

REGOLITH COMPOSITIONS FROM THE APOLLO 17 MISSION

Brian Mason, Sara Jacobson, J.A. Nelen, W.G. Melson, and Tom Simkin, Smithsonian Institution, Washington, D.C. 20560

We have investigated the following regolith samples:

71501, 71502: from Station 1a, north flank of Steno Crater; dark mantle, according to the Apollo Field Geology Investigation Team.
 72441, 72442: from Station 2, South Massif; on boundary between massif material and bright mantle.
 74121, 74122: from LRV 6, 1.1 km northeast of Station 3; bright mantle.
 75081, 75082: from Station 5, southwest rim of Camelot Crater; dark mantle.
 76501, 76502: from Station 6, North Massif; massif material.
 79511, 79512: from Station 9, southwest rim of Van Serg Crater; dark mantle.

The bulk compositions and the calculated norms for the -1 mm fines are given in Table 1. The classification of the individual fragments in the 1-2 mm fines is given in Table 2; this classification is based on the microscopic examination of thin sections prepared from these fragments. We have distinguished two groups of basalts, one medium to coarse-grained, the other fine-grained to aphanitic, the average grainsize of the latter being less than 0.1 mm; thus at least two different basalts are present at the mare sites, with the medium to coarse-grained being the commoner. Breccias range considerably, from dark brown to black matrix types in mare locations to light to dark gray matrix types in massif and bright mantle areas. The "norites" and "anorthosites" in Table 2 are probably all recrystallized breccias. The chemical analyses in Table 1 and the percentages of rock types in Table 2 clearly distinguish three distinctive regoliths: highland, mare basalt, and mare breccia, which may be treated as units.

Our samples of highland regolith came from the North Massif (76501-2), the South Massif (72441-2), and the bright mantle believed to be avalanche material from the South Massif (74121-2); the similarity in chemical composition and rock types between the latter two strongly supports the postulate of avalanche origin of the bright mantle. The chemical compositions at all three sites are very similar and correspond to an olivine norite; the relatively high K_2O and P_2O_5 indicate the presence of a KREEP component. The coarse fines from the South Massif and the bright mantle contained no basalt fragments, whereas the coarse fines from the North Massif contained some 15%, evidently because the site of the latter (Station 6) is practically on the mare-highland margin, whereas the other locations are farther removed from mare material. The material from Station 6 (76501-2) is noteworthy for its content of large plagioclase fragments, which make up 17% of the coarse fines at this site; this indicates the occurrence of a coarse-grained, perhaps unbrecciated anorthositic rock in the North Massif and its absence from the South Massif. The presence in 76501 of a concentration of

REGOLITH COMPOSITIONS

Mason, B., et al.

magnesium-rich olivine (mean composition Fa_{12}), if derived from this rock, indicates that it is a troctolite. The higher percentage of agglutinate in 74122 than in the other coarse fines suggest that the bright mantle may have been exposed to glass-forming impacts for a relatively longer period than the regolith at other sites.

The mare basalt materials (71501-2 and 75081-2) are very similar in composition and are probably representative of the dark mantle. They consist of mare basalt and comminuted material derived therefrom, with minor admixture (10-20%) of the plagioclase-rich material derived from the highlands. The absence of free silica and the presence of minor olivine in the norm indicate that the mare basalts at this site are on average slightly undersaturated.

The material from Station 9 (Van Serg Crater), although mapped as dark mantle like the preceding samples, is clearly distinct. Our samples (79511-2) contain much less basalt and much more breccia than the other mare samples. The composition is also distinctive, being higher in Al_2O_3 and lower in TiO_2 and FeO than the mare basalt sites; this can be seen in the norm as higher anorthite and lower ilmenite contents. The composition indicates a mixture of subequal amounts of highland material and mare basalt; however, few fragments of highland rocks were found in the coarse fines, and the two materials have evidently been thoroughly mixed within the breccias that appear to form the bedrock at this site. How extensive this breccia is cannot be decided from the few samples from a single site that we have examined. It does suggest, however, that it may be a distinct geological formation bordering the North Massif and the Sculptured Hills.

REGOLITH COMPOSITIONS

Mason, B. et al.

Table 1. Chemical analyses and norms of Apollo 17 fines;
72441, 74121, 79511 analysed by J. Nelen, remainder from PET report.

	71501	72441	74121	75081	76501	79511
SiO ₂	39.82	44.84	43.51	40.27	43.41	41.69
TiO ₂	9.52	1.42	2.58	9.41	3.15	6.13
Al ₂ O ₃	11.13	21.06	19.41	11.31	18.63	13.79
FeO	17.41	8.54	10.00	17.20	10.32	15.11
MnO	0.25	0.18	0.18	0.25	0.14	0.27
MgO	9.51	9.99	9.84	9.59	11.08	10.31
CaO	10.85	12.59	12.11	10.97	12.28	10.73
Na ₂ O	0.32	0.34	0.31	0.33	0.35	0.27
K ₂ O	0.07	0.27	0.19	0.08	0.10	0.18
P ₂ O ₅	0.06	0.20	0.11	0.07	0.08	0.06
S	0.12	-	-	0.12	0.07	-
Cr ₂ O ₃	0.46	0.28	0.29	0.46	0.26	0.43
Sum	99.52	99.71	98.53	100.06	99.87	98.97
Or	0.41	1.50	1.11	0.47	0.59	1.06
Ab	2.71	2.88	2.62	2.79	2.96	2.25
An	28.73	55.01	50.85	29.14	48.97	35.80
Di	20.25	6.00	6.84	20.33	9.30	13.93
Hy	23.63	18.94	21.00	24.05	16.98	24.90
Ol	5.01	11.68	10.38	4.67	14.58	8.55
Il	18.08	2.70	4.90	17.87	5.98	11.63
Ap	0.13	0.47	0.27	0.15	0.17	0.13
Cr	0.67	0.41	0.43	0.67	0.40	0.63

Table 2. Percentages of rock types in Apollo 17 1-2 mm fines;
A = medium to coarse-grained basalts, B = fine-grained basalts; C = breccias;
D = agglutinates; E = noritic rocks; F = anorthositic rocks; G = glass,
except for 76502, which are plagioclase fragments

	A	B	C	D	E	F	G
71502	52	10	13	20	1	-	4 (glasses)
72442	-	-	80	4	9	4	3 (glasses)
74122	-	-	63	30	1	1	5 (glasses)
75082	70	7	10	7	4	-	2 (glasses)
76502	5	2	50	11	10	5	17 (feldspars)
79512	5	10	66	7	-	2	10 (glass)