15205

KREEP-rich Breccia

337.3 grams

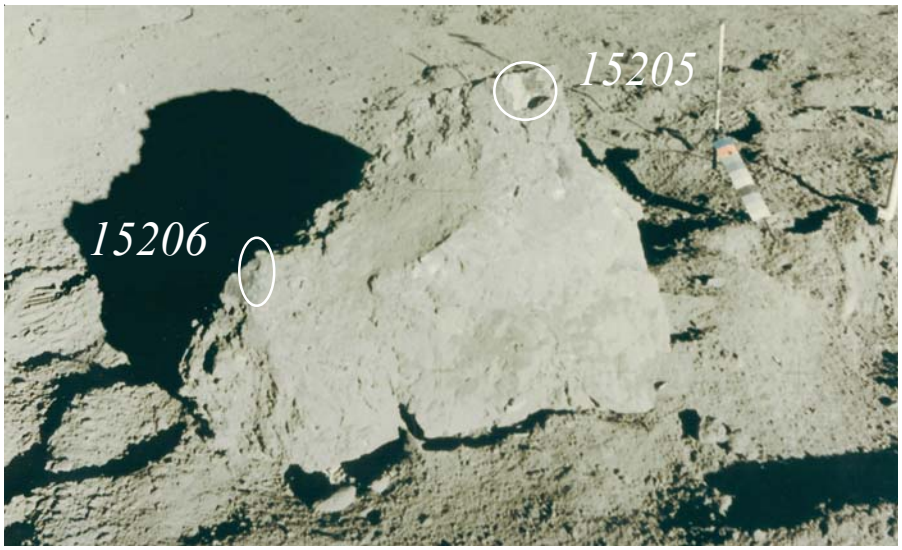


Figure 1: Boulder at station 2, from which both 15205 and 15206 were taken. AS15-86-11560. Meter-sized gnomon for scale.

Figure 2: Interior view of 15205,0. Sample is 6 cm. across. S87-50592.

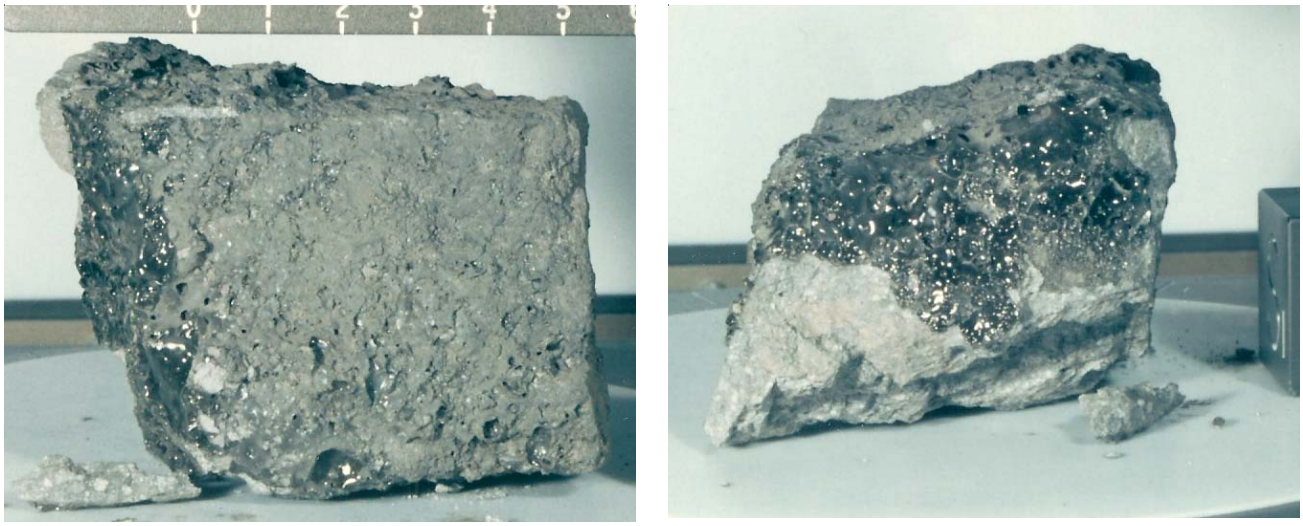


Figure 3: Two views of the glass-coated surfaces of 15205 (5 out of 6 sides were glass coated). Sample is about 6 cm on a side. S71-42985 and S71-42982.

