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ПОЛИТЕХНИЧЕСКИЙ ИНСТИТУТ
1958

Pacific National University
Khabarovsk

"FOREST RECLAMATION IN THE DEVELOPMENT STRATEGY OF THE FAR EASTERN REGION AS A BASIS FOR ENSURING ENVIRONMENTAL SUSTAINABILITY OF THE NATURAL ENVIRONMENT»

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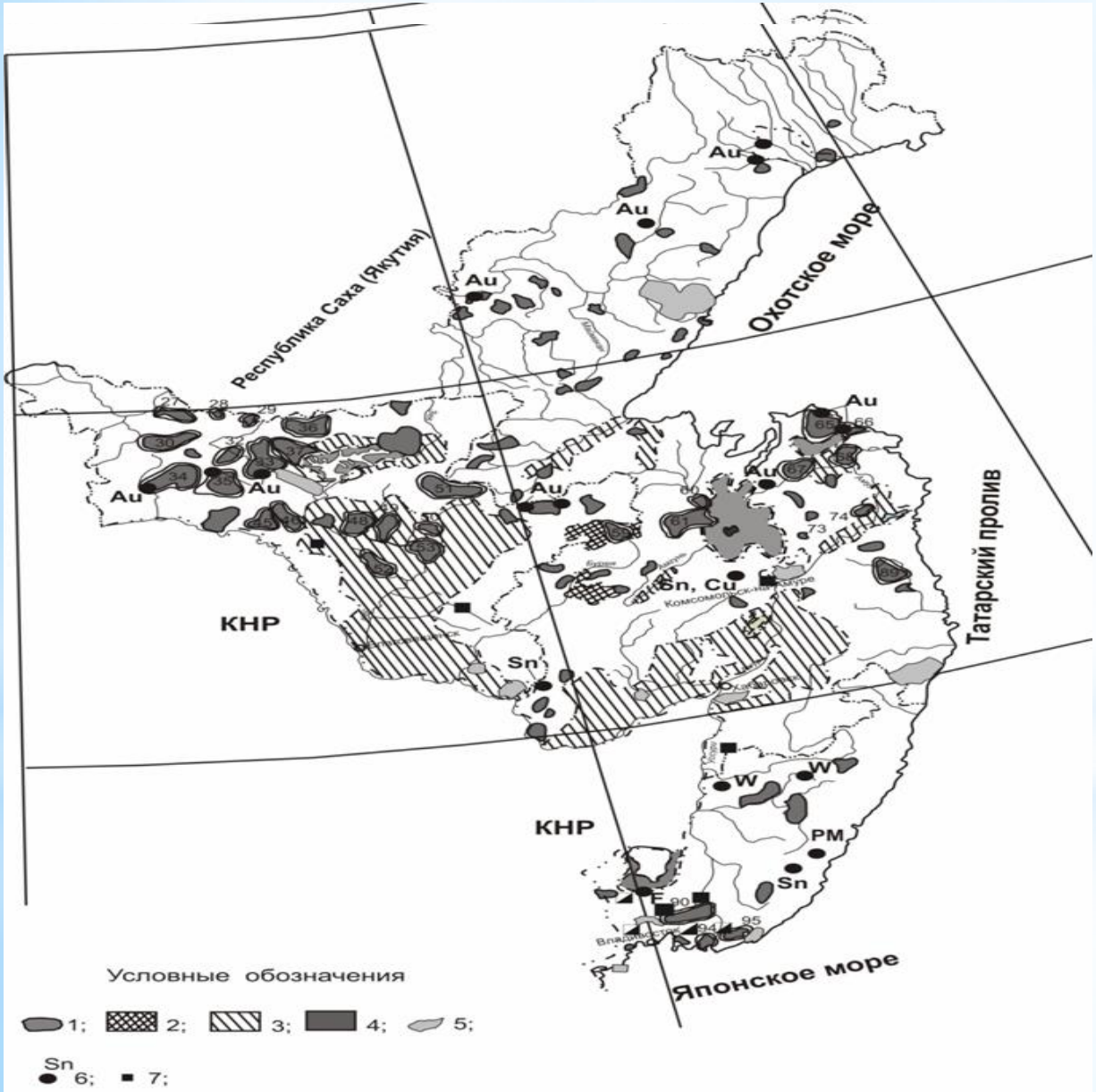
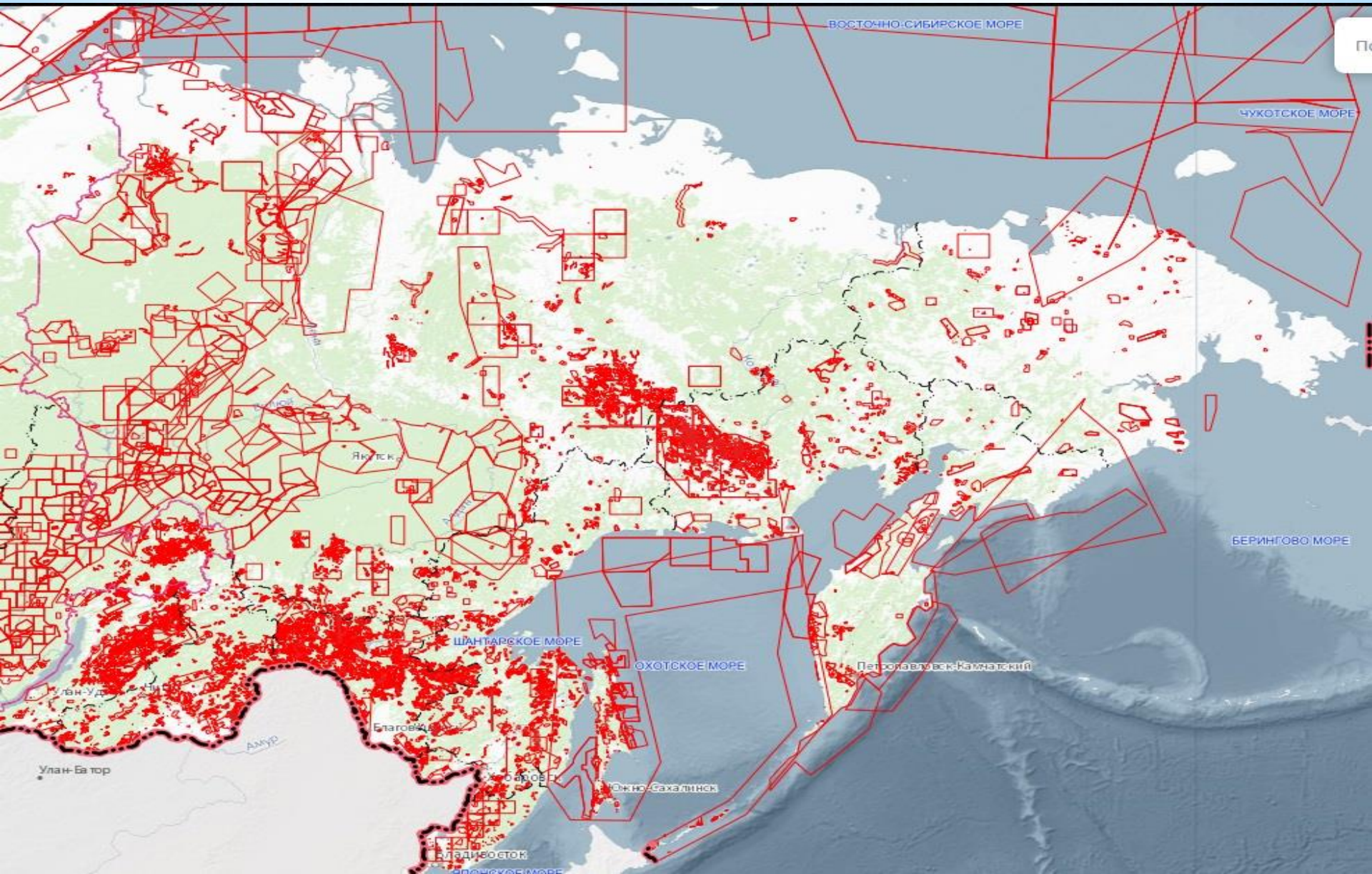
Map of the location of mountain objects on the territory of the Far Eastern region



