Evaluation of potential standards for oxygen isotope microanalysis

A. THOMEN1, K. NAGASHIMA1, M. COUAPÉL2, C. SONZOGNI2, A. ALEXANDRE2, G. R. HUSS1, A. N. KROT1

1HIGP, University of Hawai‘i at Mānoa, 1680 East-West Rd, Honolulu, HI 96822, USA
(authomen@higp.hawaii.edu)
2CEREGE, Euròpole Méditerranéen de l’Arbois, Avenue Louis Philibert, BP 80, 13545, Aix En Provence, France

Asteroidal metasomatism on the CV (Vigarano type) chondrite parent body produced a large variety of relatively fine-grained (10−20 µm) secondary phases, including andradite, anorthite, hedenbergebite, grossular, monticellite, Na-rich melilite, nepheline, sodalite, and wollastonite [1]. Accurate oxygen-isotope compositions of these minerals measured with SIMS can provide important constraints on physico-chemical conditions of the metasomatic alteration, such as temperature [2]. Oxygen-isotope analyses with SIMS require matrix-matched standards, which are largely absent for the secondary phases. To establish O-isotope standards for these minerals, we prepared a number of natural silicates (anorthite, andradite, augite, melilite, nepheline, sodalite, wollastonite) and oxides (hibonite, sapphire, spinel).

Major element compositions for each mineral are homogeneous within analytical uncertainty of EPMA. Millimeter-scale δ18O homogeneity of the minerals was investigated with the UH Cameca ims-1280 SIMS. From 12 to 25 measurements per mineral were made: 4−6 spots per group and groups were separated by 1.5 to 3 mm. Most of the minerals show reproducibility of −0.2−0.6‰ (2SD), comparable to the daily reproducibility on San Carlos olivine measurements. Hibonite and wollastonite had slightly larger δ18O variations of ~0.7 and ~0.9‰, respectively. Bulk O-isotope compositions of the minerals were measured with laser-fluorination mass spectrometry at CEREGE, France [3]. δ18O values of duplicate analyses per mineral (except for andradite and sodalite) are consistent each other within a reproducibility of internal quartz standard measurements (~0.4‰, 2SD). Two measurements of wollastonite were different by ~0.6‰, suggesting possible δ18O heterogeneity.

While more work may be necessary for andradite, sodalite, and wollastonite; most of the minerals studied appear to be homogeneous in chemical and O-isotope compositions and thus could be suitable for O-isotope microanalysis with SIMS. More details including δ18O values of the minerals will be given at the meeting.