67975 FRAGMENTAL POLYMICT BRECCIA, GLASS COAT 447 g

INTRODUCTION: 67975 is an irregularly shaped rock which has roughly equal amounts of a pale gray, fragmental, friable breccia and a coating of frothy, clast-rich glass (Fig. 1). It was picked off the regolith near Outhouse Rock, on the east rim of North Ray Crater. Its orientation is unknown. Zap pits are present on the N and W surfaces of the breccia.

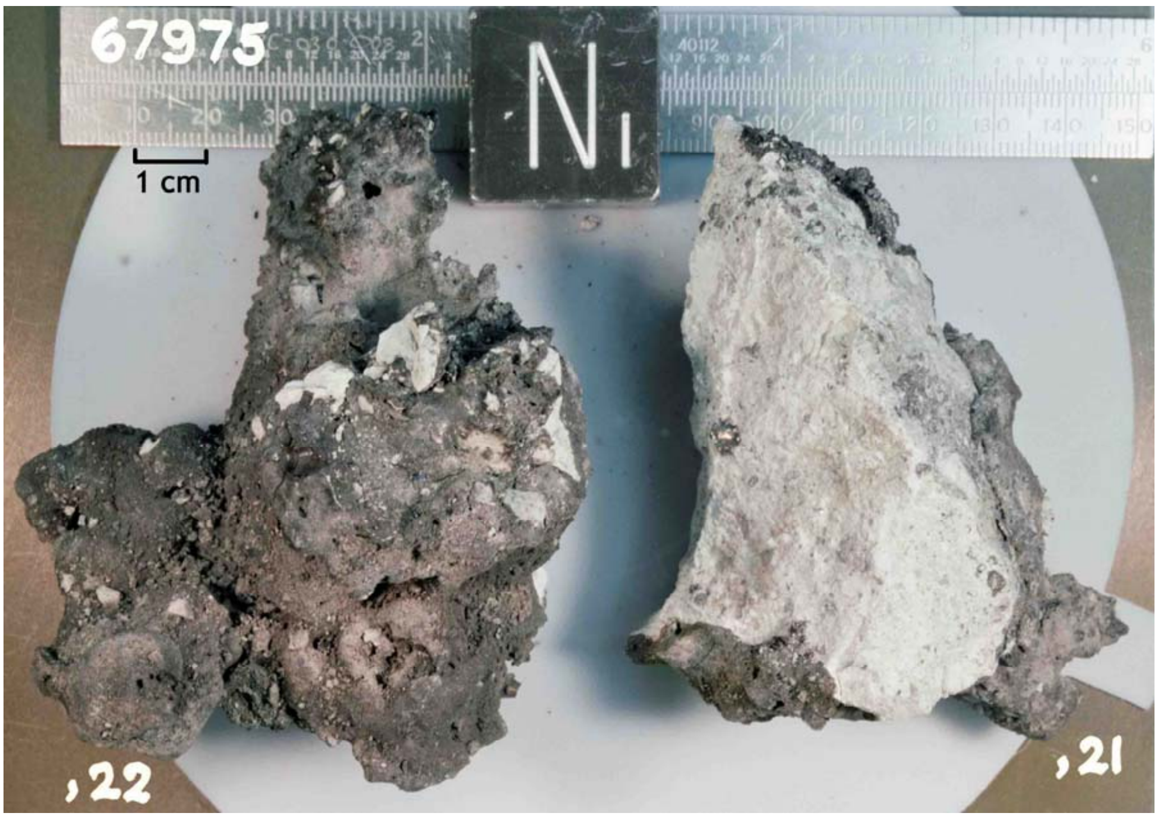


FIGURE 1. S-75-24528.

PETROLOGY: Two lithologies make up 67975 in approximately equal proportions: a fragmental, pale gray breccia, and a glassy coating. Plagioclase mineral fragments dominate the breccia (Fig. 2) with subordinate amounts of mafic minerals, Fe-metal (some rusty) and troilite, and rare ilmenite and spinel. Lithic clasts (Fig. 2) are not common and include basaltic impact melt, granoblastic troctolitic anorthosite, and cataclastic anorthosite, at least one clast of which is pristine. A few dark, irregular, metal-rich glass veins penetrate the breccia.

The glass coating (up to ~5 cm thick in places) is generally clean glass with a few mineral and lithic clasts (Fig. 2). Very fine-grained "quench" crystals of plagioclase commonly radiate from the glass/breccia contact and from the exterior surface of the coat.

