

12032
Soil
310 grams



Figure 1: Location of 12032 at Bench Crater site. AS12-48-7063.

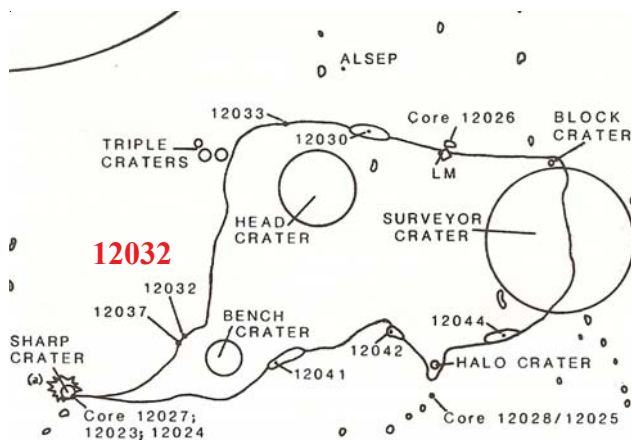


Figure 2: Location of 12032 on traverse map, Apollo 12.

Introduction

12032 are the fines collected in documented bag 4. This soil sample includes light grey material from just below the surface. It was from the north rim of Bench Crater (figure 2).

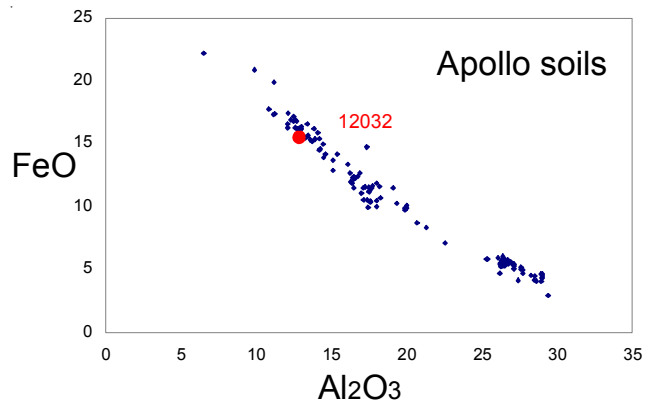


Figure 3: Composition of 12032 compared with other Apollo soil samples.

Petrography

The maturity index for 12032 is $I_s/FeO = 12$ (very immature) and the average grain size of 12032 is 108 microns (immature). McKay et al. (1971) reported only ~ 9 % “glazed aggregates” (agglutinates) in the coarse fragments, but up to 25 % in the fines.

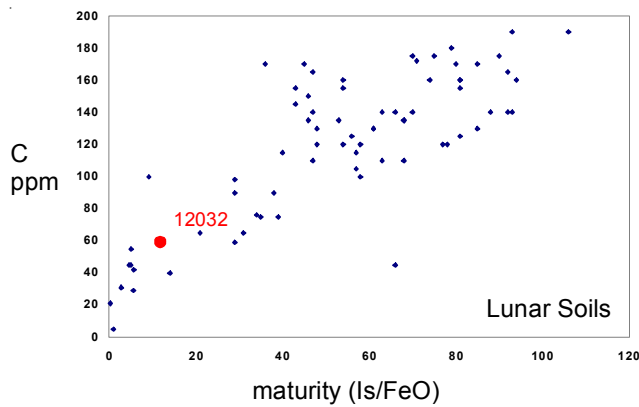


Figure 4: Carbon content and maturity index for 12032 compared with that of other Apollo soils.

Frondel et al. (1971) determined the mineral mode but did not specify agglutinates. Marvin et al. (1971) reported a high percentage of “ropy glass” in the coarse particles (figure 6). These were studied in detail by Wentworth et al. (1994).

Kurat et al. (1974) reported the mineralogy of small fragments of orthopyroxene-bearing impact melt rock (breccias). These were found to have high alkali content and included trace zircon.

Chemistry

The REE content is high in 12032 (table 1 and figure 8). Meyer et al. (1971) calculated that 12032 was about 43 % KREEP.

