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Eastern Tannu-Ola ore district of the Altai-Sayan area, Republic Tuva, Russia: structural features and metallogeny

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The Eastern Tannu-Ola iron-copper-gold ore district is located in the central part of the Altai-Sayan fold area on the Russian-Mongolian border. The district is confined to the large tectonic block of the Upper Yenisei fold system and is composed mainly of Vendian(?)–Ordovician rocks. The rocks are represented by Vendian(?)-Early Cambrian island-arc volcanogenic-sedimentary complexes, metamorphosed to greenschist facies and folded to varying scales. A characteristic feature of the Eastern Tannu-Ola district is the widespread development of massifs of intrusive rocks emplaced into the volcanogenic-sedimentary rocks. Such massifs comprise Late Cambrian diorites, granodiorites, granites, and plagiogranites. Ordovician granite-leucogranite bodies and Early Devonian granites are less common.

Occurrences of iron, gold, and copper are known within the Eastern Tannu-Ola ore district. Gold mineralization includes gold-bearing skarns and gold-sulfide-quartz type ores. Gold formation is related to the Late Cambrian granitoid massifs. Evidence of gold-bearing polymetallic mineralization, associated with the Early Cambrian volcanics is recognized in the western part of the district. In addition, there are identifiable features of auriferous porphyry Mo-Cu mineralization within the district that are associated with with the Ordovician and Early Devonian granites and leucogranites. Gold mineralization is controlled by fractures in contact zones and above the roofs of the granitoid massifs within the Early Cambrian country rocks. Indirect indicators of gold mineralization are concentrated in the southern and northeastern parts of the ore district, where the Despenskiy and Mezhegeiskiy iron-copper-gold ore clusters, respectively, are located. These clusters are characterized by similar geological structures, ore controls, mineralogies, and genetic factors. The Irbiteiskiy gold-bearing polymetallic cluster is first distinguished here in the western part of the region. Polymetallic mineralization (Cu, Pb, Zn, Ag) is confined to metasomatic alteration zones in Early Cambrian dacites and rhyolites.

The Despenskiy and Mezhegeiskiy gold ore clusters are aligned in a relatively E-W direction and confined to the South Tannu-Ola and Bai-Dagskiy faults, respectively. A characteristic feature of the geology of both clusters is the presence of numerous high- and low-order faults of various orientations and ages. Brecciated and fractured zones in volcanic-sedimentary country rocks and the granitoids provided a favorable environment for focusing of hydrothermal solutions and generation of large vein-veinlet and stockwork gold-sulfide-quartz zones. Numerous zones of skarn, sulfides, epidote, silicification, sulfide-bearing quartz veins, and veinlets with Au, Cu, Pb, and Ag mineralization are observed in endocontact and exocontact zones. Gold mineralization is localized in the contact zones of small massifs, mainly plagiogranites and granites, and in wallrock basalts, limestones, and tuffs of basic and acid composition. The gold content is 1-4 g/t, with the thickness of orebodies from 3 to 20 m. Gold was identified in quartz veins, silicified skarns, alluvial deposits, and brecciated rocks, as well as in polished sections from many of these. The gold grains are 0.01 to 3-4 mm in diameter. Typically, there is a wide range of gold fineness from 790 to 1000 ‰, although most gold has a fineness of 820-840 ‰ or 870-920 ‰. Most commonly the gold contains 0.1 to 19% silver, and some grains have 0.1-0.4 % mercury and 0.1-0.3 % copper. The

gold mineralization in the east of the cluster is characterized by its association with tellurium minerals that include hessite, altaite, and petzite.

Thus, based on the available data, the Eastern Tannu-Ola ore district is regarded as one of the most promising for resources of gold, copper, and polymetallic mineralization.