73235

Aphanitic Impact Melt Breccia
St. 3, 878.3 g

INTRODUCTION

73235 is a clast-rich aphanitic melt breccia with a variety of mineral and lithic clasts. It is similar in petrography and chemistry to the aphanitic melts of Boulder 1, Station 2 and other Station 3 aphanites. It has about 75% dense matrix, 10% lithic clasts larger than a few millimeters across, and 15% mineral clasts larger than about 0.5 mm. Poorly-defined Ar-Ar plateaus suggest an age of about 3.91 Ga. The sample was collected on the rim of a 10-m crater, near 73255. It is tough with several shallow fractures, homogeneous, and medium light gray (N6) with mottling. It is subangular to rounded (Fig. 1) and 12 x 10 x 8 cm. None of the surfaces are fresh. There are many zap pits, with varied glass linings from dark gray to almost colorless, on most surfaces. Vugs and cavities are not apparent. The sample was sawn to produce a slab (Fig. 2); extensive allocations were made from the slab and one of the butt end pieces (,8).

PETROGRAPHY

73235 has a dense, aphanitic melt groundmass with a seriate clast distribution (Figs 3 a, b), very similar to other South Massif aphanitic impact melt breccias. The fine-grained groundmass consists mainly of plagioclase and pyroxene with some opaque oxide phases. Lithic clasts include granoblastic feldspathic impactites with a variety of grains sizes, shocked anorthosites, and cataclasized troctolites, and norites. Some ophitic/subophitic melt particles, probably of impact origin, and glassy/granitic fragments (Fig. 3a) are present. Many clasts are cataclasized and strung out as schlieren within the dense matrix (Fig. 3c). One prominent white clast is a cataclasized troctolite (Fig. 3d) that was large enough for separate allocation (see below). Mineral clasts include plagioclase, olivine, pyroxene, and rare pleonaste spinels. Shock features vary from non-existent to strong and most grains are at least a little rounded by resorption.

Figure 1: Pre-processing photograph of 73235, showing rounded surface with zap pits. Some white clasts are visible. Scale divisions and cube 1 cm S-73-19663.

Brown et al. (1974) and Hodges and Kushiro (1974a, b) provided brief descriptions of 73235. Brown et al. (1974) described it as a polygenetic microbreccia with calcic plagioclase (An94), zoned Mg-olivines (17087-81 with low Cr203 that relates them to the 76535 allivalite), and bronzite. They also noted patches of potassic rhyolite and purple Cr-pleonastes. Hodges and Kushiro (1974x, b) described the sample as being a fine-grained, dark brown, slightly metamorphosed breccia with numerous mineral and lithic clasts. The mineral clasts exhibit a wide range of shock features. Hodges and Kushiro (1974 a,b) provide some microprobe data for pyroxenes and olivines (Fig. 4) and spinels, noting that pyroxenes include grains zoned from pigeonite to subcalcic augite and that some augite show thin exsolution lamellae. The olivine clasts are more magnesian than those in the lithic clasts. The lithic clasts are described as relatively unshocked, consisting predominantly of gabbroic to anorthositic rocks, and lacking mare basalts. The clast population indicates a wide range

