

ELEMENTAL COMPOSITION OF APOLLO 17 FINES, A.O. Brunfelt\*, K.S. Heier\*, B. Nilssen\*, E. Steinnes\*\* and B. Sundvoll\*,

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The abundances of 52 elements in seven samples of fines returned by the Apollo 17 mission (Table 1) have been determined by neutron activation analysis (1). The samples show great variation ranging from nearly mare basaltic (75061) to essentially non-mare (72501) composition. The fraction of mare basalt in the samples as indicated in Table 1 is in good correspondence with the geological features at each sampling site. The major elements and some trace elements determined in the soils give linear plots versus the Al content. This has been shown earlier for Fe and Ca (2). If the soils are assumed to be derived from a simple two-component mixing, the composition of the end members can be estimated from such plots (Fig.1). Based on rock analyses by Apollo 17 PET (2) we may assume 5.0% Al in the average Apollo 17 basalt and 0.5% Ti in the non-mare derived fraction. This gives the composition of the end members as shown in Table 1. The mare component is very similar to the Apollo 11 type B basalt showing low K and Rb content and depletion of the light REE ( $\text{La/Sm} = 0.52$ ). A higher Cr content and a lower level of REE and Th is however evident in the Apollo 17 basalt. The non-mare component, presumably derived mainly from the local highland formations, is different from the Apollo 16 fines with respect to a lower content of Al and Ca and a higher content of elements associated with ferromagnesian minerals. This reflects less anorthitic and more pyroxene-rich rocks than in the Apollo 16 area. As indicated by Apollo 17 PET (2) the major non-mare rock types in the Taurus-Littrow area are anorthitic rocks and noritic breccias. On the basis of their data, the non-mare component deduced from our data approximates a 50-50% composition of the two rock types, at least as far as major elements are concerned.

Fines collected near the North Massif and Sculptured Hills seem to be depleted in elements associated in the KREEP component (K, Rb, Ba, La, Hf, Ta, W, Th, U) as compared to the South Massif derived soils. This has also been shown for P, Zr and Y (2).

Fines 74261 sampled near Shorty Crater exhibits an unusually high content of Cu, Zn, and Ga relative to most other known lunar materials. A high content of the alkali elements compared to Al is also evident in this soil.

Data for 22 elements in separated fractions from 78501 are compared with the bulk fines in Table 2. Separates of plagioclase, clinopyroxene and ilmenite from basalts 70017, 71075, and 75035 are under investigation with respect to their trace element composition.

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## REFERENCES

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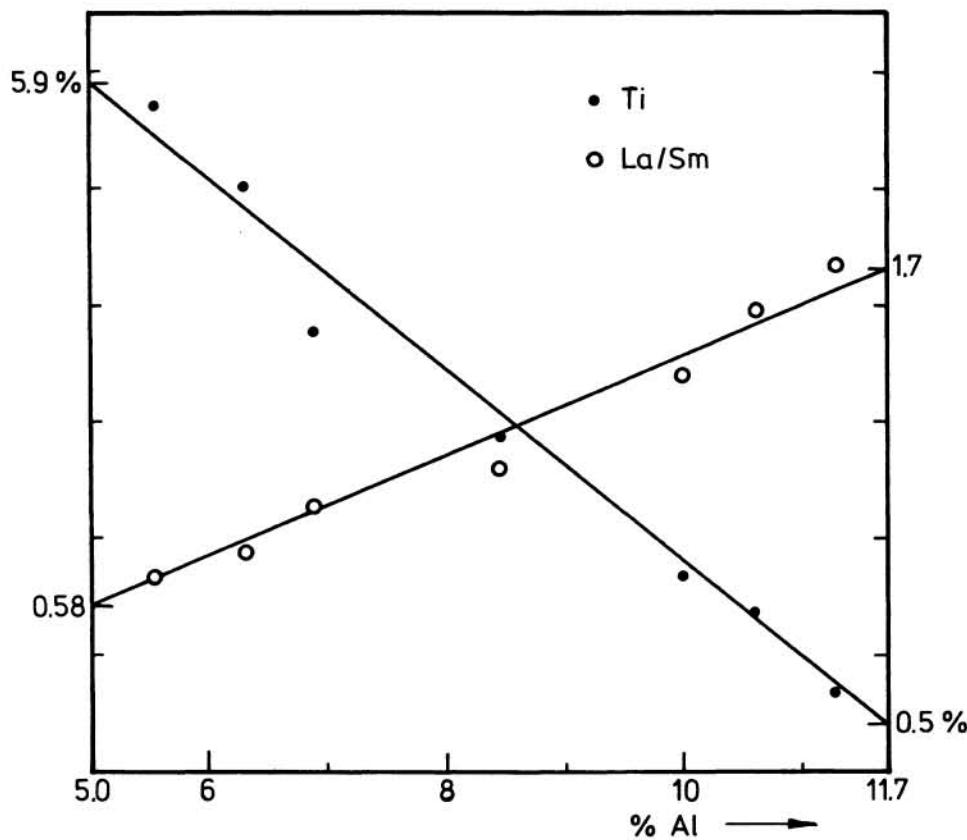


