67475 GLASSY OR FINE-GRAINED IMPACT MELT BRECCIA 175 g

INTRODUCTION: 67475 is a tough, purplish-gray, glassy breccia (Fig. 1) that was collected to sample a large, dark clast within the white boulders on the south rim of North Ray Crater. It is from the same boulder which yielded 67455.

Lunar orientation is unknown due to a lack of surface photographs. Zap pits occur on the T and S surfaces only; the other surfaces were either buried in the boulder or are freshly broken. This rock was studied as part of the Chao consortium.

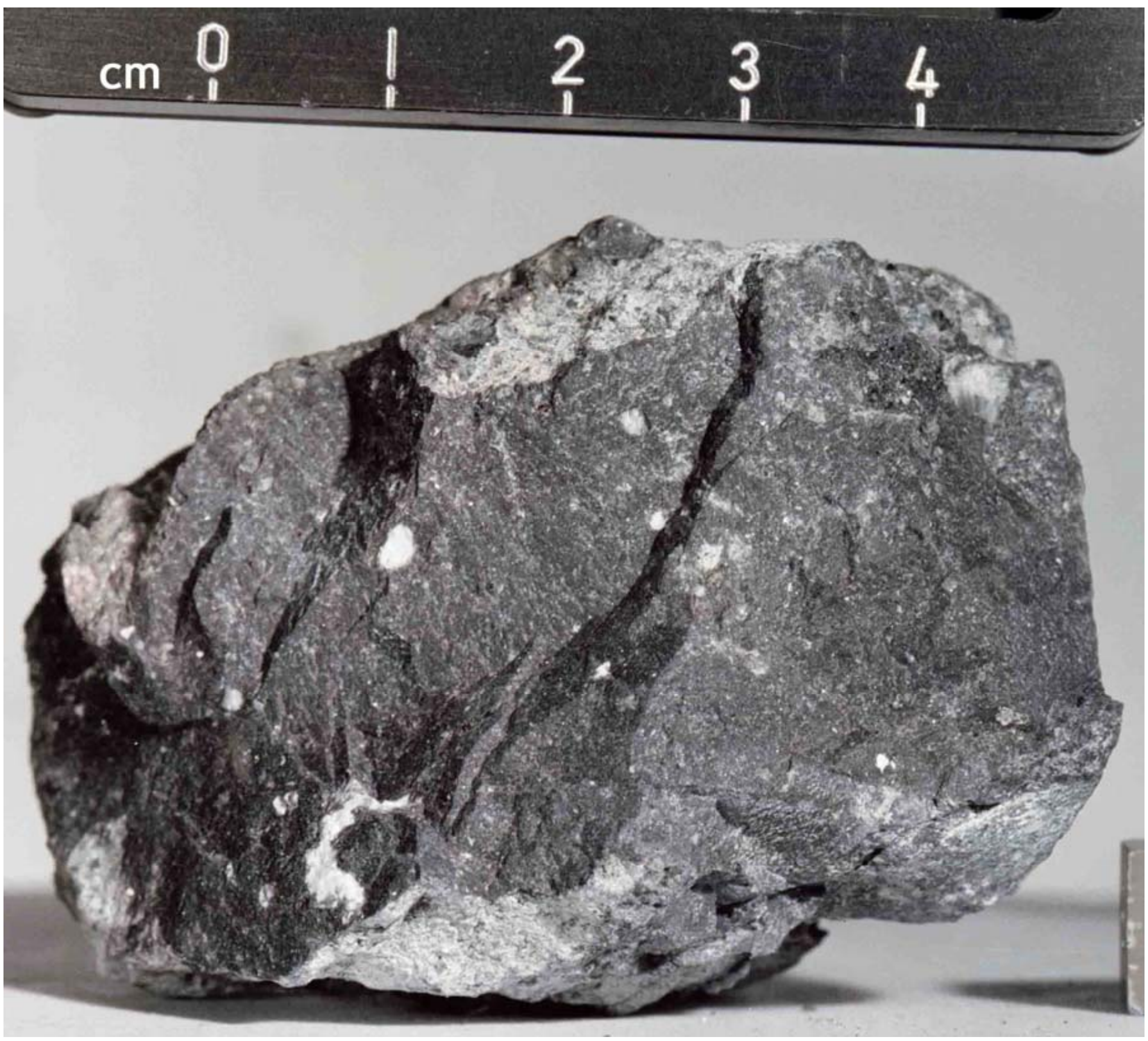

FIGURE 1. S-72-43363.

PETROLOGY: Minkin et al. (1977) give a petrographic description and most of the following is taken from that work. 67475 is a glassy, clast-rich breccia composed of three distinct lithologies: a fragment-laden, glassy matrix breccia; a dark, metal- and silica-rich breccia; and a light colored, olivine bearing breccia (Fig. 2). Contacts between all lithologies are sharp.

