15028 REGOLITH BRECCIA, GLASS-COATED ST. LM 59.4 g

INTRODUCTION: 15028 is a regolith breccia consisting of lithic, mineral, and glass fragments in a glassy matrix. It has an extensive, vesicular glass coat and thin veins of glass (Fig. 1). It is more enriched in incompatible elements than local regolith compositions, and is chemically similar to 15027.

15028 was collected and bagged with 15017, 15018, 15019, and 15027. They were lying in a subdued l-m crater 4 m south of the LM +Z footpad; 15028 was apparently typical of rocks in its size range in the area. It is subangular, tough, and light gray (Fig.1). Its lunar orientation is known; there are a few zap pits on the (laboratory) "S" and "T" surfaces.

PETROLOGY: 15028 is petrographically similar to 15027, which was collected near it. Kridelbaugh et al. (1972) described 15028 as a glass-coated breccia (Fig. 2) which shows a preferred orientation defined by elongate glass shards (Fra Mauro or KREEP composition) and vesicular glass veinlets. Normal to the preferred orientation is a set of microfaults, which truncate all components except the veinlets. There are two dominant types of lithic clasts: basalts and microbreccias. The basalts are porphyritic olivine basalt (mare). The olivine is zoned normally, Fo_{68} to Fo_{34}; pyroxenes have pigeonitic cores and augitic rims. Other minerals are plagioclase, ilmenite, chromite, Fe-metal, troilite, and residual phases. The microbreccias are well-rounded and noritic (orthopyroxene and plagioclase). Crystal fragments in the matrix include low-Ca pyroxenes (opx + pig), augitic pyroxenes, plagioclase, olivine, ilmenite, Fe-metal, troilite, and chromite.

Glass fragments constitute about 30% of 15028 by volume, and each is generally homogeneous, without devitrification. Fra Mauro (KREEP) glasses are the most abundant type in 15028, as colorless or light brown spherules, droplets, and elongate shards. Mare glasses, including AP15 Green Glass, are common. The volume distribution of the major glass compositional group is similar to that in local soils. The glass veinlets are compositionally homogeneous and similar in composition to the matrix (Tables 1 and 2).

