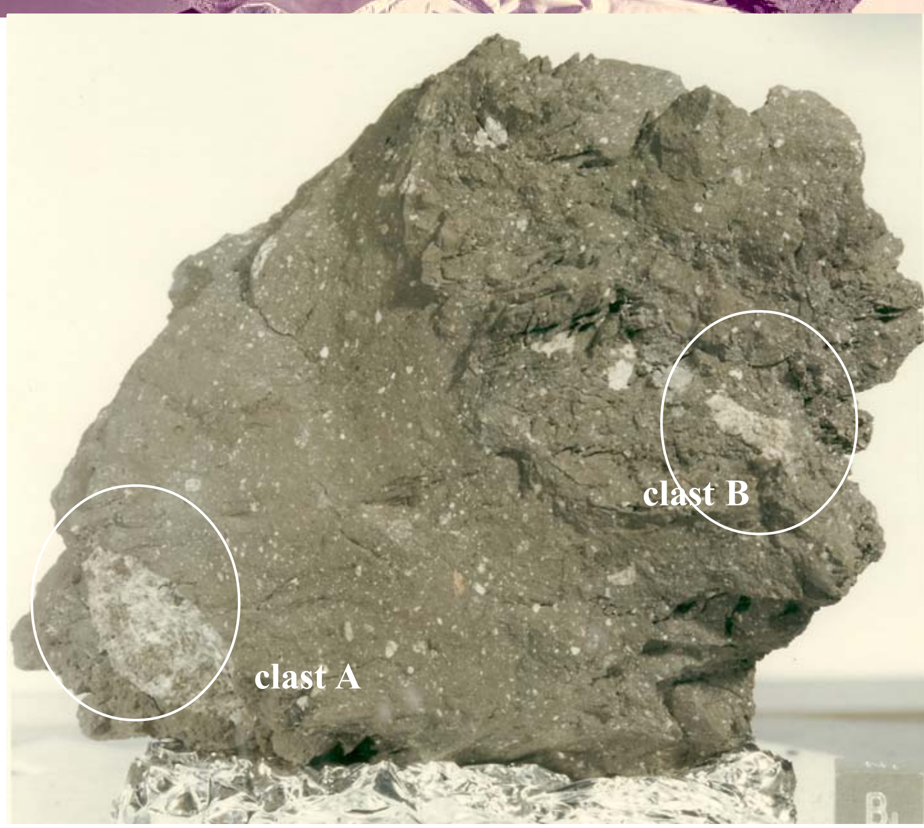
79115 – 346.3 grams
79135 – 2283 grams
Regolith Breccia



Figures 1 and 2: Photos of 79115 and 79135. 79135 is 18 cm across. NASA S73-15443. and S73-15399.

Figure 3: Surface photo of boulder on rim of Van Serg Crater where 79115 and 79135 were collected. AS17-146-22415

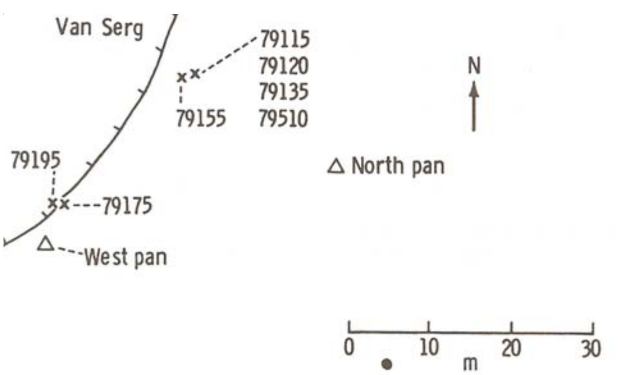


Figure 4a: Map of station 9, Apollo 17, with 79135 and 79115.

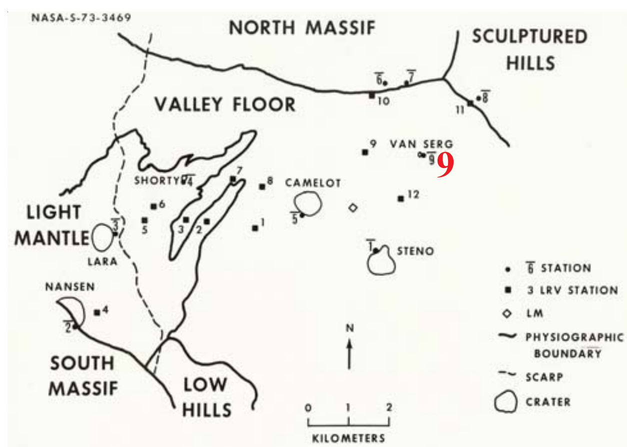


Figure 4b: Map of Apollo 17, with station 9.

