14313

Regolith Breccia

144 grams

Figure 1: Photo of 14313. Sample is 6 cm across. NASA S71-29131.

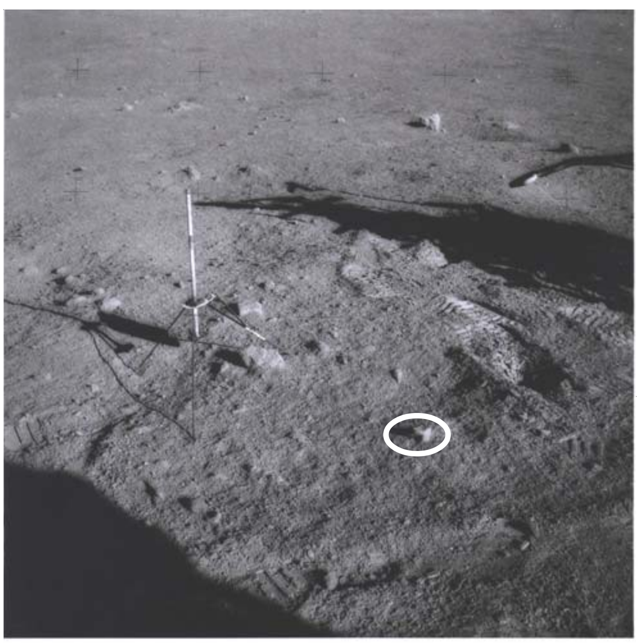


Figure 2: Photo of 14313 before it was collected (AS14-68-9466).

CDR Man, that pile of rocks – beautiful, right to your left. Oh, just the right size. Don't walk over them!
LMP No, I'm trying to stay away from them. Yes _ _ it's' bigger than we thought. Al, we'll grab sample that one; I'll get you another one here.
CDR Okay, bag 27 Nancy. (#14313)
LMP And another documented sample – a larger documented sample than we thought we were getting here, Fredo. Again, it was a burried rock: and it's too big for the sample bag; so, it'll go into the weigh bag. (#14301)

LMP We're approaching Triplet from the east, that's North Triplet from the east. There's a little rock field down here – a small boulder field, Al, to get a documeted sample from.

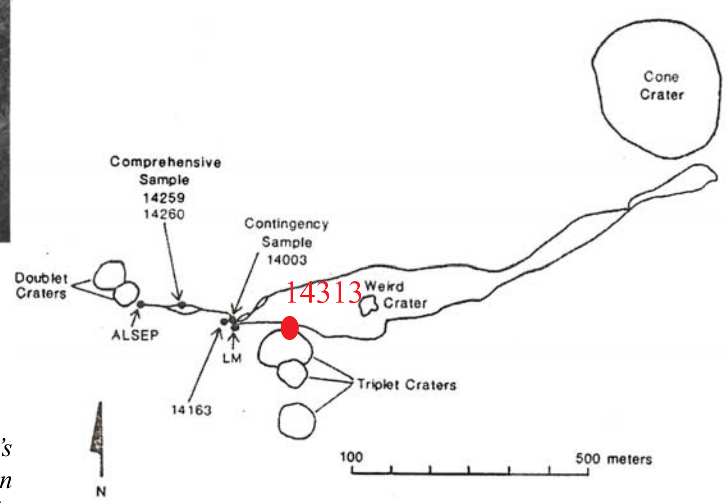


Figure 3: Map of Apollo 14 with location of `14313.

