CHONDRULE OXYGEN ISOTOPE SYSTEMATICS IN UNEQUILIBRATED ORDINARY CHONDRITES: INSIGHTS INTO THEIR NEBULAR RESERVOIR.

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Introduction: The bulk O-isotope ratios of ordinary chondrites (OCs) are close but distinct for H, L, and LL groups (Δ^{17}O ~ 0.73‰, 1.07‰, and 1.26‰, respectively [1]). However, the range of O-isotope composition of individual chondrules within OCs is indistinguishable between the different groups, showing no correlation with the classification of the host meteorite [e.g. 2]. It has been hypothesized both that OCs chondrules from the different chemical groups derive from a single population [1] or various populations [3] in the solar nebula, and that OCs bulk O-isotope composition is controlled by a chondrule size-sorting effect [1], although no systematic study have been done on the 3 OC iron groups. In order to obtain further insights about OCs chondrules and their O-isotope reservoir in the protoplanetary disk, we have performed high precision *in situ* ion microprobe O-isotope analysis of chondrule olivine, using the Sensitive High Resolution Ion Micoroprobe – Stable Isotopes (SHRIMP-SI) at The Australian National University. Three unequilibrated ordinary chondrites (UOCs): QUE 93030 (H3.6), GRO 06054 (L3.05), and LAR 06301 (LL3.8) were studied.

Results and discussion: 120 olivine grains from 80 chondrules were analyzed in QUE 93030, 100 olivines from 55 chondrules in GRO 06054, and 70 olivines from 27 chondrules in LAR 06301. A general trend in the triple O-isotope diagram is observed for the 3 UOCs (Figure 1), with most of the olivines ploting above the TF (Terrestrial Fractionation) and PCM (Primitive Chondrule Mineral, [4]) lines. The obtained slope of ~0.6 suggests that the chondrule olivines experienced mass-dependent O-isotope fractionation. The exception to this general trend are relict olivine grains with different O-isotope composition which probably remained solid during the last chondrule formation event maintaining a previous isotopic signature [5]. Some relicts show CAI-like ^{16}O-rich compositions [e.g. 6] with the most extreme as low as Δ^{17}O ~ −17‰. Other relicts show O-isotope ratios similar to those found in carbonaceous chondrite (CC) chondrules (Δ^{17}O ~ −5‰) [e.g. 4, 7, 8], suggesting that migration of solid precursors from CAI- and CC-like O-isotope reservoirs to OCs chondrule forming region might have occurred [e.g. 4, 8].

Ignoring olivine relicts, we have calculated the Δ^{17}O weighted mean of the H, L, and LL UOCs to be ~ 0.7‰, in agreement with the hypothesis that OCs sampled a single main chondrule population in the protoplanetary disk as suggested by [1]. Furtheremore, [9], [10], and [2] pointed out that if the O-isotope ratios of the ambient gas was that of the average O-isotope composition of chondrule precursors in local disk regions, then OCs chondrules possibly formed closer to the protosun related to CCs chondrules from precursor dust that was previously homogenized in O-isotopes by high temperature processing. Our data suggest that this O-isotope reservoir was Δ^{17}O ~ 0.7‰.

The heavier bulk O-isotope composition of OCs is likelly controlled by a ^{16}O-poor signature of the matrix [e.g. 11].

Conclusions: OC groups appear to have sampled a chondrule population from the same region of the protoplanetary disk whose O-isotope reservoir is represented by Δ^{17}O ~ 0.7‰. The heavier O-isotope signature of bulk OCs is probably controlled by the isotopic composition of the matrix. We have identified OCs chondrule relicts with O-isotope ratios similar to CAI values. We will improve our statistics by measuring olivine O-isotope abundances of 6 more UOCs.

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