OXYGEN ISOTOPE SYSTEMATICS OF RUMURUTI CHONDRITE CHONDRULES.

L. Baeza[1], A. Patkar[1], S. J. McKibbin[1], J. N. Ávila[2], T. R. Ireland[2], [1]Research School of Earth Sciences, The Australian National University. [2]School of Earth and Environmental Sciences, University of Queenland. email: leonardo.baeza@anu.edu.au.

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 $\Delta^{17}O$ ratios ($=\delta^{17}O-0.52\times \delta^{18}O$) and 'chondrule populations' have been suggested [2]. Recently, we statistically proved that ordinary chondrites (OC) of the different iron groups (H, L, and LL) accreted chondrules that were sampled from a single population characterized by a $\Delta^{17}O$ mean of ~0.7‰ [3]. To further understand the O-isotope reservoirs of the inner solar system we focus on chondrule olivine from unequilibrated Rumuruti (R) chondrites and performed in situ ion microprobe O-isotope analysis using the Sensitive High Resolution Ion Microprobe – Stable Isotopes (SHRIMP-SI) at The Australian National University. Two R chondrites have been studied so far: PRE95411 (R3) and ALH85151 (R3.6). A statistical assessment and comparison between chondrule populations in chondrites from the inner solar system, and chondrites in general, could provide further insight about chondrule formation environments, the processes involved in those regions, and the solid dynamics of the protoplanetary disk [4].

Results and Discussion: 65 olivine grains from 65 chondrules were analyzed in the R chondrites. Most of the measurements plot above the terrestrial fractionation (TF) line in the $\delta^{18}O$ vs. $\delta^{17}O$ diagram (Fig. 1A) in agreement with previous results [5, 6, 7]. This feature is clearer when observing the kernel density estimation (KDE) of $\Delta^{17}O$ which shows a bell-shaped distribution peaking between 0‰ and 4‰ (Fig. 1B). The KDE of $\Delta^{17}O$ for the OC dataset is also unimodal but narrower, peaking between -1‰ and 2‰. The chondrule olivine distribution of $\Delta^{17}O$ for R chondrites is characterized by an estimated mean of 1.9 ± 0.3‰ (SE, σ95%) and a variability of 2.2‰ (2SD, σ95%) while OC by a mean of 0.7 ± 0.1‰ (SE, σ95%) and a variability of 0.5‰ (2SD, σ95%).

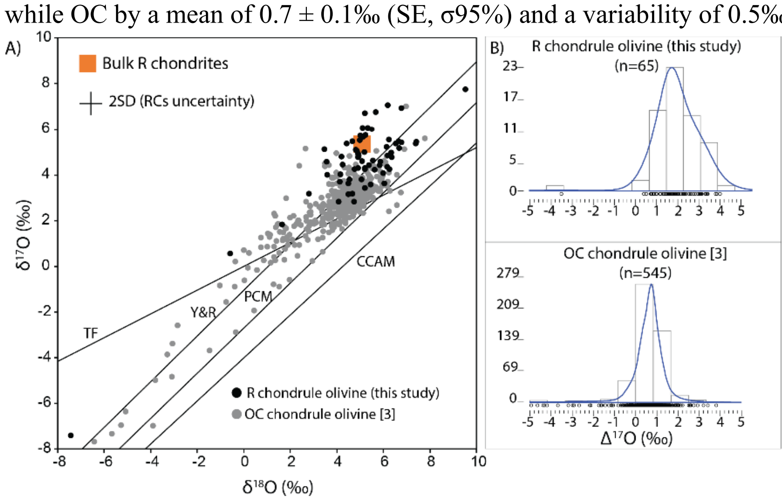

Fig. 1. A) O-isotope ratios of chondrules from R and OC. TF, Y&R [8], PCM [9], and CCAM [10] lines are shown for reference. Bulk R chondrite composition from [11]. B) KDF of chondrule olivine $\Delta^{17}O$ for R and OC.

From these characteristics the following can be inferred: 1) R chondrites accreted a majority of chondrules that formed in a location of the protoplanetary disk dominated by an O-isotope reservoir of $\Delta^{17}O$ ~1.9‰, distinctively $^{17,18}O$-richer than the reservoir of OC. 2) The chondrule forming region of R contained precursors that were more heterogeneous in terms of O-isotopes compared to OC. 3) As observed by others [5, 6, 7], R chondrules share similarities to OC chondrules. This is clear when exploring the $\Delta^{17}O$ distributions where the right tail of OC overlaps with the left tail of R chondrule olivines. 4) Based on the average compositon of chondrules from R, the shift towards $^{17,18}O$-richer compositions of bulk rock R chondrites must reside in the matrix component [2]. Compared to OC, these observations could be explained by forming R chondrites and their chondrules in environments richer in water either as ice in their feeding zone or gas in their chondrule forming region.

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