

75055
Ilmenite Basalt
949.4 grams



Figure 1: Photo of top, exterior surface of 75055, showing zap pits. NASA S73-15097. Sample is about 10 cm across.

Introduction

75055 is made up of three pieces chipped from the side of a large boulder on the rim of Camelot Crater (see excerpt of transcript in section on 75035). Following the concept of “overturned flap”, this sample may be from the deepest lava flow at Apollo 17, since Camelot Crater was the largest crater sampled (Wolfe et al. 1981). Together, the three pieces form a thin flat sample. The outside, exposed surface had micrometeorite craters (figure 1).

75055 is a medium-grained ilmenite basalt that appears to be quite similar to some of the Apollo 11 basalt samples. 75055, along with 75015 and 75035 from the same location, is slightly more aluminous and less titanium rich, than other Apollo 17 basalt samples (Rhodes et al. 1976).

The crystallization age has been determined to be 3.78 b.y., with a cosmic ray exposure age of about 80 m.y.

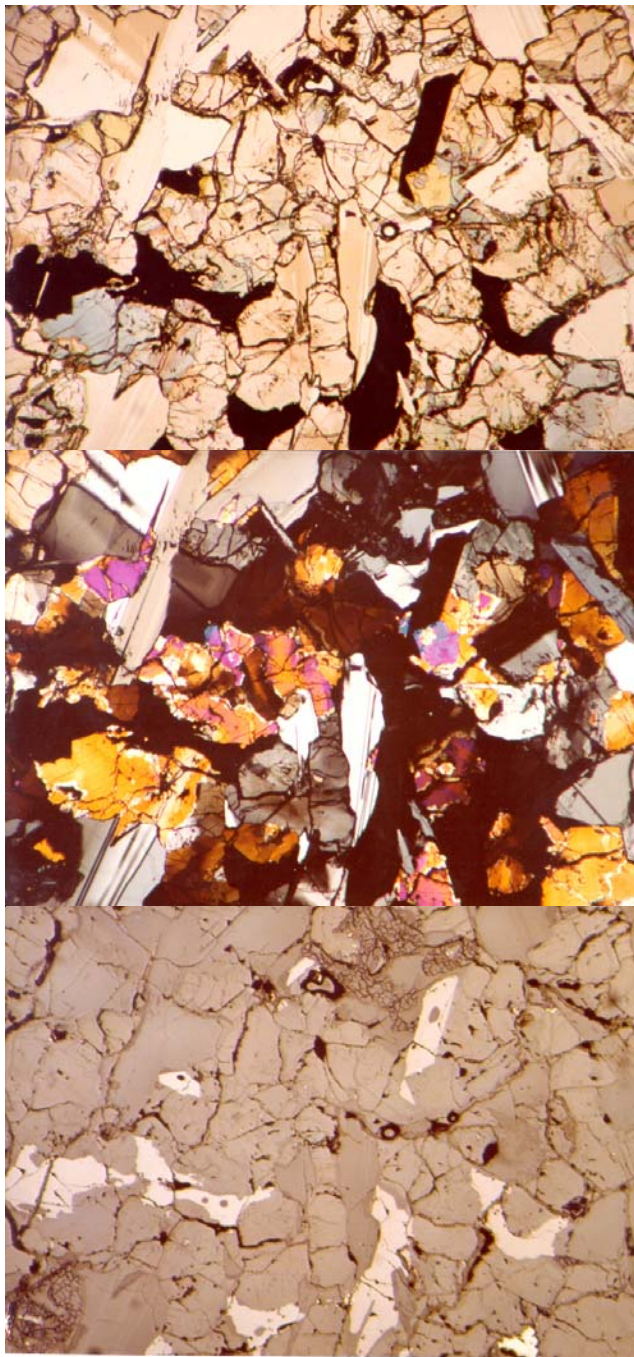


Figure 2: Photomicrographs of thin section 75055,47. Top is transmitted light, middle is with crossed polarizers and bottom is reflected light. NASA S79-27095 to 27097. Field of view is 2.5 mm.

