

76215

Vesicular Micropoikilitic Impact Melt Breccia

644 grams

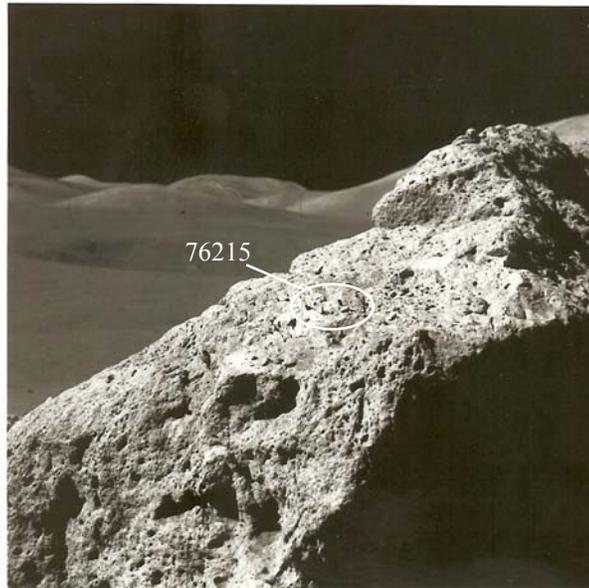


Figure 1: Photo of station 6 boulder with location of 76215 indicated. AS17-140-21421

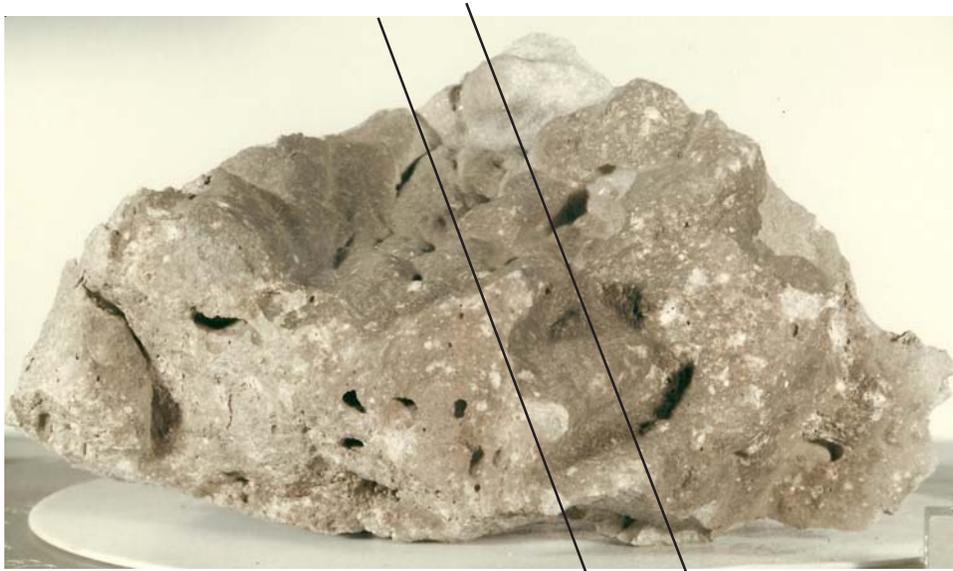


Figure 2: Photo of 76215. Sample is about 10 cm. S72-56372. Location of slab indicated.

LMP There's a big spall lying on the ground here that has been knocked off up there, from right on top of the boulder. And, I tell you, the more I look at this – the south half of this boulder, the more heterogeneous in texture it looks. It look as if it may be either a recrystallized breccia of some kind, or you had a gabbroic anorthosite magma catch up an awful lot of inclusions.

LMP

—

LMP

CDR

I guess I prefer the latter explanation because of the extreme vesicularity of the rock.

A few of the inclusions are – well, they're all subrounded to rounded, and a few of them are very light colored.

I think we ought to pick up a piece of that spall there by the gnomon.

I can break it off.



Figure 3: Thin section photomicrograph showing poikilitic texture of crystalline melt rock.



