66055

Poymict Breccia

1308 grams

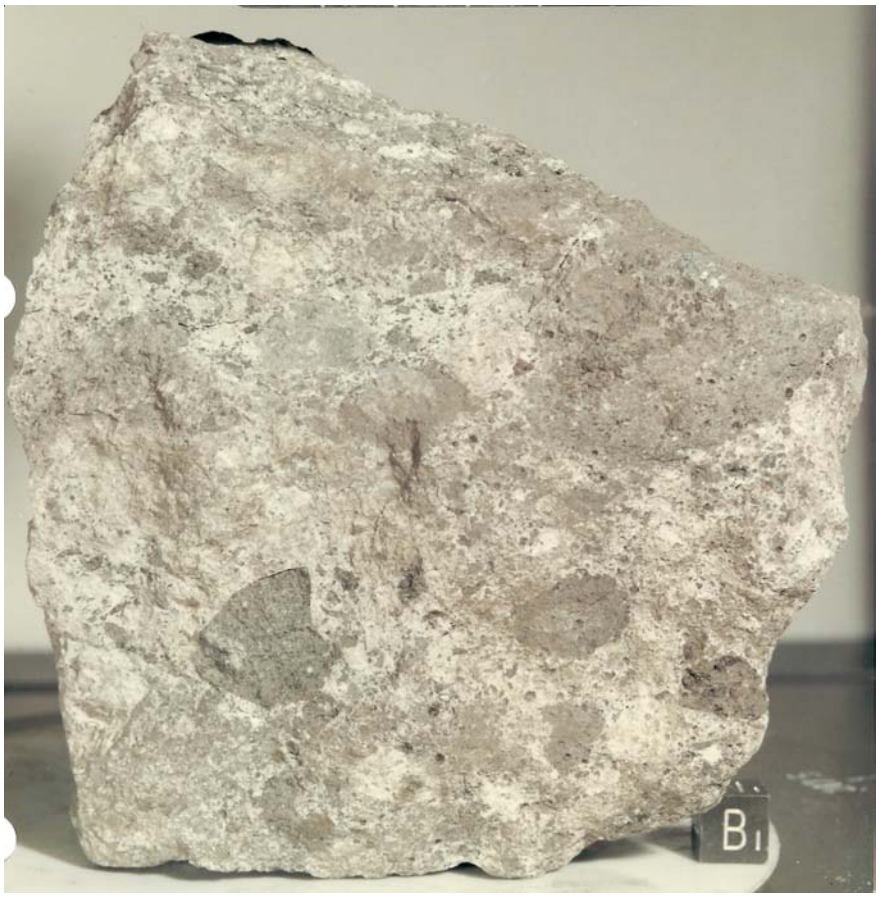


Figure 1: Photo of 66055. Cube is 1 cm for scale. NASA S72-39296.

Introduction

66055 is a complex polymict feldspathic breccia from the flanks of Stone Mountain, Apollo 16. It is somewhat different from most other Apollo 16 samples (figures 1 and 2). It appears to be intermediate between fragmental breccias and glassy melt breccias, with included abundant rounded patches of brown glass. However, Ryder and Blair (1982) conclude that 66055 is not a regolith breccia. The origin of this rock is not determined.

Micrometeorite craters are found on the T1-W1 surface (figure 2). 66055 is ~3.9 b.y. old, with an exposure to cosmic rays for 55 m.y.

Petrography

Ryder and Norman (1980) reviewed what was known about 66055. James (1982) recognized that it was somewhat different from other Apollo 16 breccias, with more than two lithologies. Ryder and Blair (1982) also determined that 66055 is "unique" with abundant KREEP glass and even some areas of granitic glass.

66055 consists of fragments of aphanitic dark materials and coarse light materials (figure 5). The dark materials vary from brown glass to mesostasis-rich basalt, with some fragments showing graduation from one to the other. The white fragments mainly have poikioblastic or granoblastic textures while other are apparently shocked cumulate materials (ANT). Everything is highly aluminous (tables).

Figure 2: Top surface of 66055 showing numerous zap pits. Cube is 1 cm. S72-39298.

