14003 – 947.9 grams
Soil
Contingency Sample

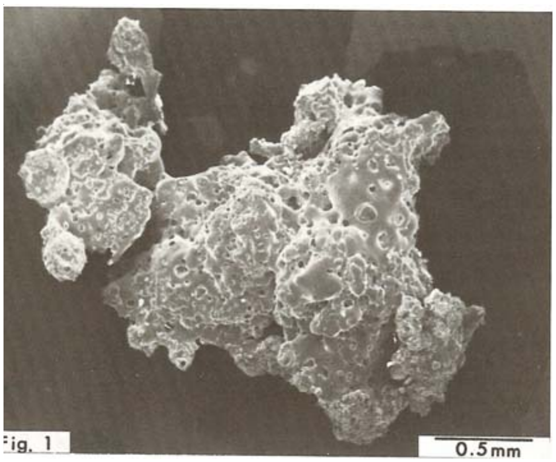


Figure 1: An agglutinate particle from 14003 (sometimes referred to as a "glazed aggregate"). This SEM picture is lifted from McKay et al. (1972).

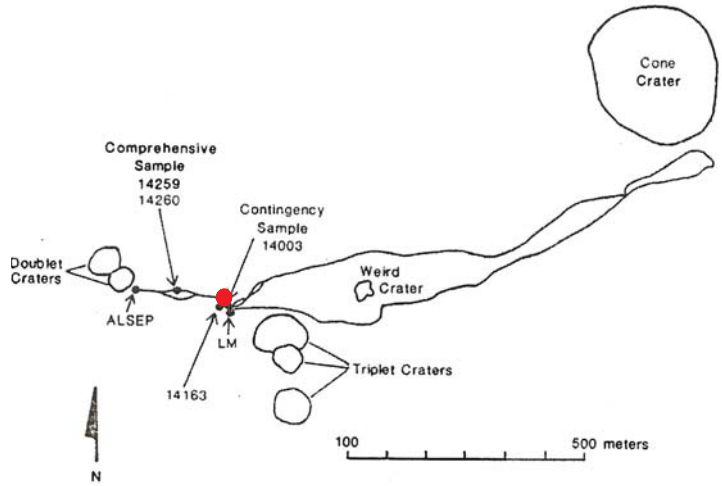


Figure 2: Map of Apollo 14 traverse to the rim of Cone Crater, which they missed by only a few feet.

Introduction
The Apollo 14 contingency sample was collected in a smooth area about 25 meters in front of the Lunar Module (figure 2). It is a mature lunar soil with about 60 % agglutinates (figure 1).

The contingency sample was originally numbered 14005 (weigh bag 1039) and subdivided by sieving as:

14001	31.8 g	2-4 mm
14002	42.1 g	1-2 mm
14003	948 g	< 1 mm
14004	33 g	4-10 mm
14006 – 12		particles > 10 mm

Petrography
The maturity index for 14003 is I_s/FeO = 66 (Morris 1978).

The grain size distribution was determined by McKay et al. (1972), King et al. (1972) and vonEngelhardt et al. (1972). The average grain size is 125 microns (figure 3).

McKay et al. (1972) and vonEngelhardt et al. (1976) determined the modal mineralogy as function of grain size. Finkelman (1973) carefully studied the 14002 and 14003. Taylor et al. (1972) and Carr and Meyer (1972) also studied the 1-2 mm coarse-fines (14002) and Kramer and Twedell (1977) cataloged the larger particles (14004).

Goldstein et al. (1976) studied the carbide and other phases in metal particles from 14003 and other soils.

Warner et al. (1980) reported the mineralogy and chemistry of an apparent mare basalt fragment in 14004 (table 1b). Snyder et al. (1992) analyzed two "felsites" particles.

Chemistry
Rose et al. (1972), Taylor et al (1972) and others analyzed 14003 (table 1 and figure 6). It is over 60 KREEP and has high meteoritic siderophiles.

