Crystal Stratigraphy of the Apollo 12 pigeonite basalt suite

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Abstract. In this study we examine the Apollo 12 pigeonite basalts using crystal size distributions (CSDs), and mineral chemistry (major and trace elemental abundances) of pyroxene crystals in samples 12007, 12017, 12019, 12039, 12043, 12052, and 12053. Determining the stratigraphy of individual crystals within a sample allows for detailed petrogenetic modeling of the sample as the crystals grew and allows an indepth evaluation of basalt formation beyond what whole-rock analysis can give. We model data obtained using equilibrium, fractional, and in situ crystallization.

Methods. CSDs are calculated from the length, width, and area of crystals of a certain phase, and are plotted as the population density versus corrected crystal length. Crystals of a particular phase are traced in *Photoshop*, and processed with *Image Tool*, *CSDslice*, and *CSDcorrections* [1,2,3]. CSDs allow for identification of multiple crystal populations, and thus can guide elemental work. Major elements are obtained via a *JEOL JXA-8200* electron microprobe, and trace elements are obtained via *New Wave* 213nm ND-YAG laser ablation system and an *Element 2* ICPMS. Modeling is conducted using parental liquids calculated from crystal core compositions and the appropriate model method (equilibrium, fractional, or in situ crystallization).

Results and Discussion. Pyroxene compositions are plotted in Figure 1. Crystals start crystallizing as Mg-rich pigeonite, evolve to augite, then to Fe-rich pigeonite. Pyroxene major and minor element data also indicate when other phases (plagioclase, ilmenite) crystallized. Figure 2 shows the Rare Earth Element profiles for all samples. Sub-parallel profiles are consistent with closed system processes during crystallization.

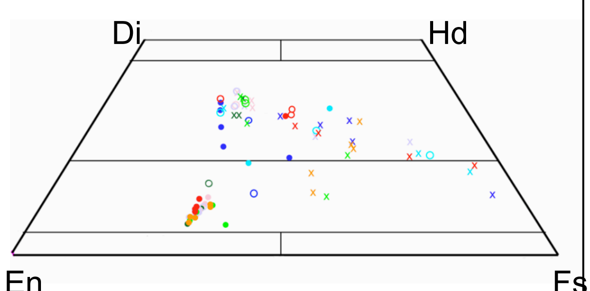

Figure 1. Major element compositions of pyroxene crystals. Red-12007, Orange-12017, Light Green- 12019, Light Blue- 12021, Dark Blue- 12039, Purple- 12043, Pink- 12052, Dark Green- 12053. Cores are solid circles, middles are open circles, and rims are X's.

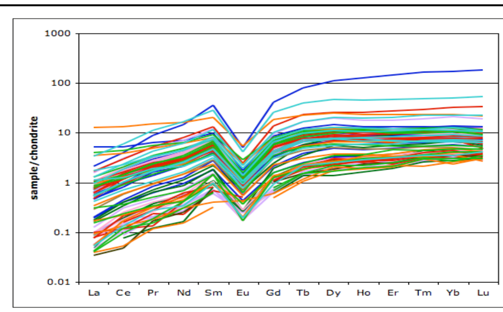

Figure 2. Rare Earth Element plot of all samples in this study. Same coloring scheme as figure 1.

References. [1] Marsh B. (1988) *Contrib. Mineral. Petrol.* **99**, 277-291. [2] Marsh B. (1998) *J. Petrol.* **39**, 533-599. [3] Higgins M. (1996) *J. Volcan. Geotherm. Res.* **70**, 37-48.