75075

Vuggy Ilmenite Basalt

1008 grams

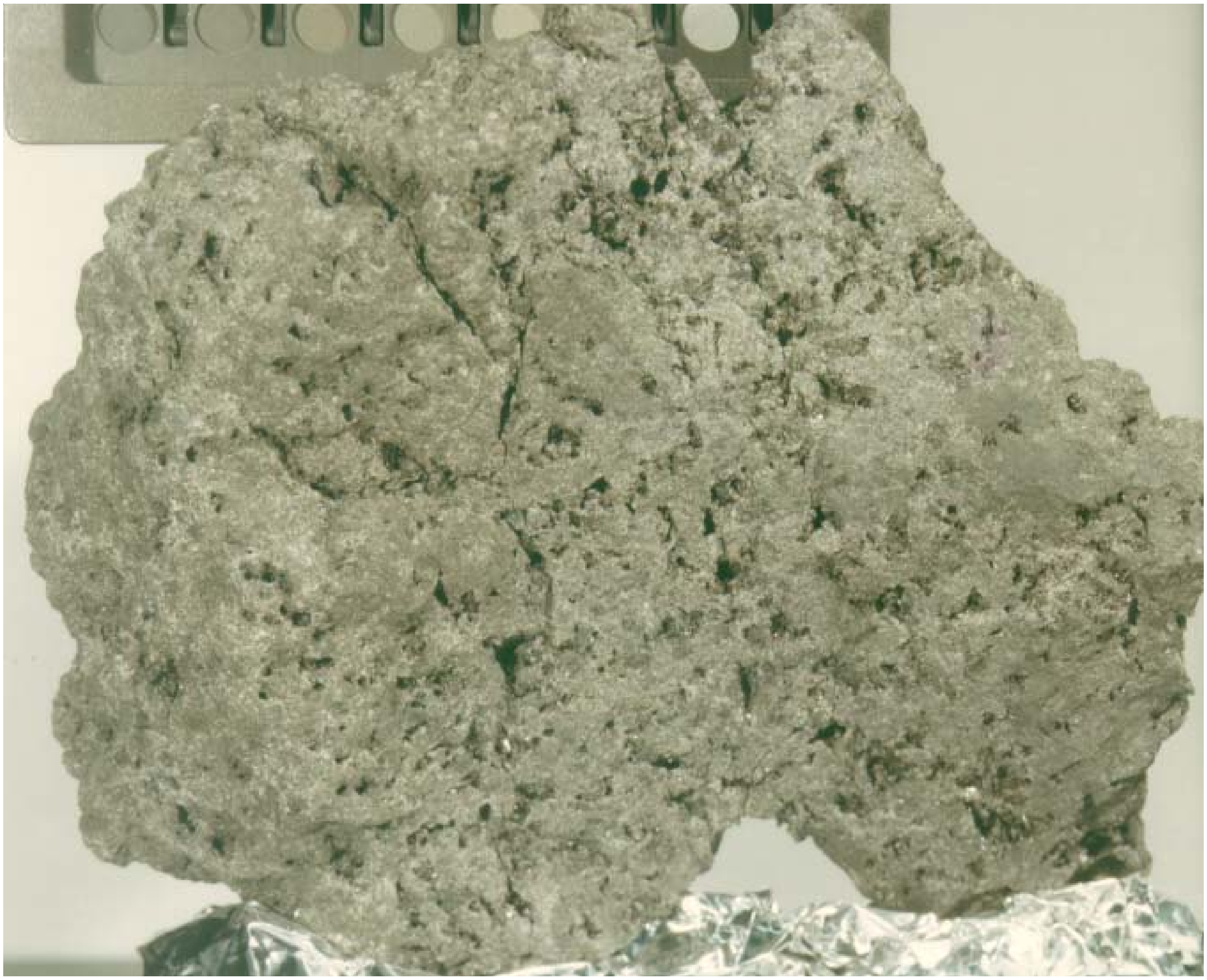


Figure 1: Photo of vuggy mare basalt sample 75075. NASA S73-15337. Sample is about 12 cm across.

Introduction

75075 was found lying loose on top of a large boulder. It is substantially different in composition from the other basalt samples from Camelot Crater, such that it is believed to have been from a different lava flow from 75055 etc. (Wolfe et al. 1981). Figure 1 shows that 75075 is a very vuggy ilmenite basalt (up to 20% by volume).