Note: 1-mostly spent gold-scattering nodes;2-intermountain depressions, areas of short-termaccumulation of suspended material, including technogenic mercury;3-low-lying plains, areas of long-term accumulation;4-drainless depressions, areas of final sedimentation;5 - nature reserves of federal significance;6-mining areas and mines for the development ofindigenous deposits of gold and non-ferrous metals, the symbol of the element – atype of mineral raw materials; 7-enterprises for the extraction of hard and brown coal

Map of the location of mountain objects on the territory of the Far Eastern Federal District



Relevance of the study

«Vysokogorskoye» tailings storage facility

«Fabrichnoye» tailings storage facility

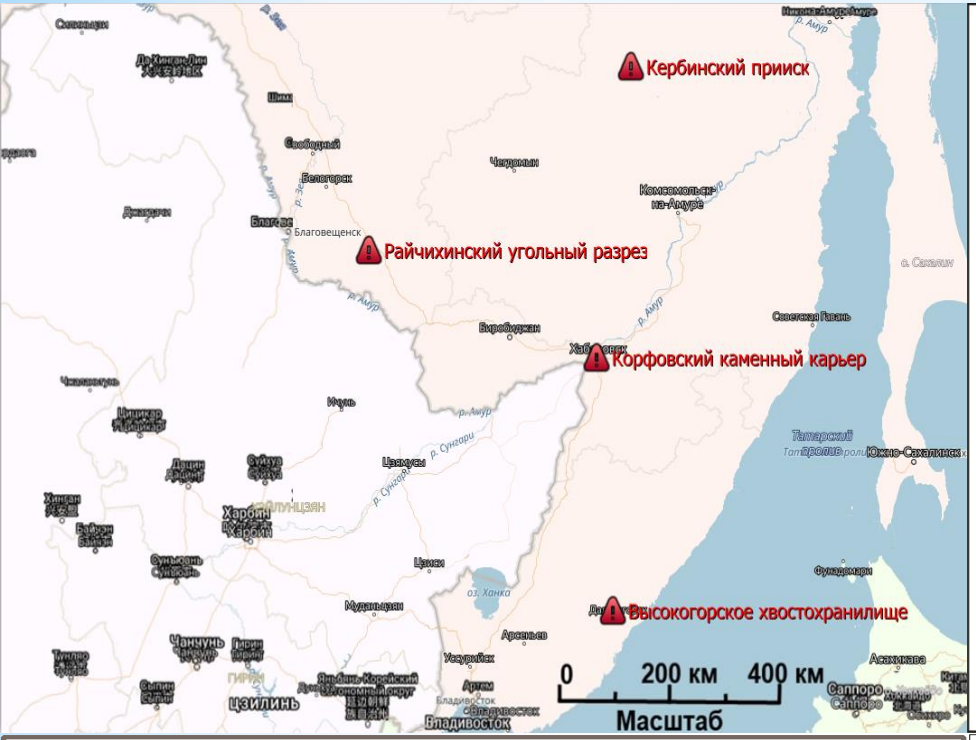
Purpose of the study

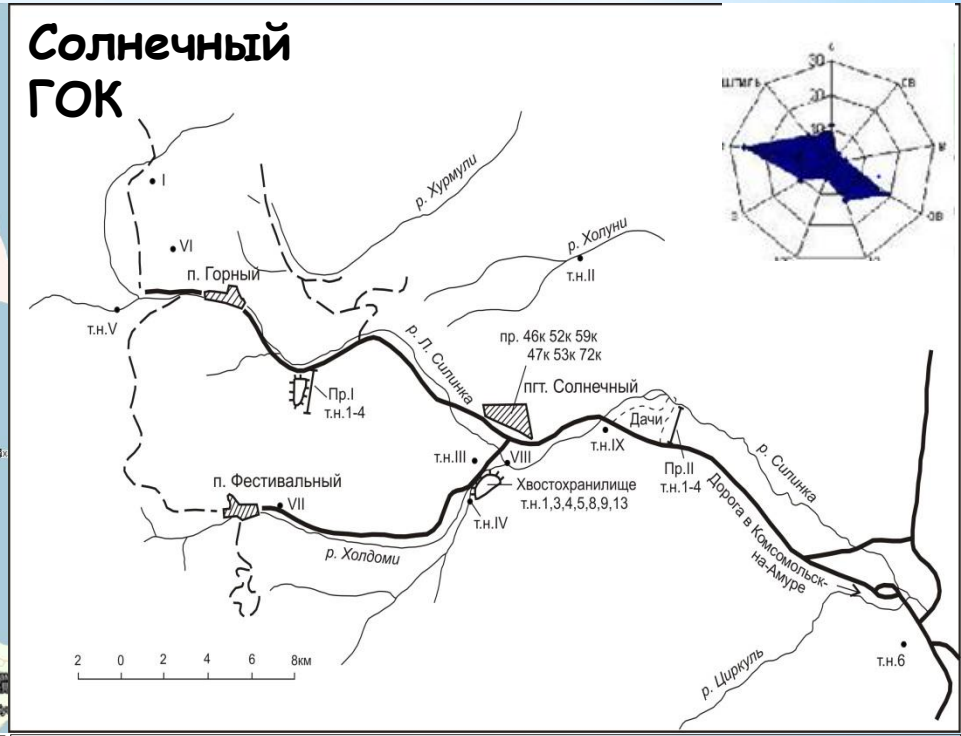
The purpose of the work was to substantiate the need to rehabilitate forest lands that are subject to the negative impact of accumulated waste from mineral processing as a result of past economic activities of mining enterprises, by conducting forest reclamation using bioremediation methods to ensure their environmental safety.

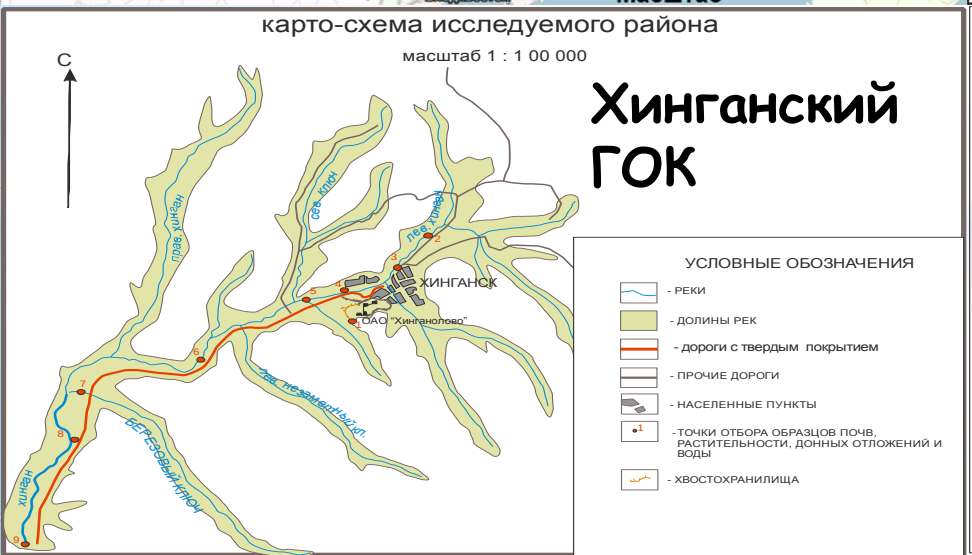
Research objectives

1. • Analysis and generalization of domestic and foreign experience on this problem;
2. • Determining the extent of destruction of forest ecosystems, studying the features of their transformation under the influence of mineral development processes;
3. • Research of technogenic formations as objects of forest reclamation;
4. • Development of measures for reforestation on technogenic formations using the potential of biological systems.

