15265 REGOLITH BRECCIA ST. 6 314.1 g

INTRODUCTION: 15265 is a coherent regolith breccia with a composition a little richer in incompatible elements than Station 6 soils. It contains typical regolith breccia constituents, and contains both KREEP and mare basalt fragments. One mare basalt, apparently an olivine-normative basalt, was dated as 3.16 ± 0.11 b.y. It was studied in a Consortium headed by Burlingame.

15265 is slabby (Fig. 1), with a series of penetrative fractures parallel to the "N" and "S" faces. It has slickensides on one end, and many zap pits on two surfaces, with a few on all other surfaces except one. 15265 was collected (along with 15259, 15266 to 15269, and 15285 to 15289) from the crest of an inner bench on the northeast wall of the 12 m crater at Station 6, downslope 15 m from the LRV. A single large rock was broken by the Commander into three pieces (15265 to 15267). The sample was documented on the lunar surface both before and after it had been broken and moved. It was originally partly buried, possibly a result of an original impact as a secondary projectile.

Figure 1. View of 15265 prior to removal of ,2 which lies on top front. The slab has already broken with ,4 lying at front bottom and ,0 at rear. S-71-48509

PETROLOGY: Little petrographic data has been published. It was originally described (Lunar Sample Information Catalog Apollo 15, 1972) as a glassy polymict breccia of non-mare origin, but it does contain mare material in addition to its "metaclastic" clasts and KREEP basalts. In thin section it is a typical regolith breccia (Fig. 2) with some coarse clasts. Glass is common, both as beads and as irregular bodies. Lithic and mineral fragments are generally unshocked and the appearance is fairly immature. Wentworth et al. (1984) found it to be porous (33.4%) with a density of 2.05 g/cc (3.08

g/cc intrinsic), and McKay and Wentworth (1983) described it as porous with a low fracture porosity, minor agglutinates, minor spheres, and minor shock features. McKay et al. (1984) found it had an I_s/FeO of 23, and Korotev (1984, unpublished) working in the same group, reported a value of 21. Kaplan et al. (1976) reported the sample to contain 0.4% Fe^0.

One thin section of grain mounts of small pieces from a prominent clast on the "N" face appears to be of mare basalt.

CHEMISTRY: Chemical analyses of bulk breccia are listed in Table 1, with rare earths plotted in Figure 3. Few authors have discussed their results. Partial analyses of two clasts are listed in Table 2.

The bulk breccia has a composition similar to local regolith, but enriched in incompatible elements; hence it is probably exotic but not from a far distant source. Analyses are fairly consistent except the U content of Reed and Jovanovic (1972) is excessively low; perhaps their split was a clast. Kaplan et al. (1976) also provided CH_4 data. The analyses listed under clasts (Table 2) are uncharacterized, except for column b, which is definitely a mare basalt (for which an internal Rb-Sr isochron was derived) and whose Rb and Sr contents suggest it is an olivine-normative mare basalt. The Ganapathy et al. (1973, 1974) analysis is ostensibly of a norite(?) clast, but its composition is compatible with a mare basalt. It is not contaminated with meteoritic material. The analysis of Wiesmann and Hubbard (1975) is not claimed as a clast but is obviously dissimilar to bulk breccia analyses; it cannot however be a pure mare basalt clast because its incompatible elements are a factor of 2 too high. It could be a mare-rich fragment of matrix. Full documentation on Burlingame's Consortium samples is not available. A clast was analyzed by Wasson's group in a search for pristine highlands clasts; the data was never reported and the clast is presumably a mare basalt, as indicated by the thin sections (see end of PETROLOGY section).