DesMarais et al. (1973) and Moore et al. (1972) determined the carbon content (125 and 140 ppm respectively) while Muller (1972) studied the nitrogen (92 ppm) as function of grain size (it's surface correlated).

Snyder et al. (1992) found two granite particles in 14004 (figure 7).

Mineralogical Mode for 14003 (McKay et al. 1972)

	150-250 u	90-150 u	60-75 u	20-30 u
Agglutinates	54.2 %	60.3	56.5	43.5
Basalt	0.8	1.3		
Anorthosite	0.2			
Breccia				
Recrystalized	19.2	20.5	16.5	7
Vitric	4.4	3	1	0.5
Glass	11.8	8.9	13.5	17
Olivine	1			
Pyroxene	4.2	3.6	10	23
Plagioclase	3.6	2.3	1.5	7
Opaques				1.5

Other Studies

Bogard and Nyquist (1972) and Heymann et al. (1972) reported the isotopic composition of rare gasses. Merlivat et al. (1972) determined the hydrogen isotopes.

Based on the determination of the maximum density of fossil nuclear tracks, Bhandari et al. (1972) calculate a "suntan" exposure age of 80 m.y.

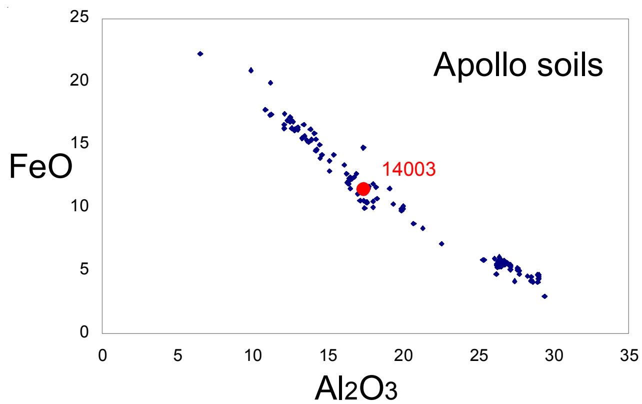


Figure 4: Composition of 14003 compared with that of other Apollo soil samples.

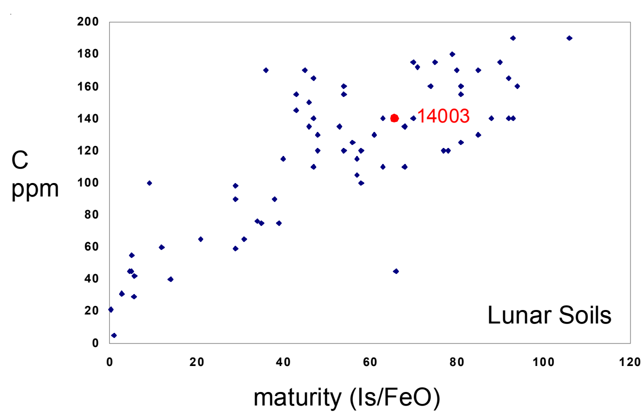


Figure 5: Carbon content and maturity index for 14003 compared with other Apollo soils.