Fig. 1. Ti and La/Sm in Apollo 17 soils plotted versus Al concentration

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	71501	72501	74121	74261	75061	76321	78501	Apollo 17 mare basalt <sup>a</sup>	Apollo 11 type B basalt <sup>a</sup>	Apollo 17 non-mare, component <sup>b</sup>	Apollo 16 average fines (5)	Noritic breccias***	Anorthitic rocks****	50% A.R. 50% N. <sup>11</sup>
	Sta 1A	Sta 2	LRV 6	Sta 4	Sta 5	Sta 6	Sta 8							
Na	0.28	0.35	0.33	0.35	0.29	0.34	0.30	0.28	0.30 ± 0.03	0.35	0.37	0.40	0.25	0.33
Mg	5.4	6.5	4.7	5.6	4.7	5.8	5.2	4.8	4.2 ± 0.5	6.1	3.8	7.6	4.0	5.8
Al	6.31	11.24	10.58	6.90	5.55	9.98	8.45	5.0	5.4 ± 0.2	11.7	14.5	9.5	14.0	11.7
K	0.071	0.140	0.124	0.111	0.070	0.102	0.089	0.064	0.063 ± 0.024	0.13	0.10	0.22	0.06	0.14
Ca	8.6	10.6	8.7	6.4	8.5	10.5	7.5**	8.2 ± 0.4	9.6**	11.0	8.1	11.0	9.6	
Si ppm	62.5	17.7	23.2	49.1	65.2	25.4	39.2	71	94 ± 5	13	8.4			
Ti ppm	5.05	0.70	1.37	3.76	5.70	1.69	2.88	5.9	6.3 ± 0.7	0.5	0.32	1.13	0.22	0.68
V ppm	116	61	57	81	137	55	68	130	75 ± 31	45	36			
Cr ppm	2770	1390	1600	2490	2840	1640	2170	3100	2020 ± 760	1300	730	1360	880	1120
Mn ppm	1750	894	1030	1540	1840	1060	1370	1920	2230 ± 180	820	560	820	620	720
Fe ppm	15.2	6.58	7.56	11.1	13.1	7.66	9.91	14.0	14.4 ± 0.7	6.0	4.0	6.9	4.4	5.7
Co ppm	27.1	38	30.0	25.5	25.0	26.6	31.6				26			
Ni ppm	8.9	6.4	9.0	21.6	6.9	6.7	6.5				8			
Zn ppm	24	20	18	120	30	20	26				20			
Ga ppm	4.9	1.5	4.8	16.0	4.1	3.9	5.0				4.8			
Rb ppm	1.3	3.8	3.2	2.6	1.3	2.5	1.9	0.8	0.8	3.5	2.5	5.6	1.3	3.5
Sr ppm	159	101	112	153	175	125	142	178	174	100	130	170	144	157
Sb ppm	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05				-			
Co ppm	0.055	0.15	0.12	0.094	0.075	0.13	0.099	0.052		0.17	0.16			
Ba ppm	70	163	141	83	76	120	88	57		140	120			
Li ppm	5.8	13.9	11.7	7.1	5.7	8.7	6.3	5.1	8.9 ± 1.6	12	11.5			
Sm ppm	7.73	7.99	7.58	7.84	8.44	6.41	6.10	8.7	15.5 ± 1.2	7.2	5.2			
Eu ppm	1.57	1.43	1.35	1.32	1.33	1.17	1.35	1.6	2.3 ± 0.6	1.3	1.3			
Th ppm	1.59	1.58	1.51	2.02	2.20	1.56	1.46	2.2		1.4	1.0			
Dy ppm	10.6	9.0	8.6	11.5	12.6	9.0	9.5	13		8	6.2			
Yb ppm	7.5	6.5	6.1	7.9	9.8	5.2	6.2		14.2 ± 3.4	6	4.2			
Lu ppm	1.02	0.89	0.84	0.98	1.08	0.75	0.86		2.0 ± 0.4		0.62			
Hf ppm	5.4	4.7	4.3	5.2	6.8	4.2	4.2		14 ± 3		4.0			
Ti ppm	1.25	0.90	0.78	1.10	1.32	0.79	0.94				0.47			
* ppm	0.14	0.52	0.29	0.19	0.12	0.18	0.19				-			
** ppm	0.56	2.24	1.96	0.95	0.61	1.46	0.88	0.5	1.6 ± 0.4	2.1	1.3			
U ppm	0.20	0.75	0.66	0.34	0.22	0.43	0.30	0.16		0.7	0.5			
Lu/Sm	0.75	1.73	1.58	0.90	0.67	1.36	1.03	0.58	0.58 ± 0.08	1.73	2.2			
% mafic component	90	6	12	72	92	26	49	100		0				

(2)

\*\*Average of rocks 7243<sup>1</sup>, 76315, 77135 (2).

\*\*\*Average of rocks 76230, 77017, 78155 (2).

<sup>a</sup>Calculated from binary plots.

Table 2. Composition of fractions separated from fines 78501

Bulk fines	Dark glass	Plagioclase	Clinopyroxene (brown)	Orthopyroxene (yellow)
Na	0.30	0.30	0.51	0.34
Mg	5.2	6.0	-	6.2
Al	8.45	6.63	17.3	1.00
Ca	10.5	6.6	13.8	9.0
Si ppm	39.2	48.6	2.23	11.3
Ti ppm	2.86	3.00	-	1.16
V ppm	.68	.66	4.20	106
Cr ppm	2170	2410	170	3400
Mn ppm	1.570	1.520	134	1060
Fe	0.91	11.5	0.93	13.0
Co ppm	51.6	34.0	6.3	19.1
Lu ppm	6.4	7.1	5.4	3.9
Sm ppm	6.10	6.57	1.24	9.07
Eu ppm	1.36	1.04	1.68	1.17
Hf ppm	1.46	1.50	0.131	2.17
Dy ppm	0.5	0.1	1.4	9.0
Yb ppm	0.2	4.5	-	11.9
Lu ppm	0.30	0.95	0.06	1.53
Hf ppm	4.2	6.0	0.70	4.9
Fa ppm	0.14	1.01	0.032	0.47
Fm ppm	0.98	1.00	0.10	-
U ppm	0.30	0.25	0.05	0.22
				0.18