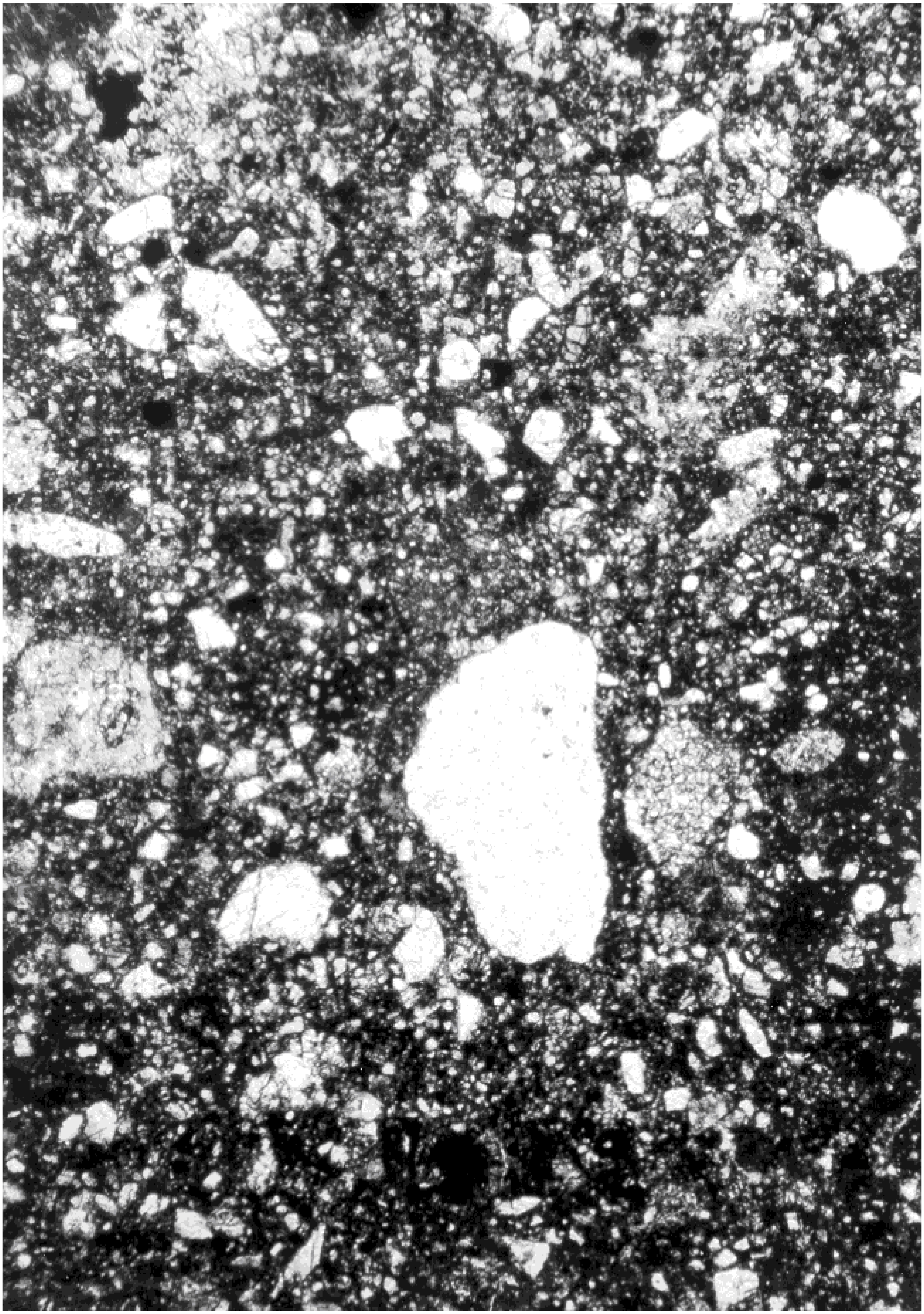


Figure 4: Thin section photomicrograph of 14313 showing seriate texture. Scale 0.5 cm. NASA S71-25455.