Figure 4: Plagioclase clast with necklace and overgrowth. Field of view 0.5 mm. (from McGee et al. 1977)

- LMP There's one right by the gnomon we can just pick up. It's a finer grained vesicular rock than – I thought I was going to get this half – Well, they like to have some of it black and white, you know.
- CDR I'll get that rock. We want to get 500s of that boulder track.
- LMP OK. A piece of that spalled rock that was sitting by the gnomon – watch out Gordon. How about that? – is in bag 535 (76215)

Introduction

76215 was collected from the lunar surface right next to the large Station 6 Boulder, but it was most certainly recently spalled from the top of block 4 of Boulder 6 (Wolfe et al. 1981), where there is a fresh mark that fits the sample directly above the location where the sample was found on top of the soil (figure 1). It is a sample of lithologic unit B of the big boulder and is similar in color, texture, composition and age to 76015 chipped from the top of adjacent boulder half.

76215 is a crystalline matrix breccia with a mostly poikilitic texture, but there are some areas that have an ophitic texture characteristic of crystallized (basaltic) melt. It has been dated at 3.94 b.y., with an exposure to cosmic rays for 19 m.y. and has an aluminous composition with high trace element content. It contains high concentrations of meteoritic siderophiles and is thought to be impact melt from the Serenitatis impact.

There is a large area on 76215 that has a surface coating, called patina, with variable thickness from top to bottom, which has not been eroded by bombardment by micrometeorites.

Petrography

Simonds (1975), McGee et al. (1977), Phinney (1981), and Meyer (1994) give descriptions of 76215. It is a vesicular, crystalline matrix breccia with a crude macroscopic foliation defined by the alignment of vesicles and cavities, including the roughly flat side of a large cavity that defines one side of the sample (figure 8). Over 90% of the matrix is poikilitic made up of a network of coalescing pigeonite and augite oikocrysts (0.5 to 2 mm) which enclose abundant tabular plagioclase chadocrysts (10-30 microns). Olivine occurs as irregular chadocrysts within pyroxene and as granular grains between oikocrysts. The remaining 10% of matrix has an ophitic texture with a fine intergrowth of euhedral plagioclase (0.2 to 0.35 mm) and subhedral pyroxene (0.2 to 0.8 mm). The contact between the two different matrix textures is said to be "distinct" (Simonds 1975). Some plagioclase clasts in the matrix have necklaces of mafic minerals and an overgrowth about 30 microns wide (figure 4).

Vugs in 76015 and 76215 contain euhedral crystals of troilite and metallic iron with crystal growth steps (Carter et al. 1975). Goldberg et al. (1975) reported thin coatings of F.

Significant Clast

Granulitic Anorthosite: ,70

McGee et al. (1977) describe a "large" anorthosite clast (2 mm) with polygonal grain boundaries and coarse texture in thin section 76215,70.

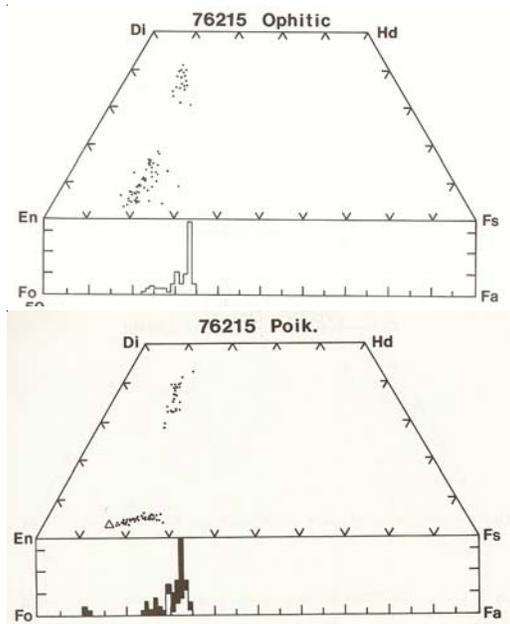


Figure 5: Pyroxene and olivine composition in 76215 (Phinney 1981).

Mineralogical Mode for 76215

	Simonds (1975)
Olivine	7-14 %
Low-Ca pyroxene	30
High-Ca Pyroxene	4-11
Plagioclase	50
Ilmenite	2

Mineralogy

Olivine: Olivine is Fo₆₅₋₇₅

Pyroxene: Simonds (1975) found that the pyroxene composition in the two different matrix textures was zoned slightly different (figure 5).