Introduction

79115 and 79135 were sampled from a boulder on the rim of Van Serg Crater, station 9, Apollo 17. 79115 is from the top surface of the boulder and 79135 was from beneath 79115 (see transcript and figure 3).

The amazing thing about this sample is that it contains the same orange glass beads, of volcanic origin, that were found at station 4! Fruland (1983), Simon et al. (1990) and others have shown that 79135 and 79115 are regolith breccias with a seriate grain size distribution, some agglutinates, high gas content and a

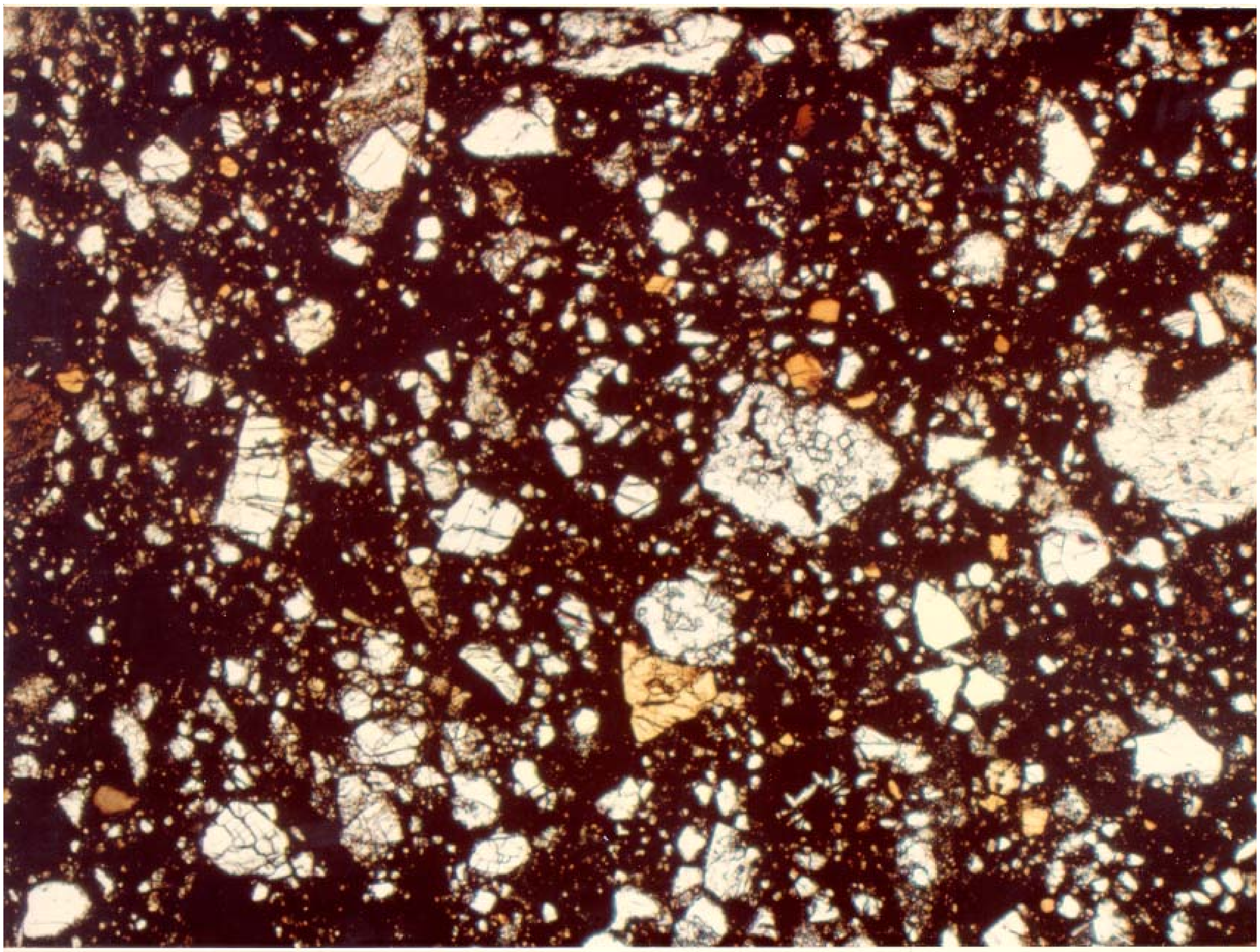


Figure 5: Thin section photomicrograph of 79135. NASA S76-20808. Scale is 3 mm.

wide range of lithic components. The exposure age was found to be about 800 m.y.

