15086

Regolith Breccia

216.5 grams

Figure 1: Photo of 15086. Sample is about 8 cm long. NASA S71-43081.

Introduction

Fruland (1983) and Simon et al. (1986) found that 15086 is a typical soil breccia. It is from a mare surface near the Apeninne Front.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 has an exposure age of 736 m.y. and includes green glass spheres dated at 3.29 b.y. Two soils, 15070 and 15080, were collected from the same location.

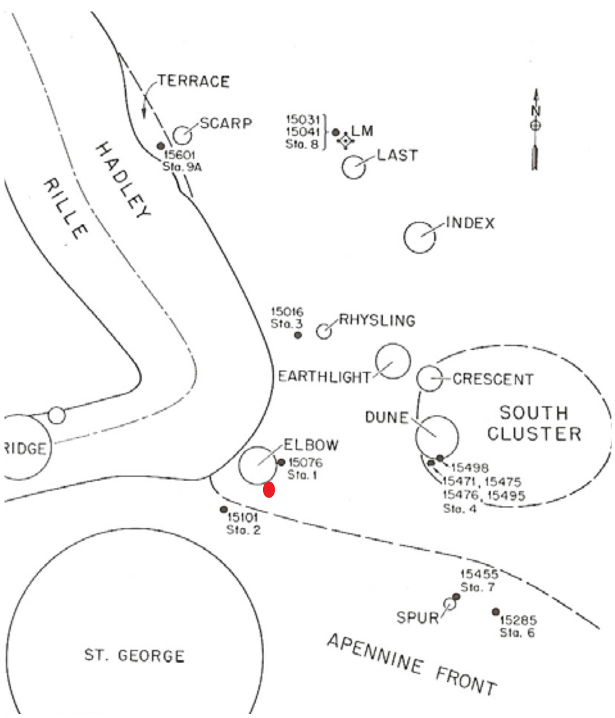


Figure 2: Location of 15086 on map of Apollo 15 site.

Petrography

McKay et al. (1989) reported that the maturity index for 15086 was I_s/FeO = 19.

McGee et al. (1977) describe 15086 as a fragmental-matrix breccias characterized by diverse population of mineral, glass and lithic clasts set is a matrix of light to dark brown glass fragments and comminuted mineral and lithic debris (figure 3). The grain size distribution

Mode for 15086 *(Simon et al. 1986)*

Matrix	<20 micron	50.7 %
	20-90 micron	90-1000 micron
Mare basalt	2.5 %	8
Plutonic Rx.		
Feld. CMB		
Feld. Basalt		0.2
KREEP basalt		0.5
Granulitic/Poik.	0.3	0.2
Reg Bx.	0.6	0.5
Agglutinate	3.5	2.2
Pyroxene	9.2	4.7
Olivine	1.4	0.7
Plagioclase	4.3	0.8
Opaque	0.4	
Glass	4.5	4.6