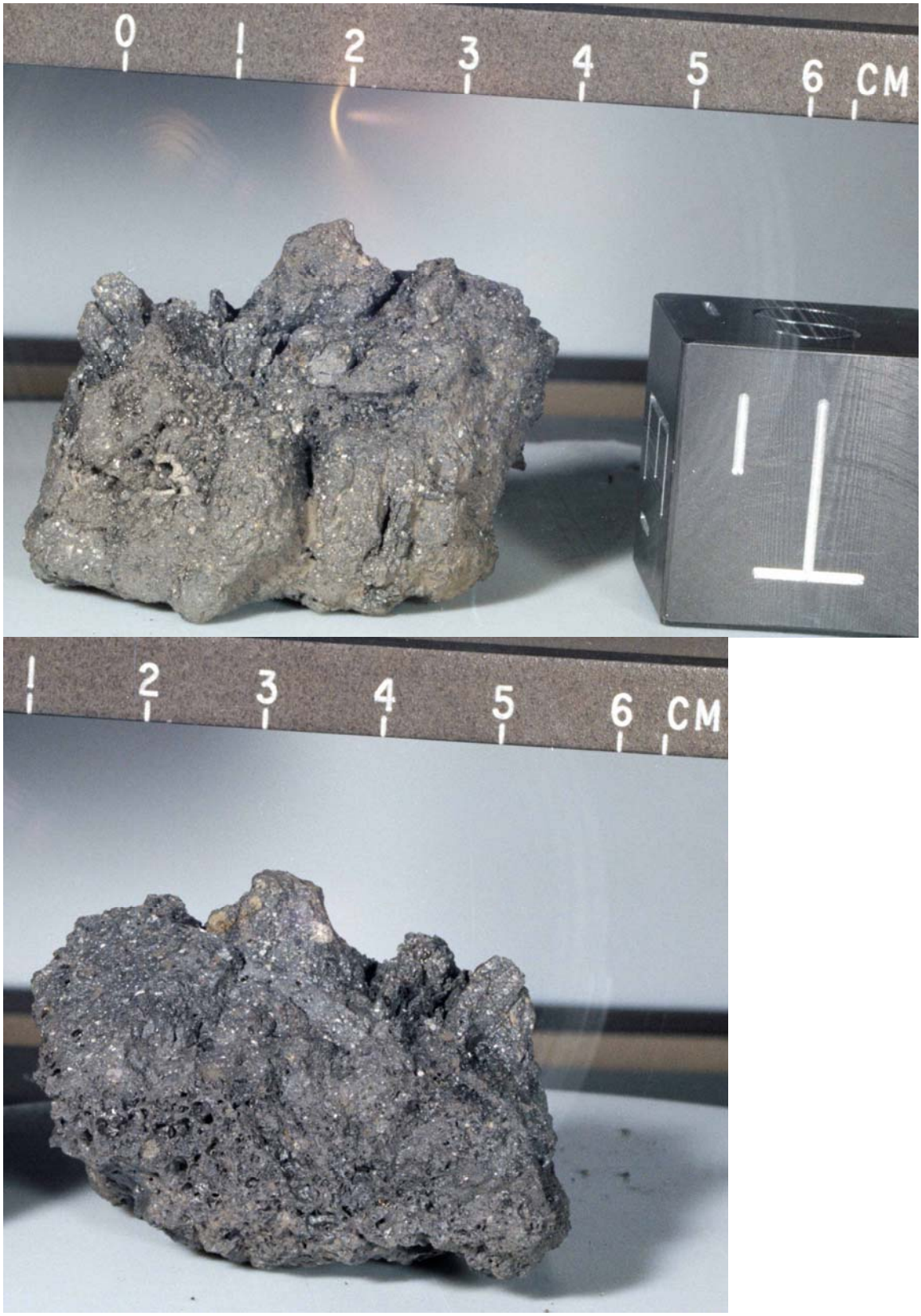

Figure 1. Photographs of 15028 showing vesicular glassy coat and fine breccia. S-71-43643 and S-71-43644

