CHEMICAL COMPOSITION OF APOLLO 17 BOULDER-2 ROCKS AND SOILS, J. C. Laul and R. A. Schmitt, Department of Chemistry and the Radiation Center, Oregon State University, Corvallis, Oregon, 97331.

Chemical data have been obtained for 42 elements. Thirty elements, including 9 REE, via INAA and 18 trace meteoritic and non-meteoritic elements via RNAA with an overlap of 6 elements, have been determined in 6 samples of 5 rocks from a 2m boulder-2 (STA 2, S. Massif), in 4 soils from the S. Massif and in 2 valley soils. Discussion of the RNAA data on the boulder rocks and soils is found in a companion paper. See abstracts of other consortium members (Albee, Hörz, Price, H. H. Schmitt and Wasserburg, consortium leader) for abstracts on their boulder-2 studies in this volume.

The following 30-40 mg specimens, chipped from boulder-2 rocks, were analyzed: 72315,3 (mostly exterior), 72315,4 (totally interior), 72335,2 (mostly exterior), 72355,7 (one exterior side), 72375,2 (mostly exterior) and 72395,3 (interior). Interior rock surfaces had freshly exposed appearances while exterior surfaces had a pitted and patina appearance, the latter attributed to appreciable exposure in the lunar environment. These metaclastic rock samples are relatively uniform with no large clasts in them. Our bulk and trace element data for 5 samples from 4 rocks are remarkably similar with 2 to 10% dispersions observed for both bulk and trace elements (Table 1, Col. 3, Fig. 1). No compositional differences were observed between "interior" and "exterior" specimens.

The average rock composition for these 4 rocks corresponds to "high alumina" rocks (52% Pl). Rock 72335,2 is a medium K anorthositic gabbro (74% Pl). The lithophile trace elements of this sample match closely to Apollo 16 soils south of the LM (Table 1, Cols. 5 and 6). The average boulder composition for 4 of the 5 rocks falls in the range of Apollo 14 clastic rocks and matches closely the Apollo 16 medium K KREEP type rocks (Table 1, cols. 3, 4, and 8) with the exception of lower LIL trace element contents in the boulder relative to Apollo 16 medium K KREEP rocks. The high Al_2O_3 and low K_2O and lithophilic trace element abundances rule out a VHA composition for these 4 rocks. The chondritic normalized pattern for the REE and other lithophilic elements in the boulders is parallel to those observed in medium K KREEP rocks. Assuming the validity of the arguments (1) that the boulders are representatives of uplifted massifs during the Serenitatis basin forming event, our data indicate that medium K KREEP may extend $\sim$700 km ESE beyond the third Imbrian ring if the massifs originated from considerable depth. If the massifs represent uplifted upper crustal matter, then the boulders could be metamorphosed representatives of pre-Serenitatis ejecta blanket material.

Four soils near boulder-2 on the S. Massif have essentially identical compositions within experimental errors. The results are listed in Table 1, col. 2. Soil 72321 was in the boulder-2 shadow; soil 72441 was the upper 4 cm of soil from under the $\sim$0.7m boulder-3, $\sim$30m ENE of boulder-2; soil 72461 was the skim soil from under the same boulder-3; and soil 72501 was $\sim$5m E. of boulder-2.

The compositions of two Apollo 17 valley soils (STA 1 and 9) are quite similar to the Apollo 11 10084 soil composition; both soils are apparently dominated by a large component of comminuted mare basalt. Absolute REE abundances in Apollo 17 valley soils are lower by about 2 relative to the Apollo 11 soil. S. Massif soils are similar to highland soils, which have a large anorthositic gabbro component. The ratio of La/Sm=1.1 for valley soils contrasts with the ratio of La/Sm=2.2 for the S. Massif soils (Fig. 1). Thorium (and presumably U) seems to give a sharp distinction (inflection) between the valley and the S. Massif soils (Fig. 1). Derivation of the S. Massif soils is matched by a 4 component simplistic model: 20% "high alumina" highland rocks (Table 1, Col. 3), 47% anorthositic gabbros like 72335,2 in the 2m boulder, 32% valley mare basalts like 71501 and 79511 soils and 2% meteoritic components.

Interelement correlations observed previously also hold good for the Apollo 17 samples and probably for the whole moon. Based on these fairly constant elemental ratios, a homogeneous accretion mechanism for the moon is preferred.

