Materials of Conferences

GEOECOLOGICAL ASPEKTS FOR MINERAL RESOURCES EXPLORATION OF THE ULUG-KHEM RIVER BASIN (TUVA)

Lebedev V.I., Lebedeva M.F.

Tuvinian Institute for Exploration of Natural Resources of Siberian Branch of the Russian Academy of Sciences, Kyzyl, e-mail: vil@tikopr.sbras.ru

The problems of geoecology of commercial exploration of mineral resources in basins of the Ulug-Khem river and its tributaries Piy-Khem and Kaa-Khem rivers on the territory of Tuva are disscussed. An influence of natural erosion and technogenous disruption on objects, contained heavy and toxic geochemical elements, has to be taken into account. Retrospective analysis and prediction of anthropogenical stress impacts, resulted from conducting of geological works in ore fields of Ag-Bi-Cu-Ni-Co-As, carbonatite, gold-ore, gold placer, rare-earth–rare metal, polymetallic, coal and chrysotile-asbestos deposits are given. Ecological advisability of utilization of wastes of «Tuvacobalt» and «Tuvaasbest» plants and sand-clay refuse of prospector's gold extraction have been considered. Data on radioactive pollution of Tuva territory have been presented. Each object revealed in Tuva contain a specific set of toxic elements. Although the distribution of anomalous endogenic concentrations is of low density and total area of districts of elevated contents of environmentally dangerous components occupies no more than 0,0001% of the Tuva territory, the availability of natural stream-forming sources and realms of their accumulation required special ecological-geochemical studies.

It is well known that Cd, As, Hg, Be, Pb, and Cr are most hazardous for the human habitat. Solis, proluvial-alluvial deposits, and rocks in most of ore regions of Tuva are enriched in these toxic elements. The Ulugoi ore cluster is a source of Cd, S, and Pb. The Khovu-Aksy, Ulatai-Choza, Chergak, Kyzyl-Oyuk, and Askhatiingol ore fields are sources of As, Sb, Cu, Co, and Ni. The rare-metal and lithium-fluorine deposits of the Sangilen deposit supply Be, B, F and natural radionuclides U and Th. The chromite-bearing ultrabasic rocks of the Kurtushibinskii, Agardag, Kaa-Khem ophiolite belts are sources of Cr and V. The barite-cinnabar ores of the Terlig-Khaya, Arzak and Chazadyr deposits, mercuric gold of quartz-veined, sulfosalt-sulfide, and copper-molybdemun-porphyric deposits, and products of amalgamation in wastes of sand-clay refuse of prospector's gold mining accumulated from 1856 to present date are main sources of Hg in environments of basin complexes of the Ulig-Khem, Piy-Khem, and Kaa-Khem rivers and their tributaries [1].

Degree of landscape complexes pollution by heavy metals, toxic elements, and natural and artificial radionuclides has been evaluated in the course of study of mountainous zones and intermountain basins on the territory of Tuva and adjacent regions of Mongolia [2]. Contents of artificial radionuclides Cs-137 and Sr-90 in soils, forest falls, and mosses have been determined as one of the ecological-geochemical researches. High density stratification suggests that the territory was repeatedly polluted by radionuclides. The geochemical studies of natural complexes permit us to make a conclusion that the most of the Tuva territory is radiation undangerous for human habitat today. Some regularities of anomalous concentration of toxic elements in natural environments have been revealed. Association of anomalous contents of Hg to the basin complexes was most conspicuous. Mercury anomalies have been studied in details with collecting heavy concentrate samples of large volume. It is established that the elevated Hg concentrates in soils, formed upon prospector's working off planted by forest vegetation, follow regenerated gold-bearing placers which magnetite jets in the near-bedrock part of sand-clay refuse are enriched in products of amalgamation with fine and dispersed gold untrapped earlier. The similar feature of mercuric gold concentration in the lower, near bottom part of the placer-forming dump of adit was established at Kyzyk–Chadr Au–Cu–Mo–porphyric deposit and for a regenerated pay dirt worked out by system of underground exploitation minings in the bed and lower terrace ridge of the Soruglug-Khem river basin [3]. Technologies and technological complexes for recovery of products of amalgamation and free gold untrapped earlier from sand-clay refuse of old prospector's working off at minimum losses of useful components and compliance with international standard of environment protection have been elaborated in Tuvinian Institute for Exploration of Natural Resources.