79115 has not been well studied – perhaps because it appears to be so similar to 79135. However, it contains at least two large white clasts (figure 2)

Petrography

Fruland (1983) and Simon et al. (1990) included 79135 in their initiative to study regolith breccias. 79135, and its companion 79115, are coherent dark matrix breccias, but they are highly fractured with two sets of fracture planes that cause these samples to readily breakup into large and small rhombs (figures 1 and 2). The dark glassy matrix is spotted with numerous white inclusions. The maturity index for 79115 is I_s/FeO = 56 (Jerde et al. 1987).

McGee et al. (1979) described 79135 as follows: "sample 79135 is a fragmental matrix breccia characterized by disperse populations of mineral, lithic and glass clasts in a homogeneous matrix of mineral debris and partially to completely devitrified opaque glass". Porosity is about 5 %.

Butler (1973) and Neal and Taylor (1993) discuss 79135 in their catalogs.

Mineralogical Mode for 79135

	(Simon et al. 1990)	
Matrix	58.9 %	
	20-90 micron	90-100 micron
Mare Basalt	0.4	1.9
KREEP Basalt		
Feld. Basalt	0.1	
Plutonic	0.2	0.6
Granulitic	0.2	0.6
Breccia	0.7	2.3
Olivine	0.9	0.5
Pyroxene	3.2	1.7
Plagioclase	3.4	1.6
Opaques	1.9	0.3
Glass	11.3	5.6
Agglutinate	0.9	5

CDR That looks like a breccia right there in front of us.
LMP Yes. There's some interesting patterns on the surface.
- - -
LMP OK, Gene's tearing apart one of the very intensely fractured rocks. And it comes off in small flakes. Let's get this one, because this will be the best oriented one of the documentation, plus why don't you get that one you've got from the inside there?
CDR Yes, I am.
LMP Bag 568 is a fragment from the surface. That's a corner, I think, of the block that Gene documented here.
CDR Yes, it is.
LMP We'll get another sample – that'll be from the inside the block.
CDR Get it with this real easy. Here's a whole big – we ought to take that just as is.
LMP Put a bag around one end if you can Here the other end is smaller.
CDR That's breccias, too. Se the white fragments in there? It's got a lot of very small - -
LMP It looks like this big one over here. You know, it might be that these might be pieces of the projectile. I don't know. Because it doesn't look like – it's not subfloor. Well that's wrapped in – if you put it end down, it might stay in the bag.
CDR I doubt it. It's 480, and it's relatively tabular shape, and it's about 10 inche long.
LMP And it's highly friable. It breaks apart, in small chips.

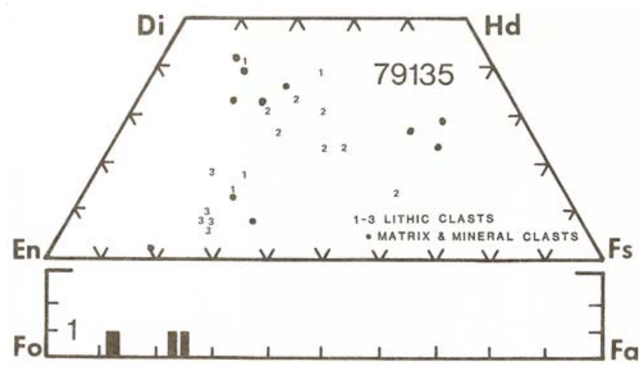


Figure 6: Mineral composition in 79135 (McGee et al. 1979).

Glass

Haggerty (1974), Chen et al. (1982), Delano and Lindsley (1983) and Shearer et al (1991) studied the abundant orange glass spheres in 79135. There are also other glasses. Much of the glass is devitrified.

