72315

Micropoikilitic Impact Melt Breccia
St. 2, 131.4 g

INTRODUCTION

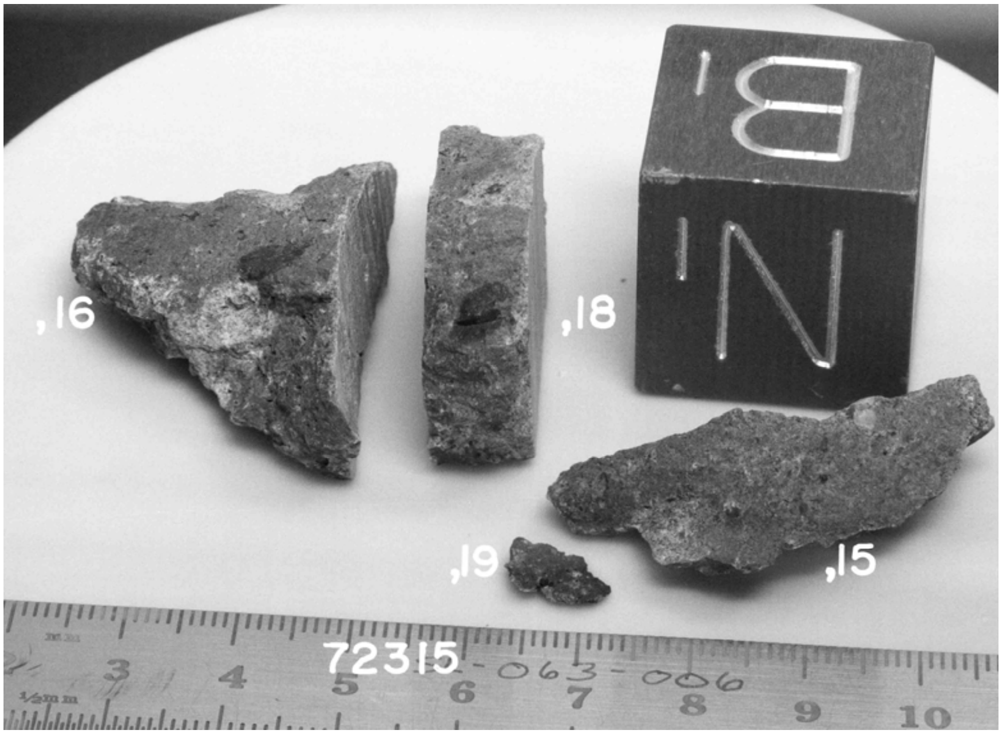
72315 is a fine-grained, clast-bearing impact melt with a poikilitic texture. Although it was sampled to represent an apparent distinctive half-meter clast (see section on Boulder 2, Station 2), 72315 is identical in all analyzed respects with all other samples from Boulder 2. Although no definitive geochronological data exist, a general assumption is that 72315 crystallized at the same time as other melts of similar petrography and chemistry at the Apollo 17 site, i.e. 3.86 Ga ago. The sample, 10 x 5.5 x 2 cm, is an angular elongate light gray (N7) slab (Fig. 1). It is tough and homogeneous, but with an irregular distribution of clasts and vugs, and there are some penetrative fractures. Clasts larger than 1 mm compose less than 5% of the rock. The exposed surface (T) of 72315 has many zap pits and the broken surface is hackly (Figs 1,2,3). Irregular cavities forming about 10% of the sample range up to 3 mm, although most are much less than 1 mm across; the larger ones have brown pyroxene linings, smaller ones have drusy linings.

72315 is so similar to other samples from Boulder 2 that it will not be described here in detail, but specific studies are referenced. It was studied mainly under a consortium led by the Caltech group (Dymek et at., 1976a), but not in as much detail as 72395. The description of 72395 can be assumed as a description of 72315. Following chipping of a few small pieces of 72315, the sample was sawn to produce mainly two end pieces and two central slabs. These slabs were entirely subdivided and produced oriented samples for track studies.

PETROGRAPHY

All five samples from Boulder 2 are very similar in petrography. Dymek et al. (1976a) gave descriptions of the petrography subsequent to a briefer description by Albee et al. (1974b) and Dymek et al. (I 976b). They did not give individual descriptions of the petrography and that practice is for the most part followed here. Thus, for a description and mineral diagrams of 72315 see sample 72395.