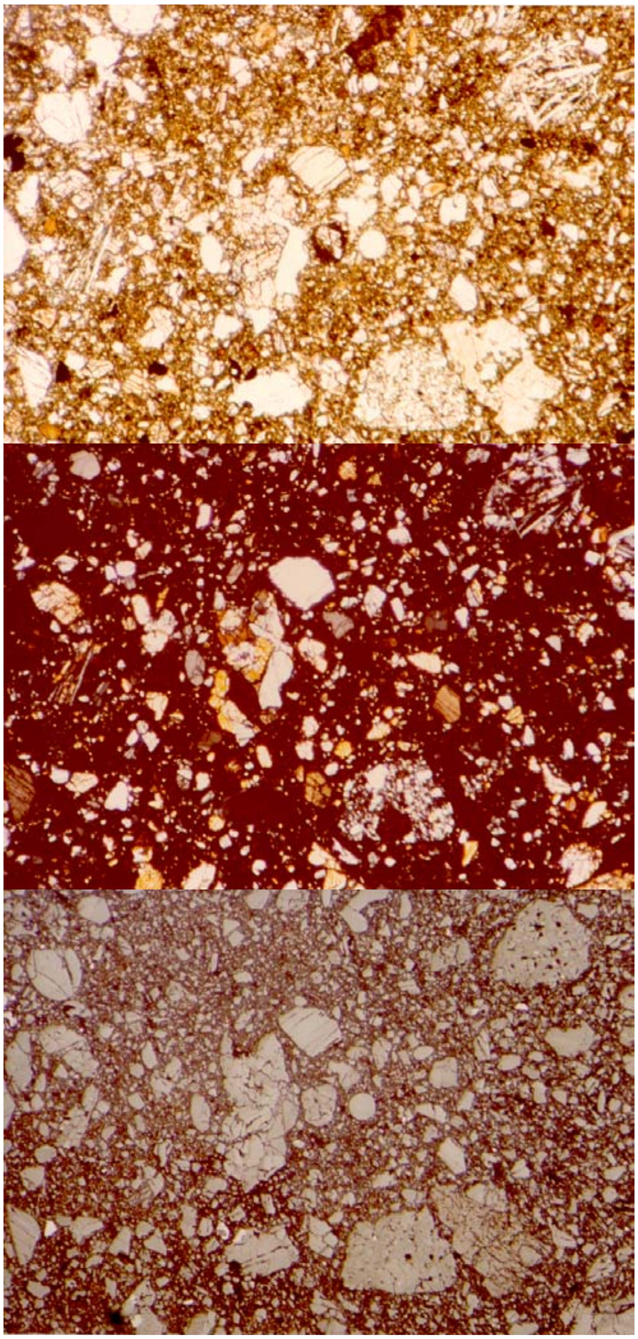


Figure 3a: Photomicrographs of thin section 15086,32. Field of view 2.5 mm. NASA S79-27461-63. Top is plane-polarized light, middle is crossed polarizers and bottom is reflected light. Note the high percentage of glass.

is seriate up to 3 mm (figure 9). Pore space is common and occurs as irregularly shaped vugs 0.4 to 2.5 mm across.

Drake and Klein (1973) and others noticed an abundance of green glass spheres, typical of the regolith in the region. Other glass is also common. Lithic clasts

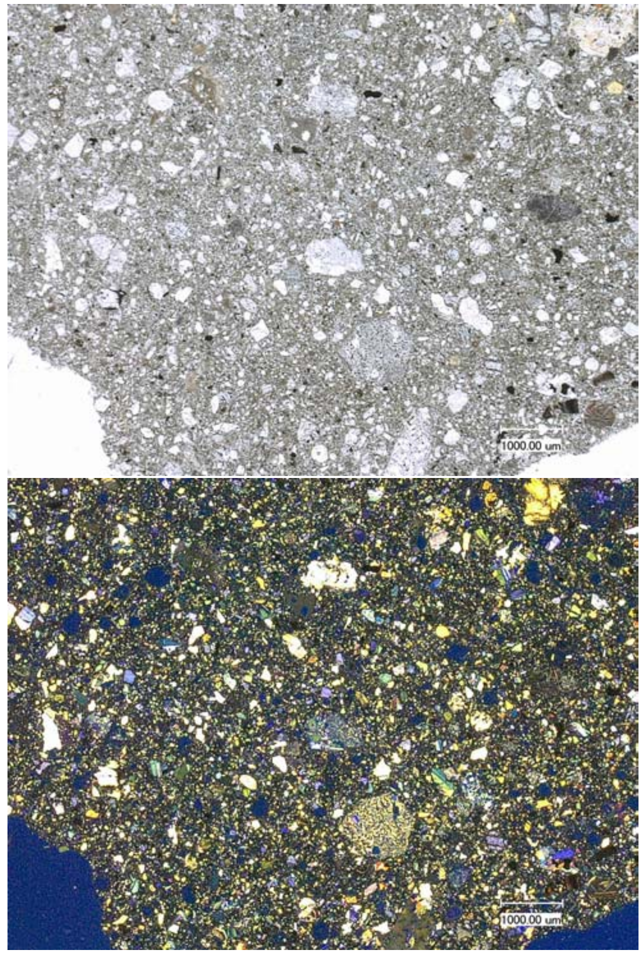


Figure 3b: Photomicrographs of 15086,64 by C Meyer Top isplae polarized., bottom is with crossed Nicols..

are mostly basaltic rocks with a variety of texture. Feldspathic basalts with KREEP composition are common. A complete description of all this is found in Ryder (1985).

