CIRCUMSTELLAR MAGNETITE IDENTIFIED IN THE LAP 031117 CO3.0 CHONDRITE.

T. J. Zega[1], P. Haenecour[2,3], C. Floss[2,4], and R. M. Stroud[5]. [1]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, USA. Email: tzega@lpl.arizona.edu. [2]Laboratory for Space Sciences, [3]Dept. of Earth and Planetary Sciences, [4]Physics Department, Washington University, St. Louis, MO 63130, USA. [5]Code 6366, Naval Research Laboratory, 4555 Overlook Avenue, Washington DC 20375.

Introduction: Oxide grains are among the varied presolar phases that have been identified in primitive meteorites [1]. Calculations predict oxide formation in the outflows of AGB stars and in the condensation sequence of our solar system. It was suggested that oxide grains such as spinel may be responsible for the 13 μm emission feature of IR spectra of O-rich AGB stars [e.g., 2], and comparison of remotely sensed infrared and laboratory-based spectra suggests that the oxide hibonite ($CaAl_{12}O_{19}$) may occur in planetary nebulae [3]. Previously we reported on the microstructural properties of hibonite and spinel [4, 5]. Here we report on the first microstructural confirmation of presolar circumstellar magnetite (Fe_3O_4).

Samples and Experimental Methods: A petrographic thin section of the LaPaz Icefield 031117 (LAP 031117) CO3.0 chondrite was examined with the Washington University NanoSIMS 50 to search for presolar grains (e.g., silicates, oxides, and SiC). From among the O-rich presolar grains identified, we selected grain LAP-103 for detailed structural and chemical analysis. We prepared an electron-transparent cross section of the grain with an FEI Nova 200 focused-ion-beam scanning-electron microscope located at Arizona State University using previously described methods [6]. The FIB section was examined using a 200 keV JEOL 2000FS transmission electron microscope (TEM) at the Naval Research Laboratory (Washington, DC).

Results and Discussion: NanoSIMS shows that grain LAP-103 has $^{17}O/^{16}O = (35.5 \pm 0.6) \times 10^{-4}$; $^{18}O/^{16}O = (2.05 \pm 0.04) \times 10^{-3}$, which places it within the Group 1 field [e.g., 7] Comparison of the O isotopic composition of LAP-103 with stellar models suggests that it condensed from an RGB star undergoing first dredge-up whose initial mass was approximately $2.2M_{\odot}$ with a solar metallicity. The TEM data identify LAP-103 as a single crystal of magnetite. That the magnetite condensed in a solar-metallicity star and is stoichiometric, we assume that equilibrium calculations, which model a condensing gas of solar composition, should be applicable. However, such calculations do not predict that magnetite will condense from the gas phase under canonical nebular conditions [8], as Fe in the gas prefers to condense into metal. An alternative pathway for magnetite formation is the oxidation of preexisting metal grains. The kinetics of this reaction and its astrophysical implications will be discussed at the meeting.

References: [1] Zinner E.K. in Meteorites, comets, and planets, A.M. Davis, Editor 2014, Elsevier: New York. p. 181-213. [2] Posch T. et al. 1999. *Astronomy & Astrophysics* **352**, 609-618. [3] Hofmeister A.M. et al. 2004. *Geochimica et Cosmochimica Acta* **68**, 4485-4503. [4] Zega T.J. et al. 2011. *The Astrophysical Journal* **730**, 83-93. [5] Zega T.J., et al. 2014, *Geochimica et Cosmochimica Acta* **124**, 152-169. [6] Zega T.J., et al. 2007. *Meteoritics & Planetary Science* **42**, 1373-1386. [7] Nittler L.R. et al. 2008. *The Astrophysical Journal* **682,** 1450-1478. [8] Ebel D.S. (2006) *Meteorites and the Early Solar System II* 253-277.