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A petrographic study of basalt fragments in Apollo regolith sample 12003 – preliminary results

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1. Introduction

Geologic mapping by [1] indicates that a large number of individual basaltic flows are located within the Oceanus Procellarum including some of the youngest mare basalts (1.1 Ga) on the Moon. Given the location of the Apollo 12 landing site within the eastern region of this maria, and the potential for lateral transport of material across the lunar surface by impact processes [2, 3], it is quite possible that some of this young basaltic material may have been sampled by the mission. For this reason, further characterization of the Apollo 12 sample collection may provide new insights to the duration of lunar volcanism and the magmatic evolution of the Moon. To this end we have been allocated 10 small (2-4 mm) fines from the Apollo 12 regolith sample 12003,308. Each sample was divided into two sub-splits (A and B), with the A split being used for geochemistry and petrography; the B split will be used for radiometric. Here we describe the petrography of four of these samples.

2. Sample descriptions

12003,308_1A is a fine grained (<0.01-0.50 mm) basalt, and consists predominantly of elongated plagioclase and pyroxene grains. The pyroxene within the sample exhibits prominent zoning (Fig. 1). Compared with typical Apollo 12 basalts [4], the sample also has a large amount of silica (approximately ~8% by mode: Table 1). Aside from this, the basalt's modal mineralogy is most similar to that observed in Apollo 12 ilmenite basalts [4].

12003,308_2A is subophitic with a slightly coarser grainsize to 12003,308_1A (0.10-0.50 mm). The plagioclase and ilmenite phases within the sample form elongated laths (Fig. 1) as seen in 12003,308_1A, however pyroxene has a more blocky appearance. As in 12003,308_1A, most of the pyroxene is zoned. In some cases the olivine occurs around the edges of the pyroxene grains. The modal mineralogy of 12003,308_2A [Table 1] is also similar to that of Apollo 12 ilmenite basalts [4].

12003,308_3A is poikilitic with a coarser grainsize (0.25-0.75 mm) than 12003,308_1A and 12003,308_2A. Both pyroxenes and olivine phases are equilibrated. Several large grains (0.05-0.10 mm in size) of Cr-spinel are observed (Fig. 1). The relative mineral abundances [Table 1] in this sample are unlike those observed in other Apollo 12 basalts, however, the coarse grainsize of the sample may mean that abundances of these minerals which we observe are not representative of the parent rock from which this sample came.

12003,308_4A is relatively coarse grained (Fig. 1). The sample contains plagioclase and ilmenite phases which form laths and tabular grains and are ophitically enclosed by olivine and pyroxene phases. In addition to the major silicate phases in the sample, there are large ilmenite (0.05-0.30 mm) and spinel (<0.10 mm) are present. The modal mineralogy of 12003,308_4A [Table 1] is consistent with that of an Apollo 12 olivine basalt [4].

Grain	Plag	Pyx	Oliv	Qtz	Ilm	Spin
308_1A	37%	52%	-	8%	3%	-
308_2A	25%	56%	12%	-	4%	3%
308_3A	32%	39%	28%	-	-	2%
308_4A	19%	63%	16%	-	2%	<1%

Table 1: Approximate sample modal mineralogies. Plag = plagioclase; Pyx = Pyroxene; Oliv = Olivine; Qtz = Quartz; Ilm = Ilmenite; Spin = Cr-spinel.

Based on the modal mineralogies and textural characteristics of the samples, it seems unlikely that they all formed from a single common parent lava flow. More extensive analyses will be required in order to better understand the petrogenesis and cooling history of these basalts and their relationship

(if any) to other basaltic samples collected at the Apollo 12 landing site.

3. Ongoing Work

We are currently performing detailed analyses of the major and minor element composition of the samples and the individual mineral phases within them using a JEOL JXA-8100 SEM with integrated EDS probe and WDS system. This data set will be further extended by the acquisition of minor and trace element compositions of the samples using LA-ICP-MS. In addition to the four samples discussed here, the six remaining allocated fragments of 12003,308 will be studied using the same techniques in order to further characterize basalt variety in the parent regolith.

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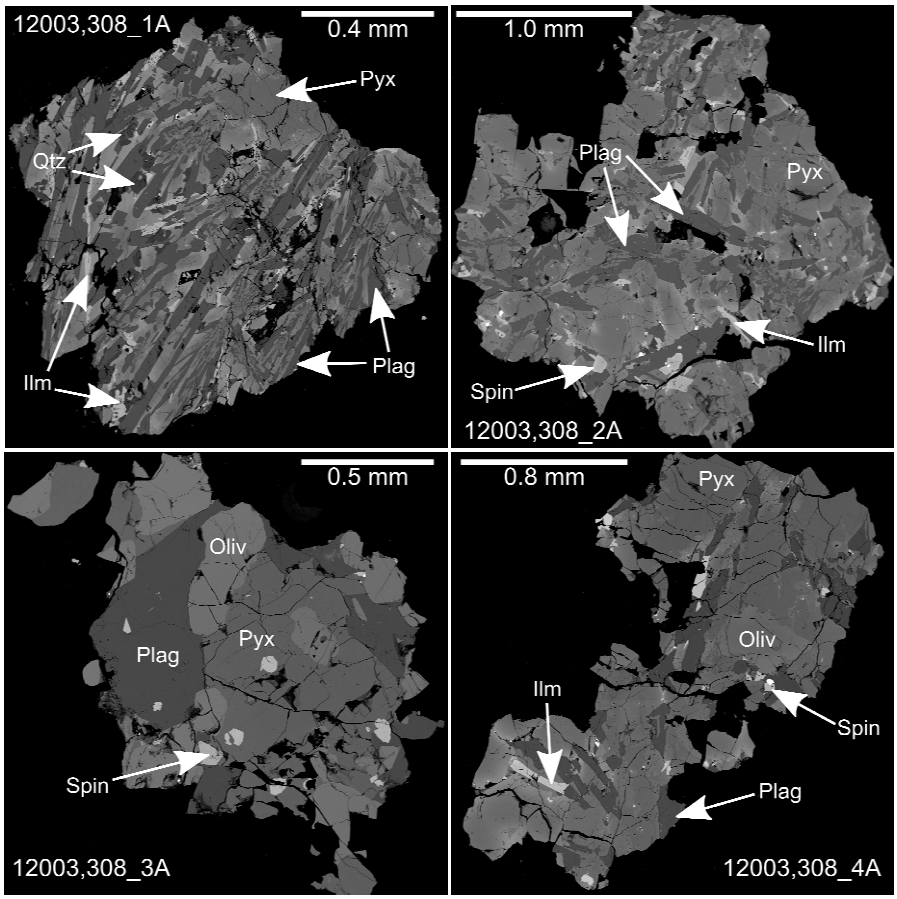

Figure 1: BSE images of the 4 samples analysed.