COMPOSITIONAL CHARACTERISTICS OF THE APOLLO 17 REGOLITH

A.R. Duncan, A.J. Erlank, J.P. Willis and M.K. Sher, Geochemistry Department, University of Cape Town, Rondebosch, South Africa.

The Apollo 17 soils exhibit considerable compositional variability which can be more closely related to selenographic position than at any other Apollo landing site. Rhodes (1) has recognised three compositional and selenographic groups of Apollo 17 soils, and we have combined his data (2) with our own (Table 1) in order to more precisely define the compositional characteristics of the Apollo 17 regolith. In order to make a unified interpretation of both the major and the trace element data available we have used principal component analysis and compositional mixing models to express soil characteristics. Fig. 1 shows that the three major soil groups recognised by Rhodes (1) are chemically distinctive with regard to relative concentrations of 18 elements, and Fig. 2 shows that soils from each individual Station are compostionally distinct. These differences can also be expressed in terms of the major rock types present in each soil or group of soils (derived from compositional mixing models) as shown in Table 2. Dark Mantle soils from Stations 1a, 5 and LM/ALSEP, together with two soils from Station 4 (74240, 74260) contain a high proportion of a basaltic component which has probably been derived in large part from the underlying sub-floor basalts. Light Mantle soils from Stations 2, 3 and 4 (74121) contain virtually no basaltic component and are compositionally dominated by anorthositic gabbro and KREEP-rich breccia. The soils from Stations 6, 8 and 9 are intermediate in character and vary systematically in composition with their distance from the North Massif and Sculptured Hills. The overall variation in soil composition according to position on the valley floor is striking and suggests that most of the soil components are of relatively local origin. However, some of the compositional mixing models show appreciable residuals for a number of elements suggesting that foreign soil components are present, but probably in lower proportions than has been typical at other Apollo landing sites.

Analytical data on four size fractions of Dark Mantle soil 75081 are given in Table 1. Many elements vary systematically with grain size and it is clear that the finest fraction of the soil is enriched not only in a KREEP-rich component as noted by Evensen et al (3), but is also enriched in an "Orange Soil" component. The concentration of material of "Orange Soil" composition in the finest soil fractions, together with its ubiquitous presence in all analysed Apollo 17 soils (as indicated by their relatively high Zn contents) suggests that this material is not of immediate local origin.

References: (1) Rhodes, J.M. (1973) EOS, 54, 6, 609-610. (2) Rhodes, J.M., et al. (1973) in "Apollo 17 Lunar Sample Information Catalog" p.50. (3) Evensen, N.M., et al. (1973) EOS, 54, 6, 587-588.

TABLE 1. CHEMICAL ANALYSES OF APOLLO 17 SOILS AND BRECCIA

MAJOR ELEMENTS (%)

	72701,12 Soil	74121,2 Soil	74220,31 Soil	76321,3 Soil	78221,1 Soil	78501,12 Soil	75081,66 A Soil +60#	75081,66 B Soil -60+120#	75081,66 C Soil -120+305#	75081,66 D Soil -305#	73235,53 Breccia
SiO_2	45.24	44.51	39.03	44.19	43.67	42.83	39.73	40.06	40.03	40.65	45.96
TiO_2	1.50	2.56	8.72	2.95	3.84	5.28	10.45	9.89	9.73	8.33	0.60
Al_2O_3	20.70	19.36	6.47	18.68	17.13	15.65	10.18	10.25	11.03	13.77	22.57
FeO	8.78	10.24	22.13	10.36	11.68	13.18	17.66	17.74	17.75	16.01	6.68
MnO	0.116	0.132	0.273	0.135	0.157	0.177	0.235	0.237	0.237	0.202	0.091
MgO	9.99	9.93	14.44	10.82	10.55	10.01	9.36	9.71	9.61	9.08	9.61
CaO	12.74	12.44	7.62	12.24	11.79	11.51	11.04	10.79	10.75	10.97	13.18
Na_2O	0.44	0.40	0.34	0.40	0.37	0.38	0.37	0.37	0.33	0.35	0.44
K_2O	0.154	0.134	0.077	0.124	0.092	0.090	0.067	0.065	0.071	0.093	0.200
P_2O_5	0.153	0.136	0.043	0.113	0.080	0.082	0.071	0.069	0.080	0.109	0.192
Cr_2O_3	0.229	0.269	0.684	0.272	0.321	0.355	0.491	0.477	0.479	0.434	0.196
S	0.074	0.083	0.073	0.080	0.088	0.109	0.125	0.120	0.100	0.189	0.027
Subtotal	100.116	100.194	99.900	100.364	99.768	99.653	99.779	99.778	100.197	100.187	99.746
O ≡ S	0.037	0.042	0.037	0.040	0.044	0.055	0.063	0.060	0.050	0.095	0.014
Total	100.079	100.152	99.863	100.324	99.724	99.598	99.716	99.718	100.147	100.092	99.732

