GIS technologies application in useful fossils search in the territory of the Republic of Sakha (Yakutia)

D V Andreev and M E Makarova

Federal State Autonomous Educational Institution of Higher Education "M. K. Ammosov North-Eastern Federal University", 58 Belinsky str, Yakutsk, Republic of Sakha (Yakutia), 677000, Russia

E-mail: verviL@List.ru

Abstract. The article discusses the idea of a project to create a Unified infrastructure for the geology of the Republic of Sakha (Yakutia). The approach to creating this project is based on the currently existing loosely coupled geological blocks of information, including spatial, quantitative and bibliographic data. The essence of the operation of the Unified geological infrastructure of the Republic of Sakha (Yakutia) is that the storage and retrieval of information of each individual information unit within a single information system is ensured by various technological solutions through a single standardized access to them.

1. Introduction
Remote sensing using geographic information technologies (GIS technologies) is promising for geological research with the goal of localizing mineral deposits. GIS technologies make it possible to use a more convenient analysis visualization form - cartographic, connecting all the information resources available in the form of databases and spreadsheets.

GIS technologies are increasingly used "in today's information society, representing a convenient and optimal mechanism for solving a large number of practical, scientific and educational problems" [1]. The presence of a developed information infrastructure created on the basis of GIS technologies is a prerequisite for ensuring the effectiveness of scientific research in this area [2].

2. Problem statement
Numerous and multi-years research in the field of geology through GIS technologies have provided a huge layer of information in the territory of Russia in general and in individual regions in particular. As a result, a lot of heterogeneous, divers, geographically distributed electronic libraries, databases and informational systems were obtained, which complicates their use to get complete and reliable information.

The integration of GIS technologies and computing resources, taking into account the organization of these resources access, is one of the most important problems in the field of geology of the Republic of Sakha (Yakutia) [3]. The search for minerals requires the creation of a holistic information field by combining available tools, analytical methods, descriptions and geodata.
3. Research questions
The design of the Unified infrastructure for geology of the Republic of Sakha (Yakutia) required the solution of the following issues:

- analysis of existing experience in creating electronic catalogs and information systems;
- using the ability to access geological data via the Internet;
- ensuring the simplicity and speed of finding the necessary data through thematic queries;
- visualization of the obtained geological data on the basis of cartography using GIS technologies.

4. Purpose of the study
The purpose of this article is to justify the need for the GIS technologies use in the search for minerals in the region in the process of creating a unified infrastructure for the geology of the Republic of Sakha (Yakutia). Therefore, as research tasks, it is necessary to solve the following:

- to determine the information base, GIS support and technical modules;
- to organize a single access point to the system;
- to ensure the integration of information resources.

5. Research methods
On the territory of the Republic of Sakha (Yakutia), GIS technologies have long been used by the State Committee for Geology and Subsoil Use and research institutes. Their application was used in the process of identifying patterns of permafrost landscapes development in the region for a very long time [4]. However, it is only more recently that they are used for localization of mineral deposits in the republic. Meanwhile, a unified corporate information system for geological objects in the Republic of Sakha (Yakutia), based on the basis of GIS technologies, is in the process of its creation [5].

It should be noted that until recently, professional GIS programs, such as: ArcGIS, MapInfo, Panorama, Operator, were oriented towards universality of use, which required the availability of technical resources and specialists for their adaptation precisely in the field of geological monitoring and forecasting [6]. However, over the past five years the situation has changed for the better. This is due to the following trends in the development of GIS technologies: the development of service architectures and the integration of data and formats [7].

As sources of information for the Unified infrastructure on geology of the Republic of Sakha (Yakutia) the following should be used:

- geographically distributed Internet resources;
- scientific materials from research and data centers;
- personal scientific publications of researches of the All-Russian Research Geological Institute named after A.P. Karpinsky and Yakutsk Scientific Center SB RAS.

Information should be of the following types [8]:

- geological cartographic information;
- topographic maps;
- state geological reports;
- open satellite information;
- expert knowledge on the geology of the Republic of Sakha (Yakutia);
- scientifically sound quantitative information;
- information about geologists in the region.
Territorial boundaries of the infrastructure being developed: Republic of Sakha (Yakutia): 62 ° N, 129 ° E [10].

To create the cartographic part of the GIS support of the Unified infrastructure for the geology of the Republic of Sakha (Yakutia), appropriate source materials are needed (figure 1).

**Figure 1.** Source materials for creating the cartographic part of the GIS support of the Unified infrastructure for geology of the Republic of Sakha (Yakutia) [11].

The idea of organizing a unified access point for the Unified Geological Infrastructure of the Republic of Sakha (Yakutia) is a one-time provision to the user of all possible information about the geological objects of the specified region and its processing services. Each separate information block of the Unified infrastructure for searching, storing information and, accordingly, its integration requires different approaches of various technological solutions (figure 2).

**Figure 2.** Generalized scheme of the Unified infrastructure for geology of the Republic of Sakha (Yakutia) [12].
Thus, the Unified infrastructure for geology of the Republic of Sakha (Yakutia) should contain the following blocks [13]:

- User interface unit.
- Request converter, which works on the principle of converting the territorial zones coordinates into geographical names.
- Supervisor of block interaction through a set of appropriate micromodules.
- A set of micromodules that interact with specific sites.
- Filtering results block.

In the project of the Unified infrastructure for geology of the Republic of Sakha (Yakutia), information search should be provided for four categories of queries: “what”, “where”, “who” and “when” [14].

When integrating geological data the following should be provided:

- accessibility to all information resources using unified user interfaces through unified protocols;
- end-to-end search across all integrated information resources;
- the ability to extract data in uniform formats;
- resources management and access to them in accordance with uniform policies [15].

The project of the Unified Infrastructure for Geology of the Republic of Sakha (Yakutia) developed in the framework of this article should ensure the storage and retrieval of information of each information unit within a unified information system, which is ensured by various technological solutions through a unified standardized access to them.

6. Findings
The need to use GIS technologies in the search for minerals in the region in the process of creating a unified infrastructure for the geology of the Republic of Sakha (Yakutia) has its own justification. This is the ability to use access to geological data via the Internet, ensuring the simplicity and speed of finding the necessary data through thematic queries, and visualizing the obtained geological data based on cartography using GIS technologies.

7. Conclusion
Summarizing the content of the article, we can conclude that GIS technologies solve the problems of integrating operational data obtained from various sources and are an effective tool in the search for mineral deposits. Their use in combination with other information resources and platforms can link loosely coupled geological blocks of information.

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