NEW INSIGHTS INTO VHK PETROGENESIS THROUGH QUANTITATIVE TEXTURAL ANALYSIS.

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Introduction: Polymict breccias returned from the Fra Mauro by the Apollo 14 mission yielded a unique rock type collected on the Moon, very high potassium (VHK) basalts (e.g., [1]). VHK basalts are similar to the Apollo 14 high-Al (HA) basalts (e.g., [2, 3]) but they have K_2O abundances > 0.5 wt%, K_2O/Na_2O >1, and K/La ratios between 500 and 1300. The unique K enrichment observed in the VHKs is problematic when trying to create the composition of VHKs through partial melting and/or fractional crystallization [4]. Four separate studies of the 16 known VHK basalt samples have produced several hypotheses for the formation of these enigmatic basalts [1, 4-6]. The hypotheses all consider the similarities that VHKs have to HA basalts and involve HA magmas as a parental magma. The difficulties in identifying the petrogenetic source of the VHKs has questioned the pristine nature of VHK basalts because at least one sample contains elevated abundances of highly siderophile elements (HSE) [4].

Quantitative textural analysis [7-11] is providing an alternative method in determining the petrogenesis of lunar mare basalts [12,13]. Crystal size distributions (CSDs) compare the number of crystals and crystal size to the area of the sample displayed in a gven thin section [e.g. 7-9]. Diagrams of the natural logarithm of the population density against the crystal size result in a negative correlation, the slope and linearity of which provide information into the crystallization histories. The CSD method has also been applied in determining pristine melts from the lunar interior from impact melts [12,13]. Here plagioclase CSDs of 4 VHK basalt clasts from breccia 14304 and 1 from breccia 14305 are analyzed to further investigate into the petrogenesis of VHK basalts.

Samples and Methods: The samples used for this study show a variety of textures, characteristic of VHK basalts (Figure 1). Sample 14304,187 is a coarse grained basalt with ophitic texture and large euhedral to subhedral plagioclase up to 1mm long. 14304,189 is a granulated basalt with large pyroxenes ≥1mm in length and plagioclase 0.5 mm long. 14304,203 is a fine-grained basalt with acicular and corroded plagioclase up to 0.5mm in length. 14305,388 is a coarse grained basalt with an intergranular texture. Acicular plagioclase up to 1mm in length are curved and exhibit a flow texture around attached breccia matrix. 14304,245 contains large tabular plagioclase up to 0.5mm.

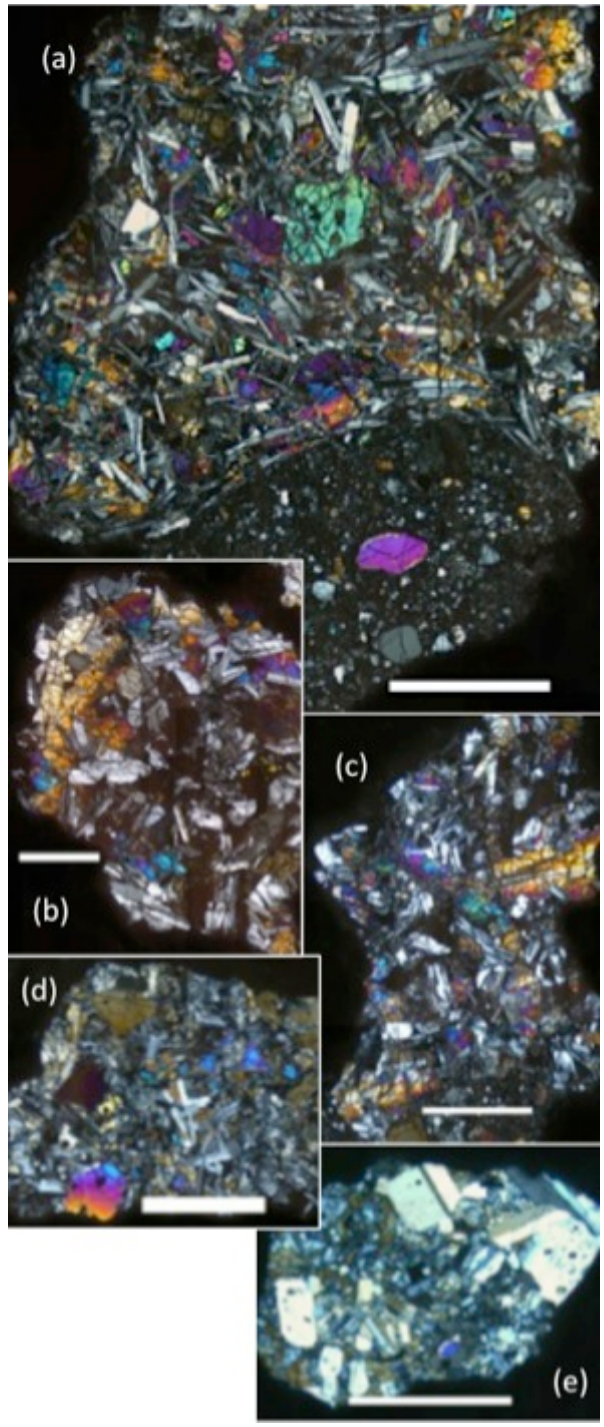

Figure 1. X-polarized images of (a) 143045,388 (b) 14304, 187, (c) 14304, 189, (d) 14305, 203, (e) 14304, 245. Scale bars represent 1mm.