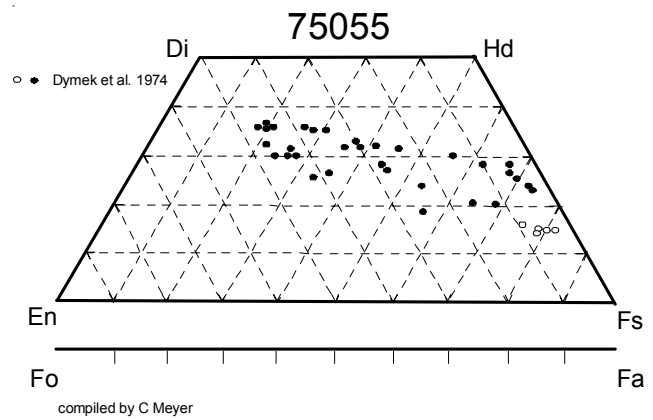


Figure 3: Pyroxene composition for 75055 (replotted from Dymek et al. 1975).

Petrography

Kriedelbaugh and Weill (1973) give the average grain size of 75055 as about 1 mm and describe the texture as ophitic (figures 2 and 4). Dymek et al. (1975) performed a detailed analysis of all minerals in 75055, combining them in the proportions of the mode to successfully calculate the bulk sample composition (Table 1). Dymek et al. described the texture as medium- to fine-grained intergranular to subophitic. McGee et al. (1977) described the texture as coarse grained subophitic with tabular plagioclase (0.05 to 2 mm) intergrown with subhedral to anhedral pyroxene (0.05 to 0.8 mm) and ilmenite laths (0.4 to 1.4 mm). Observations indicate that plagioclase may have been one of the first phases to form, along with ilmenite, during crystallization.

The mesostasis between the major minerals contains silica, troilite, Fe metal, ulvospinel, Ca phosphate and tranquillityite (Dymek et al. 1974).

Mineralogy

Olivine: none

Pyroxene: Pyroxene is chemically zoned from $Wo_{40}En_{44}Fs_{16}$ – $Wo_{16}En_3Fs_{81}$ (figure 3). Sector zoning is poorly defined (Dymek et al. 1974).

Mineralogical Mode of 75055

	Brown et al. 1975	McGee et al. 1977	Dymek et al. 1975	Kriedelbaugh and Weill 73
Olivine				
Pyroxene	50.2	45-51	50	51.4
Plagioclase	28.6	29-35	33	29.1
Ilmenite	15.9	12-20	12.1	13.4
Silica	4.5	3-5	3.4	3
Mesostasis	0.8	1-2	1.5	3

