

70011
LM Soil (vacuum)
308 grams



Figure 1: Soil scooped from under legs of lunar module (LM). AS17-143-21930

Introduction

Lunar landers use hydrazine and N_2O_4 as rocket fuel. One wishes to know if residual gas or reaction products (H_2O , CO_2 , N_2) from the rocket engine contaminate the lunar regolith.

Thus a soil sample was collected from beneath the LM (figure 1) and sealed in a special environmental sample container for return to earth (figure 5).

Petrography

Morris (1978) determined the maturity index ($I_s/FeO = 54$).

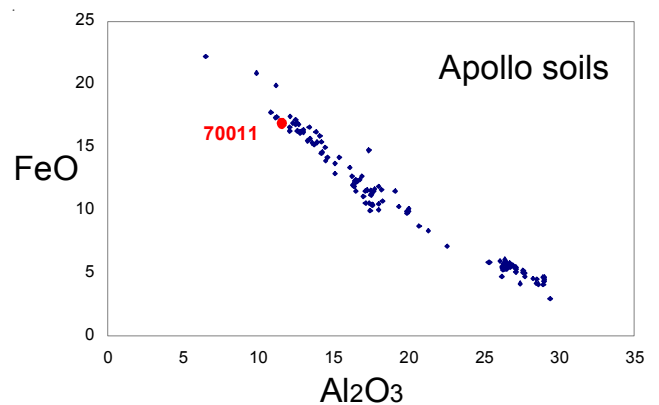


Figure 2: Composition of 70011 compared with other Apollo soil samples.

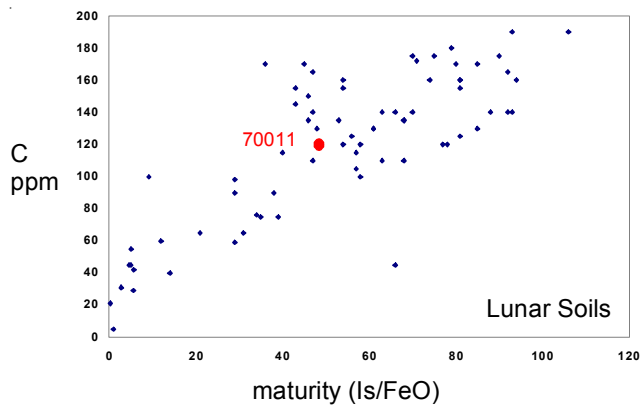


Figure 3: Carbon content and maturity index for 70011 compared with that of other Apollo 17 soils.

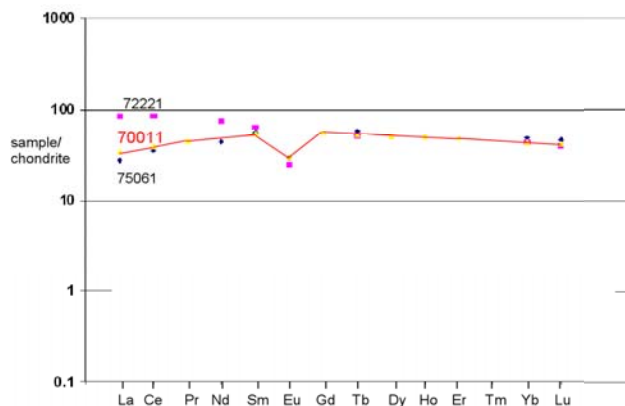


Figure 4: Normalized rare-earth-element diagram for 70011 compared with mare soil 75061 and highland soil 72221.

Chemistry

70011 is a typical mare soil (figure 2 and 4).

Moore et al. (1974) determined 120 ppm carbon (figure 2). Muller (1974) determined 73 ppm nitrogen. Petrowski et al. (1974) determined 132 ppm carbon, 77 ppm nitrogen, 36 ppm He and 55 ppm hydrogen. Gibson and Moore (1974) reported 1300 ppm sulfur. Goel et al. (1975) found 91 ppm nitrogen. Epstein and Taylor (1975) reported 88 ppm carbon. Norris et al. (1983) reported 94 ppm carbon and 81 ppm nitrogen and determined the isotopic composition as function of outgassing temperature.

Gibson and Andrawes (1978) studied nitrogen release by crushing soil (very high values due to hydrozine?).

