72535

Microsubophitic Impact Melt Breccia
St. 2, 221.4 g

INTRODUCTION

72535 is a fine-grained clast-bearing impact melt with a subophitic groundmass texture. Its chemistry is similar to the common low-K Fra Mauro melts that dominate the Apollo 17 highlands samples. It has an exposure age of about 96 Ma and may have been excavated as part of a landslide caused by Tycho secondaries.

72535 was one of several blue-gray breccias (LSIC 17, 1973) collected in the first rake sample from Station 2, adjacent to Boulder 2. It is 7.6 x 6.8 x 5.9 an, and medium dark gray (N4) (Keil et al., 1974). It is subrounded (Fig. 1) and coherent, with a few non-penetrative fractures and about 1% small vugs. There are many zap pits and one surface has a thin layer of dark glass. Other surfaces were described by Keil et al. (1974) as granulated. Matrix material (less than 1 mm grain size) was estimated as 92% of the sample.

PETROGRAPHY

The groundmass of 72535 is a very fine-grained crystallized melt, with small clasts quite distinct from the groundmass (Fig. 2). It has some patchiness but is generally homogeneous. Warner et al. (1977 b, c; 19780 described 72535 as a microsubophitic matrix breccia. Their modal data (Table 1) shows a high proportion of melt groundmass (85%) and a clast population dominated by plagioclase, similar to many other impact melt samples at the Apollo 17 site. Warner et al. (1977b, c; 1978f) described the dark porous groundmass as basaltic-textured, with plagioclase laths less than 30 microns long subophitically enclosed by irregular mafic crystals. Some mafic grains are locally ophitic to micropoikilitic in habit. Opaque minerals (mainly ilmenite) occur as irregular discrete

Figure 1: Sample 72535. S-73-20457B. Scale divisions in centimeters.

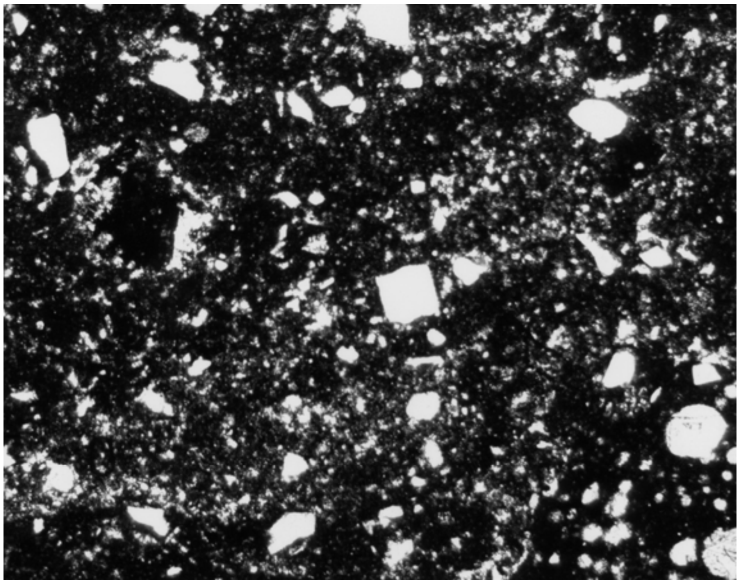

Figure 2: Photomicrograph of 72535,6, showing general groundmass. White phases are plagioclase clasts and some vugs. Plane transmitted light; width of field about 1 mm.

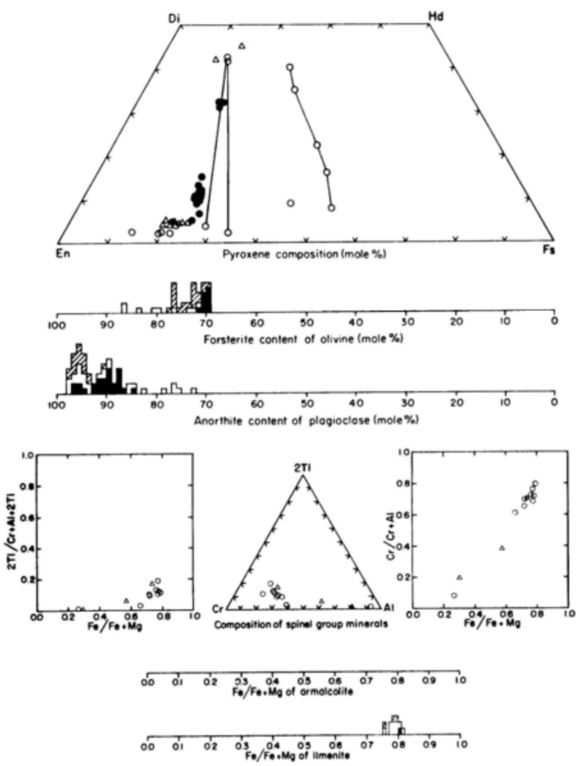

Figure 3: Microprobe analyses of minerals in 72535 (Warner et al., 1978f). Filled symbols = matrix phases. In histograms, open symbols = mineral clasts and cross-hatched = minerals in lithic clasts. In other diagrams, open circles = mineral clasts and open triangles = minerals in lithic clast.

rods less than 5 microns wide and up to 20 microns long. Tiny grains of Fe-metal and troilite are widely disseminated. Microprobe analyses (Warner et al., 1978f) are shown in Figure 3. The matrix olivines show a narrow range of composition (Fo_{69-71}), but matrix pyroxenes and plagioclases show a wider range. Engelhardt (1979) tabulated ilmenite paragenetic features, inferring that ilmenite crystallization started after plagioclase but before pyroxene.