Chemistry

Simon et al. (1990), Baedecker et al. (1974), Rose et al. (1974), Rhodes et al. (1974), Philpotts et al. (1974),

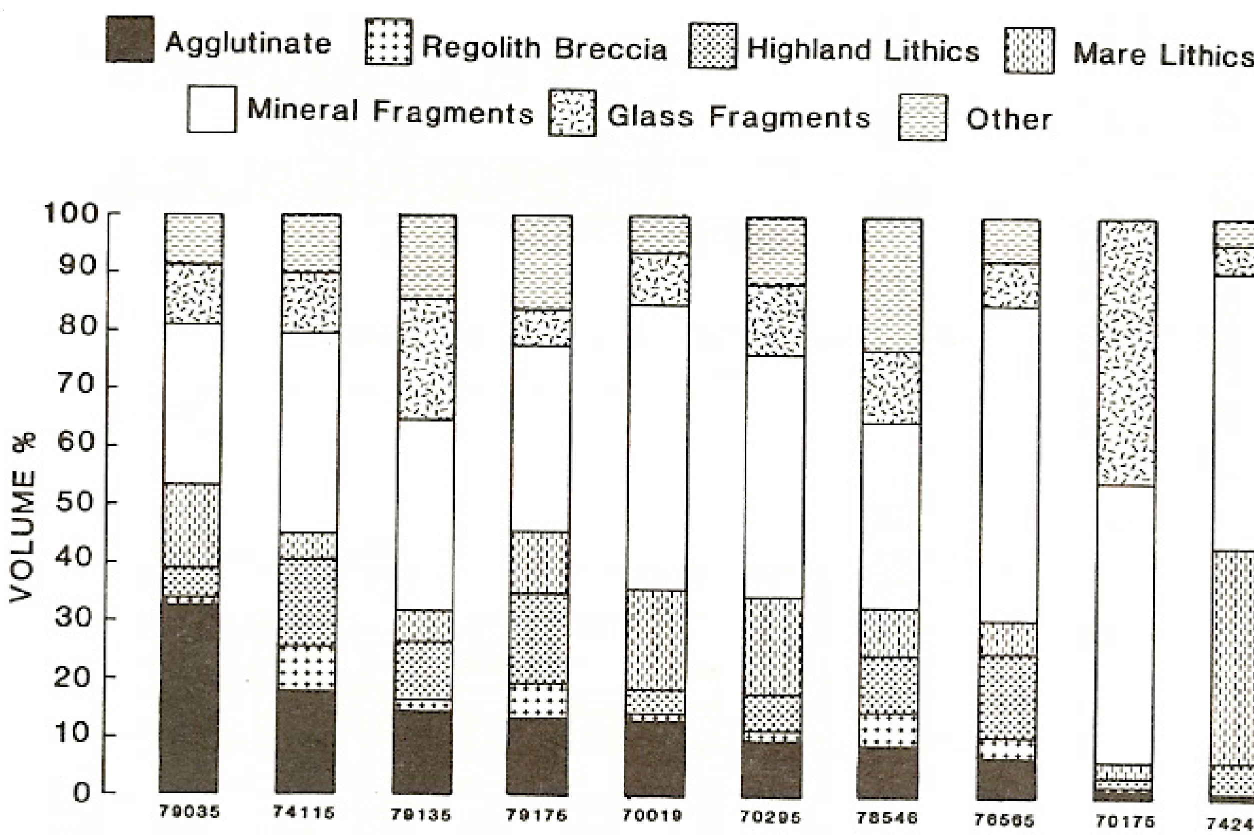


Figure 7: Direct comparison of Apollo 17 regolith breccias (Simon et al. `1990).

Wanke et al. (1974) and LSPET (1973) reported analyses of 79135 (table 1). Jerde et al. (1987) found essentially the same composition for 79115 (table 2). Both 79115 and 79135 have high Ni, Ir and Au. Zn is also high in 79135.

Moore et al. (1974) determined 150 ppm carbon (figure 9). Becker and Epstein (1981) also determined a similar amount of carbon. Norris et al. (1983) reported 143 ppm C and 45 ppm N. Gibson and Moore (1974) determined 1020 ppm S. Gibson et al. (1987) included 79135 in their attempt to study hydrogen distribution.

