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Nanostructure of platinum group minerals in Ural-Alaskan-type intrusions: From magmatic to hydrothermal environments

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The nanostructure of PtFe, PtFeCu and IrOs alloys from magmatic to subsolidus-hydrothermal environments were studied using transmission electron microscope facilities. The magmatic PtFe alloys form rare 2-3 μm inclusions in chromite phenocrysts in Uralian volcanic ankaramite [1] which could represent a parental melt for Ural-Alaskan-type intrusions. According to HRTEM data these alloys demonstrate a single crystal structure with spinodal exsolution close to top of a solvus. Guinier-Preston zone dislocations were distinguished and indicate the phenomenon of an age hardening of native minerals. The structural features of these PGM support their high-T origin. Quite different nanostructures were recognized for PGM in the matrices of Pt-rich chromitites in Ural-Alaskan-type intrusions. Chromite schlieren cut the dunite and demonstrate a late formation relative to the ultramafic host rocks. The amount of precious minerals within chromitite pods approaches 40-50%, ruling out their enrichment by magmatic processes. The PtFeIr and PtFeCu alloys studied are represented by aggregates of Pt and Ir-rich nanoparticles 2-20 nm in size, embedded within an amorphous Mg-Si-(H_2O) matrix. Pt-rich nanoclusters of similar size were found in serpentine from the ore cement. Sometimes the aggregates of nanoparticles, having colloform textures, fill the patches along the PGM grain boundaries and cracks. The results allow to conclude that strong Pt enrichment well known in epigenetic chromitites was related to subsolidus and hydrothermal redistribution of PGM nanoparticles by residual magmatic fluid, at the latest stages of plastic deformations of dunite during the semisolid tectonic emplacement of Ural-Alaskan-type intrusions. The data reported suggest that the principal forms of Pt and Ir in the melts were in the form of nanoparticles, and that enrichment took place via tectonically induced migration of late Pt-chromite-laden magmatic fluids.

[1] Kamenetsky et al. (2015) *Geology*, **43**, 903–906.