Plagioclase: Plagioclase is An₉₅₋₈₀

Metallic iron: Misra et al. (1976) determined the Ni and Co content of iron grains (figure 6).

Chemistry

Keith et al. (1974) determined the K, U and Th content of 76215 (complete sample). Simonds (1975) and Wiesmann and Hubbard (1975) found that the major and trace element composition of 76215 was identical to that of other samples of this boulder. Higuchi and Morgan (1975) determined trace volatile and siderophile elements. Puchtel et al. (2008) have

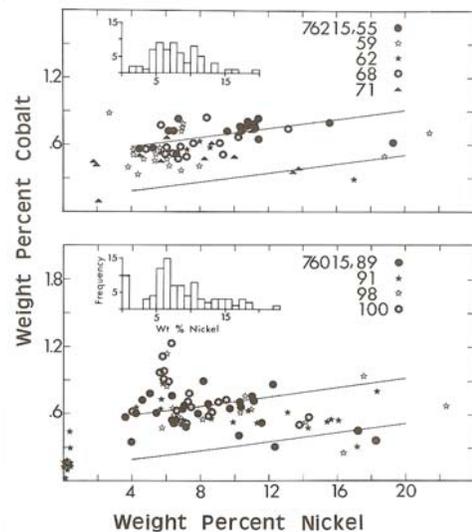


Figure 6: Ni and Co content of metal grains in 76015 and 76215 (Misra et al. 1976).

determined Re, Os, Ir, Ru, Pt, Pd and Os isotopes in 11 splits of 76215.

Radiogenic age dating

Cadogen and Turner (1976) dated 76215 along with other samples from the large boulder (figure 8). They obtained an age of 3.94 ± 0.04 b.y. by the Ar/Ar plateau technique.

Cosmogenic isotopes and exposure ages

Keith et al. (1974) determined the cosmic-ray-induced activity of $^{26}\text{Al} = 56$ dpm/kg., $^{22}\text{Na} = 60$ dpm/kg., $^{54}\text{Mn} = 22$ dpm/kg., $^{56}\text{Co} = 45$ dpm/kg and $^{48}\text{V} = 5$ dpm/kg.

Cadogen and Turner (1976) determined an exposure age of 19 m.y. by the ^{38}Ar method.

Other Studies

As in the case of 76015, 76215 has an apparently shielded interior surface of a large cavity (however, 76215 was recently broken from the boulder). The “lip” of this cavity has a thick, undisturbed patina which grades to thin (figure 9). Morrison and Zinner (1977) studied the crater size distribution and solar flare track density as function of depth in 76215.

Zinner et al. (1977) used 76215 to study Mg and Fe depth profiles in plagioclase due to solar flares, but this study is surely compromised by glass splashes on the exposed surface.

Table 1. Chemical composition of 76215.

reference weight	Higuchi75		Keith74	Putchel2008 ave.	
	Simonds75	Wiesmann75			
SiO2 %	46.13	46.02	(a)		
TiO2	1.24	1.52	(a)		
Al2O3	18.73	17.83	(a)		
FeO	8.08	8.7	(a)		
MnO					
MgO	12.43	12.21	(a)		
CaO	11.5	11.1	(a)		
Na2O					
K2O	0.24	0.28	(c)	0.26	(b)
P2O5	0.24	0.28	(a)		
S %	0.07	0.1	(a)		
<i>sum</i>					
Sc ppm					
V					
Cr					
Co					
Ni	54		(d)		
Cu					
Zn	2.5		(d)		
Ga					
Ge ppb	31.5		(d)		
As					
Se	60		(d)		
Rb	6.1	6.89	(c)		
Sr					
Y					
Zr	459	495	(c)		
Nb					
Mo					
Ru				11.4	(c)
Rh					
Pd ppb				11.4	(c)
Ag ppb	0.87		(d)		
Cd ppb	1.08		(d)		
In ppb					
Sn ppb					
Sb ppb	0.44		(d)		
Te ppb					
Cs ppm	0.192				
Ba	294	352	(c)		
La	27.3	33.4	(c)		
Ce	68.9	83.6	(c)		
Pr					
Nd	43.7	52.2	(c)		
Sm	12.3	14.9	(c)		
Eu	1.7	1.99	(c)		
Gd	15.9	19.3	(c)		
Tb					
Dy	16.5	19.7	(c)		
Ho					
Er	9.9	11.8	(c)		
Tm					
Yb	9	10.9	(c)		
Lu					
Hf					
Ta					
W ppb					
Re ppb	0.07		(d)	0.6	(c)
Os ppb				6.064	(c)
Ir ppb	0.809		(d)	6.18	(c)
Pt ppb				15	(c)
Au ppb	0.526		(d)		
Th ppm	4.61	5.2	(c)	4.6	(b)
U ppm	1.26	1.5	(c)	2.27	(b)