Mineralogical Mode

Frondel et al. 1971

Olivine +	
Pyroxene	49.9 %
Plagioclase	23.7
Opaques	10.1
Glass, angular	13.4
Glass, rounded	2.4
Silica	0.6

Mineralogical Mode

McKay et al. 1971

Grain size	37-62.5	62.5-125
Olivine	6 %	13
Pyroxene	33	15
Plagioclase	16	17
Glass	17	23
Aggregates	23	29

Mineralogical Mode (250-1000 microns)

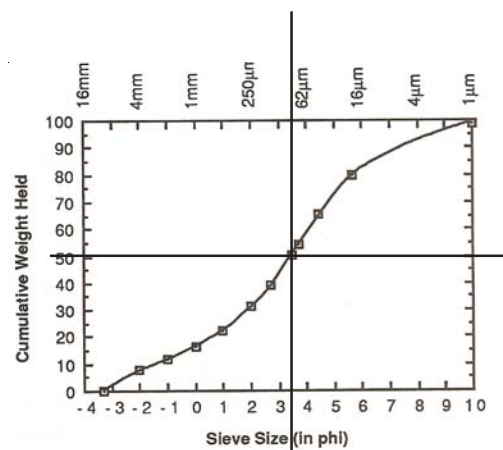
McKay et al. (1971)

Glazed	
Aggregates	9 %
Single xtl.	20
Glasses	52
Rocks	8
Breccias	10
Spherules	0.2

The carbon content is low (60 ppm)(Moore et al. 1971). Kaplan and Petrowski (1971) found 86 ppm and 37 ppm C in two splits (see figure 4). Kerridge et al. (1978) found only 41 ppm C and 14 ppm N. These low values indicate low exposure to solar wind.

Radiogenic age dating

Alexander et al. (1977) determined a young age (about 14. b.y.) by the Ar/Ar plateau technique for handpicked particles from 12032 (Figure 7). Barra et al. (2006) also obtained age data for individual glass particles from 12032.



Average grain size = 108 microns

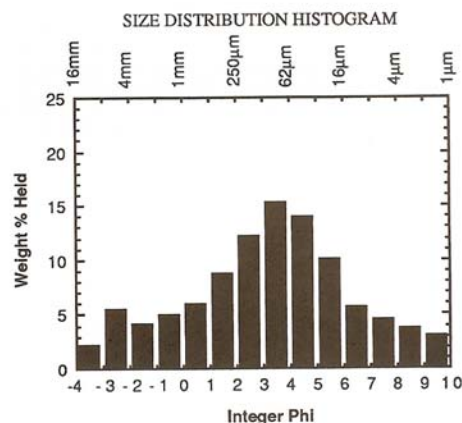


Figure 5: Grain size distribution for 12032 (Graf 1993, from data by McKay).

Table 1. Chemical composition of 12032.