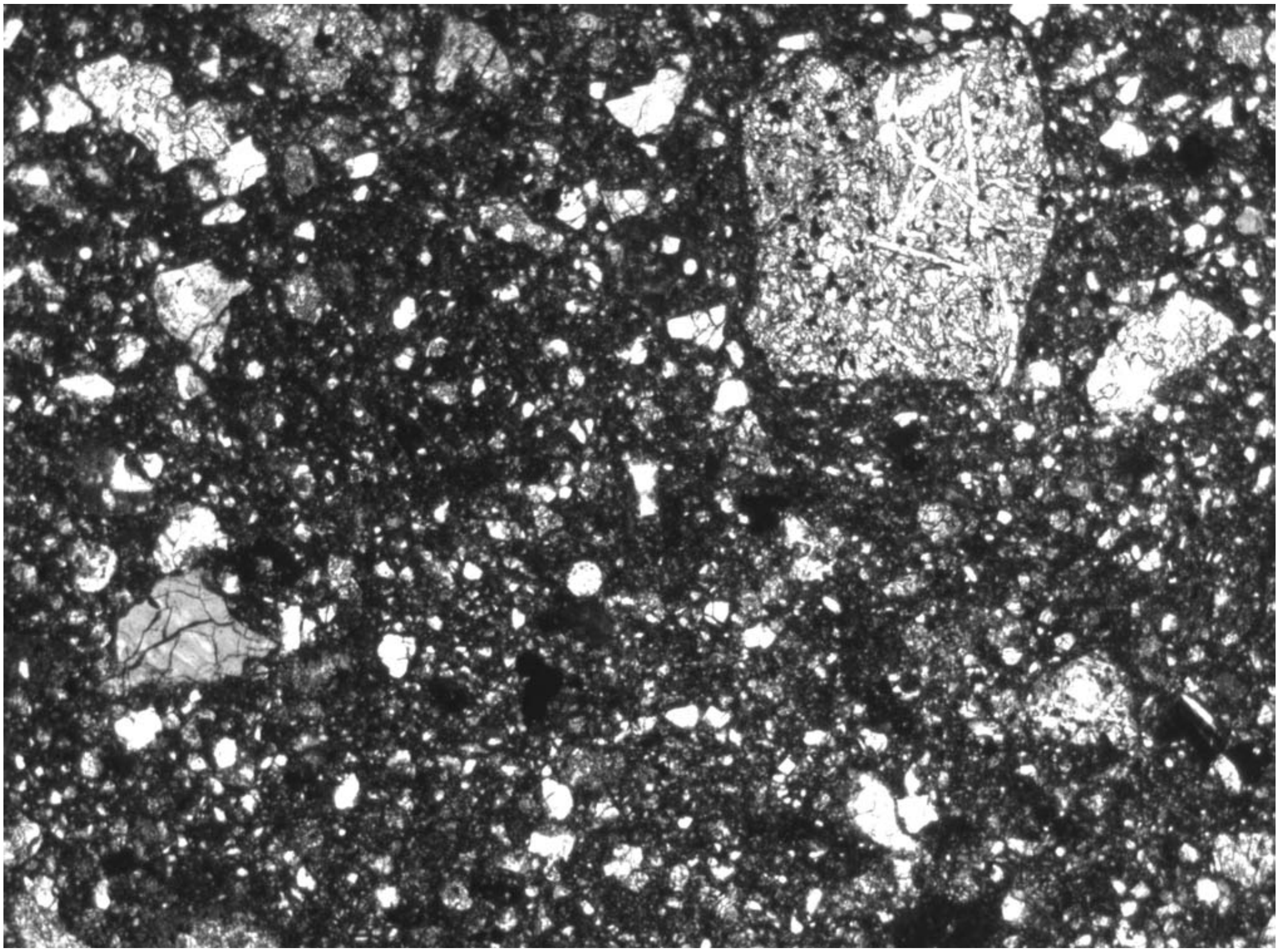


Figure 5: Photomicrograph of thin section 14314,9 showing basalt clast. Scale = 2.8 mm across. Photo by C Meyer.

Introduction

14313 was collected at station G1 on the rim of North Triplet Crater about 150 meters from the LM (figure 3). Like nearby sample 14301, it was also partially "buried" (figure 2), but has been shown to have had a complex exposure history of micrometeorite bombardment indicating "tumbling" while on the regolith surface (Morrison et al. 1972).

14313 is a fine-grained regolith breccia with seriate grain size distribution. It has few large clasts and is mostly matrix. The Apollo 14 regolith breccias (vitric matrix breccias) are slightly more aluminous than the the Fra Mauro breccias (crystalline matrix breccias). They also have intermediate values of C, N, ^{4}He and other elements from the ancient solar wind indicating that they contain a soil component.

Petrography

Lunar sample 14313 is a coherent polymict breccia that has had a complex history of "comminution and re-agglomeration" (Floran et al. 1972). The matrix is composed primarily of fine particles of brown glass (figure 4). Clasts include (1) noritic rock fragments, (2) monomineralic fragments, (3) microbreccia clasts, (4) glassy fragments including chondrules and %) rare mare basalt clasts (figure 9). There is evidence of breccia-in-breccia relations indicating multiple generations of breccia formation.