Map maps of the study areas

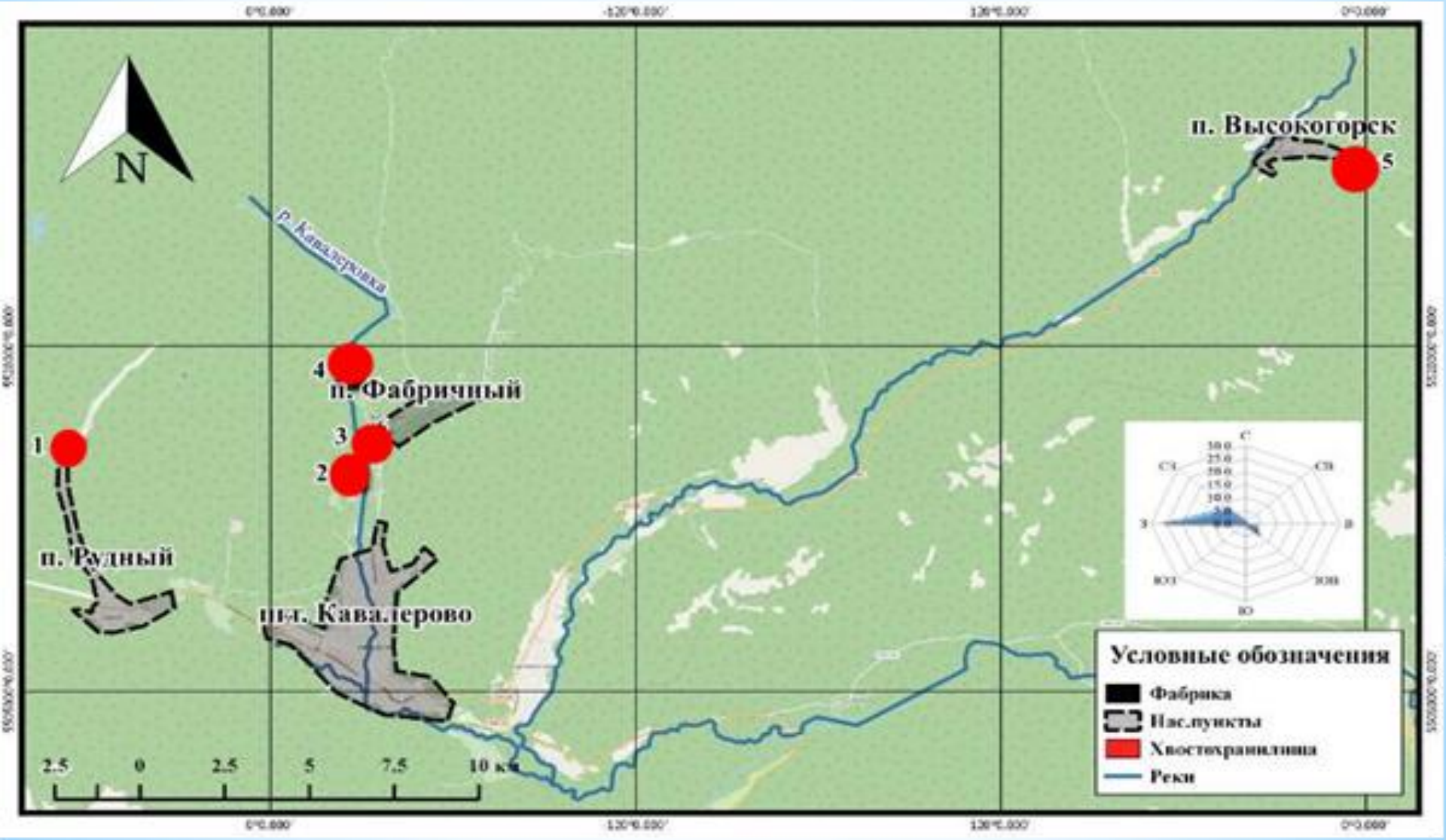






Location of tailings dumps of the closed mining enterprise Khrustalnensky GOK on the territory of the Kavalerovsky district of Primorsky Krai

(• – tailings storage facility)



Objects, methods and methodological basis

The objects of research were natural and mining systems formed during the development of mineral raw materials.The following methods were used: conventional physico-chemical, biological, and GIS technologies.The methodological basis of the research was the teaching of Academician V. V. Vernadsky about the biosphere and the noosphere and the main provisions set out in the program and methodology for studying technogenic biogeocenoses by B. P. Kolesnikov and L. V. Motorina.

Research objects

Closed mining enterprise "Khrustalnensky GOK" Kavalerovsky district of Primorsky Krai

tailings storage facility «Rudnoye»

tailings storage facility «Fabrichnoye»

tailings storage facility «Vysokogorskoye»

Scientific novelty

The scientific novelty lies in the study of technogenic formations as objects of forest reclamation and the development of measures for reforestation on technogenic formations using the potential of biological systems. According to laws, regulations and state standards:

Federal Law" On Environmental Protection " of 10.01.2002 N 7-FZ;

Decree of the Government of the Russian Federation No. 800 of July 10, 2018 "On Land reclamation and conservation";

Law of February 21, 1992 N 2395-1 " On mineral resources»

GOST 17.4.3.02-85. "Nature protection. SOILS. Requirements for the protection of the fertile soil layer in the production of earthworks" (ed. 01 September 2008)

GOST R 57446-2017. " THE BEST AVAILABLE TECHNOLOGIES. Reclamation of disturbed land and land plots. Restoration of biological diversity"). (ed. August 01, 2019)

GOST 17.5.3.05-84. " Nature protection. LAND RECLAMATION. General requirements for land use" (ed. 01 June 2002)GOST 17.5.3.04-83. " Nature protection. LAND. General requirements for land reclamation" (ed. June 01, 2002)

In the course of the conducted research, the following results were obtained : waste stored in tailings dumps, many of which are already filled beyond the design marks, is particularly dangerous for the environment and human health. They are considered from two positions:

1. As technogenic deposits containing high concentrations of base metals (HM) and associated valuable components;

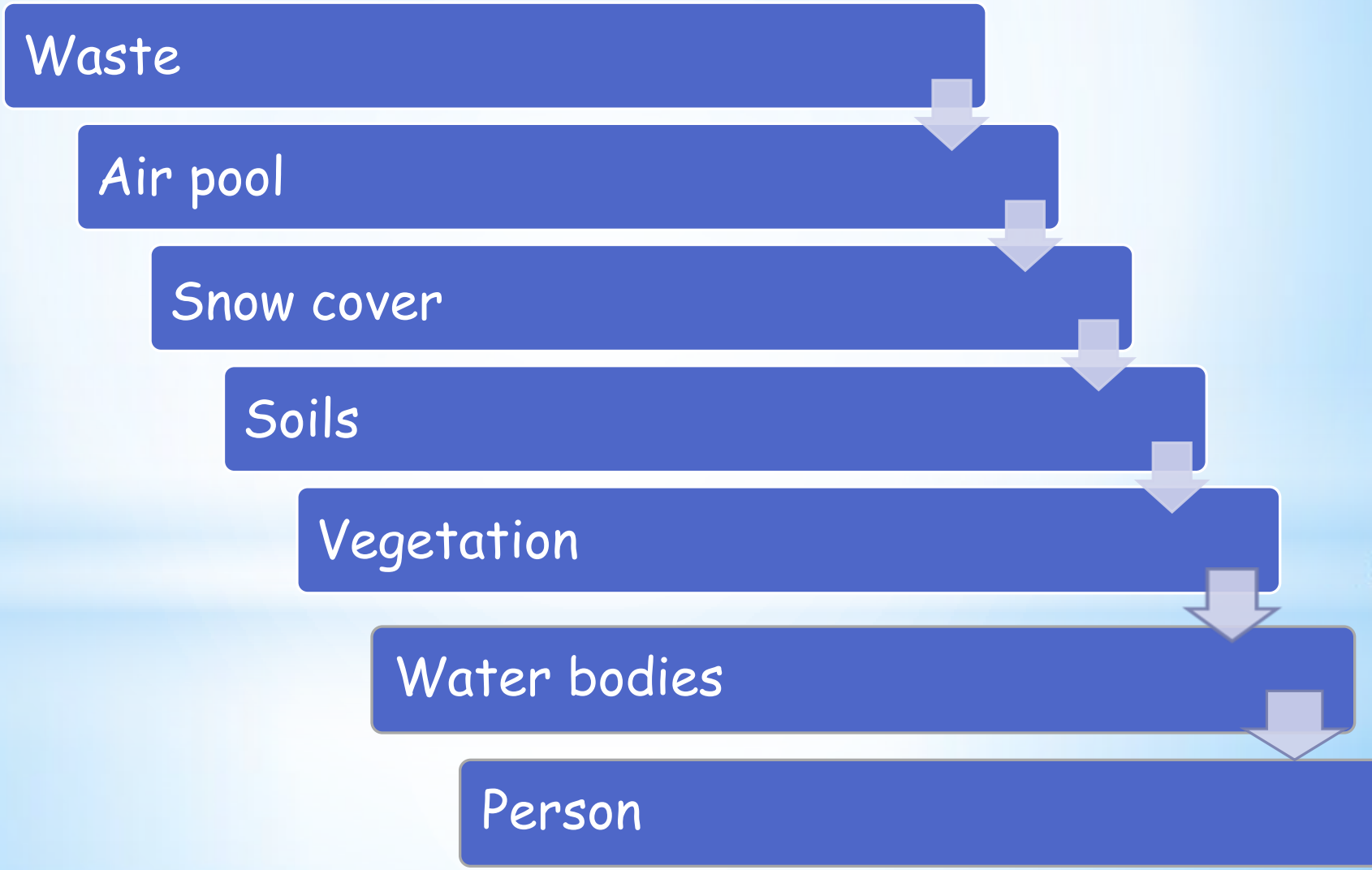
2. As a source of a real threat of environmental pollution by toxic elements. A wide range of toxic heavy metal ore compounds (Pb, Zn, Cd, As, Bi, Hg, Sn, Cr, Mo, Cu, Mn, etc.) is accumulated within the natural-mining technogenic system.)

According to the modern classification, technogenic surface formations (TPO) are substrates of technogenic landscapes that are devoid of natural soil cover. These include overburden and host rock dumps, tailings dumps, and sludge dumps.

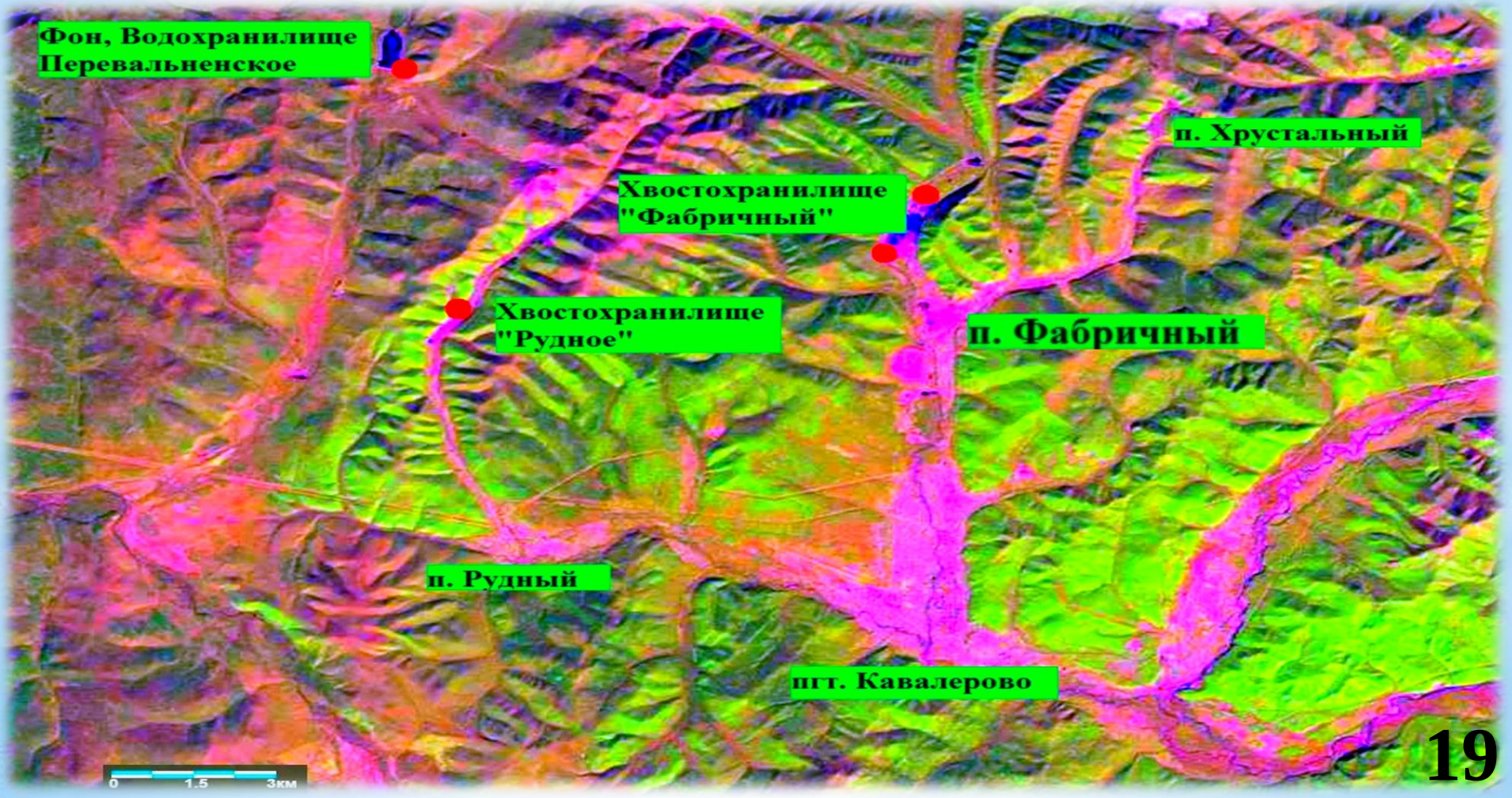
Characteristics of the impact of waste on the environment

The mineral composition of waste from processing cassiterite-sulfide mineral deposits contains: arsenopyrite, pyrite, pyrrhotite, galena, sphalerite, etc., containing a large amount of toxic heavy metals and arsenic.Highly toxic waste is classified as highly sulfidized, highly hazardous, and of the second hazard class. Under the influence of weathering processes, pollutants migrate from waste to environmental objects, which leads to intensive technogenic pollution.