<i>reference weight</i>	Morrison71	Willis71 Willis72	Schnetzler71	Laul71	O'Kelly71	Frondel71	Wakita71	
SiO ₂ %		46.58 (g)				46.5 (d)	40.3 (a)	
TiO ₂	1.83 (f)	2.56 (g)				2.9 (d)	2.8 3 (a)	
Al ₂ O ₃	15.7 (f)	13.59 (g)				15.2 (d)	14.1 14 (a)	
FeO	15 (f)	15.11 (g)				14.1 (d)	15.3 (a)	
MnO	0.22 (f)	0.207 (g)				0.2 (d)	0.195 0.199 (a)	
MgO	10.9 (f)	9.89 (g)				9.4 (d)	13.4 (a)	
CaO	10.4 (f)	10.53 (g)				10.7 (d)	12.2 10.6 (a)	
Na ₂ O	0.59 (f)	0.56 (g)				0.59 (d)	0.601 0.602 (a)	
K ₂ O	0.37 (f)	0.363 (g)	0.36 (e)		0.37 (c)	0.36 (d)	0.421 (a)	
P ₂ O ₅		0.38 (g)						
S %		0.069 (g)						
<i>sum</i>								
Sc ppm	32 (f)						36 (a,b)	
V	130 (f)						110 (a,b)	
Cr	2400 (f)	2530 (f)				1780 (d)	2367 (a)	
Co	39 (f)			42 (b)			42 (a,b)	
Ni		117 (f)						
Cu	6.5 (f)	29 (f)						
Zn	8.4 (f)	22 (f)		5.4 (b)				
Ga	4.3 (f)			5.1 (b)				
Ge ppb	7.5 (f)							
As								
Se				0.195 (b)				
Rb		8.9 (f)	9.24 (e)	7.6 (b)			8.5 (a,b)	
Sr		160 (f)	161.4 (e)					
Y		166 (f)					164 (a,b)	
Zr	590 (f)	705 (f)					640 (a,b)	
Nb		43 (f)						
Mo								
Ru								
Rh								
Pd ppb								
Ag ppb				3.2 (b)				
Cd ppb				17 (b)			53 (a,b)	
In ppb				10 (b)			130 (a,b)	
Sn ppb								
Sb ppb	130 (f)							
Te ppb				20 (b)				
Cs ppm	0.3 (f)			0.39 (b)			0.36 (a,b)	
Ba	690 (f)	531 (f)	529 (e)				400 (a,b)	
La	52 (f)	51 (f)					46 48 (a,b)	
Ce	130 (f)		117 (e)				114 (a,b)	
Pr							15 (a,b)	
Nd	97 (f)		73 (e)				75.7 (a,b)	
Sm	28 (f)		20.7 (e)				21.6 21.8 (a,b)	
Eu	2.3 (f)		2.12 (e)				2.19 2.18 (a,b)	
Gd	49 (f)		24.9 (e)				24.8 (a,b)	
Tb	6.1 (f)						4.3 (a,b)	
Dy			28 (e)				26.5 (a,b)	
Ho	6.7 (f)						6.5 (a,b)	
Er			15.9 (e)				17.3 (a,b)	
Tm	2.2 (f)						2.8 (a,b)	
Yb	18 (f)		15.2 (e)				16.5 17.6 (a,b)	
Lu	2.5 (f)		2.24 (e)				2.34 2.3 (a,b)	
Hf	15 (f)						18 (a,b)	
Ta	1.8 (f)							
W ppb	1000 (f)							
Re ppb								
Os ppb								
Ir ppb				4 (b)				
Pt ppb								
Au ppb				1.4 (b)				
Th ppm	9.6 (f)				8.8 (c)		8.1 (a,b)	
U ppm	1.5 (f)				2.35 (c)			

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

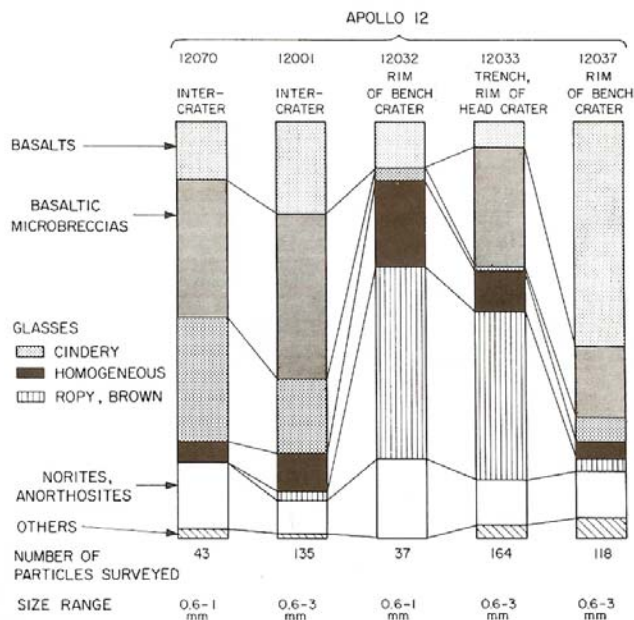


Figure 6: Modal analysis of coarse particles in Apollo 12 soils (Marvin et al. 1971).

Other Studies

Arrhenius et al. (1971) studied the frequency of grains with high fossil nuclear tracks in 12032 (and all other Apollo 12 soil and core samples). This data also indicates low maturity for this sample.

Pepin et al. (1972) and Basford et al. (1973) reported rare gas data.

Processing

There are some nice thin sections made from the coarse particles – see flow diagram.

