CRYSTAL SIZE DISTRIBUTION OF PLAGIOCLASE IN BASALT GRAINS FROM LUNA 16.

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Introduction: Crystal Size Distribution (CSD) data are a valuable tool for evaluating the crystallization histories of igneous samples [1-3]. Plotting the CSD slope and y-intercept data for minerals from different samples can identify different crystallization histories and origins, and it may also help provide constraints on whether some basaltic lunar meteorites represent impact melts [4]. This study applies CSD techniques to basaltic regolith material obtained by Luna 16 from Mare Fecunditatis in 1970. Luna 16 samples have been examined texturally (e.g., [5-9]), but this is the first study to use a quantitative method for textural analysis. Another abstract in this meeting examines the ilmenite CSDs of these grains [10].

Methods: CSD data for this study was collected similarly to that described in [4] with slight variations. Here, BackScattered Electron (BSE) images were used in conjunction with false color images representing chemical composition to identify crystals. Once the crystal traces were completed the BSE and false color images were removed from the background and the crystal traces were filled-in with a solid color. Those images were exported to *ImageJ*©, where the known scale of the images was used to determine the area, best-fit ellipse, and major/minor axis of each crystal and the sample area itself. These data were then input to *CSDSlice* [2] and *CSDCorrections* [3]. This determined the overall shape and size distribution of the crystals. *CSDCorrections* measurement options were set to Ellipse Major Axis and the size scale was five bins per decade. The resulting data were used to plot the natural log of population density versus the length of each crystal's major axis (Fig. 2), and the slope and y-intercept data from these plots were used to compare the CSDs with Apollo mare basalt samples (Fig. 3). The rules devised by [4] regarding omitting crystals below 0.3 mm in length could not be followed in this study, as these crystals were smaller than 0.3 mm (Fig. 1). However, the BSE imagery allowed accurate determination of these smaller populations such that the remaining rules [4] could be followed.

Results and Discussion: All samples are fine grained, but the plagioclase CSD data for grains 288 and 305 have steeper slopes and higher y-intercepts than were measured in grains 289 and 349. This indicates that samples 288 and 305 contain slightly smaller plagioclase crystals than 289 and 349. Steeper CSD profiles and higher y-intercepts are consistent with rapid cooling (fine-grained textures) and high nucleation

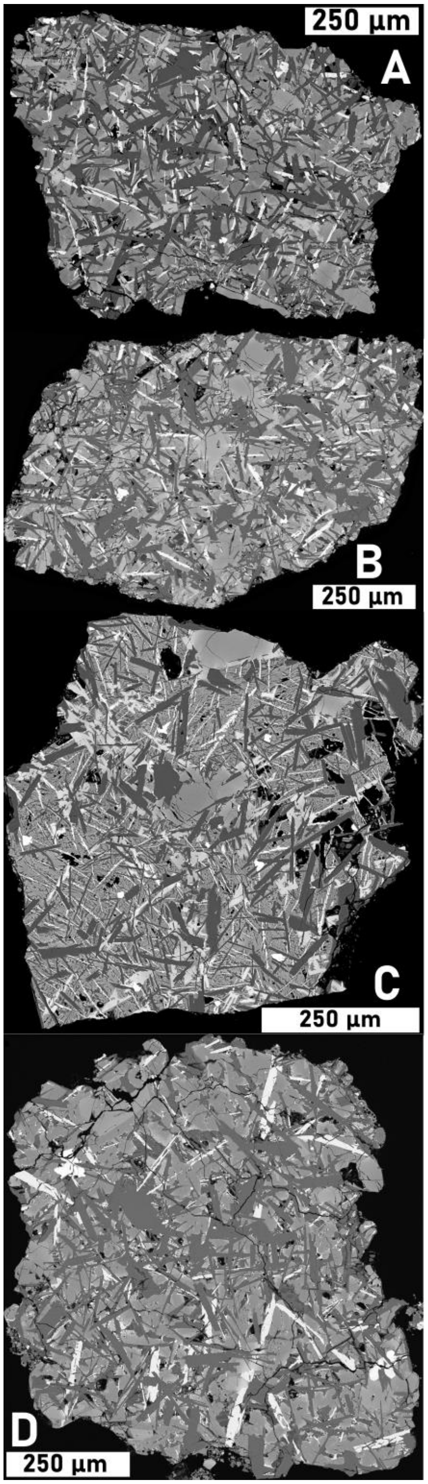

Figure 1. Backscattered Electron (BSE) images of Luna 16 regolith basalt grains (A) gr-288 (B) gr-289 (C) gr-305 (D) gr-349

densities (y-intercept) indicates the magma was close to plagioclase saturation upon eruption.