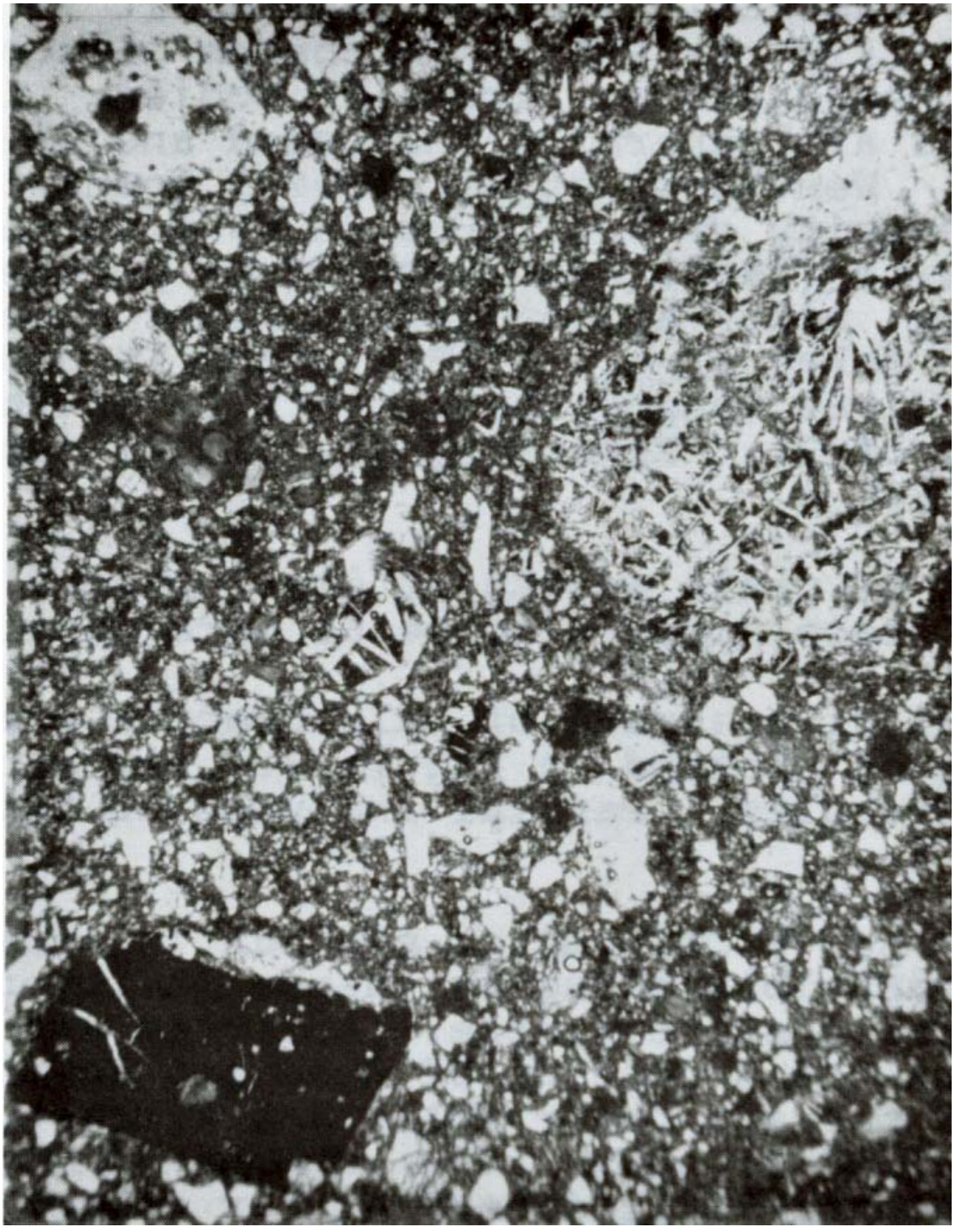

Figure 2. Photomicrograph of 15265,7.
Width about 2 mm. Transmitted light.
Basalt is an Apollo 15 KREEP basalt fragment.