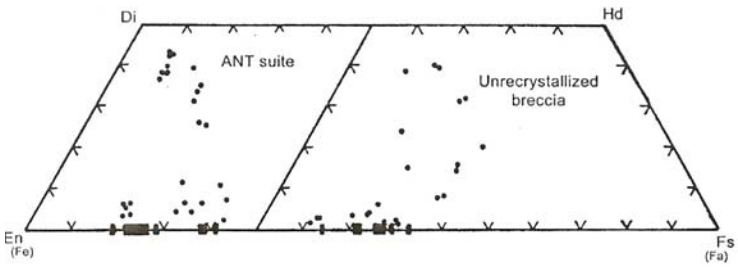


Figure 3: Pyroxene composition of various lithologies in 66055 (Fruchter et al. 1974).

Wilshire and Moore (1973) remarked on the abundant glass selvages and glass fragments in 66055. Fruchter et al. (1974) were the first to give a report on the clastic nature of 66055, and provided the only chemical analyses to date. Some of their analyses showed that 66055 contains abundant KREEP component (similar to Apollo 14). Ryder and Blair (1982) also reported that 66055 contained KREEP glass.

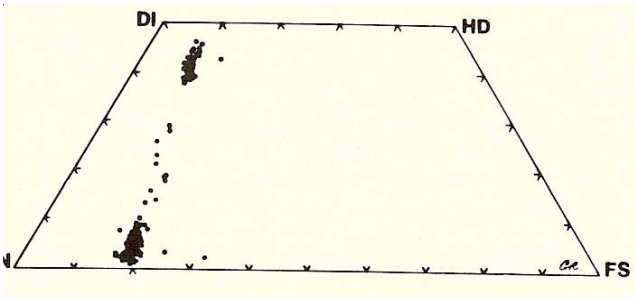


Figure 4: Pyroxenes in the feldspathic portion of 66055 (Ryder and Blair 1982).

Mineralogy

Pyroxene: Fruchter et al. (1974) and Ryder and Blair (1982) reported pyroxene compositions (figures 3 and 4).

Metal: McKay et al. (1973), Reed and Taylor (1974) reported Ni = 4-8% and Co = 0.2 – 0.5%. Kamacite, taenite and schreibersite have been reported.

Rust: Hunter and Taylor (1981) find rust!

Glass: Table 4

Figure 5: Photo of large butt end (,26) cut from 66055. Cube is 1 inch; scale is in cm. S78-38492.

Figure 6: Photo of slab pieces 66055,24. Cube is 1 cm. S79-38081

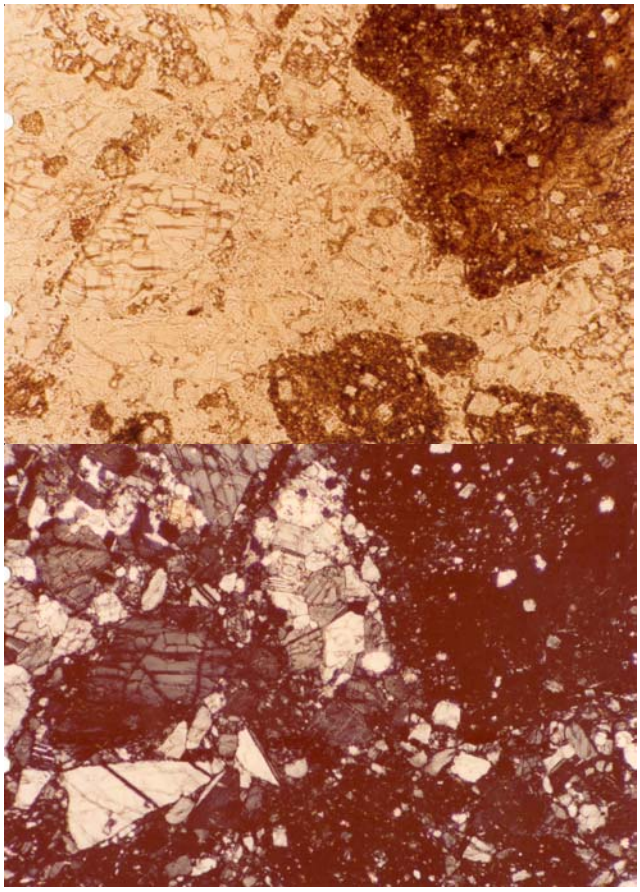


Figure 7: Photpmicrographs of 66055,75. Top is plane polarized and bottom is crossed polarized. S79-27713 and 27714. Field of view 1.3 mm.

