60215

Cataclastic Anorthosite (brecciated?)

386 grams

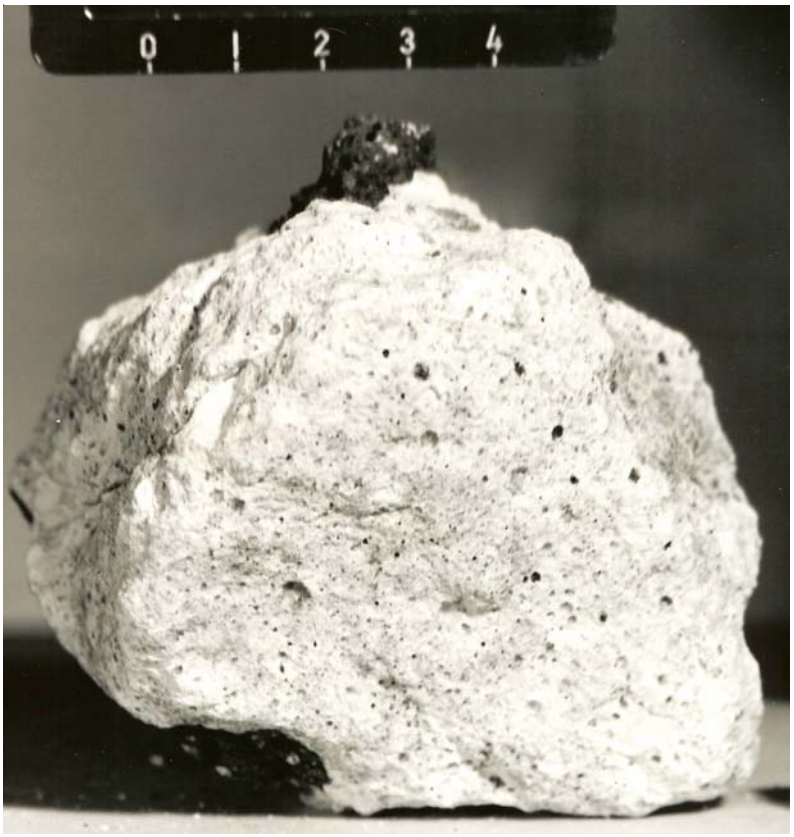


Figure 1: Photo of 60215 showing glass-lined micrometeorite pits. Scale at top is in cm. S72-44468

Introduction

60215 is actually a polymict breccia, because it apparently contains clasts of material other than anorthosite. However, the largest portion is almost pure white and very plagioclase rich (figures 9 and 10). The anorthositic portion is both highly shocked and cataclastic (figures 4 and 6).

The analysis of 60215 shows it has very little Ni, Co nor carbon, so that the main portion of 60215 is considered "pristine". It has not been dated, but an exposure age to cosmic ray of 2.3 m.y. has been determined. The rock was apparently originally encased in black glass (figure 2), which has been eroded or chipped away by micrometeorite bombardment.

Petrography

Meyer and McCallister (1973) and Dixon and Papike (1975) have reported on the petrography of 60215 and analyzed the mineral compositions. McGee (1993) reported: *"This cataclastic anorthosite is highly shocked and has numerous, brown mottled fragments of plagioclase composition (probably devitrified maskelynite) that contain abundant, minute (<1 mm) mafic inclusions. Plagioclase fragments are relatively coarse (2-3 mm). Pyroxene fragments are rare and are generally less than 0.1 mm across, except for one texturally distinctive millimeter-size, shocked and strongly zoned pigeonite clast. This pigeonite clast is relatively Mg rich and strongly zoned in Mg and Fe content ($Wo_{15}En_{69}$ to $Wo_{20}En_{55}$), has granular exsolution due to partial inversion, and has minor intergrown olivine (Fo_{67}). A second, smaller fragment adjacent to*

Figure 2: Penetrative fracture which split 60215. Also note glass splash. Cube is 1 cm. S72-44478

this pigeonite is extremely Fe rich ($Wo_{20}En_{55}$). These two zoned pyroxene fragments appear to be exotic and are not included in the data tabulations. Low-Ca pyroxene compositions are heterogeneous; subordinate high-Ca pyroxene is more homogeneous. Compositions agree with previous studies. Rare chromite and olivine are present."

