APOLLO 16: LARGE ION LITHOPHILE TRACE ELEMENT ABUNDANCES IN SOME FINES, A BASALT, AND AN ANORTHOSITE. J.A. Philpotts, C.C. Schnetzler, D.F. Nava, S. Schuhmann, C.W. Kouns, R.K.L. Lum, A.L. Bickel, NASA/Goddard Space Flight Center, Planetology Branch, Greenbelt, Maryland 20771.

Large ion lithophile (LIL) trace element abundances have been determined for nine Apollo 16 fines samples, a "basalt" (gabbro, recrystallized breccia?), and an anorthosite sample. Li, K, Rb, and Sr abundances are reported in Table 1; the soils are listed in order of collection station from north to south. Ba and rare-earth concentrations for one of the soils, the basalt, and the anorthosite are given in Table 2. We have previously reported and discussed trace and major element data for eight samples of <1mm fines from the Apollo 16 deep drill core (1,2).

Except for Sr and Eu, the relative abundances of LIL trace elements in the Apollo 16 highland soils resemble those in soils from other lunar sites. The absolute concentrations tend to be lower, however, than for most other soils. In addition, the range in concentrations is only about half that found for Apollo 12 and 15 soils. The range shown in Table 1 is similar to that found in the preliminary examination (3) and that determined for the deep drill core samples (1). The core samples showed an increase in LIL trace element concentrations with depth that can be attributed largely to a decrease in plagioclase content. Surficial soil 65500 (Table 1,2), however, has concentrations that are as high as those in the deepest core samples. Soil 63341 was collected immediately below, and has higher Li, K, and Rb abundances than Soil 63321. Soil samples from Stations 11 and 13, in the Northern part of the site, apparently have higher Sr concentrations than have soils from other stations. The relatively high Sr and Eu concentrations in all of the Apollo 16 soils probably reflect their high plagioclase content. However, the soils also show negative Eu anomalies (1) (Table 2) and this probably indicates the presence of a "late-liquid" component.

Data for two fragments of the crystalline rock 68415 are presented in Table 1. Fragment (a) was much harder to grind than was (b). The trace element concentrations are essentially identical. 68415 appears to be homogeneous on this scale and this may favor an igneous origin. Except for Sr, the LIL trace element concentrations in 68415 are lower than those in the Apollo 16 soils although not much fractionated in a relative sense except for Sr and Eu. Except for Sr, Ba, and Eu, 68415 abundances are very similar to those for Luna 20 soil (1). The small positive Eu anomaly in 68415 (Table 2) indicates an excess of plagioclase.

The anorthosite 61016 has lower LIL trace element concentrations (excluding Sr and Eu) than any lunar rock or separated plagioclase reported on to date. At some stage this rock was almost certainly a cumulate. Application of plagioclase-liquid partition coefficients to the LIL trace element concentrations of 61016 results in abundances expected for a primitive (i.e. little differentiated) lunar basalt, including the absence of a large Eu anomaly.

The Apollo 16 results appear to be consistent with a lunar model which starts with a homogeneously accreted moon or a moon that was homogenized during an early igneous event. In either case, differentiation also took place early and involved an aluminous liquid from which feldspathic and more iron-rich cumulates formed. Early feldspathic cumulates are still represented in the lunar highlands, albeit brecciated, recrystallized, etc., by impacts. During a second igneous event KREEP basalt was formed by limited partial fusion of feldspathic cumulates and primary "liquid." Later, mare basalts were produced by fusion of primary iron-rich cumulates.

TABLE 1. Li, K, Rb, and Sr Concentrations in ppm by Weight

	SOIL FINES					
	67941,17 <1 mm stn. 11	67960,3 <570μ stn. 11	63321,18 <1 mm stn. 13	63341,11 <1 mm stn. 13	63501,38 <1 mm stn. 13	61161,6 <1 mm stn. 1
Li	8.30	8.35	7.06	7.59	7.30	8.12
K	1089	941	799	886	1004	1052
Rb	3.42	2.79	2.18	2.49	2.84	2.73
Sr	183	178	179	181	188	170
wt. in g	0.14313	0.10235	0.10110	0.10126	0.10190	0.11305

TABLE 1. Continued:

	SOIL FINES			"BASALT"		ANORTHOSITE
	60051,8 1 mm stn. LM	68841,19 1 mm stn. 8	65500,5 570 stn. 5	68415,79 stn. 8 (a)	68415,79 stn. 8 (b)	61016,184 stn. 1
Li	6.95	8.66	9.71	5.63	6.80	1.66
K	795	1033	1154	502	495	44.8
Rb	2.34	2.78	3.56	1.47	1.50	0.030
Sr	173	168	162	180	180	149
wt. in g	0.32663	0.10925	0.09010	0.10715	0.09485	0.41060

TABLE 2. Ba and Rare-earth Concentrations in ppm by Weight

	Fines 65500,5 <570μ	"Basalt" 68415,79(a)	Anorthosite 61016,184
Ba	165	71.6	6.02
Ce	37.6	16.3	0.253
Nd	24.2	9.92	0.145
Sm	6.90	2.88	0.036
Eu	1.26	1.13	0.671
Gd	8.64	-	-
Dy	9.12	3.62	0.027
Er	5.46	2.18	0.014
Yb	5.02	2.02	0.017
Lu	0.77	0.33	-
Eu/Eu*	0.50	1.10	58
wt. in g	0.09010	0.10715	0.41060

REFERENCES:

1. Philpotts, J.A., Schuhmann, S., Bickel, A.L. and Lum, R.K.L. (1972), Earth Planet. Sci. Lett., 17, 13-18.

2. Nava, D.F. and Philpotts, J.A. (1973), Geochim. Cosmochim. Acta., Luna 20 Issue, in press.

3. Apollo 16 Preliminary Examination Team (1973), Science, 179, 23-34.