12023 - 407.9 grams
12024 - 56.5 grams
Trench Soils

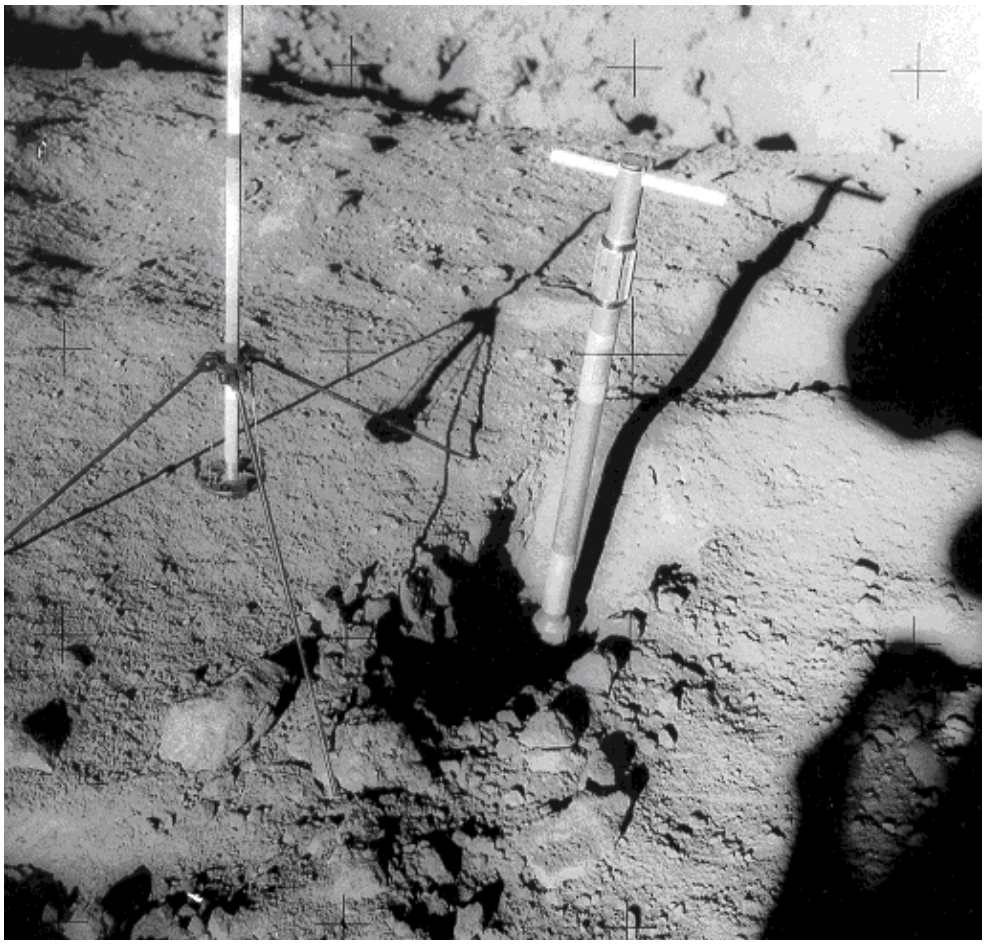
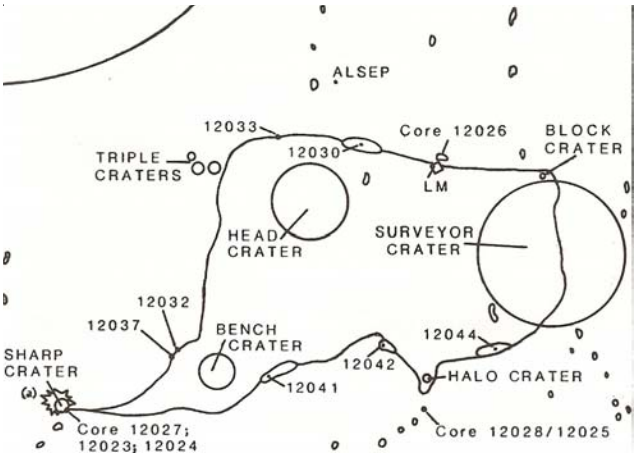


Figure 1: Trench dug at Sharp Crater, Apollo 12. AS12-48-7069.