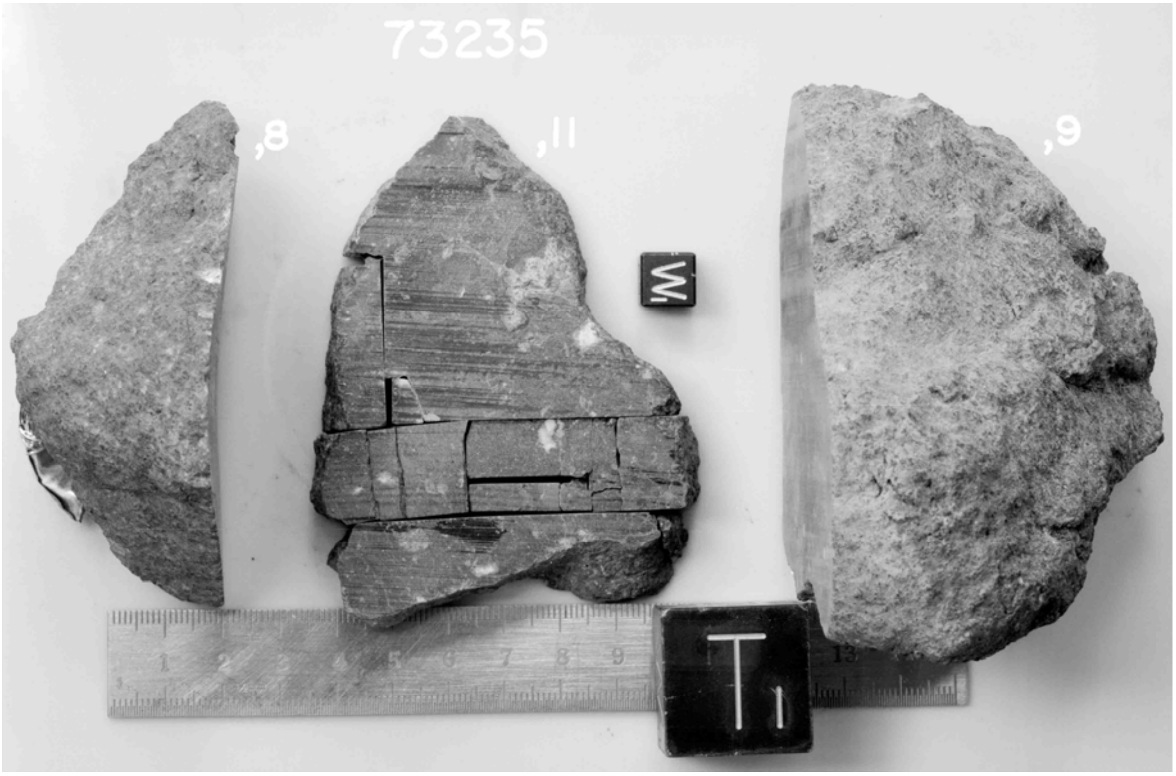


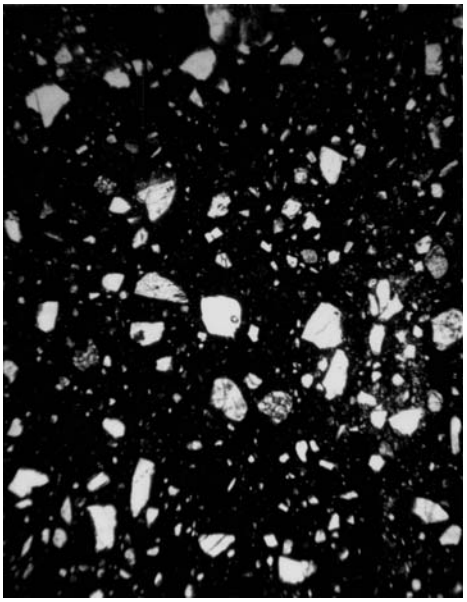
Figure 2: Post-sawing photograph of 73235, showing main subdivisions of the slab. End piece ,8 was subsequently substantially subdivided for allocations. Small cube is 1 cm. S-73-28684.

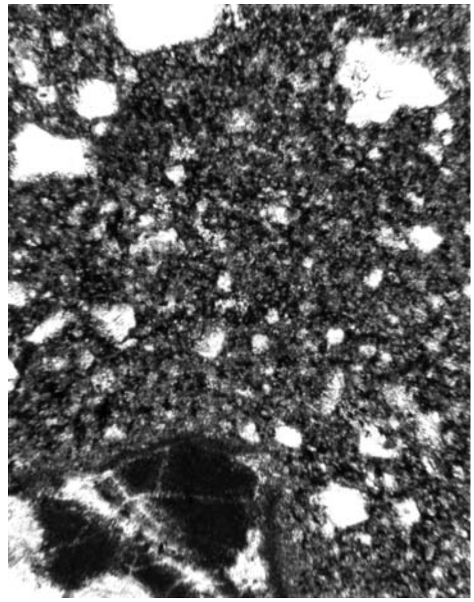
of sources. Warren and Wasson (1979) reported in diagram form microprobe analyses of olivine (Fo_{79}-$_{92}$) and plagioclase (An_{93-96}) in the matrix of 73235 (Fig. 5).

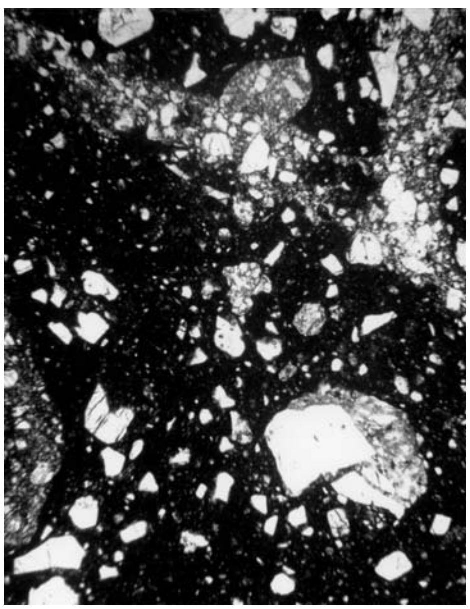
Dence et al. (1976 a,b) described 73235 as consisting of two lithologies, a coherent clast-rich dark matrix breccia interlayered with lighter more porous clastic breccia, with the former predominant. The light clastic material has irregular, locally sheared boundaries, and evidently is the material existing as schlieren described above. Dence et al. (1976 a, b) describe the clast population as large and distinctive, as much as 50% and ranging down to very small sizes. No sorting of grain size is apparent. The clasts are typical highlands samples, including noritic microbreccias and granoblastic or crushed anorthositic and troctolitic fragments. Most of the lithic clasts, except for some coarse plagioclase-rich fragments, display little shock effect, but mineral fragments have diverse shock effects. The light matrix materials consist of angular mineral fragments, especially plagioclase, but also pyroxene, olivine, and minor ilmenite. There is some loss of porosity along their contacts.

Hewins and Goldstein (1975 a,b) analyzed iron metal grains in two clasts of "anorthositic hornfels" without discussion. The metals have about 5.5 to 7.5% Ni and 0.5 to 0.7% Co on the edge of the meteoritic field.