Introduction

Breccia sample 15205 was collected from the top of a small boulder on the edge of the Hadley Rille near St. George Crater (figure 1). The boulder is probably derived from a fresh, small crater part way down the side of the Rille (Swann et al. 1971, Spudis and Taylor 2009). 15205 is noteworthy in that it contains a high percentage of KREEP basalt fragments as clasts, but also contains fragments of the mafic green glass, and mare basalt found in the Apollo 15 regolith.

15205 has not been dated, but it has an exposure age of 169 m.y. It has a thin coating of vesicular glass on most surfaces, such that it must have broke free from the boulder along an interior glass vein. Micormeteorite carters on an exposed surface have been carefully studied.

Mineralogical Mode for 15205

	(Simon et al. 1986)	
Matrix	50.4 %	
	20-90 micron	90-100 micron
Mare Basalt	0.2	2.6
KREEP Basalt	0.5	9
Feld. Basalt	0.2	0.3
Plutonic	0.2	3.6
Granulitic	0.1	
Breccia	0.4	0.3
Olivine	0.4	0.1
Pyroxene	15.4	2.4
Plagioclase	7.2	1.6
Opaques	1.6	
Glass	0.8	2
Agglutinate	0.1	0.2

Petrography

15205 is said to be a regolith breccia (Fruland 1983, McKay and Wentworth 1983), but it has very low I_s/FeO (McKay et al. 1989) and very low C content (Moore et al.1973). It is clast rich and matrix poor with little evidence of clast-matrix interaction (figure 2). There is a pronounced fabric, but this has not been documented. Dymek et al. (1974) give the mode as about 75% clasts (~40% lithic, ~15% glass and ~20% mineral fragments). A more detailed mode is given in the table.

The thin glass coating on five out of six sides of 15205 is unusual. The glass on one side has delicate spikes that suggest that the boulder was seperated from a rock mass while still molten (Wilshire and Moore 1974). The glass on other sides is frothy (figure 3).

Aluminous KREEP basalt fragments are an important component of 15205 (see section of 15382). They have a wide range of texture (figure 4), but the pyroxenes follow a common trend (figures 5 and 6). Clasts of pyroxene-phyric mare basalt are also present (figure 7).

Mineralogy

Pyroxene: Takeda et al. (1980) and Dymek et al. (1974) determined the pyroxene composition of various basalt clasts (figures 5, 6, 8 and 9).

Glass: Dymek et al. (1974) determined the chemical composition of numerous glass fragments in 15205

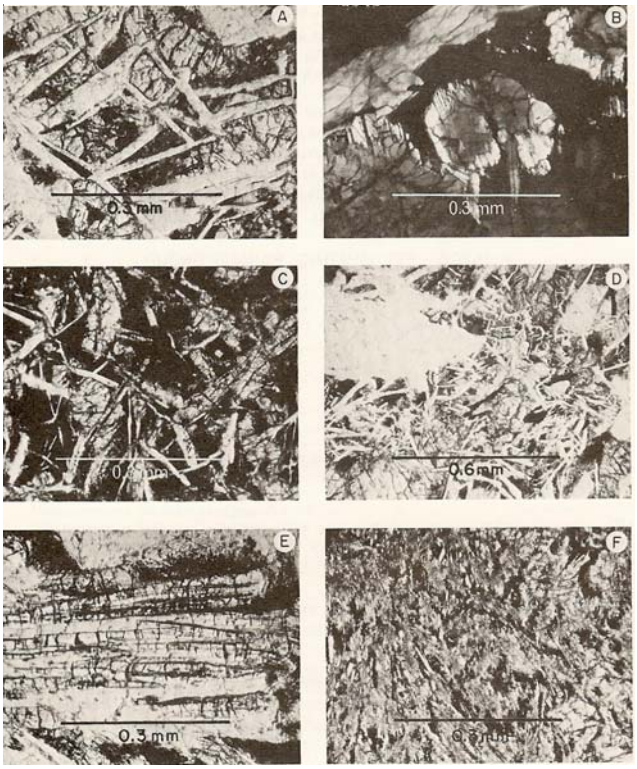


Figure 4: Textures of KREEP basalt clasts in 15205 (Dymek et al. 1974).

