63500 and 63520

Soil and bag residue

601 and 22 grams

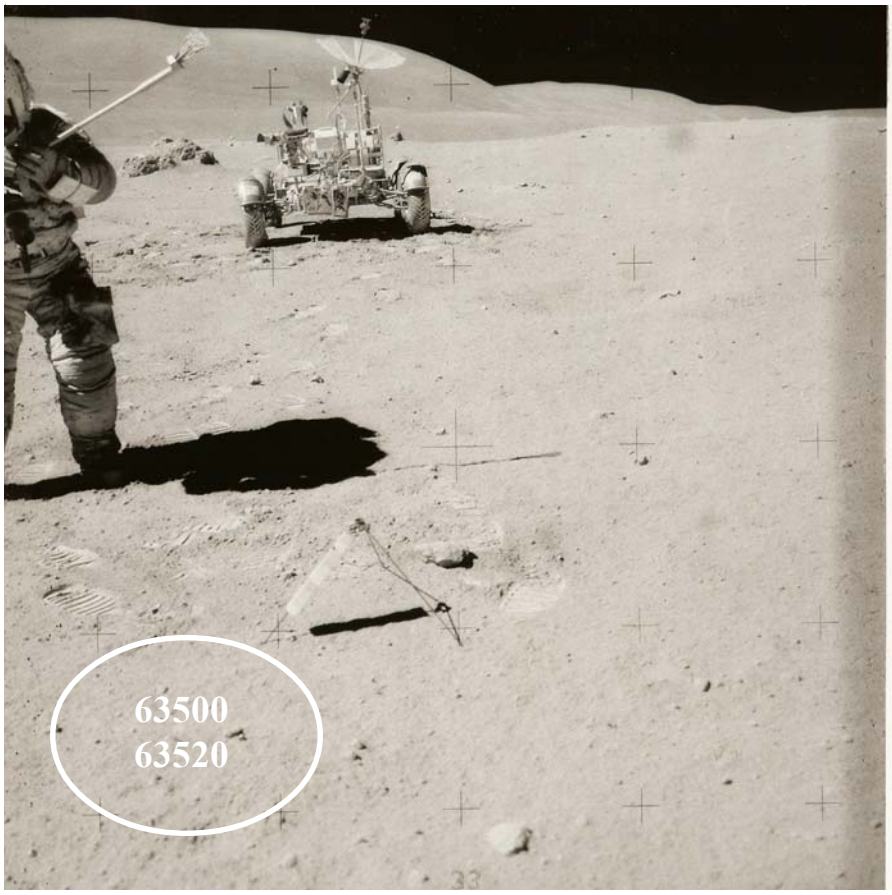


Figure 1: Photo of area where 63500 and 63520 were collected . AS16-106-17409.

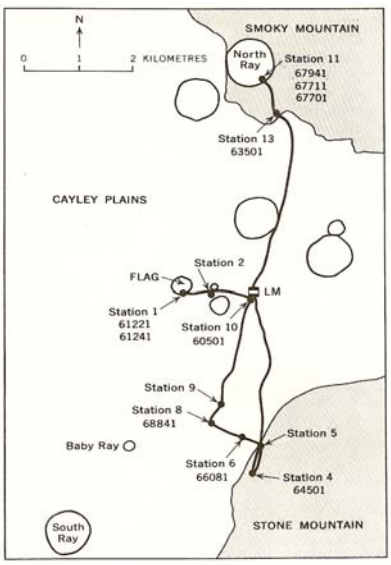


Figure 2: Traverse map of Apollo 16. site.

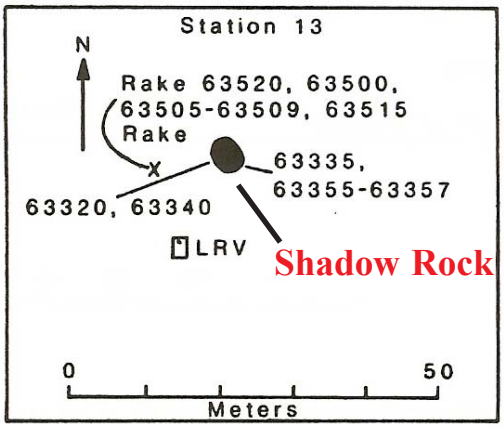


Figure 3: Close-up map of station 13.

