MSC 03209

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LUNAR SAMPLE INFORMATION CATALOG

APOLLO 15

LUNAR RECEIVING LABORATORY

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NOVEMBER 1971

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INTRODUCTION

This document contains data developed on the Apollo 15 samples in the Lunar Receiving Laboratory during the preliminary examination period, August 9, 1971 to September 30, 1971.

The data consists of a complete inventory, binocular descriptions of the rocks, and photographs of most of the rocks. For representative rocks and fines samples, thin section descriptions and chemical analyses are included.

Further information on the samples, including field relations, lunar surface photography, along with summaries and interpretations, is contained in the United States Geological Survey's Interagency Reports 32 - 36 to NASA and in the NASA Apollo 15 Preliminary Science Report.

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TABLE I . - APOLLO 15 SAMPLE INVENTORY

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15001	232.8	Drill stem bottom	Sta 8-ALSEP		
15002	210.1	Drill stem section	-----do-----		
15003	223.0	----------do----------	-----do-----		
15004	210.6	----------do----------	-----do-----	2/	
15005	239.1	----------do----------	-----do-----	--do--	
15006	227.9	Drill stem top	-----do-----	--do--	
15007	768.2	Drive tube bottom	Sta 2-St George	1/	
15008	510.2	Drive tube top	-----do-----	--do--	
15009	622.0	Drive tube single	Sta 6-Front	5/	
15010	740.4	Drive tube bottom	Sta 9a-Rille	7/	
15011	653.6	Drive tube top	-----do-----	--do--	
15012	312.2	SESC 1	Sta 6-Front	5/	
15013	296.2	SESC (blank)	Lunar Module	7/	
15014	333.2	SESC 2	Sta 8-ALSEP	5/	
15015	4770.2	Glass coated breccia	Lunar Module	4/	49
15016*	923.7	Porphyritic vesicular basalt	Sta 3-Rhysling	--do--	51
15017	9.8	Glass spherical shell	Lunar Module	5/162	54
15018	5.7	Glass object	-----do-----	--do--	56
15019	1.2	Glassy microbreccia	-----do-----	--do--	57
15020	88.7	Unsieved fines	-----do-----	CSB	
15021*	500.2	<1mm fines	-----do-----	--do--	58
15022	10.0	1-2mm fines	-----do-----	--do--	
15023	5.0	2-4mm fines	-----do-----	--do--	
15024	3.6	4-10mm fines	-----do-----	--do--	
15025*	77.3	Coherent breccia	-----do-----	--do--	59
15026	1.1	Glass coated microbreccia	-----do-----	--do--	62
15027	51.0	Breccia	-----do-----	5/162	64
15028*	59.4	Glassy breccia	-----do-----	--do--	66
15030	75.3	Unsieved fines	Sta 8-ALSEP	6/252	
15031*	207.8	<1mm fines	-----do-----	--do--	70
15032	7.0	1-2mm fines	-----do-----	--do--	
15033	6.6	2-4mm fines	-----do-----	--do--	
15034	7.0	4-10mm fines	-----do-----	--do--	
15040	113.4	Unsieved fines	-----do-----	6/253	
15041*	269.6	<1mm fines	-----do-----	--do--	70
15042	5.1	1-2mm fines	-----do-----	--do--	
15043	2.8	2-4mm fines	-----do-----	--do--	
15044	1.5	4-10mm fines	-----do-----	--do--	
15058*	2672.5	Porphyritic basalt	-----do-----	6/	72
15059	1149.2	Glass coated breccia	Lunar Module	--do--	75
15065	1475.5	Gabbro	Sta 1-Elbow	1/156	77

* Thin sections made from these samples.

TABLE I . - APOLLO 15 SAMPLE INVENTORY (Cont.)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15070	51.3	Unsieved fines	Sta 1-Elbow	1/157	
15071	100.7	<1mm fines	------do------	--do--	
15072	3.0	1-2mm fines	------do------	--do--	
15073	1.4	2-4mm fines	------do------	--do--	
15074	1.3	4-10mm fines	------do------	--do--	
15075	809.3	Gabbro	------do------	--do--	79
15076*	400.5	Gabbro	------do------	--do--	80
15080	73.5	Unsieved fines	------do------	1/158	
15081	106.9	<1mm fines	------do------	--do--	
15082	2.0	1-2mm fines	------do------	--do--	
15083	1.8	2-4mm fines	------do------	--do--	
15084	1.1	4-10mm fines	------do------	--do--	
15085*	471.3	Basalt	------do------	--do--	83
15086	216.5	Breccia	------do------	--do--	86
15087	5.7	Gabbro	------do------	--do--	88
15088	1.8	Breccia	------do------	--do--	89
15090	39.3	Unsieved fines	Sta 2-St George	1/159	
15091*	162.9	<1mm fines	------do------	--do--	90
15092	2.7	1-2mm fines	------do------	--do--	
15093	0.6	2-4mm fines	------do------	--do--	
15095	25.5	Glass coated microbreccia	------do------	--do--	93
15100	281.0	Unsieved fines	------do------	1/187	
15101*	637.6	<1mm fines	------do------	--do--	90
15102	12.2	1-2mm fines	------do------	--do--	
15103	4.1	2-4mm fines	------do------	--do--	
15104	1.5	4-10mm fines	------do------	--do--	
15105	5.6	Basalt	------do------	--do--	95,96
15115	4.0	Porphyritic basalt	------do------	1/186	96,97
15116	7.2	Gabbro	------do------	--do--	96,98
15117	23.3	Porphyritic basalt	------do------	--do--	96,99
15118	27.6	----------do----------	------do------	--do--	96,100
15119	14.1	Basalt with adhering breccia	------do------	--do--	96,101
15125	6.5	Basalt	------do------	--do--	96,102
15135	1.6	Glassy microbreccia	------do------	--do--	96,103
15145	15.1	Breccia	------do------	--do--	96,104
15146	1.0	----------do----------	------do------	--do--	96,105
15147	3.7	Soil breccia	------do------	--do--	96,106
15148	3.0	----------do----------	------do------	--do--	96,107

* Thin sections made from these samples

TABLE I . - APOLLO 15 SAMPLE INVENTORY (Cont)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15200	7.7	Unsieved fines	Sta 2-St George	1/160	
15201	18.3	<1mm fines	-----do-----	--do--	
15202	0.4	1-2mm fines	-----do-----	--do--	
15203	0.2	2-4mm fines	-----do-----	--do--	
15204	0.1	4-10mm fines	-----do-----	--do--	
15205*	337.3	Coarse breccia	-----do-----	1/161	108
15206*	92.0	Glassy breccia	-----do-----	1/160	113
15210	221.2	Unsieved fines	-----do-----	1/180	
15211	163.5	<1mm fines	-----do-----	--do--	
15212	3.6	1-2mm fines	-----do-----	--do--	
15213	2.4	2-4mm fines	-----do-----	--do--	
15214	0.2	4-10mm fines	-----do-----	--do--	
15220	160.5	Unsieved fines	-----do-----	1/181	
15221*	290.0	<1mm fines	-----do-----	--do--	90
15222	2.4	1-2mm fines	-----do-----	--do--	
15223	5.8	2-4mm fines	-----do-----	--do--	
15224	7.0	4-10mm fines	-----do-----	--do--	
15230	99.1	Unsieved fines	-----do-----	1/182	
15231*	233.9	<1mm fines	-----do-----	--do--	90
15232	5.2	1-2mm fines	-----do-----	--do--	
15233	3.8	2-4mm fines	-----do-----	--do--	
15234	1.8	4-10mm fines	-----do-----	--do--	
15240	67.1	Unsieved fines	Sta 6-Front	3/163	
15241*	197.4	<1mm fines	-----do-----	--do--	117
15242	18.9	1-2mm fines	-----do-----	--do--	
15243	31.8	2-4mm fines	-----do-----	--do--	
15244	32.6	4-10mm fines	-----do-----	--do--	
15245	115.5	89 pieces-Glass coated breccias to agglutinates	-----do-----	--do--	121
15250	207.0	Unsieved fines	-----do-----	3/164	
15251*	380.9	<1mm fines	-----do-----	--do--	117
15252	8.3	1-2mm fines	-----do-----	--do--	
15253	4.0	2-4mm fines	-----do-----	--do--	
15254	1.2	4-10mm fines	-----do-----	--do--	
15255	240.4	Glass coated breccia	-----do-----	5/190	125
15256*	201.0	Basalt	-----do-----	--do--	126
15257	22.5	Microbreccia	-----do-----	--do--	128
15259	0.7	----------do----------	-----do-----	5/192	130

* Thin sections made from these samples

TABLE I. - APOLLO 15 SAMPLE INVENTORY (Cont.)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15260	172.2	Unsieved fines	Sta 6-Front	3/166	
15261*	416.6	<1mm fines	------do------	--do--	117
15262	9.1	1-2mm fines	------do------	--do--	
15263	6.7	2-4mm fines	------do------	--do--	
15264	5.9	4-10mm fines	------do------	--do--	
15265*	314.1	Fine breccia	------do------	5/193	131
15266	271.4	----------do----------	------do------	--do--	135
15267	1.8	Microbreccia	------do------	--do--	137
15268	11.0	----------do----------	------do------	5/192	139
15269	6.0	Glassy microbreccia	------do------	--do--	141
15270	319.0	Unsieved fines	------do------	3/167	
15271*	798.3	<1mm fines	------do------	--do--	117
15272	20.7	1-2mm fines	------do------	--do--	
15273	13.7	2-4mm fines	------do------	--do--	
15274	4.4	4-10mm fines	------do------	--do--	
15281	107.0	<1mm (SCB 3 residue)	------do------	3/	
15282	9.7	1-2mm (SCB 3 residue)	------do------	--do--	
15283	13.3	2-4mm (SCB 3 residue)	------do------	--do--	
15284	38.2	4-10mm (SCB 3 residue)	------do------	--do--	
15285*	264.2	Breccia	------do------	5/192	143
15286	34.6	Vesicular basalt glass and microbreccia	------do------	--do--	147
15287	44.9	Soil breccia	------do------	--do--	150
15288	70.5	Glassy breccia	------do------	--do--	151
15289	24.1	Breccia	------do------	--do--	154
15290	55.0	Unsieved fines	------do------	3/188	
15291*	169.0	<1mm fines	------do------	--do--	117
15292	5.4	1-2mm fines	------do------	--do--	
15293	6.7	2-4mm fines	------do------	--do--	
15294	10.2	4-10mm fines	------do------	--do--	
15295	947.3	Breccia	------do------	--do--	155
15297	39.4	Breccia chips (SCB 3 residue)	------do------	3/	
15298*	1731.4	Microbreccia	------do------	--do--	157
15299	1691.7	Breccia	------do------	--do--	161
15300	390.7	Unsieved fines	Sta 7-Spur	3/173	
15301*	810.2	<1mm fines	------do------	--do--	163
15302	23.2	1-2mm fines	------do------	--do--	
15303	12.7	2-4mm fines	------do------	--do--	
15304	7.3	4-10mm fines	------do------	--do--	
15305	2.9	<10mm green soil conc.	------do------	--do--	
15306	134.2	Breccia	------do------	--do--	165,166
15307	1.3	Hollow glass sphere	------do------	--do--	165,167
15308	1.7	Breccia	------do------	--do--	165,168

* Thin sections made from these samples.

TABLE I. - APOLLO 15 SAMPLE INVENTORY (Cont.)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15310	140.6	Unsieved fines	Sta 7-Spur	3/172	
15311*	295.0	<1mm fines	-----do-----	--do--	163
15312	10.1	1-2mm fines	-----do-----	--do--	
15313	9.8	2-4mm fines	-----do-----	--do--	
15314	8.4	4-10mm fines	-----do-----	--do--	
15315	35.6	Soil breccia containing clasts of brown pyroxene basalt	-----do-----	--do--	165
15316	6.1	----------do----------	-----do-----	--do--	165
15317	0.6	----------do----------	-----do-----	--do--	165
15318	5.4	----------do----------	-----do-----	--do--	165
15319	8.0	----------do----------	-----do-----	--do--	165
15320	4.7	----------do----------	-----do-----	--do--	165
15321	0.3	Soil breccia lacking clasts of brown pyroxene basalt	-----do-----	--do--	165
15322	8.4	----------do----------	-----do-----	--do--	165
15323	4.4	----------do----------	-----do-----	--do--	165
15324	32.3	----------do----------	-----do-----	--do--	165
15325	57.8	----------do----------	-----do-----	--do--	165
15326	2.5	----------do----------	-----do-----	--do--	165
15327	12.4	----------do----------	-----do-----	--do--	165
15328	0.3	----------do----------	-----do-----	--do--	165
15329	2.2	----------do----------	-----do-----	--do--	165
15330	57.8	----------do----------	-----do-----	--do--	165
15331	2.6	----------do----------	-----do-----	--do--	165
15332	2.3	----------do----------	-----do-----	--do--	165
15333	0.3	----------do----------	-----do-----	--do--	165
15334	7.5	----------do----------	-----do-----	--do--	165
15335	6.0	----------do----------	-----do-----	--do--	165
15336	0.2	----------do----------	-----do-----	--do--	165
15337	4.3	----------do----------	-----do-----	--do--	165
15338	11.1	----------do----------	-----do-----	--do--	165
15339	0.4	----------do----------	-----do-----	--do--	165
15340	0.9	----------do----------	-----do-----	--do--	165
15341	1.6	----------do----------	-----do-----	--do--	165
15342	7.5	----------do----------	-----do-----	--do--	165
15343	6.9	----------do----------	-----do-----	--do--	165
15344	7.9	----------do----------	-----do-----	--do--	165
15345	12.3	----------do----------	-----do-----	--do--	165
15346	3.1	----------do----------	-----do-----	--do--	165
15347	3.2	----------do----------	-----do-----	--do--	165
15348	0.3	----------do----------	-----do-----	--do--	165
15349	2.3	----------do----------	-----do-----	--do--	165

* Thin sections made from these samples

TABLE I . - APOLLO 15 SAMPLE INVENTORY (Cont.)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15350	2.9	Soil breccia lacking clasts of brown pyroxene basalt	Sta 7-Spur	3/172	165
15351	4.2	----------do----------	-----do-----	--do--	165
15352	2.9	----------do----------	-----do-----	--do--	165
15353	10.6	----------do----------	-----do-----	--do--	165
15354	0.3	----------do----------	-----do-----	--do--	165
15355	5.2	----------do----------	-----do-----	--do--	165
15356	2.0	Tough microbreccia	-----do-----	--do--	165
15357	11.8	----------do----------	-----do-----	--do--	165
15358	14.6	----------do----------	-----do-----	--do--	165
15359	4.2	----------do----------	-----do-----	--do--	165
15360	9.3	----------do----------	-----do-----	--do--	165
15361	0.9	Pale green microcrystalline rock	-----do-----	--do--	165
15362	4.2	Anorthosite	-----do-----	--do--	165
15363	0.5	----------do----------	-----do-----	--do--	165
15364	1.5	----------do----------	-----do-----	--do--	165
15365	2.9	Green glass microbreccia	-----do-----	--do--	165
15366	3.3	----------do----------	-----do-----	--do--	165
15367	1.1	----------do----------	-----do-----	--do--	165
15368	0.4	----------do----------	-----do-----	--do--	165
15369	2.5	----------do----------	-----do-----	--do--	165
15370	2.9	----------do----------	-----do-----	--do--	165
15371	0.5	----------do----------	-----do-----	--do--	165
15372	0.8	----------do----------	-----do-----	--do--	165
15373	0.6	----------do----------	-----do-----	--do--	165
15374	1.0	----------do----------	-----do-----	--do--	165
15375	0.4	----------do----------	-----do-----	--do--	165
15376	1.0	----------do----------	-----do-----	--do--	165
15377	0.5	----------do----------	-----do-----	--do--	165
15378	3.3	Fine non-Mare basalt	-----do-----	--do--	165
15379	64.3	----------do----------	-----do-----	--do--	165
15380	5.2	----------do----------	-----do-----	--do--	165
15381	0.3	----------do----------	-----do-----	--do--	165
15382	3.2	----------do----------	-----do-----	--do--	165
15383	1.4	----------do----------	-----do-----	--do--	165
15384	1.4	----------do----------	-----do-----	--do--	165
15385	8.7	Coarse Mare basalt	-----do-----	--do--	165
15386	7.5	----------do----------	-----do-----	--do--	165
15387	2.0	----------do----------	-----do-----	--do--	165
15388	9.0	----------do----------	-----do-----	--do--	165
15389	2.8	Glass	-----do-----	--do--	165
15390	3.5	----------do----------	-----do-----	--do--	165
15391	0.3	----------do----------	-----do-----	--do--	165
15392	0.4	----------do----------	-----do-----	--do--	165

TABLE I. - APOLLO 15 SAMPLE INVENTORY (Cont.)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15400	47.5	Unsieved fines	Sta 6a	6/168	
15401	86.4	<1mm fines	-----do-----	--do--	
15402	4.8	1-2mm fines	-----do-----	--do--	
15403	6.1	2-4mm fines	-----do-----	--do--	
15404	7.9	4-10mm fines	-----do-----	--do--	
15405*	513.1	Breccia, recrystallized	-----do-----	--do--	172
15410	56.2	Unsieved fines	Sta 7-Spur	3/194	
15411	103.3	<1mm fines	-----do-----	--do--	
15412	7.1	1-2mm fines	-----do-----	--do--	
15413	6.7	2-4mm fines	-----do-----	--do--	
15414	4.0	4-10mm fines	-----do-----	--do--	
15415*	269.4	Anorthosite	-----do-----	3/196	176
15417	1.3	Breccia	-----do-----	3/194	178
15418*	1140.7	Breccia, vitreous matrix	-----do-----	--do--	179
15419	17.7	Breccia, with glass	-----do-----	--do--	182
15421	254.7	<1mm fines	-----do-----	3/195	
15422	15.9	1-2mm fines	-----do-----	--do--	
15423	18.3	1-4mm fines	-----do-----	--do--	
15424	19.5	4-10mm fines	-----do-----	--do--	
15425	136.3	Green and gray clods	-----do-----	--do--	184
15426*	223.6	----------do----------	-----do-----	--do--	163,186
15427*	115.9	----------do----------	-----do-----	--do--	189
15431	475.7	<1mm fines	-----do-----	5/170	
15432	39.7	1-2mm fines	-----do-----	--do--	
15433	31.2	2-4mm fines	-----do-----	--do--	
15434	51.6	4-10mm fines	-----do-----	--do--	
15435*	206.8	Gray clods, 32 splits	-----do-----	--do--	193
15445	287.2	Breccia with white clasts	-----do-----	6/171	196
15455*	937.2	Black and white breccia	-----do-----	5/198	198
15459*	5854.0	Breccia with large clasts	-----do-----	6/	202
15465	376.0	Glass coated breccia	-----do-----	5/199	206
15466	119.2	Dark glass with clasts	-----do-----	--do--	209
15467	1.1	Microbreccia	-----do-----	--do--	211
15468	1.3	Glass and breccia	-----do-----	--do--	213
15470	82.2	Unsieved fines	Sta 4-Dune	5/203	
15471	153.0	<1mm fines	-----do-----	--do--	
15472	6.1	1-2mm fines	-----do-----	--do--	
15473	4.5	2-4mm fines	-----do-----	--do--	
15474	4.7	4-10mm fines	-----do-----	--do--	
15475*	406.8	Basalt	-----do-----	--do--	214
15476	266.3	----------do----------	-----do-----	--do--	219

* Thin sections made from these samples.

TABLE I . - APOLLO 15 SAMPLE INVENTORY (Cont.)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15485	104.9	Basalt	Sta 4-Dune	5/204	220
15486	46.8	Basalt with gray coatings	-----do-----	--do--	223
15495	908.9	Gabbro	-----do-----	5/174	225
15498*	2339.8	Recrystallized breccia	-----do-----	6/	227
15499*	2024.0	Vesicular basalt	-----do-----	5/	230
15500	24.8	Unsieved fines	Sta 9-Scarp	7/255	
15501	103.0	<1mm fines	-----do-----	--do--	
15502	4.4	1-2mm fines	-----do-----	--do--	
15503	3.8	2-4mm fines	-----do-----	--do--	
15504	4.1	4-10mm fines	-----do-----	--do--	
15505	1147.4	Glass coated breccia	-----do-----	--do--	232
15506	22.9	Glass coated microbreccia	-----do-----	--do--	234
15507	3.9	Vesicular glass ellipsoid	-----do-----	--do--	236
15508	1.4	Glass coated microbreccia	-----do-----	--do--	237
15510	72.3	Unsieved fines	-----do-----	7/273	
15511	193.1	<1mm fines	-----do-----	--do--	
15512	4.9	1-2mm fines	-----do-----	--do--	
15513	4.4	2-4mm fines	-----do-----	--do--	
15514	1.1	4-10mm fines	-----do-----	--do--	
15515*	144.7	Brownish gray clods, 48 pieces	-----do-----	--do--	238
15528	4.7	Breccia	Sta 9a-Rille	2/274	243
15529	1531.0	Vesicular basalt	-----do-----	--do--	244
15530	138.0	Unsieved fines	-----do-----	7/275	
15531*	136.0	<1mm fines	-----do-----	--do--	246
15532	6.3	1-2mm fines	-----do-----	--do--	
15533	5.4	2-4mm fines	-----do-----	--do--	
15534	6.0	4-10mm fines	-----do-----	--do--	
15535*	404.4	Porphyritic olivine basalt	-----do-----	--do--	248
15536	317.2	Basalt	-----do-----	--do--	251
15537	1.9	Coarse grained basalt	-----do-----	--do--	252
15538	2.6	Olivine microgabbro	-----do-----	--do--	253
15545*	746.6	Basalt	-----do-----	7/278	255
15546	27.8	----------do----------	-----do-----	--do--	257
15547	20.1	Vuggy basalt	-----do-----	--do--	258
15548	3.3	Basalt	-----do-----	--do--	259
15555*	9613.7	Vuggy basalt	-----do-----	BSLSS	260
15556*	1542.3	Vesicular basalt	-----do-----	2/	263
15557	2518.0	Basalt	-----do-----	--do--	266
15558*	1333.3	Breccia	-----do-----	--do--	265

* Thin sections made from these samples.

TABLE I. - APOLLO 15 SAMPLE INVENTORY (Cont.)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15561	112.5	<1mm SCB 2 residue	Sta 9a-Rille	2/	
15562	20.6	1-2mm SCB 2 residue	-----do-----	--do--	
15563	30.4	2-4mm SCB 2 residue	-----do-----	--do--	
15564	50.0	4-10mm SCB 2 residue	-----do-----	--do--	
15565*	822.6	Breccia fragments, SCB 2 residue	-----do-----	--do--	271
15595	237.6	Porphyritic basalt	-----do-----	7/281	275
15596	224.8	Basalt	-----do-----	--do--	277
15597*	145.7	----------do----------	-----do-----	--do--	278
15598	135.7	----------do----------	-----do-----	--do--	280
15600	449.1	Reserve fines - comprehensive	-----do-----	7/283	
15601*	802.0	<1mm fines - comprehensive	-----do-----	--do--	246
15602	32.9	1-2mm fines	-----do-----	--do--	
15603	25.5	2-4mm fines	-----do-----	--do--	
15604	21.5	4-10mm fines	-----do-----	--do--	
15605	6.1	Basalt	-----do-----	--do--	281,283
15606	10.1	Vesicular basalt	-----do-----	--do--	281,284
15607	14.8	Coarse grained basalt	-----do-----	--do--	281,285
15608	1.2	Microporphyritic basalt	-----do-----	--do--	281,286
15609	1.1	Basalt	-----do-----	--do--	281,287
15610	1.5	Basalt with clinopyroxene	-----do-----	--do--	281,288
15612	5.9	Vesicular olivine basalt	-----do-----	7/282	281
15613	1.0	----------do----------	-----do-----	--do--	281
15614	9.7	----------do----------	-----do-----	--do--	281
15615	1.7	----------do----------	-----do-----	--do--	281
15616	8.0	----------do----------	-----do-----	--do--	281
15617	3.1	----------do----------	-----do-----	--do--	281
15618	0.8	----------do----------	-----do-----	--do--	281
15619	0.6	----------do----------	-----do-----	--do--	281
15620	6.6	----------do----------	-----do-----	--do--	281
15621	1.6	----------do----------	-----do-----	--do--	281
15622	29.5	----------do----------	-----do-----	--do--	281
15623	3.0	----------do----------	-----do-----	--do--	281
15624	0.2	----------do----------	-----do-----	--do--	281
15625	0.5	----------do----------	-----do-----	--do--	281
15626	0.6	----------do----------	-----do-----	--do--	281
15627	0.4	----------do----------	-----do-----	--do--	281
15628	0.4	----------do----------	-----do-----	--do--	281
15629	0.4	----------do----------	-----do-----	--do--	281
15630	23.2	----------do----------	-----do-----	--do--	281,289
15632	2.3	Porphyritic basalt with clinopyroxene	-----do-----	--do--	281
15633	7.4	----------do----------	-----do-----	--do--	281

* Thin sections made from these samples.

TABLE I . - APOLLO 15 SAMPLE INVENTORY (Cont.)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15634	5.2	Porphyritic basalt with clinopyroxene	Sta 9a-Rille	7/282	281
15635	0.5	----------do----------	-----do-----	--do--	281
15636	336.7	----------do----------	-----do-----	--do--	281,289
15637	0.9	----------do----------	-----do-----	--do--	281
15638	3.6	----------do----------	-----do-----	--do--	281
15639	7.0	----------do----------	-----do-----	--do--	281
15640	0.5	----------do----------	-----do-----	--do--	281
15641	6.9	----------do----------	-----do-----	--do--	281
15642	1.9	----------do----------	-----do-----	--do--	281
15643	17.9	----------do----------	-----do-----	--do--	281
15644	0.4	----------do----------	-----do-----	--do--	281
15645	0.5	----------do----------	-----do-----	--do--	281
15647	48.1	Fine subophitic basalt	-----do-----	--do--	281,289
15648	9.1	----------do----------	-----do-----	--do--	281
15649	6.2	----------do----------	-----do-----	--do--	281
15650	3.4	----------do----------	-----do-----	--do--	281
15651	1.6	----------do----------	-----do-----	--do--	281
15652	0.7	----------do----------	-----do-----	--do--	281
15653	0.4	----------do----------	-----do-----	--do--	281
15654	0.2	----------do----------	-----do-----	--do--	281
15655	0.4	----------do----------	-----do-----	--do--	281
15656	0.2	----------do----------	-----do-----	--do--	281
15658	11.6	Pyroxene phyric basalt	-----do-----	--do--	281
15659	12.6	----------do----------	-----do-----	--do--	281,289
15660	8.9	----------do----------	-----do-----	--do--	281
15661	5.9	----------do----------	-----do-----	--do--	281
15662	4.9	----------do----------	-----do-----	--do--	281
15663	10.3	----------do----------	-----do-----	--do--	281
15664	7.4	----------do----------	-----do-----	--do--	281
15665	10.2	Olivine phyric basalt	-----do-----	--do--	281
15666	3.9	Pigeonite phyric basalt	-----do-----	--do--	281,290
15667	1.1	----------do----------	-----do-----	--do--	281
15668	15.1	Olivine phyric basalt	-----do-----	--do--	281
15669	4.4	----------do----------	-----do-----	--do--	281
15670	2.0	Pyroxene phyric basalt	-----do-----	--do--	281
15671	6.1	Vesicular subophitic basalt	-----do-----	--do--	281
15672	21.4	----------do----------	-----do-----	--do--	281,290
15673	5.9	----------do----------	-----do-----	--do--	281
15674	35.7	Fine porphyritic basalt	-----do-----	--do--	281
15675	34.5	----------do----------	-----do-----	--do--	281,290
15676	25.3	----------do----------	-----do-----	--do--	281

TABLE I . - APOLLO 15 SAMPLE INVENTORY (Cont.)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15677	6.4	Fine porphyritic basalt	Sta 9a-Rille	7/282	281
15678	7.5	----------do----------	-----do-----	--do--	281
15679	0.7	----------do----------	-----do-----	--do--	281
15680	0.3	----------do----------	-----do-----	--do--	281
15681	0.3	----------do----------	-----do-----	--do--	281
15682	50.6	Plumose porphyritic basalt	-----do-----	--do--	281,290
15683	22.0	Fine porphyritic basalt	-----do-----	--do--	282,291
15684	1.4	Glass cemented breccia fragments	-----do-----	--do--	282
15685	0.8	----------do----------	-----do-----	--do--	282
16686	0.9	----------do----------	-----do-----	--do--	290,291
15687	1.4	----------do----------	-----do-----	--do--	282
15688	5.3	----------do----------	-----do-----	--do--	282,291
15689	2.8	Breccia with sugary clasts	-----do-----	--do--	282,291
15901	13.6	DB residue	Sta 1-Elbow	1/156	
15902	4.5	----------do----------	-----do-----	1/157	
15903	2.7	----------do----------	-----do-----	1/158	
15904	1.2	----------do----------	Sta 2-St George	1/159	
15906	2.8	----------do----------	-----do-----	1/160	
15907	5.3	----------do----------	-----do-----	1/181	
15908	1.2	----------do----------	-----do-----	1/161	
15909	1.7	----------do----------	-----do-----	1/182	
15910	4.9	----------do----------	-----do-----	1/186	
15911	4.8	----------do----------	-----do-----	1/187	
15912	8.1	----------do----------	Lunar Module	5/162	
15916	3.2	----------do----------	Sta 6-Front	5/190	
15917	26.6	----------do----------	-----do-----	5/192	
15918	14.5	----------do----------	-----do-----	5/193	
15924	2.7	----------do----------	Sta 7-Spur	3/196	
15925	0.8	----------do----------	-----do-----	5/170	
15926	12.4	----------do----------	-----do-----	5/198	
15927	20.1	----------do----------	-----do-----	5/199	
15931	1.7	----------do----------	Sta 4-Dune	5/203	
15932	20.5	----------do----------	-----do-----	5/174	
15933	15.9	----------do----------	-----do-----	5/204	
15936	6.7	----------do----------	Sta 9-Scarp	7/273	
15937	1.7	----------do----------	-----do-----	7/255	
15938	16.6	----------do----------	Sta 9a-Rille	2/274	
15939	4.2	----------do----------	-----do-----	7/275	
15940	3.5	----------do----------	-----do-----	7/278	
15941	10.0	----------do----------	-----do-----	7/281	
15942	58.8	----------do----------	-----do-----	7/282	
15943	1.7	----------do----------	-----do-----	7/283	

TABLE I . - APOLLO 15 SAMPLE INVENTORY (Conc.)

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SCB/DB	PAGE
15951	30.0	SCB residue	EVA 1	1	
15954	89.3	----------do----------	-----do-----	4	
15955	8.6	----------do----------	EVA 2	5	
15956	98.5	----------do----------	-----do-----	6	
15957	75.5	----------do----------	EVA 3	7	

TABLE II. - APOLLO 15 ROCK SAMPLES WEIGHING MORE THAN 25 GRAMS

SAMPLE NUMBER	WEIGHT (g)	STATION	STATUS OF RECOVERING ORIENTATION*	BASALT/BRECCIA		STUDIES
15015	4770.2	LM			X	
15016	923.7	3	X	X		TS, CA
15025	77.3	LM	Too far away		X	TS, CA
15027	51.0	LM	X		X	TS
15028	59.4	LM	X		X	TS
15058	2672.5	ALSEP	X	X		TS, CA, TC
15059	1149.2	ALSEP	X		X	CA
15065	1475.5	1	X	Gabbro		
15075	809.3	1	X	Gabbro		
15076	400.5	1	X	X		TS, CA, TC
15085	471.3	1	X	X		TS, GR
15086	216.5	1	X		X	GR
15095	25.5	2	In shadow		X	
15118	27.6	2	Rake	X		
15205	337.3	2	X		X	TS
15206	92.0	2			X	TS, GR
15255	240.4	6	X		X	
15256	201.0	6	X	X		TS, CA, GR
15265	314.1	6	X		X	TS, CA, NG, GR
15266	271.4	6	X		X	
15285	264.2	6	X		X	TS
15286	34.6	6	Too small		X	
15287	44.9	6	Too small		X	
15288	70.5	6			X	
15295	947.3	6	Broken		X	
15298	1731.4	6	Too fragile		X	TS, NG, TC
15299	1691.7	6	Too fragile		X	
15306	134.2	7			X	
15315	35.6	7	Rake		X	
15324	32.3	7	Rake		X	
15325	57.8	7	Rake		X	
15330	57.8	7	Rake		X	
15379	64.3	7	Rake	X		
15405	513.1	6a	Broken		X	TS
15415	269.4	7	Too fragile	Anorthosite		TS, CA, GR
15418	1140.7	7	X		X	TS, CA, GR, TC
15425	136.3	7	Broken	Green gray clods		GR
15426	223.6	7	Broken	Green gray clods		TS, GR
15427	115.9	7	Broken	Green gray clods		TS, NG
15435	206.8	7	Pedestal under 415	Gray clods		TS

TABLE II. - APOLLO 15 ROCK SAMPLES WEIGHING MORE THAN 25 GRAMS (Cont.)

SAMPLE NUMBER	WEIGHT (g)	STATION	STATUS OF RECOVERING ORIENTATION*	BASALT/BRECCIA		STUDIES
15445	287.2	7			X	
15455	885.4	7	Broken		X	TS, GR
15459	5854.0	7	Tenatively		X	TS, TC
15465	376.0	7	X		X	
15466	119.2	7		Dark glass with clasts		GR
15475	406.8	4	X	X		TS
15476	266.3	4	X	X		
15485	104.9	4	Partially	X		TS
15486	46.8	4	Partially	X		
15495	908.9	4	X	Gabbro		
15498	2339.8	4	Tenatively		X	TS, NG
15499	2024.0	4	X	X		TS, CA
15505	1147.4	9	X		X	
15515	144.7	9	Broken	Brownish gray clods		TS
15529	1531.0	9a	X	X		
15535	404.4	9a	X	X		TS
15536	317.2	9a	X	X		
15545	746.6	9a	Not located in photo	X		TS
15546	27.8	9a	Not located in photo	X		
15555	9613.7	9a	X	X		TS, CA, TC
15556	1542.3	9a	X	X		TS, CA
15557	2518.0	9a	X	X		
15558	1333.3	9a	No photos		X	TS, CA, NG, GR, TC
15565	822.6	9a	No photos		X	
15595	237.6	9a	X	X		
15596	224.8	9a	X	X		
15597	145.7	9a	Not located in photo	X		
15598	135.7	9a	Not located in photo	X		
15622	29.5	9a	Rake	X		
15636	336.7	9a	Rake	X		
15647	48.1	9a	Rake	X		
15674	35.7	9a	Rake	X		
15675	34.5	9a	Rake	X		
15676	25.3	9a	Rake	X		
15682	50.6	9a	Rake	X		

TABLE II. - APOLLO 15 ROCK SAMPLES WEIGHING MORE THAN 25 GRAMS (Conc.)

SAMPLE NUMBER	WEIGHT (g)	STATION	STATUS OF RECOVERING ORIENTATION*	BASALT/BRECCIA	STUDIES

EXPLANATION:

SYMBOL	TYPE ANALYSIS	TABLE
CA	Chemical analysis	V
GR	Gamma ray analysis	VI
TC	Total carbon analysis	VII
NG	Noble gas analysis	VIII
TS	Thin section description	

* Modified from Table 2 of USGS Interagency Report 36.

] Samples collected from the same boulder.

TABLE III . - SUMMARY OF FINES SAMPLES

SAMPLE NUMBER	WEIGHT (g)	STATION	STUDIES (<1 mm sample)	REMARKS
15020 -15024	607.5	LM	TS, CA, NG, TC, GR	
15030 -15034	303.7	8	TS, TC	Trench bottom
15040 -15044	392.4	8	TS, TC	Trench top
15070 -15074	157.7	1		
15080 -15084	185.3	1		
15090 -15094	205.5	2	TS	
15100 -15104	936.4	2	TS, CA, NG, TC	From rake sample area
15200 -15204	26.7	2		Soil from rock 15205
15210 -15214	390.9	2	GR	Fillet, down slope side of large boulder
15220 -15224	465.7	2	TS	Typical soil 1 m from 15210 - 15214
15230 -15234	343.8	2	TS	Soil beneath the large boulder
15240 -15244	347.8	6	TS	
15250 -15254	601.4	6	TS	
15260 -15264	610.5	6	TS	Trench bottom
15270 -15274	1156.1	6	TS, CA, TC, GR	
15281 -15284	168.2	6		Residue from SCB 3
15290 -15294	246.3	6	TS	Soil & disintegrated fragment
15300 -15305	1247.0	7	TS, CA, TC, NG, GR	15305 is a green soil conc.
15310 -15314	463.9	7	TS, NG	Fines in rake sample
15400 -15404	152.7	6a		Top of a fillet

TABLE III. - SUMMARY OF FINES SAMPLES (Conc.)

SAMPLE NUMBER	WEIGHT (g)	STATION	STUDIES (1 mm sample)	REMARKS
15410 -15414	177.3	7		
15421 -15424	308.4	7		Part soil, part disaggregated clods
15431 -15434	598.2	7	GR	Part soil, part disaggregated pedestal beneath rock 15415
15470 -15474	250.5	4	CA, TC	
15500 -15504	140.1	9	CA, TC	
15510 -15514	275.8	9		
15530 -15534	291.7	9a	TS	
15600 -15604	1331.0	9a	TS, CA, NG, TC	
15942	58.8	9a		Fines in rake sample

EXPLANATION:

SYMBOL	TYPE ANALYSIS	TABLE
CA	Chemical analysis	V
GR	Gamma ray analysis	VI
TC	Total carbon analysis	VII
NG	Noble gas analysis	VIII
TS	Thin section description	

NUMBERING OF APOLLO 15 SAMPLES

A five digit sample number is assigned each rock (coherent material greater than about 1 cm), the unsieved reserve and each sieve fraction of scooped <1 cm material, each drill stem and drive tube section and each sample of special characteristics.

The first two digits designate the mission number and is therefore 15 for all of the samples of this catalog. The last three digits are assigned with a dual purpose: to indicate sample type and to group samples by locality.

Without regard to sampling locations, the first 14 numbers (15001-15014) are assigned to drill stems, drive tubes, and special environment sample containers (SESC). 15900-15999 are housekeeping numbers used for sweepings, for material caught on filters from dusting operations, for small amounts of fines from sample containers with rocks only, and for any material that is not easily categorized. All of the other sample numbers are grouped by sampling locality (station) and the groups are arranged in order of the traverses.

Materials from the three paired rake and soil samples are assigned the centuries: 15100-15199, 15300-15399, and 15600-15699. Within each the fines are numbered in the first one or two decades according to the fines convention explained below. The remaining numbers are given to rocks which are grouped by lithology.

A decade or more of sample numbers is used for the contents of each documented bag (DB). Fines are ascribed numbers according to the following system:

15XY0	Unsieved "reserve"
15XY1	<1 mm sieve fraction
15XY2	1-2 mm sieve fraction
15XY3	2-4 mm sieve fraction
15XY4	4-10 mm sieve fraction

The rocks are given numbers ranging from 15XY5-15XY9 for each number decade. Large rocks returned loose in the sample collection bags (SCB) are assigned unused rock numbers in the decades, as are some rocks returned in documented bags without fines.

Any material removed from a sample (splits, chips, aliquots, thin sections, etc.) is identified a "specific" number, which is placed to the right of the sample number and separated from it by a comma (e.g. 15426,17).

SAMPLE LOCATIONS

Figure 1 shows the EVA traverses and station locations. Figures 2A through 2D are representative maps of the sample collection stations showing sample locations. Recent processing of samples has resulted in a few number changes from what the Field Geology group shows in maps in USGS Interagency Report 36. The changed numbers can be recognized in the figures by a slightly different type-style. USGS Interagency report 36 contains photographs showing the samples in place.

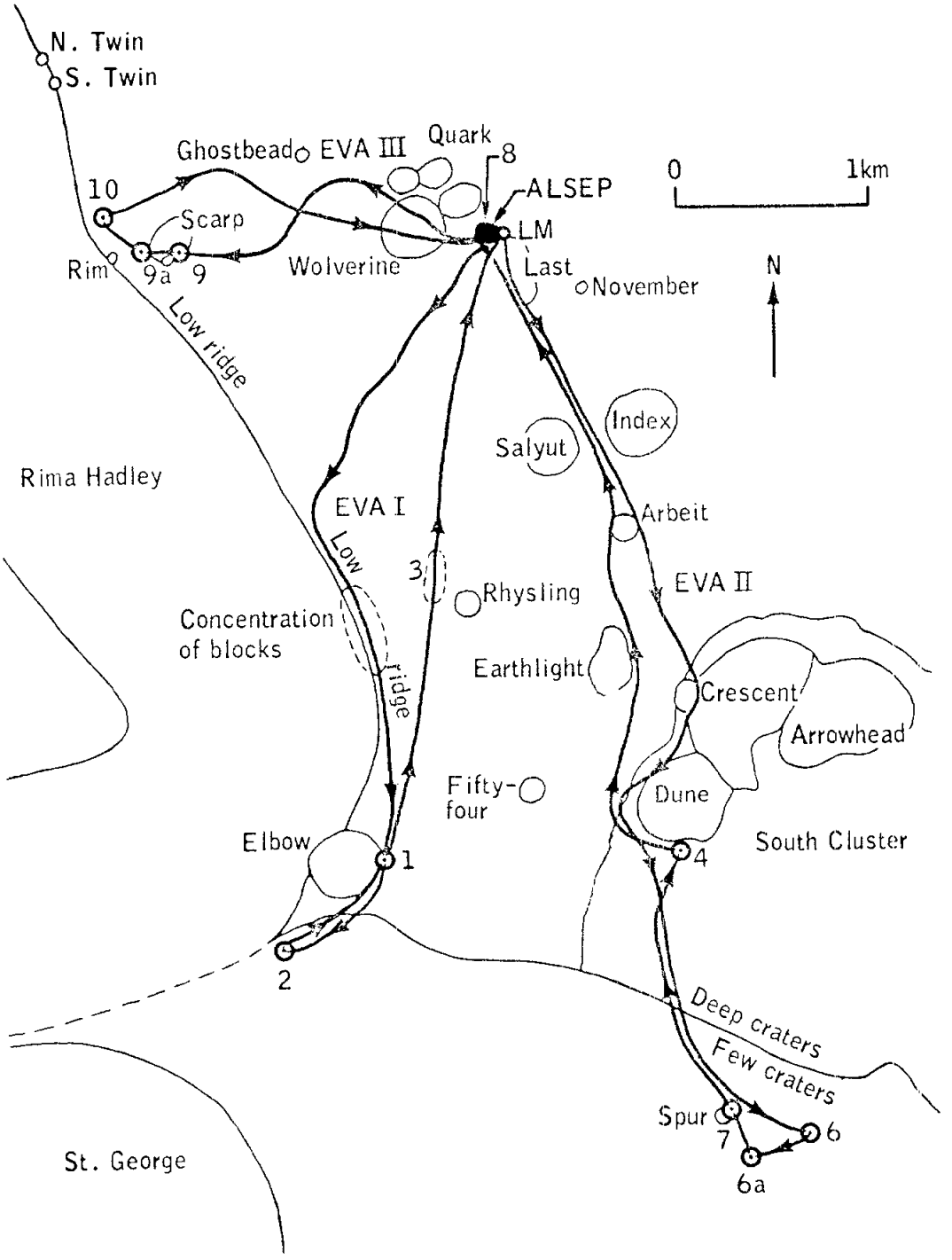


Figure 1. - Map of EVA Traverses Showing Crater Outlines and Sample Collection Stations; Modified from US Geological Survey Interagency Report.

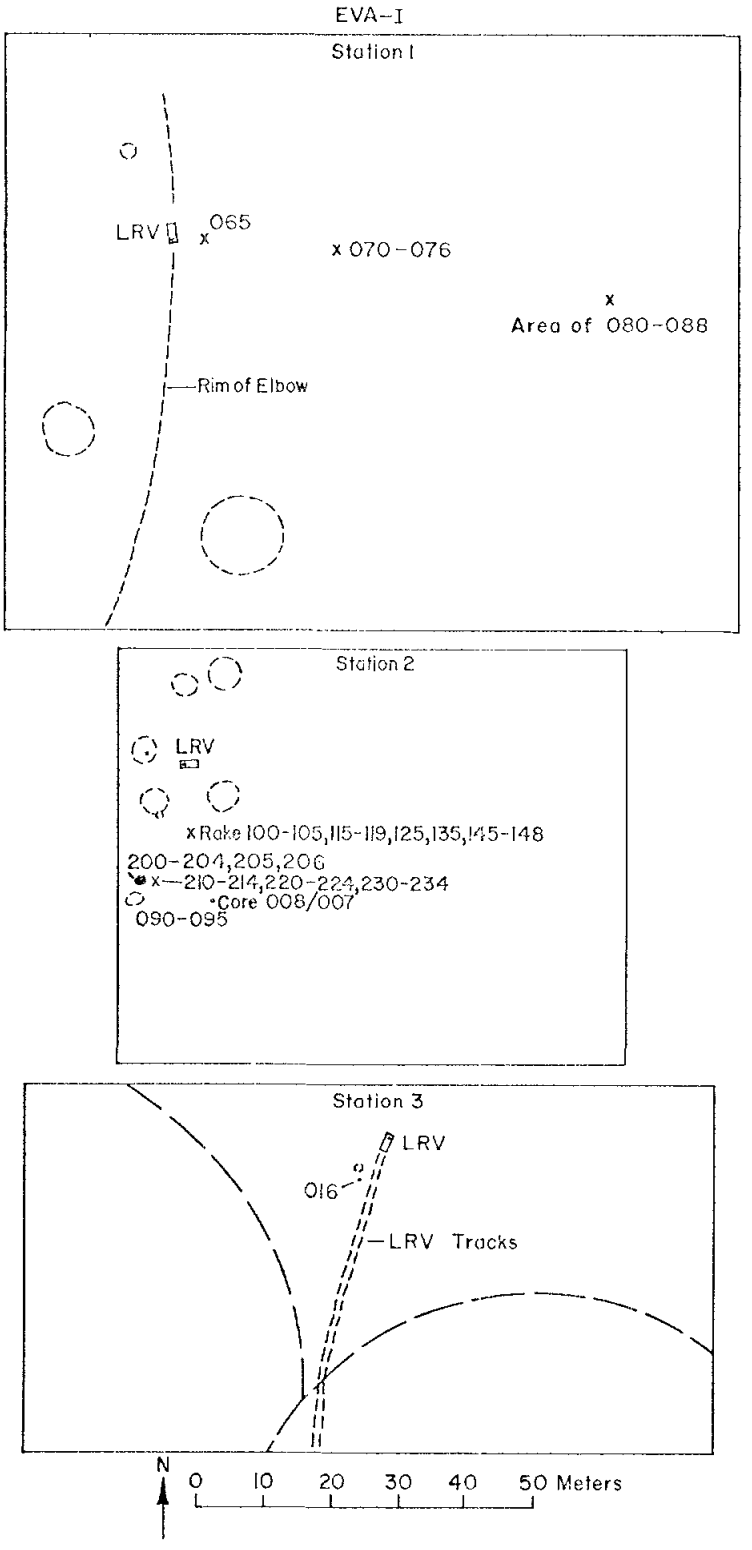


Figure 2 A. - Station Map Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 36.

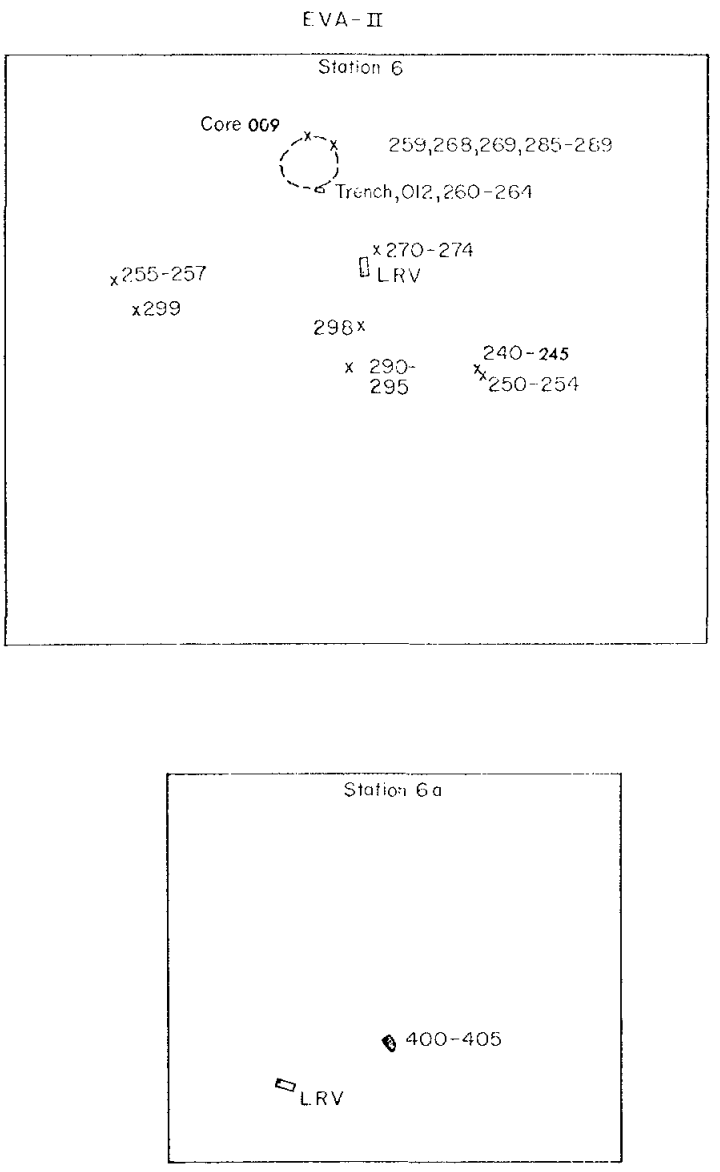


Figure 2B. - Station Map Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 36.

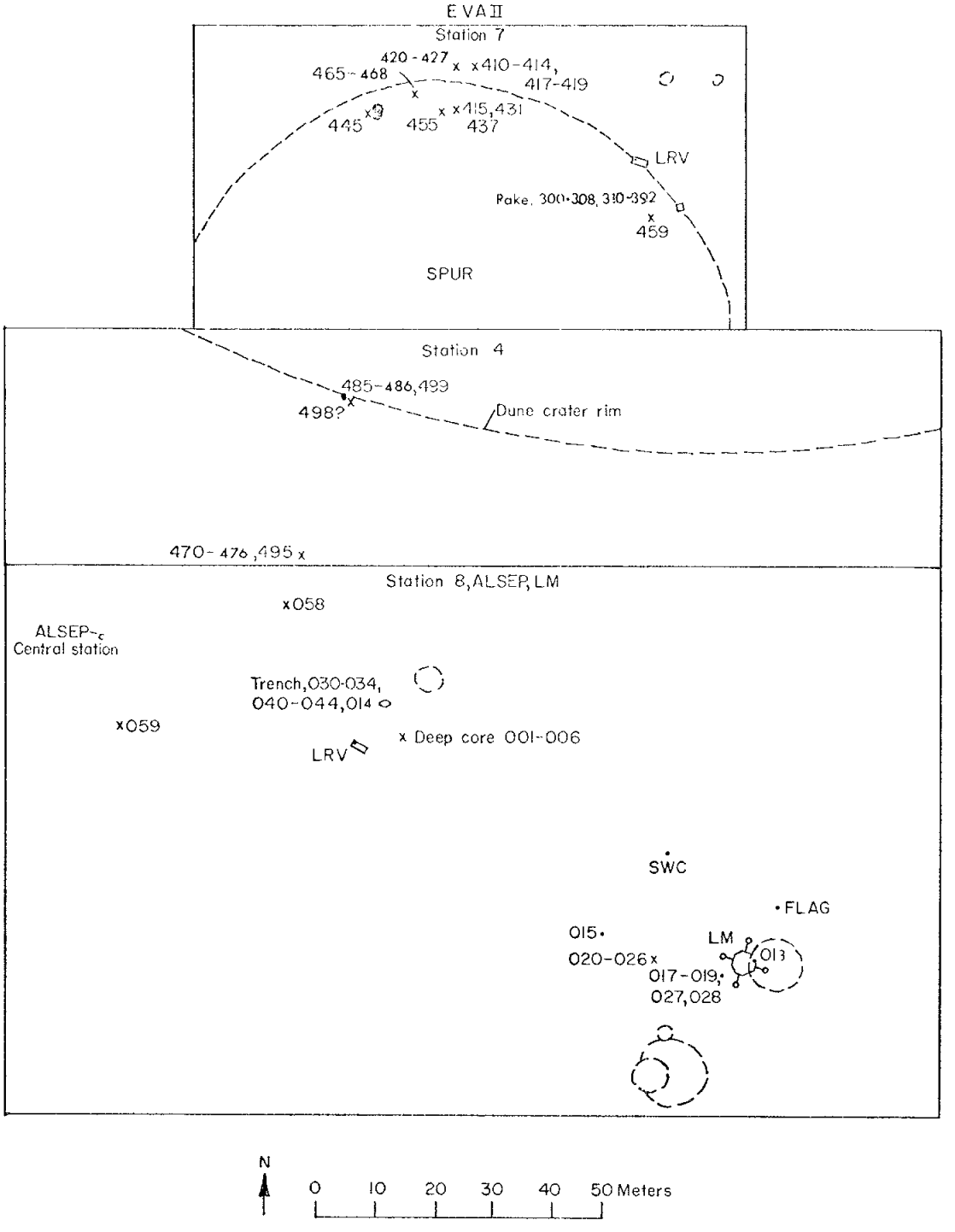
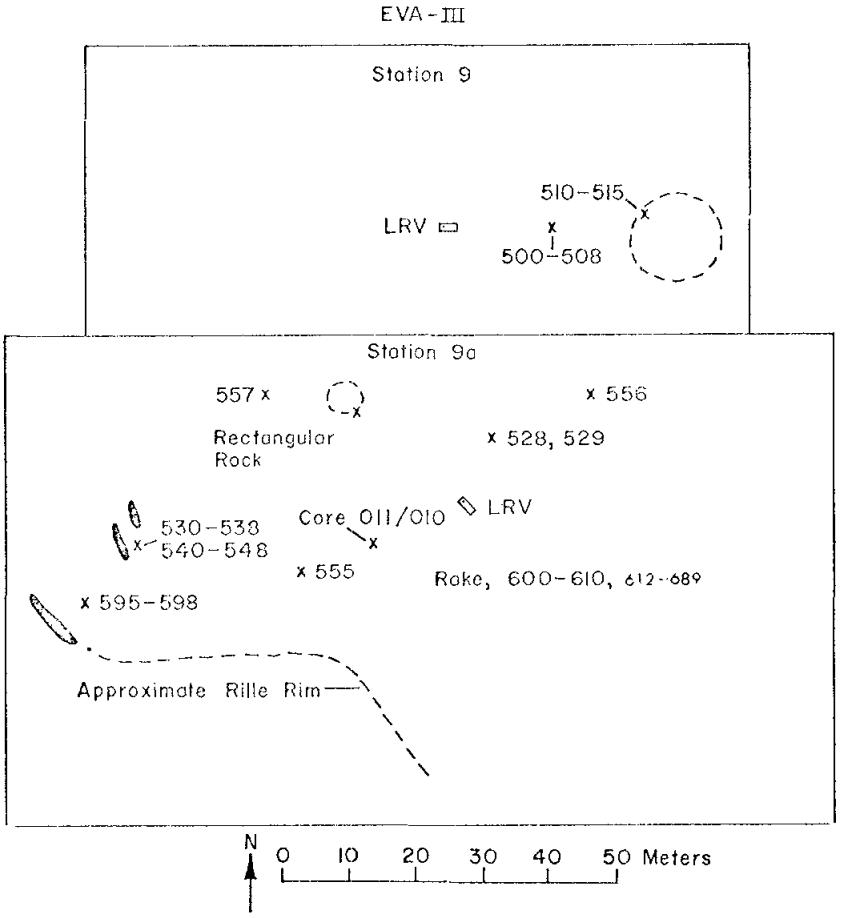


Figure 2 C. - Station Map Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 36.



Explanation for station maps

- × Location of sample containers
- LRV, dot shows TV camera
- Large rocks
- Crater rims or other topographic features

Figure 2 D. - Station Map Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 36.

SAMPLE RETURN CONTAINERS

Table IV lists the contents of the sample return containers. The containers that were processed in nitrogen atmosphere processing line 1 (previously NNPL and PCTL) are in order: SCB 4, BSLSS, SCB 2, SCB 3, SCB 6. The containers that were processed in nitrogen atmosphere processing line 2 (previously SNAP) are in order: SRC 1, SRC 2, and SCB 7.

SRC 1 sealed properly on the lunar surface and had a pressure of 35 microns Hg just prior to opening in the nitrogen processing line. SRC 2 failed to seal. SESC samples 15012 and 15014 appear to be sealed, but the cap of SESC sample 15013 did not properly seat.

TABLE IV. - CONTENTS OF SAMPLE COLLECTION & RETURN CONTAINERS

	SAMPLE NUMBER (Last 3 digits)
CONTINGENCY SAMPLE BAG (In SCB 4 in LM)	020 - 026
DRILL STEMS - (Lower 3)	001 - 003
SRC 1	
Organic Monitors	
SCB 1	
Drive Tubes 10, 03 (lower, upper)	007, 008
DB 156	065
DB 157	070 - 076
DB 158	080 - 088
DB 159	090 - 095
DB 160	200 - 204, 206
DB 161	205
DB 180	210 - 214
DB 181	220 - 224
DB 182	230 - 234
DB 186	115 - 119, 125, 135, 145 - 148
DB 187	100 - 105
SRC 2	
Organic Monitors	
SCB 5	
SESC 2	014
SESC 1	012
Drive Tube 07 (single)	009
DB 162	017 - 019, 027, 028
DB 170	431 - 435
DB 174	495
DB 190	255 - 257
DB 192	259, 268, 269, 285 - 289
DB 193	265 - 267
DB 198	455
DB 199	465 - 468
DB 203	470 - 476
DB 204	485, 486
1 Loose Rock	499

TABLE IV. - CONTENTS OF SAMPLE COLLECTION & RETURN CONTAINERS (Cont.)

	SAMPLE NUMBER (Last 3 digits)
SCB 2	
3 Drill Stems	004 - 006
DB 274	528, 529
3 Loose Rocks	556, 557, 558
Fragments (disaggregated rock)	561 - 565
SCB 3	
DB 163	240 - 245
DB 164	250 - 254
DB 166	260 - 264
DB 167	270 - 274
DB 172	310 - 392
DB 173	300 - 308
DB 188	290 - 295
DB 194	410 - 414, 417 - 419
DB 195	421 - 427
DB 196	415
Chips and fines	281 - 284, 297
2 Loose Rocks	298, 299
SCB 4	
2 Loose Rocks	015, 016
SCB 6	
DB 168	400 - 405
DB 171	445
DB 252	030 - 034
DB 253	040 - 044
4 Loose Rocks	058, 059, 459, 498
SCB 7	
Drive Tubes 14, 09 (lower, upper)	010, 011
SESC (blank)	013
DB 255	500 - 508
DB 273	510 - 515
DB 275	530 - 538
DB 278	545 - 548
DB 281	595 - 598
DB 282	612 - 630, 632 - 645 647 - 656, 658 - 689
DB 283	600 - 610

TABLE IV. - CONTENTS OF SAMPLE COLLECTION & RETURN CONTAINERS (Conc.)

	SAMPLE NUMBER (Last 3 digits)
SAMPLE RETURN BAG (BSLSS)	
1 Loose Rock	555

Abbreviations:

SCB	Sample Collection Bag
SRC	Sample Return Container (ALSRC or "rock box")
DB	Documented bag
SESC	Special environmental sample container
BSLSS	Buddy secondary life support system

SAMPLE PROCESSING

The sequence of processing rock samples is as follows:

1. Unpacking from the return container (documented bag or sample collection bag) with photographic record made of the configuration of the containers and samples in them.

2. Attempts are made to rematch any fragments which may have broken from rocks in transit.

3. Assignment of number, weighing and a photograph on the balance.

4. Dusting with a gentle jet of N_2 gas.

5. Orthogonal photography - 70 mm color views taken at 90° to one another. The rock is positioned on a rotatable photo stage on a stable face, usually with the longer axis right to left. An orientation cube, marked N_1, E_1, S_1, W_1, T_1 and B_1, is placed with N_1 facing the camera for the first photograph. The cube is then rotated synchronously with the rock for all other views. Four orthongonal views are made of rocks less than 12.5 grams and six of all larger rocks. For fragile rocks, where handling would tend to disaggregate them, inclined views are substituted for the T_1 and B_1 views.

6. No further processing is done until a set of prints of the orthogonal photography has been returned to the laboratory for reference and marked special features.

7. Rock description- The rocks are described through windows in the nitrogen processing cabinet with the aid of binocular microscopes outside of the cabinets.

8. Rock modeling - All coherent rocks weighing more than 50 grams have aluminum foil shells molded around them. These shells are transferred out of the lines and serve as molds for plaster casts. With the aid of the orthogonal photography, plaster casts are sculptured to the shape of the rocks. Plaster models of fragile rocks are made entirely from photographs. A rubber mold of the plaster cast serves for making the epoxy models that are used as a record of the original rock shape and for the planning and documentation of cutting and chipping operations.

9. Stereophotography - for all coherent rocks greater than 50 grams. The rock is positioned on the photographic stage with the orientation cube in conformity with the orthogonal photography orientations. Sixteen stereographic pairs at 45° increments are made with 8x10 inch black and white film, along with an additional set of six orthogonal photographs made with 8x10 inch color film.

10. Field geology experiment - Coherent rocks are placed on the photographic stage and illuminated with a collimated light. The rocks are maneuvered to reproduce the shadowing and appearance of rocks in lunar surface photographs in order to establish their presampling locations and orientations.

Soil samples are processed as follows:

1. The documented bags are opened and observations and photographs are made of the condition of the sample.

2. Any large rocks are removed.

3. One-quarter to one-third of the sample is scooped from the bag, placed in a preweighed container, weighed and stored as an unsieved reserve sample.

4. The remaining sample is sieved to produce the size fractions <1 mm, 1-2 mm, 2-4 mm, and 4-10 mm. Each fraction is weighed and numbered with its own five digit sample number (see the section on numbering conventions). Each coherent piece >10 mm is processed as a rock.

On the basis of information developed in the first part of the preliminary examination period, the Lunar Sample Analysis Planning Team (LSAPT), requests that further studies, such as thin section petrography and chemical analyses, be made on selected samples. The preliminary examination period is ended when these studies are completed and all the results are reported to LSAPT, at which time they plan the allocations of samples to Principal Investigators.

PROCESSING ENVIRONMENT

As no quarantine was required for the Apollo 15 mission, lunar sample processing lines were run for the first time at positive pressure (1-inch water). The gaseous nitrogen was monitored for H_2O, O_2, Ar, H_2, CH_4, CO_2 and CO. The moisture and oxygen content varied from cabinet to cabinet, the moisture was usually less than 25 ppm and oxygen less than 50 ppm in those cabinets in which the lunar samples were present. Readings were taken at least once an hour during the operational day. A more detailed report will be available at a later date.

The processing lines were carefully cleaned and inspected before the arrival of the lunar samples. None of the lines were sterilized. The cabinets are made of stainless steel, aluminum, teflon, viton gaskets, a small amount of polysulfide sealant, neoprene gloves and lexan or glass windows. All lubrication of screw threads (bolt top containers, laboratory jacks, etc.) is done sparingly with molybelenum disulfide. The lunar sample comes in contact with only the following materials: aluminum, stainless steel, and Teflon. Viton gaskets, used to seal certain containers, come in contact with some lunar fine material. The aluminum foil has shown flaking properties. All materials are cleaned to a specific procedure and certified. Detailed information on the cleaning process and results will be available at a later date. Samples are kept sealed in stainless steel containers or in heat-sealed Teflon bags when they are not being examined or processed.

CHEMICAL ANALYSES

X-ray fluorescence spectrometry was used for measuring the element abundances, with the exception of Na which was analyzed by atomic absorption analysis.

The major and minor elements, together with Zr and Sr, were determined in all samples using a fused glass disc prepared by fusing a 280 mg aliquot of the sample with a lanthanum-bearing lithium borate fusion mixture (Norrish and Hutton, 1969). Na was analyzed by atomic absorption analysis on a separate 20 mg aliquot of the sample.

Samples that were allocated in amounts in excess of 1 g were analyzed nondestructively for additional elements (Sr, Rb, Y, Th, Ni, Nb, Zr, Cr) using powdered samples and corrections made for matrix effects either by direct measurement of mass-absorption coefficients or, as in the case of Cr, calculating them from the major element data (Norrish and Chappell, 1967). Both sets of data for Zr and Rb are reported in table V as a guide to the accuracy of the glass disc method for these elements. Calibrations, for both techniques, were based on primary synthetic standards supplemented by previously analyzed U.S.G.S. and N.B.S. rock and mineral standards. An indication of the accuracy of these analyses can be gained by reference to the four control samples reported in table V. These samples were analyzed concurrently with the Apollo 15 samples.

References:

Norrish, K., and Chappell, B. W. (1967). X-ray fluorescence spectrography. In "Physical Methods in Determinative Mineralogy" (editor, J. Zussman), pp. 161-214, Academic Press.

Norrish, K., and Hutton, J. T. (1969). An accurate X-ray spectrographic method for the analysis of a wide range of geological samples. Geochim. Cosmochim. Acta. 33, 431-453.

TABLE V.- CHEMICAL ANALYSES

Sample		Basalt 15016	Fines <1 mm 15021	Basalt 15058	Gabbro 15076	Fines <1 mm 15101	Basalt 15256	Breccia 15265	Fines <1 mm 15271	Fines <1 mm 15301	Anorthosite 15415	Breccia 15418
Weight (g)		0.3	1.3	0.3	0.3	1.3	0.3	1.3	1.3	1.3	0.3	1.3
SiO_2	%	43.97	46.56	47.81	48.80	45.95	44.93	46.94	46.70	45.91	44.08	44.97
TiO_2	%	2.31	1.75	1.77	1.46	1.27	2.54	1.40	1.47	1.17	0.02	0.27
Al_2O_3	%	8.43	13.73	8.87	9.30	17.38	8.89	16.71	16.51	14.53	35.49	26.73
FeO	%	22.58	15.21	19.97	18.62	11.65	22.21	11.18	12.15	14.05	0.23	5.37
MnO	%	0.33	0.20	0.28	0.27	0.16	0.29	0.15	0.16	0.19	0.00	0.08
MgO	%	11.14	10.37	9.01	9.46	10.36	9.08	9.95	10.55	12.12	0.09	5.38
CaO	%	9.40	10.54	10.32	10.82	11.52	10.27	11.19	11.29	10.70	19.68	16.10
Na_2O	%	0.21	0.41	0.28	0.26	0.39	0.28	0.51	0.43	0.35	0.34	0.31
K_2O	%	0.03	0.20	0.03	0.03	0.17	0.03	0.25	0.21	0.16	<0.01	0.03
P_2O_5	%	0.07	0.18	0.08	0.03	0.13	0.06	0.25	0.21	0.15	0.01	0.03
S	%	0.07	0.06	0.07	0.03	0.06	0.08	0.08	0.08	0.04	0.00	0.03
Cr_2O_3	%	---	---	---	---	---	---	*0.33*	*0.38*	---	---	*0.11*
SUM		98.54	99.21	98.49	99.08	99.04	98.66	98.94	100.14	99.37	99.95	99.41
Sr	ppm	83	141	101	99	143	100	147	140	114	184	152
Sr	*ppm*	---	*135*	---	---	*142*	---	*150*	*144*	*113*	---	*149*
Zr	ppm	95	405	98	50	314	90	486	391	267	---	67
Zr	*ppm*	---	*410*	---	---	*313*	---	*469*	*382*	*260*	---	*64*
Nb	*ppm*	---	*24*	---	---	*19*	---	*29*	*23*	*17*	---	*3.7*
Rb	*ppm*	---	*6.1*	---	---	*4.9*	---	*7.8*	*5.6*	*3.8*	---	*0.8*
Th	*ppm*	---	*3.8*	---	---	*3.3*	---	*4.8*	*4.4*	*4.2*	---	*<2*
Ni	*ppm*	---	*288*	---	---	*260*	---	*235*	*269*	*268*	---	*39*
Y	*ppm*	---	*91*	---	---	*69*	---	*100*	*84*	*60*	---	*17*

Data in standard type were measured on glass disks.
Data in italics were measured on powders.

TABLE V.- CHEMICAL ANALYSES (Conc.)

										Control Sample Analyses			
Sample		Clod	Fines <1 mm		Fines <1 mm	Basalt	Basalt	Breccia	Fines <1 mm	Fines <1 mm	Fines <1 mm	Fines <1 mm	Basalt
Sample		15427	15471	15499	15501	15555	15556	15558	15601	10084	12070	14163	14310
Weight	(g)	1.3	1.3	0.3	1.3	1.3	0.3	1.3	1.3	1.3	1.3	1.3	1.3
SiO_2	%	45.18	46.10	47.62	46.21	44.24	45.11	46.31	45.05	41.86	45.91	47.17	47.19
TiO_2	%	1.14	1.58	1.81	1.81	2.26	2.76	1.89	1.98	7.56	2.81	1.79	1.24
Al_2O_3	%	15.06	12.91	9.27	12.20	8.48	9.43	12.40	10.20	13.55	12.50	17.22	20.14
FeO	%	13.72	16.24	20.26	16.72	22.47	22.25	16.54	19.79	15.94	16.40	10.35	8.38
MnO	%	0.18	0.21	0.28	0.22	0.29	0.29	0.22	0.26	0.21	0.22	0.14	0.11
MgO	%	12.14	11.11	8.94	10.80	11.19	7.73	10.51	10.89	7.82	10.00	9.37	7.87
CaO	%	11.11	10.42	10.40	10.25	9.45	10.83	10.18	9.87	12.08	10.43	10.95	12.29
Na_2O	%	0.36	0.32	0.29	0.37	0.24	0.26	0.42	0.29	0.40	0.41	0.66	0.63
K_2O	%	0.11	0.12	0.06	0.16	0.03	0.03	0.19	0.10	0.13	0.25	0.58	0.49
P_2O_5	%	0.09	0.12	0.08	0.17	0.06	0.08	0.21	0.11	0.11	0.27	0.46	0.34
S	%	0.06	0.07	0.07	0.07	0.05	0.08	0.09	0.06	0.15	0.08	0.08	0.02
Cr_2O_3	%	*0.40*	*0.47*	---	*0.49*	*0.70*	---	*0.51*	*0.56*	*0.32*	*0.43*	*0.22*	*0.18*
SUM		99.55	99.67	99.08	99.47	99.46	98.94	99.47	99.18	100.13	99.71	98.99	98.87
Sr	ppm	110	114	105	114	92	107	126	102	158	143	194	189
Sr	*ppm*	*111*	*124*	---	*122*	*95*	----	*123*	*109*	*169*	*136*	*186*	*193*
Zr	ppm	145	227	112	299	78	91	359	187	291	502	1040	847
Zr	*ppm*	*152*	*229*	---	*317*	*76*	---	*356*	*199*	*312*	*529*	*978*	*842*
Nb	*ppm*	*10*	*15*	---	*20*	*4.3*	---	*22*	*13*	*19*	*33*	*65*	*52*
Rb	*ppm*	*2.7*	*3.0*	---	*4.7*	*0.6*	---	*5.3*	*3.1*	*3.3*	*6.9*	*15*	*13*
Th	*ppm*	*<2*	*3.0*	---	*3.1*	*<2*	---	*3.6*	*<2*	*2.2*	*6.7*	*13*	*11*
Ni	*ppm*	*213*	*224*	---	*246*	*42*	---	*198*	*191*	*238*	*227*	*322*	*64*
Y	*ppm*	*39*	*54*	---	*72*	*23*	---	*78*	*47*	*105*	*110*	*213*	*174*

Data in standard type were measured on glass disks.
Data in italics were measured on powders.

The results of the analyses are presented in Table VI. The measurements of everything but the drill stems were made with the NaI (Tl) dual parameter low background system and stainless steel containers described previously (ref. 1 and 2). Fines were contained in aluminum right-circular cylinders that were enclosed in the stainless steel containers. The data acquisition followed the procedures developed for the studies of samples returned from the Apollo 11 and 12 sites (ref. 1 and 2).

