

JOHN W. DIETRICH

MSC 03210

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# LUNAR SAMPLE INFORMATION CATALOG

## APOLLO 16

### LUNAR RECEIVING LABORATORY

Sample Information Center

NASA/JSC Building 31N

PB.SAM.A16.1972.L

60162202

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

July 1972

DOCUMENT APPROVAL SHEET

APOLLO 16 SAMPLE INFORMATION CATALOG

DOCUMENT NUMBER MSC 03210	DATE Aug. 8, 1972	LEVEL 111
------------------------------	----------------------	--------------

	CODE	SIGNATURE	DATE
PREPARED BY:	TL4	P. Butler, Jr. <i>Patrick Butler Jr</i>	8-10-72
APPROVED:	TL4	M. B. Duke <i>M. B. Duke</i>	8-10-72
APPROVED:	TL	W. B. McCown <i>W.B. McCown</i>	8-11-72
APPROVED:			
APPROVED			

REVISIONS					OTHER DISPOSITION
DATE	PREPARED BY	CHANGE NO.	REVISION LTR.	SUPERSEDED BY	

## CONTENTS

<u>Section</u>	<u>Page</u>
INTRODUCTION.....	1
ACKNOWLEDGEMENTS.....	2
NUMBERING OF APOLLO 16 SAMPLES.....	4
GRAIN SIZE ANALYSES.....	35
SAMPLE LOCATIONS.....	36
SAMPLE RETURN CONTAINERS.....	43
SAMPLE PROCESSING.....	49
PROCESSING ENVIRONMENT.....	51
CHEMICAL ANALYSES.....	52
APOLLO 16 TOTAL CARBON ANALYSIS.....	57
SAMPLE DESCRIPTIONS.....	63

## TABLES

<u>Table</u>	<u>Page</u>
I Apollo 16 Sample Inventory.....	6
II Apollo 16 Rock Samples Weighing More Than 25 Grams.....	28
III Summary of Soil Samples.....	32
IV Contents of Sample Collection & Return Containers.....	44
V Chemical Analyses.....	53
VI Gamma Ray Analysis of Lunar Samples.....	55
VII Apollo 16 Total Carbon Analysis.....	58
VIII Apollo 16 Noble Gas Contents.....	59
IX Some Terms Used for Rock Descriptions.....	60
X Abbreviations Used In Thin Section Descriptions.....	62

FIGURES

<u>Figure</u>	<u>Page</u>
1 Map of EVA Traverses & Sample Collection Stations.....	37
2A Station Map Showing Sample Collection Sites.....	38
2B Station Map Showing Sample Collection Sites.....	38
2C Station Map Showing Sample Collection Sites.....	38
2D Station Map Showing Sample Collection Sites.....	38
2E Station Map Showing Sample Collection Sites.....	39
2F Station Map Showing Sample Collection Sites.....	39
2G Station Map Showing Sample Collection Sites.....	39
2H Station Map Showing Sample Collection Sites.....	40
2I Station Map Showing Sample Collection Sites.....	41
2J Station Map Showing Sample Collection Sites.....	42



## INTRODUCTION

This document contains data developed on the Apollo 16 samples in the Lunar Receiving Laboratory during the preliminary examination period, May 1, 1972 to June 23, 1972.

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 (50 - 52) to NASA and in the NASA Apollo 16 Preliminary Science Report.

## ACKNOWLEDGEMENTS

The format, style and timeliness of preparation of this catalog are due primarily to the efforts of Patrick Butler, Jr. Many people played significant parts in the development of the data, including the entire Preliminary Examination Team and the associated support personnel in the Lunar Receiving Laboratory. William C. Phinney participated in developing formats for descriptions. Richard Williams, Butler and Phinney shared editing of the rock and thin section descriptions. A. L. Eaton and Ken Johnston were largely responsible for the final compilation of the document.

The following personnel participated in the processing and studies of Apollo 16 samples during the preliminary examination period, and contributed to the preparation of this document.

### ANALYSIS GROUP

B. Bansal, LEC	A. Landry, LEC	S. L. Richards, BRN
L. Bennett, MSC	C. F. Lewis, ASU	J. M. Rhodes, LEC
D. D. Bogard, MSC	C. B. Moore, ASU	M. K. Robbins, BRN
W. J. Bouldin, BRN	D. R. Moore, BRN	K. V. Rogers, LEC
R. S. Clark, MSC	G. D. O'Kelley, ORNL	E. Schonfeld, MSC
P. N. Gast, MSC	K. A. Parker, LEC	L. A. Simms, BRN
E. K. Gibson, MSC	R. W. Perkins, BNW	N. M. Turner, BRN
W. C. Hirsch, BRN	W. R. Portenier, BRN	J. Wainwright, LEC
N. J. Hubbard, MSC	L. A. Rancitelli, BNW	R. B. Wilkin, BRN
J. E. Keith, MSC	M. A. Reynolds, MSC	

### FIELD GEOLOGY GROUP

N. G. Bailey, USGS	W. R. Muehlberger, USGS	G. A. Swann, USGS
R. M. Batson, USGS	V. S. Reed, USGS	R. L. Tyner, USGS
V. L. Greeman, USGS	G. G. Schaber, USGS	G. E. Ulrich, USGS
M. H. Hait, USGS	L. T. Silver, USGS	H. G. Wilshire, USGS
K. B. Larson, USGS	R. L. Sutton, USGS	E. W. Wolfe, USGS

### LUNAR RECEIVING LABORATORY GROUP

V. D. Alexander, BRN	I. E. Campagna, MSC	D. P. Gilmore, BRN
M. M. Anderson, BRN	R. C. Case, BRN	J. S. Goodman, BRN
A. J. Appling, BRN	R. Clark, BRN	P. Graf, MSC
J. O. Annexstad, MSC	D. L. Clement, BRN	P. A. Hassler, BRN
P. J. Armitage, MSC	L. E. Cornitus, BRN	P. R. Hayes, BRN
C. R. Ayers, BRN	C. E. Cucksee, BRN	E. J. Haynes, BRN
J. W. Bacak, BRN	H. L. Day, BRN	J. A. Holder, BRN
R. Bailey, MSC	R. L. Dickson, BRN	D. W. Hutchinson, BRN
F. M. Barbee, MSC	M. B. Duke, MSC	J. R. Ivey, BRN
A. J. Barber, BRN	R. L. Eason, BRN	H. J. Johnson, BRN
A. H. Beatty, BRN	C. A. Edwards, BRN	A. R. Johnston, MSC
D. L. Bolden, BRN	C. E. Endebrock, BRN	P. A. Jorgensen, BRN
U. O. Buchtler, BRN	L. O. Ferris, BRN	C. E. Lee, BRN
L. Caldwell, BRN	R. Fuentes, BRN	J. Lindsay, BRN

### LUNAR RECEIVING LABORATORY GROUP CONT'D.

E. A. Locke, BRN	S. L. Pike, BRN	J. Travlos, BRN
S. J. Lyskawa, BRN	J. E. Powers, BRN	C. P. Truby, BRN
D. A. Mann, BRN	C. F. Rocca, BRN	L. Villarreal, MSC
W. B. McCown, MSC	S. A. Rose, BRN	C. J. Wade, BRN
T. M. McPherson, MSC	J. Sawyer, BRN	A. C. Ware, BRN
G. E. Meschi, BRN	M. C. Schwarz, BRN	J. L. Warren, BRN
E. C. Miller, BRN	Z. J. Shannon, BRN	D. R. White, MSC
W. E. Milligan, MSC	L. L. Smith, BRN	R. M. White, BRN
J. L. Nix, BRN	K. L. Suit, MSC	G. E. Williams, BRN
W. A. Parkan, MSC	R. Trabanino, MSC	R. B. Laughon, MSC

### MINERALOGY/PETROLOGY GROUP

S. Agrell, MSC	J. A. Head, BELLCOM	D. S. Pettus, BRN
M. N. Bass, MSC	G. H. Heiken, MSC	W. C. Phinney, MSC
P. R. Brett, MSC	F. Horz, MSC	A. M. Reid, MSC
A. Bustos, BRN	E. D. Jackson, USGS	W. I. Ridley, MSC
P. Butler, Jr., MSC	D. Jezek, BRN	D. Stuart-Alexander, USGS
W. D. Carrier, MSC	G. E. Lofgren, MSC	J. L. Warner, MSC
A. L. Eaton, BRN	D. A. Morrison, MSC	R. F. Taylor, MSC

### AFFILIATIONS

ASU - Arizona State University  
BELLCOM - Bell Communications  
BNW - Battelle Pacific Northwestern Laboratory  
BRN - Brown & Root-Northrop  
LEC - Lockheed Electronics  
MSC - Manned Spacecraft Center  
ORNL - Oakridge National Laboratory  
USGS - U.S. Geological Survey

## NUMBERING OF APOLLO 16 SAMPLES

As in previous missions, five digit sample numbers are assigned each rock (coherent material greater than about 1 cm), the unsieved portion and each sieve fraction of scooped <1 cm material, the drill bit and each drill stem and drive tube section and each sample of special characteristic.

The first digit (6) is the mission designation for Apollo 16 (previous missions used the first two digits). As with Apollo 15 numbers, the Apollo 16 numbers are grouped by sampling site. Each group of one thousand numbers applies to an area as follows:

<u>Sampling Site</u>	<u>Initial Number</u>
LM, ALSEP,	60000
Stations 10 and 10 prime	60000
Station 1	61000
Station 2	62000
Station 4	64000
Station 5	65000
Station 6	66000
Station 8	68000
Station 9	69000
Station 11	67000
Station 13	63000

(The only exception now known is 60017 which was collected at station 13 according to USGS Interagency Report 52.)

The first numbers for each area were used for drill stems, drive tubes, and special samples (surface samplers), with an omitted number to separate drive tube or drill stem strings. (For example, at Station 9 69001 is a single core tube and 69003 and 69004 are the two surface samplers.) Drill stem sections and double drive tubes are numbered from the lower-most section upward.

The last digit is used to code sample type, in conformity with the conventions used for Apollo 15. Fines from a given documented bag are ascribed numbers according to:

6WXY0	unsieved material (usually <1 cm)
-------	-----------------------------------

6WXY1	<1 mm
6WXY2	1-2 mm
6WXY3	2-4 mm
6WXY4	4-10 mm

Rocks from a documented bag are numbered 6WXY5 - 6WXY9, usually in order of decreasing size.

Sample number decades were reserved for the contents of each documented bag. In the cases where the number of samples overflowed a decade the next available decade was used for the overflow. For example DB 11 contained soil, numbered 62280 - 62284, and 6 small rocks, numbered 62285 - 62289 and 62305.