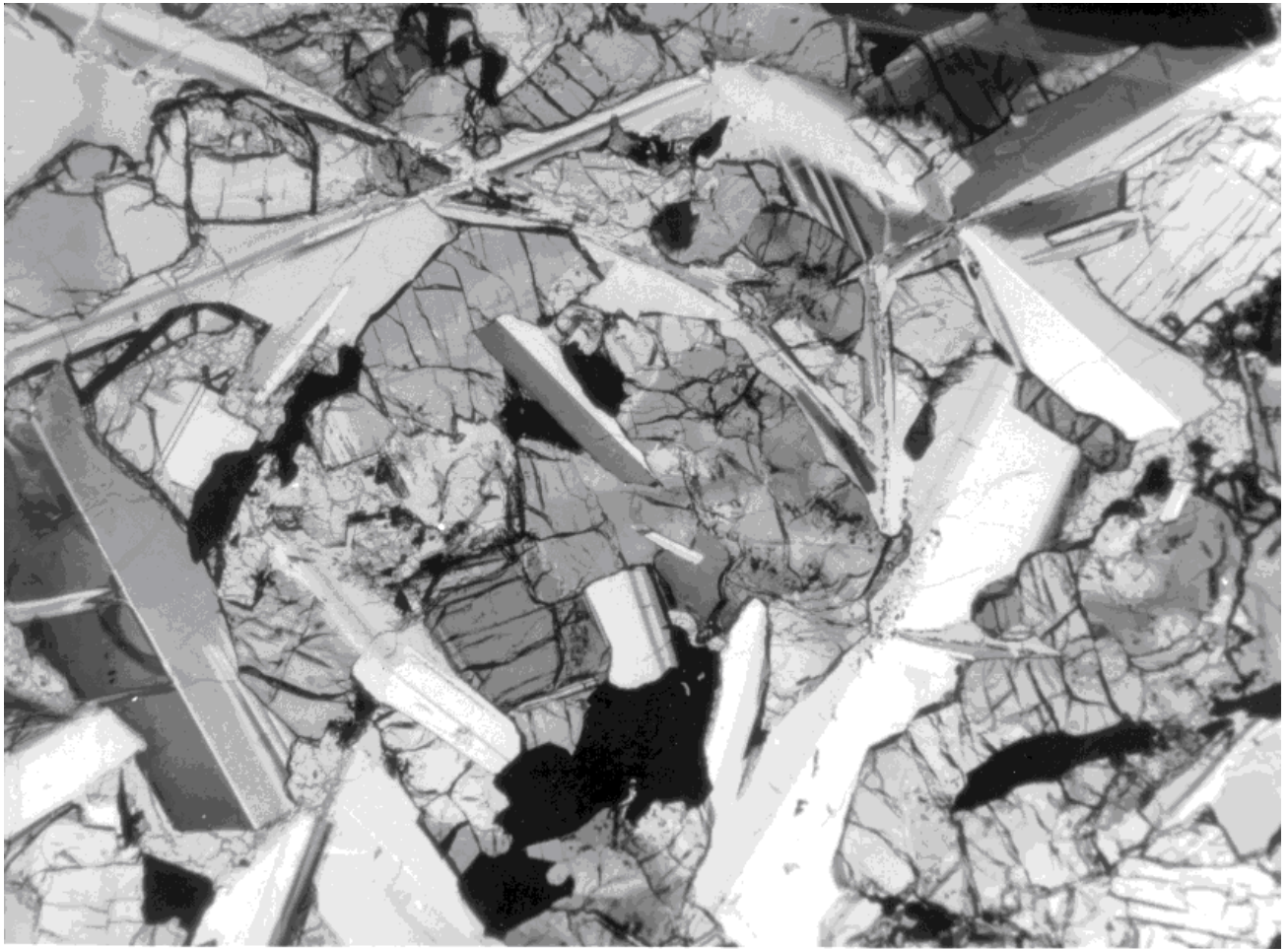


Figure 4: Photomicrograph of thin section of 75055. NASA S74-23074. Field of view is about 1.5 mm.



Figure 5: A cluster of tranquillityite crystals (grey), with breakdown to baddeleyite + ilmenite + pyroxene. Width of field 50 microns. From El Goresy et al. (1974).

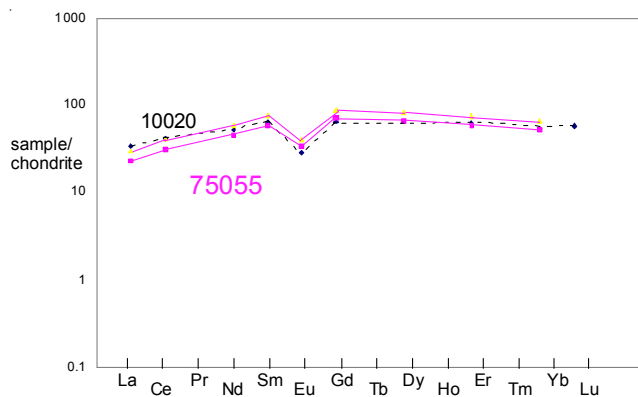


Figure 6: Normalized rare-earth-element diagram for 75055 (isotope dilution data by Shih et al. 1975) compared with Apollo 11 basalt 10020 (Wiesmann et al. 1975).

Plagioclase: Plagioclase is zoned (An_{91-72}) with increasing Fe/Mg along with increasing Na.

Ilmenite: Tabular plagioclase has a “swiss-cheese” like texture with glassy inclusions and embayed margins. Dymek et al. observed that one ilmenite was overgrown and resorbed by ulvospinel.

Silica: Both cristobalite and tridymite are present in 75055 (Dymek et al. 1975). Cristobalite has the characteristic fine “mosaic” fracture pattern, while tridymite occurs as needles.

Tranquillityite: Dymek et al. (1975) and El Goresy et al. (1974) reported tranquillityite (figure 5).

Baddeleyite: El Goresy et al. (1974) reported baddeleyite (ZrO_2).

Chemistry

The chemical composition of 75055 is remarkably similar to low K, ilmenite basalts from Apollo 11 (figures 6 and 7). Dymek et al. (1974) noted the remarkable similarity to 10044. The Ba/Rb vs. Sm discriminator indicates it is a type A, Apollo 17 basalt (figure 8).

Gibson et al. (1976) determined 2210 ppm S for 75055 (high). Jovanovic and Reed (1980) reported Cl, Br, U and phosphorous.