The gamma spectra of the drill stems were measured in a smaller system developed for the purpose consisting of two NaI (Tl) crystals five inches in diameter and four inches thick facing each other in a vertical lead shield. The drill stems, sealed in several teflon bags, are placed horizontally between them and the parts not between the two crystals are masked off with lead masks. The shield is so constructed that any part of a drill stem may be examined without disturbing the rest of it. The output of these crystals are analyzed with a 4096 channel pulse height analyzer in the coincidence mode. The activities of the radionuclides were determined by the method of least squares and by a computer-assisted spectrum-stripping method. The standards used for data reduction were either right-circular cylinders, as described previously, or phantoms (replicas that contain known amounts of radioactivity) of samples returned from previous missions. The errors that are indicated in Table VI include the statistical errors, but most of the errors are caused by differences in thickness and shape between the samples and the standards.

REFERENCES

Anon: Preliminary Examination of Lunar Samples from Apollo 11, Science, Vol. 165, No. 3899, Sept. 19, 1969, pp. 1211-1227.

Anon: Preliminary Examination of Lunar Samples from Apollo 12, Science, Vol. 167, No. 3923, Mar. 6, 1970, pp. 1325-1339.

TABLE VI . - GAMMA RAY ANALYSIS OF LUNAR SAMPLES

SAMPLE NUMBER	WEIGHT (g)	K (Weight %)	Th ppm	U ppm	Al^{26} dpm/kg	Na^{22} dpm/kg	β^+ epm/kg	REMARKS
15001		0.19 ±0.03	3.7 ±1.0	1.1 ±0.3	<11	<10	<9	Drill stem (depth 234 - 235 cm)
15004		0.17 ±0.03	4.3 ±1.0	1.1 ±0.3	16 ±18	34 ±15	45 ±10	Drill stem (depth 106 - 117 cm)
15006		0.19 ±0.03	4.7 ±1.0	1.3 ±0.3	57 ±20	33 ±18	77 ±15	Drill stem (depth 11 - 21 cm)
15021	132.0	0.16 ±0.02	5.1 ±0.7	1.3 ±0.2	175 ±25	50 ±7		<1 mm fines
15085	471.3	0.041 ±0.005	0.51 ±0.10	0.13 ±0.03	71 ±15	33 ±10		Basalt
15086	172.1	0.14 ±0.03	3.2 ±0.5	0.76 ±0.11	39 ±15	40 ±15		Breccia
15206	92.0	0.45 ±0.06	11 ±2	3.0 ±0.6	38 ±15	45 ±10		Breccia
15211,2	104.2	0.15 ±0.03	3.8 ±0.8	0.96 ±0.20	130 ±20	57 ±9		<1 mm fines
15256	201.0	0.034 ±0.004	0.46 ±0.10	0.15 ±0.02	95 ±15	36 ±8		Basalt
15265	314.2	0.19 ±0.03	5.1 ±1.0	1.3 ±0.2	79 ±15	38 ±9		Breccia
15271,16	527.9	0.16 ±0.03	4.2 ±0.8	1.2 ±0.2	130 ±20	34 ±5		<1 mm fines
15301	557.2	0.12 ±0.02	3.2 ±0.5	0.88 ±0.15	104 ±20	40 ±10		<1 mm fines
15415	269.4	0.012 ±0.002	0.007 ±0.030	0.0024 ±0.007	115 ±15	36 ±5		Anorthosite
15418	1140.7	0.0086 ±0.0010	0.13 ±0.04	0.04 ±0.01	120 ±40	25 ±10		Breccia
15426,1	125.7	0.082 ±0.01	1.9 ±0.4	0.43 ±0.10	59 ±12	38 ±8		Breccia
15431	145.4	0.19 ±0.02	4.8 ±0.7	1.1 ±0.2	68 ±14	36 ±5		<1 mm fines
15455	881.1	0.090 ±0.020	1.9 ±0.4	0.50 ±0.10	65 ±20	39 ±15		Breccia
15466	118.0	0.15 ±0.03	3.5 ±0.7	0.93 ±0.20	84 ±15	40 ±9		Breccia
15558	1333.3	0.17 ±0.02	3.4 ±0.4	1.0 ±0.1	84 ±15	36 ±10		Breccia

APOLLO 15 TOTAL CARBON ANALYSIS

The results of the total carbon analyses are in table VII. The total carbon contents were determined using oxygen combustion followed by gas chromatographic detection of the carbon dioxide produced. Samples weighing approximately 200 milligrams were placed with iron chips and a copper accelerator in a preburned refractory crucible. The crucible was then heated to greater than 1600° C in an oxygen atmosphere with an induction furnace. The combustion products were carried by the oxygen through a dust filter to remove the metal oxides and through a manganese oxide trap to remove sulfur gases. Any carbon monoxide (CO) that was formed was converted to CO_2 in a heated catalyst tube. Moisture was removed by an anhydrone trap before the CO_2 was passed into a LECO ELC 12 Analyzer. The CO_2 was carried by the oxygen stream into a collection trap. After a fixed collection time, the trap was heated and the released CO_2 was carried by a helium carrier gas through a silica-gel column into a thermal conductivity detector. The imbalance in the bridge circuit containing the thermal conductivity cell was integrated and read directly on a digital voltmeter.

The system was calibrated using the National Bureau of Standards Steel Standard 55e. Samples of this standard, containing from 10 to 70 µg of carbon were analyzed under the same conditions as the lunar samples. In order to reduce the background, the crucibles were heated in air at 1000° C for at least 6 hours. Only crucibles heated in a single batch were utilized in a sequence of standards and samples. The precision of the method was evaluated by making replicate analyses on sample blanks. A typical standard deviation of a series of ten determinations was 2 µg of total carbon. The results for the standard samples were plotted on linear graph paper and the carbon content in the lunar samples read directly from the standard curve.

TABLE VII. - APOLLO 15 TOTAL CARBON ANALYSIS

SAMPLE NUMBER	TOTAL CARBON CONTENT (μgC/g)	DESCRIPTION
15021,4	160±10	Contingency sample < 1 mm fines
15031,15	130±10	< 1 mm fines, ALSEP trench bottom
15041,15	160±10	< 1 mm fines, ALSEP trench top
15058,4	27±5	Porphyritic basalt
15076,3	21±5	Gabbro
15101,2	130±10	< 1 mm fines, St. George comprehensive soil
15271,15	170±10	< 1 mm fines, Front surface soil
15298,2	168±10	Microbreccia
15301,1	160±10	< 1 mm fines, Spur Crater comprehensive soil
15418,5	10±8	Breccia with vitreous matrix
15459,1 (interior)	85±10	Breccia with large clasts
15459,1 (surface)	130±10	Breccia with large clasts
15471,2	90±10	< 1 mm fines, Dune Crater soil
15501,1	130±10	< 1 mm fines Scarp Crater soil
15556,5	16±5	Vesicular basalt
15558,2	110±10	Breccia
15601,3	95±10	< 1 mm fines, Rille comprehensive soil

NOBLE GAS ANALYSES

Table VIII contains the results of the analyses, which were performed by mass spectrometry following procedures similar to those used for Apollo 11 samples.

REFERENCE

Warner, J.; Apollo 12 Lunar Sample Information. NASA S-243, 1970, pp. 56 - 58.

TABLE VIII. - APOLLO 15 NOBLE GAS CONTENTS

SAMPLE	WEIGHT (Mg)	X 10^{-6} cm^3/g (at STP) ^3He	^4He	^{22}Ne	^{36}Ar	^{84}Kr	^{132}Xe	X10^{-9} cm^3/g (at STP) $\frac{^4He}{^3He}$	$\frac{^{20}Ne}{^{22}Ne}$	$\frac{^{22}Ne}{^{21}Ne}$	$\frac{^{36}Ar}{^{38}Ar}$	$\frac{^{40}Ar}{^{36}Ar}$
15301,1 Fines	6.14	18.8	45,800	110	222	79.9	16.2	2435	12.60 ±.02	28.03 ±.16	5.37 ±.01	1.83 ±.01
15021,4 Fines	23.71	30.9	74,600	114	222	87.2	11.7	2419	12.68 ±.04	27.91 ±.06	5.41 ±.02	.756 ±.005
15101,2 Fines	23.06	24.3	59,450	103	197	70.2	8.68	2444	12.71 ±.06	28.56 ±.29	5.42 ±.01	1.188 ±.003
15601,3 Fines	7.62	16.8	35,600	58.3	89.4	44.3	5.51	2123	12.61 ±.02	25.42 ±.14	5.32 ±.01	.971 ±.005
15427 Glass	25.14	1.17	1,706	7.54	3.57	1.63	.332	1458	11.65 ±.02	10.93 ±.10	4.587 ±.005	4.77 ±.02
15427 Clod	8.92	2.48	5,970	14.5	6.54	5.34	1.87	2413	12.72 ±.03	25.38 ±.12	5.11 ±.02	2.90 ±.02
15265,3 Breccia	7.67	13.2	27,200	45.9	103	48.8	4.98	2062	12.57 ±.01	24.50 ±.08	5.33 ±.02	1.91 ±.01
15298,3 Breccia	8.83	22.1	50,600	89.8	194	125	14.4	2289	12.59 ±.02	27.71 ±.13	5.36 ±.01	1.11 ±.01
15498,2 Breccia	18.93	5.70	15,670	11.1	87.2	22.4	3.27	2748	12.24 ±.05	21.00 ±.09	5.30 ±.02	1.92 ±.01
15558,3 Breccia	7.47	23.8	49,150	74.2	129	78.9	13.3	2064	12.50 ±.02	24.25 ±.12	5.31 ±.02	1.91 ±.01

All abundances are ±5-10% based on multiple standard gas analyses. Uncertainties in isotopic ratios represent one standard deviation of multiple measurements. Abundance blank corrections were typically about 1% and in no case greater than 5%. Ratios have not been blank corrected.

TABLE IX. - SOME TERMS USED FOR ROCK DESCRIPTIONS

CHARACTERISTIC	TERM	DEFINITION AND COMMENT
Cavities		Not to include merely surface-related features such as clast molds.
	vugs	
	vesicles	
	crystals	projecting or lining minerals
Coherence		
Intergranular:		Grain-to-grain coherence
	very friable	crumbles under touch
	friable	crumbles under manual pressure
	coherent	must be struck to disaggregate grains
	tough	breaks across grains rather than around them
Fracturing		Terms combined as needed for a full description.
	absent	
	few	
	numerous	
	nonpenetrative	
	penetrative	visible on opposing sides
Component		Igneous rocks, breccias, and fines as applicable.
	mafic silicate	all colored translucent minerals; mainly pyroxenes and olivines.
	plagioclase	light gray and white (if shocked)
	opaque	further defined by color and shape
	matrix	aphanitic material (under binocular microscope) $\lesssim 0.1$ mm
	lithic clasts	general term
	basalt clasts	see rock types for other specific lithic terms
	mineral clasts	general term; see igneous rock for specific mineral terms
	glass	
	agglutinates	
	fragments of glass	
	basalt/vesicular glass	example for a compound grain; use two lines on form for the color, etc.

TABLE IX. - SOME TERMS USED FOR ROCK DESCRIPTIONS (Conc.)

CHARACTERISTIC	TERM	DEFINITION AND COMMENT
Fabric		To include texture
	isotropic	
	laminated	
	inequigranular	
	porphyritic	
	seriate	
	microbreccia	<1 mm average clast size
	fine breccia	1 - 5 mm average clast size
	breccia	>5 mm average clast size
Surface		Specific faces may be referenced by the laboratory orientation cube face designation.
	irregular	
	granulated	
	smooth	
	hackly	generally a freshly broken surface
	glass covered (%)	e.g., glass 30% of E and 10% of T
	grooved	for slickenside-like surfaces
Variability		Any difference in any characteristic from one part to another, e.g., grain size, lithology, mineralogy.
Zap Pit	none	none seen in quick scan
	few	$<10/cm^2$
	many	$>10/cm^2$

SAMPLE DESCRIPTIONS

All hand specimen, binocular and petrographic microscope descriptions are contained in this section in general order of sample number. Thin section grain mount descriptions, however, are grouped by station and their descriptions are placed with the lowest sample number of the group. A summary of the lithologic groupings of rocks from each rake and associated soil sample is given before the individual descriptions, which start with 15105, 15305, and 15605.

All of the rock were examined through the windows of nitrogen atmosphere processing cabinets with the aid of binocular microscopes. Conventions used for the descriptions are given in table IX.

Somewhat different formats are used in the thin section descriptions of igneous rocks, breccias, and grain mounts. In the breccia descriptions the components are placed in four groups: lithic clasts, mineral clasts, glass clasts, and matrix (all material < 0.1 mm in grain size unless otherwise indicated). In igneous rocks the only distinction made between components is the usual one of phenocryst and groundmass for rocks with a bimodal grain size distribution.

In both breccias and basalts a distinction has been made between mare and non-mare types. Mare type basalt refers to basalts with high (~2:1) pyroxene to plagioclase ratios, zoned green to deep brown clinopyroxenes of coarse grain size. Non-mare type basalt refers to basalts with about 1:1 plagioclase to mafic silicate ratios, light tan pyroxene, and generally finer grain sizes. Mare type material also may be readily distinguished from non-mare type material on the basis of total opaque content. The abundance of opaques in mare basalts (Apollo 11, 12. Luna 16, and Apollo 15) is seldom less than 3%. The abundance of opaques in non-mare material is seldom, if ever, greater that 1% and is commonly much less. Table X lists the abbreviations used in the thin section descriptions.

TABLE X. - ABBREVIATIONS USED IN THIN SECTION DESCRIPTIONS

Abbreviation	Term
aggl	agglutinates
ang	angular
anorth	anorthosite
apa	apatite
aug	augite
brn	brown
cpx	clinopyroxene
crist	cristobalite
Cr-Spin	Chrome Spinel
devit	devitrified
Fe-Ni	Fe-Ni metal
fsp-pyrox	feldspathic pyroxenite
gab-an	gabbroic anorthosite
gl	glass
ilm	ilmenite
int bas	intersertal basalt
mask	maskelynite
meso	mesostasis, too fine grained for mineral identification by microscope
oliv	olivine
opaq	opaque
opx	orthopyroxene
pig	pigeonite
plag	plagioclase
pyrox	pyroxenite
pyroxf	pyroxferroite
pyx	pyroxene
sev	several
sph	spherical
subang	subangular
subrd	subrounded
trid	tridymite
troi	troilite
ulvo	ulvospinel
unident	unidentified
vitro	vitrophyre

ROCK TYPE: Breccia, glass-coated WEIGHT: 4770.2 g
COLOR: Glass is brownish black (5YR 2/1) DENSITY:
SHAPE: Blocky, angular DIMENSIONS: 25 x 15 x 13 cm
COHERENCE Intergranular: Friable on S, "tough breccia" exposed on T.
Fracturing: B has two nonpenetrative fractures; penetrative small scale fractures on breccia edges.

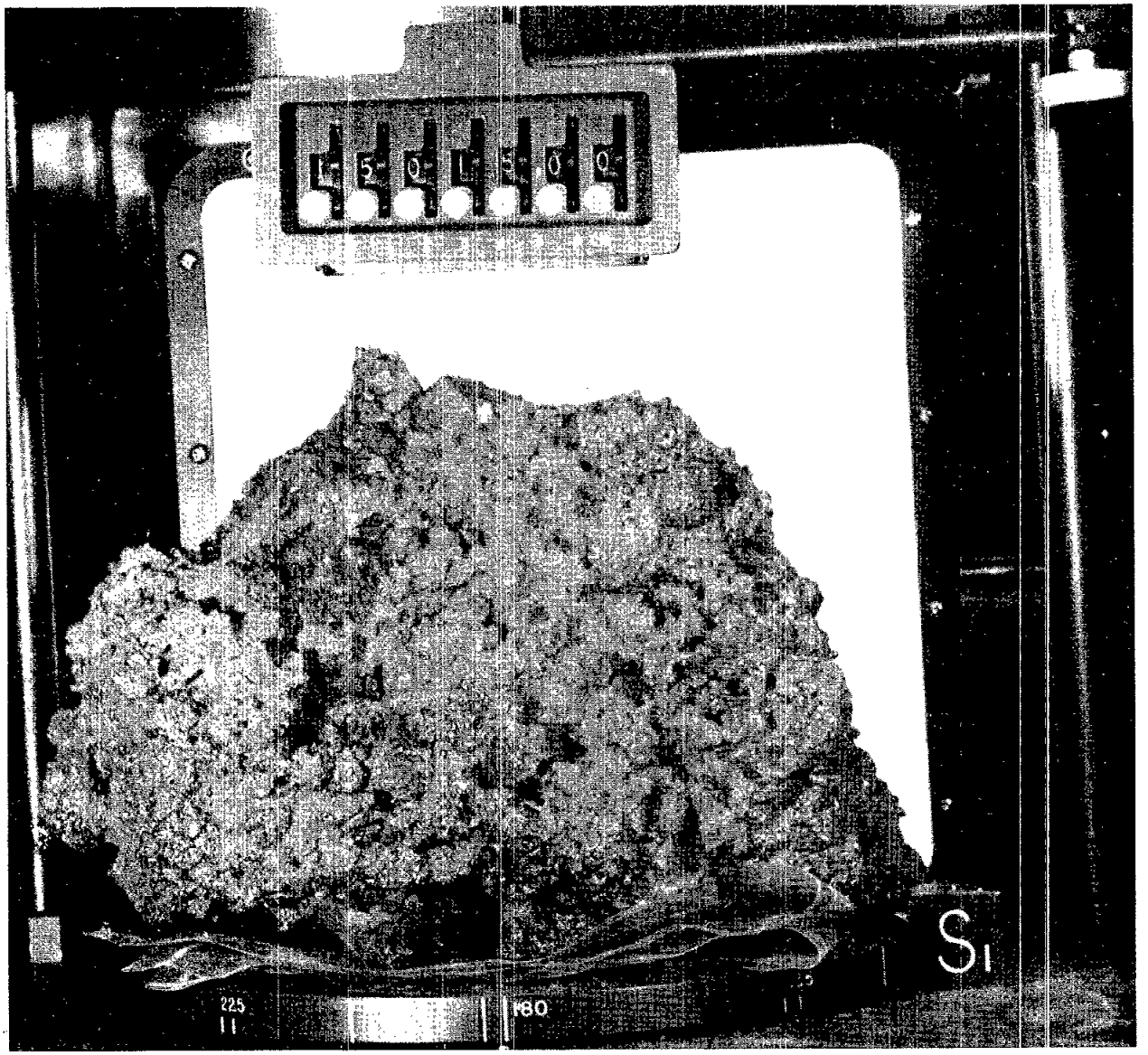
BINOCULAR DESCRIPTION BY: Horz & Wilshire DATE: 8/16/71

FABRIC: Inequigranular for the breccia, however 95% of observable surface is glass-coated.
VARIABILITY: Glass to breccia
SURFACE: 95% of rock is glass covered. B fracture surfaces with very thin (<0.2mm), spray-like glass coating. W has much dust cover, glass 10%, N has poor linear structure, T has breccia exposed, E glass surface, N breccia.
ZAP PITS: None on T, N and E. S many very small (1 mm) and no big ones. B fewer than on S.
CAVITIES: Breccia slit-like 5%; in glass round to irregular, 20-35% on B.
SPECIAL FEATURES: Zap spalls up to 5 mm wide (S) penetrate glass cover to breccia. No breccia clasts seen. Breccia exposed on T is hard, tough, has 2-3 mm light lithic clast. The surface relief of the glassy coating is highly variable, so is size and abundance of vesicles. The smooth glass coatings have no soil detritus etc. The hummocky parts contain probably a lot of soil, i.e. are a mixture of glass and soil and soil-clods. It is very likely that 90% of the rock-mass is tough, dense breccia. No detailed descriptions of the breccia are possible because 95% of the rock is glass covered.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Matrix	light gray	95		<0.1		1
Lithic clasts	white	5	angular		0.5-5	2
Mineral clasts	yellow-green	<1	angular	1		3
Glass clasts	brownish	<1	round	<1		
Lithic clast	whitish	5	angular	3		4
Lithic	yellow-green	<1	subangular	0.25		5
Lithic	white	<1	angular	3		

NOTES:

1. Appears to be fine grained crystalline material.
2. Sugary pyroxene and plagioclase.
3. Olivine.
4. Sugary texture very fine.
5. Foliation



Sample 15015 - S_1 S-71-44305

ROCK TYPE: Basalt, porphyritic, vesicular WEIGHT: 923.7 g
COLOR: Light brownish gray (5YR 6/1) DENSITY:
SHAPE: Blocky, subrounded DIMENSIONS: 13.5 x 10.5 x 6 cm
COHERENCE Intergranular: Tough
Fracturing: Few, nonpenetrative

BINOCULAR DESCRIPTION BY: Butler DATE: 8/31/71

FABRIC: Isotropic, porphyritic.
VARIABILITY: Vesicles are slightly larger on B (4 mm) than on T (3 mm).
SURFACE: The E half of the rock shows vesicles with soil coatings and therefore was probably buried.
ZAP PITS: None on all.
CAVITIES: 60%, most are vesicles, a few are vugs.
SPECIAL FEATURES: Vesicles are rounded, spheroidal, and most intersect other vesicles. Their walls are rough on a 0.05 mm scale, and show the lath shapes of the underlying plagioclase. The vesicle walls have very thin black glassy linings, which in some places is either not present or is so thin that the colors of underlying minerals are visible. Vugs compose about 2% of the cavities and show projecting brown pyroxene crystals.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	moderate yellow-green (5GY 7/4)	20	equant	0.2	0.1-0.4	1
Mafic silicate	light brown (5YR 5/6)	40	equant,	0.2	<0.1-1	2
Plagioclase	very light gray and vitreous to white	35	lath-like & tabular	0.2	0.1-1	3
Opaque	black & lustrous	2	platy & equant	0.05	<0.1-0.2	

NOTES:

1. Pyroxene
2. Pyroxene, some are phenocrysts.
3. Some are phenocrysts.

THIN SECTION DESCRIPTION BY: Warner & Brett DATE: 9/17/71

SECTION: 15016,5

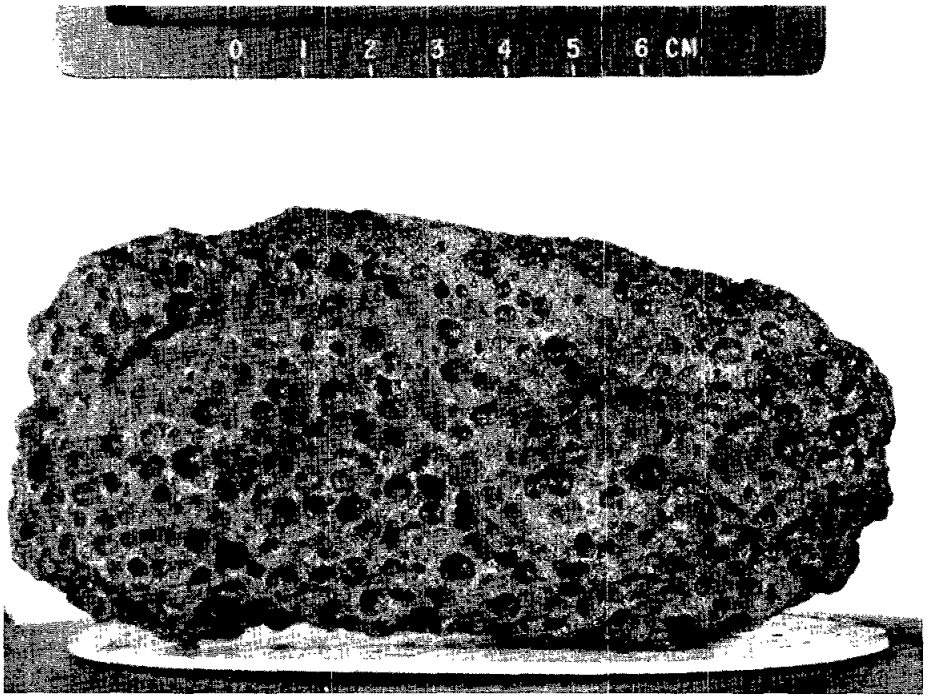
PHASE	PERCENT	SHAPE	SIZE (mm)
Cpx	65	equant to	0.3
		elongate	0.3x0.8
Plag	20	lath	0.5
Oliv	10	euhedral	0.6
Ilm	1	subhedral	<0.25
Ulvo	2	anhedral	<0.25
Cr Spin	0.5	subhedral	0.05
Troil	0.5	anhedral	0.05
Fe-Ni	0.5	anhedral	0.02
Unident	0.1	anhedral	0.1

COMMENTS:

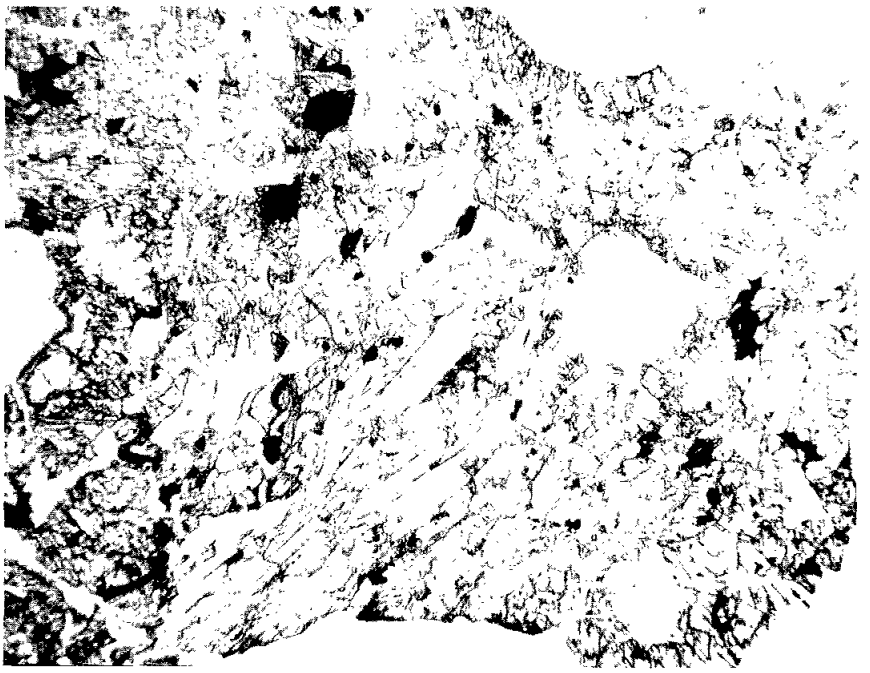
Subophitic to equigranular.
Plagioclase laths are locally aligned.
A few plumose intergrowths of plag and cpx.
Cpx zoned from pigeonite cores to augite rims but much less striking than in some rocks.
Plag is twinned and zoned. Some grains are very strongly zoned.
Ilm occurs as discrete grains and as lamellae and mutual boundary texture in ulvospinel.
Ulvo occurs as discrete grains and as very rare rims on chrome spinel.
Troil occurs about 50% as discrete grains and 50% contouring Fe-Ni blebs.
Fe-Ni almost exclusively in troilite.
Unident phase is dark gray opaque largely associated with edges of ulvospinel. Probably a Ti-Zr phase.
Some of the strongest zoning of plag yet observed in lunar rocks.

SUMARY:

Basalt



Sample 15016 - N1 S-71-45477



Photomicrograph Sample 15016,5
(width of field ≈4 mm)

ROCK TYPE: Glass spherical shell
COLOR: Dark gray, near (N3); faintly brownish.
SHAPE: Spherical shell, in 6 pieces
COHERENCE Intergranular:
Fracturing: Tough; varies with thickness of vesicle walls.

WEIGHT: 9.8 g
DENSITY:
DIMENSIONS: 3-4 cm diameter, thickness 1->3 mm.

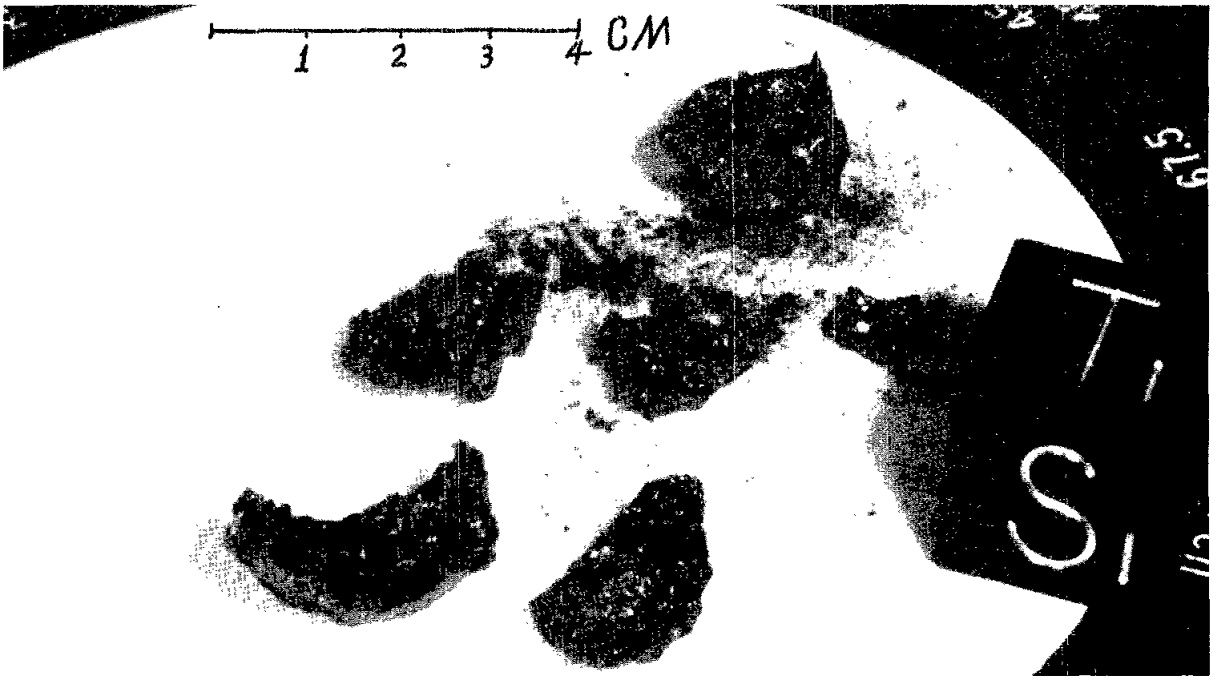
BINOCULAR DESCRIPTION BY: M.N. Bass DATE: 8/25/71

FABRIC: Isotropic
VARIABILITY: None in glass except rare small areas of fresh fracture with dull luster, possibly crystalline. Abundance of breccia fragments embedded in outer surface strongly variable.
SURFACE: Inside (concave) is vesicular, smooth to irregular. Outside (convex) is smooth where glassy; hackly to irregular where breccia fragments are embedded or vesicles are open; notably more soil in breccia-free areas.
ZAP PITS: None on inside; few on outside, but hard to identify unless spall zone well developed; light shattered haloes generally absent; vesicles broken open by zapping often have well developed spall zones, but typical central features of zap pits are absent.
CAVITIES: 50% secondary vesicles (as opposed to single large primary cavity within the sphere), 0.05-7 mm diameter, mostly spherical, larger ones irregular, many partly open-free edges invariably rounded.
SPECIAL FEATURES:

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass	dark gray	95				1
Inclusions in glass	gray and bluish gray	<0.1	round, equant irregular		0.5, 0.2	2
Breccia	medium gray or brownish gray	5	blocky, ovoid, prismatic, irregular	2-3	1-7	3
Metal	metallic gray	<0.1	irregular spots and patches; similar to splashed solder		to 0.2	4

NOTES:

1. Main component; hollow glass sphere with secondary vesicles in walls of sphere. Vesicles better developed on inner surface.
2. Unreacted inclusions completed surrounded by glass.
3. Breccia clasts imbedded in outer surface, white shocked plagioclase prominent in some, a brown phase (pyroxene? glass?) is uncommon.
4. Spots and patches similar to splashed solder. Thin surface films or blebs on interior surface only; edges well defined and raised due to surface tension.



Sample 15017 - S_1 S-71-43662

ROCK TYPE: Glass object
COLOR: Olive gray (5Y 4/1)
SHAPE: Round
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 5.7 g
DENSITY:
DIMENSIONS: 3 x 2 x 1.5 cm

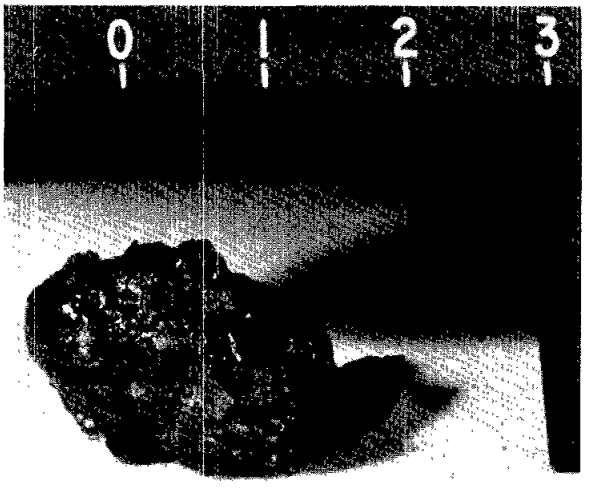
BINOCULAR DESCRIPTION BY: Morrison DATE: 8/20/71

FABRIC:
VARIABILITY: Smooth to vesicular, patchy irridescence.
SURFACE: Smooth, irregular
ZAP PITS: T and B few.
CAVITIES: Vesicles, 20% on T; 5% on B.
SPECIAL FEATURES: Possible metal on or in glass. Metallic or irridescent region bordered by gun-metal gray boundary which appears to be immiscible in the olive gray glass.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Lithic fragments stuck to glass			angular	1-2		1
Irridescent areas	vari-colored	10				2
Glass	olive gray (5Y 4/1)	90				

NOTES:

1. Basalt and microbreccia fragments.
2. Concentrated in triangle with 1 cm base; may be metal particles immersed in glass and metallic Fe on the glass.



Sample 15018 - N1 S-71-43629

ROCK TYPE: Glassy microbreccia
COLOR: Medium dark gray (N4, N5)
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 1.2 g
DENSITY:
DIMENSIONS: 1.5 x 1 x 1 cm

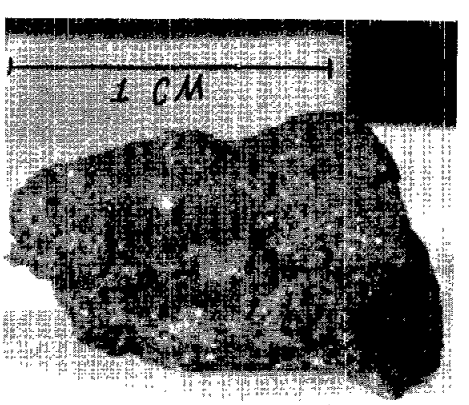
BINOCULAR DESCRIPTION BY: Wilshire & Morrison DATE: 8/23/71

FABRIC: Glassy, vesicular microbreccia
VARIABILITY: Grades from tight interiors to frothy edge. Irregular zone with faintly purplish cast, fewer clasts.
SURFACE: W smooth, irregular; others smooth regular.
ZAP PITS: Few on W, none on others.
CAVITIES: 3% vesicles up to 1 mm
SPECIAL FEATURES: Sugary texture of clasts; vesicles increase in size and number toward margin.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic mineral clast	Reddish brown	Trace	Subangular irregular	1.5		1
Lithic clasts	Light gray	15	Angular	0.1 - 1.0		2
Matrix	Vitreous	85		Seriate		3

NOTES:

1. Pyroxene with attached black vitreous mineral.
2. Small patches brown glass may be on rock, not in it. Light lithic fragments with sugary texture. Scarce plagioclase, cinnamon brown pyroxene aggregates some light brown sugary aggregates some reddish brown pyroxene clasts.
3. Finely crystalline in part, components not identified.



Sample 15019 - N_1 S-71-43664

SAMPLE TYPE: Soil, <1 mm fraction WEIGHT: 500.2 g
COLOR:
LOCATION: LM Site, the Contingency sample

THIN SECTION PETROGRAPHY BY: Heiken DATE: 9/18/71

TABLE OF COMPONENTS: (See below)
NOTES TO TABLE:

1. Fragments of pyroxene, feldspar, glass and rock (soil detritus) bonded by dark brown to black glass. Shapes range from rounded, fluidal (droplet-like agglutinates) to angular and broken.
2. Pale to dark brown, detritus-laden to detritus-free fragments. Some are devitrified.
3. Spheres and droplets, including both broken and unbroken ones. Some of droplets are clear; others contain soil particles. Some of the spheres are devitrified.
4. Shapes range from spherical to ovoid to teardrop-shaped. The glass is clear; with no detritus or phenocrysts present. Some droplets are partly devitrified.
5. Feldspar > glass groundmass > pyroxene.
6. Medium-grained pyroxene > feldspar > opaques. Some grains exhibit parallel orientation of pyroxenes and feldspars.
7. Mostly colorless grains, some pale purple-brown pigeonites.
8. Olivine, subhedral, colorless crystals.
9. Anhedral, broken crystals. Some contain small poikilitic pyroxene inclusions.
10. Angular, equant pyroxene and feldspars are set in a recrystallized matrix of small feldspar crystals.

		PERCENT OF GRAINS			
COMPONENT	COLOR	0.5-1.0mm	0.25-0.5mm	0.125-0.25mm	NOTE
Agglutinates	brown	66.6	54.0	64.4	1
Glass, angular	brown		2.5	1.0	2
Glass, droplets	brown		12.8	6.0	3
Glass, droplets	colorless		-	3.0	4
Basalt, hyalocrystalline			2.5	2.0	5
Basalt		33.3	7.7	2.0	6
Clinopyroxene				8.0	7
Olivine			12.8	2.0	8
Feldspar			-	1.0	9
Microbreccia			2.5	5.5	10
Number of grains counted		6	39	200	

ROCK TYPE: Breccia, fine
COLOR: Dark gray (N3)
SHAPE: Subrounded
COHERENCE Intergranular: Coherent
Fracturing: Few nonpenetrative

WEIGHT: 77.3 g
DENSITY:
DIMENSIONS: 5.5 x 3.5 x 3.5 cm

BINOCULAR DESCRIPTION BY: Reid & Lofgren DATE: 8/24/71

FABRIC: Isotropic
VARIABILITY:
SURFACE: T irregular smooth; B smooth but irregular (weathered).
ZAP PITS: Many on B (up to 3 mm); few on T.
CAVITIES: None
SPECIAL FEATURES: Well-formed glass lined zap pits up to 3 mm, and one large pit on S with a 5 mm diameter glass center. Striking contrast between B with many pits and T with few pits.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Igneous clasts	light gray	10	subangular	4	1-8	1
Breccias	light gray	3	subangular		up to 2	
Mineral fragments		10	subangular	<1		2
Glass	dark brown	1	subrounded	<1		3
Glass	black	<1		1		4
Matrix	medium dark gray	75		very fine grained		

NOTES:

1. Feldspar, pyroxene, olivine (gabbro clasts)
2. Feldspar, pyroxene, olivine.
3. Surface?
4. In zap pits on B, forming 2-3% of surface.

THIN SECTION DESCRIPTION BY: Morrison & Brett DATE: 9/19/71

SECTION: 15025,3

LITHIC CLASTS, 15% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Basalt 1	1 clast	ang	3x5	Basalt 1 is subophitic, 70% zoned pyx, 30% plag, 1-2% opaq. Typical Mare type. Grain size 0.25-0.5 mm. Contains ilm, ulvo, Fe-Ni, troil.
Basalt 2	1 clast	ang	1	
Basalt 3	1 clast	ang	1	
Granular	sev clasts		0.1-1	Basalt 2 is partially melted.
Breccia	sev clasts			Basalt 3 has ilm, troil, metal.
				Granular clast is mosaic of pyx and plag.
				Breccia clasts have glass rims in contact with matrix.

GLASS CLASTS, 10% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Pale tan to green	minor	ang to sph	1	Tan to green glass is not devitrified, in general.
Yellow				Yellow glass is devitrified, in general.
Brown	minor	sph		

MINERAL CLASTS, 30% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Plag	40	ang		Mineral clasts have sharp boundaries with matrix.
Opx	60	equant	0.25	Mineral clasts show varying degrees of shock.
Ilm	0.1	equant	0.25	Pyroxenes dominate feldspar 3:2.

MATRIX, 45% of rock

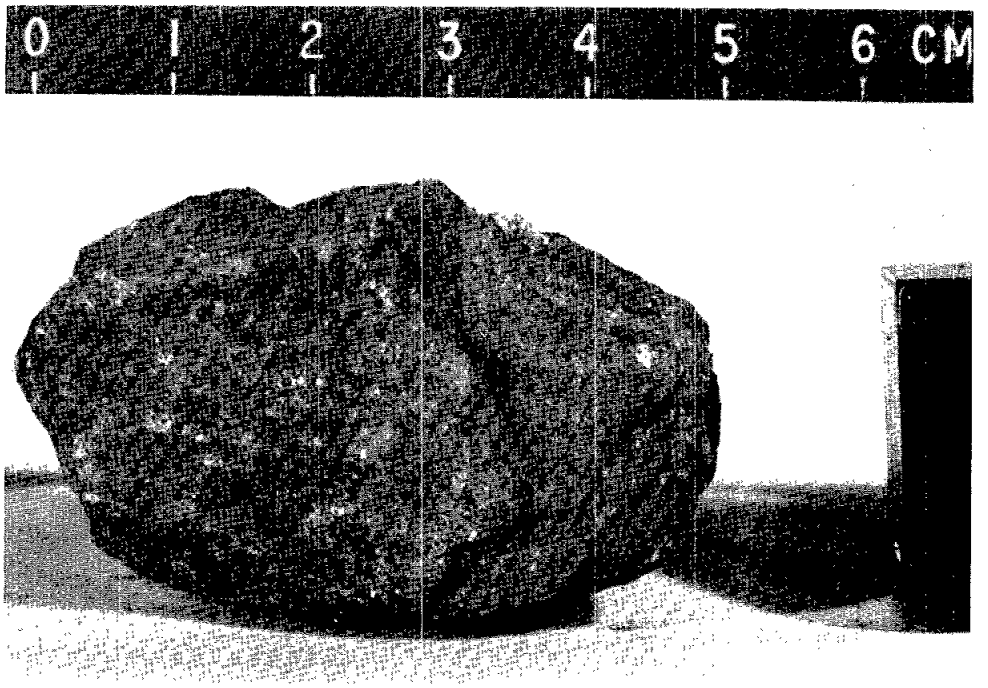
PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Brown glass & fine breccia debris	80			Fine debris consists of plag, pyx, and opaq.
Ilm	1			Matrix is not recrystallized.
				Some circular structures in matrix.

MATRIX, 45% of rock (Continued)

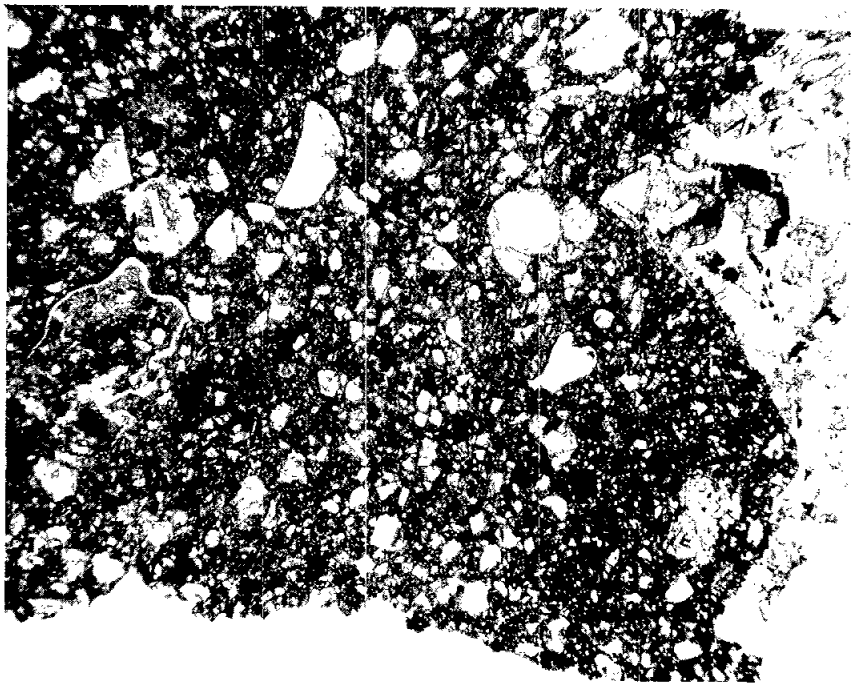
PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Ulvo	0.5			Opaques are angular to subrounded.
Troil	0.1			
Fe-Ni	0.1			

GENERAL COMMENTS: Opaque abundance in matrix is intermediate between Mare and non-Mare material. Two of the basalt clasts appear to be Mare material in opaque content and texture.

SUMMARY: Unrecrystallized soil (or welded) breccia of Apollo 11 type. Contains Mare-type basalt clasts.



Sample 15025 - N_1 S-71-43655



Photomicrograph Sample 15025,3
(width of field ≈4 mm)

ROCK TYPE: Microbreccia, glass-coated
COLOR: Medium dark gray (N4)
Glass: greenish-black (5GY 2/1)
SHAPE: Slabby, subangular
COHERENCE Intergranular: Friable
Fracturing: Few nonpenetrative (subparallel, curving).

WEIGHT: 1.1 g
DENSITY:
DIMENSIONS: 1.5 x 1.2 x 0.6 cm

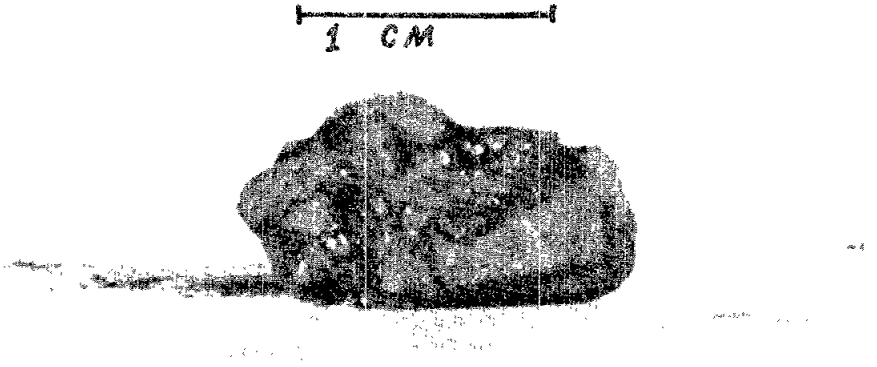
BINOCULAR DESCRIPTION BY: Lofgren & Reid DATE: 8/24/71

FABRIC: Microbreccia
VARIABILITY: Uniform glass coating on T with variable color.
SURFACE: Glass covers 95% of T. B is irregular, rounded.
ZAP PITS: Few on T, B.
CAVITIES: Vesicles compose 30% of glass.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass	green-black	10	coating			1
Plagioclase	white	4	subangular to rounded	<1		
Mafic silicates	brown	1	subangular	<1		2
Lithic clasts	gray	1	subrounded	<1		3
Glass clasts	brown-black	<1	angular	<1		4
Matrix	medium gray (N4)	85				5

NOTES:

1. Vesicular, contains rock fragments and patches of resinous black glass.
2. Mostly pyroxene.
3. Plagioclase-pyroxene rocks.
4. Glass.
5. Very fine grained.



Sample 15026 - N_1 S-71-43040

ROCK TYPE: Breccia
COLOR: Medium gray (N4, N5)
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 51.0 g
DENSITY:
DIMENSIONS: 5.5 x 3 x 2 cm

BINOCULAR DESCRIPTION BY: Wilshire & Morrison DATE: 8/20/71

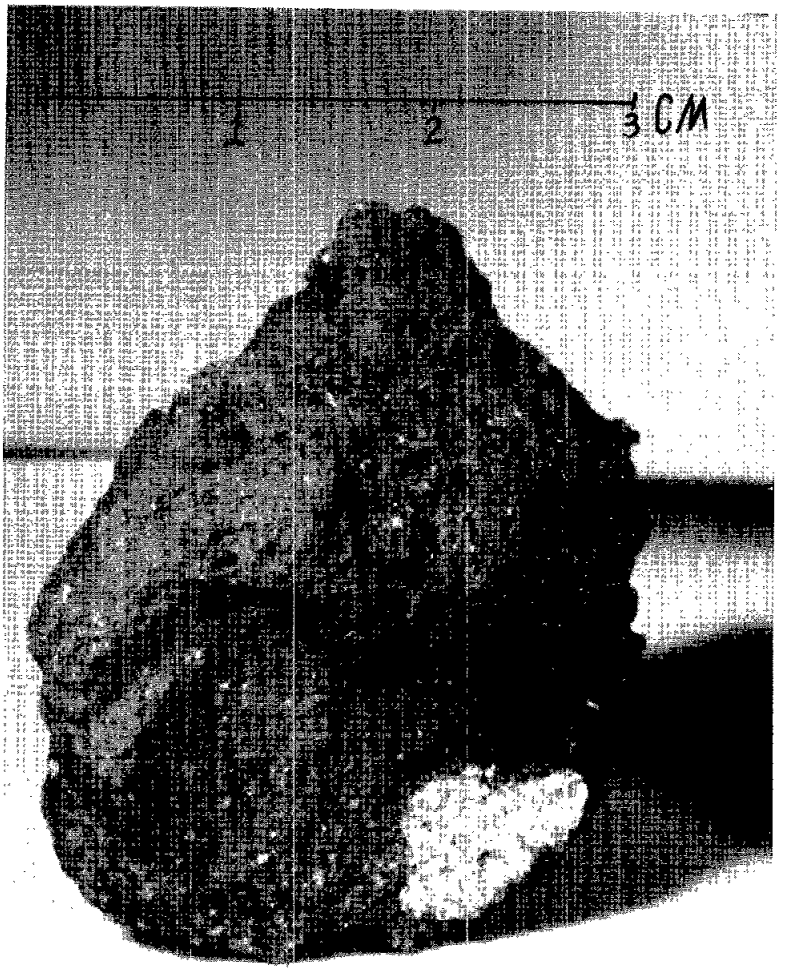
FABRIC:
VARIABILITY: Varies from vesicular glass phase to breccia phase with glassy appearing matrix.
SURFACE: 40% of the surface is very rough, rock surface is smooth and irregular. T and S have splash glass.
ZAP PITS: None on T and B; few on S, E, W; many on N.
CAVITIES: Glass: 40% vesicles up to 4 mm. There appears to be two generations indicated by size gap, one set 2 mm and larger, the other set 0.25 to 0.5 mm.
SPECIAL FEATURES: Boundary between glass and microbreccia is not distinct. Vesicular glass veinlets project into breccia, one is approximately 1 cm. Pale brown glass on breccia surface appears to penetrate breccia at low angle to surface and to be of different origin from vesicular glass.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (mm) Dom.	Range	NOTE
Clasts	chalky white	5% of glass phase	subrounded to angular	0.5	<1	1
Lithic clast #1 (see photo 71-43635)				10 x 7		2
Lithic clast	chalky white to greenish white		rounded to angular		<1	
Lithic clast	pale brownish		subrounded to angular		<1	3
Matrix	medium gray (N5)					

NOTES:

1. In vesicular glass.
2. Texture of this clast is intergranular to subophitic, plagioclase occurs as laths up to 1 mm and make up 50% of clast. Pyroxene of 0.3 mm average grain size fills spaces between and 45% of clast. Can see zoning even in groundmass pyroxene (yellow center with cinnamon brown rim) seemingly yellow mineral (pyroxene) has black inclusion. Opaques are both equant and plates, and make up 3% of clast. Dark gray phase of 0.2 to 0.5 mm makes up 1% of clast.

3. Very similar to "dunites" in Apollo 14 fragmental rocks. One seen with banding made by grain size difference. Abundant in one area of N face. May be crushed pyroxene.
4. Matrix contains 20% mineral and lithic clasts <1 mm in size. Rest of matrix is aphanitic and vitreous. It may be glassy. Mineral-lithic debris has seriate size distribution. Fine debris looks like mainly plagioclase and fine "dunite" (or crushed pyroxene) debris. Pyroxene and plagioclase are rarely together.



Sample 15027 - W_1 S-71-43636

ROCK TYPE: Glassy breccia
COLOR: Light gray (N7, N6)
SHAPE: Blocky, subangular with angular projections
WEIGHT: 59.4 g
DENSITY:
DIMENSIONS: 4.5 x 3.6 x 4 cm
COHERENCE Intergranular: Tough
Fracturing: Penetrative fractures filled with glass, a few nonpenetrative fractures.

BINOCULAR DESCRIPTION BY: Head, Phinney & Silver DATE: 8/23/71

FABRIC: Microbreccia, vesiculated glassy
VARIABILITY: Breccia grades into glass. Glass varies from zero to extensively vesiculated with vesicles reaching 3 mm.
SURFACE: Fresh side irregular hackly, smoother side (N) vesicular glassy in part; gradation from glassy vesicular surface into breccia matrix.
ZAP PITS: Few on S and T; none on others.
CAVITIES: Vesicles are variable in abundance, locally reaching 10% and averaging 5%. On N they are large ranging from 3 mm.
SPECIAL FEATURES: Small centers of fusion, very thin glass veinlets, and frothy glass are locally generated and are mobilized into and along old fractures welding the rock. Angular projections on surfaces, apparently are shattered fragments of breccia welded by glass. The vesiculated N surface is composed of glass which grades into breccia from which it appears to be derived.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Breccia matrix	reddish gray (N4) to dark gray (N3)	80		<0.1		
Glass clast	brown	1	irregular, round, platy, subparallel	0.3	1-0.2	1
Lithic clast	very light gray (N8)	3	subangular	0.6	1-0.1	
Lithic clast	medium light gray	1	subangular	0.6	1-0.1	2
Crystal or lithic clast	light olive brown (5Y 5/3)	Trace	subangular	0.1	0.1	3
Crystal or lithic clast	red brown (5YR 4/4)	1	subangular	1	0.5-5	4
Lithic clast	pale brown	Trace	subangular	0.5-1		5

NOTES:

1. Appear smeared out by flowage. May be local fusion.

NOTES:

2. Both white and gray phases.
3. Single phase, polycrystalline aggregates (pyroxene?).
4. Polycrystalline aggregates with vitreous luster (pyroxene?).
5. Basalt fragments, note cinnamon brown pyroxene; plagioclase laths, opaques.

THIN SECTION DESCRIPTION BY: Morrison & Brett DATE: 9/19/71

SECTION: 15028,2

SUMMARY: Glass-rich microbreccia with areas of melted and mobilized matrix. Abundance op opaques, Cpx/Plag proportions, and Basalt 1 all suggest a Mare origin.

LITHIC CLASTS, 1% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Basalt 1	1 clast	ang	2	Basalt 1 is subophitic and contains 80-85% pyx, 10-15% plag, 5% opaq.
Basalt 2	1 clast	ang	1	Basalt 2 is 40-50% brown interstitial glass, 30% plag, 25-30% cpx. The glass is unique in that it is free of opaques.
				Lithic clasts have sharp boundaries with matrix.

GLASS CLASTS, 25% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Pale green	95	sph	>0.25	One pale green sphere has core of microcrystalline plag. Otherwise it is homogeneous and undevitrified.
Deep brown		ang	0.25	Several of the angular glass clasts have plag cores.
				Of glass clasts $\geq$0.5 mm pale green type forms all but one.

MINERAL CLASTS, 15% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Cpx	70	ang	0.1-0.2	Cpx is augite with pale pink color. Plag displays shock effects: c-axis have planar lamellae.
Plag	20	ang	0.1-0.2	
Opx		ang	0.1-0.2	
Oliv		ang	0.1	
Spin?	1 grain	ang		
Ilm		subang	0.18	

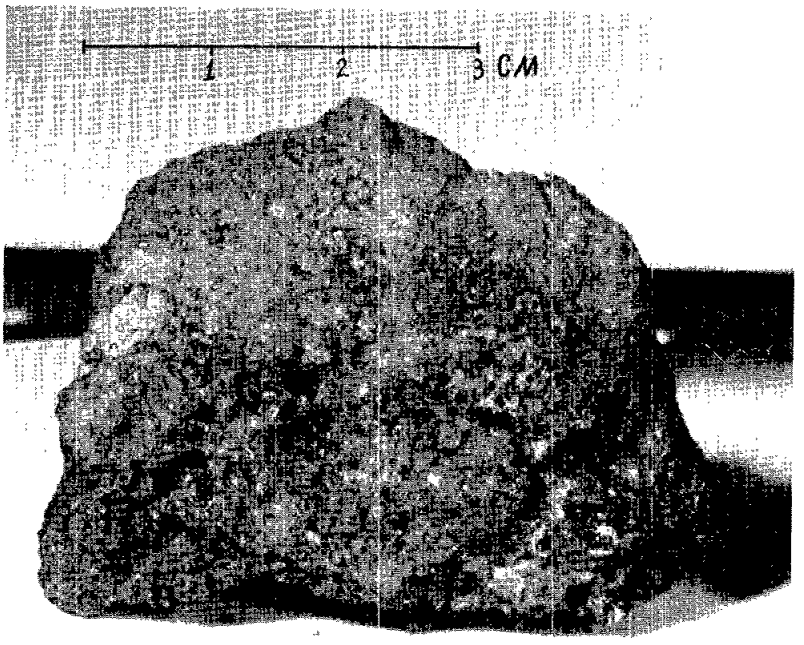
MATRIX, 60% of rock

PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Glass	40			Two types of matrix areas: one is brown glass and mineral fragments, other is vesiculated brown glass penetrating into rock. Boundary between the two types is sharp in some, transitional in others. Unident phase is opaque battleship gray with white internal reflection.
Frags	30		<0.1	
Ilm	2	subang to subrd	0.1	
Ulvo	0.5	subang to subrd	<0.05	
Troil	0.2	subang to subrd	<0.02	
Fe-Ni	0.1	subang to subrd	<0.02	
Unident	0.01	subang to subrd	<0.02	

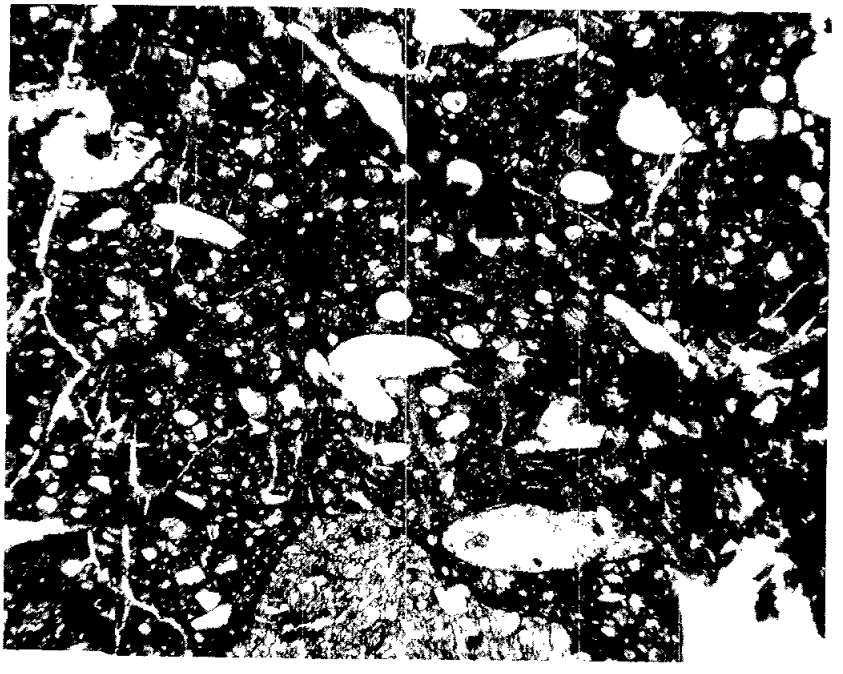
GENERAL COMMENTS: Veinlets of brown vesicular glass cross-cut other breccia components and transect preferred orientation. They appear to be vitrified and mobilized matrix material.

One glass sphere is faulted and displaced.

There may be a sorting of pale green glass clasts. They all seem to be in the 0.25 to 1 mm size range.



Sample 15028 -- N1 S-71-43639



Photomicrograph Sample 15028,2
(width of field ≈4 mm)

SAMPLE TYPE: Soil, < 1 mm fraction
COLOR:
WEIGHT: 15031 - 207.8 g
15041 - 269.6 g
LOCATION: ALSEP Site (Station 8)
15031 is from Doc. Bag 252, filled from the bottom of the Soil Mechanics Trench.
15041 is from Doc. Bag 253, filled from the top of the Soil Mechanics Trench.

THIN SECTION PETROGRAPHY BY: Heiken DATE: 9/18/71

TABLE OF COMPONENTS: Page 71
NOTES TO TABLE:

1. These consist of mineral detritus (orthopyroxene, clinopyroxene, feldspar), angular glass fragments, and lithic fragments set in light to very dark brown glass. Most exhibit at least one surface which is round, a fluidal surface.
2. Clear brown glass containing no detritus, phenocrysts, or microlites. There are a few exceptions; spheres with 10-50% mineral and lithic inclusions.
3. Clear, inclusion-free glass, also non-vesicular. Some are devitrified with pale brown spherulites made up of mostly pyroxenes.
4. These are clear and inclusion and vesicle-free.
5. The vesicular glass droplets contain abundant crystal detritus and schlieren.
6. Partly devitrified, crossed by sheaves of thin pyroxene and feldspar crystals.
7. The fragments are similar to the droplets, with abundant detrital fragments and schlieren and some grains are Y-shaped shards.
8. Most is clear, some devitrified.
9. Nearly submicrocrystalline pyroxene opaques feldspar.
10. Hyalocrystalline, euhedral clinopyroxene in a block glass groundmass.
11. Medium-grained, varies from crystalline to partly hyalocrystalline. Some grains exhibit a strong parallelism of feldspar and pyroxene grains.
12. Augite is colorless to pale purple (pleochroic, titanaugite?); some pale brown pigeonite.
13. Colorless, with stubby to elongate crystals.
14. Broken, anhedral crystals, An60 (?).
15. Polycrystalline feldspar fragments.
16. Broken and fractured feldspar and some pyroxene grains in a partly recrystallized matrix of fine-grained feldspar and glass.
17. Subhedral crystals.
18. Fine-grained, polycrystalline olivine rock with granular textures.

COMPONENT	NOTE	15031 PERCENT OF GRAINS 0.5-1.0mm	0.25-0.5mm	0.125-0.25mm	15041 PERCENT OF GRAINS 0.5-1.0mm	0.25-0.5mm	0.125-0.25mm
Agglutinates, brown	1	66.6	48.5	53.5	100.0	8.7	60.5
Glass droplets, pale brown	2	-	-	4.5	-	-	2.0
Glass droplets, pale green	3	-	2.2	3.5	-	-	3.0
Glass droplets, reddish-brown	4	-	-	Trace	-	-	Trace
Glass droplets, med. gray brown	5	-	-	1.0	-	-	-
Glass, angular, black	6	-	-	0.5	-	-	-
Glass, angular, grey-brown	7	-	6.5	1.0	-	6.2	3.0
Glass, angular, brown, clear	8	-	10.8	4.5	-	12.5	5.0
Basalt, fine, holocrystalline	9	-	-	Trace	-	-	-
Basalt, hyalocrystalline	10	-	4.4	5.0	-	12.5	1.5
Basalt, granular	11	16.6	4.4	1.5	-	6.2	3.5
Clinopyroxene	12	-	8.7	13.0	-	-	13.0
Orthopyroxene	13	-	2.2	3.5	-	-	1.5
Feldspar	14	-	2.2	3.5	-	6.2	2.5
Anorthosite	15	-	-	1.5	-	6.2	-
Microbreccia, recrystallized	16	16.6	2.2	2.0	-	12.5	1.5
Olivine	17	-	8.7	1.5	-	6.2	1.0
Ultramafic	18	-	-	-	-	6.2	1.0
Grains counted		6	46	200	2	16	200
Section number		13	12	11	13	12	11

ROCK TYPE: Porphyritic basalt
COLOR: Olive gray (near 5Y 4/1)
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: Numerous, nonpenetrative on S; few, nonpenetrative on E, absent on others.

WEIGHT: 2672.5 g
DENSITY:
DIMENSIONS: 10 x 12 x 16 cm

BINOCULAR DESCRIPTION BY: Bass DATE: 8/27/71

FABRIC: Diabasic, porphyritic
VARIABILITY: Abundance of vugs and phenocrysts
SURFACE: Granulated, irregular in vuggy areas, generally 80% soil covered (90% on N, 40% on B). Shocked plagioclase (white) over much of E, N, B.
ZAP PITS: Few on E, W, B; none on N, S, T.
CAVITIES: Vugs average 5% of rock, locally 10% on S, 50% on E, <5% on others.
SPECIAL FEATURES: Crystals in vugs are mainly plagioclase and brown pyroxene, and uncommonly a yellow-green mafic silicate! Where the vugs are abundant, the rock is locally diktytaxitic.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	colorless, white	50	laths or plates	1x0.2	0.5-2	1
Mafic silicate	yellow green	10	equant	1	1-1.5	2
Mafic silicate	yellow-green, medium to dark brown rims	2	prismatic	1x10	1-15	3
Mafic silicate	medium to dark brown	30	equant	0.5	0.2-0.8	4
Opaque	black metallic	3		0.3	0.2-1	5
Mafic	yellow, colorless	Trace	equant	0.5		6

NOTES:

1. Random orientation; phenocrysts are uncommon and are present only on faces with few vugs (e.g. B).
2. Often too large relative to plagioclase to the intergranular; brown rims uncommon, very thin; probably pyroxene.
3. Pyroxene phenocrysts, most abundant near vuggy areas; 5% on vuggy faces, 1% on others.
4. Intergranular pyroxene
5. Intergranular
6. 1 grain on S, olivine?

THIN SECTION DESCRIPTION BY: Warner & Brett DATE: 9/16/71

SECTION: 15058,14

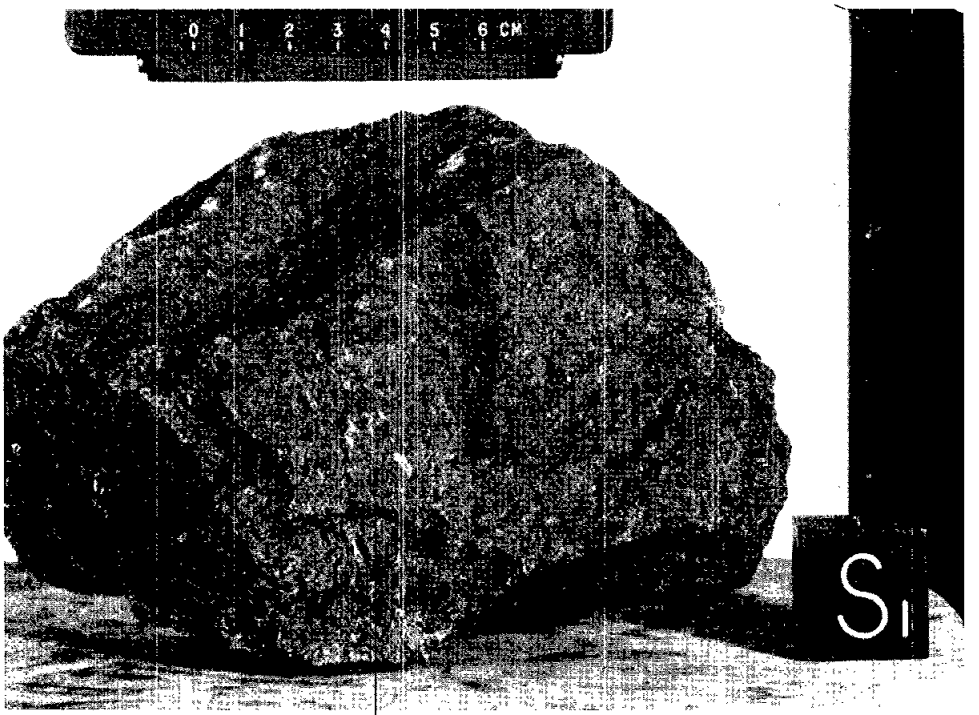
PHASE	PERCENT	SHAPE	SIZE (mm)
(Phenocrysts)			
Cpx	56	prisms	3x1.5x1.5
(Groundmass)			
Plag	24	laths	0.2x2 0.4x1
Cpx	15	anhedral	0.3
Ilm	1-2	subhedral	1.0
Ulvo	1	anhedral	0.4
Crist	1	anhedral	0.3
Meso	1		
Oliv	Trace	euhedral	1.0
Troil	<0.5	anhedral	0.25
Fe-Ni	<0.1	anhedral	0.1
Unident	<0.05	anhedral	0.1

COMMENTS:

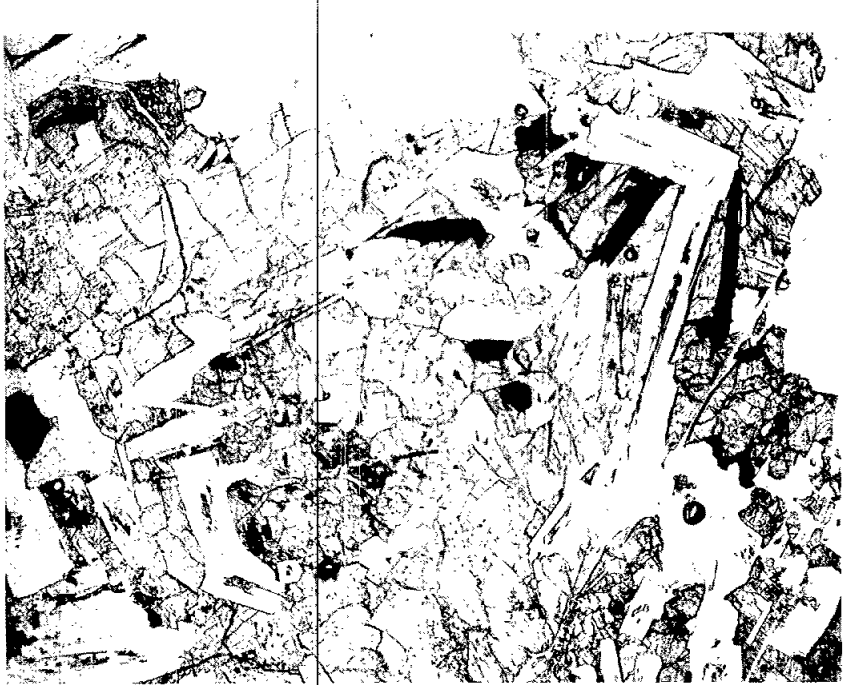
Porphyritic with subophitic matrix.
Cpx phenocrysts are zoned from pigeonite cores to augite rims.
Plag is highly zoned and contains elongate pyroxene cores along axes.
Cpx of matrix is of two types: one consists of small crystals with little zoning; the other of acicular crystals intergrown with the 0.2 x 2 mm plag laths.
Ilm occurs as laths and irregular blocky grains associated with interstitial cristobalite. Rarely as laths in ulvospinel.
Ulvo exists as blocky grains.
Crist occurs as irregular interstitial patches.
Meso contains fine needles of unknown composition.
Troil contains Fe blebs.
Fe-Ni occurs as discrete grains and inclusions in Troil.
Unident phase in opaque dark gray with low reflectivity and occurs with, and in, ilm and ulvo.

SUMMARY:

Porphyritic clinopyroxene basalt.



Sample 15058 - S_1 S-71-44202



Photomicrograph Sample 15058,14
(width of field ≈4 mm)

ROCK TYPE: Glass-coated breccia
COLOR: Breccia: medium dark gray (N4)
Glass: grayish black (N2)
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: Few nonpenetrative on B; many nonpenetrative on T in exposed breccia area.

