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Using Li concentration and isotopic composition to unravel the link between type I and II chondrule olivine

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Chondrules are submillimeter-sized silicate spheroids representing the major high-temperature components of primitive meteorites (chondrites). The chondrules can be classified into type I and type II chondrules based on the valence state of iron with its boundary set at magnesium number (Mg#) ≡ 100×(Molar [Mg/(Mg+Fe)]) = 90 with type I being Fe-poor and having a Mg# >90 and type II being Fe-rich with a Mg# <90. Experimental and isotopic data suggest a possible genetic link between both types of chondrules [1, 2].

To investigate the potential link between type I and II chondrules, we combine high-resolution cathodoluminescence (CL) maps with *in-situ* lithium (Li) concentration and isotopic composition measurements of two carbonaceous chondrites (Renazzo and NWA 852) and three ordinary chondrites (NWA 12581, NWA 12462, NWA 13501) that contain type II chondrules. Two type I chondrules were studied in detail as well as olivine crystals from ten type II chondrules. The δ^7Li composition in type I chondrule of Mg-rich olivine crystals range from –18.5‰ to 41.2‰ with large variability within individual crystals. In large crystals (~250µm) at the rim of the chondrules the δ^7Li composition varies from –18.5‰ to 39.9‰. In the core of the chondrules the δ^7Li composition in intermediate sized crystals (~100-175µm) ranges from –8.9‰ to 28.1‰ and in small crystals (~50-100µm) from 2.4‰ to 41.2‰. The δ^7Li composition in type II chondrule of Fe-rich olivine grains ranges from –27.8‰ to 3.9‰ with no size dependence.

The large variability of δ^7Li composition within single type I chondrule of Mg-rich olivine crystals hint at kinetic fractionation that took place at a late stage of the system. Olivine grains from the core of the chondrules exhibit smaller variations in δ^7Li. This may reflect different cooling/crystallisation behaviour and a potential exchange between a vapour phase and the olivine crystals at the rim of the chondrules. The type II chondrule with Fe-rich olivine crystals have smaller variations and therefore indicate less kinetic fractionation.

[1] Villeneuve J., Libourel H. and Soulie (2015) Geochimica et Cosmochimica Acta 160: 277–305.

[2] Villeneuve J., Marrocchi Y. and Jacquet E. (2020) Earth and Planetary Science Letters 542: 116318.