67461

Soil

370 grams

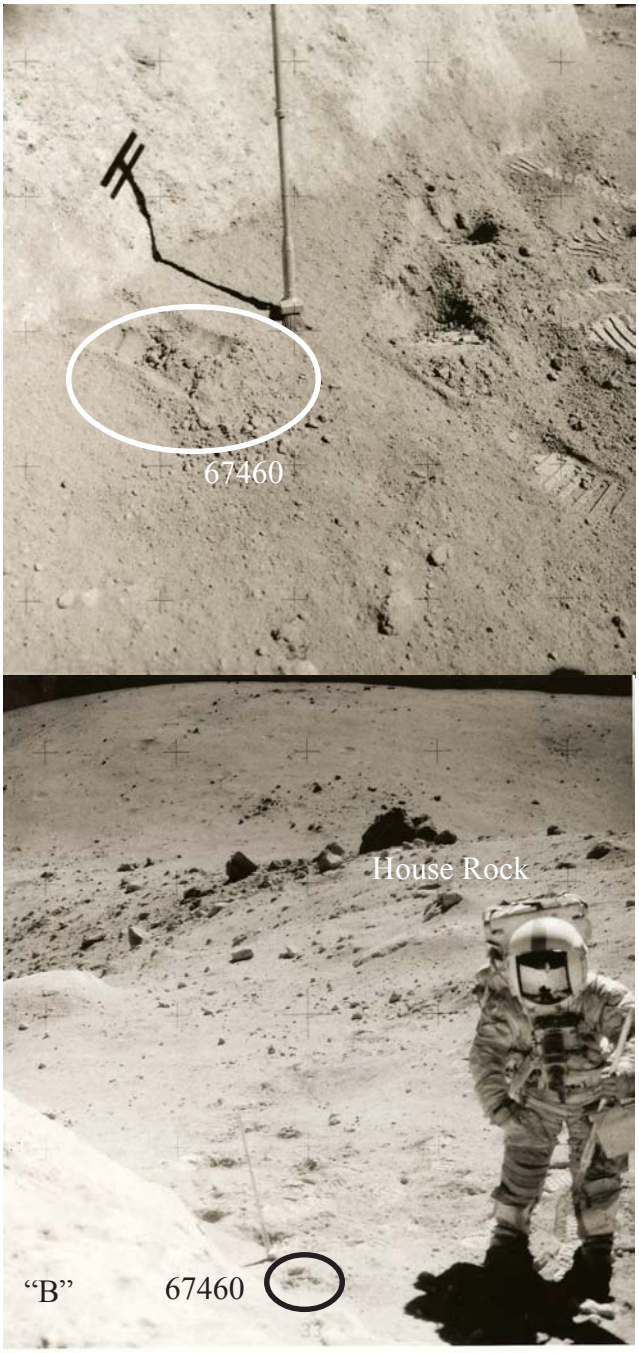

Figure 2: Two views of sample location of soil 67460 from "fillet" of white boulder "B" or rim of North Ray Crater. Top view is close-up of fillet AS16-106-17335. Bottom view is telephoto of astronaut on rim of North Ray Crater with House Rock and Smoky Mt. in background. AS16-106-17336.

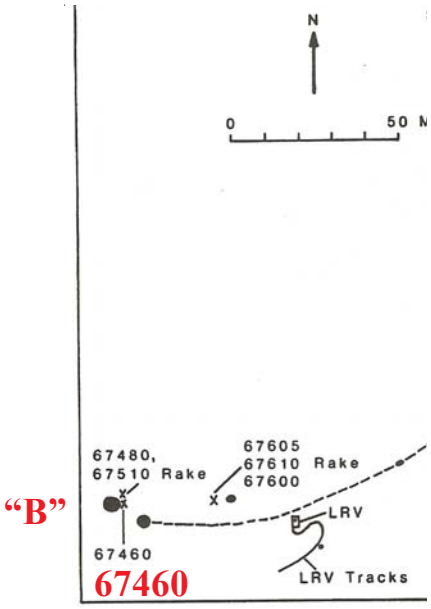

Figure 1: Map of south rim of North Ray Crater. Boulder B was the largest boulder and 67460 was a well defined "fillet" of that boulder.

