PETROGRAPHIC DIVERSITY IN APOLLO 12 REGOLITH ROCK PARTICLES.

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Introduction: As part of a project to characterize the diversity of rock types composing the Apollo 12 regolith, we selected a subset of 52 2–4 mm rock fragments from an analyzed set of 358 lithic fragments [1] for petrographic investigation. These samples were selected to represent the range of diversity and so include representatives of several apparent groups of samples as well as compositional outliers. Although the large rocks from Apollo 12 are dominated by three main groups of basalts that underlie the site, the regolith contains a substantial fraction of nonmare components, which have been described in numerous previous studies [1–8]. A prominent ray from Copernicus crosses the site and may be the source of some of the nonmare material, along with other potential sources (see [9, 10]). Compositions of regolith from the site define a mixing line between the average mare and nonmare compositions (Fig. 1). The nonmare components are dominated by KREEPy IMBs (impact-melt breccias). In this abstract, we focus on compositions and lithologies that reflect the diversity of the nonmare lithologies as well as basalts and regolith breccias that differ in some significant way from the local materials.

Methods: Bulk compositions (elements and oxides) were determined by INAA (instrumental neutron activation analysis). Phase compositions were determined by electron microprobe analyses of minerals and glasses augmented with back-scattered electron (BSE) and X-ray image analyses using the JEOL 8200 microprobe at Washington University.

Regolith Breccias: Of the 52 samples studied, 13 are regolith breccias. These classifications are based largely on the presence of spherules. As expected, most lie on the IMB–basalt mixing line (Fig. 1). They also favor the basalt end of the mixing line, as do the soils.

12001,902-5. Sample 12001,902-5 lies above (high Th) the Apollo 12 IMB–basalt mixing line. Roughly 40% of the fragment is a RE-merrillite-rich basalt clast which is likely responsible for its Th-enrichment.

KREEP Impact-Melt Breccias and Other High-Th Samples: Twenty-one of the 52 samples are rich in Th. Most are impact-melt breccias of noritic composition that are largely similar to those of the Apollo 14 site [9].

12032,366-19. 12032,366-19 deviates far from the general trend and is rich in Ba (Fig. 2) because it is a granite. A companion paper is devoted to this sample.

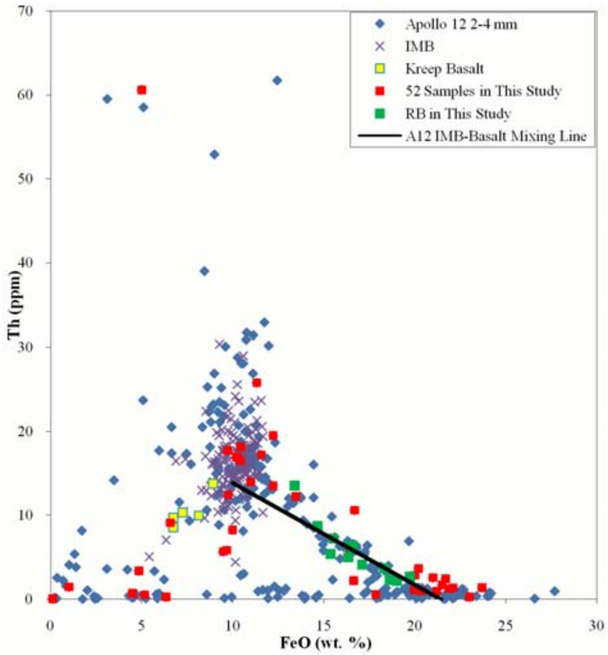

Figure 1. Bulk FeO and Th concentrations of the 52 samples studied. "Apollo 12 2-4 mm" refers to 350 2-4 mm particles from Apollo 12 described in [1]. "RB in This Study" are the 13 regolith breccias we classified. "KREEP Basalt" and "IMB" are from 14161 [3]. "IMB-Basalt Mixing Line" is the mixing line between the Apollo 12 soils and basalts.

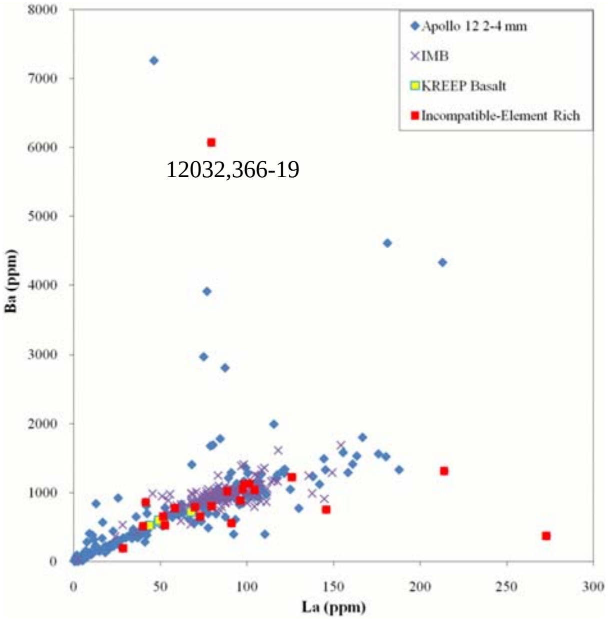

Figure 2. Bulk La and Ba concentrations of the incompatible-element rich subset of the 52 samples studied.

