69935 GLASSY AND FINE-GRAINED MELT BRECCIA 127.6 g

INTRODUCTION: 69935 is a coherent, dark gray, glassy breccia. Complex relations among a variety of lithologies mark this rock (Fig. 1).

At Station 9, two samples were taken from a dark boulder ~60 cm in diameter. 69935 was removed from the very top of the boulder and 69955 was chipped from the bottom side after the boulder was overturned by the Apollo 16 crew (Fig. 2). Lunar orientation of 69935 is not precisely known due to its small size. Many zap pits are present on the T surface; the B surface is a fracture face.

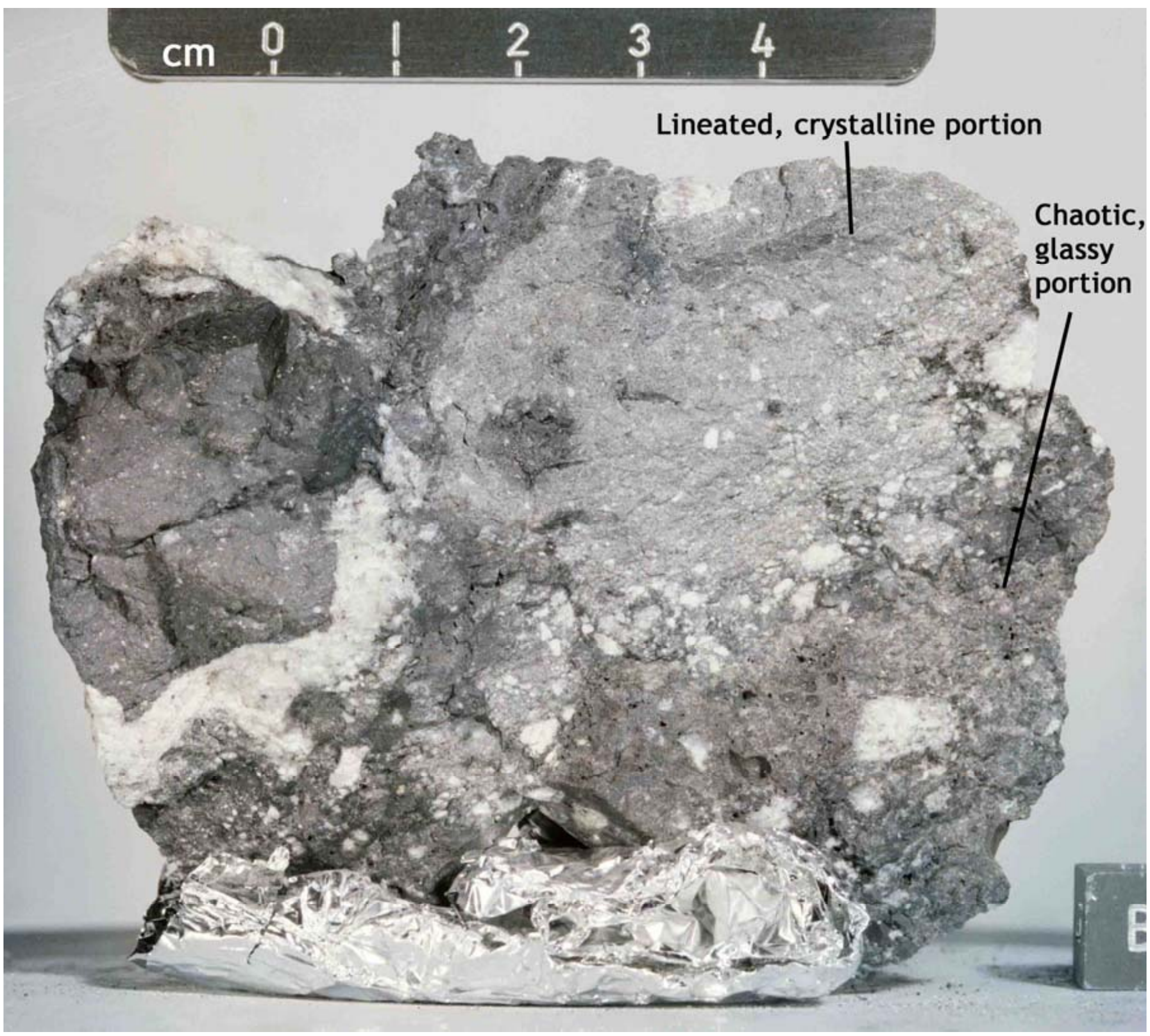

FIGURE 1. S-72-44459B.

