^{16}O-rich olivine abundances in FeO-rich chondrules and their igneous rims from CR chondrites

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Recently we have reported abundant ^{16}O-rich relict olivine grains in chondrule igneous rims that experienced only minor degrees of melting [1,2]. These ^{16}O-rich olivine grains are likely related to amoeboid olivine aggregates (AOAs) that are inferred to have formed near the proto-Sun at the birth of the Solar System, and were subsequently transported to chondrule-forming regions. Because chondrules in different chondrite groups formed in different disk regions, abundances of ^{16}O-rich relict grains in chondrules potentially provide important constraints on the efficiency of radial transport of solids. To investigate the abundance of ^{16}O-rich grains that were present in the chondrule-forming regions, we initiated studies of O-isotope distributions in chondrules and chondrule igneous rims that experienced low degrees of melting.

We studied 5 chondrules/chondrule igneous rims from CR chondrites (GRA 95229, NWA 801, Gao-Guenie (b), PCA 91082). These are texturally similar to agglomeratic olivine objects [e.g., 3,4] and are dominated by small FeO-rich olivine grains, less than ~20 μm but largely <1 μm in size. Some relatively large olivines have MgO-rich cores. Na-bearing feldspathic interstitial glass is much less abundant and pyroxenes are rare. Minor opaque minerals include Fe,Ni-sulfides and chromite. Two to five δ^{18}O isotope maps per object were obtained with the isotope microscope system [2]. The maps revealed the presence of ^{16}O-rich compositions in all objects studied. They are typically from MgO-rich cores in olivine crystals. The O-isotope boundary between ^{16}O-rich and ^{16}O-poor parts appears sharp, suggesting that ^{16}O-rich parts are relict and overgrown by ^{16}O-poor olivine crystallized from melt during formation of the chondrules/rims. Additional spot analyses were also made on some olivine grains per object and some show ^{16}O-rich compositions of ~–50‰ in $\delta^{17,18}$O, similar to those of AOAs. We conclude that AOA-like olivines were common precursors of FeO-rich chondrules in CR chondrites.

[1] Nagashima et al., *LPS* 44, abstr#1780, 2013. [2] Nagashima et al., *GCA* 151, 49-67, 2015. [3] Weisberg and Prinz, *Chondrules and the Protoplanetary Disk*, 119-127, 1996. [4] Ruzicka et al., *GCA* 76, 103-124, 2012.