14072

Olivine Basalt

45 grams

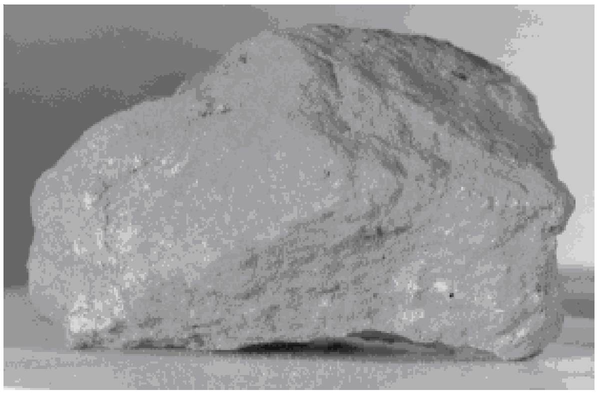


Figure 1: Photo of 14072. NASA S71-22317. Sample is 5 cm across.

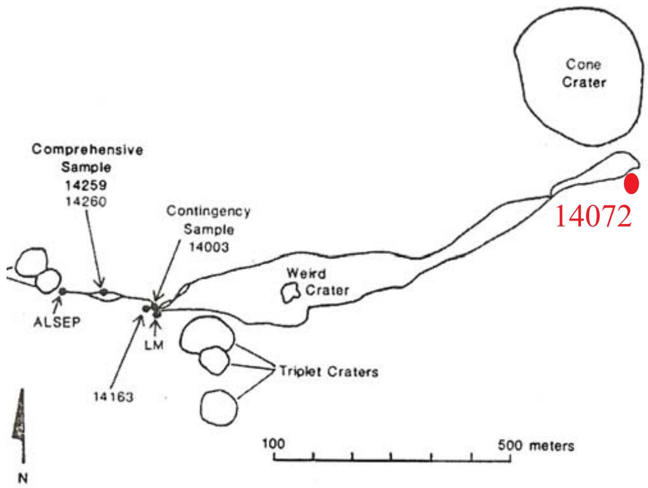


Figure 2: Traverse map for Apollo 14 showing location of 14072 on rim of Cone Crater.