Figure 1: Exposed (top) and broken (lower) surfaces of 72315. The sample is homogeneous, with a few dark and light clasts visible. Scale in centimeters. S-73-18693.



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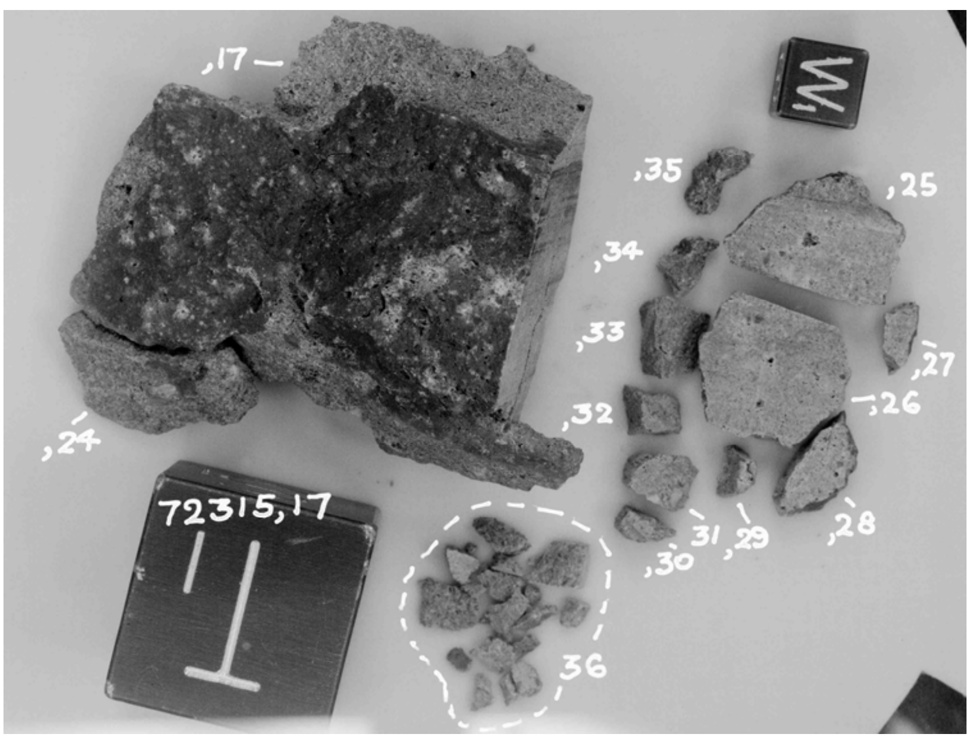


b

Figure 2: a) Post-sawing pieces, 16 (Wend), 15 (broken-off N edge); and, 18 (sawn from ,17, and from between A and ,17). Split, 19 fell of f, 18. Cube is 2 cm. S-74-15094. b) Post-sawing piece, 17 (E end) and subdivisions of an unnumbered slab cut from it adjacent to, 18. Large cube is 2.54 cm. S-74-17830.