Drozd et al. (1976) reported a high percentage of agglutinates in 14313, but Simon et al. (1989) found considerably less. Other indications of maturity are relatively high C, N and ^{4}He contents. Fruland (1983) and Simon et al. (1981) classified 14313 as a regolith breccia.

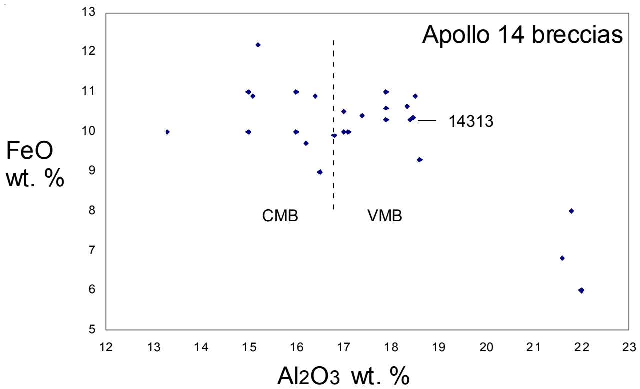


Figure 6: Composition of Apollo 14 breccias with 14313.

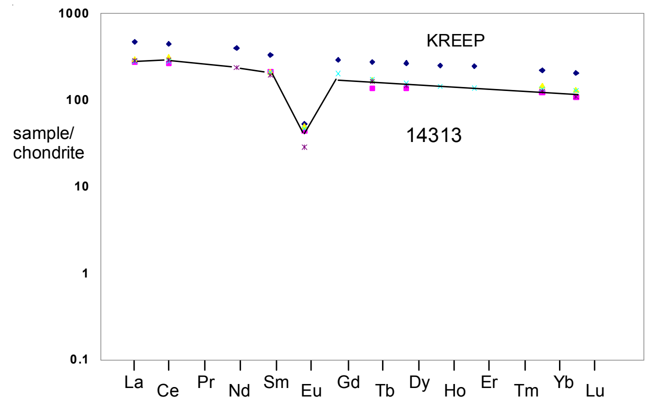


Figure 7: Noramalized rare-earth-element diagrams for 14313 and for KREEP.

King et al. (1972) studied the chondrules in 14313. Delano (1987), Simon et al. (1989) and Wentworth and McKay (1991) reported numerous glass analyses.

Significant Clast

Micronorite (or basalt)

Floran et al. (1972) described a basaltic clast in 14313 as a "micronorite" (figure 9).

Alkali Anorthosite? ,70

Warren et al. (1983) reported a clast of alkali anorthosite.

Chemistry

Boynton et al. (1975), Helmke et al. (1972), Simon et al. (1989) and Hughes et al. (1973) reported the composition of 14313 (table 1). 14313 is relatively high in Al (figure 6) and very high in REE (figure 7).

Moore et al. (1972) reported 130 and 170 ppm carbon for two subsamples of 14301 (figure 10). Becker and Clayton (1975) reported 400 x 10^{-4} ppm He and 47 ppm nitrogen (indications of a substantial solar wind component).

Radiogenic age dating

Alexandra and Kahl (1974) could not obtain an "age" for breccia 14313 by the Ar-Ar technique (figure 11), but state that it is assumed to be 3.7 ± 0.2 b.y.

Other Studies

Becker R.H. and Clayton R.N. (1975) determined the He (400 x 10^{-4} ppm) and nitrogen contents (47 ppm) and isotopic ratio of nitrogen in 14313.

