Table 1

Abundances of Different Fragment Types in the Luna-16 Soil Sample
(percent by number)

Section No. Layer Size No. of Fragments	SAO 301 D >250 μm 75	SAO 303 D >250 μm 65	SAO 318 A 75-150 μm 579	SAO 315 A 150-250 μm 236
I. Rock Fragments				
A. Basaltic	13.3	20.0	19.2	21.2
B. Feldspathic	4.0	1.5	2.4	1.3
C. Individual crystals				
1. plagioclase	1.3	0	1.2	0.4
2. pyroxene	0	0	4.8	0.4
3. olivine, others	0	0	2.2	1.3
II. Microbreccias				
A. Dark (basaltic)				
1. fine-fragmental matrix	8.0	9.2	7.8	8.9
2. glassy/vesicular matrix	38.7	26.1	22.1	40.7
3. welded/sintered matrix	17.3	12.3	23.5	8.5
B. Light (feldspathic)				
1. glassy matrix	2.7	3.1	0.5	2.1
2. crystalline or aphanitic matrix	6.7	4.6	4.3	3.0
III. Glasses				
A. Homogeneous, featureless (including devitrified)	2.7	9.2	5.4	5.9
B. Heterogeneous, flow-banded (minor inclusions and vesicles)	5.3	13.8	6.6	3.0
TOTAL	100.0	99.8	100.0	100.1
Basaltic (IA + IIA + III + IC2 + IC3)	85.3	90.6	91.6	93.3
Feldspathic (IB + IC1 + IIB)	14.7	9.2	8.4	6.8
Shock-metamorphosed (II + III)	81.4	78.3	70.2	75.4
Unshocked (I)	18.6	21.5	29.8	24.6

Two families of rock fragments have been recognized in the Luna-16 material (13). In this study, they are divided into basaltic rocks (with a variety of textures) and feldspathic rocks which range in composition from gabbros to anorthosites. Both families occur as rock and mineral fragments, as shocked rocks, and as diverse microbreccias composed of basaltic (dark) and feldspathic (light) components (Table 1). Composite fragments are often observed and generally consist of particles of light microbreccias included in dark microbreccia or glass.

Basaltic rocks are the most common. As unshocked and shocked rock fragments and as dark microbreccias, basaltic fragments constitute 85-90 percent of the fragments examined (Table 1). The basalts are generally unshocked and consist of clinopyroxene, plagioclase, and ilmenite, with minor olivine, spinel(?), Ni-Fe, and mesostasis (Figures 1-4). As far as can be estimated from the small fragments studied, opaque phases constitute less than 5-10 percent of the rocks, similar to the Apollo 12 basalts, a finding consistent with the relatively low TiO_2 content observed (13). The basaltic fragments show a variety of primary textures, including: (1) ophitic to subophitic (Figure 1); (2) microporphyritic, with larger (100μm) crystals of olivine in a fine groundmass (Figures 2, 3); (3) fine-grained to intersertal, often showing textures indicative of rapid quench crystallization from a melt (Figure 5).

Feldspathic rocks and their shocked and brecciated equivalents compose 10-15 percent of the fragments (Table 1). In contrast to the basalts, which commonly occur as unshocked rock fragments, the feldspathic rocks occur as rare, apparently shocked, fragments (Figures 5-8) and most commonly as light microbreccias with microgranular, microcrystalline, and glassy groundmasses (Figures 9-11). Many of the microbreccia fragments are clear, apparently plagioclase-rich, and often microgranular (Figure 9), resembling anorthositic particles observed in the Apollo 11 and Apollo 12 soils (e.g., 20, 21). Other microbreccia fragments are buff, yellow-brown, and brownish-gray in transmitted light (Figures 10, 11) and show some textural similarities to the unusual KREEP fragments from Apollo 12 (22, 23). However, preliminary analytical results (24) indicate that these fragments do not have the unusual high-K, high-P chemistry of KREEP fragments and are gabbroic to anorthositic in composition.

Light-colored microbreccia fragments are often found as inclusions in a matrix of dark microbreccia (Figure 12) or as cores surrounded by a rim of dark, probably basaltic, glass (Figure 13). However, fragments of dark (basaltic) microbreccia were not observed as inclusions in lighter-colored feldspathic rocks.