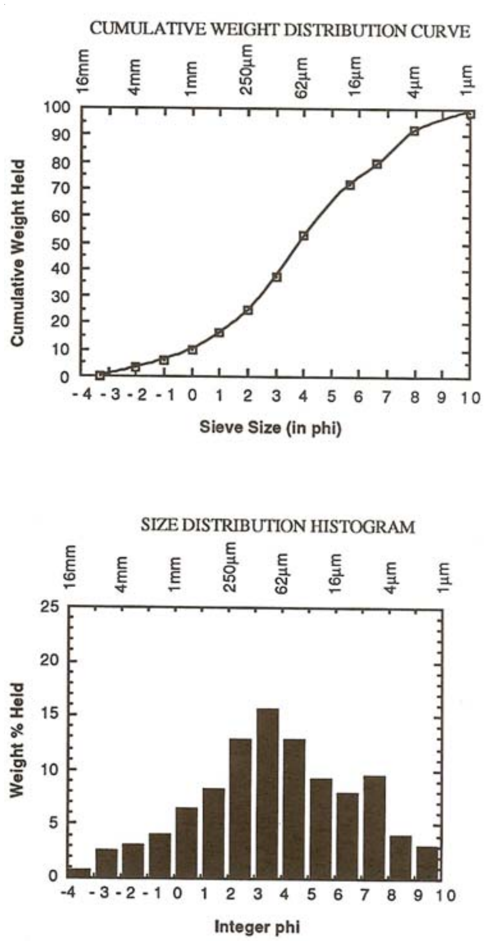
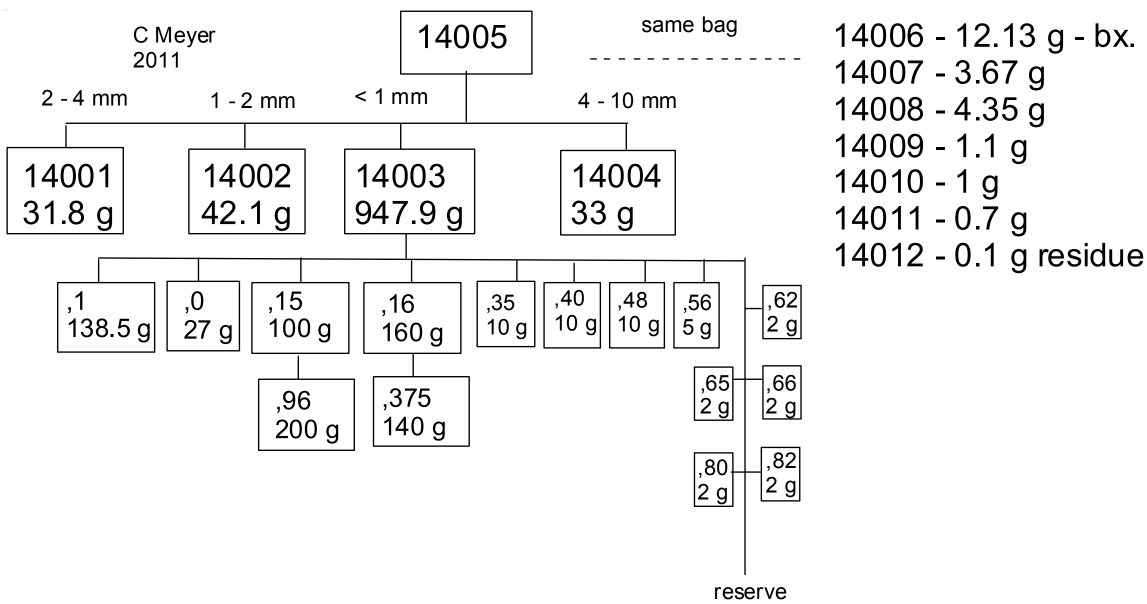


Figure 3: Grain size distribution for 14003 (Graf 1993, from data by Engelhardt et al. 1972)



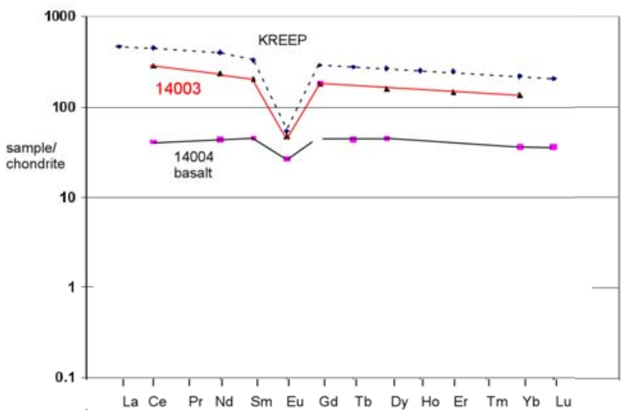


Figure 6: Normalized rare-earth-element pattern for 14003 and basalt from 14004, compared with KREEP.