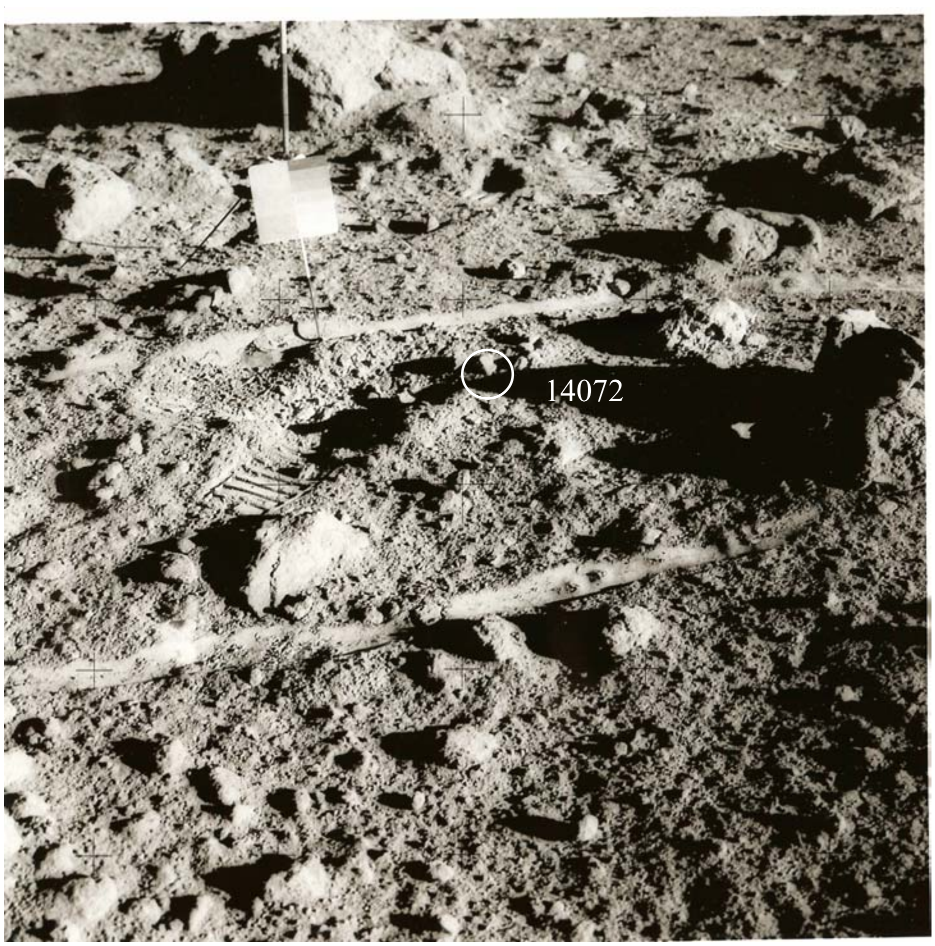


Figure 3: Location of 14072 between tracks left by MET. S71-64-9125.

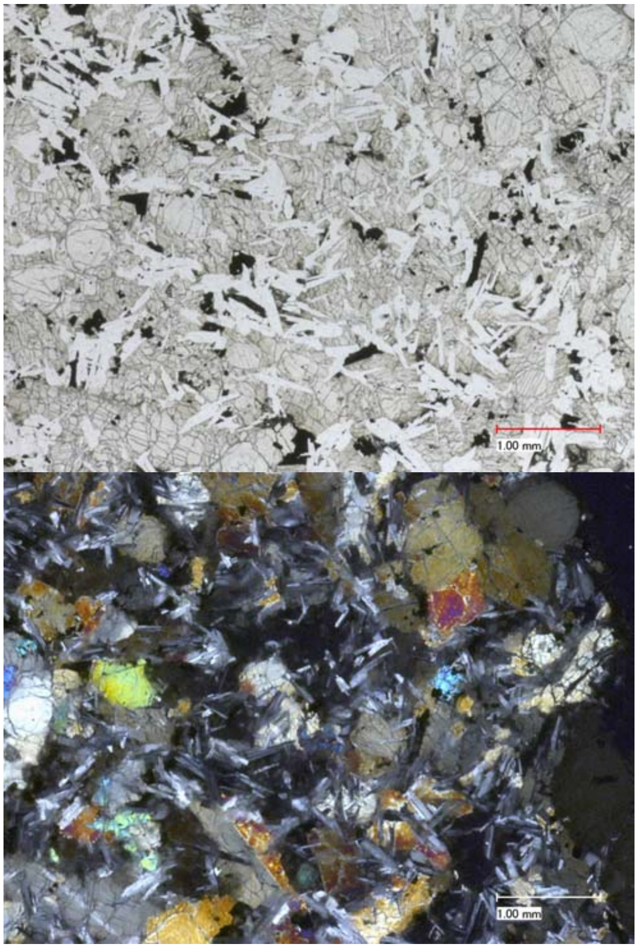


Figure 4: Photomicrographs of thin section 14072,11 by C Meyer @50x.

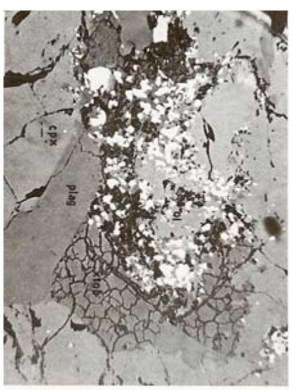


Figure 5: Photo of iron grains in mesostasis, with crystobilite etc (Longhi et al. 1972).

