15231

Soil (under boulder)

343.8 grams

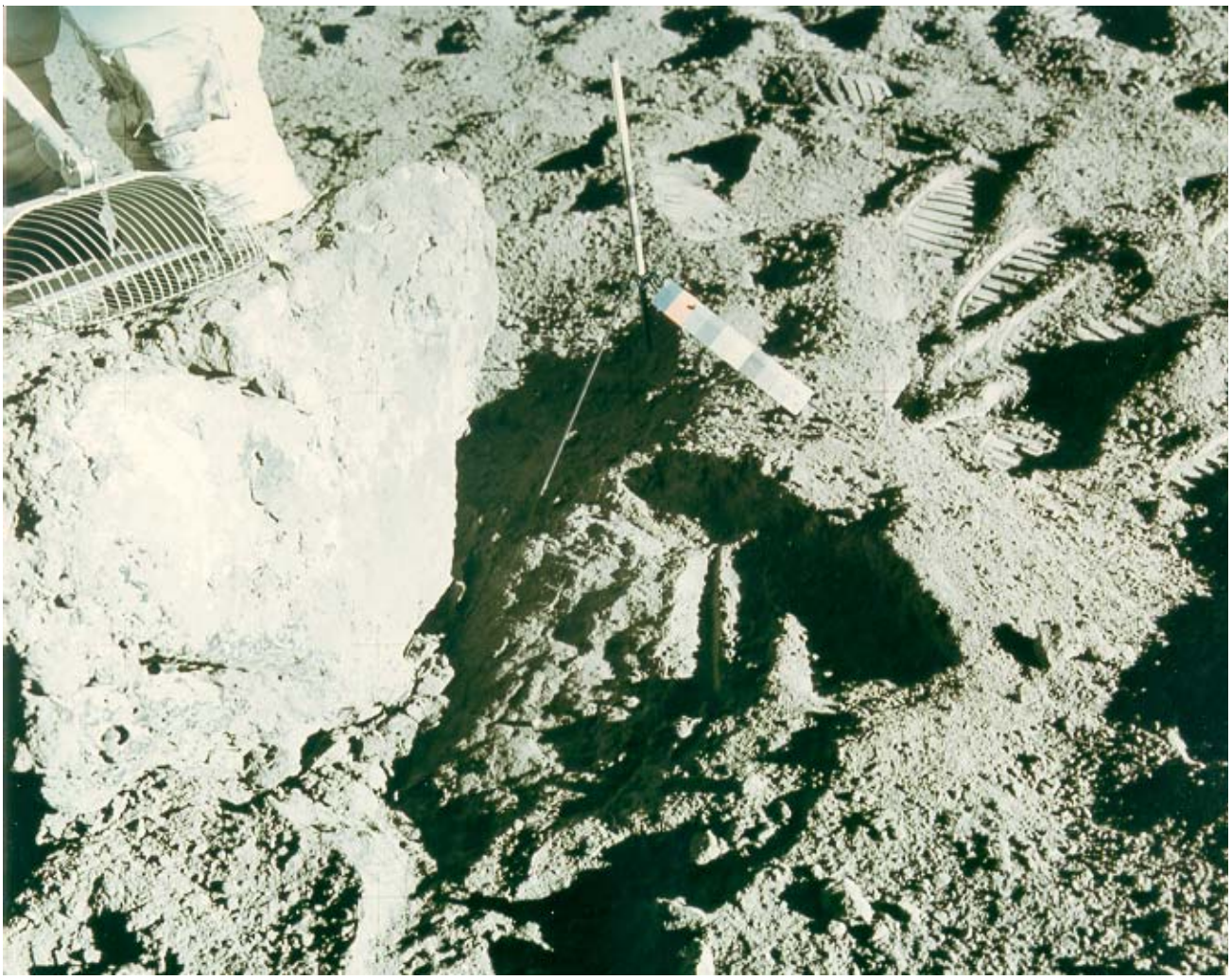
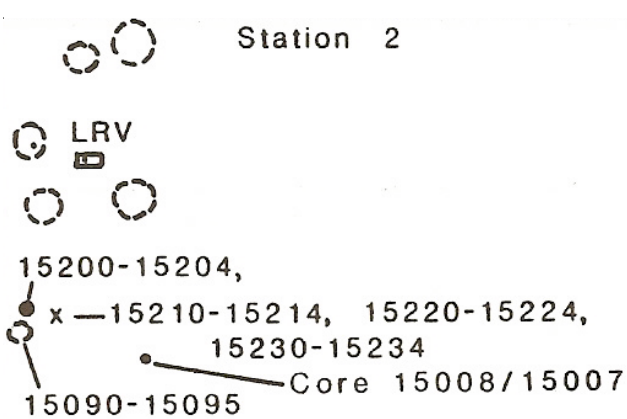