Documented bags with predominantly soil samples were assigned even numbered decades and those with rock samples were assigned odd-numbered decades. The decades for rock samples usually only have an unsieved fines number for soil (adhering to the rock or scooped up with it) mixed in with any fragments that may have broken from the rock. For example, the 12 grams of soil and rock fragments in DB 362 are numbered 61130 and the 245 gram rock is 61135.

Paired soil and rake samples for each sampling area are assigned by centuries starting with 6W500. The soil sample documented bag has the first decade or decades of the century, in conformity with the last digit coding for rocks and fines (as explained above), and the rake sample documented bag uses the following decades. For example, 67700 - 67708 were used for the sieve fractions and four rocks from the soil sample in DB 388. Then for the companion rake sample in DB 423, 67710 - 67714 were used for the fractions of soil and the 32 >1 cm rake fragments were numbered 67715 - 67719, 67725 - 67729, ... , 67765 - 67769, 67775, 67776.

In as much as possible all samples returned loose in a sample collection bag or an ALSRC were numbered in a decade. In the cases in which rocks from several stations were put into a single collection bag however, the soil and rock fragments were assigned a decade number that conforms to the the site for the largest or most friable rock. The other rocks in the same bag have numbers for their own site, generally in the second or third decade of the thousand numbers for that site.

TABLE I - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
60001	30.1	Core bit	Sta 10-ALSEP	
60002	211.9	Core stem	----do-----	
60003	215.5	Core stem	----do-----	
60004	202.7	Core stem	----do-----	
60005	76.1	Core stem	----do-----	
60006	165.6	Core stem	----do-----	
60007	105.7	Core stem	----do-----	
60009	759.8	Core 54 lower	----do-----	SRC2/
60010	635.3	Core 45 upper	----do-----	--do--
60013	757.3	Core 32 lower	----do-----	SCB7/
60014	570.3	Core 27 upper	----do-----	--do--
60015	5574.0	Crystalline	----do-----	SCB5/
60016	4307.0	Breccia	----do-----	SCB7/
60017	2102.0	Breccia	Sta 13	--do--
60018	1501.0	Breccia	Sta 10-ALSEP	--do-
60019	1887.0	Breccia	----do-----	SCB4/
60020	51.91	SCB residue	----do-----	SCB3/
60025	1836.0	Anorthosite	----do-----	--do--
60030	79.26	DB residue	----do-----	SRC1/351
60035	1052.0	Anorthosite gabbro	----do-----	--do--
60040	12.12	SCB residue	----do-----	SCB5/
60050	3.27	Unsieved fines	Sta 10-ALSEP	SRC1/355
60051	195.3	<1mm fines	----do-----	--do--
60052	11.43	1-2mm fines	----do-----	--do--
60053	7.41	2-4mm fines	----do-----	--do--
60054	8.40	4-10mm fines	----do-----	--do--
60055	35.48	Anorthosite	----do-----	--do--
60056	16.07	Breccia	----do-----	--do--
60057	3.10	Anorthosite	----do-----	--do--
60058	2.12	Breccia	----do-----	--do--
60059	1.05	Anorthosite	----do-----	--do--
60070	79.83	DB residue	----do-----	SRC1/373
60075	183.8	Breccia	----do-----	--do--
60090	0.10	DB residue	----do-----	SCB1/004
60095	46.60	Glass	----do-----	--do--
60110	2.08	DB residue	----do-----	SCB1/381
60115	132.5	Breccia	----do-----	--do--
60130	1.07	DB residue	----do-----	SCB6/430
60135	137.7	Crystalline, glass coated	----do-----	--do--

TABLE I - APOLLO 16 SAMPLE INVENTORY

SAMPLE NUMBER	MASS	DESCRIPTION	LOCATION	SRC/DB OR SCB/DB
60210	12.78	Residue	Sta 10-ALSEP	SCB6/13
60215	385.8	Anorthositic cataclasite	----do-----	--do--
60230	39.61	DB residue	----do-----	SCB6/15
60235	70.13	Crystalline	----do-----	--do--
60250	18.31	DB residue	----do-----	SCB6/17
60255	871.0	Breccia	----do-----	--do--
60270	37.26	DB residue	----do-----	SCB7/18
60275	255.2	Breccia	----do-----	--do--
60310	2.02	DB residue	----do-----	SCB7/20
60315	787.7	Crystalline	----do-----	--do--
60330	2.51	Residue	----do-----	SCB6/331
60335	317.8	Breccia	----do-----	--do--
60500	234.4	Unsieved fines (raked)	----do-----	SCB4/350
60501	433.8	<1mm fines-----do----	----do-----	--do--
60502	17.69	<1-2mm fines-----do----	----do-----	--do--
60503	9.94	<2-4mm fines-----do----	----do-----	--do--
60504	6.63	<4-10mm fines-----do----	----do-----	--do--
60510	7.67	DB residue	----do-----	SCB4/349
60515	16.74	Anorthositic (rake)	----do-----	--do--
60516	7.91	-----do-----	----do-----	--do--
60517	1.23	-----do-----	----do-----	--do--
60518	1.12	-----do-----	----do-----	--do--
60519	.50	-----do-----	----do-----	--do--
60525	12.84	Crystalline----do-----	----do-----	--do--
60526	8.42	-----do-----	----do-----	--do--
60527	7.36	-----do-----	----do-----	--do--
60528	2.94	Glass-----do-----	----do-----	--do--
60529	1.24	-----do-----	----do-----	--do--
60535	7.23	Breccia (rake)	----do-----	
60600	182.6	Unsieved fines (rake)	----do-----	SCB4/348
60601	330.2	<1mm fines-----do----	----do-----	--do--
60602	14.93	<1-2mm fines-----do----	----do-----	--do--
60603	8.57	<2-4mm fines-----do----	----do-----	--do--
60604	3.94	<4-10mm fines-----do----	----do-----	--do--
60610	34.74	DB residue	----do-----	SCB4/347
60615	32.97	Crystalline (rake)	----do-----	--do--
60616	3.40	-----do-----	----do-----	--do--
60617	2.77	-----do-----	----do-----	--do--

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
60618	21.67	Crystalline (rake)	Sta 10-ALSEP	SCB4/347
60619	28.00	Anorthosite---do-----	----do-----	--do--
60625	117.00	Crystalline---do-----	----do-----	--do--
60626	15.87	-----do-----	----do-----	--do--
60627	12.09	-----do-----	----do-----	--do--
60628	6.86	Anorthosite---do-----	----do-----	--do--
60629	4.92	-----do-----	----do-----	--do--
60635	15.05	Crystalline---do-----	----do-----	--do--
60636	35.65	-----do-----	----do-----	--do--
60637	7.98	Breccia, clastic-matrix	----do-----	--do--
60638	.72	-----do-----	----do-----	--do--
60639	175.1	-----do-----	----do-----	--do--
60645	33.5	Breccia, heterogeneous	----do-----	--do--
60646	3.39	-----do-----	----do-----	--do--
60647	1.76	-----do-----	----do-----	--do--
60648	2.84	-----do-----	----do-----	--do--
60649	1.03	-----do-----	----do-----	--do--
60655	8.63	-----do-----	----do-----	--do--
60656	11.23	-----do-----	----do-----	--do--
60657	6.05	-----do-----	----do-----	--do--
60658	5.47	-----do-----	----do-----	--do--
60659	22.20	-----do-----	----do-----	--do--
60665	90.1	Glass, vesicular (rake)	----do-----	--do--
60666	15.95	-----do-----	----do-----	--do--
60667	7.66	-----do-----	----do-----	--do--
60668	2.91	-----do-----	----do-----	--do--
60669	2.54	-----do-----	----do-----	--do--
60675	1.30	-----do-----	----do-----	--do--
60676	8.92	-----do-----	----do-----	--do--
60677	5.23	-----do-----	----do-----	--do--
60678	1.25	-----do-----	----do-----	--do--
60679	2.96	-----do-----	----do-----	--do--
61010	64.19	Residue	Sta 1-----	SRC1
61015	1804.	Breccia veined	----do-----	--do--
61016	11729.	Anorthosite	----do-----	BSLSS
61017	2.62	Breccia, friable	----do-----	SRC1/
61130	12.51	DB residue	----do-----	SRC1/362
61135	245.1	Breccia	----do-----	--do--



TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
61140	74.13	Unsieved fines	Sta 1-Traverse plum	SRC1/363
61141	134.7	<1mm fines	----do-----	--do--
61142	9.43	1-2mm fines	----do-----	--do--
61143	5.38	2-4mm fines	----do-----	--do--
61144	5.71	4-10mm fines	----do-----	--do--
61150	16.13	DB residue	----do-----	SRC1/371
61155	47.59	Breccia	----do-----	--do--
61156	58.46	Breccian, annealed	----do-----	--do--
61157	11.26		----do-----	--do--
61158	14.79		----do-----	--do--
61160	52.79	Unsieved fines	Sta 1-Surface	SRC1/356
61161	90.0	<1mm fines	----do-----	--do--
61162	5.12	1-2mm fines	----do-----	--do--
61163	3.60	2-4mm fines	----do-----	--do--
61164	2.16	4-10mm fines	----do-----	--do--
61170	16.32	DB residue	----do-----	SRC1/364
61175	542.7	Breccia	----do-----	--do--
61180	93.40	Unsieved fines	Sta 1-N of LRV	SRC1/369
61181	156.2	<1mm fines	----do-----	--do--
61182	9.43	1-2mm fines	----do-----	--do--
61183	6.23	2-4mm fines	----do-----	--do--
61184	6.09	4-10mm fines	----do-----	--do--
61190	16.61	DB residue	----do-----	SRC1/002
61195	587.9	Microbreccia, glassy	----do-----	--do--
61220	191.6	Unsieved fines (white)	Sta 1-Below surface	SRC1/357
61221	61.0	<1mm fines-----do---	----do-----	--do--
61222	6.36	1-2mm fines-----do---	----do-----	--do--
61223	9.61	2-4mm fines	----do-----	--do--
61224	10.58	4-10mm fines	----do-----	--do--
61225	3.52	Micro-crystalline	----do-----	--do--
61226	1.53	Plagioclase	----do-----	--do--
61240	160.8	Unsieved fines, upper gray soil	----do-----	SRC1/352
61241	247.1	<1mm fines, upper gray soil	----do-----	--do--
61242	17.26	1-2mm fines-----do-----	----do-----	--do--
61243	13.80	2-4mm fines-----do-----	----do-----	--do--
61244	13.25	4-10mm fines-----do-----	----do-----	--do--

