Formation of geoinformation-cartographic support of the Altai interregion on the example of creating the international atlas “Greater Altai: Nature, History, Culture”

I N Rotanova¹, G A Efremov¹ and S V Peremitina²

¹ Altai State University, 61 Lenina prosp., Barnaul 656049 Russia
² D. Serikbayev East Kazakhstan State Technical University, 69 Protozanov str., Ust-Kamenogorsk 070004 Kazakhstan

E-mail: rotanova@email.asu.ru

Abstract. The article discusses the conceptual provisions used in creating the international cartographic project “Atlas of the Greater Altai: nature, history, culture” in the context of the formation of an international geo-information and cartographic support. The creation of the atlas of the Greater Altai is based on a number of methodological, conceptual, and organizational provisions, among which, first of all, the research search for new methods and approaches, the development of modern technologies for processing spatial data, cartographic modeling and cartographic research methods. Within the framework of this project, implementation of international cooperation, exchange of experience and achievements in the field of mapping, geoinformatics and GIS design is no less significant than the international cooperation, exchange of experience and achievements in the field of mapping, geoinformatics and GIS design.

1. Introduction
Creation of electronic cartographic products, including satin geo-information systems, is conditioned by the contemporary informatization and digitalization of society. The atlas “Greater Altai: Nature, History, Culture” is created as an interdisciplinary geo-information cartographic model by a team of specialists from the Altai interregion countries, based on the principles of international information interaction. The idea to create an atlas of the Greater Altai arose due to the development of scientific and intercultural communications among the countries participating in the Altai Interregion. The accumulated results of many years of work by many teams of researchers from Russia, Mongolia, Eastern Kazakhstan, Xinjiang Uygur Autonomous Region of China, in the form of separate databases, thematic maps and geo-information systems for targeted and environmental programs, combine all our knowledge gained in the product of spatial analysis of the territorial development of the Altai interregion. The widespread use and dissemination of geo-information and web technologies makes it possible to create innovative cartographic models, including geo-information atlas projects [1].

Atlases in electronic form are posted in national and international information networks. They become an important means of spatial planning and management, a source of scientific reference information, a means of learning, education, and maintaining spatial databases and user programs (interfaces).
2. Materials and Methods

In the 21st century, a traditional geographic map is most often replaced by a geo-information model created using a geo-information system (GIS), which is based on a large amount of variable information. In turn, the last has a set of technical tools and special procedures for processing and reproducing graphic and text data, with visualization management capabilities. A serial (satin) mapping using GIS systems is being developed, which today remains one of the leading methods of the systematic geographical study of natural conditions and resources, as well as socio-economic, historical and cultural development of territories. This confirms an increase in the number of new atlases of foreign and Russian territories: from the level of the country to individual regions. The quality and scope of geographic knowledge and information concentrated in the thematic geo-information maps and complex atlases. They are the primary factors determining the efficiency of using natural resources, developing the economy, forming satellite communication and navigation systems, and substantiating the geo-political interests of states [2].

Most modern atlases cover the territories of individual countries and their administrative and territorial units. However, there are only a few examples of atlases with international regions that have a natural and historical community, but are separated by state borders. The cross-border Greater Altai is a territory for which there is a need to create an interregional atlas (i.e. a connected territory within the Altai mountain system of the border regions of Russia, Kazakhstan, Mongolia, and China).

The importance of creating an atlas is primarily due to the fact that the large transboundary region of Asia – the Greater Altai needs to create a modern, complex satin cartographic work. The satin mapping will be developed through the use of new approaches and methods, both in the subjects of thematic maps, and with the use of innovative geo-information technologies.

The main purpose of creating this Atlas is to provide the international community with an access to reliable, modern, and accurate spatial information about the cross-border region of the Greater Altai for its effective development [3].

In the process of developing geo-information support, object-oriented databases are created that meet the principles of modularity, complexity, and universality. Modularity is necessary for diverse activities, which involves the use of a single database and a cartographic basis, with the possibility of modifying the modules to solve various problems. Complexity will provide the user with information on the physical, geographical, historical, cultural and socio-economic conditions of the territory. Universality is based on the main characteristics of the geo-information software used and the possibility of creating additional application programs on its basis [4].

3. Results

The development of the atlas required the solution of a number of issues at various research levels: methodological (development of concepts and programs, priorities, architecture and functionality); scientific and methodological (development of structure, engineering and creation of GIS, construction of cartographic models in the GIS environment, etc.), information (database development, homogeneity, accessibility and reliability of mapped data), and constructive (development and construction of maps, formation of an atlas as an integrated satin geo-information system), etc. [5].

