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New data on geochemistry and mineralogy of massive ores from Noril'sk deposits, Siberia, Russia

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The PGE-Cu-Ni Noril'sk deposits are located inside the Siberian Trap Province and related to thin gabbro intrusions. The mechanisms of the formation of huge sulfide deposits in the surrounding rocks are still the subject of debate. Some researchers believe that out-contact ores are formed by the filter-pressing of sulfide melt from gabbro into sedimentary rocks, while other geologists suggest that the crystallization of ores originates from self-serving sulfide melt, which breaks away from the silicate portion of magma during crystallization. To understand genesis of massive ores, we have studied chemical and mineralogical composition of several veins from the Talnakh (Southern-2 orebody) and Kharaelakh deposits (Northern 3 and 4 orebodies) and coexisting disseminated ores. A filter-pressing mechanism is suggested to have played a significant role in massive ore formation. These two main intrusions were formed by several pulses of basaltic melts.

The Southern-2 orebody from the SW branch of the Talnakh intrusion consists of essentially pure tetragonal chalcopyrite (+bornite+cubanite), while other bodies of this deposit have a substantial pyrrhotite composition. We have studied 54 samples from Southern-2 orebody collected from cores EM-1, EM-8, and EM-6 at the Majak mine. These ores are unique and significantly Cu- and PGE-rich. The Cu/Ni ratio varies from 5 to 10. The average ΣPGE is about 100 ppm, reaching up to 5000 ppm in two samples. Not only do massive ores have high PGE contents, but disseminated ores are also unusually enriched in Pt and Pd (up to 140 ppm). Twelve PGE minerals were found in the investigated chalcopyrite ores: tetraferroplatinum, majakite, palladoarsenide, guanglinite, stillwaterite, polarite, zvyagintsevite, plyumbopalladinite, rustenburgite, atokite, stannopalladinite, and Au-, Cu- and Ag-bearing minerals. The Pd_5Pb_3 phase is common in mineral parageneses, which is significant for identifying new minerals. Major minerals in disseminated ores are the same as in massive ores: chalcopyrite, bornite, and cubanite. Massive ores from the NW branch of the Talnakh intrusion were studied in drill core OUG-2 that penetrated into 20 m of sulfide. Ores are represented by a chalcopyrite-pyrrhotite assemblage, Cu/Ni is close to 1, and ΣPGE = 6-8 ppm.

The Kharaelakh intrusion contains several orebodies, with the most famous being X-O with a zoned structure (from center to periphery): talnakhite-cubanite-pyrrhotite. We have studied the Northern 3 and Northern 4 orebodies (drill cores RT-8, RT-7, RT-30, RT-101, RT-102). The first of these orebodies consists mainly of talnakhite and pyrrhotite, with low ΣPt + Pd (3-4 ppm). High Rh contents (up to 8 ppm) are found in the Northern 3 orebody. The Northern 4 body has a chalcopyrite-pyrrhotite composition. Its distinctive feature is the presence of a large amount of bornite.

In conclusion, the high positive correlation between chemical and mineralogical compositions of massive and associated disseminated ores in the Talnakh and Kharaelakh intrusions is evidence of their origin as a result of a filter-pressing mechanism. Also, the Southern 2 orebody composition when compared with the ones from the northeastern branches of the Talnakh intrusion demonstrates their formation from individualpulses of magma.