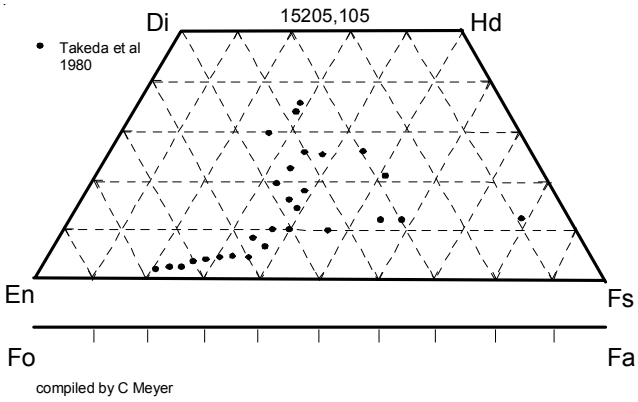


Figure 5: Pyroxene composition of a KREEP basalt clast in 15205 (Takeda et al. 1980).

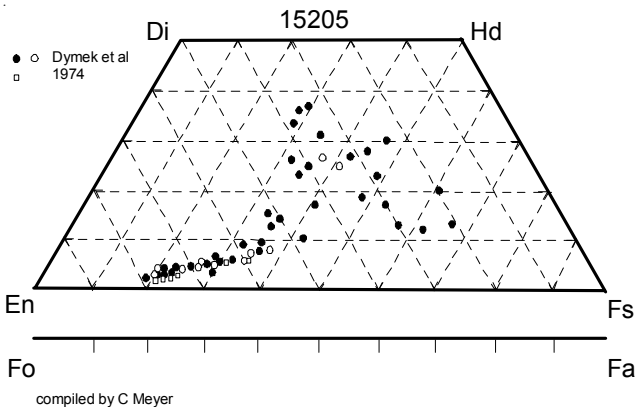


Figure 6: Pyroxene composition of a variety of KREEP basalt clasts in 15205 (Dymek et al. 1974).

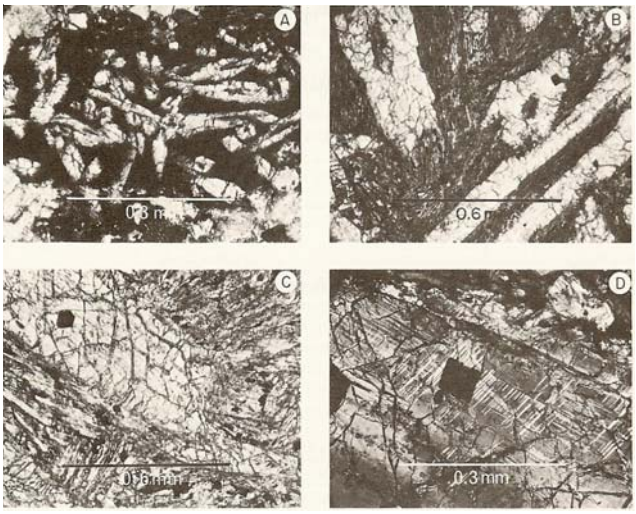


Figure 7: Textures of pyroxene-phyric basalt clasts in 15205 (Dymek et al. 1974).

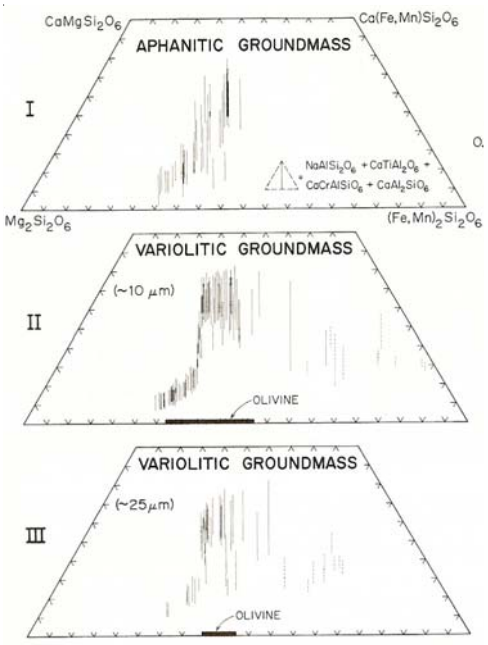


Figure 8: Pyroxene and olivine in pyroxene-phyric basalts in 15205 (Dymek et al. 1974).

