HSE and ^{187}Os-^{186}Os in mantle samples: Key tools to constrain planetary processes?

A. LUGUET[1]*, J.-P. LORAND[2], D.G. PEARSON[3]
AND G.M. NOWELL[3]

[1]Steinmann Institut, Universität Bonn, Germany
(*correspondence: ambre.luguet@uni-bonn.de)
[2]Mineralogie-Cosmochimie, CNRS-MNHN, Paris, France
[3]NCIET, Earth Sciences Dpt, Durham University, UK

Highly Siderophile Element (HSE: Os, Ir, Ru, Rh, Pt, Pd, Re) systematics and Os isotope signatures of mantle samples are potential key tools to constrain planetary processes such as metal-silicate differentiation, late accretionary history or core-mantle interaction [1]. The signatures provided by these tracers are assumed to be primary and free from magmatic overprinting. Is this really the case? The answer is NO!

In the Earth's mantle, HSE are concentrated in base-metal sulfides (BMS), which have a low melting temperature, a high wetting capacity and are important metasomatic agents of the mantle [1]. Peridotites show evidences of magmatic overprinting. Depending on P-T-FeO-fS_2-fO_2 parameters, magmas en-route to the surface precipitate metasomatic BMS within the mantle column, leading to significant S, Pd±Pt±Rh enrichments at the sample scale [1-4]. The resulting high Pd/Ir ratios can thus not be used to constrain the P-T conditions of metal-silicate differentiation or the composition of the late veneer. Metasomatic BMS may also have suprachondritic Pt/Os ratios, especially when related to pyroxenite and eclogite-derived melts. Over the few Gy that crust recycling operated, such high Pt/Os ratios will evolve toward radiogenic ^{186}Os/^{188}Os ratios, well in excess of any outer core composition used for core-mantle interaction modelling [5]. The radiogenic ^{186}Os/^{188}Os ratios of plume lavas can be explained by melting of a peridotite enriched in such metasomatic BMS [5] and thus can not be used as unique geochemical evidence for core-mantle exchange.

In any case, the use of HSE and Os isotopic signatures to constrain planetary processes requires an understanding of the origin of BMS and HSE-Os signatures via combined studies of BMS petrology, HSE and Os isotopes.

[1] Lorand *et al*. (2008a) *Elements* **4**, 247-252. [2] Luguet *et al*. (2003) *GCA* **67**, 1553-1570. [3] Lorand *et al*. (2008b) *Chem. Geol*. **248**, 174-194. [4] Lorand *et al*. (2009) *Terra Nova* **21**, 35-40. [5] Luguet *et al*. (2008) *Science* **319**, 453-456.

Adsorption of ^{90}Sr and ^{239}Pu on natural colloïds of alpine soil solution

FABIENNE LUISIER[1]*, PHILIPP STEINMANN[2],
JEAN-LUC LOIZEAU[3], MICHAEL KRACHLER[4],
HANS-RUDOLF PFEIFER[5] AND PASCAL FROIDEVAUX[1]

[1]IRA, CHUV, Grand Pré 1, 1007 Lausanne, Switzerland
(*correspondence: Fabienne.Luisier@chuv.ch)
[2]FOPH, 3097 Liebefeld, Switzerland
[3]Institute F.-A. Forel, University of Geneva, 10 Route de Suisse, 1290 Versoix, Switzerland
[4]Institute of Geosciences, Im Neuenheimer Feld 236, 69120 Heidelberg, Germany
[5]CAM, University of Lausanne, 1015 Lausanne, Switzerland

Fall-out radionuclides (Pu and ^{90}Sr) are expected to migrate slowly within the soil column. Based on published evidences of colloidal migration in natural water, we hypothesize that the migration of Pu and ^{90}Sr can be enhanced if they are adsorbed on colloids.

Method

Three soils have been selected in the Central Alps of Switzerland. Plastic suction cups were installed at three depths in order to collect the soil solution. Part of the soil solution was ultrafiltrated at 10 kDa. TOC, Ca, Fe, Al, and Si concentration were measured in all fractions. Pu was measured using sf-ICP-MS and ^{90}Sr was measured through the decay of it daughter ^{90}Y in a proportional counter, both after careful radiochemical separation.

Results

Activities of ^{239}Pu between 0.01 and 0.08 mBq/L were measured in the bulk soil solutions. 40-90 % of the ^{239}Pu was associated with colloids >10 kDa. Moreover, we observed a significant correlation between the activity of Pu and the degree of degradation of the organic matter present in the solution. Between 4 and 16 mBq/L of ^{90}Sr were measured in the bulk soil solutions. The ^{90}Sr was generally not detectable in the colloidal fraction, but measurable in the truly dissolved fraction <10 kDa indicating that the Sr is mainly present as truly dissolved species in the soil solution.