70161

Soil

316 grams

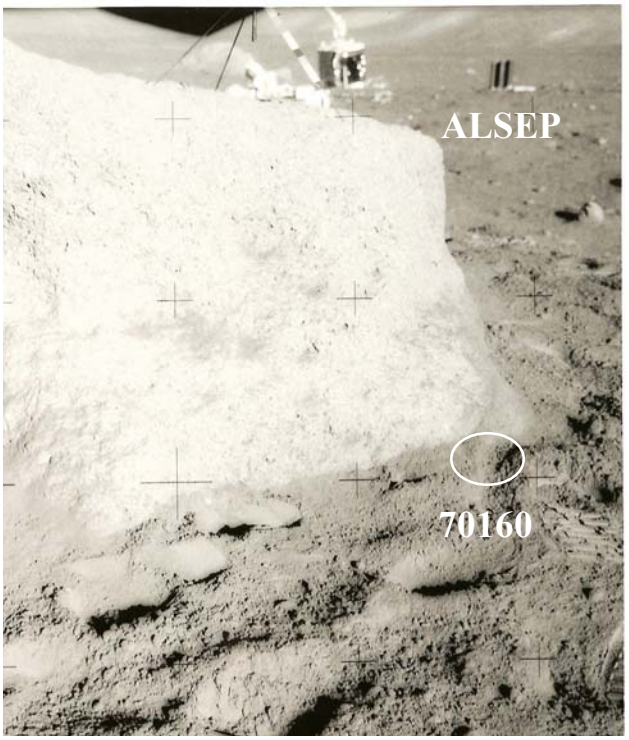


Figure 1: Photograph of boulder at ALSEP site showing location of 70160. AS17-136-20718

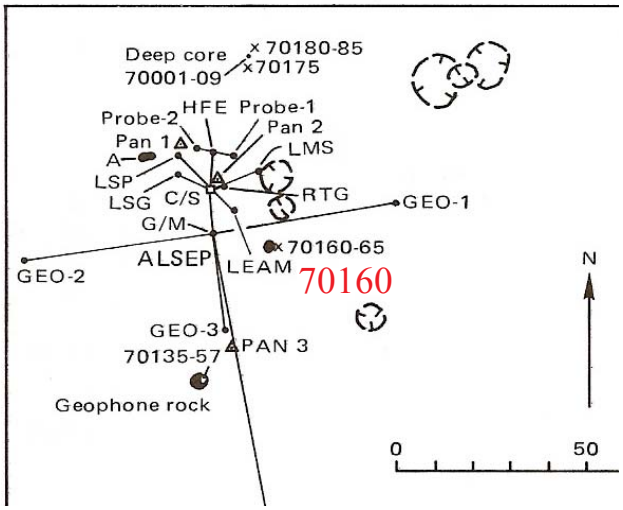


Figure 2: Map of ALSEP site, Apollo 17.

Introduction

Soil sample 70160 was collected from a fillet of sediment banked against the east base of a boulder in the ALSEP area of Apollo 17 (figures 1 - 3). As such it could be material mass wasted off of the boulder or thrown next to boulder from craters in the regolith.