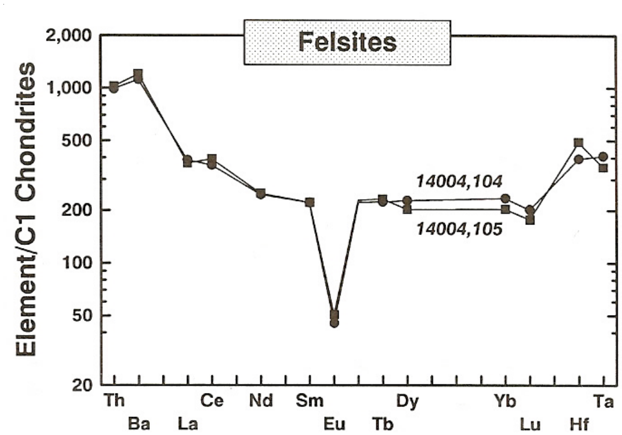


Figure 7: Normalized trace element pattern for two small granite particles form 14004 (Snyder et al. 1992).

Processing

14005 was partially spilled as it was collected (exact situation uncertain).

Table 1a. Chemical composition of 14003.

reference	Rose72		Laul72				Taylor72		Philpotts72		Baedecker72		Morgan72		Tatsumoto72		Murthy72	
weight																		
SiO2 %	48.08	(a)					48.1	(d)	48.2	(f)								
TiO2	1.77	(a)	1.8	(b)			1.83	(d)	1.75	(f)								
Al2O3	17.59	(a)	18.3	(b)			17.6	(d)	17.69	(f)								
FeO	10.45	(a)	11	(b)			10.3	(d)	10.53	(f)								
MnO	0.14	(a)					0.14	(d)	0.13	(f)								
MgO	9.27	(a)					9.78	(d)	9.52	(f)								
CaO	11.12	(a)	11	(b)			10.4	(d)	10.32	(f)								
Na2O	0.65	(a)	0.69	(b)			0.57	(d)	0.69	(f)								
K2O	0.54	(a)	0.57	(b)	0.6	(c)	0.52	(d)	0.55	(f)					0.33	(e)	0.45	(e)
P2O5	0.58	(a)							0.49	(f)								
S %																		
sum																		
Sc ppm	27	(a)	23	(b)			24	(d)										
V	58	(a)	53	(b)			48	(d)										
Cr	1779	(a)	1464	(b)	1348	(c)	1400	(d)	1231	(e)								
Co	38	(a)	39	(b)			34	(d)										
Ni	430	(a)					370	(d)			380	(c)						
Cu	16	(a)					10	(d)										
Zn	28	(a)									29	(c)	25	(c)				
Ga	5	(a)					4.6	(d)			7.6	(c)						
Ge ppb											790	(c)						
As																		
Se													310	(c)				
Rb	13	(a)			13	(c)	14	(d)	14.6	(e)			13.5	(c)	11.59	(e)	14.6	(e)
Sr	135	(a)					180	(d)	176.5	(e)					142.7	(e)	174	(e)
Y	300	(a)			192	(c)	193	(d)										
Zr	790	(a)	780	(b)			800	(d)	877	(e)								
Nb	70	(a)					45	(d)										
Mo																		
Ru																		
Rh																		
Pd ppb																		
Ag ppb													11.5	(c)				
Cd ppb											170	(c)	94	(c)				
In ppb											41	(c)						
Sn ppb																		
Sb ppb													2.4	(c)				
Te ppb													25	(c)				
Cs ppm					0.5	(c)							0.58	(c)				
Ba	1000	(a)	810	(b)			760	(d)	823	(e)							767	(e)
La	75	(a)	68	(b)	66	(c)	81	(d)										
Ce			200	(b)	193	(c)	228	(d)	170	(e)								
Pr					20.5	(c)	29	(d)										
Nd					103	(c)	121	(d)	107	(e)								
Sm			30	(b)	31.2	(c)	36	(d)	30.2	(e)								
Eu			2.6	(b)	2.56	(c)	2.38	(d)	2.63	(e)								
Gd					36	(c)	33	(d)	35.5	(e)								
Tb					6.1	(c)	4.9	(d)										
Dy					41	(c)	33	(d)	38.9	(e)								
Ho					9.7	(c)	8.3	(d)										
Er					23.9	(c)	23	(d)	22.9	(e)								
Tm					4	(c)	3.7	(d)										
Yb	27	(a)	23	(b)	22	(c)	19.3	(d)	21.6	(e)								
Lu			3.2	(b)	3.3	(c)												
Hf			20	(b)			23	(d)	20.7	(e)								
Ta																		
W ppb							0.9	(d)										
Re ppb													0.97	(c)				
Os ppb																		
Ir ppb											12	(c)	11	(c)				
Pt ppb																		
Au ppb													4.4	(c)				
Th ppm			14	(b)			12	(d)							11.7	(e)		
U ppm							3.1	(d)							2.52	(e)		

