Interdisciplinary Approach to the Analysis of Subsoil Use Systems

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Abstract. The interdisciplinary approach is based on the idea of the importance of encompassing a wide range of scientific directions that stimulate the way out of a particular problem and the emergence on this basis of new ideas and hypotheses. The analysis of subsoil use systems is necessary for realizing the concept of sustainable development of territories in practice. Fundamental scientific knowledge in the field of sustainable development of territories is based on data from biology (ecology), sociology, economics, and engineering. This approach, with respect to the analysis of subsurface use systems, is based on the analysis of cause-effect relationships in the field of subsoil use in the part of a complex interdisciplinary approach in solving subsoil use problems, regarding the status of the highest priority of the natural (ecological) factor, regarding the accounting of the time factor in economic calculations in the field of subsoil use.

1. Introduction
The interdisciplinary approach is based on the idea of the importance of encompassing a wide range of scientific directions, stimulating a way out of this or that narrow problem and the emergence on this basis of new ideas and hypotheses. In the current practice, the study of subsoil use systems with an assessment of scenarios for the socio-economic development of industrial regions is of a narrowly disciplinary nature - mainly the individual economic, biological or social problems of the territories are not studied in connection with each other. Interdisciplinarity is often declared as a justification for the economic efficiency of a particular technological system at a certain level of environmental burden on the environment, innovative measures are developed based on economic efficiency criteria without the introduction of environmental factors, and the definition of the permissible level of environmental load is limited to mentioning individual data from previous studies on the state of components environment. This approach allows us to determine rational options for particular (without detracting from their significance) issues: on specific technological solutions in accordance with the technical and economic performance criteria (mainly for a minimum of operating costs), for specific environmental activities in accordance with MPC (maximum permissible concentration) (sometimes with an estimate harm for excess negative impact). The results of such "interdisciplinary" influences in general do not allow us to obtain rational trade-offs (on the basis of an objectively formalized approach) in the complex system of "ecology-sociology-economics".

Theories and practice need a scientific fundamental basis for the environmentally sustainable development of industrial areas, which is not yet available or there are only separate, unrelated fragments. And such a basis can be obtained only on the basis of an integrated interdisciplinary approach.
Consider the main provisions of biology (ecology), social aspects, economic and technological (technical) factors, which should be the basis of a unified concept of the theory of sustainable development of industrial territories on the basis of an interdisciplinary approach.

2. Methods of research
In the process of studying the problem in the sphere of environmentally sustainable development of industrial territories, to ensure the sustainable development of society, a number of scientific methods were used, such as descriptive, analytical, comparative, prognostic.

3. Results and discussion
Academician of the Russian Academy of Sciences Zh.I. Alferov in his program (during the presidential elections in the RAS in 2013), "The Role of the Russian Academy of Sciences in Modern Russia," argued that "the most promising is the development of interdisciplinary research. But it is necessary to provide clarity - how to establish links between the set of scientific disciplines and their interaction. The ideology of establishing a common cause must be dynamic, reflecting the changing interactions of different scientific disciplines. "Responsibility here is (in the words of Zh. I. Alferov) on "system-philosophers", which justify the methodological support of interdisciplinary ties.

The interdisciplinary approach in research on subsoil use in recent years is considered in scientific publications quite often. He was mentioned and partially used by D.R. Kaplunov, L.P. Puchkov, V.L. Yakovlev, S.V. Kornilov, A.A. Arbatov, A.S. Mukhin, S.A. Vorobiev, N.M. Kachurin, S.A. Kimelev, V.A. Koroteev, E.A. Kozlovsky, I.F. Mikhee, V.P. Orlov, V.P. Pakhomov, V.I. Starostin, G.N. Cherkasov et al. Let us consider the first three publications.

Corresponding member RAS V.L. Yakovlev, Dr.Sc. S.V. Kornilov [1]. Their article is devoted to "methodological peculiarities of subsoil development at the present stage", the authors proposed "fundamentally new methodological approaches", which, in their opinion, consist of systematic, integrated and interdisciplinary research. Let's consider the novelty of these approaches. The principle of systematicity is expressed in the developed technological platform (note - technological!), Which includes a lot of technological operations on the territory of administrative education, that is, the system in the sphere of subsoil use is considered here as "the organization of enterprises ... that consume resources from outside ...". But the system of subsoil use enterprises at the present stage is described not only by "consumption of resources from outside", but also by technological, economic consequences of such consumption for the enterprise itself, for the environment (violation of biotic regulation in the regions), for society (the need to harmonize the interests of individual subsoil users with public preferences), and in the face of modern challenges and risks. And the risks are not so much from the above-mentioned increasing technological difficulties, which have internal meaning for the system under consideration, but risks from external factors for the system. It is this set of interconnected objects, phenomena and processes in the sphere of subsoil use that will be a system from the standpoint of a fundamental scientific approach.