Radiogenic age dating

Church and Tilton (1975) and Nyquist et al. (1974) reported the Pb and Sr isotopes of 79135, respectively, but no age data is obtained from this.

Cosmogenic isotopes and exposure ages

Hintenberger et al. (1974, 1975) determined the exposure age of 79135 as 810 ± 60 m.y. by the ^{21}Ne method.

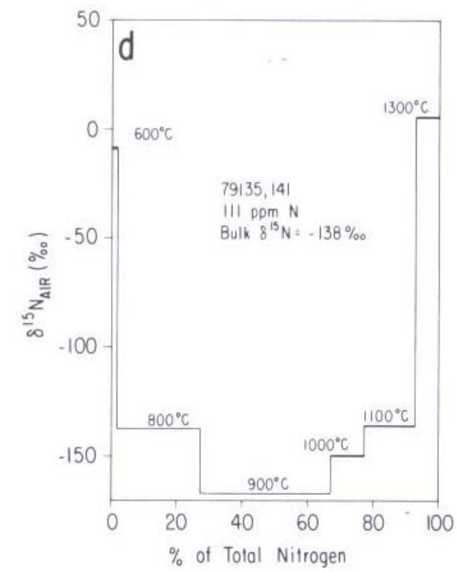


Figure 8: Temperature release of nitrogen isotopes from 79135 (Clayton and Thiemens 1980).

Other Studies

Clayton and Thiemens (1980) and Norris et al. (1983) studied the nitrogen isotopes in 79135 (figure 8) and Becker and Epstein (1981) studied the carbon isotopes.

Reese and Thode (1974) reported the composition of sulfur isotopes.

Pearce et al. (1974) and Cisowski and Fuller (1983) reported the magnetic properties of 79135.

Hintenberger et al. (1974, 1975) and Wieler et al. (1983) studied the rare gas content and isotopic composition of 79135. Heber et al. (2001) studied He distribution.

Gold et al. (1976) determined the dielectric constant.

Processing

79135 was too big for the Teflon bag it was brought back in and part of it was sticking out. There is a lot of residue in SCB#5 and some of it may be from 79135. There are 21 thin sections of 79135 and 7 thin section of 79115.

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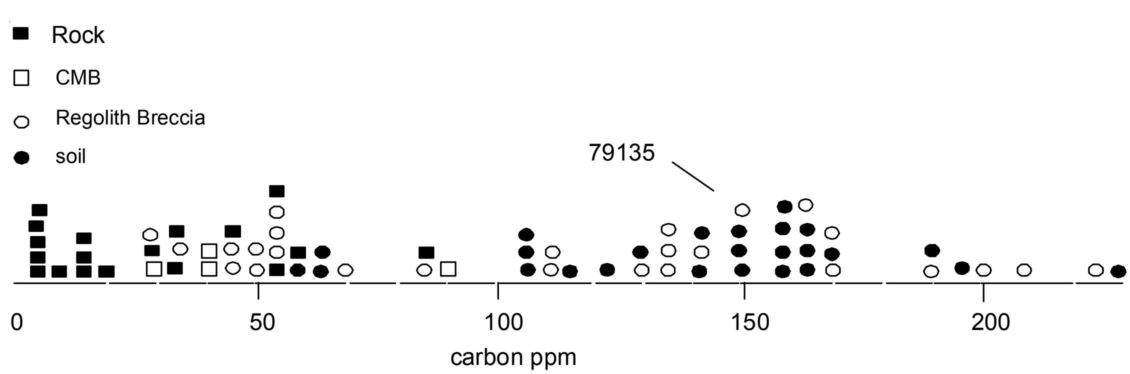


Figure 9: Carbon content of lunar samples.

Table 1. Chemical composition of 79135.