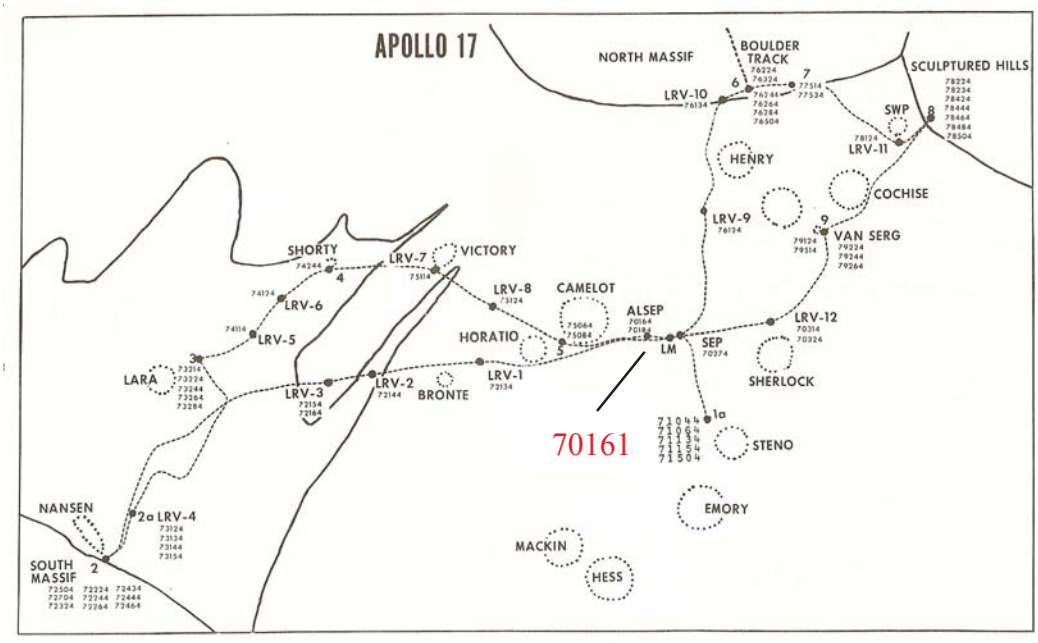


Figure 3: Location of soil sample 70161 at ALSEP site on Apollo 17 map (Meyer 1973). S73-24071

Modal content of soil 70161 (90-150 micron).
From Heiken and McKay 1974.

	70161
Agglutinates	34 %
Basalt	15
Breccia	7
Anorthosite	-
Norite	-
Gabbro	-
Plagioclase	9
Pyroxene	21.6
Olivine	0.3
Ilmenite	5
Orange glass	2
Glass other	6.1

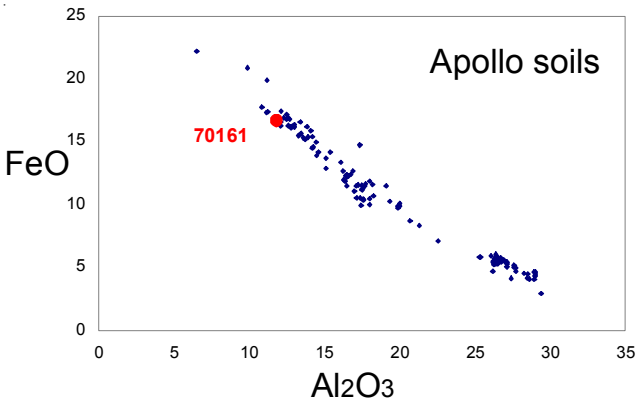


Figure 4: Composition of 70161 compared with other Apollo soils.

Petrography

The maturity of 70161 is I_s/FeO = 46 and the average grain size is 66 microns (Morris 1978, Graf 1993). Heiken and McKay (1974) determined 34 % agglutinate and an abundance of "black glass". The sample was carefully studied by von Guten et al. (1978).

Chemistry

Rhodes et al. (1974) and Korotev and Kremser (1992) have analyzed 70161 (table and figures 2 and 6). It has high Ti, Fe and Sc content (figure 4) and a rare earth element pattern like that of other mare soils (figure 6). von Guten et al. (1978) studied the distribution of volatile element in different grain size separates (figures 8 – 11).

LSPET (1973) and Moore et al. (1974) reported 150 ppm carbon (figure 5).

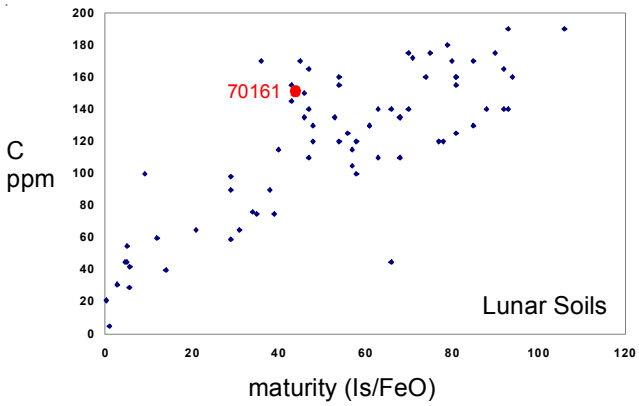


Figure 5: Carbon content and maturity index for 70160 compared with other Apollo soils.

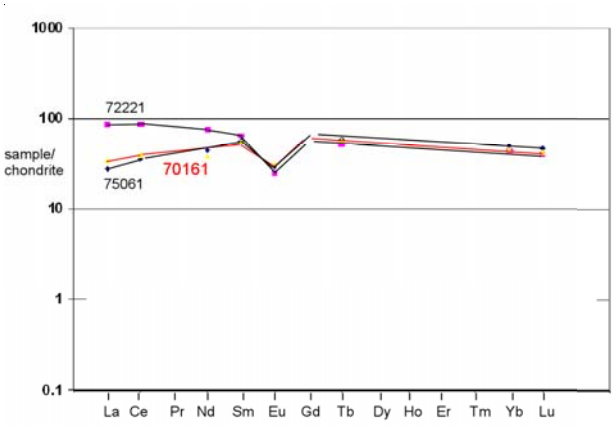


Figure 6: Noramilzed rare-earth-element diagram for 70161 showing that it is a mare soil like that of 75061.

