Development of an Algorithm for Carrying Out Geophysical and Geological Works Using Automated Systems and GIS Technologies

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Abstract. During the whole period of existing a modern geological industry, the issues of its computerization have been a priority, both in terms of providing employees of enterprises and organizations with computer equipment, and in terms of arranging information exchange and telecommunications between interacting information agents. It should be noted that there is a correlation between the increasing complexity of mining projects and the need to provide work with more and more developed software and hardware, information technologies, increasing complexity and growing number of software systems used to solve geological problems. The list of enterprises with positive experience in the development and operation of systems and complexes used in geology, geophysics and for subsurface use is also expanding very effectively. We propose the development of an algorithm for conducting geophysical and geological works using automated systems and GIS technologies, aimed at ensuring the rational development of the mineral resource potential of the region and ensuring the stage-by-stage nature of the geological exploration process. The testing was carried out using software product Diafond, which is available at the Russian Federal Geological Fund. This work was financially supported by the grant of the President of the Russian Federation No. MD-2409.2020.5.

1. Introduction

The mineral resource complex of the region is one of the elements of its sustainable development, provided that the stages of geological exploration are properly followed and that its mineral resource potential is rationally developed [1-11]. At present when conducting geophysical work, the following problems need to be solved:

- making a geological project for prospecting and exploration work [12];
- evaluating the quality of field material and processing 2D and 3D materials [13];
- generating geophysical models of deposits;
- processing and interpreting 2D and 3D marine and terrestrial seismic surveys;
- calculation of reserves by types of raw materials [15];
hydrodynamic modeling, preparation of a feasibility study for objects [17];
analysis of the resource base of the work region [16];
preparing project and technological documents for field development;
monitoring the field development [14];
preparation of supporting documentation for considering a package of documents in the State
Commission on Reserves;
conducting an expert review of information support for projects of geological exploration of
subsurface resources;
developing databases for arranging electronic storage of geological, geophysical and search
information;
developing modern software for processing and interpreting seismic and field-geophysical data,
constructing three-dimensional geological models of deposits and calculating reserves by types of raw
materials.
The use of own and joint latest developments with our partners is particularly popular at present.
This also includes the use of dynamic interpretation technology (DV-technology), which allows to
obtain qualitatively new results in the modeling and visualization of multiparametric four-dimensional
spaces. Software products such as DV-1 Discovery, DV-Geo, DV-SeisGeo, SeisProN, INPRESS are
used. These solutions are applied almost at all stages of prospecting, exploration, and exploitation of
deposits in various areas [18-20].
Technologies of geological interpretation of 2D/3D seismic data, logging and drilling, as well as
3D+VSP (vertical seismic profiling) technology are also widely used.
Let us also note new promising areas of work that need to be mastered in the framework of solving
geophysical and geological problems:
field geophysical research, including seismic exploration using common depth point (CDP) method
2D/3D, magnetic-variation profiling (MVP), vertical seismic profiling;
geophysical well logging;
geological and technological studies of wells;
processing and interpretation of information obtained as a result of seismic and gravimetical
surveys, etc.

2. Theoretical part
When carrying out work on geophysical and geological study of the subsurface, it is necessary to
focus on the following main tasks:
organization of managing the work on geological study of the subsurface and reproduction of
mineral resources in the Russian Federation and certain regions in particular;
licensing the use of mineral resources;
quality control of works on geological study of subsurface resources and reproduction of mineral
resources, carried out at the expense of the federal budget;
conducting integrated data analysis and modeling of geological objects.
During the work on making the map of geological knowledge on the territory of the Central Federal
District, program Diafond was used, which included filling in cards of geological knowledge by its
types: geological, geophysical, hydrogeological, geological-ecological, etc. (Fig. 1).
3. Practical part

The possibilities of Diafond program allow to enter data on geological (geophysical) study of the area into a special program interface designed to represent sequent results of geological (geophysical) study (Fig. 2).

![Figure 1. Interface of Diafond software.](image)

When entering information about an object, it is necessary to fill in the data about the object sequentially, fill in the information from the card file, enter information in the abstract about the object and fill in the cartogram of the work performed by the coordinates of the corner points.

We propose the following algorithm for conducting geophysical and geological work using automated systems and GIS technologies:

1. forecast of the state of the mineral resource complex of the region, production and consumption of raw materials and commodity products,
2. assessment of the potential of the region natural resources in terms of the location of new industrial and raw materials facilities,
3. assessment of ways (options) to meet the needs of the enterprises of the mineral resource complex of the region with the lowest resource costs, while ensuring the necessary increase in the reproduction of mineral resources,
4. assessment of the potential costs of geological exploration activities aimed at the reproduction of mineral resources,
5. assessment of the required investments as financial support for the relevant regional programs aimed at the reproduction of mineral resources.

As a result of measures to assess the mineral resource potential of the region, it is necessary to reflect the following stages by means of GIS technologies consistently:

1. Regional geological study of subsurface resources and forecasting of mineral resources. As a result, geological maps should be developed at a scale from 1:1000000 to 1:200,000, which will allow to make an assumption about the possibility of detecting the forecast resources P3 and P2 in the specified area.

2. Search operations, which task is to identify forecast resources of P2 and P1 categories.

3. Assessment, which purpose is to identify forecast resources of P1 category and assessed reserves of C2 category.

4. Exploration of deposits, which purpose is finding proven mineral reserves of industrial categories (A+B+C1) and C2 geological reserves.

4. Conclusion

Thus, we propose an algorithm for conducting geophysical and geological work using automated systems and GIS technologies by means of the example of Diafond program. The program features allow to fill in the data about the object sequentially, fill in the information from the card file, enter information in the abstract about the object and fill in the cartogram of the work performed by the coordinates of the corner points.

5. References

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