Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.5188

Origin of spinel in CV chondrules

NICOLAS SCHNURIGER[1], CAMILLE CARTIER[2], JOHAN VILLENEUVE[3], VALENTINA G. BATANOVA[4], MAXENCE REGNAULT[1] AND YVES MARROCCHI[5]

[1]CRPG, CNRS - Université de Lorraine

[2]Centre de Recherches Pétrographiques et Géochimiques

[3]Université de Lorraine, CNRS, CRPG

[4]Université Grenoble Alpes

[5]CRPG, CNRS-Université Lorraine

Presenting Author: nicolas.schnuriger@univ-lorraine.fr

In chondrites, spinel grains ($MgAl_2O_4$) are commonly observed in refractory inclusions (CAIs and AOAs), and in a lesser degree in chondrules. Several petrographic, chemical, and isotopic evidences suggest that chondrules could have formed from the melting of precursor materials similar to refractory inclusions [1, 2]. Considering the slow O diffusion rate in spinel [3] and its large stability field [4], chondrule spinels could thus be inherited from refractory inclusions. If spinels are refractory inclusions relicts, they would show ^{16}O-rich compositions compared to the other phases. Conversely, spinel could result from the crystallization of a silicate melt during the chondrule-forming event, and would have oxygen isotopes values similar to the coexisting phases (e.g., olivine).

We report a petrographic, mineralogical and oxygen isotope survey of type I chondrules in two CV3 chondrites (Allende and NWA10235) to better understand the origin of spinels in chondrules. We observed that spinels in chondrules occur as small euhedral grains in a glassy mesostase, or are poikilitically enclosed in Mg-rich olivine grains, in contact with a pocket of silicate melt. In refractory inclusions, spinel occurs as euhedral grains in CAIs or in complex association with olivine in AOAs. All grains reported were nearly pure spinel *sensu stricto*. The O-isotopic compositions of all spinels studied here plot along the PCM line. CAIs and AOAs spinels have $\Delta^{17}O$ ranging from -25.6 to -16.6 ‰ respectively. Chondrules spinels and the corresponding olivine grains have $\Delta^{17}O$ ranging from -10.9 to -4.6 ‰ and from -6.4 to -1 ‰ respectively.

In most cases, olivine and spinel gains in the same chondrule (i) are in contact with glassy mesostase and (ii) have similar $\Delta^{17}O$. This suggests that these minerals are co-magmatic, i.e., they crystallized from a single silicate melt. Consequently, trace element distribution between spinels and olivines can be used for determining the temperature of chondrule formation.

[1] Marrocchi et al. (2019) GCA 247, 121-141. [2] Schneider et al (2020) EPSL 551, 116585. [3] Tenner et al. (2018) Chondrules: Records of the protoplanetary disk processes, SS Russel (Cambridge Univ. Press, 2018), 196-246 [4] Ebel and Grossman (2000) GCA 64, 339-366