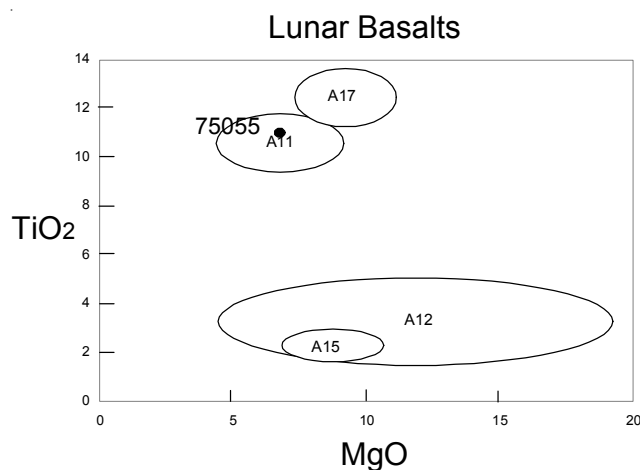


Figure 7: Composition for 75055 compared with other lunar basalts.

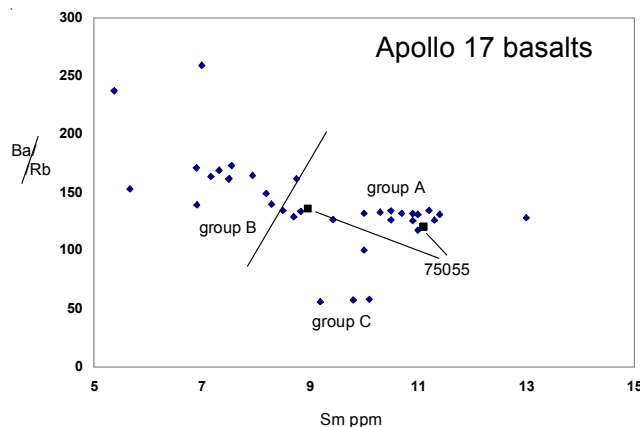


Figure 8: Trace element diagram used to distinguish various lava flows at Apollo 17.

Radiogenic age dating

Tatsumoto et al. (1973) and Tera et al. (1974) reported Rb/Sr isochron ages of 3.77 ± 0.06 b.y. and 3.83 ± 0.1 b.y. respectively, while Huneke et al. (1973) determined a more precise age of 3.78 ± 0.02 b.y. by the Argon plateau technique (figure 10). Kirsten et al. (1973) reported an age of 3.82 ± 0.05 b.y. by Ar/Ar (figure 14). Birck et al. (1973) also reported 3.83 b.y. by Rb/Sr (quoted in Kirsten et al.)

Tatsumoto et al. noted that the Pb isotopes in 75055 were very “similar to that of Apollo 11 low-K basalt.” Nunes et al. (1974), Tera et al. (1975abs) and Chen and Wasserburg (1980) also reported Pd data (figure 9). Unruh et al. (1983) determined the isotopic composition of Nd and Hf to obtain model ages.

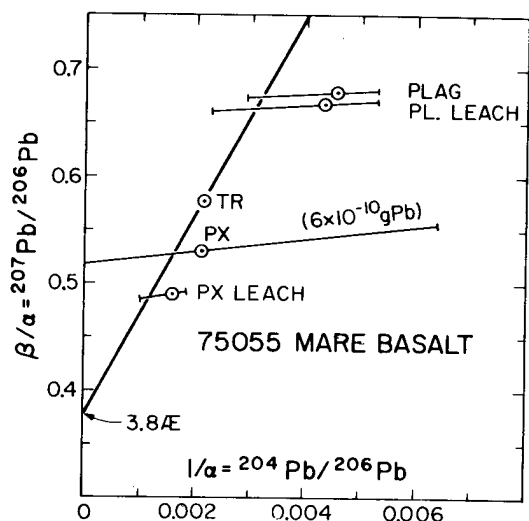


Figure 9: Pb data for mineal separates and leaches of 75055 (from Tera et al. 1975 abs).

Cosmogenic isotopes and exposure ages

Rancitelli et al. (1974) determined significant cosmic-ray-induced activity for $^{26}\text{Al} = 69 \text{ dpm/kg.}$, $^{22}\text{Na} = 85 \text{ dpm/kg.}$, $^{54}\text{Mn} = 139 \text{ dpm/kg.}$, $^{56}\text{Co} = 210 \text{ dpm/kg.}$, $^7\text{Be} = 140 \text{ dpm/kg.}$, etc.