technique: (a) XRF, (b) radiation counting, (c) IDMS, (d) ICP-MS

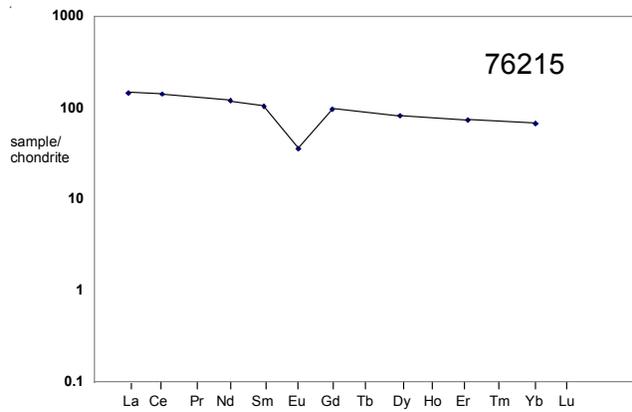


Figure 7: Normalized rare-earth-element diagram for 76215.

Processing

A slab was cut through the middle of 76215 and columns were cut from the slab (figure 11). However, their orientation with respect to the surface of the Moon, and direction of cosmic rays, is unknown. In addition, it is not known how long the sample was exposed where it was found, on top of the regolith.

There are 22 thin sections of 76215.

Gose et al. (1978) and Brecher (1976) have carefully studied the remanent magnetization of 26 subsamples from the Station 6 Boulder, finding that the direction of magnetization was generally aligned with direction of foliation.

Bogard (1974) determined the content and isotopic ratio of rare gases in 76215.

Summary of Age Data for 76215

	Ar/Ar
Cadogen and Turner (1976)	3.94 ± 0.04 b.y.
Caution: Decay constant --	

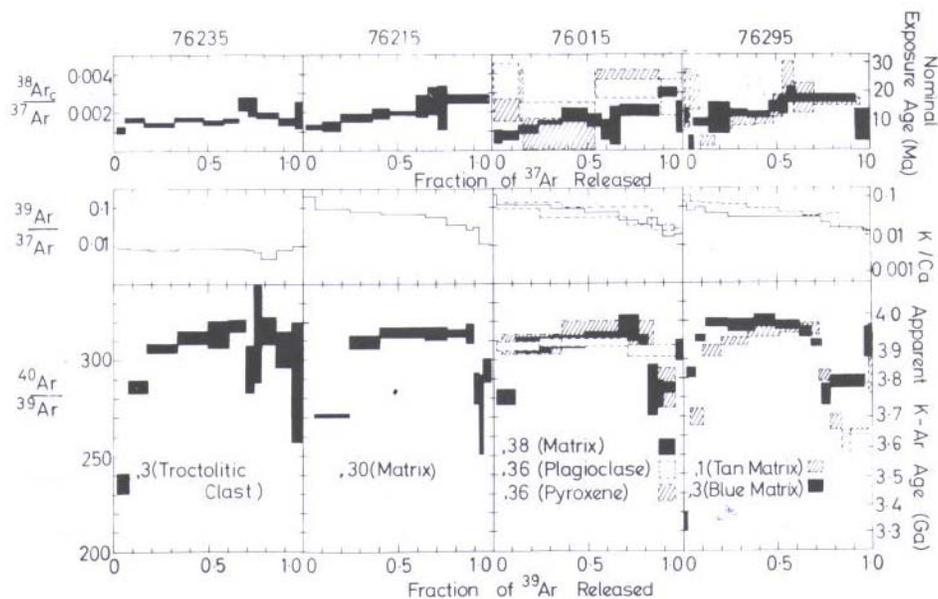


Figure 8: Argon release diagrams for samples of station 6 boulder including 76215 etc. (Cadogen and Turner 1976).

