Evaluation of potential standards for oxygen isotope microanalysis

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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, hedenbergite, 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 $\delta^{18}O$ 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 $\delta^{18}O$ 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]. $\delta^{18}O$ 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 $\delta^{18}O$ 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 $\delta^{18}O$ values of the minerals will be given at the meeting.

[1] Brearley & Krot, in *Lecture Notes in Earth System Sciences*, 659–789, 2012. [2] Choi *et al.*, MAPS, 35, 1239–1248, 2000. [3] Alexandre *et al.*, GCA, 70, 2827–2835, 2006.