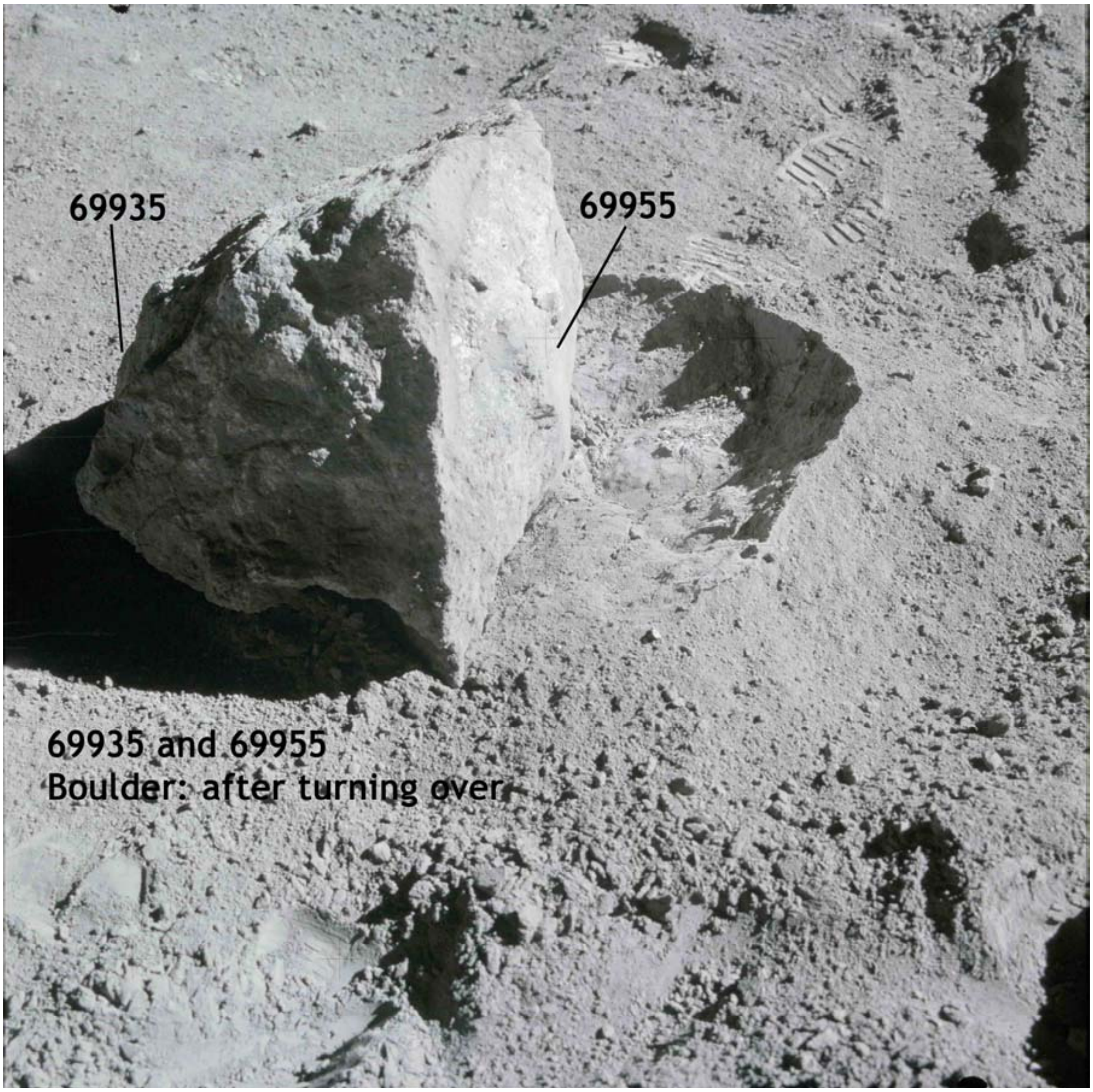

FIGURE 2. AS16-107-17573.

<u>PETROLOGY</u>: 69935 is a clast-rich, dark gray breccia that is texturally inhomogeneous. Most of the rock is chaotic, glassy, and non-porous, with a diverse clast population (Fig. 3). Vesicles are apparent macroscopically (Fig. 1). This lithology probably represents the matrix of the boulder. Clasts of basaltic impact melt, glassy matrix breccia, lightly shocked plagioclase, rusty metal and glass beads and fragments are abundant. One large (8 mm) clast of cataclastic anorthosite is also present in one thin section (Fig. 3). Several brown glass veins cut this portion of the rock (Fig. 3).

The light gray area of the rock (Fig. 1) has a lineated clast population in a fine-grained, probably melt, matrix (Fig. 3). This lithology is probably a large clast in the rock. Most of the lineated grains are angular fragments of heavily shocked plagioclase with rounded corners. Many of these grains are maskelynite. Mafic mineral clasts are very rare. Fe-metal, troilite and schreibersite are common; metal compositions are given in Figure 4 (Misra and Taylor, 1975). Rock fragments are virtually absent except for a few cataclastic anorthosites. One barred olivine fragment with inter-fingering feldspathic glass is also present (Fig. 3). The matrix of this lithology is non-porous and crystalline with blocky plagioclase grains surrounded by mafic minerals.

No thin sections of the large, white, anorthositic area (Fig. 1) have been made.

