73216

Impact melt Breccia

162.2 grams

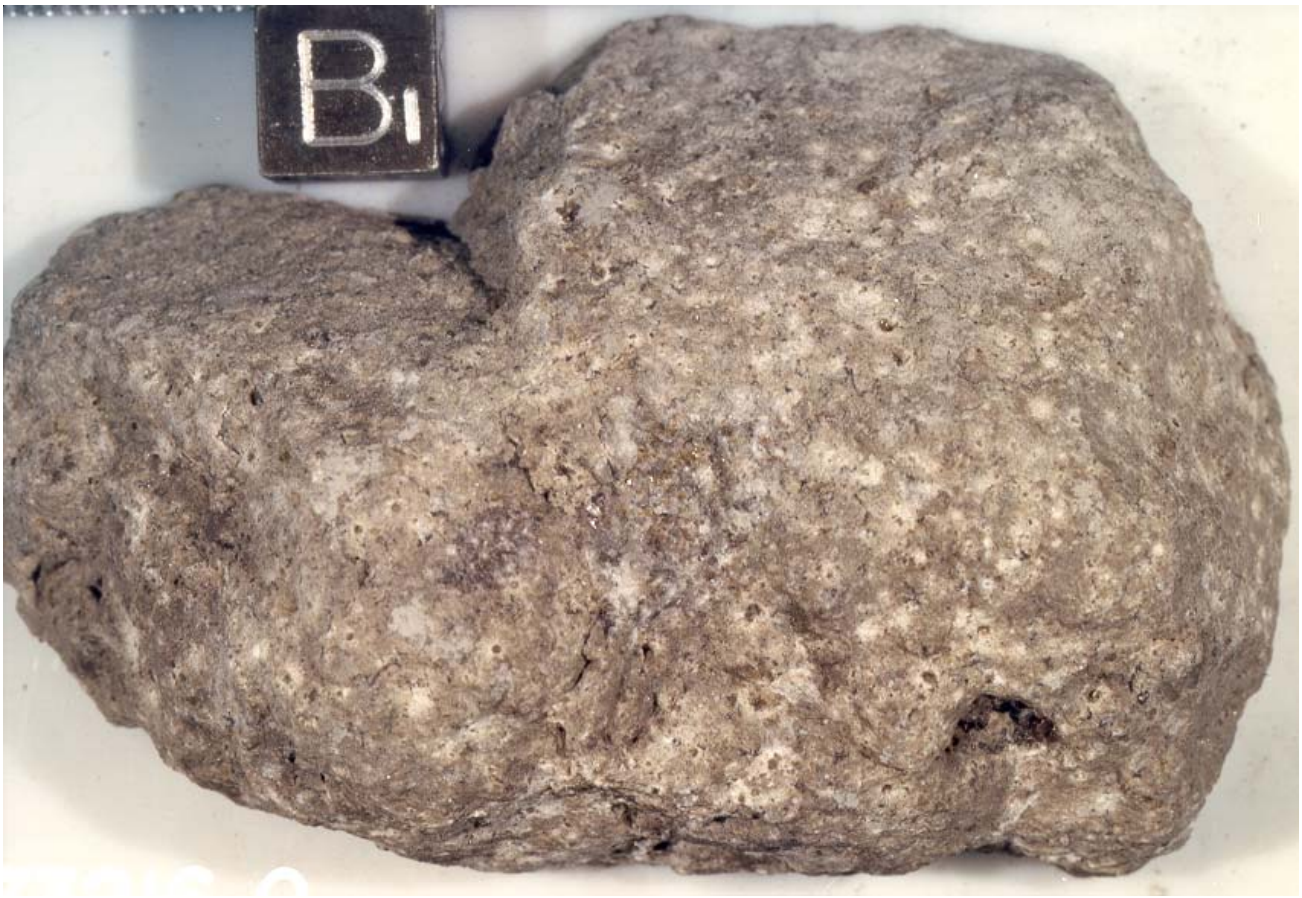


Figure 1: Photo of 73216 showing abundant micrometeorite craters. Cube is 1 cm. NASA S8946682.

Introduction

Wolfe et al. (1981) describe 73216 as having a fine-grained granoblastic matrix. Ryder (1993) describe it as a crystalline impact melt containing angular mineral and lithic clasts, with the thin sections showing a fairly dark, fine-grained groundmass. It was picked up off the regolith from the rim of a ten meter crater and has micrometeorite pits on all sides (figure 1). It has not been dated.

