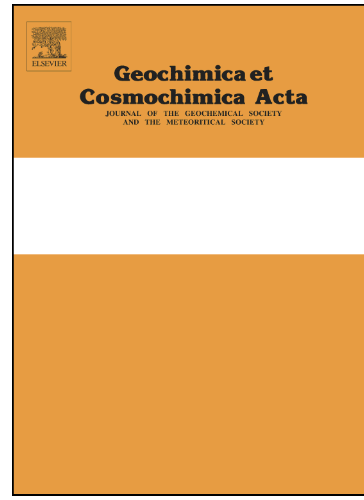

Fractionation of Rhenium from Osmium during noble metal alloy formation in association with sulfides: Implications for the interpretation of model ages in alloy-bearing magmatic rocks

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Fractionation of Rhenium from Osmium during noble metal alloy formation in association with sulfides: Implications for the interpretation of model ages in alloy-bearing magmatic rocks

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Abstract

Although Earth's continental crust is thought to derive from melting of the Earth's mantle, how the crust has formed and the timing of its formation are not well understood. The main difficulty in understanding how the crust was extracted from the Earth's mantle is that most isotope systems recorded in mantle rocks have been disturbed by crustal recycling, metasomatic activity and dilution of the signal by mantle convection. In this regard, important age constraints can be obtained from Re-Os model ages in platinum group minerals (PGM), as Re-poor and Os-rich PGM show evidence of melting events up to 4.1 Ga. To constrain the origin of the Re-Os fractionation and Os isotope systematics of natural PGM, we have investigated the linkage between sulfide and PGM grains of variable composition via a series of high-temperature experiments carried out at 1 bar. We show that with the exception of laurite, all experimentally-produced PGM, in particular Pt_3Fe (isoferroplatinum) and Pt-Ir metal grains, are systematically richer in Re than their sulfide precursors and will develop radiogenic $^{187}Os/^{188}Os$ signatures over time relative to their host base metal sulfides. Cooling of an PGM-saturated sulfide assemblage shows a tendency to amplify the extent of Re-Os fractionation between PGM and the different sulfide phases present during cooling. Conversely, laurite grains (RuS_2) are shown to accept little to no Re in them and their Os isotope composition changes little over time as a result. Laurite is therefore the PGM that provides the most robust Re-depletion ages in mantle lithologies. Our results are broadly consistent with observations made on natural PGM, where laurites are systematically less radiogenic than Pt-rich PGM. These experimental results highlight