64801 and 64810

Soil and rake residue

480 and 301 grams

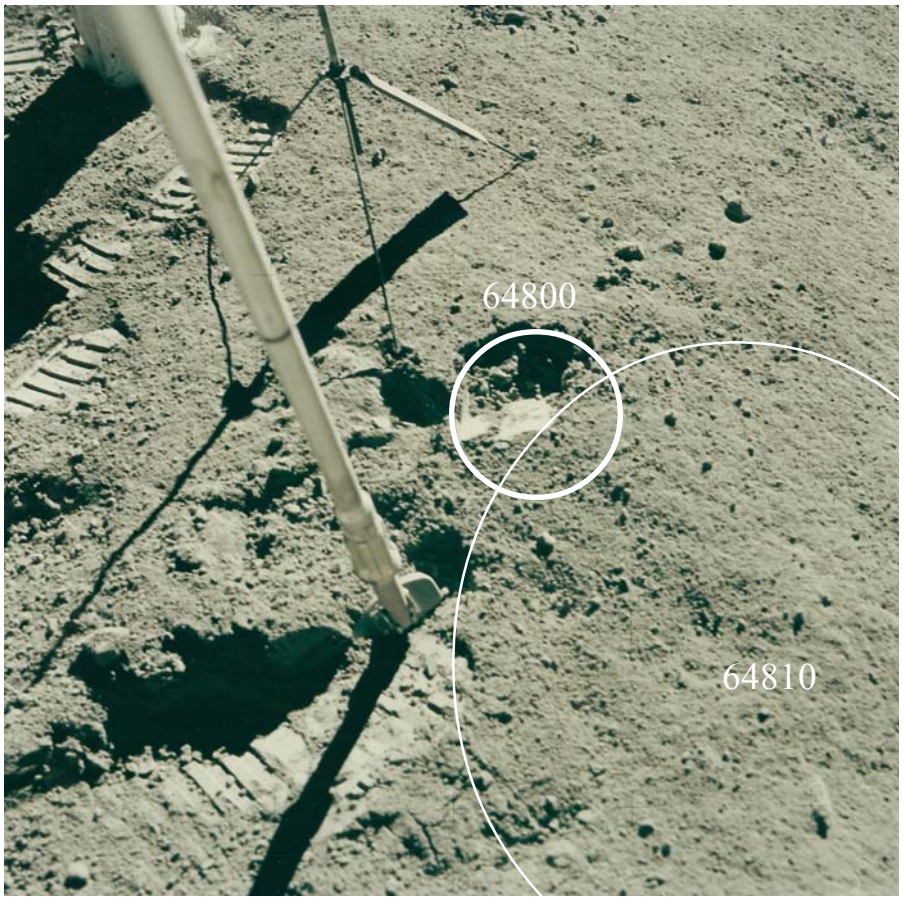
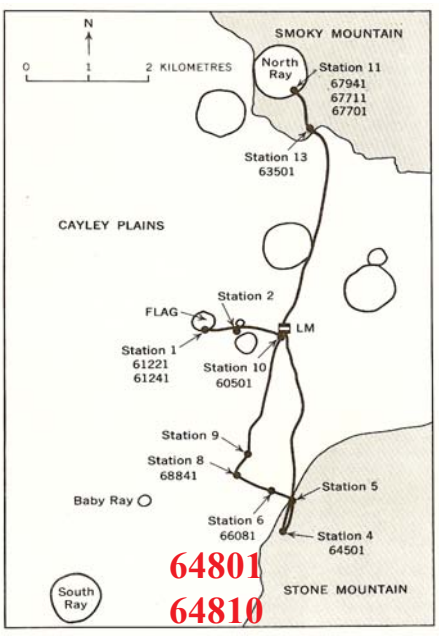
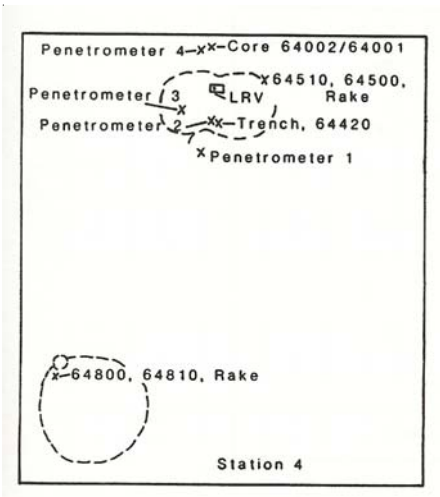


Figure 1: Close-up photo of areas where 64800 and 64810 were collected. AS16-107-17465





Figures 2 and 3: Maps of location of station 4 on Stone Mt. and samples 64801 and 64810.