Corresponding member RAS D.R. Kaplunov [2,3]. Here, the approach to designing ore deposits development has been changed - opening and preparation of ore reserves, integrated use of natural raw materials, which, according to the author, will contribute to the solution of environmental and social problems in producing regions, will form new ideas for medium and long-term prospects. It is noted that the theory of designing "mining systems" was formed as a result of the synthesis of analytical methods developed in the works of the scientific school of Academician K.N. Trubetskoi [4,5], with new ideas about the integrated development and conservation (!) of mineral resources. In the field of designing of mining technological systems, the principles of sustainable development, according to D.R. Kaplunov, have not yet found sufficient reflection. In our opinion, this is due to a lack of understanding of the essence of the concept of "sustainable development of mining technological systems" and a limited (lack of a clear) understanding of the system of the Earth's interior use. Here (Kaplunov, 2014) it is important that for the first time the problem of sustainable development is put on the first place. The named by D.R. Kaplunov principles develop and concretize the theoretical foundations of the de-
sign of subsoil development: the design of energy efficiency of mining technological systems (energy - the main parameter of all nature management); creation of software complexes for mining design (obtaining optimal strategic, i.e. long-term solutions for multi-criteria evaluation); formation of the base of mining information (geological, economic, mining, social and economic); taking into account the risks and consequences associated with the construction, production, registration and liquidation of mining enterprises (not only in connection with natural and man-made emergencies, but in the course of all production activities, including climate change, product market conjuncture, social factors); promising project tasks: robotization, mining operations in other environments and gravity, new ways of opening deposits, disintegration and transportation of rock mass.

Corresponding member RAS L.A. Puchkov [6,7]. The results of world energy consumption, the results of incorrect (!) determination of the goals of the economy and energy consumption are shown. In his view, the financial and economic methods for forecasting global mineral and energy consumption do not take into account the main natural character of mineral and energy resources, which leads to serious contradictions with the laws of nature development. L.A. Puchkov writes: "From the standpoint of the natural imperative, mineral and energy resources are the material basis for the development of civilization - the main objective of natural evolution on the planet Earth." According to the forecast of L.A. Puchkov (Center for Strategic Studies MSMU), crisis-free development of the economy can be expected only if the further development of the world civilization will be coordinated with the laws of nature.

The principle of a truly integrated interdisciplinary approach to solving the subsoil use problem in the Tominsky deposit of copper ore was proposed by Dr.Sc. I.P. Dobrovolsky and others (Chelyabinsk) [8]. He believes that the subsoil use here should combine the expected economic indicators (allocating about 4 billion rubles a year to the budget, new jobs, meeting the country's domestic copper needs under international sanctions) and neutralizing environmental risks (negative change in the hydrological regime of the territory, hydrodynamic accidents at the tailing pond with catastrophic precipitation and earthquakes), with a public attitude (according to VCIOM (The All Russian Public Opinion Research Center), 51% of the inhabitants of the municipality against the implementation of the project 61% of the inhabitants of the development area negatively estimate the construction of the MPP (mining and processing plant), and the 73% of the inhabitants of Chelyabinsk city are against it too) and with the availability of alternative options (copper, iron and zinc production from industrial waste of the Karabashsky Combine, where the copper content is 1-5%).

The methodology of a comprehensive solution of environmental, economic and social problems of subsoil use, based on an interdisciplinary approach consists of:
- substantiation of the highest priority of considering the natural environmental factor in solving the problem of providing the industrial complex with mineral resources;
- optimally built hierarchy of management levels for sustainable development of territories: conceptual, ideological, political and economic levels;
- substantiation of scientific and technological principles of the basic initial provisions of the theory of integrated solution of subsoil use problems;
- disclosure of uncertainty in optimal solutions and multi-criteria (interdisciplinary) optimization of subsoil use;
- coordination of interests of individual subsoil users with public.

The structure of the methodology for a comprehensive solution of environmental, economic and social problems of subsoil use is shown in the figure 1. Such a complex approach allowed to solve, in particular, the social and environmental and economic problems of the coal industry in Poland. In the 90-ies of the twentieth century, the volume of coal mining was adjusted there, the issues of the environmental safety of coal mines were resolved, and the issues of employment of the population in this sector were resolved. A similar integrated approach was used in Spain [9].
The hierarchy of levels of management of environmentally sustainable subsoil use includes conceptual, ideological, political and economic levels [10]. It should be noted that the existing concept of subsoil use development is mainly built on the facilities of the lowest - the economic level of the administrative hierarchy.

The conceptual level of subsoil management is a fundamental link in the management [11], since it sets the main targets for a long period of time, taking into account the established age-old traditions of those or other territories. For example, the preservation of the raw material base of metallurgy in the Urals is an obligatory component of the conceptual level; it corresponds to the spiritual and moral aspect of the society formed on the given territory - this is the preservation of "ore knowledge", the inse-
parable connection of the population with the land, it corresponds to the traditional mining in the Urals [12].

The goals of the conceptual level lies in the management of subsoil use within the boundaries of a justified "corridor" of permissible withdrawal of its resources from the natural environment and minimal negative impact on it (air, vegetation, water, soil, terrain). Estimation of the environmental impact of subsoil use should not be limited to comparing this effect with existing MPC norms; in the scientific sphere there is a lot of information about the shortcomings of this approach. From the perspective of ecologically sustainable development of the territory, it is important to consider the widespread and long-term consequences of subsoil use [13].

4. Conclusion
The system of subsoil use is a collection of objects, phenomena and processes, namely the subsoil areas under development (characterized by geological, geomechanical and aerogasdynamic processes), industrial production (geological exploration, mining and mineral processing, deep processing, waste disposal), combined with energy and information flows between themselves and the surrounding natural environment (air atmosphere, water, vegetation), as well as with society. Such a presentation of the subsoil use system allows us to consider the biological, social, economic and technological aspects together, substantiate their relative priorities in specific situations and determine the fundamental scientific basis for the sustainable development of industrial areas.

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