Uniform yet distinct isotopic reservoirs in the early Solar System: Evidence from Er and Yb isotopes in refractory inclusions

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Understanding how the early Solar System formed and evolved can be explored by characterizing the stable isotopic compositions of calcium-aluminum-rich inclusions (CAIs), the first solids to condense in the protoplanetary disk. For most elements, normal CAIs (non-FUN) found in a variety of meteorite types, contain uniform, yet distinct isotopic anomalies relative to terrestrial rocks [1-5]. This suggests that CAIs formed in an isotopically homogenous reservoir that was different from other bulk Solar System materials. One way these isotopic differences can be explained is by excesses or deficits in isotopes produced by certain nucleosynthetic processes (*p*-, *s*-, and *r*-process). Therefore, examining the isotopic composition of elements that are produced in various amounts by these processes, such as Er and Yb, can provide insights into why isotopic differences between CAIs and bulk Solar System materials exist.

In this work, we outline a method to chemically isolate Er and Yb from meteoritc materials utilizing LN-Spec resin and various strengths of hydrocholoric acid. We report the isotopic character of these elements using both MC-ICPMS and TIMS.

The Er and Yb isotopic compositions of Allende CAIs are characterized by a deficit in *r*-process material compared to terrestrial rocks. This observation is consistent with other high mass elements (A>140) previously reported from the same CAI sample set [1-2, 4]. These integrated studies demonstate the existence of a predominantly isotopically homogenous CAI reservoir that was spacially/temporally isolated from later formed material in the Solar System. Differences between the CAI reservoir and the terrestrial composition can be explained by variable amounts of *p*-, *s*- and *r*-process derived material.

[1] Brennecka et al. (2010) *Science*, **327**, 449. [2] Brennecka et al. (2013) *PNAS*, **110**, 17241. [3] Burkhardt et al. (2011) *EPSL*, **312**, 390. [4] Brennecka et al. (2014) *LPS 45*, #2280. [5] Shollenberger et al. (2015) *LPS 46*, #2593.