BASALT BOULDERS FROM APOLLO 14 "FALL-APART" EFFORTS: MINERALOGY AND PETROLOGY

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The study of mare basalts is crucial in understanding differentiation processes in the early dynamic moon and the structure and evolution of the lunar mantle. Through careful study of rock fragments from breccias and soils, a vast array of new basalts have been discovered which add significantly to our knowledge of lunar volcanism. A suite of fifteen basalt rocklets have been recovered from ongoing Apollo 14 soil "fall-apart" studies. The mineralogy and petrology of ten rocks from four different soil samples are presented here. Five others were found in an additional soil sample and are presented elsewhere in this volume [1]. The whole-rock chemistry of all samples are presented in a companion abstract in this volume [2].

PETROGRAPHY: Texturally, seven basalts exhibit convincing evidence of an unaltered basaltic igneous origin; four samples display an **ophitic** texture, and three are **subophitic**. This leads to their interpretation as *petrographically pristine* basalts. Analyses of mineral and FeNi metal grains in at least two of these samples, however, leads to the conclusion that meteoritic contamination is likely (Table 1). The use of textural criteria alone in the determination of pristinity (or lack thereof) for these samples can be misleading. Three other rock fragments exhibit a **granular** texture.

The basalts can be split into two separate groups based on texture and FeNi metal chemistry:

Sub-ophitic to ophitic (hereafter SO suite) -- Plagioclase is subhedral to euhedral, acicular to prismatic (0.1-2mm in size) and blocky (0.1-1.5mm). Only one of the seven samples (155,12) contains olivine. Ilmenite is typically interstitial and may occur as fine-grained acicular crystals (0.005-0.1 mm) or as large (0.05-1mm) sieve-textured grains (enclosing mafic phases) in association with FeNi metal (0.005-0.10 mm). All samples contain K-Ba feldspars and whitlockites, which are late-stage and interstitial.

Granular (hereafter GR suite)-- Two of the samples (160,221 and 160,222) contain phenocrystic (0.05-0.2mm) olivine. Plagioclase occurs as both coarse, euhedral, blocky (0.1-1mm) phenocrysts and as acicular subhedral to anhedral (< 0.05-0.1mm) interstitial masses. Pyroxenes occur both as phenocrysts (0.1-1mm) and as finer-grained (< 0.1mm) granular matrix. Rocks from breccia 14261 contain interstitial K-Ba feldspars (Or = 77-85, Ab = 9-16).

Table 1: Texture and ranges in mineral and FeNi metal chemistry for analyzed Apollo 14 polymict basalts. O = ophitic, SO = sub-ophitic, GR = granular.

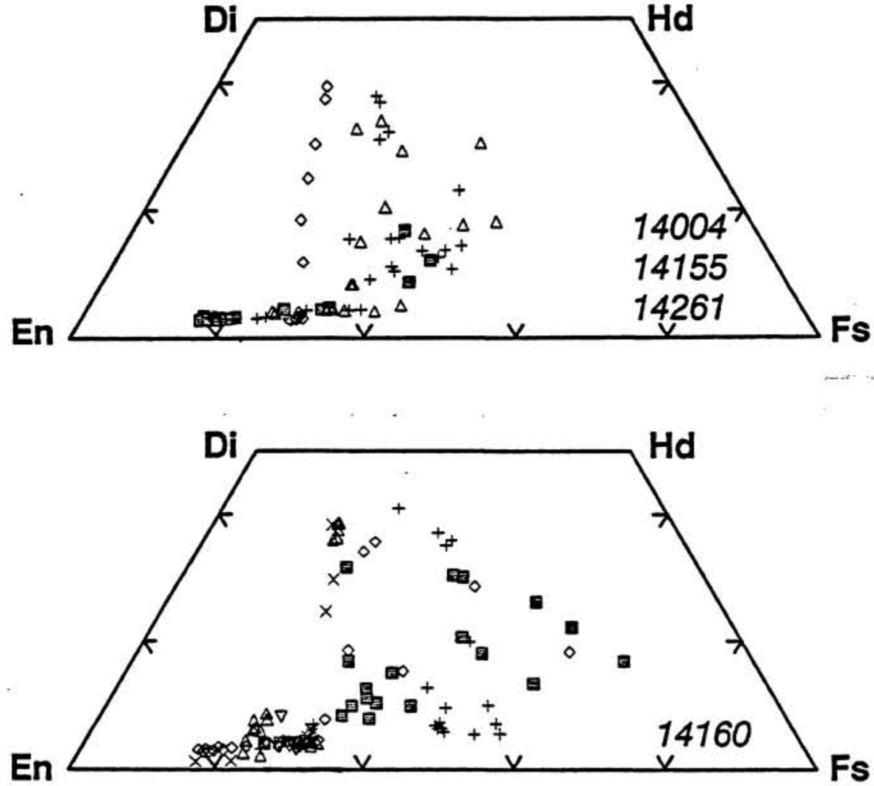
SAMPLE	TEX	OLIVINE	METAL	PLAGIOCLASE		PYROXENE		ILMENITE
		Fo	Ni	An	Ab	Wo	En	Mg#
004,106	SO	----	5-40	66-96	4-30	3-17	46-81	2-3
155,11	O	----	18	60-95	5-36	3-38	37-80	3-7
155,12	SO/GR	64-65	5-14	72-94	6-26	3-40	34-69	15-18
160,214	O	----	5-14	60-96	4-36	4-35	24-72	1-5
160,217	GR	----	2-8	60-82	17-38	3-41	32-48	9-17
160,218	O	----	5-17	60-96	4-32	3-36	24-82	1-4
160,220	O	----	5-50	71-94	5-25	3-39	42-78	5-6
160,221	GR	63-65	5-6	82-96	5-17	1-39	45-83	19-20
160,222	GR	64-65	5-8	71-90	7-28	3-5	66-76	19-21
261,27	SO	----	----	68-94	4-28	4-34	30-79	2-5

