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Ore-Metasomatic Zonation of the Freedom Area, One of the Ore Centers of the Malmyzh Au-Cu Porphyry Deposit

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The classic model of ore-metasomatic zonation of porphyry deposits is described by world geologists in many studies. As a rule, the deposit includes the central part of relatively high temperature metasomatites (Na-Ca, K, chlorite-sericite, and sericite zones) with Cu-Au-Mo mineralization. A relatively low temperature zone of propylitic metasomatites with a growing content of Zn, Pb, Ag \pm Mn is usually located along the periphery of such a core. The picture of ore-metasomatic zonation in rocks observed on the surface allows us to indirectly assess the erosion level.

The Malmyzh porphyry Au-Cu deposit is located in the Russian Far East in the Khabarovsk Territory, in the middle part of the Amur River. It was opened by international geologists team in 2005-2010. Currently, exploration continues. Mining will start in few years. Resources of Malmyzh deposit are about 5 Mt copper and 300 tons gold.

Regionally, the Malmyzh is based on the western flank of the Sikhote-Alin orogenic belt. The area of the deposit is sea-terrigenous rocks (sandstones, siltstones) that intruded stocks and dikes of intermediate rock (diorite, granodiorite), with some of these stocks linking centers of Au-Cu porphyry mineralization.

"Freedom" prospecting area is one of these centers. Mineralization of this area mainly locates in large body of magmatic-hydrothermal breccias, which framed quartz porphyritic diorite. Orebodies represent stockworks, developed in intensively altered rock. Veins and veinlets have chalcopyrite \pm pyrite-quartz composition, with small quantities of molybdenite, galena, sphalerite, bornite, and chalcocite.

Investigation of ore zonation is based on results of exploration and data of chemical analyses of drill core samples.

It has been established that the most high-temperature central part of orebodies in the Freedom area, consisting of quartz-sericite and less common potash metasomatites, characterized the Mo-Au-Cu mineralization. Peripheries of bodies consist of phyllic metasomatites and lesser propylite with increasing content of silver, arsenic, manganese, lead, and zinc.

The analysis revealed two groups of elements with increase positive relationship: first, copper, gold, and molybdenum and second, lead, zinc, and manganese. A higher correlation was observed between copper and gold (correlation coefficient -0.77).

The established relationships between elements are also displayed in their spatial distribution. Investigation of spreading of ore elements in a lateral direction shows geochemical changes from the centers orebodies to their flank: (Cu-Mo)–(Cu-Au)–(Zn + Mn)-Pb. Also, studies of the distribution of elements in a vertical direction shows that molybdenum, relatively of gold-copper mineralization, takes the high-ore level position. Elements of second group correlation (Pb, Zn Mn) constitute the low-ore level. The gold concentrates on the high-ore level, and the ratio of Cu / Au increases with depth. Also, chalcopyrite/pyrite ratio increases from high- to low-ore level.

The character of lateral and vertical zonation allow suggests a high-ore level of erosion in the Freedom area. There is the prospect of further orebodies with high-Cu (\pm Au) ore on the depth horizons.

The studied features of ore-metasomatic zonation of the Freedom prospecting area correspond with classic models for Au-Cu porphyry deposits in numerous published studies.