McGee et al. (1977) found the composition of pyroxene was dominated by pyroxene from KREEP basalt (figure 4). Taylor et al. (1975) found the metallic iron was from meteorite fragments (figure 5).

Mineralogical Mode for 15086

	(McKay et al. 1989)	
	20-500 mciron	500-1000 micron
Mare Basalt	5.7 %	62.5 %
KREEP basalt	10	0
Plutonic	0.3	0
Breccias	12.9	25
Olivine	0.8	12.5
Pyroxene	30.2	-
Plagioclase	9.3	-
Opaques	0.4	-
Glass	14.5	-
Agglutinates	5	-

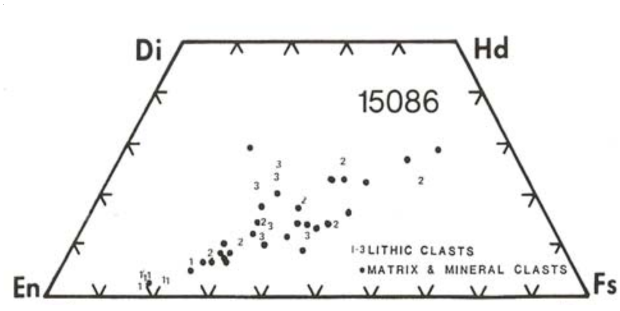


Figure 4: Compostion of pyroxene in 15086 a la McGee et al. (1979).

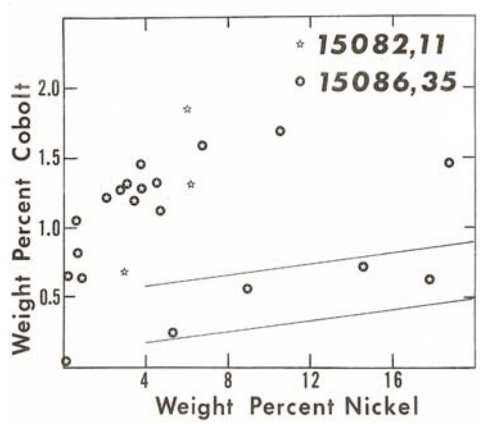


Figure 5: Chemical composition of metal particles in 15086 (Taylor et al.1975)

Chemistry

The chemical composition of 15086 is exactly the same as the soil from the same location and returned in the same bag (see table). The composition is dominated by a KREEP component (figure 6).

Thiemens and Clayton (1980) determined nitrogen isotopes and nitrogen content (36 ppm N) and Moore et al. (1973) only found 57 ppm carbon (figure 8).

Radiogenic age dating

The green glass in 15086 has been dated by Huneke et al. at 3.29 b.y. (figure 10).