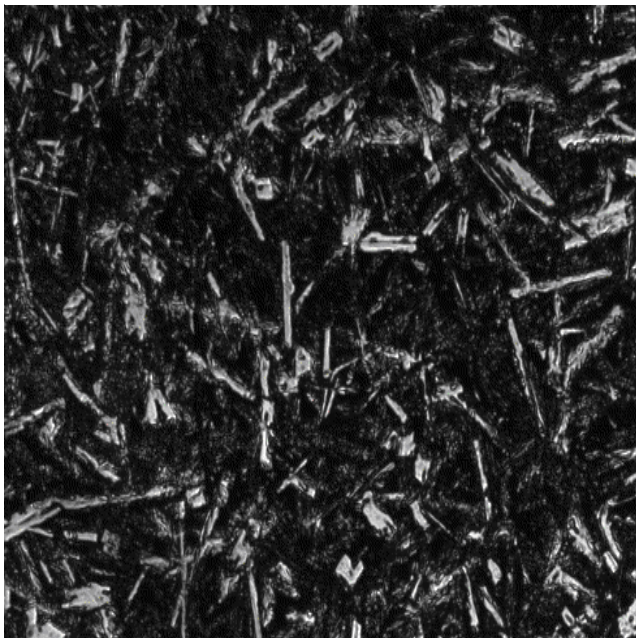


Figure 8: Thin section photomicrograph of melt in 66055.

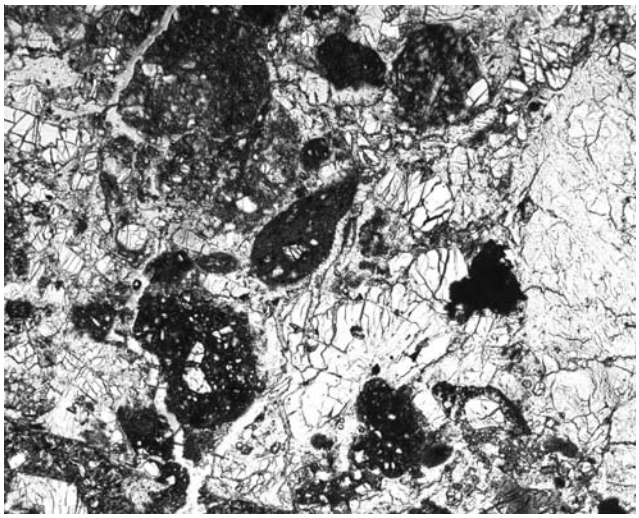


Figure 9: Thin section photomicrograph of matrix of 66055. Field of view is 2 mm. Tear drop is brown glass.

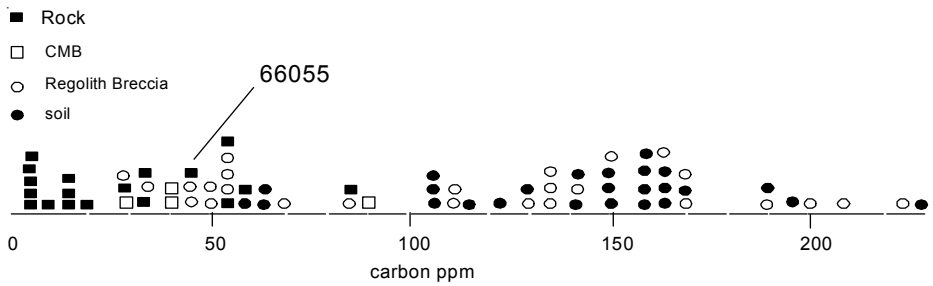


Figure 10: Carbon content of Apollo 16 samples including breccia sample 66055.