Petrography

Figure 7 shows the interior of 73216 with a few percent small cavities and vague clasts. Neal and Taylor (1998) studied five clasts extracted from the matrix of 73216. All of these clasts were found to have high Ir and Au contents.

Significant Clasts

Gabbronoritic Anorthosite ,36 ,61 ,7001 (,66)

This clast has a cumulate texture with interlocking plagioclase (An_{87-95}), low-Ca pyroxene ($Wo_{4-5}En_{75}$), high-Ca pyroxene ($Wo_{38}En_{50}$) with some recrystallized zones evident by triple junctions. Small olivine grains (Fo_{91}) occur as "necklaces" around large plagioclase grains. More details are given in Neal and Taylor (1998).

Recrystallized Anorthositic Gabbronorite ,38 ,62 ,7002 (,67)

This clast has a granulitic to granoblastic texture composed of large plagioclase (up to 1.5 mm)(An_{95-83}), smaller olivine (Fo_{70}), orthopyroxene ($Wo_{4-5}En_{75}$), clinopyroxene ($Wo_{29-39}En_{50}$) and fine plagioclase-rich matrix. Devitrified impact melt permeates the breccia

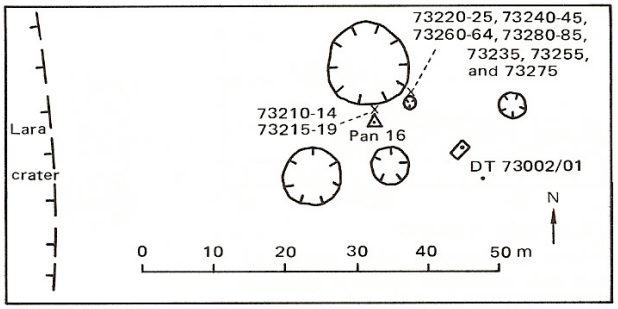


Figure 2: Map of station 3, near Lara Crater out in the middle of the light mantle.

matrix and corrodes the larger plagioclase grains. Composition (determined by Roman Schmitt) is given in table 1, figure 6.

Devitrified Impact Melt ,42 ,63 ,7003 (,68)
This clast has acicular plagioclase crystals forming a variolitic texture. Plagioclase is zoned An_{85-94}. Ilmenite needles tend to cut across the variolitic plagioclase. Olivine (Fo_{67}) forms cores to pyroxene ($Wo_{4-5}En_{75}$). More details are given in Neal and Taylor (1998).

Recrystallized Norite ,49 ,7004 (,69)
This clast has a recrystallized cataclastic to granoblastic-annealed texture (Neal and Taylor 1998). Porphyoblasts of plagioclase (An_{93-96}), skeletal ilmenite and low Ca-pyroxene are penetrated by devitrified impact melt glass.

Gabbronoritic Anorthosite ,57 ,65 ,7005 (,70)
This clast exhibits a striking orthocumulate texture with intercumulus pyroxenes (up to 0.8 mm) set in a cumulus plagioclase (An_{98-93}). The pyroxene ($Wo_{4-5}En_{75}$ and $Wo_{40}En_{50}$) contains exsolved lamellae indicating slow cooling.

Chemistry
No data on the matrix, only the clasts.

Radiogenic age dating
None

Cosmogenic isotopes and exposure ages
None

Processing
73216 was sawn in half (1989), but was not slabbed. There are 11 thin sections.

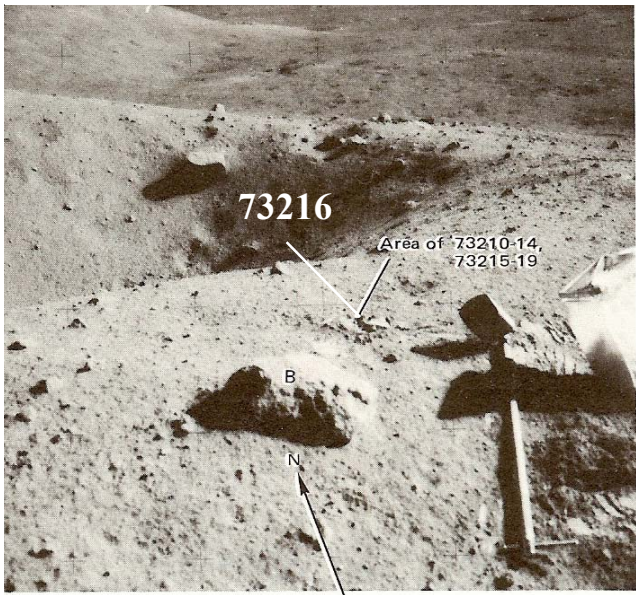


Figure 3: Location of 73216 on rim of 10 m crater near Lara.

