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Awaruite (Ni_3Fe) as a platinum-group elements concentrator: Preliminary data

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The most famous of natural occurring iron-nickel alloys are kamacite, taenite and tetrataenite, forming iron meteorites. Normally, they have significant platinum-group elements (PGE) content being a result of high siderophile behaviour of the latter. In spite of native iron and nickel having been described in terrestrial rocks, the most abundant Fe-Ni mineral in Earth's crust is awaruite (Ni_3Fe). Current work represents the preliminary results of testing the ability of awaruite to concentrate PGE.

Awaruite is a widespread accessory mineral of ultramafic complexes. Its formation is usually assessed to the serpentinization of olivine which produces reductive fluid. The latter reacts with nickel sulfides and produces awaruite. Several reports of awaruite occurring together with platinum-group minerals (PGM) are present in the literature. In the Ural-Alaskan type complexes of Koryak Highlands (Far East Russia), such cases are abundant. Textural investigations of such complexes discovered a diverse array of serpentine–related mineralization, including isoferroplatinum in chlorite matrix, isoferroplatinum–amphibole intergrowths, and a wide range of PGE, Fe and Cu alloys formed in serpentine veinlets together with awaruite and base metal sulfides. This provides evidence of the relation between awaruite and platinum mineralization.

LA-ICP-MS has been used to reveal the PGE content in awaruite and coexisting sulfides. Grains from the placers related to the Galmoenan complex of Ural-Alaskan type were used for this study. The analysis revealed that sulfides may bear significant PGE admixture. Unexpectedly, the most abundant impurity is Os. Its content varies from 0.7 to 538 ppm. The shape of the time-resolved spectra of some samples indicates the possible presence of solid inclusions which concentrate Os. However, most of them, including those with 538 ppm Os, exhibit plain time-resolved spectra suggesting homogeneous Os distribution. Contents of other PGE are moderate: up to 8.3 ppm Pt, 1.4 ppm Pd, 4.3 ppm Ru, 0.25 ppm Rh and 2.6 ppm Ir.

Some awaruite grains also show relatively high Os content (up to 89 ppm), but time-resolved spectra of them exhibit clear evidence of mineral inclusions presence. In one case, Os spike coincides with the S spike, suggesting that Os is incorporated into the sulfide phase. In the case of spikeless spectra, Os content is always below the detection limit (b.d.l.). Rhodium content also is always b.d.l., while Ru content reaches 0.44 ppm, Ir – 0.08 ppm, and Pt – 0.03 ppm. The only element explicitly showing significant and homogenous presence in the awaruite is Pd, that content reaches 5.8 ppm in one analysis and 0.2–1.1 in many others.

These data indicate that in the studied case, awaruite mineralization is accompanied by the formation of PGM, while its role as a direct PGE concentrator is moderate and restricted to the first tenths ppm of Ru and Pd. Sulfides have shown much more impressive ability in concentrating PGE. Their selective enrichment in Os is a novelty and demands explanation.

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