79155

Shocked Basalt

318.8 grams

Figure 1: Photo of top of 79155. NASA S73-15323. Sample is about 7 cm across.

Figure 2: Photo of bottom of 79155. NASA S73-15320.

Figure 3: Closeup view of interior surface of 79155,10. NASA S86-38336. Scale in mm along bottom.

Introduction

Lunar sample 79155 was probably a glass-covered "bomb" thrown out by a small impact. It sat on the lunar surface and the glass on the exposed side was apparently eroded away by micrometeorite bombardment. The main portion the the sample is a mildly-shocked coarse basalt, or "gabbro" with large grain size (2 mm). One side is smooth and rounded and densely covered with micrometeorite craters (figure 1) while the other side (figure 2) has a thick dark glass coating lacking in micrometeorite craters. Apparently only small micrometeorites hit the sample and it was not turned over on the regolith. As such, it should be considered an "oriented sample".

79155 is ~3.8 b.y. old, with an exposure age to cosmic rays of ~ 575 m.y.

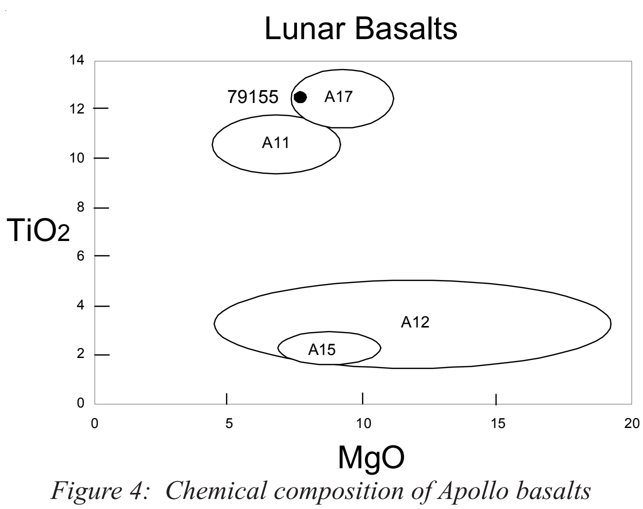

Figure 4: Chemical composition of Apollo basalts with 79155.

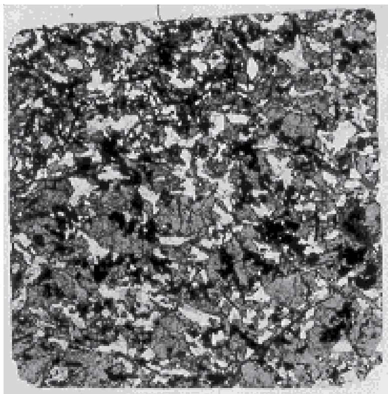

Figure 5: Photo of thin section 79155,68 (from data pack). Section about 1 cm square.

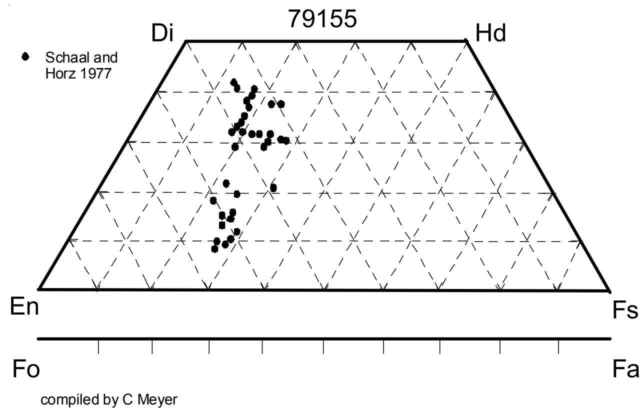

Figure 6: Composition of pyroxene in 79155.

Petrography

Neal and Taylor (1993) give a brief rock description. They find the average grain size is about 2.5 mm, that the ilmenite contains spinel and rutile exsolution. Both pyroxene and plagioclase have undulose extinction and there are "stringers" of glass throughout the thin sections indicating shock, but in general they find that 79155 was a "typical Apollo 17 basalt".

The shock features of 79155 were studied by Schaal and Horz (1977) who conclude a maximum shock pressure of 300 – 450 kbars. The relict igneous texture of 79155 is well preserved, but some plagioclase is converted to maskelynite. Shock glass is present. Roedder and Weiblen (1977) also studied glass veins in 79155.