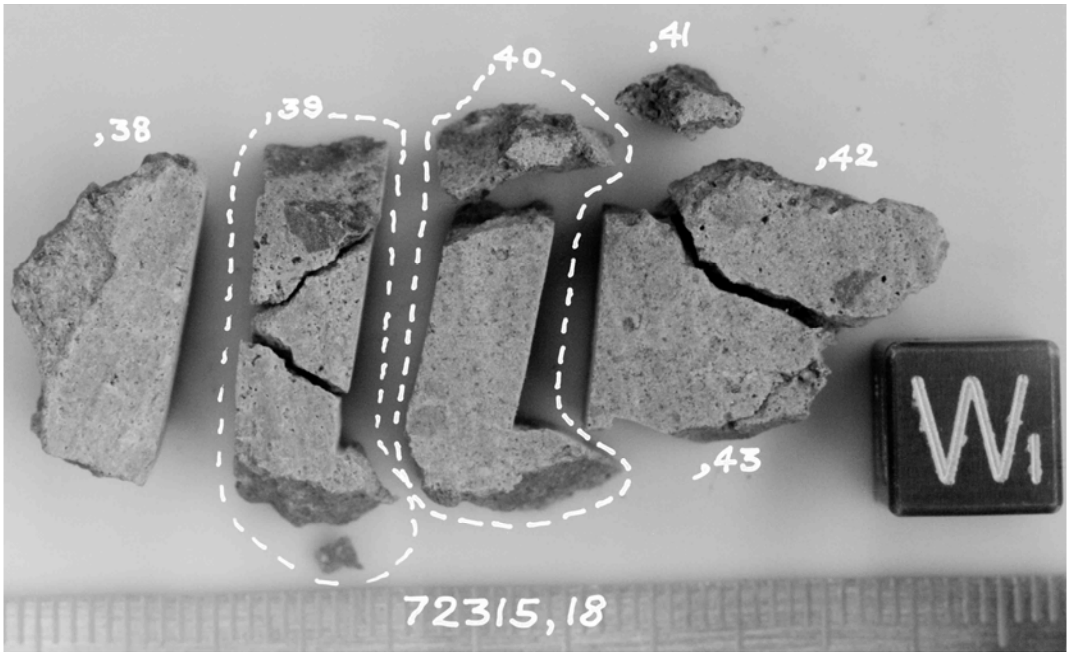
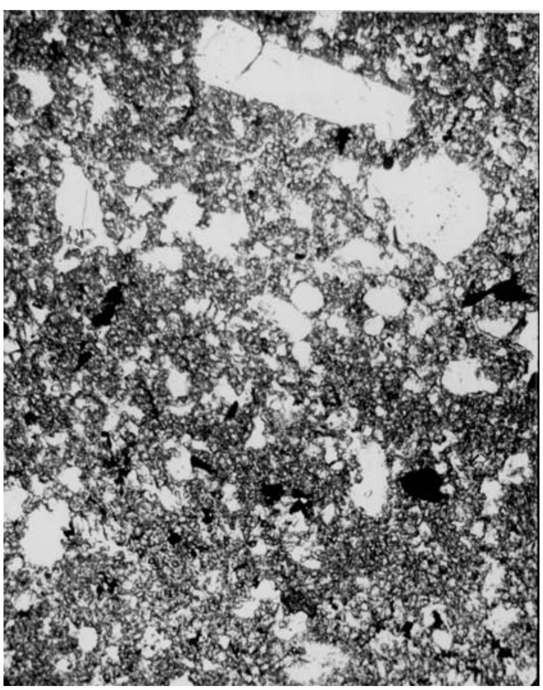


Figure 3: Subdivision of slab, 18. Cube is I cm. S-74-17835.

a



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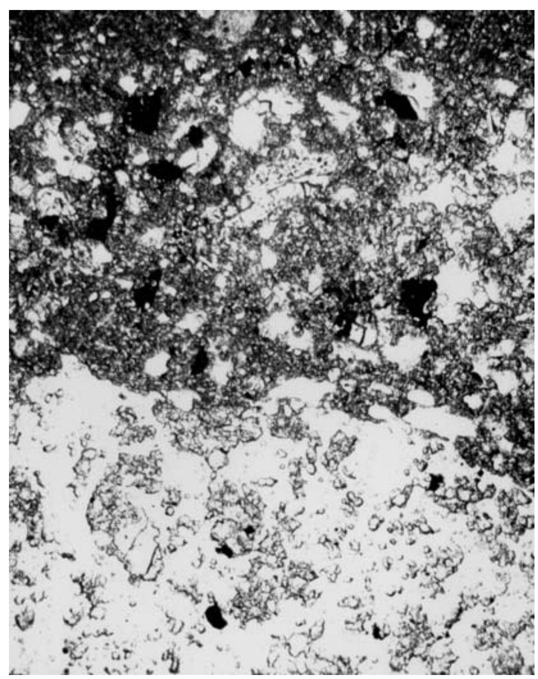

Figure 4: Photomicrographs of 72315,78. Plane transmitted light, all about 1 mm field of view. a) Melt groundmass and smaller clasts (larger white areas), mainly plagioclases with lesser mafic minerals. Ilmenites are mainly grown in the groundmass. b) Contact between melt (top) and a larger lithic clast of feldspathic granulite (bottom).

The sample is a fine-grained impact melt with a micropoikilitic texture and some small clasts (Fig. 4 and Dymek et al., 1976a). Simonds et al. (1974) referred to it as "clast-rich ophitic" with matrix feldspars and pyroxenes respectively 10 to 40 and 20 to 80 microns long. Photomicrographs of matrix and clasts are given in Dymek et al. (1976a) and Spudis and Ryder (1981). Engelhardt (1979) noted the poikilitic texture and classified the paragenesis as one with ilmenite crystallizing only after pyroxene finished crystallizing.