WEIGHT: 1149.2 g
DENSITY:
DIMENSIONS: 15 x 10 x 7 cm

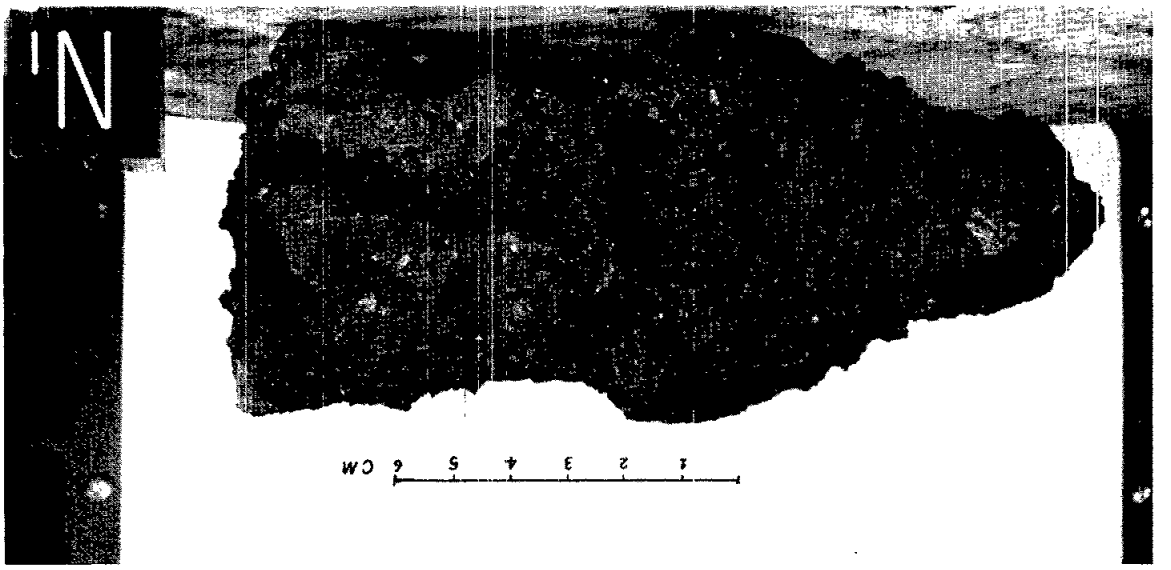
BINOCULAR DESCRIPTION BY: Phinney DATE: 8/27/71

FABRIC: Breccia
VARIABILITY: More dust adheres to B side than to other sides.
SURFACE: A coating of glass, <1 mm thick, covers most of rock. 25% of B is exposed breccia.
ZAP PITS: None
CAVITIES: Vesicles up to 4 mm over entire glass surface, none in breccia.
SPECIAL FEATURES: Exposed breccia areas were never covered with glass. Glass was spattered onto these areas at the edges of the breccia-glass contacts. Also a bluish-gray halo occurs on breccia for about 4 to 5 mm from edge of glass in places on B and W.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Matrix	gray	55			<0.1	
Lithic clasts	white	30	subangular to sub-rounded	0.4	0.1-4	1
Lithic clasts	light green to yellowish green	10	subangular to sub-rounded	0.4	0.1-1	2
Lithic clasts	light gray	2	subangular to sub-rounded	0.4	0.1-2	3

NOTES:

1. 90% white, probably plagioclase, remainder is mafic silicates. A few clasts are coarse-grained and contain 1 mm grains of plagioclase plus green and brown minerals.
2. Some are granulated around margins. May be crushed glass or silicate mineral.
3. Finely crystalline with two components, one light gray and one more brownish.



Sample 15059 - N_1 S-71-44212

ROCK TYPE: Gabbro WEIGHT: 1475.5 g
COLOR: Brownish gray (5YR 4/1) DENSITY:
SHAPE: Blocky, subrounded DIMENSIONS: 8 x 10 x 15 cm
COHERENCE Intergranular: Tough on fresh surfaces, friable on rounded surface.
Fracturing: Numerous and penetrative fractures. Two sets orthogonal, set parallel to B is dominant. One set is oblique to others.

BINOCULAR DESCRIPTION BY: Morrison & Silver DATE: 8/19/71

FABRIC: Inequigranular
VARIABILITY: Two distinct domains; predominant one is felsic with mafic: felsic ratio approximately 1:1; less abundant one has mafics 3:1 to 5:1 over plagioclase. Boundaries are generally diffuse between two domains.
SURFACE: Others smooth and rounded, S and W smooth, rounded. N irregular recessive; B hackly fresh.
ZAP PITS: B none, others few.
CAVITIES: 3% scattered, 3-4mm, with prismatic crystals, localized with pyroxene concentrations.
SPECIAL FEATURES: Fractures appear to be associated with possible pyroxene concentrations and vug development. On N an older fracture has crystals to 3.3 cm long which may have developed on the surface rather than under T.

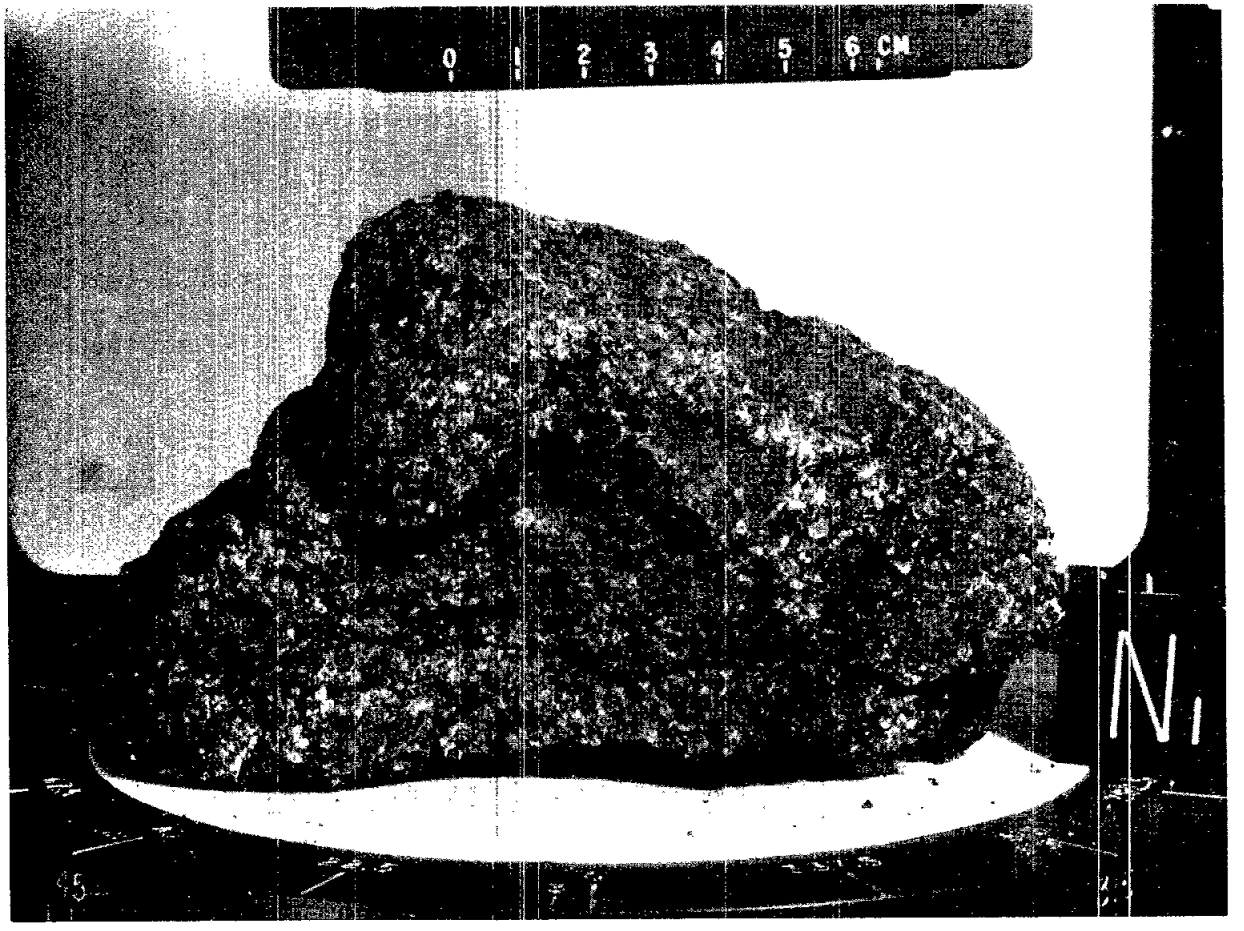
COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	white to light gray	35	anhedral to subhedral	2.5	0.5-1.5	1
Opaques	black	1	anhedral	0.1	0.05-0.25	2
Silica mineral	colorless	1	anhedral		0.2-0.5	3
Zoned pyroxenes		60		3.5	0.2-1.5	4
Rims (root-beer)	very dark red (5R 2/6) to dusty red (5R 3/4), outside blackish red (5B 2/2)		euhedral to subhedral prismatic			5
Cores (yellow-green)	pale greenish yellow (10Y 8/2) to moderate greenish yellow (10Y 7/4)		euhedral			

NOTES:

1. Some well defined plates, other anhedral.

NOTES:

2. Occasional in plagioclase and pyroxene; also ilmenite plates in some vugs.
3. Possibility.
4. Generally green core is about 1/3 of total pyroxene. One crystal has 50% radius yellow-green core with pale brown 10% inner core.
5. Boundaries between zones are moderately sharp. Several crystal cross sections have a colorless inner zone suggesting a distinct inner core phase.



Sample 15065 - N_1 S-71-42924

ROCK TYPE: Gabbro WEIGHT: 809.3 g
COLOR: Light olive gray (5Y 6/1) DENSITY:
SHAPE: Blocky, subrounded (corners rounded) DIMENSIONS: 8 x 7 x 6 cm
COHERENCE Intergranular: Tough
Fracturing: One penetrative fracture perpendicular to S.

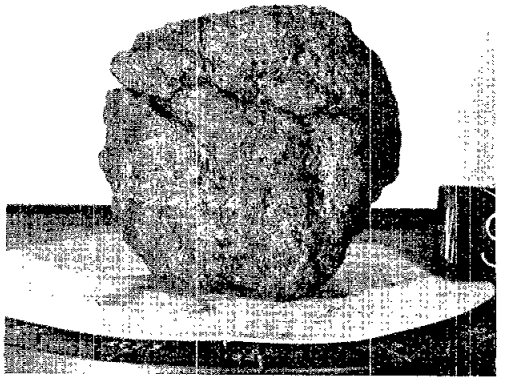
BINOCULAR DESCRIPTION BY: Morrison DATE: 8/17/71

FABRIC: Inequigranular, possible weak orientation of plagioclase.
VARIABILITY: None
SURFACE: S smooth and irregular, E has some splash glass (<1%).
ZAP PITS: None on N and W (dusty); few on T, S, E and B (dusty).
CAVITIES: Vugs - 5%, projecting plagioclase and pyroxene.
SPECIAL FEATURES: May be boundary between zapped and unzapped surfaces across T, unzapped on right. Plagioclase is ground up and white on N, possibly a sheared surface.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTES
Plagioclase	white to translucent	50	laths, long & thin	5	<1-9	1
Mafic silicate	cinnamon brown (10R 3/4)	35	prismatic to equant	<1	<0.5-2	
Mafic silicate	yellow-green (5 GY 7/4)	10	equant, anhedral	<0.5		2
Metallic	black	1	equant	<0.5		

NOTES:

1. Possibly two size groups.
2. Probably olivine although some may be pigeonite. Possibly some mantling by pyroxene. There appears to be rare olivine laths to 8 mm.



Sample 15075 - S1 S-71-43096

ROCK TYPE: Gabbro
COLOR: Light olive gray (5Y 6/1)
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: Penetrative and nonpenetrative, planar.

WEIGHT: 400.5 g
DENSITY:
DIMENSIONS: 9 x 6 x 5 cm

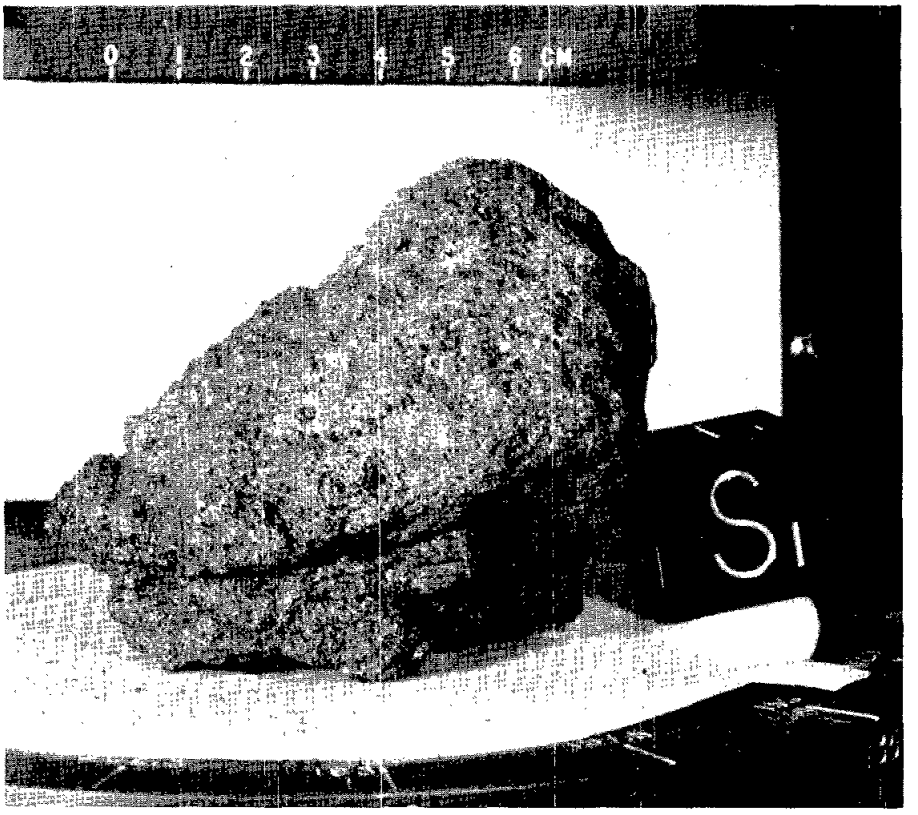
BINOCULAR DESCRIPTION BY: Wilshire DATE: 8/17/71

FABRIC: Possibly subophitic microporphyritic inequigranular, local flow alignment of plagioclase.
VARIABILITY: Vugs are irregularly distributed.
SURFACE: Slickensides, W, angular, irregular; T is dusty and not rounded.
ZAP PITS: None on T, N and W; few on S, B; none on E, but it is dusty.
CAVITIES: Vugs (5%) with projecting plagioclase crystals.
SPECIAL FEATURES: Some of long plagioclase crossing vuggy areas are bent and broken; brown mafic silicate (pyroxene) rimming green mafic silicate (olivine). No soil line found on S face.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicates	moderate yellowish green (5GY 7/4)	10	subhedral prisms	2	0.5-6	1
Plagioclase	white to translucent	50	euhedral laths and/ or plates LW ratio 10:1	2	0.2-6	2
Mafic silicate	honey brown to rich red brown	38		0.5		
Opaques		2	plates	0.5	up to 1	3

NOTES:

1. Olivine? Good parting parallel to long dimension. Pyroxene rims around olivine. One olivine is 7 x 11 mm, second is 12 mm long. Prismatic olivine may be pigeonite.
2. Plagioclase has small equant black inclusions. A closer look says seriate size distribution of plagioclase.
3. Some from these plates (ilmenite?) penetrating pyroxene.



Sample 15076 - S_1 S-71-42959

THIN SECTION DESCRIPTION BY: Morrison & Brett DATE: 9/18/71

SECTION: 15076,12

PHASE	PERCENT	SHAPE	SIZE (mm)
Cpx	55	prisms	3-4
Plag	45	laths	2-3
Trid	2	prisms	up to 2
Ilm	2	subhedral	0.5
Ulvo	1	subhedral	0.5
Cr spin	<0.1	subhedral	0.2
Troil	<0.1	anhedral	0.2
Fe-Ni	<0.05	anhedral	0.1
Unident		anhedral	0.2

COMMENTS:

Subophitic.
Cpx zoned from pigeonite cores to augite rims. Cpx may be phenocrysts.
Plagioclase is zoned and contains elongate cores of pyroxene.
Trid is usually well developed prisms associated with ilmenite.
Ilm occurs largely as laths and oriented inclusions within ulvo.
Ulvo exists as blocky grains.
Cr Spin are rare discrete grains.
Fe-Ni occurs as discrete grains and blebs in troil.
There are two unident opaque phases: one is purplish dark gray and occurs with and on edges of ilm and ulvo; the other is battleship gray, translucent and occurs as rims on meso glass within ulvo.
"Crackling" of opaque grains is indicative of weak shock.

SUMMARY:

Clinopyroxene basalt (maybe porphyritic).

Photomicrograph Sample 15076,12
(width of field ≈4 mm)

15085

ROCK TYPE: Basalt
COLOR: Light brownish gray (less brown than 5YR 6/1)
SHAPE: Blocky, subrounded
COHERENCE Intergranular: Tough, coherent
Fracturing: Few penetrative. One major irregular joint branching into irregular fractures.

WEIGHT: 471.3 g
DENSITY:
DIMENSIONS: 8.5 x 8 x 5 cm

BINOCULAR DESCRIPTION BY: Ridley & Bass DATE: 8/20/71

FABRIC: Intergranular, diabasic
VARIABILITY: N surface is much coarser and lighter colored.
SURFACE: Granular
ZAP PITS: None, glass coating on one pyroxene grain not clearly a zap pit.
CAVITIES: 2% equant vugs. Pyroxene and plagioclase project into vugs.
SPECIAL FEATURES: In coarse patches local average grain size approaches 1 cm. Pale green pyroxene is commonly mantled by brown pyroxene.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	medium to dark brown	30	anhedral	1.5	1-10	1
Mafic silicate	yellow green	10-15	anhedral	2	1-3.5	2
Plagioclase	colorless white-gray	55-60	lath tabular	2.5	1-10	3
Opaques		3				

NOTES:

1. Pyroxene, intergranular. Dominant size is 5 mm on N face.
2. Olivine or possibly green pyroxene. Contacts with plagioclase are common on N, and includes rare opaque grains.
3. Random orientation. On N face seriate grain size, the dominant size is 5 mm.

THIN SECTION DESCRIPTION BY: Wilshire & Brett DATE: 9/17/71

SECTION: 15085,2
SUMMARY: Coarse-grained clinopyroxene (may be porphyritic basalt.

PHASE	PERCENT	SHAPE	SIZE (mm)
Cpx	66	prismatic	0.3-9
Plag	22	anhedral	0.5-2
Trid	4	prisms	0.6-2.5
Pyroxf	2	equant	2.3
Ilm	1.5	subhedral laths	<0.7
Ulvo	1.5	subhedral	<0.4
Fe-Ni	<0.1	blebs	<0.04
Troil	<0.1	anhedral	<0.05
Cr spin	<0.1	anhedral	<0.04
Unident	<0.1	anhedral	<0.03

COMMENTS:

Cpx is zoned from pigeonite cores ($2V=\pm5^{o}$) to augite rims ($2V$-45-50^{o}). Pigeonite has simple twins and small equant opaque inclusions. Augite rims have many small very irregular inclusions. Some Cpx may be considered as phenocrysts.

Plag is very clean. Some grains are slightly zoned.

Trid prisms are intergrown with ilm and pyroxene.

Ulvo occurs as blocky crystals and anhedral masses rarely containing ilm in mutual boundary texture.

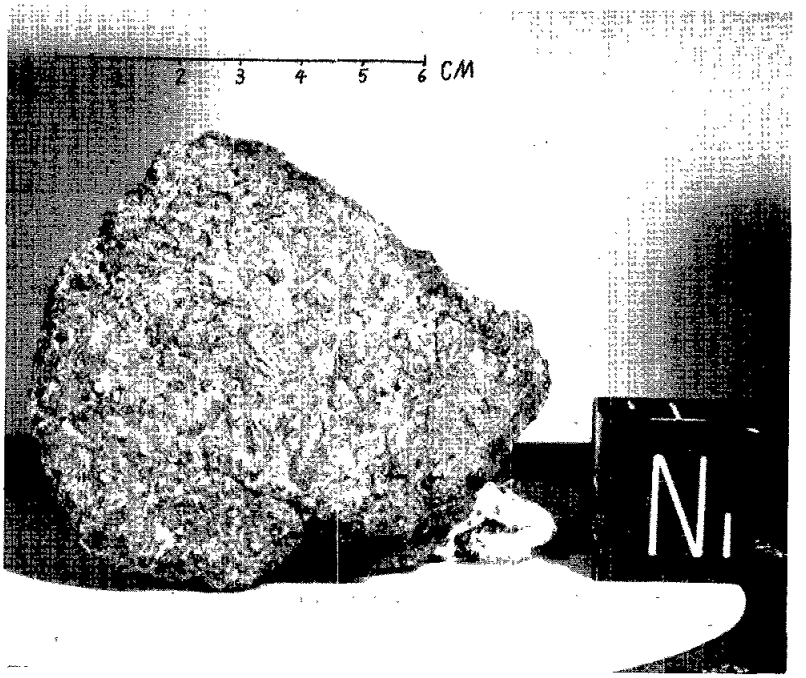
Fe-Ni as discrete blebs and inclusions of irreg shape in troil.

Cr-spin as rare cores in ulvo.

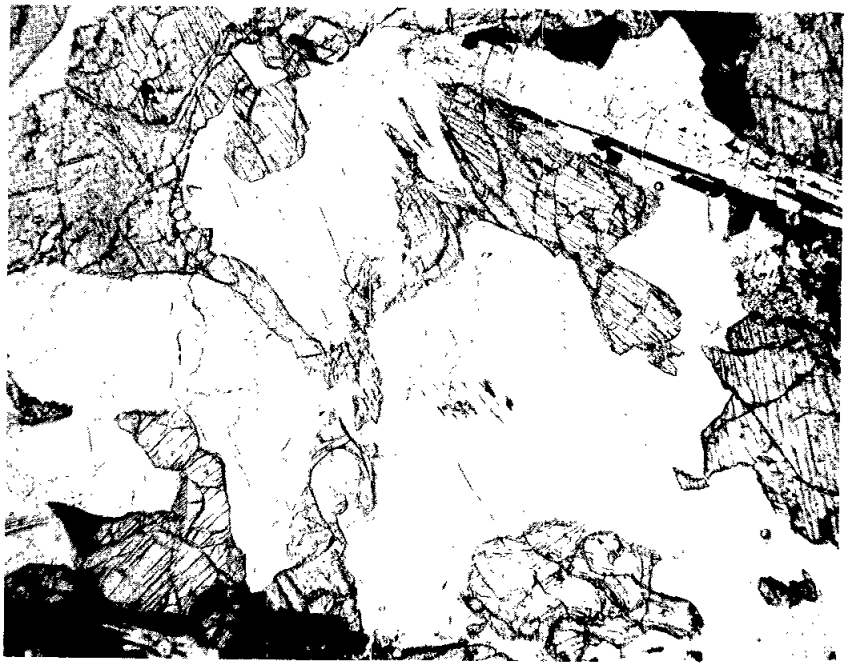
Unident phase is very rare opaque, battleship gray, and associated with ilm.

A small percent of cavities have linings of projecting crystals of trid and ilm.

A finely divided gray material with a dull luster appears to replace cpx near cavities. Some of this extends into cavities. It is separated from ilmenite by thin rims of a highly biref mineral.



Sample 15085 - N_1 S-71-43088



Photomicrograph Sample 15085,2
(width of field ≈4 mm)

ROCK TYPE: Breccia
COLOR: Medium gray (N5)
SHAPE: Subrounded
COHERENCE Intergranular: Friable
Fracturing: No penetrative fractures, surface fractures are numerous.

WEIGHT: 216.5 g
DENSITY:
DIMENSIONS: 7 x 4.5 x 4 cm

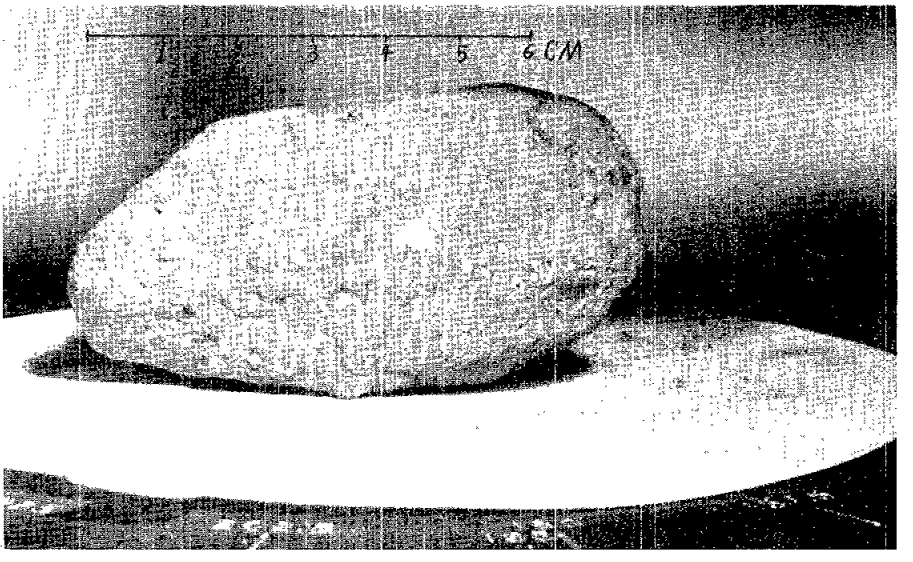
BINOCULAR DESCRIPTION BY: Morrison & Lofgren DATE: 8/20/71

FABRIC: Isotropic
VARIABILITY: None
SURFACE: N and E are angular, all others rounded to subrounded and smooth.
ZAP PITS: None on N and part of E, few on all others.
CAVITIES: None
SPECIAL FEATURES: Zap pit linings are multicolored and clearly reflect target material. This can be reasonably related both petrologically and in terms of field relations to a well sampled known crater and should be examined to determine how it became indurated. N is lunar bottom.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Subvitreous glass	dark gray to black	1	blocky	2.5	1-4	
Felsic clasts	white speckled	1	rounded	1.5	1-4	1
Basaltic clasts		4		1.5	1-5	2
Mineral clasts	brown, green			0.25-1		
Mineral clasts	white			0.25-1		
Glass	green, black amber		spherules	<0.2		
Glass clasts	variable		angular, blocky			

NOTES:

1. Fine grained, speckled with brown grains (pyroxene?)
2. These form a major part of the light colored clasts and consist of feldspar and pyroxenes. The pyroxenes are both red-brown and green types. The fragments are very similar to Elbow crater basalts.



Sample 15086 - B_1 S-71-43081

ROCK TYPE: Gabbro
COLOR: Medium light gray (N6)
SHAPE: Blocky, angular
WEIGHT: 5.6 g
DENSITY:
DIMENSIONS: 2.3 x 1.5 x 1.2 cm
COHERENCE Intergranular: Friable to coherent, coarse grains projecting into vugs are friable.
Fracturing: Nonpenetrative fractures.

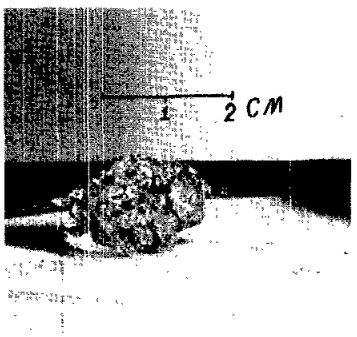
BINOCULAR DESCRIPTION BY: Head DATE: 8/19/71

FABRIC: Moderately inequigranular, coarse grains.
VARIABILITY: Irregular distribution of vugs.
SURFACE: Irregular
ZAP PITS: None
CAVITIES: Vugs 4%; rock is fractured along some vugs, pyroxene projecting into vugs; one vug slit as if controlled by adjacent plagioclase.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	clear-pale gray	50	laths and plates	2	1-7	1
Opaques	root beer brown	1	plate-like ilmenite	0.5		2
Pyroxene	cinnamon brown	25	subhedral to filling holes	0.5		3
Pigeonite	yellow-green	25	prisms	2	4 x 3/4	4

NOTES:

1. Some plates as well as laths.
2. Clear indication of intergrowth of ilmenite with outer brown zone of pyroxene.
3. Some are discrete small grains in the matrix.
4. Zoning, with outer rim of cinnamon brown pyroxene 0.1 to 0.2 mm.



Sample 15087 - N_1 S-71-43070

ROCK TYPE: Breccia
COLOR: Medium gray (N5)
SHAPE: Subrounded
COHERENCE Intergranular: Friable
Fracturing: No penetrative fracturing

WEIGHT: 1.8 g
DENSITY:
DIMENSIONS: 1.5 x 1.5 x 1 cm

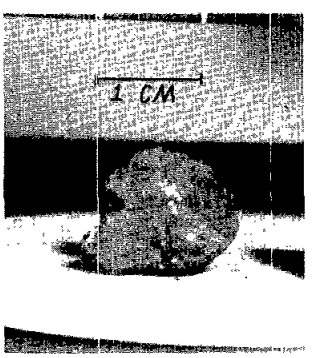
BINOCULAR DESCRIPTION BY: Morrison DATE: 8/19/71

FABRIC:
VARIABILITY: None
SURFACE: N moderately angular and may have glass splash. S smooth rounded; others too small.
ZAP PITS: None, but the nature of the surface suggests puts could easily have been rubbed off.
CAVITIES:
SPECIAL FEATURES: Small green spherules. Some felsic fragments contain translucent, clear crystals.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Felsic lithic clasts	white	1	angular	1	2-<1	1
Brown clasts	honey brown clear	<<1 over 1mm		0.1		2
Feldspar clasts	white		angular	<1		3
Matrix	medium gray	98		<0.5		4
Spherules	green	<<1 over 1mm	spherical	0.1		5

NOTES:

1. May have brown phase within felsic clast.
2. Probably glass.
3. Fairly common phase of matrix.
4. Does not show any indication of recrystallization.
5. Distinctly deep green.



Sample 15088 - N_1 S-71-43082

15091 15101 15221 15231

SAMPLE TYPE: Soil, < 1 mm fraction WEIGHT: 15091 - 162.9 g
COLOR: 15101 - 637.6 g
LOCATION: Station 2 (Apennine Front) 15221 - 290 g
15231 - 233.9 g

15091 Uphill from big boulder.
15101 The soil is dark gray and fine grained.
No difference in granularity between LM and this station. The soil is fairly cohesive with a few fragments in it.
15221 Typical soil.
15231 Scooped from underneath a large rock (breccia).

THIN SECTION PETROGRAPHY BY: McKay DATE: 10/1/71

TABLE OF COMPONENTS: Pages 90, 91
NOTES TO TABLE:

1. Vesicular, brown, inhomogeneous glass binds detrital crystals (primarily plagioclase, clinopyroxene) and glass fragments.
2. Glass clasts, plagioclase, and clinopyroxene in a dark brown, glassy fine grained matrix.
3. Inhomogeneous, vesicular and non-vesicular; exhibiting schlieren.
4. Grey-brown glass fragments with small glass vesicles.
5. Clear green glass; no inclusions
6. Inclusion-free to 10% inclusions in the glass.
7. Polycrystalline feldspar rock; some grains are finely brecciated and some are partly recrystallized.
8. Feldspar rich.

COMPONENT	NOTE	15091 PERCENT OF GRAINS 0.5- 1.0mm	0.25- 0.5mm	0.125- 0.25mm	15101 PERCENT OF GRAINS 0.5- 1.0mm	0.25- 0.5mm	0.125- 0.25mm
Agglutinate	1	66	38	35	40	60	42
Microbreccia, recrystallized	-	-	12	3	-	5	3
Microbreccia, vitric	2	-		7	-	7	4
Angular glass fragments, brown	3	-	3	10	40	-	7
Angular glass fragments, grey	4	17	10	-	-	-	2
Glass droplets, green	5	-	-	5	20	2	8
Glass droplets, brown	6	-	-	-	-	-	-
Clinopyroxene	-	17	12	8	-	4	10
Orthopyroxene	-	-	-	2	-	-	2
Olivine	-	-	-	1	-	-	2
Plagioclase	-	-	11	12	-	14	12
Orthoclase	-	-	-	1	-	-	1
Basalt, equigranular	-	-	-	2	-	-	2
Anorthosite	7	-	2	5	-	4	4
Basalt, hyalocrystalline	-	-	-	-	-	5	-
Basalt, Ophitic	8	-	-	-	-	-	-
Opaque	-	-	-	-	-	-	-
Colorless glass	-	-	-	-	-	-	-
Grains counted		6	42	185	5	54	121
Section numbers		13	12	11	16	15	14

COMPONENT		15221 PERCENT OF GRAINS 0.5-1.0mm	0.25-0.5mm	0.125-0.25mm	15231 PERCENT OF GRAINS 0.5-1.0mm	0.25-0.5mm	0.125-0.25mm
Agglutinate	1	44	61	36	40	38	43
Microbreccia, recrystallized	-	-	2	1	-	9	3
Microbreccia, vitric	2	33	10	12	20	9	8
Angular glass fragments, brown	3	-	-	6	-	7	10
Angular glass fragments, grey	4	-	-	3	-	2	2
Glass droplets, green	5	-	2	3	20	-	3
Glass droplets, brown	6	-	-	2	-	-	-
Clinopyroxene	-	11	2	14	-	7	8
Orthopyroxene	-	-	1	1	-	-	3
Olivine	-	-	-	3	-	2	1
Plagioclase	-	-	48	13	20	15	7
Orthoclase	-	-	-	-	-	-	2
Basalt, equigranular	-	-	2	-	-	-	-
Anorthosite	7	11	8	5	-	9	1
Basalt, hyalocrystalline	-	-	-	-	-	-	-
Basalt, Ophitic	8	-	-	2	-	-	5
Opaque	-	-	-	1	-	-	2
Colorless glass	-	-	-	-	-	-	2
Grains counted		9	49	110	5	86	
Section numbers		16	15	14	16	15	14

ROCK TYPE: Microbreccia, glass-coated WEIGHT: 25.5 g
COLOR: Glass - medium dark gray (N3, N4) DENSITY:
Rock - light gray (N7) DIMENSIONS: 3.5 x 3 x 3.7 cm
SHAPE: Blocky, rounded. Enclosed rock is more angular.
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative in rock inclusion.

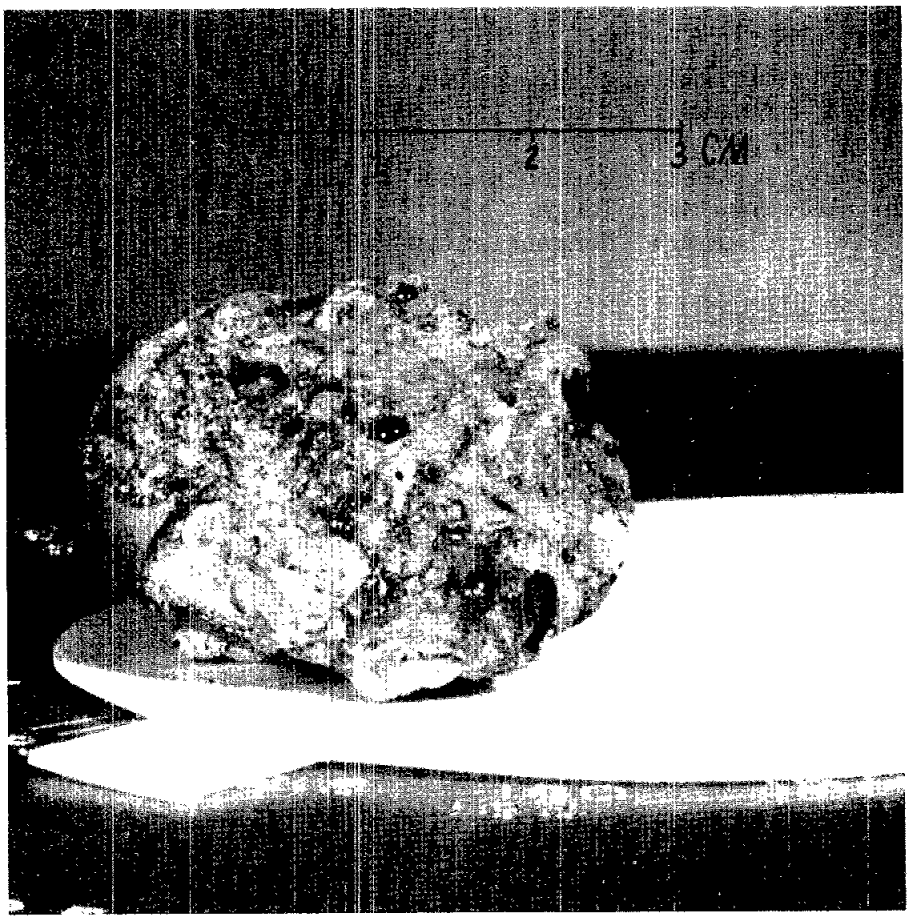
BINOCULAR DESCRIPTION BY: Wilshire & Phinney DATE: 8/19/71

FABRIC:
VARIABILITY: 1 x 2 cm area and several smaller areas of light gray breccia show through glass. Vesicles are irregularly distributed; glass is a little greener near rock inclusion.
SURFACE: Smooth irregular on glass; finely hackly on rock.
ZAP PITS: W & N many, S, T, B few.
CAVITIES: 15% vesicles in glass up to 4 mm.
SPECIAL FEATURES: Probably a thin glass coating on a large light gray recrystallized microbreccia.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass	light brown to greenish to black					1
Clasts	white	1	angular	>1 in rock inclusion		
Groundmass of inclusion	light gray	99		<0.5		2
Fragment in glass	medium gray			2 x 4		3
Fragment on glass	light gray					4

NOTES:

1. 85% of surface covered by glass.
2. Includes small lithic clasts, some with tiny plagioclase laths, some with pyroxene and plagioclase. Rest is very fine grained light gray pyroxene and white plagioclase, some of which is equant anhedral grains. This looks recrystallized and is about 55% plagioclase, 45% pyroxene.
3. Looks like a basalt, but the mafic mineral is very dark.
4. Other small (2 mm) light gray fragments stuck to glass.



Sample 15095 - S_1 S-71-42920

ROCK TYPE: Basalt
COLOR: Light olive gray (5Y 6/1)
SHAPE: Angular, blocky
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative fractures

WEIGHT: 5.6 g
DENSITY:
DIMENSIONS: 2 x 1.5 x 1 cm

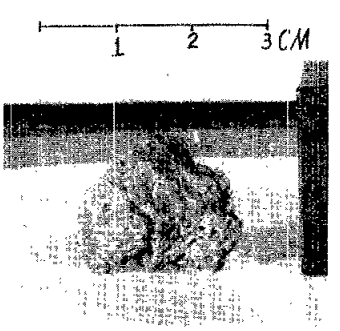
BINOCULAR DESCRIPTION BY: Morrison DATE: 8/17/71

FABRIC: Microporphyritic, phenocrysts of olivine, groundmass intergranular.
VARIABILITY: Uniform in general, certain areas may be enriched in feldspar.
SURFACE: Irregular
ZAP PITS: None
CAVITIES: Round vesicles, 5%, 1 mm.
SPECIAL FEATURES: Smooth-walled vesicles merge locally to vugs with projecting crystals; texture is moderately variable. Note that two pyroxenes may actually be color variants of one pyroxene phase. More opaques than 15075 and 15076, also different texture.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	white milky	50	laths granulated	0.2-0.4	<0.1-2	
Mafic silicate	light moderate brown	30		0.1-0.3	<0.1-1	1
Mafic silicate	moderate yellow green	3	equant prisms	0.5	<0.1-1	2
Metallic	black	2	equant	<0.1		
Mafic silicate	light honey brown	15	equant	0.1		3

NOTES:

1. Probably pyroxene. No cleavage, probably olivine although some may be pigeonite and contains black inclusions.
2. Possible variant of light and brown pyroxene.



Sample 15105 - N_1 S-71-43408

SAMPLE TYPE: Rock (fragment >1 cm) WEIGHT: 112.8 g
LOCATION: St. George Crater (Station 2) 12 Samples
From the rake sample (15115-15148) and related soil example (15100-15105)

BINOCULAR DESCRIPTION: By Wilshire, Morrison & Warner DATE: 9/71

Group 1: 15115, 15116, 15117 — Basalt, slightly vuggy, coarse-grained, zoned green to brown clinopyroxene phenocrysts.

Group 2: 15118, 15119 — Basalt, slightly vuggy, medium-grained, zoned clinopyroxene phenocrysts finer grained variant of Group 1.

Group 3: 15105 — Basalt, vesicular to vuggy, fine-grained, microphenocrystic olivine, brown pigeonite.

Group 4: 15125 — Basalt, fine-grained olivine, microphenocrysts, gray pyroxene, with no vesicles or vugs.

Group 5: 15135 — Microbreccia dark gray, vesicular glassy, with white clasts.

Group 6: 15145, 15146, 15147, 15148 — Soil breccia, light gray with clasts of Group 1 type rocks and minerals.

ROCK TYPE: Basalt, porphyritic
COLOR: Light brown
SHAPE: Angular
COHERENCE Intergranular: Tough
Fracturing: One penetration

WEIGHT: 4.0 g
DENSITY:
DIMENSIONS: 2.5 x 1.5 x 1 cm

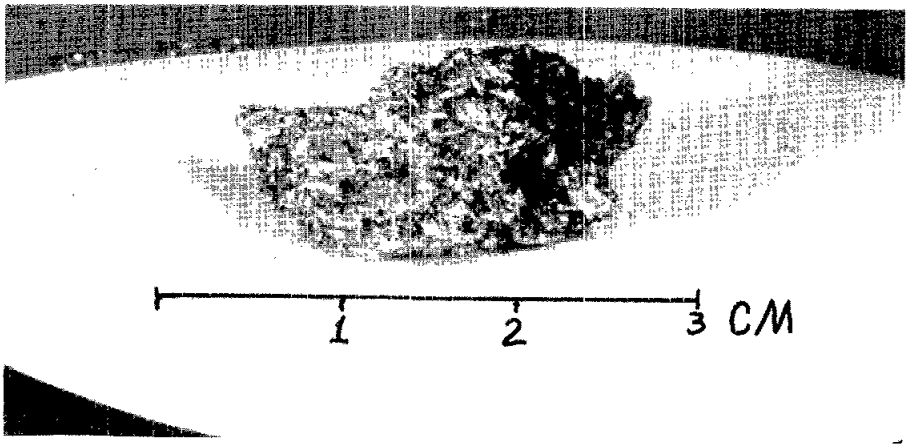
BINOCULAR DESCRIPTION BY: Morrison DATE: 9/7/71

FABRIC: Inequigranular
VARIABILITY: None
SURFACE: Hackly
ZAP PITS: None
CAVITIES: Vugs, 1-2%, to 2 mm.
SPECIAL FEATURES: Gray dust on one side, large opaques, crystals cross vugs.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	yellow green to brown	50	prisms	5		1
Mafic silicate	brown	10		1		2
Plagioclase	translucent	40	plates	2	2-4	
Opaque	black	1	plates, euhedral	<1	1.5	3

NOTES:

1. Yellow-green cores with brown rims 30% or radius. Zoned pigeonite(?).
2. Pyroxene, groundmass. Not as clearly zoned as big prisms.
3. Ilmenite(?).



Sample 15115 - S_1 S-71-48772

15116

ROCK TYPE: Gabbro
COLOR: Light brown (5YR 6/4)
SHAPE: Angular, slight tendency to be slabby
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative

WEIGHT: 7.2 g
DENSITY:
DIMENSIONS: 3 x 1.5 x 0.8 cm

BINOCULAR DESCRIPTION BY: Wilshire DATE: 9/7/7[illegible]

FABRIC: Foliated parallel to slabby surface, defined by alignment of plagioclase and pyroxene.
VARIABILITY: None
SURFACE: Surfaces are hackly
ZAP PITS: None
CAVITIES: 2-3% vugs
SPECIAL FEATURES:

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	translucent gray	45	euhedral plates	1.5	10	
Mafic silicate	yellow green	30	prisms	2	6	1
Mafic silicate		15	stubby prisms & irregular grains		0.5-0.75	2
Opaques		1-2	mostly plates some equant prisms	0.5		

NOTES:

1. Thin brown rims. Pyroxene.
2. Pyroxene, groundmass.

ROCK TYPE: Basalt, porphyritic
COLOR: Light brown
SHAPE: Subrounded
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 23.3 g
DENSITY:
DIMENSIONS: 2.5 x 3 x 1.5 cm

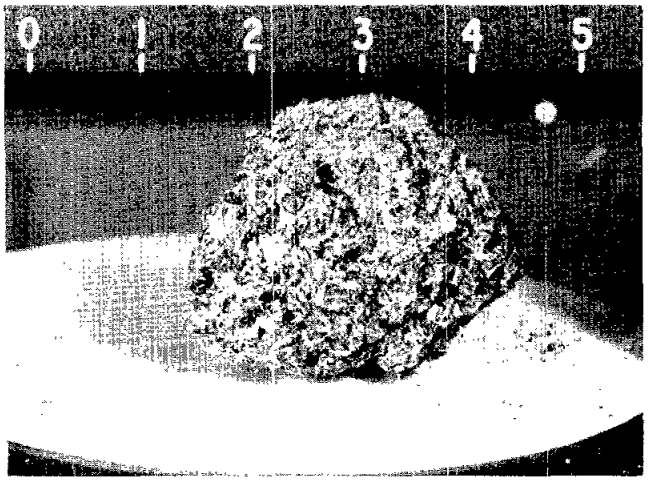
BINOCULAR DESCRIPTION BY: Morrison DATE: 9/7/71

FABRIC: Inequigranular
VARIABILITY: None
SURFACE: Irregular
ZAP PITS: None
CAVITIES: Vugs, 3% concentrated at one end.
SPECIAL FEATURES: Zoned pyroxene tends to be pheneocrysts.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	yellow-green	20-25	prisms	2.5	2.5-7	1
Mafic silicate	reddish brown	35-40		1	1-3	2
Plagioclase	translucent	45	plates	2	2-4	
Opaque	black	1	plates		to 1	

NOTES:

1. Pyroxene phenocrysts, thin brown rims, possible zoning on rims.
2. Groundmass pyroxene, local fan intergrowth with plagioclase.



Sample 15117 - Typical of St. George rake sample group 1

S-71-48768

ROCK TYPE: Basalt, porphyritic
COLOR: Light brown
SHAPE: Subrounded
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative, penetrative

WEIGHT: 27.6 g
DENSITY:
DIMENSIONS: 4 x 3 x 2 cm

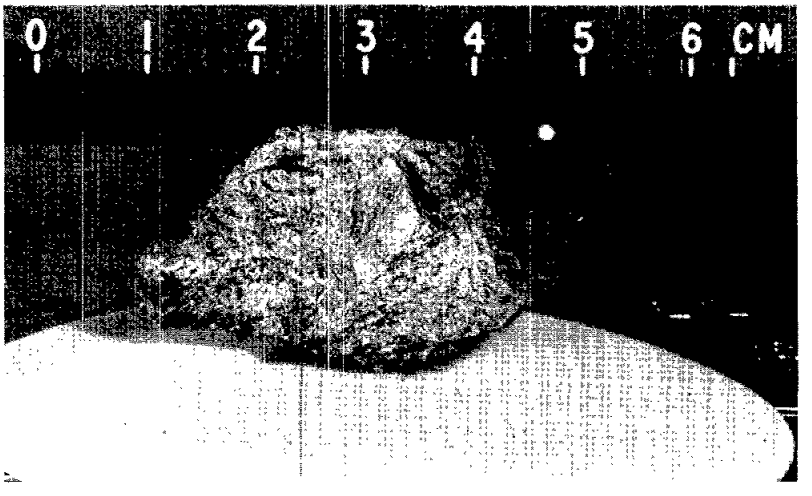
BINOCULAR DESCRIPTION BY: Morrison DATE: 9/7/71

FABRIC: Inequigranular
VARIABILITY: None
SURFACE: Irregular, smooth on pitted areas.
ZAP PITS: At least 3/4 of surface pitted.
CAVITIES: Vugs, 1%, <1 mm.
SPECIAL FEATURES: Fine-grained variant of 15116 and 15117. Zoned pigeonite? Phenocrysts have considerable disparity in size over brown matrix, pyroxene and plagioclase. Plagioclase and acicular groundmass pyroxenes are oriented when adjacent to phenocrysts indicating a flow foliation.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	yellow green	15-20	prisms	2.5	to 10	1
Mafic silicate	reddish brown	35-40	acicular, prismatic	1	to 5	2
Plagioclase		40	plates	1	to 5	
Opaque		<1	anhedral	<1		

NOTES:

1. Pyroxene phenocrysts, possibly embayed. Very thin brown rims.
2. Groundmass pyroxenes, much higher length/width than phenocrysts. Form parallel, fan and crossing intergrowths and plagioclase.



Sample 15118 - B_1 S-71-48763

ROCK TYPE: Basalt, adhering breccia WEIGHT: 14.1
COLOR: Light brown DENSITY:
SHAPE: Angular DIMENSIONS: 3.5 x 2 x 2 cm
COHERENCE Intergranular: Tough
Fracturing: Parallel set penetrative

BINOCULAR DESCRIPTION BY: Morrison DATE: 9/3/71

FABRIC: Microporphyritic
VARIABILITY:
SURFACE: Irregular
ZAP PITS: Zaps on soil
CAVITIES: 1% vugs
SPECIAL FEATURES: Fine-grained friable microbreccia adheres to the basalt and is medium, slightly brownish gray with fine grained, <0.1 mm, matrix. It contains much glass including green glass spheres; several basaltic clasts, one with much plagioclase, brown pyroxene and olivine; chalky white clasts; and small fragments of dark gray vitreous material with angular pieces of chalky white material.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	yellow green	5-10	equant	1	1.5-2	1
Mafic silicate	light brown	40-45	anhedral	0.5		2
Plagioclase	translucent	40		0.5	1	
Opaques	black	5	anhedral	0.25	1	

NOTES:

1. Olivine with small black inclusions.
2. Pyroxene.

ROCK TYPE: Basalt
COLOR: Medium dark gray (N4)
SHAPE: Angular
COHERENCE Intergranular: Tough
Fracturing: One set penetrative

WEIGHT: 6.5 g
DENSITY:
DIMENSIONS: 3 x 2 cm

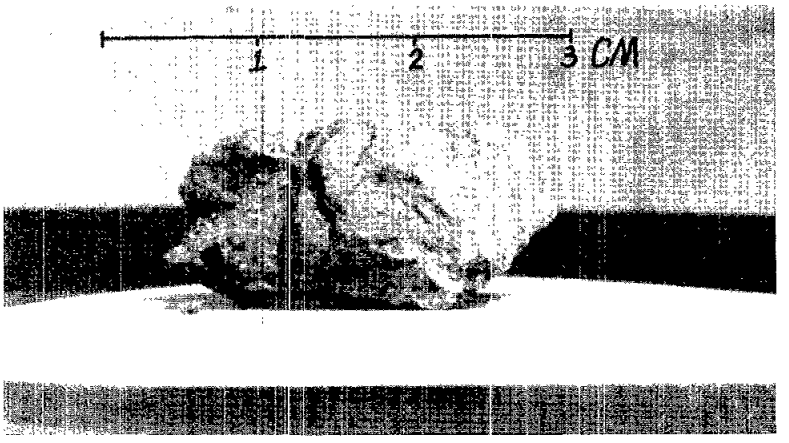
BINOCULAR DESCRIPTION BY: Morrison DATE: 9/3/71

FABRIC: Moderately inequigranular, plagioclase laths are aligned.
VARIABILITY: None
SURFACE: Glass sphere attached one corner.
ZAP PITS: Some but too dusty for abundances.
CAVITIES: None
SPECIAL FEATURES: This rock resembles sample 15603 in the unusual color of pyroxenes and in mode.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	light gray	40	laths	0.25	0.25-2	1
Mafic silicate	green	1-2	equant		0.5	2
Mafic silicate	red brown	2				3
Mafic silicate	medium gray	45-50		0.25		4

NOTES:

1. One lath has translucent en echelon core areas, possible indication of shock.
2. Olivine, tends to form phenocrysts.
3. May be a phase of the medium gray mafic silicate.
4. Pyroxene(?) with a brownish rim(?).



Sample 15125 - S_1 S-71-48780

ROCK TYPE: Glassy microbreccia
COLOR: Dark gray (N3)
SHAPE: Blocky, subangular
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 1.6 g
DENSITY:
DIMENSIONS: 1.4 x 1.2 x 1 cm

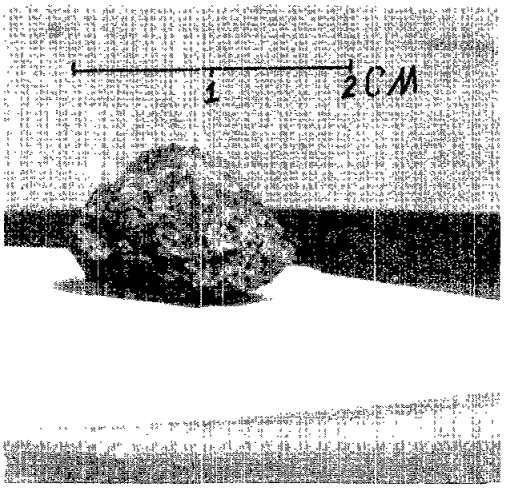
BINOCULAR DESCRIPTION BY: Wilshire & Morrison DATE: 9/7/71

FABRIC: Glassy-breccia
VARIABILITY: Glass-breccia
SURFACE: Irregular on scale of cavities.
ZAP PITS:
CAVITIES: 35% vugs and vesicles to 1-2 mm, very frothy. Vesicles have glazed walls.
SPECIAL FEATURES: Very small glassy veins cross two of the clasts; gradation between glassy breccia and vesicular material.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Anorthosite	white	5	irregular	1		1
Basalt	pale brown-white				0.1-1	2
Matrix	dark gray	95			<0.1	3

NOTES:

1. Some cataclasis.
2. Sugary pale brown pyroxene and plagioclase.
3. Glassy part contains some very fine-grained brown and white fragments.



Sample 15135 - N_1 S-71-48782

ROCK TYPE: Breccia
COLOR: Light gray (N6, N7)
SHAPE: Subangular, tendency to be slabby
COHERENCE Intergranular:
Fracturing:

WEIGHT: 15.1 g
DENSITY:
DIMENSIONS: 3.3 x 2.5 cm

BINOCULAR DESCRIPTION BY: Wilshire DATE: 9/3/71

FABRIC:
VARIABILITY:
SURFACE: One area of surface is slickensided. Splash glass on same surface.
ZAP PITS: Zap on same surface as slicks - spalls have chipped away slicks; Zaps on other surfaces also.
CAVITIES: None
SPECIAL FEATURES: Blue surface (several hundred square microns) noted on surface of one pyroxene grain. Second fragment has metallic bluish tint.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Clasts 1 mm		3-5			up to 5	
Clasts #1	chalky white	<2 of whole rock			2	1
Clasts #2						2
Clasts #3						3
Clasts #4					9x12	4
Clasts #5						5
Matrix	light gray (N7) color of <0.1 mm	40			0.1-1	6

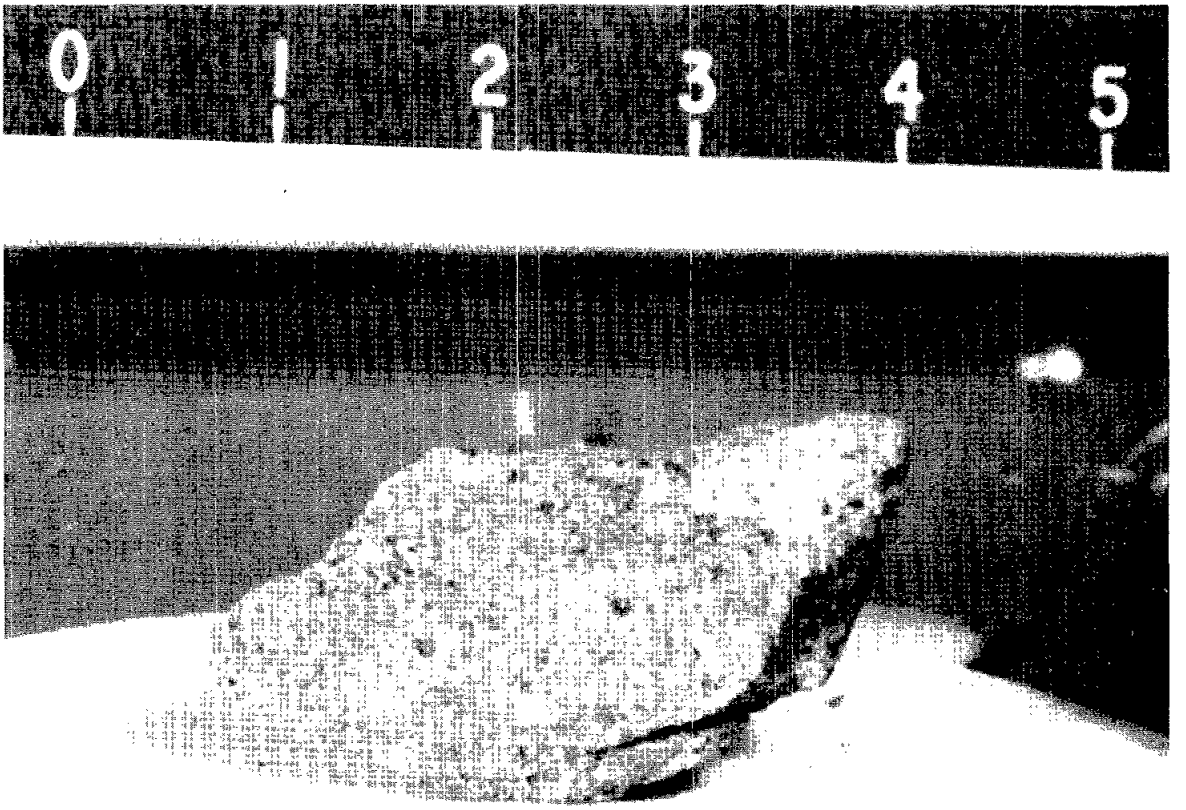
NOTES:

1. Very finely crystalline.
2. Granulated aggregate of rich red brown mineral 30%, plagioclase 30% and granulated yellow-green 40%, trace of opaque.
3. Same as above with 40% plagioclase and 2% opaque, rest is 50-55% brown and green.
4. "Hypautomorphic granular". Usual texture. Plagioclase 40%, opaques 1%, olivine 2%, yellow-green 55%, reddish brown 2%. Yellow green up to 4 mm in stubby prisms, average size 2 mm, has 3 distinct cleavages. Second type of yellow green is 1.5 mm (olivine); reddish brown rims some but not all of yellow-green pyroxene; plagioclase up to 2 mm opaques are equant in clusters.
5. Clasts 2 & 3 are most common clasts; also this type of rock supplies most of the mineral debris in matrix. Texture of these clasts is hypautomorphic granular.
6. Primarily pieces of dominant lithic clasts mainly yellowish-green mineral (pyroxene). Some of this may be olivine. Second in abundance is deep red-brown pyroxene. Plagioclase even in abundance with red-

NOTES:

brown pyroxene. Opaques. There are small lithic aggregates of these minerals. Small percentage of dull black aphanitic fragments. Trace of blood-red mineral, some occurs with plagioclase. One grain bottle green mineral or glass.

7. Clasts #5 - 7x4 mm, has plate like plagioclase up to 4x12 mm. Two mafic silicates are; 1 yellow green, 2 deep rich red brown. These get up to 1 mm - pyroxene forms along boundaries of plagioclase. One grain zoned from deep green to red brown and 2-5 mm across. Mode: 1 - light yellow green 2%; 2 - opaques (equant) <1%; 3 - zoned pyroxene 40%; 4 - plagioclase 57%.



Sample 15145 - Typical of St. George rake sample group 6
S-71-48788

15146

This rock is a piece of 15145 and is the same except it lacks some of the minor constituents of the larger sample.

ROCK TYPE: Soil breccia
COLOR: Light gray--medium gray
SHAPE: Angular
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative

WEIGHT: 3.7 g
DENSITY:
DIMENSIONS: 2 x 1.5 x 1.5 cm

BINOCULAR DESCRIPTION BY: Morrison & Wilshire DATE: 9/3/71

FABRIC:
VARIABILITY:
SURFACE:
ZAP PITS: Yes
CAVITIES: None
SPECIAL FEATURES: This rock is typical of the 15145 - 15148 soil breccias from the St. George rake sample. There is no sign of annealing in their matrices.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Basalt		5			1-7	1
Ultramafic						2
Glass			subround		1-2	3
Matrix		95			<1	4

NOTES:

1. Red-brown and yellow green pyroxene 40-55%, plagioclase 35-60%, opaques 1-5%, olivine 0-20%. Plagioclase to 6 mm, pyroxene 1.5 mm.
2. Ilmenite, reddish brown pyroxene, yellow green pyroxene? coarse ilmenite, 50-50 red brown yellow green pyroxenes. Ilmenite makes up 20%.
3. Vitreous, greenish glass of pyroxene occurs as large 1-2 mm very equant subrounded discrete fragments.
4. Mostly debris from rocks listed above. But includes black, vitreous-aphanitic, angular fragments. Ruby red mineral + plagioclase, spherules - dull gray metallic. Green milky spherules. Ilmenite plates, pale green cloudy glass fragments. Irridescent blue ilmenite. Light clast cut by new glass(?) vein; appears to have been in the clast before it was broken.

ROCK TYPE: Breccia
COLOR: Medium to light gray (N5, N6)
SHAPE: Subangular to blocky
COHERENCE Intergranular: Coherent
Fracturing: Nonpenetrative

WEIGHT: 3.0 g
DENSITY:
DIMENSIONS: 1.5 x 1.5 x 1 cm

BINOCULAR DESCRIPTION BY: Wilshire DATE: 9/3/71

FABRIC:
VARIABILITY:
SURFACE:
ZAP PITS:
CAVITIES: None
SPECIAL FEATURES: Round bottle green fragments, possibly green glass. Definite spheres and ellipsoids. 1% dull black subvitreous aphanitic grains angular to rounded, one clast of plagioclase and medium dark gray pyroxene.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Basalt		10			1-3.5	1
Ultramafic		Trace				2
Anorthosite						
Matrix	medium gray	90			0.1-1	3

NOTES:

1. Plagioclase 15-85%; mafic silicate (brown and reddish-brown pyroxene, yellow-green pyroxene and olivine) 15-85%, minor opaques. Coarse-grained plagioclase-brown pyroxene types predominate the lithic clasts.
2. One clast, 1 mm, entirely reddish brown pyroxene plus a black mineral (dark pyroxene or opaques?).
3. Crushed clast and fragments of above - higher plagioclase/pyroxene ratios than 15145. Has green glass spheres.

ROCK TYPE: Coarse breccia WEIGHT: 337.3 g
COLOR: Gray with glass coatings DENSITY:
SHAPE: Blocky, angular with orthogonal joints. DIMENSIONS: 8 x 6 x 4 cm
COHERENCE Intergranular: Tough
Fracturing: Penetrative fracture system parallel to face N, S; second system parallel to B, T.

BINOCULAR DESCRIPTION BY: Morrison DATE: 8/30/71

FABRIC: Coarse breccia
VARIABILITY: Variable amounts of glass coating.
SURFACE: B fresh surface, all other surfaces largely to entirely glass coated.
ZAP PITS: Many on W; few on T, S; none on N, E.
CAVITIES: Vesicles occur in glass coating.
SPECIAL FEATURES: Clasts make up 15-20% of rock, light colored basaltic clasts with distinctive ilmenite plates predominate; groundmass suggests recrystallization after accumulation. The appearance of the matrix and the clast population is unique among the breccias.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Basalt	medium light gray (N6) to brownish gray (5YR 4/1)	15	angular			1
Basalt	light gray (N8) to pinkish gray (5YR 1/1)		subrounded			2
Basalt porphyry	pinkish gray				to 30	3
Lithic clasts	dark gray	<1				4
Anorthosite		<1				5
Glass clasts		<1				6
Matrix	medium light gray (N5)	85			<0.1	7

NOTES:

1. This type and variants of it, form 90% of clasts. It consists of 40-50% chalky white to translucent 0.5-2 mm laths and 0.1-1 mm intergranular masses of plagioclase, 45-50% light greenish gray (5G 8/1) 0.1-1 mm granular anhedral pyroxene, and 3-5% black 0.1-1 mm thin platy opaques.

NOTES:

2. This variant consists of 45% chalky white 0.8-2 mm laths of plagioclase, 20-25% pale green 0.5-1 mm anhedral pyroxene, 15-25% brown 0.25 mm anhedral pyroxene, and 2-3% black 2x0.1 mm opaque plates.
3. Matrix is <0.1 mm; zoned pigeonite (?) phenocrysts 1-1.5 mm with yellow-green cores up to 70% of prism radius and brown rims. Some crystals show dark gray cores. One clast has a glass selvage.
4. Angular dark gray, extremely fine-grained fragments.
5. With pronounced preferred orientation of opaque minerals.
6. Glassy clasts with green structures, possibly devitrification features.
7. Granular dull appearance, glass occurs as veinlets and sometimes as a selvage on clasts. Suggestions of growth of devitrification structures in matrix, but some of these may be relict from clasts. Boundary with large clasts is sharp. Dense and compact except for gash veinlets filled with brownish black glass. One veinlet seems to cross entire rock.

15205,1

ROCK TYPE: Breccia, glass matrix
COLOR: Medium gray (N5)
SHAPE: Angular flake
WEIGHT: 1.6 g
DENSITY:
DIMENSIONS: 2.5 x 1.5 x 0.4 cm
COHERENCE Intergranular: Tough
Fracturing: Shallow fracturing from point impact. Some glass veins.

BINOCULAR DESCRIPTION BY: Phinney DATE: 8/28/71

FABRIC: Breccia
VARIABILITY: Typical breccia
SURFACE: B has dark gray thin glass coating, vesiculated.
ZAP PITS: All surfaces fresh but B has a few pits.
CAVITIES: None inside, vesicles on B face up to 2 mm.
SPECIAL FEATURES: Small chip from 15205, probably not representative.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Lithic clasts	white	60-70	angular, irregular to tabular	0.7	0.1-10	1
Clasts	gray	3-4	subrounded	3		2
Matrix	gray to black	30-35				3
Glass veins	black	2-3		0.2-0.3 thick		4

NOTES:

1. Some contain pale greenish-white pyroxene(?), plagioclase, light honey brown specks <0.1 mm (a pyroxene?), rare tiny opaque grains. All have granular texture and appear recrystallized. Largest clast appears to be recrystallized basalt.
2. Fine-grained, cherty, with black vitreous material rimming clasts.
3. Glassy matrix, variable in glass content.
4. Surrounds some fragments. Network pattern which cuts some clasts.

THIN SECTION DESCRIPTION BY: Silver & Brett DATE: 9/13/71

SECTION: 15205,3

SUMMARY: Coherent microbreccia with well-preserved accumulation fabric; very little post-accumulation glass. Matrix suggests Mare origin but clasts suggest non-Mare origin.

LITHIC CLASTS, 25% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Basalt 1	40-50	ang	0.2-2	Basalt 1 clasts are porphyritic pigeonite basalt.
Basalt 2	30			Basalt 2 clasts are ophitic pig-cpx basalt.
Gabbro	20			Gabbro clasts contain opx and aug.
Pyrox	1 clast		0.5	Pyrox clast contains pigeonite.
				These are distinctly different rocks than those found on the Mare. Some appear to have intersertal (or vitrophyritic?) textures.

GLASS CLASTS, 15% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Brown	50 (1 clast)	ang	2x3	Brown glass is an agglomerate of devitrified broken spheres in a similar matrix.
Yellow	30	ang	0.5-2	
Brown, red green	10-15	sph, ellipse	0.1-0.5	Yellow glass contains mineral relicts.
dark gray	5	ellipse	0.5	Dark gray glass is devit.
				Most glass is in form of ang frags of glassy rocks.

MINERAL CLASTS, 35% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Plag	50	ang		Minerals generally similar to those in lithic clasts.
Pig	25	ang		
Aug?	15	ang		
Opx	5-10	ang		
Oliv	Trace	ang		
Ilm	<0.1	laths	<0.2	

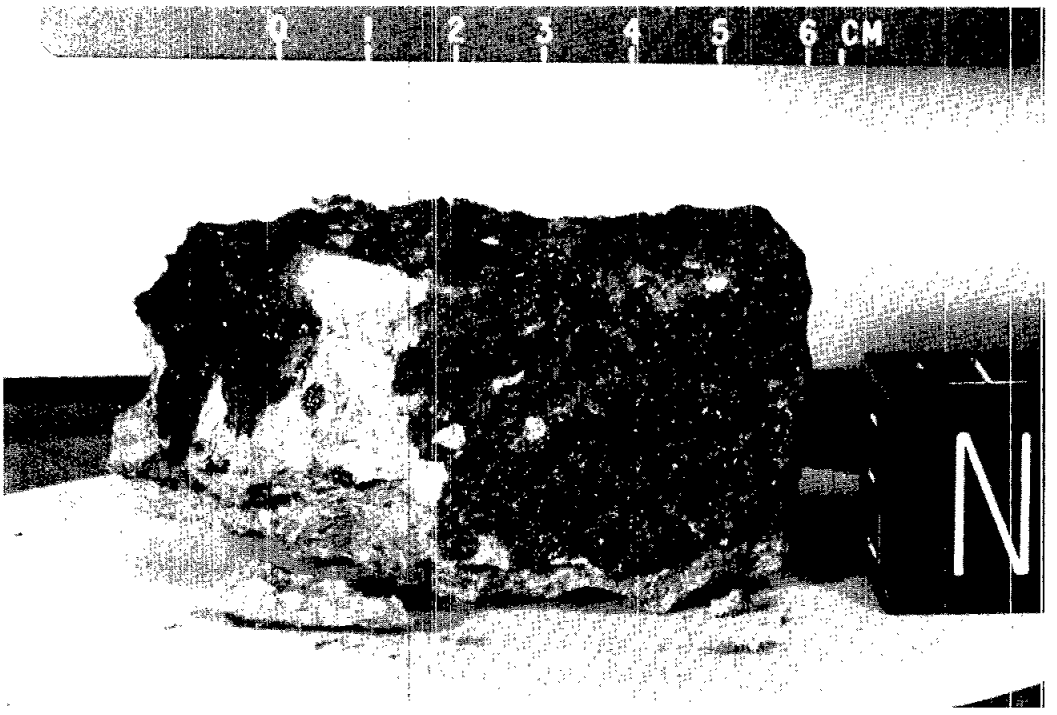
MATRIX, 25% of rock

PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Mineral	80	irreg	<0.1	Matrix consists of clasts with seriate size distribution.
Glass	10	irreg		Very slight recrystallization is possible.
Opaq	10	aggregate		Unident phase is opaque battleship gray.
Ilm	3	laths	<0.1	
Ulvo	<1	ang to subrd	<0.04	
Fe-Ni	<0.1	ang to subrd	<0.05	
Troil	<0.1	ang to subrd	<0.05	
Unident				

GENERAL COMMENTS: Platy and elongate frags show a distinct preferred orientation suggesting a depositional fabric, parallel to long dimension of thin section. Recommended careful oriented sampling of specimen for further study.

Sample bears little resemblance to a soil breccia.

Abundance of opaques in matrix indicates Mare origin but clasts are low in opaques suggesting non-Mare origin.



Sample 15205 - N_1 S-71-42981

Photomicrograph Sample 15205,3
(width of field ≈4 mm)

ROCK TYPE: Glassy breccia
COLOR: Medium gray (N4, N5)
SHAPE: Blocky, angular, broken off rock on moon.
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 92.0 g
DENSITY:
DIMENSIONS: 5 x 6 x $3\frac{1}{2}$ cm

BINOCULAR DESCRIPTION BY: Wilshire & Head DATE: 8/20/71

FABRIC: Wide banding with clasts concentrated in a band. The clasts themselves are foliated.
VARIABILITY: Extreme variations in vesicularity, in clast abundance, and in types of clasts across the rock.
SURFACE: Rough on all originally exposed surfaces (the sample was broken from a boulder).
ZAP PITS: Few on N, none on any other surface.
CAVITIES: Approximately 15% - appears to be a band of cavities approximately 1 cm wide. Vesicles range from 4 to 2 mm going away from band. They are slit-like and aligned parallel to zone in which they are concentrated; zone cuts across clast concentration bands and goes right across clasts and breaks them open. Looks like irregular contraction fractures where within clasts. Needle-like spines project into cavities, especially into irregular ones. Within same zone, another population of smaller cavities about 0.1 mm occur on surfaces of big vesicles. Two cavities within band appear to have glass rods extending across cavity. Farther into interior of rock, abundance of cavities goes down. Very irregular distribution and where clasts are dominant cavities are scarce.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Clasts	light gray	1	blocky, angular			1
Clasts		15	anhedral	>1		2
Clasts		20			0.1-1	
Matrix	medium gray (N4, N5)	60				3

NOTES:

1. Within this single large clast (1.3 x 0.7 x 0.4 mm) the average grain size is approximately 0.5 mm. Plagioclase algined along flat side of rock, ilmenite (0.5 mm) is aligned in same direction. Clast consists of 2% ilmenite, 60% plagioclase, 5% small cinnamon brown pyroxene, 20% dark gray material, 15% light gray material (may be plagioclase).
2. Two crude bands, about 1 cm wide, consist of loose concentrations of light colored mostly angular clasts, which range from 0.1 to 3 mm. There appears to be two types, one is fine grained and the other coarse grained.

Finer grained clasts - light bundle in one part of rock, 90% of rock locally; 45-50% or rock, in general, in well developed band. Net veins, <0.1 mm, in brecciated light colored rock cut some grains. Grains down to approximately 0.1 mm are prominantly foliated with mafic and felsic minerals aligned. Varies from piece to piece indicating rotation. Can distinguish two minerals, dark gray and plagioclase. Dark gray 30-35%, plagioclase 65-70%.

