

CHROMIUM-BEARING PRESOLAR OXIDE GRAINS IN A ⁵⁴CR-RICH ORGUEIL RESIDUE. L. R. Nittler and C. M. O'D. Alexander, Dept. of Terrestrial Magnetism, Carnegie Institution of Washington, 5241 Broad Branch Rd NW, Washington DC 20015.

Introduction: Chromium-54 is enriched in certain leach fractions of several chondrites, most likely indicating the presence of one or more as-yet-unidentified presolar phases, soluble in the usual treatments used to isolate presolar grains [1-3]. We report the discovery of two Cr-rich presolar oxide grains in the Orgueil (C11) meteorite. The grains were identified in a ⁵⁴Cr-enriched residue, and are hence strong candidates for being among the anomalous ⁵⁴Cr carrier(s).

Experimental: An organic-rich residue was prepared by treating an Orgueil sample with a CsF-HF solution; previous measurements showed that Cr leached from this residue with hot HCl has $\delta^{54}\text{Cr}/^{52}\text{Cr} \sim 20\%$ [3]. An aliquot of the residue was ashed in an O plasma to destroy the organics and a $\sim 1\text{-}5\mu\text{m}$ size separate of the remaining material was deposited on a gold foil for ion probe analysis. SEM-EDS indicates that the residue consists of $\sim 33\%$ MgAl₂O₄, $\sim 15\%$ TiO₂, $\sim 14\%$ Cr₂O₃, $\sim 13\%$ MgCr₂O₄, and $\sim 12\%$ other Cr-rich oxides with varying amounts of Fe, Mg, Al, and/or Mn. Minor amounts of Al₂O₃, hibonite and contamination phases make up the remainder. Individual O-rich grains were automatically analyzed for ¹⁷O/¹⁶O, ¹⁸O/¹⁶O and AlO/O⁻ ratios with the Carnegie ims-6f ion probe [4].

Results and Discussion: Of ~ 260 analyzed grains with reasonable errors, three had O-isotopic compositions indicative of a presolar origin. Subsequent SEM analysis showed that two of these are a new presolar mineral phase rich in Mg, Al, and Cr. EDS analysis suggests that both grains are $\sim 50:50$ solid solutions of spinel (MgAl₂O₄) and magnesiochromite (MgCr₂O₄). Although both pure spinel and pure MgCr₂O₄ are common in our Orgueil residue, the mixed phase is very rare ($<2\%$) and is apparently dominated by presolar grains. The third presolar grain was completely consumed during the O measurement, so its mineralogy cannot be determined.

Grain ORCR1 is a Group 2 grain [5] with $\delta^{17}\text{O} = +2130\%$, $\delta^{18}\text{O} = -900\%$; ORCR2 is a Group 1 grain with $\delta^{17}\text{O} = +1840\%$, $\delta^{18}\text{O} = -200\%$. Both grains were $\sim 1\mu\text{m}$ prior to the O measurement and sufficient material remains for NanoSIMS measurements of Cr and Mg isotopes. It is unlikely that significant nucleosynthetic effects in Cr would be found in the low-mass O-rich stellar parents of Group 1 oxide grains like ORCR2. However, the highly ¹⁸O-poor composition of ORCR1 is consistent with hot-bottom burning in an intermediate mass AGB star. Neutron-capture reactions in such stars are predicted to result in enhanced surface ⁵⁴Cr/⁵²Cr ratios, but \sim normal ⁵⁰Cr/⁵²Cr and ⁵³Cr/⁵²Cr ratios [6]. Thus, it is plausible to expect that at least grain ORCR1 could be ⁵⁴Cr-rich, though this obviously needs experimental verification.

It is unlikely that spinel-magnesiochromite is sufficiently soluble in HCl to be the major ⁵⁴Cr-rich carrier in Orgueil, though we can't rule out that very small grains could dissolve. However, stepped leaching indicates that there could be more resistant ⁵⁴Cr phases as well [2] and our grains are obvious candidates. That Cr-rich AGB stars are expected to have \sim monoisotopic ⁵⁴Cr excesses indicates that the dominant anomalous phase could in fact be soluble Cr-rich sub-grains of presolar SiC and/or graphite.

References: [1] Rotaru M. et al. (1992) *Nature*, 358, 465-470. [2] Podosek F. A. et al. (1997) *Meteorit. Planet. Sci.*, 32, 617-627. [3] Alexander C. M. O'D. (2002) *LPS XXXIII*, #1872. [4] Nittler L. R. and Alexander C. M. O'D. (2003) *GCA*, in press. [5] Nittler L. R. et al. (1997) *ApJ*, 483, 475-495. [6] Gallino R. (2003) pers. comm.