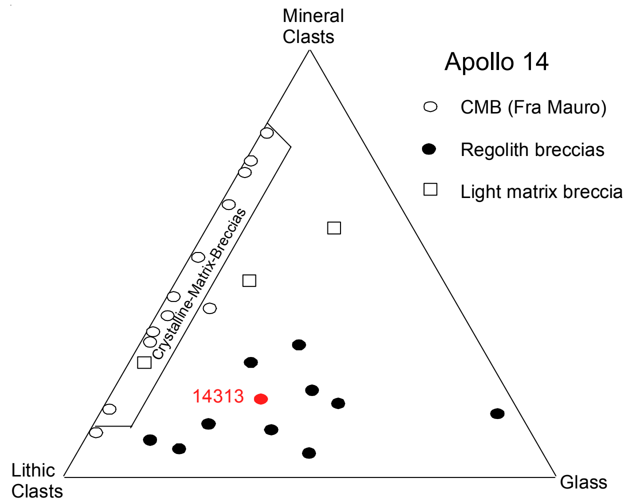


Figure 8: Ratio of clast abundance in Apollo 14 breccia samples with 14313 (Simonds et al. 1977).

Mineralogical Mode for 14313

	Drozd et al. 1977
Mineral fragments	30.9 %
Lithic fragments	19.6
Colored glass	11
Agglutinate glass	36.8
Colorless glass	0.6
Chondrules	0
Devitrified glass	1

Mineralogical Mode for 14313

	Simonds et al. 1977	Drozd et al. 1976	Simon et al. 1989
Matrix	72 %		55.1
Clasts			
Plagioclase	4		5.8
Mafic	1		6.7
Breccia	11.5		~20
Glass	2	12.6	8.1
Granulite	9		2.6
Basalt	1		0.5
Agglutinate		36.8	7.6

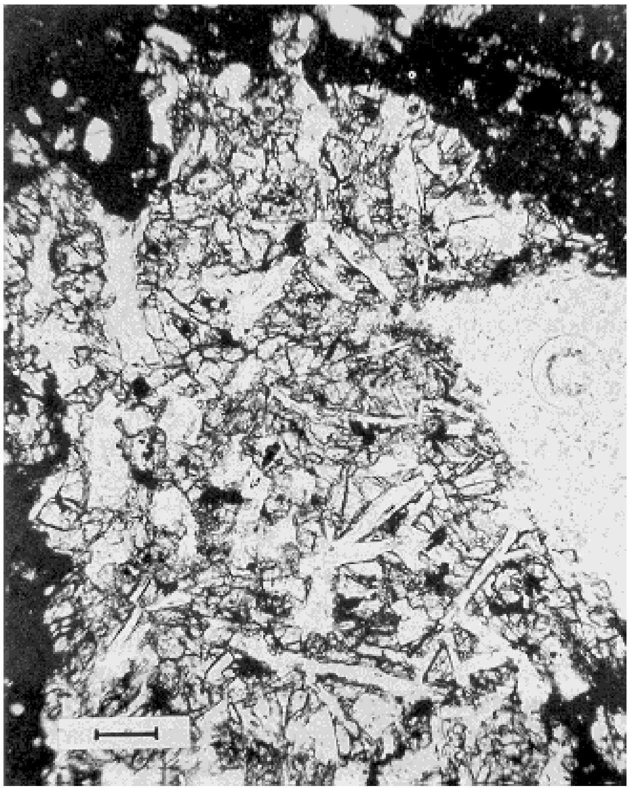


Figure 9: Basaltic or "micronorite" clast in 14313. Scale bar is 100 microns. Floran et al. 1972.

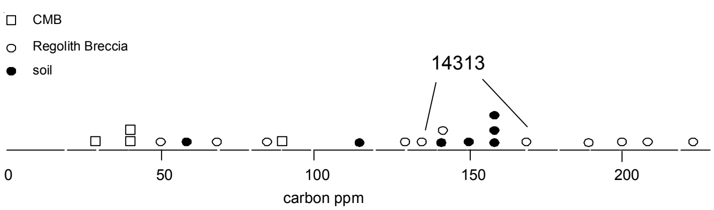


Figure 10: Carbon content of Apollo 14 breccias with values for 14313 (Moore et al. 1972).

