RELATIONSHIP BETWEEN FEO CONTENT AND $\Delta^{17}O$ IN CHONDRULES FROM CR CHONDRITES: LINKING OXYGEN FUGACITY AND O-ISOTOPE EVOLUTION.

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Introduction: In situ O-isotope measurements of chondrules provide clues about their solid precursors, melting history, and exchange with a gas reservoir [1,2]. We present observations which constrain the formation environment of ferromagnesian chondrules from CR chondrites, part of an ongoing study to understand the formation conditions of type-II chondrules [2,3].

Methods: We investigated chondrules from CR chondrites QUE 99177, GRA 95229, and GRA 06100. We analyzed element abundances of the olivines in 8 type-I and 12 type-II chondrules with the Cameca SX-50 electron microprobe at LPL. These same grains were analyzed with the UH Cameca ims 1280 ion microprobe for their O-isotope composition [2].

Results: O-isotope composition of olivine in type-II (>Fa_{10}) chondrules varies with the abundance of FeO-poor relict grains. Most type-II chondrules without relict grains have olivine phenocrysts with O compositions that cluster slightly above the TF line ($\Delta^{17}O$=0.2±1.0‰, 2σ). A second population (from MAC 87320 [1,2] and GRA 95229) of relict-free type-II chondrules has phenocrysts with compositions that plot below the TF line near the CCAM line ($\Delta^{17}O$=-1.6±0.5‰). Relict grains within type-II chondrules have $\Delta^{17}O$=-4.4±1.1‰, similar to olivine in type-I chondrules ($\Delta^{17}O$=-3.2±0.9‰) [2]. Type-II chondrules with FeO-poor relict grains contain both ^{16}O-rich ($\Delta^{17}O$=-2.5±1.1‰) and ^{16}O-poor ($\Delta^{17}O$=0.2±0.7‰) FeO-rich olivine.

Discussion: The FeO content of olivine and degree of melting experienced by chondrules are both related to $\Delta^{17}O$. In general FeO-poor olivine has low $\Delta^{17}O$, and FeO-rich olivine has high $\Delta^{17}O$. Type-I chondrule olivine has the lowest $\Delta^{17}O$ and FeO content. FeO-rich phenocrysts in type-II chondrules without relict grains have the highest $\Delta^{17}O$. Type-II chondrules with relicts contain olivine with both low $\Delta^{17}O$ and high $\Delta^{17}O$.

These data suggest that FeO and $\Delta^{17}O$ of olivine increased concurrently during type-II chondrule formation. FeO-poor, ^{16}O-rich precursors contributed to the final isotopic composition of type-II chondrules [2]. The oxidation states and isotopic compositions of type-II chondrule olivines may have been established by: (1) the composition of their silicate precursors, a mixture of ^{16}O-rich FeO-poor type-I chondrule fragments and ^{16}O-poor FeO-rich material; (2) exchange between the chondrule melt and an ^{16}O-poor, oxidizing gas reservoir; or (3) chondrule precursor materials such as H_2O ice or reduced carbon [2,4]. Components of these hypotheses are not mutually exclusive, and a combination of processes is plausible.

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