TRACE ELEMENTS (ppm)

Nb	16.9	16.5	13.6	15.8	13.3	15.2	20.2	19.8	20.2	20.6	19.7
Zr	264	244	186	210	173	186	241	235	224	238	315
Y	54.7	53.7	43.8	48.6	45.1	50.4	73.7	71.2	67.3	65.5	62.3
Sr	150	151	200	150	147	150	149	154	164	180	145
Rb	4.3	3.6	1.5	3.2	2.6	2.4	1.8	1.4	1.4	2.1	5.6
Zn	17.5	24.1	253	20.4	25.6	32.8	12.0	16.8	21.8	49.1	< 2
Cu	4.5	8.4	26.3	5.2	5.8	10.0	3.2	4.1	5.0	11.5	< 2
Ni	231	245	74.7	190	221	177	68.5	87.5	116	198	118
Co	30	33	62	30	34	32	25	26	30	37	22
V	47	58	132	54	68	82	111	103	82	75	40
Ba	190	164	82	139	109	102	95	89	91	112	252

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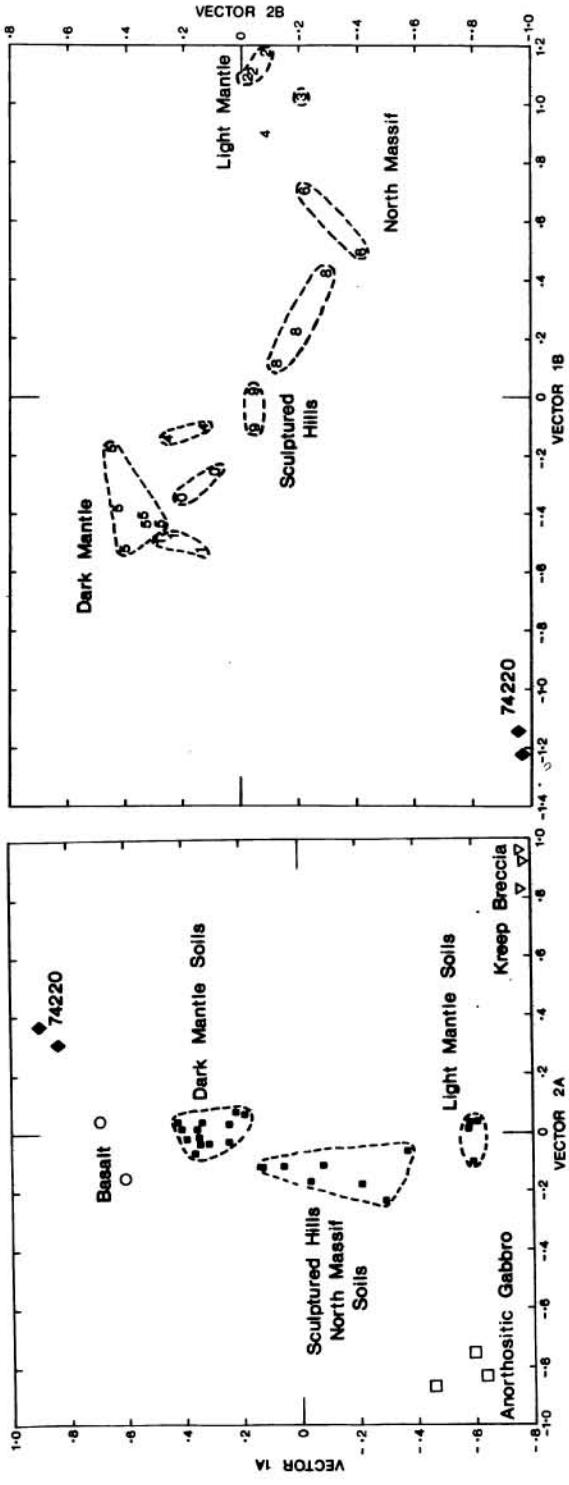

Fig. 1 Vector scores for Apollo 17 soils and selected rocks derived from Principal Component Analysis of combined rock and soil data. Data are from Table 1 and from Rhodes (2).

Fig. 2 Vector scores for Apollo 17 soils derived from Principal Component analysis of soil data only. Numbers on diagram refer to station numbers at the Apollo 17 site (1 = Station 1a, 0 = LM/ALSEP). Data are from Table 1 and from Rhodes (2).

Table 2. Compositional mixing models for Apollo 17 soils.

	% Basalt	% Anorthositic Gabbro	% KREEP-rich Breccia	% Orange Soil
Dark Mantle	63	16	8	13
Light Mantle	1	47	47	5
Station 6	13	53	28	6
Station 8	28	46	15	11
Station 9	36	34	12	18

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