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
61245	8.25		Sta 1-Below surface	SRC1/352
61246	6.05		----do-----	--do--
61247	2.48		----do-----	--do--
61248	1.71		----do-----	--do--
61249	1.17		----do-----	--do--
61255	1.13		----do-----	--do--
61280	68.49	Unsieved fines	Sta 1-Plum	SRC1/368
61281	169.6	<1mm fines	----do-----	--do--
61282	10.20	1-2mm fines	----do-----	--do--
61283	6.74	2-4mm fines	----do-----	--do--
61284	3.48	4-10mm fines	----do-----	--do--
61290	7.70		----do-----	SRC1/353
61295	187.00	Breccia	----do-----	--do--
61500	267.8	Unsieved fines	Sta 1-Crater rim	SRC1/354
61501	466.9	<1mm fines	----do-----	--do--
61502	27.43	1-2mm fines	----do-----	--do--
61503	20.08	2-4mm fines	----do-----	--do--
61504	12.70	4-10mm fines	----do-----	--do--
61505	1.651		----do-----	--do--
61510	38.88	DB residue	----do-----	SRC1/372
61515	2.00	Breccia, clastic (rake)	----do-----	--do--
61516	2.38	-----do-----	----do-----	--do--
61517	.47	-----do-----	----do-----	--do--
61518	.16	-----do-----	----do-----	--do--
61519	.33	-----do-----	----do-----	--do--
61525	10.35	-----do-----	----do-----	--do--
61526	4.08	-----do-----	----do-----	--do--
61527	.52	-----do-----	----do-----	--do--
61528	.24	-----do-----	----do-----	--do--
61529	.28	-----do-----	----do-----	--do--
61535	.23	-----do-----	----do-----	
61536	85.99	-----do-----	----do-----	
61537	6.62	-----do-----	----do-----	
61538	4.76	-----do-----	----do-----	
61539	5.78	-----do-----	----do-----	
61545	3.61	-----do-----	----do-----	
61546	110.7	Glass, vesicular (rake)	----do-----	
61547	17.93	-----do-----	----do-----	
61548	24.18	-----do-----	----do-----	
61549	3.76	-----do-----	----do-----	

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
61555	3.46	Glass, vesicular (rake)	Sta 1	SRC1/372
61556	2.23	-----do-----	----do-----	--do--
61557	.93	-----do-----	----do-----	--do--
61558	3.00	-----do-----	----do-----	--do--
61559	.62	-----do-----	----do-----	--do--
61565	.88	-----do-----	----do-----	--do--
61566	.66	-----do-----	----do-----	--do--
61567	.19	-----do-----	----do-----	--do--
61568	19.32	Crystalline (rake)	----do-----	--do--
61569	12.02	-----do-----	----do-----	--do--
61575	5.26	-----do-----	----do-----	--do--
61576	5.87	Plagioclase (rake)	----do-----	--do--
61577	.21	-----do-----	----do-----	--do--
62230	4.64	Unsieved fines	Sta 2	SRC1/005
62231	86.74	<1mm fines	----do-----	--do--
62232	6.96	1-2mm fines	----do-----	--do--
62233	5.32	2-4mm fines	----do-----	--do--
62234	8.46	4-10mm fines	----do-----	--do--
62235	319.6	Basalt	----do-----	--do--
62236	57.27	Breccia, anorthositic	----do-----	--do--
62237	62.35	Breccia, anorthositic	----do-----	--do--
62238	1.565		----do-----	--do--
62240	162.4	Unsieved fines	Sta 2-Edge of Buster	SRC1/006
62241	243.4	<1mm fines	----do-----	--do--
62242	21.74	1-2mm fines	----do-----	--do--
62243	19.60	2-4mm fines	----do-----	--do--
62244	16.37	4-10mm fines	----do-----	--do--
62245	6.03	Hornfels	----do-----	--do--
62246	4.59	Anorthosite	----do-----	--do--
62247	2.11	Breccia	----do-----	--do--
62248	1.61	Breccia	----do-----	--do--
62249	1.41	Breccia	----do-----	--do--
62250	18.43	DB residue	----do-----	SRC1/007
62255	1192.	Breccia	----do-----	--do--
62270	22.17	DB residue	----do-----	SRC1/009
62275	443.0	Breccia	----do-----	--do--
62280	143.0	Unsieved fines	----do-----	SRC1/011
62281	218.5	<1mm fines	----do-----	--do--
62282	21.71	1-2mm fines	----do-----	--do--
62283	13.11	2-4mm fines	----do-----	--do--

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
62284	14.30	4-10mm fines	Sta 2-----	SRC1/011
62285	3.524		-----do----	---do---
62286	2.917		-----do----	---do---
62287	2.474		-----do----	---do---
62288	1.939		-----do----	---do---
62289	1.135		-----do----	---do---
62290	27.70	DB residue	-----do----	SRC1/010
62295	250.8	Crystalline	-----do----	---do---
62305	.810		-----do----	SRC1/011
62315	.77	Breccia	-----do----	SRC1/006
63010	51.3	SCB residue	Sta 13-----	SCB6/
63320	320.0	Unsieved fines	-----do----	SCB6/426
63321	25.67	<1mm fines	-----do----	---do---
63322	2.65	1-2mm fines	-----do----	---do---
63323	2.02	2-4mm fines	-----do----	---do---
63324	1.14	4-10mm fines	-----do----	---do---
63335	65.4	Breccia	-----do----	SCB6/428
63340	149.7	Unsieved fines	-----do----	SCB6/427
63341	25.88	<1mm fines	-----do----	---do---
63342	2.52	1-2mm fines	-----do----	---do---
63343	2.13	2-4mm fines	-----do----	---do---
63344	.96	4-10mm fines	-----do----	---do---
63350	23.49		-----do----	SCB6/429
63355	68.24	Breccia	-----do----	---do---
63500	201.8	Unsieved fines (rake)	-----do----	SCB4/346
63501	342.5	<1mm fines	-----do----	---do---
63502	25.29	1-2mm fines	-----do----	---do---
63503	14.53	2-4mm fines	-----do----	---do---
63504	17.34	4-10mm fines	-----do----	---do---
63505	5.41	Breccia, anorthositic	-----do----	---do---
63506	4.9	Crystalline	-----do----	---do---
63507	2.78	Breccia, soil	-----do----	---do---
63508	2.61	Anorthosite	-----do----	---do---
63509	2.05	Crystalline	-----do----	---do---
63515	1.32	Crystalline	-----do----	---do---
63520	22.08	DB residue (rake)	-----do----	SCB4/345
63525	6.68	Crystalline (rake)	-----do----	---do---

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
63526	2.91	Crystalline (rake)	Sta 13-----	SCB4/345
63527	6.10	-----do-----	-----do-----	--do--
63528	4.12	-----do-----	-----do-----	--do--
63529	23.48	-----do-----	-----do-----	--do--
63535	6.85	-----do-----	-----do-----	--do--
63536	1.02	-----do-----	-----do-----	--do--
63537	4.78	-----do-----	-----do-----	--do--
63538	35.06	-----do-----	-----do-----	--do--
63539	.39	-----do-----	-----do-----	--do--
63545	15.95	-----do-----	-----do-----	--do--
63546	9.23	-----do-----	-----do-----	--do--
63547	4.90	-----do-----	-----do-----	--do--
63548	1.13	-----do-----	-----do-----	--do--
63549	26.57	-----do-----	-----do-----	--do--
63555	3.38	-----do-----	-----do-----	--do--
63556	18.10	-----do-----	-----do-----	--do--
63557	7.53	-----do-----	-----do-----	--do--
63558	7.09	-----do-----	-----do-----	--do--
63559	6.04	Glass, vesicular (rake)	-----do-----	--do--
63565	.94	-----do-----	-----do-----	--do--
63566	19.61	-----do-----	-----do-----	--do--
63567	3.21	-----do-----	-----do-----	--do--
63568	4.06	-----do-----	-----do-----	--do--
63569	.43	-----do-----	-----do-----	--do--
63575	4.72	-----do-----	-----do-----	--do--
63576	1.23	-----do-----	-----do-----	--do--
63577	12.41	Breccia	-----do-----	--do--
63578	19.60	-----do-----	-----do-----	--do--
63579	11.35	-----do-----	-----do-----	--do--
63585	32.62	-----do-----	-----do-----	SCB4/345
63586	1.98	-----do-----	-----do-----	--do--
63587	20.51	-----do-----	-----do-----	--do--
63588	2.40	-----do-----	-----do-----	--do--
63589	13.51	-----do-----	-----do-----	--do--
63595	2.10	-----do-----	-----do-----	--do--
63596	6.40	Glass, vesicular (rake)	-----do-----	--do--
63597	5.67	-----do-----	-----do-----	--do--
63598	12.66	-----do-----	-----do-----	--do--
64001	752.3	Core 38	Sta 4-----	SCB3/
64002	584.1	Core 43	-----do-----	SCB2/

TABLE I - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
64420	112.2	Unsieved fines	Sta 4-Trench bottom	SCB3/399
64421	206.9	<1mm fines	----do-----	--do--
64422	6.17	1-2mm fines	----do-----	--do--
64423	3.76	2-4mm fines	----do-----	--do--
64424	2.06	4-10mm fines	----do-----	--do--
64425	14.62	Breccia (black & white rock)	----do-----	--do--
64430	28.22	DB residue	----do-----	SCB1/394
64435	1079.0	Breccia	----do-----	--do--
64450	1.57		----do-----	SCB3/397
64455	56.68	Anorthosite, glass coated	----do-----	--do--
64470	27.09	DB residue	----do-----	SCB3/398
64475	1032.0	Breccia	----do-----	--do--
64476	125.1	Breccia	----do-----	--do--
64477	19.32	Breccia	----do-----	--do--
64478	12.34	Breccia	----do-----	--do--
64500	320.6	Unsieved fines (rake)	----do-----	SCB1/396
64501	495.7	<1mm fines	----do-----	--do--
64502	28.38	1-2mm fines (rake)	----do-----	--do--
64503	24.11	2-4mm fines	----do-----	--do--
64504	24.15	4-10mm fines	----do-----	--do--
64505	5.392		----do-----	--do--
64506	5.079		----do-----	--do--
64507	4.474		----do-----	--do--
64508	4.168		----do-----	--do--
64509	3.150		----do-----	--do--
64515	3.761		----do-----	--do--
64516	2.929		----do-----	--do--
64517	1.546		----do-----	--do--
64518	1.490		----do-----	--do--
64519	1.124		----do-----	--do--
64525	1.107		----do-----	--do--
64530	102.8	DB residue (rake)	----do-----	SCB1/395
64535	256.6	Breccia (rake)	----do-----	--do--
64536	177.5	-----do-----	----do-----	--do--
64537	124.3	-----do-----	----do-----	--do--
64538	30.03	-----do-----	----do-----	--do--
64539	17.76	-----do-----	----do-----	--do--

