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DEVELOPMENT OF THEORETICAL AND METHODOLOGICAL BACKGROUND FOR MINING REGIONS' ECONOMIC SECURITY

The paper reviews geoecology as a science of lithosphere and biosphere interaction regarding socio-economic human activity. Such interaction is more likely to take place when using mineral raw resources. This is characteristic of Urals Mining Complexes being a basis of region's economy. The place of geoecology in ecological science is specified. The geoecology structure with its main science subdivisions is developed. Fundamental principles of geoecology as a scientific discipline are defined. The research methodology for environmental technogenic transformation by Mining Complexes is considered, as well as tools, structural principles, forms, ways and methods of scientific enquiry. The approach to geo-ecological research in mining complexes is worked out, including assessment of a targeted object, background and environment. The research brought about the assessment of natural and economic damage under the influence of a mining complex.

Keywords: geoecology, lithosphere, biosphere, geoecology, lithosphere, biosphere, socioeconomic activity, mining complex

The term of geoecology was introduced [11, 12] for scientific use by the German physicist and geographer K. Troll in 1939 for describing spatial interactions of natural phenomena and relationship between different phenomena within a certain ecosystem. His brother a botanist V. Troll have borrowed the term «geoecology» and applied it in biology area for describing the ecology subdiscipline that studies ecology of Earth landscapes. Biogenesis of communities of live organisms as characteristic for certain types of a natural system (lakes, woods, tundras, etc.) was meant. Therefore, the term «geoecology» at once became a property of two sciences — geography and biology. So continued for about 50 years, hereafter «there was confusion of words, concepts and understanding of the term «geoecology» [3].

Some definitions of the term «geoecology» are presented in table 1.

Geologists accepted the term «geoecology», after the report of USSR minister of geology Ye.A. Kozlovsky «Geoecology — a new scientific field» [4] on the International geological congress in Washington at 1988, According to report this field being developed cross-disciplinary of geology and ecology sciences means the geo-ecological system as a target of research including such elements, as vegetation and fauna, human being, geological environment and technogenic objects. The primary target of geoecology is to study and evaluate of geological environment change as a result of economic activity of human being.

As can be seen from the above, geographer's views have essential differences that give an evidence of difficult process of formation of this field in geographical science [7].

Let us consider the main reasons of terminological confusion between geographers and geologists and the exit ways from it.

The first reason is terminological. If V. Troll within geographical science had termed it as geoecography, and not geoecology, then between geographers and geologists would not have existed any contradiction.

The second reason is economic. Volumes of geological prospecting work were sharply reduced due to Russia transition to a capitalist way of development since the beginning of the 90th years of the last century. Many production geological associations (PGA) have stayed out of work according to the solution of traditional prospecting tasks. At the same time, State Nature Management Committee and other authorities of state regulation of environmental conditions was ordering to users of nature task performance of an assessment of an ecological situation of territories. Having powerful potential scientific and production, geologists have begun to solve these problems. Ecological and geochemical and other types of surveying of various scales, valuation of ecological state of territories, etc. have been as a result. All this demanded a certain terminology and the term «geoecology» could not have come at a better.

Table

Definition of geocology

Definition	Author
Geocology is a term of free use and requires clarification when using to reflect the point of view of this or another author	V. T. Trofimov & D. G. Ziling [12]
Geocology as a subdiscipline of geography investigates ecosystems (geo-ecosystems) of high hierarchical levels including biosphere	N. F. Reymers (1990) [8]
Geocology is considered as the science that integrates knowledge of the fields of geography and ecology	A. P. Alkhimenko [1]
Geocology is considered as ecology about present-day landscapes (natural, changed and created by a human being), and also geological environment, ways and opportunities of use of natural resources at ecological restrictions and the socio-economic development	S. P. Gorshkov [2]
Geocology is ... science of interaction of geographical and social production systems. Objects of geo-ecological researches are considered to be economic geography, biogeography, soil science, climatology, oceanology, geomorphology	K. M. Petrov [6]
Geocology is a new scientific field of geology which investigates structures, content and properties of the geological environment as ecosystem component	G. S. Vartanyan [5,13]
Geocology is the geological science using many laws of other adjoining sciences and aimed at the responses to environmental problems of different level and scale, being shown in a lithosphere or connected to lithosphere processes	L. L. Prozorov [7]