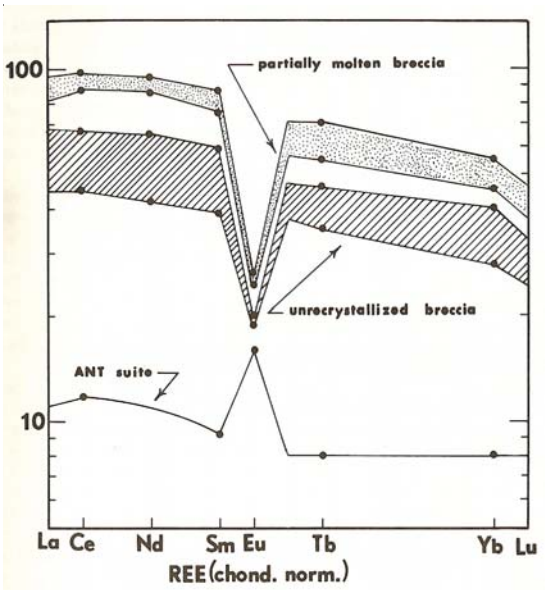


Figure 11: Normalized rare-earth-element diagram for different lithologies found in breccia sample 66055 (Fruchter et al. 1974).

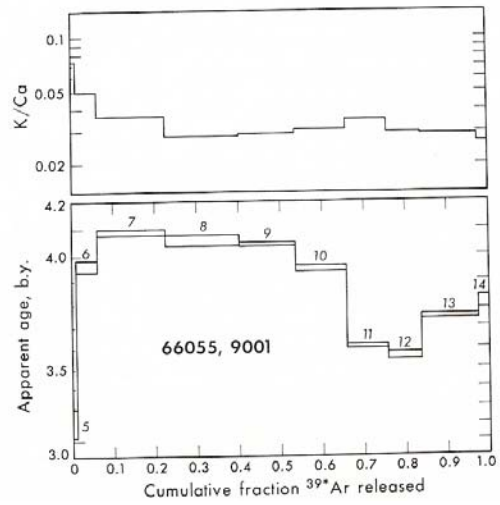


Figure 12: Ar/Ar plateau diagram for 66055 (Phinney et al. (1975).

Summary of Age Data for 66055

	K/Ar
Phinney et al. 1978	3.90 +/- 0.02 b.y.

Chemistry

The low carbon content of 66055 indicates that it is not a regolith breccia (figure 10; Moore et al. 1976). Fruchter et al. (1974) reported the composition of matrix and numerous clasts (tables and figure 11). Ross Taylor (1973) reported the composition of a white area.

Radiogenic age dating

Phinney et al. (1978) tried to date a portion of 66055 by Ar/Ar, but obtained a decreasing pattern (figure 12). They conclude the age of 66055 is best estimated by the total K/Ar age of 3.9 b.y.

Cosmogenic isotopes and exposure ages

Phinney et al. (1978) determined a ^{38}Ar-Ca exposure age of 55 +/- 13 m.y. (NOT the age of South Ray Crater).

Other Studies

Magnetic studies seemed to find a direction to the magnetic properties of 66055 (Collinson et al. 1973, Nagata et al. 1973). Katsube and Collett (1973) determined the electrical characteristics of Apollo 16 lunar samples.

Clayton et al. (1973) reported oxygen isotopes.

Macdougall et al. (1973) studied the glass with high-voltage electron microscopy and could not find many solar flare tracks (it is not a regolith breccia).

Processing

A large slab (1.5 cm thick) was cut from 66055 (figure 6 and 13). Numerous allocations have been made to Randy Korotev.

Table 1. Chemical composition of 66055.