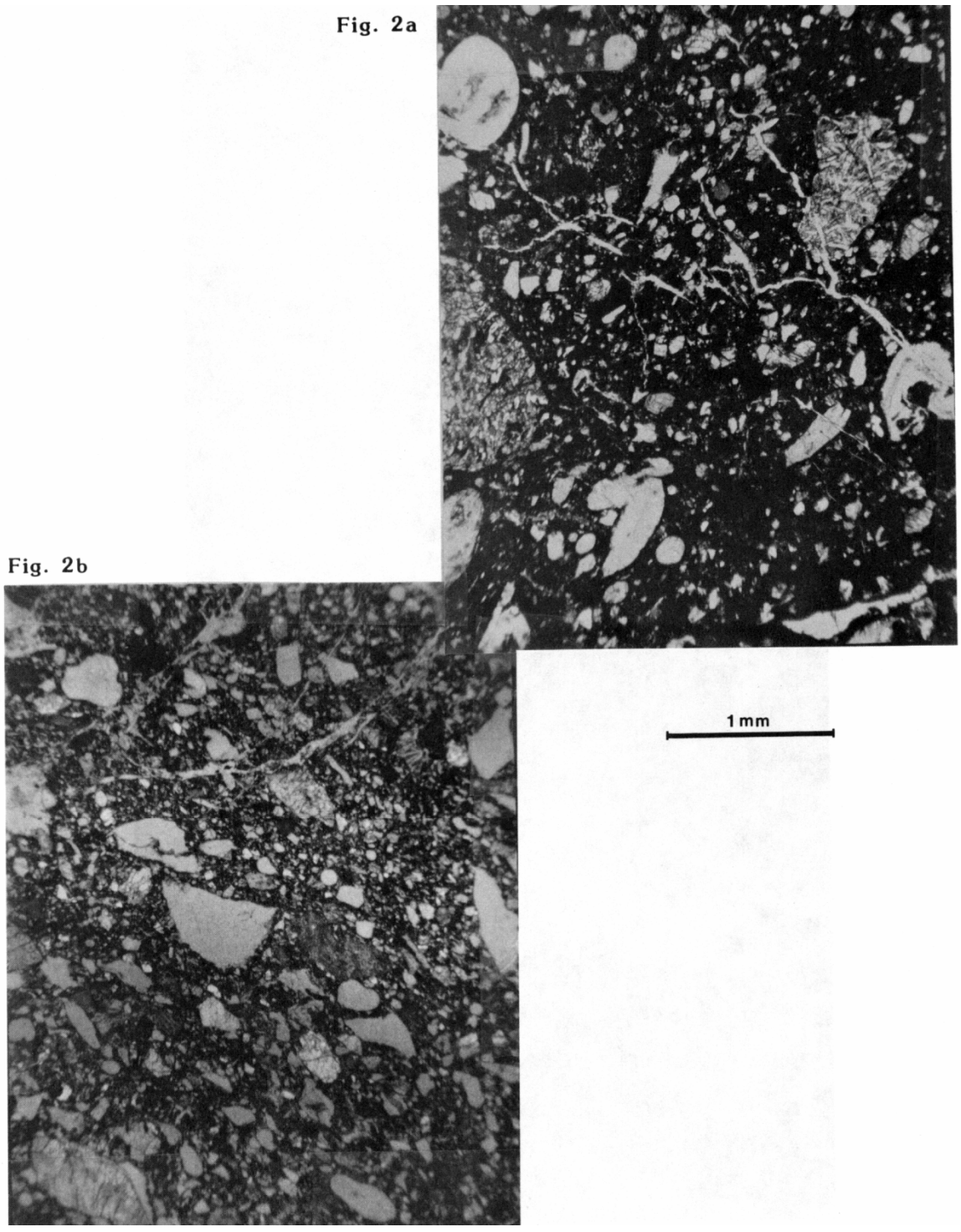

Figure 2. Photomicrographs of 15028 matrix showing foliation. Widths about 2 mm. Transmitted light. (a) 15028,5; (b) 15028,6.

McKay et al. (1984) found 15028 to have an I_s/FeO of 22 to 34 (listed as 26 by Korotev, 1984 unpublished), an immature to submature signature.

The glass analysis of Uhlmann et al. (1981) is probably of the glass coat. They studied glass crystallization kinetics, including this glass composition, and estimated viscosity temperature relations. A simplified model (l.2°C/sec) and measured (0.9°C/sec) cooling rate required to produce glass without any nucleation agree well. These rapid cooling rates could readily be attained in a body of the observed size (although whether this means the size of 15028 or of the glass coat is not actually specified in Uhlmann et al., 1981) cooling by radiation.