Both mineral and lithic clasts tend to be subrounded to subangular. Calcic plagioclases dominate the mineral clasts, and most are smaller than 100 microns; mafic mineral clasts also tend to be more refractory than the groundmass counterparts (Fig. 3). The lithic clasts are common highlands lithologies, including poikilitic norites, granoblastic feldspathic breccias, and several fine-grained crystalline feldspathic breccias. Two lithic fragments are broadly granitic.

CHEMISTRY

A 771 mg sample was analyzed by Laul and Schmitt (1975c) (Table 2; Fig. 4). The chemistry is fairly similar to that of other Apollo 17 impact melts (although K appears to be lower), and Laul and Schmitt (1975c) suggested that 72535 could be a fragment from Boulder 2 Station 2. A microprobe defocused beam analysis for the major elements (Table 3) agrees well with the neutron activation analysis.

RARE GASES AND EXPOSURE

Arvidson et al. (1976) reported Kr and Xe isotopic data for 72535, and calculated ^{81}Kr-Kr exposure age of 107 +/- 4 Ma. The hard Kr and Xe spallation spectra suggested that the sample received little shielding, and the relatively low $(^{131}Xe/^{126}Xe)_c$ is also characteristic of simple surface exposure. Assuming single stage exposure, therefore, and correcting for erosion, the exposure age was inferred to be 96 +/- 5 Ma. The exposure age is one of a group of similar exposure ages that includes samples from the central crater cluster on the mare plains and may be attributable to secondary cratering from Tycho that created the cluster and caused the light mantle landslide.

PROCESSING

A few exterior chips with total mass less than 2 g were taken in 1974. Sample, 1 was used for thin sections and the chemical analysis, and, 2 for the rare gases. The three small chips composing, 3 remain unallocated.

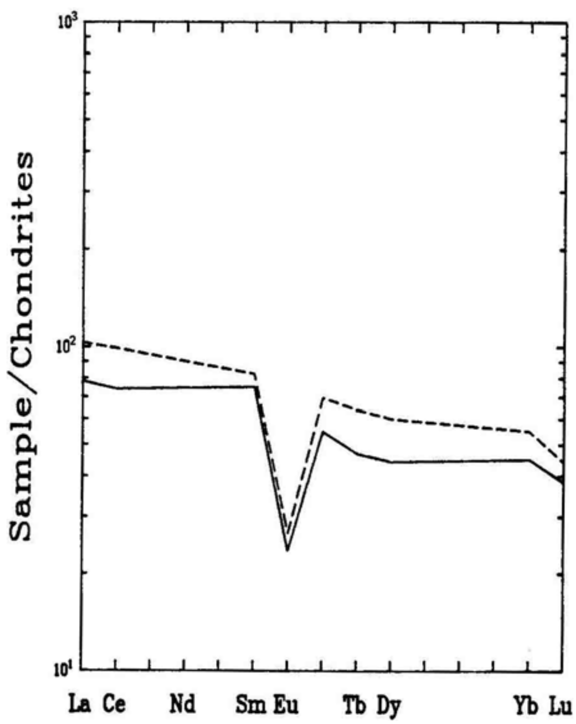

Figure 4: Chondrite-normalized rare earths in 72535,1 (solid line; Laul and Schmitt, 1975c) and average of Boulder 2 at Station 2 (dashed line; Laul and Schmitt, 1974a).

Table 1: Maul analysis of 72535, 6 (Warner et al., 1977b).

	72535
Points counted	3222
Matrix	84.8
Mineral clasts	11.0
Lithic clasts	4.2
Mineral clasts	
Plagioclase	7.1
Olivine/pyroxene	3.7
Opaque oxide	tr
Metal/troilite	0.2
Other	—
Total	11.0
Lithic clasts	
ANT	1.9
Devitrified anorthosite	0.6
Breccia	1.4
Other	0.3
Total	4.2
Percent of matrix (normalized to 100)	
Plagioclase	52.9
Olivine/pyroxene	43.8
Opaque oxide	2.9
Metal/troilite	0.1
Other	0.2

Table 2: Chemical analysis of bulk sample 72535.

Split	,1
wt %	
SiO_2	
TiO_2	1.4
Al_2O_3	17.8
Cr_2O_3	0.190
FeO	8.4
MnO	0.099
MgO	11
CaO	11.2
Na_2O	0.58
K_2O	0.13
P_2O_5	
ppm	
Sc	16
V	40
Co	29.2
Ni	250
Rb	
Sr	
Y	
Zr	400
Nb	
Hf	8.7
Ba	300
Th	3.4
U	
Cs	
Ta	1.2
Pb	
La	25.8
Ce	65
Pr	
Nd	
Sm	13.6
Eu	1.62
Gd	
Tb	2.2
Dy	14
Ho	
Er	
Tm	
Yb	9.0
Lu	1.3
	(1)

References and methods:
(1) Laul and Schmitt (1975c); INAA

Table 3: Microprobe defocused beam analysis of matrix of 72535
(from Warner et al., 1977b)

Split	
wt %	
SiO_2	47.9
TiO_2	1.68
Al_2O_3	18.1
Cr_2O_3	0.17
FeO	8.7
MnO	0.13
MgO	10.6
CaO	11.9
Na_2O	0.54
K_2O	0.07
P_2O_5	0.27

(Normalized to 100%).