Investigating Terrestrial Mantle Evolution Using Ru Isotopes

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The highly siderophile element (HSE) component of the silicate Earth may have been established via several large impacts during the latter stages of accretion [1,2]. The compositions of these impactors, and the subsequent degree of homogenization of the accreted materials into the mantle remain open questions. Recent studies of ^{142}Nd and ^{182}W have identified early-formed, yet long-lived, isotopically distinct mantle reservoirs [3,4]. This raises hope for the long-term preservation of isotopic heterogeneities in the mantle resulting from late accretionary processes.

The HSE Ru is a powerful genetic tracer for late accretionary additions to Earth. Large nucleosynthetic anomalies in ^{100}Ru have been reported for different whole rock meteorites, indicating a heterogeneous distribution of *s*-process carriers among planetesimals that may have contributed to the late accretionary flux [5].

Identification of isotopically heterogenous domains in the mantle using Ru isotopic analyses of ancient terrestrial rocks could potentially be used to constrain the nature of the impactors, and also be used to examine early mantle mixing. To this end, we have developed analytical methods for obtaining high precision Ru isotopic compostions using negative thermal ionization mass spectrometry. Replicate analyses of an *Alfa Aesar* Ru standard (n = 65) over a period of months indicate a current external precision of ±7.5 ppm (2σSD) for ^{100}Ru/^{101}Ru, which is sufficient to begin the search for nucleosynthetic anomalies.

Analysis of chromitites from the ~492 Ma old Shetland ophiolite indicates a systematic ^{100}Ru +4.5 ppm offset from the *Alfa Aesar* standard composition. It is not yet clear whether the offset represents a modification to the isotopic composition of the standard during its production, or a real, genetic variation among terrestrial materials. Further analyses of these, and older materials, will be reported.

[1] Li and Agee (2001) *GCA* **65**, 1821-1832 [2] Bottke *et al* (2010) *Science* **330**, 1527-1530 [3] Willbold *et al* (2011) *Nature* **477**, 195-199 [4] Touboul *et al* (2012) *Science* **335**, 1065-1069 [5] Chen *et al* (2010) *GCA* **74**, 3851-386