Turner et al. (1973) and Huneke et al. (1973) determined ^{38}Ar cosmic ray exposure ages of 90 and 95 m.y. respectively, which would be interpreted as the age of Camelot Crater. Kirsten et al. (1973) reported 85 m.y. (or 70 m.y. taking the geometry of the boulder into account). Arvidson et al. (1976) review the exposure age of 75055 along with adjacent samples, concluding that the numerous craters and the landside at Apollo 17, including Camelot Crater might be a secondary crater from Tycho!

Summary of Age Data for 75055

	Rb/Sr	Ar/Ar
Tatsumoto et al. 1973	$3.83 \pm 0.10 \text{ b.y.}$	
Tera et al. 1974	3.77 ± 0.06	
Huneke et al. 1973		3.82 ± 0.05
		3.78 ± 0.02
Turner et al. 1973		3.76 ± 0.05
Kirsten et al. 1973		3.82 ± 0.05

Caution: Decay Constant

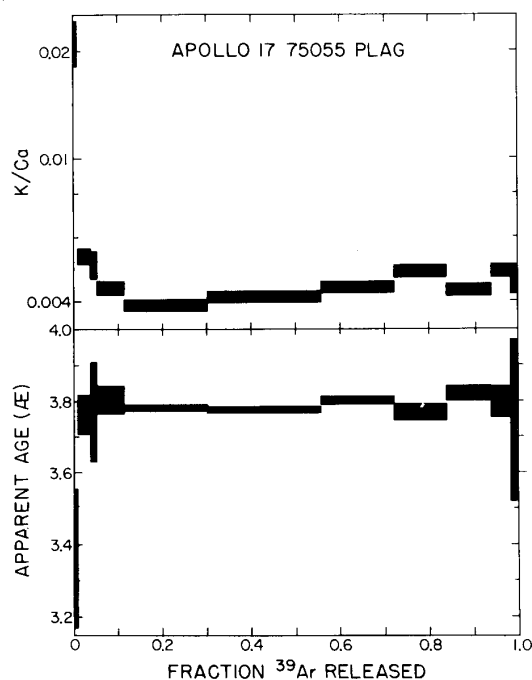


Figure 10: Argon plateau diagram for plagioclase from 75055 (Huneke et al. 1973).

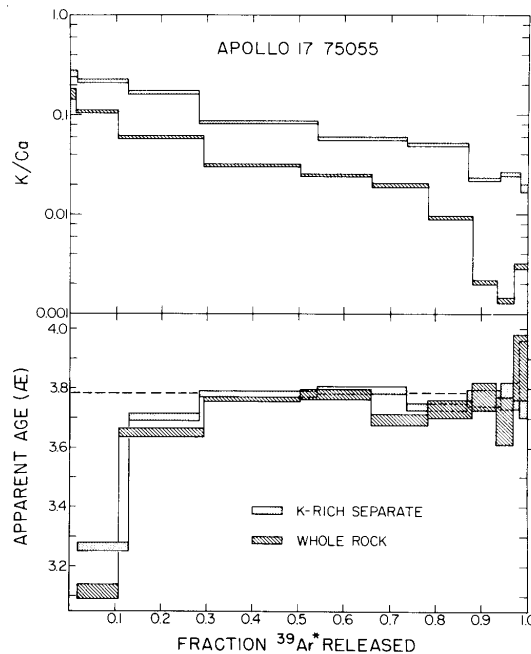


Figure 11: Argon plateau diagram for whole rock and "K-rich separate" 75055 (Huneke et al. 1973).

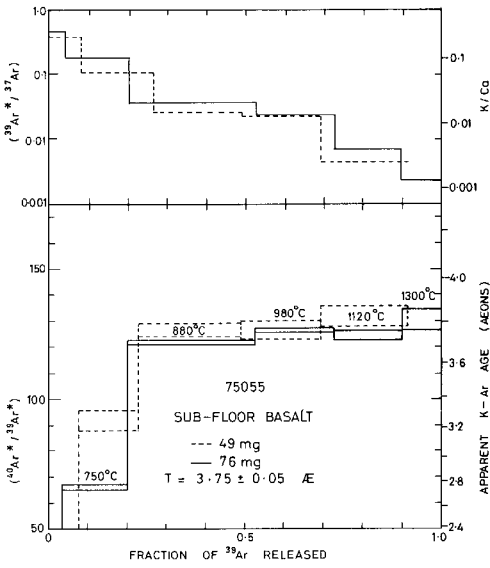


Figure 12: Argon release plateau for 75055 (Turner and Cadogan 1973).

