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Superheating and cooling rates effects on olivine growth in chondritic liquid: experimental and petrographic approach

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Chondrules - major constituent of chondrites (primitive meteorites) - belong to the first object formed in the solar system. They are millimetre-sized igneous objects resulting from partial to complete fusion and are divided into main families: non-porphyritic and porphyritic (Gooding and Keil, 1981); the latter one is more abundant in chondrites. This study aims to reproduce thermal histories of macro-porphyritic olivine chondrules (PO) and to better constrain (thermal, temporal) the conditions reigning in the early solar system.

In general, PO chondrules are composed of numerous euhedral crystals of olivine and/or pyroxene suggesting an initially melting below their liquidus temperatures. By contrast, in our study, the macro-porphyritic olivine chondrule displays only one large euhedral olivine. The low number of olivine crystals indicates that chondrule suffered an initial step of superheating, limiting nucleation process (Lofgren, 1988; Hewins et al., 1988). Moreover, embayments observed in euhedral olivine show that olivine crystal began to growth rapidly and then the growth-rate decreased during the cooling. Therefore, our petrographic investigation proposes a first high temperature stage (ΔT_{liq} = +10 °C) followed by a slow cooling.

To test this thermal history, experiments are performed to determine degree of superheating and cooling rate effect (i) on nucleation rate and (ii) on morphology of olivines formed during cooling. Preliminary results seem to confirm that macro-porphyritic olivine chondrules result from the slow cooling of a superheated initial chondritic liquid (Varela et al., 2006). Then these results allow to precise the beginning of the igneous processes (minimum thermal temperature and cooling rate) and to discuss the complete thermal evolution of the chondrule, by considering all other reaction textures observed in this chondrule: peritectic and oxidation reactions, quench texture and aqueous alteration.

References:

Gooding et al., (1981) Meteoritics, 16, No. I; Hewins et al., (1988) Meteoritics, 25, 309-318; Lofgren, (1988) Geochim. & Cosmochim. Ada, 50, 1715-1726; Varela et al., (2006) Icarus, 178 (2), 553–569.