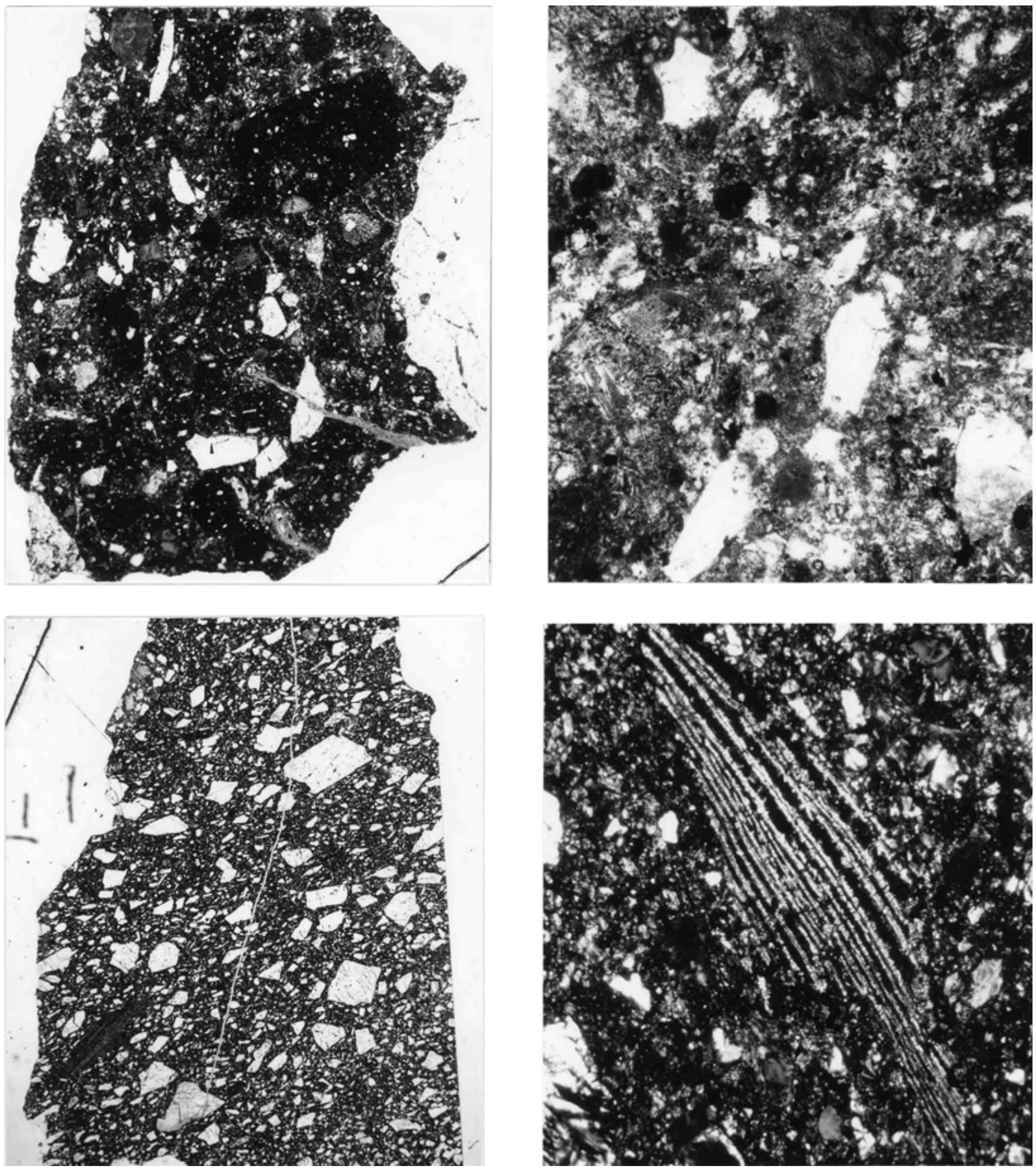

FIGURE 3.
a) 69935,65. Dark, glassy breccia, anorthosite clast to right, ppl. Width about 1 cm.
b) 69935,64. Dark, glassy breccia, ppl. Width 2 mm.
c) 69935,60. Fine-grained melt region, ppl. Width about 1 cm.
d) 69935,60. Barred olivine clast in basaltic melt portion, xpl. Width 2 mm.

EXPERIMENTAL PETROLOGY: L.A. Taylor et al. (1976) observed significant changes in metal composition following periods of subsolidus annealing (Fig. 5).

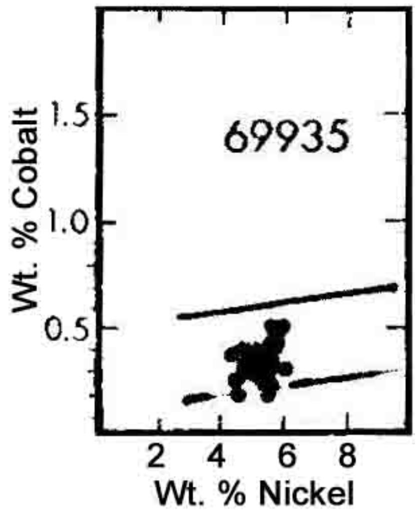

FIGURE 4. Metals in light gray area;
from Misra and Taylor (1975).

