EXPERIMENTAL SIMULATION OF CHONDRULE TEXTURES USING SYMMETRICAL HEATING AND COOLING RATES: TESTING THE RADIATIVE MODEL FOR CHONDRULE FORMATION. J. P. Greenwood[1] and W. Herbst[2], [1]Dept. of Earth & Environmental Sci., Wesleyan University, Middletown, CT 06459 USA (jgreenwood@wesleyan.edu), [2]Astronomy Dept., Wesleyan University, Middletown, CT 06459 USA

Introduction: We have recently proposed a model for chondrule formation involving the passage of dust aggregates during close fly-bys of planetesimals with exposed magma at the surface [1]. This model predicts symmetrical heating and cooling of chondrule precursor materials to make chondrules and possibly the chondrites themselves [1,2] (Fig. 1). A reasonable first test of this model is to simulate chondrule textural types under predicted thermal histories, which involve heating chondrule precursor materials to <2000 K for hours or less on symmetrical heating and cooling paths (Figs. 1,2).

Experimental Methods: We began this program of chondrule simulation experiments following the initial experimental protocols of Radomsky and Hewins [3], wherein they used sieved size fractions of minerals to match Type I and Type II chondrule compositions [4]. Specific experimental configuration: Deltech VT-31 furnace w/ Eurotherm 2404 16-step programmable temperature controller; CO_2/CO to keep fO_2 near IW; Temperature monitored with calibrated Pt-Pt13%Rh thermocouple next to the experimental charge, w/ high purity Fe next. Initial experiments were done in open Pt capsules. Chondrule analog compositions are made with a mixture of olivine, pyroxene, plagioclase, and diopside, following [3,4]. Specifically, Type I: 70% San Carlos olivine, 10% bronzite porphyry, 10% diopside, and 10% oligoclase; Type II: 70% Fayalite-rich slag (containing cm-sized Fa100 bars), 10% bronzite porphyry, 10% diopside, and 10% oligoclase. Purity of these phases will be improved.

Initial Results: Using the heating and cooling curve shown in Fig. 2, we have produced textures similar to those seen in chondrules for both FeO-rich (Barred Olivine) and FeO-poor compositions (Porphyritic Olivine). The FeO-rich Type II analog developed a texture of long fayalite-rich olivine bars and glass, for two grain-size fractions (45-63 µm; 63-125 µm). The FeO-poor, Type I composition developed a porphyritic texture, with relict grains, that was similar to chondrule textures for several size fractions (32-63 µm; 63-125 µm).

Future Work: We will continue to experiment with different size fractions of two analog compositions (Type I and II) and a range of heating and cooling paths to determine which produce chondrules, as well as which thermal paths fail to produce chondrule textures, to further refine our model. We will also try different chondrule precursor assemblages, such as granular olivine aggregates [5,6], finer grain sizes than have previously been employed, and increased level of purity of precursor minerals. We also hope to explore 'dirty snowball' precursors as well.

References: [1] Herbst W. and Greenwood J. P. (2016) *Icarus, 267,* 364–367. [2] Herbst W. and Greenwood J. P. (2017) *This meeting.* [3] Author G. H. (1996) *LPS XXVII,* 1344–1345. [3] Radomsky P. and Hewins R. H. (1990) *GCA, 54,* 3475-3490. [4] Connolly Jr. H. C. et al., (1998) *GCA, 62,* 2725-2735. [5] Libourel G. and Krot A. N. (2007) *EPSL,* 254, 1-8. [6] Whattam S. A. and Hewins R. H. (2009) *GCA, 73,* 5460-5482.

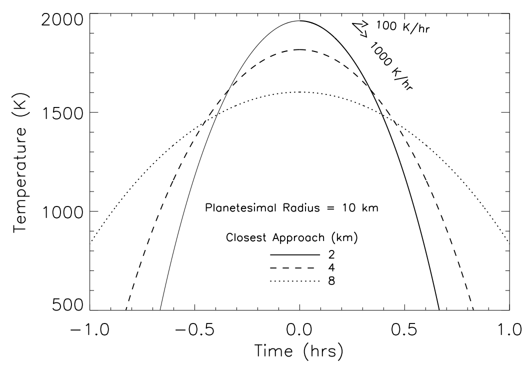

Figure 1. Calculated heating and cooling curves of dust aggregates on a model fly-by of a 10 km planetesimal with exposed magma at its surface.

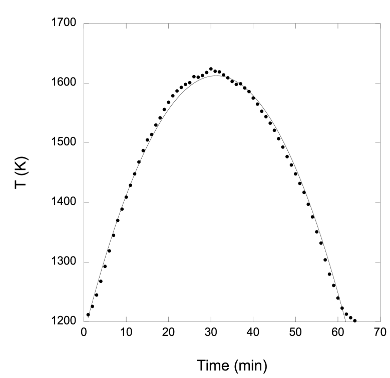

Figure 2. Heating and cooling curve of experiment S2. Solid curve is a 2[nd] order polynomial fit; points are temperature measurements of thermocouple next to experiment in hot zone of furnace.