^{186}Os mantle evidence of Hadean crust formation

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Crust-mantle differentiation events are recorded by the radiogenic signatures within crustal rocks and minerals and in their mantle counterparts. While the crustal record has been extensively studied and exhibits a peaked distribution of ages up to 4.38 Ga (detrital zircons) [1], corresponding statistical peaks of the mantle record only extend back to 3.3 Ga [2]. The oldest recorded mantle melting ages were measured in a single sulphide inclusion (3.9 Ga) within a xenocrystic olivine from the Lac de Gras kimberlite (Slave Craton) [3], and in two detrital, Os-rich platinum group minerals (PGM) (4.1 and 3.9 Ga) from the Witwatersrand sedimentary basin [4]. However, Eoarchean-Hadean Re-Os sulphide model ages have not revealed any statistically significant peaks.

The ^{190}Pt-^{186}Os isotope system is demonstrably less sensitive to crustal contamination and alteration than the Re-Os isotope system. We measured whole-rock ^{186}Os/^{188}Os and highly siderophile element (HSE) (Os, Ir, Pt and Re) compositions of Earth's oldest known chromitites, from the >3.811 Ga Ujaragssuit nunât intrusion, Southwest Greenland to provide the first ever mantle evidence of Hadean crust-mantle differentiation. Pt-Os model ages fall into two distinct groups, reflecting the dominance of either primary or secondary PGM (e.g. alloys) in each sample aliquot. Primary PGM preserve Hadean Pt-Os ages that cluster around 4.1 Ga, with individual ages as old as 4.36 Ga. These Hadean mantle depletion ages from Greenland are consistent with the oldest zircon ages from Australia (~4.0-4.38 Ga), suggesting that global crust-mantle differentiation events occurred on Earth within the first 300 million years after accretion. These findings suggest the existence of an Os-rich mantle, similar to that observed today, by 4.1 Ga. Our study therefore supports occurrence of the "late veneer bombardement" at least 0.2 billion years earlier than previously proposed.

[1] Wilde, Valley, Peck & Graham (2001) *Nature* 409, 175-178. [2] Pearson, Parman & Nowell (2007) *Nature* 449, 202-205. [3] Aulbach *et al*. (2004) *Chem. Geol*. 208, 61-88. [4] Malitch & Merkle (2004) *Can. Mineral*. 42, 631-650.

Geochemical Windows on Coral Calcification: Cellular Mechanisms and Impacts of Climate Change

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Coral reefs exist because rates of calcium carbonate ($CaCO_3$) production by coral reef calcifying organisms exceed rates of $CaCO_3$ dissolution and export. Tropical reef-building corals are critical components of the reef $CaCO_3$ budget, producing aragonite crystals a hundred times faster than abiotic precipitation could occur under ambient seawater conditions. The ability of corals to maintain such high rates of $CaCO_3$ production under ocean warming and acidification is therefore critically important for the future of coral reefs worldwide. This presentation focuses on the application of geochemical and petrographic tools to uncover the fundamental mechanisms of coral calcification. Such tools provide unprecedented opportunity to probe an inaccessible, nano-sized space beneath the coral animal, revealing the origins and composition of the calcifying fluid and the ability of corals to manipulate fluid composition to induce crystal nucleation and growth on a tightly controlled diurnal schedule. Compositional and structural features of abiotic crystals grown in controlled aragonite precipitation experiments provide the crucial framework for interpreting compositional variability in coral skeletons. Application of this framework to populations of wild corals growing across natural gradients of temperature and ocean acidification is allowing us to assess the potential for corals to manipulate the composition of the internal fluid and maintain elevated rates of calcification under global climate change.

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