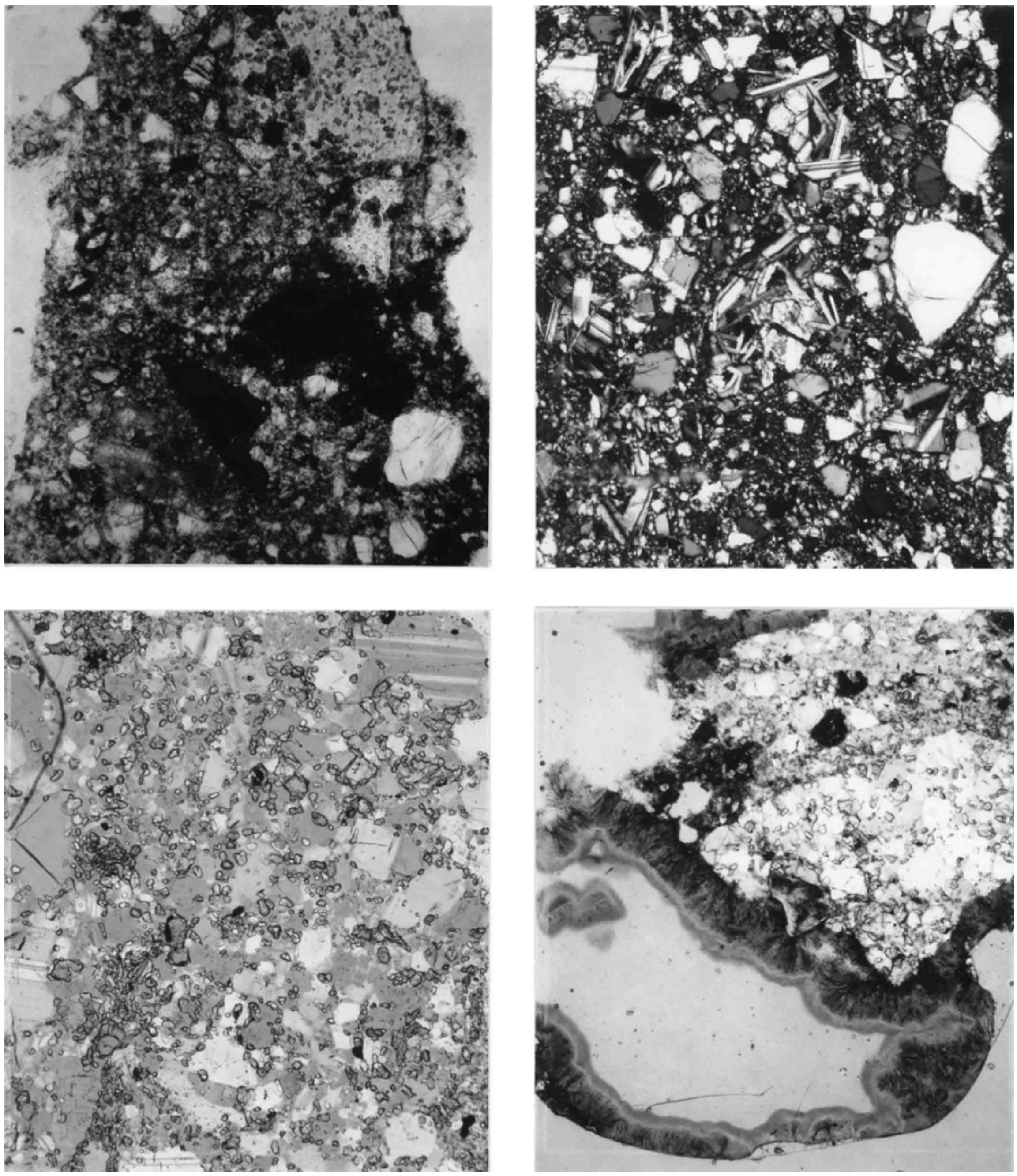


FIGURE 2.
a) 67975,81. Fragmental breccia, ppl. Width 2 mm
b) 67975,62. Fragmental breccia, basalt clasts, xpl. Width 1 mm
c) 67975,65. Granoblastic clast, partly xpl. Width 1 mm.
d) 67975,55. Granoblastic clast in glass coat, ppl. Width 2 mm.