The fragment-laden , glassy matrix breccia (Fig. 2) accounts for the majority of the rock. It is very similar to the much smaller glassy matrix breccia clasts in 67455. Plagioclase xenocrysts (An_{87-98}) dominate the fragment population within this lithology. Lesser amounts of olivine (Fo_{56-66}), orthopyroxene ($Wo_{3-4}En_{71-64}$), augite ($Wo_{42}En_{41-47}$), silica, troilite, Fe-metal (4% Ni, 0.2% Co) and devitrified glass are also present. Lithic clasts include cataclastic and polygonal anorthosites and granoblastic to poikilitic gabbroic anorthosites composed of plagioclase (An_{93-96}), augite oikocrysts ($Wo_{34-38}Ens_{52-50}$), interstitial olivine (Fo_{74-77}) and ilmenite.

The metal-and silica-rich breccia (Fig. 2) accounts for ~12% of thin section ,82 and contains a mineral assemblage appropriate for a highly differentiated residuum. Large grains of silica (up to 400 µm long) coexist with ferroaugite ($Wo_{32-42}En_{22-15}$), apatite, whitlockite and ilmenite. Potash feldspars ($Or_{82-84}An_{16-13}$) are often intergrown with lamellae of silica and plagioclase ($An_{53-63}Or_{8-5}$). Olivine ($Fo_{22-24,}$) is rare. Metal occurs as discrete grains and in myrmekitic intergrowths with silica. The “matrix” of this lithology consists of very fine-grained pyroxene ($Wo_{4-3}En_{45-34}$) and tiny blebs of metal.

The light colored, olivine-rich breccia (4% of thin section ,82) contains clasts of plagioclase (An_{92-96}, rarely $An_{60}Or_5$), orthopyroxene ($Wo_{35-42}En_{18-10}$), olivine (Fo_{63-68}), ilmenite, silica and abundant, finely dispersed troilite. Fragments of granoblastic gabbroic anorthosite similar to those in the glassy matrix breccia are also abundant here, along with a few granoblastic (polygonal) anorthosites.

CHEMISTRY: Some compositional variation among different splits of this rock is apparent from the published data. From data pack photos we have identified all allocations for chemistry as nearly homogeneous, dark fragments but the relative abundances of either the glassy or the metal/silica-rich lithologies are unknown.

Major and trace element analyses are provided by Lindstrom et al. (1977), Miller et al. (1974) and Garg and Ehmann (1976) (Table 1; Fig. 3). Hertogen et al. (1977) give meteoritic siderophile and volatile abundances for two splits. Both splits have similar amounts of volatiles and similar inter-element ratios, but the absolute abundances of siderophiles vary by a factor of four (Table 2). Cripe and Moore (1975) and Moore and Lewis (1976) report total C, N and S abundances. Natural and cosmogenic radionuclides for the whole rock were determined by Clark and Keith (1973) using gamma-ray spectroscopy.

67475 is a very aluminous breccia with a relatively high Fe/Mg (Table 1, see also Figs. 4 and 5 of 67455). In terms of major elements, 67475 is very similar to the bulk rock from which it was taken (represented by 67455) but rare earths in 67475 are considerably