Engelhardt (1979) listed 73235 as having a granular matrix and with a paragenesis in which ilmenite, plagioclase, and pyroxene crystallized simultaneously. Knoll and Stoffler (1979) described the matrix as equigranular, with areas of light, coarser matrix. Smith et al. (1986) described a clast ("pomegranate") that consisted largely of zircons entirely enclosed by bytownite (An_{80}-$_{85}$), as part of a geochronological study. The zircons, for which microprobe analyses are given, are 10-100 microns across and both they and the zircons were fractured at one time and later the zircons had overgrowth. Bickel and Warner (1978a) listed the sample in their study of plutonic and granulitic fragments, but presented no data or description. Simonds et al. (1974) listed 73535 as having a subophitic matrix with groundmass feldspars 5-15 microns long and pyroxene oikocrysts about 125 microns; this does not agree with the description given here and may be an erroneous tabulation.

Warren (1979) and Warren and Wasson (1979) described two clasts (with chemistry, below) from 73235. One (their c l), from a prominent white clast visible macroscopically, is extremely cataclastic (Fig. 3d) with no grain fragments more than about 1.3 mm a 

b 

c 

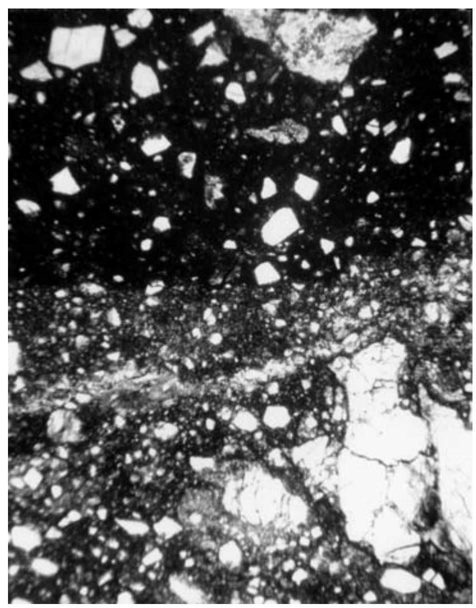
d 

Figure 3: Photomicrographs of 73235, all plane transmitted light. Field of view 2mm except b) about 500 microns. All 73235,58 except d) 73235,83. a) general dense matrix with small mineral and lithic clasts ranging from angular to rounded b) detail of groundmass and ragged edges of small class. Clast in lower left is a glassy silicic particle. c) schlieren of cataclasized feldspathic impactite (across top) in general dense groundmass. d) boundary of impure cataclasized troctolite (bottom) and dense matrix (top).

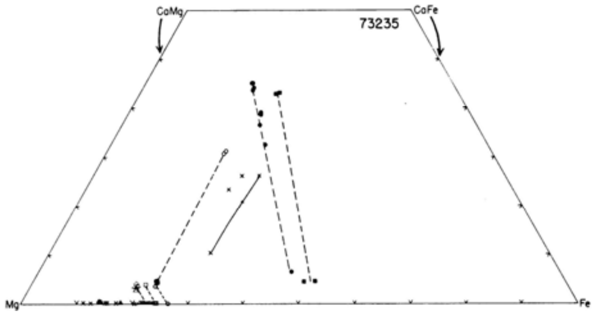


Figure 4: Plot of compositions of pyroxenes and olivines in 73235. Open symbols represent lithic clasts, closed symbols represent pyroxenes exsolution lamellae, and x's represent monomineralic clasts. (Hodges and Kushiro, 1974x).

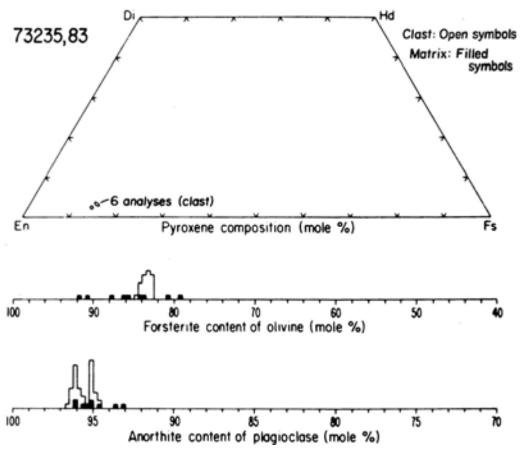


Figure 5: Plots of compositions of silicate mineral phases 73235,83 troctolite (open symbols) and groundmass (filled symbols). (Warren and Wasson, 1979).

across. It contains about 60% plagioclase, 30% olivine, and 10% low-Ca pyroxene. Microprobe analyses are given in Figure 5, and show the troctolite to be a member of the Mg-suite of highlands rocks Warren and Wasson (1979) favor a pristine igneous origin on the basis of the restricted mineral chemistry. A second clast studied by Warren (1979) and Warren and Wasson 0979) (their c2) is also a brecciated troctolite, with about 2/3 plagioclase and 1/3 olivine, and lacking pyroxene. The largest grain fragments are 0.7 mm across. Again mainly on the basis of restricted mineral chemistry (Fig. 6), Warren and Wasson (1979) favored a "probably pristine" igneous origin for the troctolite, which also is a member of the Mg-suite.