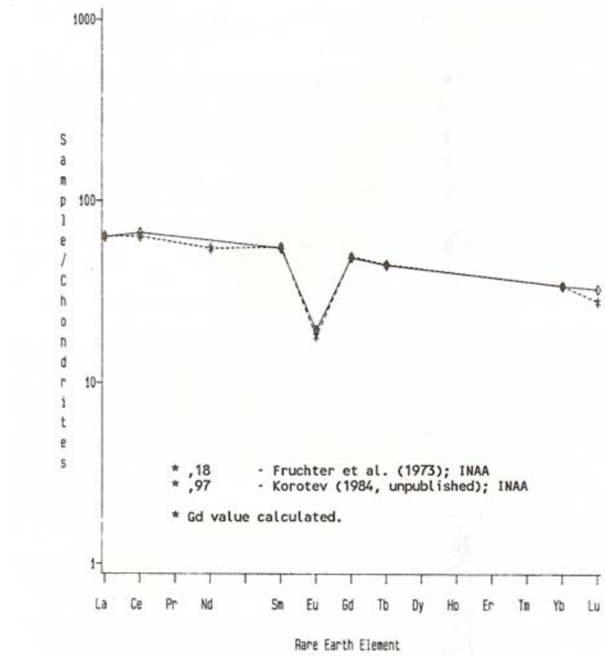


Figure 6: Normalized rare-earth-element diagram for 15086 (see table).

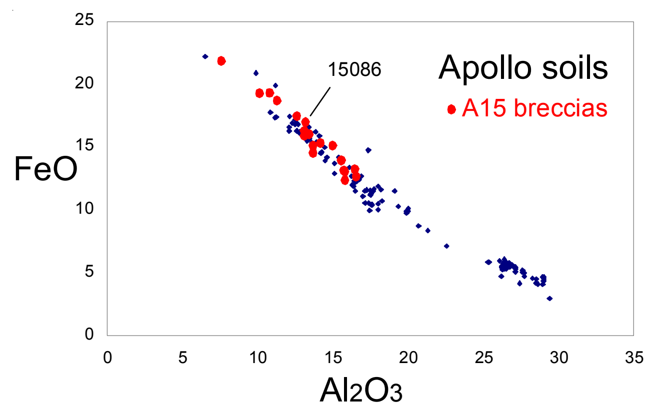


Figure 7: Composition of 15086 in comparison with that of Apollo 15 breccias and Apollo soils.

Cosmogenic isotopes and exposure ages

Keith et al. (1973) determined the cosmic-ray-induced activity of ^{26}Al = 39 dpm/kg, ^{22}Na = 50 dpm/kg, ^{56}Co = 11 dpm/kg and ^{46}Sc = 2.5 dpm/kg. Thiemens and Clayton (1980) determined the cosmic ray exposure to be 736 m.y. by nitrogen spallation (figure 11).

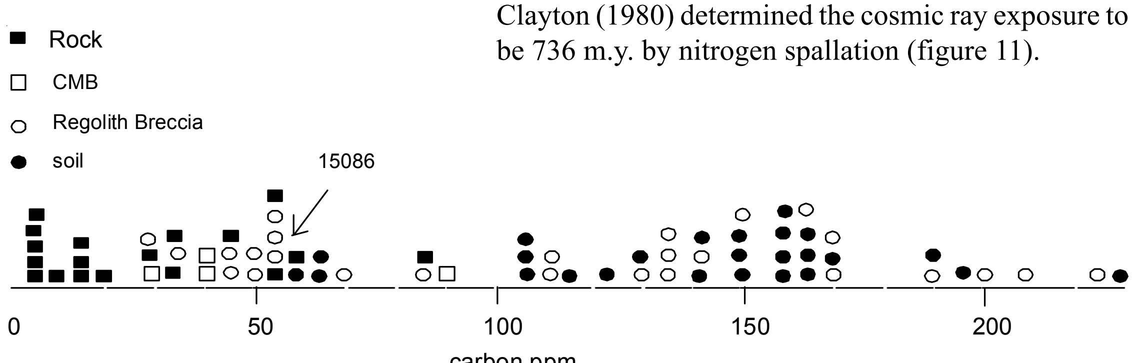
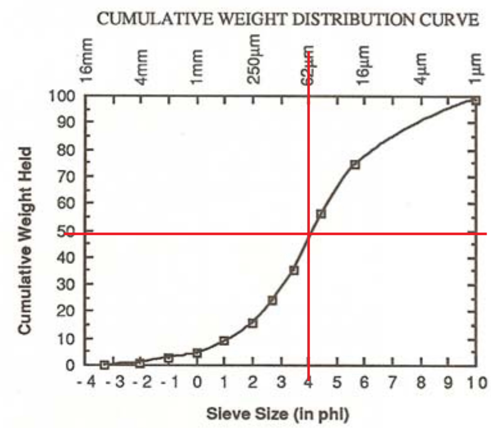


Figure 8: Carbon content of soils and breccias.



