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Partitioning of highly siderophile elements (HSE) in very refractory peridotites

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In order to identify the mineral(s) concentrating the HSE (Os, Ir, Ru, Rh, Pt, Pd, Au and Re) in refractory peridotites and therefore better understand the behavior of HSE and their radiogenic isotopes during partial melting, 3 spinel harzburgites from the Lherz massif (French Pyrenees) were studied using EMP and SEM coupled with ID-ICP-MS analyses of whole-rock and mineral separates. These harzburgites (0.3-1.22 wt.% Al_2O_3) show S contents ranging between 100 and <5 ppm [1].

Whole-rock HSE contents are 2-5 ppb for Ir, Ru and Pt, 0.2-2 ppb for Pd and 15-70 ppt for Re. The CI-chondrites normalized HSE patterns show a progressive depletion from Ir and Ru to Pt, Pd and Re (Pt_N/Ir_N: 0.7-0.77; Pd_N/Ir_N: 0.08-0.52; Re_N/Ir_N:0.05-0.23, N: CI-chondrites normalized after [2]) consistent with their highly refractory character. HSE abundances of silicates and spinel range from <5 ppt up to 23 ppb. Olivine and spinel are the richest in HSE (e.g. 0.5-1.2 ppb Os, Ir; 1.1-3.1 ppb Pt, 0.2-0.7 ppb Pd and 0.4-23.4 ppb Os, 0.7-4.3 ppb Ir, 2.3-13.1 ppb Pt, 0.2-7.1 ppb Pd, <5-340 ppt Re, respectively). Orthopyroxene and clinopyroxene have similar HSE concentration ranges, 10 to 1000 times lower than olivine and spinel (e.g. <10 ppt Os, Ir; <400 ppt Pt; <150 ppt Pd and <350 ppt Os, <210 ppt Ir; 460-1345 ppt Pt, <30 ppt Pd; <5 ppt Re, respectively).

Because of their low HSE contents and/or their low modal abundances, silicates and spinel only account for 20-30% of the whole-rock HSE abundances of Pyrenean harzburgites. Therefore the mineral(s) mainly controling HSE in very refractory peridotites are isolated HSE-rich microphases such as HSE alloys or refractory sulfides, not identified so far but likely occuring at the sub-micron scale. Because of their refractory character and their potential inert nature, these microphases and their potential survival in the convecting mantle may be the key to understand how the $^{187}Os/^{188}Os$ heterogeneities of the upper mantle can persist on longtime scales [3,4].

References

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