DYNAMIC CRYSTALLIZATION EXPERIMENTS ON CHONDRULE MELTS OF RADIAL PYROXENE COMPOSITION. Lofgren, G. E., NASA/JSC, Houston, TX 77058, Kinnebrew, Q., LEMSCO, Houston, TX 77058, and Russell, W. J., LPI, Houston, TX 77058.

Dynamic crystallization experiments have been performed on a synthetic analog of a radial pyroxene chondrule composition. Previous work on a similar composition material by Hewins et al. (1981) demonstrated the strong relationship between the size and composition of the dendrites in radial pyroxene chondrules and cooling rate. Hewins was attempting to reproduce the textures of chondrules in Manych (LL3 chondrite), but reproduced only those with a radial texture. Hewins suggested that a broader range of cooling rates than they explored or other effects such as heterogeneous nuclei of the type studied by Lofgren et al. (1978) were important. It is the purpose of this study to systematically explore the effects of heterogeneous nucleation and a broader range of cooling rates.

Two starting materials have been prepared: one by mixing oxides (CH-3); the other by mixing minerals (RP). The final compositions are close, but not identical. The object is to have a glassy or nearly glassy (material was quenched to a very fine spherulitic texture) and totally crystalline (with a variety of minerals) starting materials. The minerals used are olivine (Fo_{92}), enstatite ($En_{84}Fs_{15}$), bytownite (An_{77}), albite (An_9), and magnetite. Both materials were finely ground. Run procedures are as described by Lofgren (1983). Pt-wire loops were plated with iron to reduce Fe loss. Matrices of runs were completed which encompassed melt temperatures both above and below the liquidus temperature and cooling rates of 5, 100, and approximately 2500 to 3000°C/hr. Orthopyroxene is the liquidus phase and olivine was present just below the liquidus in both starting materials.

The textures in the run products vary from granular to porphyritic (Fig. 1), to dendritic where a single dendrite comprises the entire charge (Fig. 2), to radial (Fig. 3) and sometimes excentroradial. This broad range of textures is as much a function of the presence or absence of nuclei (melt temperature) as cooling rate. The entire range of texture is present at a single coooling rate as a function of melt temperature as well as at a single melt temperature as a function of cooling rate.

Despite the marked differences in the physical state of the starting materials, the textures show only modest differences. For the porphyritic textures, the phenocrysts are less skeletal or not skeletal at all and the radial fibrous textures are much finer grained when the mineral mix (RP) was used. This similarity of textures is probably the result of the crystalline nature of the CH-3 starting material (albeit very fine-grained) rather than a lack of difference in the behavior of glassy vs. crystalline starting materials. Olivine phenocrysts are present in runs cooled slowly from a complete melt in the CH-3 composition while olivine phenocrysts are not present in the RP composition. This difference is probably more a function of slight compositional differences between the starting materials than their physical makeup. Gravity obviously has a marked effect in that phenocrysts sink to the bottom of the charges.

There is one obvious conclusion. A number of the textures present in pyroxene-rich chondrules can be reproduced at a single cooling rate by modest changes in the temperature of melting (and by extrapolation from a previous study on basalt, time of melting, Lofgren, 1983). The entire range of textures can be reproduced within the conditions of the experiments conducted. This does not restrict the cooling rates which could be faster (until glasses are produced) or slower. The importance of nuclei derived most readily from preexisting crystalline material supports an origin based

on remelting of crystalline material.

REFERENCES: Hewins, R. H. et al. (1981), Proc. Lunar Planet. Sci., 12B, 1123-1133. Lofgren, G.E. (1983), J. Petrol., 24, 229-255. Lofgren, G.E. et al. (1978), Proc. Lunar Planet. Sci. Conf. 9th, 959-975.