References for 73216
Butler P. (1973) Lunar Sample Information Catalog Apollo 17. Lunar Receiving Laboratory. MSC 03211 Curator's Catalog. pp. 447.

Eckert J.O., Taylor L.A. and Neal C.R. (1991a) Spinel troctolite from Apollo 17 breccia 73215: Evidence for petrogenesis as deep-seated lunar crust (abs). *Lunar Planet. Sci.* **XXII**, 329-330. Lunar Planetary Institute, Houston.

Eckert J.O., Taylor L.A., Neal C.R. and Schmitt R.A. (1991b) Cumulate lithologies and melt rocks from Apollo 17 breccias: Correlations of whole-rock and mineral chemistry (abs). *Lunar Planet. Sci.* **XXII**, 333-334. Lunar Planetary Institute, Houston.

Eckert J.O., Taylor L.A., Neal C.R. and Patchen A.D. (1991c) Anorthosites with negative Eu anomalies in Apollo 17 breceias: Further evidence for "REEP" metasomatism (abs). *Lunar Planet. Sci.* **XXII**, 331-332. Lunar Planetary Institute, Houston.

LSPET (1973) Apollo 17 lunar samples: Chemical and petrographic description. *Science* **182**, 659-672.

LSPET (1973) Preliminary Examination of lunar samples. Apollo 17 Preliminary Science Rpt. NASA SP-330. 7-1 – 7-46.

Meyer C. (2010) Lunar Sample Compendium (abs#1016). The *41st Lunar Planet. Sci. Conf.* @ The Woodlands

Muehlberger et al. (1973) Documentation and environment of the Apollo 17 samples: A preliminary report. Astrogeology

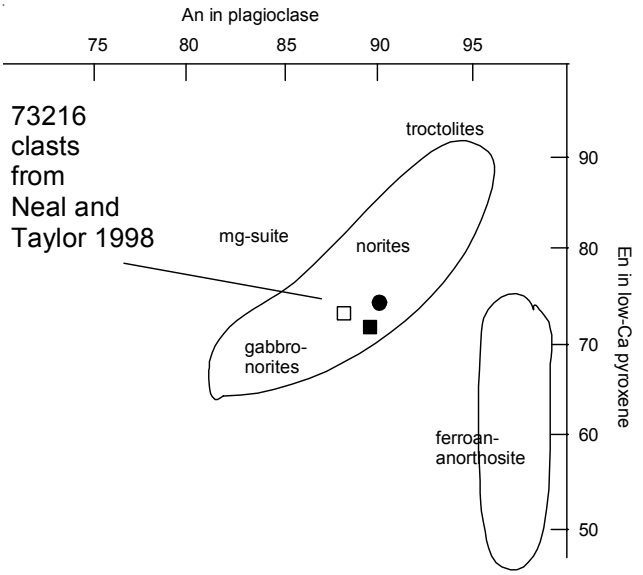


Figure 4: Composition of minerals in clasts in 73216.

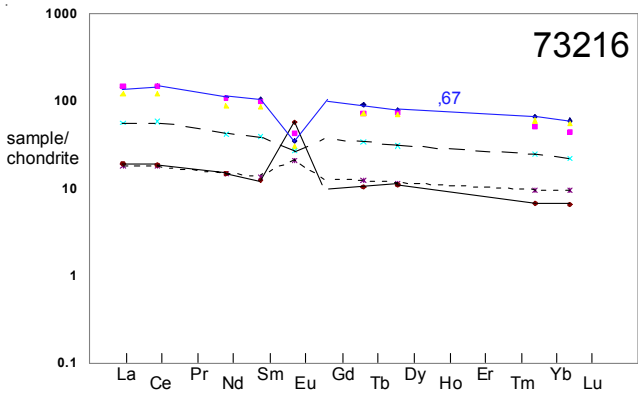


Figure 5: Normalized rare-earth-element diagram for clasts in 73216. Data from Table 1.