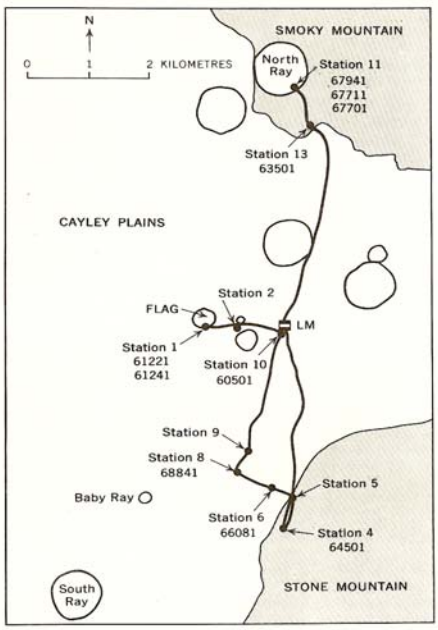

Figure 3: Map of Apollo 16 site showing North Ray Crater.

Mineralogical Mode for 67461

	Simon et al. 1981 1000-90	*Labotka et al. 1980 90-20 micron*	*20-10*
Agglutinate	8.5 %	15.7	8.2
Breccia	42		
Anorthosite	22		
Olivine		3.1	3.8
Pyroxene	0.5	6.6	9.2
Plagioclase	12.2	61.2	62.6
Opaques	1.1	0.3	0.2
Basalt	0.5		
Glass	4.2		
Mare glass			1.2
Highland glass		5.8	9

Introduction

67461 was collected from the "fillet" of boulder "B" on the rim of North Ray Crater, immediately below where breccia sample 67455 was collected (Sutton 1981). It was chosen as a "reference soil" for the "lunar highland initiative" (Simon et al. 1981) and is not greatly different from other soil samples from North Ray Crater.

Petrography

Lunar soil 67461 has a low maturity index $I_s/FeO = 25$ and few agglutinates in the 1000-90 micron separate (Simon et al. 1981). The grain size distribution has not been reported.

Labotka et al. (1980) and Simon et al. (1981) gives the mode for different grain size separates of 67461. They also determined the composition of mineral and glass grains in the different size fractions (figure 4).

Walker and Papike (1981) studied the formation of agglutinates, finding more Fe and less Al than the bulk soil.

Chemistry

Compston et al. (1973), Wanke et al. (1973) and Laul and Papike (1980) found that 67461 was one of the most aluminous lunar soils (figure 5). This is probably because of aluminum-rich from the adjacent boulder. Wanke et al. (1973) and Boynton et al. (1973) determined the trace element content (figure 6) and found low Ni.

Laul and Papike (1980) determined the composition of different grain size fraction, finding slightly more REE in the finest fraction.

Kerridge et al. (1975a) determined 87 ppm carbon and 30 ppm nitrogen for 67461, but Kerridge et al.

