Investigating Signatures of Late Accretion: The ruthenium isotopic composition of the Earth's mantle

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The highly siderophile element (HSE) composition of Earth's mantle was likely established by late-stage accretion adding ~0.5wt. % of Earth's mass to the mantle [1,2]. The HSE Ru is potentially a powerful tracer of the genetics of these late accretionary additions to Earth [3]. The utility of the system is based on the observation that large nucleosynthetic anomalies (most notably $^{100}Ru/^{101}Ru$) are found in a variety of meteorite groups. The magnitude of the anomalies can serve as genetic tracers of late accretionary materials. These factors, in combination with evidence for the preservation of primordial isotopic heterogeneities in the mantle (e.g., $^{182}W/^{184}W$; [4]), provide a premise for the preservation of genetically-diverse late accretionary signatures in the Ru isotopic composition of materials from Earth's mantle.

We have refined analytical techniques for the purification and high precision measurement of Ru [5], and can now reach $^{100}Ru/^{101}Ru$ ±8 ppm (2σSD), which is sufficient to search for evidence of diverse late accretionary additions to the mantle that are preserved in the rock record.

To begin this search we are initially characterizing materials that sample the convecting upper mantle over the past 2 Gyr. Our work has focused mainly on ophiolite-derived Os-Ir-Ru alloy grains and chromitites. We compare these data with newly obtained Ru isotope compositions of chondritic and achondritic meteorites [6]. Our data indicate that the Phanerozoic mantle has a Ru isotopic composition that is distinguishable from all meteorites studied except for IAB iron meteorites.

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