The coarser grained clasts average 0.3 mm, and contain approximately 60% plagioclase with the rest dark material identical to matrix of breccia.

Outside of the clast-rich bands the rock is also loaded with sub mm feldspathic debris of extremely irregular shapes which constitute approximately 20% of these areas.

3. Appears to be crystalline with some glazed spots on partly exposed surfaces of vesicles. Skinny prismatic minerals in matrix are about 0.5 mm long.

THIN SECTION DESCRIPTION BY: Wilshire & Brett DATE: 9/17/71

SECTION: 15206,3

SUMMARY: Glassy microbreccia with dominantly basaltic lithic and mineral fragments. Low abundance of opaques indicates that breccia is not composed of typical Mare material.

LITHIC CLASTS, 30% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Basalt 1				Subophitic basalt clasts with aug or pig are dominant.
Basalt 2				Intersertal basalt with finer grain size than 1. Has aligned plag laths.
Lithic	1 clast			Only one non-basaltic lithic clast: a dark aphanitic partly glassy rock.

GLASS CLAST, 5% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Pale green		irreg	0.1-0.2	Very pale greenish blass with peculiar globular texture is predominant.
Brown		irreg	0.1-0.2	Some glass clasts appear to be largely melted lithic and/or mineral fragments.
Colorless		irreg	0.1-0.2	

MINERAL CLASTS, 30% of rock

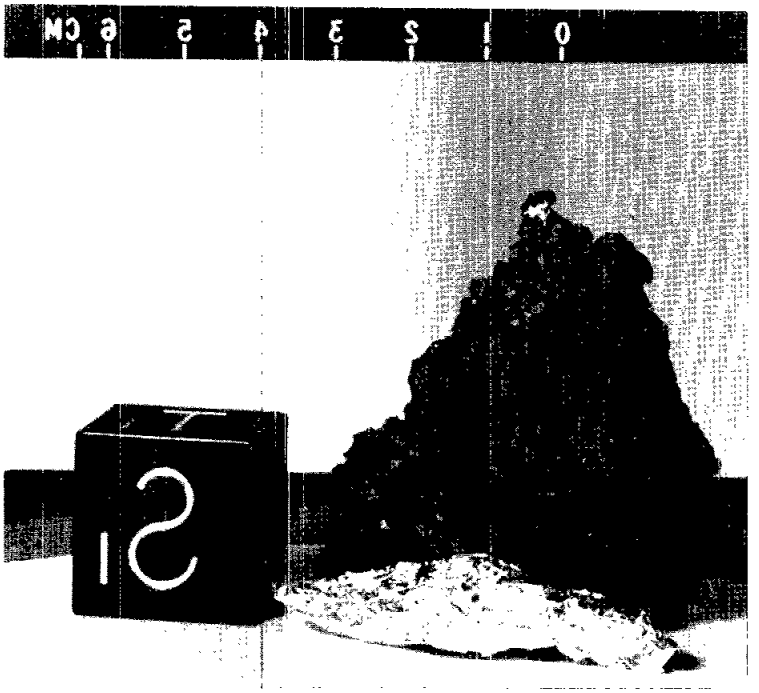
PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Aug			0.1-1	
Plag			0.1-1	
Pig			0.1-1	

MATRIX, 35% of rock

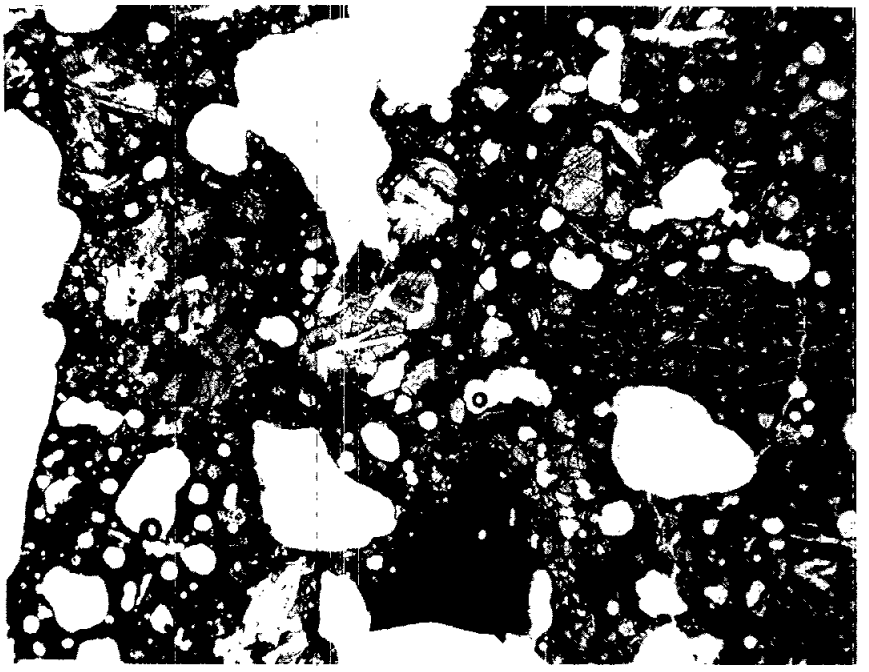
PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Devit				
Ilm	0.1-0.2	subrd to subang	<0.02	Well-developed devitrification textures in interior, spherulitic in places.
Ulvo?	<0.1	subrd to subang	<0.01	
Troil	<0.1	subrd to subang	<0.01	
Fe-Ni	<0.1	subrd to subang	<0.01	

GENERAL COMMENTS: 20% irregular to round coalescing cavities; particularly well developed in and across edges of two basalt clasts.

A number of clasts are partly melted lithic or mineral fragments in which glass of various colors and textures surround embayed plagioclase relicts.



Sample 15206 - S_1 S-71-43192



Photomicrograph Sample 15206,3
(width of field ≈4 mm)

15241 15251 15261 15271 15291

SAMPLE TYPE: Soil, < 1 mm fraction
COLOR:
LOCATION: Station 6

WEIGHT: 15241 - 197.4 g
15251 - 380.9 g
15261 - 416.6 g
15271 - 798.3 g
15291 - 169.0 g

THIN SECTION PETROGRAPHY BY: McKay & Heiken DATE: 10/2/71

TABLE OF COMPONENTS: Pages 117, 118
NOTES TO TABLE:

1. Brown, consisting of mineral detritus (pyroxene, feldspar, opaque minerals), angular glass fragments and lithic fragments, bonded together by medium brown to very dark brown glass. Angularity ranges from the round droplet-like agglutinates to very angular fragments. Some fragments exhibit schlieren; the finer-grained mineral detritus makes most of the glassy matrix cloudy, sometimes nearly opaque. Some grains have coats of glass spatter.
2. Angular fragments of clear, light, brown glass. Some are devitrified, and some have up to 15% crystallites.
3. Grey glass fragments, which exhibit good schlieren.
4. Clear green glass spheres, droplets, and angular fragments (broken spheres). The glass is totally free of crystals, crystallites, and detritus. Some of the grains have secondary coatings of brown, detritus-laden glass. Some are devitrified, with sheaves of very thin fledspar and pyroxene crystals.
5. Brown glass droplets and spheres, which grade into agglutinates, but generally contain considerably less detritus. Some are free of crystals or mineral detritus, but some grains are devitrified. Many exhibit good schlieren.
6. Ophitic and subophitic textures. Minerals proportions vary, but generally are around 60% feldspar, 40% clinopyroxene and a trace of opaque minerals.
7. Equigranular, consisting of about 45%, equant, stubby clinopyroxene, 50% stubby feldspar crystals and, irregular, elongate opaque minerals.
8. Hyalocrystalline, consisting of well-developed feldspar laths and stubby, poorly developed clinopyroxene crystals in a black, glassy groundmass.
9. Recrystallized and consists of fine-grained, equant feldspar and some pyroxene fragments in a very fine grained, recrystallized matrix. The matrix is made of mostly equant feldspar crystals.
10. Vitric, with about 50%, equant, angular clinopyroxene and feldspar crystals in a groundmass of clear, light brown glass. Most of the crystal detritus exhibits shock effects; most are highly fractured.
11. Colorless to pale purplish-brown crystals, some of which are zoned. Mostly augite, but some pigeonite crystals. The zoned crystals are colorless in the center and pale brown (pigeonitic) around the edges.
12. Colorless to pale purple anhedral grains.
13. Fractured, euhedral crystals; many exhibit shock effects.
14. Colorless, subhedral crystals.
15. About 90% feldspar, 5% pyroxene (small equant crystals) and 5% opaque minerals.
16. Colorless with high refractive index.
17. Granular texture with about 90% clinopyroxene and 10% opaques.

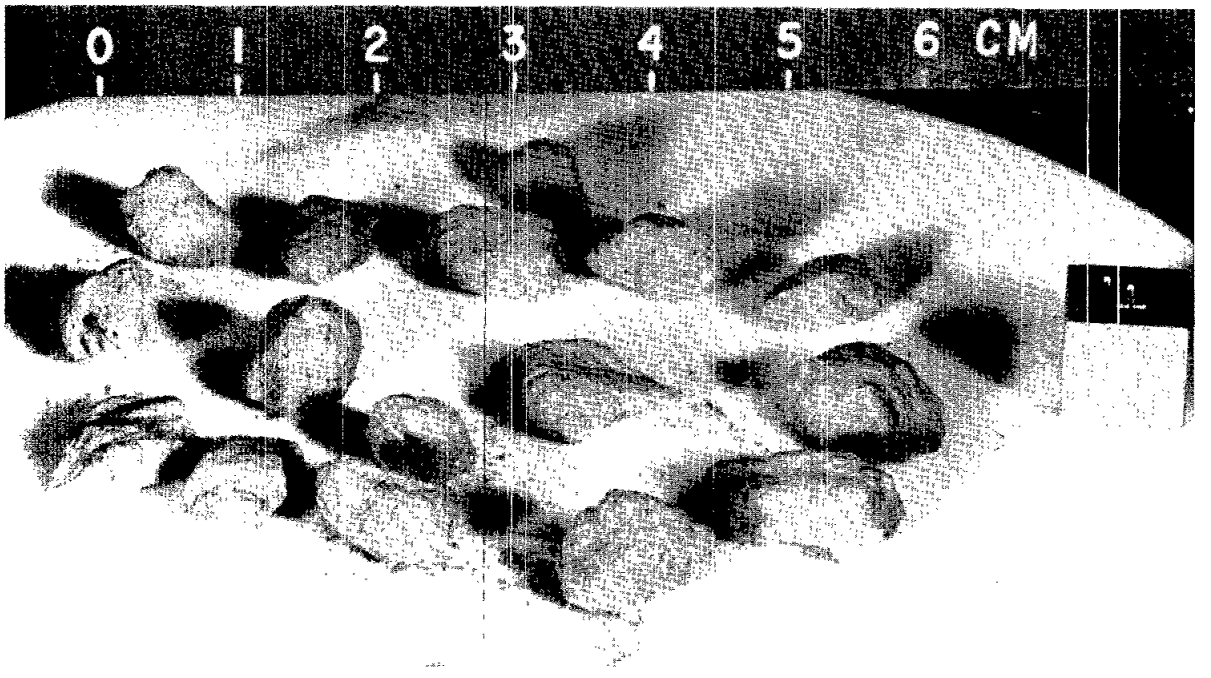
COMPONENT	NOTE	15241 PERCENT OF GRAINS 0.5-1.0mm	0.25-0.5mm	0.125-0.25mm	15251 PERCENT OF GRAINS 0.5-1.0mm	0.25-0.5mm	0.125-0.25mm	15261 PERCENT OF GRAINS 0.5-1.0mm	0.25-0.5mm	0.125-0.25mm
Agglutinates	1	25	31.8	45	57.0	63.0	54.0	-	52.5	50.5
Glass fragments	2	-	9.1	5	14.3	5.3	5.5	50	7.9	5.0
Glass fragments	3	-	2.2	-	-	2.6	0.5	-	-	-
Glass droplets	4	-	4.5	10	-	2.6	9.5	-	7.9	11.5
Glass droplets	5	-	-	2	-	-	3.5	-	5.3	2.5
Basalt	6	-	-	-	14.3	-	2.0	50	2.6	3.0
Basalt	7	12.5	4.5	2	-	-	2.5	-	-	-
Basalt	8	-	-	-	-	10.5	0.5	-	-	1.0
Microbreccia	9	-	2.2	6	14.3	8.0	4.0	-	5.3	7.0
Microbreccia	10	37.5	29.5	1	-	-	2.5	-	7.9	1.5
Clinopyroxene	11	-	4.5	9	-	5.3	9.5	-	2.6	13.0
Olivine	12	12.5	2.2	7	-	-	2.0	-	5.3	2.5
Feldspar	13	-	6.8	9	-	2.6	2.5	-	-	-
Orthopyroxene	14	12.5	-	3	-	-	1.5	-	-	1.0
Anorthosite	15	-	-	-	-	-	-	-	-	0.5
Glass fragments	16	-	2.2	1	-	-	-	-	2.6	0.5
Pyroxenite	17	-	-	-	-	-	-	-	-	0.5
Grains counted		-	44	100	7	38	200	2	38	200
Sections numbers		12	11	10	13	12	11	7	6	5

		15271			15291		
		PERCENT OF GRAINS			PERCENT OF GRAINS		
COMPONENT	NOTE	0.5-1.0mm	0.25-0.5mm	0.125-0.25mm	0.5-1.0mm	0.25-0.5mm	0.125-0.25mm
Agglutinates	1	33.3	44.5	54.0	25	15	16.0
Glass fragments	2	-	12.5	4.5	25	15	5.0
Glass fragments	3	-	-	-	-	12	-
Glass droplets	4	-	4.8	7.0	-	15	3.0
Glass droplets	5	-	8.0	5.5	-	4	2.0
Basalt	6	-	1.6	3.5	-	-	-
Basalt	7	-	6.3	-	-	8.0	8.0
Basalt	8	-	3.2	-	-	-	-
Microbreccia	9	33.3	8.0	5.5	-	4	-
Microbreccia	10	-	1.6	2.0	50	15	32.0
Clinopyroxene	11	-	3.2	9.0	-	4.0	12.0
Olivine	12	33.3	1.6	2.0	-	-	2.0
Feldspar	13	-	1.6	4.5	-	-	12.0
Orthopyroxene	14	-	1.6	1.0	-	-	-
Anorthosite	15	-	1	0.5	-	12.0	4.0
Glass colorless	16	-	-	-	-	-	-
Grains counted		6	63	200	4	50	150
Section numbers		13	12	11	13	12	11

ROCK TYPE: Glass-coated breccias to agglutinates
COLOR: Greenish gray (5GY 5/1) (breccia and glass)
SHAPE: Compact to open and irregular
WEIGHT: 115.5 g
DENSITY:
DIMENSIONS: 89 pieces
FIELD RELATIONS: Fragments from the bottom of 1 m fresh crater.

BINOCULAR DESCRIPTION BY: Horz & Morrison DATE: 9/7/71

FABRIC:
VARIABILITY: From smooth breccia pieces to glass-coated and cemented breccias to agglutinates. The pieces were arranged in order of increasing degree of porosity, irregularity of surface, and amount of glass, and were individually numbered (15245,1-15245,89) accordingly. The following descriptions apply to five groups.
SURFACE:
ZAP PITS:
CAVITIES:
SPECIAL FEATURES:



Sample 15245,1 - 15245,16 - N_1
S-71-47912

15245,1 - 15245,21

ROCK TYPE: Microbreccia
COLOR: Greenish gray (5GY 5/1)
SHAPE: Angular, subrounded
COHERENCE Intergranular: Friable
Fracturing: None

WEIGHT: 19.02 g
DENSITY:
DIMENSIONS: 21 pieces

BINOCULAR DESCRIPTION BY: Horz DATE: 9/7/71

FABRIC: Microbreccia, some foliation, weakly developped.
VARIABILITY: None
SURFACE: Minute glass splashes present, though rare. Smooth.
ZAP PITS: None
CAVITIES: None
SPECIAL FEATURES: Many glass-spheres, especially greenish type. Absence of microcraters suggests recent breakup, possibly in transit.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Matrix	greenish gray	90				
Plagioclase	white	5-7	angular	0.5	0.2-1	
Glass spherules	green	2-5	spherules	<0.5	<0.5	
Glass spherules	dark green	<1	spherules	<0.5	<0.5	
Clast?	brownish	<1	angular	0.5	<0.5	1

NOTES:

1. Glass? or pyroxene?

15245,22 - 15245,27

ROCK TYPE: Breccia
COLOR: Greenish gray (5GY 5/1)
SHAPE: Angular
WEIGHT: 3.22 g
DENSITY
DIMENSIONS: 6 pieces
COHERENCE Intergranular: Friable
Fracturing: Penetrative and nonpenetrative

BINOCULAR DESCRIPTION BY: Horz DATE: 9/7/71

FABRIC: Microbreccia
VARIABILITY: Microbreccia and glass coating.
SURFACE: Small glass splashes, 2-10 mm^2, very thin glass coating with numerous windows, produced by surface tension; the glass is hetrogeneous, dark black and yellow green.
ZAP PITS: Few small (0.050-0.1 mm) on most glass coatings.
CAVITIES:
SPECIAL FEATURES: The breccias are the same as in the 15245,1-15245,22 group, but there are some clusters of feldspar clasts which compose as much as 40% of the rock. Fair lineation is also present.

15245,28 - 15245,32

ROCK TYPE: Microbreccia
COLOR: As previous groups
SHAPE: Angular, subangular
COHERENCE Intergranular: Friable
Fracturing: Penetrative and nonpenetrative

WEIGHT: 6.48 g
DENSITY:
DIMENSIONS: 5 pieces

BINOCULAR DESCRIPTION BY: Horz DATE: 9/7/71

FABRIC: Microbreccia
VARIABILITY: Microbreccia and glass
SURFACE: Glass coatings are of medium size (5-20 mm^2) with stringers, splashes and trains of spherules, all indicating shocks on surface. Some coatings are cratered (0.050-0.1 mm size craters).
ZAP PITS: Few on some coatings (0.05-0.1 mm pits).
CAVITIES:
SPECIAL FEATURES: The breccia is the same as the first group. There are two varieties of glass, which are intergradational. The light glass is dusky yellow green (5SY 5/2) and the dark is dark greenish gray (5S 4/1). The color may also depend on total thickness of glass, the thin parts being more greenish and the thick parts darker. The glasses have hair-line cracks.

15245,33 - 15245,65

ROCK TYPE: Breccia with partial glass coats
COLOR: Gray
SHAPE: Angular
COHERENCE Intergranular: Coherent to incoherent
Fracturing:

WEIGHT: 63.34 g
DENSITY:
DIMENSIONS: 33 pieces

BINOCULAR DESCRIPTION BY: Morrison DATE: 9/8/71

FABRIC:
VARIABILITY: The amount of glass coating increases from 10-20% for the lowest numbered pieces to 60-80% for those with the highest numbers. Concommitantly there are increases in the degree of shattering and the amount of fracture-filling and cementation by glass. Some soil clots occur in glass-rich pieces.
SURFACE: Gray to olive green on all fragments. Some glass has areas of metallic irridescence and also areas of gray metal-like glass.
ZAP PITS:
CAVITIES: Glass is 20% vesicular.
SPECIAL FEATURES: Shape and surfaces of some pieces suggest that they are parts of shatter cones. Others have dilational fractures with and without glass fillings.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Anorthosite	white		angular	1	1-3	1
Lithic clast	white with greenish cast	3	angular	1	1-3	2
Matrix		97				3

NOTES:

1. Granular feldspar.
2. Feldspar (60-70%) and green mineral or glass (30-40%), similar to white part of rock 15455.
3. In some of the breccias a black, fine-grained to subvitreous matrix; in others are coarser-sized and seriate mineral and glass debris. Further components of various pieces are black glass fragments, green glasses, dark brown-black spherules, ruby red fragments, olive brown crushed fragments (pyroxenes?), crushed feldspar, various mineral fragments.

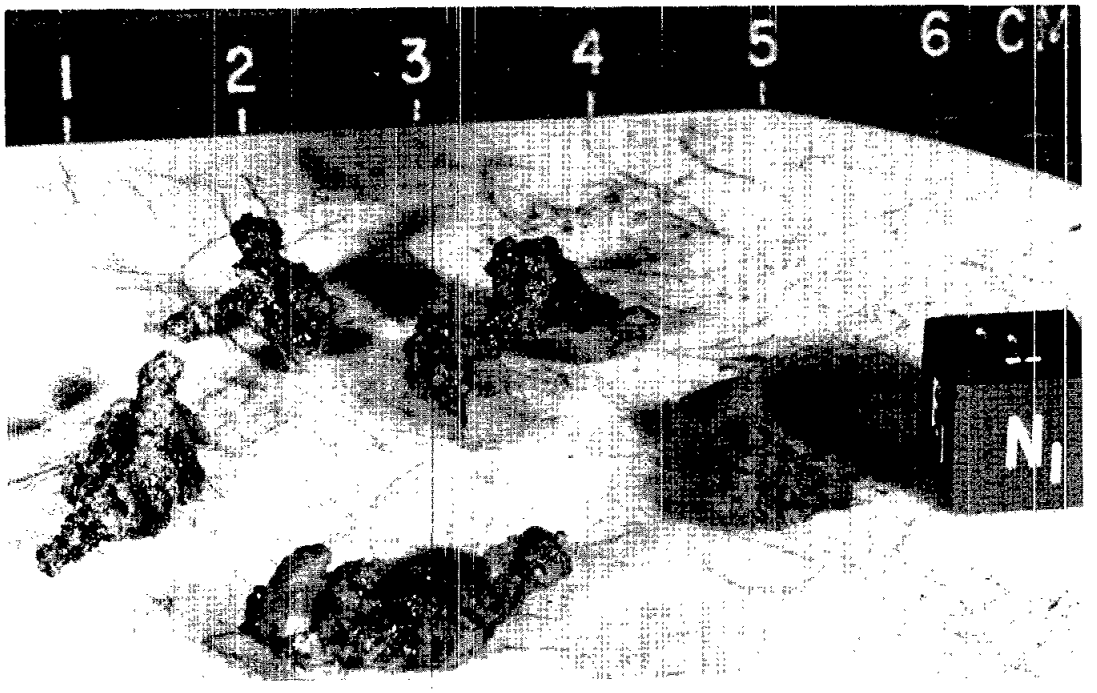
15245,66 - 15245,89

ROCK TYPE: Agglutinates
COLOR
SHAPE: Irregular to dendritic
COHERENCE Intergranular:
Fracturing:

WEIGHT: 22.44 g
DENSITY:
DIMENSIONS: 24 pieces

BINOCULAR DESCRIPTION BY: Morrison DATE: 9/8/71

FABRIC:
VARIABILITY: Irregularity of shape increases with the sample number.
SURFACE: Soil is bonded to most of the exterior glass surfaces.
ZAP PITS:
CAVITIES:
SPECIAL FEATURES: Most of the non-glass material is soil.



Sample 15245,85 - 15245,89 - N_1

S-71-47989

ROCK TYPE: Breccia, glass-coated
COLOR: Medium light brownish gray (5YR 6/1 to N6) Glass surface: brownish dark gray (5YR 4/1 to N4)
SHAPE: Subangular, rounded
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative, parallel to N face, but mainly irregular, deep fractures.

WEIGHT: 240.4 g
DENSITY:
DIMENSIONS: 4.5 x 5 x 7.5 cm

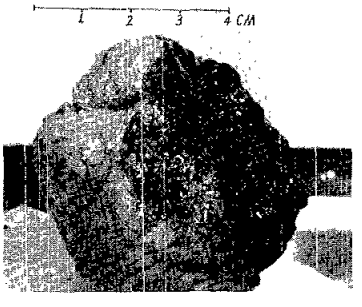
BINOCULAR DESCRIPTION BY: Ridley & Jakes DATE: 8/27/71

FABRIC: Fine breccia
VARIABILITY: Homogeneous matrix, evenly distributed clasts.
SURFACE: Glass covers 100% of N and 50% of E. S and W are irregular.
ZAP PITS: Many on T, B, S; few on E, W; none on N.
CAVITIES: None
SPECIAL FEATURES: The glass coating is medium dark gray and finely fractured, with vesicles up to 15 mm in size. There are a few black, sharply defined areas in the glass.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	sugary white	15-20	subrounded	<1	0.15-3	
Mafic silicate	yellowish	5		1	0.05-2	1
Feldspar single crystals		5			<0.05	
Matrix	bluish gray	70				2

NOTES:

1. Mainly pyroxene with some plagioclase.
2. Very homogeneous.



Sample 15255 - E_1 S-71-44512

ROCK TYPE: Basalt
COLOR: Light greenish gray (5GY 8/1), weathers brownish
SHAPE: Blocky
COHERENCE Intergranular: Coherent
Fracturing: One penetrative and few nonpenetrative

WEIGHT: 201.0 g
DENSITY:
DIMENSIONS: 8 x 5.5 x 4.5 cm

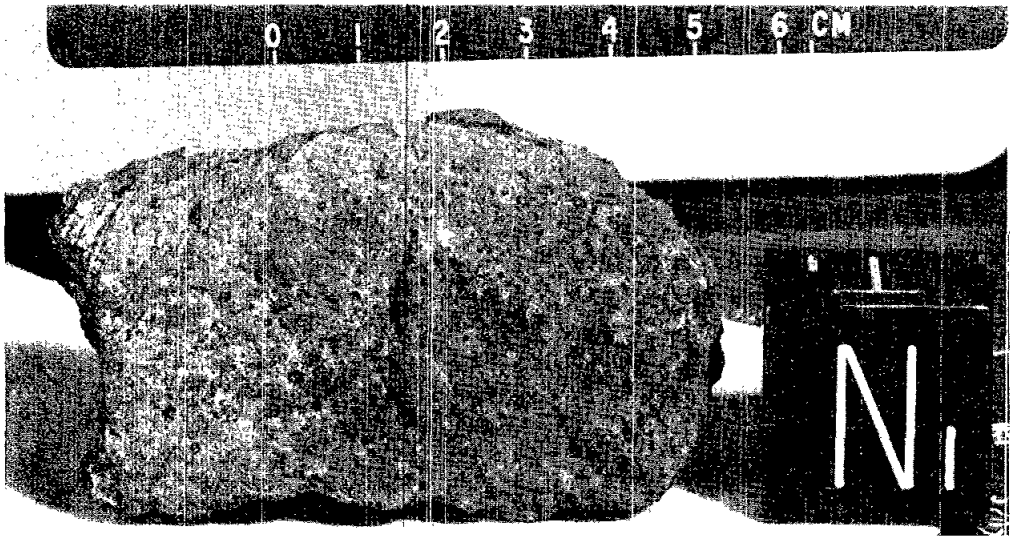
BINOCULAR DESCRIPTION BY: Warner DATE: 8/27/71

FABRIC: Porphyritic, aphanitic
VARIABILITY: Porphyritic
SURFACE: Granulated; 2% of B is glass coated
ZAP PITS: Few on all, but B has fewer than the others.
CAVITIES: None
SPECIAL FEATURES: B is dust covered and has fewer pits, suggesting it was buried on the lunar surface.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	white	60			0.1-0.2	1
Opaque	black	2	equant	0.5		
Mafic silicate	brown	30			0.1-0.2	2
Mafic silicate		5	equant		0.5-2	3

NOTES:

1. Matrix
2. Matrix - augite
3. Phenocrysts, zoned yellow-green pigeonite in center, rimmed by brown augite.



Sample 15256 - N_1 S-71-44501

THIN SECTION DESCRIPTION BY: Warner & Brett DATE: 9/17/71

SECTION: 15256,16

SUMMARY: Mixture of inclusions in shock melt of what was probably an igneous rock.

PHASE	PERCENT	SHAPE	SIZE (mm)
(Inclusions)			
Cpx	10	round	1
Clast	10	round	2
(Groundmass)			
Cpx	45	subhedral	0.2
Plag	30	laths	0.02x0.1
Ilm	4	euhedral	0.1
Ulvo	1	anhedral	0.05
Troil		anhedral	0.01
Fe-Ni		anhedral	0.01
Cr Spin		anhedral	0.05

COMMENTS:

Intergranular.

Cpx and plag are aligned along curving flow-type structure.

Ilm occurs as laths tending towards skeletal texture. This is unique among the Apollo 15 igneous rocks.

Ulvo occurs in association with Cr-spin and ilm and rarely as discrete grains.

Fe-Ni occurs as discrete grains, as blebs in troil, and as discontinuous veins and smears along fractures.

Plag fills veins in section.

Opaque assemblage and associations reminiscent of Apollo 12 fine-grained basalts.

Fracturing in opaques, but without ilm twinning indicated that rock is mildly shocked.

Photomicrograph Sample 15256,16
(width of field ≈4mm)

ROCK TYPE: Microbreccia WEIGHT: 22.4 g
COLOR: Medium dark gray (N4); glass cover on N is grayish black (N2) DENSITY:
DIMENSIONS: 2.5 x 3 x 3 cm
SHAPE: Blocky, subangular to subrounded.
COHERENCE Intergranular: Coherent to tough
Fracturing: Few, open and penetrative

BINOCULAR DESCRIPTION BY: Bass DATE: 9/2/71

FABRIC: Isotropic
VARIABILITY: Abundance of glass cover.
SURFACE: Glass cover 100% on N, 15% on B, none on others.
ZAP PITS: Many on S; few on B; none on others. On B the pits occur on both breccia and glass cover.
CAVITIES: Vesicles (now opened to shallow depressions) in glass on N and B; 0.1-3 mm mostly 0.5-1 mm; all are open, edges are rounded and receded.
SPECIAL FEATURES: Metal specks on surface of glass on N occurs in flow lines around open, collasped vesicles. Metal formed before vesiculation was complete and was pushed aside by collasping or receding vesicles - not found inside them.

Greenish yellow to dark glass spheres on surface of glass on N; 0.05 to 0.2 mm; perched on surface or partially embedded (only one is more than 50% embedded; all others over half exposed); apparently formed as spray of cool, relatively rigid glass spheres which impinged on still soft, tacky surface of glass cover after vesiculation of glass had largely ceased (some spheres are inside vesicles).

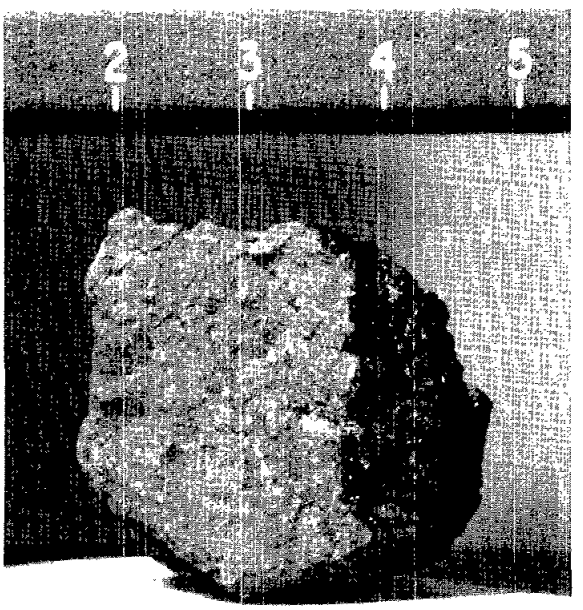
Clasts in breccia: two clasts on B and one on S are >1 mm (largest <3 mm); otherwise all are less than or equal to 1 mm. Paucity of brown pyroxene and of lithic clasts with brown pyroxene indicates source almost free of basalt of microgabbro. Source of plagioclase-rich, with minor to subordinate light green or tan green pyroxene and a trace of red spinel; probably anorthosite, gabbroic anorthosite and anorthositic gabbro.

Matrix of breccia: not recrystallized or glassy, but may give impression of glassiness when thin veins of dark glass are numerous and closely spaced.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Anorthosite	white	23	angular, blocky			1
Basalt	brown and white	<1	blocky to prismatic, angular			
Mafic silicate	light green, brown, red-brown	1	blocky to irregular			2
Mafic silicate	red	<1	angular, blocky			3
Matrix	dark gray	70		<0.1		
Glass	grayish black	5	sheet			4

NOTES:

1. Plagioclase mineral clasts are probably more abundant than plagioclase-rich lithic clasts; rare unshocked plagioclase is gray to colorless.
2. Pyroxene probably.
3. Transparent, glassy, shattered; 3 grains, probably spinel.
4. Vesicular, covers N.



Sample 15257 - E_1 S-71-45815

ROCK TYPE: Microbreccia
COLOR: Medium-light gray (N6)
SHAPE: Slabby, subangular
COHERENCE Intergranular: Friable
Fracturing: None

WEIGHT: 0.7 g
DENSITY:
DIMENSIONS: 1.4 x 1.2 x 0.5 cm

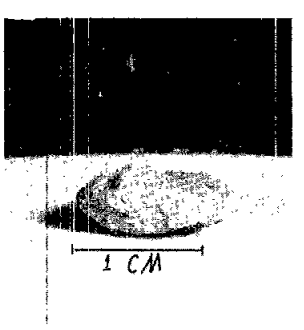
BINOCULAR DESCRIPTION BY: Reid & Ridley DATE: 8/28/71

FABRIC: Microbreccia
VARIABILITY: Homogeneous
SURFACE: Granular
ZAP PITS: None
CAVITIES: None
SPECIAL FEATURES: Glass spheres occur in the matrix.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	light gray-chalky white	10	subangular		0.1-3	
Basalt	dark gray-black	5	subangular	1	0.5-2	
Mafic silicates	dark brown, bluish green, yellow green	5	subangular	1	1-2	1
Spheres	dark green to black	2			<0.1	
Matrix	brownish gray	80			<0.1	

NOTES:

1. Pyroxenes and/or glass.



Sample 15259 - N_1 S-71-44958

ROCK TYPE: Fine breccia
COLOR: Medium dark gray (N4)
SHAPE: Slabby
COHERENCE Intergranular: Coherent
Fracturing: Series of penetrative fractures parallel to N and S faces.

WEIGHT: 314.2 g
DENSITY:
DIMENSIONS: 14 x 7.5 x 4.5 cm

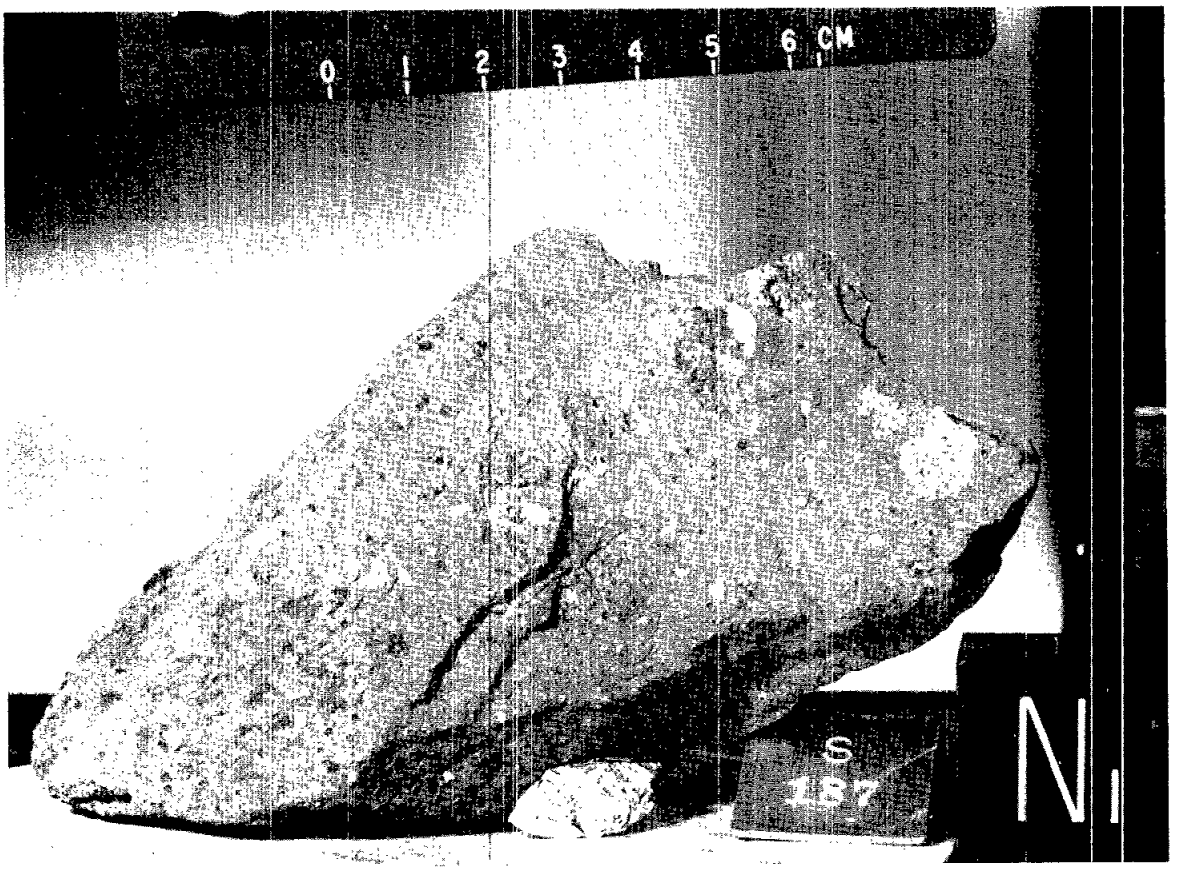
BINOCULAR DESCRIPTION BY: Ridley & Reid DATE: 8/27/71

FABRIC: Fine breccia, equigranular matrix
VARIABILITY: Homogeneous, some variability in clast abundances, largest at W end.
SURFACE: Irregular. E end of N has slickensides.
ZAP PITS: Many on B, T (at E end); few on N, S, E (dusty); none on W.
CAVITIES: None
SPECIAL FEATURES: On N is a clast with feldspar and a bright red mineral. All clasts are angular to subrounded.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (mm) Dom.	Range	NOTE
Basalt	dark gray	<5		2	2-15	1
Basalt	dark gray	5		2	2-10	2
Anorthosite	white	5-8		0.3	0.1-1	3
Microgabbro	light	<5				4
Mafic silicate	dark brown	<2			0.1-1	5
Mafic silicate	green	<2			0.1-0.5	
Plagioclase	white, colorless	<2			0.1-0.5	
Glass beads	black, gray brown, green		irregular fragments			
Matrix	light gray	85	granular		<0.1	6

NOTES:

1. Fine grained
2. Coarse grained, with brown pyroxene and plagioclase.
3. Granulated, both white and gray plagioclase
4. 50% white plagioclase, 50% light honey colored pyroxene, rare ilmenite.
5. Some of the green fragments may be olivine.
6. Mineral fragments.



Sample 15265 - N_1 S-71-44152

THIN SECTION DESCRIPTION BY: Wilshire & Brett DATE: 9/18/71

SECTION: 15265,17

SUMMARY: Glassy polymicit breccia having an unusual abundance of metaclastic clasts. Non-Mare origin.

LITHIC CLASTS, 5% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Metaclastic			up to 1	Metaclastics consist of several light and dark metaclastic clasts.
Basalts			up to 1.5	Basalts consist of intergranular, intersertal, and variolitic textures. One is an olivine vitrophyre, another is ilm-rich variolite.
Breccia			1	Breccia is dark fine-grained matrix with light metaclastic fragments.

GLASS CLASTS, 5% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Pale yellow		irreg	0.8	Pale yellow glass contains small clasts of metaclastic rock.
Colorless		irreg		Brown glass is devitrified spherulitically.
Brown				
Colorless		sph		
Orange		sph		
Green		sph		

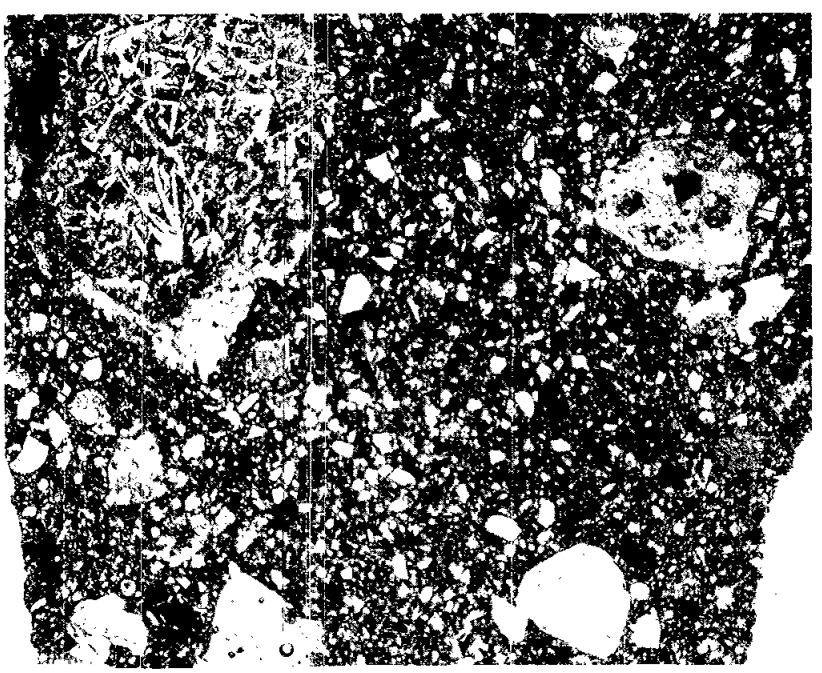
MINERAL CLASTS, 15% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Plag			0.1-1	Plagmafic materials about 1:1.
Aug			0.1-1	
Pig			0.1-1	
Opx			0.4	
Oliv				
Ilm	<0.01	ang	0.1-0.12	

MATRIX, 75% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Ilm	<0.5	subang subrd	<0.1	Matrix contains brown glass and mineral debris.
Fe-Ni	<0.1	subang subrd	<0.05	
Ulvo	<0.1	subang subrd	<0.03	
Troil	<0.1	subang subrd	<0.03	

GENERAL COMMENTS: Very low opaque content indicates almost entirely non-Mare origin.



Photomicrograph Sample 15265,17
(width of field ≈4 mm)

ROCK TYPE: Fine breccia WEIGHT: 271.4 g
COLOR: Medium gary (N5, N6) DENSITY:
SHAPE: Blocky, angular DIMENSIONS: 6.5 x 6 x 5 cm
COHERENCE Intergranular: Coherent to friable
Fracturing: Penetrative and nonpenetrative

BINOCULAR DESCRIPTION BY: Wilshire & Morrison DATE: 8/26/71

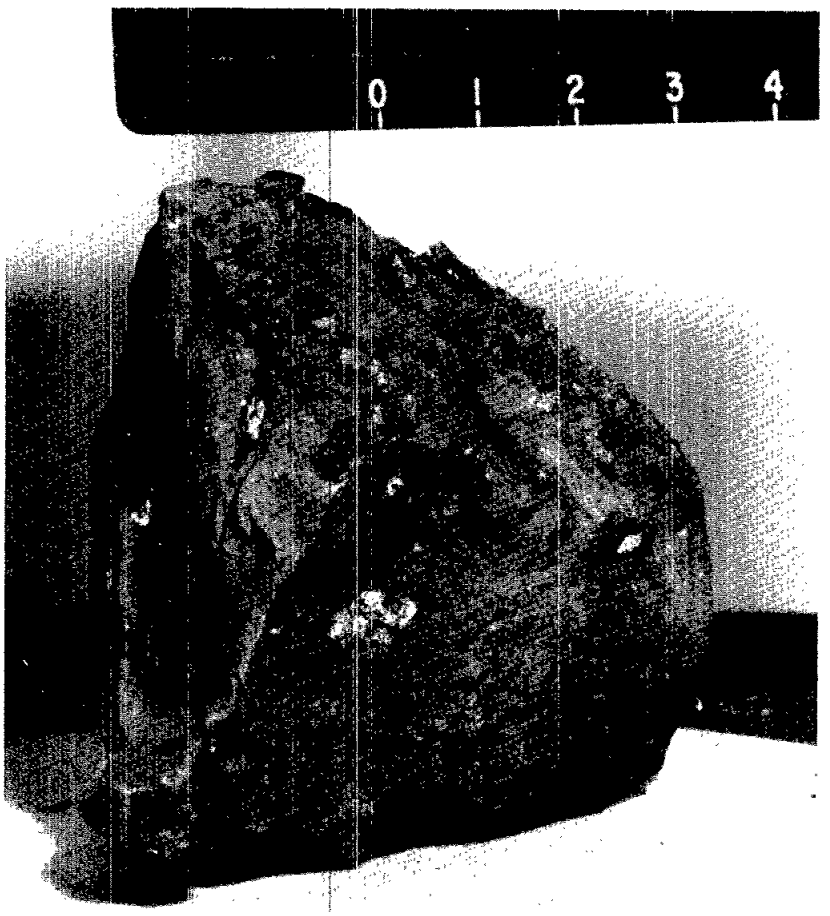
FABRIC:
VARIABILITY: None
SURFACE: Irregular. About one half of T is grooved and slickensided. The grooves are up to 10 mm long, and show definite splaying or fanning. The surfaces sonsist of glass loaded with fragmental debris.
ZAP PITS: Many on N, E (northeast face), and W; few on T; none on S and B.
CAVITIES: None
SPECIAL FEATURES: Basalt clasts are clearly dominant in the 0.5 mm sizes and range from fine to very fine-grained with granular to intergranular textures.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Basalt clast	brownish	1	subrounded	2	>1	1
Basalt clast	brownish	1	angular	3	>1	2
Basalt clast	mottled gray and white	1	subrounded	3	>1	3
Basalt	brownish	1	angular	1.4	>1	4
Aphanitic glass	dark gray	1	angular	3	>1	5
Mafic silicate	yellow-green	one grain	angular	2		6
Mafic silicate	dark green	1	angular	2		7
Feldspar	chalky white		angular	2.5	>1	
Green fragment with gray inclusions			slabby, angular	3		
Clasts		15-20	angular		0.1-1	8
Matrix	light gray	75-80			<0.1	

NOTES:

1. Fine grained basalt, 35% plagioclase, 30% brown pyroxene, 30% yellow green pyroxene, 5% opaques.
2. 50% brown pyroxene, 40% plagioclase, 5% opaques, 1% yellow green pyroxene.
3. Intersertal basalt 5-10% yellow green pyroxene, trace of brown pyroxene, and the rest is equal amounts of plagioclase and dark gray interstitial material.
4. Intergranular basalt with 0.25 mm grain size and 2-3% olivine phenocrysts, 3-4% opaques, and the rest brown pyroxene and slightly more abundant plagioclase.

5. One has a plagioclase porphyroclast.
6. Sugary with relict ungranulated areas on borders. May be olivine.
7. May be pyroxene.
8. Includes dark glass spheres, some green glass including at least 2 spherules, blood-red mineral attached to plagioclase grains, much basalt debris, and fragments of light green material.



Sample 15266 - S_1 S-71-44172

ROCK TYPE: Microbreccia
COLOR: Medium dark gray (N4), mottled with white
SHAPE: Blocky, subangular
COHERENCE Intergranular: Coherent
Fracturing: Few nonpenetrative.

WEIGHT: 1.8 g
DENSITY:
DIMENSIONS: 0.8 x 1.4 x 1.5 cm

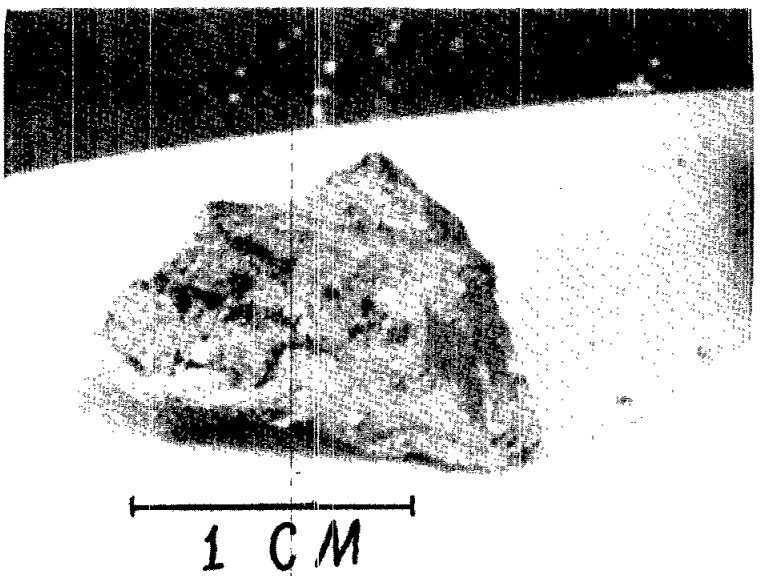
BINOCULAR DESCRIPTION BY: Bass DATE: 8/30/71

FABRIC: Laminated parallel to T and B, fracturing rather than depositional lamination.
VARIABILITY: Abundance of type of >1 mm clasts.
SURFACE: T is 75% glass covered; glass in turn 20% soil covered; glass mainly approximately 0.1 mm film with sharp contact versus breccia; grooved (N-S); medium to dark brownish gray, translucent, vesicular glass (0.1-0.2 mm vesicles, partly dust-filled) in part covers grooves and must have flowed over surface after grooving; vesicular glass <5% of surface. Other faces are smooth to granulated fresh fractures. B 3% clasts >1 mm; much less (<1%) on other faces.
ZAP PITS: None (questionable one on T).
CAVITIES: None except vesicles in part of glass cover.
SPECIAL FEATURES: Glass cover on T does not penetrate fractures; two generations of glass cover - older one grooved, younger vesiculated. N, E, S, and W, have fewer large clasts and fewer lithic clasts than on B.

COMPONENT	COLOR	% OF ROCK	SHAPE	NOTE Dom.	NOTE Range	NOTE
Basalt	brown, dark gray		blocky		-2	1
Anorthosite	white, greenish tinge		blocky, irregular			2
Glass	gray, medium to dark green	1	blocky, ovoid		-2.5	3
Ultramafic	medium green and brown		irregular		-3	4
Breccia	grayish brown		blocky, rounded		-4	5
Matrix	medium to dark gray, slightly brownish	95			<0.1	

NOTES:

1. Very fine grained to 1 mm, 40-60% brown pyroxene, 40-60% plagioclase, trace of opaques.
2. Plagioclase or green mafic 0-30%
3. Some spheroidal, some devitrified.
4. May be shattered pyroxene grain or pyroxenite.
5. Richer in relatively large matrix grains (<1 mm) than host.



Sample 15267 - N_1 S-71-44222

ROCK TYPE: Microbreccia
COLOR: Medium gray (N5), slight brownish tinge
SHAPE: Slabby subrounded
COHERENCE Intergranular: Coherent
Fracturing: None

WEIGHT: 11.0 g
DENSITY:
DIMENSIONS: 3.2 x 2.5 x 1 cm

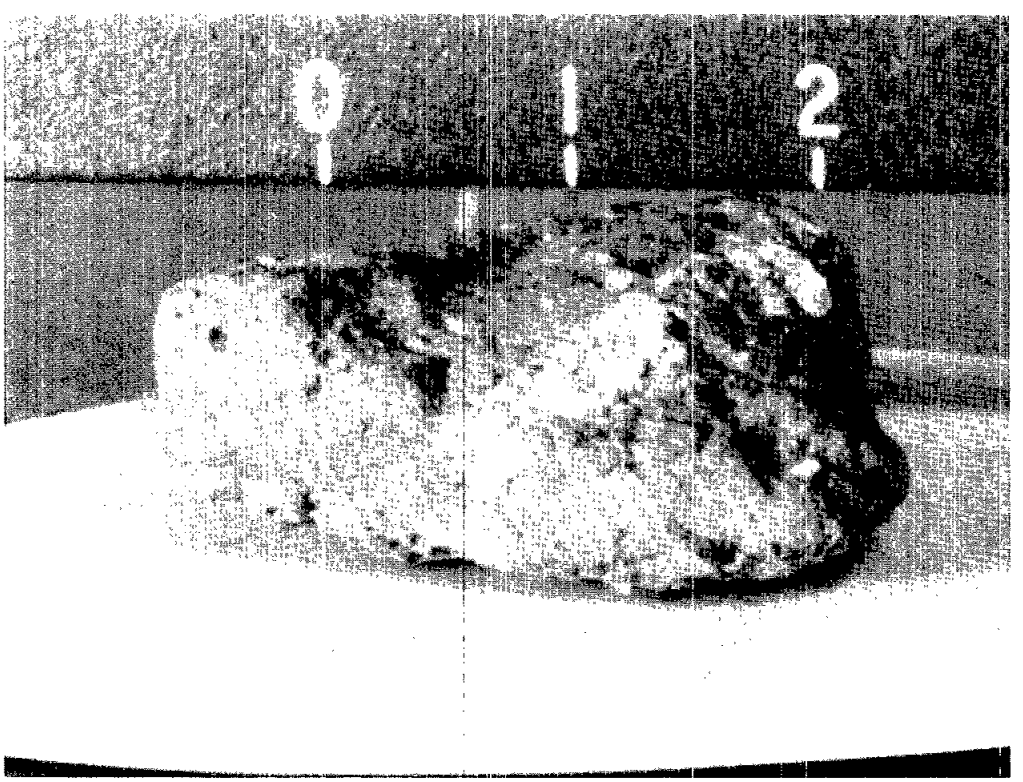
BINOCULAR DESCRIPTION BY: Bass & Ridley DATE: 8/28/71

FABRIC: Mostly isotropic. White breccia band on E discordant to general slabby shape of specimen; vague suggestion of lenticular lamination parallel to T & B.
VARIABILITY: 4 mm white breccia band rich in shocked plagioclase (which comprises almost 50% of 1-5 mm clasts). Abundance of clast types.
SURFACE: Irregular. T no soil cover, B soil in zap pits.
ZAP PITS: Many to few on B; few on T; none on others.
CAVITIES: None
SPECIAL FEATURES: Discontinuous 4 mm band is discordant to shape of sample, and crosses T and the S half of B. It is probably a flattened lithic clast rather than a depositional layer.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Plagioclase	chalky white to light gray	5	equant irregular		<1-2.5	1
Mafic silicate	brownish green		subrounded		up to 3	2
Glass	medium brown	Trace	angular			3
Glass	green	Trace	spherules & irregular			
Glass	dark brown	1	spherules, irregular, & some broken spheres			4
Mafic silicate	green to light brown	Trace				
Lithic clasts	gray to brownish gray	0.5	angular, subangular			5
Matrix	gray, slightly brownish	97			<0.1	6
Mafic silicate	red	Trace	irregular		0.1-0.2	7
Mafic silicate	dark green	Trace		0.3x1		8

NOTES:

1. 1% of gray rock, 35% of band.
2. Pyroxene? shattered. It composes 2-3% of the band where it occurs in white clasts.
3. Transparent
4. May include some mineral fragments.
5. Dense, aphanitic, dull lustre, possibly devitrified glass.
6. Light color suggests paucity if very dark minerals and glass. About 50% of the band.
7. Three grains, transparent, vitreous, similar to spinel in Apollo 14 breccia.
8. A single clast; the only definite large mineral clast in the band.



Sample 15268 - S_1 S-71-44826

ROCK TYPE: Glassy microbreccia WEIGHT: 6.0 g
COLOR: Grayish black (N2); vesicular glass black (N1) and dark gray (N3) DENSITY:
DIMENSIONS: 3 x 1.5 x 0.8 cm
SHAPE: Prismatic, angular
COHERENCE Intergranular: Tough
Fracturing: Three open, nonpenetrative fractures on N & B.

BINOCULAR DESCRIPTION BY: Bass DATE: 9/2/71

FABRIC: Isotropic
VARIABILITY: Glass to glassy breccia, depending on extent of melting.
SURFACE: W, E, N - irregular to smooth (fractured faces); T, B, S - irregular or hackly (vesicular).
ZAP PITS: Few on T, N, E, B(?); none on W, S;
CAVITIES: Vesicles <0.5 to 4 mm in surficial glass on T, B, S.
SPECIAL FEATURES: Locally the outer vesicular glass runs over breccia with sharp contact, but generally they grade into each other either rapidly or through a finely porous, sintered, intermediate zone. The vesicular glass is not splashed, but is melted breccia. On S the glass is streaked like paint which failed to wet a surface collected into blobs; streaks locally resemble slickensides, but raised blobs and curvature of some streaks preclude this.

On N are some raised mounds of dark glass(?); some have raised rounded edges, and one of these has a central mound. They look like soft cow pies, are definitely not zap pits, and may be splash.

The source area for the rock components was apparently anorthositic and lacked significant amounts of basalt or microgabbro.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass	grayish black	75-80				1
Glass	black	10				2
Glass	dark gray	5 or less				3
Clasts	white	10	blocky, angular, subrounded	0.5-1	0.3-1.8	4
Mafic silicate	tan	Trace				5

NOTES:

1. Matrix of breccia.
2. Vesicular outer glass, with rare white or light gray unmelted relics.
3. Transition between vesicular glass and breccia matrix - about 1 mm thick, finely porous.
4. Only one definitely 1 mm; only two white clasts were observed to contain mafics - light tan green in one, brown in the other.
5. Pyroxene?

Sample 15269 - N_1 S-71-45826

ROCK TYPE: Breccia WEIGHT: 264.2 g
COLOR: Medium dark gary (N4) DENSITY:
SHAPE: Blocky or prismatic, subangular DIMENSIONS: 3.5 x 4.5 x 9 cm
COHERENCE Intergranular:
Fracturing: Coherent on W, less so on shattered E end.

BINOCULAR DESCRIPTION BY: Jackson & Bass DATE: 8/28/71

FABRIC:
VARIABILITY: Fairly homogeneous for a breccia
SURFACE: W end lumpy, E end hackly, possibly edge of shatter cone; glass cover variable; B none, T 40%, N 5-10%, S 50%, E 100%.
ZAP PITS: Few on N, B, S; none on T; none on glass.
CAVITIES: Vesicles in glass cover, 2-10 mm, some cintain dust (on T, S).
SPECIAL FEATURES: Almost all of the clasts 1 mm or larger are light colored basalts or fine-grained gabbros.

COMPONENTS	COLOR	% OF ROCK	SHAPE	SIZE (mm) Dom.	Range	NOTE
Basalt	white and greenish tan mottled	5-10	subrounded		1-11	1
Basalt	white, yellow green and deep root beer brown	<1	angular	3x5		2
Mineral	red	Trace				
Matrix		90				

NOTES:

1. About 50% plagioclase, 50% pyroxene (both greenish tans and brownish tans are present in variable porportions), up to 5% tiny opaques. In some: internal glass veins; white shocked plagioclase and shattered pyroxene.
2. Representative clast on B: 50% feldspar; 45% deep root beer brown pyroxene; 5% yellow green, equant mineral, probably olivine; tiny black glass veins.

THIN SECTION DESCRIPTION BY: Bass & Brett DATE: 9/18/71

SECTION: 15285,2

SUMMARY: Microbreccia - Devitrified and broken glass spherule indicate a multiple shock history; but these multiple events did not supply much debris from older breccias of which only one clast was seen. Lithic, silicate mineral, and opaque mineral contents suggest a largely but not wholly non-Mare material contribution.

LITHIC CLASTS, 19.6% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Shocked ign rx	31.7		up to 0.34 x 0.48	One round area may be an accretionary lapillus.
Basalt	14.4		up to 1.1 x 0.85	Shocked ign rx are predominantly gab an, but some norite and intergranular basalt.
Pyrox	13.7		up to 0.5	Basalts are of ophitic, diabasic, and variolitic types with zoned cpx and plag.
Micro gabbro	12.2			Pyrox is polygranular pig and aug.
Gab-anorth	9.4		up to 1.15 x 0.53	Microgabbro contains subequal plag and pyx.
Fsp-pyrox	7.9		up to 0.4 x 0.34	Vitro contains oliv prisms in glass.
Vitro	2.9			Norite is mostly plag with rounded blebs of pyx.
Int bas	2.9			
Norite	2.3		0.22 x 0.36	
Anorth	1.4		up to 0.46 x 0.35	
Breccia	0.7		0.18 x 0.22	

GLASS CLASTS, 20.8% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Yellow to green	32.4	irreg	to 0.6	Yellow to yellowish green glass is generally irregular in shape but there are some spheres and frags of spheres. Some fragments contain flow structure.
Colorless	32.4	ang irreg	to 0.15	Colorless irregular glass may be, in part, maskelynite.
Devit	20.9	irreg to round	to 0.5 x 0.9	Devit material is brown to yellow with bundles of sheaves of very fine needles (pyx and plag?).
Colorless	6.8	round to irreg	to 0.15	KREEP is grayish purple glass with flow structure.
Red brown	6.8		to 0.38	
KREEP	0.7		to 0.26	

MINERAL CLASTS, 59.6% of rock

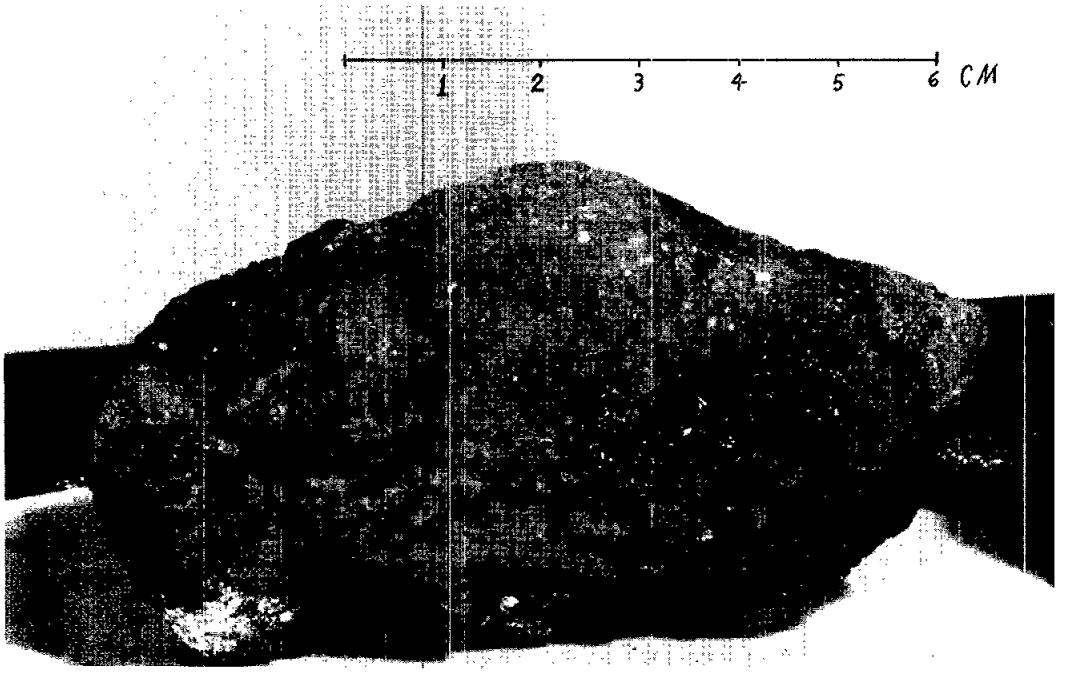
PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Cpx	51.4		up to 0.4	Cpx is largely brownish pigeonite.
Shocked plag	27.8		up to 0.23x 0.43	Unident phase is battleship gray in reflected light, red-brown in transmitted light, and anisotropic (Tranquillite?).
Plag	13.7			
Opx	3.8		up to 0.33 x 0.28	
Ilm	2	ang	up to 0.15	
Devit mask	0.2			
Fe-Ni	0.1-0.2	ang to subrd		
Troil	<0.1	ang to subrd		
Ulvo	<0.1	ang to subrd		
Unident		ang to subrd		

MATRIX, 1% of rock

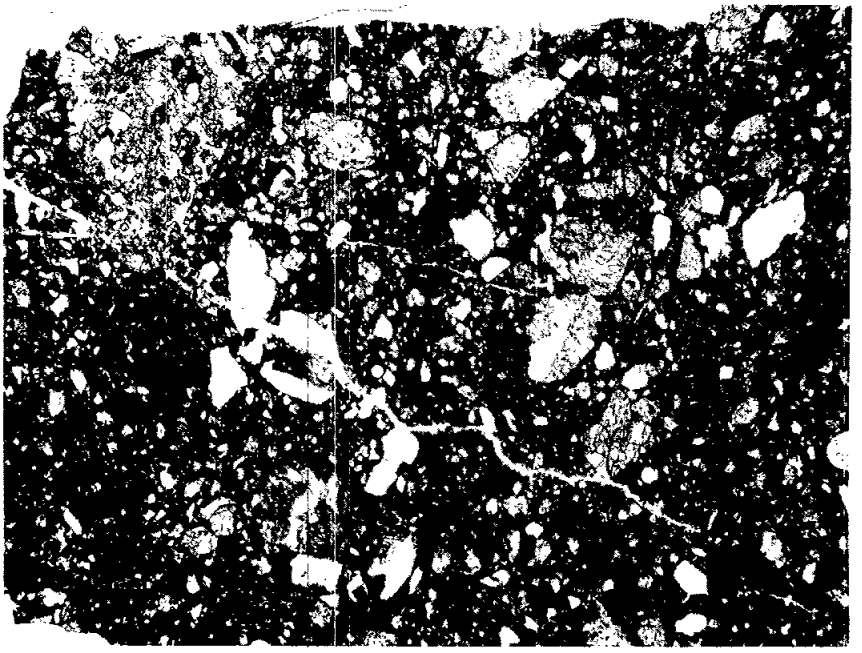
PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
	100		<0.005	Fine brown "paste" along grain boundaries.

GENERAL COMMENTS: Modes based on all grains >0.05 and grains >0.02 in 15% of section. This is a grain count not a volume estimate.

Section is cut by two irregularly pinching and swelling brown glass veins averaging 0.015 mm thick; and by a similar 0.3 mm thick vein with abundant mineral inclusions and microvesicles; and by a triangular area much like the thickest vein.



Sample 15285 - T_1 S-71-44509



Photomicrograph Sample 15285
(width of field ≈4 mm)

ROCK TYPE: Vesicular basalt glass and microbreccia
WEIGHT: 34.6 g
DENSITY:
COLOR: Fresh - grayish black (N2)
Matte exterior - dark gray (N3)
Microbreccia - medium gray (N5) with slight brownish tinge
DIMENSIONS: 5.5 x 3.5 x 3 cm
SHAPE: Irregular ovoid, rounded to angular
COHERENCE Intergranular: Glass - tough microbreccia - coherent
Fracturing: Penetrative and nonpenetrative fractures in microbreccia in two sets subparallel to length of microbreccia septum and intersecting at acute angle (15-20°). Irregular open fractures in parts of vesicular glass.

BINOCULAR DESCRIPTION BY: Bass DATE: 8/31/71

FABRIC: Septum of microbreccia enclosed by vesicular glass; septum exposed on S, B and W pinches out toward E and re-expands at eastern tip; septum is 3.5 x 2 x 1 cm.
VARIABILITY: Glass vs. microbreccia
SURFACE: Exterior smooth, broken vesicules hackly, microbreccia smooth to hackly; N hackly mainly; T, B, E smooth to irregular; S, W, smooth to hackly.
ZAP PITS: Few to many on all surfaces - well developed on glass, larger and poorly preserved (only central glassy area left) on microbreccia. On glass most common on dull matte exterior (expecially E end of N). One zap pit inside main cavity on N indicates main cavity was at least partially open prior to collection.
CAVITIES: Main part of specimen is glass ovoid exposed on N - center - irregular vesicle about 30 mm in diameter with secondary vesicles in walls (<0.5-4 mm) opening toward interior of main cavity. Vesiculates toward exterior only at W end of N.
SPECIAL FEATURES: In area of S (and T) where microbreccia septum virtually pinches out (near E end), the microbreccia surface is slightly slickensided (E-W parallel to length of septum.) In this general area the glass crawls out over microbreccia with distinct raised edge and without evidence of reaction or melting of microbreccia. This is typical contact relation; elsewhere a very thin (0.1 mm roughly) zone of microbreccia vs. glass has a welded or partially melted look, but this is a typical; it is best seen where microbreccia has largely pulled away from glass leaving small blobs firmly attached here and there.

In some general area of S and T the glass contains spheroidal blobs of metal and raised edges - up to 0.2 mm diameter. Metal is light yellow, which may be an effect of irridescent cover or patina. Similar irridesence seen on glass nearby adjacent to edge of microbreccia, and may be the cause of a hazy bluish-white color in the bottoms of some secondary vesicles.

Similar metal blobs on inside surface of large cavity exposed on N also have yellow tarnish. On matte exterior of E end of N similar metal blobs are metallic gray, confirming that yellow tinge is due to tranish.

SPECIAL FEATURES (Continued):

Metal blob never seen exposed on freshly fractured interior of glass but may be more than half embedded. Also, on freshly broken wall of main cavity on N a hemispherical "vesicle" is partly lined by gray metal, so apparently metal could form in small holes in the glass as well as at its surface and inside the main cavity.

Edges of secondary vesicles inside main cavity range from rounded (due to surface tension) to sharp and angular (broken). At least a part of breakage due zapping to judge from presence of zap pit in secondary vesicle inside main cavity on N, and from presence of numerous zap pits at W end, not only inside vesicles, but also on "fresh" fractures of wall of main cavity.

Glass: main glass component almost wholly glassy, but in a few small areas around small vesicles (in one case along exterior surface) freshly broken surfaces have a dull lithic luster suggesting devitrification.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass	grayish black	60	irregular			1
Basalt	brownish white to olive gray		irregular,		1-3	2
Anorthosite	white, slightly tan		blocky		1-6	3
Ultramafic	brown and green		blocky, angular		-2.5	4
Glass	brown	Trace	rounded	1		5
Matrix	medium gray, brownish	38		<0.1	<0.1-1	6

NOTES:

1. Unmelted inclusions (about 1%) are gray, white, colorless, rarely light green - apparently mostly plagioclase.
2. 45-55% plagioclase, 35% yellow green mafic, 15% brown pyroxene, 5% opaques, yellow green in patches up tp 2 mm - possibly much coarser than plagioclase and brown pyroxene.
3. Shattered plagioclase crystal or anorthosite; trace opaques, brown pyroxene to 20%; thin vein of glass(?).
4. Pyroxenite; half brown, half medium yellow green mafic.
5. 1 mm fragment of spheroid - probably glass.
6. Coarser components, in rough order of abundance: dark gray glass spheres; shocked white plagioclase; brown pyroxene; green mafics; microgabbro or basalt; green glass spheres and broken spheres; relatively unshocked plagioclase.

Sample 15286 - S_1 S-71-44952

ROCK TYPE: Soil breccia
COLOR: Olive gray between (5Y 4/1) and dark greenish gray (5GY 4/1) mottled to lighter gray locally
SHAPE: Blocky, subrounded
COHERENCE Intergranular: Coherent to tough
Fracturing: Few, nonpenetrative.

WEIGHT: 44.9 g
DENSITY:
DIMENSIONS: 4.8 x 2.5 x 4.2 cm

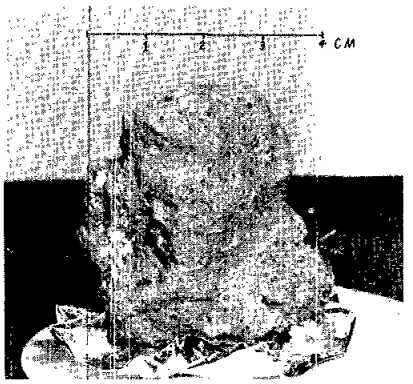
BINOCULAR DESCRIPTION BY: Silver & Head DATE: 8/28/71

FABRIC: Microbreccia
VARIABILITY: Variations in matrix, and in abundance of light colored clasts.
SURFACE: Smooth to rounded.
ZAP PITS: Few on T, S, E, W; many on N and on lower corner of B.
CAVITIES: None

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Matrix	olive green to dark greenish gray	90		<0.05		1
Clasts	light	6	angular	1.5	0.5-5	2
Clasts	dark	2				3

NOTES:

1. Contains a fair amount of white feldspar and some dark glass. Green glass fragments also occur in matrix.
2. Consists predominantly of fine-grained white feldspar with granular pale green pyroxene. Clasts are concentrated locally. There are also basalts containing cinnamon brown pyroxene and light gray plagioclase.
3. Consist of glass and pyroxene fragments.