Introduction

Soil sample 64801 and rake sample 64810 were collected adjacent to each other at Station 4, on the slope of Stone Mountain (figures 1, 2 and 3). The area was free of the blocky material found at the Doublet Crater nearby (64501 etc) and, indeed, the rake sample yielded only a few small rocks.

Petrography

The maturity index I_s/FeO = 71 for 64801 and 54 for 64810 (Morris 1978). This is a relatively mature soil with average grain size 80 microns (figure 8).

Phinney and Lofgren (1973) and Marvin (1972) cataloged the particles picked out of these samples.

Butler et al. (1973) reported a mineral mode for different size fractions of 64801 and Simkin et al. (1973) reported the mode for the large residue from rake sample 64811. There are a lot of agglutinates in each size range.

Chemistry

64801 is a typical high-Al highland soil (figures 4 and 6). It should be considered as a reference to the soils from the nearby Doublet Crater which is thought to have been created by ejecta from South Ray Crater. Together, these soils should include material from the elusive Descartes Formation, but in fact they haven't been distinguished from the material from the Cayley Plains.

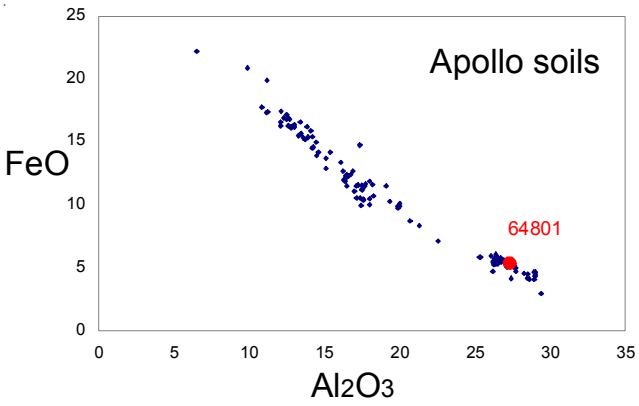


Figure 4: Composition of 64801 and other Apollo soil samples.

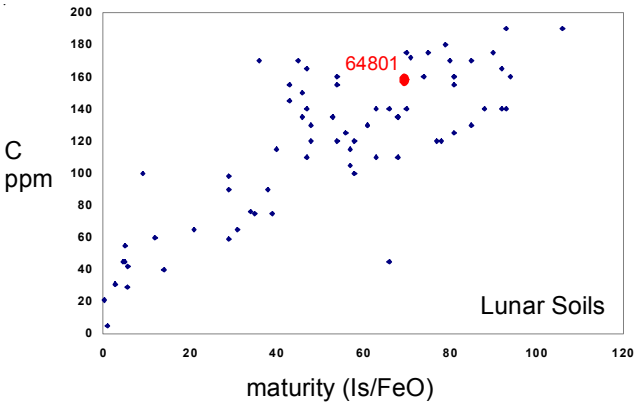


Figure 5: Carbon content and maturity index for 64801 (Moore et al. 1973; Graf 1993).

Moore et al. (1973) determined 160 ppm carbon for 64801 (figure 5). Kerridge et al. (1975) and Moore and Lewis (1975) reported 86 ppm and 113 ppm nitrogen, respectively for 64801. Jovanovic and Reed (1973) determined the halogens, Li, U and Te. The meteoritic siderophiles (Ni, Ir and Au) are very high.

Cosmogenic isotopes and exposure ages

Eldridge et al. (1973) determined the cosmic-ray-induced activity of ^{26}Al = 105 dpm/kg and ^{22}Na = 50 dpm/kg. Wrigley (1973) determined the cosmic-ray-induced activity of ^{26}Al = 116 dpm/kg and ^{22}Na = 55 dpm/kg .