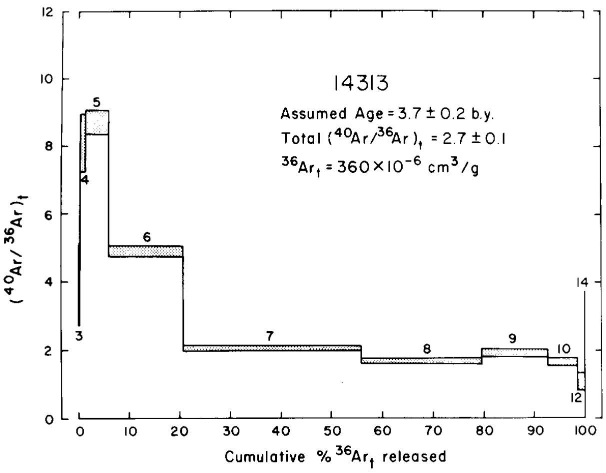


Figure 11: Ar-Ar relase pattern with no age information Alexander and Kahl (1974).

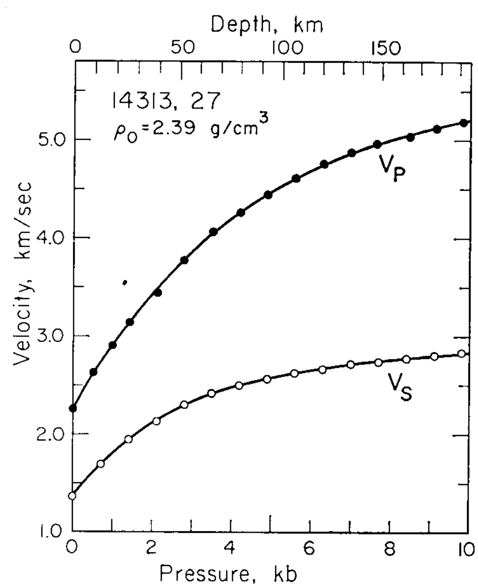
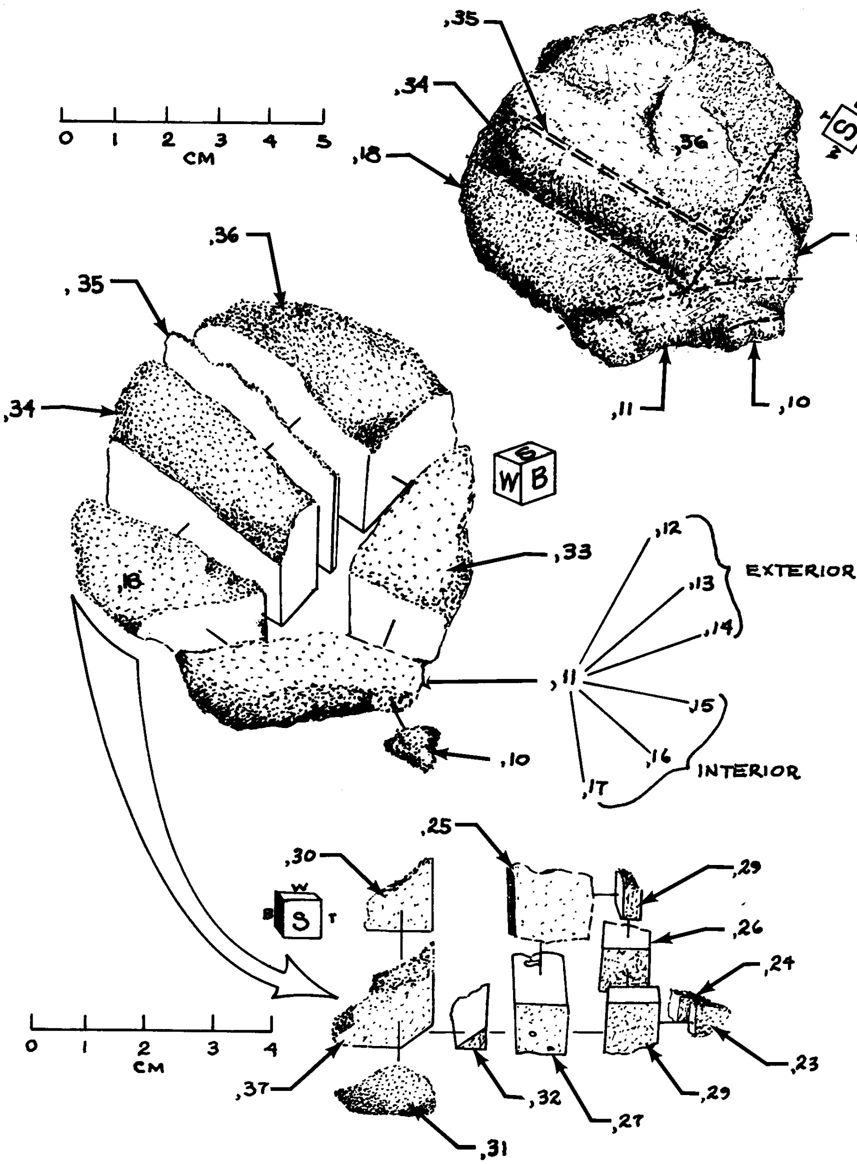