Another exotic material found within 60215 is represented small inclusions of "troctolitic basalt" (figures 7 and 8).

Warren (1993) argued that at least a portion of this sample is "pristine". Hunter and Taylor (1981) found no rust.

Mineralogy

***Olivine**:* Dixon and Papike (1975) give a complete analysis of an olivine xenocryst (Fo_{78}).

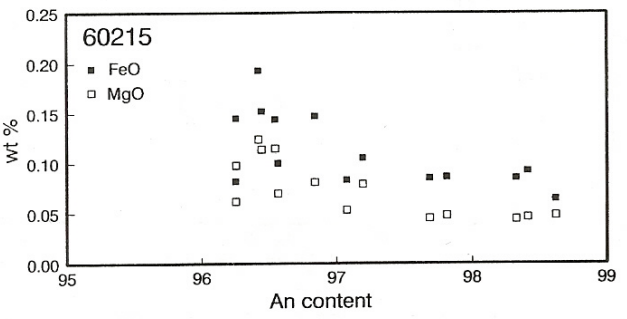


Figure 3: Composition of plagioclase a la McGee (1993).

Pyroxene: Bersch et al. (1991) give precise analyses of pyroxene. Ishii et al. (1976) calculated an equilibrium temperature of 1005 deg. C using the pyroxene data from Dixon and Papike (figure 4 a,b). Other grains of zoned pyroxene are found as xenocrysts.