TABLE 15265-1. Chemical analyses

			,66	,0	,13,5	,13	,9004	,9004	,13	,17	,9009
Wt %	SiO2	46.94									
	TiO2	1.40									
	Al2O3	16.71									
	FeO	11.18	11.2								
	MgO	9.95									
	CaO	11.19	11.4								
	Na2O	.51	0.51								
	K2O	.25		0.253							0.263
	P2O5	.25									
(ppm)	Sc		21.4								
	V										
	Cr	2260	2070								
	Mn	1160									
	Co		34.0								
	Ni		214		205						
	Rb	7.8			6.1						6.96
	Sr	150	165								142
	Y	100									
	Zr	469(a)	420								
	Nb	29									
	Hf		10.0								
	Ba		292								
	Th	4.8	4.6	5.05							
	U		1.21	1.27	1.33					0.067	
	Pb										
	La		27.8								
	Ce		73								
	Pr										
	Nd		38								
	Sm		13.1								
	Eu		1.48								
	Gd										
	Tb		2.55								
	Dy										
	Ho										
	Er										
	Tm										
	Yb		8.8								
	Lu		1.26								
	Li									9.1	
	Be										
	B										
	C					57	76				
	N						41				
	S	800					870	830	1010		
	F										
	Cl									26.2	
	Br				0.140					0.62	
	Cu										
	Zn				16.8						
(ppb)	I									0.24	
	At										
	Ga										
	Ge				360						
	As										
	Se				236						
	Mo										
	Tc										
	Ru										
	Rh										
	Pd										
	Ag				10.9						
	Cd				0.62						
	In										
	Sn										
	Sb				2.15						
	Te				16						
	Cs		330		420						
	Ta		1220								
	W										
	Re				0.619						
	Os										
	Ir		7.8		6.22						
	Pt										
	Au		2.1		3.46						
	Hg										
	Tl				2.7						
	Bi				1.9						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

References to Table 15265-1

References and methods:

(1) LSPET (1972); XRF
(2) Korotev (1984, unpublished); INAA
(3) Keith et al. (1972), LSPET (1972); gamma ray spectroscopy
(4) Ganapathy et al. (1973); RNAA
(5) Moore et al. (1973); combustion, gas chromatography
(6) Kaplan et al. (1976); combustion
(7) Kaplan et al. (1976); hydrolysis
(8) Moore (1974); combustion, gas chromatography
(9) Reed and Jovanovic (1972); neutron activation, leaching
(10) Mark et al. (1974); isotope dilution, mass spectrometry

Notes:

(a) erroneously listed as 169 ppm in NASA SP-289 LSPET report.