Figure 1: Location of soil sample 15230 from beneath 1 meter boulder after it was rolled over. AS15-86-11565.



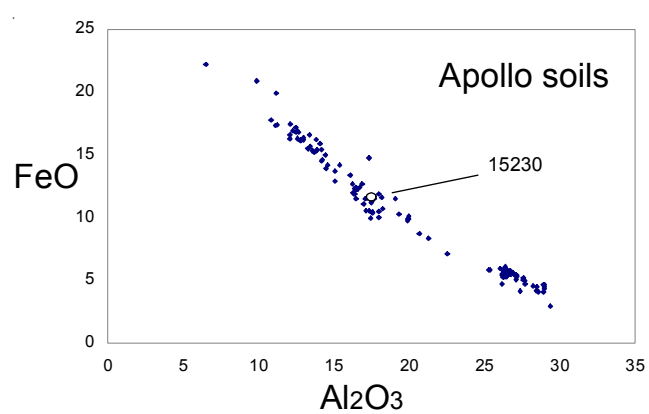


Figure 2: Composition of 15230 compared with other lunar soils.

Introduction

Soil sample 15230 is a "shielded sample" that was collected from beneath a one meter-size boulder after it was rolled over (Swann et al. 1971). The boulder is thought to be freshly placed, because it has a frothy glass coating that has not been eroded, and because there was no fillet on one side (the cosmic ray exposure of 15205 or 15206 should give the age).

The fact that the ^{22}Na activity of the samples of this boulder (15205, 15206) is at saturation while the ^{26}Al is at one-half to one-third of saturation indicates that this boulder has been in its present position for less that one million years (Rancitelli et al. 1972; Fruchter et al. (1981).

Petrography

15231 is a mature soil with I_s/FeO = 71 and 43% agglutinates (Morris 1978). Morris et al. (1983) published a mineral mode determined by McKay et al.

King et al. (1972) determined the grain size distribution (figure 5). The average grain size is 52 microns.

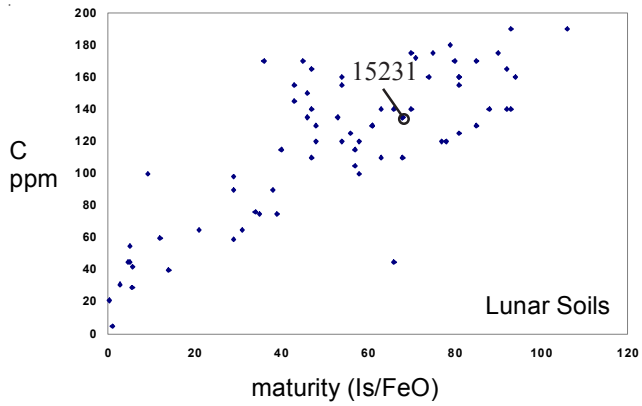


Figure 3: Carbon and maturity in lunar soils (Morris 1977, Moore et al. 1973).

