# TEXTURES AND CHEMICAL COMPOSITIONS OF EXPERIMENTAL CHONDRULE SYNTHESIS BY A RADIATIVE HEATING MODEL.

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**Introduction:** A radiative heating model recently proposed may explain chondrite formation as well as chondrule formation [1]. According to this model, chondrules and chondrites formed together during a brief radiative heating event caused by the close encounter of a small (m to km-scale), primitive planetesimal with incandescent lava on the surface of a large (100 km-scale) differentiated planetesimal. In this study, we performed chondrule synthesis experiments under the condition predicted by the radiative heating model and compared synthesized chondrules with natural Type I chondrules.

**Experimental:** We prepared three starting materials as chondrule analog; (1) Globe mix, (2) Type IA chondrule composition, (3) Type IAB chondrule composition. Globe mix consists of natural peridotite xenolith from Globe, AZ that was picked, cleaned and sieved to <20 µm and mixed with similar grain size of plagioclase feldspars (Miyake anorthite and Salva Tierra oligoclase) and graphite. We prepared the bulk compositions of Type IA [2] and IAB [3] chondrule by oxide regents and $Fe^0$, respectively. Chondrule synthesis experiment was conducted for four thermal trajectories predicted by the radiative heating model (Fig. 1) using a Deltech furnace with gaseous mixtures of CO and $CO_2$ to control $fO_2$ to IW-1. Experimental charges were analyzed using Hitachi SU5000 FEG-SEM equipped with EDAX Apollo 10/X/Octane Pro SiDD for observation and chemistry.

**Result and Discussion:** The Globe mix charges are mainly composed of porphyritic olivine ($Fo_{98-99}$) with a size of 30–50 µm in diameter, glass, and small amount of low-Ca pyroxene. There is little difference of texture and chemical composition among thermal trajectories. The IA charges have numerous smaller porphyritic olivines ($Fo_{97-98}$) with ~10 µm in diameter for NG4a, 5a and 6a and ~20 µm in diameter for 7a. The olivines often include tiny chromite. Chromite outside olivines are larger and sometimes form aggregate. Chemical compositions of glass in Globe mix and IA match well with average composition of glass in Semarkona Type I chondrule. The IAB charges are variable in texture among thermal trajectories. Olivine grains in NG4a, 5a and 6a has a massive shape with ~100 µm in diameter and cylindrical shape with various width and length, whereas olivines in NG7a show barred shape. Pyroxenes grow from olivines as dendritic. The dendritic pyroxenes in NG4a are coarser than those in NG5a and 6a. Chromite grains are attached to pyroxenes. The chromites in NG6a and NG7a are dendritic. Chemical compositions of glass in IAB charges are slightly depleted in MgO, $Al_2O_3$ and CaO. A lot of tiny bubbles exist into glass in NG6a and 7a.

Porphyritic olivines in IA charges seem to be slightly smaller than those of natural Type I PO chondrule because of small grain size of starting materials [4]. It infers that it might be difficult to produce porphyritic olivines with similar size to natural PO chondrule directly from fine grains such as matrix materials by the single heating event. In spite of fine grain size of starting materials, IAB charges have similar grain size of natural Type IAB chondrule though our pyroxenes are dendritic.

**References:** [1] Herbst W. and Greenwood J. P. (2019) *Icarus* Accepted, in press. [2] Jones R. H. and Scott E. R. D. (1989) *Proc. Lunar Planet. Sci. Conf. 19th*, pp. 523–536. [3] Jones R. H. (1994) *Geochim. Cosmochim. Acta*, 58, 5325–5340. [4] Fox G. E. and Hewins R. H. (2005) *Geochim. Cosmochim. Acta*, 69, 2441–2449.

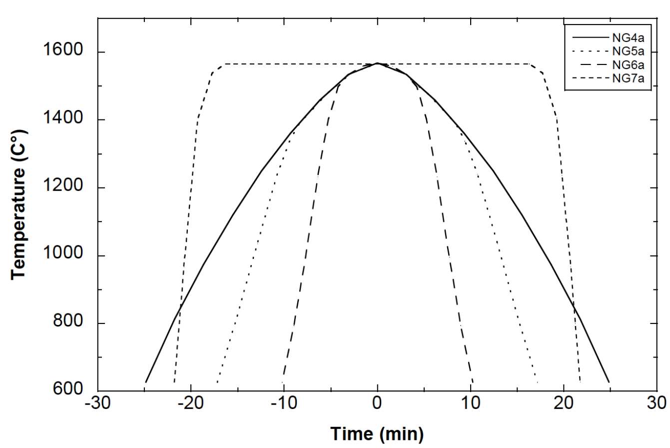


**Fig. 1** Thermal trajectories predicted by the radiative heating model [1] used in this study.