CHEMISTRY

Chemical analyses of bulk rock (groundmass plus clasts) are given in Table 1 and rare earth elements are plotted in Figure 5 with other data for comparison. Laul and Schmitt (1974a, b, c) and Laul et al. (1974) analyzed both exterior and interior chips which are essentially indistinguishable. The chemistry is similar to that of the other samples from Boulder 2 and other LKFM poikilitic melts from the Apollo 17 landing site; the incompatible element abundances are the lowest among the Boulder 2 samples (Fig. 5).

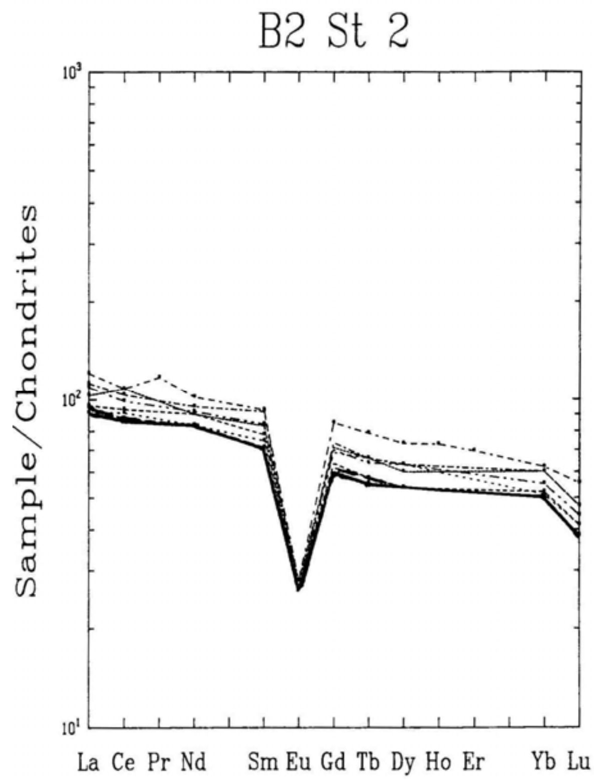

Figure 5: Rare earth elements in splits of 72315 (bold lines) and other Boulder 2, Station 2 samples. 72315 data from Table 1: solid line is, 3; long dashed line is, 4. The two splits are identical for several elements.

RADIOGENIC ISOTOPES AND CHRONOLOGY

Tera et al. (1974a) reported Rb and Sr isotopic data for a 24 mg whole-rock split of 72315 without specific discussion. $^{87}Rb/^{86}Sr$ (0.1445) and $^{87}Sr/^{86}Sr$ (0.70839+/-5) correspond with T_{BABI} of 4.44 Ga. Hutcheon et al. (1974b) studied fission tracks in apatite crystals, tabulating densities. Assuming negligible cosmic ray induced fission, the densities correspond with ages of 3.09 Ga and 2.94 Ga; assuming induced fission, the densities correspond with ages of 2.51 Ga and 2.30 Ga (Table 2). These ages are younger than the probable crystallization age of the rock (about 3.86 Ga) because of thermal fading of tracks over the last 10 to 20 Ma, in which 50 to 60% of tracks have been annealed.

EXPOSURE AGES

Hutcheon et al. (1974a,b,c) and MacDougall et al. (1974) studied cosmic ray tracks in samples from 72315. Hutcheon et al. (1974a) described the collection and sampling of 72315; the studied sample was a column (Fig: 6). The inner side of 72315 was a crevice on the boulder, and with the known orientation, allows the determination of the direction in space from which the particles arrived. The sampling allowed a virtually uneroded Fe spectrum averaged over several hundred thousand years, in the range of about 1 to about 460 MeV/a.m.u. By tying the intensity of solar flare to that of galactic cosmic rays, an exposure age can be determined assuming production rates. The track density-depth relationships are shown in Figure 7. From these data and the production spectrum of Walker-Yuhas, Hutcheon et al. (1974a) derived an exposure to galactic cosmic rays of about 0.22 Ma, and exposure to solar flares for 0.32 Ma (probably consistent with each other), for an estimated exposure of the crevice for 0.27 Ma. This exposure age is almost certainly unrelated to the time that the boulder rolled down the slope, and reflects only the age of a spall event that removed a large fragment from the surface of the boulder. Surface microcrater counts suggest an exposure age of about 0.15 Ma. Hutcheon et al. (1974b) measured tracks in an unoriented

Table 1: Chemical analyses of bulk samples of 72315.

