15085

Pigeonite Basalt
471.3 grams

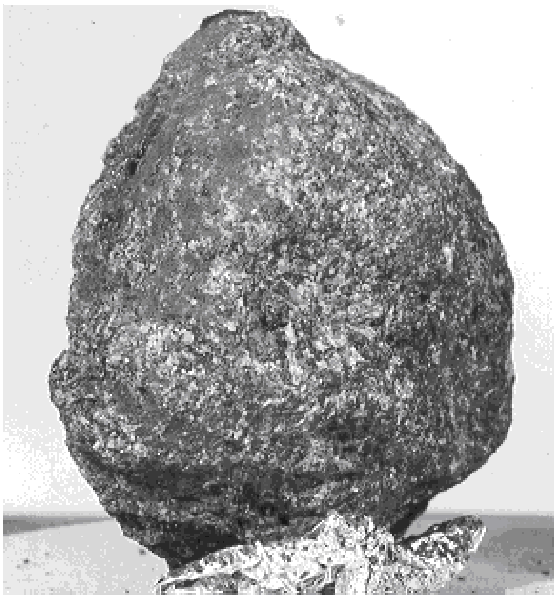


Figure 1a: Photo of 15085 showing rounded character. Sample is 6 cm across. NASA S71-45866.

Figure 1b: Photo of 15085 showing basaltic texture. Cube is 1 inch. NASA S71-43088.

Introduction

15085 was found on the surface about 60 meters east of the rim of Elbow Crater and probably came from the ejecta blanket of Elbow Crater (Swann et al. 1971). It is one of the samples collected as a suite, from different distances from a small crater (15065 to 15085). It is a coarse grained mare basalt that is about 3.4 b.y. old.

Petrography

15085 is a coarse-grained, quartz-normative mare basalt (catalog reports 5 mm) dominated by pigeonite. Brown et al. (1972) found extreme Fe-enrichment during pyroxene growth. The rounded surface of 15085 was probably caused by micrometeorite bombardment, but there we no zap pits.

The cooling rate of this suite of mare basalts has been determined by several techniques (Onorato et al. 1979). Lofgren et al. (1975) performed controlled cooling rate experiments to obtain similar textures from melts. Takeda et al. (1975) studied the order of cations in pyroxene crystals, while Taylor et al. (1975) used the Zr content of ilmenite. Grove and Walker (1977) determined the cooling rate from plagioclase dimensions.

Mineralogical Mode for 15085

	Sample Catalog Butler 1971	Sample Catalog Wilshire, Brett	Papike et al. 1976	Brown et al. 1973
Olivine			1.3	
Pyroxene	40-45	66	46.2	62.3
Pyroxferroite		2		
Plagioclase	55-60	22	47.9	31.3
Opaque	3	3+	3.5	3,5
Silica			0.7	1.6
Other			1.7	tr.

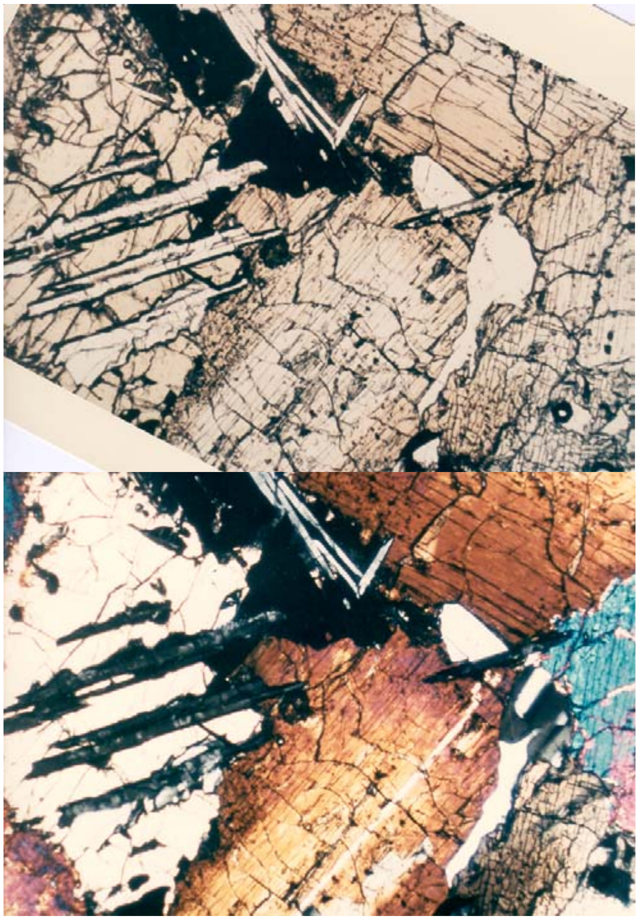


Figure 2a: Photomicrographs of thin section of 15085 showing parellel plates of tridymite. Field of view is 2 mm. NASA S71-51773 and 51772.