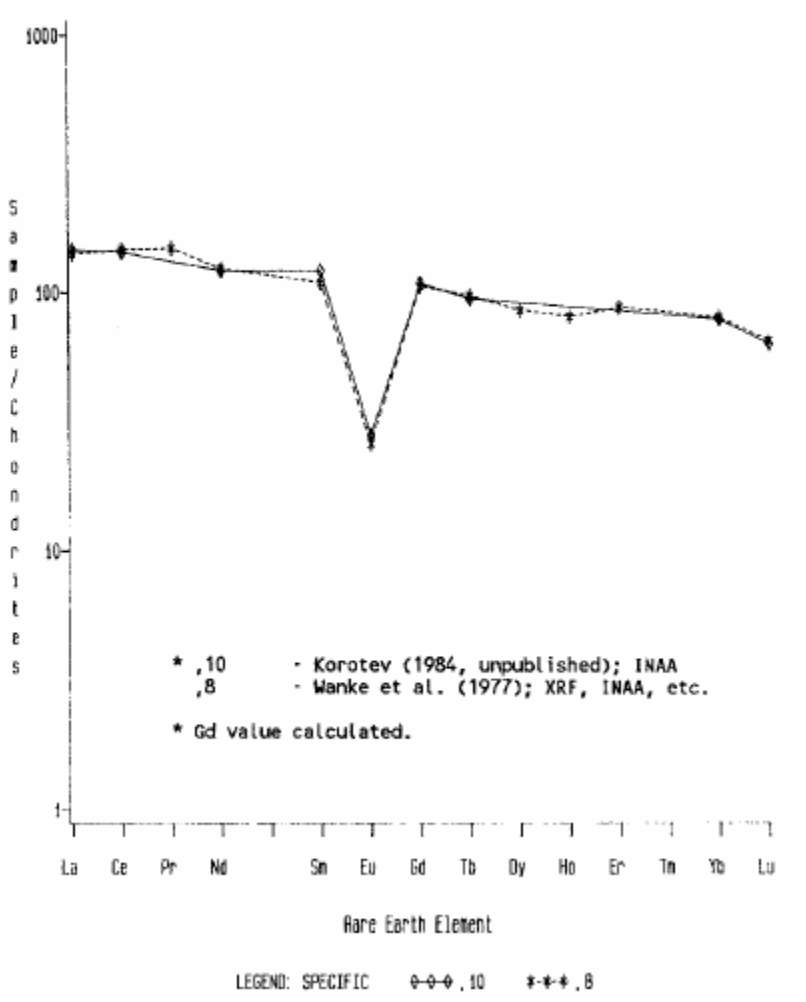

Figure 3. Rare earths in 15028 matrix.

CHEMISTRY: Chemical analyses of the breccia matrix are shown in Table 2 and Figure 3. Wanke et al. (1977) also analyzed for oxygen (42.82%); they did not specifically discuss the data. The breccia is enriched in incompatible elements compared with local regolith, by a factor of almost 2, but the major elements are fairly similar to those of local regolith. The chemistry is similar to that of 15027.

PROCESSING AND SUBDIVISIONS: Only a few pieces have been chipped from the sample, with ,0 now having a mass of 56.70 g. Chip ,1 was made into thin sections ,2 to ,6.

TABLE 15028-1. Microprobe analyses of glass

		a	a	b
Wt %	SiO2	47.98	46.47	48.8
	TiO2	1.75	1.60	1.4
	Al2O3	14.66	16.49	12.9
	FeO	14.10	13.72	14.1
	MgO	8.73	8.56	7.4
	CaO	10.30	10.69	9.5
	Na2O	0.59	0.64	0.6
	K2O	0.41	0.36	0.4
	P2O5	0.30	0.37	
ppm	Cr	1600	950	1300
		(1)	(1)	(2)

References:

(1) Kridelbaugh et al. (1972)
(2) Uhlmann et al. (1981)

Notes:

(a) glass veins
(b) glass coat(?)

TABLE 15028-2. Chemical analyses of matrix of 15028

		,8	,10
Wt %	SiO2	48.90	
	TiO2	1.79	2.00
	Al2O3	12.87	13.6
	FeO	14.16	14.5
	MgO	9.25	9.2
	CaO	10.37	9.8
	Na2O	0.5852	0.55
	K2O	0.4061	
	P2O5	0.3595	
(ppm)	Sc	29.9	28.7
	V	95.6	78
	Cr	2570	2410
	Mn	1470	1460
	Co	39.1	35.2
	Ni	200	135
	Rb	10.7	
	Sr	139,148	170
	Y	154	
	Zr	666	660
	Nb	48	
	Hf	17.0	18.0
	Ba	501	523
	Th	7.49	8.3
	U	2.37	2.37
	Pb		
	La	46.9	48.6
	Ce	130	127
	Pr	16.7	
	Nd	74	73
	Sm	19.7	21.9
	Eu	1.77	1.896
	Gd	26.2	
	Tb	4.53	4.42
	Dy	26.9	
	Ho	5.6	
	Er	17.4	
	Tm		
	Yb	15.8	15.5
	Lu	2.18	2.12
	Li	26.2	
	Be	7.59	
	B		
	C		
	N		
	S		
	F	84	
	Cl	29.7	
	Br	0.24	
	Cu	5.29	
	Zn	8.0	
(ppb)	I		
	At		
	Ga	3360	
	Ge	300	
	As	63	
	Se	350	
	Mo		
	Tc		
	Ru		
	Rh		
	Pd		
	Ag		
	Cd		
	In		
	Sn		
	Sb		
	Te		
	Cs	530	440
	Ta	2010	2080
	W	980	
	Re	0.51	
	Os		
	Ir		3.8
	Pt		
	Au	4.0	9.6
	Hg		
	Tl		
	Bi		
		(1)	(2)

References and methods:

(1) Wanke et al. (1977); XRF, INAA, etc.

(2) Korotev (1984 unpublished); INAA