TABLE I - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
64545	14.09	Breccia (rake)	Sta 4-----	SCB1/395
64546	12.80	-----do-----	-----do-----	--do--
64547	10.90	-----do-----	-----do-----	--do--
64548	8.49	-----do-----	-----do-----	--do--
64549	6.47	-----do-----	-----do-----	--do--
64555	5.29	-----do-----	-----do-----	--db--
64556	5.15	-----do-----	-----do-----	--do--
64557	4.790	-----do-----	-----do-----	--do--
64558	3.130	-----do-----	-----do-----	--do--
64559	21.82	Crystalline (rake)	-----do-----	
64565	14.73	-----do-----	-----do-----	--do--
64566	14.13	-----do-----	-----do-----	--do--
64567	13.86	-----do-----	-----do-----	--do--
64568	9.379	-----do-----	-----do-----	--do--
64569	14.32	-----do-----	-----do-----	--do--
64575	6.837	-----do-----	-----do-----	--do--
64576	6.916	-----do-----	-----do-----	--do--
64577	5.692	-----do-----	-----do-----	--do--
64578	5.596	-----do-----	-----do-----	--do--
64579	4.802	-----do-----	-----do-----	--do--
64585	4.696	-----do-----	-----do-----	SCB1/395
64586	3.337	-----do-----	-----do-----	--do--
64587	7.180	Breccia (rake)	-----do-----	--do--
64588	2.546	-----do-----	-----do-----	--do--
64589	4.039	Anorthosite (rake)	-----do-----	--do--
64800	166.3	Unsieved fines (rake)	Sta 4-Crater rim	SCB3/400
64801	286.8	<1mm fines	-----do-----	--do--
64802	10.96	1-2mm fines	-----do-----	--do--
64803	8.09	2-4mm fines	-----do-----	--do--
64804	7.89	4-10mm fines	-----do-----	--do--
64810	102.14	Unsieved fines	-----do-----	SCB3/401
64811	174.7	<1mm fines	-----do-----	--do--
64812	9.53	1-2mm fines	-----do-----	--do--
64813	9.10	2-4mm fines	-----do-----	--do--
64814	5.34	4-10mm fines	-----do-----	--do--
64815	20.90	Ultramafic, crushed (rake)	-----do-----	--do--
64816	3.83	Crystalline, fine-grained	-----do-----	--do--
64817	8.98	-----do-----	-----do-----	--do--
64818	15.98	-----do-----	-----do-----	--do--
64819	11.76	Anorthosite,-----do---(rake)	-----do-----	--do--

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
64825	21.50	Breccia (rake)	Sta 4-----	SCB3/401
64826	11.33	-----do-----	-----do----	----do---
64827	8.11	-----do-----	-----do----	----do---
64828	.97	-----do-----	-----do----	----do---
64829	2.20	-----do-----	-----do----	----do---
64835	2.32	-----do-----	-----do----	----do---
64836	1.76	-----do-----	-----do----	----do---
64837	2.18	-----do-----	-----do----	----do---
65010	42.37	SCB residue	Sta 5-----	SCB1/
65015	1802.0	Crystalline	-----do----	SCB3/
65016	21.02	Glass sphere	-----do----	SCB1/
65030	45.0	DB residue	-----do----	SCB1/404
65035	446.1	Breccia	-----do----	----do---
65050	32.29	DB residue	-----do----	SCB3/337
65055	500.8	Crystalline	-----do----	----do---
65056	64.78	Glass agglutinate	-----do----	----do---
65070	5.05	DB residue	-----do----	SCB1/403
65075	107.9	Breccia	-----do----	----do---
65090	23.26	DB residue	-----do----	SCB3/336
65095	560.1	Breccia, anorthosite	-----do----	----do---
65310	45.08	DB residue	-----do----	SCB1/405
65315	300.4	Breccia (put into rake DB)	-----do----	----do---
65325	67.87	Anorthositic (rake)	-----do----	----do---
65326	36.40	-----do-----	-----do----	----do---
65327	6.97	-----do-----	-----do----	----do---
65328	1.28	-----do-----	-----do----	----do---
65329	1.92	-----do-----	Sta 5-----	----do---
65335	1.63	-----do-----	-----do----	----do---
65336	.63	-----do-----	-----do----	----do---
65337	11.57	Breccia (rake)	-----do----	----do---
65338	2.65	-----do-----	-----do----	----do---
65339	1.62	-----do-----	-----do----	----do---
65345	.86	-----do-----	-----do----	----do---
65346	.80	-----do-----	-----do----	----do---
65347	.43	-----do-----	-----do----	----do---
65348	11.66	Glass, vesicular (rake)	-----do----	----do---
65349	7.58	-----do-----	-----do----	----do---
65355	4.94	-----do-----	-----do----	----do---
65356	2.53	-----do-----	-----do----	----do---



TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
65357	18.76	Crystalline (rake)	Sta 5----	SCB1/405
65358	7.02	-----do-----	----do----	---do---
65359	2.53	-----do-----	----do----	---do---
65365	2.16	-----do-----	----do----	---do---
65366	8.48	Glass, fragment (rake)	----do----	---do---
65500	413.0	Unsieved fines (rake)	----do----	SRC2/333
65501	150.0	<1mm fines-----do-----	----do----	---do---
65502	9.50	1-2mm fines-----do-----	----do----	---do---
65503	23.24	2-4mm fines-----do-----	----do----	---do---
65504	22.48	4-10mm fines-----do-----	----do----	---do---
65510	171.3	Unsieved fines (rake)	----do----	SRC2/332
65511	190.2	<1mm fines-----do-----	----do----	---do---
65512	14.68	1-2mm fines-----do-----	----do----	---do---
65513	20.21	2-4mm fines-----do-----	----do----	---do---
65514	13.98	4-10mm fines-----do-----	----do----	---do---
65515	50.25	Soil clods (rake)	----do----	---do---
65516	10.49	-----do-----	----do----	---do---
65517	11.85	-----do-----	----do----	---do---
65518	9.477	-----do-----	----do----	---do---
65519	10.58	-----do-----	----do----	---do---
65525	7.483	-----do-----	----do----	---do---
65526	3.545	-----do-----	----do----	---do---
65527	2.890	-----do-----	----do----	---do---
65528	3.082	-----do-----	----do----	---do---
65529	2.55	-----do-----	----do----	---do---
65535	2.658	-----do-----	----do----	---do---
65536	1.575	-----do-----	----do----	---do---
65537	2.426	-----do-----	----do----	---do---
65538	2.342	-----do-----	----do----	---do---
65539	2.180	-----do-----	----do----	---do---
65545	1.797	-----do-----	----do----	---do---
65546	1.346	-----do-----	----do----	---do---
65547	1.587	-----do-----	----do----	---do---
65548	3.023	-----do-----	----do----	---do---
65549	2.094	-----do-----	----do----	---do---
65555	2.202	-----do-----	----do----	---do---
65556	1.170	-----do-----	----do----	---do---
65557	1.114	-----do-----	----do----	---do---
65558	1.695	-----do-----	----do----	---do---
65559	1.533	-----do-----	----do----	---do---

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
65565	.852	Soil clods (rake)	Sta 5----	SRC2/332
65566	1.998	-----do-----	----do---	---do---
65567	1.289	-----do-----	----do---	---do---
65568	.808	-----do-----	----do---	---do---
65569	.873	-----do-----	----do---	---do---
65575	.907	-----do-----	----do---	---do---
65576	.906	-----do-----	----do---	---do---
65577	.706	-----do-----	----do---	---do---
65578	.320	-----do-----	----do---	---do---
65579	.612	-----do-----	----do---	---do---
65585	9.294	Glassy agglutinates (rake)	----do---	---do---
65586	6.763	-----do-----	----do---	---do---
65587	2.141	-----do-----	----do---	---do---
65588	9.629	Plagioclase (rake)	----do---	---do---
65700	92.30	Unsieved fines (rake)	----do---	SCB1/402
65701	171.3	<1mm fines-----do---	----do---	---do---
65702	4.89	1-2mm fines-----do---	----do---	---do---
65703	1.58	2-4mm fines-----do---	----do---	---do---
65704	1.39	4-10mm fines-----do---	----do---	---do---
65710	91.23	Rake sample	----do---	SCB1/334
65715	31.36	Breccia (rake)	----do---	---do---
65716	14.28	-----do-----	----do---	---do---
65717	7.415	-----do-----	----do---	---do---
65718	10.61	-----do-----	----do---	---do---
65719	7.04	-----do-----	----do---	---do---
65725	6.67	-----do-----	----do---	---do---
65726	5.19	-----do-----	----do---	---do---
65727	4.30	-----do-----	----do---	---do---
65728	4.22	-----do-----	----do---	---do---
65729	3.81	-----do-----	----do---	---do---
65735	4.26	-----do-----	----do---	---do---
65736	2.74	-----do-----	----do---	---do---
65737	.85	-----do-----	----do---	---do---
65738	1.17	-----do-----	----do---	---do---
65739	.95	-----do-----	----do---	---do---
65745	7.76	-----do-----	----do---	---do---
65746	4.19	-----do-----	----do---	---do---
65747	.82	-----do-----	----do---	---do---
65748	.97	-----do-----	----do---	---do---
65749	.95	-----do-----	----do---	---do---

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
65755	1.42	Breccia (rake)	Sta 5----	SCB1/334
65756	.77	-----do-----	-----do---	-----do---
65757	26.20	-----do-----	-----do---	-----do---
65758	5.95	-----do-----	-----do---	-----do---
65759	3.11	-----do-----	-----do---	-----do---
65765	1.12	-----do-----	-----do---	-----do---
65766	1.01	-----do-----	-----do---	-----do---
65767	17.51	Agglutinates, glassy (rake)	-----do---	-----do---
65768	3.25	-----do-----	-----do---	-----do---
65769	2.74	-----do-----	-----do---	-----do---
65775	3.50	-----do-----	-----do---	-----do---
65776	2.33	-----do-----	-----do---	-----do---
65777	16.53	Crystalline (rake)	-----do---	-----do---
65778	12.22	-----do-----	-----do---	-----do---
65779	12.71	-----do-----	-----do---	-----do---
65785	5.16	-----do-----	-----do---	SCB1/334
65786	83.02	Breccia (rake)	-----do---	-----do---
65787	8.28	-----do-----	-----do---	-----do---
65788	9.32	-----do-----	-----do---	-----do---
65789	12.24	Anorthosite, granular (rake)	-----do---	-----do---
65795	6.84	Anorthosite, gabbroic (rake)	-----do---	-----do---
65900	233.2	Unsieved fines (rake)	Sta 5-15 cm below surface	SCB1/406
65901	393.2	<1mm fines-----do----	-----do---	-----do---
65902	14.84	1-2mm fines-----do----	-----do---	-----do---
65903	11.40	2-4mm fines-----do----	-----do---	-----do---
65904	9.51	4-10mm fines-----do----	-----do---	-----do---
65905	12.08		Sta 5----	-----do---
65906	6.584		-----do---	-----do---
65907	4.658		-----do---	-----do---
65908	2.162		-----do---	-----do---
65909	2.024		-----do---	-----do---
65915	2.060		-----do---	-----do---
65916	0.994		-----do---	-----do---
65920	12.06	Rake sample	-----do---	SCB1/335
65925	3.82	Breccia (rake)	-----do---	-----do---
65926	3.03	-----do-----	-----do---	-----do---
65927	.72	-----do-----	-----do---	-----do---