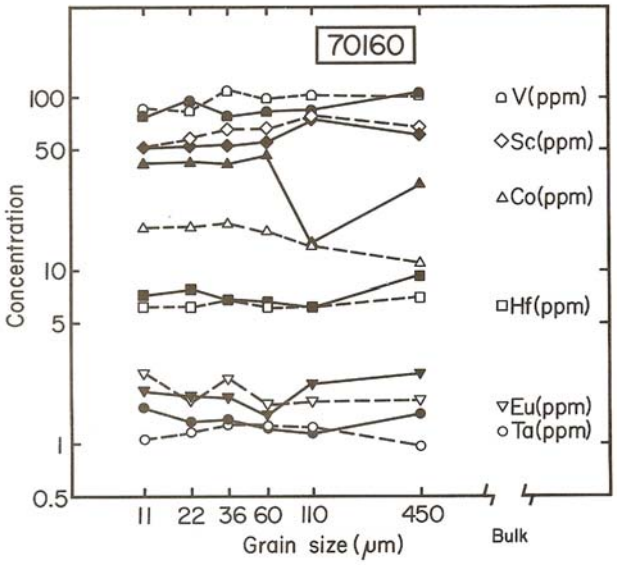


Figure 8: Composition of grain size separates of 70161 (von Guten et al. 1978)

Table 1. Chemical composition of 70161

reference	Korotev92		LSPET73	
weight			Rhodes74	
SiO2 %			40.37	(b)
TiO2			8.99	(b)
Al2O3			11.6	(b)
FeO	17	(a)	17.01	(b)
MnO			0.23	(b)
MgO			9.79	(b)
CaO			10.98	(b)
Na2O	0.383	(a)	0.32	(b)
K2O			0.08	(b)
P2O5			0.08	(b)
S %			0.12	(b)
sum				
Sc ppm	60.7	(a)		
V				
Cr	3080	(a)	3147	(b)
Co	33.2	(a)		
Ni	180	(a)	161	(b)
Cu				
Zn			41	(b)
Ga				
Ge ppb				
As				
Se				
Rb			1.4	(b)
Sr	170	(a)	168	(b)
Y			77	(b)
Zr	150	(a)	218	(b)
Nb			19	(b)
Mo				
Ru				
Rh				
Pd ppb				
Ag ppb				
Cd ppb				
In ppb				
Sn ppb				
Sb ppb				
Te ppb				
Cs ppm				
Ba	100	(a)		
La	7.89	(a)		
Ce	23.4	(a)		
Pr				
Nd	17	(a)		
Sm	8.11	(a)		
Eu	1.74	(a)		
Gd				
Tb	2.03	(a)		
Dy				
Ho				
Er				
Tm				
Yb	7.2	(a)		
Lu	1.01	(a)		
Hf	7.12	(a)		
Ta	1.25	(a)		
W ppb				
Re ppb				
Os ppb				
Ir ppb	6	(a)		
Pt ppb				
Au ppb	4	(a)		
Th ppm	0.84	(a)		
U ppm	0.18	(a)		

technique: (a) INAA, (b) XRF

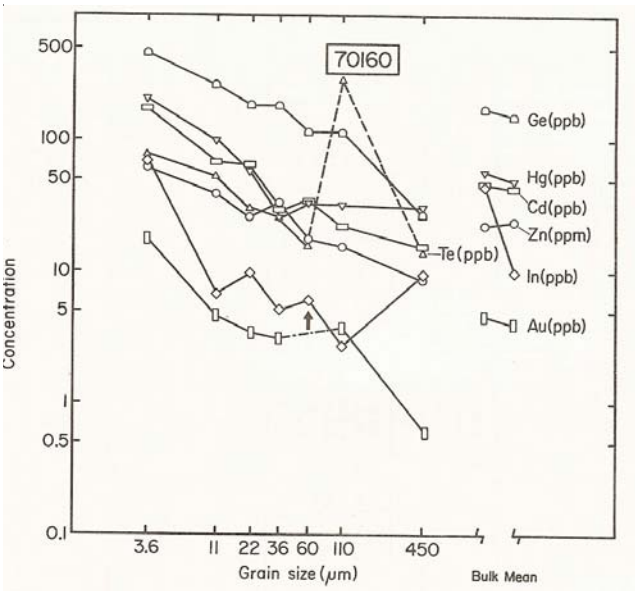
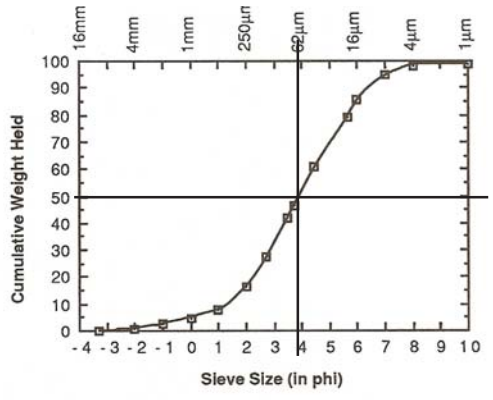