reference	McKinley 84		Fruchter74				
weight			matrix				
SiO2 %	45.9	(a)					
TiO2	0.91						
Al2O3	23.6		28	30.4	32.3	27	(b)
FeO	5.9		5.27	3.35	4.37	4.5	(b)
MnO	0.12						
MgO	9.26						
CaO	13.2						
Na2O	0.41		0.44	0.44	0.31	0.43	(b)
K2O	0.28		0.13		0.11	0.1	(b)
P2O5	0.2						
S %							
sum							
Sc ppm			7.7	5.3	6.8	6.2	(b)
V							
Cr			742	568	723	620	(b)
Co			30	19	20	32	(b)
Ni							
Cu							
Zn							
Ga							
Ge ppb							
As							
Se							
Rb							
Sr							
Y							
Zr							
Nb							
Mo							
Ru							
Rh							
Pd ppb							
Ag ppb							
Cd ppb							
In ppb							
Sn ppb							
Sb ppb							
Te ppb							
Cs ppm							
Ba			130	89	120	84	(b)
La			14.4	6	9.3	7.3	(b)
Ce			37.3	15.2	24.3	21.3	(b)
Pr							
Nd			24.7				(b)
Sm			6.9	2.8	4.3	3.2	(b)
Eu			1.2	1.1	1.1	1.2	(b)
Gd							
Tb			1.4	0.6	0.8	0.7	(b)
Dy							
Ho							
Er							
Tm							
Yb			5.1	2.6	3.7	3.2	(b)
Lu			0.7	0.4		0.5	(b)
Hf			5.1	2	3.2	2.9	(b)
Ta			0.6	0.3	0.4	0.4	(b)
W ppb							
Re ppb							
Os ppb							
Ir ppb							
Pt ppb							
Au ppb							
Th ppm							
U ppm			3	1.2	1.8	1.9	(b)

technique: (a) calculated (b) INAA

Table 2. Chemical composition of 66055 (clasts).

reference	Fruchter74										R. Taylor 73	
weight	partially molten clasts					microbreccia chips					white cl.	
SiO2 %	45.1					45.4				(c)	43.6	
TiO2	0.9					1.12				(c)	1.8	
Al2O3	23.2	23	21.5	26	24	20.9	23	25.3	28.7	(b)	31.4	
FeO	5.76	9	9.4	8	7.3	7.45	6.3	6	4.9	(b)	2.2	
MnO												
MgO	9.05					9.06				(c)	4.1	
CaO	13					12.2				(c)	16.8	
Na2O	0.52	0.47	0.5	0.56	0.5	0.43	0.47	0.44	0.48	(b)	0.37	
K2O	0.2	0.3	0.2	0.26	0.25	0.35	0.2	0.16	0.3	(b)	0.1	
P2O5	0.2					0.3				(c)		
S %												
sum												
Sc ppm	11.5	11.8	11.5	13.4	11.1	7.3	9.7	9.3	8.6	(b)		
V												
Cr	1160	1100	1040	1200	1050	640	880	790	780	(b)		
Co	55	85	113	11	46	28	42	38	22	(b)		
Ni												
Cu												
Zn												
Ga												
Ge ppb												
As												
Se												
Rb											0.98	(a)
Sr												
Y											10.4	(a)
Zr											39	(a)
Nb											3.5	(a)
Mo												
Ru												
Rh												
Pd ppb												
Ag ppb												
Cd ppb												
In ppb												
Sn ppb											150	(a)
Sb ppb												
Te ppb												
Cs ppm												
Ba	280	300	250		260	160	180	240		(b)	64	(a)
La	27.3	29.5	27.8	32		15.3	22.5	20.3	9.3	(b)	3.2	(a)
Ce	76.9	79.9	73.4	85.5	63.8	42.1	57.8	73.4	38	(b)	8.4	(a)
Pr											1.1	(a)
Nd	51	56	55		45	32	42	46		(b)	3.9	(a)
Sm	13.6	14.6	13.2	15.6	12.8	6.9	10.6	9.5	5.9	(b)	1	(a)
Eu	1.6	1.7	1.5		1.6	1.4	1.4	1.5		(b)	0.83	(a)
Gd											1.2	(a)
Tb	2.5	2.7	9.9	4.2	2.6	2.1	2.1	2.1		(b)	0.21	(a)
Dy											1.47	(a)
Ho											0.34	(a)
Er											0.97	(a)
Tm											0.15	(a)
Yb	9.1	10.4	9.9	10.8	9.6	5.5	8.1	7	5.2	(b)	0.91	(a)
Lu	1.3	1.4	1.2	1.6	1.1	0.7	1.1	1	0.6	(b)	0.14	(a)
Hf	9.6	10.3	9.3	8	9.3	5.7	7.4	7.5	2.8	(b)	0.72	(a)
Ta	1.2	1.2	1.1		1.1	0.7	0.9	1		(b)		
W ppb												
Re ppb												
Os ppb												
Ir ppb												
Pt ppb												
Au ppb												
Th ppm	4.4	4.4	4.6	5.7	4.7	3	4	3.7	6.2	(b)	0.35	(a)
U ppm												