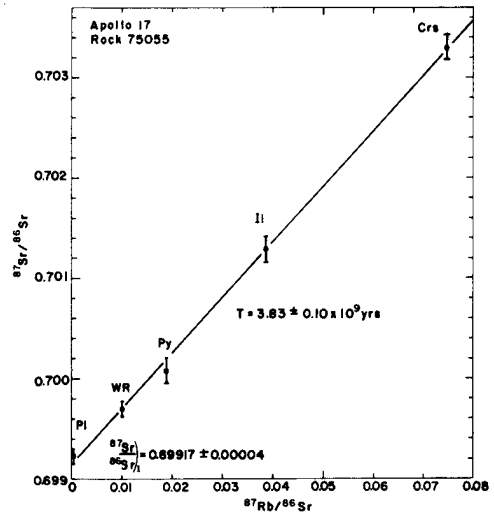


Figure 13: Rb/Sr mineral isochron for 75055 (Tatsumoto et al. 1973).

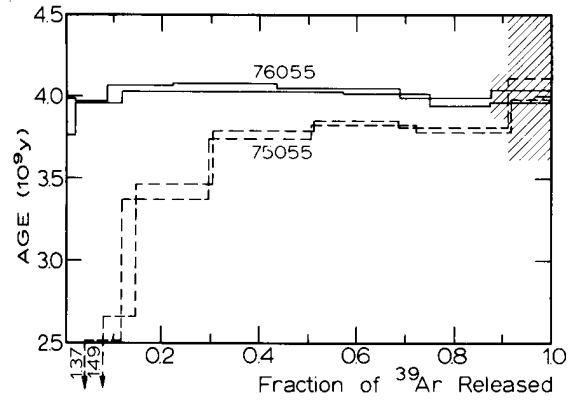


Figure 14: Ar-Ar plateau diagram for 75055 (Kirsten et al. 1973).

	U ppm	Th ppm	K ppm	Rb ppm	Sr ppm	Nd ppm	Sm ppm	technique
Nunes et al. 1974	0.1359	0.4472						idms
Shih et al. 1975	0.13	0.44		0.685	201	27.1	11.3	idms
				0.482	180	20.7	8.8	idms
Rancitelli et al. 1973	0.1	0.4	650					counting
Wolf et al. 1979	0.128							RNAA
Unruh et al. 1983						25.2	10.6	idms

Table 1a. Chemical composition of 75055.

reference weight	LSPET73	Garg76	Rancitelli 74 405 g	Boynton75 473 mg 505 mg	Shih 75 Nyquist 75	Rhodes76	Dymek74
SiO2 %	41.27 (b)					39.93 (b)	41.51 (e)
TiO2	10.17 (b)			10.4 (a)		11.41 (b)	10.48 (e)
Al2O3	9.75 (b)			10.77 (a)		9.58 (b)	10.28 (e)
FeO	18.24 (b)	20.3 (a)		16.8 15.6 (a)		17.77 (b)	17.86 (e)
MnO	0.29 (b)			0.25 (a)		0.27 (b)	0.25 (e)
MgO	6.84 (b)					7.26 (b)	5.75 (e)
CaO	12.3 (b)			12.6 11.62 (a)		12.4 (b)	12.83 (e)
Na2O	0.44 (b)			0.46 0.42 (a)		0.42 (b)	0.58 (e)
K2O	0.09 (b)		0.078 (c)		0.056 0.075 (d)	0.06 (b)	0.07 (e)
P2O5	0.07 (b)					0.06 (b)	0.05 (e)
S %	0.19 (b)					0.14 (b)	0.03 (e)
sum							
Sc ppm		83.3 (a)		79 75 (a)	82.7 (d)		
V							
Cr	1847 (b)	1660 (a)		1950 1840 (a)	1857 (d)	1748 (b)	2670 (e)
Co		16.7 (a)		16 13 (a)	14.5 (d)		
Ni	2 (b)						
Cu							
Zn	7 (b)						
Ga							
Ge ppb							
As							
Se							
Rb	0.7 (b)				0.482 0.685 (d)		
Sr	209 (b)				180 201 (d)		
Y	112 (b)						
Zr	272 (b)	362 350 (a)					190 (e)
Nb	25 (b)						
Mo							
Ru							
Rh							
Pd ppb							
Ag ppb							
Cd ppb							
In ppb							
Sn ppb							
Sb ppb							
Te ppb							
Cs ppm							
Ba					66 86.4 (d)		
La				6 5.7 (a)	5.39 7.14 (d)		
Ce		49.6 (a)		26 27 (a)	18.5 24.5 (d)		
Pr							
Nd					20.7 27.1 (d)		
Sm				9.6 9 (a)	8.8 11.3 (d)		
Eu		2.39 (a)		2 1.86 (a)	1.91 2.27 (d)		
Gd					13.9 17.5 (d)		
Tb		3 (a)		2.1 2.5 (a)			
Dy					16.1 20.1 (d)		
Ho							
Er					9.54 11.9 (d)		
Tm							
Yb				9.1 9.2 (a)	8.68 10.9 (d)		
Lu		1.9 (a)		1.4 1.24 (a)			
Hf		11.6 11.7 (a)		7.4 7 (a)			
Ta							
W ppb							
Re ppb							
Os ppb							
Ir ppb							
Pt ppb							
Au ppb							
Th ppm			0.4 (c)			0.44 (d)	
U ppm			0.1 (c)			0.13 (d)	