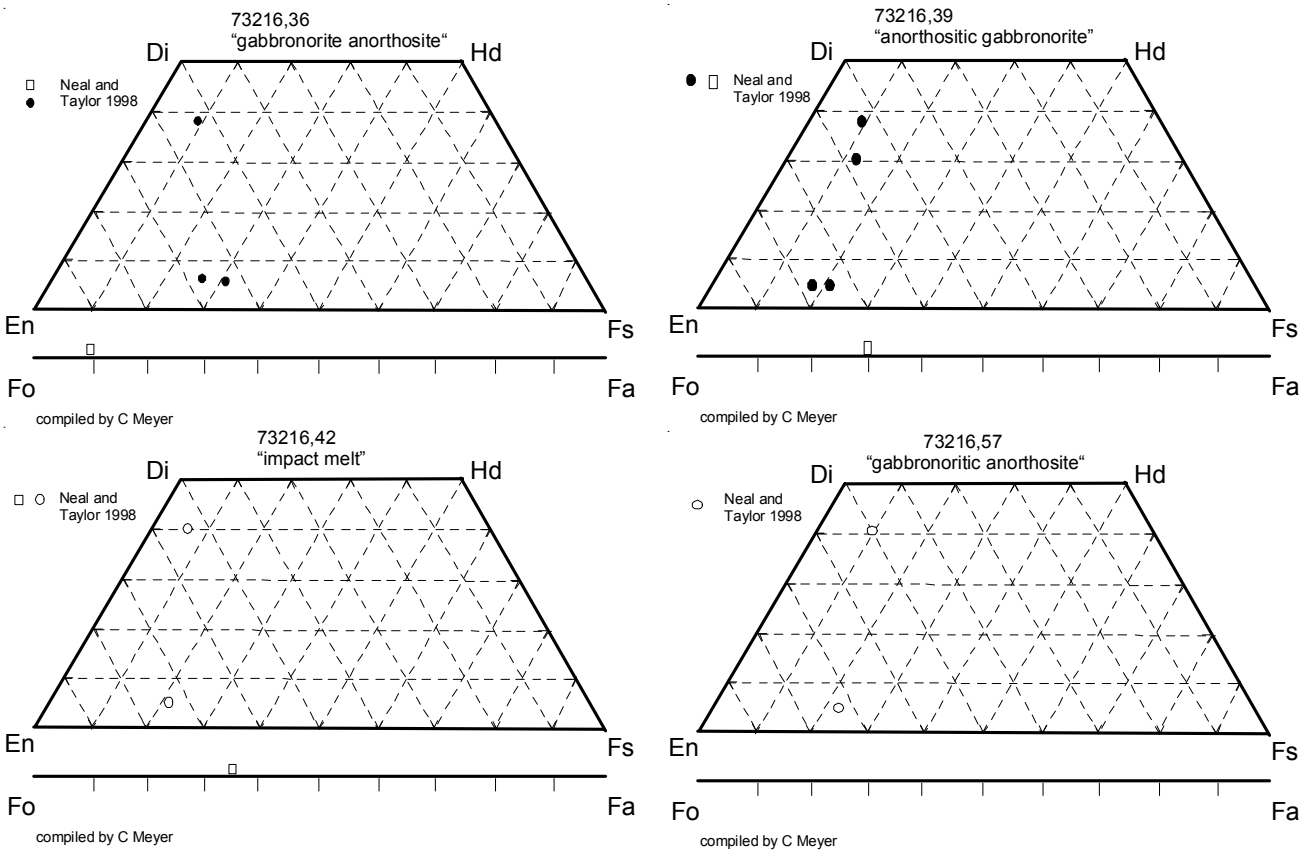


Figure 6: Pyroxene and olivine data for clasts in 73216 (from Neal and Taylor 1998).

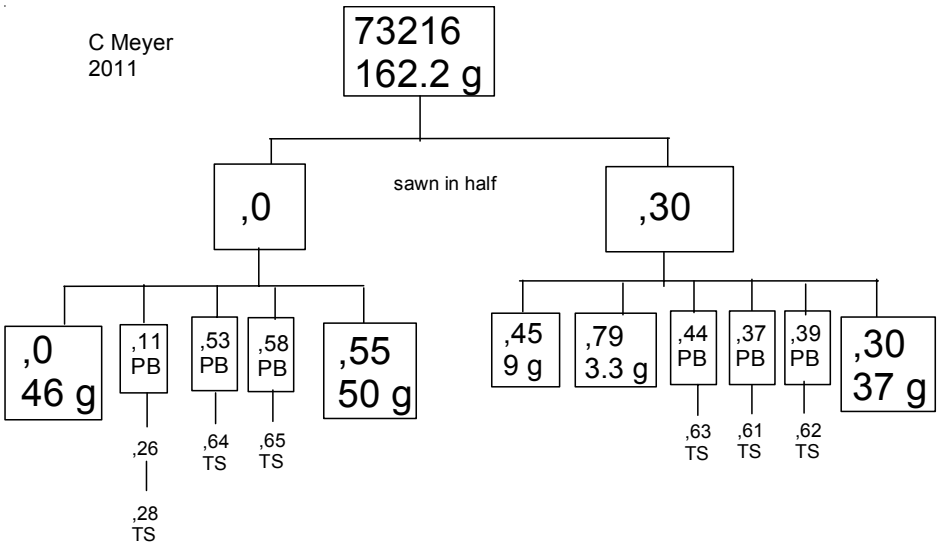
71 322 pp superceeded by Astrogeolgy 73 (1975) and by Wolfe et al. (1981)