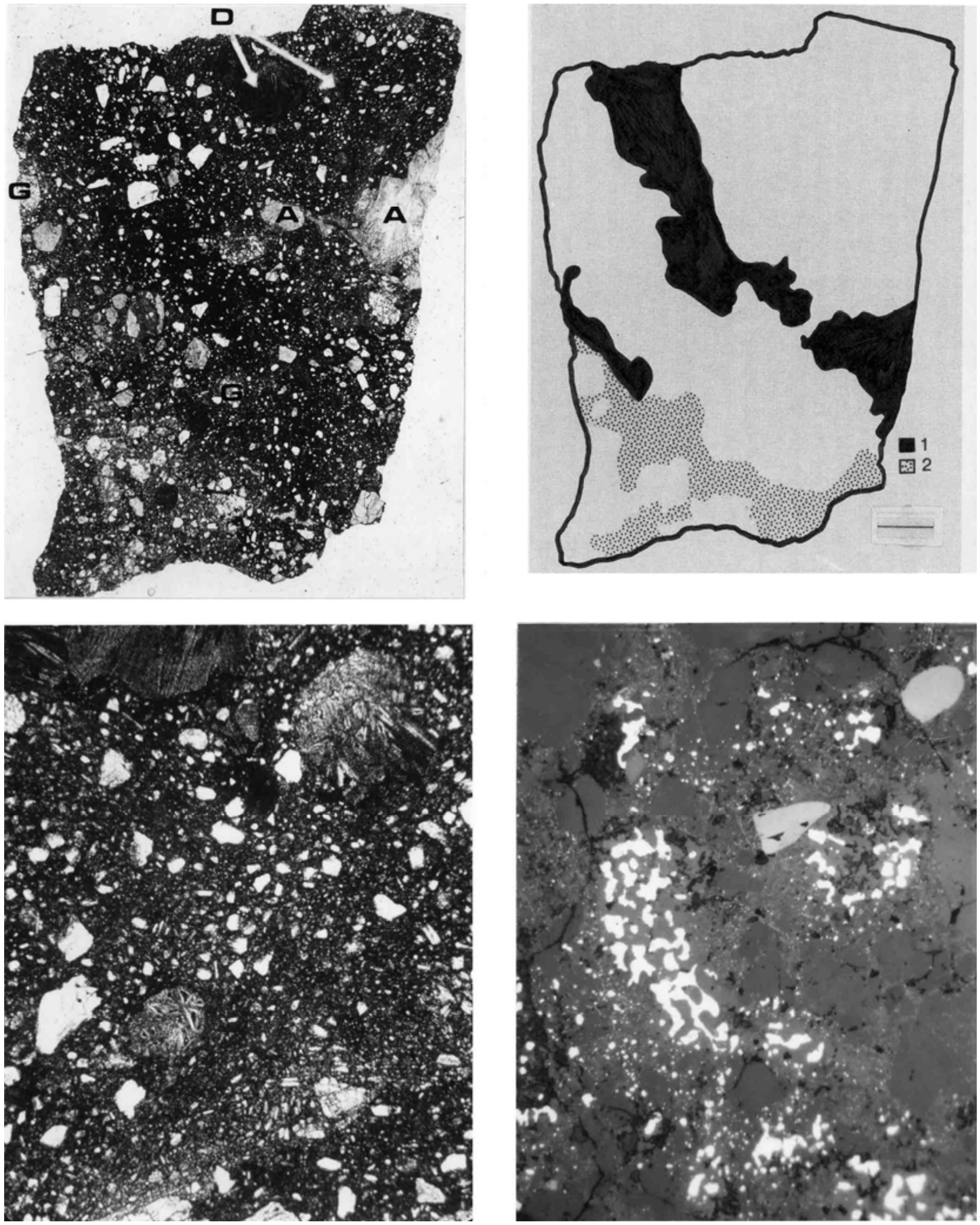

FIGURE 2. 67475,82
a) Whole thin section, ppl. Width about 8 mm.
Labeled clasts are: A = cataclastic anorthosites, D = devitrified glass, and
G = recrystallized olivine bearing gabbroic anorthosites; from Minkin et al. (1977).
b) Map of thin section ,82 outlining the major lithic types.
1 = metal- and silica-rich breccia, 2 = light colored, olivine-rich breccia;
the remainder of the section is fragment-laden, glassy breccia.
Scale bar is 1 mm; from Minkin et al. (1977).
c) Glassy matrix breccia, ppl. Width 2 mm.
d) Metal- and silica-rich breccia, rfl. Width 0.5 mm.

enriched over those in 67455. Although petrographically similar to the glassy matrix breccia clasts of 67455, 67475 is somewhat more aluminous and considerably richer in REEs than these clasts (Lindstrom et al., 1977). Also notable is the high S abundance of 67475 (Table 1).

TABLE 1. Summary chemistry of 67475.

SiO_2	44.5	Sr	216
TiO_2	~0.4	La	
Al_2O_3	30.5	Lu	0.140
Cr_2O_3	0.04	Rb	0.74
FeO	3.1	Sc	5.92
MnO	0.04	Ni	~60
MgO	3.0	Co	7.8
CaO	17.8	Ir ppb	1.68-7.01
Na_2O	0.60	Au ppb	0.382-1.27
K_2O	0.05	C	11
P_2O_5	<0.02	N	135
		S	995
		Zn	1.4
		Cu	