Figure 9: Composition of grain size separates of 70161 (von Guten et al. 1978)



Average grain size = 66 microns

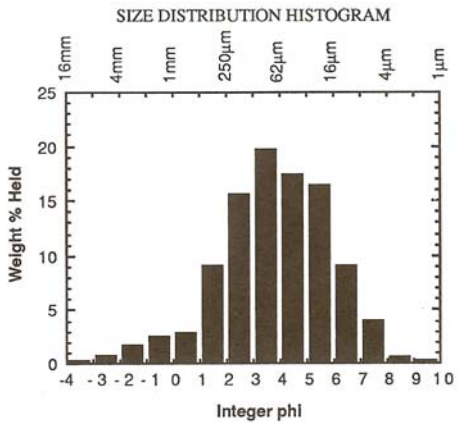


Figure 7: Grain size distribution for 70161 (Graf 1993).

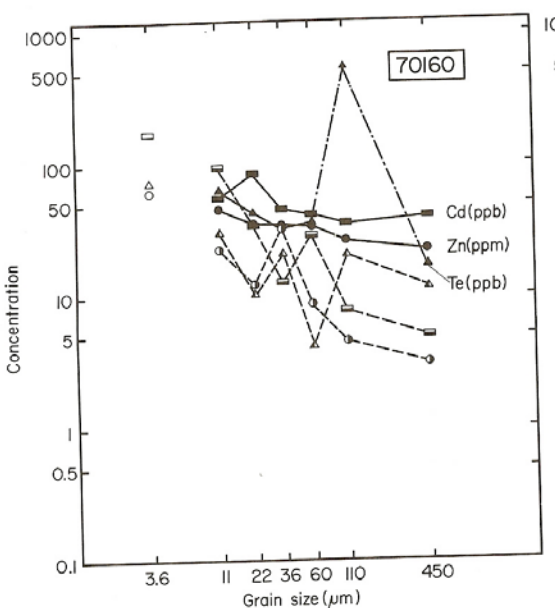


Figure 10: Composition of grain size separates of 70161 (von Guten et al. 1978)

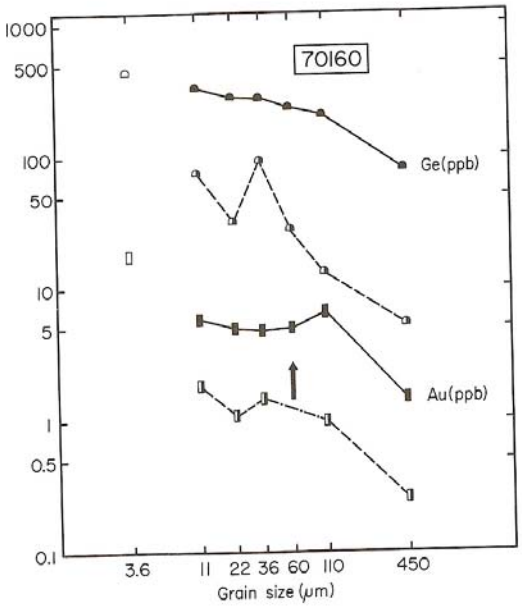
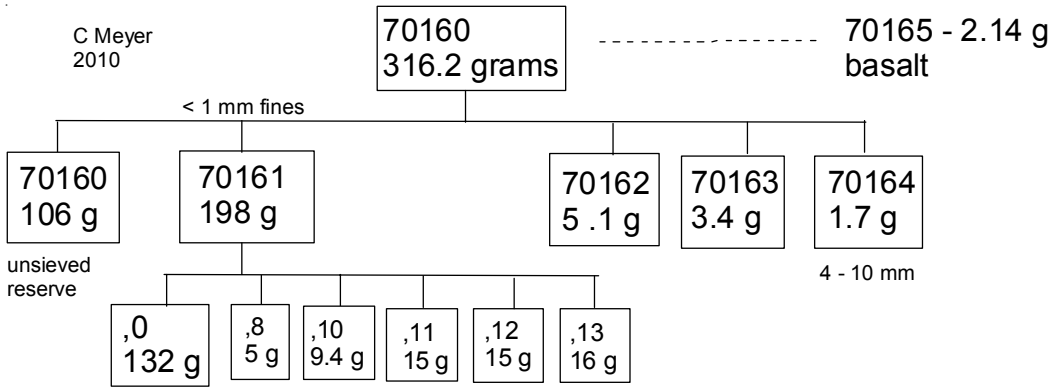


Figure 11: Composition of grain size separates of 70161 (von Guten et al. 1978)



References for 70161.