1. Head J.W. (1973) Morphology and structure of the Taurus-Littrow highlands (Apollo 17): evidence for their origin and evolution, The Moon, in press.
2. Bansal B.M., Gast P.W., Hubbard N.J., Nyquist L.E., Rhodes J.M., Shih C.Y. and Wiesmann H. (1973) Lunar Science IV, 48.
3. Laul J.C. and Schmitt R.A. (1973) Proc. Fourth Lunar Sci. Conf. 2, 1349.
4. Laul J.C., Wakita H., Showalter D.L., Boynton W.V. and Schmitt R.A. (1972) Proc. Third Lunar Sci. Conf. 2, 1181.
5. Krähenbühl U., Ganapathy R., Morgan J.W. and Anders E. (1973) Proc. Fourth Lunar Sci. Conf. 2, 1325.
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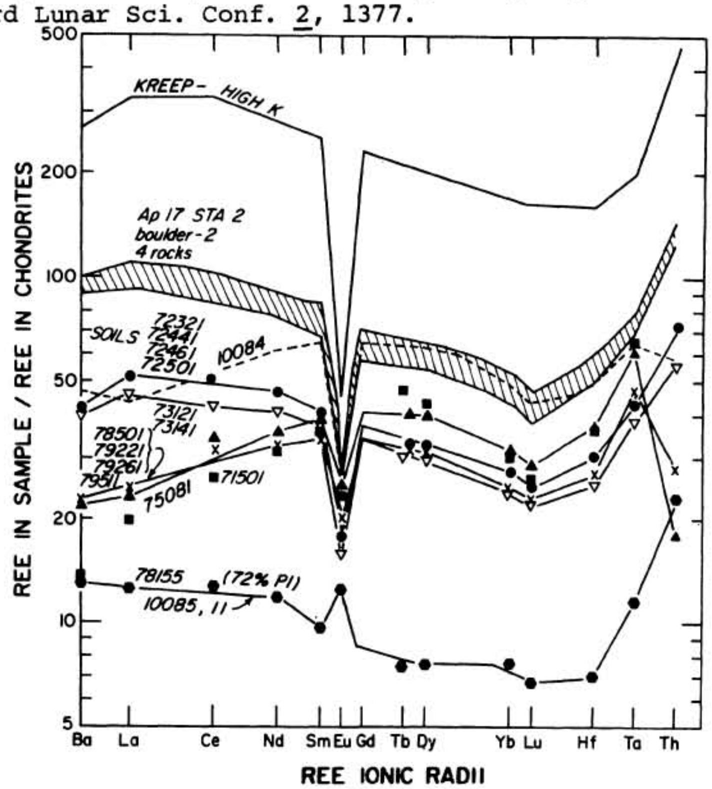

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Table 1. Average abundances for Apollo 17 soils and boulder-2 rocks.

Element	Ap 17 STA-2 Soils	Ap 17 Boulder-2 4 Rocks	Ap 16 Med. K KREEP Rocks*	Ap 17 Boulder-2 1 Rock	Ap 16 Soils S. of LM+	Ap 16 VHA Rocks*	Ap 14 Clastic Rocks+
	72321	72315,3	60315	72335,2		62295	14063
	72441	72315,4	62235			61156	14066
	72461	72355,7	65015			60615	14083
	72501	72375,2	60636				14318
		72395,3	65777				
TiO_2 (%)	1.5	1.6±0.1	1.2	0.60	0.62	0.62	1-2
Al_2O_3	21.2	18.8±0.5	19.2	27.3	26.5	21.6	17-22
FeO	8.6	8.8±0.3	8.9	4.8	5.7	6.5	7-10
MgO	10	12	11	8	7	13	---
CaO	12.1	11.1	11.4	15.4	15.3	12.0	10-13
Na_2O	0.48	0.67±0.02	0.52	0.45	0.46	0.41	0.7 -1.1
K_2O	0.15	0.31±0.03	0.36	0.13	0.11	0.10	0.1 -1.0
MnO	0.11	0.113±0.002	0.11	0.060	0.067	0.07	0.08-0.11
Cr_2O_3	0.21	0.192±0.014	0.22	0.100	0.11	0.13	0.1 -0.2
Sc(ppm)	18	16±1	15	8.0	10	9	13-20
V	49	50	35	30	24	30	30-50
Co	30	33	46	25	30	32	20-30
Zr	200	440	550	150	160	170	800-1000
Ba	190	360±20	450	120	140	170	300-1000
La	17.7	34±3	54	13.2	13.9	18.7	20-100
Ce	46	87	140	31	34	47	50-200
Nd	30	54	87	21	23	30	---
Sm	8.2	14.9±1.5	24	5.8	6.4	8.4	10-40
Eu	1.31	1.84±0.05	2.30	0.90	1.21	1.21	2-3
Tb	1.6	3.0	5.0	1.1	1.2	1.4	2-8
Dy	10	19	30	7.0	7.8	10.7	---
Yb	6.1	11±1	16	4.2	4.7	6.0	10-30
Lu	0.85	1.5	2.2	0.55	0.66	0.83	1-4
Hf	6.1	11±1	15	4.2	4.5	5.0	--30
Ta	0.84	1.5	1.8	0.59	0.58	0.65	--4
Th	2.8	5.7	7.0	2.4	2.2	2.7	--20
U	1.0	1.8	2.5	0.71	0.66	0.9∇	1-5
Ni	270	300	420-1100	360	490	220-490∇	---
Ir(ppb)	10	8	10-17	15	14	4-9∇	1-11ǂ
Au(ppb)	5	5	5-22	5	9	3-8∇	0.2-9ǂ

*Values for 60315, 62235, 65015, 62295 and 61156 taken from (2) Bansal et al. (1973) and for 60636, 65777 and 60615 from (3) Laul and Schmitt (1973)
+(3) Laul and Schmitt (1973); (4) Laul et al. (1972)
∇(3) Laul and Schmitt (1973) and (5) Krähenbühl et al. (1973)
ǂfor different Ap 14 clastic rocks by (6) Morgan et al. (1972).