The crystallization age of 75075 is 3.74 ± 0.02 m.y. with an apparent old exposure age of 143 m.y. Although it has an old exposure age, and was found on top of a boulder, it doesn't appear to have many micrometeorite craters. The exposed surface has a pronounced, smooth patina instead (figure 2).

Petrography

Figure 3 shows the interior texture of 75075. The texture is described as subvariolitic to subophitic (Neal and Taylor 1993). The average grain size is 1-2 mm, with plagioclase and ilmenite forming the larger crystals. Mineral chemistry has not been reported, but it is noted that there is no interstitial glass. Roedder and Weiblen (1975) reported low-K melt inclusions in ilmenite. Vugs in 75075 are 2 – 20 mm in size and interconnecting (figure 1).

Figure 2: Photo of 75075 (top side) showing thick patina(?). NASA S73-15342.

Figure 3: Thin section photomicrograph of 75075(from Neal and Taylor 1993). Field of view 2.5 mm.

Mineralogical Mode of 75075

	Brown et al. 1975
Olivine	1.2
Pyroxene	52.2
Plagioclase	20.7
Ilmenite	24.1
Silica	1.5
Mesostasis	0.3

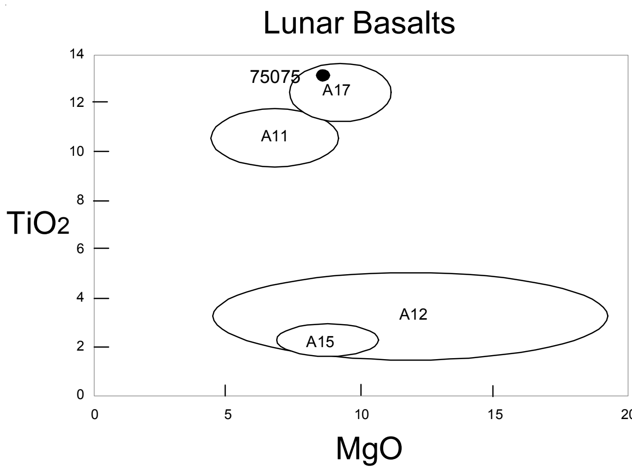


Figure 4: Composition of 75075 compared with other Apollo basalt samples.

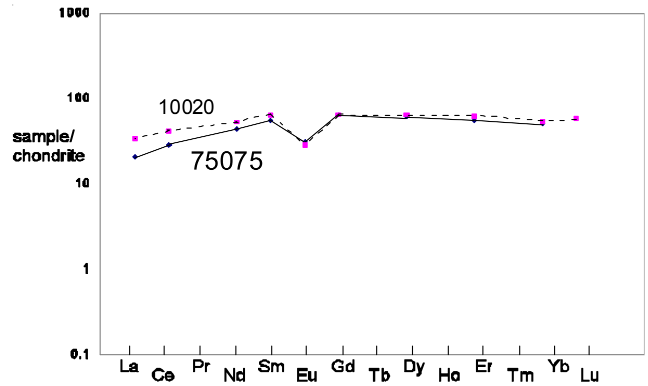


Figure 5: Normalized rare-earth-element diagram for 75075. Isotope dilution data from Shih et al. 1975.

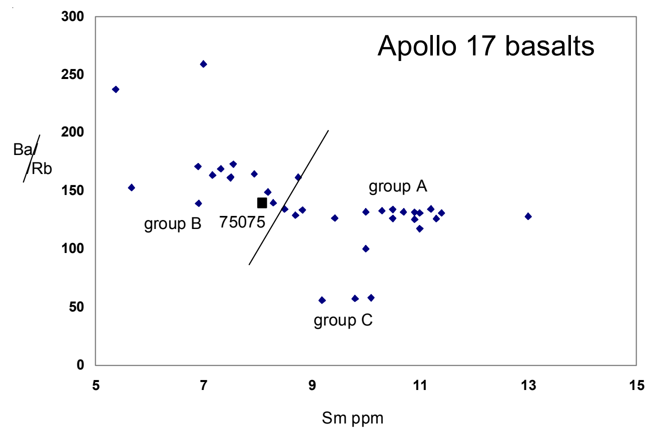


Figure 6: Trace element diagram for Apollo 17 basalts, with data for 75075.

