

Iron Oxide, Copper (\pm Silver, Gold, PGE) Deposits of the Udokan-Chineysky Ore-Magmatic System, Western Siberia, Russia

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One of the largest ore provinces in Russia is located in the Northern Transbaikalia, Siberian craton. It comprises three unique deposits: Fe-(Au)-Ag-Cu-Udokan, Fe-Ti-V, Co-Ni-Cu-Ag-Au-PGE, and REE + U-Chineysky and U-REE-Ta-Nb Katugin. They were formed in Paleoproterozoic epoch. Total reserves of the Udokan sandstone deposit are as follows: copper – 26.7 Mt and silver - 1056 (Moz), iron >10 Mt and gold - 13 t. The satellites of Udokan (Unkur, Krasnoe, Pravoingamkitsky, Burpala deposits) contain approximately 12 Mt Cu. Another type of copper deposit is represented by Chineysky complex of layered massifs (Chineysky, Maylavsky, Luktursky). The resources of the Chineysky massif are (Mt) 15.7 Cu, 2.1 Ni, 0.3 Co; Au-166 t, Ag -7960 t.

The Chineysky Massif contains Russia's largest V ore resources, hosted within titanomagnetite-rich layers, concentrated in the Magnitny and Etyrko deposits. The titanomagnetite ore reserves were estimated at 2 billion tons. In addition, two large Cu-PGE deposits—Rudny and Kontaktovy—are hosted in the contact rocks of the intrusion and the sandstone floor rocks. A distinctive feature of the Chineysky sulfide ores is their Cu-enriched composition with much lesser amounts of nickel and cobalt (Cu/Ni/Co~76:7:1). The sulfide ores contain up to 355 ppm of PGE and 30 ppm Au, Ag. Three types of sulfide mineralization have been distinguished: (1) endocontact disseminated sulfides, (2) exocontact impregnations in sandstone, and (3) veins of massive sulfides in the exo-contact sandstone. The ores consist predominantly of chalcopyrite, with less abundant pentlandite, pyrrhotite, arsenides, and Co-Ni sulfoarsenides, linneite-group minerals, sphalerite, cubanite, and millerite. In addition, many rare minerals were recognized in the ores, including PGM (e.g., sperrylite, maichenerite, merenskyite).

Different scenarios of relationships between copper sandstones and sulfide mineralization in gabbro were suggested. According to the first model, copper of the Chineysky massif was a result of assimilation of copper sandstones by basic magma, whereas the second one suggests the appearance sulfide mineralization in sandstones from fluids separated from the magmatic chamber. The study of sulfur isotopic compositions of sulfides in copper deposits showed typical enrichment in light isotopes in almost all sandstone-hosted copper deposits of the region ($\delta^{34}\text{S}=-16-27$). The $\delta^{34}\text{S}$ values of the ores of the Chineysky Massif are 0 to 4‰ and are closely similar to those of other Proterozoic copper–nickel deposits worldwide (Gongalsky, 2012). So copper sandstones and magmatic rocks had different sulfur sources.