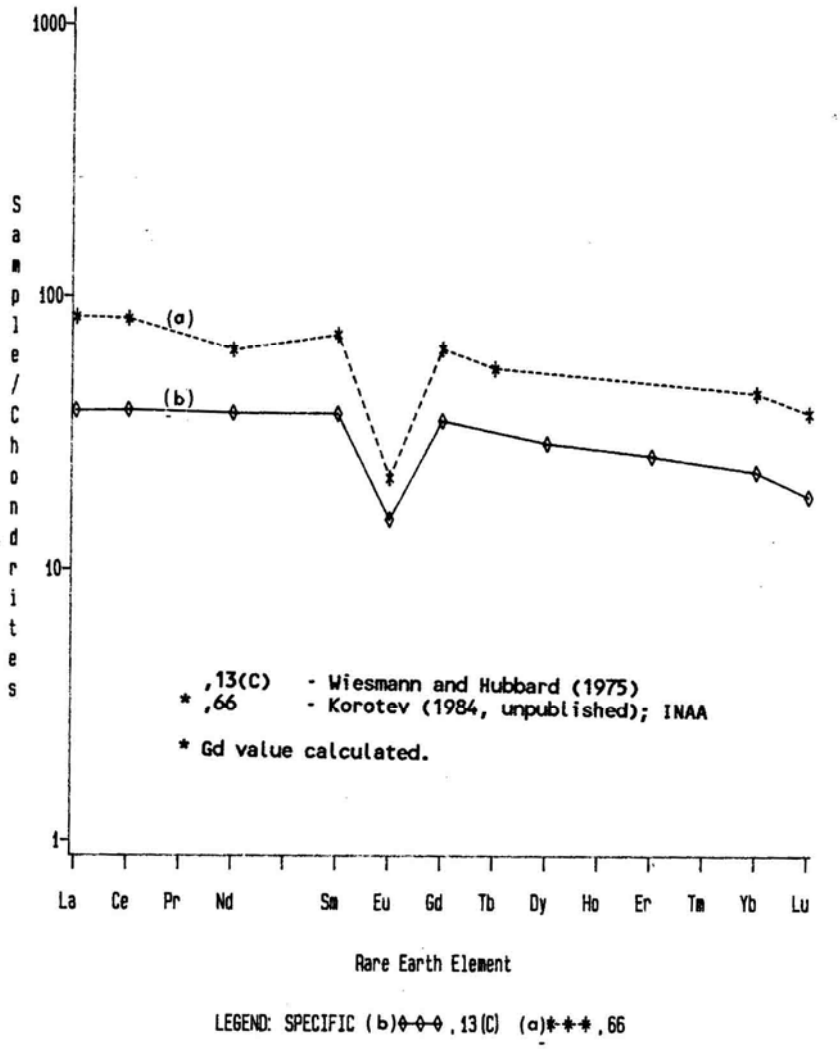

Figure 3. Rare earths in 15265 a) matrix (Korotev, 1984, unpublished); b) clast? (Wiesmann and Hubbard, 1975).

TABLE 15265-2. Chemical analyses of clasts

		,13,6(a)	,9005(b)	,13(c)
Wt %	SiO2			
	TiO2			2.13
	Al2O3			
	FeO			
	MgO			
	CaO			
	Na2O			
	K2O		0.040	0.112
	P2O5			
(ppm)	Sc			
	V			
	Cr			3225
	Mn			
	Co			
	Ni	55		
	Rb	0.84	0.743	2.71
	Sr		98.06	109
	Y			
	Zr			181
	Nb			
	Hf			
	Ba			130
	Th			1.95
	U	0.167		0.54
	Pb			
	La			12.5
	Ce			33.5
	Pr			
	Nd			22.2
	Sm			6.66
	Eu			1.05
	Gd			8.66
	Tb			
	Dy			9.11
	Ho			
	Er			5.19
	Tm			
	Yb			4.54
	Lu			0.625
	Li			9.6
	Be			
	B			
	C			
	N			
	S			
	F			
	Cl			
	Br	.03		
	Cu			
	Zn	0.97		
(ppb)	I			
	At			
	Ga			
	Ge	6.2		
	As			
	Se	117		
	Mo			
	Tc			
	Ru			
	Rh			
	Pd			
	Ag	6.4		
	Cd	0.66		
	In			
	Sn			
	Sb	0.14		
	Te	2.8		
	Cs	36		
	Ta			
	W			
	Re	0.006		
	Os			
	Ir	0.023		
	Pt			
	Au	0.09		
	Hg			
	Tl	0.25		
	Bi	0.20		
		(1)	(2)	(3)

References and methods:

(1) Ganapathy et al. (1973, 1974); RNAA
(2) Mark et al. (1974); isotope dilution, mass spectrometry
(3) Wiesmann and Hubbard (1975); isotope dilution, mass spec. and others

Notes:

(a) Norite(?)
(b) Mare basalt
(c) ?