Despite a covert terminology targets of research in geocology, not only for geographers, but also for geologists are the landscape elements (air, snow cover, the soil, vegetation, fauna, surface and underground water). Source of effect is technogenesis, especially strongly being shown when using mineral and raw natural resources. Therefore, the geocology is the scientific discipline oriented towards environmental problems. It aims at understanding the natural processes and economic activity in lithosphere to identify particular problems related to human use of the biosphere.

A term of ecology was offered in 1866 by the German biologist E. Gekkel in his work *The General Morphology Of Organisms*. He specified ecology as the study of the relationships between living organisms and their environment. In 1869, he wrote that the ecology investigates the general relation of animals as to their organic, and inorganic environment, their friendly and hostile attitude towards other animals and plants with which they enter to direct and indirect contacts, i.e. in the struggle for existence. E. Gekkel believed environment to be conditions created by the inorganic and organic nature. Herewith he referred physical and chemical specific characteristics of habitats of living organism to inorganic conditions: climate (warmth, humidity, and illumination), composition of water and soil, feature of atmosphere, and also inorganic food (minerals and chemical compounds). He considered organic conditions as a relationship between organisms existing within one community and an ecological niche.

Currently, there are hundreds of definitions of ecology. In fact, it has become a complex meta science (commensurable with philosophy) of the relationship of organisms with the environment, the interactions of nature and society, synthesizing all natural-historical knowledge and conclusions about the nature.

Environment is constantly changing dynamic system. Its changes happen under the influence of different factors, which can be subdivided as follows: genetic, essential and scale (tab. 2).

Types, species and subspecies of impact on environmental are specified within the group.

Genetic factor determines the type of action on environment. It can arise from space or inner geosphere of the Earth, (including lithosphere, mantle and core). In view of intensive anthropogenesis of environment, natural and anthropogenesis factors are allocated. Since natural and anthropogenic

Table 2

Classification of ecological factors of environmental impact

Factor	Type	Species	Subspecies
Genetic	Cosmogeneous Biogeneous Lithogeneous	Atmospheric Hydrospheric Pedosphere	Natural Anthropogenous Complex
Essential	Individual Species Ecosystem	Material Energetic Information	Physical Chemical Biotic
Scale	Local Regional Global	Incidental Periodic Constant	Background Intensive Extreme