Introduction

Lunar samples 12023 and 12024 were collected on the east rim of Sharp Crater, a small (10 meter) fresh crater about 400 meter southeast of the Lunar Module (figure 2). 12023 was collected with a Lunar Environment Sample Container (LESC) from the bottom of trench (figures 1 and 12). 12024 was collected in a Gas Analysis Sample Container (GASC) from the top of the trench (figure 5). The depth of the trench is about 20 cm.

Drive tube 12027 was also collected from the bottom of the trench (20 cm deep) where 12023 and 12024 were collected.



12023

Figure 2: Location of 12023 and 12024.

Figure 3: Another view of the trench at Sharp Crater where samples 12023, 12024 and core 12027 were taken. AS12-48-7067.

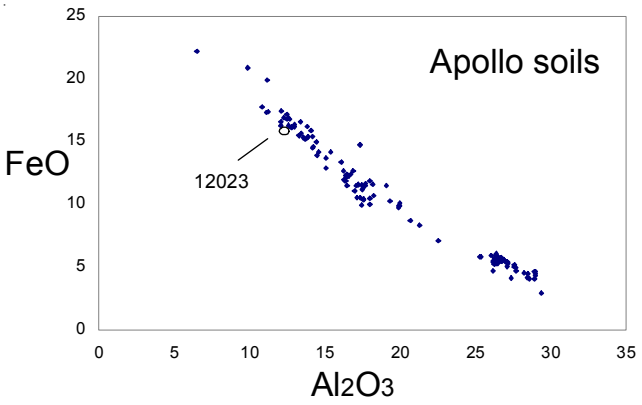


Figure 4: Composition of 12023 compared with other lunar soils.

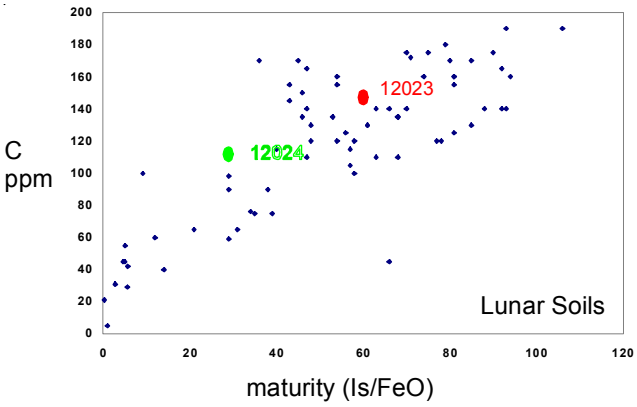


Figure 5: Carbon content and maturity index for 12023 and 12024, compared with other Apollo soil samples.

Petrography

12023 has a maturity index $I_s/FeO = 60$ (mature), while 12024 has $I_s/FeO = 30$ (submature) (Morris 1978). The average grain size of 12023 is 48 microns (mature).

Levine et al. (2005) extracted a large number of glass particles from a 5 gram split of 12023.

Due to a sample *mixup*, the mode given for 12023 in Morris et al. (1977) is incorrect (*it is the mode for an Apollo 14 soil*). Thus, the modes for 12023 and 12024 are unknown.

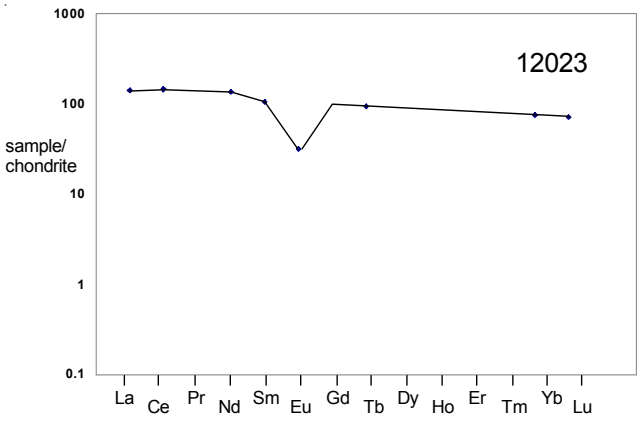


Figure 6: Normalized rare-earth-element diagram for 12023 soil (no data available for 12024)(from Warren et al. 1978).