Split	,3(c)	,3(c)	,4(d)	,4(d)	17	,3	Split
wt%							wt%
SiO_2							SiO_2
TiO_2	1.4		1.4				TiO_2
Al_2O_3	19.8		19.2				Al_2O_3
Cr_2O_3	0.186		0.187				Cr_2O_3
FeO	8.5		8.5				FeO
MnO	0.111		0.111				MnO
MgO	11		12				MgO
CaO	11.6		11.3				CaO
Na_2O	0.61		0.70				Na_2O
K_2O	0.32		0.35		0.341	0.3166	K_2O
P_2O_5							P_2O_5
ppm							ppm
Sc	16		16				Sc
V	50		50				V
Co	21	20	32	33			Co
Ni	180	180	330	340			Ni
Rb		8.5		9.6		8.21	Rb
Sr		157		165		165.0	Sr
Y							Y
Zr	400		400				Zr
Nb							Nb
Hf	10		10				Hf
Ba	290	(b)320	280	(b)340			Ba
Th	5.2		5.4		4.80		Th
U	1.4	1.58	1.5	1.53	1.53		U
Cs		0.450		0.430			Cs
Ta	1.4		1.4				Ta
Pb							Pb
La	30		31				La
Ce	76		77				Ce
Pr							Pr
Nd	50		50				Nd
Sm	12.8		12.9				Sm
Eu	1.82		1.83				Eu
Gd							Gd
Tb	2.6		2.7				Tb
Dy	17		17				Dy
Ho							Ho
Er							Er
Tm							Tm
Yb	10		10				Yb
Lu	1.3		1.3				Lu
Li							Li
Be							Be
B							B
C							C
N							N
S							S
F							F
Cl							Cl
Br							Br
Cu							Cu
Zn		2.6		2.5			Zn
ppb							ppb
Au	3	2.8	4	6.1			Au
Ir	5	4.3	10	9.0			Ir
I							I
At							At
Ga							Ga
Ge							Ge
As							As
Se		110		120			Se
Mo							Mo
Tc							Tc
Ru							Ru
Rh							Rh
Pd							Pd
Ag		1.1		0.84			Ag
Cd		(a)300		8.1			Cd
In		0.4		0.5			In
Sn							Sn
Sb		1.3		2.0			Sb
Te							Te
W							W
Re		0.43		0.98			Re
Os							Os
Pt							Pt
Hg							Hg
Tl		1.3		0.66			Tl
Bi							Bi
	(1)	(2)	(1)	(2)	(3)	(4)	

References and methods:
(1) Laul et al (1974) Laul and Schmitt (1974a); INAA
(2) Laul et al (1974) Laul and Schmitt (1974 a, c); RNAA.
(3) Keith et al (1974 a, b); gamma-ray spec.
(4) Tera et al (1974 a); ID/MS

Notes:
(a) probably high from contamination, according to authors.
(b) typographical error, reported as Bd in original papers.
(c) mostly exterior.
(d) mostly interior.

interior chip in 72315, located several centimeters from the column sample. Assuming a simple exposure history would suggest an exposure of about 5 Ma, but from the shape of the track density profile in the whole column it can be shown that the boulder has experienced a complicated exposure extending over several million years in an orientation different from that at the present, and that a spall occurred about 0.27 Ma ago (above).

Keith et al. (1974a,b) tabulated count data for cosmogenic nuclides without specific discussion. Yokoyama et al. (1974) used the data of Keith et al. (1974a,b) in discussing ^{22}Na-^{26}Al relationships. They found the sample to be unsaturated in $^{26}A1$, suggesting very short exposure times (of the order of 10^5 years), consistent with the Hutcheon et al. (1974a) results.

Table 2. Fission track data and calculated ages for apatites in 72315 (Hutcheon et al., 1974b). a=assuming cosmic ray induced fission. b=assuming negligible cosmic ray induced fission.