Bersch (1990) and Bersch et al. (1991) reported precise microprobe analyses of olivine and high-Ca pyroxene from thin section ,83 which contains the prominent white troctolite clast described by Warren and Wasson (1979). They also reported precise analyses of low- and high-Ca pyroxene, supposedly from a norite, from thin section , 136 which contains the other troctolite.

CHEMISTRY

Chemical analyses of the groundmass/matrix of 73235 are given in Table 1, with the rare earth elements plotted in Figure 7. Most of the analyses were presented by the authors with little specific comment, other than some note of its general similarity with other Apollo 17 highlands materials, including local soil. The chemistry is similar to that of other aphanitic melt breccias from the South Massif, but tends to be slightly more acuminous and with slightly lower abundances of incompatible trace elements. The sample clearly contains meteoritic contamination, but lacks regolith characteristics such as high C or S. The ratios of the meteoritic siderophiles place 73235 in a group 2 (Serenitatis) of Morgan et al. (1976) and Hertogen et al. (1977); however, the sample is slightly enriched in Br, Zn, and Cd compared with other "Serenitatis" melt rocks. Jovanovic and Reed (1974x, 1975c, 1980 a) discussed the sample in terms of Cl (residual after leaching)/P_20_5 ratios. Masuda et al. (1974) and Tanaka et al. (1974) noted the presence of positive Ce and Yb anomalies in their rare earth element plots, and even a small Dy anomaly, compared with the straight line fit (which they call "liquid-type pattern") of the other rare earth elements.

Analyses of clasts from 73235 are given in Table 2 with rare earth elements plotted in Figure 8. The two analyses of the prominent white clast, characterized by Warren and Wasson (1979) as a very probably pristine but cataclasized troctolite (their el) are acceptably similar. The rare earth

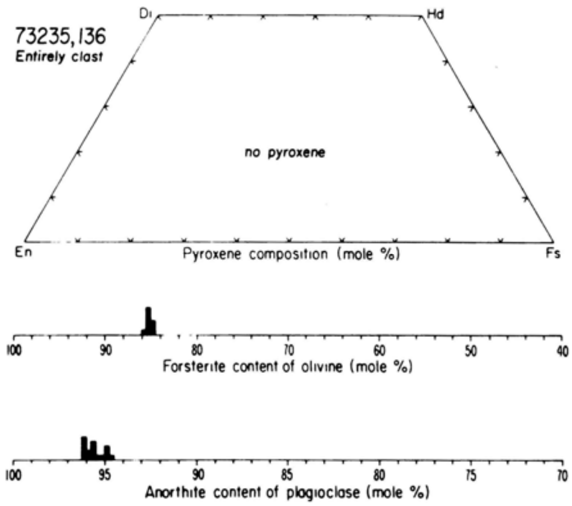


Figure 6: Plots of compositions of silicate mineral phases in 73235,136 troctolite. (Warren and Wasson, 1979).

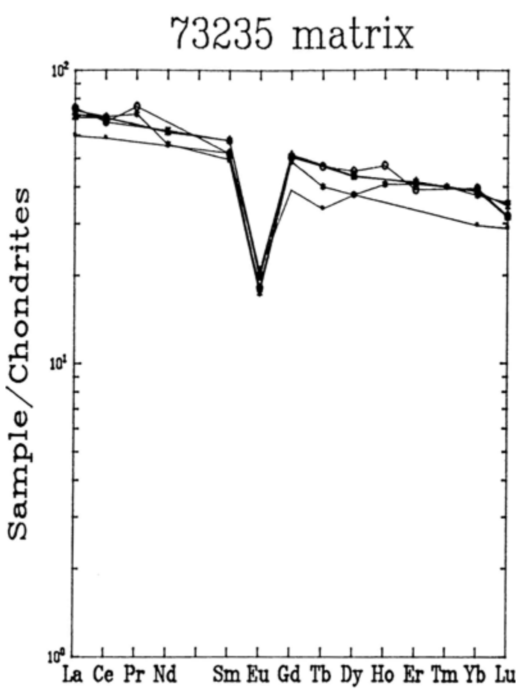


Figure 7: Chondrite -normalized plot of rare earth elements in bulk rock or groundmass for 73235. Data from Table 1.

elements, while in low abundance, are only slightly fractionated with respect to KREEP. The analyses probably include a little matrix gradational), thus the details of trace element chemistry may not reflect the original pristine lithology. The "probably pristine" troctolite clast c2 of Warren and Wasson (1979) has slightly higher rare earth element abundances, again only mildly fractionated with respect to KREEP. Contamination with exterior (patina) surface might account for the fairly high siderophile abundances, which could alternatively reflect an indigenous component. The petrographic characters of the two clasts with very incomplete chemical data (Table 2) are unknown. The "anorthositic inclusion" has such low Fe and Sc as to suggest a true anorthosite or plagioclase separate; the "basaltic clast" is actually extremely similar to the melt groundmass of 73235 for all the reported elements.

STABLE ISOTOPES

Rees and Thode (1974a) reported a (δ) ^{34}So/oo of + 1.5, substantially lower than that in soils, and in the field of indigenous rocks, signifying that the bulk of the components of 73235 had no significant history of incorporation in the melt.

