OXYGEN ISOTOPE SYSTEMATICS OF ORDINARY CHONDRITE CHONDRULES AND THEIR MAIN CHONDRULE POPULATION

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Introduction: Chondrites are cosmic breccias with well defined bulk O-isotope compositions on the triple-O diagram [1]. However, it appears that each chondrite contains specific groups of chondrules with distinct Δ^{17}O ratios (= δ^{17}O-0.52× δ^{18}O) and 'chondrule populations' have been suggested but never statistically assessed [2]. We focus on the *in situ* O-isotope of chondrule olivine from unequilibrated ordinary chondrites (OCs) of the different iron groups (H, L, and LL) and performed high precision ion microprobe O-isotope analysis using the Sensitive High Resolution Ion Microprobe – Stable Isotopes (SHRIMP-SI) at The Australian National University. Nine unequilibrated OCs were studied: WSG95300 (H3.3), QUE93030 (H3.6), ALHA77299 (H3.7), GRO06054 (L3.05), DOM10556 (L3.1), MIL 05050 (L3.1), LAR06279 (LL3.8), LAR06301 (LL3.8), and LAR12034 (LL3.8). A statistical treatment of chon-drule populations in OCs, and chondrites in general, would provide further insight about chondrule formation envi-ronments, the processes involved in those regions, and the solid dynamics of the protoplanetary disk [3, 4].

Results and discussion: 794 olivine grains from 537 chondrules were analyzed. Most of the measurements plot above the terrestrial fractionation (TF) line in the δ^{18}O vs. δ^{17}O diagram (Fig. 1A). This distinctive feature is clearer when exploring the probability density function (PDF) of the Δ^{17}O value of the studied chondrules showing a unimodal bell-shaped distribution peaking between 0‰ and 2‰ no matter the host chondrite group (Fig. 1B). This suggests that OCs accreted one main chondrule population, in agreement with the assertion of [4]. To statistically evaluate that OCs sampled the same population(s) of chondrules, a Kolmogorov-Smirnov test was applied to the chondrule Δ^{17}O distri-butions. The test confirms that the samples have the same continuous distribution at the 95% confidence interval ($\sigma_{95\%}$), meaning that the probability for the Δ^{17}O chondrule distribution to be different between the H, L, and LL samples is 5%. Therefore, OCs incorporated chondrules into their parental bodies that are statistically the same, in terms of their oxygen isotope composition.

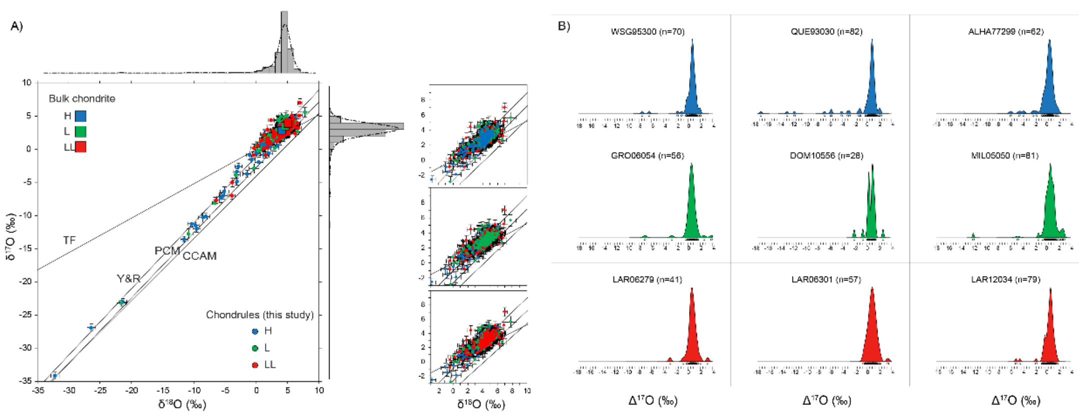

Fig. 1. A) O-isotope ratios of chondrules per OC group. PDFs of δ^{18}O and δ^{17}O and a zoom in are shown. TF, Y&R [6], PCM [7], and CCAM [8] lines are shown for reference. Bulk equilibrated OCs compositions are from [5]. B) PDFs of chondrule Δ^{17}O per meteorite sample.

In order to constrain the boundaries of the main chondrule population, all Δ^{17}O data from H, L, and LL chondrites were merged into one database. This allows to exploit the sample size on behalf of finer statistics for the population. The preferred method to estimate the mean of this population is the weighted mean at $\sigma_{95\%}$. After this analysis, the MSWD statistic of the sample is 1.12, allowing to infer that the chondrule sample was drawn from a single population, ergo the main chondrule population of OCs. The main chondrule population is characterized by a Δ^{17}O weighted mean of 0.72 ± 0.08‰ (external error, $\sigma_{95\%}$) with a variability of 0.50‰ (2SD, $\sigma_{95\%}$). It is stated then that OCs accreted a majority of chondrules that formed in a location of the protoplanetary disk dominated by an oxygen isotope gaseous reservoir of Δ^{17}O ~0.7‰. The consequences of having such a sample distribution of Δ^{17}O chondrule compositions in OCs is relevant considering its predictive power. This will be discussed at the conference.

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