Search for Early Archean mantle lacking the late-veneer component

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The overabundance of highly siderophile elements (HSEs) in the modern terrestrial mantle, relative to predicted composition is frequently attributed to the late influx of chondritic materials (late veneer) after the efficient stripping of HSEs to the metallic core. Although this model is not universally accepted due to insufficient knowledge of metal-silicate partitioning under high P-T conditions, broadly chondritic ratios of HSEs in fertile peridotites from a variety of tectonic settings provide strong support for the late veneer model.

A recent discovery of ^{182}W enrichments in ~3.8 Ga crustal rocks from Isua, West Greenland suggests that this area of Earth's surface has escaped addition of the late veneer, and remained unaffected by subsequent replenishment [1]. Furthermore, possible secular increase of HSE abundances for the komatiite source has been attributed to the progressive pollution of the HSE-poor deep mantle by the late veneer component between 3.5 and 2.9 Ga [2]. These studies raise the possibility that ~3.8 Ga ultramafic rocks from West Greenland and Labrador, Canada, can be used to establish HSE abundances of the Earth's mantle before the arrival of the late veneer.

We present HSE abundances and Re-Os systematics for a set of ultramafic rocks from Saglek-Hebron area of northern Labrador. Based on field and geochemical data, they were classified into two suites: residual peridotites occurring as tectonically-emplaced slivers of lithospheric mantle, and metakomatiites comprising mostly pyroxenite layers in supracrustal units. The samples analysed here have been investigated previously for Sm-Nd and Pb-Pb systematics, supporting their >3.8 Ga formation [3, 4]. Thus, the primary aim is to test whether the meta-peridotites and komatiites record peculiar HSE signatures of the early Archean shallow and deep mantle, respectively.

The two suites display contrasting HSE patterns that are consistent with their inferred protoliths. The harzburgitic to dunitic metaperidotites are typically marked by depletion of Pt, Pd and Re relative to Os, Ir and Ru, resulting from extensive melt extraction. In contrast, metakomatiites show smooth patterns with gentle positive slopes (except for Re). Overall, in terms of HSE patterns and abundances, both suites do not differ from their late Archean equivalents, such as the harzburgitic to dunitic xenoliths from North Atlantic Craton [5] and the 2.7 Ga Belingwe/Abitibi komatiites [6]. Moreover, a rare lherzolitic sample shows a very similar HSE pattern to that of PUM estimate [7]. These observations suggest that 3.8 Ga mantle has been influenced by the late veneer. We will discuss the possible reasons for the decoupling between W isotope evidence from crustal rocks and HSE signatures in mantle materials.

[1] Willbold *et al.* (2011) *Nature* **477**, 195-198. [2] Maier *et al.* (2009) *Nature* **460**, 620-623. [3] Collerson *et al.* (1991) *Nature* **349**, 209-214. [4] Wendt & Collerson (1999) *Precamb. Res.* **93**, 281-297. [5] Wittig *et al.* (2010) *Chem. Geol.* **276**, 166-187. [6] Puchtel *et al.* (2009) *GCA* **73**, 6367-6389. [7] Becker *et al.* (2006) *GCA* **70**, 4528-4550.

Coupling between separative techniques and inductively coupled plasma mass spectrometry for lanthanides separation and on-line isotope ratio measurements

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The precise lanthanide (Nd, Sm, Eu) isotope composition is of major interest in geosciences (geochronology, erosion studies, paleo-circulation reconstruction…) as well as in nuclear industry (determination of nuclear fuel burn-up, management of the spent fuel nuclear fuel…). Direct determination of lanthanides by mass spectrometry is hampered by isobaric interferences and so previous chemical separations are then required before mass spectrometric measurements. In most cases isotope ratio are determined off-line after chemical separation processes.

We would like to present here the simultaneous online determination of some lanthanides (Nd, Sm, Eu) isotopic composition in nuclear samples by the hyphenation of two separative techniques with inductively coupled plasma mass spectrometry.

The first one is the coupling between liquid chromatography and ICPMS [1]. The LUNA SCX column which includes benzene sulfonic acid group and 2-hydroxy-2-methylbutyric acid as a complexing agent in eluent solution were used for the separation. The column has been directly coupled to ICPMS. Data acquisition and correction of mass bias by different approaches are discussed.

The second one present the development and conception of a microchip for the lanthanides separation. This microchip is based on the isotachophoresis (ITP) separation of lanthanides and was directly coupled to an MC-ICPMS for the on-line measurements of Nd and Sm isotopic ratio [2]. This is the first time that such a coupling is performed and the feasibility is demonstrated in this study. These on-line methods are a great challenge related to the limited signal duration [3] but a very attractive approach to decrease the sample size and the sample preparation time. Such a coupling and further applications could be envisaged for geochemical applications.

[1] Bourgeois M. et al. (2011) *JAAS* **26**, 1660-1666. [2] Vio et al. (2012) *JASS* accepted, in press. [3] Günther-Leopold et al. (2004) *Anal. Bioanal. Chem.* **378**, 241-249.