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
66030	50.49	Unsieved fines	Sta 6----	SCB1/407
66031	75.6	<1mm fines-----do---	----do---	---do---
66032	2.99	1-2mm fines-----do---	----do---	---do---
66033	2.16	2-3mm fines-----do---	----do---	---do---
66034	3.36	4-10mm fines----do---	----do---	---do---
66035	211.4	Breccia	----do---	---do---
66036	4.384	--do---	----do---	---do---
66037	3.718	--do---	----do---	---do---
66040	166.5	Unsieved fines (gray soil)	----do---	SRC2/338
66041	357.4	<1mm fines-----do-----	----do---	---do---
66042	19.5	1-2mm fines-----do-----	----do---	---do---
66043	15.5	2-4mm fines-----do-----	----do---	---do---
66044	11.3	4-10mm fines----do-----	----do---	---do---
66050	30.36	DB residue	----do---	SCB1/408
66055	1306.0	Breccia	----do---	---do---
66070	8.06	DB residue	----do---	SRC2/409
66075	347.1	Breccia	----do---	---do---
66080	106.1	Unsieved fines (white patch on regolith)	----do---	SRC2/339
66081	177.3	<1mm fines-----do-----	----do---	---do---
66082	9.85	1-2mm fines-----do-----	----do---	---do---
66083	4.53	2-4mm fines-----do-----	----do---	---do---
66084	3.13	4-10mm fines-----do-----	----do---	---do---
66085	3.66		----do---	---do---
66086	2.027		----do---	---do---
66090	9.47	DB residue	----do---	SCB1/410
66095	1185.0	Anorthosite	----eo---	---do---
67010	459.5	Residue	Sta 11---	SCB7/
67015	1194.0	Breccia	----do---	---do---
67016	4262.0	--do---	----do---	BSLSS
67020	357.6	Residue	----do---	---do---
67025	16.06	Anorthosite	----do---	---do---
67030	.77	Fragments	----do---	SCB7/382
67031	52.73	<1mm fragments	----do---	---do---
67032	13.30	1-2mm----do---	----do---	---do---
67033	14.88	2-4mm----do---	----do---	---do---
67034	14.55	4-10mm----do---	----do---	---do---
67035	245.2	Breccia	----do---	---do---

TABLE I - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
67050	18.54	DB residue	STA 11---	SCB7/383
67055	221.88	Breccia	----do---	---do---
67070	.70	DB residue	----do---	SCB7/384
67075	219.2	Anorthosite	----do---	---do---
67090	3.86	DB residue	----do---	SCB7/385
67095	339.8	Breccia	----do---	---do---
67110	17.28	DB residue	----do---	SCB7/386
67115	240.0	Breccia	----do---	---do---
67210	276.9	Breccia	----do---	SCB6/PDB1
67230	938.34	Breccia	----do---	SCB6/PDB2
67410	58.72	DB residue	----do---	SCB6/387
67415	174.9	Breccia, anorthosite	----do---	---do---
67430	23.26	DB residue	----do---	SCB6/415
67435	353.5	Breccia	----do---	---do---
67450	217.2	DB residue	----do---	SCB6/416
67455	942.2	Breccia	----do---	---do---
67460	123.7	Unsieved fines (fillet soil)	----do---	SCB6/417
67461	222.2	<1mm fines	----do---	---do---
67462	17.4	1-2mm fines	----do---	---do---
67463	6.24	2-4mm	----do---	---do---
67464	.70	4-10mm fines (fillet soil)	----do---	---do---
67475	175.1	Breccia	----do---	SCB6/418
67480	87.05	Unsieved fines (ref soil)	----do---	SCB6/419
67481	132.7	<1mm fines	----do---	---do---
67482	14.65	1-2mm fines	----do---	---do---
67483	8.37	2-4mm fines	----do---	---do---
67484	6.02	4-10mm fines	----do---	---do---
67485	6.55	Crystalline, aphanitic	----do---	---do---
67486	5.80	Glass	----do---	---do---
67487	2.65	Crystalline, aphanitic	----do---	---do---
67488	2.25	Crystalline, aphanitic	----do---	---do---
67489	2.06	Crystalline, aphanitic	----do---	---do---
67495	1.34	Breccia	----do---	---do---

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
67510	9.22	Unsieved fines (rake soil)	Sta 11---	SCB6/420
67511	59.5	<1mm fines	----do---	----do---
67512	14.46	1-2mm fines	----do---	----do---
67513	19.39	2-4mm fines	----do---	----do---
67514	31.03	4-10mm fines (rake soil)	----do---	----do---
67515	60.8	Anorthositic, granulated (rake)	----do---	----do---
67516	14.38	-----do-----	----do---	----do---
67517	9.65	-----do-----	----do---	----do---
67518	3.74	-----do-----	----do---	----do---
67519	2.04	-----do-----	----do---	----do---
67525	2.52	-----do-----	----do---	----do---
67526	2.44	-----do-----	----do---	----do---
67527	2.40	-----do-----	----do---	----do---
67528	1.24	-----do-----	----do---	----do---
67529	1.13	-----do-----	----do---	----do---
67535	.99	-----do-----	----do---	----do---
67536	1.20	-----do-----	----do---	----do---
67537	1.29	-----do-----	----do---	----do---
67538	1.77	-----do-----	----do---	----do---
67539	2.12	-----do-----	----do---	----do---
67545	1.88	-----do-----	----do---	----do---
67546	1.50	-----do-----	----do---	----do---
67547	.83	-----do-----	----do---	----do---
67548	1.36	-----do-----	----do---	----do---
67549	43.1	Breccia, heterogeneous (rake)	----do---	----do---
67555	3.54	-----do-----	----do---	----do---
67556	8.21	-----do-----	----do---	----do---
67557	3.30	Breccia, friable	----do---	----do---
67558	2.56	-----do-----	----do---	----do---
67559	32.9	Crystalline	----do---	----do---
67565	10.43	-----do-----	----do---	----do---
67566	4.31	-----do-----	----do---	----do---
67567	11.51	Glass, vesicular	----do---	----do---
67568	11.05	-----do-----	----do---	----do---
67569	7.27	-----do-----	----do---	----do---
67575	4.47	-----do-----	----do---	----do---
67576	3.98	-----do-----	----do---	----do---

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
67600	2.17	Unsieved fines (rake soil)	Sta 11-Crater rim	SCB6/422
67601	161.8	<1mm fines (rake soil)	----do---	---do---
67602	13.45	1-2mm fines	----do---	---do---
67603	6.16	2-4mm fines	----do---	---do---
67604	2.62	4-10mm fines	----do---	---do---
67605	44.52	Breccia	----do---	---do---
67610	66.83	DB residue (rake)	----do---	SCB6/421
67615	8.77	Crystalline (rake)	----do---	---do---
67616	21.29	-----do-----	----do---	---do---
67617	14.32	-----do-----	----do---	---do---
67618	11.17	-----do-----	----do---	---do---
67619	6.15	-----do-----	----do---	---do---
67625	6.72	-----do-----	----do---	---do---
67626	19.19	Glass, vesicular (rake)	----do---	---do---
67627	79.64	-----do-----	----do---	---do---
67628	49.71	-----do-----	----do---	---do---
67629	32.84	-----do-----	----do---	---do---
67635	9.12	Anorthositic, granulated (rake)	----do---	---do---
67636	3.23	-----do-----	----do---	---do---
67637	2.34	-----do-----	----do---	---do---
67638	7.23	Breccia (rake)	----do---	---do---
67639	7.34	-----do-----	----do---	---do---
67645	.84	-----do-----	----do---	---do---
67646	3.94	-----do-----	----do---	---do---
67647	47.72	-----do-----	----do---	---do---
67648	7.88	-----do-----	----do---	---do---
67649	1.60	-----do-----	----do---	---do---
67655	4.11	-----do-----	----do---	---do---
67656	1.93	-----do-----	----do---	---do---
67657	1.70	-----do-----	----do---	---do---
67658	1.35	-----do-----	----do---	---do---
67659	1.62	-----do-----	----do---	---do---
67665	5.88	-----do-----	----do---	---do---
67666	5.47	-----do-----	----do---	---do---
67667	7.89	Ultramafic, crushed (rake)	----do---	---do---
67668	3.58	Crystalline (rake)	----do---	---do---
67669	12.54	Breccia (rake)	----do---	---do---
67675	1.07	Glass, vesicular (rake)	----do---	---do---
67676	2.33	Crystalline (rake)	----do---	---do---

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
67700	142.6	Unsieved fines (rake soil, white)	Sta 11----	SCB 4/388
67701	235.0	<1mm fines	----do---	----do---
67702	21.69	1-2mm fines	----do---	----do---
67703	13.71	2-4mm fines	----do---	----do---
67704	7.47	4-10mm fines	----do---	----do---
67705	6.57	Breccia	----do---	----do---
67706	2.08	-----do-----	----do---	----do---
67707	1.84	-----do-----	----do---	----do---
67708	1.43	-----do-----	----do---	----do---
67710	133.39	Unsieved fines (rake)	----do---	SCB 4/423
67711	205.3	<1mm fines	----do---	----do---
67712	34.84	1-2mm fines	----do---	----do---
67713	22.45	2-4mm fines	----do---	----do---
67714	12.66	4-10mm fines (rake)	----do---	----do---
67715	9.44	Breccia (rake)	----do---	----do---
67716	17.02	-----do-----	----do---	----do---
67717	5.56	-----do-----	----do---	----do---
67718	41.05	-----do-----	----do---	----do---
67719	2.13	-----do-----	----do---	----do---
67725	5.85	-----do-----	----do---	----do---
67726	4.53	-----do-----	----do---	----do---
67727	1.80	Glass, vesicular (rake)	----do---	----do---
67728	9.25	-----do-----	----do---	----do---
67729	73.2	-----do-----	----do---	----do---
67735	13.30	Crystalline, fine-grained (rake)	----do---	----do---
67736	14.92	-----do-----	----do---	----do---
67737	4.56	-----do-----	----do---	----do---
67738	5.84	-----do-----	----do---	----do---
67739	2.03	-----do-----	----do---	----do---
67745	3.53	-----do-----	----do---	----do---
67746	3.47	-----do-----	----do---	----do---
67747	6.30	-----do-----	----do---	----do---
67748	4.74	-----do-----	----do---	----do---
67749	11.47	Breccia (rake)	----do---	----do---
67755	3.53	-----do-----	----do---	----do---
67756	4.82	-----do-----	----do---	----do---
67757	4.83	-----do-----	----do---	----do---
67758	4.06	-----do-----	----do---	----do---
67759	4.56	-----do-----	----do---	----do---