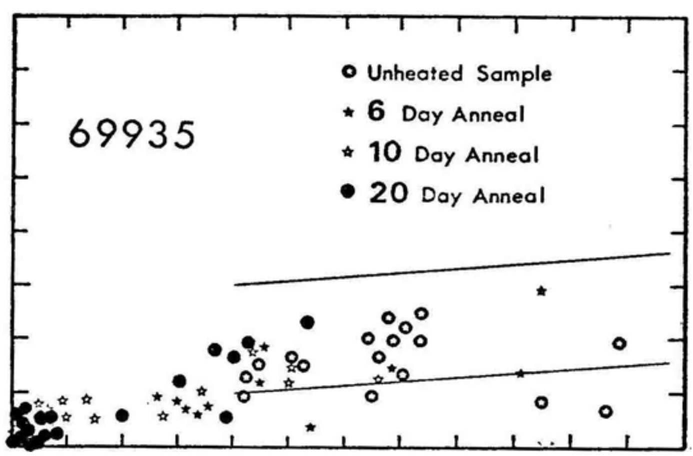

FIGURE 5. from L.A. Taylor et al. (1976).

CHEMISTRY: Major and trace element analyses of clast-rich fragments from the glassy portion of the rock are provided by Rose et al. (1973) and Laul and Schmitt (1973). Meteoritic siderophile and volatile elements from similar fragments are given by Ganapathy et al. (1974). Rancitelli et al. (1973a, b) report whole rock natural and cosmogenic radionuclide abundances.

The analyzed splits of 69935 are very aluminous (Table 1) and resemble some Station 11 rocks in this respect. Unlike most of these rocks, however, 69935 contains levels of REEs similar to the local mature soils (Table 1, Fig. 6). Siderophiles are also enriched in 69935 indicating a significant meteoritic component. Hertogen et al. (1977) assign the siderophiles in 69935 to meteoritic group 1H a group largely restricted to Apollo 16.

TABLE 1. Summary chemistry of 69935.

SiO_2	44.7	Sr	125
TiO_2	0.29	La	11.2
Al_2O_3	30.0	Lu	0.52
Cr_2O_3	0.06	Rb	3.9
FeO	3.2	Sc	5.6
MnO	0.04	Ni	408
MgO	3.3	Co	19
CaO	17.6	Ir ppb	12.7
Na_2O	0.42	Au ppb	11.9
K_2O	0.08	C	
P_2O_5	0.15	N	
		S	
		Zn	0.88
		Cu	3.6

Oxides in wt%; others in ppm except as noted.

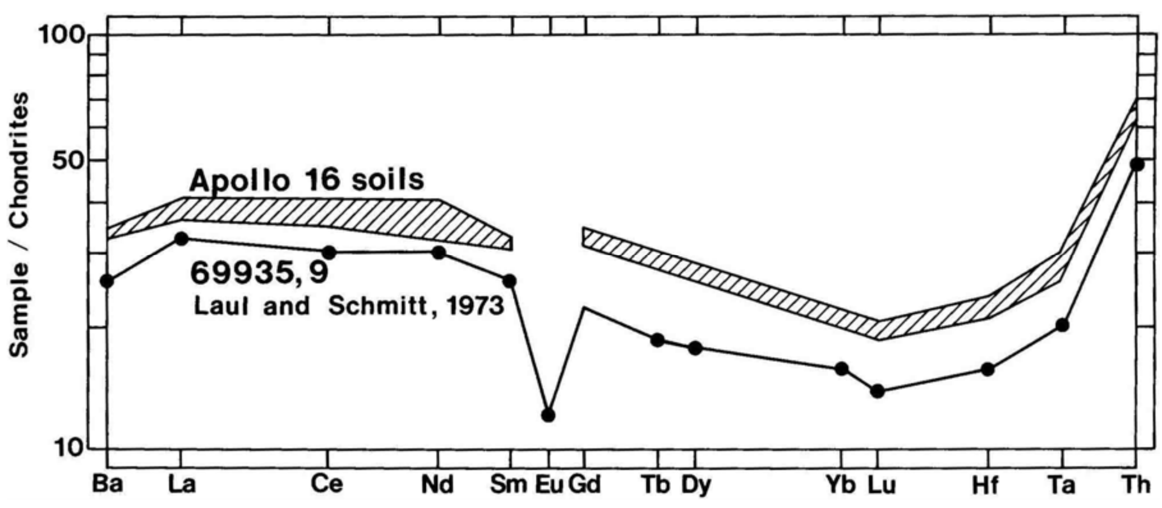

FIGURE 6. Rare earths.