technique: (a) INAA, (b) XRF, (c) radiation counting, (d) IDMS, (e) elec. probe

Table 1b. Chemical composition of 75055.

reference	Wolf 79	Hughes 85	Nunes74	Tera 74	Unruh84	Chen80
weight	51 mg					
SiO ₂ %						
TiO ₂						
Al ₂ O ₃						
FeO						
MnO						
MgO						
CaO						
Na ₂ O						
K ₂ O				0.0725	(d)	
P ₂ O ₅						
S %						
sum						
Sc ppm						
V						
Cr						
Co						
Ni	<4	(f)				
Cu						
Zn	1.53	(f)				
Ga						
Ge ppb	2.54	(f)				
As						
Se	119	(f)				
Rb	0.538	(f)		0.796	(d)	
Sr				188	(d)	
Y						
Zr		150	(a)			
Nb		6.9	(a)			
Mo						
Ru						
Rh						
Pd ppb	1.1	(f)				
Ag ppb	0.76	(f)				
Cd ppb	1.92	(f)				
In ppb	0.57	(f)				
Sn ppb	<40	(f)				
Sb ppb	0.99	(f)				
Te ppb	<2	(f)				
Cs ppm	0.019	(f)				
Ba						
La						
Ce						
Pr						
Nd					25.2	(d)
Sm					10.6	(d)
Eu						
Gd						
Tb						
Dy						
Ho						
Er						
Tm						
Yb						
Lu					1.66	(d)
Hf		6.9	(a)		9.61	(d)
Ta						
W ppb						
Re ppb	0.0031	(f)				
Os ppb	<0.02	(f)				
Ir ppb	0.035	(f)				
Pt ppb						
Au ppb	0.007	(f)				
Th ppm			0.4472		(d)	
U ppm			0.1359		(d)	43 ng
technique:	(a) INAA, (d) IDMS, (f) RNAA					

