

УДК 551.1(571.51)

## **Geological Monuments and Natural Places of Interest in the Krasnoyarsk Territory (History and Systematics)**

**Tatyana A. Ananyeva<sup>a\*</sup>,  
Sergey A. Ananyev<sup>b</sup> and Yury A. Zadisensky<sup>c</sup>**

*<sup>a</sup>Krasnoyarsk State Pedagogical University  
them. VP Astafeva*

*89 Ada Lebedeva Str., Krasnoyarsk, 660049 Russia*

*<sup>b</sup>Siberian Federal University*

*79 Svobodny, Krasnoyarsk, 660041 Russia*

*<sup>c</sup>KGBU Geological Museum of Central Siberia*

*Bld. 3, 3 Profsoyuzov Str., Krasnoyarsk, 660021 Russia*

Received 25.07.2013, received in revised form 05.08.2013, accepted 12.08.2013

---

*Geological monuments and places of interest of the Krasnoyarsk Territory and the history of their discovery are described, their systematization and typification are determined, and new approaches are suggested for identification of natural geological heritage objects.*

*Keywords: geological monuments, geological places of interest.*

---

There are a significant number of unique natural objects valuable in the scientific and cultural relations in the Krasnoyarsk Territory. These objects can be referred to geological natural objects and geological places of interest. Many of them are located in hard-to-access areas and will remain undisturbed for a long time, while a part of natural monuments falls in the sphere of industrial human activity and is therefore at the verge of destruction because their protection is not organized.

Geological natural monuments include unique forms of relief and associated natural landscapes; geological outcrops of specific scientific value (reference sections, stratotypes,

rare mineral, rock and mineral resource outcrops); location of rare and specifically valuable paleontological objects; natural and hydromineral complexes; thermal and mineral water sources, and location of therapeutic muds.

First geological natural monuments (and these are geomorphologic objects as per the current classification) at the area of the Krasnoyarsk Territory were approved by the order of the Krasnoyarsk Executive Committee in 1977. These included the Aydashenskaya, the Mayskaya, the Kubinskaya, the Karaulsnaya, the Lysanskaya, the Bolshaya Oreshnaya and the Badzheyskaya caves.

In 1981 the Krasnoyarsk Executive Committee declared geological outcrops Pestrый skaly and the geological outcrop Popigayskoye being a part of the Popigay astrobleme in the Khatanga District of the Taymyr Autonomous District, the geological section at the Oresh River in the Yermakov District and the landscape zone Stone Town to be geological natural monuments with Decision No. 404 dated 21.09.1981.

Later the Permafrost Museum in Igarka, the ice-mineral complex Ledyanaya gora and the Minino columns were referred to geological natural monuments.

We developed a plan for ranking different types of geological natural monuments in the Krasnoyarsk Territory on the basis of their significance value. A genetic principle, significance values and the official status (Table) served as classification indicators.

According to the existing classifications (Ananyev et al, 1986; Lapo et al, 1993) and our studies, the geological objects at the area of the Krasnoyarsk Territory can be divided into the following types on the basis of genetic indicators and modern processes in them.

1. Stratigraphic. This type includes natural or artificial outcrops of stratified formations

containing full information on the composition, structure, age, and nature of interrelations with typical analogues. Both geological monuments and geological places of interest with various official statuses are identified at the area of the Krasnoyarsk Territory amidst stratigraphic objects of nature-protecting value (Fig. 1, 2).

2. Paleontological. They represent a location of paleontological remains with unique integrity or systematic composition, allowing to solve general and special questions of biology, paleontology, paleogeography and paleoclimatology. All identified paleontological objects are geological places of interest. The Torgashino site composed of fragmented formations of the Lower Devonian Karymovskaya suite ( $D_1kr$ ) is one of the richest locations of the Siberian Devonian propteridophyte flora. The propteridophyte flora (Fig. 3) was collected and described in the 50s by A.R. Ananyev – a major specialist of Devonian formations (Ananyev et al, 1986). It shall be noted that this paleontological object can be also considered as a geological (tectonic-type) natural monument “Angular unconformity between Cambrian and Devonian deposits” (Guide on Training Geological., 2010).