Other Studies

Bhandari et al. (1973) determined the fossil nuclear track density and found a 'suntan' age of only 6 m.y.

Pearce et al. (1973) reported magnetic properties for 64801 and other samples.

Walton et al. (1973) determined the rare gas content and isotopic rations. The ^{21}Ne exposure age is 310 m.y.

Processing

Since there was a lot of residue in the rake sample 64810, it was treated as a soil and sieved.

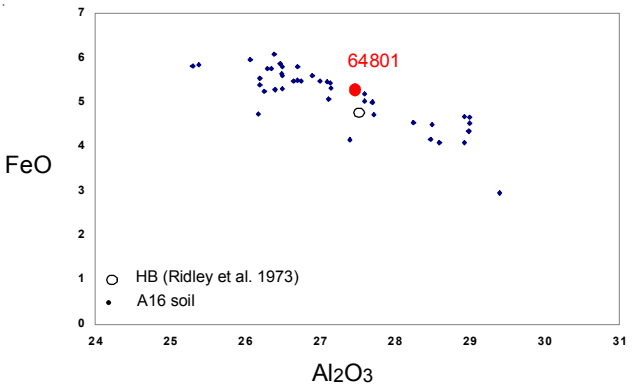


Figure 6: Composition of 64801

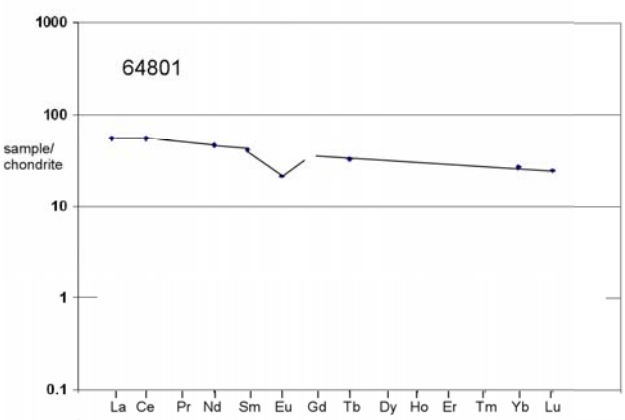
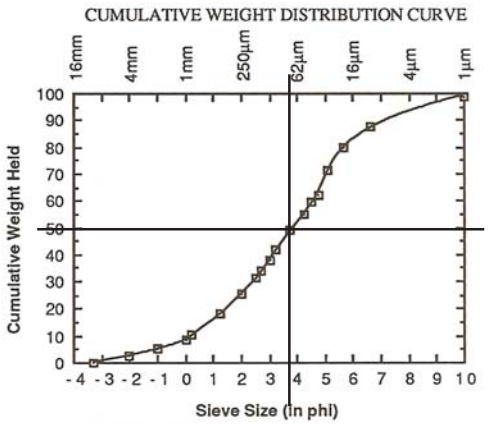


Figure 7: Normalized rare-earth-element diagram for 64801.



average grain size = 80 microns

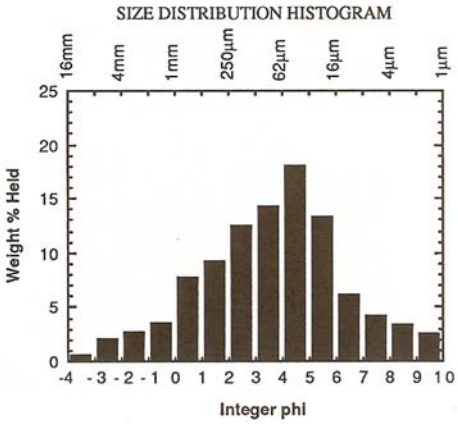


Figure 8: Grain size distribution for 64800 (Graf 1991, from data by Butler et al.)

