

Simultaneous measurements of C and O isotopic composition in carbonates by NanoSIMS

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Carbonates in aqueously altered chondrites and in Martian meteorites potentially provide important information about fluid elemental and C and O isotopic compositions, carbonate formation temperatures, and the timing of alteration. Most studies of carbonates in chondrites have been bulk measurements, but recent published in situ petrologic and O isotopic studies show that there is considerable grain-to-grain heterogeneity within a single meteorite (e.g., [1-3]). Detailed in situ studies of both C and O isotopes, including determination of internal zoning of grains, will be needed to understand the conditions of carbonate formation and the sources of the altering fluids [4].

To this end, we aim to use the high spatial resolution and multicollector capabilities of the Carnegie NanoSIMS 50L to measure both C and O isotopic compositions simultaneously. We used several different carbonate standards (calcite, dolomite, ankerite, siderite, magnesite and strontianite) to study the matrix effects on the instrumental fractions for both C and O isotopes. Carbon and O isotopes were measured in multi-collection mode with five detectors for masses ¹²C, ¹³C, ¹⁶O, ¹⁷O and ¹⁸O at a mass resolving power of more than 9000. An 8 kV primary Cs⁺ beam of about 80 pA focused to a few hundred nanometers were rastered over 5x5 μm² on the sample during the data collection. An electron flood gun was used to compensate for surface charging during the extraction of the secondary negative ions at -8 kV. ¹⁶O was measured using a Farady cup, while all the other masses were counted using electron multipliers. Each spot analysis took 21 minutes, including four minutes of presputter. Ten repeat analyses of the same standard gives typical standard deviations of δ¹³C of about ±1‰ (1σ), δ¹⁷O: ±1‰ and δ¹⁸O: ±2‰. We will discuss the analytical details at the conference presentation including the matrix effects and sputtering rates on IMFs and aging of the electron multiplier for mass ¹²C. Some results of the measurements of C and O isotopes in carbonates of CM-CR chondrites will be discussed.

[1] Tyra et al. (2012) *GCA* **77**, 383-395. [2] Jenniskens et al. (2012) *Science* **338**, 1583-1587. [3] Lee et al. (2013) *GCA* **121**, 452-466. [4] Alexander et al. (2015) *M&PS*, in press.