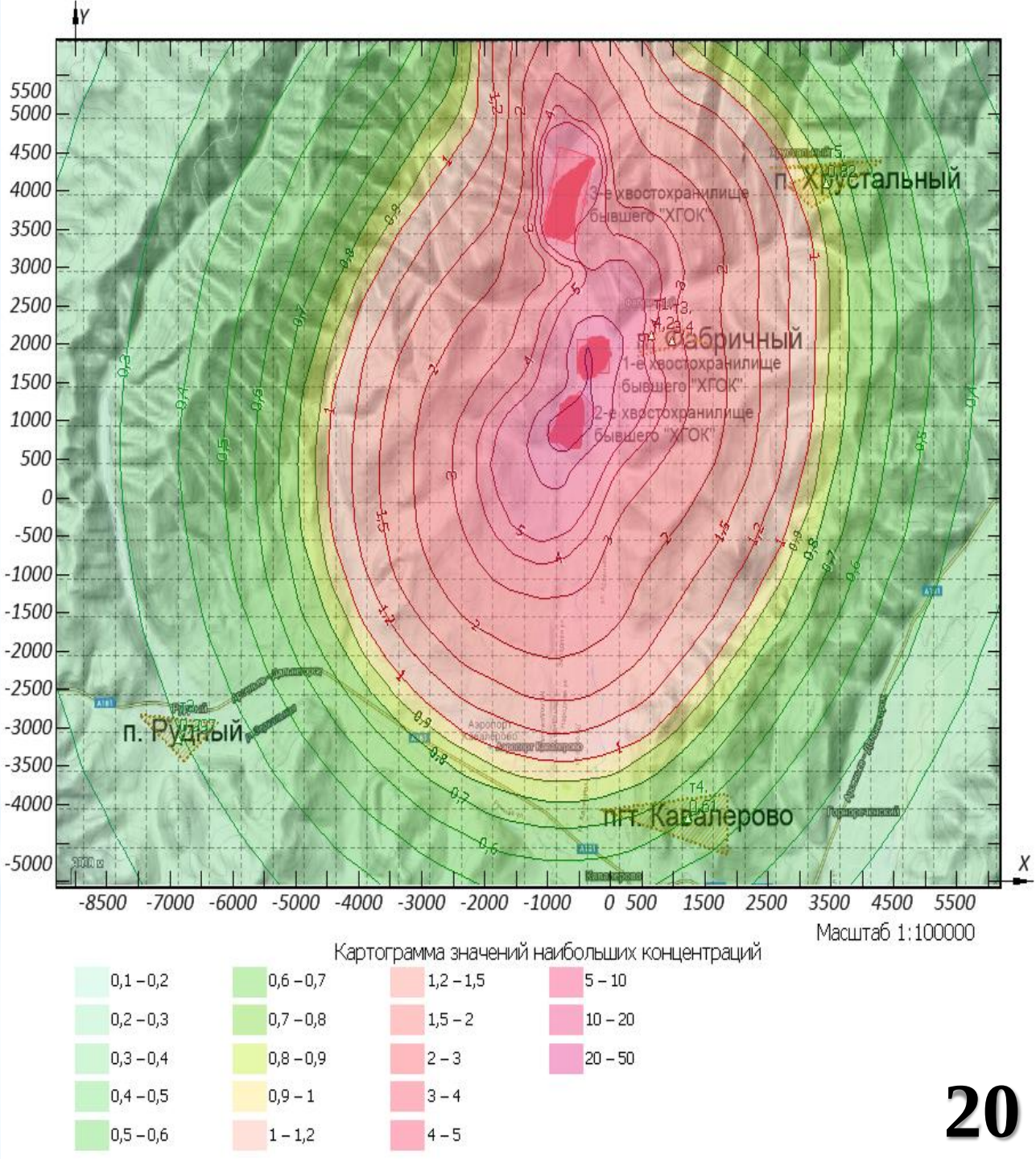
Migration of heavy metal compounds



According to the multichannel satellite image of Landsat 8 dated September 28, 2018, synthesized in color from the spectral bands 7-4-2, it was possible to distinguish the areas of atmospheric pollution by the characteristic pink-purple phototone. The spread of pollutants from the surface of the tailings storage facility to the territory of the settlement occurs in the south-east direction with the distribution of air flows. There is also a pink-purple photon along the riverbed of the Kavalerovka River, passing through a man-made object.



The pollution calculation for the majorant was carried out for all sources of atmospheric pollution, substances and summation groups. In this case, the calculation result for each calculation point is the highest value of the maximum calculated concentrations obtained for this point separately for each of the substances and summation groups.

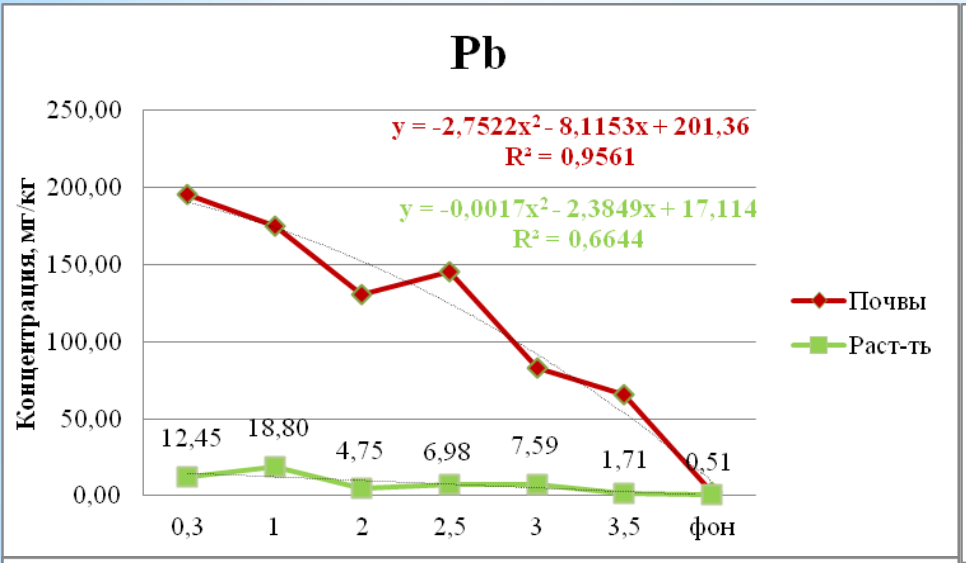


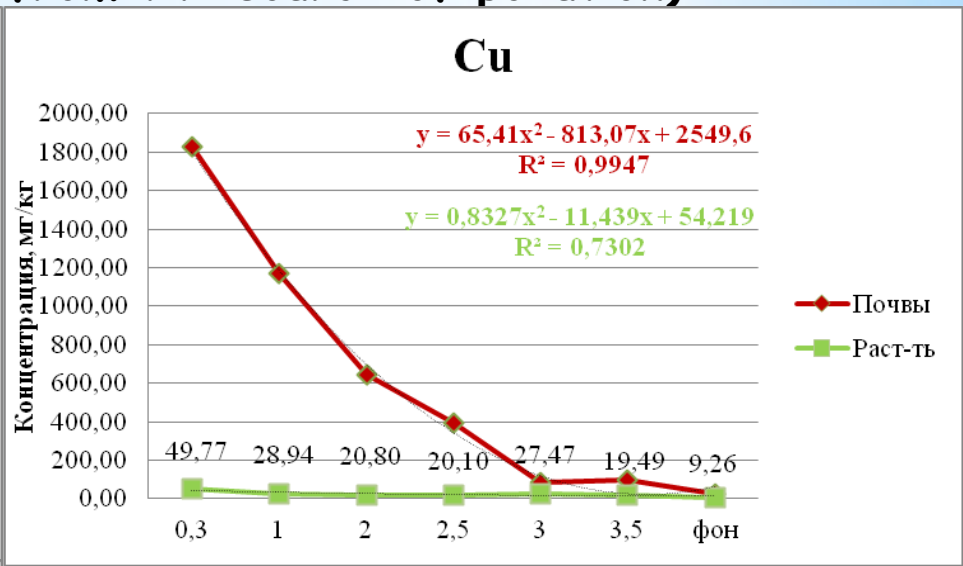
The content of Pb, Zn, and Cu compounds in soils at different distances from the surface of tailing dumps

