

Nanomineralogy of the highly siderophile elements in the SCLM: implications for ore genesis

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Nanoparticles (NPs) of the highly siderophile elements (PGE: Os, Ir, Ru, Rh, Pt, Pd, and Au) are increasingly being documented from exposed fragments of the subcontinental lithospheric mantle (SCLM) – i.e., peridotite massifs and xenoliths. The analysis of these HSE-bearing NPs using a wide range of techniques (including microbeam synchrotron radiation X-ray fluorescence analysis, FEG-SEM and LA-ICPMS) has led to a general thought that they formed during subsolidus re-equilibrium of base-metal sulfides originally saturated with HSE. Recent observations with High-Resolution TEM (HRTEM) of thin lamellas of base-metal sulfides performed using Focused Ion Beam (FIB) seems to confirm this hypothesis. Thus, [1] have reported NPs of Pt-Fe alloys showing similar orientation than their pyrrhotite-pentlandite hosts from a peridotite xenolith from the Bultfontein kimberlite, South Africa. However, these observation contrasts with the fact that HSE-bearing NPs (including native gold, Pt-bearing alloys and sulfides) hosted in metasomatic silicate glasses and base-metal from Patagonian mantle xenoliths. In the latter case the HSE-bearing NPs do not show orientation but significant misorientation and no structural match with the host mineral, indicating an earlier crystallization of the HSE-bearing NPs. Furthermore, inclusions of gold-bearing nanominerals found in within plastically deformed mantle-derived olivine from the Lherz peridotite [2] seems to confirm that HSE-bearing nanoparticles may be stable in high-temperature silicate and sulfide melts. This observation that has support in recent experimental work led us to suggest that fractionation, concentration and transport of the HSE in melts take place by physical instead chemical processes. This has impact in our current understanding of the geochemistry of HSE in the SCLM itself but also in the generation of ortomagmatic PGE deposits originated by crystallization in the continental crust of HSE-bearing melts derived from the SCLM. The accepted models for PGE concentration in these types of ores is based nearly exclusively on their chemical high sulfide/silicate partition coefficient, an assertion that must be reevaluated.

[1] Wainwright et al. (2016). *Earth Planet Sci Lett* **447**, 60-

[2] Ferraris & Lorand (2014) *Phys Chem Minerals* DOI 10.1007/s00269-014-0706-9

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