Mineralogical Mode for 14072

	Longhi et al. 1972	McGee et al. 1977
Olivine	2.5 %	2 – 3 %
Pyroxene	50	50
Plagioclase	38.3	38
Ilmenite + Chromite-ulvo.	7.7	8
Cristobalite	1.7	2

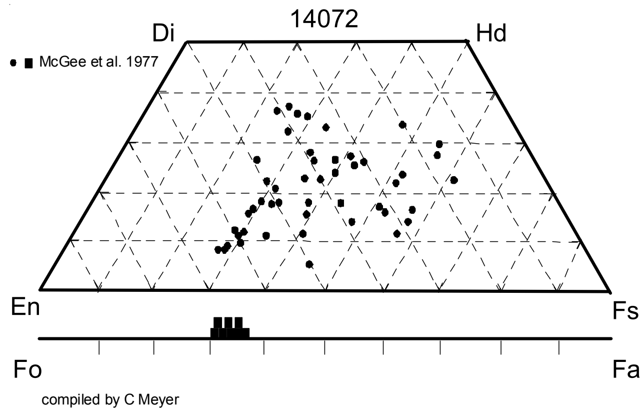


Figure 6: Pyroxene and olivine composition of 14072 (McGee et al. 1977).

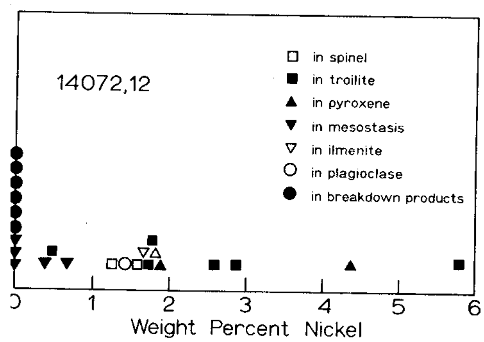


Figure 7: Composition of iron grains in 14072 (El Goresy et al. 1972).

Introduction

Sample 14072 was picked up on the rim of Cone Crater (Swann et al. 1971). It is a mare basalt with an old crystallization age of ~ 4.0 b.y. and an exposure age of 21 m.y. (Cone Crater age). 14072, and its companion 14053, are highly reduced with unique masses of spongy metallic iron in the mesostasis.

Petrography

17072 is a porphyritic basalt with medium-sized olivine phenocrysts, subophitc to ophitic texture and little glass in its residium (Longhi et al. 1972). Olivine appears in 14072 as large, subrounded pheopcrysts (Fo_{75}) up to 2 mm across, as inclusions (Fo_{65}) in large pyroxenes and as part of the late-stage assemblage (Fo_{35}) with cristobalite and spongy network of native iron (figure 5).

El Goresy et al. (1972) studied the opaque mineralogy.

Neal and Kramer (2006) claimed that "14072 is unique when compared with the other Apollo 14 basalts". However, it has some similarity with 14053.

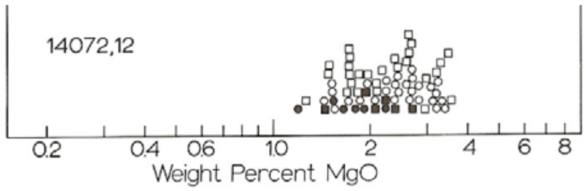


Figure 8: MgO content of ilmenite in 14072 (ELGoresy et al. 1972).

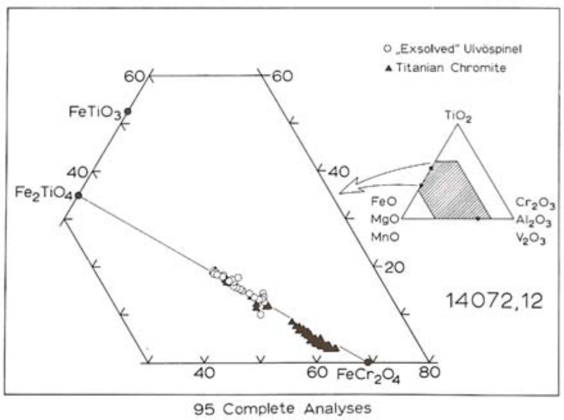


Figure 9: Chromite-ulvospinel composition for 14072 (ElGoresy et al. 1972).