Figure 2b: Photomicrographs of thin section of 15085. Field of view about 2 mm. NASA S71-51775 and 51774. Video file

Mineralogy

Olivine: none

Pyroxene: Lage pyroxene grains in 15085 are beautifully zoned and twinned (figures 2, 3 and video). Brown et al. (1972) and Papike et al. (1976) reported compositions of pyroxene (figure 4). Takeda et al. (1975) determined cell dimensions of both pigeonite and augite..

Spinel; Taylor et al.(1975) studied the solid solution of chromite – ulvospinel.

Metallic iron: Taylor et al. (1975) found high contents of Ni in iron grains in 15085 (figure 5).

Silica: Mason et al. (1972) described and analyzed tridymite and cristobalite in 15085.

Chemistry

Mason et al. (1972), Duncan et al. (1975) and Fruchter et al. (1973) found that 15085 was similar to other Apollo 15 basalts (especially the 15065-15076 suite). Wanke et al. (1976), Helmke et al. (1973) and others determined the trace elements (figure 6).

Rhodes and Blanchard (1983) reported that they had analyzed 15085, but gave no data. Gibson et al. (1975) determined the sulfur content (855 ppm). Helmke et al. (1972) also provided trace element analyses of mineral separates (showing that plagioclase has high Eu)..

Radiogenic age dating

Papanastassiou and Wasserburg (1973) determined an age of 3.40 ± 0.04 b.y. by Rb/Sr isochron (figure 8). Unruh and Tatsumoto (1977) determined the U, Th and

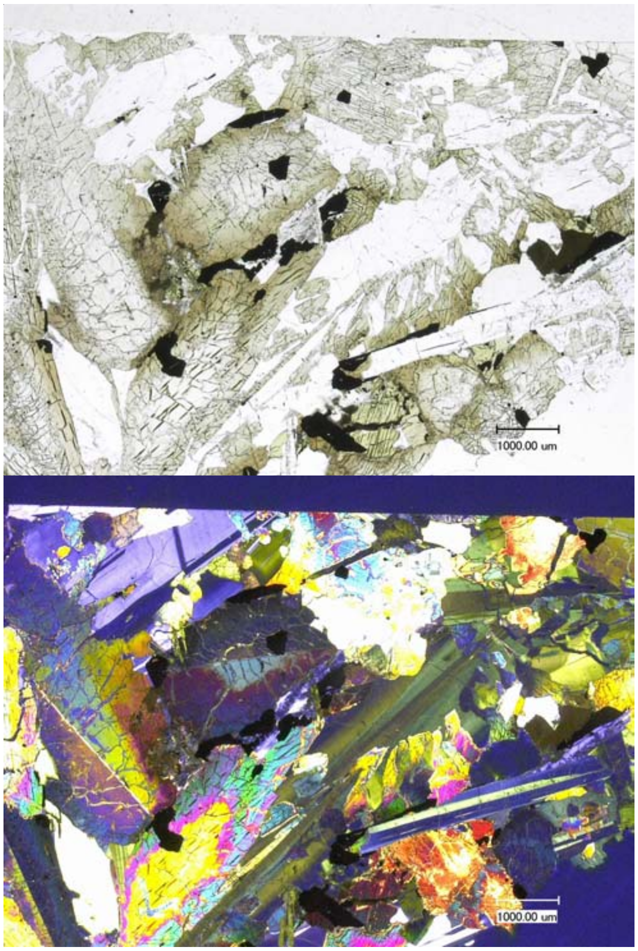


Figure 3: Photomicrographs of 15085,19 by C Meyer with video.

