DYNAMIC CRYSTALLIZATION STUDIES ON TWO OLIVINE THOELIITE FLOWS: SIMILARITIES AND DIFFERENCES. Russell,W.J., LPI, Houston, Tx. 77058, Lofgren,G.E., NASA-JSC, Houston, Tx. 77058.

Dynamic crystallization experiments were conducted on two olivine tholeiite flows(2M and 3M) from the Taos volcanic field, New Mexico. This study is modelled after and the experimental methods are the same as reported by Lofgren (1983) except that in this study Pt loops were iron plated to minimize iron loss(Grove,1981). The purpose of this study was to compare and contrast the crystallization behavior of three closely related flows. The runs duplicate only a portion of the matrices completed by Lofgren, i.e., only for a single melt time (7 hr.) and a single cooling rate(2°C/hr.). Melt temperatures ranged from 1180°C to 1220°C.

Olivine is the liquidus mineral in both samples; the disappearance temperatures are 1225°C and 1205°C for the 2M and 3M samples respectivley. The disappearance temperature of plagioclase was recorded at 1190°C for both samples. The higher disappearance temperature of olivine in the 2M sample is apparently due to a slightly higher MgO content.

Three distinct textures were produced (Fig.1). The transition from one texture to another is abrupt. At the highest melt temperatures parallel growth dendrites and skeletal olivine are enclosed in a matrix of glass(Fig.1a). At melt temperatures below these, but above the 1190°C, the textures are intersertal in which the plagioclase crystals are elongate and skeletal(Fig.1b). Spherulitic, composite branching (Mackenzie et al, 1982) and intergranular cpx is present. Olivine is present as both equant phenocrysts and fine dendrites. At melt temperatures at or below the disappearance temperature of plagioclase, the texture remains intersertal, but the plagioclase is stubby and more equant and consequently does not form a true fretwork(Fig.1c). Scattered olivine phenocrysts are present. Clinopyroxene is intergranular in character. Intersertal glass is still present.

These textures are remarkably similar to those produced by Lofgren(1983) in the closely related 7M flow from the Taos volcanic field. The similarity of results demonstrates the value of the experimental technique for studying crystallization histories of basalt flows and suggest a degree of consistancy in heterogeneous nucleation.

In spite of the fact that the 2M flow has a liquidus temperature approximatly 20°C higher than that of the 3M, the transitions between textures occur at approximatly the same temperature. This is consistent with Gibb's(1974) results and reinforces the idea of Lofgren(1983) that the texture of basalts is predominantly controlled by the density of plagioclase nuclei prior to cooling. Using the disappearance temperature of plagioclase as a guide, one can impose limits on the melt history and extrusion temperature of a basalt flow.

As shown by Lofgren(1983), and further confirmed here, basaltic textures are controlled largely by melt history. The melt history controls the variety and abundance of heterogeneous nuclei. Because plagioclase has a reluctance to nucleate on substrates other than itself or other similar complex tectosilicates, the presence and density (number per unit volume) of plagioclase nuclei is important in determining texture.If no plagioclase nuclei are present prior to cooling then no plagioclase will grow (at cooling rates of 2°C/hr. or greater). If there is a low density of plagiocase nuclei present in the melt a loosely arranged fretwork of large elongate,skeletal plagioclase crystals result. An abundance of nuclei results in an abundance of smaller, stubby crystals. The transition from elongate, skeletal to smaller stubby plagioclase crystals illustrates the effects of supercooling

on crystal shape (Gibb, 1974; Lofgren, 1974). The reluctance of plagioclase to nucleate leads to growth at a high degree of supercooling, thus the elongate, skeletal shapes.

References: Gibb,F.G.F.(1974)Mineral.Mag.,39,641-653. Lofgren,G.E.(1983) J.Petrol., 24,229-255. Lofgren,G.E.(1974) Amer.J. Sci., 274,243-273. Mackenzie,W.S.,et al.(1982) Atlas of Igneous Rocks and Their Textures. Halsted Press, John Wiley and Sons, New York.