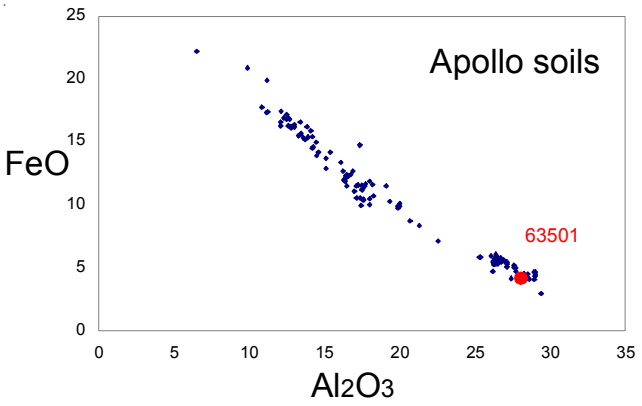


Figure 4: Composition of Apollo soil samples with 63501.

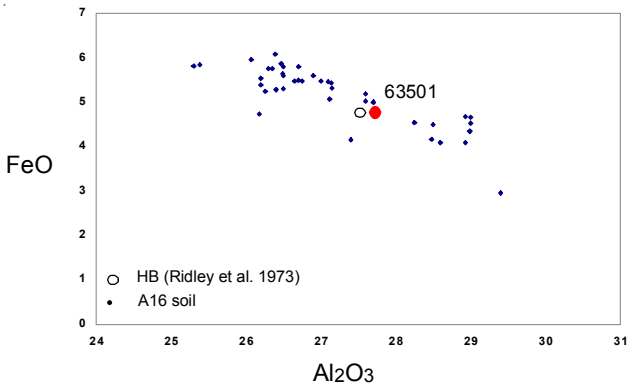


Figure 5: Composition of 63501.

Introduction

Soil sample 63500 was collected as a reference for the shaded samples (63320) under Shadow Rock nearby (Horz 1972). A large rake sample was also collected (figure 1), but although some soil was found as a residue in this bag, the grinding of the rake samples in the bag would have diluted the soil with rock fragments. 63520 – 63598 was made up of 39 individual rake samples. Most of these samples from station 13 are probably from North Ray Crater (figure 2).

Petrography

The maturity index of 63500 is I_s/FeO = 46 (submature). The agglutinate content is about 40 %, as determined by both Heiken et al. (1973) and Houck (1982). The average grain size is 112 or 160 microns depending on whether Heiken or Butler et al. determined it (figure 8 ab).

Marvin (1972) cataloged the 4 – 10 mm particles from 63504. Phinney and Lofgren (1973) gave a brief description of rake samples from 63525 and beyond.

Chemistry

For most elements, the chemical composition of 63500 and 63320 are identical to 63320 (figures 4, 6 and 7). However, Krahenbuhl et al. (1973) reported some difference in labile elements (see section on 63320). It should be noted that the average chemical composition of this soil is nearly identical to the average of numerous aluminous glass particles (termed 'highland basalt' by Ridley et al.).

Several investigators reported the light elements. desMarais et al. (1973) determined 69 ppm carbon for 63500 (figure 5). Kerridge et al. (1975) determined 92 ppm carbon and 68 ppm nitrogen, Muller (1973)

Modal content of soils 63320, 63340 and ref. 63501 (90-150 micron).
From Heiken et al. 1973.

