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PGE tellurides and Cu-Ni sulfide mineralization in gabbroids of the NW Mongolia (Tsagaan-Shuvuut mountains)

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Recent years, scientists studying the history of the Central Asian fold belt have a great interest to identify the features of Devonian mafic magmatism. Volcanic and subvolcanic basalt and gabbro bodies are widespread in the Altai-Sayan area (the border of Russia and NW Mongolia). Our research group conducted expeditions that allowed to find a high-magnesian differentiated gabbroid bodies in one of which is found a zone with sulfide Cu-Ni-PGE mineralization.

The ores are of two types: disseminated and large differentiated sulfide droplets diameter of 5-30 mm. In the disseminated ores dominated by pyrrhotite, chalcopyrite, often in close association with oxide phases - spinel, titanomagnetite and ilmenite. Droplets are more varied mineral composition and, moreover, complicated by the different exsolution structures. In all studied droplets pyrrhotite is the major phase, located mostly on one side of the droplet. In some cases, pyrrhotite in the marginal zone of the droplets has a skeleton structure with inclusions of oxide and silicate minerals. The central part of the droplets mainly composed of pentlandite, and the side opposite to pyrrhotite consists of chalcopyrite. Chalcopyrite in addition fills the cracks in pyrrhotite and pentlandite.

PGM have been discovered in polished sections in reflected light, and then examined by Tescan SEM with EDS attachment. The grain size ranged from 5 to 50 microns, they are euhedral and have been found only in large sulfide droplets, predominantly in their marginal zones. These minerals are represented exceptionally tellurides with a considerable admixture of Bi (up to 9.9 at.%). PGM were found in all three major phases of the droplets: in chalcopyrite, pyrrhotite and pentlandite, and there is a pattern of changes in the composition of these minerals depending on the host-phase. PGM from the contact zones of pentlandite-chalcopyrite segregations are moncheite-merenskyite solid solution with Pt/Pd ratio close to 1 $(Pt_{0.49}Pd_{0.48}Ni_{0.03}Fe_{0.02})_{1.02}(Te_{1.71}Bi_{0.26})_{1.97}$. In pyrrhotite-hosted PGM grains, Pt/Pd ratio is decreased to 0.64-0.80 $(Pd_{0.54}Pt_{0.43}Ni_{0.02}Fe_{0.03})_{1.02}(Te_{1.73}Bi_{0.23})_{1.96}$, - thus increasing the content of merenskyite component. And finally, the minimum values of Pt/Pd ratio (0.6) in the merenskyite $(Pd_{0.49}Pt_{0.29}Ni_{0.09}Fe_{0.05})_{0.92}(Te_{1.80}Bi_{0.23})_{2.03}$ are characteristic for grain which is localized in the massive chalcopyrite.

In one of the sulfide droplets in close association with highly nickeliferous pentlandite and chalcopyrite, found grain of Pt-Ni telluride atypical composition differing the absence of palladium and a small admixture of rhodium $(Ni_{0.43}Pt_{0.30}Rh_{0.02}Fe_{0.01})_{0.76}(Te_{1.93}Bi_{0.29})_{2.22}$. Most of the researchers involved in study of solid solutions merenskyite-moncheite-melonite, note that these compositions not found in nature, and may have only limited miscibility between melonite and moncheite. In this case, it is possible that the presence of bismuth, has allowed this mineral form. In recalculation composition formula units in the scheme MX_2, shows a strong non-stoichiometric composition, but as (Te+Bi)/(Pt+Ni) ratio is 3.01, we assume the possibility of the existence of a phase $(Pt,Ni)(Te,Bi)_3$, and recalculate the composition of this mineral as a $(Ni_{0.58}Pt_{0.41}Rh_{0.03}Fe_{0.02})_{1.04}(Te_{2.57}Bi_{0.39})_{2.96}$.