GEOCHRONOLOGY AND RADIOGENIC ISOTOPES

Nyquist et al. (1974a) presented Rb and Sr isotopic data for a bulk rock sample of 73235 (Table 3). The sample falls with other Apollo 17 noritic melt breccias on a 3.94 +/- 0.10 Ga line (old constants 4.02 =/- 0.10 Ga), whose age significance is uncertain. Oberli et al. (1978) also presented bulk rock Rb and Sr isotopic data, as well as data for a bulk clast (Table 3). The clast contains much less Rb than the

Table l: Chemical compositions of bulk rock or groundmass for 73235.

Split	,52	,53	,55	,55	,88	,49	,91	,59	,54	,45	,89	,48	,46
wt%													
SiO_2		45.96		46.20		46.4	46.7		47.7				
TiO_2	0.75	0.60		0.67		0.63	0.65						
Al_2O_3	22.2	22.57		21.28		21.2	20.5		20.79				
Cr_2O_3	0.183	0.196	0.194			0.22	0.198						
FeO	6.6	6.68		7.32		7.33	7.40		7.9				
MnO	0.091	0.091		0.11			0.100		0.10				
MgO	10.6	9.61		11.05		10.7	11.6		12.9				
CaO	12.9	13.18		12.55		12.5	11.9		11.1				
Na_2O	0.47	0.44	0.51	0.48		0.47	0.456		0.47				
K_2O	0.173	0.200	0.210	0.20	0.197	0.18	0.197						
P_2O_5		0.192		0.20			0.185						
ppm													
Sc	12.1					17	13.4						
V	51	40				58	50.7						
Co	23.7	22				33	26.3						
Ni	150	118				250	205			144			
Rb	4.1	5.6	5.13		5.26	3.1				4.7			
Sr	137	145	146.9		141		150						
Y		62.3				85	69						
Zr		315	341		366	350	343						
Nb		19.7				21.5	20.4						
Hf	7.7					6.5	7.85						
Ba	238	252	263		288	315		260					
Th	2.85		4.19			4.3	3.75						
U	0.75		1.14			1.1	1.05			1.060		1.2(a)	
Cs	0.17					0.15				0.198			
Ta	0.87						0.94						
Pb						3.0							
La	19.7		23.3			24	24.5	22.8					
Ce	51.5		60.6		58.4	61	58.5	60.4					
Pr						7.92	8.4						
Nd			37.0		37.3	33.5		36.7					
Sm	9.43		10.4		10.4	8.95	9.4	10.4					
Eu	1.43		1.37		1.35	1.20	1.25	1.42					
Gd			12.8		12.6	12.1	12.5	12.6					
Tb	1.58					1.88	2.2						
Dy	11.9		13.8		13.7	11.9	14.3	13.7					
Ho						2.85	3.3						
Er			8.2		8.27	8.15	7.8	8.28					
Tm						1.2							
Yb	5.9		7.7		7.69	7.47	7.9	7.74					
Lu	0.98				1.17	1.2	1.08	1.07					
Li			11.9		12.5		13.5					5.5	
Be													
B													
C													54
N													30
S		270		400							400		500
F							27					30	
Cl							20.0					(b)20	
Br							0.11			0.09		(b)0.115	
Cu	4.3	<2				1	3.8						
Zn	3	<2								9.4			
ppb													
Au							3.2			2.31			
Ir										3.71			
I												1.9	
At													
Ga	3400						4000						
Ge							360			230			
As							130						
Se										53			
Mo													
Tc													
Ru												5.3	
Rh													
Pd													
Ag										1.0			
Cd										27			
In													
Sn													
Sb										1.14			
Te										4.3			
W	260						580						
Re										0.385			
Os												14	
Pt													
Hg													
Tl										2.1			
Bi										0.69			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)

References and methods:
(1) Brunfelt et al. (1974); INAA,XRF
(2) Duncan et al. (1974a); XRF
(3) Hubbard et al. (1974), Nyquist et al. (1974a); ID/MS, AA
(4) Rhodes et al. (1974a,b); XRF, AA
(5) Philpotts et al. (1974a); ID/MS
(6) Taylor et al. (1974); Microprobe/Spark source MS
(7) Wanke et al. (1974, 1977); INAA, RNA, XRF.
(8) Masuda et al. (1974), Tanaka et al. (1974); ID/MS
(9) Ehmann et al. (1974), Miller et al. (1974); INAA
(10) Morgan et al. (1974a,b; 1976), Hertogen et al. (1977); RNA
(11) Rees and Thode (1974a); Chem.sep./gravimetry
(12) Jovanovic and Reed (1974a,1975c); INAA, RNA
(13) Moore et al. (1974a); Moore and Lewis (1976); Combustion
(14) Oberli et al. (1978); ID/MS

Notes:
(a) Value of 0.42 ppm also given
(b) combined leach and residue

Table 2: Chemical compositions of clasts in 73235.

