ZIRCONIUM-HAFNIUM EVIDENCE FOR SEPARATE SYNTHESIS OF LIGHT NEUTRON-RICH NUCLEI.

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Introduction: Hafnium has four stable non-radiogenic isotopes (^{177,178,179,180}Hf) that are produced by an s-/r-process combination. These isotopes have recently been shown to be homogeneously distributed in various carbonaceous chondrites, CAIs and the Earth [1] and this is in line with the observed s-/r-process homogeneity of Sm and Nd isotopes. In contrast, nucleosynthetic anomalies have been reported for lighter (s-/r-process) isotopes in bulk carbonaceous chondrites and their components (Ba, Ni, Cr, and Ti). This was interpreted as evidence for the synthesis of neutron-rich isotopes (via the r-process) in two distinct astrophysical sites for the light ($Z \leq 56$) and heavy ($Z > 56$) nuclei, respectively [1]. Zirconium ($Z = 40$) and Hf ($Z = 72$) are both of similar refractory and geochemical nature, and therefore coincident isotope measurements of the two elements provide a good way of studying variable s-/r-process nucleosynthetic sites for light and heavy nuclei. Here we thus report new Zr high precision data for the samples previously analyzed for Hf isotopes.

Analytical technique and results: In this study, a terrestrial andesite (AGV-2), three carbonaceous chondrites (Murchison [CM2], Dar al Gani 137 [CO3], Dar al Gani 275 [CK4/5]) and four CAIs from Allende (CV3) were analysed. Sample preparation and digestion is described in [1] and the Zr fractions obtained from [1] were passed through an additional anion exchange column to ensure adequate removal of Zr from the sample matrix. All five Zr isotopes ($^{90, 91, 92, 94, 96}$Zr) were measured on a Nu Plasma MC-ICPMS using the same analytical procedure as outlined in [3, 4].

Both Murchison and the CAIs display ^{96}Zr excesses, which are consistent with the values that we reported previously [3]. Furthermore, the new CAI data show identical ^{96}Zr enrichments (ε^{96}Zr = 2.0 ± 0.2) to those previously measured [2, 3], suggesting that most CAIs formed from a reservoir with a homogeneous Zr composition, which is clearly distinct to that of the terrestrial standard. This is analogous to the relatively constant positive shifts observed in CAIs for the neutron-rich nuclide ^{50}Ti (ε^{50}Ti ~ +9) [5]. As ^{50}Ti is synthesized in supernovae, this link potentially indicates a common astrophysical origin for the two isotopes.

In conclusion, our data shows well-resolved ^{96}Zr excesses, in good agreement with previous data, but no variation for r-process dominated Hf isotopes (data obtained from the same sample digestion). Since both elements are produced through a combination of the s- and r-process, this new data further substantiate the decoupling of nucleosynthetic components. This is consistent with at least two distinct stellar sources for the production of neutron-rich isotopes that operated in different mass regimes.

Refernces: [1] Sprung P. et al. 2010. *Earth & Planetary Science Letters* 295:1-11. [2] Schönbächler M. et al. 2003. *Earth & Planetary Science Letters* 216:467–481. [3] Akram. M W. et al. 2011. *LPSC* 42, abstract 1908. [4] Schönbächler M. et al. 2004. *The Analyst* 129:32-37. [5]. Leya I. et al. *The Astrophysical Journal* 702: 1118-1126.