DYNAMIC CRYSTALLIZATION CHARACTERISTICS OF ADOR: COMPOSITIONAL VARIATIONS; Gary Lofgren, SN-2 NASA Johnson Space Center, Houston, TX 77058; and A. B. Lanier, LESC, 1830 NASA Rd. 1, Houston, TX 77258.

INTRODUCTION: Previous work using a synthetic Angra Dos Reis (ADOR1) composition showed that phenocrysts of fassaite will grow readily and rapidly under optimum growth conditions (1). Because fassaite phenocrysts can grow readily, a porphyritic texture resulting from a volcanic or hypabyssal origin is possible giving credence to the model proposed by Treiman (2). Showing that a volcanic origin is possible does not negate the cumulate model of Prinz et al. (3). Several problems remained with the attempt to experimentally reproduce ADOR with a volcanic-like cooling history. Olivine, present in ADOR, was not present in the experiments on ADOR1. Conversely, a pyroxferroite like phase was present in the experiments, but not in ADOR. Because the composition used in the original study was a silica rich extreme for compositions reported for ADOR (Table 1), we used a second composition (ADOR2) from the low silica extreme of the reported compositions (Table 1) to determine (a) if olivine would be stabilized and (b) if the pyroxferroite like phase would persist.

RESULTS: A limited set of cooling experiments were preformed at a cooling rate of 5°C/hr and a range of melting temperatures from 1265 to 1350°C. The experimental conditions are identical with those used by Lofgren and Lanier (1). The textures of the charges are intergranular (Fig. 1A) with melt temperatures between 1265-1305°C. Large skeletal phenocrysts (Fig. 1B) appear only when the material is melted at 1330°C, which is approximately 60°C above the liquidus. Dendrites form when the melting temperature is 1350°C (Fig. 1C). Thus, there is only a small range of melting temperatures at which the large skeletal crystals (potential phenocrysts) form before fassaite dendrites become stable. This small interval is only approximately 20°C, compared to the approximately 60°C interval in the original ADOR1 composition (1).

For both low- and-high silica ADOR compositions, the minor phases are essentially the same. However, in ADOR2 high Ca olivine is stabilized as a primary phase, (Table 1) and the amount of the pyroxferroite-like phase is reduced. While the Ca-rich olivine is similar in composition (although lower in CaO) to the patches in the kirschsteinite reported by (1), the olivine appears to be an inclusion, not a patch which resulted from exsolution or simultaneous growth. An annealing experiment at 1000°C for 14 days was conducted on an ADOR1 charge cooled from 1265°C at 5°C/hr. This annealing period did not measurably alter the fassaite or the matrix phases other than enabling a general coarsening of the grain size.

SUMMARY AND CONCLUSIONS: The problems encountered with the ADOR1 composition have been mitigated by using the less silica-rich ADOR2 composition, but not eliminated. These experiments have shown that rare Ca-rich olivine does occur and that the stability of the pyroxferroite like phase is significantly reduced. The crystallization characteristics, however, change significantly. With this low-silica composition, the formation of a porphyry still possible, but less likely. If a porphyry origin is correct, subsequent metamorphism must play a significant role in modifying the texture and mineralogy. Moreover, the metamorphic event must be longer than the annealing experiment conducted for 14 days at 1000°C.

REFERENCES: (1) Lofgren G.E. and Lanier A.B. (1990) Lunar and Planetary Science XXI, 714-715. (2) Treiman A.H. (1989) Proc. Lunar Planet. Conf. 19th, 443-450. (3) Prinz et al. (1977) Earth Planet. Sci. Lett., 317-330. (4) Mittlefehldt D.W., Lindstrom M.M. and Lindstrom D.J. (1990) Geochim. Cosmochim. Acta 54, 3209-3218.

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Table 1. Average ADOR compositions obtain from the literature, the two starting compositions used in this study, and the Ca-rich olivine found in the matrix of the ADOR2 crystallization experiments.

OXIDE	ADOR 1	ADOR 2	ADOR1 START	ADOR2 START	Ca-rich Olivine
SiO_2	42.93	43.7	44.29	42.01	36.19
TiO_2	2.46	2.05	1.97	2.60	0.12
Al_2O_3	9.82	9.35	9.25	9.81	0.13
FeO	9.21	9.4	10.20	9.95	32.28
MnO	0.08	0.10	0.09	0.08	0.40
MgO	11.41	10.8	10.52	11.19	28.60
CaO	23.64	22.9	23.00	22.94	3.44
Na_2O	0.04	0.03	0.03	n.d.	0.01
Cr_2O_3	0.27	0.21	0.21	0.18	0.05
P2O5	0.13	0.13	0.13	0.13	n.d.
TOTAL	100.0	98.68	99.70	98.90	101.25