As noted above, the BSE images allowed for accurate plagioclase CSD data to be acquired for crystals smaller than 0.3 mm. In this study, plagioclase crystals smaller than 0.1 mm were manually traceable, without a reduction in data quality until crystal length decreased below about 0.08 mm. Previous studies have not been able to capture plagioclase CSD data for such fine-grained samples, so the addition of these Luna 16 basaltic grains significantly expands the field of plagioclase CSD data for lunar basalts (Fig. 3). The Luna 16 data extend the high-Al basalt data defined by Apollo 14 basalts and together they define a faster cooling trend. Generally, plagioclase data from other Apollo mare basalts define a slower cooling trend (Fig. 3). We interpret the former as indicating rapid cooling/quenching and the latter represent a change to a slower cooling regime where textural coarsening could occur (cf. [10,11]).

Conclusions: Quantitative textural analysis utilizing BSE images allows a higher fidelity CSD to be created. This allows for CSD data to be gathered for fine-grained samples that previously could not have been studied and allows for much greater expansion of CSD datasets. Data from Luna 16 basalts show rapidly cooled textures from the edges of a lava flow. Further expansion of this Luna 16 dataset is required in order to examine a larger range of CSDs, although this is limited by sample size.

Combined with plagioclase CSD data from other lunar basalts, the Luna 16 data help define a faster cooling trend with Apollo 14 high-Al basalts when CSD slope is plotted again intercept (Fig. 3). The majority of other basalt data form a slower cooling trend. The former is due to rapid cooling/quenching upon eruption. The latter represents a change to slower cooling where textural coarsening may also occur, fundamentally changing the CSD profile.

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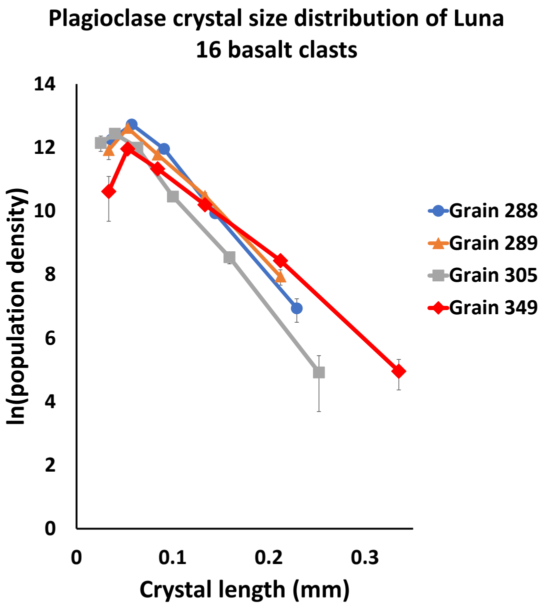

Figure 2. Plagioclase CSDs from this study. If error bars are not visible then they are within the area of the symbol.

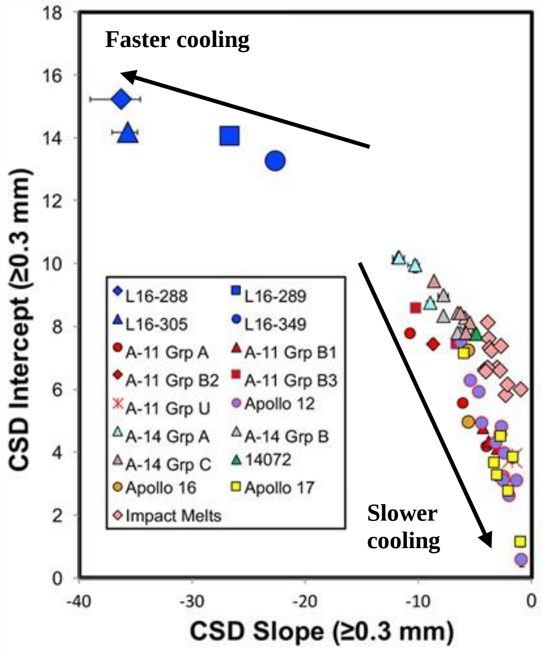

Figure 3. A plot of plagioclase CSD slope vs y-intercept (as used in [4]). The fine-grained Luna 16 samples define a faster cooling trend.