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INTERNATIONAL MAPPING PROJECT “THE ATLAS OF GREATER ALTAI: NATURE, HISTORY, CULTURE” AS THE FOUNDATION FOR MODELS OF SUSTAINABLE DEVELOPMENT

ABSTRACT. The paper presents the concept and approaches to the creation of a special interdisciplinary Atlas of Greater Altai. The main objective of the Atlas is to ensure the maximal possible access of the international community to reliable, current, and accurate spatial information on the transboundary Greater Altai region. The paper discusses the preconditions that facilitate the development of this unique cartographic product, the main sections of its structure (nature, history, and culture), and the main themes of its maps. The paper demonstrates the need for geoinformation support and a web-based version of the GIS-based Atlas. The Atlas can be used in decision-making in the scope of the international cross-border cooperation in the Altai region.

KEY WORDS: Altai, GreaterAltai, the Altai region, Atlas of Greater Altai, GIS, web-atlas.

INTRODUCTION

“The Atlas of Greater Altai: Nature, History, Culture” is an interdisciplinary unique cartographic model that is being developed by an international team of scientists. The main objective of the Atlas is to ensure the maximal possible access of the international community to reliable, current, and accurate spatial information on the transboundary Greater Altai region for its effective development.

Altai is a mountain system located in the heart of Eurasia. Four countries, namely Russia, Kazakhstan, Mongolia, and



Fig. 1

China, share the Altai region (Fig. 1). The international cross-border cooperation in the Altai region has historical roots. For centuries, this vast mountain region (about 30 thousand sq. km.) has been unified by cultural, ethnic, trade-economic, political, and migration ties. Currently, there are six administrative-territorial divisions: Altai Krai and Altai Republic (Russia), East Kazakhstan Oblast (Kazakhstan), Xinjiang Uyghur Autonomous Region (China), and Bayan-Ulgii and Hovd Aimags (Mongolia). The name "Greater Altai" symbolizes community, unity, and cooperation of the numerous peoples inhabiting this wide geographical area. In 1993, the near-border districts created the International Coordinating Council "Our Common Home Altai", which plays an important role in strengthening international relations in the region [Rotanova, Ivanov, 2013].

The Altai natural mountain formation located in the heart of a vast continent has the significant geographical uniqueness considered by many researchers who have studied it as a characteristic phenomenon in the region. Climatic, hydrological, and atmospheric processes are formed in this region; these processes then spread over vast areas of Central and North Asia. The Altai glaciers are the source of the largest rivers, i.e., Irtysh, Ob, and Hovd; these rivers are used by many millions of people in Russia, Kazakhstan, China, and Mongolia. In the

depths of Altai, the rich mineral resources have been explored. The region contains almost the entire periodic table, including a full range of non-ferrous metals and rare earth elements.

Diversity of climatic conditions, created by mountain and basin landforms, altitude, and exposition, defines a rich set of features of the species and communities of flora and fauna. High levels of biodiversity and preservation of much of the landscape in a state little affected by human activities were the crucial factors for the inclusion of Altai, at the end of the XXth century, in the list of two hundred virgin or little altered regions of the Earth ("Global – 200"), which received the international status of ecoregions.

One of the priority areas of cooperation, implemented by all countries of Greater Altai, is environmental activities, including preservation of biodiversity and other environmental issues. In all the countries in the Greater Altai border areas, there is a functional network of specially protected natural areas (SPNA). The network includes the state natural reserves, national and natural parks, and wildlife and refuge complexes. Greater Altai represents the region of the priority implementation of the ecoregional approach to environmental protection. The agreement between the Governments of the Russian Federation and the Republic of Kazakhstan to establish a transboundary reserve "Altai" based on the Katun Biosphere Reserve and the Katon-Karagaisky National Park has been signed and is being implemented. The importance of natural and cultural values of Altai has been confirmed by the inclusion of the area "Golden Mountains of Altai" (Russia) in the List of the World Cultural and Natural Heritage; this area consists of five clusters: the Altai and the Katun State Biosphere Nature Reserves, the Natural Park "Belukha", the Natural Park "The Quite Area Ukok", and Teletskoe Lake. It is noteworthy that the area "Golden Mountains of Altai" may soon become the international, four-lateral, World Natural and Cultural Heritage object,

extended to the neighboring countries: China, Mongolia, and Kazakhstan [Badenkov, Rotanova, 2011; Badenkov, Andreeva, Rotanova 2012].

Greater Altai is rich in archaeological, historical, and cultural values, ethnic and cultural diversity, and the extant traditional way of life of its peoples. Within this region, Slavic, Turkic, Mongolian, and Chinese ethnic groups come into intercultural interaction. The religious situation in Greater Altai is also unique: Christians, Buddhists, followers of Islam, and traditional shamanic cults coexist peacefully. Altai today represents the center of Eurasian ethno-cultural consolidation.

