15515 REGOLITH CLODS ST. 9 144.7 g

INTRODUCTION: 15515 consists of 48 extremely friable clods which were the greater-than-1 cm fraction of two clods which were individually collected but disintegrated. The samples are caked clods which "look like a piece of mud". They consist of porous, glassy, non-annealed regolith components, including glass, mineral, and mare basaltic fragments. Most have disintegrated to fines. The bulk chemistry is very similar to that of the local regolith.

15515 and its fines (15510 and 15514) were collected as two clods from the northwest rim crest of the 15 m, cloddy crater at Station 9. The clods appeared to be typical of local material.

PETROLOGY: The clods consist of glassy, fine-grained, non-annealed breccia with predominantly mare basalt clasts. They also contain varied glass and mineral fragments. Only ,18 was made into grain size fractions and thin sections. A mode from PET (Lunar Sample Information Catalog Apollo 15, 1972) is given as Table 1. Reed et al. (1977) found a clod to contain 0.57% metal iron (chemical methods). Tsay et al. (1976) used electron spin resonance techniques to determine a total Fe-metal content of 0.62 wt %. The weight % (SP+SD) Fe^0 was 0.39.

TABLE 15515-1. Petrographic components of 15515
(Lunar Sample Information Catalog Apollo 15, 1972)

		PERCENT OF GRAINS		
COMPONENTS	NOTE	0.5-1.0mm	0.25-0.5mm	0.125-0.25mm
Agglutinate	1	22	33.5	53
Clinopyroxene	2	-	20.0	19.5
Plagioclase	3	-	2.5	5.0
Glass spheres, green	4	27.5	6.5	4.5
Glass spheres, colorless	5	-	3.5	3.0
Basalt, ophitic	6	-	10.5	3.5
Basalt, hyalocrystalline	7	11	6.0	2.5
Microbreccia, vitric	8	11	5.0	4.0
Microbreccia, recrystallized	9	5.5	5.0	1.5
Glass frags, brown	10	5.5	3.0	1.5
Basalt, equigranular	11	11	2.0	1.0
Anortho ite	12	-	1.0	-
Glass droplets	13	5.5	2.0	-
Grains counted	-	18	200	200
Section number		58,63,64	75,62	56,61

NOTES TO TABLE:

1. Glass and mineral (feldspar, pyroxene) detritus bound together in welded droplets of very dark brown to black glass.
2. Colorless, broken, anhedral to subhedral crystals of augite. Sere are zoned from pigeonite to augite. The pigeonite has a very pale brown color. Also there are some unzoned pigeonite.
3. Fractured and shocked.
4. Clear and free of detritus or schlieren; some are devitrified.
5. Devitrified; sheaves of thin feldspar crystals.
6. Clinopyroxene > plagioclase > opaques. Some grains have feldspar with parallel orientations.
7. Feldspar cloths and opaque minerals in a clear brown glassy matrix.
8. About 50% small clinopyroxene crystals in a clear brown glass matrix.
9. Detritus in a finely crystalline feldspar matrix.
10. Angular, 5-8% debris in clear brown glass with some schlieren.
11. Equigranular basalt - clinopyroxene > feldspar > opaques.
12. Equigranular, 5% pyroxene, 95% feldspar.
13. Spheres both vesiculated and non-vesiculated contain up to 20% detritus.

CHEMISTRY: Chemical analyses of different clod pieces (designated by split numbers) are given in Table 2 and the rare earths are shown in Figure 1. The clod pieces all seem to be similar to one another and to local regolith in all respects. Jovanovic and Reed (1975) listed leached and residue data for Cl and Br separately, and noted that the leach Cl/Br ratio was different from that of nearby materials 15501 and 15505. Reed et al. (1977) tabulated separate leach and residue data for ^{204}Pb, Bi, Te, and Zn.