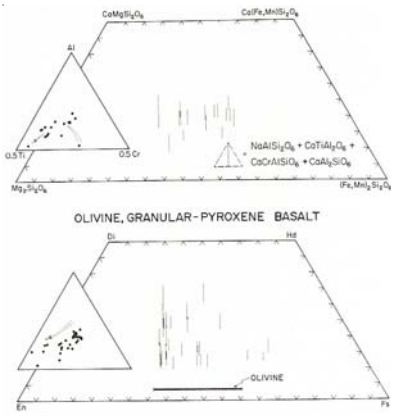


Figure 9: Pyroxene and olivine in mare basalt clasts in 15205 (Dymek et al. 1974).

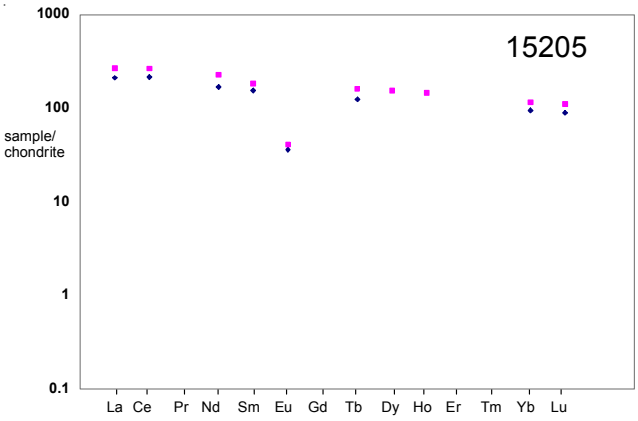


Figure 10: Normalized rare-earth-element diagram of 15205 (data from Simon et al, 1986 and McKay et al. 1989).

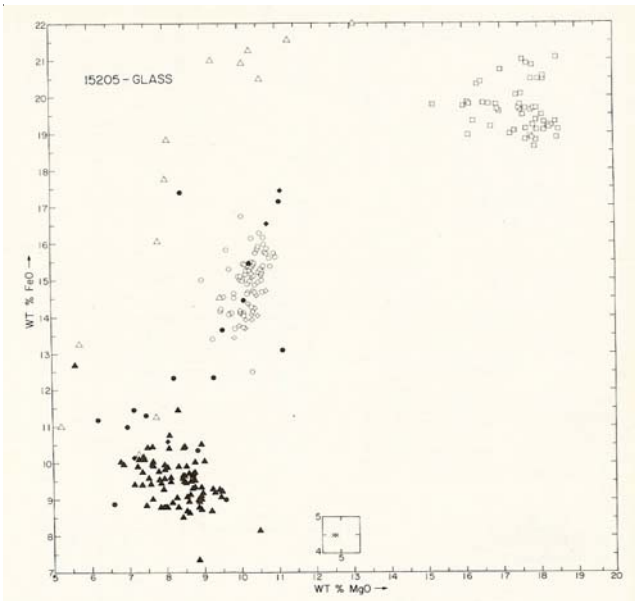


Figure 11: Chemical composition of glass in 15205 (Dymek et al. 1976). Filled triangles are KREEP glass, open squares are "green glass" and intermediate compositions are glass coatings and mare glasses.

(figure 11). The mafic green glass is characteristic of the Apollo 15 soil (see section on 15425). However, the most abundant glass is an aluminous glass with high trace element content (termed KREEP glass).

Zircon: Andersen and Hinthorne (1973) used the ion probe to date a zircon in 15205 amd determine its REE pattern.

Chemistry

Radiation counting showed that the bulk sample is very high in Th (Keith et al. (1972) and Rancitelli et al. 1972). The high Th is accompanied by high trace element content (figure 10).

Reed and Jovanovic (1972) determined the halogen content of 15205 and 15206. 15205 only has 22 ppm C (Moore et al. 1973).

Radiogenic age dating

Andersen and Hinthorne (1973) used the $^{207}Pb/^{206}Pb$ ion probe method to date a zircon in 15205 at 4.01 ± 0.11 b.y.

Cosmogenic isotopes and exposure ages

Keith et al. (1972), Rancitelli et al. (1972) and Fruchter et al. (1978) determined the cosmic-ray-induced activity of ^{26}Al, ^{22}Na, ^{46}Sc, ^{48}V, ^{54}Mn, ^{56}Co and ^{60}Co. Drozd et al. (1976) reported a ^{81}Kr expsoure age of 169 m.y., but the sample has had a rather complicated exposure history (see discussion in Ryder 1985). Bhandari (1977) determined the number of solar flare tracks.