Mineralogy

Pyroxene: Some pyroxene grains have undulatory extinction, indicating shock. They are apparently grey in color, while in most basalts they are honey-brown (figure 3). Both subcalcic augite and pigeonite are present, but without the normal zoning to Fe-rich (figure 6). This was apparently a slowly cooled basalt.

Plagioclase: Some plagioclase has been shocked to maskelynite.

Glass: Glass "pods" and "stringers" have been reported as probable shock features (tabe 2). Mao et al. (1974) studied the color (spectra) and composition of the glass coating.

Chemistry

Eldridge et al. (1974), Rhodes et al. (1976), Rose et al. (1975), Wanke et al. (1974) and Shih et al. (1975) have analyzed 79155 and find that it is a normal high-Ti Apollo 17 basalt (figure 4, 7 and 8).

Gibson et al. (1976) reported 2025 ppm sulfur. Nunes et al. (1974) repoerted U, Th and Pb for 79155, but values seem high. Jovanovic and Reed (1978) have reported P and halogens.

Radiogenic age dating

Kirsten and Horn (1974) determined the crystallization age of 79155 of 3.80 ± 0.04 b.y. by the Ar plateau technique (figure 9). However, it should be remembered that this sample shows evidence of shock.

Mineralogical Mode of 79155

	Roedder and Weiblen 1975	Brown et al. 1975	Schaal and Horz 1977
Olivine	0.8	0.9	tr.
Pyroxene	57.2	41.5	52
Plagioclase	16.8	21.6	19
Oxides	20.8	28.7	24
Metal	0.2		tr.
Silica	tr.	-	
Mesotasis	1.2	7.3	

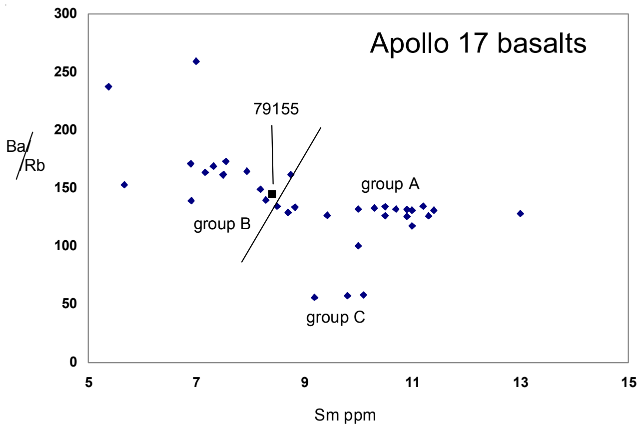

Figure 7: Basalt sample 79155 may be A or B !?

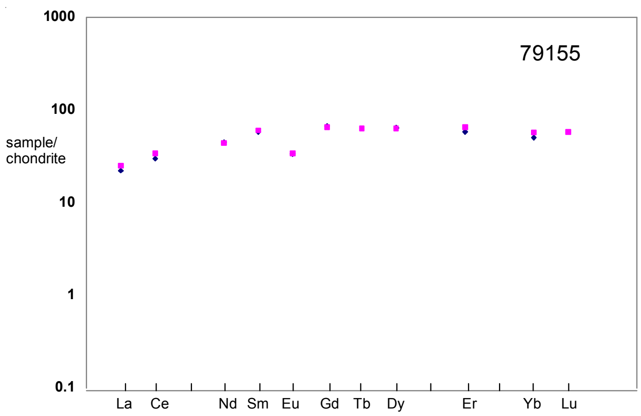

Figure 8: Normalized rare-earth-element diagram for 79155 (data by Shih et al. and Wanke et al.).

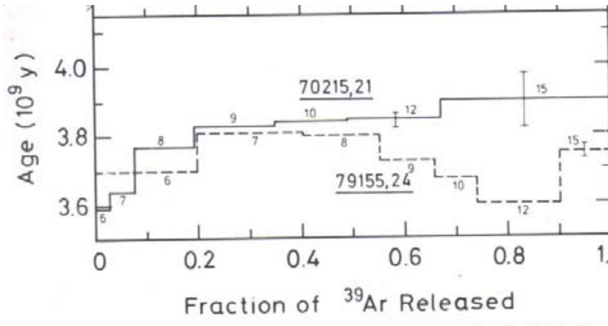

Figure 9: Ar/Ar plateau diagram for two Apollo 17 basalts (Kirsten and Horn 1974).