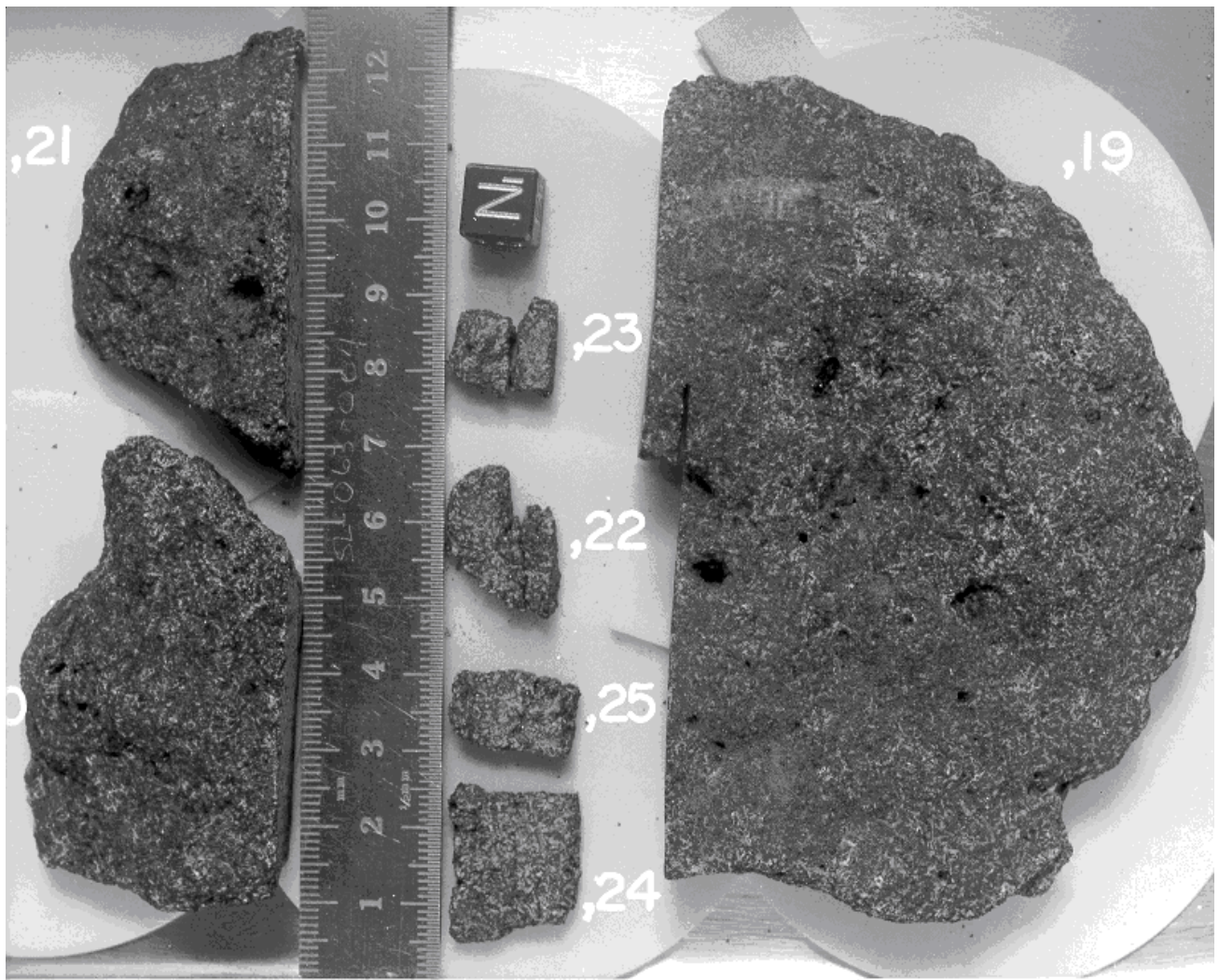
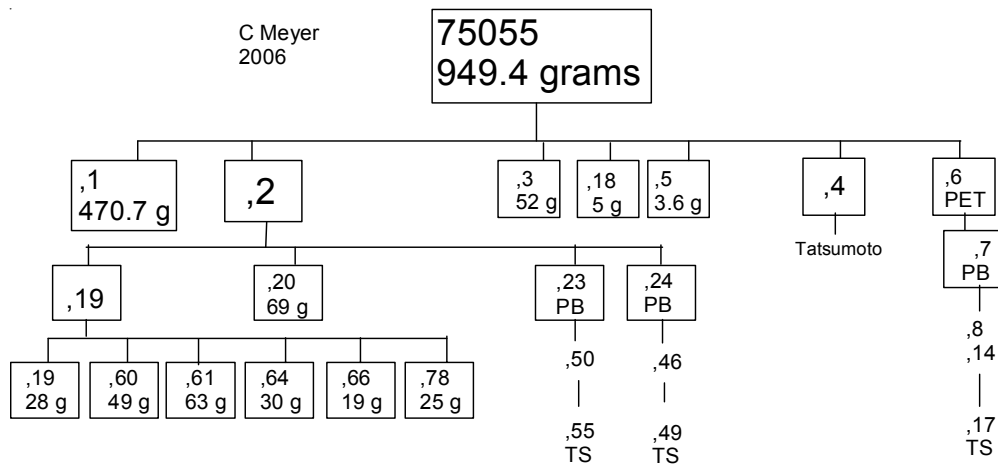


Figure 15: Processing photo of 75055. NASA S74-17400. Cube and scale are cm and cm.



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