Additional notes for norite(?) clast:
(see errata, 8th Proceedings, p. i)

(i) Te incorrect in Ganapathy et al. (1974)
(ii) U incorrect in Ganapathy et al. (1973)
(iii) Ag and Ge superior values of Ganapathy et al. (1974)
(iv) Incorrectly listed as "matrix" in Ganapathy et al. (1974)

STABLE ISOTOPES: Kaplan et al. (1976) reported isotopic analyses for C, N, and S. $\delta^{13}C$ °/oo PDB is -20.6, which is not as low as most soils but more like basalts. $\delta^{34}S$ °/oo CDT is +7.7 (combustion) and +6.4 (hydrolysis), values which are lower than most soils but not as low as basalts. $\delta^{15}N$ °/oo AIR is +74 which is slightly higher than soils. The nature of the Kaplan et al. (1976) samples is not known but presumably is bulk breccia.

RADIOGENIC ISOTOPES: Mark et al. (1974) reported a mineral isochron for a mare basalt clast (Fig. 4) from mineral separate Rb-Sr isotopic data (Table 3). The age and initial Sr isotopic ratio are consistent with Apollo 15 mare basalts. Mark et al. (1974) also provided an analysis of the breccia matrix (Table 3). This analysis differs from that of a split of 15265 reported by Wiesmann and Hubbard (1975) ($^{87}Sr/^{86}Sr = 0.70340 \pm 5$) which appears to be a mixture of matrix and mare basalt.

RARE GASES AND EXPOSURE: Rare gas data for apparently bulk breccia samples were reported by LSPET (1972) and Bogard and Nyquist (1972), and by Kaplan et al. (1976). LSPET (1972) provided data for ^{3}He, ^{4}He, ^{22}Ne, ^{36}Ar, ^{84}Kr, and ^{132}Xe. The ratios are similar to those of most other fines and breccias (i.e., $^{20}Ne/^{22}Ne$, $^{21}Ne/^{22}Ne$, $^{36}Ar/^{38}Ar$, $^{40}Ar/^{36}Ar$, $^{4}He/^{36}Ar$). Bogard and Nyquist (1972) found spallation ^{126}Xe to be 0.81 ± 0.7 ($10x10^{-10}$ cc/g) but provided no specific discussion on the Kr and Xe isotopic data they added to their LSPET (1972) report. Kaplan et al. (1976) found $4.74x10^{-2}$ cc/g of He from combustion, and $4.55x10^{-2}$ cc/g from hydrolysis.

Radionuclide data by Keith et al. (1972) shows that ^{26}Al is unsaturated, as confirmed by Yokoyama et al. (1974). Keith and Clark (1974) derived an exposure age of 0.97 m.y. (+0.48 m.y., -0.33 m.y., 1 sigma error). Bhandari et al. (1972, 1973) studied tracks in surface chips ,14 and ,15, finding densities of $10x10^{6}$ cm^{-2} and $6x10^{6}$ cm^{-2} respectively, both having "suntan" ages of less than 1 m.y.

PROCESSING AND SUBDIVISIONS: 15265 was easily chipped (Fig. 5). ,4 was substantially divided for allocation with its remaining mass being 28.8 g. A small chip ,1 was used for thin sections ,7 to ,12, and further matrix thin sections were made from ,13 (,26 and ,62) and from ,69 (,74). A clast grain mount (,65) was made from the material allocated to Wasson. Several generations of chipping have been done: 1972, 1975, 1977, and 1983. ,13 (from ,4) was allocated to the Burlingame Consortium and is now 36 g. ,0 is now 180 g. Several subsplits of ,4, and ,4 itself, are stored at Brooks.

TABLE 15265-3. Rb-Sr isotopic data (Mark et al., 1974).