Usselman et al. (1975) used experiments to show that 75075 cooled at about 1 deg/hr. O'Hara and Humphries (1975) used 75075 to experimentally determine the early formation of armalcolite. Muan et al. (1974) determined the phase relations.

Note: Pictures show that there was a mysterious red patch on the exterior surface (probably orange soil). The original PET catalog (Butler 1973) mentioned a "burnt sienna" color!

Mineralogy

Olivine: A small amount of olivine is found in cores of pyroxene grains.

Pyroxene: Jagodzinski et al. (1975) demonstrated the presence of exsolved pigeonite in augite cores.

Armalcolite: Neal and Taylor (1993) describe armalcolite in 75075 as a discrete phase, sometimes mantled by ilmenite.

Chemistry

The chemical composition is given in table 1 and figures 4, 5 and 6. Paces et al. (1991) classify 75075 as a type B A17 basalt (figure 6). Gibson et al. (1976) determined 1700 ppm S for 75075. Liech et al. (1974), Jovanovic and Allen (1974, 1980) and Allen et al. (1977) studied F, Cl and P concentrations in 75075.

Radiogenic age dating

Nyquist et al. (1975) and Murthy and Coscio (1976) obtained the Rb/Sr age for 75075 (figures 8 and 10). Lugmair et al. (1975) determined the Sm – Nd age by internal mineral isochron (figure 9). Jessberger et al. (1975) and Horn et al. (1975) determined the age by Ar/Ar, with plagioclase being the most reliable (figure 7). Chen et al. (1978) carefully studied the Pb isotopes in 75075, but were unable to obtain age information by this technique. They concluded that there may have been a disturbance in the U – Pb system about 2.8 b.y., suggesting Pb loss by volatility in the temperature range 400 – 900 deg C.

Cosmogenic isotopes and exposure ages

The ^{38}Ar exposure age is 118 m.y. (Horn et al. 1975), based on the most reliable plagioclase separate. Lugmair et al. (1975) reported 143 ± 5 m.y. as determined by ^{81}Kr and 144 m.y. by ^{38}Ar. This is older than the apparent age of Camelot Crater (~80 m.y.) as determined from 75035 and 75055 (see discussion in Arvidson et al. 1976).

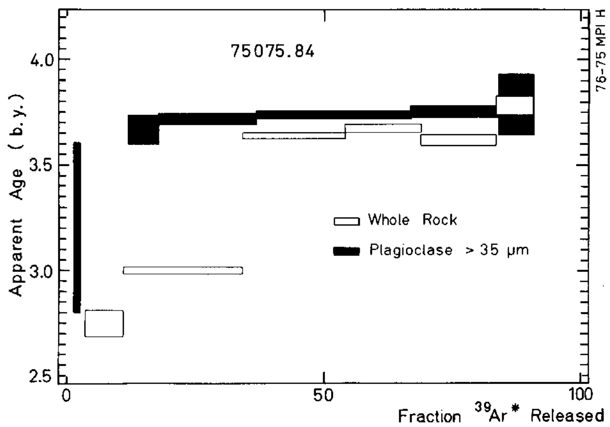


Figure 7: Ar release pattern for coarse plagioclase from 75075 as compared with that of whole rock (Horn et al. 1975).

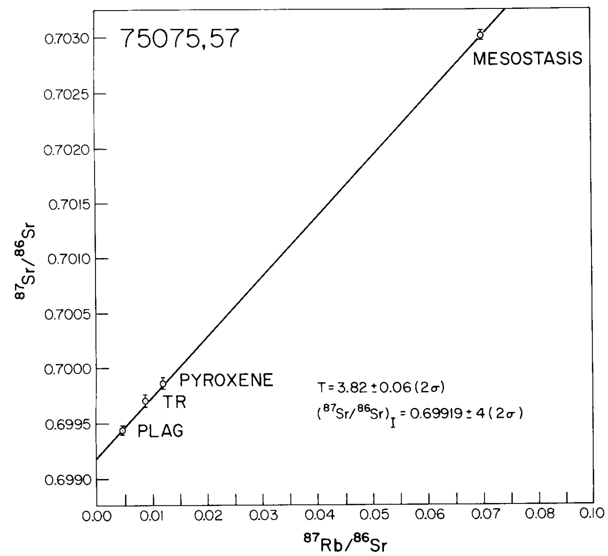


Figure 8: Rb/Sr mineral isochron for 75075 (from Murthy and Coscio 1976).