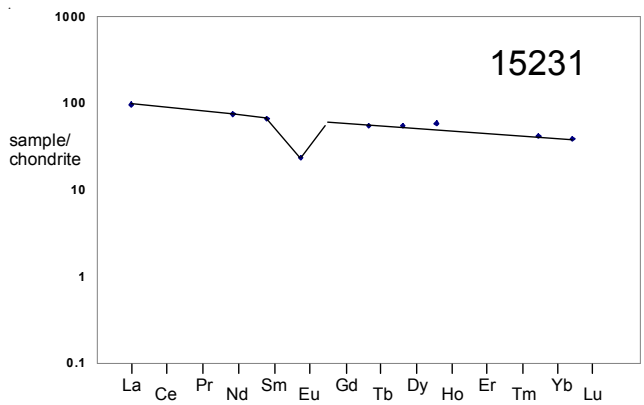
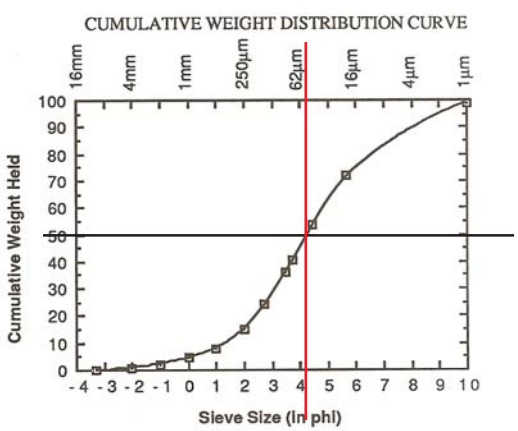


Figure 4: Normalized rare-earth-element diagram for 15231.



Average grain size = 52 microns

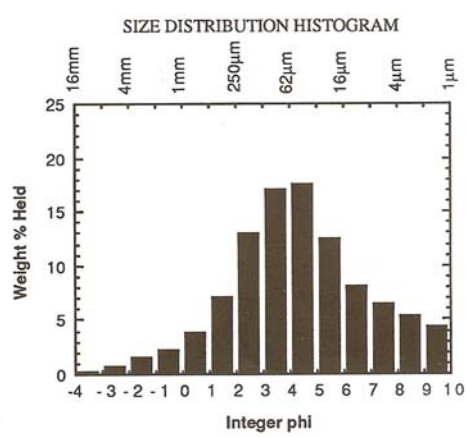


Figure 5: Grain size distribution of 15230 (Graf 1993).

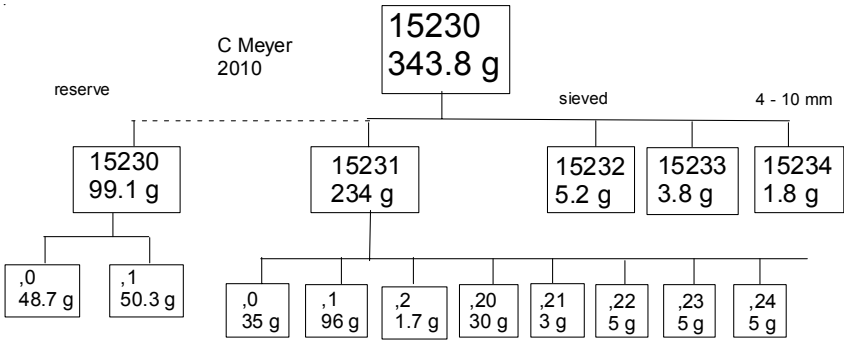
Modal content of soils 15230.
From McKay (unpublished)

Agglutinates	43
Basalt	5
Breccia	11
Anorthosite	1
Norite	
Gabbro	
Plagioclase	9
Pyroxene	11
Olivine	1
Ilmenite	
Glass other	17

Table 1. Chemical composition of 15230.

