RARE EARTH ELEMENT PRODUCTION IN ASYMPTOTIC GIANT BRANCH STARS.

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Introduction: Presolar grains provide an isotopic record of nucleosynthesis in individual stars of a variety of types, including asymptotic giant branch (AGB) stars, core collapse supernovae, and novae [1]. Silicon carbide is the most widely studied type of presolar grain and most (~90%) SiC grains have isotopic properties consistent with formation in low mass AGB stars. These stars are thought to be the primary stellar site for *s*-process nucleosynthesis. Many of the rare earth elements (REE) have elevated concentrations in presolar SiC [2]. We summarize here predictions of *s*-process nucleosynthesis calculations for low mass AGB stars for the rare earth elements in anticipation of future measurements in individual presolar grains by resonant ionization mass spectrometry (RIMS). Analysis of REE by mass spectrometry suffers from isobaric interferences of many REE isotopes on one another, and RIMS offers the possibility of minimizing these interferences while measuring with high sensitivity.

The *s*-process in AGB stars is driven by two neutron sources: $^{13}C(\alpha,n)^{16}O$ during interpulse periods, and $^{22}Ne(\alpha,n)^{25}Mg$ during thermal pulses. Immediately after each thermal pulse, freshly synthesized *s*-process products are dredged up from the He intershell into the envelope of the star. Although the amount of ^{13}C available to produce neutrons is essentially a free parameter, but recent measurements of the isotopic compositions of Zr, Mo, and Ba suggest that most SiC grains come from AGB stars with ^{13}C pocket amounts within 50% of the standard case that explains the solar system s-process abundances well [3]. There are a number of *s*-only isotopes among the REE and these are all predicted to be enriched by about a factor of 10 compared to Si in the envelope of a low mass AGB star. *r*-Only or *p*-only isotopes are not produced in low mass stars, so they are expected to have solar abundances relative to Si for a solar metallicity AGB star. Isotopes with mixed *s*- and *r*- or *p*-process production will have enrichments between 1 and 10.

The REE comprise 15 elements with atomic numbers from 57 to 71. Along the *s*-process path in the REE region, there are a number of branch points that are sensitive indicators of neutron density during thermal pulses. Of the 15 REE, promethium has no long-lived or stable isotopes, praseodymium, terbium, holmium, and thulium have only one stable isotope, and, although lanthanum has two stable isotopes, one is of very low abundance. Of the remaining REE, Nd, Sm, Gd, and Dy are of greatest interest in terms of sensitivity to neutron density and potential branching effects.

[1] Lugaro M. 2005 *Stardust from Meteorites*, Singapore, World Scientific Publishing, 209 p. [2] Yin Q.-Z. et al. 2006. *Astrophysical Journal* 647:676. [3] Barzyk J. G. et al. 2007, *Meteoritics & Planetary Science* 42:1103.