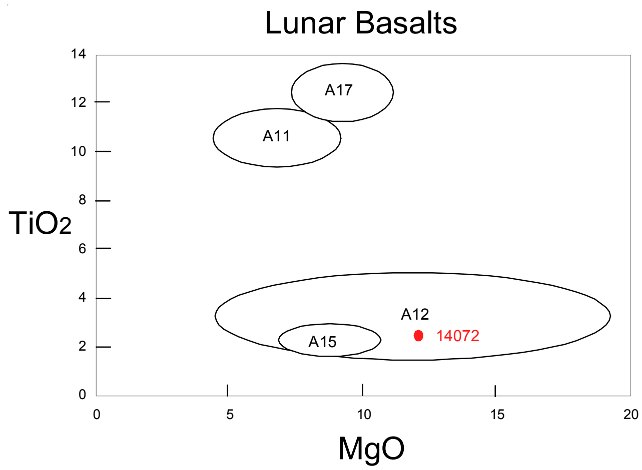


Figure 10: Composition of 14072 compared with other Apollo basalts.

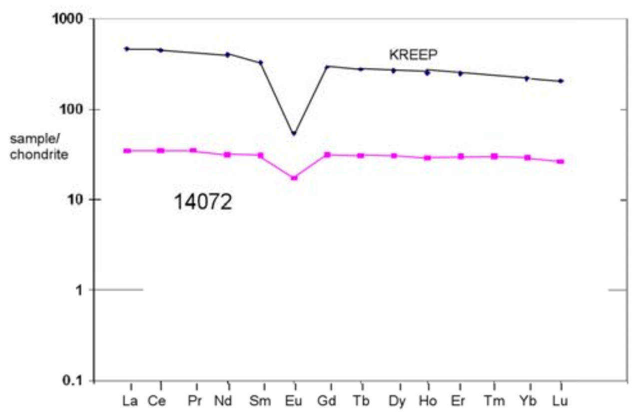


Figure 11: Normalized rare-earth-element diagram for 14072.

Walker et al. (1972) determined the phase diagram for a melt with the composition of 14072 (figure 13).

Mineralogy

Olivine: Haggerty (1977) carefully studied the various types of olivine in 14072. Olivine phenocrysts are found to have symplectite.

Pyroxene: McGee et al. (1977) determined the pyroxene composition (figure 6).

Metallic iron: Haggerty (1977) found that the metallic iron that is an apparent reduction phenonemen is low in Co, while the initial iron grains included in olivine had high Co content (figure 7).

Ilmenite: von Engelhardt (1979) noticed that ilmenite in 14072 was similar to that in 14053 – a mare basalt. ElGoresy et al. (1972) determined that it had 2 % MgO (figure 8). Haggerty (1977) also reported on ilmenite.

Chromite-Ulvospinel: Haggerty (1977) and ElGoresy et al. (1972) studied the "breakdown" and exsolution in ulvospinel (figure 9).

Chemistry

Helmke et al. (1972), Taylor et al. (1972), Dickenson et al. (1985, 1989) and Neal (2001) determined the chemical composition of 14072 (figures 10 and 11). Hughes et al. (1973) also reported data for siderophile and volatile element concentrations. Note that their data indicate that 14072 is uncontaminated by meteoritic material (unlike 14310). Warner et al. (1980) noted that the composition of 14072 was somewhat like that of 14053.

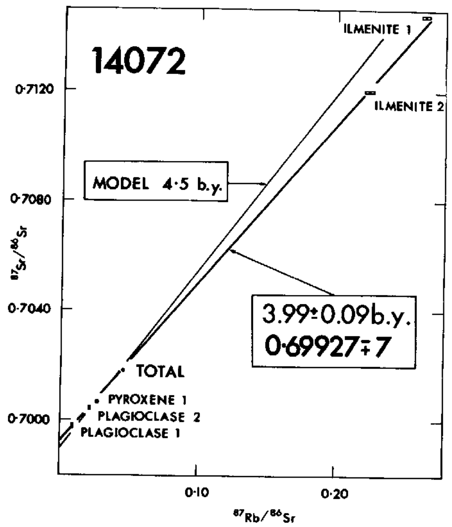
Radiogenic age dating

Compston et al. (1971) determined a Rb/Sr mineral isochron with age of 3.99 ± 0.09 b.y. (figure 12). York et al. (1972) reported an Ar-Ar age of 4.04 ± 0.05 b.y. for 14072.