Average grain size = 48 microns

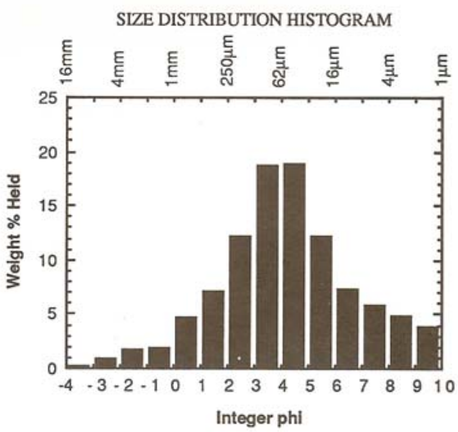


Figure 9: Grain size distribution for freeze-thaw-cycled 15086 (Graf 1987, from data by McKay).

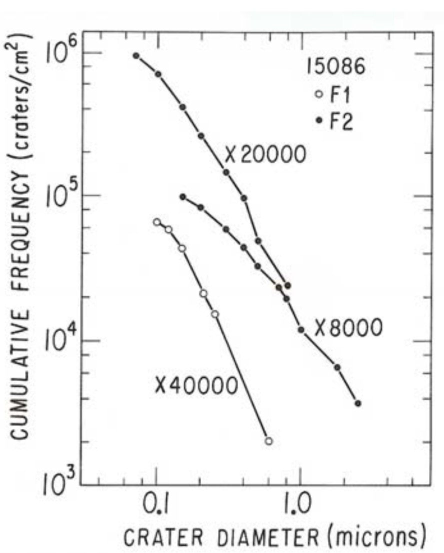


Figure 12: Micrometeorite craters on glass spheres inside of regolith breccia 15086 (Goswami et al. 1976).

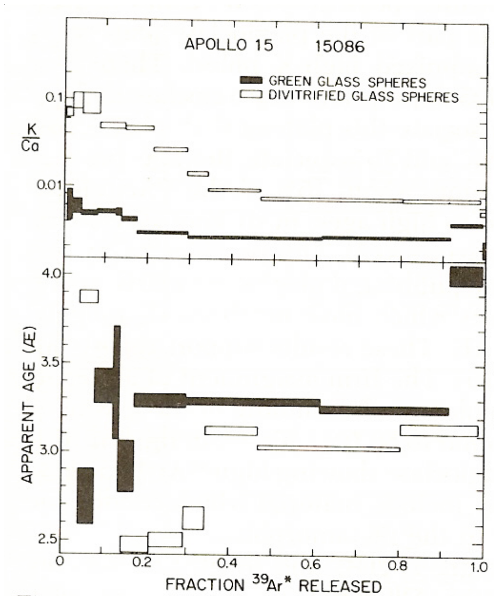


Figure 10: Ar/Ar plateau age for 15086 (Huneke et al. 1974).

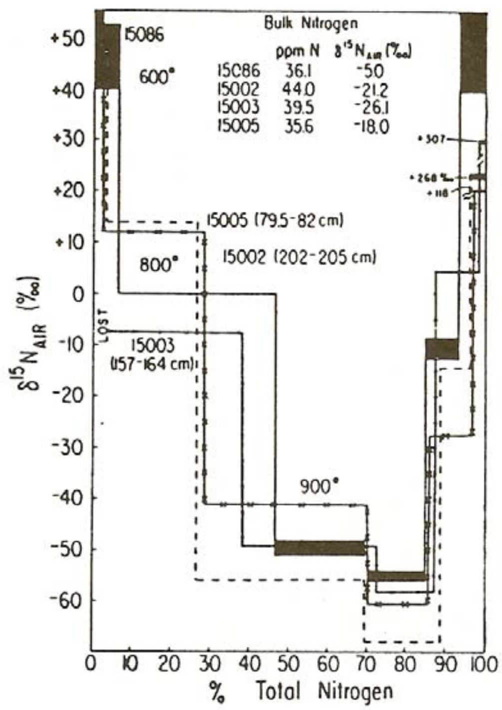


Figure 11: Nitrogen isotope ratiofor gas released as function of temperature (Thiemans and Clayton 1976).