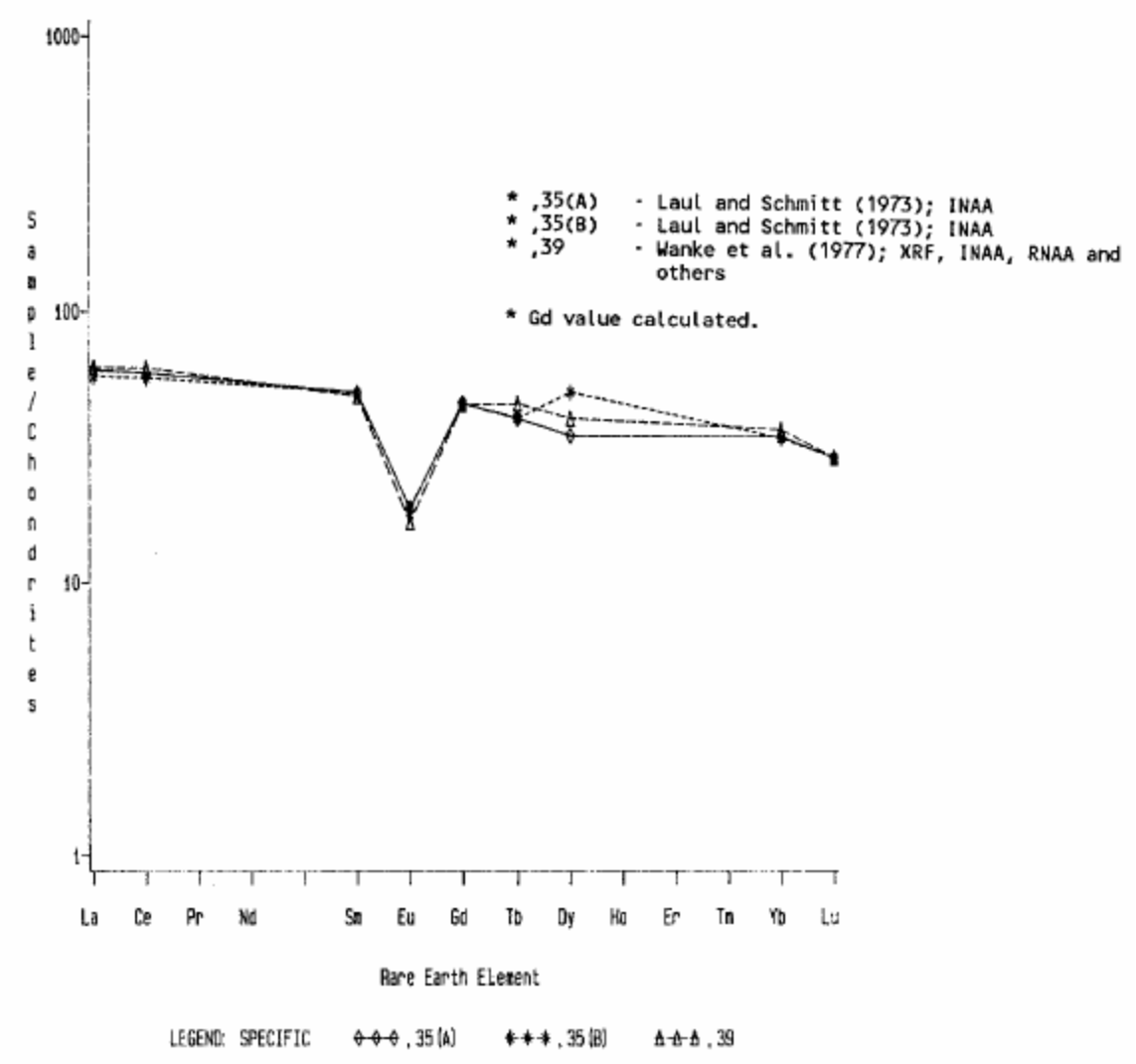

Figure 1. Rare earths in 15515.