The novelty and uniqueness of the atlas “Greater Altai: Nature, History, and Culture” is predetermined on the basis of the conceptual provisions underlying it as a geo-information cartographic model, as well as the thematic content of individual original maps.

The Atlas has a multilevel structure. The Greater Altai, in the spatial aspect, is created as an integral interregion comprising from the territories of four states. The format (landscape orientation) was adopted for the atlas, and the scale of the mapping series was determined (1: 5,000,000). The inter-regional and macro-regional level includes the general maps of the Greater Altai on the following scales: 1: 4 000 000, 1: 5 000 000, 1: 8 000 000, 1: 10 000 000. The local-regional level corresponds to the scale: 1: 1 000 000, 1: 2 000 000, 1: 3 000 000. A full map can be accessed (in Russian) at [6].

Unity in the atlas as a system is ensured by a set of projections and scales, a single set of cartographic generalization, a consistent system of conventional signs and a single design.
In the content and plot context, it has three main sections, corresponding to its name: “Nature,” “History,” and “Culture”. These sections are preceded by an introductory section containing geographic information, borders of countries and border administrative and territorial units (subjects of the Greater Altai), as well as an image of the region from space.

The database structure of the atlas of the Greater Altai was created on the same principle as the structure of the atlas itself. Thematic databases are distinguished in accordance with the titular sections of the atlas: “Nature,” “History,” “Culture”. A distinctive feature is that the databases are created separately for each of the countries of the Greater Altai: Russia, Mongolia, Kazakhstan, and China. This is due to the fact that they are formed by the author teams of each of the states. Shared databases containing aggregated data for Greater Altai are created collectively [7].

Additionally, a separate database called “Basic mapping” is being developed, which contains elements of a cartographic basis, namely: geodetic basis, hydrography, communications, settlements, administrative division, vegetation and soils, land relief and socio-economic objects. It also has an internal structure and is subdivided into 2 thematic blocks: socio-geographical and physico-geographical. The database “Base mapping” is the basis for creating base maps. The creation of base maps is given special attention, since they serve as the foundation on which thematic maps of sections are formed. For the “Nature” section, three maps were taken as basic: Physical Map, Landscape Map, and Population Settlement Map. The “Nature” section contains information about the natural conditions, ecological and natural potential, economic impact on the environment, and the quality of the environment in the Greater Altai region at the beginning of the 21st century. The quality of the environment is considered as a consequence of the economic, social and cultural development of the border administrative and territorial entities of four countries located within the Altai mountain system. The special attention is paid to the environmental policy and the network of specially protected natural territories of the Greater Altai.

For the section of thematic maps “History,” as the base maps were selected the Map of the stages of development and settlement of the Greater Altai, showing the stages of formation of the territory the Map of historical areas, the Map (a series of maps) of the location of objects of historical (archaeological) heritage with a display of the location and a database containing information about artifacts reflecting the history of human society based on material evidence (monuments) of people's lives and activities. The “History” section is closely related to the “Culture” section, one of two subsections of which is devoted to the rich historical and cultural heritage of the Greater Altai, and the other one addressed the modern culture. The “Culture” section selected these base maps: Ethnic and Ethnographic Map, Map of Cultural Heritage Objects, Cultural and Educational Map [8].

4. Discussions
In the process of developing geo-information support, object-oriented databases are created that meet the principles of modularity, complexity and universality. Modularity is due to the diverse content of sections of the atlas blocks, however, it assumes the use of a single database and a cartographic base, with the possibility of modifying them within the framework of solving various problems. Complexity will provide information on the physico-geographical, historical, cultural, and socio-economic conditions of the territory. The universality is based on the main characteristics of the geo-information software used and the possibility of creating additional application programs on its basis [8].

The GIS-project of the atlas allows to conduct an analysis of the natural, economic, socio-demographic situation in the Greater Altai, it can become the basis for creating a permanent geo-information monitoring system available for its use through the Internet.

5. Conclusion
When creating an atlas as a modern GIS-cartographic project, the design of various thematic maps took into account modern and traditional approaches. The experience of creating the best samples of domestic and foreign satin cartographic works was studied. In accordance with them, approaches to the design of maps of the Atlas of the Greater Altai were determined.
The atlas “Greater Altai: nature, history, culture” creates a new image of the Altai interregion, thanks to its visibility and informativeness in displaying the main advantages of its territory. As a result of modern geo-information cartographic modeling, the atlas will contribute to the development of GIS engineering methods in order to provide information support for international projects to strengthen international relations and investment attractiveness of the Altai interregion.

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