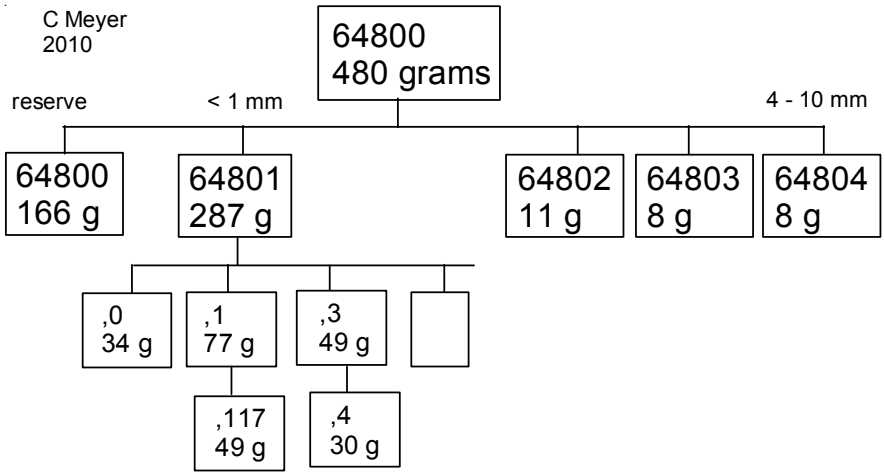


Table 1. Chemical composition of 64801.

reference	Hubbard73		Compston73		Simkin73	Taylor73		Wrigley73		Eldridge73		Korotev91		Krahenbuhl73		ave. st. 4 Korotev81
weight																
SiO2 %	45.03	(e)	45.05	(e)	44.6	44.9	(b)									45.1
TiO2	0.61	(e)	0.61	(e)	0.49	0.47	(b)									0.52
Al2O3	27.37	(e)	27.12	(e)	26.9	27.7	(b)									27.6
FeO	5.36	(e)	5.16	(e)	5.59	5.01	(b)					5.17	(a)			4.6
MnO	0.08	(e)	0.07	(e)	0.04											0.06
MgO	5.66	(e)	5.7	(e)	5.5	5.69	(b)									5.1
CaO	15.64	(e)	15.87	(e)	15.5	15.7	(b)					15.7	(a)			16.2
Na2O	0.36	(e)	0.44	(e)	0.5	0.51	(b)					0.45	(a)			0.47
K2O	0.13	(e)	0.12	(e)	0.19	0.22	(b)	0.1	(d)	0.13	(d)					0.112
P2O5	0.13	(e)	0.1	(e)		0.16	(b)									
S %	0.08	(e)	0.05	(e)												
sum																
Sc ppm						11	(b)					9.6	(a)			8.2
V					8	28	(b)									15
Cr					770	750	(b)					756	(a)			625
Co					24	27	(b)					25.4	(a)			24
Ni					290	300	(b)					336	(a)	640	(c)	320
Cu					10	7.6	(b)									
Zn														20	(c)	
Ga																
Ge ppb														1250	(c)	
As																
Se																
Rb			3.02	(f)		2.3	(b)							3	(c)	2.55
Sr			168	(f)	150							165	(a)			166
Y					44	36	(b)									41
Zr					220	210	(b)					193	(a)			192
Nb						15	(b)									
Mo																
Ru																
Rh																
Pd ppb																
Ag ppb														8.6	(c)	
Cd ppb														68.5	(c)	
In ppb																
Sn ppb						70	(b)									
Sb ppb														4.23	(c)	
Te ppb														27	(c)	
Cs ppm						0.07	(b)					0.16	(a)	0.129	(c)	
Ba					180	175	(b)					136	(a)			144
La						12.8	(b)					12.9	(a)			11.6
Ce						37.1	(b)					33.1	(a)			
Pr						4.2	(b)									
Nd						16.7	(b)					21	(a)			
Sm						4.95	(b)					6	(a)			5.4
Eu						0.99	(b)					1.17	(a)			1.16
Gd						6.5	(b)									
Tb						1.01	(b)					1.18	(a)			1.16
Dy						6.25	(b)									
Ho						1.44	(b)									
Er						4.15	(b)									
Tm						0.66	(b)									
Yb						4	(b)					4.32	(a)			3.75
Lu						0.62	(b)					0.591	(a)			0.55
Hf						3.5	(b)					4.59	(a)			4.2
Ta												0.558	(a)			0.52
W ppb																
Re ppb														2.34	(c)	
Os ppb																
Ir ppb												10.3	(a)	26	(c)	
Pt ppb																
Au ppb												15.6	(a)	16.6	(c)	
Th ppm						2.17	(b)	2.21	(d)	2.23	(d)	2.09	(a)			2
U ppm						0.61	(b)	0.58	(d)	0.6	(d)	0.56	(a)	0.66	(c)	0.58

technique: (a) INAA, (b) SSMS, (c) RNAA, (d) radiation count. (e) XRF, (f) IDMS

Table 2. Chemical composition of 64811.