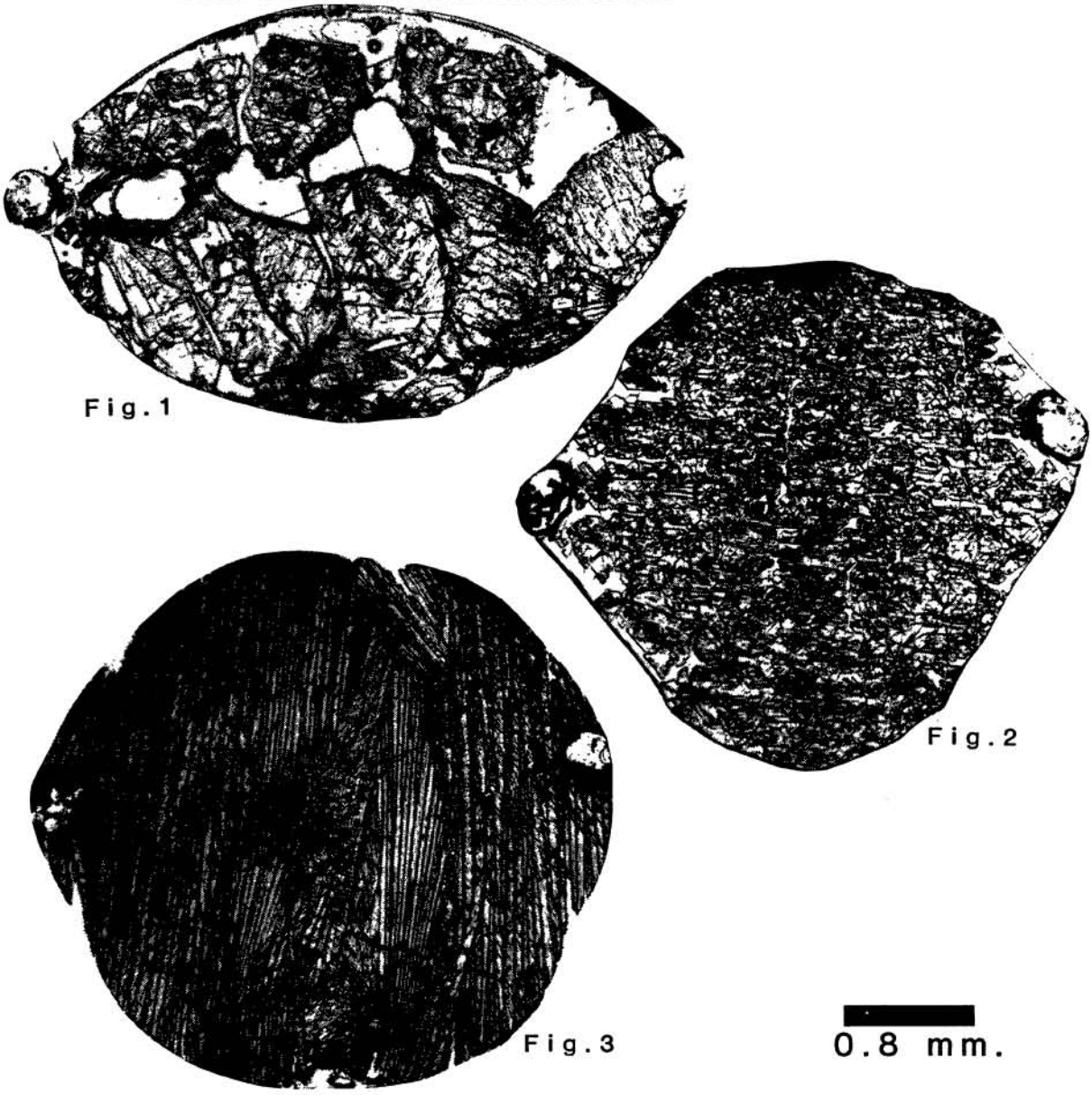

Figure 1. Porphyritic pyroxene texture with large equant pyroxene phenocrysts (melted at 1435° C for 17 hrs., cooled at 5°C/hr.; RP composition).
Figure 2. Dendritic texture in which a single pyroxene dendrite comprises the entire charge (melted at 1485°C for 17 hrs., cooled at 100 °C/hr.; CH-3 composition).
Figure 3. Radial pyroxene texture comprising an intergrowth of spherulitic and dendritic pyroxene (melted at 1450°C for 17 hrs., cooled at 3550°C/hr.; CH-3 composition).