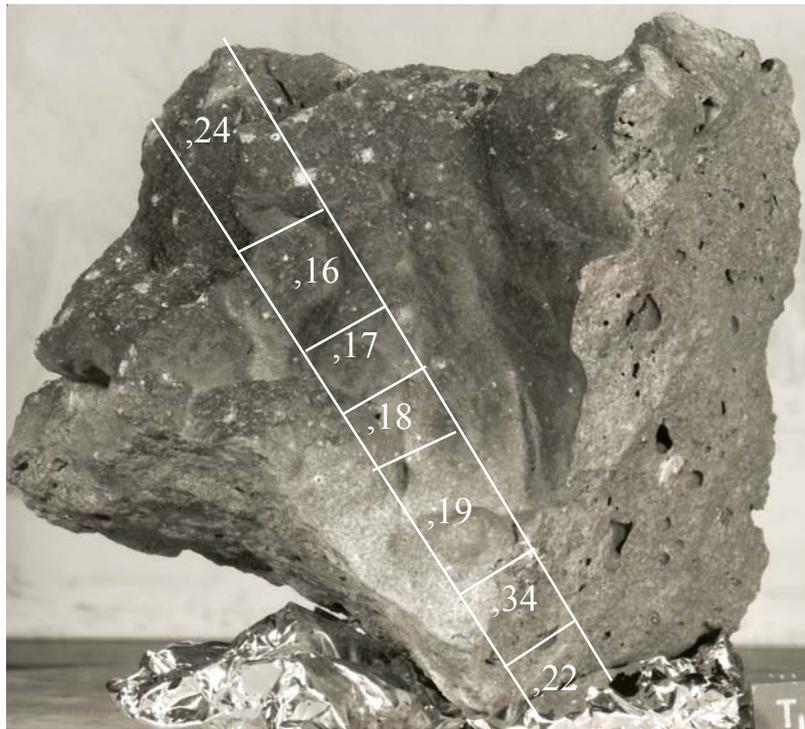


Figure 9: Patina-covered surface of 76215 showing thick patina at top with minor zap pits gradational to thin patina and no zap pits at bottom. Cube is 1 cm. S73-28422.

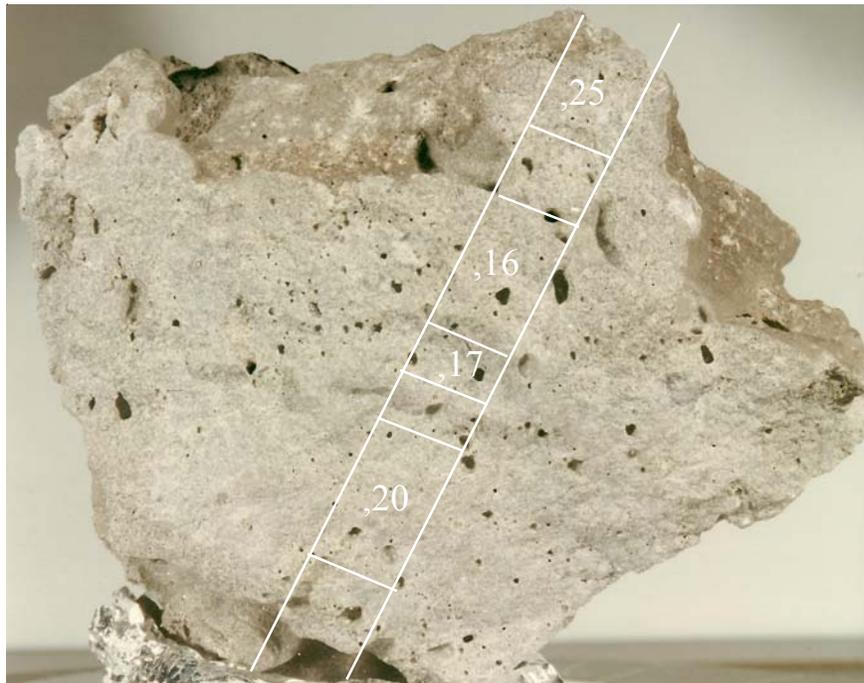


Figure 10: Broken surface of 76215 (B1) showing position of slab. S72-56374.