TABLE 15515-2. Chemical analyses of 15515 clods

		,9	,35	,35	,39	,15	,15	,23	,97(,4)	,13
Wt %	SiO2				46.1					
	TiO2		1.9	1.7						
	Al2O3		12.4	12.2	11.7					
	FeO		17.4	17.0	17.0					
	MgO		12	11	10.8					
	CaO		10.0	10.9	10.4					
	Na2O		0.369	0.364	0.381					
	K2O		0.14	0.14	0.167					
	P2O5				0.199	0.19				
(ppm)	Sc		32	32	35.3					
	V		149	150						
	Cr		3110	2980	3260					
	Mn		1670	1680	1775					
	Co		48	48	49.4					
	Ni				230					
	Rb									
	Sr				114					
	Y				76					
	Zr		630(a)	470(a)	306					
	Nb				23					
	Hf		6.4	6.9	7.50					
	Ba		220	180	200					
	Th		3.0	4.1	3.2				3.49	3.619
	U		0.7	0.9		0.61			0.85	0.974
	Pb								1.99	
	La		20	19	20.5					
	Ce		52	50	54.2					
	Pr									
	Nd									
	Sm		9.1	9.1	8.80					
	Eu		1.3	1.3	1.15					
	Gd									
	Tb		1.9	1.9	2.14					
	Dy		11	16	12.8					
	Ho									
	Er									
	Tm									
	Yb		6.9	6.8	7.28					
	Lu		0.98	0.98	0.98					
	Li					17(b)				
	Be									
	B									
	C							110		
	N							98		
	S	1140			530			750		
	F									
	Cl					17.2				
	Br					0.179				
	Cu									
	Zn						11.77			
(ppb)	I					2300				
	At									
	Ga									
	Ge									
	As									
	Se	270								
	Mo									
	Tc									
	Ru									
	Rh									
	Pd									
	Ag	6.5								
	Cd									
	In									
	Sn									
	Sb									
	Te									
	Cs									
	Ta		1200	1000	920					
	W									
	Re	0.59								
	Os	5.8								
	Ir	5.7								
	Pt									
	Au	2.4								
	Hg									
	Tl	1.4					0.61			
	Bi	0.61								
		(1)	(2)	(2)	(30	(4)	(5)	(6)	(7)	(8)

References and methods:

(1) Hughes et al. (1973); RNAA
(2) Laul and Schmitt (1973); INAA
(3) Wanke et al. (1977); XRF, INAA, RNAA and others
(4) Jovanovic and Reed (1975); INAA
(5) Reed et al. (1972); INAA
(6) Cripe and Moore (1975), Moore and Lewis (1976); combustion-titration, gas chromatography
(7) Silver (1972); ID/MS
(8) Rose holt (1974)

Notes:

(a) uncertainties about 30%
(c) conc. based on average specific activity of monitors from other irradiations.

STABLE ISOTOPES: Reed et al. (1977) tabulated data for residue and leach ^{204}Pb. Garner et al. (1975) reported Li and K isotopic data (Table 3), finding values similar to 15511, the fines from the same sample.

TABLE 15515-3. Isotopic analyses (Garner et al., 1975)

$^{6}Li/^{7}Li$ sample / $^{6}Li/^{7}Li$ std. (a)	$^{39}K/^{41}K$	$^{41}K/^{40}K$
1.007	13.743	573.6
(a) standard = NBS reference standard 9A.		

RADIOGENIC ISOTOPES: Silver (1972) reported Pb isotopic data for clod ,4 (Table 4). The isotopes are slightly discordant and within the region occupied by the upper part of the ALSEP drill core sample, with higher $^{207}Pb/^{235}U$ and higher $^{206}Pb/^{238}U$ than mare basalts. Rosholt and Tatsumoto (1973) and Rosholt (1974) reported a $^{232}Th/^{230}Th$ ratio slightly less than expected from the $^{232}Th/^{238}U$ ratio (expected ratio/measured ratio = 1.02), but much closer to the expected than are the mare basalts. Garner et al. (1975) determined a $^{85}Rb/^{87}Rb$ ratio of 2.5914.

PROCESSING AND SUBDIVISIONS: Clods were originally individually numbered from ,1 to ,48; several became largely fines on sample handling. ,8 was used for thin sections and for grain-size separates. Most clod pieces have not been allocated.

TABLE 15515-4. Pb isotopic data (Silver, 1972)

Pb ppm	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$
1.99	314.3	193.7	313.6