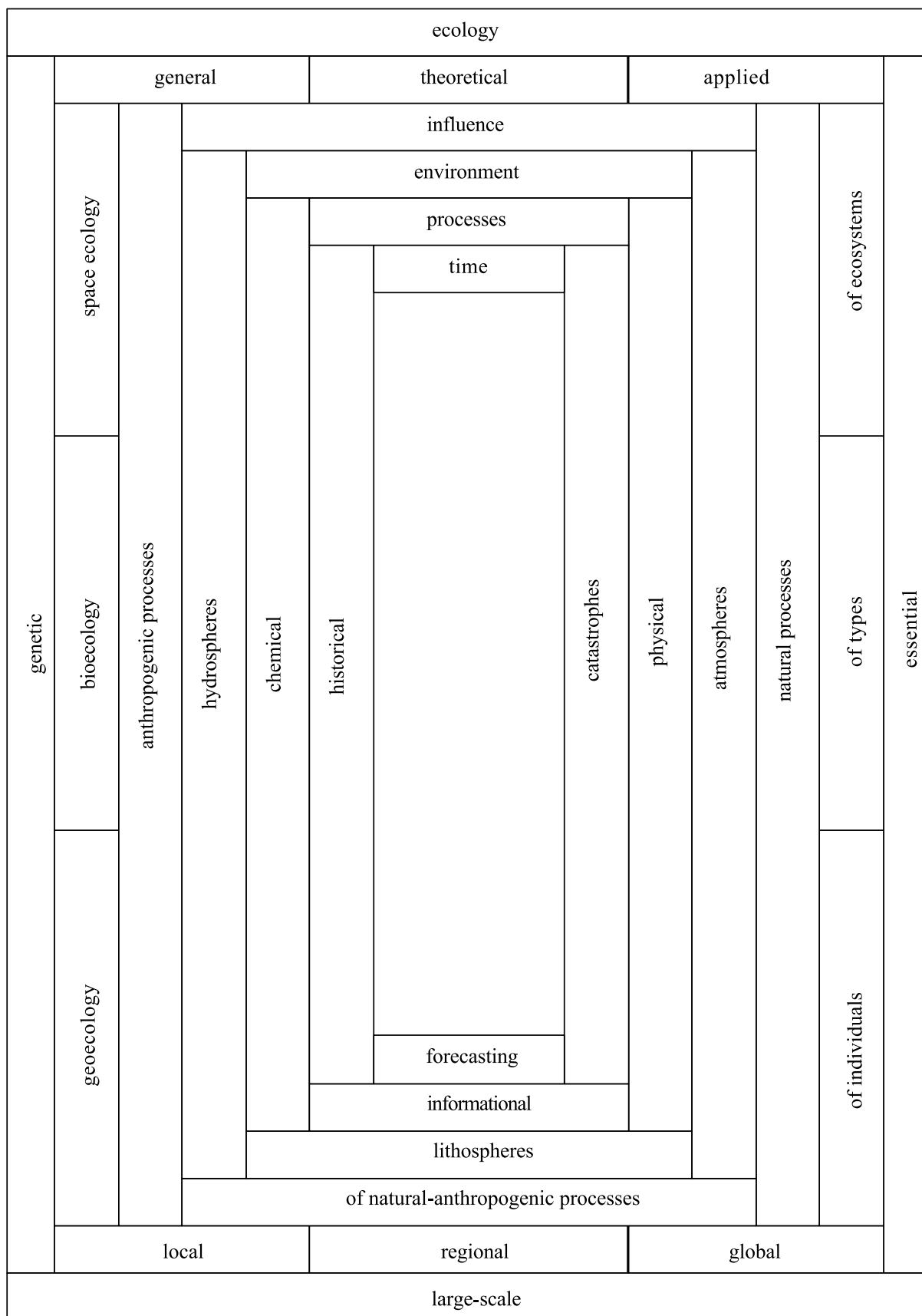


Fig. 1. Systematization of directions in ecological science

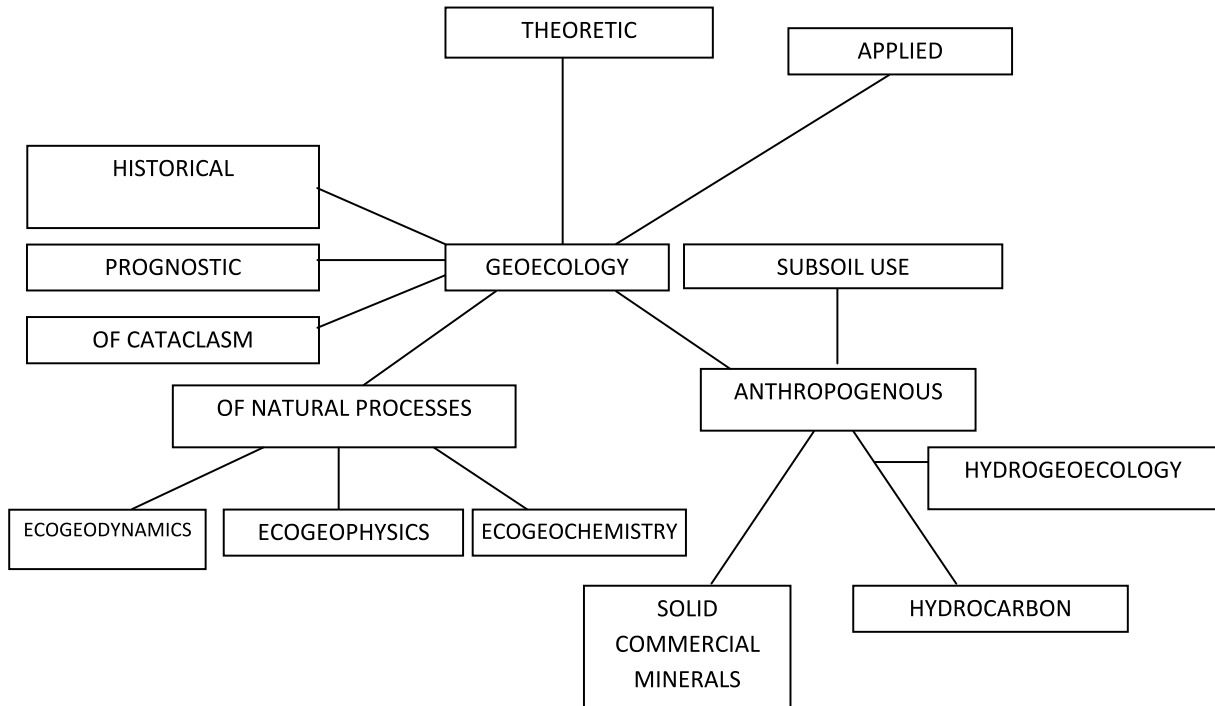


Fig. 2. Main sections of geoecology

process is often combined, the complex factor is specified in their overall impact. As the result, the changes in environment can occur in its components, specifically in atmosphere, hydrosphere and pedosfer or their combination.

The essential factor determines the flow of materials, energy and information from a source to biosphere components — individual, species, population, ecosystem or biosphere as a whole. Their transfer occurs physically, chemically or biotic. The combination of these factors can give 81 versions of impact on the environment. For example, solar flares are cosmogeneous, natural, physical, ecosystem, global and periodic factor for creatures on Earth.

A typical example of biogeneous is virus epidemics being material, intensive, global and periodic. One of the varieties of biogeneous factor is anthropogenous factor.

A catastrophic earthquake in Japan (2011) was determined by the lithogenous, natural, energetic, extreme, regional, episodic factors.

A large number of combinations of various factors led to the fact that the environment components and their changes due to the impact on the biosphere became a subject of many areas of science related to ecology. Proposed classification allows systematizing various areas and defining their place and role in the system of ecological science (fig. 1).

Population ecology is related to bioecology, and an ecological demography belongs to popula-

