Rhodium, gold and other highly siderophile element abundances in terrestrial peridotites

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The abundance excess and approximately chondritic proportions of highly siderophile elements (HSE) in Earth´s mantle suggest that the budget of these elements in the silicate Earth may have been affected by late accretion after core formation. Recent HSE data, however, require that Pd/Ir, Pd/Pt and Ru/Ir in fertile mantle are slightly suprachondritic, while other HSE ratios are chondritic. Understanding these deviations from chondritic values is critical, because they may reflect the conditions during planetary core formation or may provide information on the nature of impacting bodies during late accretion. While the data base for precise and accurate abundances of Re, Os, Ir, Ru, Pt and Pd in mantle-derived rocks has been steadily increasing, this is not the case for Rh and Au abundances. Here, we report new abundance data of Rh, Au and other HSE in the same sample aliquot for fertile and depleted terrestrial peridotites. Rh/Ir in lherzolites varies between 0.32 and 0.37, similar to values of ordinary and enstatite chondrites, but unlike those of carbonaceous chondrites. Rh/Ir data acquired so far show no correlation with peridotite fertility, thus suggesting compatible behavior of Rh during melting or refertulization, as has been suspected before. In contrast, Au/Ir varies as a function of Al content, with harzburgites showing Au/Ir as low as 0.1 and fertile lherzolites displaying Au/Ir near 0.6. Thus, the behavior of Au during melting processes appears to be most similar to the moderately incompatible elements Re and Pd. Au/Ir values in fertile lherzolites match those of enstatite chondrites, but not ordinary or carbonaceous chondrites. When Rh/Ir is plotted vs. Au/Ir, the most likely composition for fertile mantle would lie inbetween the fields of ordinary and enstatite chondrites. These data, together with suprachondritic Pd/Ir and Ru/Ir inferred previously, suggest a unique composition for fertile mantle that is different from any known primitive meteorite group. The unique HSE signature of the primitive upper mantle model may originate from late accretion of objects with HSE compositions that differ slightly from chondrites, a residual signature of terrestrial core formation, some poorly constrained mantle differentiation process, or from a combination of these processes.

Si isotopic composition of the Earth's mantle and meteorites

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Current models for the formation of the Earth predict that during accretion, metal and silicate separated during a deep magma ocean stage with small metal droplets equilibrating with the surrounding silicate liquid while sinking [1]. Core segregation scenarios are mainly constrained by the dependence of siderophile element partitioning on temperature, pressure, and oxidation state (e.g. [2]).

The high Mg/Si ratio of the upper mantle as compared to chondrites [3] can be accounted for by (i) evaporative loss or incomplete condensation; (ii) the possibility that the composition derived from primitive peridotites is not representative of the Bulk Silicate Earth; (iii) incorporation of Si in the Earth's core; (iv) considering that the Earth does not having a strictly chondritic composition. Based on differences in stable Si isotopic composition between chondrites and the Earth's mantle, Georg *et al.* [4] argued that the missing Si must reside in the core. Based on the depletion of siderophile elements in the Earth's mantle it was proposed that metal-silicate equilibration in the terrestrial magma ocean occurred at ~3000 K [5]. Model calculations predict that no resolvable Si isotope fractionation should occur at such temperatures. To further investigate this issue, we determined the Si isotope composition for a series of ordinary and carbonaceous chondrites as well as for a suite of peridotites and basalts. Si isotopes were measured to high precision ($\leq$0.24‰ for δ^{30}Si (2SD)) using the large geometry Nu Plasma 1700 MC-ICPMS, allowing efficient resolution of isobaric interferences.

In contrast with previous results [4], our data show no resolvable Si isotopic difference between carbonaceous chondrites and terrestrial samples. If Si is present in the core, this result is consistent with predicted temperatures of ~3000K for metal-silicate equilibration [5]. However, per se, Si isotopes do not provide evidence for or against Si in the Earth's core.

[1] Rubie D. *et al.* (2003) *EPSL* **205**, 239. [2] Righter K., (2002) *Ann. Rev. Earth Planet. Sci.* **31**, 135. [3] Jagoutz *et al.* LPSC (1979), **2031**. [4] Georg *et al.* (2007) *Nature* **447**, 1102. [5] Wade & Wood (2005) *EPSL* **236**, 78.