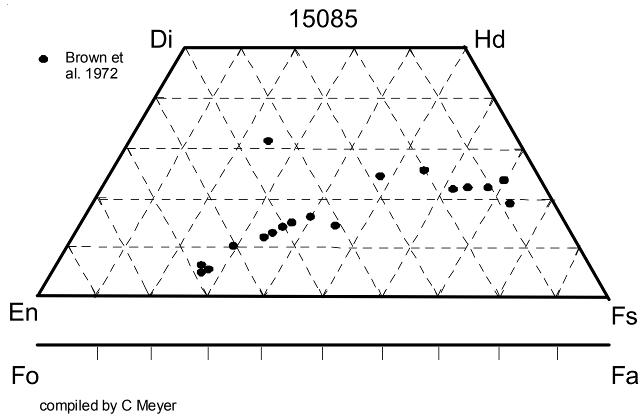


Figure 4: Pyroxene composition of 15085.

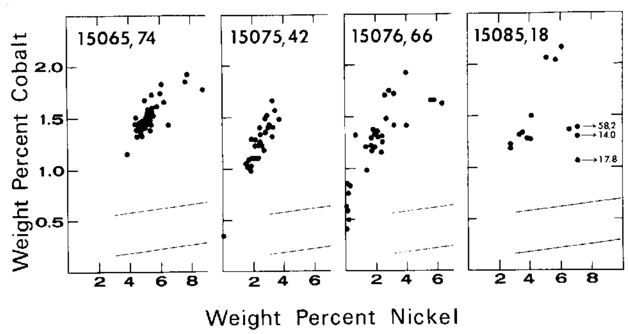


Figure 5: Composition of metal grains in basalt samples from Elbow Crater (from Taylor et al. 1975).

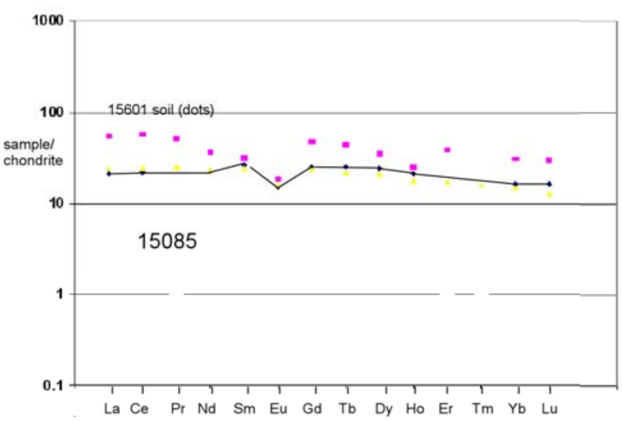


Figure 6: Normalized rare-earth-element pattern for 15085 compared with 15601 soil.

Pb isotopes of mineral seperates, but the age obtained (~3.5 b.y) was not precise.

Cosmogenic isotopes and exposure ages

Keith et al. (1972) determined the cosmic ray induced activity of ^{22}Na = 37 dpm/kg, ^{26}Al = 84 dpm/kg, ^{46}Sc = 3.9 dpm/kg, ^{54}Mn = 23 dpm/kg and ^{56}Co = 12 dpm/kg.

Other Studies

Collinson et al. (1973) determined the magnetic properties, Bhnadari et al. (1973) studied the distribution of solar flare tracks and Greenman and Gross (1972) reported luminescence due to radiation damage under soft X-ray bombardment.

Processing

15085 was chipped, not sawn. There are 17 thin sections.

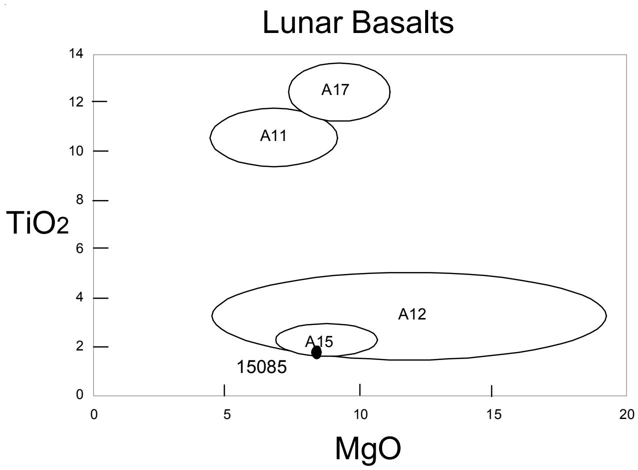


Figure 7: Composition of 15085 compared with that of other Apollo samples.