Muehlberger W.R. and many others (1973) Preliminary Geological Investigation of the Apollo 17 Landing Site. *In* **Apollo 17 Preliminary Science Report.** NASA SP-330.

Neal C.R. and Taylor L.A. (1998) Exploring the complexities of the Serenitatis basin: Breccia clasts from Apollo 17. *International Geology Review* **40**, 945-962. (also in Planetary Petrology and Geochemistry 155-172. GSA)

Ryder G. (1993c) Catalog of Apollo 17 rocks: Stations 2 and 3. Curators Office JSC#26088.

Figure 7: NASA S89-46683. Sawn surface of 73216,0 before breaking. About 7.5 cm across.



Wolfe E.W., Bailey N.G., Lucchitta B.K., Muehlberger W.R., Scott D.H., Sutton R.L and Wilshire H.G. (1981) The geologic investigation of the Taurus-Littrow Valley: Apollo 17 Landing Site. US Geol. Survey Prof. Paper, 1080, pp. 280.

Table 1. Chemical composition of 73216.

	matrix	impact	norite	anor.	anor.	anor.	
reference	Neal and Taylor 1998 (analyses by Roman Schmitt)						
weight	,67	,68	,49	,60	,70	,229	
SiO2 %							
TiO2	1.7	1.45	1.32	0.66	0.23	0.69	(a)
Al2O3	17.8	21.8	15.3	28.2	27.7	27.4	(a)
FeO	7.94	4.4	8.9	3.4	2.67	3.9	(a)
MnO	0.1	0.06	0.13	0.04	0.04	0.05	(a)
MgO	10.2	7	13.3	3.3	4.2	5.9	(a)
CaO	11.9	14.7	9.7	15.9	17.5	14.2	(a)
Na2O	0.71	0.75	0.57	0.64	0.39	1.21	(a)
K2O	0.36	0.39	0.24	0.14	0.03	0.18	(a)
P2O5							
S %							
sum							
Sc ppm	17.5	9.8	17.7	8.9	5.3	3	(a)
V	41	27	43	25	15	17	(a)
Cr	1260	700	1500	660	390	440	(a)
Co	20.8	8.2	18.6	20.1	5.8	5.8	(a)
Ni	190	80	160	170	60		(a)
Cu							
Zn							
Ga							
Ge ppb							
As							
Se							
Rb				4			(a)
Sr	220	270	140	200	190	410	(a)
Y							
Zr							
Nb							
Mo							
Ru							
Rh							
Pd ppb							
Ag ppb							
Cd ppb							
In ppb							
Sn ppb							
Sb ppb							
Te ppb							
Cs ppm	0.43	0.42	0.26				
Ba	390	430	320	170	80	130	(a)
La	34	35	29	13.1	4.3	4.5	(a)
Ce	89	89	73	35	11.1	11.3	(a)
Pr							
Nd	50	49	40	19	6.8	6.7	(a)
Sm	15.2	14.1	12.6	5.8	1.98	1.81	(a)
Eu	1.96	2.42	1.68	1.49	1.18	3.19	(a)
Gd							
Tb	3.3	2.6	2.6	1.22	0.45	0.38	(a)
Dy	19	18	17	7.5	2.8	2.7	(a)
Ho							
Er							
Tm							
Yb	10.7	8.3	9.7	4	1.55	1.09	(a)
Lu	1.45	1.08	1.35	0.53	0.23	0.16	(a)
Hf	12.4	10	9.6	3.4	1.02	0.9	(a)
Ta	1.92	1.49	1.32	0.55	0.13	0.19	(a)
W ppb							
Re ppb							
Os ppb							
Ir ppb	5				15		
Pt ppb							
Au ppb	4	8	5	8	11	6	
Th ppm	5.3	4.8	4.4	1.53	0.45	0.47	(a)
U ppm	1.5	1.4	1.3	0.42			(a)
technique:	*(a) INAA*						