tion ecology according to N.F. Reyemrs, who has made an attempt to systematize areas of ecological science. In proposing classification these two areas belong to bioecology (man is a biosocial being), and then are divided depending on natural or anthropogenous processes. It can contain both more general and fractional areas. For example, physical ecology includes radio ecology, regional ecology — ecology of the North, steppes, islands and other geographical regions. Information ecology is ecology of culture, soul ecology, etc.

It should be noted that areas of ecology science develop unevenly — some faster, some slower, depending on practical tasks. Currently, geoecology being a part of ecology develops more intensively. The geoecology can be subdivided on theoretical and applied. On the impact on the biosphere, it can be divided into geoecology of natural processes (eco-geodynamics, eco-geophysics and eco-geochemistry) and anthropogenous processes (fig. 2)

An important link in anthropogenous processes is the geoecology solid commercial minerals, hydrocarbons and hydrogeoecology. The use of subsurface resources covers social-and-ecological and legal aspects of use of earth interior. The historical geoecology includes the analysis of change of geological conditions in the history of Earth and its influence on the biosphere. The prognostic geoecology based on mathematical methods and modeling solves a problem of a prediction of change of a geo-

logical situation in the future and its influences on the biosphere. Geocology tackling catastrophes defines measures for forecasting and prevention of the negative phenomena in the biosphere in connection with catastrophic lithospheric processes.

