15299

Regolith Breccia

1692 grams

Figure 1: Photo of 15299,0. NASA # S74-32566 Scale in background is in cm.

Introduction

15299 was found laying on top of the regolith at station 6, which was about 100 meters up the north slope of Hadley Delta. The bulk sample is brownish, with small white clasts (figure 1). It is a coherent soil breccia with inclusions of glass found in the regolith (McKay et al. 1989). Fractures have slickensides.

Simon et al. (1986) studied soil breccias from Apollo 15 and argued that some of them represent ancient lunar soils. However, 15299 is very like A15 soil. The Apollo 15 catalog by Ryder (1985) contains additional information.

Petrography

15299 is a brown glass matrix breccia that is made up of compressed and welded soil components similar to the local soil (figure 2). Juan et al. (1972) describe 15299 as: 12% lithic fragments (mare basalt, micrograbbro, anorthosite and pre-existing breccia), 11% mineral fragments (bytownite, clionopyroxene, orthopyroxene, olivine, spinel and opaques), 3% glass fragments, 4% glass spheres set in 70% glassy matrix (<0.1 mm).

McKay and Wentworth (1983) reported that 15299 was compact, with low fracture porosity, minor shock features, rare agglutinates and minor class spheres. Wentworth and McKay (1984) determined the bulk density of 15299 as 2.49 g/cm^3 (relatively compact). McKay et al. (1984) determined the maturity index (I_s/FeO) between 22-34 (submature) (see also summary in McKay et al. 1989).

Warren et al. (1987) studied the texture, mineralogy and composition of two basalt clasts from 15299 (figure 3) and found them similar in detail with some other

Figure 2: Photomicrograph of thin section 15299,67. Scale 1 cm. S80-42341.

Apollo 15 mare basalts (see their paper for detail). Split ,196 is the clast pictured in figure 3. Split ,201 is from a chip that fell off the sample.

Significant Clasts

Mare basalt ,74 ,197TS

This is probably the coarse grained basalt clast pictured in figure 3 (and ,196 in Warren).

Chemistry

Wanke et al. (1973), Taylor et al. (1973), Korotev (in McKay et al. 1989) and others give analysis of matrix of 15299, which is found to have a composition similar to the bulk soil at station 6 (table 1). Taylor et al. calculated that 15299 was a mixture of 15.8% "highland basalt" and 84.2% "low-K Fra Mauro". Warren et al. (1987) analyzed two basalt clasts (figure 4). Kothari and Goel (1973) determined 74 ± 4 ppm nitrogen and Filleau et al. (1978) reported 30-42 ppm carbon (the relatively low C content is at odds with high C in other A15 brown glass matrix breccias).

Other Studies

The rare gas content and isotopic composition of 15299 were determined by Bogard and reported in McKay et al. (1989). The carbon content has been studied by Filleux et al. (1978), hydrogen by Merlivat et al. (1974), and nitrogen by Kothari and Goel (1973).

Silver (1973a) determined the U-Th-Pb systematics of 15299 and found them similar to that of the Apollo 15 soils.

Figure 3: Close-up photo of broken piece of 15299 showing basalt clast. Cube is 1 cm. NASA S74-32786.

Processing

Piece ,1 was sawn to produce a small slab (,3) for alloctions (figure 7). Large piece ,0 was also sawn (1975) to produce two large pieces ,0 and ,161 (figure 5). There are 47 thin sections. 15299 is one of the rocks included in the Lunar Educational Thin Section Set (Meyer 1987).

List of Photo #s

S71-43053-43058	color
S74-32786-90	
S75-33048	
S80-42341	TS

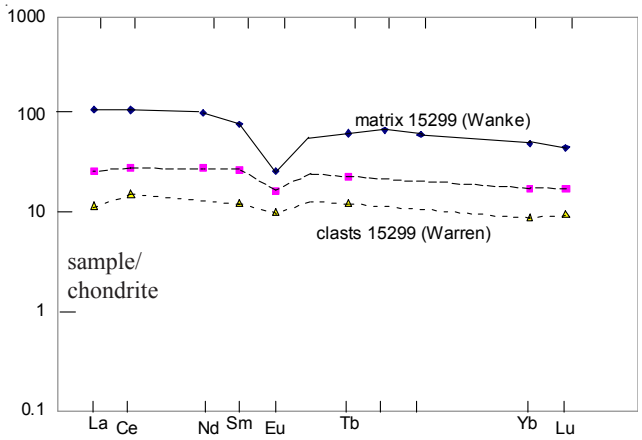


Figure 4: Normalized rare-earth-element pattern for matrix and clasts in soil breccia 15299 (data from table 1).