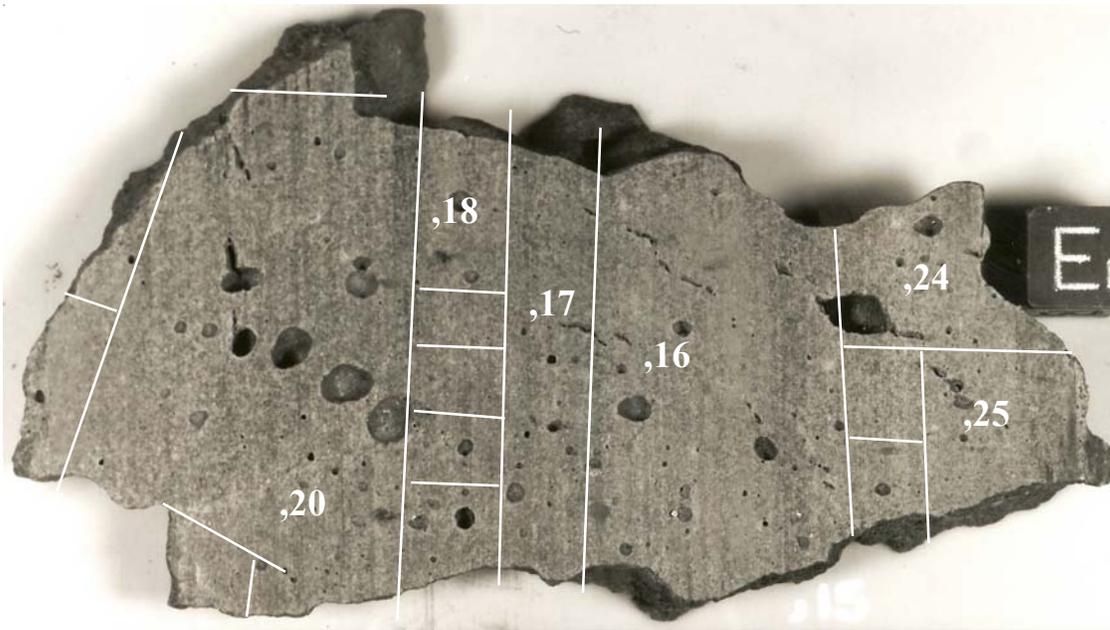
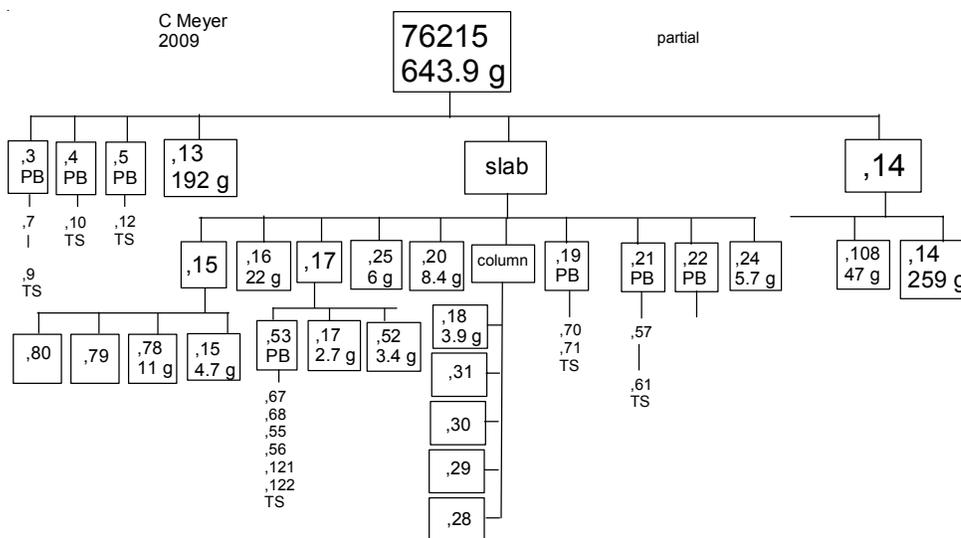


Figure 11: Photo of slab ,15 cut from 76215. Cube is 1 cm. S74-20758. Location of columns indicated.



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