Fundamental principles of geocology as a science discipline are as follows:

1) at the heart of its subject matter lies three sciences — ecology, biology and geography and one social discipline — economy;

2) along with the anthropogenous processes and phenomena are equally studied natural environmental (lithospheric) ones influencing the biosphere;

3) anthropogenous (technogenic) processes are considered among biospheric as a manifestation of the human population having certain specifics. A man is considered as a biosocial being in which two forms — biological (natural) and social (public) are combined.

Research methodology in geocology including ways, principles, forms, modes and methods of sci-

entific knowledge, defines the logical scheme (structure) of research [9]. Developing such a scheme is key problem information about of system of ecological safety of territories. On its basis according to the corresponding theoretical and empirical basis scientifically reasonable models of impact on the biosphere have to be developed. The influence of the lithosphere on the biosphere in the absence of influential models in the present time is impossible as specific problems of the environmental management, based on minimization of loads of the biosphere thus to be solved at the same time. Therefore, the methodology of influence has to be directed on achievement of the specific high-priority targets i.e. an assessment of loads on the biosphere and development of scientifically reasonable nature protection actions for their reduction.

Establishing a scientific rationale of loads is a first priority target. A critical moment is as follows: to understand how technologically and economically achievable they will be. Many of enforceable

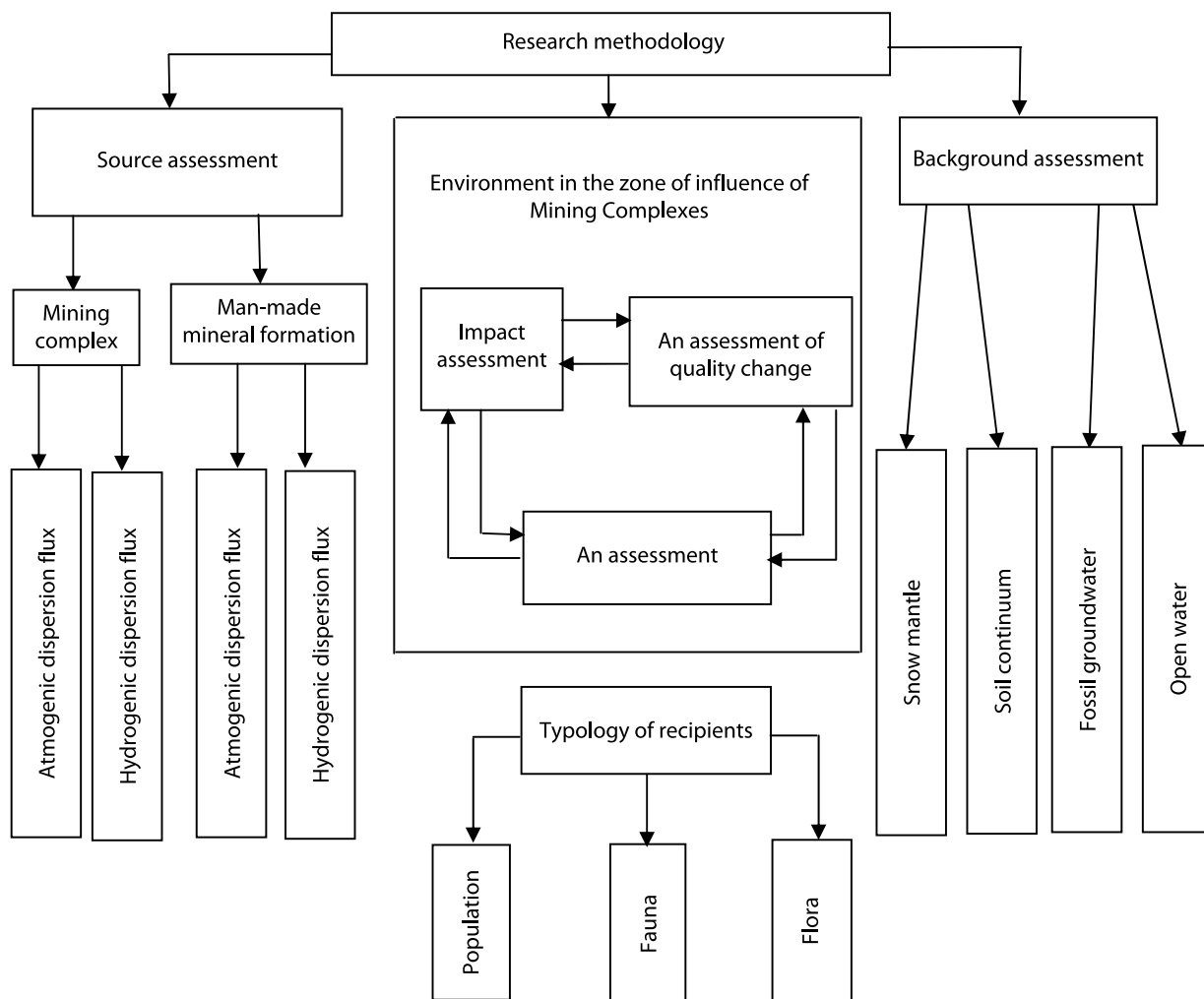


Fig. 3. Research methodology of technogenic transformation of environment and formation of consequences

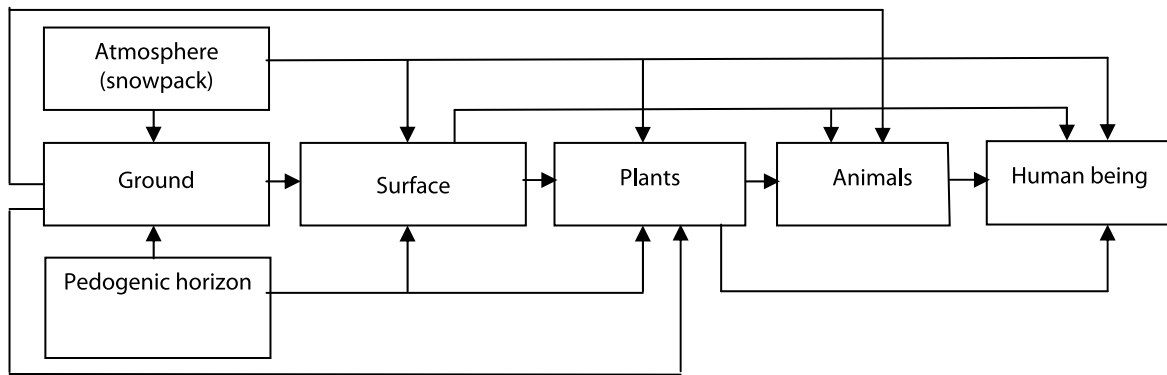


Fig. 4. The scheme of migration of polluting substances in ore areas

standards of the last century have been technically reachless for its time. However further technologies were modified, and their observance became possible. Therefore, norms of influence also have to be an incentive for re-engineering.

Nowadays there is no lack of general theoretical development and specific observations, but the problem with their mutual connection expressed in the construction of correct modeling of bioenvironmental effect. Therefore, developing the methodological procedures is necessary. Practical works on more objective forecasting and valuation effects can be developed on its basis. All of the theoretical developments focus on the need of the solution of a specific applied problem — reducing the impact on the biosphere. It causes certain assumptions and simplifications and without them achievement of the applied purpose in the foreseeable future is impossible.