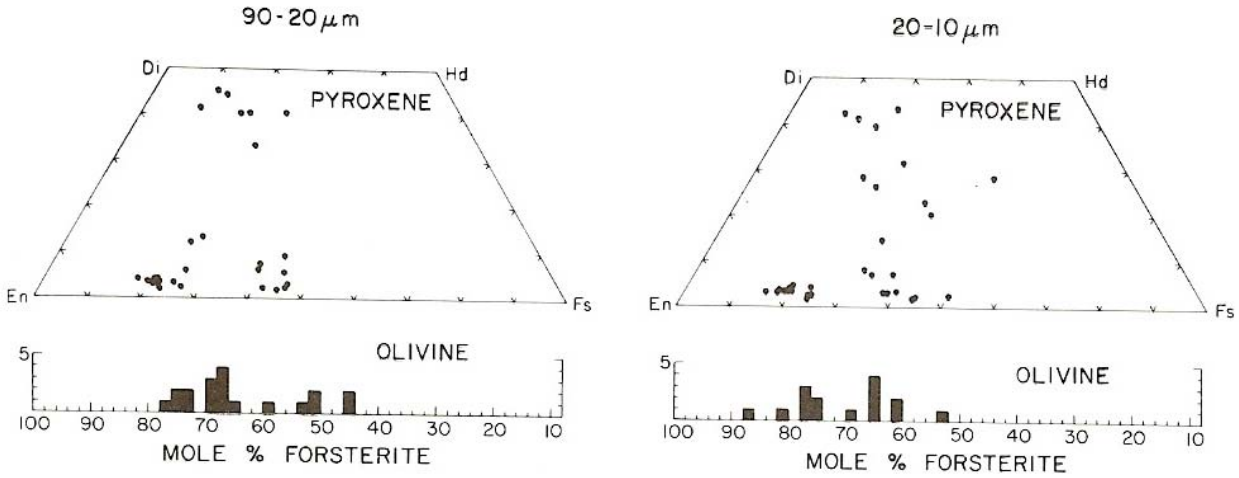

Figure 4: Composition of mafic minerals in fines and very fines of 67461 (Labotka et al. 1980).

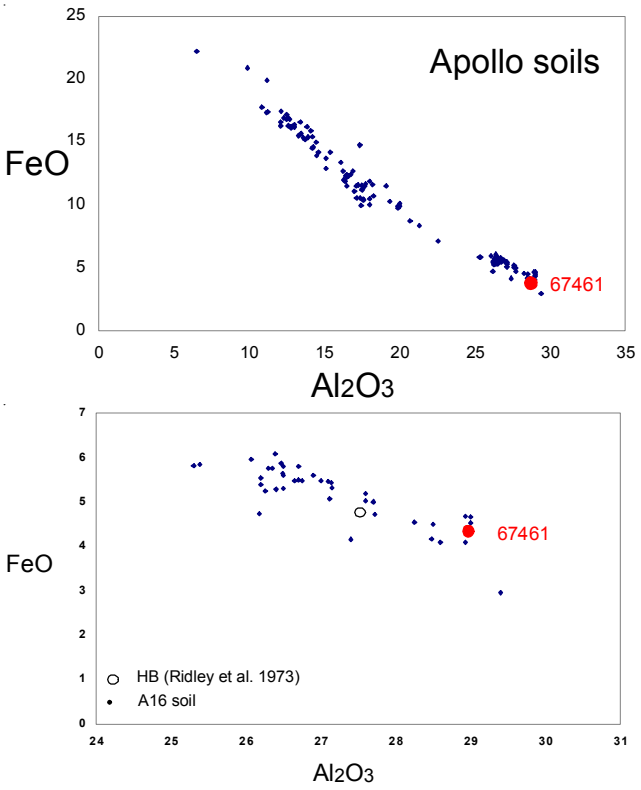

Figure 5: Composition of 67461 compared with that of other Apollo soils.

(1975b) reported only 19 ppm nitrogen for bulk 67460 (figure 7).

Other Studies

Behrmann et al. (1973) measured the density of fossil nuclear tracks in grains from 67461 (figure 8).

Hintenberger and Weber (1973) determined the rare gas content and isotopic ratios. Nunes (1975) reported on lead loss.