Table 1. Chemical composition of 15299.

reference	Taylor 73		Wanke 73	Brunfeldt 72	McKay 89		Baedecker73		Juan 1972	Warren 87	Warren 87	
weight	matrix									clast	clast	
SiO2 %	46.9	(a)	46.42						45.9	46.21	42.79	(b)
TiO2	1.33	(a)	1.5	1.22		(b)			3	2.22	1.42	(b)
Al2O3	17.9	(a)	16.27	16.48		(b)			18.5	9.07	5.86	(b)
FeO	10.9	(a)	11.93	11.71	11.9	(b)			11.65	21.74	23.16	(b)
MnO			0.15	0.16		(b)			0.153	0.29	0.28	(b)
MgO	10.1	(a)	11.01						10.08	9.28	17.9	(b)
CaO	11.6	(a)	11.75	10.77	11.2	(b)			10.9	10.91	7.27	(b)
Na2O	0.45	(a)	0.48	0.47	0.46	(b)			0.43	0.23	0.18	(b)
K2O	0.17	(a)	0.2						0.224	0.04	0.02	(b)
P2O5												
S %												
sum												
Sc ppm	16	(a)	23.2	22.2	23.2	(b)				58	36.6	(b)
V	45	(a)		104		(b)						
Cr	2000	(a)	2290	2290	2220	(b)				3940	*11300*	(b)
Co	44	(a)	39.6	39.3	37.9	(b)			71	44	89	(b)
Ni	195	(a)	150	230	208	(b)	239	(c)	244	16	150	(b)
Cu	4.7	(a)		5.5		(b)			3			
Zn				14		(b)	17.7	(c)	35	1.01	1.05	(b)
Ga	3.8	(a)		4.3		(b)	4.5	(c)	10			
Ge ppb							410	(c)				
As				0.17								
Se				0.33								
Rb	5	(a)		4.5					5			
Sr				100	145	(b)			265			
Y	82	(a)										
Zr	385	(a)			320	(b)				210	<580	(b)
Nb	27	(a)										
Mo												
Ru												
Rh												
Pd ppb												
Ag ppb				19		(b)						
Cd ppb							49	(c)				
In ppb				4		(b)	3.8	(c)				
Sn ppb	220	(a)										
Sb ppb												
Te ppb												
Cs ppm	0.19	(a)		0.22	0.29	(b)						
Ba	320	(a)		221	251	(b)				<180	<270	(b)
La	26	(a)	27	20	24.1	(b)				6.3	2.9	(b)
Ce	68	(a)	68	78	62	(b)				17.6	9.8	(b)
Pr	9.1	(a)										
Nd	38	(a)	48		37	(b)				13		(b)
Sm	10.8	(a)	11.9	12.2	11.3	(b)				4.1	1.95	(b)
Eu	1.45	(a)	1.51	1.21	1.39	(b)				0.94	0.59	(b)
Gd	11.9	(a)										
Tb	2.1	(a)	2.4	2.09	2.21	(b)				0.89	0.47	(b)
Dy	12.9	(a)	17.4	12.2		(b)						
Ho	3.1	(a)	3.6	2.3		(b)						
Er	8.7	(a)		8.4		(b)						
Tm	1.3	(a)										
Yb	8.1	(a)	8.5	7.3	8	(b)				3	1.5	(b)
Lu	1.3	(a)	1.15	0.73	1.08	(b)				0.43	0.24	(b)
Hf	7	(a)	8.7	9.8	9	(b)				2.5	1.14	(b)
Ta			1.06	1.08	1.12	(b)				0.37	0.12	(b)
W ppb	190	(a)		910		(b)						
Re ppb										24	24	(b)
Os ppb												
Ir ppb				6	7	(b)	7.8	(c)		0.126	0.113	(b)
Pt ppb						(b)						
Au ppb				3.9	2.2	(b)	2.2	(c)		0.009	0.36	(b)
Th ppm	3.77	(a)		3.5	4.6	(b)				0.58	0.24	(b)
U ppm	0.99	(a)		0.97	1	(b)				0.2		(b)
technique	*(a) SSMS, (b) INAA, (c) RNAA*											

