OXYGEN ISOTOPIC DIVERSITY OF CHONDRULE PRECURSORS AND THE NEBULAR ORIGIN OF CHONDURLES

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FeO-poor (type I) porphyritic chondrules formed by incomplete melting of solid dust precursors *via* a yet-elusive mechanism. Two settings are generally considered for their formation: (i) a nebular setting where primordial solids were melted, e.g. by shock waves propagating through the gas and (ii) a collisional planetary setting. Here we report a new method combining high-current electron microprobe X-ray mapping and quantitative measurements to determine the chemical characteristics of relict olivine grains inherited from chondrule precursors. These olivine crystals are Ca-Al-Ti-poor relative to host olivine crystals and show variable $\Delta^{17}O$, even in individual chondrule. This is inconsistent with derivation from planetary interiors as previously argued from 120° triple junctions also exhibited by the chondrules studied herein. This indicates that chondrule precursors correspond to solid nebular condensates formed under changing physical conditions.

We propose that porphyritic chondrules formed during gas-assisted melting of nebular condensates comprising relict olivine grains with varying $\Delta^{17}O$ values and Ca-Al-Ti-rich minerals such as those observed within amoeboid olivine aggregates. Incomplete melting of chondrule precursors produced Ca-Al-Ti-rich melts (CAT-melts), allowing subsequent crystallization of Ca-Al-Ti-rich host olivine crystals *via* epitaxial growth on relict olivine grains. Incoming MgO and SiO from the gas phase induced (i) the dilution of CAT-melts, as attested by the positive Al-Ti correlation observed in chondrule olivine crystals, and (ii) buffering of the O-isotope compositions of chondrules, as recorded by the constant $\Delta^{17}O$ values of host olivine grains. The O-isotopic compositions of host olivine grains are chondrule-specific, suggesting that chondrules formed in an array of environments of the protoplanetary disk with different $\Delta^{17}O$ values, possibly due to variable solid/gas mixing ratios.