<u>RARE GASES/EXPOSURE AGES</u>: Surface exposure ages by a variety of methods are consistently ~2 m.y. (Table 2), indicating that the 69935/55 boulder was excavated by the South Ray Crater event.

From a "soft" component in the Kr-spallation spectrum, Behrmann et al. (1973) and Drozd et al. (1974) conclude that the 69935/55 boulder must have experienced significant near-surface exposure prior to its emplacement in its present configuration. Behrmann et al. (1973) infer that the boulder was buried ~1-5 m below the surface prior to excavation. Drozd et al. (1974) note significant differences between the apparent exposure ages of 69935 and 69955 and conclude that the boulder must have been inverted relative to its present position during its subsurface residence (see 69955).

TABLE 2. Surface exposure ages of 69935.

Method	Age (m.y.)	Reference
^{81}Kr-^{83}Kr	3.3±0.3	Behrmann *et al.* (1973)
^{81}Kr-^{78}Kr	1.9±0.2	"
^{22}Na-^{21}Ne (direct)	2.0±0.3	"
^{22}Na-^{21}Ne (normalized)	2.2±0.3	"
^{81}Kr-^{78}Kr	1.99±0.16	Drozd *et al.* (1974)
^{21}Ne	1.40±0.33	"
^{38}Ar	4.0±1.7	"
Cosmic ray tracks	2.3	Yuhas (unpublished, referenced in Crozaz *et al.*, 1974)

Whole rock ^{22}Na and ^{26}Al data are given by Rancitelli et al. (1973a). From these data Yokoyama et al. (1974) conclude that 69935 is saturated in ^{26}Al activity.

^{26}Al data and a cosmic ray track profile (Fig. 7) are provided by Bhandari (1977). Calculated exposure ages from these data (0.4 ± 0.3 m.y. and 0.5 m.y., respectively) are significantly less than the ~2 m.y. exposure ages discussed above. Bhandari (1977) notes that lunar surface photographs show a large crack in the 69935/55 boulder and that his sample came from a face of 69935 exposed along this crack. He concludes that the boulder was split in a fragmentation event ~0.5 m.y. ago.

<u>MICROCRATERS</u>: Size-frequency distribution data (Fig. 8) are given by Morrison et al. (1973), Neukum et al. (197.3) and Fechtig et al. (1974). Nagel et al. (1975) report diameter/depth ratios (Fig. 9). An exposure age of 2.8 m.y. based on an empirically calibrated constant flux is calculated by Morrison et al. (1973).

<u>PROCESSING AND SUBDIVISIONS</u>: In 1972, 69935 was slabbed and several other pieces removed by sawing and chipping. Thin sections that sample the lineated and the glassy lithologies were made from ,19 (sections ,59 - ,63) and ,25 (sections ,64 - ,67), respectively (Fig. 10). Many chips remain in stock at JSC; the largest single piece is ,1 (66.12 g) which contains all major lithologies in the rock. ,3 (15.55 g, split from ,2 in Fig. 10) is stored at the Brooks Remote Storage Vault and is largely the lineated lithology.