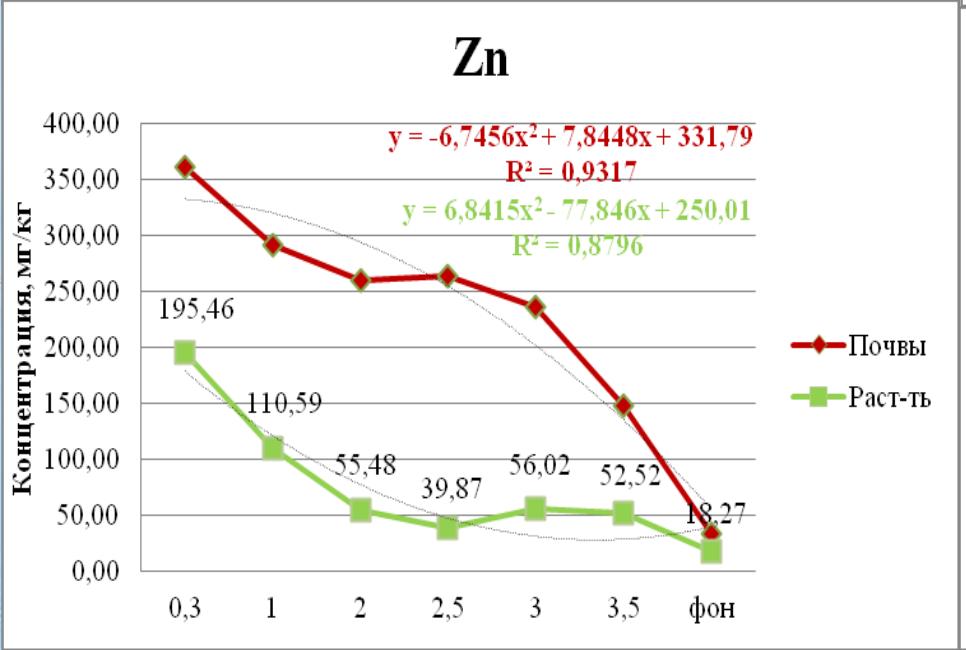
Geochemical series of TM compounds in technogenic soils of the boundaries of the influence of the tailings dumps of the Khrustalnensky GOK (Data for the period from 2016-2018)

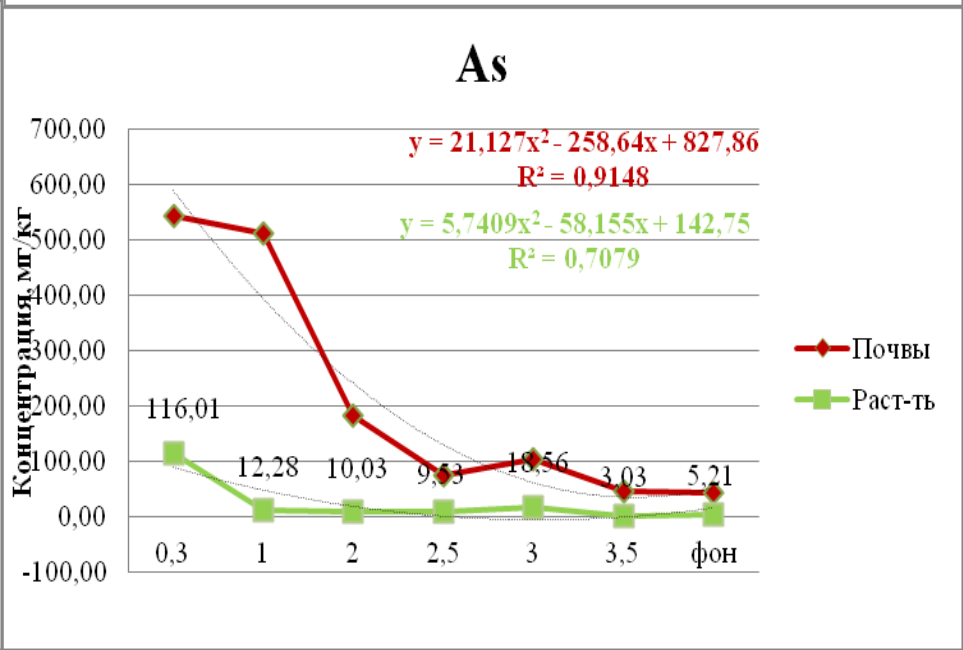
Geochemical series . Data for the period 2016-2018.			
№	Sampling location	Geochemical range, sampling depth 0-10 cm	Geochemical range, sampling depth 10-20 cm
1	Zone 1; 0.3 km from the tailing dump	Cu> Zn> Pb	Zn> Cu >Pb
2	Zone 1; 1 km from the tailing dump	Cu> Zn> Pb	Zn> Cu> Pb
3	Zone 1; 3 km from the tailing dump	Zn> Pb>Cu	Zn> Pb> Cu
4	Zone 1; 5 km from the tailing dump	Cu> Zn >Pb	Cu> Zn >Pb
5	Zone 1; 7 km from the tailing dump	Cu> Zn> Pb	Zn> Cu> Pb
6	Zone 2; 9 km from the tailing dump	Zn> Pb>Cu	Cu> Pb> Zn
7	Zone 3; 19 km from the tailing dump	Zn> Cu >Pb	Cu> Pb> Zn
8	background	Zn> Cu> Pb	Zn> Cu> Pb

Results of chemical analysis of technogenic soils and vegetation in the zone of influence of the tailings storage facility of the closed mining enterprise Solnechny GOK.(Dependence of the concentration in the soil and vegetation cover at different distances from the source of pollution)