The results of our works on Central Ural Mountains [9] are considered as an example of methodology realization. Here, environment transformation under the influence of mining complex was studied during several decades. Load under a source of this type — one of the most powerful and having catastrophic consequences for the biosphere.

The methodology of technogenic transformation of environment under the influence of mining complex (fig. 3), including an assessment of influence and change of quality of environment and an assessment of the consequences, is presented in the scheme in fig. 2.

The soil horizon and surface water directly influence live organisms according them the maximum permissible concentration are developed. The most critical components of the environment within which consequences are formed, are vegetation and animals. Their ecological condition defines human welfare (fig. 4).

Polluting substances getting to an organism cause the hardest diseases due to their interaction with a

number of enzymes and their inhibition. Danger of polluting substances also is caused by their ability to bio-accumulation — to accumulate for a long time and to the creation of toxic concentration.

The assessment of sources of pollution is carried out at stages of production, enrichment and metallurgical conversion. Except Mining Complexes the sources of environmental pollution is the technogenic and mineral formation. Atmospheric and hydrogenic dispersion flux of polluting substances in the form of emissions and sewage discharge are formulated. Criterion of an assessment of input of contaminants into environment is the technological and geochemical balance of mining and secondary elements in a full cycle of minerals processing. That is the correlations of mobilized geochemical mineral resources and its distribution on the technical processing cycles.

The main quantity of polluting substances (75–85%) is known to arrive in a human body mainly by the vegetable food. Their direct effect on a human body comes also through the polluted air or water and has relevant consequences.

Methodical recommendations about identification and typification of environmental pollution effect of the influence of an object of a lithosphere can be presented as follows:

1. Choice of an object of research.
2. Substantiation of the main types of geological and mining formations and its specific geochemical specialization, definition of belonging to one of the revealed formations.
3. Assessment of the background pollution content into snow mantle, surface water and pedogenic horizon with the use of geochemical methods of approbation.
4. The characteristic of man-made impact appearing as pollution of components of the environment taking place in the development within studied object. Identification among them the most

significant by comparison of the actual maintenance of this or that element in a soil layer, snow mantle, surface water with its background value.

5. Territory zoning around of the object — a pollution source, based on the concentration of the revealed most significant elements in snow cover, soil, surface water.

6. Identification of typical recipients in the studied territory, exposed to influence: types and groups of plants and animals, fish, age-sex groups of the population, quantitative characteristics of their condition (population density, forest stock etc.).

7. Assessment of the accumulated concentration of elements in plants, animals, fish individuals, human being (blood, urine, hair). Determining of correlation dependences between the content of elements in plants, animals, fish individuals, human being and the content of the same elements in an environment. Differentiation of correlation dependences for separate groups of surveyed recipients taking into account their specifics.

8. Research of consequences of accumulation of elements into plants, organism of animals, fishes, human being, being shown in this or that type of disease, physical ugliness, deadly outcome, changes at the gene level. Determining of correlation dependences between the parameter of probability of formation of the consequences of this or that group recipients and pollution size.

9. Assessment of economic damage from environmental impact [9].

This technique is universal and can be applied with success at any kinds of influence of objects of a lithosphere on the biosphere, at any kinds of social and economic activity of the people.

Exploration of mineral resources makes powerful economic effect however is attended by intensive environmental impact. At the same time, the solution of social problems with redeployment of labor is necessary, providing the possibility of their effective development.

Therefore, the solution of economic, environmental, social problems among themselves is closely interconnected in mining regions, forming uniform geological economic and social system. Therefore theoretical and methodological substantiation of administrative decisions at development of economy of mining regions is necessary.

Realization of development of theoretical and methodological bases of the geoecology is reflected in practical works on ensuring regions economic security. It belongs, first of all, to regions of development of fields of firm minerals in Sverdlovsk region where the works based on theoretical and methodological development are conducted since the beginning of the 1990th years to present. Also, approaches are realized in the development of an oil complex of the Orenburg region and some other regions.

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