reference	LSPET73		Wiesmann75		Simon 1990		Rose74		Philpotts74		Wanke74		Baedecker74	
weight	Rhodes74													
SiO2 %	42.29	(a)					42.6	(d)			42.58	(d)		
TiO2	5.15	(a)			5.75	(c)	6.33	(d)			5.42	(d)		
Al2O3	15.08	(a)			13.6	(c)	14.7	(d)			13.8	(d)		
FeO	14.01	(a)			14.8	(c)	15.2	(d)			14.97	(d)	16.1	(c)
MnO	0.19	(a)			0.2	(c)	0.19	(d)			0.195	(d)	0.2	(c)
MgO	10.42	(a)			10.3	(c)	9.1	(d)			10.8	(d)		
CaO	11.44	(a)			10.7	(c)	10.9	(d)			11	(d)		
Na2O	0.4	(a)	0.42	(b)	0.5	(c)	0.4	(d)			0.47	(d)	0.51	(c)
K2O	0.1	(a)	0.1	(b)	0.116	(c)	0.11	(d)	0.104	(b)	0.097	(d)		
P2O5	0.07	(a)									0.07	(d)		
S %	0.1	(a)												
sum														
Sc ppm					41.1	(c)	50	(d)			39.5	(d)	43	(c)
V					85	(c)	76	(d)						
Cr	2670	(a)	2550	(b)	2930	(c)	3079	(d)			2550	(d)	2700	(c)
Co					36.7	(c)	52	(d)			38.3	(d)	41	(c)
Ni	218	(a)			140	(c)	280	(d)			170	(d)	161	(f)
Cu							26	(d)			19.6	(d)		
Zn	72	(a)			80	(c)	39	(d)			97.6	(d)	98	(f)
Ga											8	(d)	8.57	(f)
Ge ppb											440	(d)	286	(f)
As											24	(d)		
Se														
Rb	2.1	(a)	1.937	(b)		(c)	1.5	(d)	1.99	(b)				
Sr	166	(a)	169	(b)	185	(c)	163	(d)	171	(b)	200	(d)		
Y	55	(a)					64	(d)			47	(d)		
Zr	185	(a)			130	(c)	260	(d)			186	(d)	178	(c)
Nb	14	(a)					17	(d)			12.6	(d)		
Mo														
Ru														
Rh														
Pd ppb														
Ag ppb														
Cd ppb													112	(f)
In ppb													6.9	(f)
Sn ppb														
Sb ppb														
Te ppb														
Cs ppm					0.12	(c)					0.05	(d)		
Ba			105	(b)	120	(c)	129	(d)	123	(b)	120	(d)		
La					10.1	(c)					9.88	(d)		
Ce			24.2	(b)	27	(c)			29.2	(b)	25.8	(d)	36	(c)
Pr											3.9	(d)		
Nd			19.3	(b)	22.3	(c)			21.7	(b)				
Sm			6.51	(b)	7.25	(c)			7.51	(b)	7.26	(d)		
Eu			1.49	(b)	1.55	(c)			1.64	(b)	1.6	(d)	1.8	(c)
Gd			8.96	(b)	10.1	(c)					9.5	(d)		
Tb					1.72	(c)					1.8	(d)	1.7	(c)
Dy			9.78	(b)	10.9	(c)			11.7	(b)	10.5	(d)		
Ho											2.5	(d)		
Er			5.7	(b)							6.2	(d)		
Tm					0.82	(c)								
Yb			5.19	(b)	5.07	(c)	6.4	(d)	5.85	(b)	5.71	(d)	4.8	(c)
Lu			0.771	(b)	0.7	(c)			0.79	(b)	0.78	(d)		
Hf					5.7	(c)					5.7	(d)	6.2	(c)
Ta					1	(c)					0.94	(d)	0.79	(c)
W ppb											180	(d)		
Re ppb											0.88	(d)		
Os ppb														
Ir ppb					6.4	(c)					10	(d)	5.8	(f)
Pt ppb														
Au ppb					3.4	(c)					3.1	(d)	2.6	(f)
Th ppm			1.36	(b)	1	(c)							< 0.46	(c)
U ppm			0.36	(b)	0.38	(c)					0.33	(d)		

technique: (a) XRF, (b) IDMS, (c) INAA, (d) “microchemical”, (e) mutiple, (f) RNAA

Table 2. Chemical composition of 79115.

