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New insights on highly siderophile and chalcophile element behaviour in abyssal-type and supra-subduction zone mantle sections of the New Caledonia ophiolite

Arianna Secchiari (1,2), Harry Becker (1), Philipp Gleissner (1), Chunhui Li (1,3), Alessandra Montanini (2), and Delphine Bosch (4)

(1) Institut für Geologische Wissenschaften, Freie Universität Berlin, Germany, (2) Department of Chemistry, Life Sciences and Environmental Sustainability, University of Parma, Italy , (3) Department of Geophysics and Planetary Sciences, University of Science and Technology of China, Hefei, China, (4) Géosciences Montpellier, Université de Montpellier, France

The New Caledonia Ophiolite hosts one of the largest obducted mantle sections worldwide. The mantle section is mostly composed of harzburgite and dunite, however, minor serpentinized spinel and plagioclase lherzolites also occur in the northern part of the island. The major and trace element and Sr-Nd-Pb isotopic composition of the harzburgites can be reconciled with a complex history of multiple melting episodes followed by localized overprint by fluids and/or hydrous melts in a supra-subduction zone setting, while the lherzolites are similar to abyssal-type peridotites (Secchiari, 2016).

As the harzburgites were not altered by low-temperature processes and apparently reflect the transition from 'normal' oceanic lithospheric mantle to supra-subduction zone mantle, this rock association offers the unique opportunity to study the behaviour of highly siderophile (HSE: Os, Ir, Ru, Rh, Pt, Pd, Au, Re) and chalcophile elements (S, Se, Te) in mantle from these different geodynamic settings.

The lherzolites are homogeneous with chondritic to slightly suprachondritic initial $^{187}Os/^{188}Os_i$ (0.1273-0.1329). They display gently sloping primitive mantle-normalized HSE patterns with increasing depletion towards Re and Au and Se-Te concentrations, similar to variably depleted upper mantle peridotites. Sulfur contents (202-1268 ppm) were likely increased by serpentinization and seawater-related alteration. The HSE and S, Se, Te abundances of the lherzolites can be explained by sulphide melt-silicate partitioning during partial melting, melt infiltration and mixing of different generation of sulphides.

Harzburgites can be grouped in two different sub-types. Type A harzburgites ($+9.3 \leq epsilonNd_i \leq +13.3$) show subchondritic $^{187}Os/^{188}Os_i$ (0.1203-0.1254), coupled with low Os concentrations (0.55-1.51 ppb) and low Re/Os. These harzburgites display fractionated, Os-Ir-Ru–enriched patterns, with increasing depletion towards Au and Re and a pronounced positive spike of Pt. S, Se and Te are often at, or below, the detection limit. These features can be ascribed to sulphide exhaustion after high melting degrees and Os-Ir-Ru and Pt-Ir alloy stabilization.

Type B harzburgites ($+0.8 \leq epsilonNd_i \leq +4.0$) show chondritic to suprachondritic measured $^{187}Os/^{188}Os$ (0.1273-0.1524), very low Os and Ir concentrations (0.003-0.277 ppb) and suprachondritic and highly variable $^{187}Re/^{188}Os$ (2-30). HSE have "melt-like" patterns with strongly fractionated Os-Ir-Ru (Os_N/Ru_N=0.02-0.46) coupled with strongly negative Pt anomalies and positive Au spikes. S, Se, Te are close to or below the detection limit. Such element patterns have never been identified in mantle peridotites before. We interpret these features as resulting from localized modification of type-A harzburgites after interaction with subduction-related oxidizing fluids or S-undersatured hydrous melts, which caused the breakdown and dissolution of sulphides and alloys, preferentially removing Os, Ir, Pt and elements hosted by mantle sulphides.

The present work indicates that some of the features displayed by arc lavas such as positive Pt spikes may be complementary to the composition of sub-arc mantle sources.

Secchiari A., 2016. "Geochemical and Sr, Nd, Pb isotope investigation of the New Caledonia ophiolite". Plinius, 42, 94-100, DOI: 10.19276/ plinius. 2016. 01012