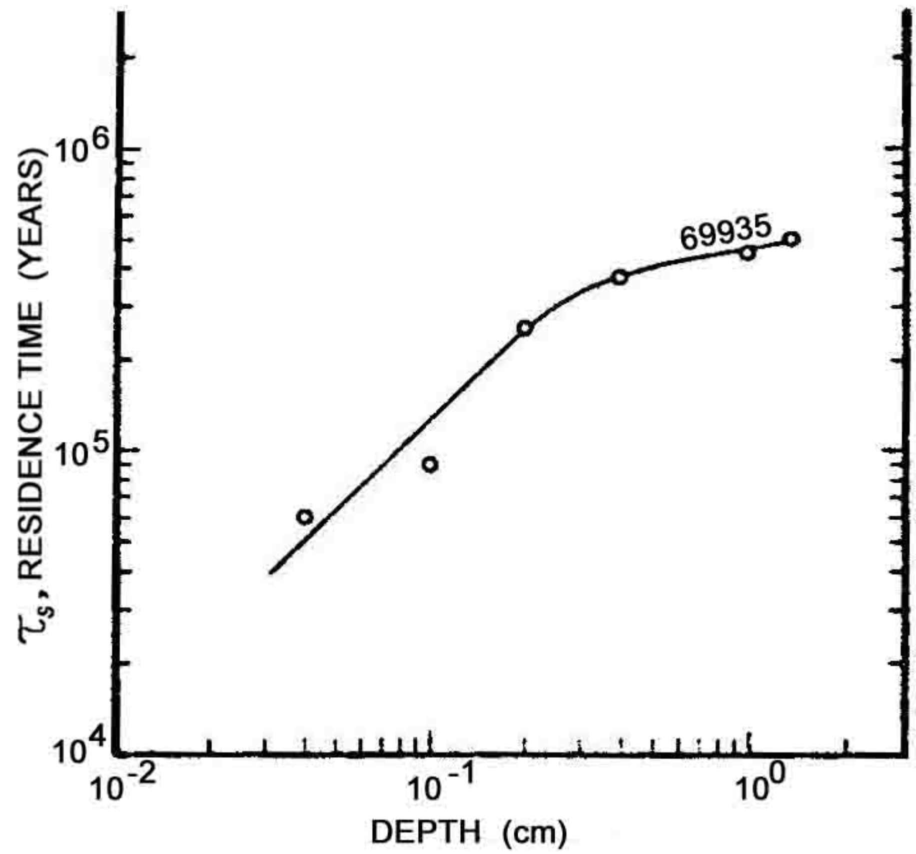

FIGURE 7. Cosmic ray track profile; from Bhandari (1977).

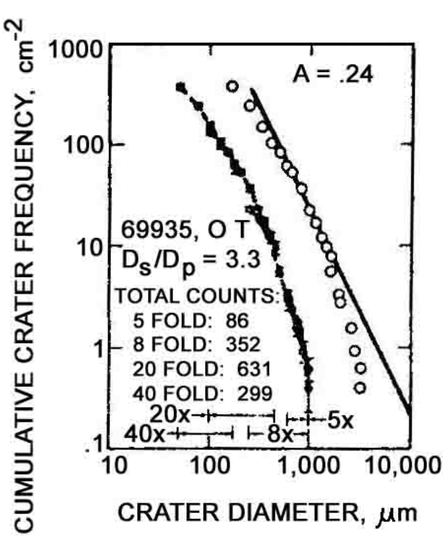

FIGURE 8. Microcraters; from Morrison et al. (1973).

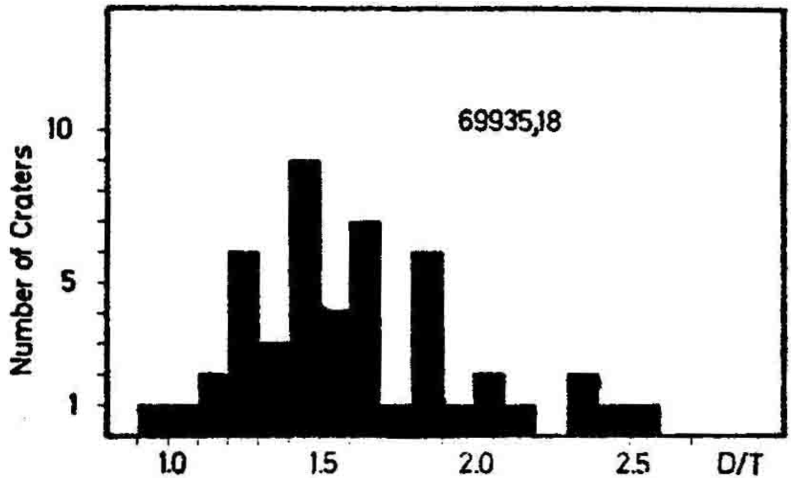

FIGURE 9. Microcraters; from Nagel et al. (1975).