technique: (a) "microchemical" (b) INAA, (c) RNAA, (d) SSMS, (e) IDMS, (f) AA, (g) XRF

Table 1b. Chemical composition of 14003 (cont.).

							14004		14004	14004	
reference	Brown72			Muller75	Ehman75		Warner80		Snyder92		
weight							basalt				
SiO2 %					49.65	(b)			69	69	
TiO2					2	(b)	5.4	(b)	1.35	1.14	(b)
Al2O3					17.4	(b)	12	(b)	12.3	13.2	(b)
FeO					10.8	(b)	18.4	(b)	7.7	6.3	(b)
MnO					0.13	(b)	0.24	(b)	0.106	0.081	(b)
MgO				9.13	7.63	(b)	6.9	(b)			
CaO				11.1	9.8	(b)	10.4	(b)	5.1	5.1	(b)
Na2O				0.72	0.63	(b)	0.412	(b)	1.56	1.54	(b)
K2O				0.52			0.06	(b)	3.1	3.2	(b)
P2O5											
S %											
sum											
Sc ppm							56	(b)	15.8	13.6	
V							109	(b)			
Cr	5065	2135	(g)				1587	(b)	92	139	(b)
Co							25	(b)	2.4	2.7	(b)
Ni	350	349	(g)								
Cu	9	12	(g)								
Zn	32	37	(g)								
Ga											
Ge ppb											
As											
Se											
Rb	15	13	(g)	14.6					87	92	(b)
Sr	209	179	(g)	188					150	110	(b)
Y	246	209	(g)								
Zr	1089	914	(g)				170	(b)			
Nb	56	43	(g)								
Mo											
Ru											
Rh											
Pd ppb											
Ag ppb											
Cd ppb											
In ppb											
Sn ppb											
Sb ppb											
Te ppb											
Cs ppm				0.63					2	2.9	(b)
Ba	602	393	(g)	825			90	(b)	2610	2810	(b)
La				69			9	(b)	91	87	(b)
Ce							25	(b)	218	237	(b)
Pr								(b)			
Nd							20	(b)	111	113	(b)
Sm							6.7	(b)	32.5	32.5	(b)
Eu							1.49	(b)	2.53	2.82	(b)
Gd											
Tb							1.6	(b)	8.1	8.4	(b)
Dy							11	(b)	55	49	(b)
Ho											
Er											
Tm											
Yb							5.9	(b)	38	33	(b)
Lu							0.86	(b)	4.9	4.3	(b)
Hf							4.7	(b)			
Ta							0.9	(b)			
W ppb											
Re ppb											
Os ppb											
Ir ppb											
Pt ppb											
Au ppb											
Th ppm							0.4	(b)			
U ppm				3.3							

technique: (b) INAA, (c) RNAA, (d) SSMS, (e) IDMS, (f) AA, (g) XRF

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