10024

Ilmenite Basalt (high K)

68.1 grams

Figure 1: Photo of 10024. Sample is 3.2 cm long. NASA S69-46035.

Introduction

10024 was collected as part of the contingency sample and returned (in air) to the crew reception area in the lunar receiving laboratory JSC. It is a medium-grained high-K ilmenite basalt (figure 1).

The crystallization age of 10024 has been determined as 3.6 b.y. with a cosmic ray exposure age of 360 m.y.

Petrography

Schmitt et al. (1970) termed 10024 as a "medium-grained, vuggy, granular cristobalite basalt." Beaty and Albee (1978) found that it was the coarsest grained of the high-K variety of Apollo 11 basalts. Kushiro and Nakamura (1970) reported the maximum grain size in 10024 as about 2 mm.

Mineralogy

Olivine: There is only a trace of olivine (Fo_{70-65}).

Pyroxene: Kushiro and Nakamura (1970) determined the composition of pyroxene (figure 3). They provided tie lines for the composition of coexisting pigeonite and augite.

Plagioclase: Plagioclase in 10024 is An_{80-78}.

Ilmenite: Reid et al. (1970) reported the composition of ilmenite.

Cristobalite: Kushiro and Nakamura (1970) reported large grains of cristobalite.

Figure 2: Photomicrographs of thin section of 10024 showing medium-grained basaltic texture. Field of view is 2.5 mm. NASA S70-49977 and 978.

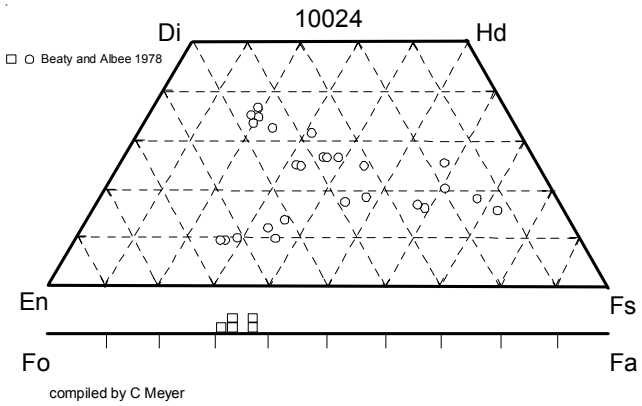


Figure3: Pyroxene and olivine composition of 10024 (from Beaty and Albee 1978).

Metallic Iron: Kushiro and Nakamura (1970) found 0.6 wt % Ni in metallic iron.

Chemistry

Compston et al. (1970), Rose et al. (1970) and others reported the chemical analysis (table 1, figures 4 and 5).

N*ote: the chemical analysis of 10044 reported by Philpotts and Schnetzler (1970) may be that of 10024 instead – see page 1473.*

Radiogenic age dating

Papanastassiou and Wasserburg (1971) measured a Rb/Sr isochron as 3.61 ± 0.07 b.y. (figure 6) and Turner (1970) determined the age of 10024 by Ar/Ar as 3.48 b.y.

Cosmogenic isotopes and exposure ages

Turner et al. (1970) determined ^{38}Ar exposure age of 360 m.y. Eberhardt et al. (1970) also reported 360 m.y.

Other Studies

The total organic carbon content of 10024 was determined by hydrogen flame ionization pyrolysis (Ponnamperuma et al. 1970).

Nagata et al. (1970) studied the magnetic properties of 10024.

Funkhouser et al. (1970) and Bogard et al. (1971) reported the abundance and isotopic composition of rare gasses from 10024.

Processing

Apollo 11 samples were originally described and cataloged in 1969 and "re-cataloged" by Kramer et al. (1977).

There are 11 thin sections.