Other Studies

The rare gas content and isotopic ratio of 15205 is reported in McKay et al. (1989). It has the lowest gas content of any of the Apollo 15 breccias studied, consistent with its low maturity index. Schaeffer et al. (19760 used a laser probe to determined He, ne and ar on expsoed surfaces. Oxygen isotopes were reported by Epstein and taylor (1972).

A detailed study of solar flare tracks in pyroxenes directly under micrometeorite craters in the glass on 15205 was conducted by Hartung and Storzer (1974) and Zook et al. (1976).

Adams and McCord (1972) and Charette and Adams (1977) determined reflectance spectra.

Processing

Lunar sample 15205 was the subject of a consortium study led by Wasserburg (but no age was determined except by ion probe!). Ryder (1985) gives an excellent summary.

Two external surfaces , at right angles to each other, were removed and slabbed (figures 14, 15 and 16). There are 52 thin sections.

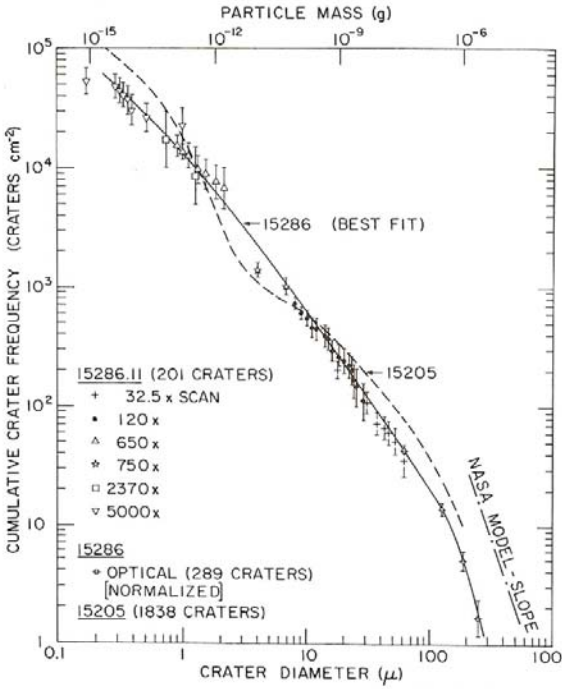


Figure 12: Size distribution of micrometeorite craters on surface of 15205 (Brownlee et al. 1973; Schneider et al. 1973).

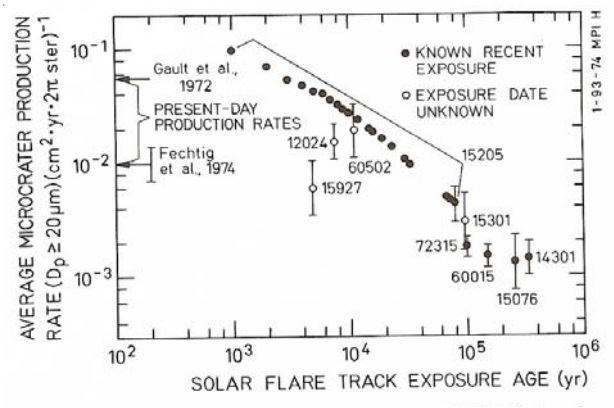


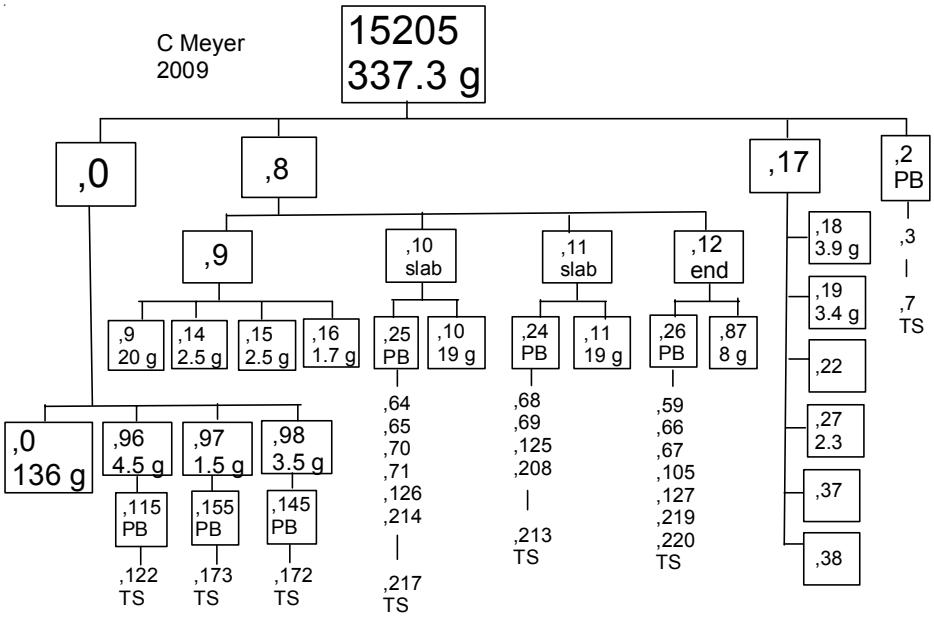
Figure 13: Summary of solar flare track data under micrometeorite craters (Hartung and Storzer 1974).