Sample 15287 - N_1 S-71-44537

ROCK TYPE: Breccia, glassy
COLOR: Medium gray (N4)
SHAPE: Subangular
COHERENCE Intergranular: Tough
Fracturing: Few, penetrative

WEIGHT: 63.1 g
DENSITY:
DIMENSIONS: 4.8 x 3.3 x 3.5 cm

BINOCULAR DESCRIPTION BY: Butler DATE: 9/2/71

FABRIC: Isotropic, microbreccia
VARIABILITY: None
SURFACE: 30% vesicular black glass on T, less on other faces.
ZAP PITS: Few? on S, none on others.
CAVITIES: None
SPECIAL FEATURES: The black glassy matrix and the vesicular dark glass coatings on the rock appear to be the same material and to form a continuous mass in places.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Basalt clasts	light brown	<1	angular	1.5	1-2	1
Plagioclase	white	35	angular subsequent	0.3	0.1-0.5	
Mafic silicate	light to dark cinnamon brown	5	subsequent	0.2	0.1-0.5	2
Mafic silicate	moderate yellow green	<1	rounded, subsequent	0.2	0.1-0.5	3
Mafic silicate	medium bluish gray	Trace		0.2		
Matrix glass	black	30	interstitial			
Matrix clasts	light gray and light brown	30	angular		<0.1	4

NOTES:

1. Has about the same mineralogy as represented by the mineral clasts: Plagioclase 50%, brown (pyroxene) 35%, green (pyroxene) 15%.
2. Pyroxene
3. Pyroxene and possibly a few are olivine.
4. Appears to be mainly plagioclase and pyroxene mineral fragments like the larger clasts.

ROCK TYPE: Glassy microbreccia
COLOR: Grayish black (N2)
SHAPE: Blocky, slightly flattened parallel B and T, angular
COHERENCE Intergranular: Tough
Fracturing: Few penetrative, many nonpenetrative.

WEIGHT: 7.4 g
DENSITY:
DIMENSIONS: 2.6 x 2.1 x 1.5 cm

BINOCULAR DESCRIPTION BY: Bass DATE: 8/31/71

FABRIC: Isotropic
VARIABILITY: Dust cover and frequency of fracturing
SURFACE: B, N irregular (fresh fractures?); T, S hackly; E, W hackly to irregular; minor to moderate dust cover on T, E, W; clasts 1 mm are 3% of N, 1% of B.
ZAP PITS: Few on T; none on N, S, B, E(?), W(?).
CAVITIES: None
SPECIAL FEATURES: Comples fracturing with some grooves and slickensides suggests the rock was part of a shatter cone. One fracture is glass-filled.

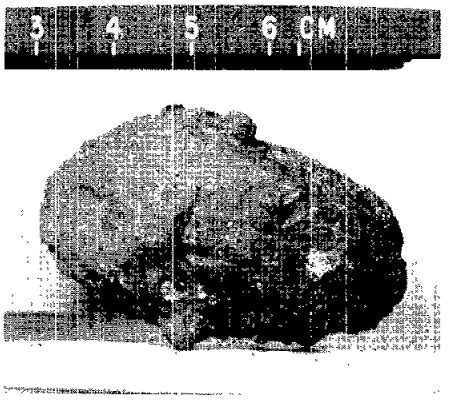
COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Matrix	black	60				1
Basalt	medium brown to brownish green	3	blocky angular		1-3	2
Plagioclase	white to light gray		blocky angular		1-2	3
Shocked plagioclase	white to light gray	25	blocky to irregular		<0.1-1	4
Mafic silicate (& glass?)	light brown to medium brown to grayish brown	5	blocky to irregular		<0.1-1	5
Mafic silicate (& glass?)	various shades of green	2	blocky to irregular		<0.1-1	6
Lithic clasts	brown or gray	3			<0.1-1	7

NOTES:

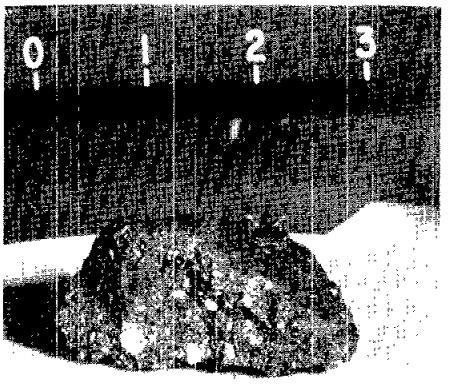
1. Apparently glass.
2. 20% shattered single crystals or anorthosites, 60% white plagioclase, 47% brown and light green pyroxene (mode varies inversely with plagioclase mode), 2-5% opaques. Grain size <0.5-1 mm.
3. 5% opaques, grain size 0.1-<0.5 mm.

NOTES:

4. Single crystals or plagioclase-rich rocks.
5. Single pyroxene crystals, commonly finely granulated with dull earthy luster.
6. Pyroxene and possibly devitrified green glass.
7. Basalt or microgabbro with brown pyroxene; one clast of gray intersertal diabasic basalt.



Sample 15288 - B_1 S-71-45825



Sample 15288,1 - N_1 S-71-44802

ROCK TYPE: Breccia
COLOR: Medium dark gray (N3), gray (N4)
SHAPE: Blocky, angular
COHERENCE Intergranular: Coherent to friable
Fracturing: Penetrative (large cracks)

WEIGHT: 24.1 g
DENSITY:
DIMENSIONS: 4 x 2.5 x 2.5 cm

BINOCULAR DESCRIPTION BY: Jakes DATE: 8/30/71

FABRIC: Fine breccia, size of clast 0.3-5 mm.
VARIABILITY:
SURFACE: W, T, S, irregular; B glass coated; W dust coated; T freshly broken with little glass coating.
ZAP PITS: Few on S, B; none on N.
CAVITIES: None
SPECIAL FEATURES: Rock contains appreciable amounts of white sugary feldspar fragments. An unusual rounded clast has pyroxenes of brown-reddish color.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass coating	dark gray to grayish black	coating	vesicular			1
Anorthosite	white, sugary	32	subrounded	0.4	0.2-1	2
Lithic clasts	greenish-white	4	subrounded, angular	0.6	0.2-1.2	3
Lithic clasts	pale light brown (pinkish)	4	rounded	2	0.8-5	4
Matrix	dark gray	60			<0.1	

NOTES:

1. Broken on several places, vesicles about 2 mm, homogeneous in color.
2. Dominating among clasts, minor or rare mafic minerals in this type.
3. Some elongated, monomineralic, olivine(?).
4. Mainly feldspar and pyroxene mineralogy.

Sample 15289 - N_1 S-71-44834

ROCK TYPE: Breccia
COLOR: Medium light gray (N5, N6)
SHAPE: Angular
COHERENCE Intergranular: Tough
Fracturing: Penetrative and nonpenetrative, weakly healed by glass.

WEIGHT: 947.3 g
DENSITY:
DIMENSIONS: See photo

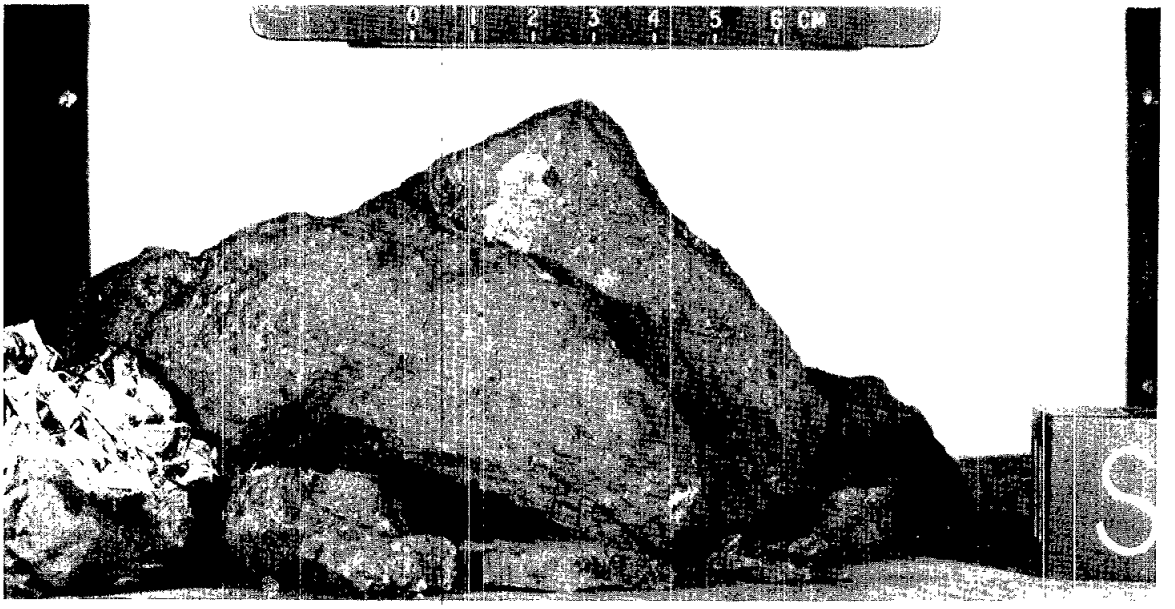
BINOCULAR DESCRIPTION BY: Wilshire & Morrison DATE: 8/24/71

FABRIC: Inequigranular, breccia
VARIABILITY: Rock to glass surfaces
SURFACE: Irregular, 3% glass on E.
ZAP PITS: Few on S, E. W is an interior surface and others are too dusty.
CAVITIES: Vesicles in glass.
SPECIAL FEATURES: Glass on interior surface highly vesicular. Crack dilated and opposite sides did not weld.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	chalk white	5	angular, subangular	20x7x9	to 15x10	
Basalt	light		angular subangular	1-3		1
Lithic	light gray		subangular subrounded	1-12		2
Lithic	pale crystalline green to light green		subangular	1-2		3
Clasts	light	35	angular	0.1-1		4
Matrix		60		<0.1		5

NOTES:

1. All are fine grained, some intergranular for the plagioclase laths and brown pyroxene, others equigranular.
2. Equigranular rocks, one has foliated plagioclase and light gray pyroxene, another has red-brown spinel.
3. Sugary texture.
4. Includes all types listed under >1 mm clasts but with greater dominance of feldspar plus some cinnamon brown pyroxene debris.
5. May be weak foliation in matrix.



Sample 15295 - S_1 S-71-44080

ROCK TYPE: Microbreccia
COLOR: Greenish gray (5GY 4/1 to 5GY 6/1)
SHAPE: Blocky, angular
COHERENCE Intergranular: Friable to coherent
Fracturing: Numerous and penetrative

WEIGHT: 1731.4 g
DENSITY:
DIMENSIONS: 19 x 11 x 10 cm (two large fragments together)

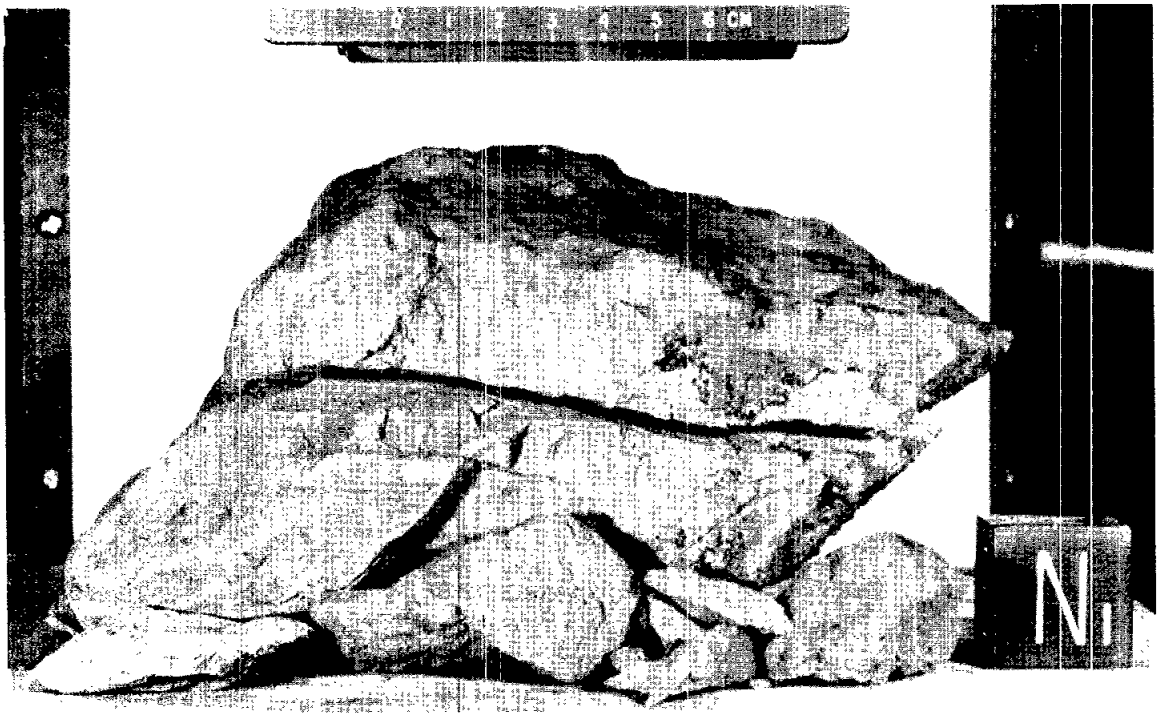
BINOCULAR DESCRIPTION BY: Wilshire & Head DATE: 8/18/71

FABRIC: Microbreccia (<1% of fragments >1 mm)
VARIABILITY: None
SURFACE: Smooth, irregular overall. Splash glass on 10-15% of N, slickensides approximately 2 x 1 cm and well developed feather fractures also on N.
ZAP PITS: N dusty, T very dusty, E,W, none. S many especially on rounded surface.
CAVITIES: None
SPECIAL FEATURES: Textures of lithic clasts do not look igneous. Glass goes down into crack separating two major fragments. Glass may be on surface but is more likely in veins since fresh surfaces expose glass; glass penetrates along fracture for 3-4 cm. Rock has broken along coarsely fluted surface. The flutes look like coarse feather fractures and are approximately 1 mm apart, trace for about 3-4 cm. No horsetailing. These could be shatter cones.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Matrix	greenish gray	99		0.1	-1	1
Lithic clasts	mostly chalky white	1			2-5	2
Lithic mineral and glass clast	white, green and black		angular to round		0.2-1	3

NOTES:

1. Can not resolve shape; coarser sizes are angular.
2. Fine grained polymineralic and heavily shocked.
3. Mostly shocked feldspar, dark brown glass beads and fragments. Light green is less abundant and has finely crystalline (olivine or glass) sugary texture. Black is least abundant and has exceptionally fine crystalline material (pyroxene). (Scarce small deep reddish spinel).



Sample 15298 - N_1 S-71-43044

THIN SECTION DESCRIPTION BY: Morrison & Brett DATE: 9/17/71

SECTION: 15298,5

SUMMARY: Non-annealed glassy matrix breccia containing pre-existing breccia clasts. Non-Mare derivation.

LITHIC CLASTS, 10% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Basalt 1		subang	1	Basalts are fine grained (<0.4 mm) and do not resemble Mare types. Gab an represented by several clasts which are granoblastic plag-pyx. One breccia clast is of annealed type.
Basalt 2		ang	1	
Gab an		ang	1	
Felsic			1	
Breccia 1		ang	4	
Breccia 2		ang	3-4	

GLASS CLASTS, 5% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Light brn		ang		Some brown glass shows spherulitic devitrification.
Pale green		ang	up to 1	
Deep brown		ang spheres	up to 1	

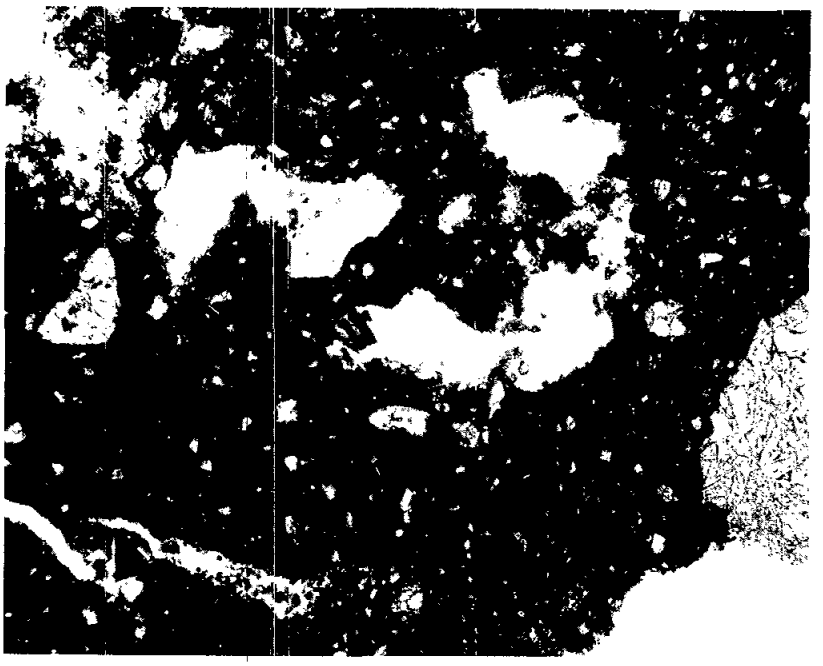
MINERAL CLASTS, 10% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Plag	50	subrd	0.2-1	
Pyx	30	ang	up to 1	
Oliv	Minor			
Spinel?	<1			
Fe-Ni	<0.01	ang	0.1-0.15	

MATRIX, 75% of rock

PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Plag	40	ang	<0.2	Brown glass in the binder in unannealed matrix. Unident phase is opaque, battleship gray with low reflectivity.
Mafic	30	ang	<0.2	
Glass	30			
Ilm	<0.1	ang	<0.05	
Ulvo	<0.1	ang	<0.02	
Fe-Ni	<0.1	ang	<0.02	
Troil	<0.1	irreg	<0.02	
Unident	Trace			

GENERAL COMMENTS: Extremely low abundance of opaques indicates non-Mare derivation of breccia.



Photomicrograph Sample 15298,5
(width of field ≈4 mm)

ROCK TYPE: Breccia
COLOR: Dark gray (N3)
SHAPE: Blocky, angular
COHERENCE Intergranular: Coherent
Fracturing: Penetrating and nonpenetrating fractures are abundant, one penetrating set parallels N face.

WEIGHT: 1691.7 g
DENSITY:
DIMENSIONS: 12 x 12 x 11 cm

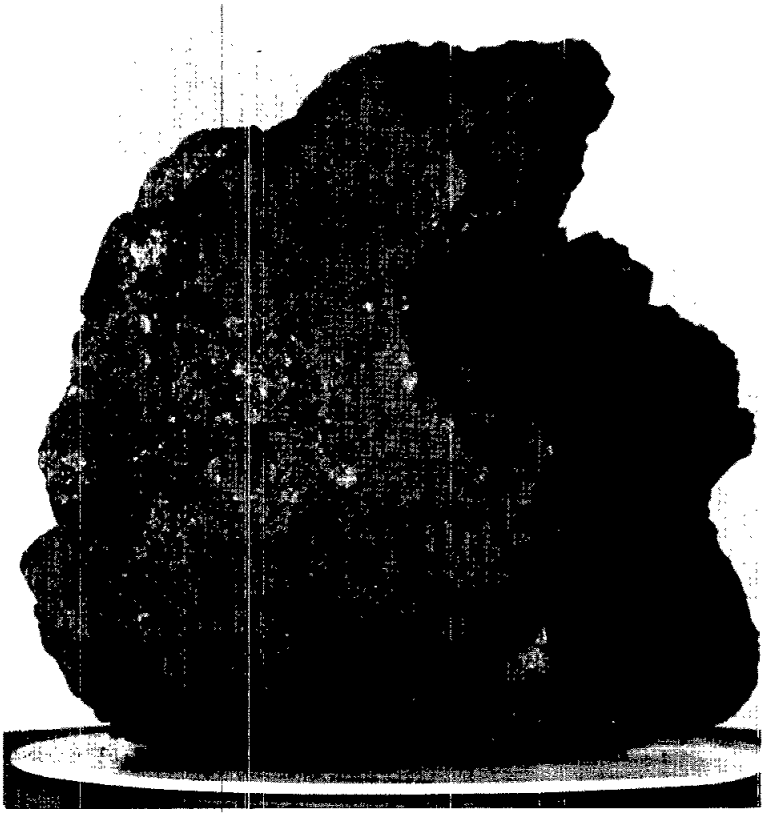
BINOCULAR DESCRIPTION BY: Morrison & Horz DATES: 8/19/71

FABRIC: Seriate clast population randomly distributed, 5-10% >1mm in size. 95% of clasts are white lithic fragments.
VARIABILITY: None
SURFACE: Surface of chip is vesicular glass grooved beneath this glass. It may have been injected along fracture. N face may be grooved also.
ZAP PITS: Rock too dusty and too delicate for this determination.
CAVITIES: None
SPECIAL FEATURES: White lithic clasts are the dominant fragments in all size ranges of this rock, crystal clasts are 20-30% of rock.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Lithic clasts	white	4	rounded, angular	1-2	<1-20	1
Lithic clasts	gray brown	<1	angular	1-2	<1-5	2
Glass(?)	pale green (10G H/2)	<1	subangular	<1	<1-1	3
Glass or pyroxene(?)	reddish brown	<1			<1-1	4
Glass	brown to black	1	angular			
Matrix	dark gray (N3)	70-80	coherent	1		5

NOTES:

1. 95% of clasts >1 mm are of this type.
2. Igneous or breccia, impossible to determine.
3. Some appear granulated, probably are glasses.
4. Some appear to be reddish brown pyroxene in feldspar matrix. This type of red-brown fragment has the same or slightly greater abundance than pale green fragments.
5. Appears to have considerable dark gray to black material. The appearance of the granular matrix suggests that it may have partially recrystallized.



Sample 15299 - W_1 S-71-43056

15301 15311 15426

SAMPLE TYPE: Soil, < 1 mm fraction WEIGHT: 15301 - 810.2 g
COLOR: 15311 - 294.9 g
LOCATION: Spur Crater (Station 7) 15426 - 223.6 g

15301 Soil plus a big glass spherule.
15311 Soil included in the spur rake sample.
15426 Grains abraded or shaken from very friable clods.
See thin section petrography of 15426 for a description of an impregnated clod which was adhering to the rock surface.

THIN SECTION PETROGRAPHY BY: Heiken DATE:

TABLE OF COMPONENTS: Page 161
NOTES TO TABLE:

1. Pale green glass as spheres, ovoids, tear-drop shapes or sphere fragments. Most glass is clear and free of any crystallites, phenocrysts, or detritus, but about one third are devitrified, exhibiting sheaf-like bundles of dendritic orthopyroxene crystals. Some "mesh-like" devitrification textures. There is about 1% "second generation" green glass, containing mineral detritus and schlieren.
2. Light yellowish-brown glass with a small amount of mineral detritus; some are completely clear glass. There are spheres, ovoids, and sphere fragments present.
3. Colorless high refractive index, containing about 3% well-oriented orthopyroxene microlites.
4. Mineral detritus (feldspar, pyroxene) and small, angular brown glass fragments bonded by welded droplets of pale brown glass.
5. Recrystallized; shocked, feldspar-rich lithic fragments and aphanitic feldspar matrix.
6. Colorless to pale brown augite.
7. Colorless.
8. Fractured anhedral fragments. A composition for one grain is about An65.
9. Texture is equigranular, porphyritic. About 60% feldspar, 25% clinopyroxene, 15% opaque minerals.
10. Mostly feldspar; a trace of clinopyroxene.
11. Consisting of all green glass, as described in note 1.
12. Angular light brown glass fragments containing 5-10% mineral detritus and crossed by schlieren.
13. Vitric, consists of 50-75% mineral detritus (mostly angular fragments of clinopyroxene, feldspar and olivine) in a clear, brown glass matrix. There are no schlieren made up of trains of fine-grained detritus.
14. Colorless.

COMPONENT	NOTE	15301 PERCENT OF GRAINS 0.5-1.0mm	15301 PERCENT OF GRAINS 0.25-0.5mm	15301 PERCENT OF GRAINS 0.125-0.25mm	15311 PERCENT OF GRAINS 0.5-1.0mm	15311 PERCENT OF GRAINS 0.25-0.5mm	15311 PERCENT OF GRAINS 0.125-0.25mm	15426 PERCENT OF GRAINS 0.5-1.0mm	15426 PERCENT OF GRAINS 0.25-0.5mm	15426 PERCENT OF GRAINS 0.125-0.25mm
Glass droplets, clear, pale green	1	25	32.8	36.9	16.6	29	46.5	31.0	77.0	82.0
Glass droplets, yellow-brown	2	-	5.2	1.4	-	4.8	4.5	8.0	9.0	7.3
Glass fragments	3	-	1.7	1.4	-	-	1.0	-	-	-
Agglutinates	4	25	50.0	39.0	16.6	8.1	9.0	23.0	3.0	8.4
Microbreccia	5	-	5.2	13.6	33.3	12.9	6.0	-	-	0.3
Clinopyroxene	6	-	1.7	7.2	-	11.3	7.5	-	-	1.3
Orthopyroxene	7	-	-	2.8	-	3.2	2.5	-	-	0.3
Feldspar	8	-	-	2.8	16.6	9.7	3.0	-	-	0.7
Basalt	9	50	1.7	2.8	16.6	6.4	5.5	-	3.0	-
Anorthosite	10	-	1.7	-	-	1.6	-	-	-	-
Clastic rock	11	-	1.7	-	-	1.6	1.0	38.0	6.0	-
Glass fragments	12	-	-	-	-	6.4	1.5	-	-	-
Microbreccia	13	-	-	-	-	3.2	9.0	-	-	-
Olivine	14	-	-	-	-	1.6	1.0	-	-	-
Grains counted		4	58	200	6	62	200	13	33	200
Section number		15	14	13	12	11	10	16	15	14

15306 - 15308, 15315 - 15392

SAMPLE TYPE: Rock (fragment >1 cm) WEIGHT: 663.5 g
COLOR: 81 samples
LOCATION: Spur Crater (Station 7)
From the rake sample (15310-15392) and related soil sample (15300-15308)

BINOCULAR DESCRIPTION: By Morrison & Wilshire DATE: 9/71

Group 1: (6 samples)	15315 15316 15317 15318 15319 15320	Soil breccias distinguished by clasts of basalt containing cinnamon brown pyroxene. Other clasts of anorthosite-gabbro group, gray pyroxene basalt, green-glassy microbreccias and the basalts of Group 7 may also be present.
Group 2: (36 samples)	15306 15321 thru 15355	Soil breccias distinguished by lack of basalt containing cinnamon brown pyroxene. Otherwise the clasts are similar to Group 1.
Group 3: (6 samples)	15308 15356 thru 15360	Tough microbreccias with light colored lithic and mineral clasts in dark gray, aphanitic, subvitreous matrix (similar to black part of 14455).
Group 4:	15361	Pale green, tough, microcrystalline rock: probably a finely granulated gabbro or norite.
Group 5:	15362 15363 15364	Anorthosite: one is finely granulated, other two are coarser grained.
Group 6: (13 samples)	15365 thru 15377	Friable green glass microbreccia: one contains clasts of green pyroxene bearing gabbro in a matrix of green glass and pyroxene.
Group 7: (7 samples)	15378 thru 15384	Fine-grained basalts with very light brown to light yellow-brown pyroxenes and a plagioclase: mafic ratio of 1:1. No vugs or vesicles.
Group 8:	15385 15386 15387 15388	Basalt slightly vuggy, coarse grained, zoned green to red-brown pyroxene, with plagioclase to mafic ratio of nearly 1:2.
Group 9: (5 samples)	15307 15389 thru 15392	Glass

ROCK TYPE: Breccia
COLOR: Brownish-gray (5YR 4/1)
SHAPE: Round, subangular
COHERENCE Intergranular: Coherent
Fracturing: Few. Rock has broken into three pieces.

WEIGHT: 134.2 g
DENSITY:
DIMENSIONS: 7 x 5 x 3 cm

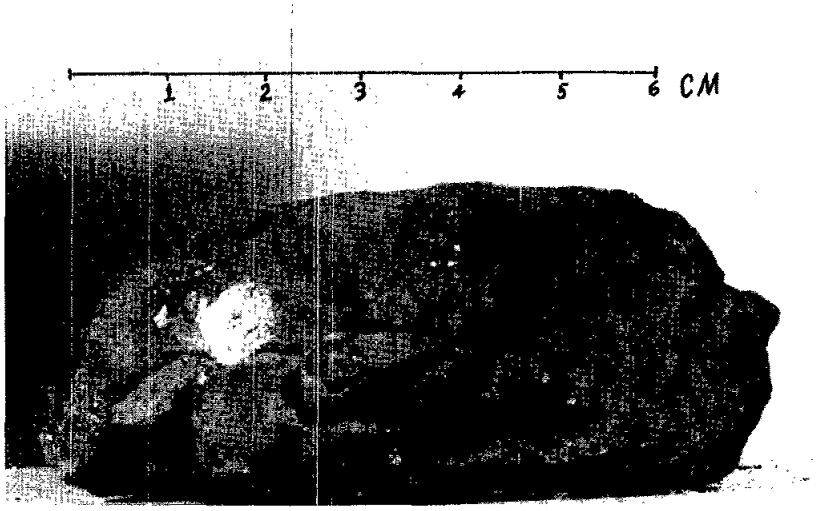
BINOCULAR DESCRIPTION BY: Warner DATE: 8/18/71

FABRIC: Breccia
VARIABILITY: Homogeneous for breccia
SURFACE: Irregular
ZAP PITS: Few
CAVITIES: 1%
SPECIAL FEATURES: Pits glass lined.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTES
Matrix	gray	96				
Light clast	white	3	ovoid	1	0-10	1
Green clast	green	Trace		1		
Black glass	black	Trace		0.1		
Brown glass	brown	Trace		0.1		
Green glass	green	Trace		0.1		

NOTES:

1. Light clasts include feldspar aggregates, anorthosite and plagioclase-rich basalt.



Sample 15306 - S_1 S-71-43061

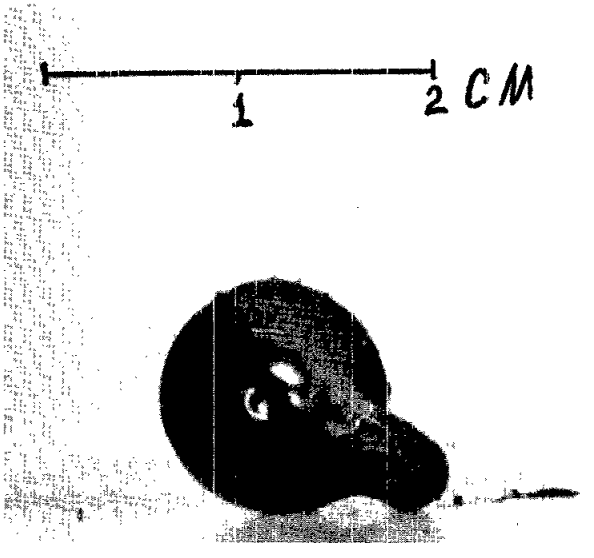
ROCK TYPE: Glass, hollow sphere
COLOR: Dark green black (5G 2/1)
SHAPE: Spheroidal with a protruding lip
COHERENCE Intergranular:
Fracturing:

WEIGHT: 1.3 g
DENSITY:
DIMENSIONS: 1.3 cm

BINOCULAR DESCRIPTION BY: Warner DATE: 8/25/71

FABRIC: Glass
VARIABILITY: None
SURFACE: Smooth in general with bubble dimples. One hemisphere is shinny black glass, the other mostly dust-covered.
ZAP PITS: None
CAVITIES:
SPECIAL FEATURES: One hole broken in the glass shows it to be a shell. A roll or lip of glass is attached to one side.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass	green black	100%	hollow sphere	1.4		



Sample 15307 - E_1 S-71-43037

ROCK TYPE: Breccia
COLOR: Gray
SHAPE: Subangular
COHERENCE Intergranular: Coherent
Fracturing: Absent

WEIGHT: 1.7 g
DENSITY:
DIMENSIONS: 1.5 x 1 x 1 cm

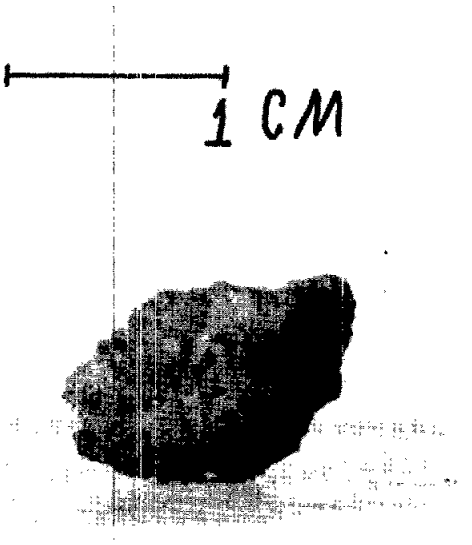
BINOCULAR DESCRIPTION BY: Warner DATE: 8/25/71

FABRIC: Fine breccia
VARIABILITY: None
SURFACE: Irregular
ZAP PITS: None
CAVITIES: None
SPECIAL FEATURES:

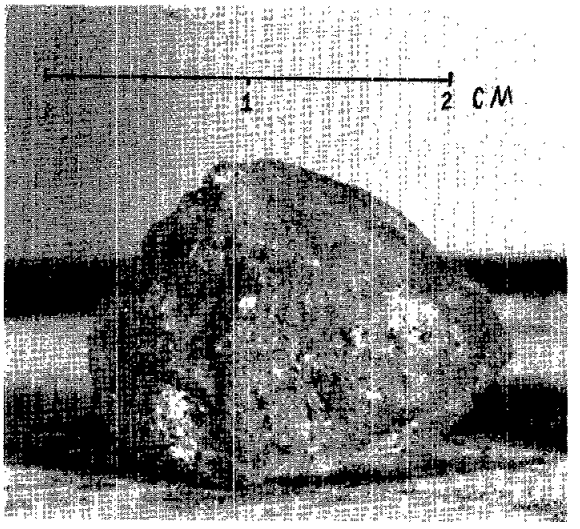
COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Lithic clasts	white	4				1
Matrix	dark gray	95			0-0.2	
Glass bead	black	1	spheres		0.5	

NOTES:

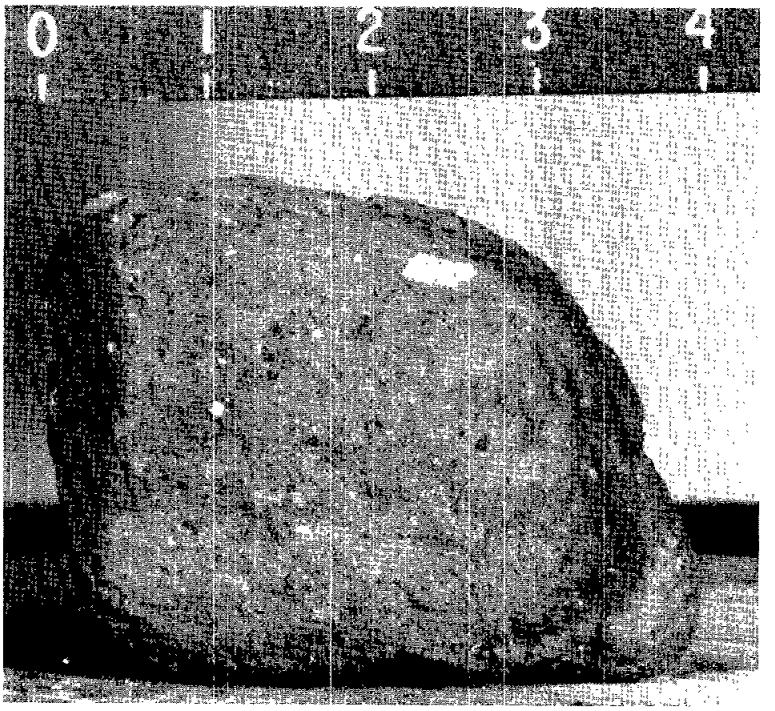
1. Various types.



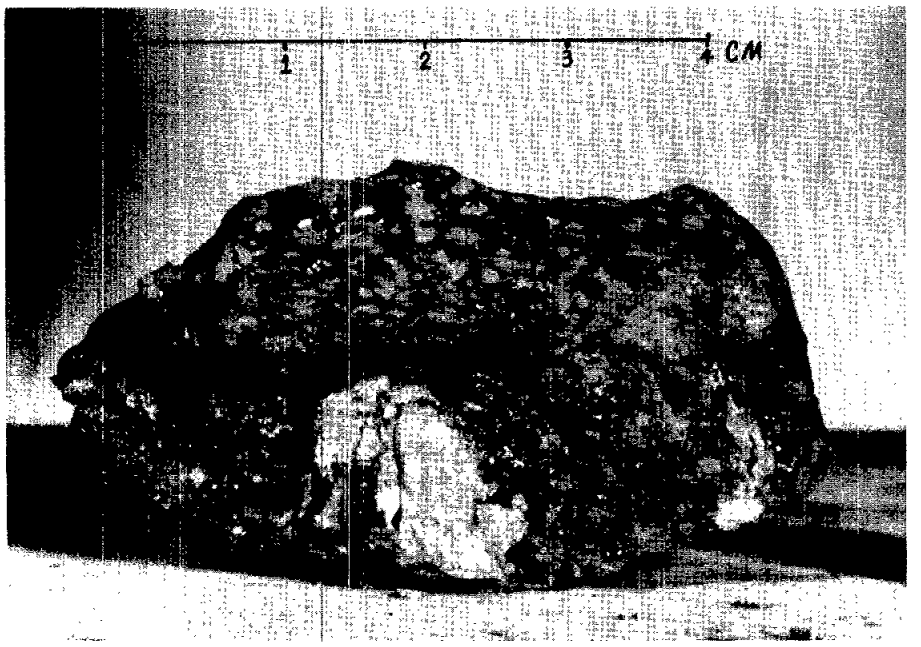
Sample 15308 - N_1 S-71-43065



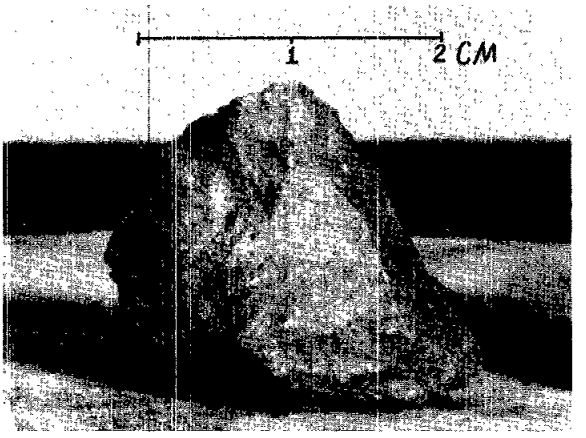
Sample 15320 - Typical of
Spur rake sample group 1
S-71-49377



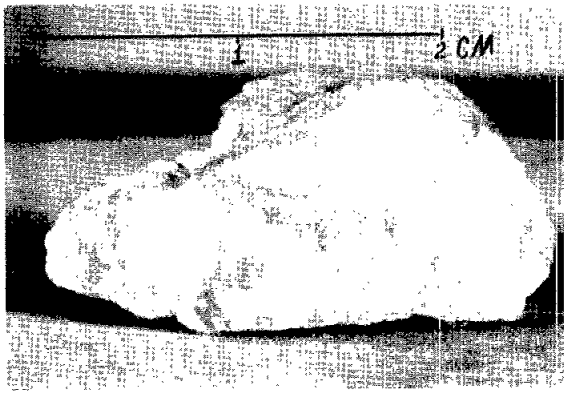
Sample 15324 - Typical of
Spur rake sample group 2
S-71-49640



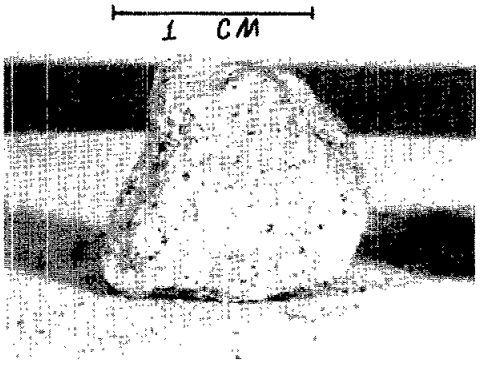
Sample 15325 - Typical of
Spur rake sample group 2
S-71-49645



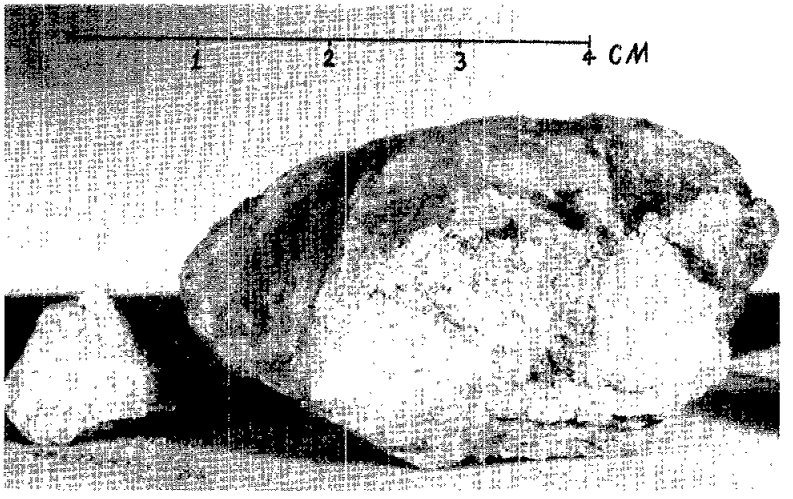
Sample 15357 - Typical of
Spur rake sample group 3
S-71-49353



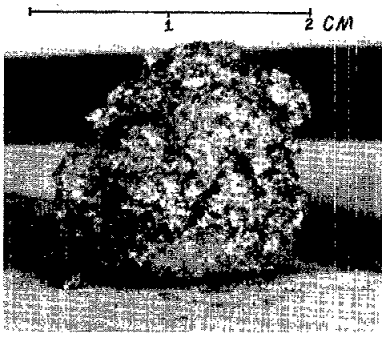
Sample 15362 - Typical of
Spur rake sample group 3
S-71-49629



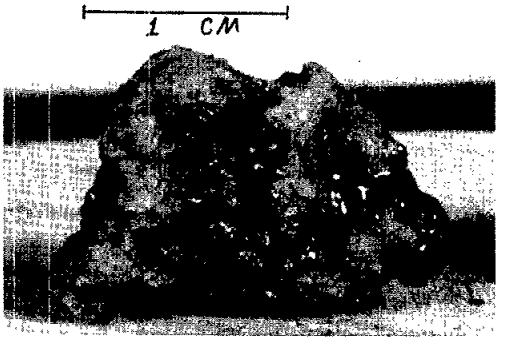
Sample 15369 - Typical of
Spur rake sample group 6
S-71-49165



Sample 15379 - Typical of
Spur rake sample group 7
S-71-49170



Sample 15385 - Typical of
Spur rake sample group 8
S-71-49189



Sample 15389 - Typical of
Spur rake sample group 9
S-71-49144

ROCK TYPE: Breccia (photo 44120) WEIGHT: 513.1 g
COLOR: Olive (10Y 6/2) and light olive gray, (5Y 5/2) for surficial coating, N5 and parts to N3 for matrix beneath coating. DENSITY:
DIMENSIONS: 9 x 8.8 x 5 cm
SHAPE: Blocky, angular
COHERENCE Intergranular: Coherent
Fracturing: Numerous penetrative fractures in irregular shatter patterns, dilated as in explosive fracturing.

BINOCULAR DESCRIPTION BY: Silver & Morrison DATE: 8/25/71

FABRIC: Shattered breccia
VARIABILITY: Rock appears to be intensely fractured black and white breccia with irregular distribution of light colored phases. A superficial coating of light olive green glass. Rich, fine material is variably distributed on different surfaces.
SURFACE: Extremely hackly, smoothed by green glass dust coating.
ZAP PITS: Few(?) on T, none on other faces.
CAVITIES: 3-5% formed in the dilation of fractues.
SPECIAL FEATURES: Most recent shattering has made a new breccia from the old breccia. The rock looks like a dilatedly fractured older breccia comprised of very light gray to white cataclastically deformed(?) feldspathic inclusions and darker gray (N3-N5) material that seems to have variable abundance of light colored clasts. Grain size of gray material is very fine. Some gray material appears to be veining light inclusions. Light inclusions not uniformly distributed. A few scattered coarser crystal fragments, most appear to be a pale green pyroxene (?). The fracturing has been superimposed on this complex intergrowth of light and dark material as if by impact shattering. This fracturing cuts across all older structures including veined light inclusions. The green glass-rich superficial coating appears to be plastered on and into open cracks of the fractured breccia, and is suprisingly uniform in its properties, resembling the light green rock, 15425.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Greenish dust coating	light green to olive green	5	rich in green glassy spheres			1
Matrix	medium gray (N5) to dark gray (N4)	65	irregular distribution some veinlets, sugary			2
Anorthosite	light gray to white	30	subangular	5	0.1-15	3
Basalt		<1				4

NOTES:

1. Matrix has fine dusty yellowish gray green in aggregates, and containes green spheres, dumb-bells and shards of glass. Largest glass particles are 0.2-0.3 mm. Dust is adhesive and is retained on all other surfaces.
2. In irregular masses up to 3 cm and in some veinlets as thin as 0.1-0.2 mm and 10-20 mm long. Grain size variable, mostly less than 0.5 mm. Occassional glassy bubbles, probably not glass-mineral.
3. Plagioclase grains and plagioclase rich rocks. Milky white plagioclase, granulated with islands of translucent plagioclase. A few small pale green-gray and brown grains (pyroxene?). Some clasts are veined by gray material.
4. Fine-grained with very pale brown, pale yellow green olivine(?), dark gray material and plagioclase.

THIN SECTION DESCRIPTION BY: Morrison & Brett DATE: 9/19/71

SECTION: 15405,2

SUMMARY: Recrystallized breccia with preferred orientation of calsts. Lithic clasts and matrix are of non-Mare origin.

LITHIC CLASTS, 35% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Basalts		ang	1-2	Basalts contain 65% plag and 35% zoned cpx. Texture is intergranular. Clast-matrix boundary is sharp.
Granular rocks		ang	1-2	Granulated igneous rx which were similar to the basalts. Several have at least 50% plag. Glass occurs in two such clasts.

GLASS CLASTS, 5% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Colorless to green		ang	1	Only one large glass clast seen. It is not devitrified and has has sharp contacts with matrix.

MINERAL CLASTS, 55% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Plag	60	ang	0.25-1	Rare plag grains reacted with matrix to form recrystallized rims.
Cpx	20	ang	0.1	
Mottled grains	10			

MATRIX, 5% of rock

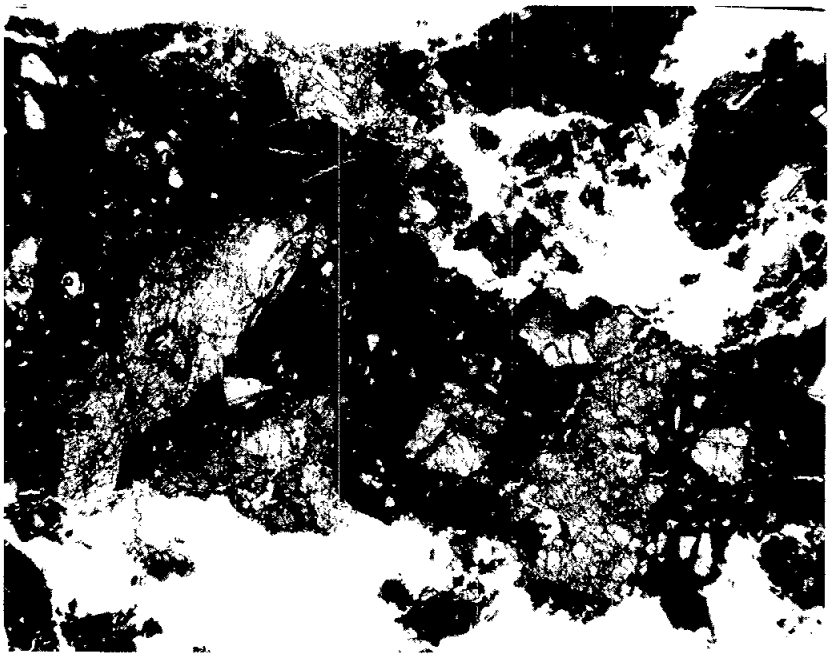
PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Granular silicates	60	blebs	<0.025	Matrix is opaque-rich and recrystallized but contains undevitrified glass clasts.
Opaque	20	ang to acicular	<0.05	Opaques are extremely fine-grained. (Many below resolution.)
Debris + glass	10	ang	<0.25	Euhedral ilm indicates recrystallized matrix.
Ilm	<1	ang + laths	<0.05	
Fe-Ni	<0.1	blebs	<0.05	
Ulvo	<0.1	ang	<0.02	
Troil	<0.1	irreg	<0.04	

GENERAL COMMENTS: Lithic and mineral clasts appear to have preferred orientation of long axes.

Basalt clasts are more plag-rich than Mare basalts.

Opaque content indicates a non-Mare origin for matrix. Clasts are also very low in opaque content, an indication of non-Mare origin.

Sample 15405 - S_1 S-71-44127



Photomicrograph Sample 15405,2
(width of field ≈4 mm)

ROCK TYPE: Anorthosite
COLOR: Very light gray (N8) where opaque, slightly toward pinkish gray (5YR 8/1) where translucent
SHAPE: Blocky, angular to subrounded
COHERENCE Intergranular: Tough to friable
Fracturing: Penetrative marked by opaquing in feldspar, systematic parallel.

WEIGHT: 269.4 g
DENSITY:
DIMENSIONS: 8.8 x 5.8 x 4 cm

BINOCULAR DESCRIPTION BY: Silver & Phinney DATE: 8/23/71

FABRIC: Equigranular originally, now granulated in local regions.
VARIABILITY: Local opaque white feldspar regions on surface as on B are more granular than elsewhere.
SURFACE: Irregular, hackly on fresh faces; smoother, less hackly on dust covered surfaces.
ZAP PITS: S few; others none.
CAVITIES: None
SPECIAL FEATURES: Local granulation at grain boundaries and fractures. Pervasive fracture set in T photo from 11 o'clock to 5 o'clock.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	very light gray	99	subhedral	8	5-15	1
Mafic silicate	brownish	3 grains (2 on N & 1 on S)	platy			2

NOTES:

1. Nongranulated feldspar is somewhat vitreous. One crystal shows evidence of two twin laws, others show single polysynthetic twins.
2. Pyroxene.

THIN SECTION DESCRIPTION BY: Silver & Brett DATE: 9/28/71

SECTION: 15415,17; 15415,19; 15415,21; 15415,29; 15415,30

PHASE	PERCENT	SHAPE	SIZE (mm)
Plag	99	polyhedral	ave 3-4
Pyx	1	equant	0.05
Ilm	Trace	anhedral	<0.05
Apa	Trace	elongate ellipsoid	<0.05

COMMENTS:

Very coarse granulitic. Both plag and pyx are polyhedral (polygonal in thin section) but not idiomorphic.

Largest plag grain extends across entire 7 mm width of thin section. All grain sizes have similar texture except where superimposed mechanical granulation and shock effects modify them.

Pyroxenes consist of at least two and probably three mineral species on the basis of optics. They display textures such as inclusions and interfeldspar beads that are metamorphic.

Only a few small blebs of ilmenite occur as opaques. No other opaque minerals.

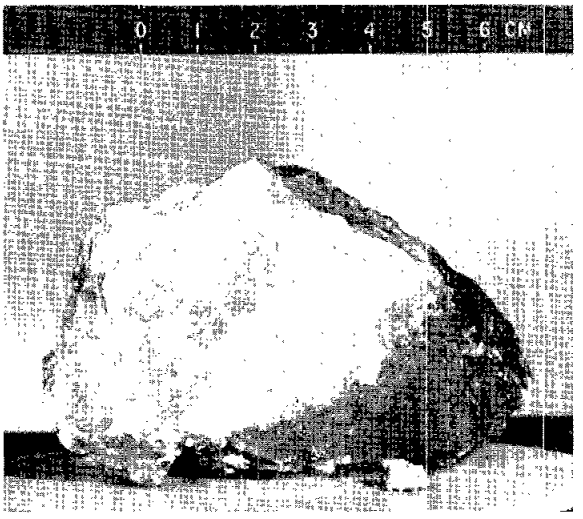
Only one grain of apatite seen.

Cataclastic and/or shock textures are prominent in all thin sections. They include compound non-displacive fractures, numerous microfaults, local thin zones of granulation, larger anastomosing granulation zones, probable planes of shock melting and devitrification.

A good set of textural and mineralogical evidence suggests more than one stage of high-temperature recrystallization. There is also evidence for more than 1 episode of cataclastic and shock effects.

SUMMARY:

The "anorthosite" is actually a metamorphic rock, a pyroxene granulite, of extremely felsic composition. Probably an original "igneous" anorthosite, but it's complicated history suggests it should be interpreted with great care.



Sample 15415 - N_1 S-71-42951

Photomicrograph Sample 15415
(crossed polars, field ≈4 mm)

ROCK TYPE: Breccia
COLOR: Light brownish gray (5YR 6/1)
SHAPE: Rounded
COHERENCE Intergranular: Coherent
Fracturing: Few, penetrative, small scale.

WEIGHT: 1.3 g
DENSITY:
DIMENSIONS: 1.5 x 1.5 x 1 cm

BINOCULAR DESCRIPTION BY: Warner DATE: 8/30/71

FABRIC: Breccia
VARIABILITY: None
SURFACE: Smooth
ZAP PITS: None
CAVITIES: None
SPECIAL FEATURES: One surface is fresh, the rest are rounded and weathered. There may be a white coating(?) on the fresh break.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Matrix	gray	80			0-0.2	
Plagioclase	white	16			0.2-2	
Mafic silicate		2			0.2-1	
Igneous	white	2			1-2	

Sample 15417 - S_1 S-71-43887

ROCK TYPE: Breccia, vitreous matrix
COLOR: Medium dark gray to dark gray (N2, N4)
SHAPE: Blocky, subrounded
COHERENCE Intergranular: Tough
Fracturing: One nonpenetrative set parallel to N-S.

WEIGHT: 1140.7 g
DENSITY:
DIMENSIONS: 8 x 15 x 10.5 cm

BINOCULAR DESCRIPTION BY: Morrison DATE: 8/24/71

FABRIC: Inequigranular
VARIABILITY: Vesicles are concentrated on part of N.
SURFACE: All smooth. Slip surfaces are locally exposed.
ZAP PITS: Many on N, S, (W side); few on S (E side), E, W.
CAVITIES: Vesicles average 1%, but are concentrated, probably relating to fracturing, on N where they range from about 1-10 mm. They are smooth walled with no projecting crystals, but are lined by sheafs or felted acicular crystals.
SPECIAL FEATURES: The glassy appearance of the rock and the color of the vitreous or cryptocrystalline areas are unlike the other breccias.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Anorthosite	white mottled, light gray, vitreous	5-10	rounded to angular	5	0.1-15	1
Plagioclase	white to medium gray	20	lath		0.1-4	
Glass	colorless	5				2
Mafic silicate	green	Trace				3
Matrix	gray (N4)	60			<0.1	4
Opaque		Trace			<0.1	5

NOTES:

1. Vary from whitish granular, sugary fragments to white fragments with a nearly opaline luster. Rare pale brown and green pyroxenes(?) occur in the clasts. Some cleavages are present, particularly smaller clasts. Appear to have a cleavage. Most boundaries with the matrix are sharp, but some are gradational. The matrix penetrates and interdigitates with some clasts.
2. Very vitreous, transparent areas, either glass or quartz.
3. Plagioclase lath occurs in one such area.
4. Granular, cryptocrystalline.
5. Scattered in matrix. Clasts appear to be free of opaques.

THIN SECTION DESCRIPTION BY: Silver & Brett DATE: 9/17/71

SECTION: 15418,8

SUMMARY: Partially shock melted, devitrified, and recrystallized rock. Original material not certain from this thin section. Heterogeneity of rock may allow some clasts to display better clues of original mineralogy and texture.

PHASE	PERCENT	SHAPE	SIZE (mm)
(Region A)			
Devit			
Plag			
Pyx			
(Region B)			
Plag		laths	up to 0.25x0.05
Pyx		skeletal	
(Region C)			
Plag		laths	length 0.05-0.1
Pyx			
(All Regions)			
Fe-Ni	<0.01	angular to anhedral	0.05
Troil	<0.01	angular to anhedral	0.05

COMMENTS:

Devitrified glass of Region A is chaotically swirled and contains plag patches, swirled dusty appearing regions, clots of medium biref. mafic silicates (opx or cpx?), rounded to subrounded mottled mafic clasts, and relict pyx. This region is, in part, recrystallized.

Plag laths of Region B are randomly oriented with dusty interstitial areas containing skeletal pyx including opx. Feathery devit. of the interstitial areas produces the pyx.

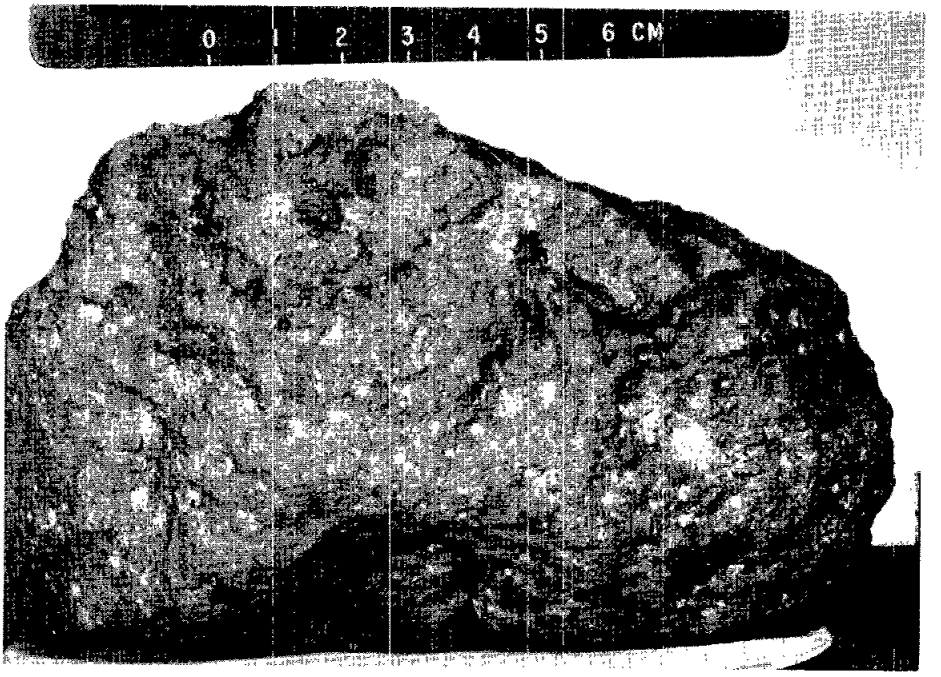
Plag laths of Region C have well-formed pyx crystals interstitial to them in contrast to skeletal crystals of B. Region C contains a microcrystalline plag clast which is reacting with the matrix.

Total opaque content is less than 0.01%. There is very little Fe-Ni in Troil.

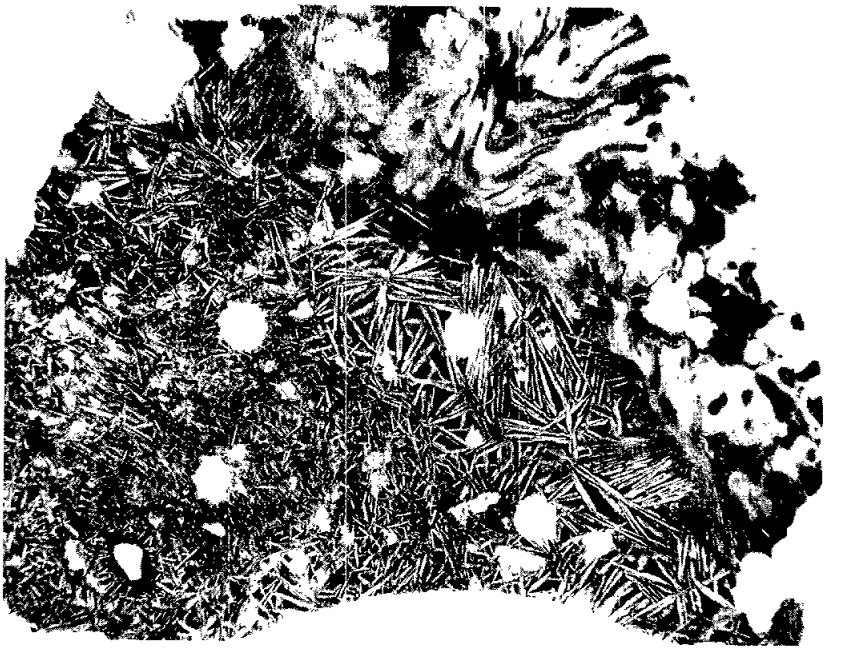
Thin section contains three texturally distinct regions. Outermost is labeled A, next is B, then C.

Region A has irregularly shaped vesicles. Regions B and C have round vesicles.

The rock appears to have formed by shock melting of parent material producing a liquid-clast mass, followed by crystallization of liquid patches and crystallization, in solid state, of glass. Glass/liquid ratio is undefined by crystalline sequence. Melting was not sufficient to reduce all clasts to liquid as relict clast remain; but these have recrystallized along with matrix.



Sample 15418 - N_1 S-71-43656



Photomicrograph Sample 15418,8
(width of field ≈4 mm)

ROCK TYPE: Breccia with glass
COLOR: Medium light gray (N6)
SHAPE:
COHERENCE Intergranular: Coherent
Fracturing: Penetrative and nonpenetrative

WEIGHT: 17.7 g
DENSITY:
DIMENSIONS: 3.5 x 2.5 x 1.5 cm

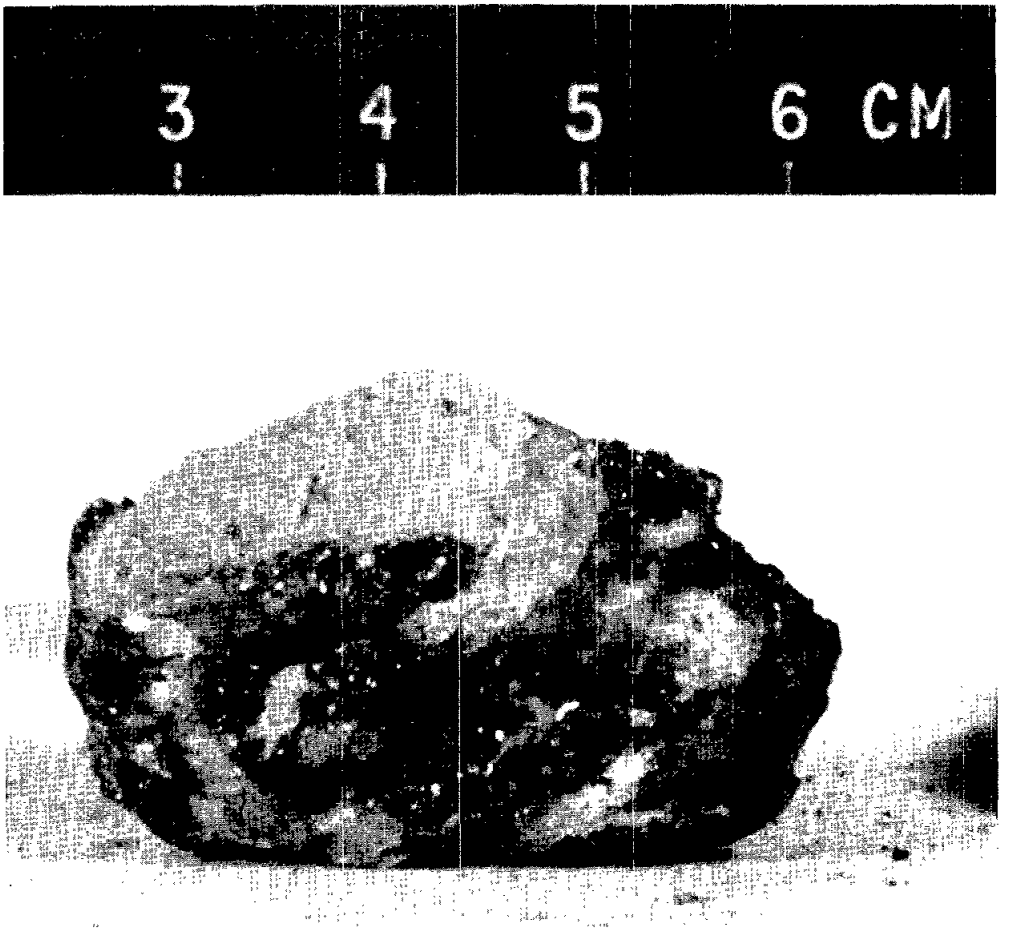
BINOCULAR DESCRIPTION BY: Wilshire DATE: 8/24/71

FABRIC:
VARIABILITY: Vesicular glass and rock surfaces.
SURFACE: B has prominent slickensides.
ZAP PITS: Few on N; none on T, B, E, W.
CAVITIES: Vesicles are 35% of glass surface and reach 3 mm diameter.
SPECIAL FEATURES: Glass is not gradational with surrounding rock, but it penetrates the breccia in thin stringers. A 1.5 mm sugary yellow-green clast (pyroxene?) has a very dark brownish rim on one side.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass	deep brown	surface				1
Lithic clasts >1 mm	5				>1 to 6	
Basalt	brownish		1 clast	1.5		2
Basalt	brownish		1 clast	largest		3
Basalt			1 clast	2		4
Aphanitic	dark				up to 2	5
Sugary agg.	yellow-green					
Sugary agg.	brownish					6
Plagioclase	light gray to milk white				up to 1	
Matrix		95			<1	7

NOTES:

1. 5 mm long clasts of breccia adhere to the glass or are enclosed by it.
2. Composed of plagioclase laths and intergranular cinnamon brown pyroxene.
3. Yellow green mineral 25%, brown mineral 20%, plagioclase 45%, and opaques 2%. Average grain size is 0.5 to 0.7 mm.
4. Has very dark mineral along with brown pyroxene and plagioclase.
5. Prominent in 1 mm size patches.
6. Possibly olivine.
7. Contains angular aphanitic dark clasts predominantly, common plagioclase and brownish pyroxene, small basalt fragments, and some red spinel. There is an overall dominance of light colored clasts over dark ones. In the <1 mm size most of clasts are basalts.



Sample 15419 - S_1 S-71-43651

ROCK TYPE: Breccia
COLOR: Light greenish gray (5G 5/1), dust cover greenish-brown gray (5GY 5/1 or 4/1)
SHAPE: Blocky, subrounded
COHERENCE Intergranular: Very friable.
Fracturing: Few nonpenetrative on two large pieces.

WEIGHT: 136.3 g
DENSITY:
DIMENSIONS: 4 pieces

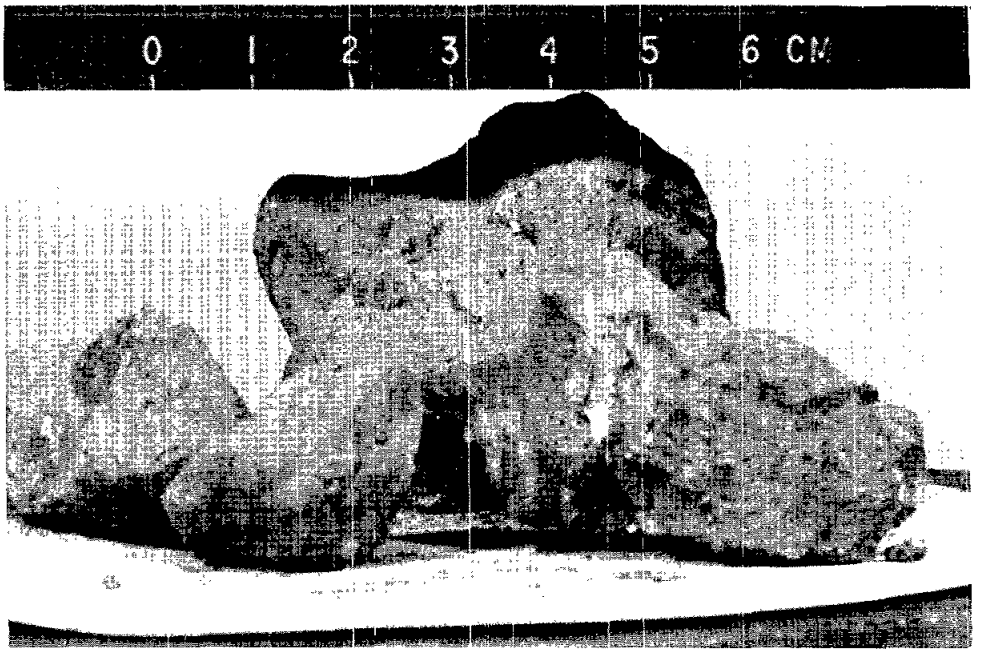
BINOCULAR DESCRIPTION BY: Jakes DATE: 8/20/71

FABRIC: Isotropic
VARIABILITY: Two types (largest piece contains rock clasts and does not have exposure of light greenish gray material).
SURFACE: Smooth (smoother on largest piece).
ZAP PITS: None
CAVITIES: None
SPECIAL FEATURES: The concentrations of light green spherules and of plagioclase vary from place to place from 1 to 20%. Largest piece is distinct from the others.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Spherules	green	1	spherical & oval	<0.2	0.5-0.08	
Spherules	brown	2	spherical	0.2	0.04-1	
Plagioclase	white	3	irregular, equant, elongate	0.2	0.05-0.3	1
Matrix	light greenish gray, greenish-brown	95		0.1		2
Glass	dark brown	1	irregular	0.4		3
Clasts	white		rounded	7		4

NOTES:

1. Not in largest piece. No cleavage seen.
2. Color is light greenish-gray in the smaller pieces, and is greenish brown in the largest one.
3. Isolated broken.
4. Just a few clasts, only in the largest piece, of monomineralic plagioclase rock which is shocked opaque white.



Sample 15425 - W_1 S-71-43591

ROCK TYPE: Breccia
COLOR: Light grayish yellow-green (5GL 7/2)
Dusting coating: light gray (6GY 6/1)
SHAPE: Blocky, rounded
COHERENCE Intergranular: Very friable
Fracturing: Absent to few

WEIGHT: 223.6 g
DENSITY:
DIMENSIONS: 3 pieces

BINOCULAR DESCRIPTION BY: Bass DATE: 8/20/71

FABRIC: Isotropic
VARIABILITY: Relative abundance of glass types.
SURFACE: Smooth
ZAP PITS: None
CAVITIES: None
SPECIAL FEATURES: Abundant glass spherules.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Spherules	brown	10	spheroid	0.2	<0.1-0.4	1
Spherules	medium to light green or colorless	10				
Glass	medium gray	0.5	irregular to blocky, rounded to subangular	0.4	0.3-0.5	2
Plagioclase	white	<0.5	irregular, blocky, flat	0.4	0.3-0.5	
Mafic silicate or glass	medium brown	Trace	irregular	0.7		3
Matrix	light grayish yellow-green	80		0.05		4
Dust cover	light brownish gray	Trace		0.01		5

NOTES:

1. Spherules strikingly abundant and easily visible, ovoids and broken pieces are much less abundant.
2. Probably shocked plagioclase, may have some white remnants; sometimes "knobby"; abundance variable, more common in 2.5 cm piece (1% or more).
3. Shattered.
4. May be green glass mainly; friable; abrades to smooth surface.
5. Original? or from dust in collection bag?

THIN SECTION DESCRIPTION BY: Butler & Brett DATE: 9/18/71

SECTION: 15426,17

SUMMARY: Glass-rich breccia: Overall the rock is composed of 60% glassy spherules and fragments, 15% pyroxene fragments, 15-20% plagioclase fragments, and 5% anorthosite, fine-grained breccia, and basalt. Pale green glass spheres predominate the glass in larger sizes (0.1-0.3 mm) whereas angular brown glass predominates in the <0.1 mm sizes. The lithic, opaque, and silicate mineral fragments indicate a non-Mare origin.