Figure 12: Measeured seismic wave velocity as function of pressure for breccia 14313 (Mitzutani et al. 1972).

Table 1. Chemical composition of 14313 .

reference	Boynton 75			Helmke72		Simon 89		Hughes 73		
weight	262	259 mg				156 mg				
SiO2 %										
TiO2						1.68	(a)			
Al2O3	17.38		(a)			18.4	(a)			
FeO	8.6	10.7	(a)			10.3	(a)			
MnO	0.13		(a)	0.13	(a)	0.123	(a)			
MgO						9.4	(a)			
CaO	9.8	10.6	(a)			11	(a)			
Na2O	0.77		(a)			0.77	(a)			
K2O						0.53	(a)			
P2O5										
S %										
sum										
Sc ppm	19.2	22	(a)	24.6	(a)	21.4	(a)			
V						51	(a)			
Cr	1200	1370	(a)	2450	(a)	1290	(a)			
Co	30	36	(a)	31.5	(a)	32	(a)			
Ni	338		(b)	273	(a)	390	(a)			
Cu										
Zn	35		(b)	56	(a)					
Ga	8.09		(b)	11	(a)					
Ge ppb	700		(b)							
As										
Se										
Rb						13	(a)			
Sr						110	(a)			
Y										
Zr						750	(a)			
Nb										
Mo										
Ru										
Rh										
Pd ppb										
Ag ppb								16	12	(b)
Cd ppb	280		(b)							
In ppb	24		(b)							
Sn ppb										
Sb ppb										
Te ppb										
Cs ppm						0.75	(a)			
Ba	690	760	(a)			810	(a)			
La	64	70	(a)	65.4	(a)	67	(a)			
Ce	160	190	(a)	171	(a)	176	(a)			
Pr										
Nd				114	(a)	108	(a)			
Sm	31	31	(a)	30.8	(a)	28.7	(a)			
Eu	2.46	2.81	(a)	2.65	(a)	2.8	(a)			
Gd				40	(a)					
Tb	5	6.2	(a)	6.3	(a)	6	(a)			
Dy	33		(a)	38	(a)	36	(a)			
Ho				8	(a)					
Er				22	(a)					
Tm										
Yb	20	24	(a)	21.8	(a)	20.1	(a)			
Lu	2.6	3.2	(a)	3.17	(a)	2.65	(a)			
Hf	19	20	(a)	21	(a)	21.3	(a)			
Ta	3		(a)			2.9	(a)			
W ppb										
Re ppb								1.21	0.51	(b)
Os ppb								16.8	7.1	(b)
Ir ppb	10.3		(b)			7	(a)	18	8.1	(b)
Pt ppb										
Au ppb	5.1		(b)			7.2	(a)	8	4.8	(b)
Th ppm	11	13	(a)			11.9	(a)			
U ppm						3.1	(a)			