reference	Carron72		Fruchter73		Baedecker72		Wanke73		Rancitelli72		Juan72	
weight	*Cuttitta73*											
SiO2 %	46.4	(a)					47	(b)			47.48	(d)
TiO2	1.35	(a)	1.38	(b)			1	(b)			1.44	(d)
Al2O3	17.14	(a)	17.2	(b)			17.9	(b)			18.5	(d)
FeO	11.53	(a)	11.7	(b)			11.6	(b)			11.35	(d)
MnO	0.16	(a)					0.14	(b)			0.153	(d)
MgO	10.47	(a)					10.6	(b)			9.82	(d)
CaO	11.88	(a)					11.2	(b)			10.64	(d)
Na2O	0.41	(a)	0.37	(b)			0.42	(b)			0.39	(d)
K2O	0.19	(a)					0.17	(b)	0.17	(c)	0.195	(d)
P2O5	0.15	(a)										
S %												
sum												
Sc ppm	22	(a)	22	(b)			21	(b)				
V	82	(a)										
Cr	1574	(a)	2150	(b)			2110	(b)				
Co	42	(a)	38	(b)							71	(d)
Ni	315	(a)			270	(b)	120	(b)			292	(d)
Cu	7.8	(a)										
Zn	18	(a)			15	(b)					30	(d)
Ga	2.9	(a)			4	(b)						
Ge ppb					460	(b)						
As												
Se												
Rb	5	(a)									5	(d)
Sr	155	(a)									243	(d)
Y	69	(a)										
Zr	270	(a)										
Nb	12	(a)										
Mo												
Ru												
Rh												
Pd ppb												
Ag ppb											56	(d)
Cd ppb					40	(b)						
In ppb					11	(b)						
Sn ppb												
Sb ppb												
Te ppb												
Cs ppm												
Ba	290	(a)										
La	28	(a)	23.6	(b)			22.9	(b)				
Ce			57	(b)								
Pr												
Nd							34	(b)				
Sm			9.7	(b)			9.9	(b)				
Eu			1.36	(b)			1.33	(b)				
Gd												
Tb			1.8	(b)			2	(b)				
Dy							13.4	(b)				
Ho							3.3	(b)				
Er												
Tm												
Yb	6.8	(a)	6.7	(b)			6.8	(b)				
Lu			1.05	(b)			0.95	(b)				
Hf			7.4	(b)			7	(b)				
Ta			1.3	(b)			0.91	(b)				
W ppb												
Re ppb												
Os ppb												
Ir ppb					11	(b)						
Pt ppb												
Au ppb											5	(d)
Th ppm			6.7	(b)					3.59	(c)		
U ppm									0.94	(c)		

technique: (a) microchemical, (b) INAA, (c) radiation counting, (d) AA, colometric



Powell (1972) and Ryder and Sherman (1989) briefly described the coarse-fines.

Chemistry

Cuttitta et al. (1973), Fruchter et al. (1973), Wanke et al. (1973) and others determined the bulk composition (table 1, figure 2 and 3).

The total carbon is 130 ppm (Moore et al. 1973) or 142 ppm (Kaplan et al. 1976). Reed et al. (1972) also determined the halogens, Li, Hg Te, Ru and Os.

Walker and Papike (1981) calculated 24 % KREEP, 23 % mare basalt.

Cosmogenic isotopes and exposure ages

Rancitelli et al. (1972) reported the cosmic-ray-induced activity of ^{22}Na = 44 dpm/kg., ^{26}Al = 104 dpm/kg., ^{46}Sc = 2.8 dpm/kg., ^{48}V = 9 dpm/kg., ^{54}Mn = 9 dpm/kg etc. Stoenner et al. (1972) determined ^{37}Ar, ^{39}Ar and ^{3}H.

Crozaz et al. (1972) reported the solar flare track density.

Russ et al. (1972) determined the isotopic ratio of gadolinium, giving a measure of exposure to neutrons produced in the regolith by cosmic rays.

Other Studies

Bauer et al. (1972) and Frick et al. (1973) determined the rare gasses and their isotopes.

Processing

15230 was returned in a sealed ALSRC (#1).

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