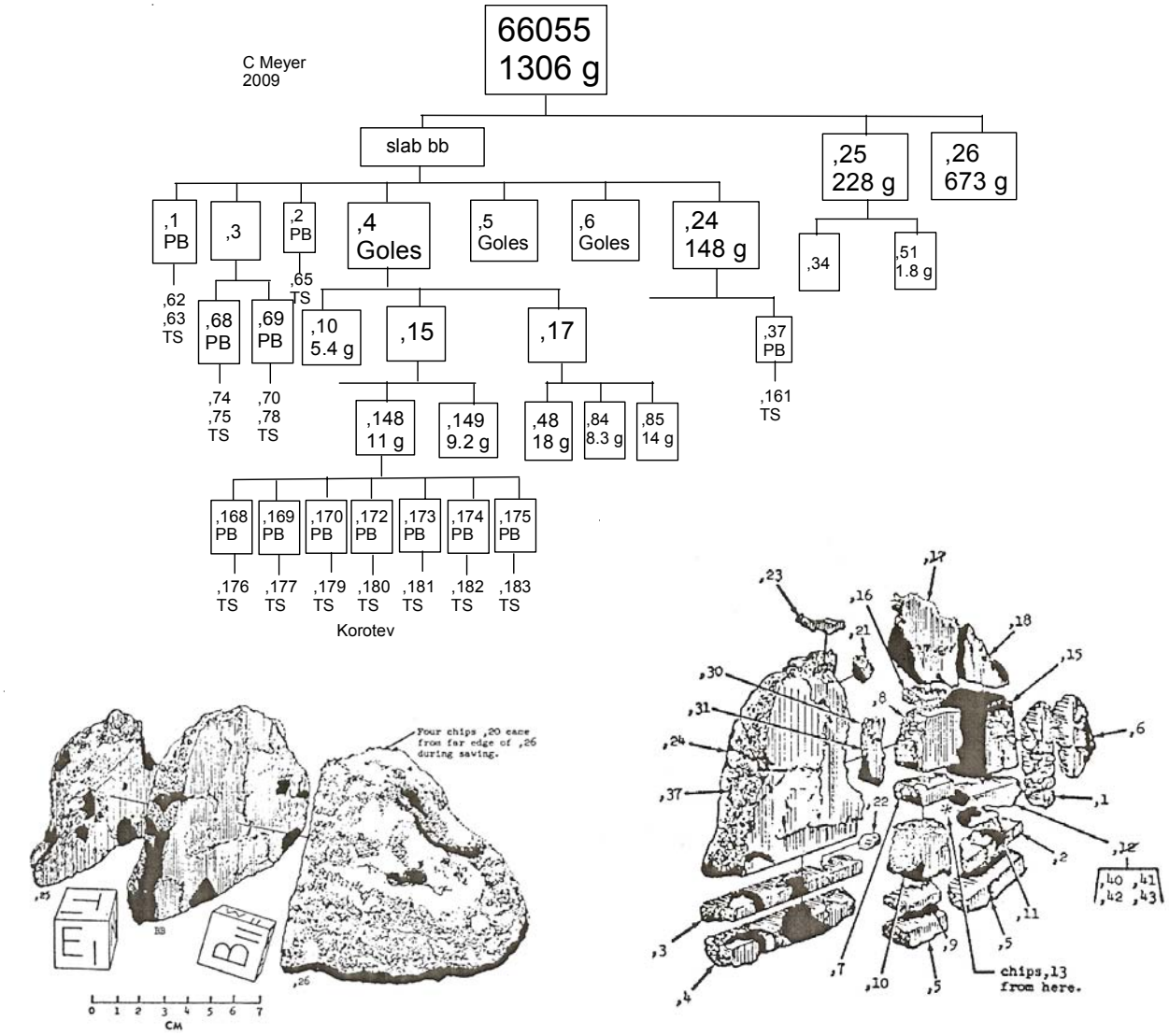
technique: (a) spark mass spec. (b) INAA, (c) broad beam e probe

