

10029
Ilmenite Basalt (low K)
5.5 grams



Figure 1: Photo of 1 cm cube and 10029,13. NASA S75-33058 (out of focus).

Introduction

10029 was collected as part of the contingency sample and returned with the astronauts to the crew area of the LRL. 10029 is similar to 10003 except that this sample looks like it has rusted (figure 1). It has been dated at about 3.9 b.y. with an exposure age about 130 m.y.

Petrography

James and Jackson (1970) and Radcliffe et al. (1970) found that 10029 was a “medium-grained” ophitic basalt (figure 2). Beatty and Albee (1978) reported the “average” grain size as ~ 500 microns and described the texture as “spectacularly-ophitic” with equant, blocky grains of ilmenite, small anhedral mantled olivine and plagioclase laths set in much coarser pyroxene (figure 2).

Radcliffe et al. (1970) studied the internal structures of minerals in 10029. Beatty and Albee (1978) discuss the evidence for silicate liquid immiscibility in the residual glass.

Mineralogy

Olivine: Olivine is found enclosed in pyroxene and ranges Fo_{63-3} (Beatty and Albee 1978).

Pyroxene: Both Beatty and Albee (1978) and Gamble et al. (1978) determined the composition of pyroxene in 10029 (figure 3). Pyroxene zones to ferrohedenbergite as well as pyroxferroite.

Plagioclase: Plagioclase is normally zoned from An_{93-70} . The “average” plagioclase analysis is An_{84} .

Ilmenite: Ilmenite in 10029 has low Mg (Gamble et al.). Radcliffe et al. (1970) studied internal texture.

Akaganeite: Gamble et al. (1978) reported 15 micron-sized grains of rust associated with troilite and iron.

Phosphate: Beatty and Albee (1978) determined that the phosphate in 10029 had 4 % fluorine.

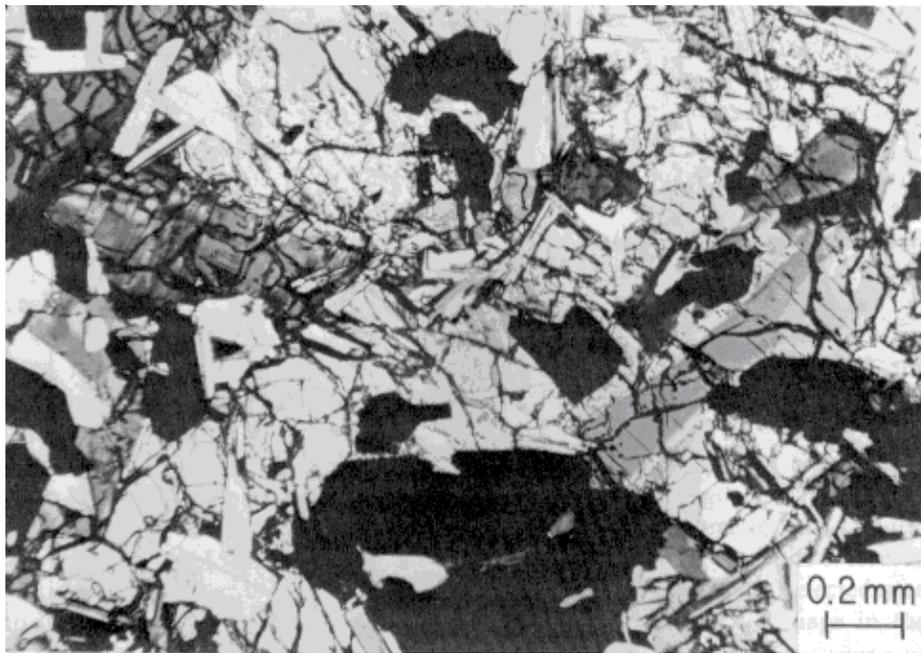


Figure 2: Optical micrograph of lunar sample 10029 showing ophitic texture. Crossed polarizers. From Radcliffe et al. 1970.