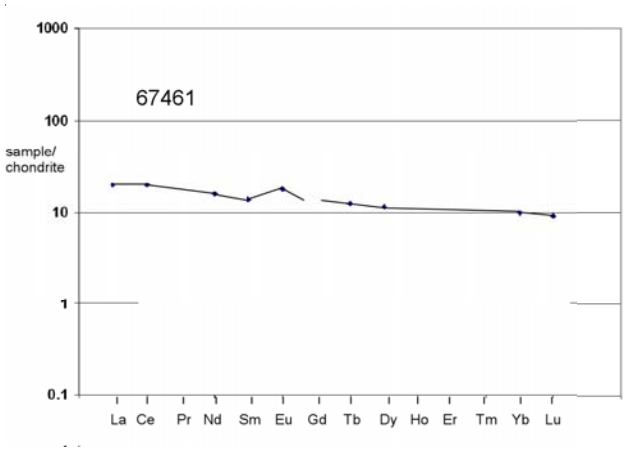

Figure 6: Normalized rare-earth-element diagram for 67461.

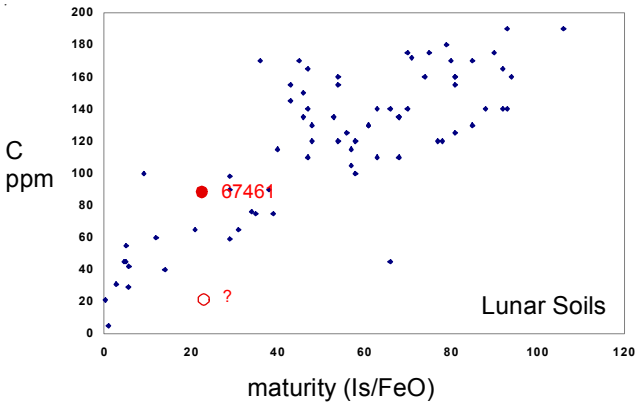

Figure 7: Carbon content and maturity index for 67461 compared with other Apollo soils.

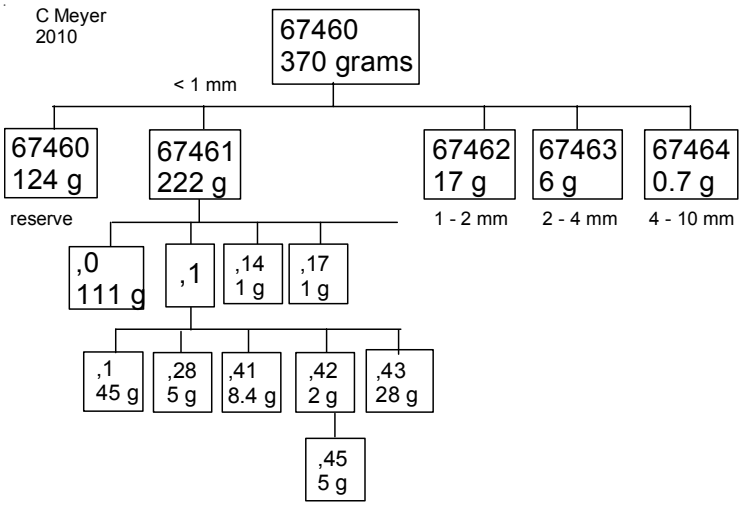

Table 1. Chemical composition of 67461.