To construct a CSD, photomosaics of each sample are created and crystals are traced by hand in *Adobe Photoshop*. The length and area of the crystals are measured in an image processing program (*ImageJ*, available at http://rsbweb.nih.gov/ ij/) [14]. *CSDSlice* (v.4) Excel© database determines the best habit for the crystals [15]. The habit along with the length of and width were entered into *CSDCorrections* (v1.4.1) producing the CSD graph [10]. For samples 14304,189 and 14304,203, the crystals and areas of each segment are combined together to produce one CSD. The attached breccia matrix in sample 14304,245 was excluded from area calculations in CSD construction. To compare CSDs of the same crystal phase from different samples, only a portion is used. Plagioclase lengths ≤ 1.5 mm are used unless the errors on the data points exceed 15%. A decrease in slope at the smaller crystal sizes indicated a limit of detection for the CSD method and these data are excluded. After the data has been refined, the slope and the y-axis intercept are determined and these are plotted against each other.

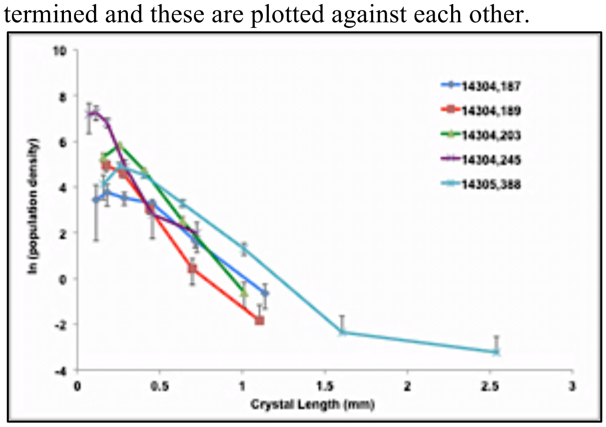

Figure 2. Plagioclase CSDs of the 5 VHK samples. Error bars represent the minimum and maximum population density per that crystal bin size.

Results: The CSDs calculated for the VHK basalts is shown in Figure 2. Figure 3 shows the slope and y-axis intercept from each CSD that fits the previously described criteria plotted against other plagioclase data derived for mare basalts by the Notre Dame group over the past 5 years.

Discussion: The CSDs for samples 14304, 245 and 14304, 203 have steep slopes and high y-axis intercepts, similar to Apollo 14 HA basalts. This supports a new hypothesis for the formation of VHK basalts through secondary enrichment of K in otherwise HA basalts. Samples 14304,203, 14305,388, and 14304,187 do not plot with the Apollo 14 HA basalts. In addition, they do not fall within the impact melt field, suggesting the plagioclase did crystallize from a pristine melt of the lunar interior. This suggests that the HA basalt precursor of these VHK basalts may not be represented in the suite returned from Apollo 14. However, if the K-rich nature of these basalts is due to infiltration of K-rich impact melt into otherwise pristine HA basalt clasts [16], then one would expect the plagioclase CSDs to indicate a pristine origin. Crystal stratigraphic details for all these samples are in progress to better identify the petrogenesis of these VHK basalts and results will be presented at LPSC.

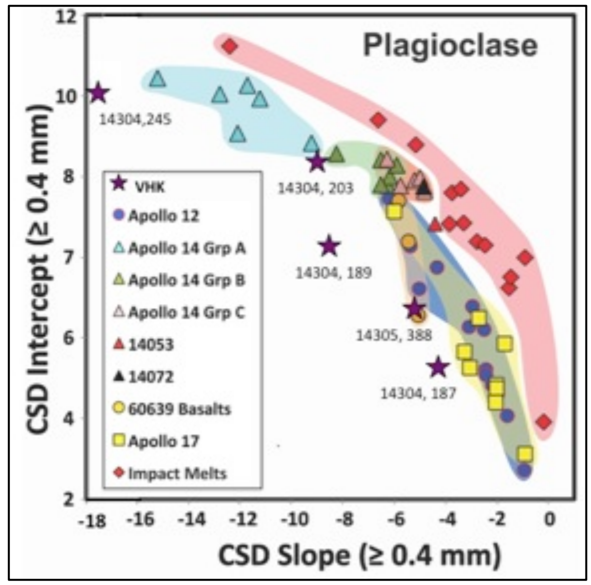

Figure 3. Slope vs. Intercept CSD plot for plagioclase.

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