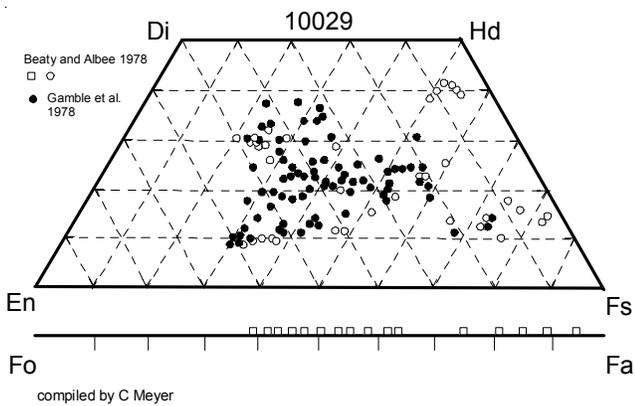


Figure 3: Pyroxene and olivine composition of 10029 (replotted from Beatty and Albee 1978 and Gamble et al. 1978).

Chemistry

The chemical composition of 10029 is given in table 1 and figures 4 and 5.

Radiogenic age dating

Guggisberg et al. (1979) obtained an Ar/Ar plateau age for 10029 of 3.89 ± 0.3 b.y. (figure 6).

Cosmogenic isotopes and exposure ages

Guggisberg et al. obtained an $^{37}\text{Ar}/^{38}\text{Ar}$ exposure age of about 130 m.y.

Mineralogical Mode for 10029

	James and Jackson 1970	Beatty and Albee 1978	Gamble et al. 1978
Olivine	0.7	0.3	
Pyroxene	46.8	47.5	44.8
Plagioclase	35.9	35	42.8
Ilmenite	14.1	15.8	10.8
mesostasis	0.3		0.5
silica	0.8	0.6	0.2
troilite	0.9	0.5	0.8
phosphate	0.1	0.25	

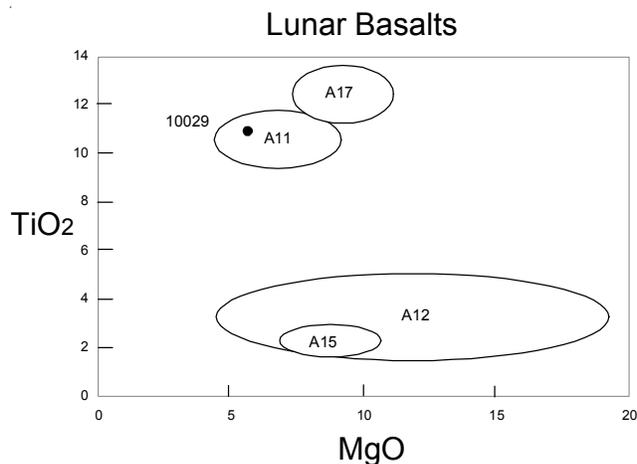


Figure 4: Composition of 10029 compared with that of other Apollo lunar samples.

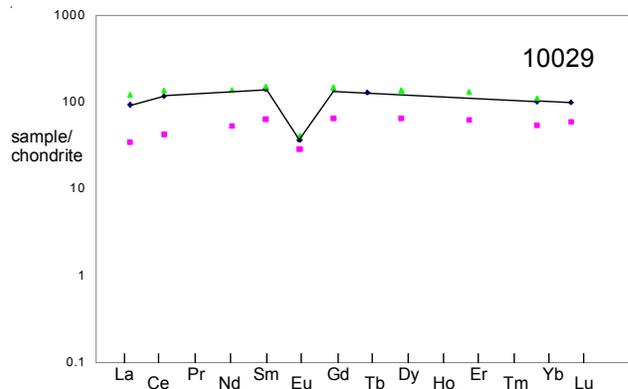


Figure 5: Normalized rare-earth-element composition for high-K basalt 10029 (the line) compared with that of low-K basalt 10020 and high-K basalt 10049 (the dots) (data from Wiesmann et al. 1975).

