Os isotope systematics of Os-bearing alloys and sulfides from continental and oceanic mantle: new data

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The advantage of the Re-Os system, applied to Os-rich platinum-goup minerals (PGMs), is that PGMs contain Os as a main or trace element, while at the same time almost lack Re. Consequently, primary Os-rich PGMs (e.g., laurite-erlichmanite series (RuS_2-OsS_2) and Os-Ir-Ru alloys), frequently the earliest minerals in ultramafic mantle rocks, are (1) the best tracers of mantle melting events, and (2) promising targets to constrain initial $^{187}Os/^{188}Os$ ratios of different mantle environments.

This contribution summarizes the extensive data set of Os isotopic compositions of bedrock and detrital Ru-Os sulfides and Os-Ir-Ru alloys derived from continental and oceanic ultramafic complexes. Os isotopic composition of PGMs was evaluated by negative thermal ionization mass-spectrometry (NTI-MS) and laser ablation (LA) attached to multiple collector inductively coupled plasma mass spectrometry (MC-ICP-MS). PGMs were extracted from bedrock samples using the innovative non-destructive concentration teqnique at NATI Research JSC (St. Petersburg, Russia).

The range of $^{187}Os/^{188}Os$ values in Os-bearing alloys and sulfides from chromitite and dunite at Kondyor, Inagli and Guli (Siberian Craton, Russia) show a relatively narrow range of 'unradiogenic' $^{187}Os/^{188}Os$ values, indicative of a subchondritic mantle source of PGE (e.g., 0.1230-0.1253, n=135, NTI-MS and LA MC-ICP-MS data). In contrast, Ru-Os sulfides of podiform chromitites from ophiolitic mantle sections at Shetland (U.K.), Kraubath and Hochgrössen (Austria) yield a very wide range of subchondritic $^{187}Os/^{188}Os$ values (0.1158 ± 0.0015 to 0.1244 ± 0.0005, n=27, NTI-MS and LA MC-ICP-MS data), which is almost identical to that of Os-Ir-Ru alloys (e.g. 0.1094-0.1252, n=45, NTI-MS data) derived from the Kunar and Ust'-Bel'sky dunite-harzburgite complexes (Russia). 'Radiogenic' $^{187}Os/^{188}Os$ (0.1302 to 0.1321) values, indicative of a suprachondritic source, are characteristic of osmium alloy from clinopyroxenite at Kondyor and Ru-Os sulfides from banded chromitite within the Moho transition zone at Kraubath.

The Os isotopic system of Os-bearing alloys and sulfides from the mantle sections of ophiolites provides isotopic evidence for locally restricted but temporally extended melting events in parent ultramafic protoliths. This variability is probably controlled by deep-geodynamic processes implying that source rocks in the residual mantle have a more complex geological history that it is frequently assumed.