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

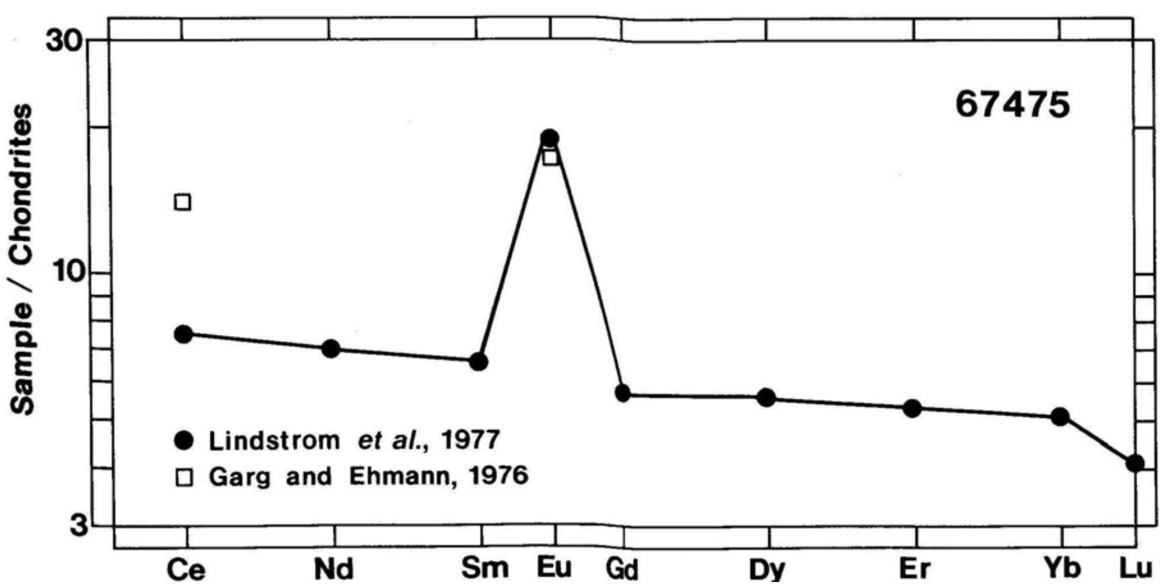

FIGURE 3. Rare earths.

EXPOSURE AGES: Cosmogenic radionuclide abundances are provided by Clark and Keith (1973). From these data, Yokoyama et al. (1974) conclude that 67475 is probably saturated in ^{26}Al activity. This contrasts with 67455 which Yokoyama et al. (1974) believe to be unsaturated.

PROCESSING AND SUBDIVISIONS: In 1973 this rock was slabbed. During sawing the slab broke along natural fractures, as did several exterior chips from the butt ends (Fig. 4). In 1974, under Chao's direction, several more pieces were chipped for allocations from both the slab and the smaller end pieces. The largest single piece remaining is ,3 (76.56 g).

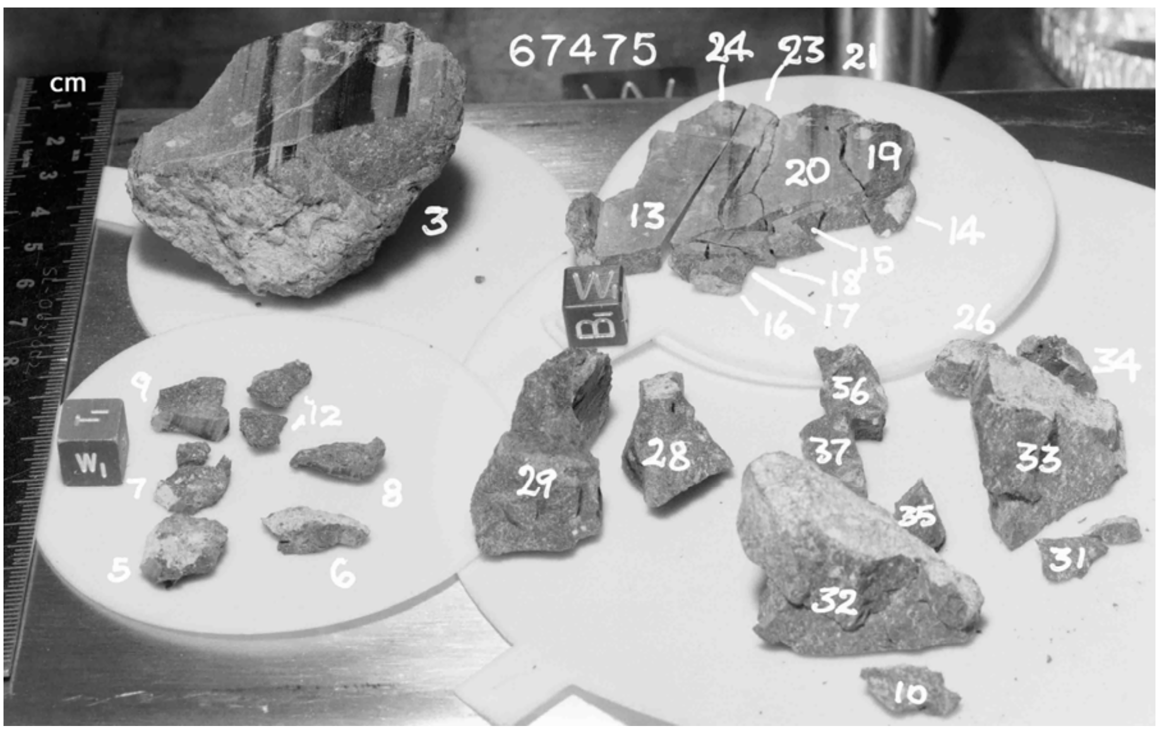

FIGURE 4. Major subdivisions of 67475. S-73-30708.