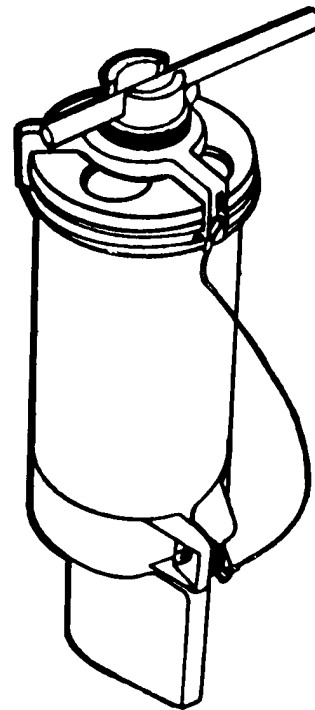


Figure 5: Special environmental sample container (SESC) used to sample soil beneath lunar module (LM).

Other Studies

Rees and Thode (1974) determined the sulfur concentration and isotope ratios in Apollo 17 samples.

Hubner et al. (1975) reported the rare gas content and isotopic ratio.

Table 1. Chemical composition of 70011.

reference weight	Rose74	Wanke74	
SiO ₂ %	41.03	(a) 41.52	(b)
TiO ₂	8.3	(a) 7.36	(b)
Al ₂ O ₃	11.98	(a) 12.4	(b)
FeO	16.25	(a) 15.95	(b)
MnO	0.23	(a) 0.22	(b)
MgO	10.08	(a) 9.93	(b)
CaO	11.08	(a) 11.06	(b)
Na ₂ O	0.31	(a) 0.37	(b)
K ₂ O	0.08	(a) 0.08	(b)
P ₂ O ₅	0.1	(a) 0.048	(b)
S %			
sum			
Sc ppm	57	(a) 53.1	(b)
V	84	(a)	
Cr	2805	(a) 2630	(b)
Co	52	(a) 31.6	(b)
Ni	240	(a) 110	(b)
Cu	23	(a) 11	(b)
Zn	28	(a) 39	(b)
Ga	7.2	(a) 5	(b)
Ge ppb		290	(b)
As		23	(b)
Se			
Rb	1.2	(a)	
Sr	180	(a) 210	(b)
Y	78	(a) 61	(b)
Zr	252	(a) 210	(b)
Nb	26	(a) 15	(b)
Mo			
Ru			
Rh			
Pd ppb		5	(b)
Ag ppb			
Cd ppb			
In ppb			
Sn ppb			
Sb ppb			
Te ppb			
Cs ppm			
Ba	290	(a) 102	(b)
La		8.03	(b)
Ce		23.5	(b)
Pr		4	(b)
Nd			
Sm		8	(b)
Eu		1.67	(b)
Gd		10.9	(b)
Tb		1.9	(b)
Dy		12.5	(b)
Ho		2.8	(b)
Er		7.7	(b)
Tm			
Yb	6.4	(a) 7.04	(b)
Lu		1.02	(b)
Hf		6.5	(b)
Ta		1.2	(b)
W ppb			
Re ppb		0.63	(b)
Os ppb			
Ir ppb			
Pt ppb			
Au ppb		5.7	(b)
Th ppm			
U ppm		0.24	(b)

technique: (a) "microchemical", (b) multiple

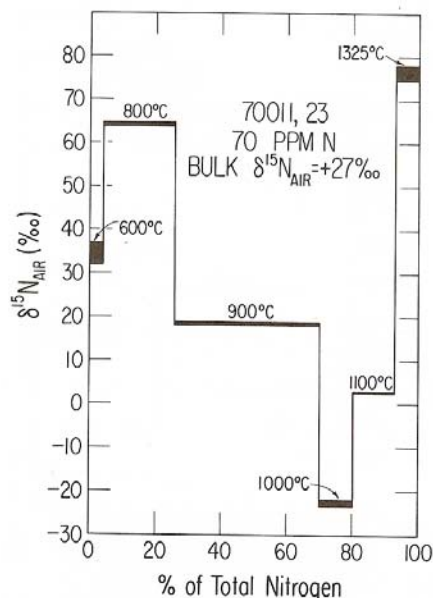


Figure 6: Nitrogen isotopes for 70011 (Becker and Clayton 1977).

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