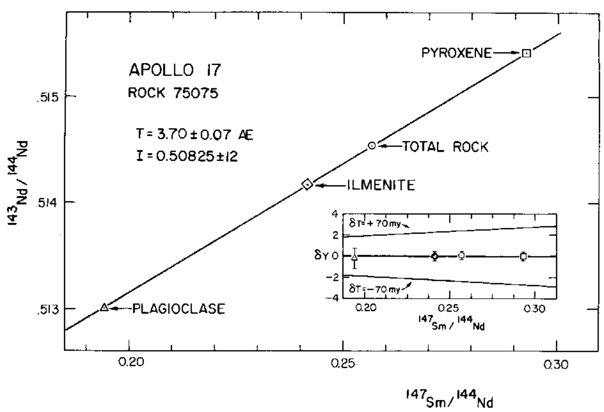


Figure 9: Sm/Nd isochron for 75075 (from Lugmair and Marti 1975).

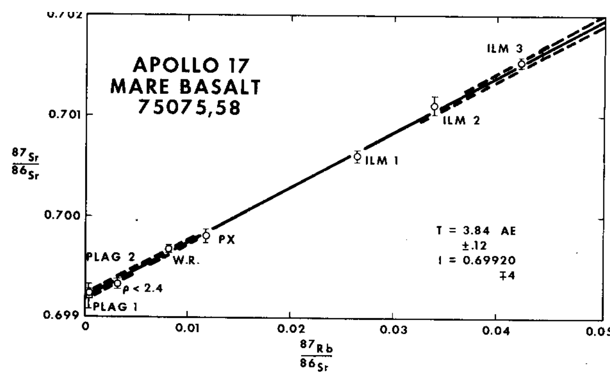


Figure 10: Rb/Sr mineral isochron for 75075 (from Nyquist et al. 1975).

Other Studies

Mayeda et al. (1975) reported the isotopic composition of oxygen for various mineral separates. Petrowski et al. (1975) determined carbon and sulfur isotopes. Chen et al. (1978) performed interesting experiments with Pb isotopes (see above).

Lugmair et al. (1975) reported the isotopic composition of Xe, Kr, Sm and Nd.

Horn et al. (1975) used 75075 to investigate the effects of recoil on Ar/Ar ages.

Processing

This rock was chipped, not sawn. Neal and Taylor (1993) discuss the analysis of 75075 in their re-catalog. Although a large number of thin sections were distributed, no mineralogical results were forthcoming for this rock.

Summary of Age Data for 75075

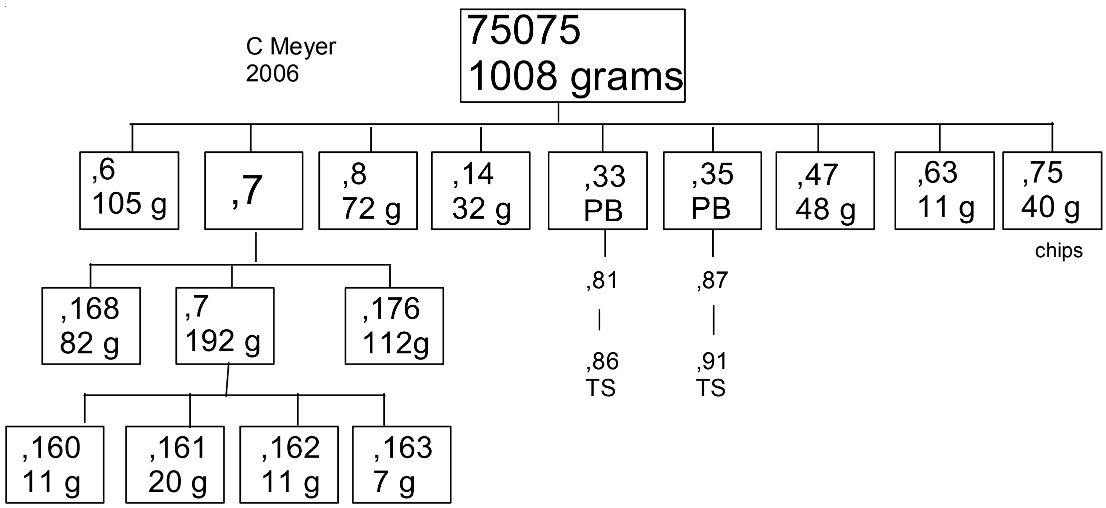
	Rb/Sr	Sm/Nd	Ar/Ar
Murthy and Coscio 1976	3.82 ± 0.06 b.y.		
Nyquist et al. 1975	3.84 ± 0.12		
Lugmair and Marti 1975		3.70 ± 0.07	
Horn et al. 1975			3.74 ± 0.04
			3.71 ± 0.05
			3.74 ± 0.02 plag. coarse
			3.66 ± 0.02 plag. fine