Coarse Fines

Some of the larger particles that were picked out of 12023 and 12024 are described briefly in Marvin (1978). Figure 13 shows a relatively large olivine vitrophyre 12024,15 (14.1 g) that has been subdivided, but apparently never studied. The other large chips in this photo (,41 ,52 etc) seem to be the same material. 12024,16 (8.3 grams) is a composite glass-coated soil breccia.

Laul (1985), Simon and Papike (1985), and Simon et al. (1985) analyzed particles 12023,114 (breccia) and ,118 (KREEP basalt).

Chemistry

Warren et al. (1978) have analyzed 12023, finding it typical of Apollo 12 soils (figures 3 and 6). Woodcock and Pillinger (1978) determined the composition as function of grain size, even to the extent of getting the composition of "smoke" (the finest fraction). The composition of 12024 has not been reported.

Moore et al. (1971) reported 150 ppm C and 120 ppm N for 12023 and 115 ppm C for 12024 (figure 5). Kaplan and Petrowski (1971) found 120 ppm C in 12023 (average of 5 splits). Kerridge et al. (1978) found 108 ppm C and 72 ppm N, while Norris et al. (1983) reported 115 ppm C and 70 ppm N.

Radiogenic age dating

Levine et al. (2005, 2007) and Barra et al. (2006) obtained the age of numerous (81?) glass beads by the $^{40}Ar/^{39}Ar$ plateau technique. The majority of ages were less than 500 m.y. What are we to conclude from this?

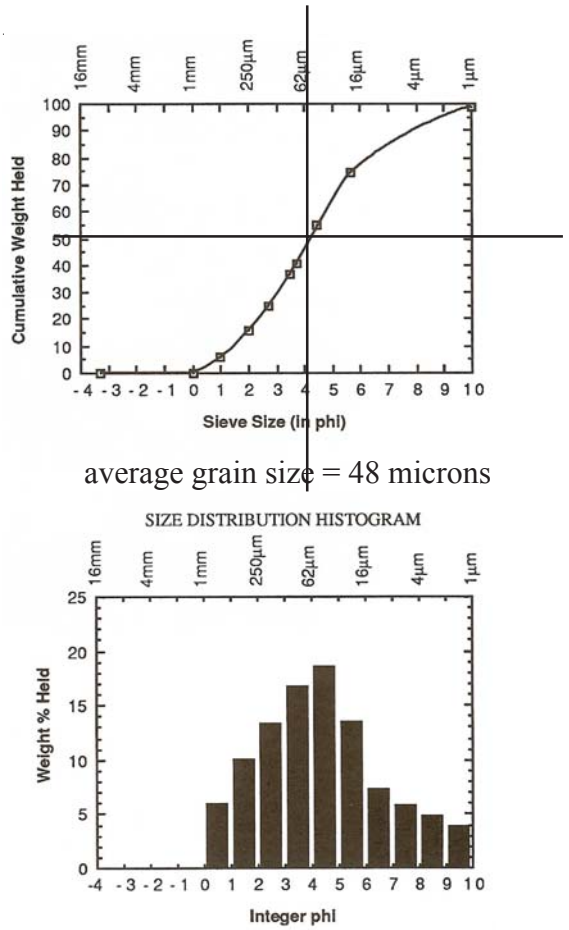


Figure 7: Grain size distribution for 12023 (Graf 1993, data by McKay et al.).

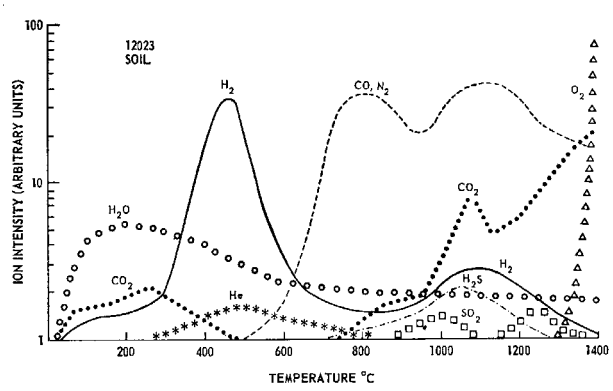


Figure 8: Gas release pattern for 12023 (from Gibson and Johnson 1971).