	63321	63341	**63501 (ref.)**
Agglutinates	32.6 %	40	44.6
Basalt	-	1.7	0.3
Breccia	42.5	35.5	36.3
Anorthosite	11.2	5.9	3
Norite	1.6	0.3	1.3
Gabbro	-	-	-
Plagioclase	9.6	12.6	10.3
Pyroxene	2.6	1.7	2
Olivine	-	-	-
Ilmenite	-		
Glass other	4.6	2	2.2

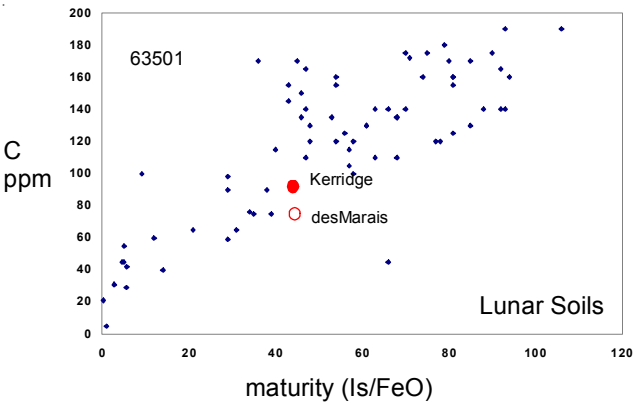


Figure 6: Carbon content and maturity index of 63501.

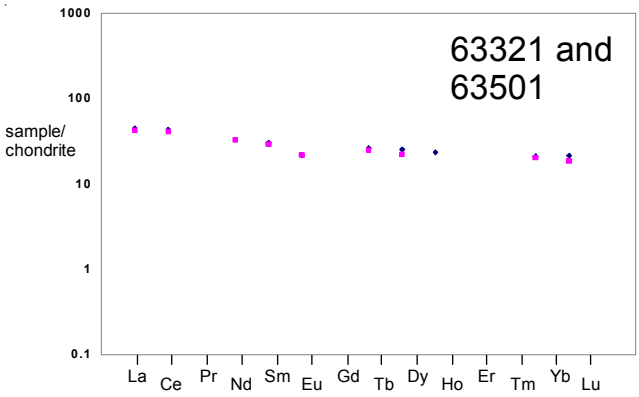


Figure 7: Normalized rare-earth-element diagram for 63501.

and Kothari and Goel (1973) reported 83 ppm and 72 ppm nitrogen, respectively. Muller also studied the nitrogen content in different grain size separates. Moore and Lewis (1975) reported 107 ppm nitrogen.

Jovanovic and Reed (1973) determined the halogens, Li, U, Te, Hg, Ru and Os.

Cosmogenic isotopes and exposure ages

Eldridge et al. (1973) determined the cosmic-ray-induced activity of ^{26}Al = 220 dpm/kg and ^{22}Na = 55 dpm/kg. Schaeffer and Husain (1973) determined exposure ages of about 40 – 150 m.y. for particles from 63503.

Other Studies

Bhandari et al. (1973) studied the fossil nuclear track density and estimated the 'suntan exposure age' to be greater than 100 m.y.

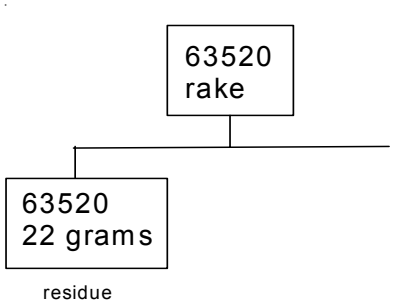
Bogard and Nyquist (1973) and Kirsten et al. (1973) reported the rare gas content. Fireman et al. (1973) reported the tritium (^{3}H) content.

Nyquist et al. (1973) and Evenson et al. (1973) reported Rb/Sr and Sr isotope ratios. Silver (1973) determined U, Th and Pb isotopes.

Schaeffer and Husain (1973) determined Ar/Ar ages for three particles from 63503.