TABLE I - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
67765	1.73	Breccia (rake)	Sta 11----	SCB4/423
67766	5.47	-----do-----	----do---	---do---
67767	1.67	-----do-----	----do---	---do---
67768	.99	-----do-----	----do---	---do---
67769	3.05	-----do-----	----do---	---do---
67775	6.58	-----do-----	----do---	---do---
67776	3.10	-----do-----	----do---	---do---
67910	180.3	Residue	----do---	SCB4/
67915	2559.0	Breccia	----do---	---do---
67930	8.51	Unsieved fines	----do---	SCB4/389
67935	108.9	Breccia	----do---	---do---
67936	61.82	-----do-----	----do---	---do---
67937	59.67	-----do-----	----do---	---do---
67940	27.22	Unsieved fines	Sta 11-E-W split in boulder	SCB4/390
67941	105.9	<1mm fines	----do---	---do---
67942	12.23	1-2mm fines	----do---	---do---
67943	9.36	2-4mm fines	----do---	---do---
67944	8.59	4-10mm fines	----do---	---do---
67945	4.37	Metaclastic	----do---	---do---
67946	3.20	Breccia	----do---	---do---
67947	2.43	-----do-----	----do---	---do---
67948	1.59	Crystalline	----do---	---do---
67950	8.21		----do---	---do---
67955	162.6	Breccia	----do---	---do---
67956	3.70	Crystalline	----do---	---do---
67957	1.73	Breccia	----do---	---do---
67960	12.11	Unsieved fines	----do---	SCB4/391
67970	3.15	DB residue	----do---	SCB4/392
67975	446.6	Breccia	----do---	---do---
68001	840.7	Core 36	Sta 8----	
68002	583.5	Core 29	----do---	
68030	2.85	DB residue	----do---	SCB3/413
68035	20.96	Breccia	----do---	---do---
68110	35.76	DB residue	----do---	SRC2/340
68115	1191.0	Breccia	----do---	---do---

TABLE I. - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
68120	90.49	Unsieved fines	Sta 8-----	SRC2/374
68121	141.9	<1 mm fines	-----do-----	----do----
68122	10.92	1-2 mm fines	-----do-----	----do----
68123	7.36	2-4 mm fines	-----do-----	----do----
68124	8.65	4-10 mm fines	-----do-----	----do----
68410	1.46		-----do-----	SRC2/341
68415	371.2	Crystalline	-----do-----	SRC2/341-2
68416	178.4	Allivatite	-----do-----	SRC2/341
68500	304.5	Unsieved fines (rake soil)	-----do-----	SCB3/412
68501	521.1	<1 mm fines	-----do-----	----do----
68502	37.80	1-2 mm fines	-----do-----	----do----
68503	25.10	2-4 mm fines	-----do-----	----do----
68504	17.27	4-10 mm fines	-----do-----	----do----
68505	1.30	Breccia	-----do-----	----do----
68510	17.48	Crystalline	-----do-----	SCB3/411
68515	236.1	Breccia (rake)	-----do-----	----do----
68516	34.04	-----do-----	-----do-----	----do----
68517	13.13	-----do-----	-----do-----	----do----
68518	29.82	-----do-----	-----do-----	----do----
68519	10.56	-----do-----	-----do-----	----do----
68525	38.96	Crystalline, fine-grained (rake)	-----do-----	----do----
68526	7.21	-----do-----	-----do-----	----do----
68527	3.03	-----do-----	-----do-----	----do----
68528	1.08	Breccia (rake)	-----do-----	----do----
68529	7.03	Glass, fragment (rake)	-----do-----	----do----
68535	8.04	Crystalline, fine-grained (rake)	-----do-----	----do----
68536	1.85	-----do-----	-----do-----	----do----
68537	1.41	-----do-----	-----do-----	----do----
68810	72.3	Residue	-----do-----	SRC2/
68815	1826.0	Breccia	-----do-----	SRC2/343
68820	83.73	Unsieved fines (fillet)	-----do-----	SCB1/375
68821	123.9	<1 mm fines-----do-----	-----do-----	----do----
68822	7.35	1-2 mm fines-----do-----	-----do-----	----do----
68823	3.52	2-4 mm fines-----do-----	-----do-----	----do----
68824	1.50	4-10 mm fines-----do-----	-----do-----	----do----
68825	8.658		-----do-----	----do----

TABLE I - APOLLO 16 SAMPLE INVENTORY

<u>SAMPLE NUMBER</u>	<u>MASS</u>	<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SRC/DB OR SCB/DB</u>
68840	154.46	Unsieved fines (reference soil)	Sta 8-----	SCB1/344
68841	266.6	<1mm fines-----do-----	-----do---	---do---
68842	14.36	1-2mm fines-----do-----	-----do---	---do---
68843	8.89	2-4mm fines-----do-----	-----do---	---do---
68844	5.01	4-10mm fines-----do-----	-----do---	---do---
68845	4.556		-----do---	---do---
68846	2.284		-----do---	---do---
68847	2.854		-----do---	---do---
68848	1.770		-----do---	---do---
69001	558.3	Core 34	Sta 9----	SRC2/CSVC
69003	0.0	Surface sampler 1	-----do---	SCB1/
69004	0.0	-----do----- 2	-----do---	---do---
69920	.71	Unsieved fines (skim soil)	-----do---	SCB3/376
69921	12.9	<1mm fines	-----do---	---do---
69922	2.8	1-2mm fines	-----do---	---do---
69923	1.7	2-4mm fines	-----do---	---do---
69924	1.3	4-10mm fines	-----do---	---do---
69930	4.13	DB residue	-----do---	SCB3/378
69935	127.57	Breccia	-----do---	---do---
69940	149.4	Unsieved fines (scoop soil)	-----do---	SCB3/377
69941	254.7	<1mm fines	-----do---	---do---
69942	11.85	1-2mm fines	-----do---	---do---
69943	8.07	2-4mm fines	-----do---	---do---
69944	4.47	4-10mm fines	-----do---	---do---
69945	6.88	Crystalline	-----do---	---do---
69950	3.77	DB residue	-----do---	SCB3/380
69955	75.94	Anorthosite	-----do---	---do---
69960	171.0	Unsieved fines	Sta 9-under boulder	SCB3/379
69961	307.9	<1mm fines	-----do---	---do---
69962	13.93	1-2mm fines	-----do---	---do---
69963	9.93	2-4mm fines	-----do---	---do---
69964	4.80	4-10mm fines	-----do---	---do---
69965	1.11	Breccia, glass veined	-----do---	---do---

LIST OF ACRONYMS

CSVC Core Sample Vacuum Container  
 DB Documented Bag  
 PDB Padded Documented Bag  
 SCB Sample Collection Bag  
 SRC Sample Return Container

TABLE II. - APOLLO 16 ROCK SAMPLES WEIGHING MORE THAN 25 GRAMS

SAMPLE NUMBER	WEIGHT (g)	ORIENTATION* LABORATORY FOR		ROCK TYPE‡	STUDIES
		LUNAR TOP	LUNAR NORTH		
		†	†		
60015	5574.0	-	insuf photo	II	
60016	4307.0	-	insuf photo	I	TS
60017	2102.0	-	unsuccessful	IV	TS
60018	1501.0	S	T	IV	
60019	1887.0	B	S/W	I	
60025	1836.0	N	B/W	II	TS
60035	1053.0	B	N/W	II	
60055	35.5		too small	II	
60075	184.0		broken	II	
60095	46.6		too small	Glass	
60115	133.0	S/B	S/E	I	
60135	138.0		deferred	II	
60215	386.0		broken	II	TS
60235	70.1		too small	III	
60255	871.0	W/B	T	IV	TS
60275	255.0	S/B	S/T	IV	
60315	788.0	T	E/N	III	TS, CA,
60335	318.0	S	T/W	III	CA, TS
60615	33.0		rake	III	
60619	28.0		rake	III	
60625	117.0		rake	III	
60636	35.6		rake	III	
60639	175.0		rake	I	
60645	33.5		rake	IV	
60665	90.1		rake	Glass	
61015	1803.0	T	S	IV	TS
61016	11729.0	T	E	II	CA, TS
61135	245.0	N	E/B	I	
61155	47.6	T	S	IV	
61156	58.5	S	E/B	III	CA, TS
61175	543.0	T	W	I	
61195	588.0	T	E	II	GR
61295	187.0	B/W	W/T	I	CA, TC, NG, TS
61536	86.0		rake	I	
61546	111.0		rake	Glass	

TABLE II. - APOLLO 16 ROCK SAMPLES WEIGHING MORE THAN 25 GRAMS (Cont.)

SAMPLE NUMBER	WEIGHT (g)	ORIENTATION* LABORATORY FOR		ROCK TYPE‡	STUDIES
		LUNAR TOP	LUNAR NORTH		
62235	320.0	† W/B	† W/N	III	CA, TS
62236	57.3	S	E/T	II	
62237	62.4	S	E	II	
62255	1192.0	T	S/E	II	
62275	443.0	B	W	II	TS
62295	251.0	B	W	III	GR, TS
63335	65.4	broken		I	CA, TS
63355	68.2	broken		I	
63538	35.1	rake		III	
63549	26.6	rake		III	
63585	32.6	rake		I	
64435	1079.0	S/E	T	IV	TS
64455	56.7	too small		II	
64475	1032.0	B	E	IV	
64476	125.0	T	W	IV	GR
64535	257.0	rake		IV	
64536	177.0	rake		IV	
64537	124.0	rake		IV	
64538	30.0	rake		IV	
65015	1802.0	unphotographed		III	GR, TS
65035	446.0	B	E	II	
65055	501.0	W/N	W/B	III	GR
65056	64.8	too small		Glass	
65075	108.0	broken		II	
65095	560.0	unsuccessful		II	TS
65315	300.0	unphotographed		II	TS
65325	67.9	rake		II	
65326	36.4	rake		II	
65515	50.2	rake		Clod	
65715	31.4	rake		I	
65757	26.2	rake		IV	
65786	83.0	rake		I	
66035	211.0	B	N	I	TS
66055	1306.0	W/B	S	IV	
66075	347.0	T	W	I	
66095	1185.0	B	S	III	CA, TS
67015	1194.0	broken		I	TS
67016	4262.0	B/S	B/N/W	I	
67035	245.0	broken		II	
67055	222.0	S/T	S/E	IV	

TABLE II. - APOLLO 16 ROCK SAMPLES WEIGHING MORE THAN 25 GRAMS (Cont.)