Split	,49 (a)	,54A (b)	,54B (c)	,127(d)	,135(e)
wt %					
SiO_2	44.2			44.3	42.6
TiO_2					.33
Al_2O_3	23.1			24.9	21.9
Cr_2O_3	0.09	0.006	0.197	0.103	0.157
FeO	5.06	0.65	6.7	4.5	6.2
MnO				0.05	0.07
MgO	14.0			12.5	17.8
CaO	12.7			13.7	11.1
Na_2O	0.30			0.275	.381
K_2O	0.06			0.056	0.077
P_2O_5					
ppm					
Sc	5	0.8	13.2		
V	33				
Co	17	7	27	19.8	33
Ni	28			94	206
Rb					
Sr				200	210
Y	18				
Zr	85		365		
Nb	5.2				
Hf	1.53	0.21	8.03	1.6	2.1
Ba	100			110	130
Th	1.0			0.98	1.6
U	0.27				0.34
Cs					
Ta				0.23	0.26
Pb	1.2				
La	5.31		23	5.4	8.4
Ce	13.3			14	21
Pr	1.76				
Nd	7.33			8.4	13
Sm	2.17			2.43	4.1
Eu	0.79		1.6	1.0	1.0
Gd	2.73				
Tb	0.48			0.48	0.80
Dy	2.97				
Ho	0.67				
Er	1.85				
Tm	0.28				
Yb	1.72			1.7	2.5
Lu	0.27			0.23	0.34
Li					
Be					
B					
C					
N					
S					
F					
Cl					
Br					
Cu	1				
Zn				0.94	5.0
ppb					
Au				0.140	1.370
Ir				0.380	5.510
Ga				3500	3100
Ge				10.4	92
In				4.3	4.7
Re				0.029	0.410
	(1)	(2)	(2)	(3)	(3)

References and methods:
(1) Taylor et al. (1974); Microprobe/Spark source MS
(2) Ehmann and Chyi (1974), Chyi and Ehmann(1974), Garg and Ehmann (1976a), Miller et al. (1974); RNA
(3) Warren and Wasson (1979), Warren (1979), Warren and Kallemeyn (1984); INAA, RNA, microprobe.

Notes:

(a) white clast
(b) "anorthositic inclusion"
(c) "basaltic clast"
(d) same clast as that of Taylor et al. (1974)
(e) white troctolite clast

Table 3: Rb and Sr isotopic data for 73235.

Split	Rb/^{86}Sr	^{87}Sr//^{86}Sr	TBabi (Ga) (I=0.69910)	TLuni (Ga) (I=0.69903)	Reference
bulk:					
,55	0.1010+/-9	0.70539+/-6	4.35+/-0.08a 4.26+/-0.08b	4.39+/-0.08a 4.30+/-08b	(1)
,50B	0.1134	0.70606+/-5	4.35+/-0.04a 4.26+/-0.04b		(2)
clast:					
,50W	0.02159	0.70030+/-5	4.27+/-0.16a 4.18+/-0.16b		(2)

a) old decay constant, lamda (^{87}Rb) = 0.0139 Ga^{-1}
b) new decay constant, lamda (^{87}Rb) = 0.0142 Ga^{-1}.

(1) Nyquist et al. (1974a)
(2)

Table 4: Sm and Nd isotopic data for 73235.

Sample	^{147}Sm/^{144}Nd	^{143}Nd/^{144}Nd	T_{Juv}[a]	T_{Chur}[b]	Reference
,50B bulk	0.1688+/-1	0.511057+/-17	4.54+/-0.02	4.73+/-0.13	(1)
,50W clast	0.1656+/-1	0.510931+/-21	4.51+/-0.02	4.86+/-0.13	(1)

a) model age calcuted from the initial ^{143}Nd/^{144}Nd of Juvinas
b) model age calculated from the intersection of sample evolution line with the chondritic evolution line.

(1) Oberli et al. (1978).

Table 5: Elastic wave velocities for 73235,18. (Mizutani and Osako, 1974a, b)

Pressure Kb	0.0	0.5	1.0	2.0	3.0	5.0	7.0	9.0
Vp km/sec	5.42	6.02	6.39	6.72	6.88	7.08	7.12	7.14
Vs km/sec.	2.95	3.32	3.48	3.66	3.77	3.86	3.90	3.92

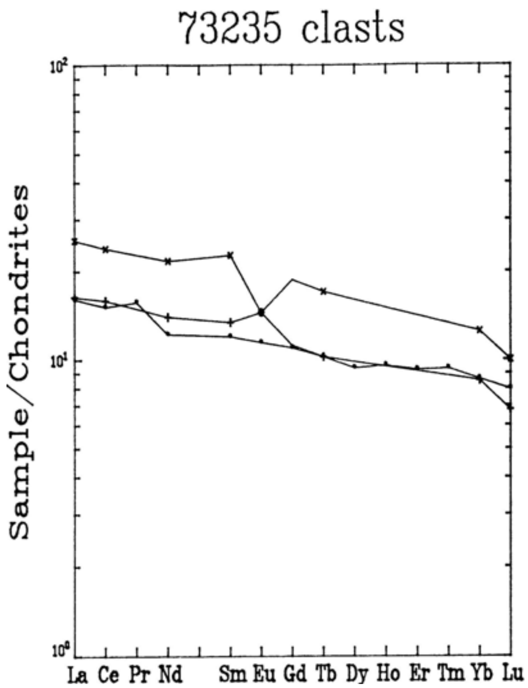


Figure 8: Chondrite-normalized plot of rare earth elements in clasts in 73235. Data from Table 2.

