60050

Soil

225.8 grams

LMP: I'm going over to this crater and get you some of this white soil. I think it is coming off of this rock here, but it looks like caliche. I never thought I'd use that word up here, but that's what the coating looks like. CDR: Gosh, Charlie, it does look like caliche. LMP: Doesn't it look like caliche? CDR: Yeah, but it's just a bunch of white frag, I believe.



Figure 1: Location of 60050 from side of small crater. AS16-114-18386

Introduction

60050 was collected from the side of a small crater about 20 meters from the Apollo 16 deep drill core near the ALSEP station (figure 1). It was collected because it was lighter colored than the adjacent soil. It was found to include five friable rock fragments 60055 - 59, made of cataclastic anorthosite (table 2). The higher Al₂O₃ and lower REE content of the soil is apparently due to addition of this anorthosite (figure 5).

Petrography

60050 is a submature soil with a maturity index of Is/FeO = 57 (Morris 1978). Butler et al. (1973) and Graf



Figure 2: Chemical composition of Apollo soil 60051 *compared with all Apollo soils.*

(1993) report the grain size analysis based on sieving (figure 7). Simkin et al. (1973) reported that the 1-2 mm coarse-fines (60052) contained 13 % anorthosite, 20 % plagioclase and only 9 % agglutinate particles. About 3 grams worth of anorthosite were found in the 4-10 mm fraction (figure 8).

Chemistry

This soil is one of the most aluminous of the Apollo soils (figure 2), because of the addition of the friable anorthosite rocks that were collected along with it. The rare-earth-element content is between that of 60501, a soil colleted nearby, and anorthosites (60055 etc) found in the same bag (figure 5). Moore et al. (1973) reported 110 ppm carbon (figure 6).

Cosmogenic isotopes and exposure ages

Wrigley (1973) determined the cosmic-ray-induced activity of ${}^{26}Al = 115$ dpm/kg and ${}^{22}Na = 56$ dpm/kg.

Other Studies

Bogard D.D. and Nyquist L.E. (1973) and Signer et al. (1977) determined the rare gas content and isotopic ratios in bulk soil and various components. It was noted that most of the rare gas was located in the agglutinates. Exposure ages were not calculated.



Figure 3: Normalized rare-earth-element diagram for Apollo 16 soils with 60051.



Figure 4: Chemical composition of Apollo 16 soil with average composition of 'highland basalt' (glass) and 60051.



Figure 5: Comparison with friable ferroan anorthosites found in same bag.







Figure 6: Carbon content of Apollo 16 samples.

Lunar Sample Compendium C Meyer 2010

reference weight SiO2 %	Simkin 73		Korotev	82 ??		McKay86		Korotev 97 compiled 44.8 (b)		Philpotts73		Wrigley73		Fruchter74	
TiO2 Al2O3 FeO MnO MgO CaO Na2O K2O P2O5 S % sum	0.44 28.5 4.5 0.04 5.05 16.2 0.46 0.14	(c) (c) (c) (c) (c) (c) (c) (c)		3.75	(a)	0.44 28.5 4.26	(a) (a) (a)	0.44 28.2 4.47	(b) (b) (b)					28.1 4.1	(a) (a)
				0.484	(a)	5.05 15.8 0.484	(a) (a) (a)	5.3 15.9 0.457 0.12	(b) (b) (b) (b)	0.096	(e)	0.0988	(f)	0.47	(a)
Sc ppm	-	(1)	7.83	7	(a)	7.75	(a)	7.75	(b)					8.1	(a)
V Cr Co Ni Cu Zn Ga Ge ppb As Se Rb Sr	7 730 27 270 7	(d) (d) (d) (d) (d)	19 612 21.3 250	580 13.2 200	(a) (a) (a)	594 19.5 260	(a) (a) (a)	615 24.7 342	(b) (b) (b)					611 23.6	(a) (a)
	3	(d)													
	205		165			200	(a)	188	(b)	2.34 173	(e) (e)				
Y Zr	28 110		165			160	(a)	150	(b)						
Mo Ru Rh Pd ppb Ag ppb Cd ppb In ppb Sn ppb Sb ppb Te ppb															
Cs ppm Ba La Ce	140		0.1 108 10.06 27	10.2 26.5	(a) (a)	0.12 110 10 26.4	(a) (a) (a) (a)	0.11 110 10 26.6	(b) (b) (b) (b)	26.8	(e)			130 9.9 25.2	(a) (a) (a)
Pr Nd Sm Eu			4.88 1.12	4.7 1.01	(a) (a)	10 4.6 1.195	(a) (a) (a)	14 4.7 1.14	(b) (b) (b)	16.9 4.84 1.07	(e) (e) (e)			16 5.1 1.2	(a) (a) (a)
Tb Dy Ho Er			1.04	1	(a)	0.89	(a)	0.96	(b)	6.15	(e)			1	(a)
Tm Yb Lu Hf Ta W ppb Re ppb			3.42 0.501 3.89 0.526	3.3 0.46 3.4 0.5	(a) (a) (a) (a)	3.16 0.446 3.6 0.44	(a) (a) (a) (a)	3.31 0.47	(b) (b)					3.5 0.5 3.3 0.4	(a) (a) (a) (a)
Os ppb Ir ppb			7.6			8.1	(a)	10.9	(b)						
Pt ppb Au ppb Th ppm U ppm			1.76 0.46	1.7	(a)	4.6 1.8 0.45	(a) (a) (a)	7.1 1.73 0.46	(b) (b) (b)			1.68 0.42	(f) (f)	2	(a)

Table 1. Chemical composition of 60050.

technique: (a) INAA, (b) compiled, (c) fused-bead e. probe, (d) emis. spec., (e) IDMS, (f) radiation counting

Table 2: Walnut Samples from 60050 (DB355)

	weight	Ryder's term	ref					
60055	35.48	cataclastic anorthosite	Warren and Wasson 1978					
60056	16.07	cataclastic anorthosite	Bersch et al. 1991					
60057	3.1	cataclastic anorthosite						
60058	2.12	fragmental breccia						
60059	1.05	cataclastic anorthosite						
also	coarse	se fines						
60054,3	3	cataclastic anorthosite	Marvin 72					



Figure 8: Photo of some (anorthositic) coarse-fines from 60050 bag. Scale bar is marked in mm. NASA S72-46349. (these are NOT "caliche")



Lunar Sample Compendium C Meyer 2010

References 60050

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