LITHIC CLASTS, 5% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Anorth	65	subrd		Some anorthosite may have been single plag grains before becoming a shock mosaic, but several have grains as large as 1 mm.
Breccia	20	subrd		
Basalt	10	subrd		Basalts are fine grained (0.1 mm) with 60% pyx and 40% plag laths.
Gab-an	5	subrd		

GLASS CLASTS, 10% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Pale green	80	round	0.1-0.3	Most of the pale green and yellow glass is entirely undevitrified. One pale grain shows skeletal plag? and pyx?
Yellow	15			
Brown	2	irreg	0.5	

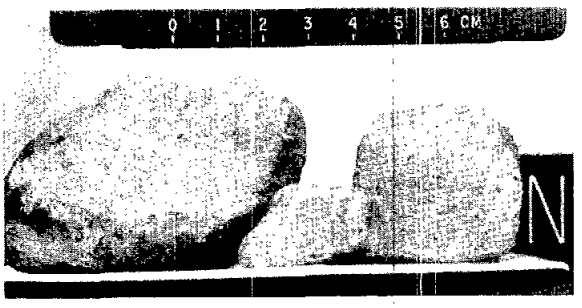
MINERAL CLASTS, 5% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Plag	50	subang	up to 0.7	The largest grains are 1-2 mm and show only slight shock effects.
Pyx	50	subang		

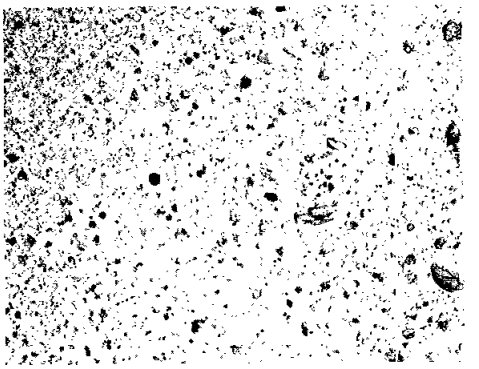
MATRIX, 80% of rock

PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Brn glass	50	ang	<0.1	Angular brown glass fragments predominate.
Plag	15	subang	<0.1	
Pyx	15	subang	<0.1	
Pale green glass	10	round	0.05-0.1	
Agal	10			
Red-brn glass	Trace	sph		
Ilm	<0.5	ang	<0.5	
Ulvo	<0.3	ang	<0.5	
Fe-Ni	<0.1	ang	<0.3	
Troil	<0.1	subrd	<0.3	
Unident	1 grain			

GENERAL COMMENTS: Grain size is seriate from 2 mm to less than resolvable. Rock is dense with no void space.
Glass and clast contacts are sharp and show no recrystallization, in conformity with lack of devitrification of glass.



Sample 15426 - N1 S-71-43584



Photomicrograph Sample 15426,17 (width of field ≈4 mm)

THIN SECTION DESCRIPTION BY: Bass DATE: 10/17/71

SECTION: 15427,27 Green Glass Breccia

SUMMARY: Weakly coherent vitric breccia, probably a compacted soil. Main component is colorless (green in hand specimen) glass. Despite preponderance of one glass type there are a wide variety of mineral and rock clasts. The only major rock group absent is Mare basalts unless they are represented by the orange-brown glass. Essentially identical to 15426.

LITHIC CLASTS, 0.5% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Gab an	1 clast	blocky, subang	0.6 x .33	Gab an and gabbro are shocked. Gabbro contains devit. maskelynite and opx with aligned inclusions.
Gabbro	1 clast	blocky, subang	0.09 x .12	
Shocked anorth	14	blocky, subrd	0.16 x .08	Breccia (?): 3 of 5 grains are extremely fine grained and one contains a plag clast; these three could be devitrified glass. The other two are true breccias with olive brown stain as seen in matrix.
Anorth	21	blocky, ang	0.16 x .13	
Breccia (?)	36	blocky, subrd	up to 0.15 x .08	
Pyroxenite	14	blocky, ang		Pyroxenite includes slightly shocked opx (2V=60° (-)).

GLASS CLASTS, 60.8% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Colorless (green in hand specimen)	56.6	sph and frags of sph	0.5 dia, up to 1.3 x 0.7	Colorless glass is homogeneous. Some glass crystallized to prisms and dendrites in whole or part. Prisms and dendrites are the same mineral and crystallographically continuous in
Colorless with trace to over 90% prisms and dendrites	26.0	sph and frags of sph	up to 1.1 x 0.6	

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
				many cases. They are not spherulites. Extinction is parallel; 2V's are negative, estimated in range 30° to 80°; low birefringence (maximum first order yellow colors, commonly gray) suggests orthopyroxene rather than olivine. In one sphere are tiny prisms without the usual signs of dendritic growth; and suggests early high temperature crystallization. One ovoid contains a striking prism with expanded dendritic ends giving a "dumbbell" shape. The largest particles contain abundant nonoriented prisms and few or no dendrites; they have an ovoidal or spherical core, but are eccentrically extended by lobate dendrites along the whole or part of their peripheries.
Brown	9.0	sph and frags of	up to 0.30 x 0.35	
Yellow	7.9	sph and ang, twisted	up to 1.05 x 0.5	
Orange-brn	0.25	sph and ang blocks and splinters	up to	
Olive green	0.25	subrd	up to	
Maroon	1 grain	irreg	0.08 x 0.02	

Brown glass is now almost entirely dendritic.

In yellow glass, vesicles are rare, spherical when seen; no visible flow structure. Dendrites are rare, seen in only two clasts; much coarser than in the colorless glass. Mineral inclusions common in several large clasts;

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
				include olivine and/ or orthopyroxene (-2V about 70° in one case; 2V about 90° in another), rare pigeonite (+2V = 0°), and very rare plagioclase; the plagioclase may actually by part of the host matrix filling a hole in the yellow glass clast rather than a true mineral inclusion. Maroon glass is color of KREEP but has no flow structure.

MINERAL CLASTS, 2.4% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Plag	41.9	blocky, ang	up to 0.55 x .55	Opx rarely twinned, contains some exsolution lamellae.
Opx	32.3	blocky, ang	up to 0.12 x .17	Cpx may include some opx. Quartz is full of .01 mm and smaller opaque inclusions.
Opaq	12.9	blocky, equant ang to subang	up to 0.08 x .05	Devit maskely is olive brown.
Cpx	9.7	blocky to prism ang	up to 0.23 x .11	
Oliv	1 grain	blocky, ang	0.12	
Quartz	1 grain	blocky, ang	0.09	
Devit maskely	1 grain	blocky subang	1.1 x 0.06	

MATRIX, 36.3% of rock

PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Colorless glass		blocky, ang	0.008	Local areas contain drab olive-brown stain.

GENERAL COMMENTS: Liquidus phase of main glass type is orthopyroxene. Olive brown stain of matrix and clasts may be a sublimate. Abundant cracks in colorless glass may indicate residual strains. The lobes on the glass spheres do not appear to develop from glass in the host. A fracture bounding one broken ovoid cuts core and dendritic lobes alike, indicating that the dendrites arrived in the present state, which indicates either that these particles were once in a glass or glassy breccia matrix undergoing dendritic crystallization, or else, the cores, during flight, were spattered with fluid glass blobs that adhered to the relatively rigid cores; the blobs spread out partially, but not uniformly around the cores; the cores crystallized prisms, whereas the blobs crystallized dendritically.

ROCK TYPE: Clod
COLOR: 5Y 6/1 Light Olive Gray
SHAPE: Equant to elongate, angular to subrounded
WEIGHT: 206.8 g
DENSITY:
DIMENSIONS: Range 1 cm to 5 cm diameter
COHERENCE Intergranular: Friable, less friable than the clod in bag 273, more friable than the "soil" breccias
Fracturing:

BINOCULAR DESCRIPTION BY: Heiken DATE: 9/8/71

FABRIC: Clastic rock
VARIABILITY: None in color
SURFACE:
ZAP PITS:
CAVITIES: 10% where clasts have fallen out.
SPECIAL FEATURES: Some small white clasts within the clods. Probably fine sand to silt size matrix; holes on the outer surfaces where clasts have fallen out are 5 mm to 10 mm in diameter.

THIN SECTION DESCRIPTION BY: Wilshire & Brett DATE: 9/15/71

SECTION: 15435,34

SUMMARY: A very unusual rock composed of banded glass, debris-laded glass, and intersertal basalt. Low abundance of opaques definitely categorizes this as of non-Mare origin.

LITHIC CLASTS

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Int. bas.		subrd	0.15	Intersertal basalt is scarce and very finely crystalline.
Clastic		subrd	0.15	Clastic rocks are scarce and metamorphosed.
Ilm bas	1 clast	subrd	0.15	Rare euhedral ilm in the ilm basalt.

GLASS CLASTS

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Green		sph	<0.3	Green glass occurs as spheres and fragments of spheres.
Light brown				A few light brown spheres and fragments of spheres occur.
Orange			0.03	Reddish brown clasts are devitrified.
Colorless			0.2	
Red-brown		irreg	0.15	

MINERAL CLASTS

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Plag		ang	0.1	Clasts vary in type and abundance from band to band.
Oliv		ang	0.1	
Cpx		ang	0.1	
Opx		ang	0.1	

MATRIX

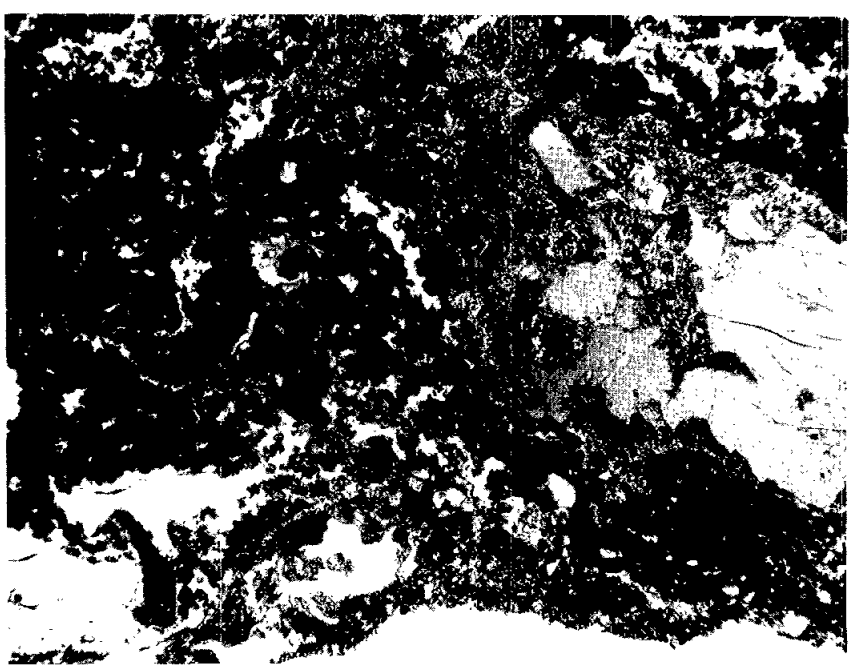
PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Ilm	<0.1	ang	0.05	Glass and devit glass varying markedly in color and texture from band to band.
Ulvo	<0.1	ang	0.05	
Fe-Ni	<0.1	ang	0.01	
Troil	<0.1	ang	0.01	

GENERAL COMMENTS: Section consists of hairline to 17 mm wide bands of glassy breccia, glass, and intergranular basalt.

A pale yellow glass band occurs along one side and wraps around one end. It encloses small, debris-laden, devitrified glass inclusions.

Next is a band, locally internally banded, of deep reddish brown devitrified glass laden with crystal debris and a few small intersertal basalt fragments. This sandwiches a band of interlayered intersertal, ocellar basalt and brown to pale brown glass.

Another band of mineral and lithic debris plus green glass spheres in greenish vesicular glass occurs along one side.



Photomicrograph Sample 15435,34
(width of field ≈4 mm)

ROCK TYPE: Breccia, chalk-white clasts WEIGHT: 287.2 g
COLOR: Medium dark gray (N4) DENSITY:
SHAPE: Blocky, angular DIMENSIONS: 6.5 x 6.5 x 5 cm
COHERENCE Intergranular: Tough
Fracturing: Irregular penetrative and nonpenetrative

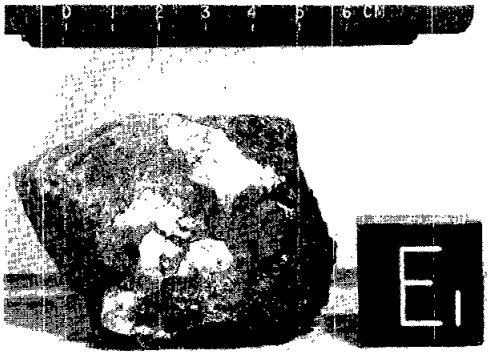
BINOCULAR DESCRIPTION BY: Wilshire & Head DATE: 8/24/71

FABRIC: Breccia, finely crystalline matrix
VARIABILITY: Dark matrix with white inclusions
SURFACE: Smooth, irregular
ZAP PITS: Few on T, B, N, S; none on E.
CAVITIES: Vugs reach 3% of the rock and occur mostly on broken end (W) away from the abundant inclusions. A few are elsewhere. Drusy coating; on the walls of a few there are bright, yellow metallic balls.
SPECIAL FEATURES: Discontinuous veins of matrix, from hairline thickness to 1 mm, cut a clast on B. The vein material is dense, fine-grained, dark gray, and produced no reaction rims. Other clasts are extensively veined as well; the margins of some inclusions are so extensively veined that they look like intrusion breccias. Uncommon dark chilled zones, up to 0.7 mm thick, partially envelope some clasts. Light gray reaction zones occur locally in white inclusions. Locally on the surfaces of thin veins there are parallel, close-spaced grooves.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Lithic clasts	chalk white	25	blocky		up to 30	1
Lithic clasts	chalk white with green				up to 40	2
Lithic clasts	white with red				<1-18	3
Lithic clasts	pale greenish gray to dark gray to white	2	round	4		4
Lithic clasts	light gray to greenish		rounded		2-7	5
Basalt(?)	yellow green olivine		rounded		2-3	6
Plagioclase	gray		angular		1-3	7
Mafic silicate	pale to medium golden brown		irregular		0.1-1	8
Plagioclase	light gray		anhedral		1-1.5	9
Matrix	dark gray	73			<1	10

NOTES:

1. 3 cm clast on B is typical. At highest magnification tiny cleavages are visible; larger pieces appear angular; white and light gray are the only constituents, except a few with a trace of red mineral.
2. 4 cm clast on T is typical. Contains light green mineral, which occurs in patches of finely granulated material and composes 10-15% of the clast. Bigger pieces are darker green, small ones approach the plagioclase in color.
3. 1.8 cm clast on E is typical. This clast is very broken up at edges and invaded by thin veinlets of matrix, with many pieces stoped off. Red mineral is 5-8% of clast, granulated, and strung out to 3 mm with crude local foliation, some is in irregular patches; big pieces are blood red; in places the granulation is so fine that it appears to be a red stain on the surface. White and light gray mineral(s?) with cleavage are present and also a green mineral, which is difficult to distinguish from the gray in finer grain sizes. Some "chilled" zones and veining by matrix.
4. A typical clast has an irregular center of vitreous pale greenish gray, a thin spotted dark gray zone in which cleavages are visible; outside of that is a partial zone of material like the core.
5. Cryptocrystalline, light gray, and greenish.
6. Fine-grained yellow green olivine(?) and plagioclase. Apparent dark $\frac{1}{2}$ mm reaction rim. Several other small pieces around.
7. Several pieces with a gray reaction zone surrounded by a dark zone in matrix.
8. Pyroxene?
9. Fresh plagioclase, unlike the more common chalky variety.
10. Matrix same varities of inclusions as in the >1 mm size fraction. Some 0.5 mm opaque mineral. Clastic debris in a very fine, sugary matrix of dark gray (80%) and light gray (20%) finely crystalline material. Parallel, widely spaced grooves on matrix in one small projection from the main body of the rock.



Sample 15445 - E_1 S-71-44129

ROCK TYPE: Black and white breccia WEIGHT: 937.2 g
COLOR: Dark gray (N3, N4) and white (N9) DENSITY:
SHAPE: Blocky, angular DIMENSIONS: 10.5 x 10 x 7 cm
COHERENCE Intergranular: Tough
Fracturing: Penetrative and nonpenetrative fractures in both; more abundant in white part. Received as one large piece and 22 pieces 1 to 3 g.

BINOCULAR DESCRIPTION BY: Wilshire & Morrison DATE: 8/23/71

FABRIC: Black; inequigranular. White; equigranular, crudely foliated.
VARIABILITY: Two main rock types.
SURFACE: Smooth. The black part of face S has a large flat surface, which appears to be an ungrooved slip-face.
ZAP PITS: Many on N, S, W; few on T, B.
CAVITIES: Vugs 5-10% of black matrix, average 2 mm and reach 5 mm, are more abundant near big white clast.
SPECIAL FEATURES: About one third of the rock consists of clasts of white rock, ranging up to 8 cm in size, set in a dark aphanitic matrix. The matrix does not look like typical basalt and may be shock-melted breccia. The clasts are crudely foliated and cataclastic rocks composed of plagioclase and pyroxene. Plagioclase ranges from 60% to more than 95% and the variation in its proportion to pyroxene suggests an original layering.

Veins of black aphanitic material are a ubiquitous feature of the white clasts. The veins reach 5 cm long, pinch and swell from hairline to 3 mm, and are very irregular in trend with no obvious relation to fractures or foliation. Thin apophyses of the veins extend into the white material. In the veins angular to rounded inclusions, up to 2 mm in size, apparently have been stoped from the adjacent walls. Dark gray to medium light gray zones, about 0.2 mm thick, border the veins and appear to be an alteration of the white material rather than of the veins themselves. Both the inner and outer contacts of these zones are equally sharp. The medium gray material is obviously crystalline.

In the matrix adjacent to the largest white clast is a 0.2-0.5 mm "chill" zone, which is darker gray, possibly finer grained, lacks vesicles, and looks like the vein material in the white clasts. Pieces of the largest clast have been stoped off into the matrix. The smaller white clasts are veined and fractured. Light gray border zones range up to 2 mm wide, but are absent at many contacts.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Pyroxene	pale green gray	5-10	angular			1
Plagioclase	white to light gray	25-30	angular		up to 80	2
Lithic clast	dark gray	<1		3		3

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	dark gray	Trace	equant	<0.1		4
Lithic clast	gray bluish	Trace				5
Mafic silicate	orangish red	Trace	angular			
Matrix	light gray	15	equant		<0.1	6
Matrix	dark gray	55	equant		<0.1	6

NOTES:

1. Pyroxene, 2-40% of white clasts, some are very pale brown, occurs in small patches or in very irregular stringers, up to 1.3 cm long, which define a crude foliation. Larger pieces have prismatic cleavage.
2. Composes 60-98% of white clasts, sugary, larger grains are irregular, some show good cleavage.
3. Very fine grained clasts in white clasts, look like the black matrix material.
4. Tiny specks in light green area.
5. Two clasts on N, with thin glass(?) films on the outside. Inside are irregular to angular areas of darker gray with a bluish tint.
6. Aphanitic too fine to identify.

THIN SECTION DESCRIPTION BY: Wilshire & Brett DATE: 9/16/71

SECTION: 15455,27 Breccia Part

SUMMARY: Breccia containing clasts of norite, anorthosite and possibly olivine gabbro as well as non-Mare type basalts. The opaque content is further evidence of non-Mare origin.

LITHIC CLASTS

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Norite	1 clast	ang		Anorthosite clast is embayed and recrystallized (devitrified?). It contains laths of plag, tiny very rare ilm, and pyrox. Prominent "dessication" cracks are prominent.
Anorth	1 clast	rounded	1.7	
Breccia	1 clast	rounded		Breccia clast is embayed and appears similar to matrix with many plag and oliv grains in very finely crystalline material. A few large patches of coarser, deformed plag with some coarse oliv suggest that this may be a cataclastically deformed oliv gabbro.
Basalt				Basalt clasts are much smaller and probably hornfelsed intergranular, gray-pyroxene basalt.

MINERAL CLASTS

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Plag		ang		
Oliv		ang		
Pyr				
Pink spinel				
Fe	<0.1	ang to subrd	0.1	
Ilm	<0.1	ang to subrd	0.1	

THIN SECTION DESCRIPTION BY: Wilshire & Brett DATE: 9/16/71

SECTION: 15455,27 Igneous part

SUMMARY: Severely crushed, originally coarse-grained norite, cut by a fine-grained, black vein containing abundant mineral and lithic debris. (See breccia description of the vein below.)

PHASE	PERCENT	SHAPE	SIZE (mm)
Plag	75		up to 2
Opx	25		0.7
Cpx	Trace		
Unident	Trace		
Ilm	Trace		

COMMENTS:

Plag and opx are severely shattered relicts of what were once coarser grains. These are crossed by thin granulated zones.

Opx areas contain small amount of brown glass.

Unident phase is a pale brown mafic silicate apparently reacting to form a pale green mafic silicate after granulation.

Reconstruction of relict grains indicates coarse plag grains with interstitial opx.

One side of the black vein the cataclastic norite is folded, the structure being marked by strung-out granulated pyx bands in brown glass. There is marked limb thinning of the pyx bands as well as faults at a low angle to the axial plane. The faults are marked by granulated pyx and plag.

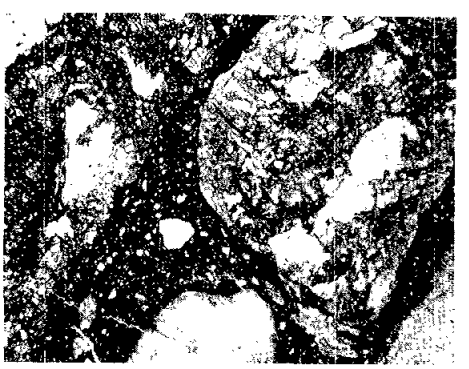
On the other side of the black vein the norite is not so broken-up although there is one prominent shear zone along which the rock is intensely granulated.

MATRIX

PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Olivi		euhedral		Matrix is very finely crystalline and most is too fine to fine to identify phases.
Plag		laths		
Fe	<0.1	ang to subrd	<0.1	Olivine has both equant and prismatic euhedral grains.
Ilm	<0.1	ang to subrd	<0.1	
Ulvo	<0.1	ang to subrd	<0.1	
Troil	<0.1	ang to subrd	<0.1	

GENERAL COMMENTS: This is a black vein through white norite. (See igneous description of norite.)

Sample 15455 - S_1 S-71-43891



Photomicrograph Sample 15455,27
(width of field ≈4 mm)

ROCK TYPE: Breccia
COLOR: Medium dark gray (N5)
SHAPE: Blocky, orthogonal
WEIGHT: 5854.0 g
DENSITY:
DIMENSIONS: 28 x 13.5 x 12.5 cm
COHERENCE Intergranular: Tough, old fractures are penetrated by glass.
Fracturing: Penetrative, subparallel N-S, external shape of rock seems to be controlled by similar fracture systems.

BINOCULAR DESCRIPTION BY: Silver & Horz DATE: 8/26/71

FABRIC: Coarse breccia. Tabular clasts of all sizes are preferentially in near N-W plane.
VARIABILITY: Typical for breccia with large clasts, to 4x8 cm.
SURFACE: N smooth, grooved (slickensides), glass present from preexisting glass filled fracture glass veinlets.
ZAP PITS:
CAVITIES: Less than 1%, a compact breccia.
SPECIAL FEATURES: This is a tough indurated breccia with light colored clasts dominant, but with a great diversity of types. Light clasts are anorthosite (fragmented) to leucobasalt, with pale green pyroxene. The less abundant types are very fine-grained gray lithic clasts, pale green recrystallized pyroxene or olivine, recrystallized cinnamon brown pyroxene, and exotic types as described. The matrix is dense and very finely granular to glassy. There are local segregations of glass into patches and local glass selvages in contact with clasts. No fragmental glass was identified.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Anorthosite	white	15	angular to subangular		up to 40	1
Basalt	pale olive (10Y 6/2)	10	subangular		up to 80	2
Lithic clast	medium gray (N5)	2	subrounded		up to 5	3
Lithic clast	gray	1	subangular			4
Mafic silicate	green (5GY 7/2 to 5G 7/2)	1	subrounded		0.2-0.5	5
Mafic silicate	cinnamon brown	1	subrounded		up to 30	6
Mineral clast	medium red (5R 5/4)	Trace	subrounded	1		7
Matrix	medium dark gray (N5)	70			<0.1	8

NOTES:

1. Predominantly translucent to opaque plagioclase. Very fine grained, sugary and dull in some clasts, or grains up to 1 mm in other clasts. Pale yellowish to colorless pyroxene(?) reaches 10% of some clasts. A vitreous phase may be quartz. Tiny black glass veins occur in some clasts. This dark glass is hard to distinguish from the 5% opaques in some clasts.
2. The 4x8 cm clast on B is described here as the type specimen. It is composed of: 50-60% light olive (10 Y 4/2) pyroxene(?) 0.5-3 mm; 30-50% white plagioclase in laths up to 1.5 mm long; 5% pale yellowish brown (10YR 5/2) pyroxene(?), 0.3-1 mm; up to 5% gray phase with a slight brown tinge and vitreous luster; 2-3% equant, black opaques, 0.05-0.1 mm.
3. Fine-grained, granular, 90% plagioclase with pyroxene(?), black opaques. A hornfels(?). One clast has an internal glass vein.
4. Mostly plagioclase with scattered opaques, and yellow-green material (olivine?) which looks like a band. It seems to be parallel to a general fabric (foliation), as is the long direction of clast.
5. Very fine grained, probably olivine. Shades to blue green on one side, which could be pyroxene or just an edge effect. In some there is a red rim around the core.
6. Fine-grained, all cinnamon brown, cut by glass, may be a pyroxenite.
7. Partly covered by black glass, granular; spinel (?), or garnet (?).
8. Contains abundant dark glass as veinlets and as integral part of groundmass. The matrix grades in size from minute fragmental particles up to clast sizes.

THIN SECTION DESCRIPTION BY: Silver & Brett DATE: 9/18/71

SECTION: 15459,4

SUMMARY: Partially shocked-melted breccia with extremely diverse clast types (most of which are not present in this thin section). In part a soil breccia. Igneous clast types and low opaque content indicate a non-Mare origin.

LITHIC CLASTS, 15% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Basalt 1	60	ang to irreg	up to 0.3	Most lithic clasts show partial to profound shattering and shock effects.
Basalt 2	25	ang to irreg	up to 0.3	A few remnants of original basaltic texture exist. Recrystalization varies from slight to extreme.
Ign 1	15	ang to irreg	up to 0.3	Basalt type 1 consists of fine-grained granulated leucobasalts. Basalt type 2 consists of coarse pigeonite-augite basalts. Igneous type 1 consists of shocked and recrystallized feldspar-rich rock with opx and cpx.

GLASS CLASTS, 60% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Colorless	50	sph		Colorless glass and golden yellow glass consists of spheres and fragments of spheres.
Golden yellow	10-15	sph		
Brown	10-15	irreg	up to 10	
Pale green	5-10	sph		
red-brown	5	sph		

MINERAL CLASTS, 15% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Plag	55	ang	up to 0.3	Sharpness of clast boundaries with matrix varies. Partial reaction with matrix occurs in some parts.
Cpx	45	ang to resorbed	up to 0.3	
Opx	Trace	ang to resorbed	up to 0.3	
Oliv	Trace	ang to resorbed	up to 0.3	
Ilm	<0.1	ang	<0.4	

MATRIX, 10% of rock

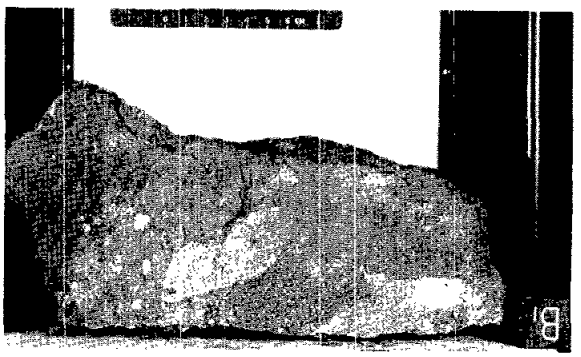
PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Glass	50			Matrix defined as <0.05 mm.
Frags	50	anhedral	<0.05	Fe-Ni occurs as discrete grains and blebs in troil.
Ilm	<1	subang to subrd	<0.05	Unident. phase is light gray in reflected light, an isotropic, translucent, colorless, high relief, high biref.
Ulvo		subang to subrd	<0.03	
Fe-Ni		subang to subrd	<0.03	
Troil		subang to subrd	<0.03	
Unident		subang to subrd	<0.05	

GENERAL COMMENTS: Total opaque content is <1%, mostly as discrete grains. Distinction between clasts and matrix is commonly very difficult because old fragmental glass and devitrified glass has been mobilized, vitrified and/or devitrified in several stages. Part of glassy matrix represents fused glass or crystalline fragments. The largest clast, a devit. brown glass clast filling half the thin section, has been remobilized along one side and appears to be injecting a mineral clast breccia zone which has glass (a new stage?) developing in its matrix and has lost the distinct glassy clasts visible elsewhere.

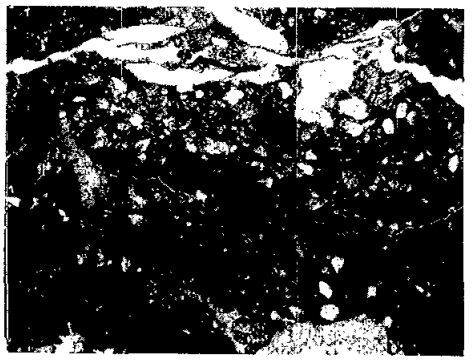
Glass veinlets, some vesiculated, may be both indigenous and exogenous to the thin section. Some appear to be developing from old clastic glass in diffuse regions; elsewhere similar glass veins sharply cross-cut all types of clasts.

Even lithic clasts show evidence of fusion in some parts of the section while elsewhere spheres, dumbbells, and fragments of glass show no deformation or mobilization at all.

A multiple shock event history for clasts and the subsequent aggregate which is responsible for the complexity of textural relations is suggested. No simple single stage alternative comes to mind.



Sample 15459 - B_1 S-71-44181



Photomicrograph Sample 15459,4
(width of field ≈4 mm)

ROCK TYPE: Breccia, glass-coated WEIGHT: 374.8 g
COLOR: Breccia: medium light gray (N6, N7) DENSITY:
Glass: dark greenish gray (5GY 4/1) DIMENSIONS: 11.5 x 8.5 x 5.5 cm
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough with many delicate protrusions.
Fracturing: Penetrative and nonpenetrative fractures both partly healed by glass. Glass penetrates fractures as small as <0.1 mm.

BINOCULAR DESCRIPTION BY: Wilshire & Head DATE: 8/25/71

FABRIC: Breccia glass
VARIABILITY: Glass to breccia
SURFACE: Rough, hackly
ZAP PITS: 70 x 25 mm block of breccia has many zaps on one side, surrounding glass has no zaps.
CAVITIES: 30-40% vesicles up to 7 mm; appear to be two generations one >2 mm; one $\frac{1}{4}$-$\frac{1}{2}$ mm. Strong blue grading to red brown irridescence. Glass drained back into vesicles after vesiculation.
SPECIAL FEATURES: Some fractures have glass stretched to very thin hairs between walls; very spectacular; drainback features may allow top and bottom to be established. An unusual example in which zaps can be shown to pre-date the glass penetrating the breccia. The rock is dominantly a coherent breccia with a wide variety of basalt clasts, fragments of anorthosite, abundant mineral and lithic debris in the 0.1-1 mm size range, and glass debris. The breccia has broken and penetrated by a highly vesicular glass. A 2.5 x 2.5 mm fragment of green material like 15425 is in the breccia (see photo N).

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Green fragments	green		subangular	2.5x2		1
Glass	dark greenish gray					
Anorthosite			subrounded		1-50	2
Basalt					1-50	3
Lithic clasts					0.1-1	4
Glass clasts	green		spheres			5
Matrix					<0.1	6

NOTES:

1. 5% of dark glass beads and fragments; about 60% of green (various shades) material mostly angular pieces, some almost certainly spheres; rest is finely divided material with pale green tint.

NOTES:

2. Plagioclase rich rock and plagioclase grains up to 4 mm; appear to be cut across and surrounded by fine-grained chalky plagioclase; in places chalky dominates and encloses islands of translucent light gray. 3-4% light greenish brown mineral may be two colors, light gray and light brown. Clasts look like cataclastic gabbro with original texture still intact. Large light clast on N should be preserved because it resembles anorthosite but has considerably more mafic silicates than 15415.
3. To 1 mm average grain size, plumose texture, 50-60% cinnamon brown pyroxene, 35% plagioclase, 0-15% olivine(?) 2 mm long; opaque minerals, 2% ilmenite(?).
4. All lithic types mentioned above. In addition quite a bit of pyroxene and plagioclase debris, opaque minerals, some glass beads, some dark glass fragments. Goes down in seriate fashion to a salt and pepper like matrix.
5. In local area, fair number of broken pieces and spheres.
6. Rectangular areas of very deep brown to brownish gray finely crystalline to vitreous material, resemble bigger clasts which had pigeonite prisms (without pigeonite). Locally abundant small sugary textured aggregates light brown and light green (0.5-1 mm) probably pyroxene and olivine. Occasional relicts. Quite a few stringers of glass, go through clasts, sometimes concentrated on edge of clasts. Small blood red mineral grain.

15465,1

ROCK TYPE: Glass, breccia
COLOR: Dark gray
SHAPE: Irregular
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 1.2 g
DENSITY:
DIMENSIONS: 1.5 x 1.5 x 1 cm

BINOCULAR DESCRIPTION BY: Ridley DATE: 8/31/71

FABRIC: Glass
VARIABILITY: Inhomogeneous, (homogeneous dark gray glass, light gray-white breccia fragments).
SURFACE: All surfaces irregular, hackly. No soil cover except on W face.
ZAP PITS: None
CAVITIES: Abundant cavities on all glass faces. Average 0.2 mm, ovoid irregular empty.
SPECIAL FEATURES:

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass	dark gray dull luster	85-90				1
Anorthosite	white	<5		10x10		2
Breccia	light gray	10	irregular			3

NOTES:

1. Weaky fluidal texture, abundant microvesicles (may be zap pits).
2. Coarse grained, euhedral feldspar laths (white, gray) one or two dark opaque specks.
3. Almost all of W, this piece is light gray, mottled, fine-grained matrix surrounding; one large coarse basalt clast (45% dark brown pyroxene, 45% feldspar laths, <10% yellow-green olivine); one leucocratic basalt (50% honey brown pyroxene, 50% feldspar); one deep reddish brown sphere (<0.1 mm diameter), single fragments of white plagioclase, brown pyroxene.

Sample 15465 - S_1 S-71-44190

ROCK TYPE: Dark glass with clasts
COLOR: Olive gray (5Y 4/1)
SHAPE: Angular
COHERENCE Intergranular: Tough
Fracturing: No penetrative

WEIGHT: 119.2 g
DENSITY:
DIMENSIONS: 8 x 2 x 4 cm

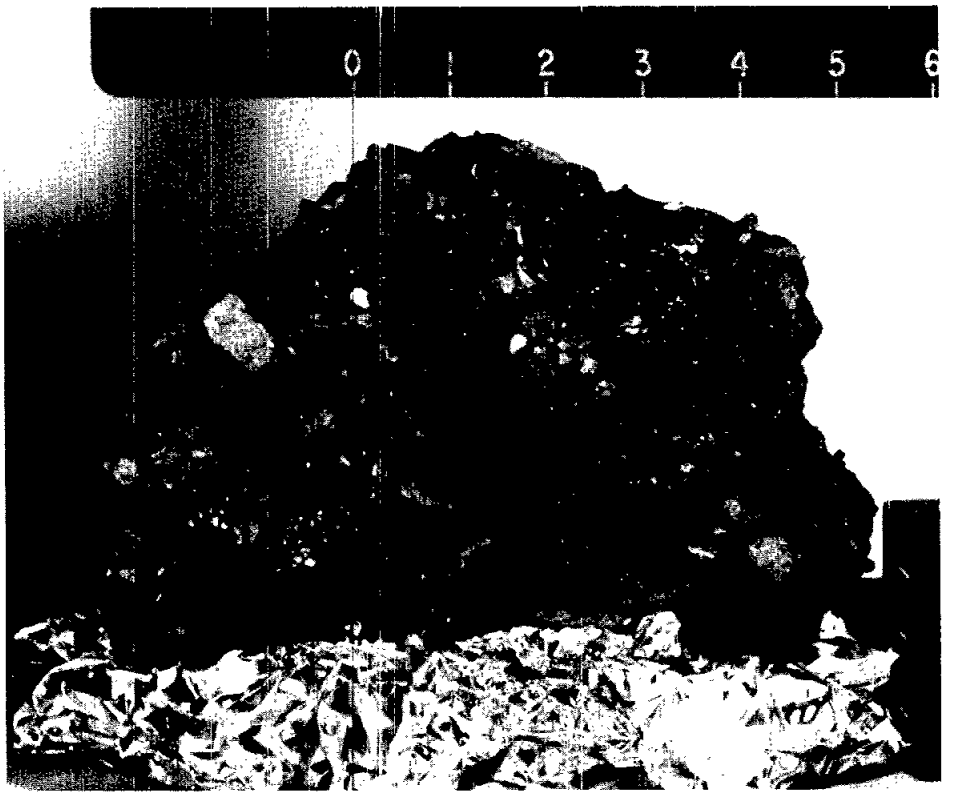
BINOCULAR DESCRIPTION BY: Morrison DATE: 8/26/71

FABRIC:
VARIABILITY: Rock is hetrogeneous. Color is of glass fraction.
SURFACE: Metal on N, and on or in S. All surfaces smooth to hackly. S surface has much more debris stuck onto it, particularly on one end. The glass must have been soft when debris stuck onto it.
ZAP PITS: None on N; few on S (one area).
CAVITIES: Glass has 20% vesicles.
SPECIAL FEATURES: Some sheared clasts must have been disrupted before glass engulfment. Metal occurs in swirls and patches, several bluish almost irridescent patches may or could be metal penetrations in this glass.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass matrix	olivine green	90				1
Breccia	medium to light gray	10	angular	2	2-20	2
Anorthosite	white	<1				3
Basalt	brown	<1				4

NOTES:

1. Vesicular and contains metal.
2. Breccias form 95% of the clasts. There are two types, the predominant type has basalt clasts and the other has none. A typical breccia clast contains a basalt composed of pigeonite 10-20%, brown pyroxene 40-50%, olivine 5%, and plagioclase 20%. The breccia contains angular green and gray glasses and sugary brown and green clasts all in a feldspar-rich matrix. The breccia clasts without basalts contain angular anorthosite fragments with or without pale green pyroxene(?), angular glasses from brown to gray, and green spherules with some gray to black glass. The matrix grain size seems larger than in the breccias with basalt clasts.
3. Milky, crushed, polycrystalline aggregates.
4. Light brown pyroxene 20%, 10-20% olivine or pigeonite, 40-50% plagioclase, 2% opaques.



Sample 15466 - N_1 S-71-44182

ROCK TYPE: Microbreccia
COLOR: Medium gray (N5); glass grayish black (N2), slightly brownish in transparent thin walls.
SHAPE: Blocky, angular
COHERENCE Intergranular: Coherent
Fracturing: One parallel E open, several parallel to T partly glass filled.

WEIGHT: 1.1 g
DENSITY:
DIMENSIONS: 2 pieces
1.7 x 0.9 x 1 cm
0.5 x 0.5 x 0.5 cm

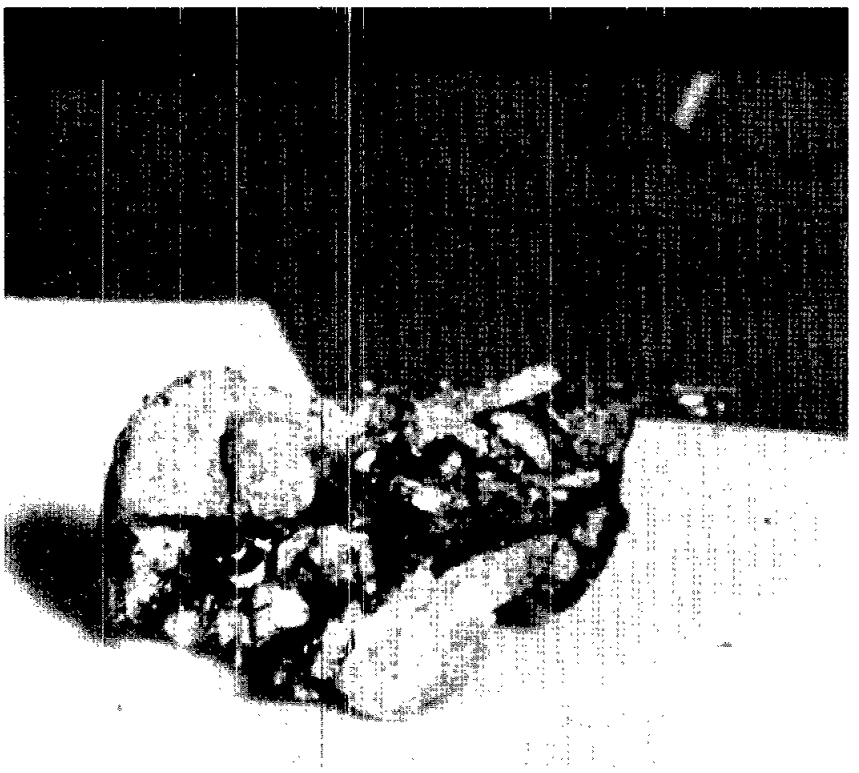
BINOCULAR DESCRIPTION: BY: Bass DATE: 8/30/71

FABRIC: Isotropic
VARIABILITY: None
SURFACE: Irregular to hackly (broken vesicles); S and B relatively smooth; T and N partly soil covered.
ZAP PITS: None
CAVITIES: Open joints, some largely filled with vesicular glass, vesicles less than 0.1 to 1 mm, spherical.
SPECIAL FEATURES: Glass filling fractures encloses one white clast.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
(In order of abundance)						
Lithic	dark gray		blocky, equant	<0.5	0.1-1	1
Feldspar	white		equant		0.1-1	2
Mafic silicate	brown		equant, angular		0.1-1	3
Mafic silicate	medium green to greenish tan	20	equant to slabby, angular	0.5-1	0.1-1.5	4
Glass	dark		spherical	<0.5	0.1-0.5	5
Glass	green		spherules, broken spheres	<0.5	0.1-0.5	6
Mafic	red		equant, angular	0.5	0.1-0.8	7
Matrix	white and medium gray, mottled	50		<0.1		8
Glass	gray-black	30	fills fractures			

NOTES:

1. Devitrified glass? Mafic silicates?
2. Shocked plagioclase; only rarely observed mixed with pyroxene because of small clast sizes.
3. Pyroxene, only rarely observed mixed with plagioclase because of small clast sizes.
4. Pyroxene; abundant among the few relatively large clasts (1 mm and larger).
5. Moderately common.
6. Uncommon.
7. Trace, probably spinel.
8. White is mainly shocked plagioclase.



Sample 15467 - N_1 S-71-44910

ROCK TYPE: Glass and breccia
COLOR: Dark gray (N3)
SHAPE: Irregular
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 1.3 g
DENSITY:
DIMENSIONS: 1 x 2 x 3 cm

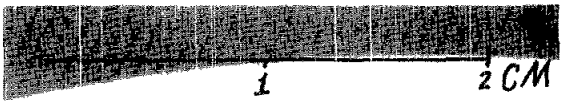
BINOCULAR DESCRIPTION BY: Ridley DATE: 3/31/71

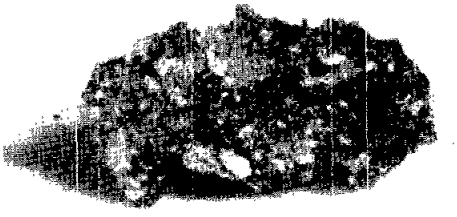
FABRIC: Glassy
VARIABILITY: Homogeneous dark glass, and lighter breccia inclusions.
SURFACE: All faces irregular, hackly.
ZAP PITS: None
CAVITIES: Abundant vesicles on all glass surfaces, maximum size 1.5 mm, average 0.5 mm.
SPECIAL FEATURES: Clasts in breccia are exclusively small whitish fragments, but are not very abundant.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass	dark gray	70				1
Breccia	light gray	30		0.3	0.1-0.8	2

NOTES:

1. Weakly fluidal.
2. Angular fragments embedded in glass with sharp contacts.





Sample 15468 - N1 S-71-44914

ROCK TYPE: Basalt
COLOR: Light brown (5YR 6/4)
SHAPE: Blocky, subangular corners
COHERENCE Intergranular: Tough
Fracturing: One penetrative fracture, two pieces have broken off the largest one.

WEIGHT: 298.2 g
DENSITY:
DIMENSIONS: 6 x 6 x 5 cm (largest piece of 3)

BINOCULAR DESCRIPTION BY: Morrison DATE: 8/26/71

FABRIC: Inequigranular
VARIABILITY: Mafic-felsic concentration varies from 60-40 to nearly 50-50.
SURFACE: All surfaces are hackly to irregular. Certain areas of rock have coating of light gray soil distinctly lighter than brown "regolith" soil.
ZAP PITS: Few on T, S, W; none on E (fresh surface), SE (dull), B (dull).
CAVITIES: 2% vugs, irregular shape and formed around crystals.
SPECIAL FEATURES: The white euhedral vug mineral (on N) can be removed easily for study.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	green to reddish brown	55	prismatic euhedral to subhedral	5	2-15	1
Mafic silicate	pale yellow	1	subhedral to anhedral		-1	2
Plagioclase	white to translucent	35-45	laths and plates	2	2-8	3
Opaques	black	1	equant subhedral to anhedral	<1		4
Vug mineral	white	Trace	equant euhedral		0.1-1	5

NOTES:

1. Pigeonite cores, moderate yellow green (10Y 7/4), are surrounded by thick augite(?) rims, reddish brown (10R 3/4 to 10R 4/6), which form 40-60% of radius of crystals. The boundary between core and rim is sharp but irregular. In one grain the yellow green core appears to be cored itself by colorless translucent mineral. Fine-grained brown pyroxene(?) may also be present.
2. Olivine(?) interstitial grains, does not have the green cast of pigeonite.
3. Occurs both as laths and plates, which grow across vugs, and as milky granulated interstitial masses.
4. Rare plates in vugs and as rare black inclusions in other phases.
5. On N face.

THIN SECTION DESCRIPTION BY: Silver & Brett DATE: 9/18/71

SECTION: 15475,11

SUMMARY: Coarse-grained clinopyroxene basalt (porphyry?). Probably a cumulate rock, which could add much to the interpretation of the Dune area flows.

PHASE	PERCENT	SHAPE	SIZE (mm)
Cpx	75	subhedral	8x1-2
Plag	20	euhedral to subhedral	
Ilm	4	subhedral	0.2-0.5
Ulvo	<1	anhedral	<0.4
Trid	0.5	euhedral prisms	1-0.2
Crist	Trace	broken	0.1
Brn glass	Trace	interstitial to plag	<0.2
Fe-Ni	<0.1	blebs	<0.05
Troil	<0.1	anhedral	<0.15

COMMENTS:

Inequigranular with apparent preferred orientation of larger cpx prisms in a girdle. Some orientation of zoned plag plates perpendicular to cpx prisms, as well as parallel (but not random).

Cpx is zoned from pale yellow pigeonite cores (2V-0-20°+) to brown subcalcic augite rims (2V-20-35°+). Cores make up about 50% of prisms. Opaque inclusions are common in brown rims.

Plagioclase is strongly zoned with euhedral zonation. Minute inclusions are concentrated toward many centers and a small pyroxene crystal appears to be a-axial in many crystals of plag.

Fe-Ni largely as blebs in cpx.

Cpx appears to be a cumulate product, probably as pigeonite, with an augite adcumulus overgrowth.

Opaque content is slightly low for Mare basalt.

ROCK TYPE: Microgabbro WEIGHT: 85.2 g
COLOR: Near medium dark gray (N4) with slight olive tinge DENSITY:
DIMENSIONS: 3.5 x 6 x 2 cm
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: N prominent, nonpenetrative fracture; B, S, E may be fracture controlled faces.

BINOCULAR DESCRIPTION BY: Bass & Ridley DATE: 8/28/71

FABRIC: Diabasic, microporphyritic
VARIABILITY: Homogeneous
SURFACE: S hackly, minor soil cover; T 60% soil cover (especially E end) N 30% soil cover, B no soil cover except E end, E heavy soil cover, W minor soil cover.
ZAP PITS: Few on S (glass coated), T; none on N, E, W, B.
CAVITIES: 5% vugs
SPECIAL FEATURES: Phenocrysts (pyroxene) from less than 5% of the rock.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	colorless, gray, white	45	lath to tabular	1.5	1.5-6 long 1 0.3-0.8 wide	
Mafic silicate	medium to dark brown	35-40	anhedral to euhedral	1.5	0.2-15	2
Mafic silicate	light to medium-dark brown green	15-20	anhedral	1.5	1	3
Opaque	metallic dark gray	2-3	anhedral	0.6	0.5-1	

NOTES:

1. White, shocked on T.
2. Smaller sizes occur as rims to zoned grains. Probably pyroxene. On N the phenocrysts are 1x15 mm.
3. Rarely light yellow green, most variants have brown rims. Probably pyroxene, but a few of the yellowish green grains without brown rims may be olivine. On fresh surfaces the green color is distinctly yellowish.

ROCK TYPE: Basalt
COLOR: Brownish dark gray surfaces not fresh
SHAPE: Blocky, subangular
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative (one deeper penetrative fracture along length of sample).

WEIGHT: 23.4 g
DENSITY:
DIMENSIONS: 4.5 x 2.4 x 2.5 cm

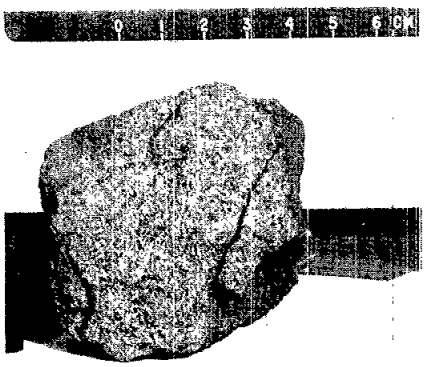
BINOCULAR DESCRIPTION BY: Jakes DATE: 8/30/71

FABRIC: Microporphyritic
VARIABILITY: Dust coating varies only, appears homogeneous rock.
SURFACE: T dust coated, irregular, other surfaces irregular with numerous vugs.
ZAP PITS: Few on T(?); none on others.
CAVITIES: 20% vugs, with pyroxene and feldspar crystals.
SPECIAL FEATURES: Plagioclase phenocrysts "coating" attached often to pyroxene phenocrysts.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	brown to light yellowish	35-40	prismatic, euhedral	2.5 long 0.2 wide	0.3-7 long 0.1-0.5 wide	1
Plagioclase	white lustrous	10	laths plates	2 long		2
Opaque	metallic black lustrous	5	euhedral, equant	0.5	0.1-0.6	
Glass	dark brown-blackish	<1				
Plagioclase	white, sugary	45	anhedral	0.4	0.1-0.6	3
Mafic silicate	brown		anhedral	0.4	0.1-0.6	3

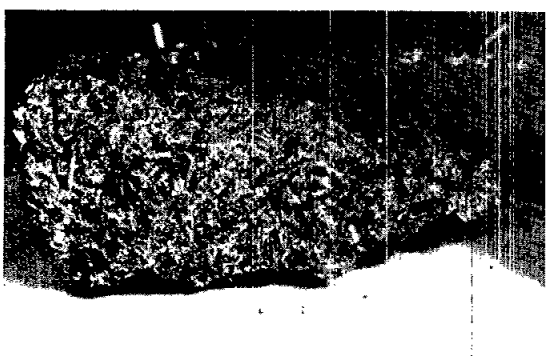
NOTES:

1. Pyroxene, a few broken crystals show zonality in coloring.
2. Phenocrysts
3. Groundmass pyroxene and plagioclase

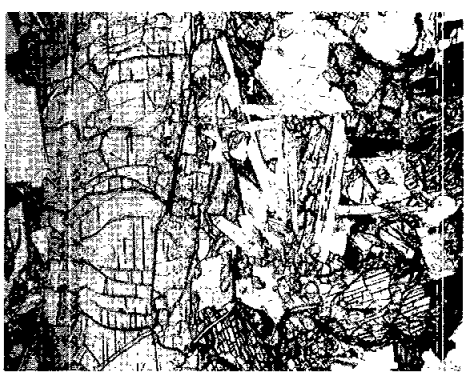


Sample 15475 - B1 S-71-44231

Sample 15475,1 - T_1 S-71-44248



Sample 15475,2 - N_1 S-71-44238



Photomicrograph Sample 15475,11
(width of field ≈4 mm)

ROCK TYPE: Basalt
COLOR: Light brown (5YR 6/4), green gray (5GY 6/1)
SHAPE: Slabby
COHERENCE Intergranular: Coherent
Fracturing: Few, one major fracture parallels N.

WEIGHT: 266.3 g
DENSITY:
DIMENSIONS: 8.5 x 7 x 3 cm

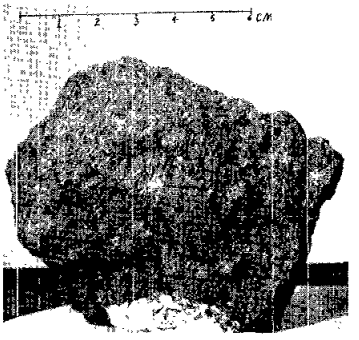
BINOCULAR DESCRIPTION BY: Warner DATE: 8/27/71

FABRIC: Porphyritic spherulitic
VARIABILITY: Foliated and porphyritic
SURFACE: Granulated
ZAP PITS: Few on all faces
CAVITIES: 3-2% vugs, matrix phases project into cavity.
SPECIAL FEATURES: The orientation of lath-shaped plagioclase produces a crude foliation parallel to E & W planes. A lineation is produced in this plane by the orientation of elongate pyroxene parallel to the T & B planes. Similar to 14086 in structure and gross appearance.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	colorless to white		lath	0.2x1	-3	1,2
Opaque	black		equant		0.1-0.05	2
Mafic silicate	green brown		columnar	2x15		3
Mafic silicate	honey brown		lath	0.2x2		2,4

NOTES:

1. Lath-shaped, generally oriented with a girdle of lath poles N, E, S, W, slightly sheaf-like pattern.
2. Matrix
3. Phenocrysts, zoned pigeonite to augite.
4. Augite, columnar crystals parallel to B.



Sample 15476 - S_1 S-71-44166

ROCK TYPE: Basalt
COLOR: Medium gray (N5)
SHAPE: Angular
COHERENCE Intergranular: Tough
Fracturing: None (single fracture on B created during collection of sample by hammer)

WEIGHT: 104.9 g
DENSITY:
DIMENSIONS: 7 x 3 x 3.5 cm

BINOCULAR DESCRIPTION BY: Lofgren DATE: 8/27/71

FABRIC: Isotropic
VARIABILITY: Surfaces vary from fresh to weathered; diktytaxitic to sub-ophitic one side of rock to the other.
SURFACE: N fresh broken surface; S is half exterior surface, half interior fracture surface with yellowish material on the surface; B is exterior surface.
ZAP PITS: Few on B; none on others.
CAVITIES: 20-60% rounded to angular; rounded are often glass lined; angular are formed by large crystals.
SPECIAL FEATURES: Yellowish white powder (sublimate) seeped in along fracture between chip 15485,1 and main rock fragment for about 5 mm as seen in S face photo.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	yellowish gray	40-50	lath, tabular		0.5-10	1
Mafic silicate	dark black	45-50	prismatic to equant	1-3		2
Mafic silicate	rose	1-2	equant	<1		3
Mafic silicate	pale yellowish green	<1	equant	<1		4
Mafic silicate	cinnamon brown	2-3	equant	<1		5
Fracture filling material	greenish yellow		powdery			

NOTES:

1. Forms some spherulite clusters.
2. Pyroxene - pigeonite, striations parallel to prismatic axis.
3. Spinel(?) evenly distributed through rock.
4. Olivine.
5. Pyroxene.

THIN SECTION DESCRIPTION BY: Reid & Brett DATE: 9/17/71

SECTION: 15485,3

SUMMARY: Porphyritic clinopyroxene basalt vitrophyre (similar to 15499 and 15597).

PHASE	PERCENT	SHAPE	SIZE (mm)
(Phenocrysts)			
Cpx	64	skeletal prisms	up to 4
(Groundmass)			
Pyx	33	laths	0.03x0.003
Plag		laths	0.03x0.003
Ilm	0.1	laths	0.01x0.001
Fe-Ni	0.1	spherules	0.1
Cr Spin	0.1	subhedral	0.1
Ulvo	0.1	subhedral	
Troil	0.1	anhedral	0.02

COMMENTS:

Porphyritic with extremely fine-grained devitrified groundmass of plumose intergrowths of pyx and plag.

Cpx phenocrysts are elongate, euhedral, skeletal prisms zoned from hollow cores (now filled with groundmass) through pigeonite to augite rims. Although pigeonite and augite show discontinuous boundary, each is continuously zoned within itself. Phenocrysts have common orientation.

Ilmenite needles commonly oriented in same direction as cpx phenocrysts.

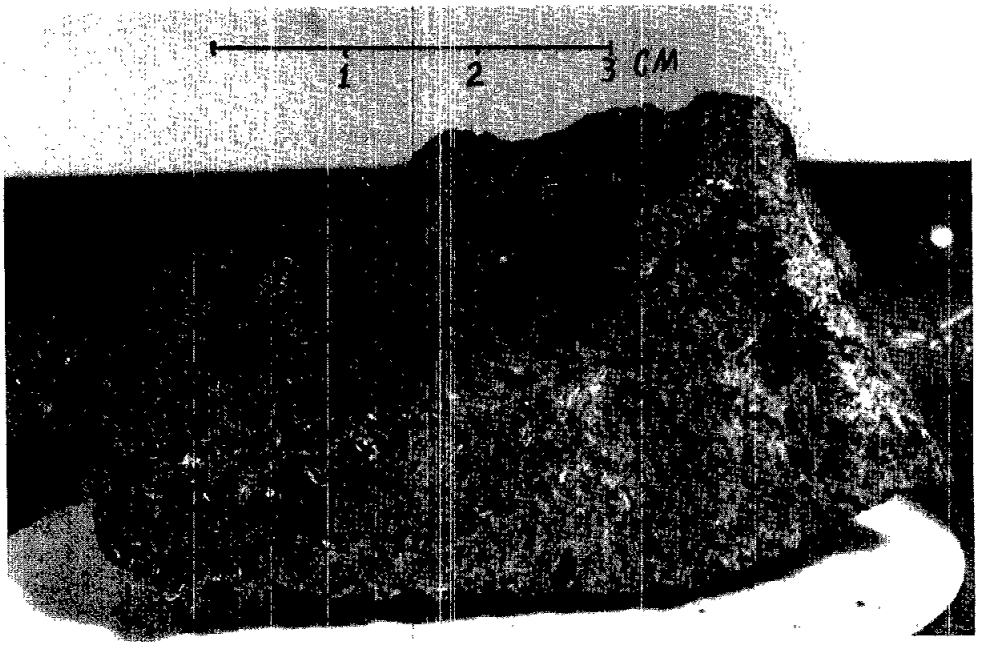
Fe-Ni occurs as discrete grains in matrix, as blebs in troilite and cpx phenocrysts.

Cr spin occurs as discrete grains.

Ulvo commonly rims Cr spinel.

Opaque mineralogy and textures are reminiscent of 12008.

5-10% of section is smooth walled cavities.



Sample 15485 - T_1 S-71-44236

Photomicrograph Sample 15485,3
(width of field ≈4 mm)

ROCK TYPE: Basalt with gray coatings WEIGHT: 46.8 g
COLOR: Olive black (5Y 2/1), grayish black (N2), color of coating: fresh-medium dark gray (N4) DENSITY:
DIMENSIONS: 5.6 x 3 x 2.5 cm
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: Few penetrative and few nonpenetrative.

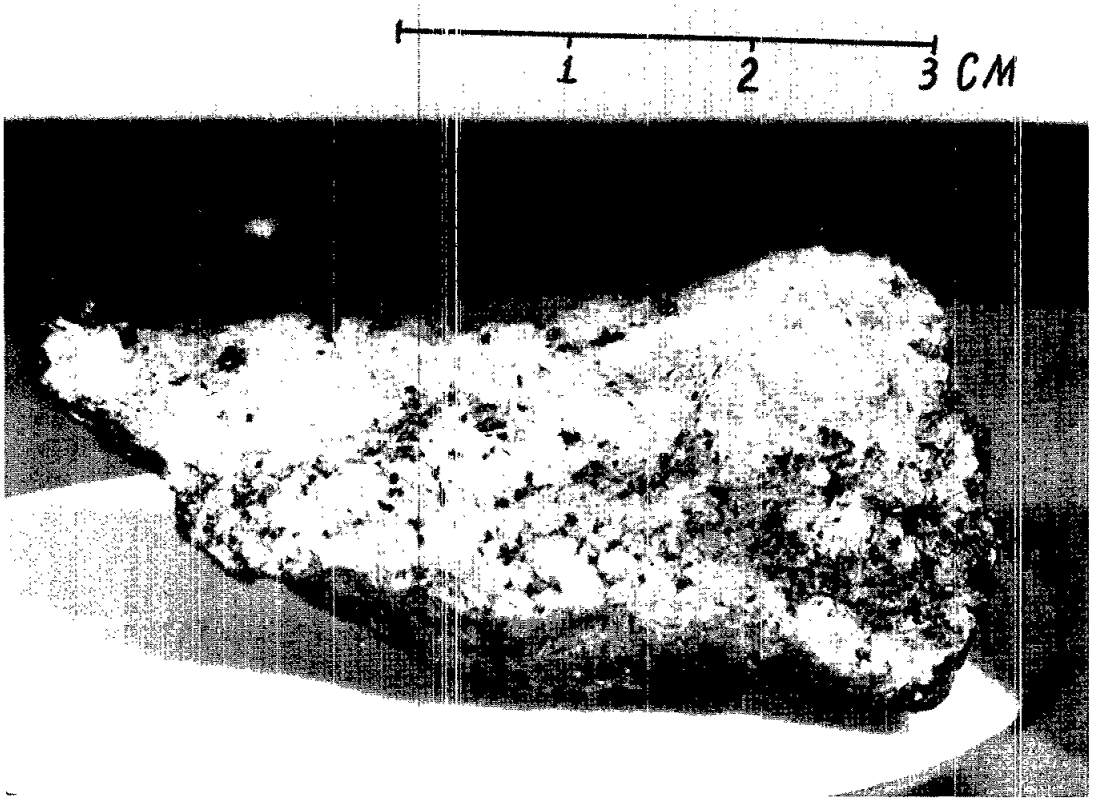
BINOCULAR DESCRIPTION BY: Silver & Jakes DATE: 8/28/71

FABRIC: Porphyritic, inequigranular
VARIABILITY: Differences in coating on several surfaces and in the densities of vugs.
SURFACE: T is a break along veins of pre-existing vugs with coalescing walls. B is smoother with a darker coating. N has glassy vugs, a light olive gray coating, and faint straitions with preferred orientation.
ZAP PITS: Few to many on B; few on T; none on N, W.
CAVITIES: 5% vugs. T has one 1 cm vug with crystals 5-7 mm. B locally has a high density of vugs with 1-10 mm pyroxene prisms. These prisms have a few greenish spots.
SPECIAL FEATURES: Coating of light olive gray on N is clearly related to a fracture, which can be followed into the rock. Metallic surface grains on T are probably part of the alteration or coating. Alteration or coatings are on the surfaces of pyroxene prisms. On old penetrative fractures the mineralogy is obscured by coating.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Mafic silicate	pale brown	50	prismatic		5-7 x 0.2-1	1
Matrix		45	plumose			2
Plagioclase	light gray		anhedral		<0.2	
Mafic silicate	pale yellow-green	Trace				3
Opaque	black	Trace			<0.1	
Metal	silvery					4
Coating	light olive gray	1	fracture coating		<0.1	5

NOTES:

1. Pyroxene, pale brown with thin dark rims and some with darker cores, randomly oriented with interlocking grains.
2. Pyroxene(?) intergrowths, pyroxene to feldspar porportion is 3:2.
3. May be olivine.
4. Mostly in coated areas.
5. Compare with 15485, 15487.



Sample 15486 - N_1 S-71-44250

ROCK TYPE: Gabbro WEIGHT: 908.9 g
COLOR: Brownish gray near (5YR 4/1) DENSITY:
SHAPE: Blocky, subangular DIMENSIONS: 12 x 10 x 6.5 cm
COHERENCE Intergranular: Tough
Fracturing: Few nonpenetrative (S); second set, three members, one of them exposed on B.

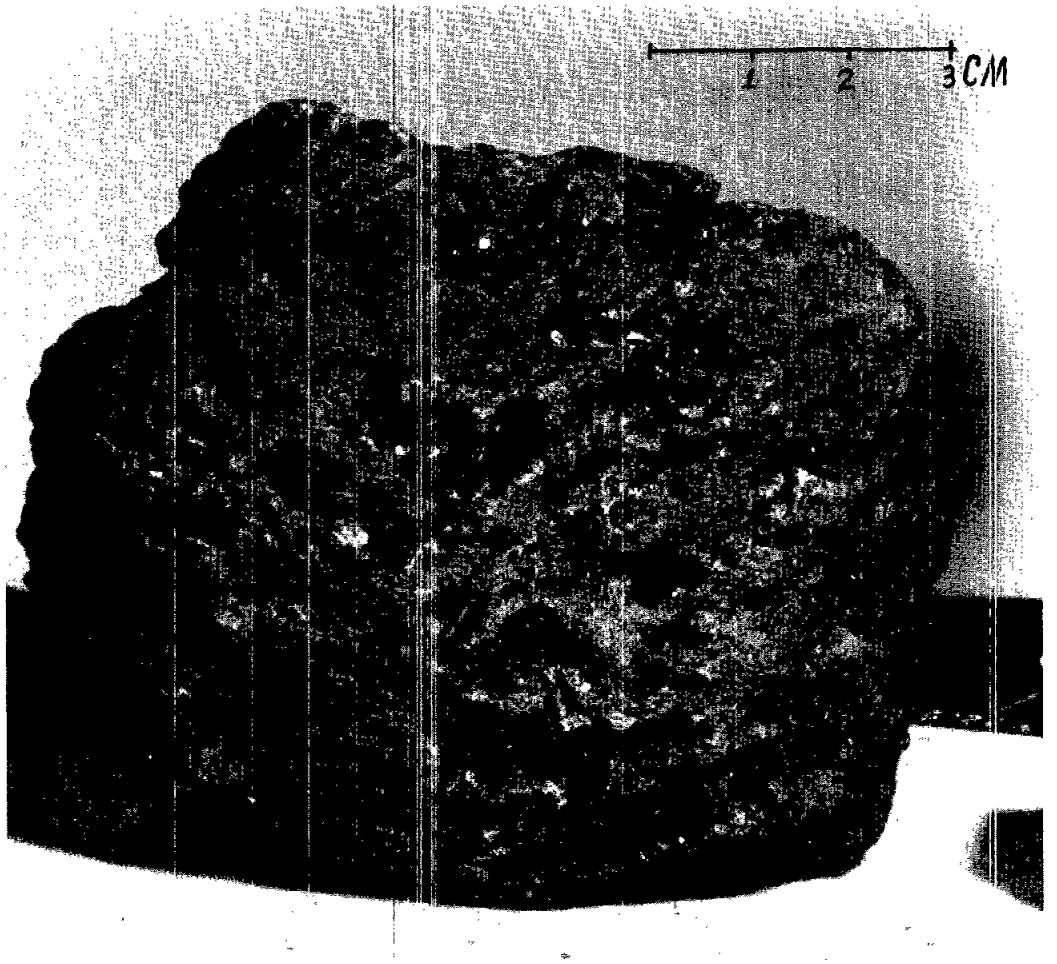
BINOCULAR DESCRIPTION BY: Reid & Bass DATE: 8/26/71

FABRIC: Porphyritic; parallel to subradial feldspar-pyroxene intergrowths in groundmass, with preferential orientation E-W on S.
VARIABILITY: Moderate variability in abundance of vugs.
SURFACE: Granulated.
ZAP PITS: None on N, W; few on S, T, E, and B. Shattered feldspar suggests S may be saturated with zap pits from which glassy central areas were lost.
CAVITIES: 5-10% vugs with abundant pyroxene and minor plagioclase and ilmenite crystals.
SPECIAL FEATURES: Euhedral pyroxene prisms up to 15 x 2 mm (dark brownish green exterior, green cores) exposed in vugs, otherwise similar to phenocrysts. The rock is gabbro by grain size and porphyritic variolitic basalt by texture (compare 12021).

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Mafic silicate	yellow-green cores, thick dark brownish green rims	20	prismatic	10x3	up to 25x3	1
Mafic silicate	brown	40	elongate lamellar	3x<1	2-5x<1	2
Plagioclase	white to colorless	40	elongate lamellar	3x<1	2-5x<1	3
Opaque	metallic black	<5	equant, hexagonal plates in vugs	<1		
Glass ?	brown	Trace	round	<1		4

NOTES:

1. Pyroxene phenocrysts, more abundant on S than on N, hollow cores in some, discontinuous color zoning, green cores are possibly pigeonite.
2. Pyroxene, intergrown with feldspar.
3. White, opaque where shocked. Intergrown with pyroxene. No definite phenocrysts.
4. Round vitreous surfaces exposed in a few vugs on N.



Sample 15495 - N_1 S-71-44206

ROCK TYPE: Breccia, recrystallized WEIGHT: 2339.8 g
COLOR: Dark gray (N5) with brown tint DENSITY:
SHAPE: Angular, with only 4 faces: DIMENSIONS: 18 x 14 x 12 cm
T (grooved and smooth), B (planar), N and S (convex).
COHERENCE Intergranular: Coherent
Fracturing: Few, nonpenetrative

BINOCULAR DESCRIPTION BY: Warner DATE: 8/25/71

FABRIC: Breccia
VARIABILITY: Matrix is glassy in some areas and finely granular in others.
SURFACE: Hackly, glass coats; 15% of T, 20% of S, 10% of N, 30% of B. The glass coatings are black, vesicular, and vary in thickness from a film up to 5 mm. Most surfaces are very dusty.
ZAP PITS: Few on B; none on S, T, N.
CAVITIES: None in the breccia. The glass coatings are vesicular.
SPECIAL FEATURES: The rock shows evidence of some melting and a high degree of recrystallization. Four types of glass are present: coatings, matrix, veinlets and clasts.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Matrix		84			<0.2	1
Breccia		2			1-2	2
Basalt		10			0.5-2	2
Glass	black		vesicular		0.2-1	
Plagioclase		3			0.2-1	
Mafic silicate		1			0.2-0.5	

NOTES:

1. More than 70% glass in parts of the rock.
2. Lithic clasts show some evidence of melting: black glass rims breccia and/or basalt clast; black glass veinlets cut clasts; frothy black glass forms a major part of the matrix surrounding clasts.

THIN SECTION DESCRIPTION BY: Wilshire & Brett DATE: 9/18/71

SECTION: 15498,4
SUMMARY: Glassy fine breccia with clasts derived mainly from coarse pyx-rich basalt. Primarily of Mare origin from both silicate and opaque occurrences.

LITHIC CLASTS, 10% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Anorth	1 clast	irreg	2.5	Anorth consists of maskelynite with a little relict plag and shocked pyx.
Pyrox	1 clast		1.5	Pyrox contains coarse pig, oliv, aug and opaque.
Basalt			0.1-1	Basalt clasts are intersertal and equigranular.
Pyrox				Pyroxenite appears to be granulated pale brown pyx.
Clastic				Clastic rock clast is finely recrystallized.
Aphan				Aphanitic rocks clasts are dark with very fine quench texture.

GLASS CLASTS,

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Yellow			<0.5	Glasses are generally clear but some of the brown and pale green fragments contain much mineral debris.
Brown			<0.5	
Deep brown			<0.5	One 0.3 mm piece of vesicular glass.
Pale green				Some of the glass fragments are broken spheres.

MINERAL CLASTS,

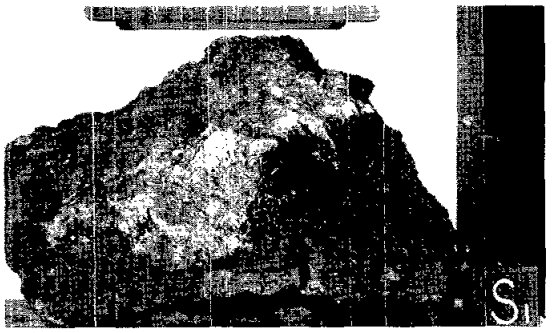
PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Cpx		ang	0.1-1	Cpx includes aug and pig. Cpx is the dominant mineral clast species.
Plag			0.1-1	Plag, oliv, and opx are in order of decreasing abundance.
Oliv			up to 7	
Opx			0.2	Opx identified by having (-) 2V.
Ilm	<0.1	ang	0.25	
Ulvo	<0.1	ang	0.1-1.5	
Fe-Ni	<0.1	irreg ragged	0.1-0.4	

MATRIX,

PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Ilm	1.5	ang	<0.1	The <0.1 mm fraction has a brown cast and contains glass.
Ulvo	1	ang	<0.1	
Fe-Ni	<0.1	irreg	<0.1	
Troil	<0.1	irreg	<0.1	
Cr spin	<0.1	subhed	<0.05	

GENERAL COMMENTS: <1 mm fraction makes up 90% of section. Moderate foliation of lineation formed by alignment of elongate fragments.