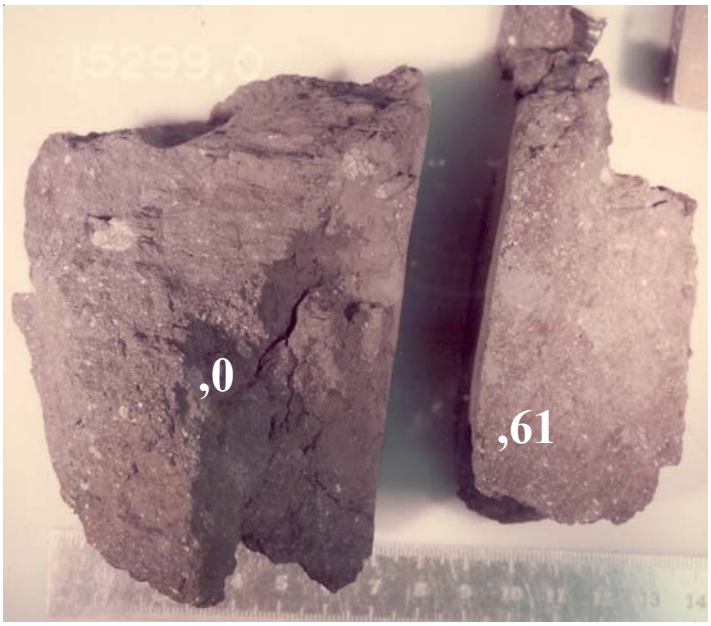


Figure 5: Saw cut through 15299,0. Large piece is about 8 cm across. S75-33048.