Table 3. Chemical composition of clasts.

reference	Fruchter et al. 1974							
weight								
SiO2 %								
TiO2								
Al2O3	36.7	27.4	30	27.8	11.7	28.2	28.7	(a)
FeO	0.13	3.86	4.25	4.1	6.81	5.4	10.2	(a)
MnO								
MgO								
CaO								
Na2O	0.37	0.26	0.41	0.41	0.52	0.44	0.45	(a)
K2O			0.076	0.076	0.23	0.15	0.1	(a)
P2O5								
S %								
sum								
Sc ppm	0.4	4.9	6.2	6.5	9.7	6.3	7.7	(a)
V								
Cr	21	987	755	825	911	530	680	(a)
Co	1	18	22	13	50	80	199	(a)
Ni								
Cu								
Zn								
Ba				70	230	180		(a)
La			3.7		24.1	15.5	16.8	(a)
Ce		5.4	10.5	5.9	64	42	48	(a)
Pr								
Nd								
Sm	0.2	0.8	1.5	0.8	12.2	6.6	8.4	(a)
Eu	1.5		1.1	1.4	1.6	1.2	2.2	(a)
Gd								
Tb		0.2	0.3		3.1	1.6	2.2	(a)
Dy								
Ho								
Er								
Tm								
Yb		0.8	1.8	1.8	7.5	5.9	5.7	(a)
Lu				0.2	1.2	0.7	0.8	(a)
Hf		0.4	1.3		5.7	5.3	4.3	(a)
Ta			0.2		1.1			(a)
W ppb								
Re ppb								
Os ppb								
Ir ppb								
Pt ppb								
Au ppb								
Th ppm		0.3	0.9		3.9	3	3.1	(a)
U ppm								
technique	*(a) INAA*							

Table 4. Chemical composition of glass.

reference	Ryder and Blair			
weight	brown		granite	
SiO2 %	47.3	47.7	78.7	(a)
TiO2	1.3	1.4	0.46	(a)
Al2O3	19	18.8	13	(a)
FeO	8.5	7.8	1.4	(a)
MnO				
MgO	11.4	10.6	0	(a)
CaO	11.8	11.8	1.1	(a)
Na2O	0.7	0.76	0.2	(a)
K2O	0.4	0.32	7.4	(a)
technique:	*(a) elec. Probe*			



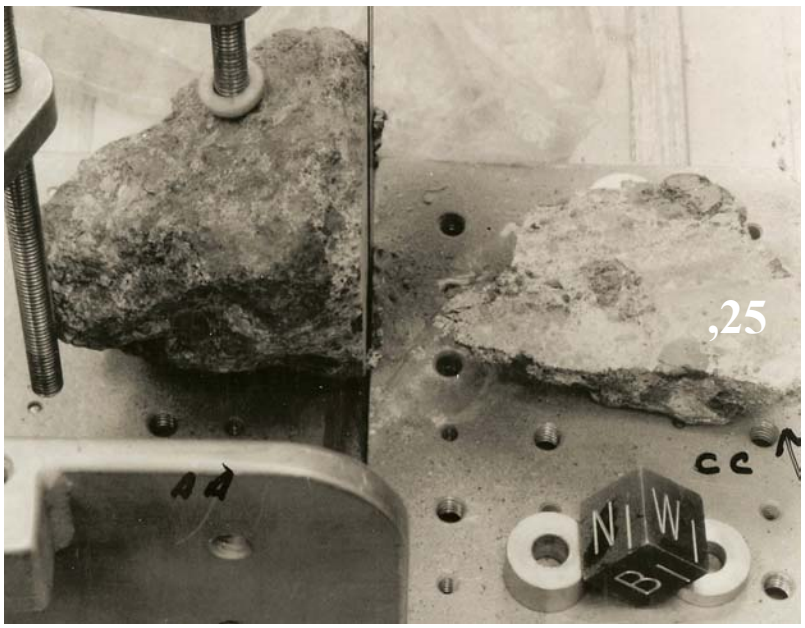


Figure 13: Location of first saw cut 66055. S76-21691 Cube is 1 inch.

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