						67460		ave. st. 11
reference	Laul80		Wanke73		Compston73	Boynton76		Korotev81
weight								
SiO2 %	45	(d)	45.6	(a)	44.77	(b)			45.1
TiO2	0.29	(d)	0.33	(a)	0.37	(b)	0.5	(d)	0.41
Al2O3	29.2	(d)	30.2	(a)	28.99	(b)	28.34	(d)	28.9
FeO	4.2	(d)	4.32	(a)	4.35	(b)	4.24	(d)	4.2
MnO	0.055	(d)	0.054	(a)	0.07	(b)	0.057	(d)	0.056
MgO	3.9	(d)	3.95	(a)	4.2	(b)	4.14	(d)	4.3
CaO	17.6	(d)	16.94	(a)	16.85	(b)	16.66	(d)	16.5
Na2O	0.43	(d)	0.43	(a)	0.44	(b)	0.42	(d)	0.48
K2O	0.055	(d)	0.046	(a)	0.06	(b)	0.05	(d)	0.065
P2O5			0.06	(a)	0.05	(b)			
S %					0.05	(b)			
sum									
Sc ppm	7.8	(d)	7.1	(a)			7.8	(d)	7.3
V	20	(d)					17	(d)	18
Cr	513	(d)	470	(a)			530	(d)	515
Co	9	(d)	12.5	(a)			11.8	(d)	14.5
Ni	80	(d)	120	(a)			92	(e)	140
Cu			4.6	(a)					
Zn			11	(a)			10.4	(e)	
Ga			4.2	(a)			4.3	(e)	
Ge ppb			350	(a)			350	(e)	
As			0.035	(a)					
Se									
Rb			2	(a)	1.22	(c)			1.65
Sr	170	(d)	145	(a)	164	(c)			180
Y			18	(a)					20
Zr			72	(a)					83
Nb			3.8	(a)					
Mo									
Ru									
Rh									
Pd ppb									
Ag ppb									
Cd ppb							48	(e)	
In ppb			4	(a)			2.6	(e)	
Sn ppb									
Sb ppb									
Te ppb									
Cs ppm			0.14	(a)					
Ba	60	(d)	57	(a)			50	(d)	71
La	4.67	(d)	4.5	(a)			4.6	(d)	5.9
Ce	12	(d)	13	(a)			11	(d)	
Pr			1.7	(a)					
Nd	7.2	(d)	8	(a)					
Sm	2	(d)	2.1	(a)			2	(d)	2.8
Eu	1	(d)	1.05	(a)			0.93	(d)	1.13
Gd			2.8	(a)					
Tb	0.45	(d)	0.4	(a)			0.44	(d)	0.56
Dy	2.8	(d)	2.5	(a)			2.4	(d)	
Ho			0.5	(a)					
Er			2.1	(a)					
Tm	0.25	(d)							
Yb	1.6	(d)	1.6	(a)			1.62	(d)	2.05
Lu	0.22	(d)	0.22	(a)			0.21	(d)	0.29
Hf	1.6	(d)	1.45	(a)			1.2	(d)	1.85
Ta	0.24	(d)	0.22	(a)			0.2	(d)	0.3
W ppb			74	(a)					
Re ppb			0.5	(a)					
Os ppb									
Ir ppb							2.8	(e)	
Pt ppb									
Au ppb			1.5	(a)			1.6	(e)	
Th ppm	0.83	(d)	0.6	(a)			0.66	(d)	1
U ppm			0.18	(a)			0.2	(d)	0.27

technique: (a) multitech. (b) XRF, (c) IDMS, (d) INAA, (e) RNAA

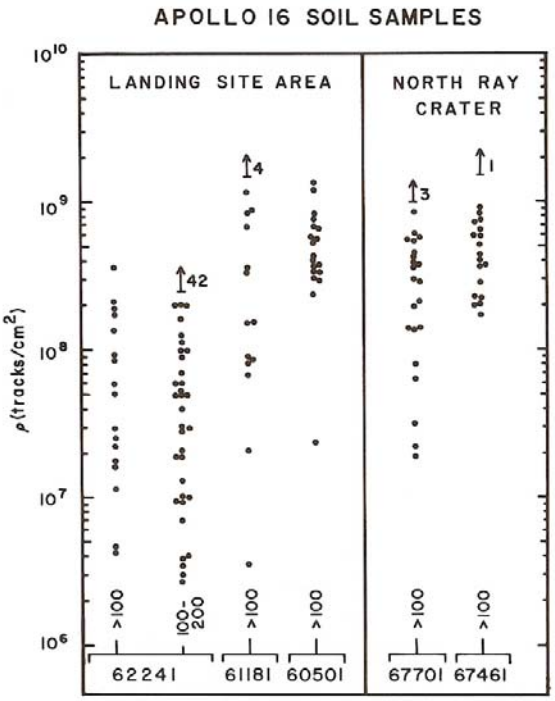

Figure 8: Density of fossil nuclear tracks in Apollo 16 soils (Behrmann et al. 1973).

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