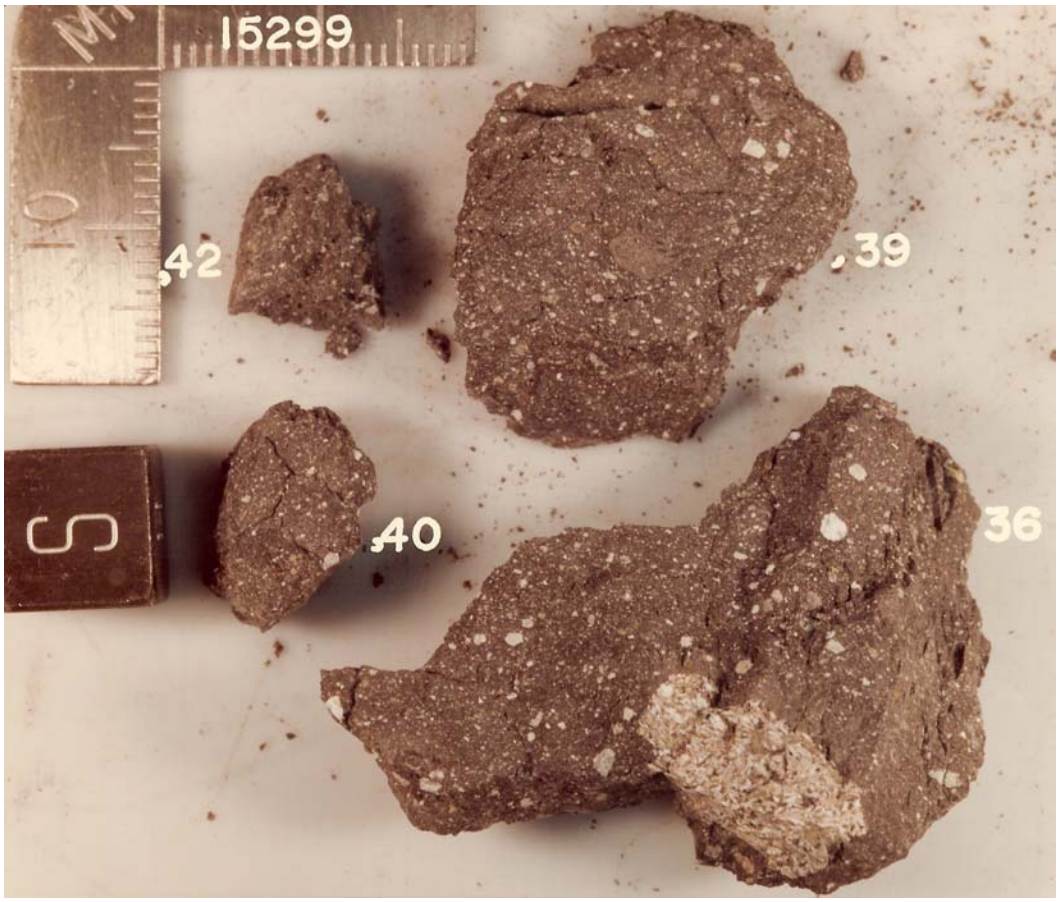
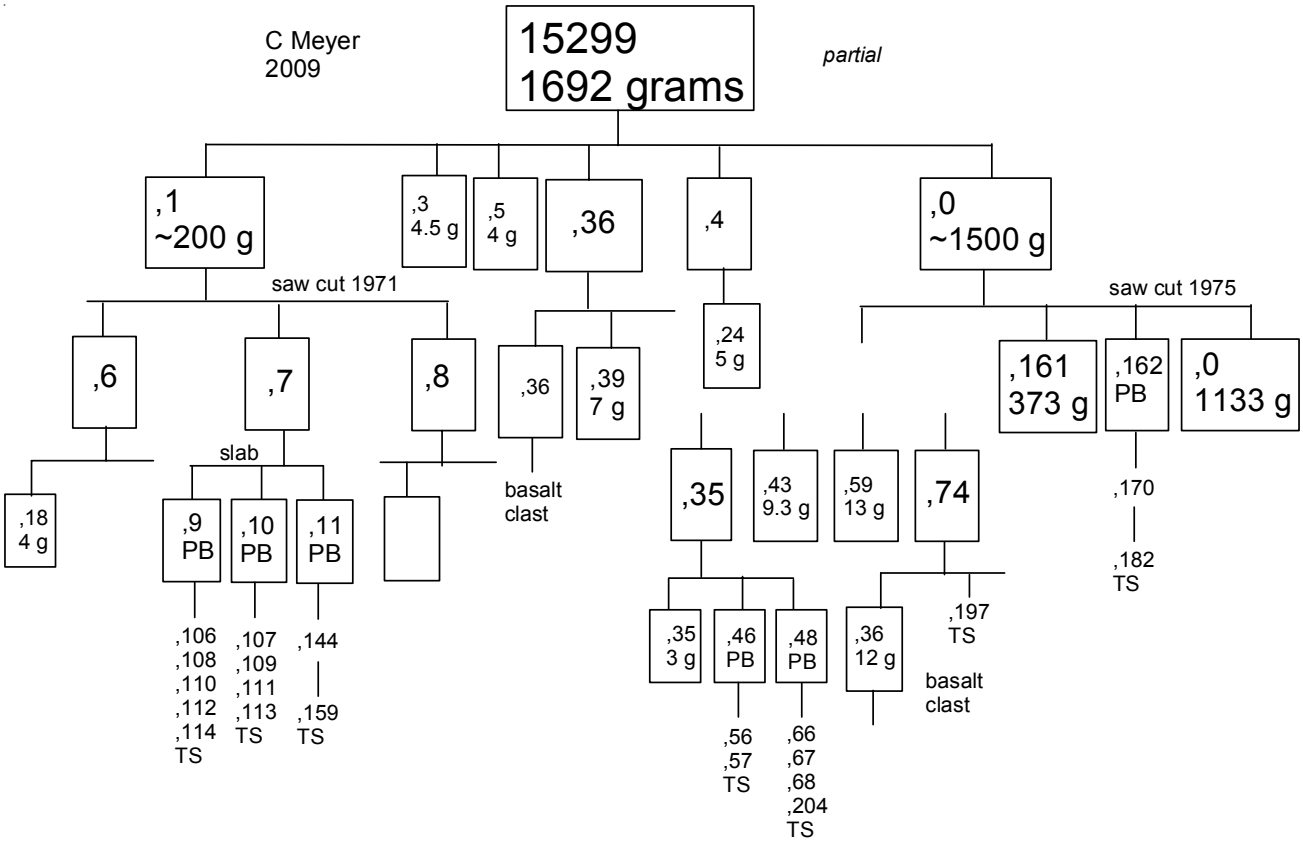


Figure 6: Subdivision of 15299,36. Cube is 1 cm. S74-32790.



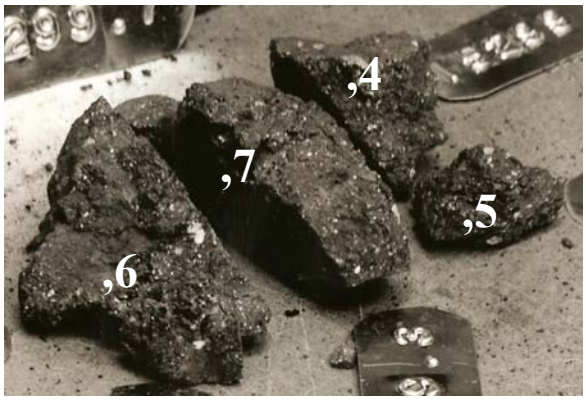


Figure 7: Sudivision of 15299,1 showing slab (,7). Slab is 1 cm thick. S71-60293.

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