ADOR 1 — From Treiman (2), silica by difference
ADOR 2 — From Mittlefehldt and Lindstrom (4)
ADOR1 START — Attempt to duplicate Mittlefehldt composition
ADOR2 START — Attempt to duplicate Treiman composition

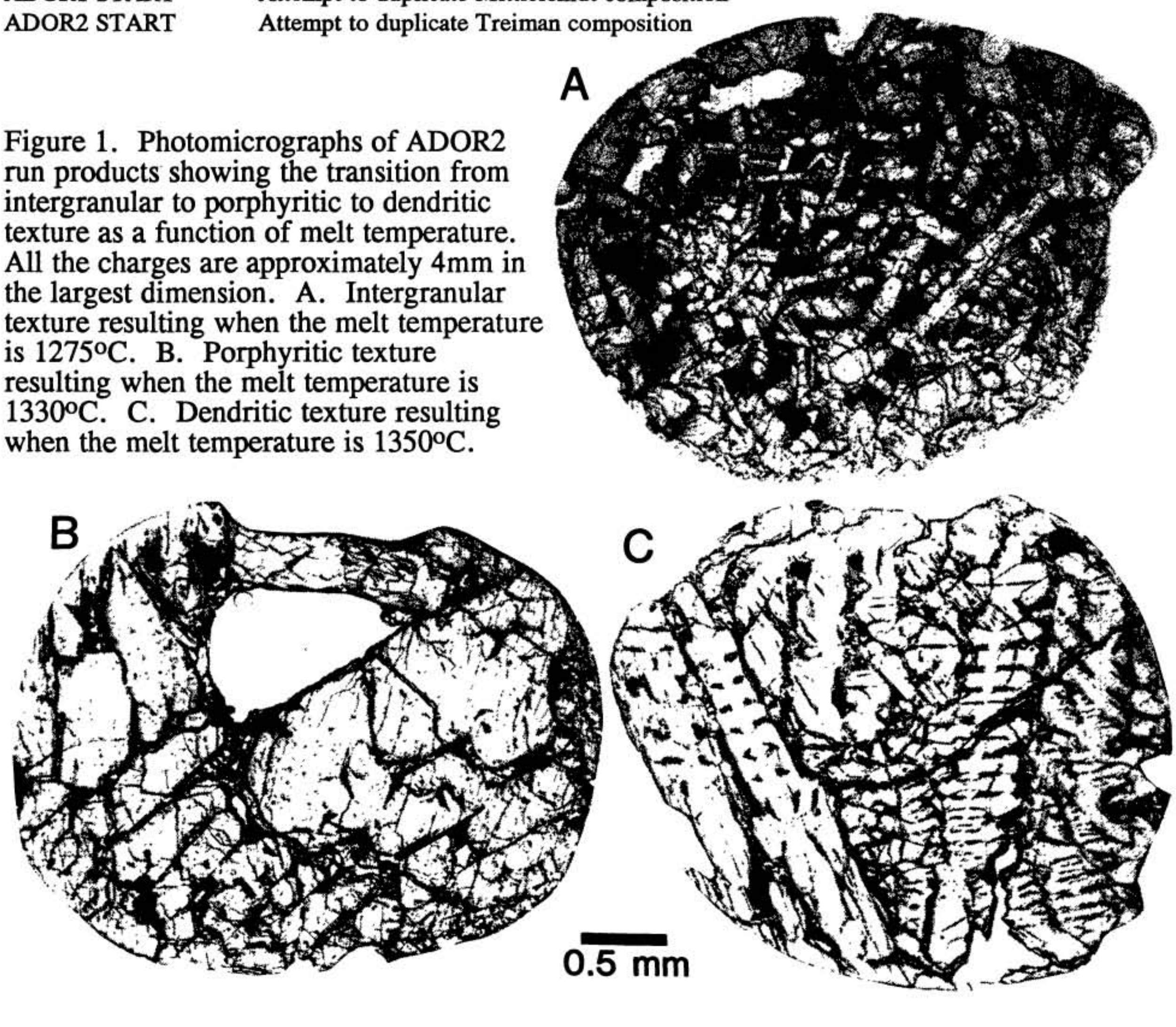

Figure 1. Photomicrographs of ADOR2 run products showing the transition from intergranular to porphyritic to dendritic texture as a function of melt temperature. All the charges are approximately 4mm in the largest dimension. A. Intergranular texture resulting when the melt temperature is 1275°C. B. Porphyritic texture resulting when the melt temperature is 1330°C. C. Dendritic texture resulting when the melt temperature is 1350°C.