The above-mentioned facts and factors explain the increased interest to Greater Altai from the positions of many spheres of activity and, primarily, as a very promising region for tourism and recreational activities, including international/cross-border tourism. The tourism industry within Greater Altai, currently, has some level of development in all countries located in the region. It is mainly based on the ecological and natural potential and utilizes natural attractiveness of each country and the situation of the environmental well-being of the region.

The idea of developing the Atlas arose from the results of years of work of different groups of researchers who accumulated a large volume of information indifferent databases, thematic maps, and geographic information systems (GIS) for environmental and target programs running in the countries of Greater Altai.

THE CONCEPTUAL FRAMEWORK OF THE ATLAS

The Atlas will be based on the studies and analysis of modern scientific-methodological and technological advances of different areas of science (geography, biology, ecology, history, cultural studies, geoinformatics, etc.) and computer mapping, while maintaining continuity of the best examples of Russian and foreign fundamental cartographic

works. Novelty and uniqueness of “The Atlas of Greater Altai” are predetermined by the conceptual provisions of the original thematic structure. The internal unity of the Atlas is ensured by comparability, complementarity, and linkage of the sections and individual maps, appropriate choice of projections and scales, a single approach to cartographic generalization, a coherent system of symbols, and a common design.

The year of 2013 was the phase of conceptualization. At this stage, a coordination system for work under the compilation of the Atlas in the participating countries was established. The year of 2014 is the phase of development of conceptual solutions and the Atlas programs.

The Atlas concept is based on the idea of the balanced development of the transboundary area of Greater Altai. The concept, in the same way as all phases of its implementation, utilizes the advances in theoretical and practical cartography, which have been accumulated and developed in the last decades. This information will be substantially improved in the course of the geographic information implementation of the concept.

The compilation of the thematic maps of the Atlas will be based on the modern scientific approaches: comprehensive, historical, cultural, dynamic, etc. The Atlas will use three approaches for the information representation. The main one is the analytical (comparative) representation at the macro-regional level with the network model elements (summary maps of Greater Altai). The second approach incorporates the transition from the national (state, macro-regional) level to the regional and local levels. Finally, the third approach is a matrix, whereby the blocks of maps at the administrative-territorial divisions are defined (local).

Several methodological approaches developed in the practice of atlas mapping will be used to represent the thematic maps

most completely and expressively. Thus, the Atlas will utilize multi-level mapping of phenomena and objects at the national (state), regional, and local (respectively, at different scales) levels. In some cases, they are very well rendered as anamorphic images. The comparative method is widely applicable for the representation of features of Greater Altai in relation to other administrative units of the Russian Federation, Kazakhstan, China, and Mongolia.

Mapping will be performed at three levels of aggregation of information: analytical, integrated, and synthetic. The analytical maps will enable the isolation and rendering of individual and the most important properties and/or characteristics of objects and phenomena of the mapped territory from an array of numerous features. The integrated maps will render not only multifaceted (polythematic) characteristics of the region, but will also help analyzing and exploring relationships, interactions, and dynamics of covered objects and phenomena. The synthetic maps will rely mainly on the integration of a number of individual parameters and will facilitate derivation of integral characteristics of the mapped objects, reflect typological zoning, isolate clusters, and present the results of mathematical-cartographic modeling.

The tasks of the Atlas require addressing a number of issues at different levels of research: methodological (concept development, conceptual apparatus, selection of priorities); scientific-procedural (design of the informational structure, GIS-based format, etc.), informational (uniformity, availability, reliability of the mapped data), structural (map compilation), etc. The greatest difficulty is associated with differences in the data collected in the Russian Federation, Kazakhstan, China, and Mongolia.

THE STRUCTURE OF THE ATLAS

The structure, content, and thematic division of the Atlas are currently at the stage of development and coordination. The title of

the main sections of the Atlas corresponds to the names of the Atlas title: Nature, History, and Culture. These sections will be preceded by the introductory section that will contain geographic information on the borders of the countries and the near-border administrative-territorial divisions of Greater Altai and space images of the region.

Section "Nature" will contain spatial-temporal information on the natural conditions, economic impact on the natural environment, and environmental quality in Greater Altai in the beginning of the XXIth century. The quality of the environment is perceived as the consequence of the economic, social, and cultural development of the near-border administrative-territorial entities of the four countries located within the Altai mountain system.

Section "Nature" will have three major subsections:

- Natural conditions
- The impact of economic activity on the environment.
- Sustainable development of the territories. Protection and optimization of the natural environment.

