ZINC DISTRIBUTION IN ALLENDE REVEALED VIA SYNCHROTRON ANALYSIS AND ITS LINK TO ALKALI-METASOMATISM OF REFRACTORY INCLUSIONS

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Introduction: Refractory inclusions (CAIs and AOAs) are thought to be amongst the first objects to form from the solar nebula. They are commonly found in CV3s (e.g., Allende). While these objects are often analyzed to learn about the earliest stages of solar system formation, in many cases, they may also have been subjected to parent-body processes that significantly alter their chemistry (e.g. [1]). Zinc is a moderately volatile, highly labile element [2]; therefore, its composition and distribution in these objects may reveal insights into their processing both in the solar nebula and on the parent body.

Methods: Analysis of an Allende thin section was undertaken on the X-ray Fluorescence Microscopy beamline at the Australian Synchrotron, Victoria, Australia [3]. Subsequent mapping was undertaken at CSIRO using a Zeiss Ultra FEG-SEM with coupled Bruker X-Flash EDS detector using a 20KeV 2nA beam.

Results: Areas ("hotspots") of Zn enrichment at the μm-scale are observed within Allende matrix. In addition, there are ~5 macroscopic objects displaying high-Zn concentration. These areas are commonly associated with refractory inclusions. We describe two of them here.

The first, spherical object (d = 250 μm) bears close resemblance to spinel-bearing inclusions previously described [4]. It has a 50 μm-thick spinel-hibonite layer surrounded by a typical Wark-Lovering rim sequence of feldspathoids and Al-rich pyroxene. However, it has an interior that appears to have been entirely metasomatized by a Na, K, Cl-bearing hydrothermal fluid.

The second is an elongated, >1mm long inclusion composed primarily of garnet (i.e. andradite), spinel, and feldspathoids. These phases display complex layering, with the feldspathoids found in the interior. No other phases (e.g., sulfides, olivine) have been found thus far. Synchrotron data also shows both objects are enriched in Sr relative to the rest of the thin section.

Implications: Previous work on Zn isotopes found light compositions consistent with spinel as a carrier phase [5]. While this is consistent with our findings, in the spherical object described here, high Zn is observed throughout and is not restricted to spinel. Zinc may be predominantly in the spinel phase in the later object. This may indicate element mobility was restricted during hydrothermal alteration of Allende. Zinc may have been leached from spinel and incorporated adjacent alteration phases. Alternatively, in some cases, such as the elongated object described, spinel may be a hydrothermal alteration product.

References: [1] Krot A.N. et al. 2007. *GCA* 71:4342-4364. [2] Lipschutz M.E. and Woolum D.S. 1988. *Meteorites in the Early Solar System* 7.6: 462-487. [3] Ryan, C.G., et al., *AIP Conference Proc*. 2010. 1221:9-17. [4] Kornacki A.S. and Wood J.A. 1985. *GCA* 49:1219-1237. [5] Luck et al. 2005. *GCA* 69:5351-5363.