Fig. 1. Section along the Sukhaya Tunguska River \*

\* All photographs are provided by Yu.A. Zadisensky (Zadisensky et al, 2004)



Continuation table

1	2	3	4	5	6	7	8	9	10
			Location of the Lower Carboniferous flora Trifonovskoye; Location of the cyclostign complex Uvaly-Tumana; Location of the Later Devonian flora Lenny Log;						
	Objects reflecting the processes of development of large regions (processes either typical or rare and unique for specific regions)	Section of the Dzhebashskaya series at the Oresh River; Section of Triassic formations Mys Tsvetkova	Location of Permian wood prints Kayerkan	Southern carbonate massif Gulinsky of the alkaline-ultrabasic intrusion; Location of globular lavas at the Beret Village		Krasnye skaly outcrop; Oydashinskaya cave; Karaulnaya-2 cave; Kubinskaya cave; Mayskaya cave; Badzheyskaya cave; Bolshaya-Oreshnaya cave; Lysanskaya cave; Stone Town	Igarka Permafrost Museum, Ice-Mineral Complex Ledyanaya gora		
Regional			Jurassic flora and fauna deposit Kubekovo; Location of the Early Carboniferous flora Voznesenka	Location of lydrites at the Mana River (regional); Petrotypical massif Saibarsky Magmatic Complex		Minino columns; Paleo volcano Udachny; Paleo volcano Sliznevsky massif, Saratovsky; Paleo volcano Lutagsky massif			Chernaya Sopka Mountain
Local	Objects reflecting processes typical for parts of regions	Bazaikha horizon							

\* Note: Geological places of interest are in italic.



Fig. 2. Bedrock outcrops of the Bazaikha horizon



Fig. 3. Propteridophyte prints from the Torgashino location of Early Devonian flora

The Trifonovsky Bay of the Krasnoyarsk water reservoir arouses great interest. There Early Carboniferous outcrops with multiple large-trunk lepidophytes, trunks of *Caulopteris ogurensis* (Schm.), leaves of *Sphenopteris* sp. and *Sphenophyllum* sp. are observed (Fig. 4). A new project was recently suggested on formation of a natural reserve Pushkarikha, which would include the natural objects Trifonovsky Bay and the Kurtak-Primorsky section. In the event this project is implemented, this area can be considered as a polygon for scientific and training purposes.

3. Petrographic – outcrops and massifs of typical or rare rocks and ores with graphic

demonstration of their composition, structure or texture; fragments of ancient volcanic apparatus; notable forms of introduction and bedding of magnetism products. The study of geological objects with indicators of petrographic monuments allowed to identify: the southern carbonatite massif Gulinskoy of the alkaline-ultrabasic intrusion; the location of globular lavas near the Beret Village (Fig. 5), the location of lydrites at the Mana River, and the petrotypical massif Saybarsky Magmatic Complex.

4. Geomorphologic – separate relief forms or complexes of relief forms most clearly reflecting the interrelation of endogenous and exogenous



Fig. 4. Bedrock outcrops in the Trifonovsky Bay with Early Carboniferous flora



Fig. 5. Globular lava outcrops at the Mana River

geological processes (with the leading role of the latter). These also include relief forms with specific esthetic, cognitive and recreational value.

Caves, the formation of which predetermined a wide development of carbonate formations of different ages at the area of the Krasnoyarsk Territory, form the main share in this category of natural monuments and places of interest. All above-specified caves have the status of regional natural monuments.

The list of geomorphologic objects can quite conditionally include paleo volcanoes if they have indicators meeting the requirements of this category of natural objects. When these are missing, the occurrences of ancient volcanic

activity shall be better referred to petrographic places of interest.

We refer the Yergaki massif to the geomorphologic type. The detail study of this natural object allowed to both define it as a complex type and assign a status of the national park Yergaki to it (April 04, 2005).

5. Geocryological – specific cryogenic formations typical for a cryolithozone (permafrost zone). The Igarka Permafrost Museum and the ice-mineral complex Ledyanaya gora are unique objects in the north of the Krasnoyarsk Territory, declared geological natural monuments. The detail study of these formations allowed to refer them to the period of Zyryanovskoye glaciation.



Fig. 6. Rock massif of the Yergaki Mountain Ridge



Fig. 7. Pyrochlore of the Tatarskoye deposit

6. Ore-mineralogical. These objects of geological heritage represent locations of rare minerals and well-shaped crystals of minerals, their crystallographic and aggregate forms, a unique mineral paragenesis and the sites of demonstrative occurrence of modern mineral formation. A rich and unique mineral base of the Krasnoyarsk Territory allows to identify in this category of geological objects quite a lot of objects for their reference to geological places of interest or natural monuments (Zadisensky et al, 2012). The Tatarskoye deposit localized within the Yenisey Ridge is at the initial stage of development. With no possibility or need to preserve the deposit as a geological natural moment of a common type, it is planned to refer

it to geological natural monuments of a federal value with a specific mode of protection. Such mode will provide for the necessity to collect especially large and rare minerals, pyrochlore (Fig. 7), zircon, pyrite and others in particular for studies and museum collections.

In the future, by the end of development of the deposit it is feasible to preserve one or several pillars with different natural ore types in their natural form.