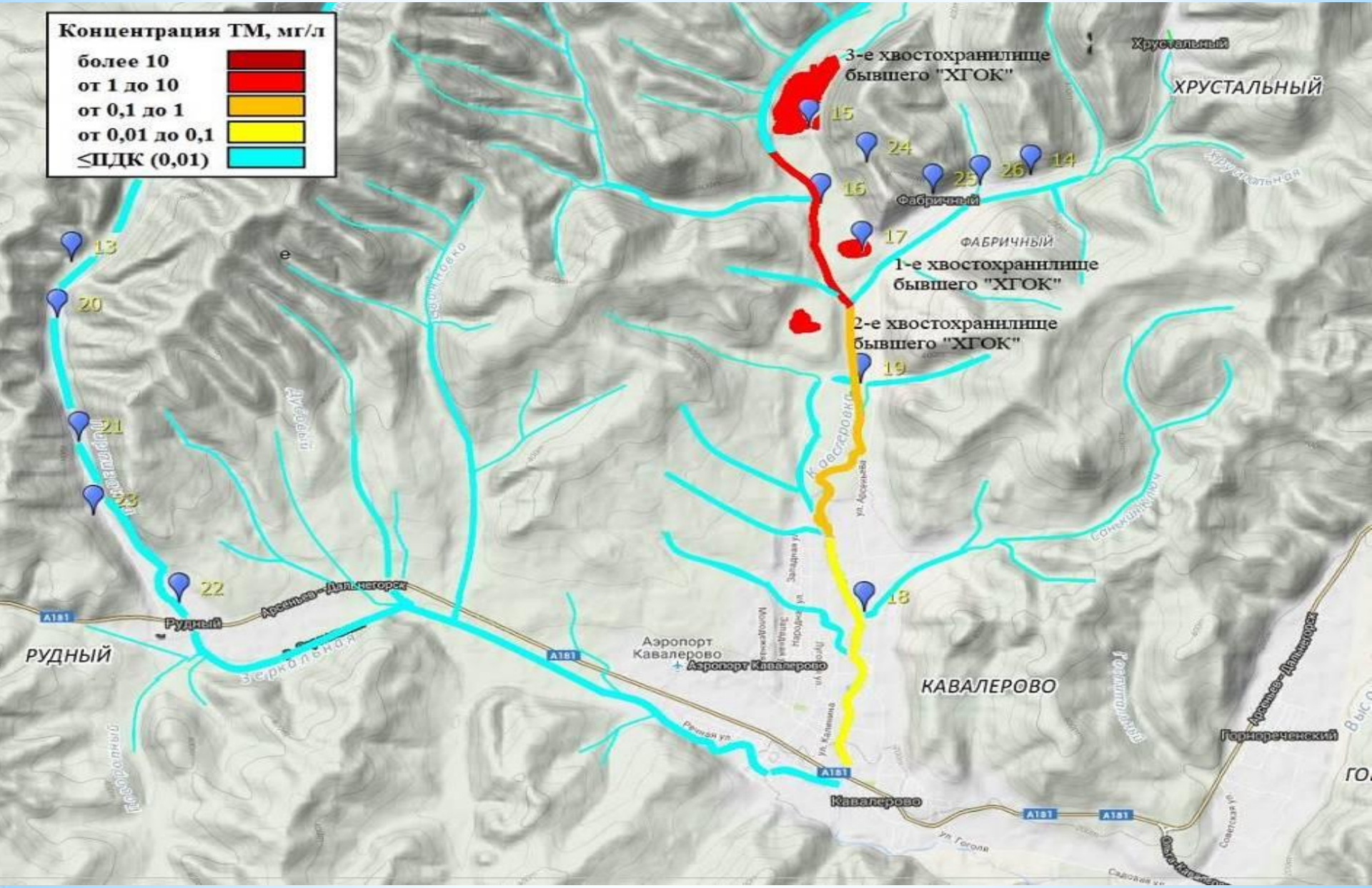








Migration of lead compounds in the waters of the Mirror River (in the lower reaches)

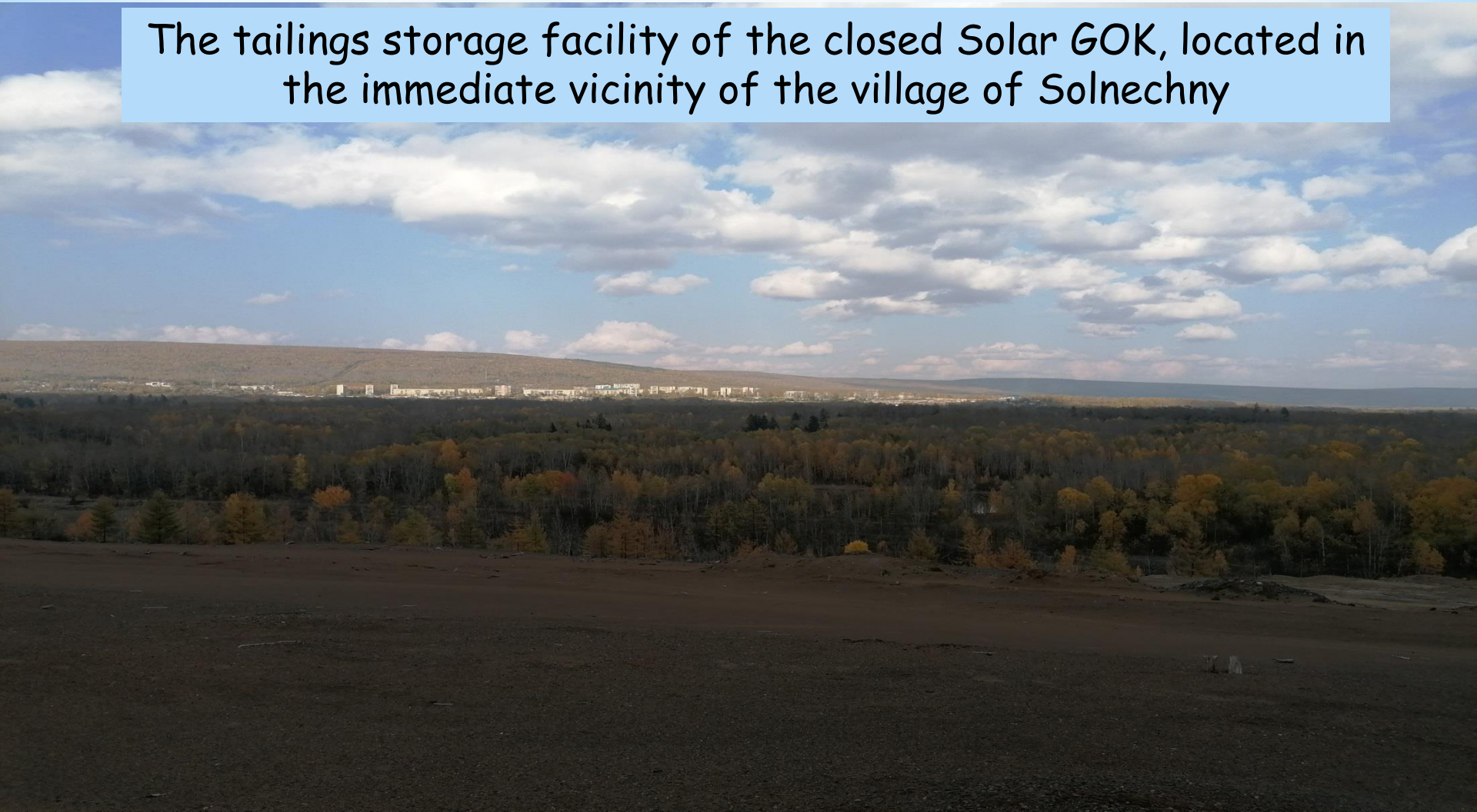


Degradation of the surfaceof the «Vysokogorsky» tailing dump»

Degradation of the surface of the Solar tailings storage facility

Erosion processes on the slopes of the dam

The adverse impact of tailing dumps (man-made formations) is a negative factor for the health of the population of mining settlements. This circumstance determines the need to intensify research on land reclamation, including forest land, which will minimize damage to the natural environment and human health and solve the strategic task.