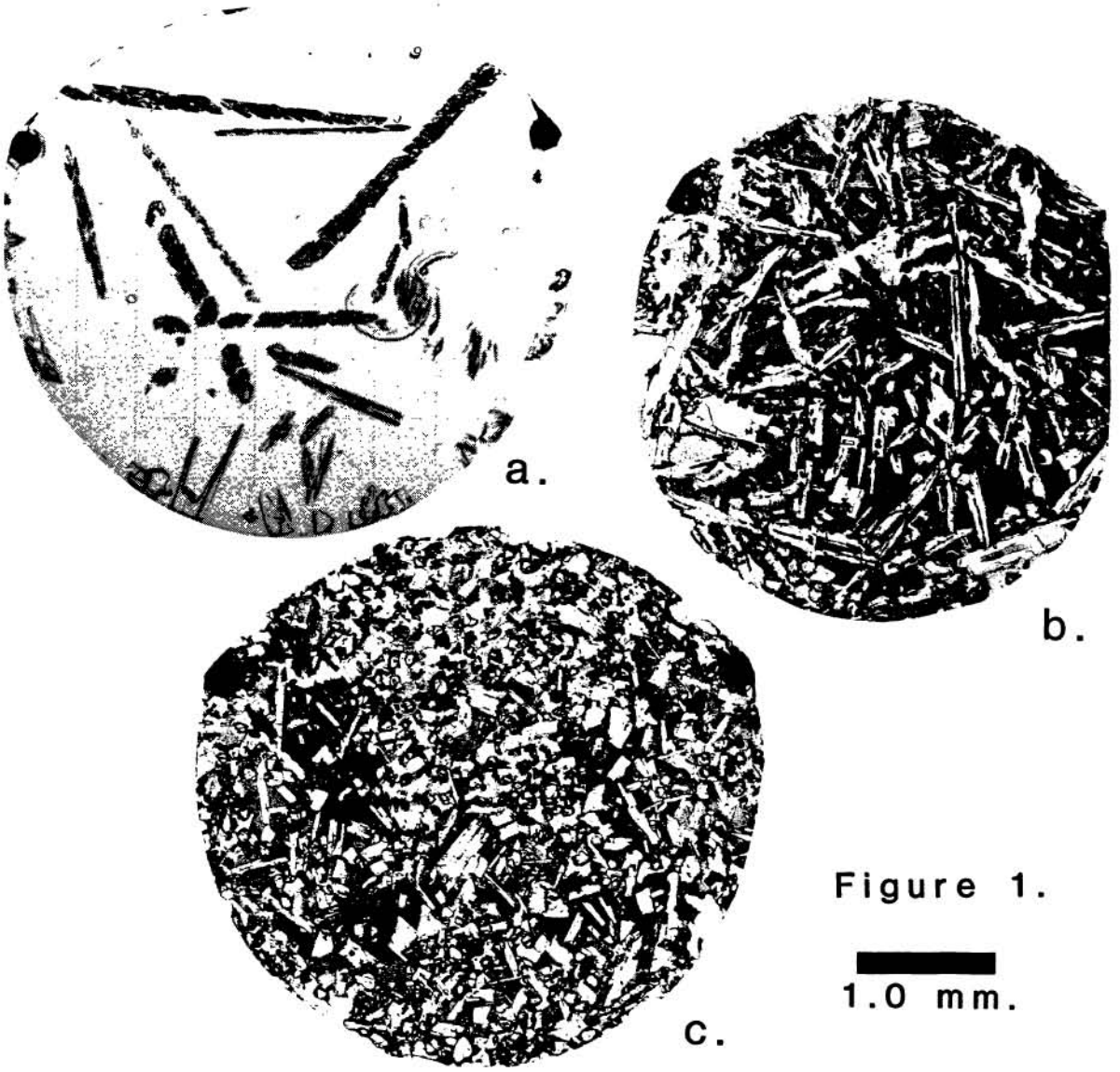

Figure 1. a) Skeletal and dendritic olivine are enclosed in matrix of glass (melted for 7 hr. at 1210°C before cooling at 2°C/hr.). b) Texture is intersertal with elongate and skeletal plagioclase crystals (melted for 7 hr. at 1200°C before cooling at 2°C/hr.). c) Texture is intersertal with stubby, equant plagioclase crystals consequently lacking a fretwork (melted at 1180°C for 7 hr. before cooling at 2°C/hr.).