Mineralogical Mode of 10024

	Kushiro and Nakamura 70	Beaty and Albee 78
Olivine		0.1
Pyroxene	52.2	51.4
Plagioclase	16.4	21.7
Ilmenite	21.8	16.4
mesostasis	9	8.2
silica	0.7	1.3
troilite		0.53
phosphate		0.24

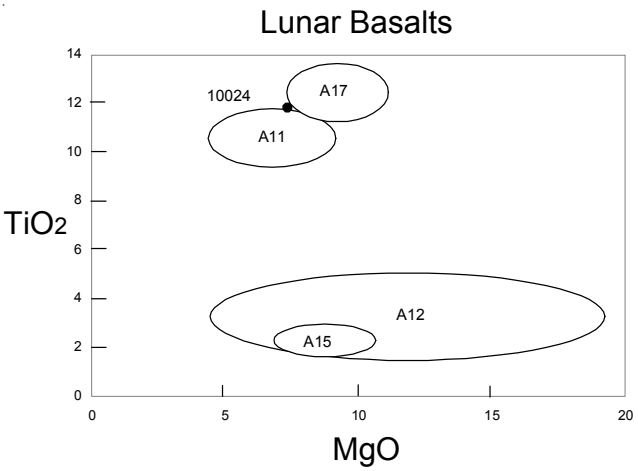


Figure 4: Composition of 10024 compared with that of other Apollo lunar samples.

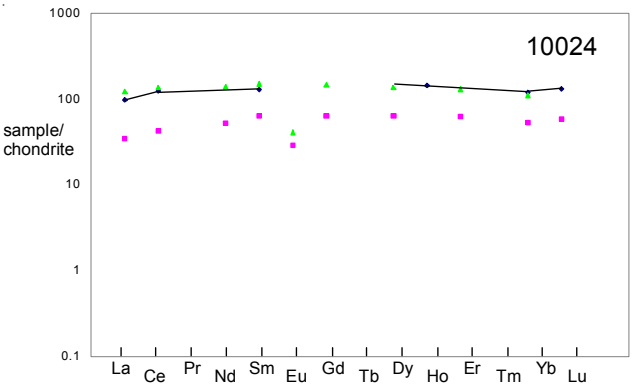


Figure 5: Normalized rare-earth-element composition for high-K basalt 10024 (the line) compared with that of low-K basalt 10020 and high-K basalt 10049 (the dots) (data from Wiesmann et al. 1975).

List of Photo #s for 10024

S69-46026 – 035 PET mug B&W
S69-46620 – 621
S69-46397
S70-48948 – 949 TS color
S70-48977 – 980 TS color
S70-49192 – 193
S70-49880 – 881
S76-26260 – 262

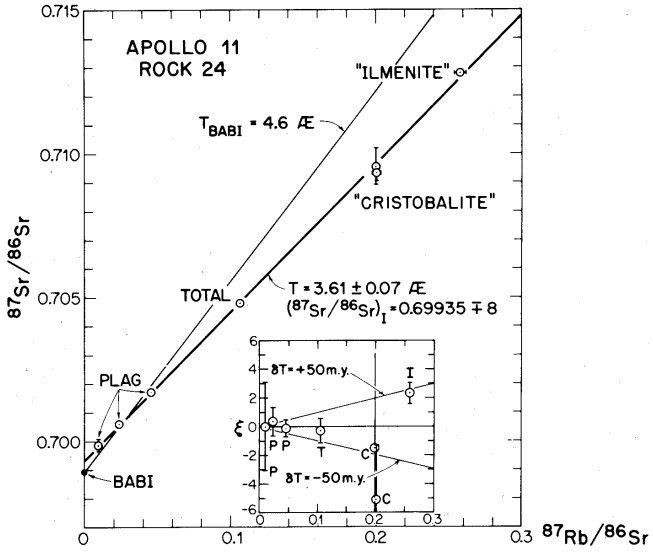
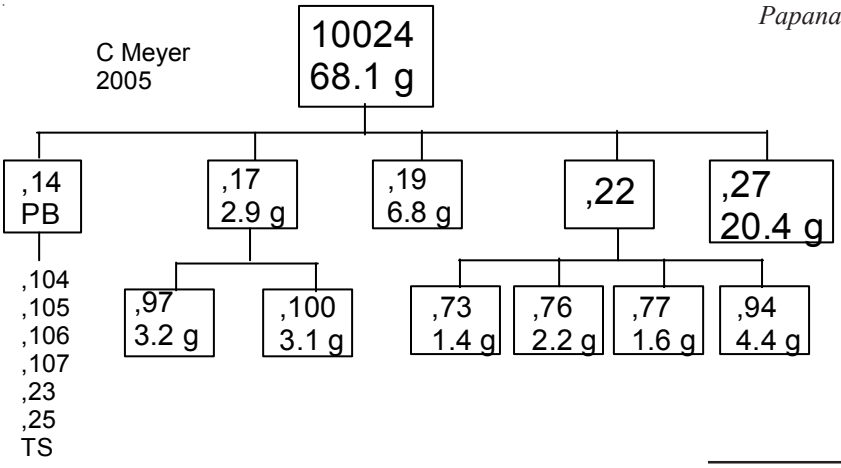