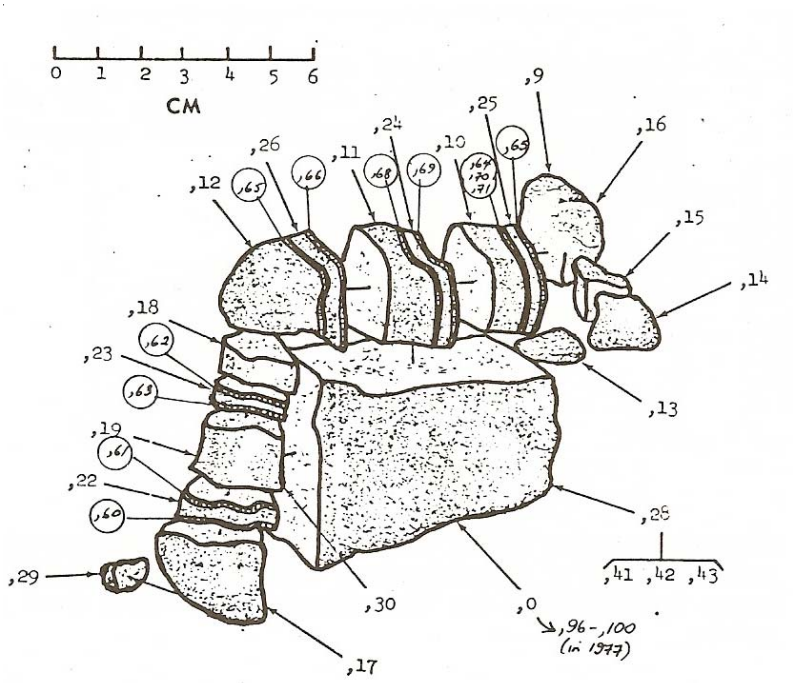
Table 1. Chemical composition of 15205.

reference	Keith72	Rancitelli72		Willis72		McKay89		Baedecker73		Simon86		Reed72
weight		334 g										
SiO2 %				51.03	(c)							
TiO2				1.99	(c)					1.9	(d)	
Al2O3				14.92	(c)	13.2	(d)			14.9	(d)	
FeO				11.28	(c)	13.3	(d)			10.9	(d)	
MnO				0.16	(c)					0.156	(d)	
MgO				8.23	(c)	9.2	(d)			9.6	(d)	
CaO				9.94	(c)	8.9	(d)			9.8	(d)	
Na2O				0.73	(c)	0.66	(d)			0.775	(d)	
K2O	0.53	0.65	(a)	0.53	(c)					0.52	(d)	
P2O5				0.56	(c)							
S %				0.08	(c)							
sum												
Sc ppm						28.5	(d)			22.5	(d)	
V										65	(d)	
Cr				2330	(c)	2770	(d)					
Co					(c)	30.2	(d)			23.1	(d)	
Ni						59	(d)	28	(b)	30	(d)	
Cu												
Zn								4.5	(b)			
Ga								5	(b)			
Ge ppb								84	(b)			
As												
Se												
Rb				14.4	(c)							
Sr				171	(c)	150	(d)			140	(d)	
Y				201	(c)							
Zr				979	(c)	710	(d)			820	(d)	
Nb				59.4	(c)							
Mo												
Ru												
Rh												
Pd ppb												
Ag ppb												
Cd ppb								16	(b)			
In ppb								2.6	(b)			
Sn ppb												
Sb ppb												
Te ppb												
Cs ppm						0.48	(d)					
Ba				673	(c)	500	(d)			640	(d)	
La						49.6	(d)			63	(d)	
Ce						131	(d)			160	(d)	
Pr												
Nd						76	(d)			103	(d)	
Sm						22.8	(d)			27	(d)	
Eu						2.02	(d)			2.3	(d)	
Gd												
Tb						4.54	(d)			5.9	(d)	
Dy										37.3	(d)	
Ho										8.1	(d)	
Er												
Tm										3.1	(d)	
Yb						15.5	(d)			19	(d)	
Lu						2.16	(d)			2.7	(d)	
Hf						18.5	(d)			20	(d)	
Ta						2.15	(d)			2.5	(d)	
W ppb												
Re ppb												
Os ppb												
Ir ppb						<3	(d)	0.14	(b)			
Pt ppb												
Au ppb						<4	(d)	0.41	(b)			
Th ppm	12	12.6	(a)			8	(d)			10.4	(d)	
U ppm	2.9	3.28	(a)			2.2	(d)			2.8	(d)	3.2

