HETEROGENEOUS OXYGEN ISOTOPE RATIOS OF OLIVINE IN CHONDRULES FROM Y-793408 (H3.2) CHONDRITE.

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Introduction: Oxygen isotope ratios in chondrules in primitive meteorites generally show a range of ^{16}O enrichment [1]. Based on ^{16}O-rich relict olivine grains in chondrules, it has been suggested that the variation resulted from a reaction between ^{16}O-poor nebula gas with molten chondrules [e.g., 2]. It is expected that $\Delta^{17}O$ ($=\delta^{17}O-0.52\times\delta^{18}O$) in different phases in a chondrule would increase with a crystallization sequence, such as olivine <low Ca pyroxene < high Ca pyroxene. However, SIMS oxygen isotope analyses of Ca-pyroxene in chondrules from Semarkona (LL3.0) do not show measurable difference (<1‰) between coexisting olivine and low Ca pyroxene [3, 4]. These data are not consistent with extensive oxygen isotopic exchange with ^{16}O-poor nebula gas during chondrule melting.

Chondrules from Y-793408 (H3.2): We have reported high precision oxygen three isotope analyses of 56 chondrules from Y-793408 (H3.2), one of the least equilibrated H chondrites [5, 6]. Compared to the previous study on LL 3.0-3.1 chondrites [3], chondrules in Y-793408 show wider variation in $\Delta^{17}O$. 13 chondrules show internal heterogeneity in $\Delta^{17}O$ (≥1‰) along a slope 1 line, with lowest $\delta^{18}O$ down to -13‰. They include all types of porphyritic chondrules. In most cases, the lowest $\Delta^{17}O$ is observed from Mg-rich olivine often enriched in Al and Cr, and depleted in Mn, sharing a similar tendency with the refractory forsterite [7]. At the same time, all type I chondrules also contain olivine with high $\Delta^{17}O$ above 1‰ with maximum ~1.8‰. This is significantly higher than bulk H chondrites ($\Delta^{17}O$ ~0.7‰). The $\Delta^{17}O$ values in pyroxene analyzed from 10 chondrules do not show significant internal variation with values similar to or lower than the highest $\Delta^{17}O$ of olivine in the same chondrules.

Discussion: A wide range of $\Delta^{17}O$ among olivine grains in a single chondrule indicates that they are partial melting residues during chondrules melting events and did not exchange oxygen isotope ratios. These results suggest that solid precursors of UOC chondrules might be depleted in ^{16}O prior to chondrule forming events. Mixing of ^{16}O-rich refractory precursors would result in the observed heterogeneous oxygen isotope ratios in these chondrules. In several chondrules, $\Delta^{17}O$ values in low Ca pyroxene grains are similar to those of average olivine grains, consistent with pyroxene being crystallized from a melt in which oxygen isotope ratios were homogenized. Therefore, it is likely that oxygen isotope ratios of chondrule melt are inherited from those of solid precursors, but may not be a result of isotope exchange with nebula gas.

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