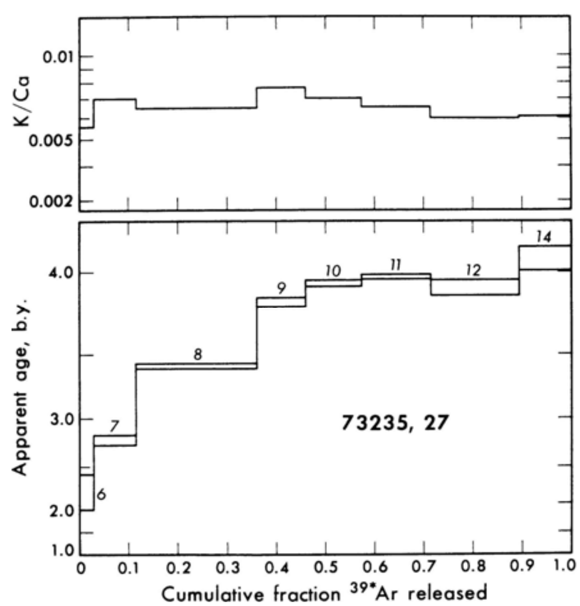


Figure 9: Ar release for 73235,27 (Phinney et al. 1975)

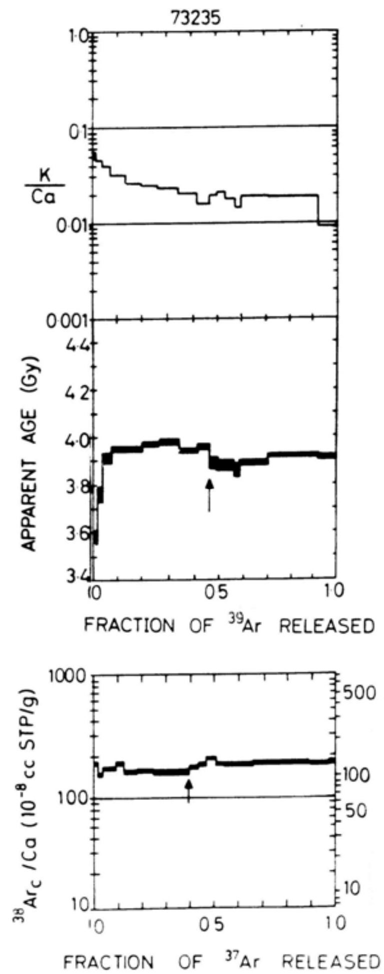


Figure 10: Ar release for 73235,30 (Turner and Cadogan 1975a).

groundmass and gives slightly younger model ages. The model ages require young crust formation (i.e. about 4.3 Ga) or remelting at less than 4.3 Ga of materials relatively rich in Rb that had been produced before 4.3 Ga; loss of Rb as a volatile does not explain the data

Oberli et al. (1978) presented Sm and Nd isotopic data for a bulk rock sample of 73235, as well as for the same clast that was analyzed for Rb and Sr isotopes (Table 4). The model ages are older than those for the Rb system, demonstrating that there was no change in the Sm/Nd ratio while events might have been

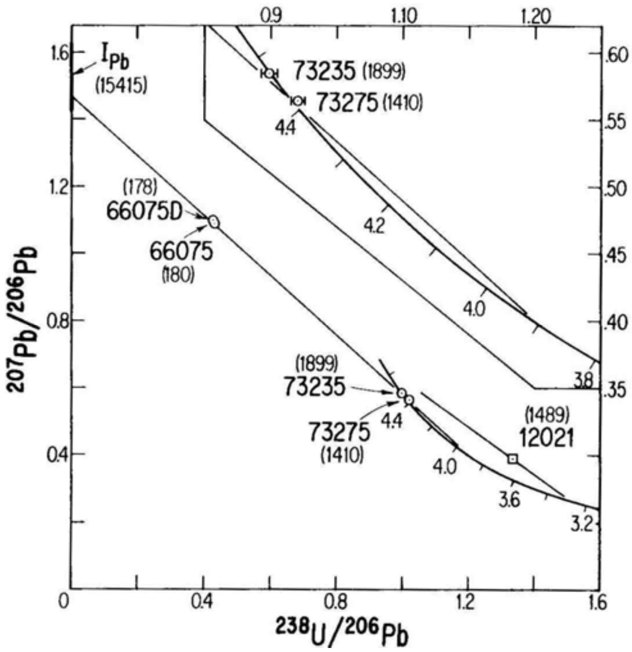


Figure 11: U-Pb evolution diagram for 73235 and some other lunar samples. The u values are given in parentheses. A reference line is drawn through points on concord corresponding to 4.42 Ga and 3.90 Ga. 12021 is a mare basalt. (Oberli et A 1978).