MINERAL CHEMISTRY: The mineral chemistry of these 10 basaltic rocks from Apollo 14 soils is summarized in Table 1 and will be discussed below. Only one sample from the SO suite contains olivine, 155,12. The olivine in this sample is homogeneous with compositions from Fo64 to Fo65. However, as indicated in Table 1, this sample has a "transitional" texture, containing both subophitic regions and granular portions. Two of the three from the GR suite contain olivine, usually as phenocrysts. This olivine is homogeneous within a sample and is similar in composition (Fo63-65) from sample to sample.

Chemistry of the pyroxenes is summarized on Figure 1. Both low- and high-Ca pyroxene are found in all clasts (except 160,222); however, low-Ca pyroxene is predominant. Zoning in low-Ca pyroxenes is common from En-rich cores to rims which are richer in Ca and Fe. Large variations in the compositions of low-Ca pyroxene cores (En20-30) exist within a sample.

Ilmenites in these samples can be divided on the basis of Mg# into two groups: (1) one noticeably Mg-poor, found in samples which are free of olivine, and (2) one more Mg-rich with Mg# in ilmenite directly correlated with Fo content of olivine. Little within-sample compositional variation is observed. FeNi metal grains are common and vary in grain size and shape from subhedral blocky grains to anhedral "amoeboidal" grains and are often associated with troilite. Ni contents are high for FeNi metal grains in rocks from the SO suite (5-40 wt.%). One sample (160,220) contains a grain of tetrataenite composition (50.2% Ni, 48.3% Fe, 1.5% Co). Ni contents in the FeNi metal grains from the GR suite are much lower (2-8 wt.%) than those in the SO suite (4-50 wt.%).

Figure 1



DISCUSSION: Petrographic study of the SO suite samples alone could lead to the conclusion that they are pristine. The textures of these samples are not unlike other Apollo 14 basalts which have been interpreted to be pristine [3]. However, the mineral chemistry leads to a different conclusion. High Ni contents (up to 50%) in the FeNi metal and high whole-rock Ir in these samples were not likely generated during igneous fractionation processes . Instead, it is suggested that these subophitic to ophitic basalts have been contaminated (though possibly only to a minor degree; see companion abstract [2]) by meteoritic material.

Granular basalts have much lower abundances of Ni in the native metal. As such, these basalts cannot be explained simply as SO suite basalts which have been granulated by meteoritic impact, which has been previously suggested for similar basalt suites from the Apollo 14 breccias [3]. Obviously, there is a marked difference between the designation of a suite of samples as pristine on a petrographic basis as opposed to those so designated on a chemical basis. **Both chemical and petrographic criteria must be used in determining the pristinity of a sample.**

REFERENCES: [1] Snyder & Taylor (1991), ***LPSC XXII***, this volume; [2] Snyder & Taylor (1991), ***LPSC XXII***, this volume; [3] Neal et al. (1988), ***LPSC 19***, 835-836.