Table 1. Chemical composition of 75075.

reference	Rhodes 76		Murthy 76		Rose 74		Shih 75		Masuda 74		Unruh 83		Lugmair75	
weight	Rhodes 74						Wiesmann75							
SiO2 %	37.64	(a)			38.51	(c)								
TiO2	13.45	(a)			13.33	(c)								
Al2O3	8.2	(a)			8.29	(c)								
FeO	18.78	(a)			18.85	(c)								
MnO	0.28	(a)			0.25	(c)								
MgO	9.49	(a)			9.68	(c)								
CaO	10.29	(a)			10.17	(c)								
Na2O	0.4	(a)			0.37	(c)	0.4							
K2O	0.05	(a)	0.043	(d)	0.11	(c)	0.052	(d)						
P2O5	0.05	(a)			0.12	(c)								
S %	0.16	(a)												
sum														
Sc ppm					82	(c)	78.3	(d)						
V					108	(c)								
Cr	3900	(a)			3763	(c)	2880	(d)						
Co					32	(c)	20.5	(d)						
Ni	1	(a)			31	(c)								
Cu														
Zn	5	(a)												
Ga					6.5	(c)								
Ge ppb														
As														
Se														
Rb	0.5	(a)	0.387	(d)	1	(c)	0.46	(d)						
Sr	166	(a)	131	(d)	390	(c)	165	(d)						
Y	81	(a)			98	(c)								
Zr	208	(a)			296	(c)	235	(d)						
Nb	21	(a)			31	(c)								
Mo														
Ru														
Rh														
Pd ppb														
Ag ppb														
Cd ppb														
In ppb														
Sn ppb														
Sb ppb														
Te ppb														
Cs ppm														
Ba			62.4	(d)			64.4	(d)	72.3	(d)				
La							5.01	(d)	5.67	(d)				
Ce							17.6	(d)	19.5	(d)				
Pr														
Nd							19.8	(d)	21	(d)	17.3	(d)		
Sm							8.29	(d)	8.9	(d)	7.26	(d)		
Eu							1.77	(d)	2	(d)				
Gd							12.9	(d)	12.9	(d)				
Tb														
Dy							15.1	(d)	15.7	(d)				
Ho														
Er							8.89	(d)	9.48	(d)				
Tm														
Yb					7.4	(c)	8.31	(d)	8.71	(d)				
Lu							1.21	(d)	1.22	(d)	1.09	(d)		
Hf							9.3	(d)			7.5	(d)		
Ta														
W ppb														
Re ppb														
Os ppb														
Ir ppb														
Pt ppb														
Au ppb														
Th ppm							0.32	(d)						
U ppm							0.096	(d)						

technique: (a) XRF, (b) , (c) mixed, (d) IDMS

Table 2	U ppm	Th ppm	K ppm	Rb ppm	Sr ppm	Nd ppm	Sm ppm	technique
Murthy and Coscio 1976			356	0.387	131			idms
Chen et al. 1978	0.089	0.326						idms
	0.106	0.322						idms
Shih et al. 1985	0.096	0.32		0.46	165	19.8	8.29	idms
Nyquist et al. 1975				0.46	164.6			idms
Lugmair and Marti 1975						28	48	idms
Unruh et al. 1983						17.3	7.3	idms
Masuda et al. 1974						21	8.9	idms



List of Photo #s for 75075

S73-15337 – 341

S73-17259 – 269 B&W

S73-17801

S73-36796 – 800 processing

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