Opaques indicate that breccia is largely Mare-derived. Some lithic clasts have low opaque abundance.



Sample 15498 - S_1 S-71-44196

Photomicrograph Sample 15498,4
(width of field ≈4 mm)

ROCK TYPE: Basalt, vesicular
COLOR: Medium dark gray (N4)
SHAPE: Blocky, angular, subangular
COHERENCE Intergranular: Tough
Fracturing: Few irregular, nonpenetrative.

WEIGHT: 2024.0 g
DENSITY:
DIMENSIONS: 17 x 15 x 8 cm

BINOCULAR DESCRIPTION BY: Ridley & Jakes DATE: 8/28/71

FABRIC: Microporphyritic, diktytaxitic texture.
VARIABILITY: Homogeneous, E has more matrix material.
SURFACE: S irregular, vesicular, homogeneous, granulated; N deep, irregular, penetrative fracture.
ZAP PITS: Many on S (0.2 mm, 40-50/cm^2); few on W; none on N, E.
CAVITIES: Vesicles 30% (variable) subrounded, ovoid, empty.
SPECIAL FEATURES: On a microscopic scale some areas of N are exclusively dark brown pyroxene and minor olivine. Another area is fine-grained, dark gray, homogeneous, with 10% cavities irregularly distributed. Microphenocrysts (0.4 mm) of plagioclase(?), greenish pyroxene. Medium brown-gray, equigranular, submicroscopic. Sharpish contact with coarse, diktytaxitic basalt.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	yellow to brown	70	euhedral	1x4	0.1-10	1
Matrix	dark brownish gray	30			<0.1	2

NOTES:

1. Zoned pyroxene with yellow cores and dark brown rims, some very thin. Marked diktytaxitic texture.
2. Fine-grained matrix to the patches of pyroxene.

THIN SECTION DESCRIPTION BY: Reid & Brett DATE: 9/17/71

SECTION: 15499,4
SUMMARY: Porphyritic clinopyroxene (and olivine) basalt vitrophyre (similar to 15485 and 15597).

PHASE	PERCENT	SHAPE	SIZE (mm)
(Phenocrysts)			
Cpx	42	skeletal prisms	1x7
Oliv	one grain	skeletal elongate	1x7
(Groundmass)			
Cpx }	52	elongate	0.01x0.1
Plag }		laths	0.01x0.1
Ilm	5	needles	0.05x0.005
Fe-Ni	0.1	blebs	0.01
Cr spin	0.1	euhedral	0.1
Troil	0.1	anhedral	0.005
Ulvo	0.1	anhedral	0.01

COMMENTS:

Porphyritic with fine-grained devitrified groundmass of variolitic plumose intergrowths of cpx and plag. Opaques restricted to groundmass.

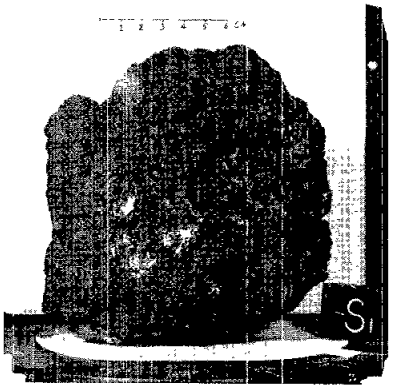
Cpx phenocrysts are elongate, euhedral, skeletal prisms zoned from hollow cores (now filled with groundmass) through pigeonite to augite rims. Although pigeonite and augite show discontinuous boundary, each is continuously zoned within itself. Phenocrysts have common orientation.

Single olivine crystal is elongate, euhedral, skeletal prism.

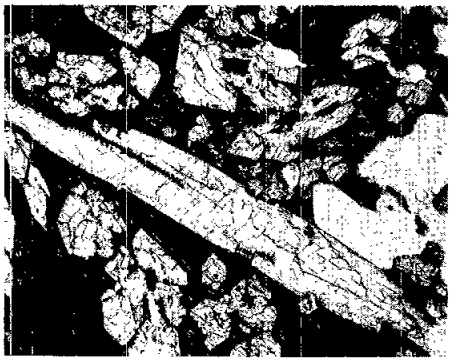
Ilm needles commonly oriented in same direction as cpx phenocryst.

Cr spin is associated with Fe-Ni.

Troil and ulvo occur as discrete grains.



Sample 15499 - S_1 S-71-44160



Photomicrograph Sample 15499,4
(width of field ≈4 mm)

ROCK TYPE: Breccia, glass-coated
COLOR: Glass: dark gray (N3)
Breccia: medium dark gray (N4)
SHAPE: Blocky, irregular
COHERENCE Intergranular: Cannot tell.
Fracturing: Many nonpenetrative, glass-covered fractures parallel to T, W, and S and one post-glass fracture on S.

WEIGHT: 1147.4 g
DENSITY:
DIMENSIONS: 13.5 x 9 x 5 cm

BINOCULAR DESCRIPTION BY: Jackson & Reid DATE: 8/28/71

FABRIC: Breccia
VARIABILITY: Breccia is visible on only 3% of the rock surface, but it is moderately heterogeneous.
SURFACE: Degree of glass covering is: N, 90%; T, 100%; S, 95%; B, 99%; E, 95%. T, B are dust-covered. B face may have burial line across it. B face has parallel concave grooves slightly curved subparallel to N. W face has glass-coated parallel grooves parallel to S.
ZAP PITS: None
CAVITIES: 0-20% vesicles in glass over about 50% of surface. 1-5 mm diameter. Some with raised, unbroken, fragile walls.
SPECIAL FEATURES: Parallel fractures, all glass-coated, shallow grooves, also glass-coated, on W, parallel to S. 97% glass-coated, glass is 0-5 mm thick and highly vesicular.

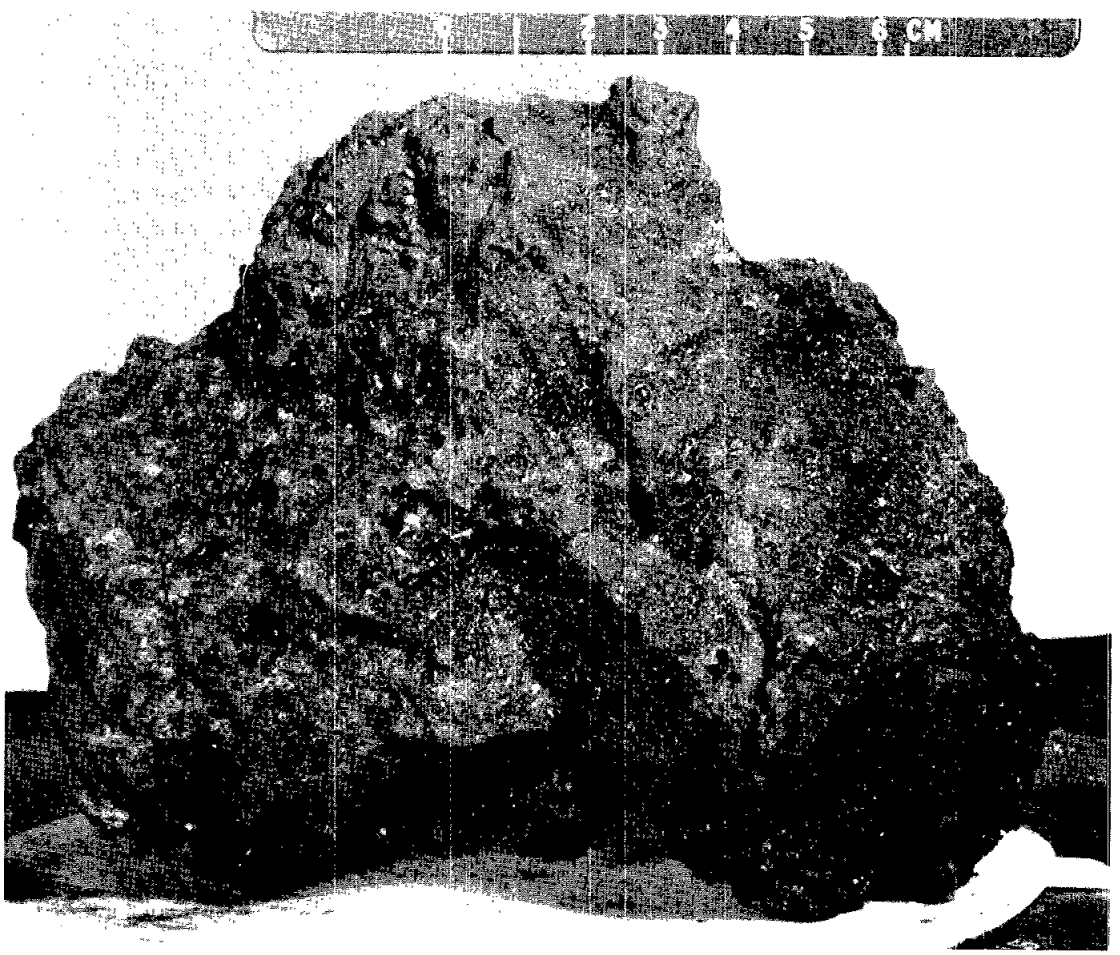
COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Glass	dark gray					
Gabbro	gray	1	angular	5x9		1
Breccia	medium gray	1				2
Anorthosite	white	1	subangular	2.3		3
Breccia	dark medium gray	1		15x15		4
Breccia	medium gray	1		10x10		5
Breccia	medium dark gray	1		10x20		6

NOTES:

1. On face N (<1 mm) fine-grained with prismatic or tabular feldspar 50%, half greenish black, half pale tan pyroxene 50%, planar alignment of minerals, <1 mm grain size.
2. NW corner of face B has five fragments >1 mm, all feldspathic, in medium gray very fine grained matrix of white (feldspar) and tan fragments.
3. On W face, surrounded by 2-3 mm of glass.
4. On W face, microbreccia, no clasts, all <1 mm vesicular matrix, glassy breccia.

NOTES:

5. On E face, white feldspathic clasts in medium gray matrix.
6. N face, five <0.5 mm clasts, (3 plagioclase, 2 fine-grained plagioclase-rich rocks) in matrix of fine feldspar-rich spots, not vesicular, dense, may be glassy.



Sample 15505 - T_1 S-71-44461

ROCK TYPE: Glass-coated microbreccia
COLOR: Breccia: medium dark gray (N4)
Glass: olive black (5Y 2/1) to olive gray (5Y 4/1)
SHAPE: Subangular
COHERENCE Intergranular: Moderately friable
Fracturing: Three prominent penetrative sets at 60° to each other producing rhombohedral pattern. One set subparallel to E face.

WEIGHT: 22.9 g
DENSITY:
DIMENSIONS: 2.9 x 2.6 x 2.6 cm

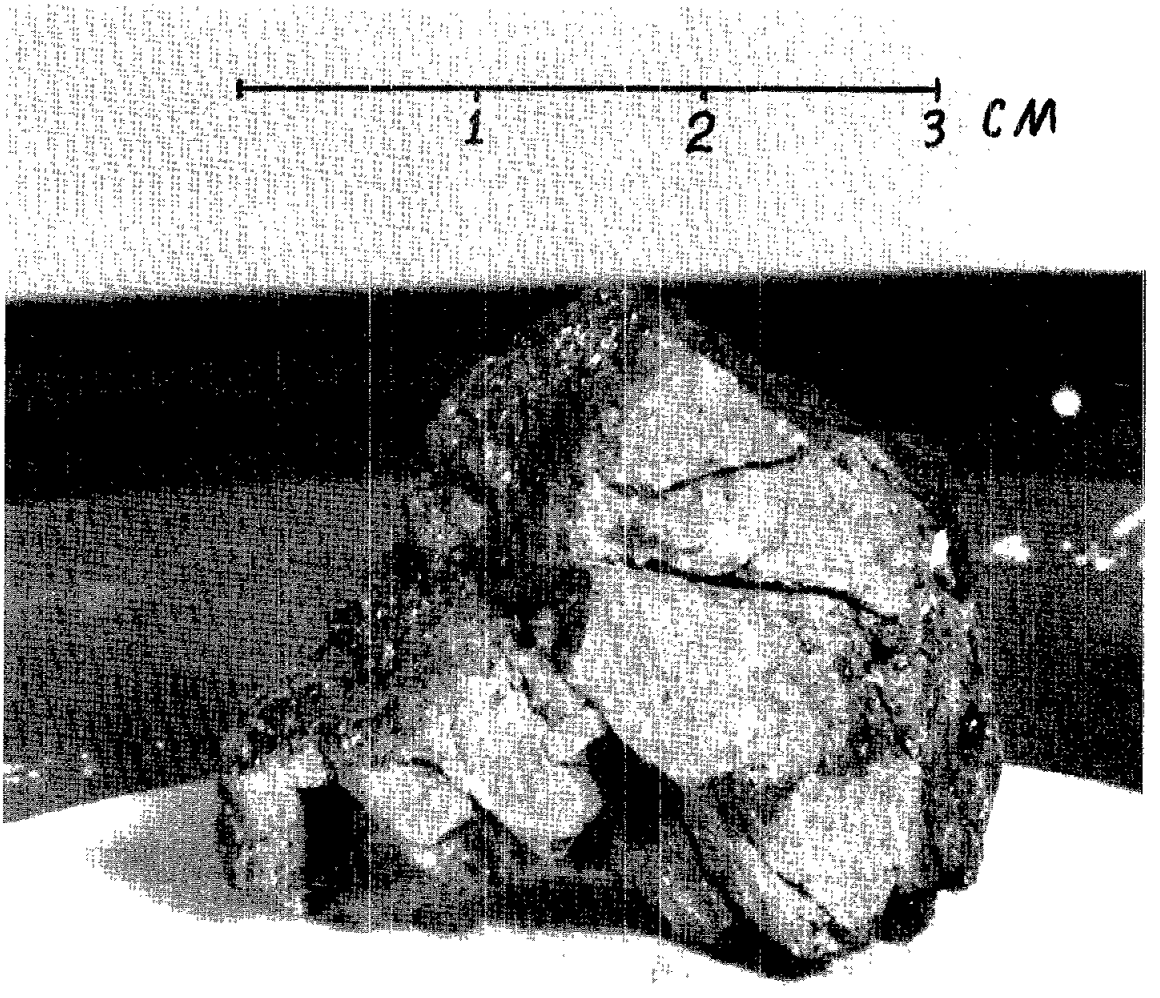
BINOCULAR DESCRIPTION BY: Horz DATE: 8/28/71

FABRIC: Microbreccia, faint foliation on S face.
VARIABILITY: Breccia to glass coating.
SURFACE: N is glassy with some dust cover, smooth and hummocky, some windows through glass breccia. T and E have grooves resembling slickensides, about 1 mm spacing and have glass over part of surface. Other surfaces are breccia and are hackly and shattered.
ZAP PITS: Few on T, N, W; none on S, E, B.
CAVITIES: 1% of breccia.
SPECIAL FEATURES: One penetrative fracture set partially filled with vesicular glass.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Matrix	medium dark gray	90			<0.1	
Plagioclase	white	10	angular some elongate	0.5	0.5-2	
Lithic clast	light gray	<1	angular	2		1
Glass clast	bottle green	<1	subrounded	0.3		2
Mineral clast	light brown	<1	angular	0.2		3

NOTES:

1. Has gray-brown phase (pyroxene?) in it.
2. Probably glass, only one of these.
3. Pyroxene(?)



Sample 15506 - S_1 S-71-44529

ROCK TYPE: Glass ellipsoid, vesicular
COLOR: Olivine brown to grayish brown (5YR 3/2)
SHAPE: 3 fragments combine to form an egg-shaped object
COHERENCE Intergranular: Tough
Fracturing:

WEIGHT: 3.9 g
DENSITY:
DIMENSIONS: 3 fragments, approximately equal in size.

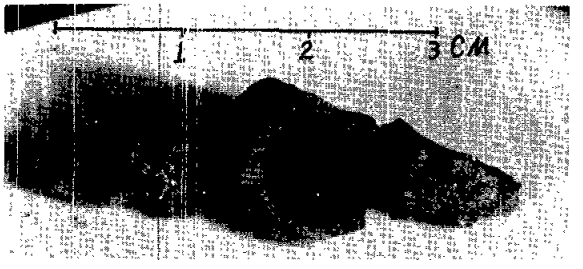
BINOCULAR DESCRIPTION BY: Morrison DATE: 8/30/71

FABRIC:
VARIABILITY: Dusty surfaces to glassy vitreous surface free of dust.
SURFACE: Surfaces have patches of adhering dust.
ZAP PITS: Few on external surfaces; one on internal surface.
CAVITIES: 40-50% vesicles, up to 1 mm, both external and internal.
SPECIAL FEATURES: This object was broken before collection because a vesicle lining on interior surface has a zap pit (visible on photo S-71-44521).

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Soil or breccia clasts	medium gray	10-15	very irregular	5		1
Metal (?)	metallic gray	1(?)		minute		2
Metal (?)	metallic white					3
Glass	olive brown to gray brown	85-90				

NOTES:

1. Three soil clots or breccia fragments were enveloped by the glass.
2. Glass appears to have swirls of gray material which may be metal.
3. Spheroid projecting above surface of largest vesicle in largest fragments, similar objects occur elsewhere in the rock.



Sample 15507 - N_1 S-71-44521

ROCK TYPE: Microbreccia, glass-coated WEIGHT: 1.4 g
COLOR: Medium gray (N5) DENSITY:
SHAPE: Irregular DIMENSIONS: 3 x 2 x 1 cm
COHERENCE Intergranular: Coherent
Fracturing: Few, nonpenetrative.

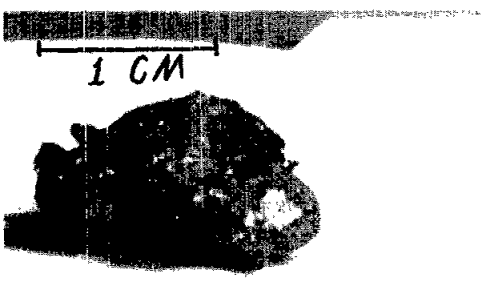
BINOCULAR DESCRIPTION BY: Ridley DATE: 8/30/71

FABRIC: None
VARIABILITY: None
SURFACE: Black glass coatings on W (30%), E (10%), and T (5%).
ZAP PITS: None on N, E, S, W, and T.
CAVITIES: None in breccia, common vesicles in black glass coating, maximum size 2 mm, round and ovoid, some are soil filled.
SPECIAL FEATURES:

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Gabbro		5	subrounded	2x2		1
Mafic silicate	dark-medium brown	1	irregular	0.1	0.1-0.3	2
Plagioclase	translucent, white, turquoise	1	irregular	0.1	0.1-0.3	
Glass spheres	black	1			0.1	
Matrix		92				

NOTES:

1. One clast with white feldspar and brown pyroxene.
2. Pyroxenes.
3. Equigranular, irresolvable.



Sample 15508 - E_1 S-71-44813

15515

SAMPLE TYPE: Soil, <1 mm fraction WEIGHT: 144.7 g
COLOR:
LOCATION: Station 9; rim of a crater south of Scarp Crater. The sample is a caked clod and looks like a piece of mud.

DESCRIPTION: Heiken DATE: 10/2/71

TABLE OF COMPONENTS: Page
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. Some 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.

15515

COMPONENTS	NOTE	PERCENT OF GRAINS 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
Anorthocite	12	-	1.0	-
Glass droplets	13	5.5	2.0	-
Grains counted	-	18	200	200
Section number		58,63,64	75,62	56,61

THIN SECTION DESCRIPTION BY: Reid & Brett DATE: 9/18/71

SECTION: 15515,51

SUMMARY: Glassy, fine-grained, non-annealed breccia with predominantly cpx-rich basalt clasts. At least partly of Mare origin.

LITHIC CLASTS, 15% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Basalt	90	ang	up to 2	Most basalt clasts are intergranular cpx-plag rocks with 50% cpx and low opaques.
Plag-rich	7	ang	up to 0.8	Plag-rich clasts are commonly deformed and contain about 80% plag.
Oliv	3	ang	up to 0.6	Oliv clasts are polycrystalline intergrown oliv grains.
				No breccia clasts.
				Clasts have some opaque assemblage as matrix (euhedral to subhedral).

GLASS CLASTS, 15% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Brown	40	sph to irreg	0.01-0.3	About 90% of the glass occurs as spheres. Remainder as irregular fragments.
Clear	50	sph to irreg	0.01-0.3	Many of the glass clasts are devit.
Yellow	10	sph to irreg	0.01-0.3	Some glasses contain flow structure and metal spherules.

MINERAL CLASTS, 15% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Cpx	55	ang	up to 5	
Plag	30	ang	up to 5	
Opx	5	ang	up to 5	
Oliv	5	ang	up to 5	
Ilm	<0.1	ang	0.1-0.2	
Ulvo	<0.1	ang	0.1-0.15	

MATRIX, 55% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Ilm	<1	ang	<0.1	Matrix has high content of brown glass and many very small mineral fragments.
Ulvo	<0.5	ang	<0.1	
Cr spin	<0.1	ang	<0.04	No evidence of recrystallization.
Fe-Ni	<0.1	blebs	<0.05	
Troil	<0.1	blebs	<0.06	

GENERAL COMMENTS: No glass structure is visible.
No obvious sorting of clasts except that almost all clasts are <2 mm.
No obvious shock effects.
Opaque abundance of matrix suggests non-Mare origin. Some lithic clasts are rich in opaques and are similar to Mare rocks, some are not.

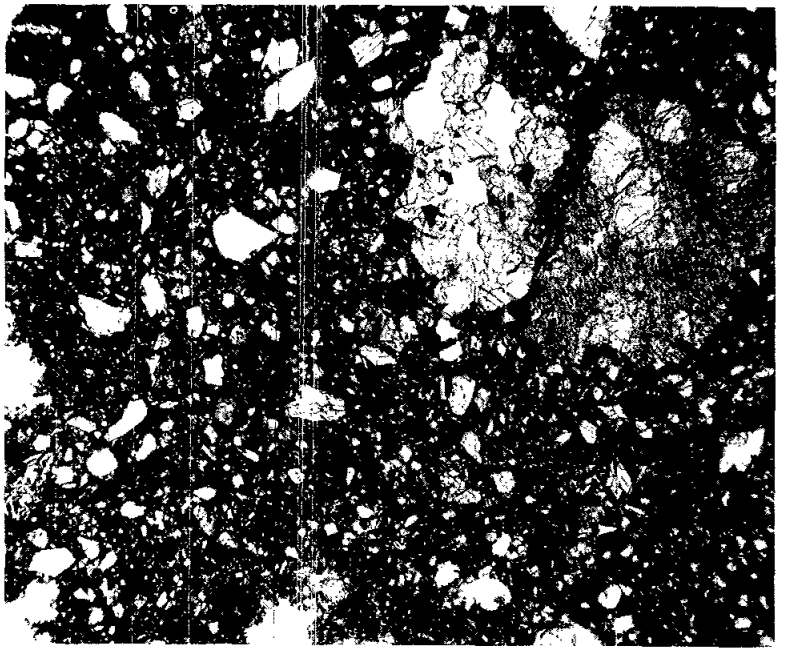
SAMPLE TYPE: Fines from clods WEIGHT: 144.7 g
COLOR:
LOCATION: Station 9; rim of a crater south of Scarp Crater. The sample is a caked clod and looks like a piece of mud.

THIN SECTION PETROGRAPHY BY: Heiken DATE: 10/2/71

TABLE OF COMPONENTS: Page
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. Some 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 laths 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.

COMPONENTS	NOTE	PERCENT OF GRAINS 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
Anorthocite	12	-	1.0	-
Glass droplets	13	5.5	2.0	-
Grains counted	-	18	200	200
Section number		58,63,64	57,62	56,61



Photomicrograph Sample 15515
(width of field ≈4 mm)

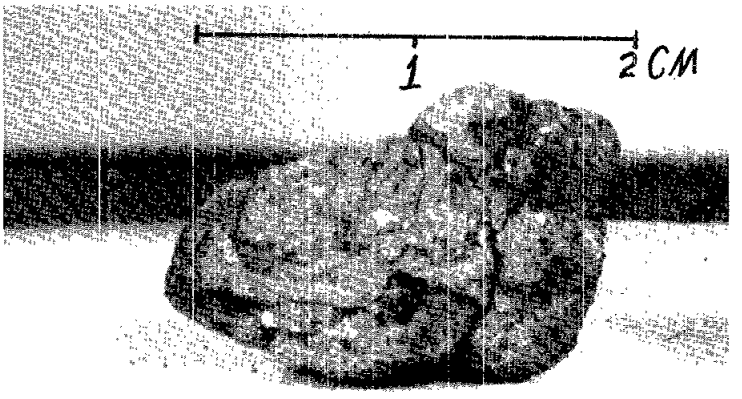
ROCK TYPE: Breccia
COLOR: Brownish gray (5YR 4/1)
SHAPE: Subrounded
COHERENCE Intergranular: Friable
Fracturing: Few and penetrative. Rock now in two pieces.

WEIGHT: 4.7 g
DENSITY:
DIMENSIONS: 2 x 2 x 1.5 cm

BINOCULAR DESCRIPTION BY: Warner DATE: 8/30/71

FABRIC: Breccia
VARIABILITY: None
SURFACE: Smooth
ZAP PITS: None to few.
CAVITIES: None
SPECIAL FEATURES:

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Matrix	gray	88			0-0.2	
Plagioclase	white	1			0.2-2	
Mafic	gray	3			0.2-3	
Opaque	black	1			0.4-1	
Lithic	black	3			0.2-1	
Glass	black	4			0.2-1	



Sample 15528 - N_1 S-71-43645

ROCK TYPE: Vesicular basalt
COLOR: Light olive gray (5Y 5/2)
SHAPE: Rounded, in part subangular
COHERENCE Intergranular: Coherent to tough
Fracturing: A few parallel fractures, nonpenetrative, although soil and weathering partly obscures (see special features)

WEIGHT: 1531.0 g
DENSITY:
DIMENSIONS: 14 x 10 x 10 cm

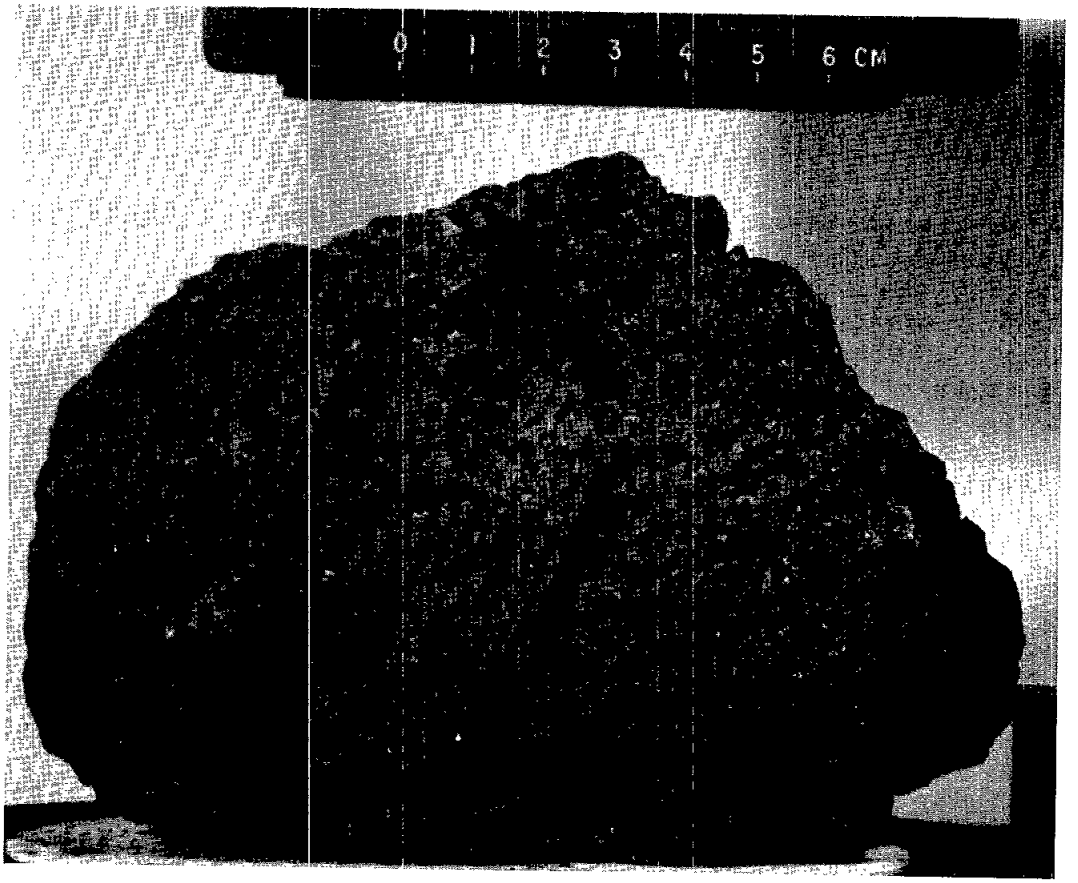
BINOCULAR DESCRIPTION BY: Head DATE: 8/23/71

FABRIC: Equigranular
VARIABILITY: Grain size appears to approach aphanitic in places.
SURFACE: Very irregular due to vesicles, smoother where soil adheres and is weathered. Intervesicular areas range from smooth to hackly depending on abundance of vesicles and coincidence of walls. Vesicles are glass lined with some crystals parallel to linings of vesicles.
ZAP PITS: None
CAVITIES: Vesicles are 30% of rock, average 4 mm and reach 7 mm. Some vugs are present.
SPECIAL FEATURES: Vesicles are generally glass-lined and show no apparent preferred orientation. Vesicles on bottom and sides of rock are generally filled with soil. T appears most soil free. There appears to be a series of parallel fractures which cut through vesicles and range from 1-4 cm apart. These are best shown on W face. Vesicles have minute laths (pyroxene?). Vug has plagioclase plates protruding into it. Glass-lined cavities and intervesicle areas appear to be worn smooth, rather than just soil filled.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	white	25-30	elongate platy to laths	0.4	0.2-1	1
Plagioclase	gray	20-25	equant to tabular	≈0.2	0.1-4	
Mafic silicate	light honey to cinnamon brown	45-55	equant to elongate	≈0.2	0.1-0.6	
Opaques	black	≈1	equidimensional stubby		<0.1-0.3	

NOTES:

1. White plagioclase 0.2 x 1 mm laths have no prefered orientation. Plagioclase content is very variable over whole rock.



Sample 15529 - N_1 S-71-42930

15531 15601

SAMPLE TYPE: Soil, < 1 mm fraction WEIGHT: 15531 - 136.0 g
COLOR: 15601 - 802.0 g
LOCATION: Rille (Station 9A)
THIN SECTION PETROGAPHY BY: Heiken DATE: 10/2/71

TABLE OF COMPONENTS:
NOTES TO TABLE:

1. Brown mineral and glass detritus in a dark brown to black glassy matrix; welded droplets of the detritus-laden glass.
2. Colorless to pale brown anhedral to subhedral crystals of pigeonite and augite; some are zoned. Many are highly fractured.
3. Pyroxene > feldspar > opaques.
4. Feldspar > pyroxene.
5. Skeletal, euhedral, clinopyroxenes in a pale brown, partly devitrified glassy matrix.
6. Clear spheres and sphere fragments.
7. Spheres and sphere fragments; some are devitrified; a few contain 5-20% detritus.
8. Clear; some are devitrified.
9. Generally clear, but some have up to 5% inclusions.
10. Mineral detritus in a fine-grained feldspar matrix.
11. Small, equant fragments of feldspar and clinopyroxene in a pale brown glass matrix.
12. Colorless and subhedral.
13. Colorless and anhedral.
14. Approximately An_{70}.

		15531			15601		
		PERCENT OF GRAINS			PERCENT OF GRAINS		
COMPONENT	NOTE	0.5-1.0mm	0.25-0.5mm	0.125-0.25mm	0.5-1.0mm	0.25-0.5mm	0.125-0.25mm
Agglutinates, brown	1	20	31.5	28.0	-	50.5	34.5
Clinopyroxene	2	-	21.3	35.0	-	17.9	30.5
Basalt, equigranular	3	-	7.8	3.5	50	9.5	2.5
Basalt, ophitic	4	40	24.7	12.5	-	6.3	10.5
Basalt, hyalocrystalline	5	-	-	-	12.5	2.0	-
Glass Spheres, green	6	-	3.4	4.0	-	2.0	1.0
Glass Spheres, brown	7	-	3.4	1.5	-	-	-
Angular glass, brown	8	-	-	-	12.5	1	1.5
Angular glass, colorless	9	-	-	2.0	-	-	1.5
Microbreccia, recrystallized	10	-	1.1	1.0	-	2	2.5
Microbreccia, vitric	11	20	22.5	3.5	-	-	2.5
Olivine	12	20	2.2	2.0	-	5.2	3.5
Orthopyroxene	13	-	-	-	-	-	2.5
Plagioclase	14	-	1.1	8.0	-	3.1	4.5
Grains counted		5	89	200	9	95	200
Section number		13	12	11	16	15	14

ROCK TYPE: Porphyritic olivine basalt
COLOR: Medium dark gray (N4) to brownish gray (5YR 4/1) to olive gray (5Y 4/1)
SHAPE: Slabby, subangular to angular
COHERENCE Intergranular: Tough
Fracturing: Several penetrative subparallel to principal surfaces.

WEIGHT: 404.5 g
DENSITY:
DIMENSIONS: 12.5 x 7 x 3.5 cm

BINOCULAR DESCRIPTION BY: Silver & Phinney DATE: 8/28/71

FABRIC: Porphyritic, granular
VARIABILITY: None
SURFACE: Irregular, somewhat hackly, T is mostly fresh surfaces where chipped from boulder.
ZAP PITS: Few on N, S (more than on N), T (upper edge only), B, E, W.
CAVITIES: 3-5% vugs, crystals project into cavities.
SPECIAL FEATURES:

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	greenish yellow	15	equant to irregular	2	0.5-4	1
Mafic silicate	pale brown to cinnamon brown	40-45	anhedral	0.3	<0.05-1.5	2
Mafic silicate	dark brown to black	2	subround to irregular	0.1	up to 0.5	3
Opaques	black	3	equant to platy	0.05	up to 0.2	4
Plagioclase		35	subhedral to anhedral, platy	0.3	0.1-4	5

NOTES:

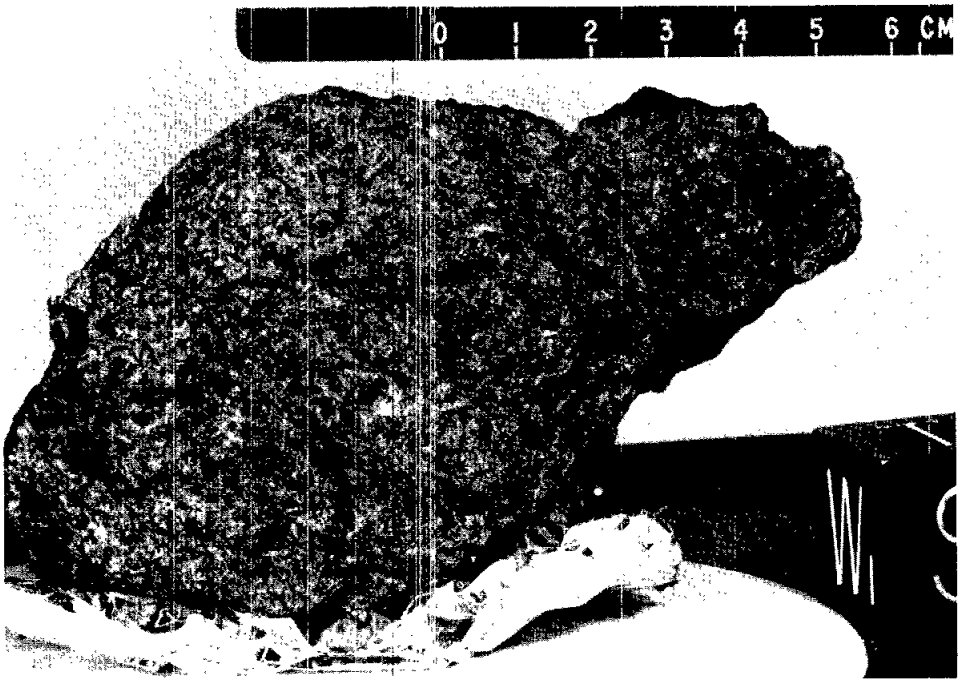
1. Probably olivine phenocrysts.
2. Darkest around vugs, euhedral in vugs, probably pyroxene.
3. Translucent, very high luster, may not be silicate.
4. Occur as inclusions in all other phases.
5. Granular crystals range 0.1-0.5 mm in size; large platy ones reach 0.5x4 mm.

THIN SECTION DESCRIPTION BY: Silver & Brett DATE: 9/17/71

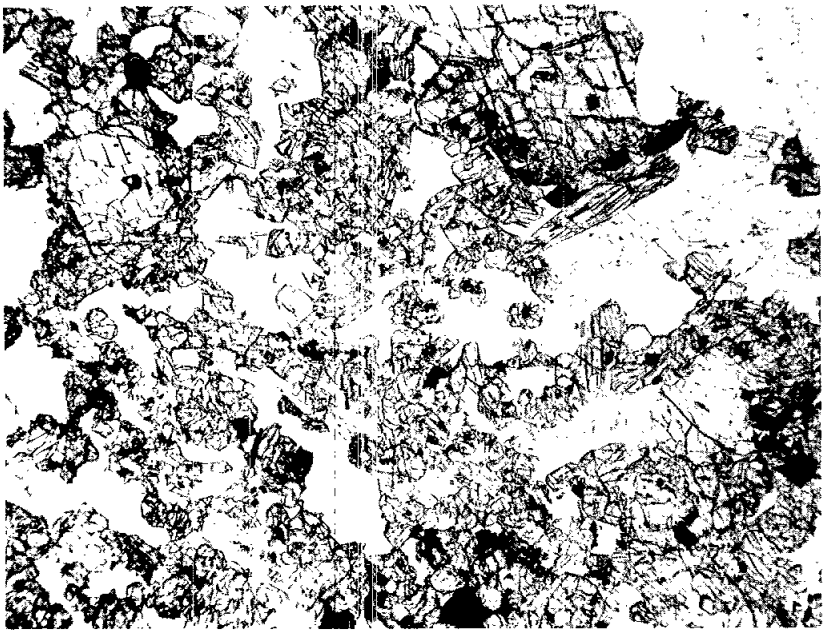
SECTION: 15535,9
SUMMARY: Porphyritic olivine basalt.

PHASE	PERCENT	SHAPE	SIZE (mm)
(Phenocrysts)			
Oliv	10	anhedral equant	0.5-2
(Groundmass)			
Cpx	53	subhedral to euhedral	0.1-0.8 ave 0.3
Plag	32	subhedral plates	1-2 x 0.2-0.4
Ulvo	2	subhedral	<0.3
Ilm	1	subhedral	<0.5
Brown glass	1	interstitial	0.05-0.3
Crist	0.5	subhedral	0.1-0.2
Fe-Ni	<0.1	anhedral	<0.02
Troil	<0.1	anhedral	<0.1
Unident	Trace		

COMMENTS:
Porphyritic inequigranular. Regions of thin section contain stray local preferred orientation of tabular plag.
Oliv phenocrysts contain inclusions of partly devitrified glass. Oliv has 2V of $87^{o}(-)$.
Cpx is weakly zoned from a pigeonite core to a subcalcic augite rim.
Plag is crowded with inclusions of well-formed cpx. Slight zoning occurs in some plag.
Interstitial glass is commonly partly devitrified.
Unidentified phase is battleship gray opaque.
Mode based on 176 points.
Vugs make up 5% of section.
Numerous fractures in plag, cpx, and oliv show thin film (0.001-0.002 mm) coatings. These look like possible lunar alteration products. (Does this indicate H_2O?)



Sample 15535 - S_1 S-71-44481



Photomicrograph Sample 15535,9
(width of field ≈4 mm)

ROCK TYPE: Basalt
COLOR: Light olive gray (5Y 5/2)
SHAPE: Blocky, angular to subangular
COHERENCE Intergranular: Tough
Fracturing: Irregular, nonpenetrative, few. Penetrative on B.

WEIGHT: 317.2 g
DENSITY:
DIMENSIONS: 11 x 8 x 3.5 cm

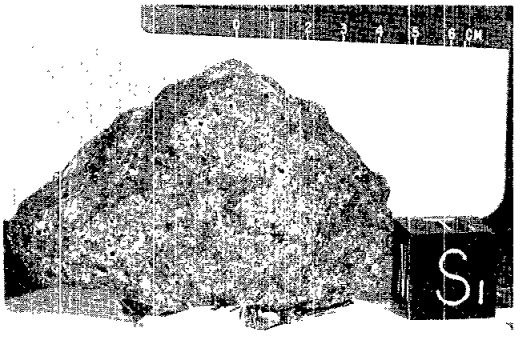
BINOCULAR DESCRIPTION BY: Jakes & Ridley DATE: 8/28/71

FABRIC: Equigranular
VARIABILITY: Microscopic banding with pyroxene-rich and plagioclase-rich bands.
SURFACE: N, S granulated. Light patchy soil cover on S.
ZAP PITS: N none, S few.
CAVITIES: Vugs are 5%, average 2 mm, and contain pyroxene crystals.
SPECIAL FEATURES: B face shows cataclastic texture and 3 mm accumulations of olivine.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	dark to light brown	40	anhedral	0.5	0.3-1	1
Mafic silicate	glassy yellowish green	20	anhedral	0.8	up to 2.5	2
Plagioclase	translucent to white	40	lath shape	1	0.2-3	3
Opaque	black lustrous	2	anhedral	0.2	0.05-3	4

NOTES:

1. Pyroxene, together with olivine and much less plagioclase, forms clusters and bands.
2. Olivine.
3. Mode varies inversely with mafic silicates from 20% to 60% in plagioclase-rich bands.
4. Ilmenite.



Sample 15536 - S_1 S-71-44487

ROCK TYPE: Basalt, coarse grained
COLOR: Medium dark gray (N4) to brownish gray (5YR 4/1)
SHAPE: Angular, blocky
COHERENCE Intergranular: Coherent
Fracturing: None

WEIGHT: 1.9 g
DENSITY:
DIMENSIONS: 2 x 2 x 1.5 cm

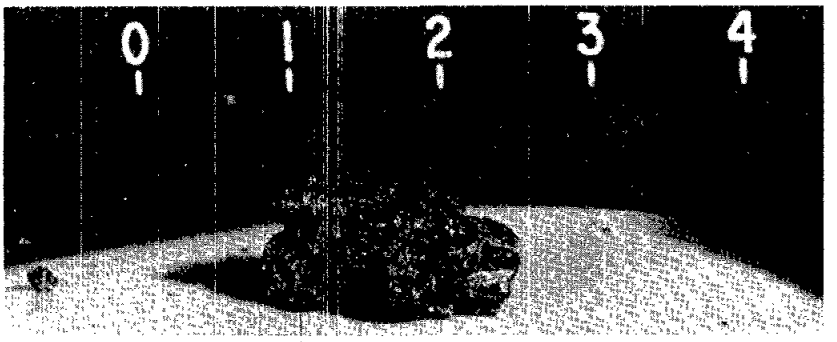
BINOCULAR DESCRIPTION BY: Jakes & Ridley DATE: 8/28/71

FABRIC: Equigranular
VARIABILITY: Homogeneous
SURFACE: Irregular
ZAP PITS: S is fresh and has no zap pits.
CAVITIES: 10% vugs with 1 mm average size.
SPECIAL FEATURES: Vugs on N face reach 3 mm and are very irregular.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	medium brown	40	anhedral	0.2	0.1-0.4	1
Mafic silicate	yellowish-green	15	subhedral to euhedral	0.2	0.1-0.5	2
Plagioclase	white to translucent	40	anhedral to lath shape	0.1	.04 wide 1 long	
Opaque	black metallic luster	2	lath to anhedral		<0.1	3

NOTES:

1. Homogeneous pyroxene
2. Olivine
3. Ilmenite



Sample 15537 - N_1 S-71-44523

ROCK TYPE: Olivine microgabbro WEIGHT: 2.6 g
COLOR: Mottled light or medium gray, brownish tinge (near N6 or 5YR 6/1) DENSITY:
DIMENSIONS: 1.5 x 2 x 0.7 cm
SHAPE: Blocky, angular, overall somewhat flattened.
COHERENCE Intergranular: Tough
Fracturing: No fractures

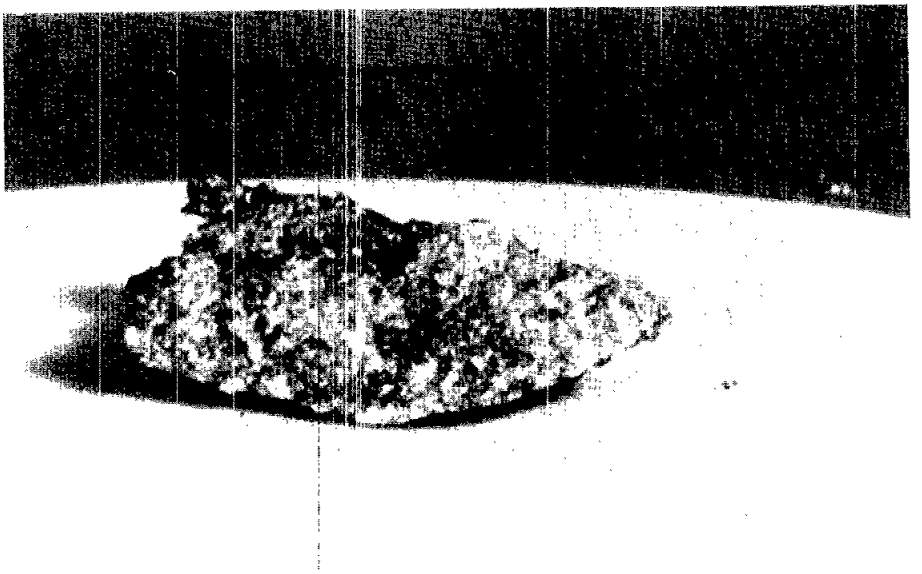
BINOCULAR DESCRIPTION BY: Bass DATE: 8/30/71

FABRIC: Banded, equigranular.
VARIABILITY: Relative concentrations of salic and mafic minerals.
SURFACE: B is convex, granulated, covered with gray patina (possibly in part glass condensation). All others are freshly granulated and the specimen is probably a spall from a larger specimen. Patina occurs only on B - coating or weathering effect(?) definitely not a soil cover and contains little glass except in zap pits. Opaques show up prominently in areas of patina. Probably glass condensation.
ZAP PITS: On B only, glass lined.
CAVITIES: Vugs 2%; mainly pyroxene, olivine, opaques projecting into vugs, lesser plagioclase.
SPECIAL FEATURES: Concentration of salics and mafics into irregular, discontinuous bands (E trend - W on T, possibly flattened parallel to N) which are up to about 80% plagioclase or 60-70% mafic; vugs only in mafic bands or lenses; probably a spall from larger specimen; recommend thin section to study mineral segregation and nature of banding.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	colorless to light gray	50	equant to slabby laths	1	1-3	1
Mafic silicate	medium brown	35-40	equant anhedral	1		2
Mafic silicate	yellow-green	10	equant anhedral	1.5	1-3	3
Opaque	black	3-4	equant anhedral	0.15	0.1-0.4	4

NOTES:

1. Dominantly equant, anhedral, not lath shaped usually.
2. Pyroxene.
3. Olivine, opaque inclusions common.
4. Often included in olivine.



Sample 15538 - N_1 S-71-44810

ROCK TYPE: Basalt
COLOR: Light brownish gray (5YR 6/1)
SHAPE: Blocky
COHERENCE Intergranular: Coherent
Fracturing: Few, nonpenetrative

WEIGHT: 746.6 g
DENSITY:
DIMENSIONS: 13 x 6 x 5 cm

BINOCULAR DESCRIPTION BY: Warner DATE: 8/27/71

FABRIC: Intergranular
VARIABILITY: None
SURFACE: Granulated. All faces are dust covered but B, which may be the lunar upper surface.
ZAP PITS: Few on all faces.
CAVITIES: 2% vugs with all matrix phases projecting into them.
SPECIAL FEATURES: Nonporphyritic.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	white	55	equant, some laths	0.4		
Opaque		8		0.3		
Mafic silicate		30		0.2		1
Mafic silicate		7		0.1		2

NOTES:

1. Pigeonite
2. Augite

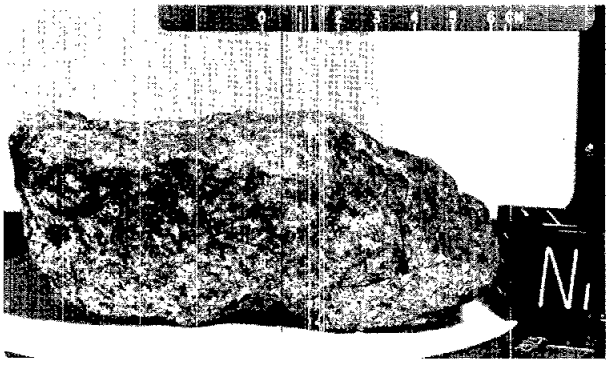
THIN SECTION DESCRIPTION BY: Silver & Brett DATE: 9/17/71

SECTION: 15545,2
SUMMARY: Porphyritic olivine basalt with late stage interstitial plagioclase.

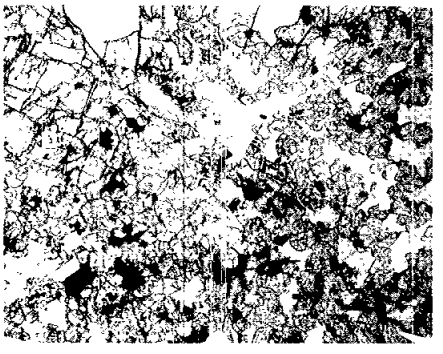
PHASE	PERCENT	SHAPE	SIZE (mm)
(Pheoncrysts)			
Oliv	11	anhedral	0.5-1.5
(Groundmass)			
Cpx	50	anhedral to euhedral	0.1 to 1.0 ave 0.2
Plag	30	anhedral to subhedral	2-3x0.3
Ulvo	3	subhedral	0.4
Ilm	3	subhedral	0.4
Crist	1.5	subhedral to anhedral	0.1-0.3
Glass	0.5		0.1-0.3
Cr spin	0.1	subhedral	0.05
Fe-Ni	0.1	blebs	0.05
Troil	0.1	anhedral	0.02

COMMENTS:

Porphyritic, inequigranular.
Olivine shows variations of 2V from 89(-) at center to 85(-) at rim.
Cpx zoned from pigeonite core (2V = 10°+) to subcalcic augite (2V = 30°+). A few (2-3%) of the cpx grains could be considered as phenocrysts.
Plag is quite poikilitic with primarily cpx but some opaque inclusions. A few plag grains are weakly zoned. Plag is randomly oriented.
Ulvo occurs largely as discrete grains but may be intergrown with Cr spin.
Ilm, troil and Cr spin are discrete grains.
Fe-Ni occurs as blebs in troilite.
Mode estimated from 200 points.
Section has 10-15% vugs into which cpx projects.



Sample 15545 - N1 S-71-44824



Photomicrograph Sample 15545
(width of field ≈4 mm)

ROCK TYPE: Basalt
COLOR: Brownish gray (5YR 4/1)
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 27.8 g
DENSITY:
DIMENSIONS: 2.5 x 2.5 x 2.5 cm

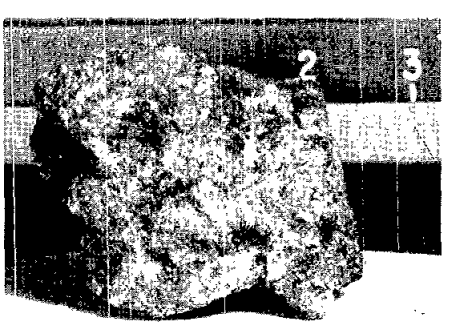
BINOCULAR DESCRIPTION BY: Morrison & Wilshire DATE: 8/31/71

FABRIC: Equigranular
VARIABILITY: Pyroxenes concentrated around vugs
SURFACE: Glass on N; hackly on grain size scale; B dusty with a little glass, S a little glass.
ZAP PITS: Few on all surfaces.
CAVITIES: Irregular and interconnected vugs 3-5%.
SPECIAL FEATURES:

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	white to translucent	45	laths	0.7-5		
Mafic silicate	brown	55	prisms	0.7-1.5		1
Mafic silicate	yellow green	1	anhedral	0.25		2
Opaques	black	<1	equant	very fine		3

NOTES:

1. Pyroxene, occurs next to vugs, where it attains concentration up to 80%, and as anhedral grains in groundmass. Zoned green to brown.
2. Olivine with black inclusions.
3. In plagioclase, olivine and pyroxene.



Sample 15546 - N_1 S-71-44926

ROCK TYPE: Basalt, vuggy
COLOR: Medium dark gray (N2) with brownish tinge
SHAPE: Prismatic, angular
COHERENCE Intergranular: Tough
Fracturing: Irregular penetrative and nonpenetrative

WEIGHT: 20.1 g
DENSITY:
DIMENSIONS: 4 x 2 x 1.8 cm

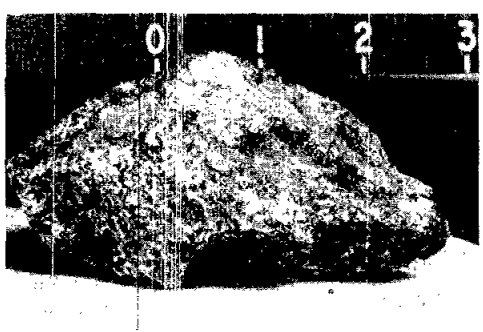
BINOCULAR DESCRITPION BY: Bass DATE: 8/31/71

FABRIC: Isotropic, equigranular
VARIABILITY: None
SURFACE: Granulated, about 30% soil cover on B.
ZAP PITS: Few on T, N; none on others.
CAVITIES: 3% vugs, with pyroxene, plagioclase, minor opaques.
SPECIAL FEATURES: On B are white to medium gray slickensides with an earthy luster. They are oriented roughly E-W, coincident with the position of spiral fracture on B. Moderate amount of shocked white plagioclase on N and B, minor amount on E.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	colorless to white	50	lath to equant	1	0.6-1.5	1
Mafic silicate	yellow green	10	equant	1	0.6-2	2
Mafic silicate	brown and light to medium green	40	equant to stubby prismatic	0.8	0.5-1.1	3
Opaques	black	2	equant	<0.1	<0.1-0.2	

NOTES:

1. Granular, not diabasic.
2. Olivine with tiny opaque inclusions; olivine not seen in vugs.
3. Mainly brown pyroxene. Green occurs both alone and as cores in zoned grains with brown rims.



Sample 15547 - T_1 S-71-44968

ROCK TYPE: Basalt
COLOR: Light brown-gray (5YR 6/1)
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative

WEIGHT: 3.2 g
DENSITY:
DIMENSIONS: 1.8 x 1.2 x 1 cm

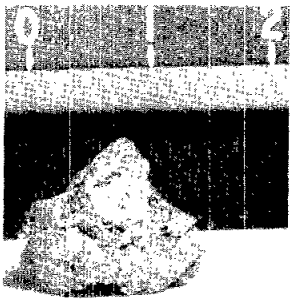
BINOCULAR DESCRIPTION BY: Wilshire DATE: 9/1/71

FABRIC: Microporphyritic, intergranular
VARIABILITY: There is some suggestion of a cognate zenolith (2 mm long) with different mode of same material.
SURFACE:
ZAP PITS: One pit on side of N; all other surfaces fresh.
CAVITIES: 2-3% spherical vugs, with a distinct 0.2 mm lining of coarser pyroxene and plagioclase, few opaques.
SPECIAL FEATURES:

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	yellowish green	2-3	stubby prisms	1	3-2	1
Mafic silicate	cinnamon brown	50	equant	0.2	<0.1-0.3	2
Plagioclase	translucent	50	translucent	0.3	0.3-1	3
Opaques	black	3	equant & platy	0.2	<0.1-0.3	

NOTES:

1. Olivine, a deeper color than usual, abundant black inclusions.
2. Pyroxene, no apparent yellow-green cores.
3. Plagioclase takes no color of adjacent pyroxene making mode difficult.



Sample 15548 - N_1 S-71-44918

ROCK TYPE: Basalt, vuggy
COLOR: Brownish-gray (5YR 4/1)
SHAPE: Blocky, subrounded
WEIGHT: 9613.7 g
DENSITY:
DIMENSIONS: 30 x 15 x 15 cm
COHERENCE Intergranular: Tough
Fracturing: Set of fractures generally E-W dipping 45° N.

BINOCULAR DESCRIPTION BY: Morrison & Lofgren DATE: 8/16/71

FABRIC: Equigranular; possibly subophitic
VARIABILITY: None
SURFACE: Unequally smooth surface
ZAP PITS: Few on B, many on all others.
CAVITIES: Vugs are irregular up to 1 mm, contain euhedral crystals, and make up 10% of rock.
SPECIAL FEATURES: Face S has a large pit with central glass area of 8 mm diameter and 2.2 mm spall zone. Crystal surfaces in some areas have glassy films. B is less rounded than other faces and may have been shielded.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Olivine	pale yellowish green	5-10	equant		0.7-1	1
Plagioclase	translucent to white	50	laths inequigranular		0.3-0.6	2
Pyroxene	red-brown	30	equant		0.3-0.6	3
Pyroxene	light honey brown	10-15	equant		0.3-0.6	
Opaques		<1	equant			4

NOTES:

1. Contains minute opaque inclusions.
2. Less plagioclase than in vesicular types of rocks.
3. Prismatic in vugs.
4. Widely disseminated, rare.

THIN SECTION DESCRIPTION BY: Warner & Brett DATE: 9/15/71

SECTION: 15555

SUMMARY: Porphyritic pyroxene (and olivine?) basalt with late stage interstitial plagioclase.

PHASE	PERCENT	SHAPE	SIZE (mm)
(Phenocrysts)			
Cpx	45	subhedral	1x1x2
(Groundmass)			
Plag	26	anhedral	up to 0.5x2
Oliv	15	euhedral	0.75
Cpx	10	equant euhedral	0.5
Ulvo	3	subhedral	0.3
Meso	1		
Crist	0.5	subhedral	
Ilm	<1	subhedral	0.2
Fe-Ni	<1	anhedral	<0.1
Troil	<1	anhedral	0.1
Cr spin	<1	subhedral	0.1

COMMENTS:

Porphyritic with preferred alignment of cpx and plag.

Cpx has seriate distribution from groundmass size to phenocrysts. Many crystals are twinned. Zoning ranges from none to highly zoned from pigeonite cores to augite rims.

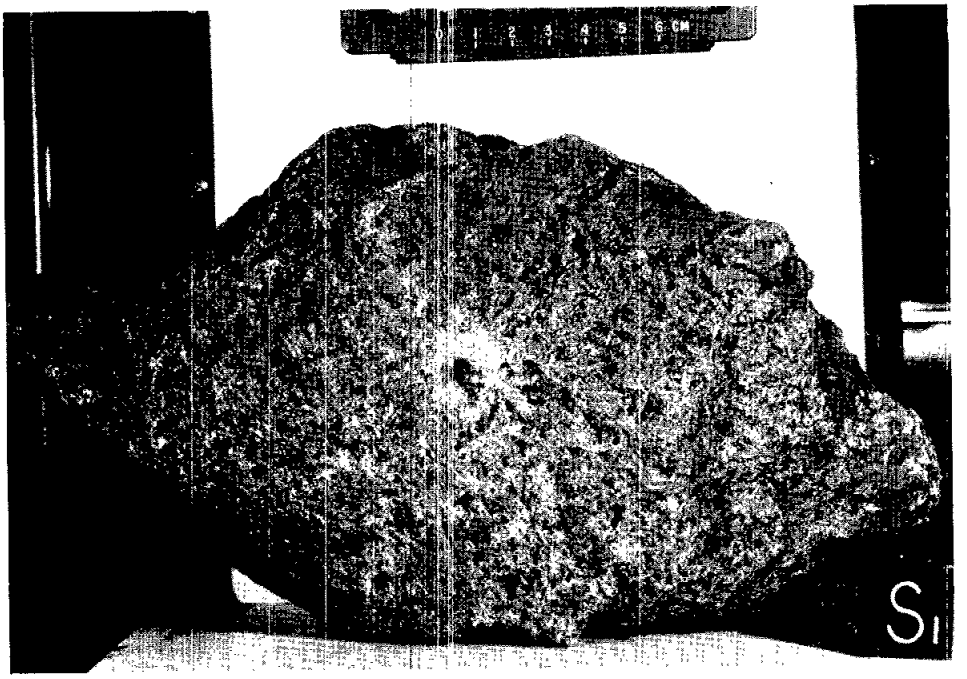
Plag is highly twinned and generally interstitial to pyx and oliv. It is poikilitic with many inclusions of cpx and oliv. Weak zoning occurs in some grains.

Some oliv could be considered as phenocrysts.

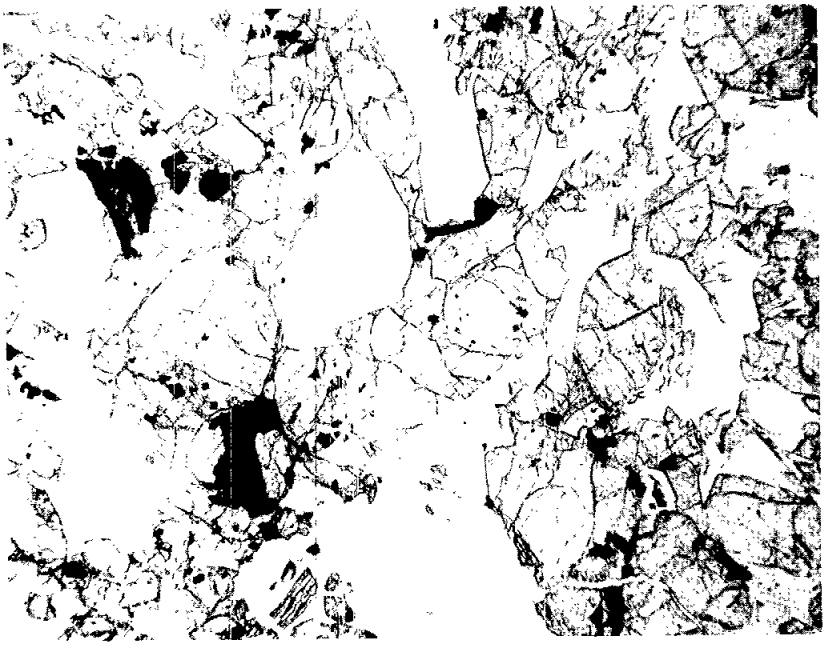
Needles of an unknown accessory phase are common in meso.

Ilm occurs as laths and mutual boundary texture in ulvo as well as rare discrete grains.

Fe-Ni occurs as rare discrete grains and blebs in troil.



Sample 15555 - S_1 S-71-43393



Photomicrograph Sample 15555
(width of field ≈4 mm)

ROCK TYPE: Basalt, vesicular
COLOR: Medium gray (N5)
SHAPE: Subrounded
COHERENCE Intergranular: Tough
Fracturing: Few fractures

WEIGHT: 1542.3 g
DENSITY:
DIMENSIONS: 13 x 10 x 11 cm

BINOCULAR DESCRIPTION BY: Lofgren DATE: 8/16/71

FABRIC: Inequigranular, isotropic
VARIABILITY: There are continuous changes from T to B manifested by an increase in vesicle size and abundance, concurrent with a decrease in grain size. On T, vesicles are 50% of the rock volume and range <1 mm to 3mm. On B the vesicles reach 80% and range 2-10 mm in size. The coarsest grains are on T, approaching 1 mm, and decrease by a factor of two on B.
SURFACE:
ZAP PITS: Few on all faces, T has more than others.
CAVITIES: Vesicles (see Variability) appear to be glass lined with some crystals showing through. A vug is totally lined with crystals like a miarolitic cavity.
SPECIAL FEATURES: The rapid changes in vesicularity and grain size across the rock indicates if formed at or near the top of a lava flow, with the B face closest to the surface. A 1 cm zenolith (face W) has about the same mineralogic composition as the rest of the rock, with perhaps slightly more plagioclase, but is distinguished by coarser grains than elsewhere, some reaching 2 mm.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTES
Mafic silicate	light yellow green	<5	equant	0.2	0.1-0.4	1
Pyroxenes	light brown	35		0.4		2
Plagioclase	light gray	55	laths to equant	0.2	0.1-0.3	
Opaque	dark gray to black	10	equant			3

NOTES:

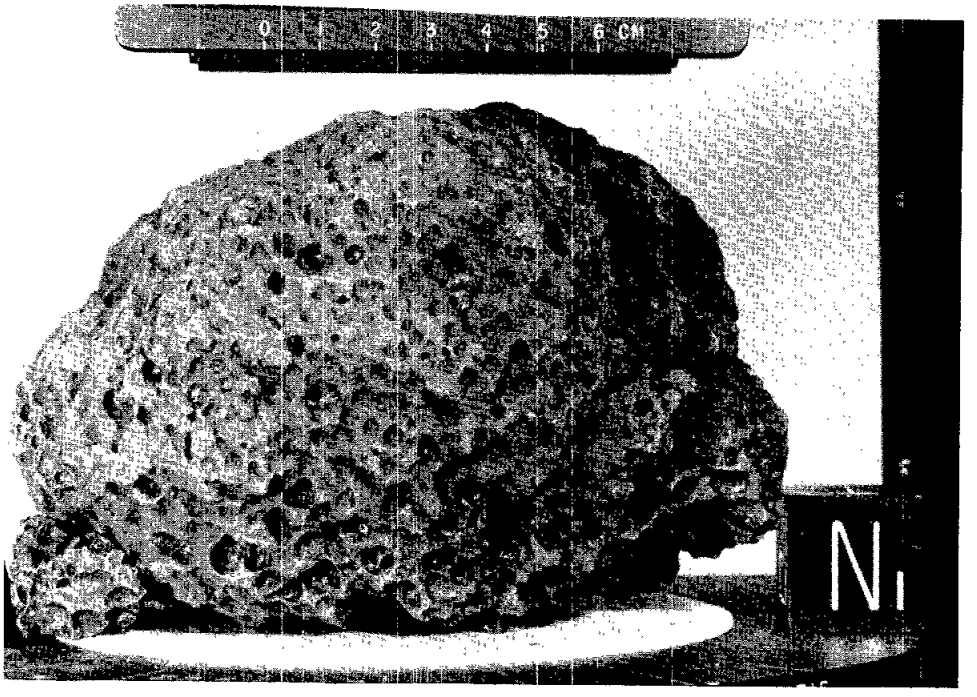
1. Olivine phenocrysts.
2. Color variable from light brown to medium cinnamon brown and may indicate more than one type of pyroxene.
3. Very fine grained.

THIN SECTION DESCRIPTIONS BY: Reid & Brett DATE: 9/17/71

SECTION: 15556,15
SUMMARY: Very vesicular clinopyroxene basalt.

PHASE	PERCENT	SHAPE	SIZE (mm)
Cpx	50	anhedral	up to 0.5
Plag	30		up to 1
Oliv	5	subhedral to anhedral	0.1-0.4
Crist	5	anhedral	up to 0.2
Ilm	3	needles	0.05x0.3
Ulvo	3	subhedral equant	0.05-0.2
Cr spin	2	subhedral equant	0.075
Meso	1		0.05-0.3
Fe-Ni		anhedral	0.05
Troil		anhedral	0.05

COMMENTS:
Intergranular.
Cpx weakly zoned from colorless core to pinkish margin.
Plag is zoned
Oliv grains surrounded by Cpx grains. Oliv contains Fe-Ni inclusions.
Ilm occurs as discrete grains and as mutual boundary texture with ulvo.
Some ulvo rims on Cr spin.
Some Cr spin as discrete grains.
Fe-Ni as discrete grains, blebs in Troil, and inclusions in oliv.
Some vesicles partly lined by opaques.



Sample 15556 - N_1 S-71-43323

Photomicrograph Sample 15556,15
(width of field ≈4 mm)

ROCK TYPE: Basalt
COLOR: Light gray to medium light gray (N7, N6), corners and edges very light gray (N8)
SHAPE: Blocky, subangular
COHERENCE Ingergranular: Tough
Fracturing: Nonpenetrative

WEIGHT: 2518.0 g
DENSITY:
DIMENSIONS: 18.1 x 10.5 x 7.2 cm

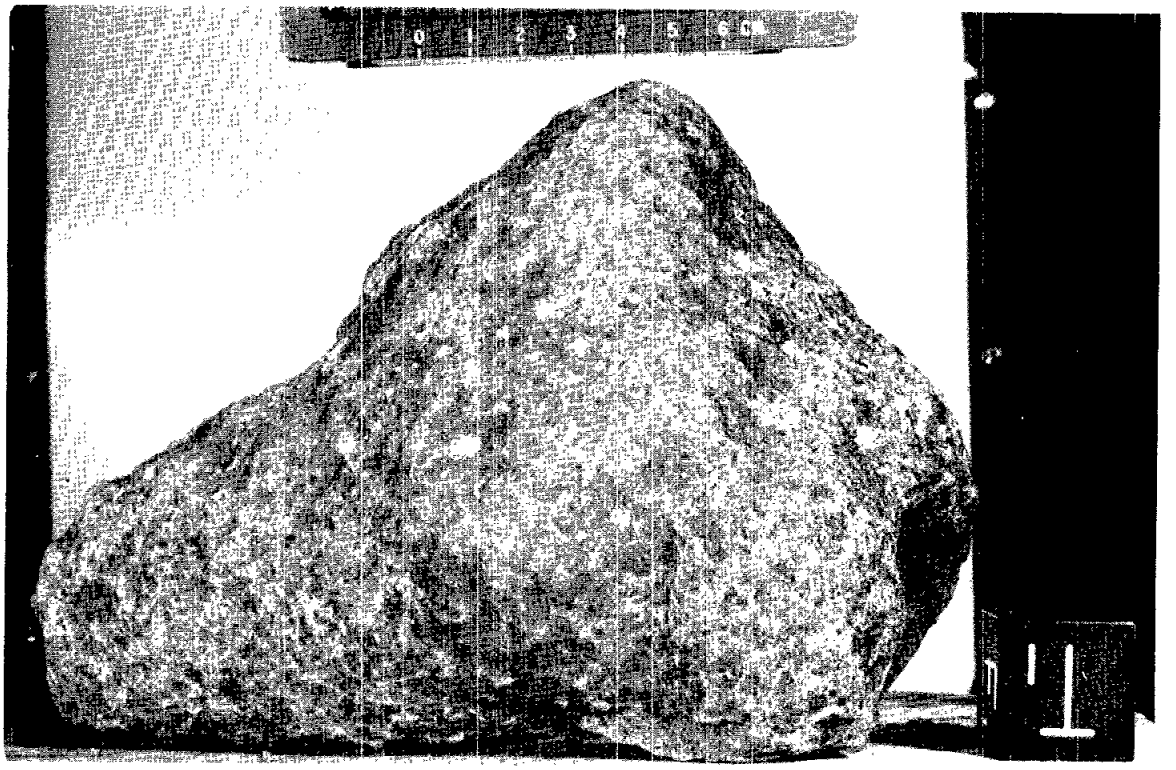
BINOCULAR DESCRIPTION BY: Wilshire & Silver DATE: 8/16/71

FABRIC: Microporphyritic, intergranular groundmass
VARIABILITY: Cavities irregularly distributed in generally uniform rock.
SURFACE: All are smooth to finely irregular.
ZAP PITS: None on B; few on N (dusty); S (dusty); E and W.
CAVITIES: One irregular to angular vug. No lining.
SPECIAL FEATURES: Weak alignment of plagioclase laths parallel to concave surface of rock.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	light yellow green	3	euhedral to subhedral	1	0.5-3	1
Mafic silicate	cinnamon brown	45	equant anhedral	0.5	0.1-1	2
Metallic	black	3	equant	0.2	0.1-0.25	
Plagioclase	light gray white	50	subhedral lath	0.5	<0.5-1	3

NOTES:

1. Isolated crystals
2. Color varies from light to dark.
3. Small percentage of microphenocrysts about 1 mm.



Sample 15557 - T1 S-71-44449

ROCK TYPE: Breccia
COLOR: Gray
SHAPE: Subangular
COHERENCE Intergranular: Coherent to tough
Fracturing: Few penetrative

WEIGHT: 1333.3 g
DENSITY:
DIMENSIONS: 10 x 12 x 12 cm

BINOCULAR DESCRIPTION BY: Warner DATE: 8/23/71

FABRIC: Breccia
VARIABILITY: None
SURFACE: Smooth, glass coatings on: 25% of N; 12% of E; 15% of T. Glass or metal droplets adhere to 5 cm^2 of T.
ZAP PITS: Few on all.
CAVITIES: None
SPECIAL FEATURES: Vesicular black glass coats part of the rock and fills fractures.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Matrix	gray	90			0.2	
Glass clasts	black		angular		0.2-2	
Igneous clasts	various		equant		0.2-2	1
Plagioclase	white		equant		0.2-0.9	
Mafic silicate			equant		0.2-0.7	
Opaque	black		equant		0.2-1	
M.	green		equant		0.3	

NOTES:

1. Types range from anothosite with 90% polycrystalline plagioclase to basalt to ultramafic rock with 10% plagioclase. One clast shows a contact: half plagioclase and half pyroxene.