7. Cosmogenic—astroblemes and their groups as well as areas of meteorite falling, containing traces of their impact on hosting formations. According to the classification given in our work, this type includes the Popigay astrobleme (Pestrye skaly stow). The Popigay crater appeared





Fig. 8. Outcrop with Carboniferous flora

in the end of the Eocene epoch 35.7 M years ago. Although impact structures are known in many other parts of the Earth as well, the Popigay crater is the largest of the Cenozoic impact structures discovered to date. It is one of the ten largest craters in the world, and only six impact craters with the diameter 100 km and above are currently known and reliably established at the Earth.

The object uniqueness consists in its dimensions, presence of large reserves of impact diamonds, uniqueness of landscapes, rare fauna and flora representatives. This all allows to consider the Popigay meteorite crater as the area which can be assigned the status of a national park.

8. Complex. Some natural objects can fall into several groups (types) simultaneously on the basis of their indicators. A combination of several unique features and peculiarities in one object increases their absolute value. Such objects at the area of the Krasnoyarsk Territory include the natural reserve Stolby, the Chernaya Sopka mountain (petrological and petrographic, paleo volcanic, geomorphologic types) (Markov et al, 2012), and the Kurtak-Primorsky section (Fig. 8).

9. Historical-geological. This type unites remains of ancient mines and known (reference) outcrops of mined mineral deposits. Based on the available data we include the Irbinskoye deposit into this type. The first in Siberia state Irbinsky iron plant was founded on its basis more than two and a half centuries ago, in 1734. It shall be noted that there are almost no material evidences of mining after fires in 1859 and 1867.

Geological monuments and polygons for scientific and training activity are formed on the basis of earlier operated mines in some major mining regions in the world, for example in Germany. Positive experience of formation of such nature protection objects can be successfully used at the area of the Krasnoyarsk Territory as well as in southern bordering republics – Khakasia and Tyva.

In the conclusion it shall be noted that the analysis of geographic distribution of geological monuments and natural places of interest shows that there are no districts in the Krasnoyarsk Territory where there are no monuments at all, and presence of some “white” spots can testify to lack of study only.

## References

1. Ananyev, A.R., Zakharova, E.V. (1986). Protohyena Janovii (Cladoxylopsida) from Ems of Siberia. *Botanic Journal*, Vol. 1. No. 5. 11 p.



2. Anisimova, N.P. (2000). Natural Monuments as the Basis for Development of Geotourism at the Area of the Republic of Altay. *Results and Prospects of Geological Study of Gorny Altay* (Conference Materials). Gorno-Altaysk. 173-177.

3. Zadisensky, Yu.A., Romanov, A.P., Dyatlova, I.N. et al. (2004). Report "Discovery and Description of Geological Natural Monuments and Geological Places of Interest in the Krasnoyarsk Territory with Compilation of an Electronic Catalogue for 2000-2002". Krasnoyarsk. 238.

4. Zadisensky, Yu.A., Ananyev, S.A., Ananyeva, T.A., Bondina, S.S. (2012). Semi-Precious Stone Resources as the Source of Collection Minerals and Rocks, *Vestnik KGPU im. V.P. Astafyeva*. 4 (22). Kras. Gos. Ped. Un-t im. V.P. Astafyeva. Krasnoyarsk. 423-435.

5. Lapo, A.V., Davydov, V.I., Pashkevich, N.G. et al. (1993). Methodological Basis of Study of Geological Natural Monuments in Russia. *Stratigraphy. Geological Correlation*. V. 1. 75-83.

6. Markov, V.N., Sovluk, V.I., Analyeva, T.A. et al. (1999). Report "Discovery and Description of Geological Natural Monuments and Geological Places of Interest in the Krasnoyarsk Territory with Compilation of an Electronic Catalogue for 1999-2000". Krasnoyarsk. 86.

7. Sazonov, A.M., Tsykin, R.A., Ananyev, S.A. et al. (2010). Guide on Training Geological Traverses in the Surroundings of Krasnoyarsk. Krasnoyarsk, Siberian Federal University. 212 p.

## **Геологические памятники и достопримечательности природы Красноярского края (история и систематика)**

**Т.А. Ананьева,**

**С.А. Ананьев, Ю.А. Задисенский**

*<sup>а</sup>Красноярский государственный педагогический университет  
им. В. П. Астафьева*

*Россия 660049, Красноярск, ул. Ады Лебедевой, 89*

*<sup>б</sup>Сибирский федеральный университет*

*Россия 660041, Красноярск, пр. Свободный, 79*

*<sup>в</sup>Музей геологии Центральной Сибири*

*Россия 660021, Красноярск, ул. Профсоюзов, 3, стр. 3*

---

*Рассмотрены геологические памятники и достопримечательности Красноярского края, история их выявления, определены систематизация и типизация, предложены новые подходы к выделению объектов природного геологического наследия.*

*Ключевые слова: геологические памятники, геологические достопримечательности.*

---