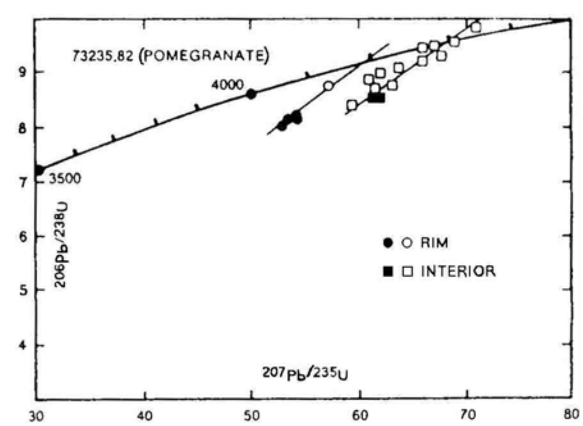


Figure 12: Concordia diagram for rim and interior of zircon assemblage in 73235, 82. Open symbols = 1984 data, closed symbols = 1985 data

increasing the Rb/Sr ratio in source materials.

Phinney et al. (1975) and Turner and Cadogan (1975 a,b) presented bulk sample Ar-Ar stepwise heating isotopic data, depicted in Figures 9 and 10. Phinney et al. (1975) reported a plateau age of 3.92 +/-0.04 Ga (new decay constants; old decay age is 3.98 Ga), noting, however, that the plateau was at best "poorly developed" (Fig. 10). The release is dominated by ^{40}Ar loss over the first 50% of release, and the total Ar age is only 3.69+/-0.03 Ga (new decay constants; old decay age is 3.74 Ga). The K/Ca ratio is fairly constant, implying well mixed Ca and K rather than release from a single mineral. The bulk K and the K/Ca ratio determined are much lower than either bulk rock or the Turner and Cadogan (1975 a, b) samples. Turner and Cadogan (1975 a, b) reported a plateau age of 3.91 +/-0.04 (new decay constants; old decay age is 3.96 Ga), but although the plateau is better defined than that of Phinney et al. (1975), it is not a good one (Fig. 10). It is bimodal with lower apparent ages at high temperatures (3.90 Ga) than at low (3.80-3.86 Ga) and perhaps reflects a recoil effect. The total Ar age is 3.87 Ga (no uncertainty stated).

Oberli et al. (1978) presented U, Th, and Pb isotopic data for the bulk rock sample of 73235 that they also analyzed for Rb-Sr and Sm-Nd isotopes. The U-Th-Pb data are concordant at 4.47 Ga within 0.1 %. However, the near-tangential relationship of a discordant data array as represented by the reference line with the concordia curve (Fig. 11) provides poor discrimination between truly concordant and discordant data. The ^{207}Pb/^{206}Pb age is 4.470 +/- 0.001 Ga; the ^{206}Pb/^{238}U age is 4.474 + 0.018/-0.022 Ga; and the 208pb/232-a age is 4.474 + 0.044/- 0.047Ga.

Smith et al. (1986) used a high resolution ion microprobe to make Pb isotopic determinations and ages on zircons in a zircon-anorthite clast ("pomegranate") in thin section 73235, 82 (Figure 12). The zircons have been through an original crystallization event at 4.310 Ga, were fractured, and then overgrown at 4.183 Ga i.e., the rims are 120 Ma years younger. The clast was emplaced in the groundmass (at about 3.9 Ga. according to the Ar isotopic data) without either Pb loss or gain.

EXPOSURE

Phinney et al. (1975) calculated an Ar exposure age of 195 +/- 20 Ma for split, 27 which could be interpreted as the age of the light mantle if a single-stage model is appropriate. However, Phinney et al. (1975) are reluctant to assume a single stage model. A similarly-calculated Ar exposure age by Turner and Cadogan (1975 a, b) is only 110 Ma (Fig. 10), similar to that of Boulder 1, Station 2 and some other South Massif samples. Horz et al. (1975) reported a 110 Ma exposure age for the sample, citing Reynolds (pers. comm.) as the source.

Padawer et al. (1974) attempted to obtain a hydrogen profile from the exterior to the interior of the sample, using LNM microanalysis with a Van de Graaf accelerator. However, for this sample, interferences were too great to obtain hydrogen concentrations.

PHYSICAL PROPERTIES

Mizutani and Osako (1974 a, b), referring to the sample as a "fine-grained anorthositic breccia," reported elastic wave velocities, both compressional and shear wave, for 73235,18 (Table 5). The velocities are lower than those appropriate for the "lower layer" (25-65 km depth) of the lunar crust.

Watson et al. (1974) used thermomagnetic analysis (Js v. T) and microscopy to identify the magnetic carriers in 73235. The carvers are mainly iron metals, some nickel free and others with up to 6% nickel. The total Fe^{O} is 0.31 wt %, more than in basalts. The average NRM is 6 x 10^{-6} emu/gm, less than about a third that of basalts. The iron is fine-grained compared with basalts, and is partially oxidized (in the experiment) to Fe_3O_4, even at an fO2 of 10^{-22}. Some of the iron is "newly-formed" iron, that is, produced in the impact event and not relict clasts.

PROCESSING

A small number of chips were initially taken from different parts of 73235 for allocations. Subsequently a slab (, 11) was cut through the sample and itself subdivided (Fig. 2), providing interior and exterior samples. The sawing produced two butt ends, of which, 9 at over 500 g remains unprocessed. Butt end, 8 was completely subdivided such that its largest subsample (, 35) is now 50 g. This butt end is the source of the conspicuous white troctolite clast. Four different chips from both the slab and the, 8 butt have been used for thin sections, of which a large number exist.