Butler P. (1973) Lunar Sample Information Catalog Apollo 17. Lunar Receiving Laboratory. MSC 03211 Curator's Catalog. pp. 447.

Graf J.C. (1993) Lunar Soils Grain Size Catalog. NASA Reference Pub. 1265, March 1993

von Guten H.R., Krahenbuhl U., Grutter A., Jost D., Meyer G., Peng K., Wegmuller F. and Wyttenbach A. (1978) Trace and major elements in grain size fraction of separated minerals and agglutinates of soil 70160 and implications on their origin. *Proc. 9th Lunar Planet. Sci. Conf.* 2269-2286.

Heiken G.H. (1974) A catalog of lunar soils. JSC Curator

Heiken G.H. (1975) Petrology of lunar soils. *Rev. Geophys. Space Phys.* **13**, 567-587.

Heiken G.H. and McKay D.S. (1974) Petrology of Apollo 17 soils. *Proc. 5th Lunar Sci. Conf.* 843-860.

Korotev R.L. and Kremser D. (1992) Compositional variations in Apollo 17 soils and their relationships to the geology of the Taurus-Littrow site. *Proc. 22nd Lunar Planet. Sci. Conf.* 275-301.

LSPET (1973a) Apollo 17 lunar samples : Chemical and petrographic description. *Science* **182**, 659-690.

LSPET (1973c) Preliminary examination of lunar samples. Apollo 17 Preliminary Science Report. NASA SP-330, 7-1—7-46.

McKay D.S., Fruland R.M. and Heiken G.H. (1974) Grain size and the evolution of lunar soils. *Proc. 5th Lunar Sci. Conf.* 887-906.

Meyer C. (1973) Apollo 17 Coarse Fines (4-10 mm) Sample Location, Classification and Photo Index. Curator Report. pp. 182.

Mitchell J.K., Carrier W.D., Costes N.C., Houston W.N., Scott R.F. and Hovland H.J. (1973) 8. Soil-Mechanics. *In* Apollo 17 Preliminary Science Rpt. NASA SP-330. pages 8-1-22.

Moore C.B., Lewis C.F. and Cripe J.D. (1974a) Total carbon and sulfur contents of Apollo 17 lunar samples. *Proc. 5th Lunar Sci. Conf.* 1897-1906.

Moore C.B., Lewis C.F., Cripe J.D. and Volk M. (1974b) Total carbon and sulfur contents of Apollo 17 lunar samples (abs). *Lunar Sci.* **V**, 520-522. Lunar Planetary Institute, Houston.

Morris R.V. (1976) Surface exposure indicies of lunar soils: A comparative FMR study. *Proc. 7th Lunar Sci. Conf.* 315-335.

Morris R.V., Score R., Dardano C. and Heiken G. (1983) Handbook of Lunar Soils. Two Parts. JSC 19069. Curator's Office, Houston

Morris R.V. (1978) The surface exposure (maturity) of lunar soils: Some concepts and Is/FeO compilation. *Proc. 9th Lunar Sci. Conf.* 2287-2297.

Papike J.J., Simon S.B. and Laul J.C. (1982) The lunar regolith: Chemistry, Mineralogy and Petrology. *Rev. Geophys. Space Phys*. **20**, 761-826.

Rhodes J.M., Rodgers K.V., Shih C., Bansal B.M., Nyquist L.E., Wiesmann H. and Hubbard N.J. (1974) The relationships between geology and soil chemistry at the Apollo 17 landing site. *Proc. 5th Lunar Sci. Conf.* 1097-1117.

Schonfeld E. (1974) The contamination of lunar highland rocks by KREEP: Interpretations by mixing models. *Proc. 5th Lunar Sci. Conf.* 1269-1286.

Wolfe E.W., Bailey N.G., Lucchitta B.K., Muehlberger W.R., Scott D.H., Sutton R.L and Wilshire H.G. (1981) The geologic investigation of the Taurus-Littrow Valley: Apollo 17 Landing Site. US Geol. Survey Prof. Paper, 1080, pp. 280.