Table 1. Chemical composition of 14072.

reference	Neal2001	Neal 2006		Hubbard72		Taylor72			Dickinson85		Helmke72		Dickinson89			Longhi72		Hughes73	
weight																			
SiO2 %				45.2	(c)	45.15		(c)								44.94	(e)		
TiO2				2.57	(c)	2.57		(c)	2.6	(b)						2.56	(e)		
Al2O3				11.1	(c)	11.07		(c)	11.1	(b)						11.31	(e)		
FeO				17.8	(c)	17.82		(c)	17.8	(b)			16.5	17.7	(b)	17.07	(e)		
MnO				12.2	(c)	0.27		(c)	0.27	(b)									
MgO						12.16		(c)	12.2	(b)						12.21	(e)		
CaO				9.84	(c)	9.84		(c)	9.3	(b)			8	8.82	(b)	9.63	(e)		
Na2O				0.32	(c)	0.32		(c)	0.32	(b)			0.32	0.34	(b)	0.38	(e)		
K2O				0.08	(c)	0.08		(c)	0.08	(b)						0.11	(e)		
P2O5				0.08	(c)	0.08		(c)											
S %						0.51		(c)										0.135	(f)
sum																			
Sc ppm	57.3	51.6	(d)								47.1	(b)	51	54	(b)				
V	117	104	(d)					(c)											
Cr	3558	2994	(d)	3490	(c)	2500		(c)	2463	(b)	3880	(b)	4200	3800	(b)				
Co	40.8	39.7	(d)								32	(b)	32	37	(b)				
Ni	47.2	52.4	(d)								31	(b)							
Cu	17.2																		
Zn	20.1										8	(b)							
Ga	3.13	5.2	(d)								3.8	(b)	37	23	(b)				
Ge ppb													1200	1008	(b)				
As																			
Se																		120	(f)
Rb	1.53	1.55	(d)			1.5	1.3	(a)											
Sr	83.3	93.4	(d)			110	106	(a)					101	125	(b)				
Y	46.8	41.4	(d)			40	36	(a)											
Zr	141	141	(d)			160	172	(a)	170	(b)									
Nb	13.6	12.9	(d)			9.9	13	(a)											
Mo	0.44	0.16	(d)																
Ru																			
Rh																			
Pd ppb																			
Ag ppb																		2.5	(f)
Cd ppb																			
In ppb																			
Sn ppb							300	(a)											
Sb ppb																			
Te ppb																			
Cs ppm	0.05	0.12	(d)																
Ba	105	107	(d)			135	120	(a)	127	(b)			211	129	(b)				
La	7.96	7.8	(d)			8.7	8.7	(a)	8.7	(b)	6.76	(b)	8.2	9.1	(b)				
Ce	20.8	20.2	(d)			26	27	(a)	26	(b)	17.9	(b)	22	23	(b)				
Pr	3.1	2.87	(d)			3.4	3.2	(a)											
Nd	14.1	12.9	(d)			13	13	(a)	13	(b)	13	(b)	16	19	(b)				
Sm	4.45	4.21	(d)			4.3	4.4	(a)	4.4	(b)	3.93	(b)		5.1	(b)				
Eu	0.97	0.98	(d)			1.02	0.97	(a)	1	(b)	0.88	(b)	1	1.1	(b)				
Gd	6.12	5.23	(d)			5.3	6.4	(a)			4.2	(b)							
Tb	1.08	1.02	(d)			0.88	0.93	(a)	0.9	(b)	0.98	(b)	1.2	1.3	(b)				
Dy	7.35	6.95	(d)			6.3	5.9	(a)	6.1	(b)	6	(b)							
Ho	1.59	1.46	(d)			1.9	1.6	(a)			1.5	(b)							
Er	4.71	4.28	(d)			4.4	4.7	(a)			3.5	(b)							
Tm	0.72	0.64	(d)			0.79	0.76	(a)					0.48	0.61	(b)				
Yb	4.69	4.01	(d)			4	4	(a)	4	(b)	4.05	(b)	4.9	5.2	(b)				
Lu	0.63	0.59	(d)								0.61	(b)	0.92	0.83	(b)				
Hf	3.87	3.68	(d)			3	3.2	(a)	3.1	(b)	6.9	(b)	3.8	4.4	(b)				
Ta	0.75	0.73	(d)										0.89	0.9	(b)				
W ppb	0.14					200	100	(a)											
Re ppb																		0.11	(f)
Os ppb																		2.4	(f)
Ir ppb																		0.15	(f)
Pt ppb																			
Au ppb																		0.089	(f)
Th ppm	1.13	1.02	(d)			0.78	1.04	(a)	0.9	(b)			1.3	1.3	(b)				
U ppm	0.31	0.29	(d)			0.22	0.29	(a)											