Sample	K (ppm)	Rb (ppm)	Sr (ppm)	K/Rb (weight)	$^{87}Rb/^{86}Sr$ (atomic)	$^{87}Sr/^{86}Sr \pm 2\sigma$
15265,9005						
plagioclase (H)	487	0.461	289.8	1056	0.00458	0.69965±6
"whole rock" (F)	337	0.743	98.06	507	0.0218	0.70043±8
"clinopyroxene" (I)	338	0.762	63.79	444	0.0343	0.70102±10
"clinopyroxene" (I')	359	0.809	65.88	444	0.0353	0.70101±6
15265,9009						
breccia matrix (B)	2188	6.96	142.0	314	0.140	0.70771±22

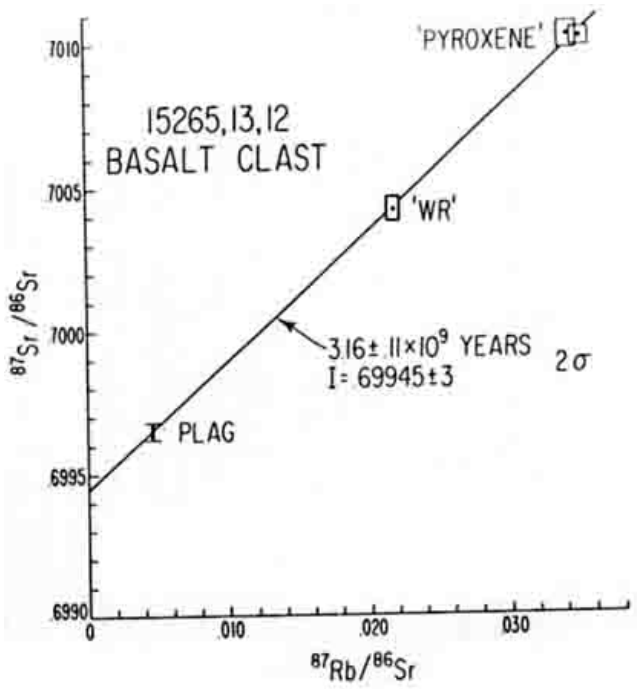

Figure 4. Rb-Sr internal isochron for a mare basalt clast (Mark et al., 1974).

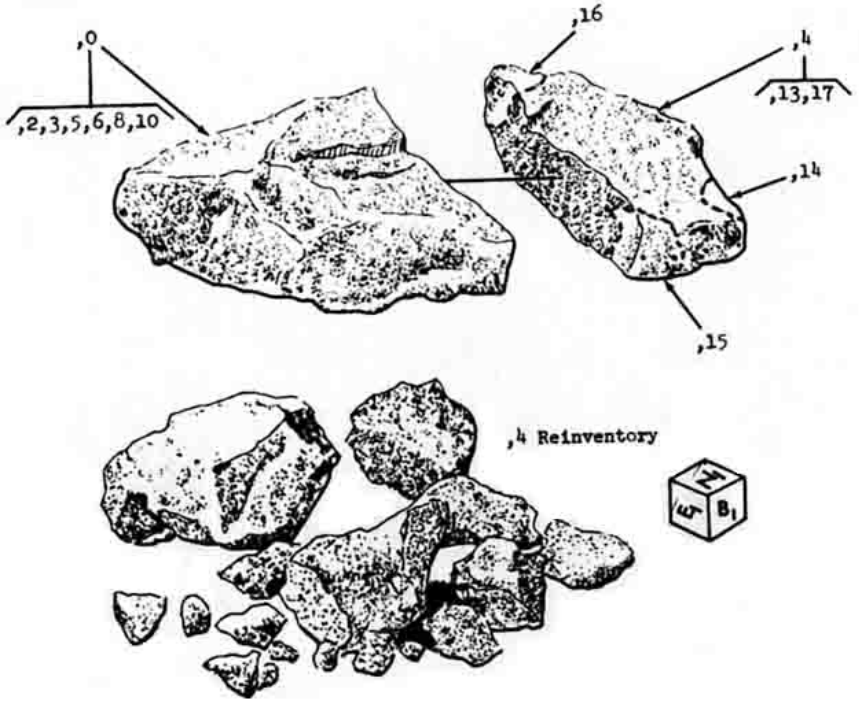

Figure 5. Early splitting of 15265.