THIN SECTION DESCRIPTION BY: Warner & Brett DATE: 9/17/71

SECTION: 15558,5
SUMMARY: Glassy, non-annealed breccia with only one breccia clast. Lithic clast types and high opaque content (5-10%) make this clearly of Mare origin.

LITHIC CLASTS, 11% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Basalt 1	80			Basalt 1 has granular texture.
Basalt 2	10			Basalt 2 has plumose texture
Basalt 3	5			Basalt 3 is a vitrophyre.
Breccia	5			Breccia is recrystallized and and similar to 14082.
				Basalt clasts contain euhedral ilmenite laths, subhedral ulvo, and anhedral Fe-Ni and troil.

GLASS CLASTS, 5% of rock

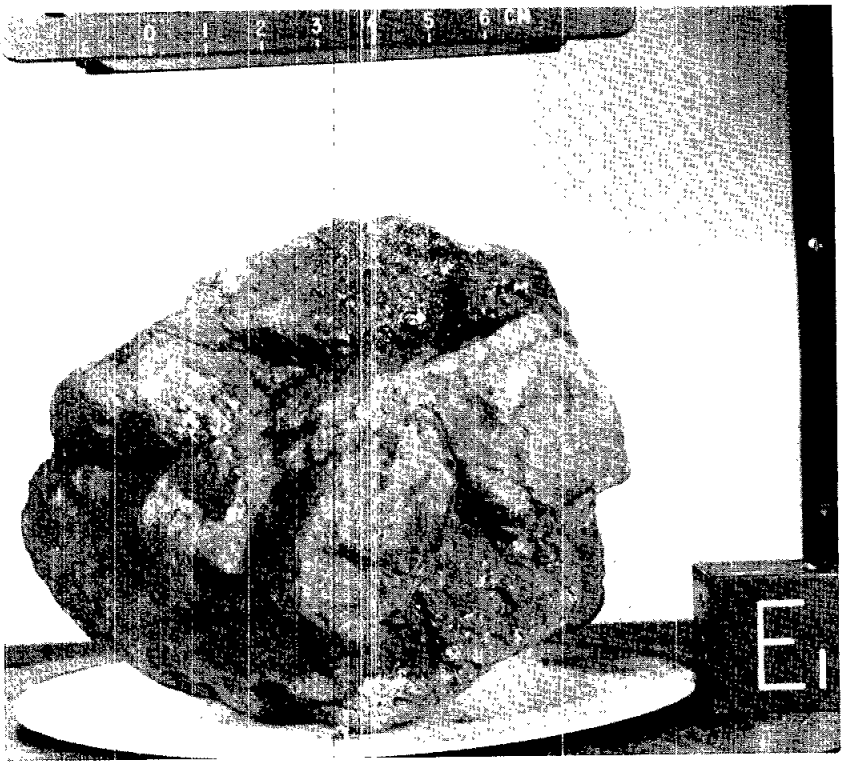
COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Brown		sph		Brown spheres are predominant.
Pale green		sph		

MINERAL CLASTS, 15% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Pyx	60		>0.1	One pyx contains lamellae indicative of inverted pigeonite.
Plag	30		>0.1	
Ilm	1	ang	up to 0.25	
Ulvo	1	subrd	0.1	
Troi	1	subrd	0.1	
Fe-Ni	1	subrd	0.1	

MATRIX, 69% of rock

PHASE	% OF MATRIX	SHAPE	SIZE (mm)	COMMENTS
Ilm	3	ang	<0.1	Contains brown glass plus mineral debris. Matrix is not annealed.
Ulvo	<1	ang	<0.1	
Troil	<1	subrd	<0.1	
Fe-Ni	<1	subrd	<0.1	



Sample 15558 - E_1 S-71-43333

Photomicrograph Sample 15558,5
(width of field ≈4 mm)

ROCK TYPE: Breccia
COLOR: Gray
SHAPE: Subrounded
WEIGHT: 822.6 g
DENSITY:
DIMENSIONS: 38 fragments
COHERENCE Intergranular: Friable to coherent.
Fracturing: Numerous, penetrative, and irregular.

BINOCULAR DESCRIPTION BY: Butler DATE: 10/11/71
FABRIC: Isotropic
VARIABILITY:
SURFACE: Thin black glass coating on one face of a small fragment is the only surface glass.
ZAP PITS: None on most fragments. Many on one or two surfaces of several fragments.
CAVITIES: None.
SPECIAL FEATURES: Description is based on study of color photography of the large fragments, and on binocular examination of a few of the smaller fragments. A few of the fragments may have broken from 15558, a similar breccia which was returned in SCB2 with the pieces that comprise 15565.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Basalt	brown	5	subangular		1-30	1
Basalt	light gray	1	subangular	1		2
Anorthosite	white	1			1-10	
Glass	black	4	angular		0.1-10	
Ultramafic	yellowish green	<1	rounded		1-8	3
Mafic silicate	honey brown	1	angular		0.1-1	
Mafic silicate	yellowish green	1	angular		0.1-1	
Plagioclase	white	1	angular		0.1-1	
Matrix	medium gray	85			<0.1	4

NOTES:
1. Pyroxene: plagioclase about 1:1; both reddish brown and yellowish green pyroxene; several % opaques.
2. Pyroxene: plagioclase about 1:2; only yellowish green pyroxene; fine-grained; opaque specks.
3. May be granulated large mineral clasts.
4. Probably aphanitic mineral and glass fragments.

THIN SECTION DESCRIPTION BY: Warner & Brett DATE: 9/17/71

SECTION: 15565

SUMMARY: Classy non-annealed breccia. Low opaque abundance indicates, in part, a non-Mare origin. Lithic clasts are a mixture of what are probably Mare and non-Mare types.

LITHIC CLASTS, 12% of rock

TYPE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Devit breccia	1 clast	ang	1x1.2	Devit breccia contains mainly brown and colorless glass around several plag clasts and some granulated plag + pyx clasts. A large clast of the latter type bounds one side of the entire clast. It is possible that the glass may have been a vein through a granular rock.
Basalt	8-10	ang to subang	up to 0.7	About 15 clasts of cpx and plag in textures ranging from intersertal through diabasic and supophitic to ophitic. Grain size ranges from 0.5 mm in some diabasic clasts to 0.1 mm long plag grains in the opitic clasts. The cpx to plag ratios vary, but probably average about 1:1.
Pyrox	2 clasts	rectang	0.7 x 0.5	Pyrox occurs as one larger clast 0.7 x 0.5 mm and one much smaller clast. They contain equant to elongate grains with low extinction angles and contain a much higher opaque content than remainder of section.

GLASS CLASTS, 8% of rock

COLOR	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Pale green		sph	0.15	Some of the pale green and brown glass is devit.
Brown		sph	0.15	Pale green glass is most predominant.
Dark brown		irreg		Dark brown irreg glass is rare and contains a small percentage of mineral fragments.

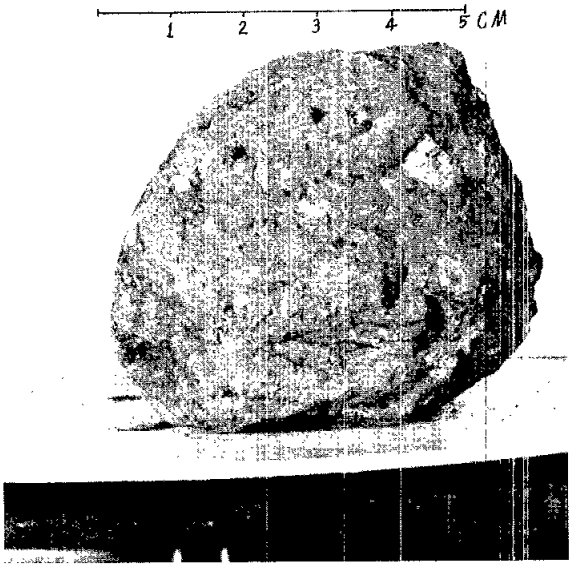
MINERAL CLASTS, 20% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Cpx	70	subang to ang	up to 0.5	Cpx highly dominant over plag. Some cpx contain lamellae of other pyx. Pyx tend to be Ca-poor. Some ulvo contains ilm lamellae.
Plag	30	subang to ang	up to 0.3	
Ulvo	<1	subang	0.1	
Ilm	<1	subang	0.1	
Oliv	Trace	subrd	0.12	

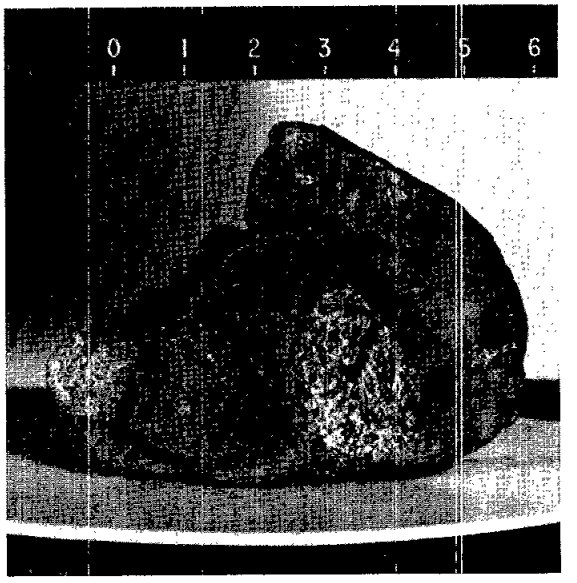
MATRIX, 60% of rock

PHASE	% OF CLASTS	SHAPE	SIZE (mm)	COMMENTS
Ulvo	<1	subang	<0.1	Matrix is about one-half brown glass, and one-half mineral debris. Matrix is unannealed.
Ilm	<1	subang	<0.1	
Fe-Ni	<0.2	subang	<0.1	
Troil	<0.1	subanb	<0.1	

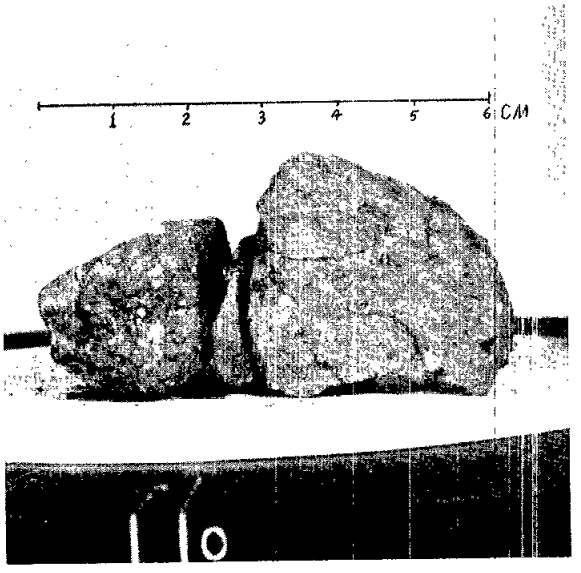
GENERAL COMMENTS: No large clasts. Opaques are of low abundance, in general.



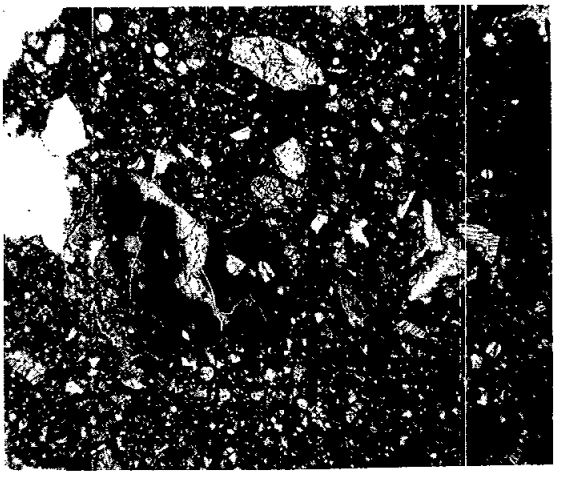
Sample 15565,2 - T_1 S-71-42974



Sample 15565,3 - T_1 S-71-43021



Sample 15565,13 - T_1 S-71-42979



Photomicrograph Sample 15565,4
(width of field ≈4 mm)

ROCK TYPE: Basalt, porphyritic
COLOR: Between olive gray (5Y 4/1) and olive black (5Y 2/1)
SHAPE: Angular
COHERENCE Intergranular: Tough
Fracturing: No penetrative, part of E face, may be or old fracture.

WEIGHT: 237.6 g
DENSITY:
DIMENSIONS: 10 x 5 x 4.5 cm

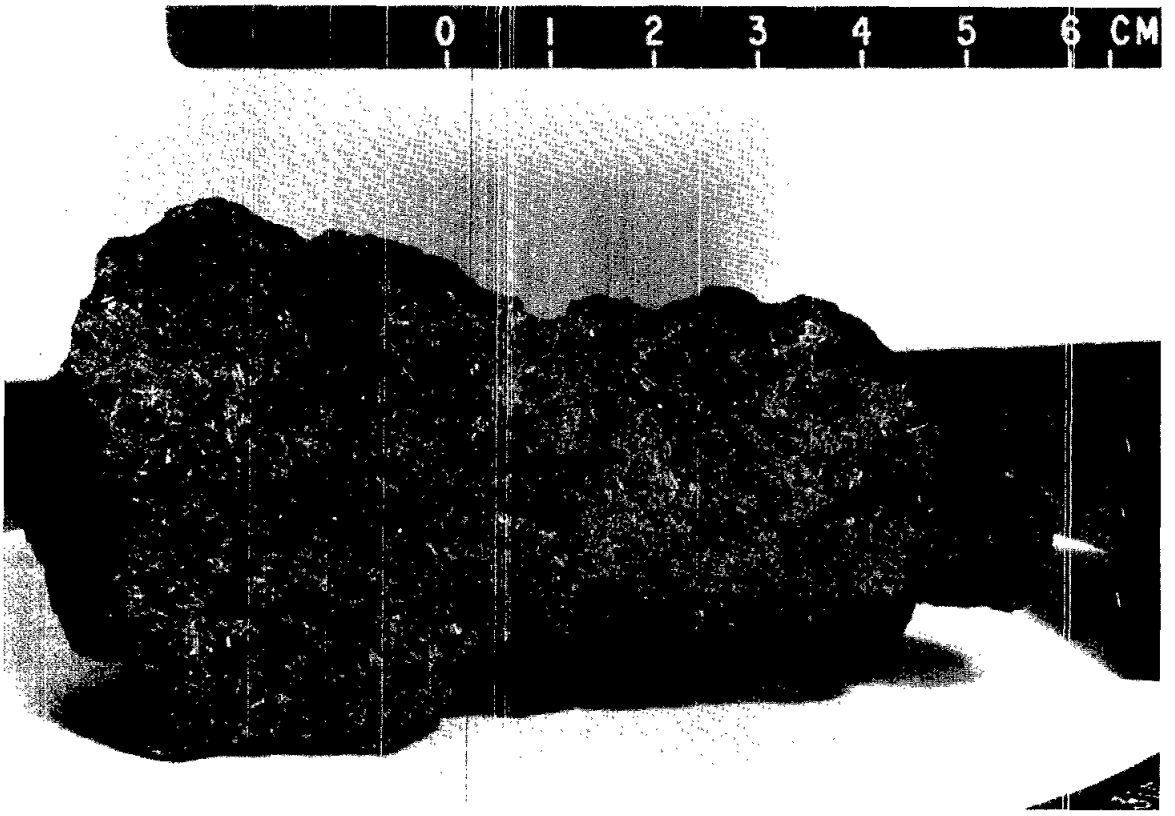
BINOCULAR DESCRIPTION BY: Phinney DATE: 8/27/71

FABRIC: Porphyritic, inequigranular.
VARIABILITY: Vugs are irregularly distributed in clusters.
SURFACE: N hackly, others irregular to smoothed.
ZAP PITS: Many on T, B, S and top area of W; none on E, N.
CAVITIES: Vuggy over 30% of fresh surface, brown pyroxene prisms projecting into and through vugs.
SPECIAL FEATURES: Gray black stain on face E is deserving of special study. Top from lunar surface photos shown on B view.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	light green cores with very thin outer rim	30-35	zoned prisms	4x0.4	up to 6x0.5	1
Mafic silicate	lemon yellow	3-5	equant	0.3	0.1-0.5	2
Mafic silicate	brownish gray	30	plumose intergrowths			3
Plagioclase	medium gray	35	tabular	0.2x0.7		4
Opaques	black	1	plates	0.1		

NOTES:

1. Probably pyroxene, occur as phenocrysts.
2. Probably olivine phenocrysts. Total phenocrysts compose 35-40% of rock.
3. Matrix contains prisms. The linear elements oblique to prisms are probably pyroxene.
4. Some interleaved with pyroxene.



Sample 15595 - N_1 S-71-44491

ROCK TYPE: Basalt
COLOR: Medium olive gray (5Y 5/2 to 5Y 3/2)
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative, irregular, few.

WEIGHT: 224.8 g
DENSITY:
DIMENSIONS: 8.5 x 7 x 4 cm

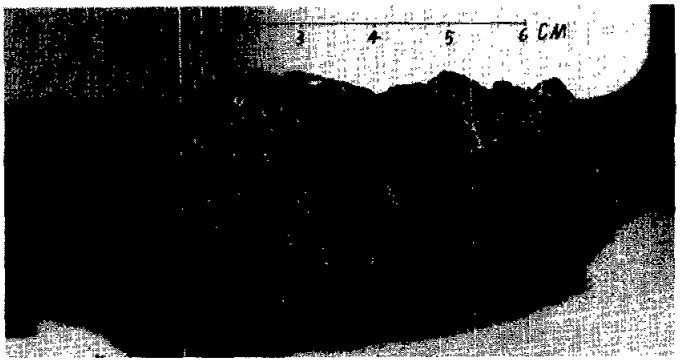
BINOCULAR DESCRIPTION BY: Reid & Jakes DATE: 8/27/71

FABRIC: Porphyritic
VARIABILITY: Irregular distribution of vugs
SURFACE: S granulated and rough; N irregular, granular, rough.
ZAP PITS: Many on N; none on S.
CAVITIES: 15% vugs.
SPECIAL FEATURES: The prismatic euhedral pyroxenes have two zones, dark-brown rims and yellow green cores, and some have a thin core of dark brown color as a third zone.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	SIZE(mm) Range	NOTE
Mafic silicate	dark brown rim yellow green core	25	prismatic elongate in vugs	0.5x4	2-10 long	1
Mafic silicate	brown	35	equant to elongate		0.1-1	2
Plagioclase	gray white	35	elongate		0.1-1	
Opaque	shinny metallic black	5	equant		0.2	

NOTES:

1. Pyroxene phenocrysts
2. Pyroxene in matrix



Sample 15596 - B_1 S-71-44468

ROCK TYPE: Basalt WEIGHT: 145.7 g
COLOR: Medium dark gray (N4) DENSITY:
SHAPE: Slabby, two flat faces, subangular DIMENSIONS: 8 x 5 x 2.5 cm
COHERENCE Intergranular: Tough
Fracturing: Few nonpenetrative fractures expecially on E end.

BINOCULAR DESCRIPTION BY: Reid & Jackson DATE: 8/28/71

FABRIC: Lineate lamination of phenocrysts. Diabasic.
VARIABILITY: Homogeneous
SURFACE: On S planar lamination of phenocrysts (2 grains) goes from top left to bottom right. On N, planar lamination of phenocrysts top left to bottom right, one grain plunges E. On T, broken dusty surface. Planar lamination strike E. One grain has steep plunge to E (50-60°). Some cross sections of phenocrysts on this face. E, vugs concentrated on this face. Lamination of phenocrysts continued. This face shows two directions of elongation of phenocrysts. B, phenocrysts five cross sections on this face.
ZAP PITS: Few on S (more than others), N, E, B, T (W end only).
CAVITIES: Small (1 mm) vugs, 1%.
SPECIAL FEATURES: Definite lineate lamination of olivine phenocrysts. Rock should be cut with that in mind. Plane of lamination shown on N and S photos. May have two generations of olivine, or may be seriate. Different from Apollo 15 basalts we have seen in texture, structure, and abundance of pyroxene.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Phenocrysts	yellow green	1	prismatic	2x4	up to 6	1
Plagioclase	white clear	40	equant to tabular	0.5 x 2	0.1-3	
Mafic silicate	brownish red	10	mantled on black interstitial grains	0.1-0.2		2
Mafic silicate	black	45	equant to interstitial	1x1	1x1	3
Mafic silicate	greenish yellow	5	prismatic	0.5x1		4

NOTES:

1. Oriented in rock. Contains some glass, random to roseate.
2. Pyroxene. Some is prismatic in vugs, a late mineral.
3. Pyroxene, diabasic between feldspar.
4. Microphenocrysts of olivine(?).

THIN SECTION DESCRIPTION BY: Silver & Brett DATE: 9/18/71

SECTION: 15597,12

SUMMARY: Porphyritic pigeonite basalt vitrophyre.

PHASE	PERCENT	SHAPE	SIZE (mm)
(Phenocrysts)			
Cpx	59	euhedral prisms	1x0.1
(Groundmass)			
Devit	41		
Cr spin	<0.1	euhedral	<0.05
Fe-Ni	<0.1	blebs	<0.015
Ulvo	<0.1	euhedral	<0.01

COMMENTS:

Porphyritic, vitrophyritic.

Cpx consists of euhedral, hall tubular pigeonite (2V=0-10°+) with excellent terminations. One large crystal is 5 x 0.5 cm.

Groundmass is partly devitrified glass with maroon tint on thin edges. Individual grains are not resolvable. Devitrification proceeds normal to phenocrysts surfaces.

Cr spin occurs mainly within phenocrysts, rarely in matrix. Cr spin may have thin rim of ulvo.

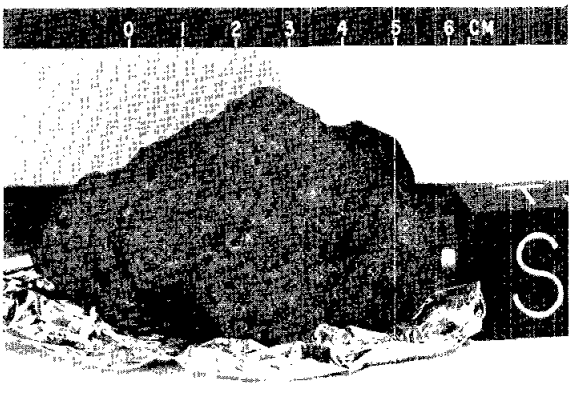
Fe-Ni occurs as discrete grains in phenocrysts and matrix; and is commonly associated with Cr spin.

Ulvo occurs primarily as rims on Cr spin but one discrete grain was seen.

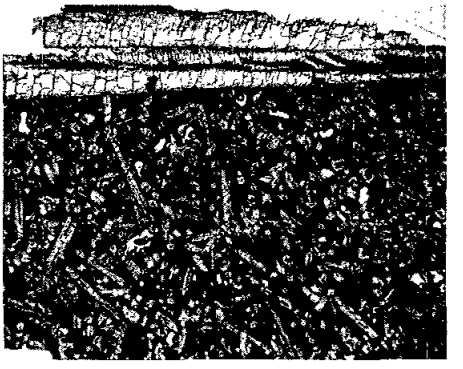
There are suggestions of many opaques in matrix but they are not resolvable at 562 power.

Modal estimate based on 200 points.

Wine or maroon color raises questions of origin of glass color.



Sample 15597 - S_1 S-71-44457



Photomicrograph Sample 15597,12 (width of field ≈4 mm)

ROCK TYPE: Basalt
COLOR: Light brownish gray (5YR 6/1)
SHAPE: Blocky, subrounded
COHERENCE Intergranular: Tough
Fracturing: None penetrative

WEIGHT: 135.7 g
DENSITY:
DIMENSIONS: 6 x 5.5 x 3 cm

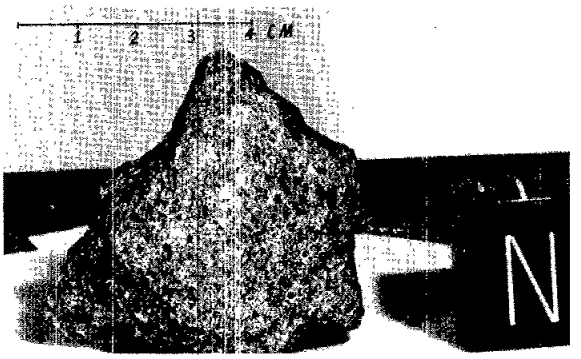
BINOCULAR DESCRIPTION BY: Morrison DATE: 8/27/71

FABRIC: Inequigranular, nearly microporphyritic
VARIABILITY: May be minor variations in mode and texture.
SURFACE: S hackly, others irregular.
ZAP PITS: Many on N, E, W, B; few on S; T is pitted but also has fresh areas; note number of small fresh surfaces.
CAVITIES: 1% vugs, 1 mm; crystals project into but not through cavities.
SPECIAL FEATURES:

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	light brown	50	anhedral to prismatic	0.2	<0.1-0.8	1
Plagioclase	white to translucent	45	granular to laths	0.2	<0.1-3	
Mafic silicate	yellowish green	5	equant to	1	1-2	2
Opaques	black	2	euhedral to irregular	<0.1	0.1-3	3

NOTES:

1. Pyroxene, no indication of zoning
2. Olivine, microphenocrysts
3. Ilmenite(?), as minute inclusions in olivine, rare plates, and small black anhedral crystals.



Sample 15598 - N_1 S-71-44477

SAMPLE TYPE: Rock (fragment >1 cm) WEIGHT: 920.8 g
COLOR: 81 samples
LOCATION: Rille (station 9a)
From the rake sample (15612 - 15689) and related soil sample (15600-15610)

BINOCULAR DESCRIPTION: By Warner, Silver, & Wilshire DATE: 9/71

Group 1: (20 samples)	15606 15612 thru 15630	Basalt highly vesicular (40-50%), red-brown pyroxene, porphyritic olivine, equigranular to subophitic.
Group 2: (15 samples)	15610 15632 thru 15645	Basalt, vuggy, medium grained, zoned green to red-brown clinopyroxene (and olivine?) phenocrysts.
Group 3: (12 samples)	15608 15609 15647 thru 15656	Basalt, fine-grained subophitic with deep brown pyroxene and few to no olivine phenocrysts, no vesicles and only a few vugs. 15647 may be slightly recrystallized.
Group 4: (9 samples)	15605 15658 thru 15664 15670	Basalt, vuggy, medium-grained, zoned green to red-brown pyroxene phenocrysts, equigranular to subophitic.
Group 5:	15607 15665 15668 15669	Basalt, moderately vesicular to vuggy, fine-grained, olivine phenocrysts, equigranular groundmass.
Group 6:	15666 15667	Basalt vuggy, medium grained, large zoned green to brown pyroxene phenocrysts, probably subophitic.
Group 7:	15671 15672 15673	Subophitic basalt, highly vesicular to partly vuggy, medium-grained, zoned green to brown pyroxene.
Group 8: (8 samples)	15674 thru 15681	Basalt, slightly vuggy, phenocrystic olivine, fine-grained, equigranular matrix with reddish brown pyroxene in matrix.
Group 9:	15682	Porphyritic basalt with zoned green to brown pyroxene phenocrysts and plumose plagioclase-reddish brown pyroxene intergrowth as matrix.

Group 10:	15683	Intergranular basalt, slightly vuggy, fine-grained, porphyritic olivine and plagioclase phenocrysts.
Group 11:	15684 15685 15686	Breccia fragments cemented by black glass (agglutinates).
Group 12:	15687 15688	Basalt fragments cemented by vesicular black glass.
Group 13:	15689	Breccia with unique, bright, orange-brown, sugary clasts (pyroxene?), and also clasts of anorthosite.

ROCK TYPE: Basalt
COLOR: Brownish gray (5YR 4/1)
SHAPE: Slightly slabby, angular
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative

WEIGHT: 6.1 g
DENSITY:
DIMENSIONS: 2.8 x 1 x 0.7 cm

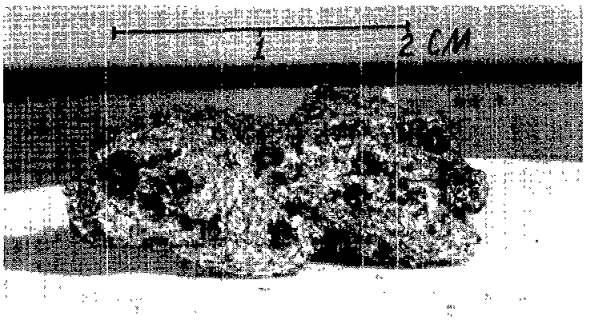
BINOCULAR DESCRIPTION BY: Wilshire DATE: 8/31/71

FABRIC: Intergranular, moderately inequigranular
VARIABILITY: None
SURFACE: Hackly on grain size scale.
ZAP PITS: None
CAVITIES: 15% spherical 1-4 mm vesicles, 2-3% irregular vugs with projecting plagioclase and pyroxene.
SPECIAL FEATURES: Vesicle paragenesis has ilmenite(?) last, brown pyroxene before ilmenite. Large brown pyroxenes are concentrated around vesicles.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	white translucent	40-45	laths	1	0.5-2	
Mafic silicate	cinnamon brown	50	equant to prisms	0.2-0.5	0.1-1	1
Mafic silicate	deep yellow green	3-5	equant	0.5	0.2-1	2
Opaque	black	2-3	equant		0.1-0.5	3
Opaque	black		plates	0.2		4

NOTES:

1. Pyroxene, with weak zoning deep green to brown.
2. Olivine, in equant, stubby prisms with black inclusions.
3. Ilmenite dominant?
4. Outermost lining of vesicle walls.



Sample 15605 - Typical of Rille rake sample group 4
S-71-44944

ROCK TYPE: Basalt
COLOR: Brownish gray (5YR 4/1)
SHAPE: Blocky, slightly slabby, subangular
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 10.1 g
DENSITY:
DIMENSIONS: 3 x 2.5 x 1 cm

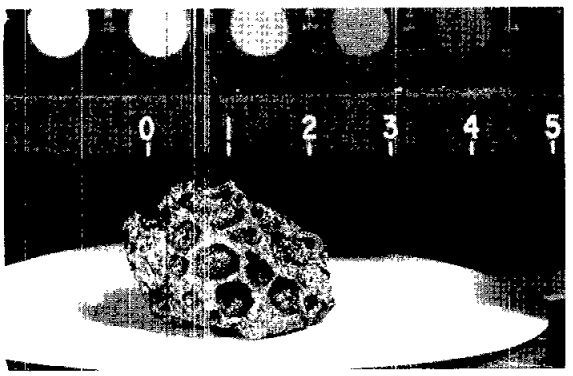
BINOCULAR DESCRIPTION BY: Wilshire DATE: 8/31/71

FABRIC: Equigranular, intergranular
VARIABILITY: None
SURFACE: Rough on the scale of the vesicles
ZAP PITS: None
CAVITIES: 45% spherical vesicles to 5 mm. Platy ilmenite is last lining on vesicle walls.
SPECIAL FEATURES: Pyroxene is browner and bigger(?) near vesicles but not more abundant.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	white translucent	48	laths	0.5-0.75	0.2-2	1
Mafic silicate	deep green to brown	47	equant	0.5	0.2-1	2
Mafic silicate	yellow green	3	stubby prisms	0.5	0.3-1	3
Opaques	black	1-2	equant & platy	0.3	0.1-0.5	

NOTES:

1. Black inclusions
2. Pyroxene, weak zoning in places.
3. Olivine, with black inclusions.



Sample 15606 - Typical of Rille rake sample group 1
S-71-41940

ROCK TYPE: Basalt, coarse grained
COLOR: Gray brown (5YR 3/2)
SHAPE: Irregular
COHERENCE Intergranular: Coherent
Fracturing: Several irregular, penetrative

WEIGHT: 14.8 g
DENSITY:
DIMENSIONS: 3 x 3 x 2 cm

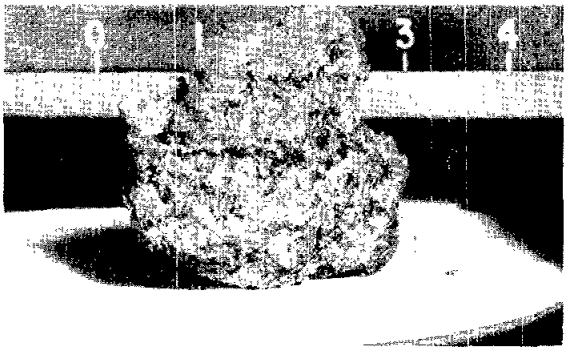
BINOCULAR DESCRIPTION BY: Ridley DATE: 8/30/71

FABRIC: Coarse, granular, porphyritic.
VARIABILITY: None
SURFACE: B 5% soil cover; T no soil, irregular; W, N, S irregular.
ZAP PITS: None
CAVITIES: Vugs are 2% of the rock and 0.3 mm in size.
SPECIAL FEATURES: Possible mafic rich layers.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	dark medium green	35	anhedral, subhedral	0.2	0.1-0.4	1
Mafic silicate	green-yellow	6	anhedral	0.4	0.1-1	2
Plagioclase	gray translucent	55	subhedral, lath-shaped, anhedral	0.1	0.6-1	
Opaques	black lusterous	4	anhedral	0.2	0.2-0.5	3

NOTES:

1. Pyroxene projects from groundmass into vugs, in which they are euhedral. No extensive colar zoning.
2. Olivine occurs mainly as subrounded porphyritic which are either fractured, large single crystals, or groups of smaller crystals with cataclastic texture.
3. Appears to be an early crystallizing phase.



Sample 15607 - Typical of
Rille rake sample group 5
S-71-44932

ROCK TYPE: Microporphyritic basalt, fine grained
COLOR: Gray (N5)
SHAPE: Angular, subrounded corners
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 1.2 g
DENISTY:
DIMENSIONS: 1.5 x 1 x 0.5 cm

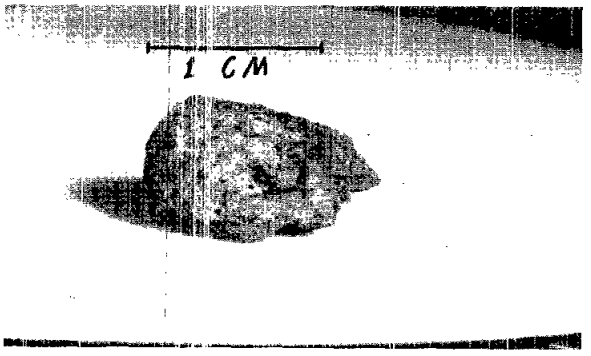
BINOCULAR DESCRIPTION BY: Morrison DATE: 9/1/71

FABRIC: Inequigranular
VARIABILITY: None
SURFACE: Irregular
ZAP PITS: Many on T, N, E, B; few on W.
CAVITIES: Vugs 1-2%; crystals grow across vugs.
SPECIAL FEATURES: The average grain size of this rock is less than that of most Apollo 15 basalts. Pyroxene (?) or plagioclase color differs from that of pyroxenes from other Apollo 15 basalts.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Mafic silicate	yellow	2	equant	0.5	0.2-0.7	1
Mafic silicate	olive gray to dark greenish gray (5G 4/1)	55	laths to anhedral mass	0.15	<0.1-1	2
Plagioclase	yellowish white	40	anhedral	0.1	0.1	3

NOTES:

1. Olivine, occurs as phenocrysts in granular groundmass areas.
2. Appears granular aqay from vugs but becomes prismatic around vugs. The gray color of this mineral is unusual if it is pyroxene.
3. Granular mineral in matrix.



Sample 15608 - Typical of Rille rake sample group 3
S-71-44966

ROCK TYPE: Basalt
COLOR: (Dust covered)
SHAPE: Blocky, subangular
COHERENCE Intergranular: Tough
Fracturing: Nonpenetrative

WEIGHT: 1.1 g
DENSITY:
DIMENSIONS: 1.1 x 1.1 x 0.4 cm

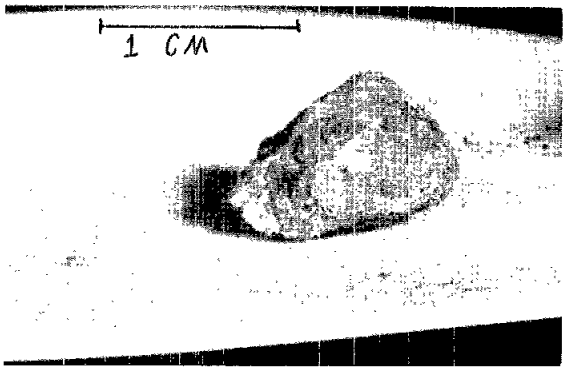
BINOCULAR DESCRIPTION BY: Wilshire DATE: 8/31/71

FABRIC: Moderately inequigranular, intergranular
VARIABILITY:
SURFACE: Hackly at grain size level.
ZAP PITS:
CAVITIES: None
SPECIAL FEATURES: Too dusty for accurate description.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	white translucent	50	equant to lath	0.5	0.5-1	
Mafic silicate	pale to deep brown	43	equant	0.4	0.2-0.8	1
Mafic silicate	yellow-green	5	stubby prisms	0.7	0.7-1	2
Opaques	black	2	equant to plates	0.2	0.2-0.5	

NOTES:

1. Pyroxene
2. Olivine, with black inclusions.



Sample 15609 - Typical of Rille rake sample group 3
S-71-44962

ROCK TYPE: Basalt
COLOR: Brownish gray (5YR 4/1)
SHAPE: Blocky, angular
COHERENCE Intergranular: Tough
Fracturing: None

WEIGHT: 1.5 g
DENSITY:
DIMENSIONS: 1.3 x 1 x 0.5 cm

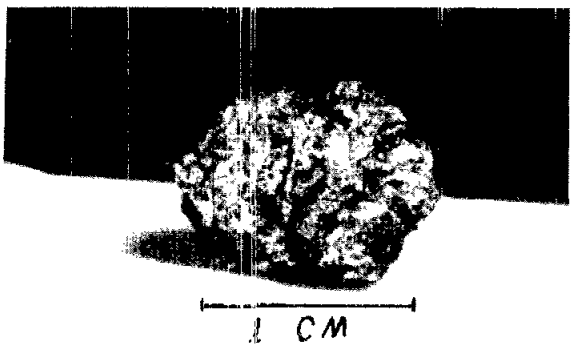
BINOCULAR DESCRIPTION BY: Wilshire & Morrison DATE: 8/31/71

FABRIC: Inequigranular
VARIABILITY: None
SURFACE: Hackly to irregular on grain size scale. Glass on one area of W and on one corner of E.
ZAP PITS: Few on T; none (?) on N, S, B.
CAVITIES: 10-15% irregular cavities with large pyroxene prisms crossing them.
SPECIAL FEATURES:

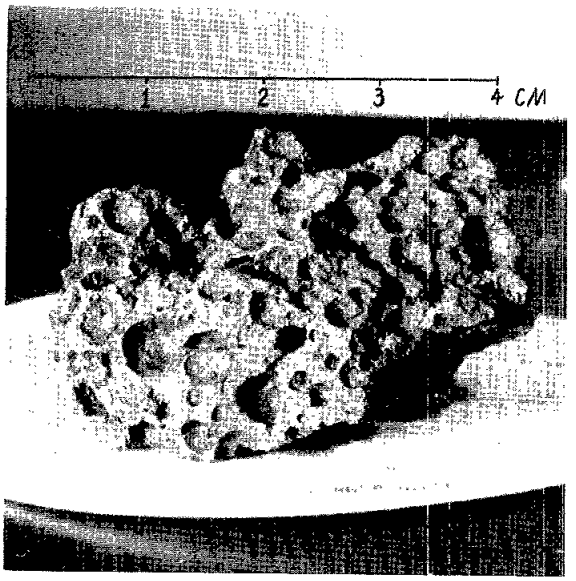
COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(mm) Dom.	Range	NOTE
Plagioclase	translucent to very light gray	40	laths	0.5-0.7	0.2-1	
Mafic silicate	deep brown to yellow green	60	prisms to equant grains	1	0.2-3	1
Mafic silicate	yellow green	1	equant	0.5		2
Opaques		1	equant some plates	<0.5	0.1-0.5	

NOTES:

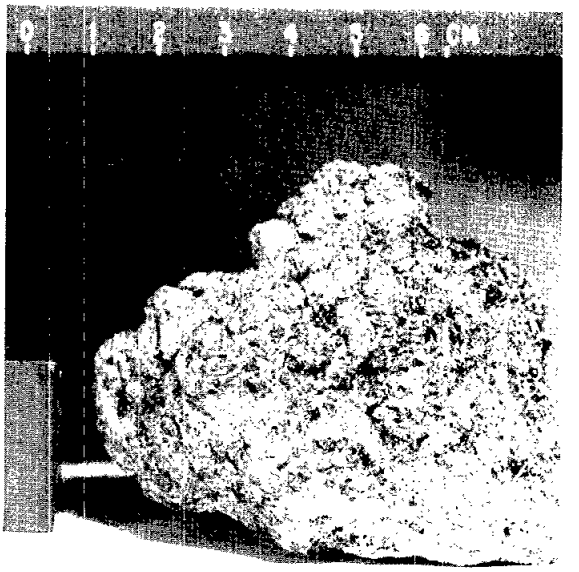
1. Pyroxene, zoned from yellow green to brown. Also as granular brown groundmass pyroxene; large crystals are prismatic, small ones are equant.
2. Olivine.



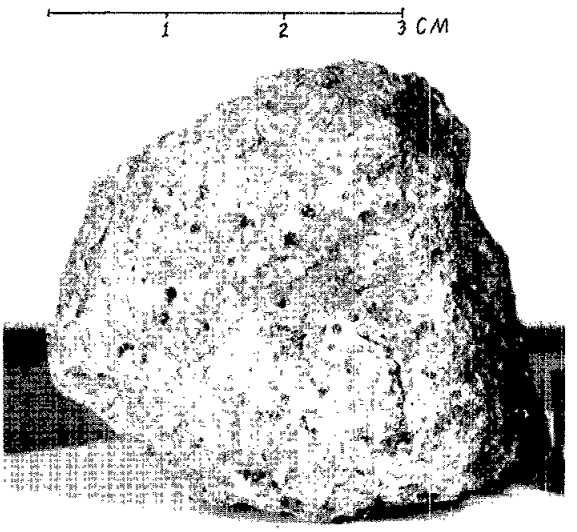
Sample 15610 - Typical of Rille rake sample group 2
S-71-15610



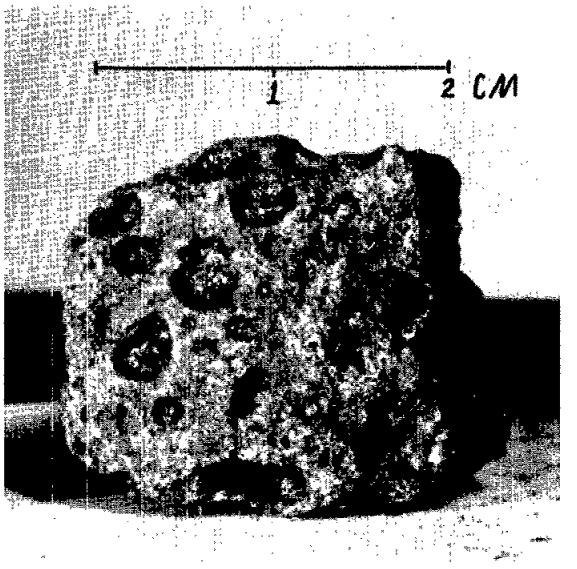
Sample 15630 - Typical of Rille rake sample group 1
S-71-49269



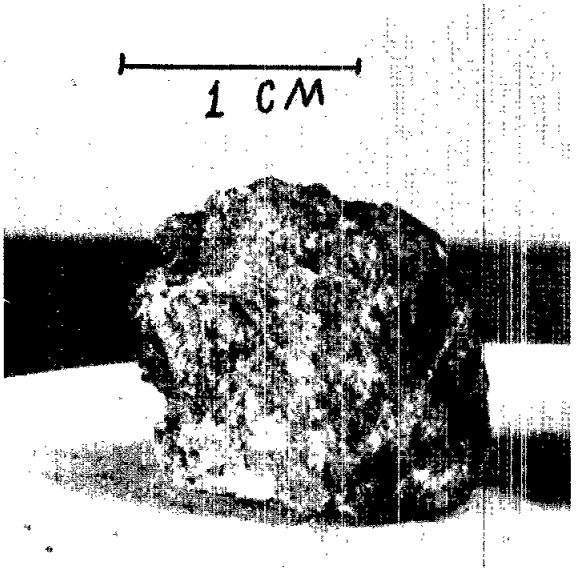
Sample 15636 - Typical of Rille rake sample group 2
S-71-49300



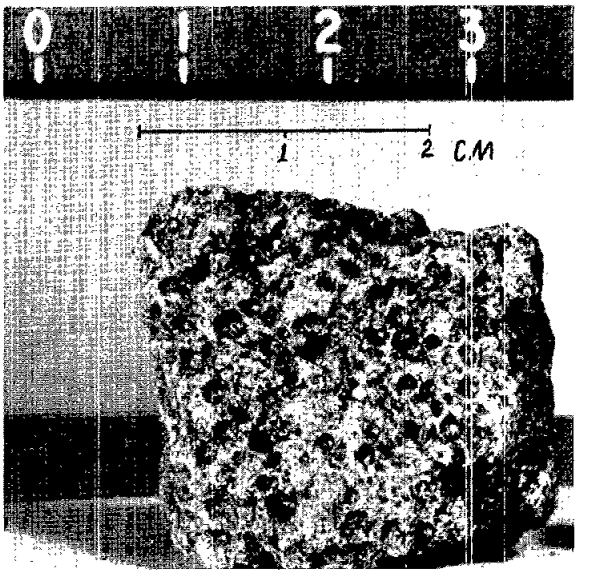
Sample 15647 - Typical of Rille rake sample group 3
S-71-49581



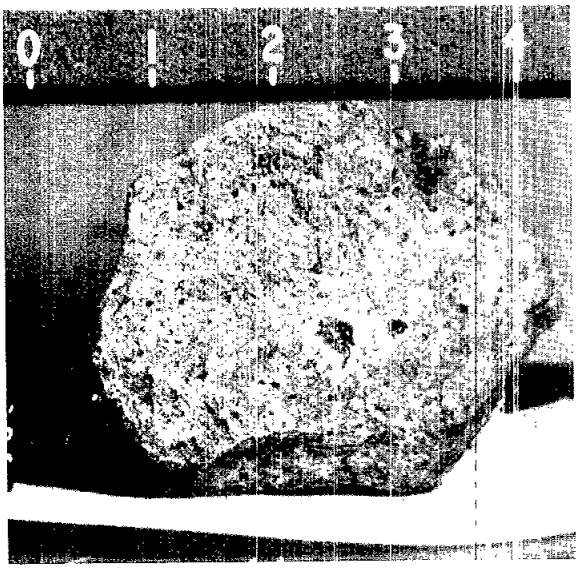
Sample 15659 - Typical of Rille rake sample group 4
S-71-49756



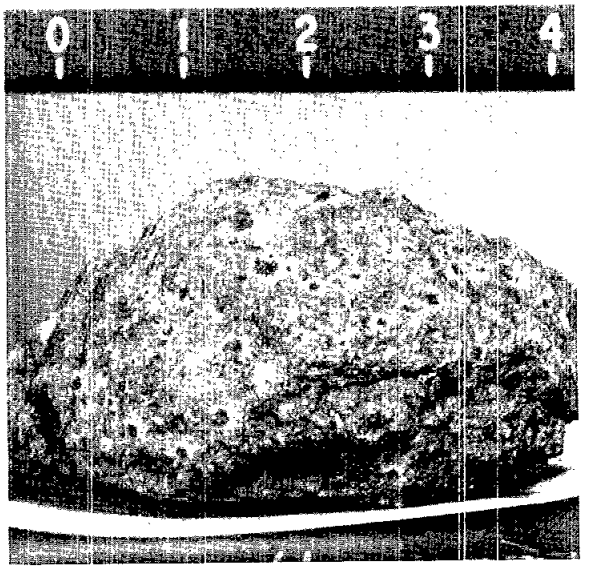
Sample 15666 - Typical of
Rille rake sample group 6
S-71-49760



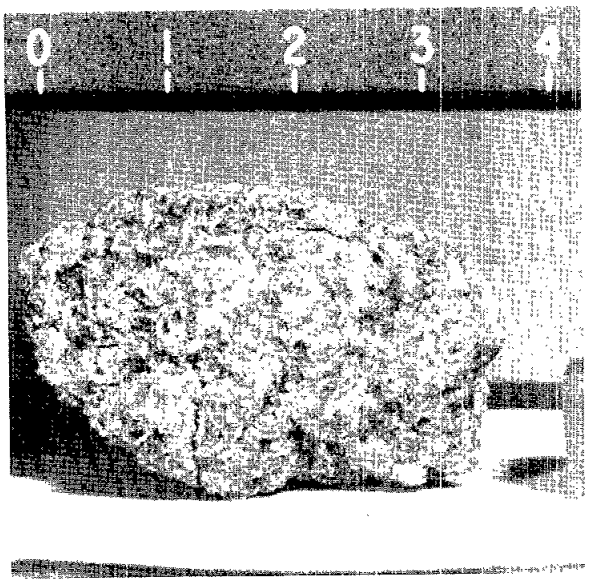
Sample 15672 - Typical of
Rille rake sample group 7
S-71-49818



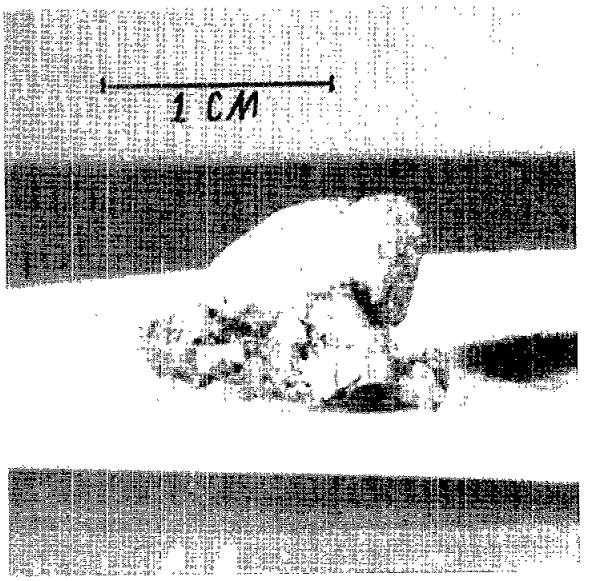
Sample 15675 - Typical of
Rille rake sample group 8
S-71-49826



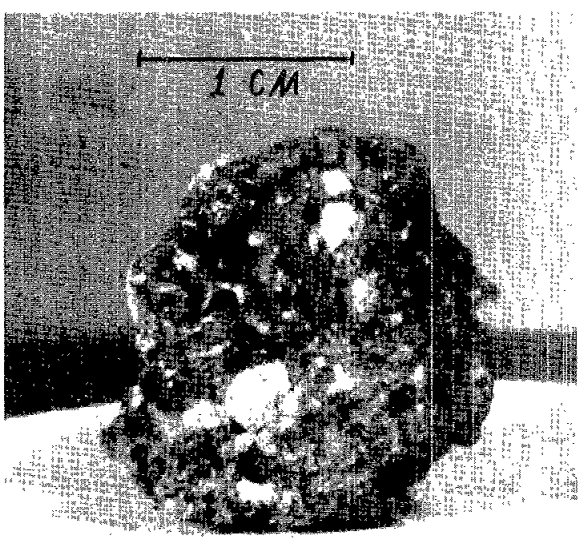
Sample 15682 - Typical of
Rille rake sample group 9
S-71-49893



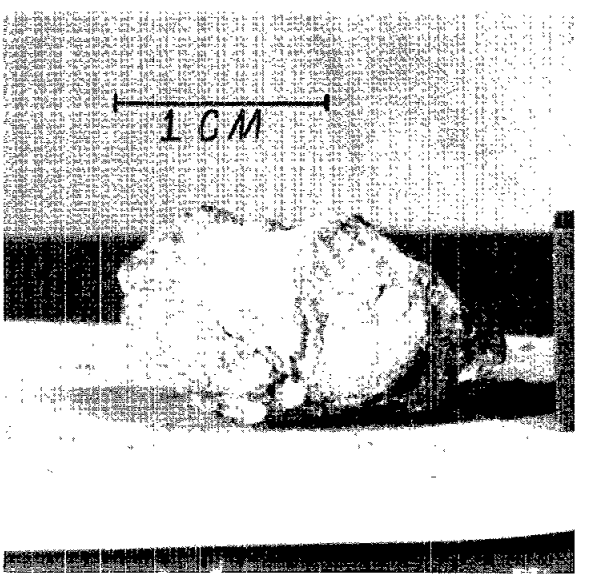
Sample 15683 - Typical of
Rille rake sample group 10
S-71-49885



Sample 15686 - Typical of
Rille rake sample group 11
S-71-49871



Sample 15688 - Typical of
Rille rake sample group 12
S-71-49843



Sample 15689 - Typical of
Rille rake sample group 13
S-71-49814

PHOTOGRAPHIC INDICES BY SAMPLE AND PHOTOGRAPH NUMBERS

The index of photographs by sample number (table XI) is designed to help locate photographs that show part or all of any specific Apollo 15 lunar sample. Conversely, the index of samples by photograph number (tabel XII) is designed to help locate photographs that are not listed by sample number. The latter index is more complete and contains more explanatory information.

TABLE XI.- LUNAR SAMPLE PHOTOGRAPHIC INDEX

BY SAMPLE NUMBER

Sample Number	NASA photograph number
15015	S-71-43303 to S-71-43308 S-71-43944 to S-71-43949 S-71-44720 to S-71-44751
15016	S-71-45477 to S-71-45482 S-71-46630 to S-71-46635 S-71-46962 to S-71-46993
15017	S-71-43662 to S-71-43663
15018	S-71-43629 to S-71-43632
15019	S-71-43664 to S-71-43667
15025	S-71-43317 to S-71-43322 S-71-43655 S-71-44866 to S-71-44871 S-71-45073 to S-71-45104
15026	S-71-43040 to S-71-43043
15027	S-71-43633 to S-71-43638 S-71-45649 to S-71-45680 S-71-45782 to S-71-45787
15028	S-71-43639 to S-71-43644 S-71-45788 to S-71-45793 S-71-45681 to S-71-45712
15058	S-71-44200 to S-71-44205 S-71-45190 to S-71-45195 S-71-45019 S-71-45025 to S-71-45028 S-71-45042 to S-71-45068 S-71-47786
15059	S-71-44212 to S-71-44217 S-71-45971 to S-71-45972 S-71-45985 to S-71-45988
15059 (Cont'd)	S-71-45722 to S-71-45734 S-71-45736 S-71-45745 to S-71-45761
15065	S-71-42924 to S-71-45929 S-71-45776 to S-71-45781 S-71-45617 to S-71-45648
15075	S-71-43094 to S-71-43099 S-71-43965 to S-71-43970 S-71-43843 to S-71-43858
15076	S-71-42957 to S-71-42962 S-71-43959 to S-71-43964 S-71-43827 to S-71-43842 S-71-47676 to S-71-47681 S-71-47752 to S-71-47783
15085	S-71-43088 to S-71-43093 S-71-45900 to S-71-45905 S-71-45862 to S-71-45895
15086	S-71-43076 to S-71-43081 S-71-47408 to S-71-47413 S-71-47629 to S-71-47660
15087	S-71-43070 to S-71-43075
15088	S-71-43083 to S-71-43087
15095	S-71-42918 to S-71-42923
15105	S-71-43408 to S-71-43413
15115	S-71-48770 to S-71-48773
15116	S-71-48754 to S-71-48757
15117	S-71-48764 to S-71-48769

TABLE XI.- LUNAR SAMPLE PHOTOGRAPHIC INDEX

BY SAMPLE NUMBER - (Continued)

Sample Number	NASA photograph number
15118	S-71-48758 to S-71-48763
15119	S-71-48774 to S-71-48777
15125	S-71-48778 to S-71-48781
15135	S-71-48782 to S-71-48785
15145	S-71-48786 to S-71-48789
15147	S-71-49329 to S-71-49332
15148	S-71-49321 to S-71-49324
15205	S-71-42981 to S-71-42986 S-71-46325 to S-71-46356 S-71-46579 to S-71-46584
15206	S-71-43190 to S-71-43195 S-71-46034 to S-71-46065 S-71-46028 to S-71-46033
15245,01	S-71-47912 to S-71-47915
15245,17	S-71-47908 to S-71-47911
15245,22	S-71-47904 to S-71-47907
15245,28	S-71-47916 to S-71-47919
15245,33	S-71-47928 to S-71-47931
15245,37	S-71-47936 to S-71-47939
15245,40	S-71-47924 to S-71-47927
15245,48	S-71-47920 to S-71-47923
15245,56	S-71-47994 to S-71-47997
15245,62	S-71-48010 to S-71-48013
15245,67	S-71-47998 to S-71-48001
15245,71	S-71-48002 to S-71-48005
15245,80	S-71-48006 to S-71-48809
15245,85	S-71-47989 to S-71-47993
15255	S-71-44511 to S-71-44516 S-71-46453 to S-71-46484 S-71-46549 to S-71-46554
15256	S-71-44499 to S-71-44504 S-71-46561 to S-71-46566 S-71-46357 to S-71-46388 S-71-47790
15256,09	S-71-47793
15256,10	S-71-47788
15256,11	S-71-47789
15256,13	S-71-47791
15256,14	S-71-47792
15257	S-71-45814 to S-71-45819
15258	S-71-44794 to S-71-44795 S-71-44802 to S-71-48803
15259	S-71-44956 to S-71-44959
15265	S-71-44152 to S-71-44157 S-71-46555 to S-71-46560 S-71-46485 to S-71-46516

TABLE XI.- LUNAR SAMPLE PHOTOGRAPHIC INDEX

BY SAMPLE NUMBER - (Continued)

Sample Number	NASA photograph number
15266	S-71-44170 to S-71-44175 S-71-46196 to S-71-46201
15267	S-71-44222 to S-71-44225
15268	S-71-44826 to S-71-44829
15269	S-71-45826 to S-71-45829
15285	S-71-44505 to S-71-44510 S-71-46293 to S-71-46324 S-71-46567 to S-71-46572
15286	S-71-44796 to S-71-44799 S-71-44950 to S-71-44955
15287	S-71-44533 to S-71-44538
15288	S-71-44517 to S-71-44520 S-71-44497 to S-71-44498 S-71-45820 to S-71-45825 S-71-47720 to S-71-47751
15289	S-71-44830 to S-71-44835
15295	S-71-44078 to S-71-44083
15298	S-71-43044 to S-71-43049
15299	S-71-43053 to S-71-43058 S-71-44851 to S-71-44855 S-71-44859 S-71-44413 to S-71-44420 S-71-44425 to S-71-44448
15306	S-71-43059 to S-71-43064 S-71-44848 to S-71-44850 S-71-44856 to S-71-44858 S-71-44385 to S-71-44412 S-71-44421 to S-71-44424
15307	S-71-43036 to S-71-43039
15308	S-71-43065 to S-71-43069
15321	S-71-49803 to S-71-49806
15322	S-71-49615 to S-71-49618
15326	S-71-49603 to S-71-49606
15327	S-71-49791 to S-71-49794
15330	S-71-49593 to S-71-49598
15334	S-71-49807 to S-71-49810
15337	S-71-49799 to S-71-49802
15339	S-71-49607 to S-71-49610
15341	S-71-49623 to S-71-49626
15342	S-71-49619 to S-71-49622
15343	S-71-49589 to S-71-49592
15344	S-71-49599 to S-71-49602
15345	S-71-49687 to S-71-49690
15346	S-71-49679 to S-71-49682
15347	S-71-49701 to S-71-49705
15348	S-71-49671 to S-71-49674
15349	S-71-49713 to S-71-49716
15350	S-71-49693 to S-71-49696
15351	S-71-49697 to S-71-49700
15352	S-71-49675 to S-71-49678

TABLE XI.- LUNAR SAMPLE PHOTOGRAPHIC INDEX

BY SAMPLE NUMBER - (Continued)

Sample Number	NASA photograph number
15353	S-71-49705 to S-71-49708
15354	S-71-49709 to S-71-49712
15355	S-71-49683 to S-71-49686
15359	S-71-49795 to S-71-49798
15364	S-71-49611 to S-71-49614
15365	S-71-49178 to S-71-49181
15366	S-71-49148 to S-71-49151
15367	S-71-49046 to S-71-49049
15369	S-71-49164 to S-71-49167
15370	S-71-49152 to S-71-49155
15371	S-71-49174 to S-71-49177
15372	S-71-49042 to S-71-49045
15374	S-71-49190 to S-71-49194
15377	S-71-49156 to S-71-49159
15379	S-71-49169 to S-71-49173
15380	S-71-49038 to S-71-49041
15381	S-71-49054 to S-71-49057
15382	S-71-39160 to S-71-49163
15385	S-71-49186 to S-71-49189
15386	S-71-49182 to S-71-49185
15387	S-71-49050 to S-71-49053
15388	S-71-49194 to S-71-49197
15405	S-71-44120 to S-71-44127
15415	S-71-42951 to S-71-42956 S-71-45172 to S-71-45177 S-71-44977 to S-71-45008
15417	S-71-43885 to S-71-43888
15418	S-71-43656 to S-71-43661 S-71-44860 to S-71-44865 S-71-45266 to S-71-45297
15419	S-71-43649 to S-71-43654
15425	S-71-43588 to S-71-43591
15426	S-71-43584 to S-71-43587
15445	S-71-44128 to S-71-44133 S-71-45196 to S-71-45201 S-71-45009 to S-71-45018 S-71-45020 to S-71-45024 S-71-45029 to S-71-45041 S-71-45069 to S-71-45072
15450	S-71-44176 to S-71-44181
15455	S-71-43889 to S-71-43894 S-71-46517 to S-71-46548 S-71-46585 to S-71-46590
15455,01	S-71-43923 to S-71-43928
15455,02	S-71-43895 to S-71-43898
15455,03	S-71-47383 to S-71-47386
15455,04	S-71-44142 to S-71-44145
15455,05	S-71-44092 to S-71-44095

TABLE XI.- LUNAR SAMPLE PHOTOGRAPHIC INDEX

BY SAMPLE NUMBER - (Continued)

Sample Number	NASA photograph number
15455,06	S-71-44146 to S-71-44149
15455,07	S-71-44112 to S-71-44115
15455,08	S-71-43919 to S-71-43922
15455,09	S-71-44108 to S-71-44111
15455,10	S-71-44084 to S-71-44087
15455,11	S-71-44100 to S-71-44103
15455,12	S-71-44104 to S-71-44107
15455,13	S-71-43907 to S-71-43910
15455,14	S-71-44088 to S-71-44091
15455,15	S-71-43899 to S-71-43902
15455,16	S-71-43903 to S-71-43906
15455,17	S-71-44138 to S-71-44141
15455,18	S-71-43915 to S-71-43918
15455,19	S-71-43911 to S-71-43914
15455,20	S-71-44096 to S-71-44099
15455,21	S-71-44134 to S-71-44137
15455,22	S-71-44116 to S-71-44119
15459	S-71-45585 to S-71-45616 S-71-45976 to S-71-45780 S-71-45784
15459,06	S-71-50640 to S-71-50652 S-71-50660 to S-71-50671 S-71-50673 to S-71-50679 S-71-40785 to S-71-40790
15459,07	S-71-50616 to S-71-50639 S-71-50635 to S-71-50659 S-71-50672 S-71-50779 to S-71-50784
15459,08	S-71-50769 to S-71-50774
15459,09	S-71-50791 to S-71-50794
15465	S-71-44188 to S-71-44193 S-71-46421 to S-71-46452 S-71-46573 to S-71-46578
15466	S-71-44182 to S-71-44187 S-71-47033 to S-71-47038 S-71-46738 to S-71-46769
15467	S-71-44910 to S-71-44913
15468	S-71-44914 to S-71-44917
15469	S-71-44906 to S-71-44909
15475	S-71-44226 to S-71-44231 S-71-47057 to S-71-47062 S-71-47932 to S-71-47935
15476	S-71-44164 to S-71-44169 S-71-47051 to S-71-47056
15477	S-71-44244 to S-71-44249 S-71-46624 to S-71-46629
15478	S-71-44238 to S-71-44243
15485	S-71-44232 to S-71-44237 S-71-47039 to S-71-47044
15486	S-71-44250 to S-71-44255
15487	S-71-44218 to S-71-44221

TABLE XI.- LUNAR SAMPLE PHOTOGRAPHIC INDEX

BY SAMPLE NUMBER - (Continued)

Sample Number	NASA photograph number
15495	S-71-44206 to S-71-44211
15498	S-71-44194 to S-71-44199
	S-71-45973 to S-71-45975
	S-71-45981 to S-71-45983
	S-71-45713 to S-71-45721
	S-71-45735
	S-71-45737 to S-71-45744
	S-71-45762 to S-71-45775
15499	S-71-44158 to S-71-44163
	S-71-47414 to S-71-47419
	S-71-47688 to S-71-47719
15505	S-71-44461 to S-71-44466
	S-71-47279 to S-71-47310
	S-71-47363 to S-71-47368
	S-71-47063 to S-71-47068
15506	S-71-44527 to S-71-44532
15507	S-71-44539 to S-71-44540
	S-71-44521 to S-71-44522
15508	S-71-44808 to S-71-44809
	S-71-44812 to S-71-44813
15528	S-71-43645 to S-71-43648
15529	S-71-42930 to S-71-42935
	S-71-45178
	S-71-45186 to S-71-45189
	S-71-45105 to S-71-45114
	S-71-45117 to S-71-45118
	S-71-45125 to S-71-45128
	S-71-45131 to S-71-45132
	S-71-45135 to S-71-45136
	S-71-45139 to S-71-45140
	S-71-45143 to S-71-45148
	S-71-45151 to S-71-45154
	S-71-48199

Sample Number	NASA photograph number
15535	S-71-44479 to S-71-44484
	S-71-47027 to S-71-47032
15536	S-71-44487 to S-71-44490
	S-71-44485 to S-71-44486
	S-71-47357 to S-71-47362
	S-71-47247 to S-71-47278
15537	S-71-44523 to S-71-44526
15538	S-71-44806 to S-71-44807
	S-71-44810 to S-71-44811
15545	S-71-44820 to S-71-44825
	S-71-46618 to S-71-46623
	S-71-46770 to S-71-46801
15546	S-71-44922 to S-71-44927
15547	S-71-44968 to S-71-44969
	S-71-44946 to S-71-44949
15548	S-71-44918 to S-71-44921
15555	S-71-43390 to S-71-43395
	S-71-43950 to S-71-43955
	S-71-44752 to S-71-44783
15556	S-71-43323 to S-71-43328
	S-71-45202
	S-71-45212 to S-71-45216
	S-71-45218 to S-71-45220
	S-71-45222 to S-71-45231
	S-71-45233 to S-71-45241
	S-71-45243
	S-71-45249
	S-71-45257
	S-71-45260
	S-71-44836 to S-71-44838
	S-71-44841 to S-71-44843

TABLE XI.- LUNAR SAMPLE PHOTOGRAPHIC INDEX

BY SAMPLE NUMBER - (Continued)

Sample Number	NASA photograph number
15557	S-71-43309 to S-71-43316 (S-71-43315 deleted) S-71-44449 to S-71-44454 S-71-45203 to S-71-45211 S-71-45217 S-71-45221 S-71-45232 S-71-45242 S-71-45244 to S-71-45248 S-71-45250 to S-71-45256 S-71-45258 to S-71-45259 S-71-45261 to S-71-45265 S-71-44839 to S-71-44840 S-71-44844 to S-71-44847
15558	S-71-43329 to S-71-43334 S-71-45115 to S-71-45116 S-71-45119 to S-71-45124 S-71-45129 to S-71-45130 S-71-45133 to S-71-45134 S-71-45137 to S-71-45138 S-71-45141 to S-71-45142 S-71-45149 to S-71-45150 S-71-45155 to S-71-45168 S-71-45179 to S-71-45184
15565	S-71-42964 to S-71-42969
15566	S-71-42963 and S-71-42970 to S-71-42974
15567	S-71-43017 to S-71-43022
15568	S-71-43011 to S-71-43016
15569	S-71-43023 to S-71-43028
15575	S-71-43396 to S-71-43401
15576	S-71-43402 to S-71-43407
15577	S-71-43029 to S-71-43034
15578	S-71-42987 to S-71-42992
15579	S-71-42999 to S-71-43004
15585	S-71-43005 to S-71-43010
15586	S-71-42993 to S-71-42998
15587	S-71-42975 to S-71-42980
15595	S-71-44491 to S-71-44496 S-71-46706 to S-71-46737
15596	S-71-44467 to S-71-44472 S-71-47069 to S-71-47074 S-71-46802 to S-71-46833
15597	S-71-44455 to S-71-44460 S-71-46636 to S-71-46641 S-71-46930 to S-71-46961
15598	S-71-44473 to S-71-44478 S-71-47045 to S-71-47050 S-71-46674 to S-71-46705
Fines	S-71-43050 to S-71-43052
15605	S-71-44942 to S-71-44945
15606	S-71-44938 to S-71-44941
15607	S-71-44932 to S-71-44937
15608	S-71-44964 to S-71-44967
15609	S-71-44960 to S-71-44963
15610	S-71-44928 to S-71-44931
15612	S-71-49066 to S-71-49069
15613	S-71-49074 to S-71-49077

TABLE XI.- LUNAR SAMPLE PHOTOGRAPHIC INDEX

BY SAMPLE NUMBER - (Continued)

Sample Number	NASA photograph number
15615	S-71-49062 to S-71-49065
15614	S-71-49070 to S-71-49073
15616	S-71-49120 to S-71-49123
15617	S-71-49058 to S-71-49061
15618	S-71-49112 to S-71-49115
15619	S-71-49108 to S-71-49111
15620	S-71-49116 to S-71-49119
15621	S-71-49098 to S-71-49101
15622	S-71-49102 to S-71-49107
15623	S-71-49313 to S-71-49316
15624	S-71-49325 to S-71-49328
15625	S-71-49317 to S-71-49320
15626	S-71-49309 to S-71-49312
15632	S-71-49295 to S-71-49298
15633	S-71-49291 to S-71-49294
15634	S-71-49287 to S-71-49290
15635	S-71-49283 to S-71-49286
15636	S-71-49299 to S-71-49304
15637	S-71-49305 to S-71-49308
15638	S-71-49559 to S-71-49562
15639	S-71-49551 to S-71-49554

Sample Number	NASA photograph number
15640	S-71-49563 to S-71-49566
15641	S-71-49555 to S-71-49558
15642	S-71-49575 to S-71-49578
15645	S-71-49567 to S-71-49570
15647	S-71-49579 to S-71-49584
15649	S-71-49585 to S-71-49588
15650	S-71-49547 to S-71-49550
15653	S-71-49571 to S-71-49574
15656	S-71-49735 to S-71-49738
15658	S-71-49531 to S-71-49534
15660	S-71-49535 to S-71-49538
15661	S-71-49527 to S-71-49530
15662	S-71-49731 to S-71-49734
15663	S-71-49717 to S-71-49720
15664	S-71-49539 to S-71-49542
15665	S-71-49739 to S-71-49742
15668	S-71-49725 to S-71-49730
15669	S-71-49543 to S-71-49546
15671	S-71-49721 to S-71-49724
15672	S-71-49816 to S-71-49820
15674	S-71-49831 to S-71-49836

TABLE XI.- LUNAR SAMPLE PHOTOGRAPHIC INDEX

BY SAMPLE NUMBER - (Completed)

Sample Number	NASA photograph number	Sample Number	NASA photograph number
15675	S-71-49822 to S-71-49826		
15680	S-71-49827 to S-71-49830		
15681	S-71-49867 to S-71-49870		
15682	S-71-49889 to S-71-49894		
15683	S-71-49883 to S-71-49888		
15684	S-71-49837 to S-71-49840		
15685	S-71-49875 to S-71-49878		
15686	S-71-49871 to S-71-49874		
15687	S-71-49879 to S-71-49882		