. Trubetskoy was awarded Krupinsky Commemorative Medal, the highest WMC award.