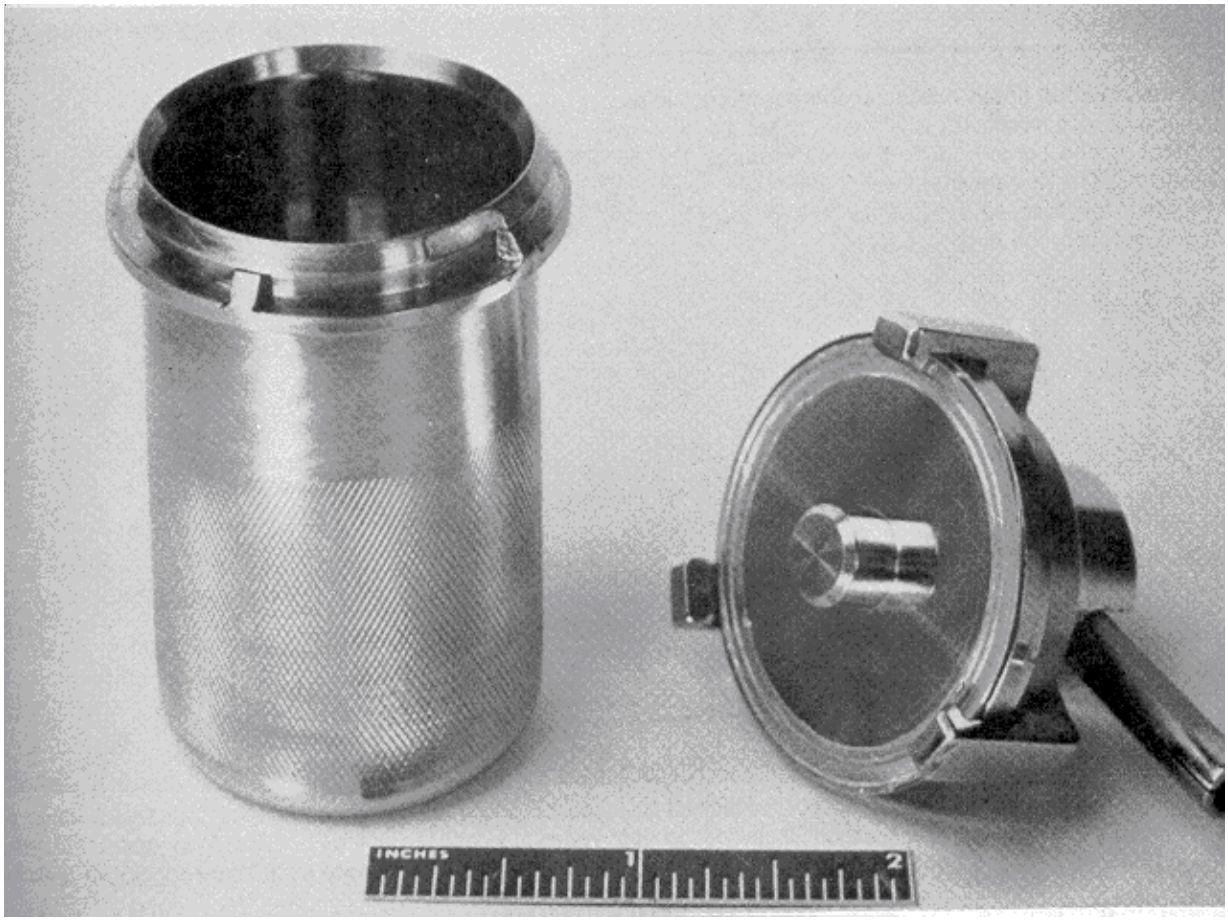


Figure 9: Gas analysis sample container (GASC) used to collected 12024 from rim of trench AS88-52660. Note the scale in inches. This is a small version of what became the SESC used on later missions.