technique: (a) radiation counting, (b) RNAA, (c) XRF, (d) INAA

Figure 14: Group processing photo of piece (,8) off of 15205. Metal tags are about 2 cm long. S72-15585.





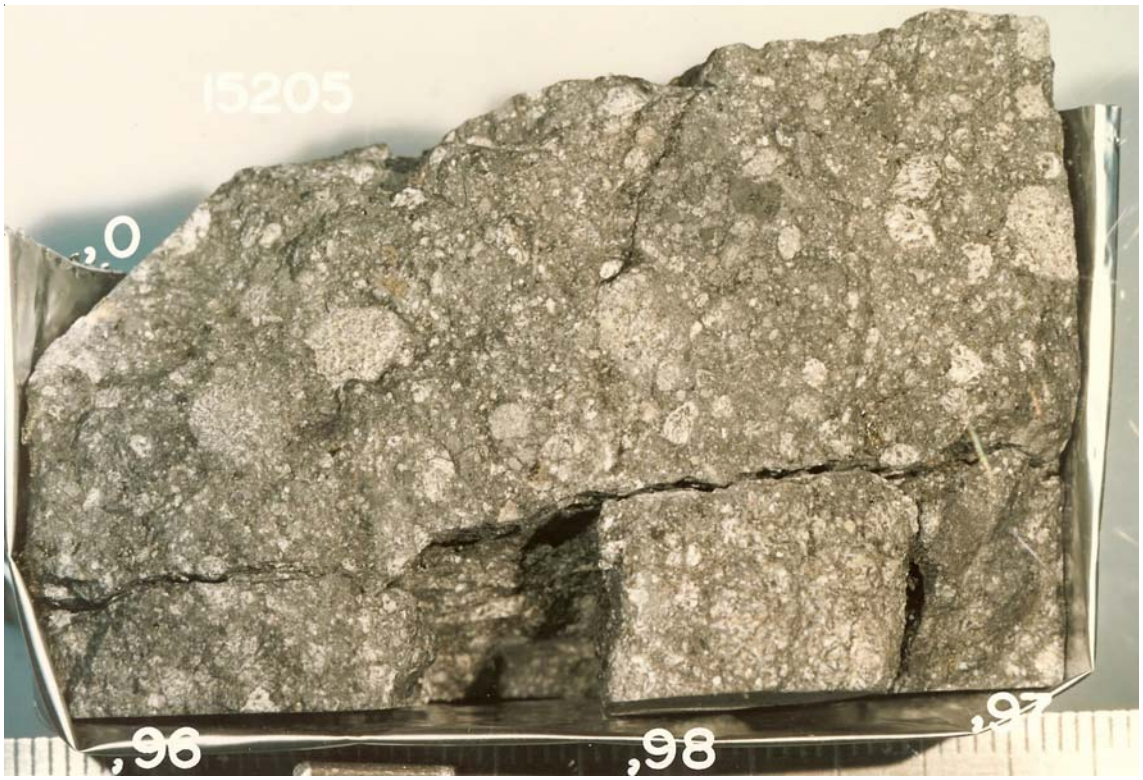


Figure 15: Interior surface of 15205. S87-50590. Scale in mm.

Figure 16: Interior surface of 15205. Scale in mm. S87-50591

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