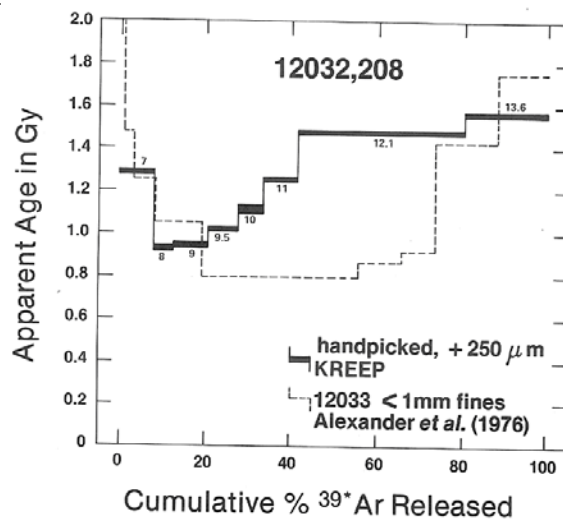
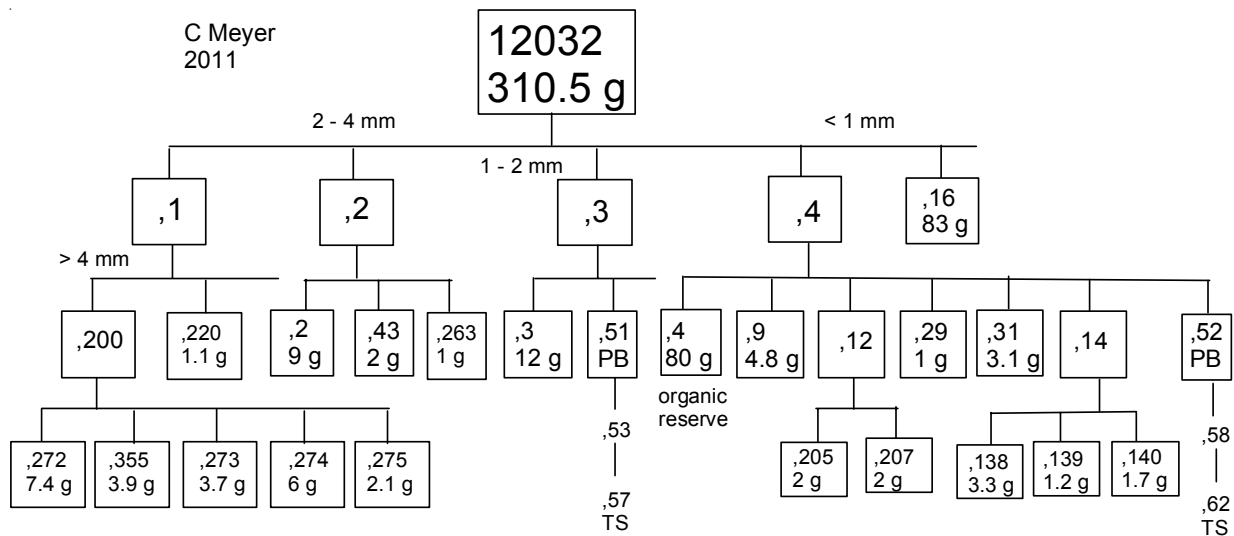


Figure 7: Ar/Ar plateau diagram for 12032 KREEP (Alexander et al. 1977).

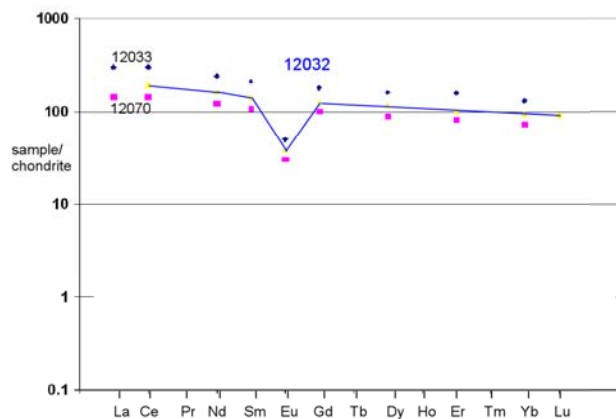


Figure 8: Normalized rare-earth-element diagram for Apollo 12 soils, with 12032 data by Schnetzler et al. (1971).

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