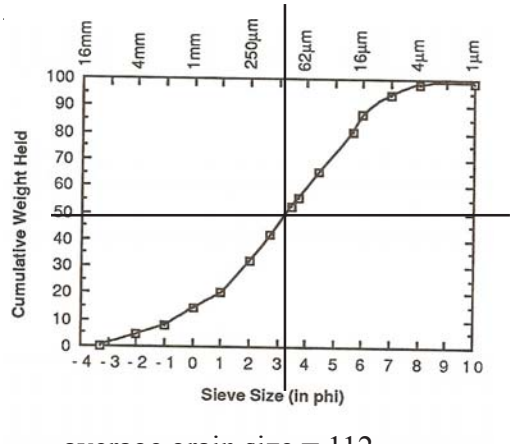
Modal content of soils 63320, 63340 and ref. 63501 (90-150 micron).
From Houck 1982.

	63321	63341	**63501 (ref.)**
Agglutinates	31.4 %	32	40.9
Basalt	-	-	-
Breccia	46.9	43.9	39.9
Anorthosite	0.3	0.7	-
Norite	-	-	-
Gabbro	-	-	-
Plagioclase	12.2	15.7	15.1
Pyroxene	3.6	2	0.3
Olivine	-	0.3	0.7
Ilmenite	-		
Glass other	5.3	5.6	2.6

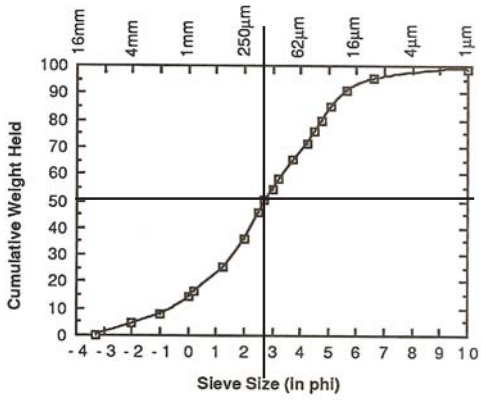


63525 - 6.7 g
63526
63527
63528
63529 - 23.5 g
63535
63536
63537
63538 - 35 g
63539
63545 - 16 g
63546
63547
63578
63549 - 26.6 g
63555
63556 - 18 g
63557
63558
63559

63565
63566 - 19.6 g
63567
63568
63569
63575
62576
63577 - 12.4 g
63578 - 19.6 g
63579 - 11.3 g
63585 - 32.6 g
63586
63587 - 20.5 g
63588
63589 - 13.5 g
63595
53596
63597
63598 - 12.7 g



average grain size = 112



average grain size = 160 microns

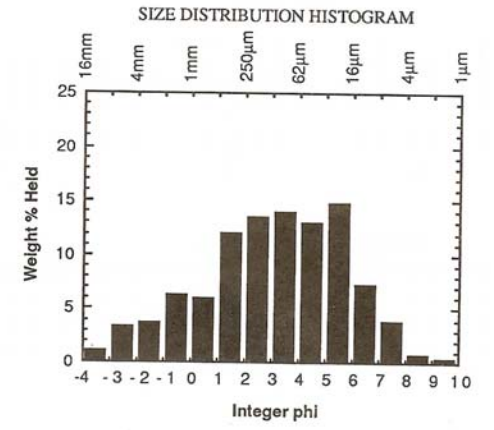


Figure 8a: Grain size distribution for 63501 (Graf 1991, fom data by McKay et al).

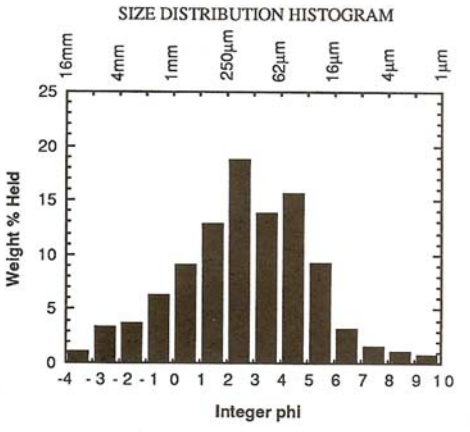


Figure 8b: Grain size distribution for 63501 (Graf 1991, fom data by Butler et al).

Table 1a. Chemical composition of 63501.

