Insights into planetary evolution from Pt stable isotopes

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Highly siderophile elements (HSE; Pt, Pd, Ir, Os, Ru, Rh, Re, and Au) are strongly partitioned into metals during metal–silicate differentiation, leading to their concentration into metallic cores during planetary differentiation. Given this geochemical behaviour, the relatively high abundances of these elements observed in planetary mantles have been explained through a late-veneer of chondritic material that was accreted after core formation, stranding HSEs in the mantle. However, it has been demonstrated from our previous work on Pt stable isotopes, as well as work from others on W and other HSE isotopes, that several ancient terrestrial mantle domains exist that have escaped complete equilibration with the late-veneer. These Archean rocks provide important constraints on the composition of Earth's mantle prior to the accretion of the late-veneer, as well as the conditions under which core formation must have occurred.

Here, we expand our Pt stable isotope dataset of Archean rock samples to include a suite of well-characterised komatiites from a number of localities worldwide. This dataset of mafic and ultramafic rocks, ranging in age from ca. 3.8–2.7 Ga, is used to place further constraints on the composition of the pre-late-veneer mantle, and the equilibration of late accreted material with the mantle through time. We also compare and contrast these terrestrial data with data for a suite of shergottites (i.e., mafic to ultramafic silicate rocks from Mars), and explore the delivery of late accreted material and conditions of core formation on Mars.

Finally, we will present new data that demonstrate the applicability of $10^{13}\Omega$ amplifier technology to MC-ICPMS analysis. We show that amounts of sample required can be reduced significantly, permitting analysis of samples that were hitherto impractical to obtain in sufficient quantities.