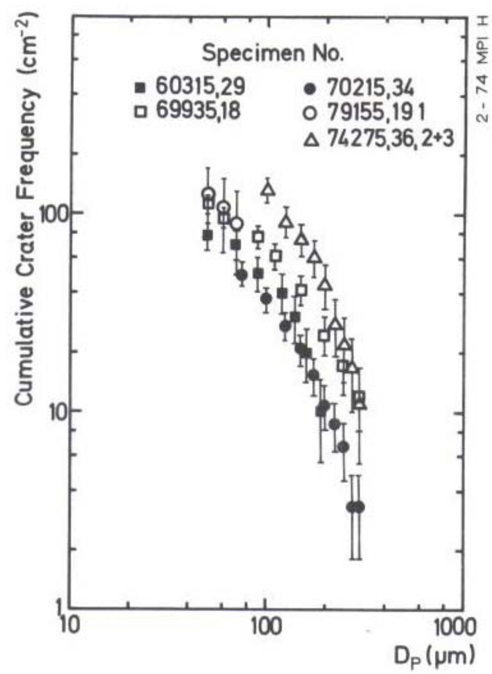

Figure 10: Size distribution of zap pits on lunar samples including 79155 (data by Fechtig et al. 1974).

Summary of Age Data for 79155

	Ar/Ar
Kirsten and Horn 1974	3.80 ± 0.04 b.y.

Caution: Based on old decay constants.

Cosmogenic isotopes and exposure ages

Kirsten and Horn (1974) reported an exposure age of 575 ± 60 m.y by the ^{38}Ar method for 79155.

O'Kelley et al. (1974) studied the effect of the intense August 1972 solar flare. They found the cosmic-ray inducted activity of ^{22}Na = 63 dpm/kg., ^{26}Al = 70 dpm/kg., ^{46}Sc = 65 dpm/kg., ^{54}Mn = 129 dpm/kg. and ^{56}Co = 153 dpm/kg.

Other Studies

Cisowski et al. (1977, 1983) studied the magnetic properties of 79155.

Fechtig et al. (1974) reported the size distribution of micrometeorite craters on 79155 (figure 10).

Klein et al. (1975) and Uhlmann et al. (1979) studied cooling rate for glass in 79155.

Processing

A slab was cut from 79155 (figure 12) and twelve thin sections prepared. The large end piece with attached glass coating makes a nice display (figure 11).

Table 1. Chemical composition of 79155.

reference	Rhodes 76		Rose 75		Wanke75		Shih75		Eldridge74		Baedecker74		Boynton75	
weight							Wiesmann75							
SiO2 %	37.5		39.13	(b)	40.9	(c)	Nyquist75							
TiO2	12.99		12.56	(b)	11.8	(c)							12.38	(a)
Al2O3	8.58		9.4	(b)	9.2	(c)							8.13	(a)
FeO	19.04		18.19	(b)	19	(c)							19.1	(a)
MnO	0.28		0.27	(b)	0.26	(c)							0.26	(a)
MgO	9.14		9.58	(b)	9.28	(c)								
CaO	10.29		10.19	(b)	10.6	(c)							10.78	(a)
Na2O	0.38		0.36	(b)	0.35	(c)							0.385	(a)
K2O	0.055	(a)	0.08	(b)	0.053	(c)	0.055	(a)	0.053	(e)				
P2O5	0.05		0.04	(b)	0.055	(c)								
S %	0.17				0.14	(c)								
sum														
Sc ppm			78	(b)	87.4	(c)	82.5	(d)					80	(a)
V			62	(b)										
Cr			3421	(b)	3680	(c)							3500	(a)
Co			30	(b)	22.5	(c)	20.7	(d)					22	(a)
Ni			1	(b)							2.7	(f)	4.4	(f)
Cu			37	(b)	4.7	(c)								
Zn			4.6	(b)	2.7	(c)					1.9	(f)	2.9	(f)
Ga			6.8	(b)	3.36	(c)					4.34	(f)	4.1	(f)
Ge ppb					50	(c)					2	(f)	2	(f)
As					4.9	(c)								
Se					0.21	(c)								
Rb	0.485	(a)			0.41	(c)	0.485	(a)						
Sr	173	(a)	148	(b)	158	(c)	173	(a)						
Y			104	(b)	70	(c)								
Zr			255	(b)	197	(c)	222	(a)						
Nb					17.4	(c)								
Mo														
Ru														
Rh														
Pd ppb														
Ag ppb														
Cd ppb											6.5	(f)	8	(f)
In ppb											0.226	(f)	0.62	(f)
Sn ppb														
Sb ppb														
Te ppb														
Cs ppm					0.021	(c)								
Ba	65.3	(a)	180	(b)	65	(c)	65.3	(a)						
La	5.2	(a)			5.79	(c)	5.2	(a)					4.6	(a)
Ce	17.9	(a)			20.6	(c)	17.9	(a)					23	(a)
Pr					3.5	(c)								
Nd	20.1	(a)			20	(c)	20.1	(a)						
Sm	8.5	(a)			8.86	(c)	8.5	(a)					7.7	(a)
Eu	1.88	(a)			1.9	(c)	1.88	(a)					2.2	(a)
Gd	13.2	(a)			12.8	(c)	13.2	(a)						
Tb					2.3	(c)							1.8	(a)
Dy	15.6	(a)			15.2	(c)	15.6	(a)						
Ho					3.9	(c)								
Er	9.22	(a)			10.3	(c)	9.22	(a)						
Tm														
Yb	8.51	(a)			9.3	(c)	8.51	(a)					9	(a)
Lu	1.17	(a)			1.4	(c)							1.3	(a)
Hf					8.77	(c)							8	(a)
Ta					1.7	(c)							2	(a)
W ppb					66	(c)								
Re ppb					0.2	(c)								
Os ppb														
Ir ppb											0.07	(f)	0.13	(f)
Pt ppb														
Au ppb					0.097	(c)					0.26	(f)		
Th ppm									0.32	(e)				
U ppm					0.109	(c)	0.092	(a)	0.11	(e)				