reference	Korotev82		Simkin73	
weight				
SiO2 %			44.6	(b)
TiO2			0.49	(b)
Al2O3	27	(a)	26.9	(b)
FeO	5.56	(a)	5.59	(b)
MnO	0.073	(a)	0.04	(b)
MgO	6.1	(a)	5.5	(b)
CaO	14.6	(a)	15.5	(b)
Na2O	0.462	(a)	0.5	(b)
K2O			0.19	(b)
P2O5				
S %				
sum				
Sc ppm	9.27	(a)		
V	21	(a)	8	(c)
Cr	733	(a)	770	(c)
Co	35.5	(a)	24	(c)
Ni	465	(a)	290	(c)
Cu			10	(c)
Zn				
Ga			4	(c)
Ge ppb				
As				
Se				
Rb				
Sr	165	(a)	150	(c)
Y			44	(c)
Zr	225	(a)	220	(c)
Nb				
Mo				
Ru				
Rh				
Pd ppb				
Ag ppb				
Cd ppb				
In ppb				
Sn ppb				
Sb ppb				
Te ppb				
Cs ppm	0.17	(a)		
Ba	159	(a)	180	(c)
La	14.21	(a)		
Ce	38.3	(a)		
Pr				
Nd				
Sm	6.82	(a)		
Eu	1.185	(a)		
Gd				
Tb	1.44	(a)		
Dy				
Ho				
Er				
Tm				
Yb	4.83	(a)		
Lu	0.684	(a)		
Hf	5.67	(a)		
Ta	0.76	(a)		
W ppb				
Re ppb				
Os ppb				
Ir ppb	14.8	(a)		
Pt ppb				
Au ppb				
Th ppm	2.68	(a)		
U ppm	0.7	(a)		

technique: (a) INAA, (b) fused bead e-probe, (c) ES

References for 64801 and 64811.

Bhandari N., Goswami J. and Lal D. (1973) Surface irradiation and evolution of the lunar regolith. Proc. *4th Lunar Sci. Conf.* 2275-2290.

Butler P. (1972) Lunar Sample Information Catalog Apollo 16. Lunar Receiving Laboratory. MSC 03210 Curator's Catalog. pp. 370.

Butler J.C., Greene G.M. and King E.A. (1973) Grain size frequency distribution and modal analysis of Apollo 16 fines. *Proc. 4th Lunar Sci. Conf.* 267-278.

Compston W., Vernon M.J., Chappell B.W. and Freeman R. (1973) Rb-Sr model ages and chemical composition of nine Apollo 16 soils (abs). *Lunar Sci.* **IV**, 158.

Eldridge J.S., O'Kelley G.D. and Northcutt K.J. (1973) Radionuclide concentrations in Apollo 16 lunar samples determined by nondestructive gamma-ray spectrometry. *Proc. 4th Lunar Sci. Conf.* 2115-2122.

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

Hubbard N.J., Rhodes J.M., Gast P.W., Bansal B.M., Shih C.-Y., Wiesmann H. and Nyquist L.E. (1973b) Lunar rock types: The role of plagioclase in non-mare and highland rock types. *Proc. 4th Lunar Sci. Conf.* 1297-1312.

Jovanovic S. and Reed G.W. (1973b) Volatile trace elements and the characterization of the Cayley formation and the primitive lunar crust. *Proc. 4th Lunar Sci. Conf.* 1313-1324.