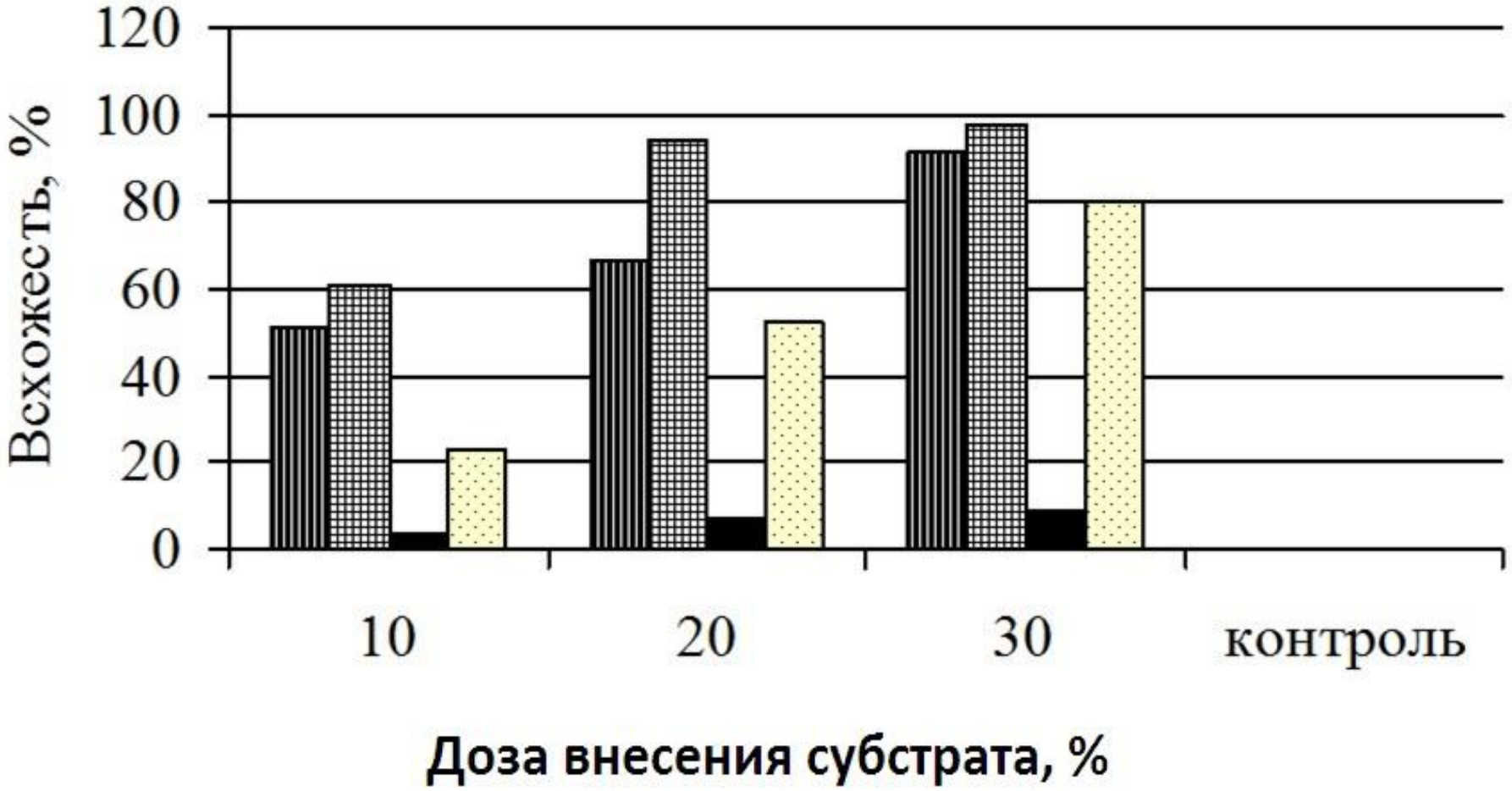
The tailings storage facility of the closed Solar GOK, located in the immediate vicinity of the village of Solnechny

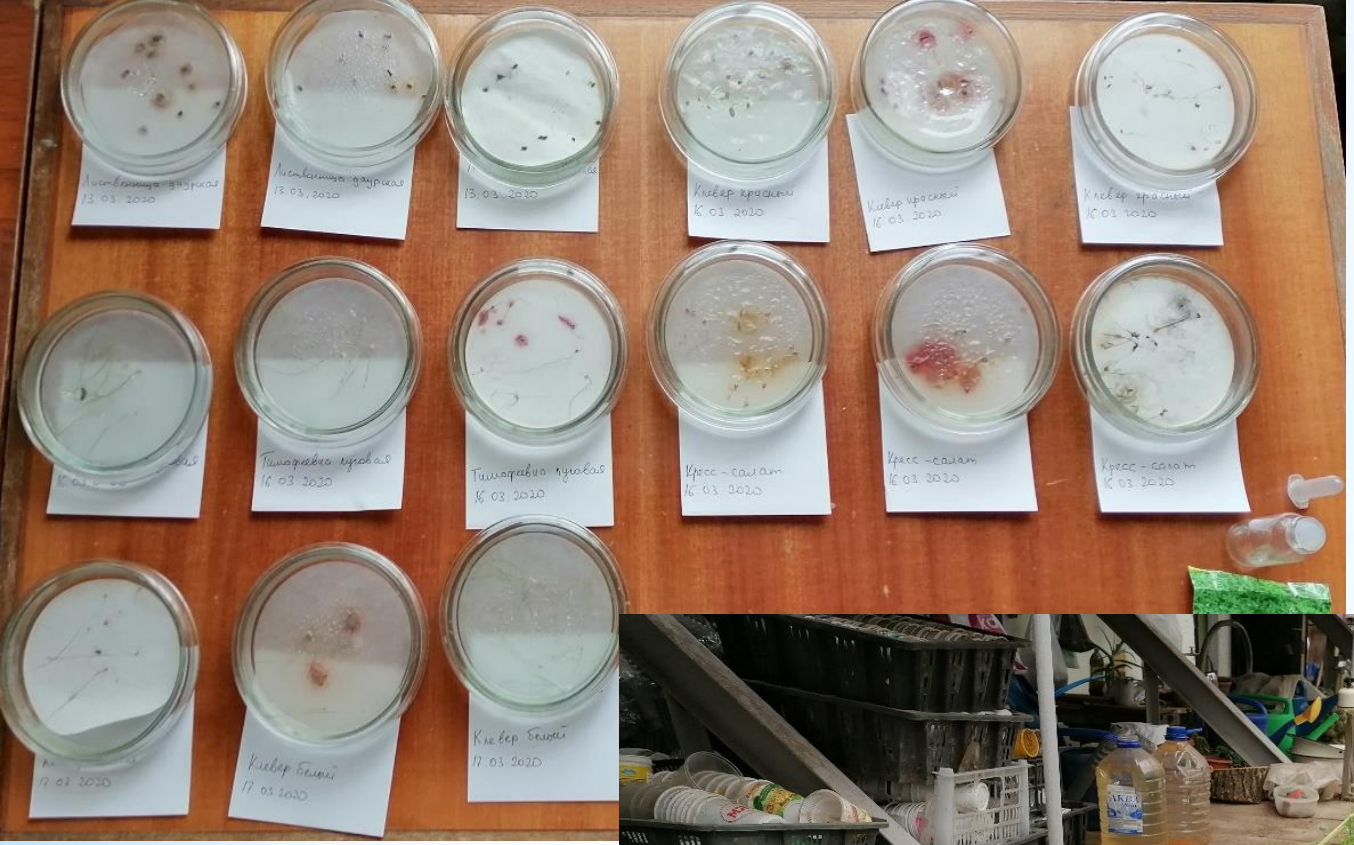
Results of experimental studies in the greenhouse on the use of the biological potential of living systems (bioremediation) in solving the problem of reducing the negative impact of toxic tailings waste on ecosystems

Placing waste in containers

Substrate application

Germination of plants in 10 days




Клевер красный
16.03.2020
Клевер красный
16.03.2020
Клевер красный
16.03.2020
Тимофеевка луговая
16.03.2020
Тимофеевка луговая
16.03.2020
Кресс - салат
16.03.2020
Кресс - салат
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Кресс - салат
16.03.2020
Клевер белый
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Клевер белый
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Compost based on cultured strains of basidial fungi Pleurotus ostreatus-common oyster mushroom (bioremediation)

Conducting experimental studies in production conditions

Results of the experiment in production conditions

It is established that on the surface of tailing dumps, soil-ecological functions are restored in a very short period of time (one growing season), which is very important, and a stable phytocenosis is formed. The scientific and practical significance of the results of the study is to substantiate the problem of creating a favorable habitat for the population of the mining village and the environmental safety of the storage of toxic waste, the rational use of natural resources at mining enterprises. A technological solution to minimize the impact of waste is proposed and recommended for use not only in the Far Eastern Federal District, but also at other mining enterprises in Russia and the countries of the Asia-Pacific region.

Conclusion

1. The analysis and generalization of domestic and foreign experience on this problem is carried out;
2. 2. The scale of the destroyed forest ecosystems is determined, the features of their transformation under the influence of mineral development processes are studied;
3. 3. Technogenic formations as objects of forest reclamation are investigated.
4. 4. Measures have been developed for reforestation on the surface of tailing dumps (technogenic formations) using the potential of biological systems.
5. The ecological and economic efficiency of remediation of the surface of tailing dumps containing toxic waste from processing of ore raw materials using bioremediation is calculated. The cost of recreating the productivity of the lands disturbed by the tailing dump is significantly less (5.5 times) compared to the traditional method (applying a soil layer).

Thank you for your attention!