Processing

Apollo 11 samples were originally described and cataloged in 1969 and “re-cataloged” by Kramer et al. (1977). There are 4 thin sections.

List of Photo #s for 10029

S69-45748 – 749 B&W
S75-33058 – 060 color

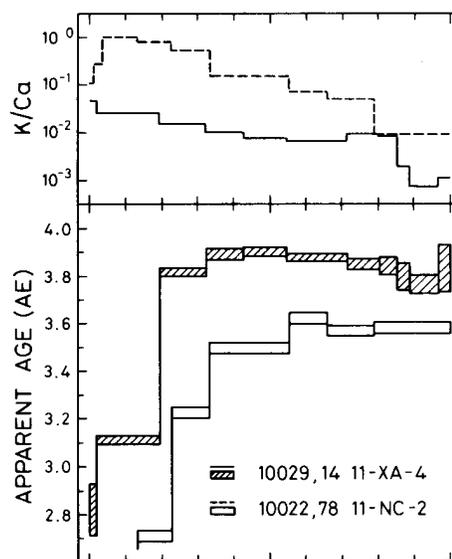
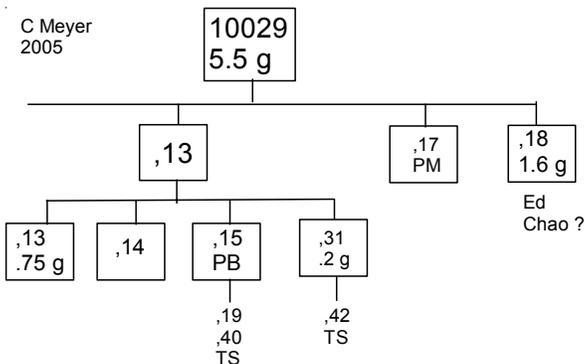


Figure 6: Ar/Ar plateau age of 10022 compared with 10029 (from Guggisberg et al. 1979).



Summary of Age Data for 10029

Guggisberg et al. (1979) Ar/Ar plateau 3.89 ± 0.3 b.y.

Table 1. Chemical composition of 10029.

reference weight	Rhodes80	Beaty 78	
SiO ₂ %	38.59	(a) 37.89	(c)
TiO ₂	11.1	(a) 12.15	(c)
Al ₂ O ₃	10.24	(a) 10.32	(c)
FeO	21.71	(a) 20.49	(c)
MnO	0.3	(a) 0.23	(c)
MgO	6.45	(a) 7.53	(c)
CaO	10.3	(a) 10.47	(c)
Na ₂ O	0.42	(b) 0.39	(c)
K ₂ O	0.08	(a) 0.03	(c)
P ₂ O ₅	0.21	(a) 0.09	(c)
S %		0.23	(c)
sum			
Sc ppm	79	(b)	
V			
Cr	1570	(b)	
Co	14.1	(b)	
Ni			
Cu			
Zn			
Ga			
Ge ppb			
As			
Se			
Rb			
Sr			
Y			
Zr			
Nb			
Mo			
Ru			
Rh			
Pd ppb			
Ag ppb			
Cd ppb			
In ppb			
Sn ppb			
Sb ppb			
Te ppb			
Cs ppm			
Ba			
La	22.2	(b)	
Ce	72	(b)	
Pr			
Nd			
Sm	20.9	(b)	
Eu	2.05	(b)	
Gd			
Tb	4.7	(b)	
Dy			
Ho			
Er			
Tm			
Yb	16.6	(b)	
Lu	2.43	(b)	
Hf	16	(b)	
Ta	2.6	(b)	
W ppb			
Re ppb			
Os ppb			
Ir ppb			
Pt ppb			
Au ppb			
Th ppm	1.8	(b)	
U ppm			

technique: (a) XRF, (b) INAA, (c) elec. Probe

References for 10029

Beaty D.W. and Albee A.L. (1978) Comparative petrology and possible genetic relations among the Apollo 11 basalts. *Proc. 9th Lunar Planet. Sci. Conf.* 359-463.

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