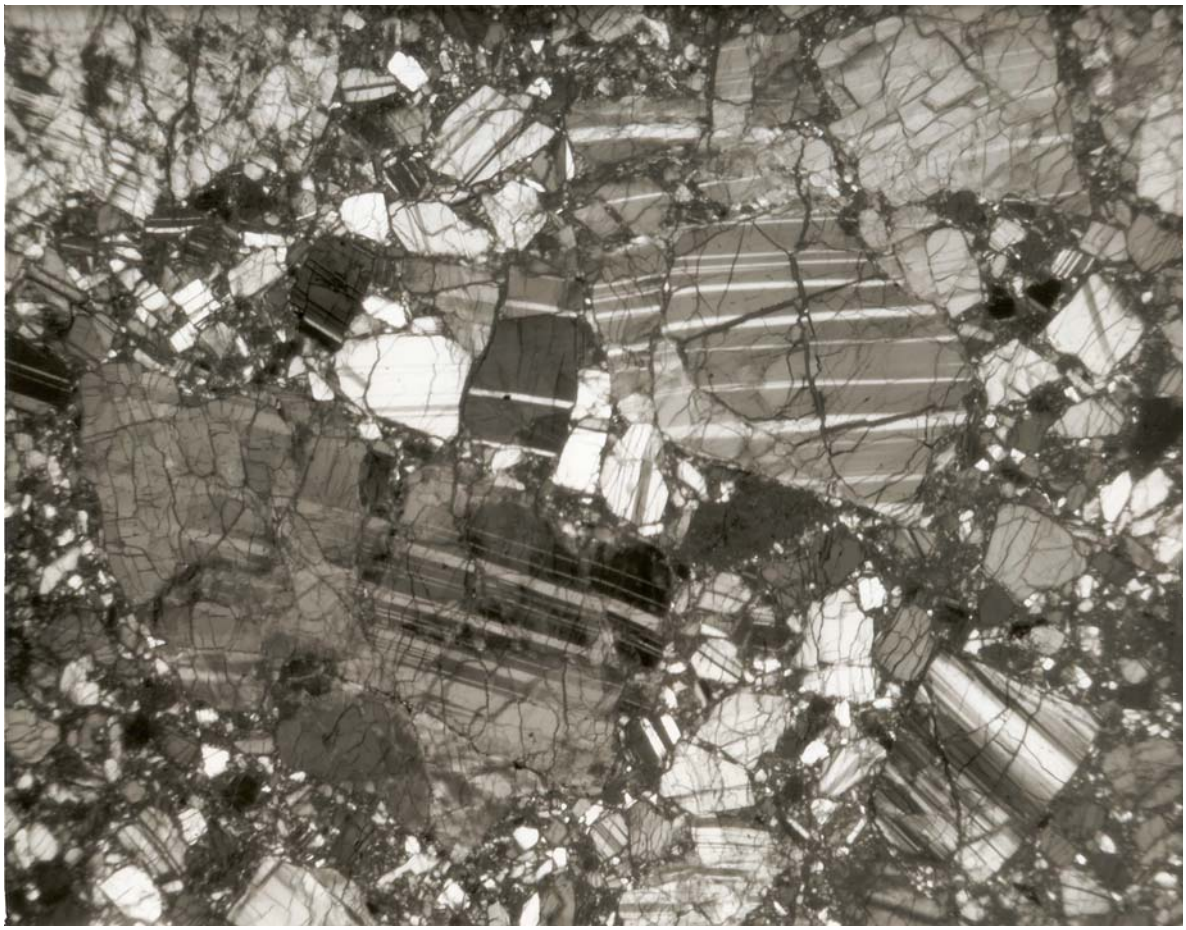


Figure 4: Photomicrograph (with crossed polarizers) of thin section of 60215. Scale about 2 mm. S72-43966

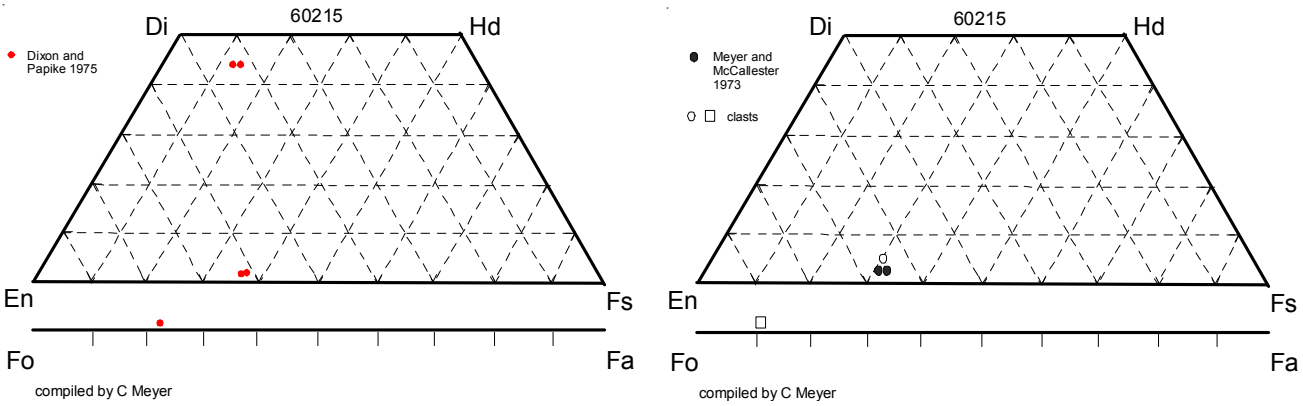


Figure 5 a, b: Mafic mineral compositions reported for 60215.

Plagioclase: McGee (1993) determined trace elements in plagioclase (figure 3).

Glass: See et al. (1986) and Morris et al. (1986) determined the composition of the black glass on 60215.

Significant Clasts

Basaltic Troctolite: Meyer and McCallister (1973) reported broad bean microprobe analyses of two clasts of "troctolitic basalt" (figures 7 and 8). They give bulk analyses.

Figure 6: Thin section photomicrograph (crossed-nicol) of thin section 60215,13. Scale is about 2 mm. S72-43964

Figure 7: Clast with basaltic texture in section ,14. Scale is about 3 mm. (from Norman and Ryder 1979).

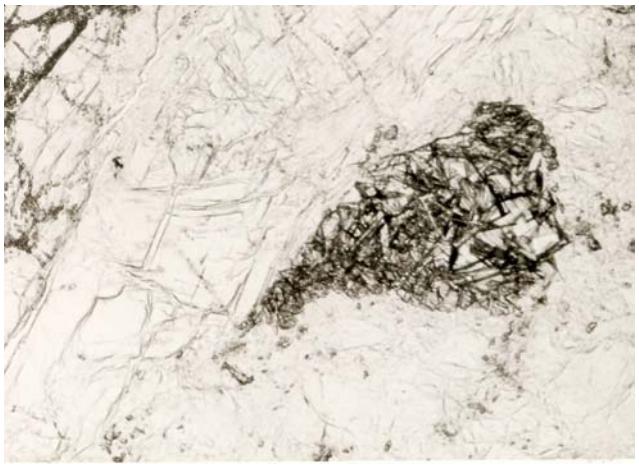


Figure 8: Another small clast with basaltic texture from thin section ,13. Scale unknown. S72-45701.

