

**PRELIMINARY NANOSIMS ANALYSIS OF CARBON ISOTOPE OF CARBONATES IN CALCIUM-ALUMINUM-RICH INCLUSIONS.** Y. Guan, J. M. Paque, D. S. Burnett, and J. M. Eiler. Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125, USA.

**Introduction:** Carbonate minerals observed in primitive meteorites are products of either terrestrial weathering or aqueous alteration in the early solar system. Most of the carbonate minerals in carbonaceous chondrites occur primarily as isolated grains in matrix, as crosscutting veins, or as replacement minerals in chondrules [e.g., 1, 2]. A few calcium-aluminum-rich inclusions (CAIs) have been reported containing carbonate minerals as well [2, 3]. The C and O isotopes of carbonates in carbonaceous chondrites, mostly measured by stepwise extraction of bulk samples with phosphoric acid [4-7], are largely distinctive from those of terrestrial carbonates, whereas textural and petrographic evidence indicates that some carbonates in primitive meteorites are terrestrial in origin [2]. This study attempts to investigate from the aspect of C isotope the origin of rare carbonate minerals in some CAIs. If of extraterrestrial origin, carbonates in CAIs can provide important information and constraints on the ubiquitous aqueous alteration process in the early solar system.

**Samples and Analytical Techniques:** We have selected carbonate-bearing CAIs from Murchison (CM) and Leoville (CV) for this study. One of the CAIs from Murchison is the extensively studied Blue Angel – an altered hibonite inclusion containing large amount calcite (10-70  $\mu\text{m}$ ) [3]. The other Murchison CAI is a 100x50  $\mu\text{m}$  calcite fragment enclosing small grains of spinel, melilite, fassite and perovskite. The calcite in the type B Leoville 3537-2 CAI occurs as narrow veins (less than  $\sim 10 \mu\text{m}$ ) at the center of the inclusion. Carbon isotope was measured with the Caltech NanoSIMS 50L ion microprobe. A rastering (3x3  $\mu\text{m}$ ) primary beam of  $\sim 10 \text{ pA}$  was used to sputter the sample and generate secondary ions. Both  $^{12}\text{C}$  and  $^{13}\text{C}$  were simultaneously collected with EMs. Carbonate standards (calcite, dolomite, magnesite, and siderite) were used to check possible matrix effect and instrumental mass fractionation (IMF). Typical analytical errors under such conditions are  $\sim 1 - 2\%$  ( $1\sigma$ ) for  $\delta^{13}\text{C}$ .

**Results and Discussion:** The results from standard measurements indicate that there are significant matrix effects in C isotope analysis of carbonates with a NanoSIMS. The IMF increases by  $\sim 30\%$  from calcite to dolomite, magnesite, and siderite. To date, three calcite grains from the Blue Angel CAI were analyzed for their C isotope, yielding  $\delta^{13}\text{C}$  values from +16 to +23‰. Three spots on a calcite vein in Leoville 3537-2, on the other hand, show lower  $\delta^{13}\text{C}$  values from -2 to -8‰. Though these CAI carbonate data fall within the ranges obtained from bulk measurements of CM or CV meteorites [4], the  $\delta^{13}\text{C}$  values are not high enough to exclude a terrestrial origin for the Leoville sample. Oxygen isotope data are needed to further constrain the nature of the CAI carbonates. Nonetheless, the data suggest that there is no presolar C component in CM CAI carbonates that could be responsible for the peculiar high  $\delta^{13}\text{C}$  values observed in some bulk carbonates.

**References:** [1] Benedix G. et al. (2003), *GCA*, 52, 1577-1588. [2] Abreu N. M. and Brearley A. (2005) *MAPS*, 40, 609-625. [3] Armstrong J. T. et al. (1982) *GCA*, 46, 575-595. [4] Grady M. M. et al. (1988), *GCA*, 52, 2855-2866. [5] Zito et al. (1998) *MAPS*, 33, A171-A172. [6] Brearley A. J. et al. (1999), *LPS*, XXX, Abstract #1301. [7] Guo W. and Eiler J. M. (2006), *LPS*, XXXVII, Abstract #2288.