High-La/Ba Samples. Three samples deviate from the general trend in that they are rich in La and have high La/Ba ratios (Fig. 2). The fragments are a regolith breccia, a monzonorite breccia, possibly monomict, and a KREEP impact melt rock. The La-enrichment comes from the relatively large abundance of RE-merrillite in each sample.

Basalts: We have identified 8 basalts in our subsample which are plotted in Fig. 3 as well as average compositions of the four types of basalt common to the Apollo 12 site. One sample is petrologically and chemically typical of pigeonite basalt and another is extremely similar to the 12038 feldspathic basalt (Fig. 3). Five samples have anomalously high REE's in bulk composition all of which are ilmenite basalts.

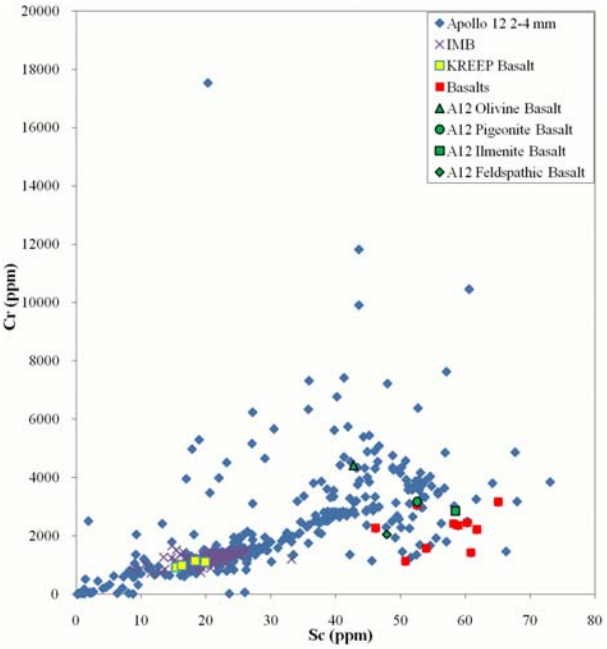

Figure 3. Bulk Sc and Cr concentrations of the basalts in the 52 samples studied.

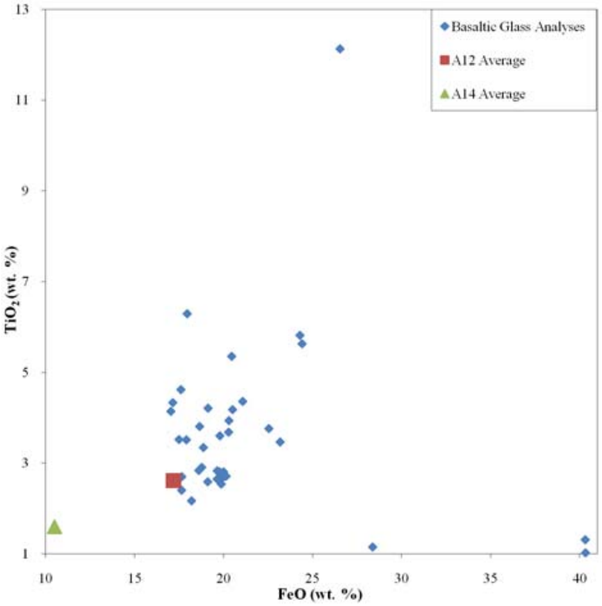

Figure 4. FeO and TiO_2 concentrations of the basaltic glasses in the 52 samples studied.

Feldspathic Breccias: Eight of the 358 particles are feldspathic breccias that, on average, have a composition very similar to the "average" feldspathic lunar meteorite [11]. These particles are random samples from points in the feldspathic highlands.

Discussion: All of the large rocks that have been studied from Apollo 12 are represented among the 2–4 mm fragments of this work. We have also found some rock types that are new [12,13]. This work, like previous studies of this type [9,13,14,15] illustrate that a handful of "gravel" from the regolith provides a wide diversity of lithologies of both local and distant origin.

Acknowledgements: This work was funded by NASA grant NNG04GG10G.

References: [1] Korotev R. L. et al. (2002) *LPS XXXIII*, Abstract #1395. [2] Korotev R. L. et al. (2000) *LPS XXXI*, Abstract #1363. [3] Hubbard N. J. et al. (1971) *EPSL* 10, 341–350. [4] Lindsay J. F. (1971) *EPSL* 12, 57–72. [5] Smith M. R. et al. (1985) *PLPSC15*, C507–C516. [6] Simon S. B. and Papike J. J. (1985) *PLPSC16*, D47–D60. [7] Simon S. B. et al. (1985) *PLPSC16*, D75–D86. [8] Laul J. C. (1986) *PLPSC16*, D251–D261. [9] Jolliff, B. L. et al. (1991) *LPS XXI*, 193–219. [10] Jolliff, B. L. et al. (2000) *LPS XXXI*, Abstract #1671. [11] Korotev R. L., et al. (2003) *GCA* 67, 4895–4923. [12] Barra F. et al. (2006) *GCA* 70, 6016–6031. [13] Jolliff B. L. et al. (2005) LPS36, abstract #2357. [14] Jolliff B. L. et al (1996) *M&PS* 31, 116–145. [15] Zeigler et al (2006) *M&PS* 41, 263–284.