Subsection "Natural conditions" will cover the following areas: landscapes, sustainability of the environment, climatic zoning, climatic comfort, hydrological areas, glaciers and mudflows, permafrost (distribution, temperature, thickness, seasonal freezing and thawing), soil zoning, bioclimatic mapping of the vegetation types, biodiversity, and biodiversity uniqueness coefficient.

Subsection "Impact of economic activity on the environment" will have the following thematic maps: population distribution, population density, urban population, functional types of settlements, age-structure of the population, main types of the culture of natural resource use, agricultural level of development of the landscapes, agricultural

land, anthropogenic load on the landscapes, impact of economic activities on the environment, anthropogenic changes of the soil-forming processes, pollution of the snow cover, atmospheric emissions of pollutants from stationary sources, emissions structure, wastewater, wastewater composition, extreme pollution of surface water, impact of the mining industry on the environment, toxic waste, hazards from oil and natural gas transport, forest cover, forest logging, forest fires, secondary forests, volume of solid municipal waste of large settlements, conflicts in natural resource use at different territorial levels, and environmental-economic map.

Subsection “Sustainable development of territories. Protection and optimization of the natural environment” will include the following maps: natural, technological, biological and social risks, hazards and risks of natural emergencies, hazards and risks of endogenous processes (earthquakes, avalanches, glacial activity, landslides, mudslides, karst, subsidence, erosion, flooding, permafrost processes), hazards and risks of meteorological processes (desertification, drought, climate extremes, extreme air temperatures, snow, blizzards, fog, black ice and icing, thunderstorms, hail, hurricanes), hazards and risks of hydrological processes (floods, flash floods), hazards and risks of wildfires, monitoring, methods and means of mitigation of hazardous natural processes and phenomena, hazard and risk of technogenic situations, synergetic manifestation of hazardous natural and man-made processes, biological and social hazards (natural focal infectious, parasitic, and other diseases of humans and farm animals, spread of insects – pests of forests and crops, distribution of midges), and organization of prevention and mitigation of emergency situations.

Subsection “Sustainable development of the territories. Protection and optimization of the natural environment” will cover the following areas: distribution ranges of the Red-Book rare and disappearing species of plants and communities, distribution ranges

of the Red-Book rare and disappearing species of animals, the Red-Books of the Russian Federation and of its administrative entities (on soils, plants, and animals), SPNAs, development of the environmental network, sustainable development of territories, optimization of the natural environment, environmental monitoring, environmental public organizations, youth and children public organizations, international environmental organizations operating in Greater Altai (Greenpeace, WWF, etc.), and international cooperation in environmental protections.

The main purpose of section “History” is to consistently reveal the course of historical development of Greater Altai from antiquity to the present and to provide spatial and temporal information about the historical heritage of the region. This section will include a series of interrelated maps describing stages of settlement and development of the territory: settlement sites of primitive people, habitats of the peoples, emergence of statehoods, changes in the state borders, changes in the structure of settlements and population, objects of heritage, archaeological sites, military conflicts, trails of discoverers and expeditions of travelers and scientists, etc. The section will present known extant cartographic works of past centuries [Barnaul, 2006; Borodayev, Kontev, 2006; Special ..., 1998]. The section will conclude with a glossary of terms and a chronological table of important dates and events related to Greater Altai.

Section “Culture” will be composed of two subsections, one of which is dedicated to the rich cultural heritage of Greater Altai and the other – to the modern culture. Culture is seen as a social phenomenon and as a branch of the social sphere. Cultural heritage is one of the most modern resources that determine the socio-economic and socio-cultural development of Greater Altai globally. The maps of the section will be created using modern information and knowledge about the laws and practice of information sharing and the development of

regional and national cultures, ethnography and folklore, and their existing relationships and prospects for cooperation in the conservation and restoration of the cultural environment of Greater Altai. The main themes of the maps of contemporary culture are: public education, literature, theater, music, museum, library, cultural heritage, and famous people (natives of Altai and those who worked in Altai).

The maps will also show monuments and other various forms of monumental art, locations of folk arts and crafts (wood, metal, stone, bone, glass, weaving, and knitting crafts, etc.). The maps will also show the network and the activities of various cultural institutions: theaters, museums, libraries, archives, clubs, and institutions of higher education in the field of culture.

The Atlas will have a separate block of maps dedicated to cognitive tourism and excursions showing the use of cultural facilities in the tourism sector. Thus, the theme of one of the maps will be the systematized data on the potential international tourist route "Golden Ring of Altai", as well as the information on the roadside infrastructure and services.

These themes of the maps, sections, and subsections selected through mutual effort and coordination will be the foundation of the Atlas and map layouts and will provide for the logical interconnection of the map content.