technique: (a) IDMS, (b) “microchemical”, (c) combined, (d) INAA, (e) radiation counting, (f) RNAA

Table 2. Chemical composition of glass 79155.

reference	Morgan74		Shaal and Horz 1977				Roedder77	
weight	black		orange	red	yellow		veins?	
SiO2 %			43.3	37.6	41.2	(b)	43.6	(b)
TiO2			7.26	16.35	9.38	(b)	8.42	(b)
Al2O3			8.93	9.27	11.41	(b)	12.2	(b)
FeO			16.4	20.44	17.05	(b)	18	(b)
MnO			0.25	0.34	0.26	(b)	0.22	(b)
MgO			10.57	7.95	7.92	(b)	7.92	(b)
CaO			11.2	9.18	10.8	(b)	10.6	(b)
Na2O			0.46	0.38	0.54	(b)	0.12	(b)
K2O			0.06	0.06	0.1	(b)		
P2O5								
S %								
sum								
Sc ppm								
V								
Cr								
Co								
Ni	79	(a)						
Cu								
Zn	2.6	(a)						
Ga								
Ge ppb	24	(a)						
As								
Se	205	(a)						
Rb	0.84	(a)						
Sr								
Y								
Zr								
Nb								
Mo								
Ru								
Rh								
Pd ppb								
Ag ppb	5.1	(a)						
Cd ppb	3.5	(a)						
In ppb								
Sn ppb								
Sb ppb	2.45	(a)						
Te ppb	1	(a)						
Cs ppm	0.042	(a)						
Ba								
La								
Ce								
Pr								
Nd								
Sm								
Eu								
Gd								
Tb								
Dy								
Ho								
Er								
Tm								
Yb								
Lu								
Hf								
Ta								
W ppb								
Re ppb	0.143	(a)						
Os ppb								
Ir ppb	2.4	(a)						
Pt ppb								
Au ppb	0.81	(a)						
Th ppm								
U ppm	0.178	(a)						