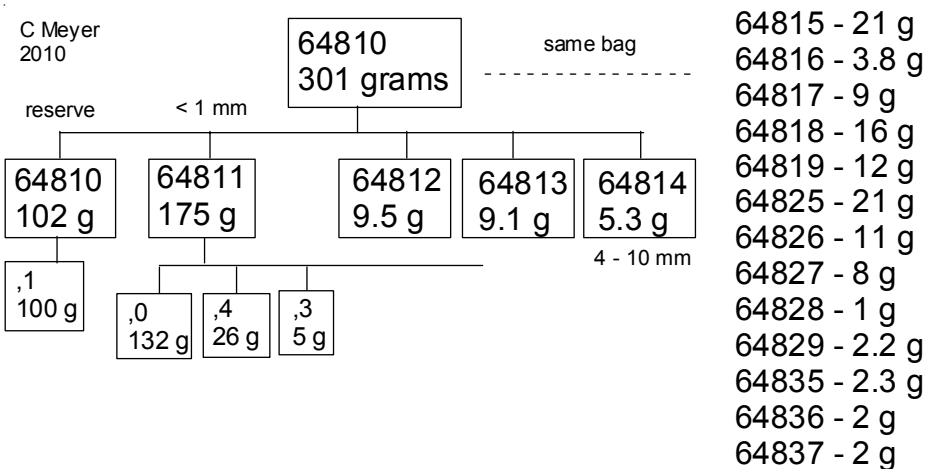
Korotev R.L. (1982) Comparative geochemistry of Apollo 16 surface soils and samples from cores 64002 and 60002 thru 60007. *Proc. 13th Lunar Planet. Sci. Conf.* A269-A278.

Korotev R.L. (1991) Geochemical stratigraphy of two regolith cores from the Central Highlands of the Moon. *Proc. 21st Lunar Planet. Sci. Conf.* 229-289. Lunar Planetary Institute, Houston

Kothari B.K. and Goel P.S. (1973) Nitrogen in lunar samples. *Proc. 4th Lunar Sci. Conf.* 1587-1596.

Krahenbuhl U., Ganapathy R., Morgan J.W. and Anders E. (1973b) Volatile elements in Apollo 16 samples: Implications for highland volcanism and accretion history of the moon. *Proc. 4th Lunar Sci. Conf.* 1325-1348.

LSPET (1973) The Apollo 16 lunar samples: Petrographic and chemical description. *Science* **179**, 23-34.



LSPET (1972) Preliminary examination of lunar samples. Apollo 16 Preliminary Science Report. NASA SP-315, 7-1—7-58.

Marvin U.B. (1972) Apollo 16 coarse fines (4-10 mm): Sample classification, description and inventory. JSC Catalog.

Moore C.B., Lewis C.F. and Gibson E.K. (1973) Total carbon contents of Apollo 15 and 16 lunar samples. *Proc. 4th Lunar Sci. Conf.* 1613-1923.

Moore C.B. and Lewis C.F. (1975) Total nitrogen contents of Apollo 15, 16 and 17 lunar fines samples. *Lunar Sci.* **VI**, 569-571.

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.

Pearce G.W., Gose W.A. and Strangway D.W. (1973) Magnetic studies on Apollo 15 and 16 lunar samples. *Proc. 4th Lunar Sci. Conf.* 3045-3076.

Phinney W. and Lofgren G. (1973) Description, classification and inventory of Apollo 16 rake samples from stations 1, 4 and 13. Curators Office.

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

Simkin T., Noonan A.F., Switzer G.S., Mason B., Nelen J.A. and Thomson G. (1973) Composition of Apollo 16 fines 60051, 60052, 64811, 64812, 67711, 67712, 68821 and 68822. *Proc. 4th Lunar Sci. Conf.* 279-289.

Sutton R.L. (1981) Documentation of Apollo 16 samples. In Geology of the Apollo 16 area, central lunar highlands. (Ulrich et al.) U.S.G.S. Prof. Paper 1048.

Taylor S.R., Gorton M.P., Muir P., Nance W.B., Rudowski R. and Ware N. (1973a) Composition of the Descartes region, lunar highlands. *Geochim. Cosmochim Acta* **37**, 2665-2683.

Walton J.R., Lakatos S. and Heymann D. (1973) Distribution of inert gases in fines from the Cayley-Descartes region. *Proc. 4th Lunar Sci. Conf.* 2079-2096.

Wrigley R.C. (1973) Radionuclides at Descartes in the central highlands. *Proc. 4th Lunar Sci. Conf.* 2203-2208.