Figure 6: Rb/Sr isochron for 10024 (from Papanastassiou and Wasserburg 1971).



Summary of Age Data for 10024

	Rb/Sr	Ar/Ar plateau
Papanastassiou and Wasserburg 1971	3.61 ± 0.07 b.y.	
Tuner 1970		3.48 ± 0.05

Table 1. Chemical composition of 10024.

reference	Compston70		Rose70		Goles70		*Philpotts69* *Philpotts70*		Beaty78	
weight							*10044 ??*			
SiO2 %	40.25	(a)	39	(b)	39.6	(c)			40	(e)
TiO2	11.9	(a)	13.2	(b)	12.5	(c)			12.93	(e)
Al2O3	8.09	(a)	9.5	(b)	7.9	(c)			7.2	(e)
FeO	19.46	(a)	18.5	(b)	19.8	(c)			19.09	(e)
MnO	0.24	(a)	0.24	(b)	0.21	(c)			0.23	(e)
MgO	7.53	(a)	8.11	(b)	7.13	(c)			8.74	(e)
CaO	10.66	(a)	10	(b)	9.93	(c)			10.1	(e)
Na2O	0.52		0.8	(b)	0.49	(c)			0.43	(e)
K2O	0.3	(a)	0.28	(b)			*0.29*	(d)	0.41	(e)
P2O5	0.2	(a)							0.1	(e)
S %	0.22	(a)							0.26	(e)
sum										
Sc ppm					76.2	(c)				
V	37				84	(c)				
Cr	2610		2737	(b)	2290	(c)				
Co	32				28.4	(c)				
Ni	<20									
Cu	16									
Zn	14									
Ga	5									
Ge ppb										
As										
Se										
Rb	5.96	(a)					*5.64*	(d)		
Sr	178	(a)					*167*	(d)		
Y	168	(a)								
Zr	375	(a)			650	(c)				
Nb	25									
Mo										
Ru										
Rh										
Pd ppb										
Ag ppb										
Cd ppb										
In ppb										
Sn ppb										
Sb ppb										
Te ppb										
Cs ppm										
Ba	310				170	(c)	*285*	(d)		
La	39				23	(c)				
Ce	108				76	(c)	*76.6*	(d)		
Pr	12									
Nd	55						*66.1*	(d)		
Sm					19.2	(c)	*23.4*	(d)		
Eu							*2.21*	(d)		
Gd							*28.6*	(d)		
Tb										
Dy							*33.6*	(d)		
Ho					8.1	(c)				
Er							*19.3*	(d)		
Tm										
Yb					19.6	(c)	*16.6*	(d)		
Lu					3.2	(c)				
Hf					20	(c)				
Ta					2.4	(c)				
W ppb										
Re ppb										
Os ppb										
Ir ppb										
Pt ppb										
Au ppb										
Th ppm										
U ppm					0.67	(c)				

technique: (a) XRF, (b) semimicro XRF, (c) INAA, (d) IDMS, (e) elec. Probe

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