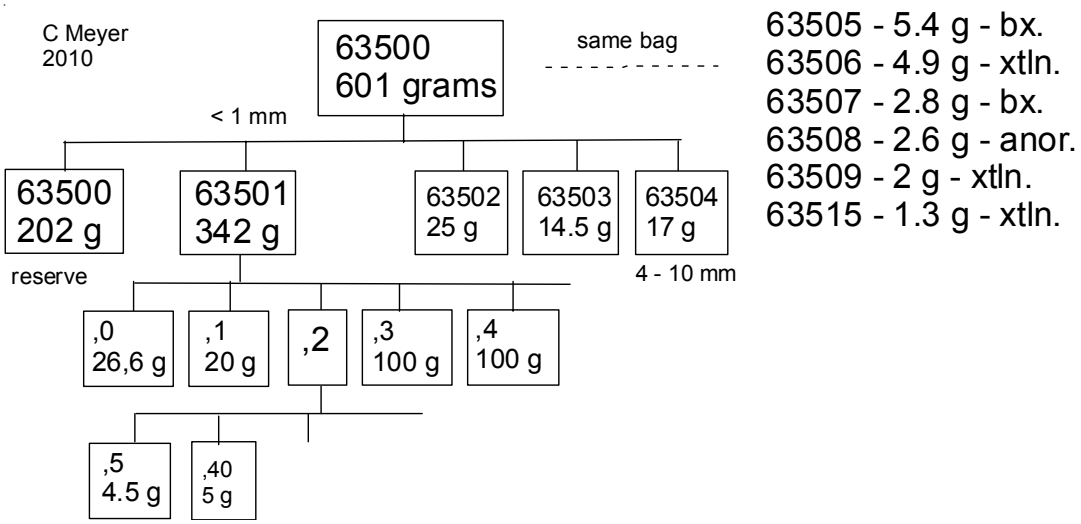
			Hubbard73										ave. st. 13
reference	Eldridge73		Bansal72		Rose75			Philpotts73		Krahenbuhl73		Wanke75		Korotev81
weight	Eldridge75		Weismann		< 30 um	30-1000 um								
SiO2 %			45	(b)	45.4	45.39	(d)					45.1	(f)	45.1
TiO2			0.53	(b)	0.51	0.48	(d)					0.53	(f)	0.54
Al2O3			27.72	(b)	27.71	27.78	(d)					27.8	(f)	27.6
FeO			4.72	(b)	4.56	4.54	(d)					4.67	(f)	4.8
MnO			0.07		0.07	0.06	(d)					0.062	(f)	0.063
MgO			5.25	(b)	5.43	5.45	(d)					5.17	(f)	5.4
CaO			15.87	(b)	15.7	15.88	(d)					15.7	(f)	15.8
Na2O			0.46	(b)	0.44	0.44	(d)					0.51	(f)	0.535
K2O	0.113	(a)	0.05	(c)	0.1	0.1	(d)	0.12	(c)			0.092	(f)	0.098
P2O5			0.1		0.11	0.09	(d)					0.11	(f)	
S %			0.08									0.06	(f)	
sum														
Sc ppm					8.6	8.4	(d)					8.65	(e)	8.4
V					12	13	(d)							15
Cr			985	(c)	684	616	(d)					650	(e)	635
Co					13	15	(d)					17.8	(e)	19.5
Ni					286	312	(d)					260	(e)	280
Cu					8.6	6	(d)							
Zn					18	5.9	(d)			12	(d)			
Ga					4	3.7	(d)							
Ge ppb										655	(d)			
As														
Se														
Rb			1.86	(c)				2.84	(c)	1.6	(d)			2.1
Sr			188	(c)	141	135	(d)	188	(c)			180	(e)	181
Y					33	30	(d)							31
Zr					108	116	(d)							112
Nb														
Mo														
Ru														
Rh														
Pd ppb														
Ag ppb														
Cd ppb										53.5	(d)			
In ppb														
Sn ppb														
Sb ppb										1.85	(d)			
Te ppb										13.6	(d)			
Cs ppm										0.072	(d)	0.082	(e)	
Ba			102	(c)	122	93	(d)					115	(e)	110
La			8.9	(c)	10	10	(d)					10	(e)	10
Ce			22.4	(c)								25	(e)	
Pr														
Nd			14.1	(c)								15	(e)	
Sm			4.03	(c)								4.35	(e)	4.5
Eu			1.24	(c)								1.22	(e)	1.21
Gd														
Tb												0.91	(e)	0.94
Dy			5.42	(c)								5.45	(e)	
Ho														
Er														
Tm														
Yb			3.03	(c)								3.31	(e)	3.35
Lu			0.436	(c)								0.45	(e)	0.47
Hf												3.17	(e)	3.3
Ta												0.4	(e)	0.44
W ppb														
Re ppb										0.955	(d)			
Os ppb														
Ir ppb										11.2	(d)	9	(d)	
Pt ppb														
Au ppb										8.51	(d)	6.1	(d)	
Th ppm	1.53	(a)										1.4	(e)	1.5
U ppm	0.41	(a)								0.382	(d)			0.43