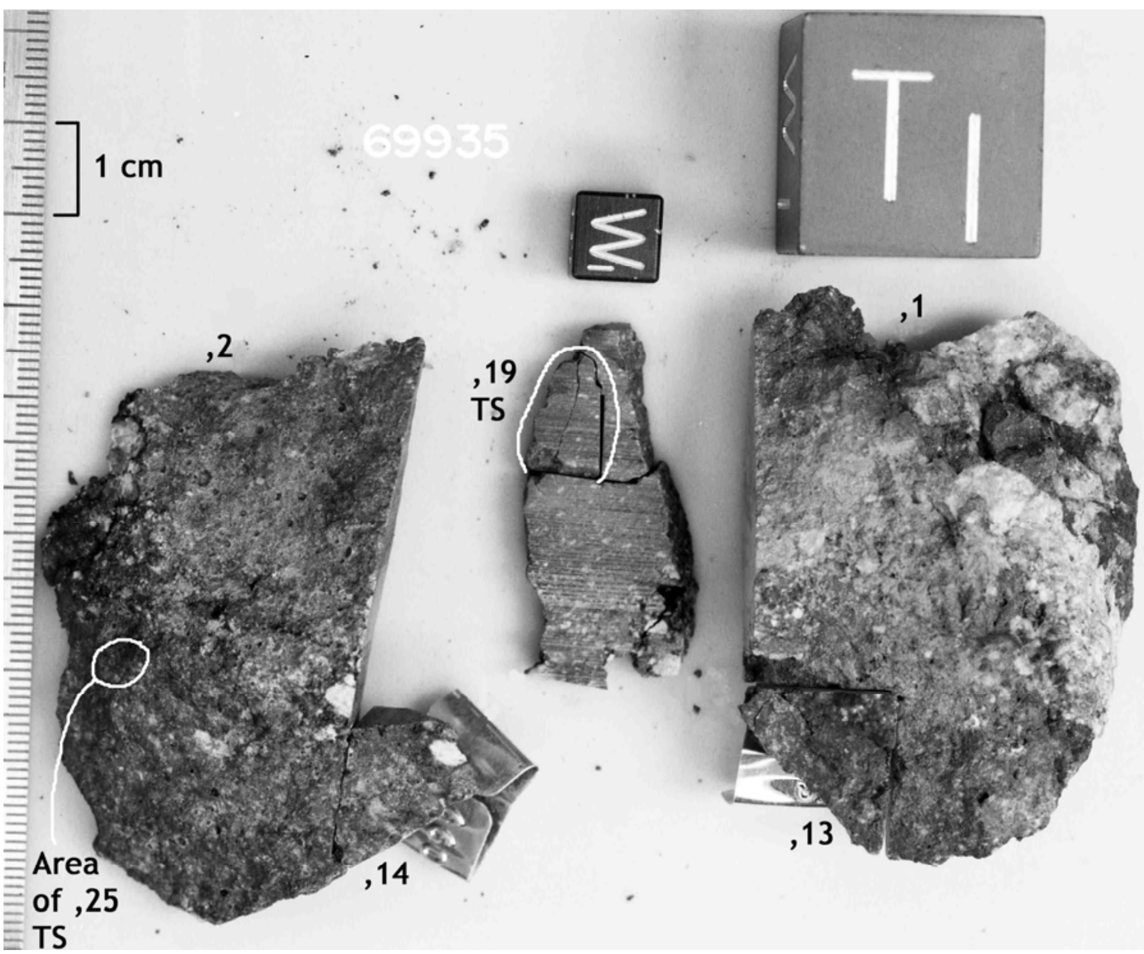

FIGURE 10. S-73-22567.