Other Studies

Huthcheon et al. (1972), Macdougall et al. (1973), Rajan et al. (1974) and Goswami et al. (1976) studied the micrometeorite craters and fossil tracks on glass and mineral grains form 15086 (figure 12).

Hintenberger et al. (1975) determined rare gas data.

Table 1. Chemical composition of 15086.

												15081soil
reference	Rose 75		Drake73	Fruchter73		Simon86		McKay89		Keith72		Wanke75
weight			Ito									
SiO2 %	47.5	(a)	46.7									46.8
TiO2	1.67	(a)	1.6	1.72	(b)	1.8	(b)	1.72	(b)			1.58
Al2O3	11.01	(a)	15.2	12.3	(b)	13	(b)	12.3	(b)			13.7
FeO	17.49	(a)	14.8	15.8	(b)	14.7	(b)	16	(b)			15.3
MnO	0.26	(a)	0.2			0.21	(b)					0.2
MgO	10.55	(a)	10.2			12	(b)					10.6
CaO	10.26	(a)	10.4			10.9	(b)	10	(b)			10.7
Na2O	0.35	(a)	0.38	0.4	(b)	0.41	(b)	0.39	(b)			0.38
K2O	0.14	(a)	0.17			0.16	(b)			0.17	(c)	0.14
P2O5	0.17	(a)	0.22									0.15
S %												0.05
sum												
												31.7
Sc ppm	33	(a)		33	(b)	28.9	(b)	32.1	(b)			
V	92	(a)				120	(b)					
Cr	2874	(a)	3216	2700	(b)	2894	(b)	3010	(b)			
Co	42	(a)		41	(b)	40.2	(b)	44.8	(b)			45.1
Ni	79	(a)	180			140	(b)	146	(b)			260
Cu	12	(a)										
Zn	28	(a)										
Ga	5.1	(a)										
Ge ppb												
As												
Se												
Rb	4.1	(a)										
Sr	83	(a)				105	(b)	145	(b)			160
Y	68	(a)										
Zr	234	(a)		260	(b)	260	(b)	340	(b)			290
Nb	19	(a)										
Mo												
Ru												
Rh												
Pd ppb												
Ag ppb												
Cd ppb												
In ppb												
Sn ppb												
Sb ppb												
Te ppb												
Cs ppm								0.22	(b)			0.14
Ba	146	(a)		230	(b)	230	(b)	214	(b)			220
La	19			21	(b)	20.5	(b)	21.1	(b)			18.4
Ce				59	(b)	50	(b)	56	(b)			51
Pr												
Nd						34	(b)	33	(b)			29
Sm				10	(b)	9.3	(b)	10.2	(b)			8.5
Eu				1.35	(b)	1.2	(b)	1.25	(b)			1.2
Gd												
Tb				2.1	(b)	2	(b)	2.11	(b)			1.85
Dy						13.5	(b)					11.4
Ho						2.9	(b)					2.3
Er												
Tm						1	(b)					
Yb	9.4			6.9	(b)	6.65	(b)	6.9	(b)			6.03
Lu				1.13	(b)	0.94	(b)	0.96	(b)			0.86
Hf				7.4	(b)	6.3	(b)	8.2	(b)			6.53
Ta				1.4	(b)	0.9	(b)	1.04	(b)			0.88
W ppb												
Re ppb												
Os ppb												
Ir ppb								3	(b)			8
Pt ppb												
Au ppb								3	(b)			
Th ppm				3.7	(b)	3.1	(b)	3.1	(b)	3.2	(c)	2.58
U ppm						0.8	(b)	1	(b)	0.76	(c)	