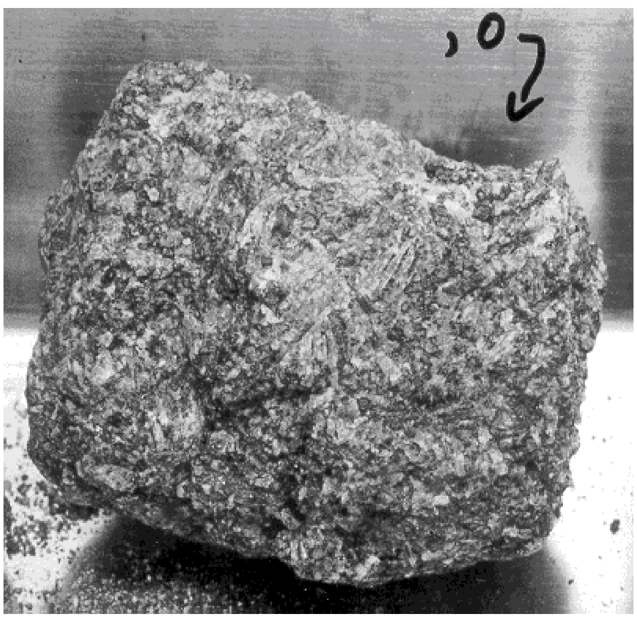


Figure 9: Close up photo of freshly broken surface of 15085,0 after chipping showing interior basaltic texture (intrgrown plagioclase and pyroxene). NASA S76-21719. Sample is 6 cm across.

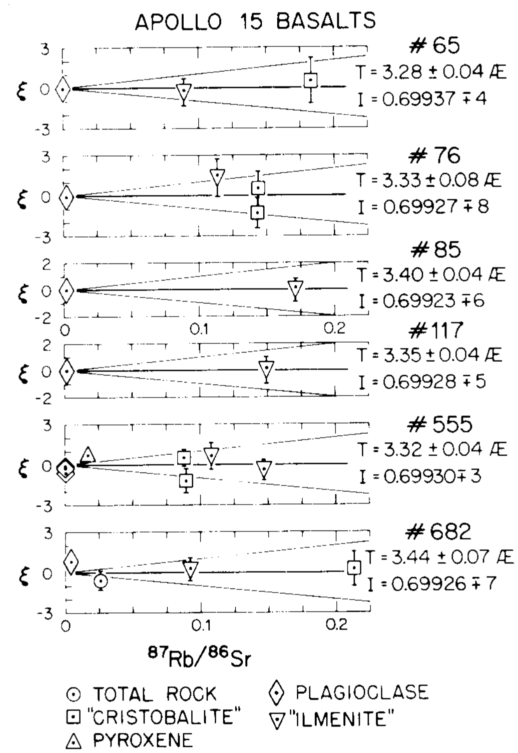


Figure 8: Rb/Sr isochrons for various Apollo 15 basalts including 15085 (two point isochron!). From Papanastassiou and Wasserburg (1973).

Summary of Age Data for 15085

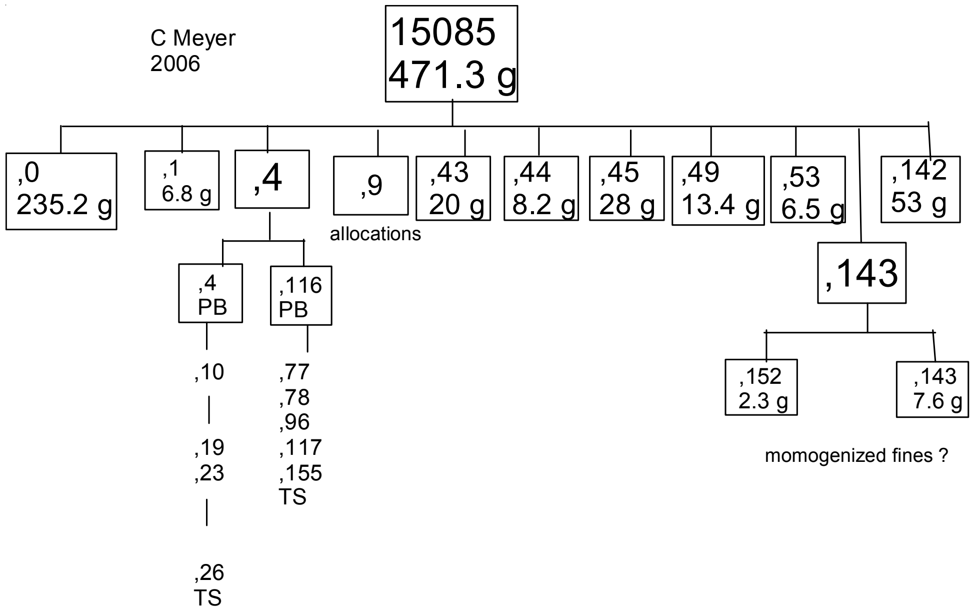
	Rb/Sr
Papanastassiou and Wasserburg 1973	3.40 ± 0.04 b.y.