White Clast ,10:
Warren and Wasson (1977) and Warren (1993) report this to be “pristine”.

Table1. Chemical composition of 60215.

	glass		anor.	
reference	Morris 86		Rose 75	
weight	See 86			
SiO2 %	44.69	(a)	44.5	(b)
TiO2	0.37	(a)	0	(b)
Al2O3	27.51	(a)	35.53	(b)
FeO	4.82	(a)	0.15	(b)
MnO			0.01	(b)
MgO	6.05	(a)	0.14	(b)
CaO	15.25	(a)	19.34	(b)
Na2O	0.37	(a)	0.4	(b)
K2O	0.11	(a)	0.02	(b)
P2O5				
S %				
sum				
Sc ppm	6.1	(a)	2	(b)
V			5.8	(b)
Cr	660	(a)		
Co	47	(a)		
Ni	757	(a)	1.8	(b)
Cu				
Zn				
Ga			2.2	(b)
Ge ppb				
As				
Se				
Rb				
Sr			121	(b)
Y				
Zr			10	(b)
Nb				
Mo				
Ru				
Rh				
Pd ppb				
Ag ppb				
Cd ppb				
In ppb				
Sn ppb				
Sb ppb				
Te ppb				
Cs ppm				
Ba	188	(a)		
La				
Ce	11.37	(a)		
Pr				
Nd	34.2	(a)		
Sm	5.3	(a)		
Eu	0.92	(a)		
Gd				
Tb	1.13	(a)		
Dy				
Ho				
Er				
Tm				
Yb	3.5	(a)		
Lu	0.53	(a)		
Hf	3.72	(a)		
Ta	0.51	(a)		
W ppb				
Re ppb				
Os ppb				
Ir ppb				
Pt ppb				
Au ppb				
Th ppm	2.89	(a)		
U ppm	0.81	(a)		

technique: (a) INAA, (b) "microchemical"

Chemistry

Rose et al. (1975) provide the only analysis of 60215. The REE have not been reported except for the glass (which has nothing to do with the interior anorthosite).

Moore and Lewis (1976) and Cripe and Moore (1975) reported C = 17 ppm and N = 105 ppm.

Radiogenic age dating

None

Cosmogenic isotopes and exposure ages

Eugster (1999) determined the cosmic ray exposure age of 60215 to be 2.31 ± 0.5 m.y. by the ^{38}Ar method.

Processing

60215 broke into subequal parts during PET along the existing penetrating fracture(figures 2 and 9). A large interior chip (,10) was pure white material (figure 10). There are 10 thin sections of 60215, but most of the thin sections are from a piece that broke off initially.

So, apparently, 60215 has not been sawn (and that's a good thing – call me, if you want to know why).