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

Table 1b. Chemical composition of 63501.

reference	Finkelman 75			Boynton75			Evenson73		Muller75			Brunfeld73	
weight	c	<30 um											
SiO2 %													
TiO2												0.47	(b)
Al2O3									28	27.6	(e)	28.4	(b)
FeO				4.63	4.9	(b)			5.03	5.22	(e)	4.62	(b)
MnO												0.066	(b)
MgO									5.35	5.1	(e)	6.6	(b)
CaO				15.5	16	(b)			16.4	15.7	(e)	16.8	(b)
Na2O					0.54	(b)			0.6	0.56	(e)	0.57	(b)
K2O							0.09	(c)	0.092	0.1	(d)	0.1	(b)
P2O5													
S %													
sum													
Sc ppm	8.4	8.6	(a)	8.4	8.6	(b)						7.57	(b)
V	13	12	(a)									35	(b)
Cr				630	660	(b)						630	(b)
Co	15	13	(a)	20	21	(b)						22.5	(b)
Ni	312	286	(a)									322	(b)
Cu	6	8.6	(a)									9.8	(b)
Zn	5.9	18	(a)									21	(b)
Ga	3.7	4	(a)									4.2	(b)
Ge ppb													
As													
Se													
Rb	1.3	1.3	(a)				1.78	(c)	2.1	2.7	(d)	1.5	(b)
Sr	135	141	(a)				186	(c)	179	177	(d)	140	(b)
Y	30	32	(a)										
Zr	116	108	(a)										
Nb													
Mo													
Ru													
Rh													
Pd ppb													
Ag ppb													
Cd ppb													
In ppb												31	(b)
Sn ppb													
Sb ppb													
Te ppb													
Cs ppm									0.1	0.13	(d)	0.12	(b)
Ba	93	122	(a)		120	(b)	99.1	(c)	115	159	(d)	104	(b)
La				9.4	9.2	(b)			9	13.4	(d)	9.7	(b)
Ce				24	28	(b)						21.3	(b)
Pr													
Nd													
Sm				4.6	4.4	(b)						4.25	(b)
Eu				1.15	1.17	(b)						1.19	(b)
Gd													
Tb				0.7	0.9	(b)						0.86	(b)
Dy												4.99	(b)
Ho												1.3	(b)
Er													
Tm													
Yb	2	2.8	(a)	3.1	3.4	(b)						3.57	(b)
Lu				0.44	0.48	(b)						0.54	(b)
Hf				2.9	3.2	(b)						2.9	(b)
Ta												0.35	(b)
W ppb													
Re ppb													
Os ppb													
Ir ppb													
Pt ppb													
Au ppb													
Th ppm				1.6	1.5	(b)						1	(b)
U ppm									0.39	0.58	(d)	0.3	(b)

technique : (a)OES, (b) INAA, (c) IDMS, (d) NAA, (e) AA



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