More than 86 million cubic meters of removal rocks (chrysotile serpentinites) and wastes of asbestos enrichment were accumulated as a result of commercial exploration of richest chrysotile-asbestos loads of the Aktovrak deposit in the Alash-Khemchic interfluve. It is evident that imperfect extraction of chrysolite-asbestos from serpentinites and intense pollution of agricultural lands and basin complexes of the Khemchik river valley by technogenous wastes have serious environmental impacts. A geotechnology of environmentally safe complex hydro-acid processing of chysotile serpentinites and utilization of wastes of asbestos pneumatic enrichment with production of high value commodity products has been elaborated under di-

rection of V.V. Velinskii [4]. These products are ultra-pure silica gel (silica filler) and amorphous SiO_2 for production of fiber glass optics and automobile cord, periclase for lining of open-hearth and steel furnaces, medicine gypsum, unsorted microasbestos for production of superlight heat resistant composite materials, and sulfide-chromite-magnetite concentrate contained elements of platinum group. Technologies for production of magnesium binder being almost as good as Portland cement in quality for use in one-story construction were elaborated in Institute.

A large body of veined mass containing arsenides and sulfides was accumulated in adit dumps of the Khovu-Aksy deposit. More than 1,5 million cubic meters of wastes of hydrometallurgical conversion were stored in burial reservoirs of «Tuvacobalt» Plant. The results of revision works on evaluation of quality and reserves of technological wastes of cobalt production suggest that it is appropriate and required to recovery the wastes. It is established that concentrations of As (3,5–6,4 %), Co (0,14–0,24 %), Ni (0,15–0,29 %), Bi (0,01–0,02 %), Ag (24–98 ppm), Cu (0,14 %), Zn (0,11 %), and Au (60 mg per ton) are very high. The burial reservoirs contained more than 2000 ton of Co are an artificial deposit. Hypochlorite-ammoniac-carbonate method and experimental technological equipment for deep processing of enrichment wastes were elaborated in Tuvinian Institute for Exploration of Natural Resources, Siberian Branch of the RAS. It is possible to organize production of high value commodity products (crude Co, Ni, and Cu, cathode Ag, sulfopone, Co salts, and pigments) and recovery of As as thiosulfide and other nontoxic compounds and preparations [5, 6]. We emphasize that more than 50 thousands ton of As environmentally hazard to the basin of the Elegest and Ulug-Khem rivers are accumulated in the burial reservoirs. Ecological catastrophe can occur at washing out the burial reservoirs by showers or destruction as a result of seismic events and so on.

The geoecological state of human habitat and spatial-temporal distribution of heavy metals and toxic elements can be evaluated and reasons of their accumulation and distribution can be analyzed using methods of Earth's sciences. The experience of conducting of geoecological investigation strongly suggests that it is necessary to combine field, stationary, and distant methods for obtaining information about environment changes in response to natural processes of degradation and human activity.

References

1. Burdin N.V., Lebedev V.I., and Chadamba P.V., Geotechnologies of gravitational recovery of fine and dispersed gold // Nauka i Tekhnologii v Promyshlennosti. – 2002. – no. 2 (9). – P. 81–84.

2. Lebedev V.I., Shcherbov B.L., and Orlova S.V., Toxic metals and radiocesium in environments of Tuva, in: Proceedings of Conference «Ecology and Health». – Kyzyl, 1995. – P. 15–33.

3. Lebedev V.I., Lebedeva M.F., Borovikov A.A., Vas'kov A.S., and Cherezov A.M., Ore gold of the Republic of Tyva: regularities of localization and problems of exploration // Gornyi Zhurnal. – 2000. – no. 11-12. – P. 14–16.

4. Lebedev V.I., Concept of industrial development of the Republic of Tuva, in: About Concept of industrial development of the Republic of Tuva. – Kyzyl, 1997. – P. 7–22.

5. Lebedev V.I., Samdanchap T.Kh., and Kan-ool A.Kh., Efficiency of commercial exploration of polymetallic and rare-earth deposits in Tuva, in: State and exploration of natural resources of Tuva and adjacent regions. Geoecology of environment and society: Proceedings of Tuvinian Institute for Exploration of Natural Resources, SB of the RAS. – Kyzyl, 2002. – P. 78–87.

6. Lebedev V.I., Kotel'nikov V.I., Myshlyavtsev A.V., Lebedeva M.F., Polulyakh Yu.G., and Samdanchap T.Kh., Mineral-resource potential and effective directions of its use prior to 2005, in: State and exploration of natural resources of Tuva and adjacent regions of Central Asia. Geoecology of environment and society: Proceedings of Tuvinian Institute for Exploration of Natural Resources, SB of the RAS. – Novosibirsk, 2000. – P. 75–81.

The work was submitted to the International Scientific Conference «Ecology industrial regions of Russia», London, 20-27, October, 2012, came to the editorial office on 31.08.2012.