technique: (a) RNAA, (b) electron probe

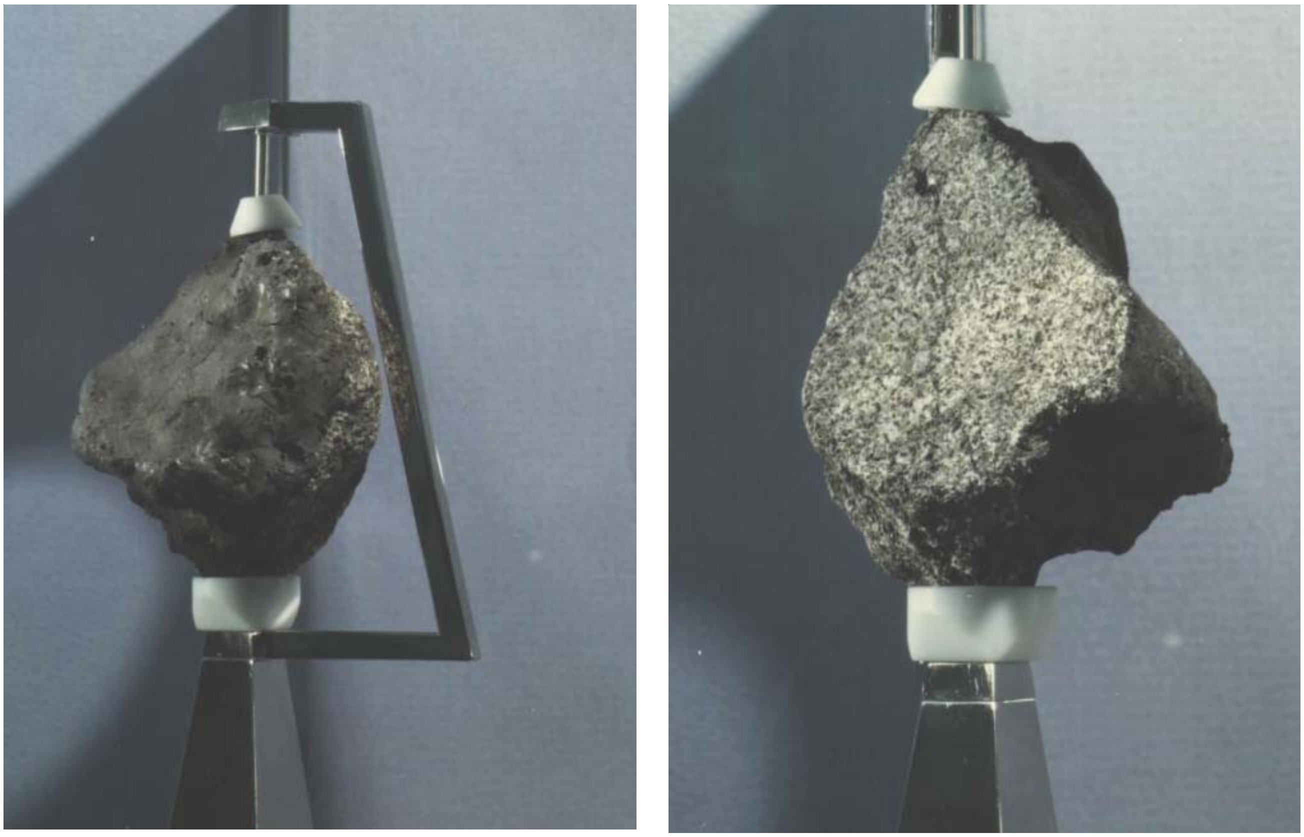

Figure 11: Two views of 79155 PAO exhibit in Chicago. NASA S87-34944 and 943 (right).

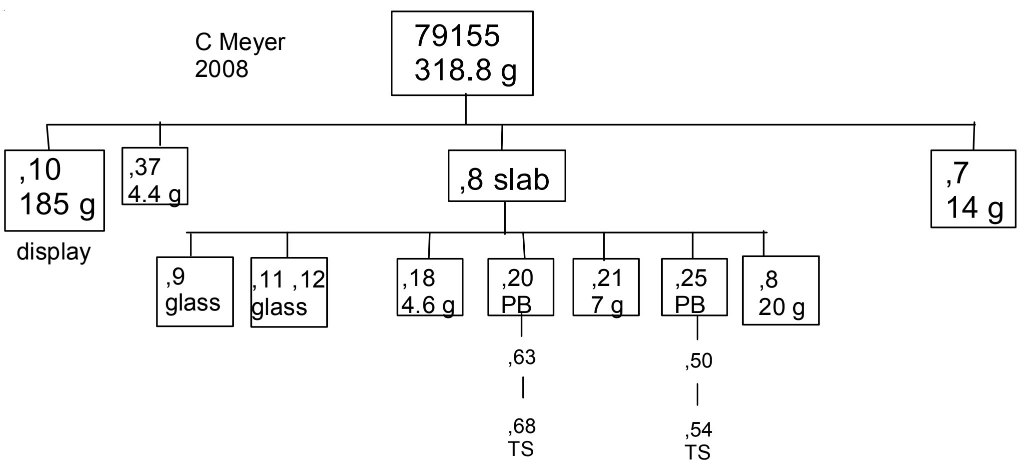

Figure 12: Group photo of 79155 after saw cuts. NASA S73-36700. Cube is 1 cm.

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