technique: (a) INAA, (b) RNAA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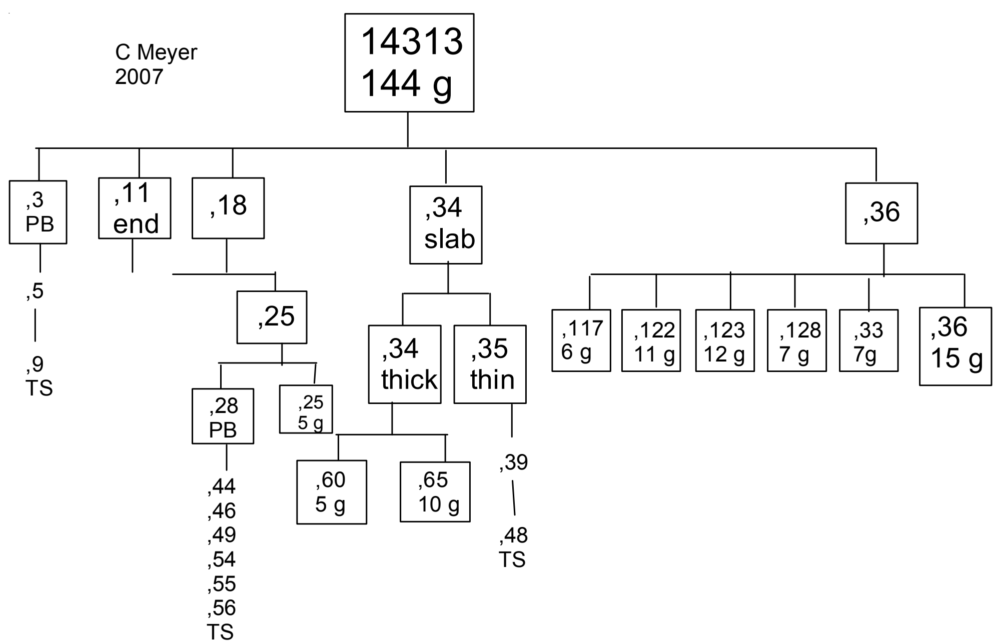
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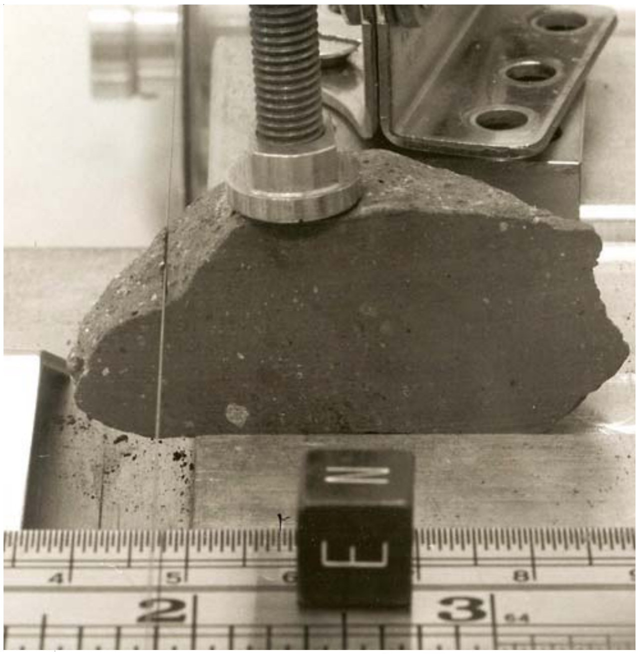

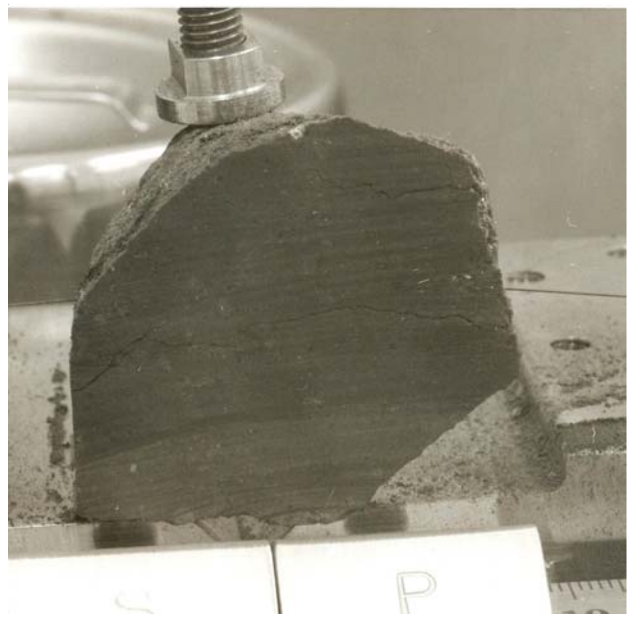


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