CHEMISTRY: Major and trace element analyses of representative chips of glass coat and fragmental breccia are given by Christian et al. (1976) (splits ,3 and ,43 respectively). Hertogen et al. (1977) report meteoritic siderophile and volatile element abundances for the glass coat, the fragmental breccia, a pristine cataclastic anorthosite clast, and a dark, aphanitic clast. Total N and C abundances of the glass and the breccia are provided by Moore and Lewis (1976). Clark and Keith (1973) measured natural and cosmogenic radionuclide abundances in the whole rock. Uhlmann et al. (1977) report an average microprobe major element analysis of the glass coat.

A summary chemistry for each analyzed lithology is given in Table 1. The major element data for the glass coat are those by Christian et al. (1976). The microprobe analysis of the glass coat by Uhlmann et al. (1977) is significantly more aluminous (30.4% Al_2O_3), possibly indicating some heterogeneity in the glass. Significant compositional differences between the glass coat and the fragmental breccia are apparent, especially for Al_2O_3 and Fe/Mg. Except for the pristine anorthosite clast, all samples are contaminated with meteoritic material.

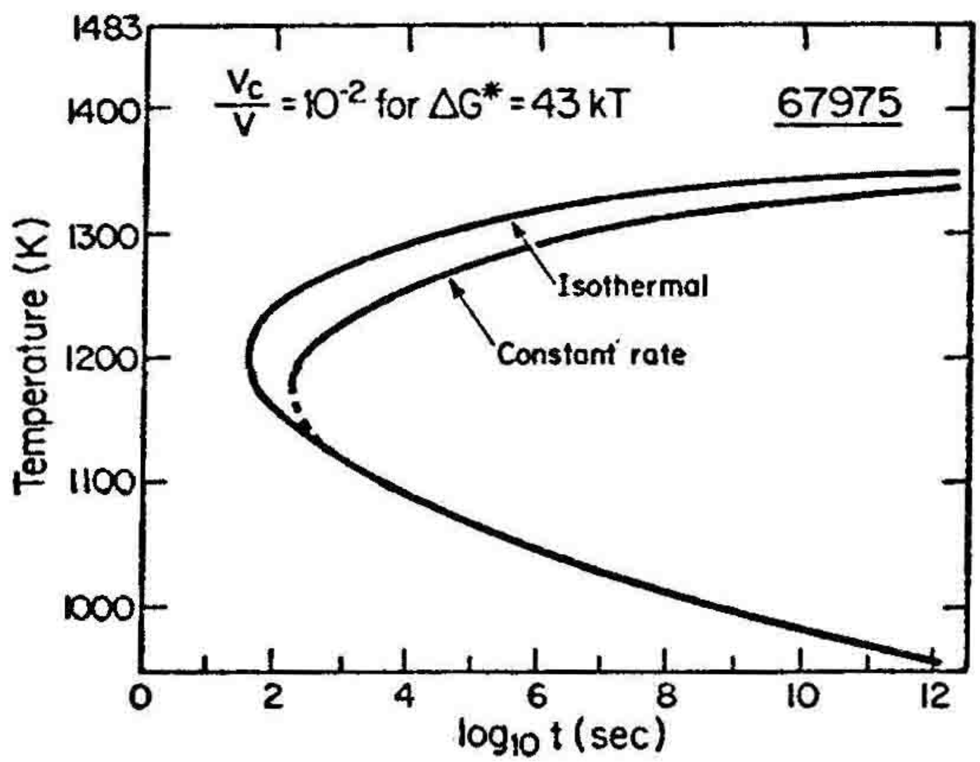
TABLE 1. Summary chemistry of 67975 lithologies.

SiO_2	44.23	45.33		
TiO_2	0.40	0.49		
Al_2O_3	29.12	27.50		
Cr_2O_3	0.05	0.08		
FeO	4.61	4.27		
MnO	0.06	0.06		
MgO	4.09	5.58		
CaO	16.70	15.90		
Na_2O	0.42	0.52		
K_2O	0.13	0.11		
P_2O_5	0.20	0.11		
Sr	130	150		
La	<10	11		
Lu				
Rb	0.5-1	~1.8	0.58	2.46
Sc	8.7	6.8		
Ni	20	95	≤11	44
Co	4.6	6		
Ir ppb	0.493	5.14	0.091	1.66
Au ppb	0.046	1.48	0.0084	0.98
C	51	31		
N	42	54		
S				
Zn	1.44	2.44	4.25	7.49
Cu				