technique: (a) "microchemical", (b) INAA, (c) radiation counting

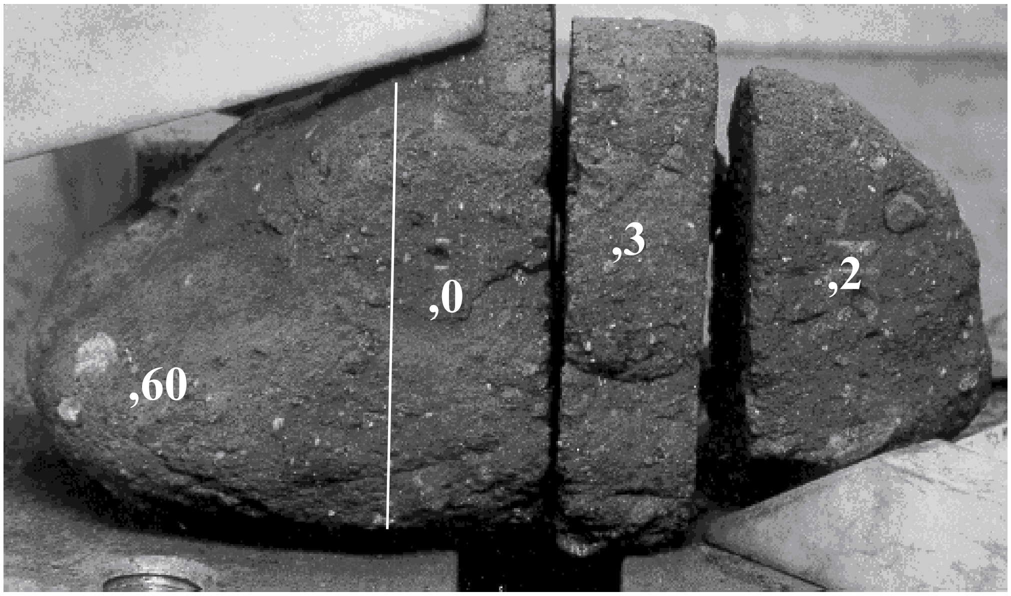
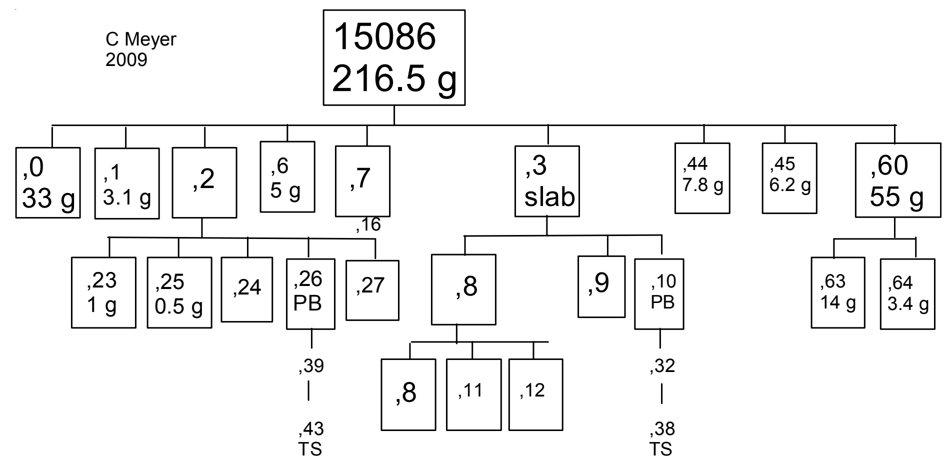


Figure 13: 15086 after saw cut. NASA S71-60988. Slab ,3 is about 1 cm. thick.



Collinson et al. (1972) reported on the remanent magnetism in 15086.

Processing

Two slabs and a column were cut from 15086 (figure 13). There are 13 thin sections.

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