Other Studies

Woodcock and Pillinger (1978) and Fallick et al. (1980) studied the carbon and fine-grained metallic iron content of 12023 (figure 11). Norris et al. (1983) studied the isotopic composition of carbon and nitrogen as function of release temperature. Becker and Clayton (1978) also determined the isotopic composition of nitrogen (figure 10).

A large portion of 12023,21 was used to look for "organic compounds" (Abell et al. 1971; Oro et al. 1971 and others).

Gibson and Johnson studied the thermal release of various gas components (figure 8).

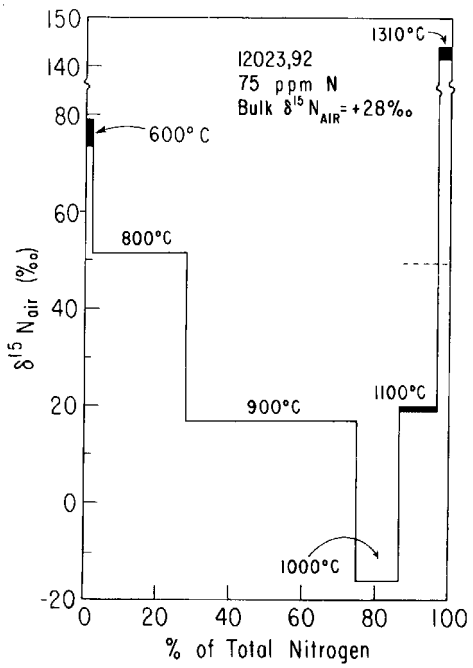
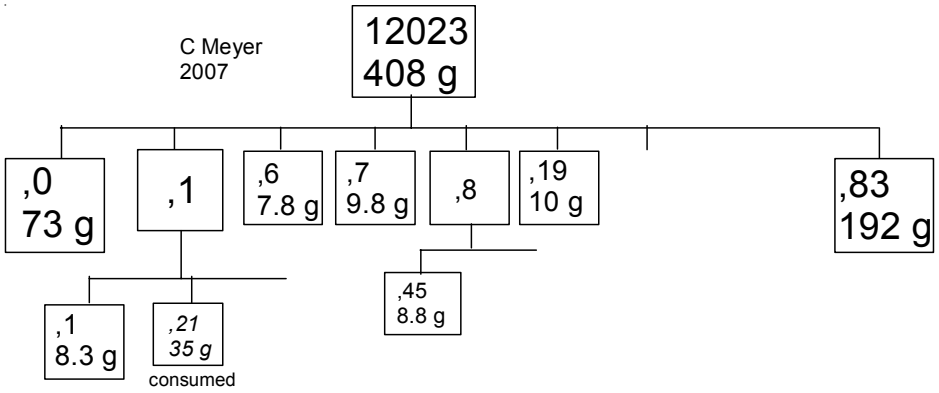


Figure 10: Isotopic composition of nitrogen as function of release temperature (Becker and Clayton 1978).



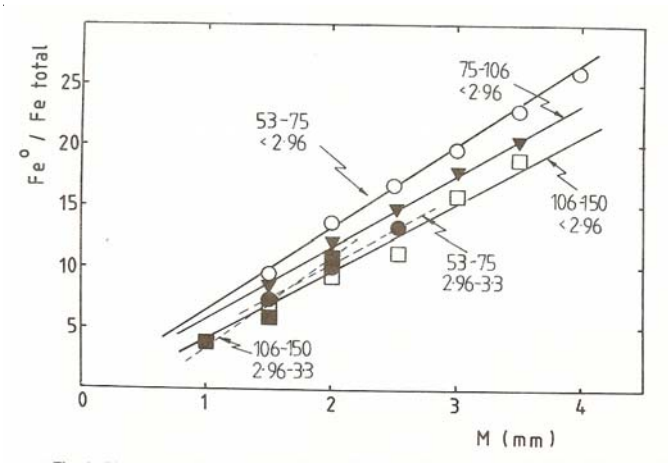


Figure 11: Magenetic susceptibility as percentage of total iron (Woodcock and Pillinger 1978).

Figure 12: LMP holding LESC and toasting the field geology team in mission control. AS12-49-49-7278.