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

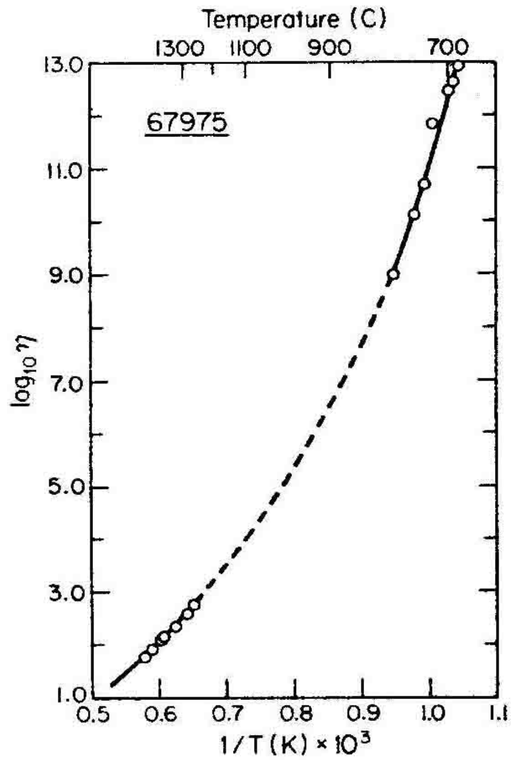
PHYSICAL PROPERTIES: Uhlmann et al. (1977,1978) experimentally and theoretically studied various aspects of the glass forming process for a composition matching their microprobe analysis of the 67975 glass coat (Figs. 3, 4, and 5). The relatively low liquidus temperature (1210ºC) and the high viscosity of this composition make it a good glass-former. Uhlmann et al. (1977) estimate the cooling rate of the 67975 glass coat to have been 0.06ºC/min and conclude that it did not form as an isolated body but as part of a larger cooling unit.

PROCESSING AND SUBDIVISIONS: In 1972 a few chips of glass coat were pried off for allocations. In 1975 the rock was extensively subdivided by chipping and prying. The sample has never been sawn. During the 1975 processing the rock was broken into two large pieces (Fig. 1) representing the bulk of the fragmental breccia (,21) and a large portion of the glass coat (,22). ,21 (172.55 g) is stored at the Brooks Remote Vault. ,22 (227.59 g) remains at JSC.



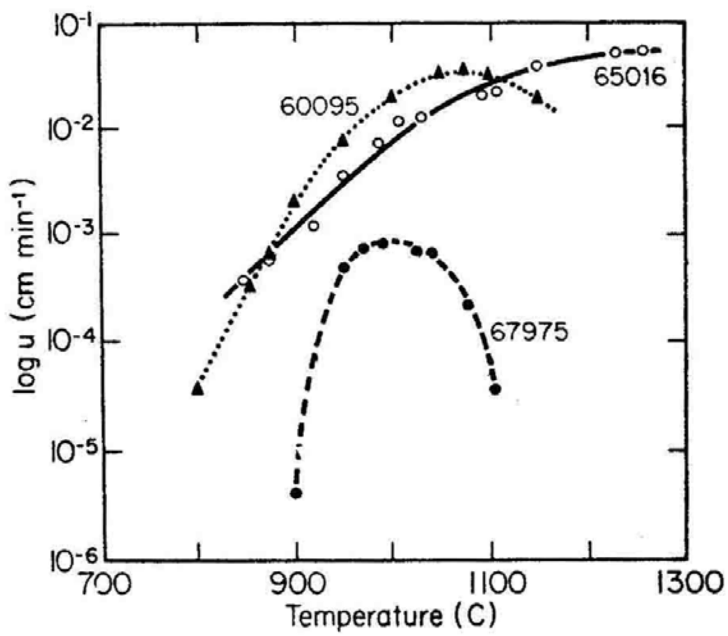
Time-temperature-transformation (TTT) and continuous cooling (CT) curves for matrix composition of lunar breccia 67975. Nucleation barrier = 43 kT at $\Delta T_r = 0.2$.

FIGURE 3. From Uhlmann et al. (1978).



Viscosity versus temperature relation for lunar composition 67975.

FIGURE 4. From Uhlmann et al (1977).



Crystal growth rate versus temperature relations for lunar compositions 67975, 60095, and 65016.

FIGURE 5. From Uhlmann et al. (1977).