SAMPLE NUMBER	WEIGHT (g)	ORIENTATION* LABORATORY FOR		ROCK TYPE‡	STUDIES
		LUNAR TOP	LUNAR NORTH		
67075	219.0	†	broken	II	CA, TS, TC
67095	340.0		insufficient photography	II	
67115	240.0		broken	II	
67210	277.0		not processed	Padded Bag	
67230	938.0		not processed	Padded Bag	
67415	175.0		broken	II	
67435	354.0	B	N	IV	TS
67455	942.0		broken	II	
67475	175.0		unphotographed	IV	
67515	60.8		rake	II	
67549	43.0		rake	IV	
67556	82.0		rake	IV	
67559	32.9		rake	III	
67605	44.5		rake	I	
67627	79.6		rake	Glass	
67628	49.7		rake	Glass	
67629	32.8		rake	Glass	
67647	47.7		rake	I	
67718	41.0		rake	IV	
67729	73.2		rake	Glass	
67915	2559.0		insufficient photography	IV	
67935	109.0		broken	IV	
67936	61.8		broken	IV	
67937	59.7		too small	IV	
67955	163.0		broken	II	CA, TS
67975	447.0		deferred	Glass	
68115	1190.0	E	N	IV	TS
68415	371.0	S/T	T/E	III	GR, TS, CA
68416	178.0	E	N	III	TS
68515	236.0		rake	IV	
68516	34.0		rake	IV	
68518	29.8		rake	IV	
68525	39.0		rake	III	
68815	1826.0	S/T/E	S	IV	CA, TC, TS
69935	128.0		too small	IV	GR
69955	75.9		too small	II	GR

TABLE II. - APOLLO 16 ROCK SAMPLES WEIGHING MORE THAN 25 GRAMS (Conc.)

<u>SAMPLE NUMBER</u>	<u>WEIGHT (g)</u>	<u>ORIENTATION* LABORATORY FOR</u>		<u>ROCK TYPE</u>	<u>STUDIES</u>
		<u>LUNAR TOP</u>	<u>LUNAR NORTH</u>		

EXPLANATION:

<u>SYMBOL</u>	<u>TYPE ANALYSIS</u>	<u>TABLE</u>
*	R. Sutton, USGS	
CA	Chemical analysis	V
GR	Gamma ray analysis	VI
TC	Total carbon analysis	VII
NG	Noble gas analysis	VIII
TS	Thin section description	
#	Notes to Rock Type	
I	Clastic matrix breccia - white to very light gray, moderately friable with matrix material of less than a few tenths of a millimeter predominant.	
II	Crushed anorthosite - white, generally very friable but variable coherency, highly brecciated.	
III	Coherent crystalline - variety of homogeneous types with plagioclase ranging upward from 70% in most.	
IV	Gray and white breccia - dark to light gray interchangeable matrix-clast relationships, white generally more friable than gray, which is aphanitic and tough.	

+ Orientations on cubes in orthogonal photographs (NOT LUNAR) generally with subscript "I".

TABLE III. - SUMMARY OF SOIL SAMPLES

<u>LRL NUMBER</u>	<u>WEIGHT (g)</u>	<u>LOCATION COMMENTS</u>	<u>COLOR</u>	<u>STUDIES</u>	<u>ESTIMATED COMPOSITION OF COMPONENTS IN COARSE FRACTIONS (&gt;1 mm)</u>
60050-4	226	ALSEP-white	5Y 5/1	-	White, friable breccias > vesicular black glass > gray to black coherent breccias.
60500-4	466	Rake soil	-	GR	Dark gray breccias > light gray breccias > white breccias.
60600-4	540	Rake soil	N4	CA	Dark gray breccias > black glass (scoriaceous) > black glass droplets > powdery white breccia.
61140-4	229	Traverse from plum	5YR 5/1	-	Agglutinates > medium gray breccias > white, powdery fragments > black scoriaceous glass.
61160-4	154	Surface	7N to 5YR7/1	-	Light gray breccias > white breccias > dark gray, vesicular breccias > brown glass spheres > agglutinates.
61180-4	271	N of LRV	5Y 5/1	-	Medium gray, fine-grained breccias > vesicular black glass > agglutinates > powdery white breccia.
61220-4	279	Below surface-white	5Y 6/1	CA	No description.
62230-4	107				
61240-4	452	Upper-gray soil	5Y 4/1	CA	Medium to dark gray breccias.
61280-4	258	Fillet at plum	5Y 5/1	-	Light gray, friable breccias > dark gray breccias with white clasts > medium gray, coherent breccia > agglutinates.
61500-4	795	Crater rim, rake soil	5Y 5/2	-	Dark to medium gray breccias > light gray breccias > agglutinates > black glass droplets > metal fragments.
62240-4	464	Edge of buster	5Y 5/1	-	Dark to medium gray breccias > glass-bonded soil > aphanitic basalt(?) > vesicular black glass.
62280-4	411	-	5Y 6/1	-	Coherent, medium gray breccias > powdery white breccias > scoriaceous black glass fragments.



TABLE III. - SUMMARY OF SOIL SAMPLES (Cont.)

LRL NUMBER	WEIGHT (g)	LOCATION COMMENTS	COLOR	STUDIES	ESTIMATED COMPOSITION OF COMPONENTS IN COARSE FRACTIONS (>1 mm)
63320-4	352	-	-	-	-
63340-4	181	-	-	-	-
63500-4	602	Rake soil	≈N6	-	Medium gray breccias > light gray breccias > dark gray breccias > powdery white breccia.
64420-4	331	Trench bottom	5YR 4/1	CA, GR	Coherent dark gray breccia > powdery white breccia > vesicular black glass droplets.
64500-4	893	Rake soil	5Y 5/1	-	White to medium gray breccias (friable) > vesicular black glass > black glass droplets.
64800-4	480	Rake soil Crater rim	5YR 4/1	GR	Coherent, fine-grained gray breccias > light gray to white breccias > agglutinates.
65500-4	618	Rake soil	-	-	-
65510-4	410	with rake sample	-	-	-
65700-4	272	Rake soil	5Y 4/1	CA	Medium gray breccia > dark gray breccia > white, powdery breccias > black glass spheres > metal fragment.
65900-4	662	15 cm below surface	5Y 4/1	-	} Gray breccia with gray and light gray clasts > light gray breccia with black clasts > agglutinates > glass droplets.
66030-4	135	with rake sample	-	-	
66040-4	570	Gray soil	-	CA, GR, TC	-
66080-4	301	White patch on regolith	-	CA	-
67030-4	96	-	-	-	Fragments of gray breccia - not a true soil.
67460-4	370	Fillet soil	N7	-	Light gray, fine-grained breccias > dark gray breccias.
67480-4	249	Reference soil	N6-N7	CA, GR	Light to medium gray breccias > agglutinates.
67510-4	134	Soil with rake sample	-	-	-

TABLE III. - SUMMARY OF SOIL SAMPLES (Cont.)

<u>LRL NUMBER</u>	<u>WEIGHT (g)</u>	<u>LOCATION COMMENTS</u>	<u>COLOR</u>	<u>STUDIES</u>	<u>ESTIMATED COMPOSITION OF COMPONENTS IN COARSE FRACTIONS (&gt;1 mm)</u>
67600-4	186	Crater rim rake soil	N6	CA	Medium gray breccias.
67700-4	420	Rake soil "white"	N6	-	Light to medium gray breccias > black, vesicular glass fragments.
67710-4	409	Soil with rake sample	-	-	-
67940-4	163	E-W split in (boulder)	N6	-	Medium gray breccias > trace of black glass fragments.
67960	12	-	-	-	-
68120	259	-	-	-	-
68500-4	906	Rake soil	N6	-	Medium dark gray breccias > light gray breccias > agglutinates.
68820-4	220	Fillet	5Y 4/1	-	Black glass fragments (vesicular and non-vesicular) = light gray breccias with white clasts > medium gray breccias.
34 68840-4	448	Reference soil for fillet	N4-N5	CA	Agglutinates > dark gray breccia = light gray breccia.
69920-4	66	"Skim soil"	5Y 5/1	GR	Medium to dark gray breccias > light to medium gray breccias > agglutinates > powdery white breccias.
69940-4	428	"Scoop soil"	N5 to 5YR 2/1	-	Black glass droplets (spheres, ovoids, agglutinates) > dark gray breccias > light gray breccias.
69960-4	508	Under boulder	N4 to 5YR 2/1	-	Dark gray vitric breccia > black glass agglutinates and droplets > powdery white breccia.

## Grain Size Analyses

BY: Heiken

DATE: June 8, 1972

<u>Sta 1</u>	<u>Graphic Mean, <math>M_z</math></u>	<u>Sorting (Graphic)</u>
61220	0.03 $\phi$ [920 $\mu$ ]	5.5 $\phi$ [extremely poorly sorted]
 <u>Sta 6</u>		
66041	3.11 $\phi$ [112 $\mu$ ]	2.55 $\phi$ [VPS]
66081	3.70 $\phi$ [76 $\mu$ ]	2.55 $\phi$ [VPS]
 <u>Sta 11</u>		
67600	0.33 $\phi$ [820 $\mu$ ]	5.35 $\phi$ [E.P.S.]
67480	1.93 $\phi$ [260 $\mu$ ]	3.5 $\phi$ [VPS]
 <u>Sta 8</u>		
68820	3.16 $\phi$ [112 $\mu$ ]	2.8 $\phi$ [VPS]
68840	3.4 $\phi$ [96 $\mu$ ]	2.75 $\phi$ [VPS]
 <u>Sta 4</u>		
64420	3.68 $\phi$ [79 $\mu$ ]	2.6 $\phi$ [VPS]

## SAMPLE LOCATIONS

Figure 1 shows the EVA traverses and station locations. Figures 2A through 2J are representative planimetric maps of the sample collection stations showing sample locations. USGS Interagency Report 51 contains photographs showing the samples in place.