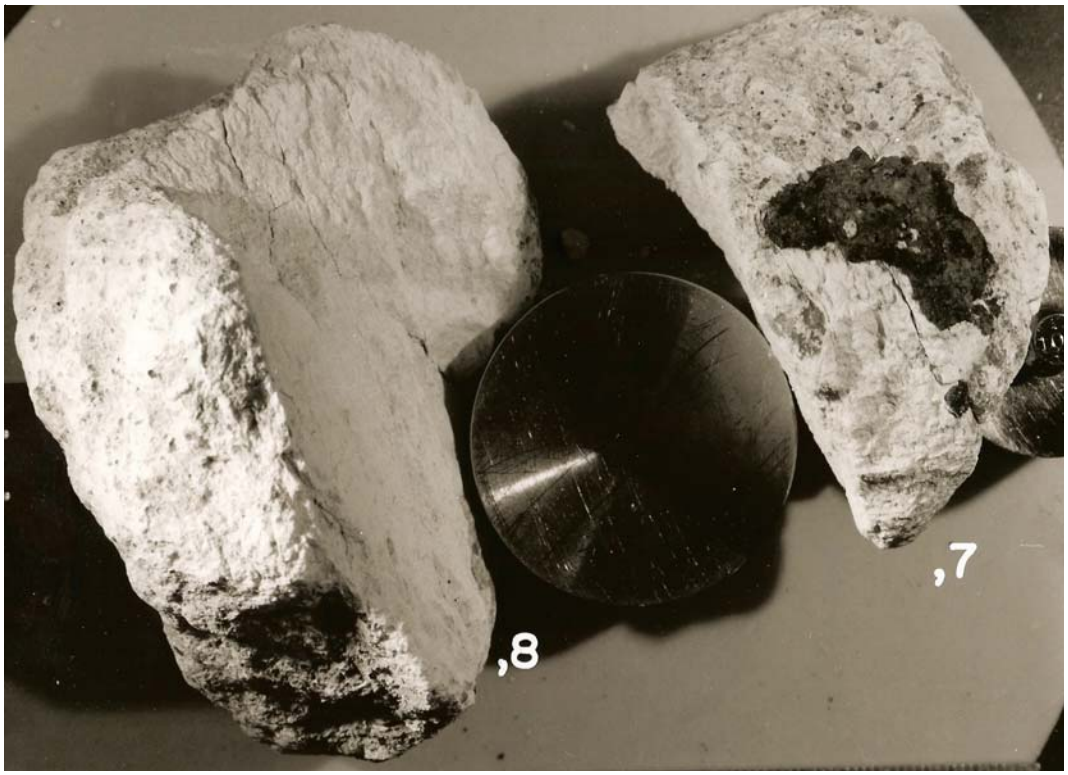


Figure 9: 60215 broke in two main pieces. S74-32059. Compare with figure 2.

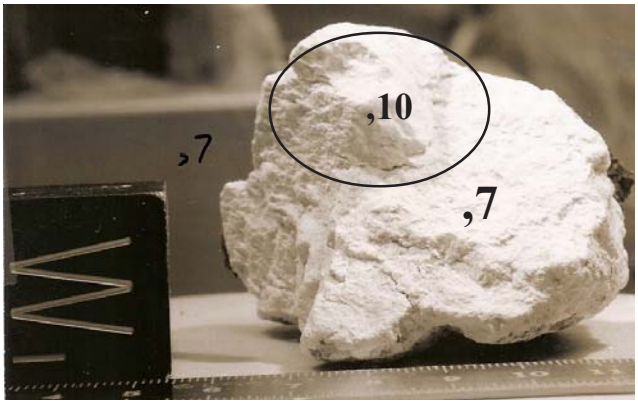
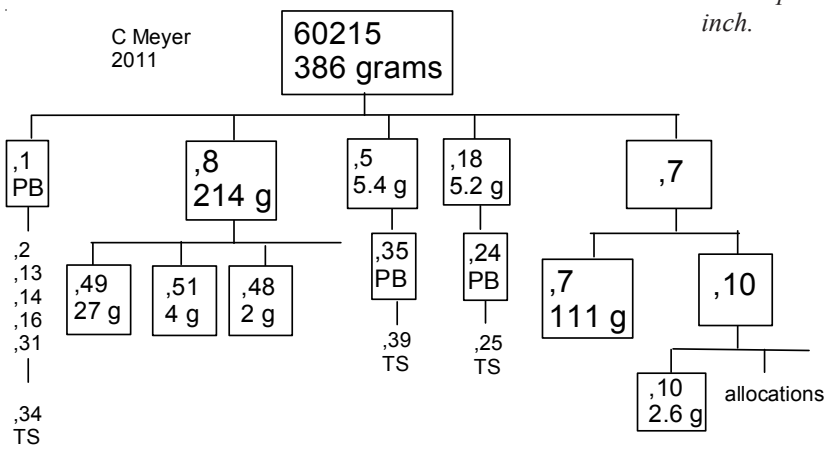


Figure 10: Interior surface of 60215,7 showing location of pure white material for ,10 allocations. This is processing photo (no number). Cube is 1 inch.



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