The Atlas will be presented in the traditional printed format; however, it will be created with the use of GIS-technology, which will ensure the systemic integrity of its content and coherence of the maps. Thus, there will be an electronic version of the Atlas.

GEOINFORMATION SUPPORT OF THE ATLAS

The GIS-component of the Atlas will allow assessing the natural, economic, social, and demographic situation in the Altai transboundary region and could become

the framework for the subsequent creation of a permanent geoinformation monitoring system available for use over the Internet. In addition, the mapping, aerial-space, and text data consolidated into a single GIS database and designed as a hypermedia system capable of rendering graphics, hypertext, slides, and, possibly, a small film with a soundtrack, will provide for the full integral characterization of the region in comparison with other parts of the four countries. This will also help tracking the nature of changes and creating a strategy for the environmentally sound sustainable development of Greater Altai.

The electronic mapping of Greater Altai will be done at different scales that correspond to the size of the territories: local – 1:10 000, 1:25 000, 1:50 000 (cities); sub-regional – 1:100 000, 1:200 000 (administrative regions, Somons); regional – 1:1 000 000, 1:1 500 000, 1:2 000 000, 1:2 500 000, 1:3 000 000 (Altai Republic, Altai Krai, Hovd Aimag, etc.), the inter-regional or macro – 1:1 000 000, 1:2 000 000, 1:3 000 000, 1:5 000 000, 1:8 000 000 (Greater Altai within the territories of the bordering countries, etc.).

In general, the thematic database (TDB) of the electronic version of the Atlas will be based on the following requirements: it must be uniform in terms of time-scale, i.e., the quantitative data stored must have the same point in time for all its parameters; must have a sufficient degree of detail; must be spatially accurate; must be compatible with other data; must adequately reflect the nature of phenomena; and must be accessible to users.

Special activities will be undertaken to establish the necessary framework for the digital mapping. They should be brought to a common geodetic coordinate system and created as the digital topographic bases for the region. Landscape and land use maps will represent the framework for mapping of different geographical phenomena.

Table 1. The maps of the introductory section of "The Atlas of Greater Altai: Nature, History, Culture"

Map themes	Scale
Structure and boundaries of Greater Altai	1: 3 000 000
Russian part of Greater Altai	1: 1 000 000
Mongolian, Kazakhstan, and Chinese parts of Greater Altai	1: 1 000 000
The Greater Altai region on the world map	1: 30 000 000
Greater Altai as part of the Central Asian region	1: 20 000 000
Greater Altai on the maps of Russia, China, Kazakhstan, and Mongolia	
The Russian part of Greater Altai on the map of Russia	1: 10 000 000
The Mongolian part of Greater Altai on the map of Mongolia, China, and Kazakhstan	1: 5 000 000
The Russian part of Greater Altai as part of the Siberian Federal District	1: 5 000 000
The administrative-territorial division of Greater Altai, the Russian part	1: 2 500 000
The administrative-territorial division of Greater Altai, the Mongolian, Kazakhstan, and Chinese parts	1: 2 500 000
Barnaul – the capital of Altai Krai	1:50 000
Gorno-Altaiisk – the capital of Altai	1: 50 000
Hovd – the capital of Hovd Aimag, Mongolia	1: 50 000
Bayan-Ulgii – the capital of Bayan-Ulgii Aimag	1:50 000
Altai – the capital of the Altai District of China	1: 50 000
Ust-Kamenogorsk – the capital of the East Kazakhstan Oblast	1: 50 000
Space imagery of Greater Altai	1: 20000 000

The structure of the GIS-based TBD will provide for the characteristics of the maximal possible number of the geo-system elements of Greater Altai in the digital version of the Atlas.

The TDB and its thematic coverage will reflect the physical-geographic and socio-economic conditions of the mapped territory, character of the covered phenomena and processes, and the assessment of the current conditions.

The list of the themes and working scales of the introductory section of the Atlas presented below is an example of the information contained in the Atlas. The digital maps of this section will relate the geographical locations and boundaries of the administrative-territorial division of Greater Altai (Table 1).

CONCLUSION

The Atlas of Greater Altai can be considered as part of the digital atlas of

sustainable development of the Russian Federation, whose main purpose is to present a unified geoinformation space for development and improvement of the management system. The Atlas is important not only for the electronic-cartographic representation of one of the largest territorial formations of North Asia, but also contributes significantly to the development of the national information resources in Russia.

The potential range of its users is extremely wide. The maps of the Atlas may help raising the investment attractiveness of the region and enhance innovation activities for the entire region and its parts. The Atlas will be useful for resource mobilization, including business structures for the integrated development of environmentally oriented sectors. The Atlas will help its users to stay current and, thus, make informed decisions on a wide range of issues determining the development of Greater Altai. ■

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