	72315 Apatite 1	72315 Apatite 2
Uranium content (ppm)	72	78
Total track density (t/cm^2)	1.55×10^8	1.58×10^8
Reactor induced (t/cm^2)	2.82×10^7	3.06×10^7
Cosmic ray (t/cm^2)	3.0×10^6	3.0×10^6
C.R. induced fission* (t/cm^2)	2.82×10^7	3.06×10^7
Age† (m.y.) (a)	2.51×10^9	2.30×10^9
(b)	3.09×10^9	2.94×10^9

PROCESSING

Several early allocations were made from small documented chips (,2 to ,6 and ,11)removed from 72315 prior to sawing. In 1973/4 sawing produced the W end piece,16 (17.1 g, now stored at Brooks; Fig. 2a) and E end piece,17 (now 70.6 g). Piece ,17 was resawn to produce the slab,18 (which was subsequently entirely subdivided, Fig. 3) and a second unnumbered slab that was also entirely subdivided (Fig. 2b). During sawing a large piece (, 15,7.8g)fell off (Fig. 2a). Few of the slab pieces have been used for allocations.

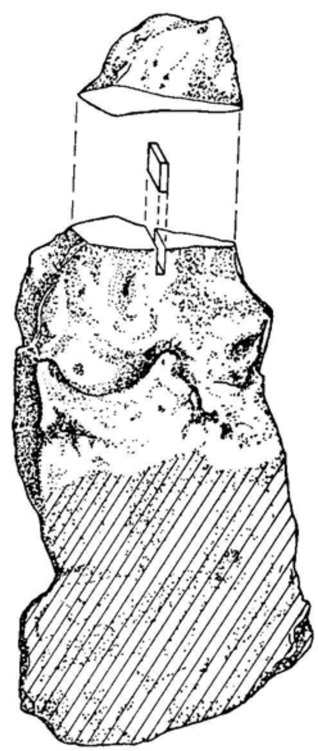

Figure 6: Sketch of the crevice side of 72315, showing the orientation of the track column through the sample. Height of the sample is about 10 cm. (Hutcheon et al., 1974a).

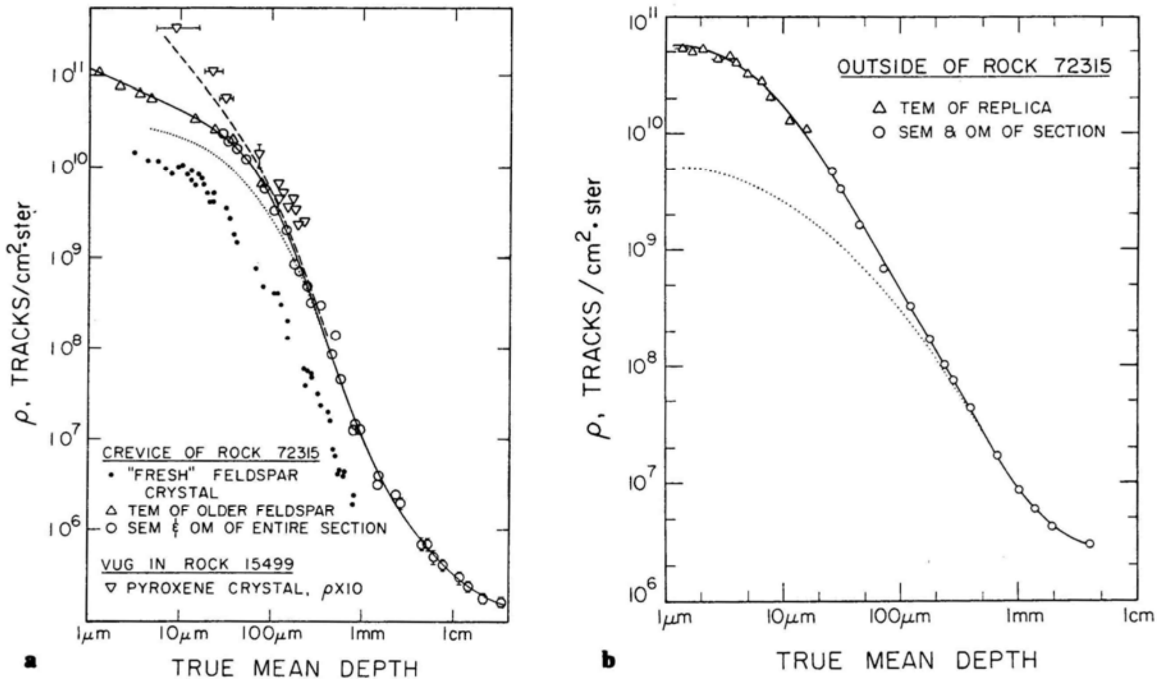

Figure 7: Track density profiles through interior (a) and exterior (b) parts of 73215. Triangles are for TEM measurements and open circles are for SEM measurements. (Hutcheon et at, 1974a).