Caution: old decay constant for Rb used.

Table 1. Chemical composition of 15085.

reference	Fruchter73			Wolf79		Mason 72		Helmke72		Keith 72		Duncan 75			Wanke 76	
weight				Ganapathy73												
SiO2 %						46.39	(a)					46.61	47.73	(e)	48.06	(a)
TiO2	1.67	2.6	(c)			3.07	(a)					2.63	1.96	(e)	1.57	(a)
Al2O3	10.01	6.61	(c)			5.79	(a)					7.13	9.92	(e)	11.17	(a)
FeO	18.27	22.9	(c)			26.75	(a)					24.39	19.69	(e)	18.42	(a)
MnO						0.37	(a)					0.3	0.26	(e)	0.26	(a)
MgO						8.2	(a)					7.9	8.84	(e)	7.85	(a)
CaO			(c)			9.12	(a)					9.68	10.63	(e)	11.23	(a)
Na2O	0.31	0.24	(c)			0.21	(a)					0.26	0.33	(e)	0.365	(a)
K2O						0.07	(a)			0.048	(d)	0.059	0.035	(e)	0.054	(a)
P2O5						0.09	(a)					0.107	0.064	(e)	0.055	(a)
S %												0.137	0.068	(e)		
sum																
Sc ppm	41	51	(c)												44	(a)
V						110	(b)					172	165	(e)		
Cr	3350	3980	(c)			4600	(b)					4200	3565	(e)	2940	(a)
Co	42	48	(c)									43	41	(e)	36	(a)
Ni						45	(b)	37				20	23	(e)	31	(a)
Cu						18	(b)					9	29	(e)		
Zn				1.05	(a)							<1.5	17	(e)		
Ga						5	(b)									
Ge ppb				2.8	(a)											
As																
Se				123	(a)											
Rb				0.86	(a)	<5	(b)					1.8	<1.5	(e)	0.73	(a)
Sr						92	(b)					120	112	(e)	107	(a)
Y						54	(b)					44	28.6	(e)	21	(a)
Zr						150	(b)					156	92	(e)	99	(a)
Nb												10	6.6	(e)		
Mo																
Ru																
Rh																
Pd ppb																
Ag ppb				1	(a)											
Cd ppb				0.68	(a)											
In ppb				0.6	(a)											
Sn ppb																
Sb ppb				0.035	(a)											
Te ppb				6.2	(a)											
Cs ppm				0.04	(a)											
Ba						87	(b)	68				110	60	(e)	62	(a)
La	4.5	6.5	(c)					4.92	(c)						5.88	(a)
Ce								13.2	(c)						16.5	(a)
Pr															2.5	(a)
Nd								10.2	(c)						13.1	(a)
Sm	3.15	4.5	(c)					3.86	(c)						3.79	(a)
Eu	1.02	1.12	(c)					0.84	(c)						1.07	(a)
Gd								4.9	(c)						5.4	(a)
Tb	0.7	1.1	(c)					0.9	(c)						0.92	(a)
Dy								5.79	(c)						5.65	(a)
Ho								1.16							1.2	(a)
Er															3.5	(a)
Tm																
Yb	2	3.1	(c)					2.63	(c)						2.72	(a)
Lu	0.36	0.53	(c)					0.393	(c)						0.43	(a)
Hf	2	3.1	(c)												2.44	(a)
Ta	0.46	0.77	(c)												0.41	(a)
W ppb															59	(a)
Re ppb				0.0015	(a)											
Os ppb																
Ir ppb				0.0069	(a)											
Pt ppb																
Au ppb				0.012	(a)										0.44	(a)
Th ppm										0.57	(d)				0.42	(a)
U ppm				0.135	(a)					0.138	(d)				0.13	(a)

technique: (a) RNAA, (b) SSMS, (c) INAA, (d) radiation counting, (e) XRF



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