reference	Jerde87	
weight		
SiO2 %	42.37	(a)
TiO2	5.03	(a)
Al2O3	14.97	(a)
FeO	13.16	(a)
MnO	0.19	(a)
MgO	10.41	(a)
CaO	10.96	(a)
Na2O	0.466	(a)
K2O	0.098	(a)
P2O5		
S %		
sum		
Sc ppm	37	(a)
V		
Cr	2410	(a)
Co	36	(a)
Ni	190	(a)
Cu		
Zn		
Ga	7	(a)
Ge ppb		
As		
Se		
Rb	<9.2	(a)
Sr	170	(a)
Y		
Zr	200	(a)
Nb		
Mo		
Ru		
Rh		
Pd ppb		
Ag ppb		
Cd ppb		
In ppb		
Sn ppb		
Sb ppb		
Te ppb		
Cs ppm	0.55	(a)
Ba	113	(a)
La	8.8	(a)
Ce	24	(a)
Pr		
Nd	18	(a)
Sm	6.3	(a)
Eu	1.41	(a)
Gd		(a)
Tb	1.35	(a)
Dy	9.8	(a)
Ho		
Er		
Tm		
Yb	4.9	(a)
Lu	0.76	(a)
Hf	4.5	(a)
Ta	0.66	(a)
W ppb		
Re ppb		
Os ppb		
Ir ppb	6.7	(a)
Pt ppb		
Au ppb	1.6	(a)
Th ppm	1.25	(a)
U ppm	0.43	(a)

technique: (a) INAA

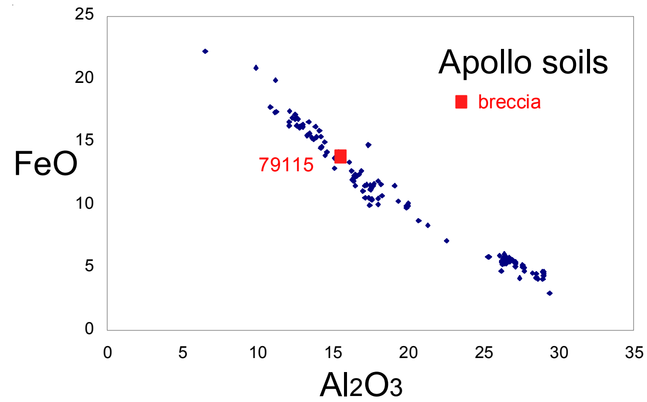
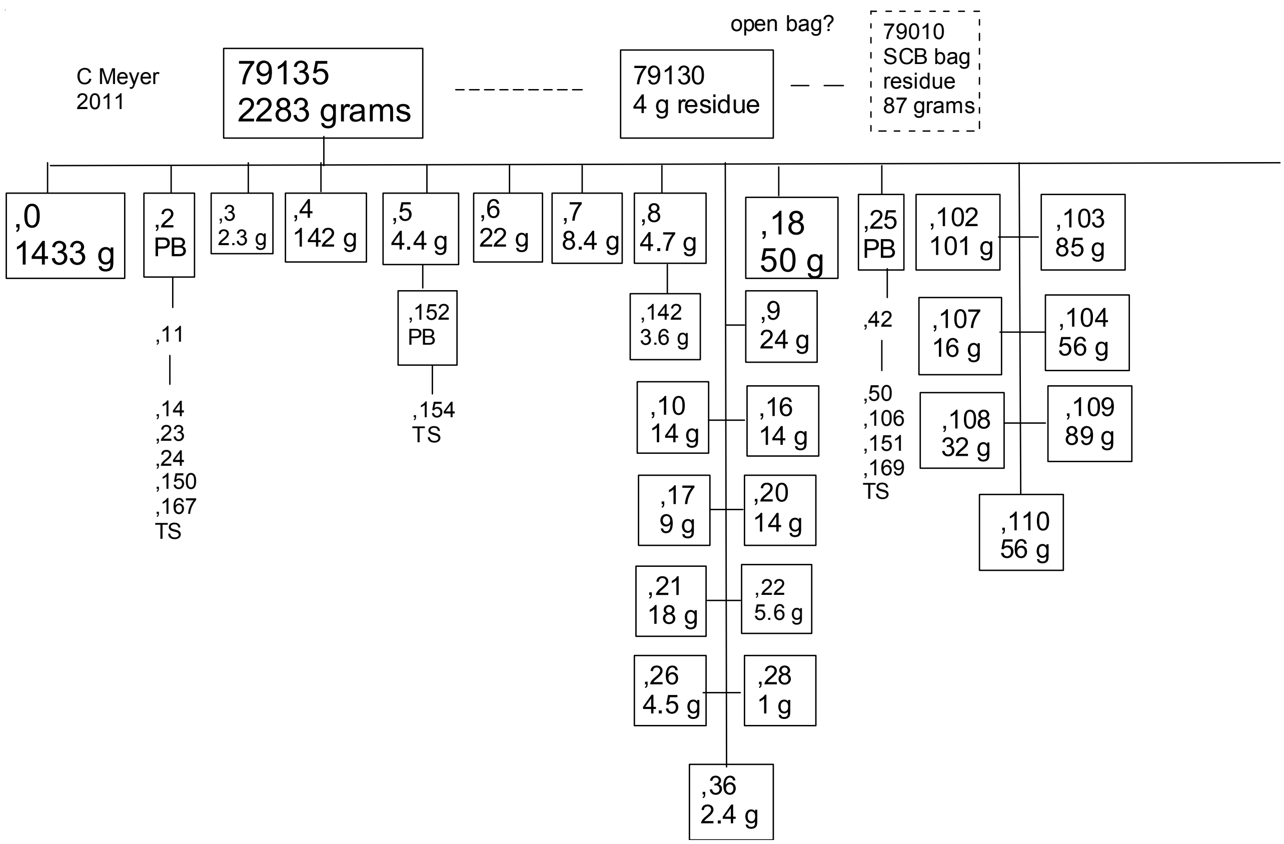
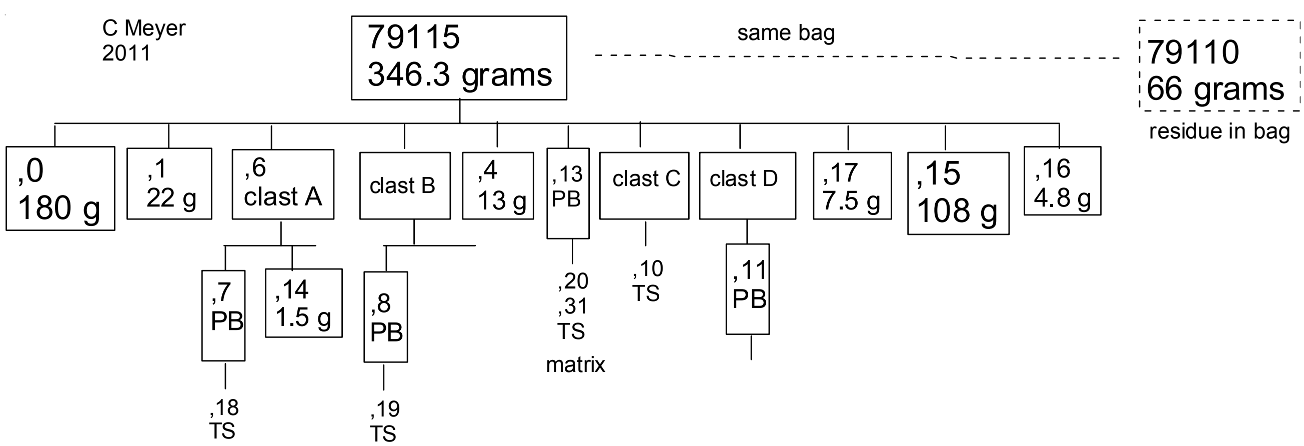


Figure 10: Composition of Van Serg breccias compared with Apollo soils.


C Meyer
2011
79135
2283 grams
79130
4 g residue
open bag?
79010
SCB bag
residue
87 grams
,0
1433 g
,2
PB
,11
,14
,23
,24
,150
,167
TS
,3
2.3 g
,4
142 g
,5
4.4 g
,152
PB
,154
TS
,6
22 g
,7
8.4 g
,8
4.7 g
,142
3.6 g
,18
50 g
,9
24 g
,10
14 g
,16
14 g
,17
9 g
,20
14 g
,21
18 g
,22
5.6 g
,26
4.5 g
,28
1 g
,36
2.4 g
,25
PB
,42
,50
,106
,151
,169
TS
,102
101 g
,103
85 g
,107
16 g
,104
56 g
,108
32 g
,109
89 g
,110
56 g


C Meyer
2011
79115
346.3 grams
same bag
79110
66 grams
residue in bag
,0
180 g
,1
22 g
,6
clast A
,7
PB
,18
TS
,14
1.5 g
clast B
,8
PB
,19
TS
,4
13 g
,13
PB
,20
,31
TS
matrix
clast C
,10
TS
clast D
,11
PB
,17
7.5 g
,15
108 g
,16
4.8 g

,

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