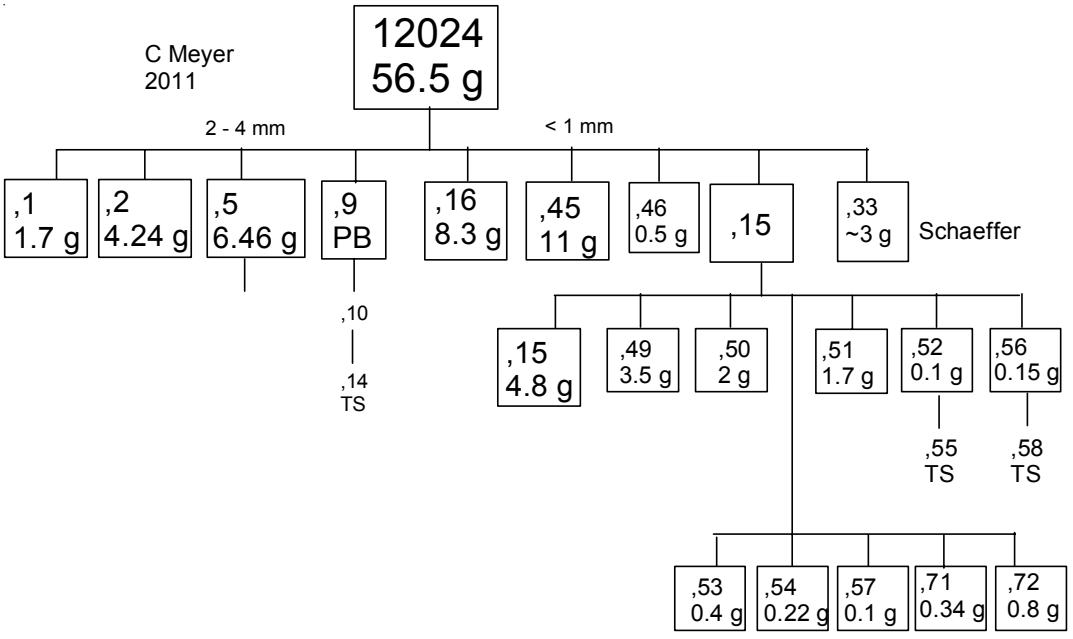
Processing

The LESC (12023) was originally opened in the "Bio Prep" laboratory in the LRL (Warner 1970). As such, it may have been opened in air and/or otherwise "contaminated".

Note: Logic would dictate that 12024 should be directly compared with 12023, but I can find no such comparison.

Mixup: An Apollo 14 sample returned by Oro was mislabeled 12023, and re-allocated to certain investigators (i.e. Morris 1977) by mistake (see discussion in Warren).

Figure 13: 12024,15 was a large dark rock found within the GASC. NASA S89-36052. Cube is 1 cm.



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12023 12024

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Table 1. Chemical composition of 12023.

reference	Warren78	
weight		
SiO2 %		
TiO2	2.45	(a)
Al2O3	10.77	(a)
FeO	15.3	(a)
MnO	0.2	(a)
MgO	11.94	(a)
CaO	9.24	(a)
Na2O	0.43	(a)
K2O	0.26	(a)
P2O5		
S %		
sum		
Sc ppm	35.7	(a)
V		
Cr	2580	(a)
Co	42	(a)
Ni	220	(a)
Cu		
Zn		
Ga		
Ge ppb		
As		
Se		
Rb		
Sr		
Y		
Zr	460	(a)
Nb		
Mo		
Ru		
Rh		
Pd ppb		
Ag ppb		
Cd ppb		
In ppb		
Sn ppb		
Sb ppb		
Te ppb		
Cs ppm	0.38	(a)
Ba	423	(a)
La	33	(a)
Ce	88	(a)
Pr		
Nd	62	(a)
Sm	15.5	(a)
Eu	1.8	(a)
Gd		
Tb	3.4	(a)
Dy		
Ho		
Er		
Tm		
Yb	12.4	(a)
Lu	1.74	(a)
Hf	11.6	(a)
Ta	1.5	(a)
W ppb		
Re ppb		
Os ppb		
Ir ppb		
Pt ppb		
Au ppb		
Th ppm	6.3	(a)
U ppm	1.7	(a)
technique:	*(a) INAA*	

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