technique: (a) spark source ms, (b) INAA, (c) XRF, (d) ICP-MS, (e) the easy way, (f) the hard way



Firuge 12: Rb/Sr isochron for 14072 (Compston et al. 1972).

Summary of Age Data for 14072

	Ar/Ar	Rb/Sr
York et al. 1972	4.04 ± 0.05 b.y.	
Compston et al. 1971		3.99 ± 0.09

Caution: be careful of decay constant and Ar standard.

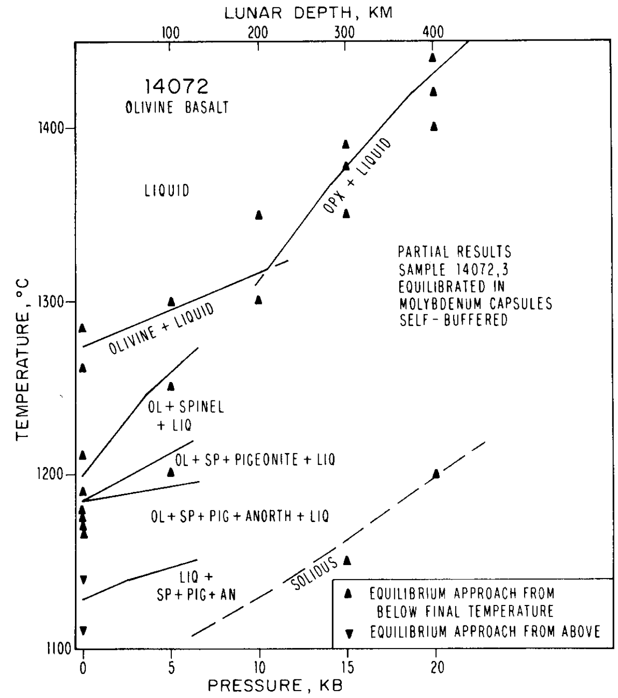


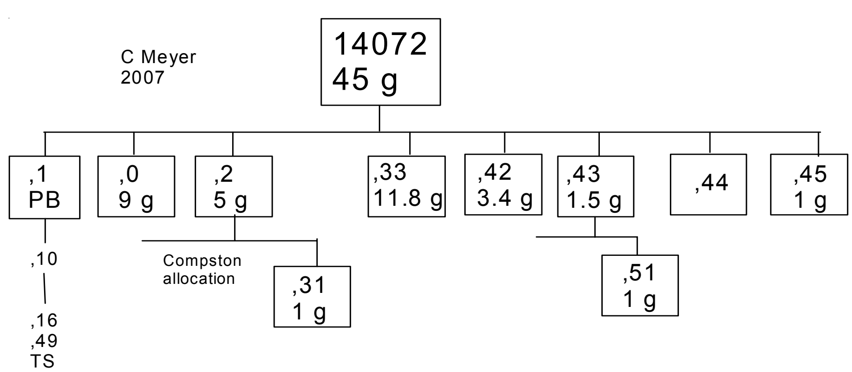
Figure 13: Phase diagram for 14072 (Walker et al. 1972).

Cosmogenic isotopes and exposure ages

York et al. (1972) determined an ^{38}Ar exposure age of 21 m.y.

Processing

14072 was returned in bag 10N in ALSRC 1006. There are 7 thin sections for 14072.



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