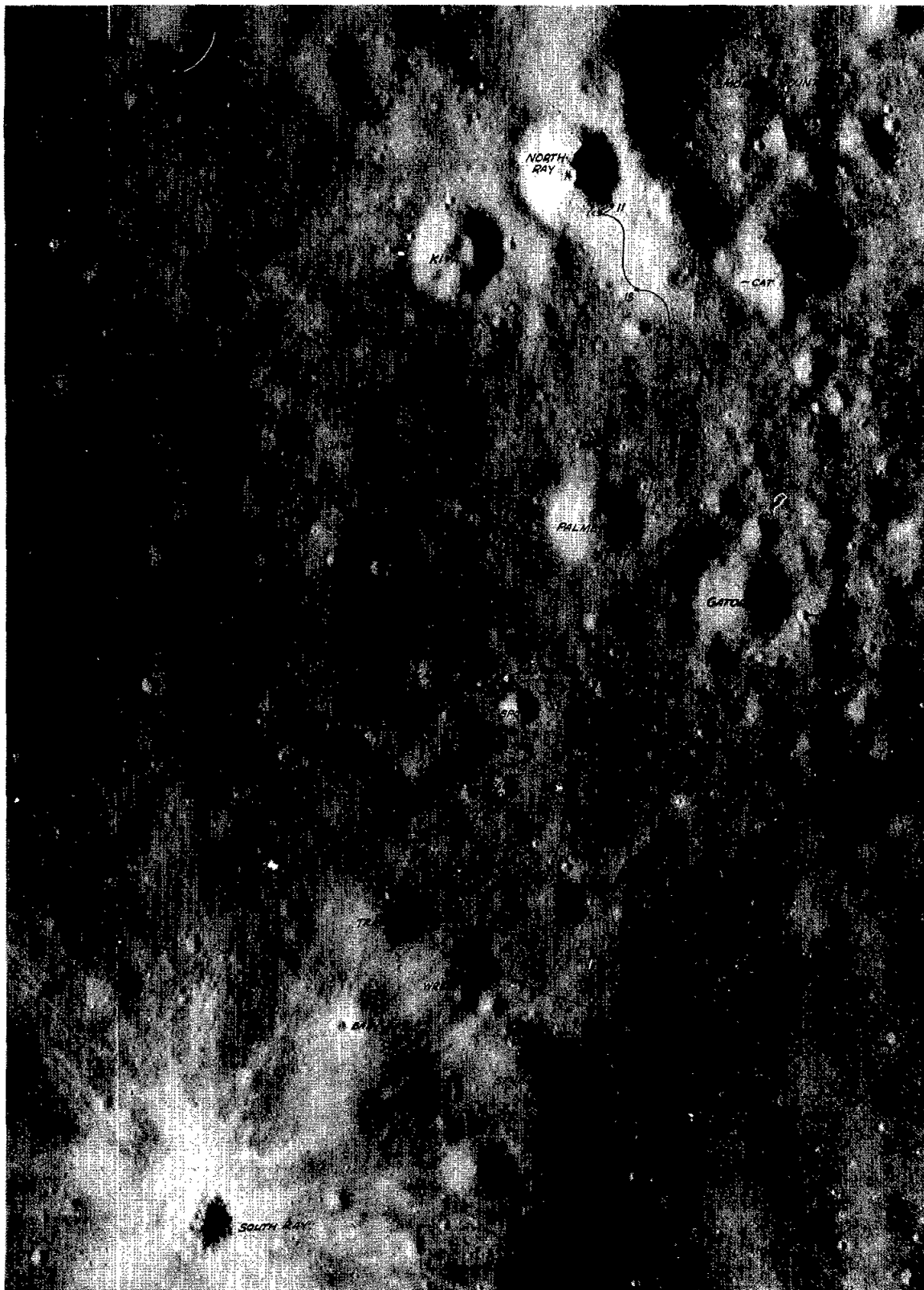


Figure 1. - Map of EVA Traverses and Sample Collection Stations; from US Geological Survey Interagency Report.

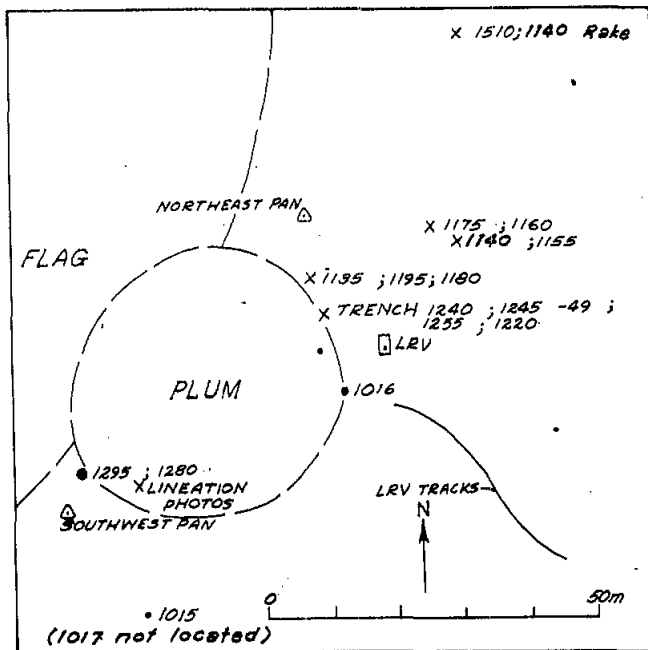


Figure 2A. - Planimetric Sketch Map of Station 1

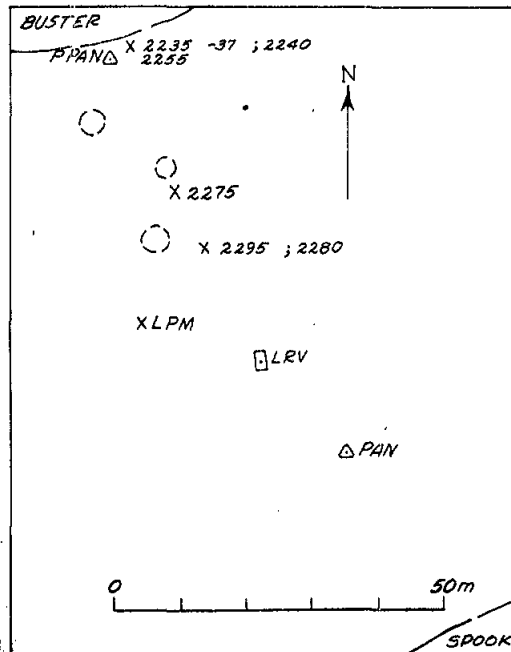


Figure 2B. - Planimetric Sketch Map of Station 2

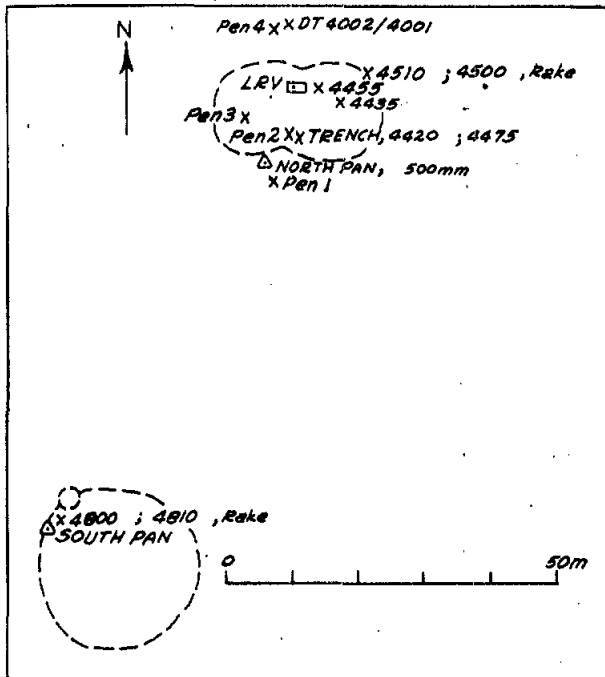


Figure 2C. - Planimetric Sketch Map of Station 4

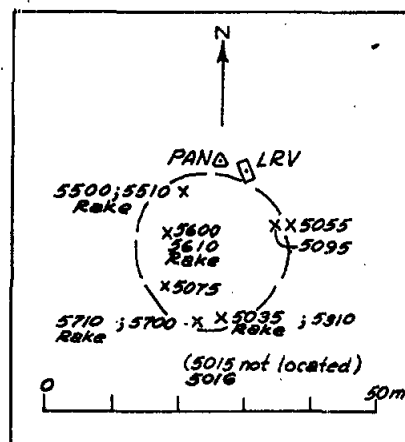


Figure 2D. - Planimetric Sketch Map of Station 5

Figures 2A - 2D. - Station Maps Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 51.

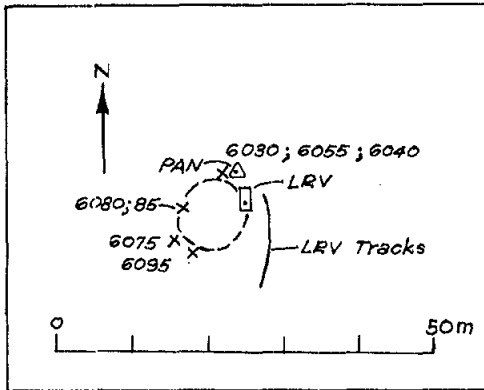


Figure 2E. - Planimetric Sketch Map of Station 6

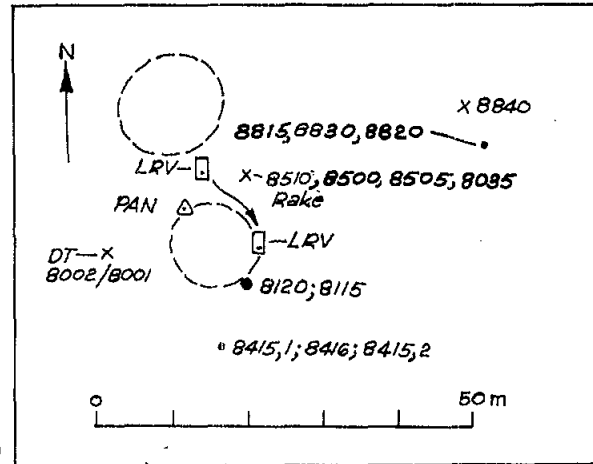


Figure 2F. - Planimetric Sketch Map of Station 8

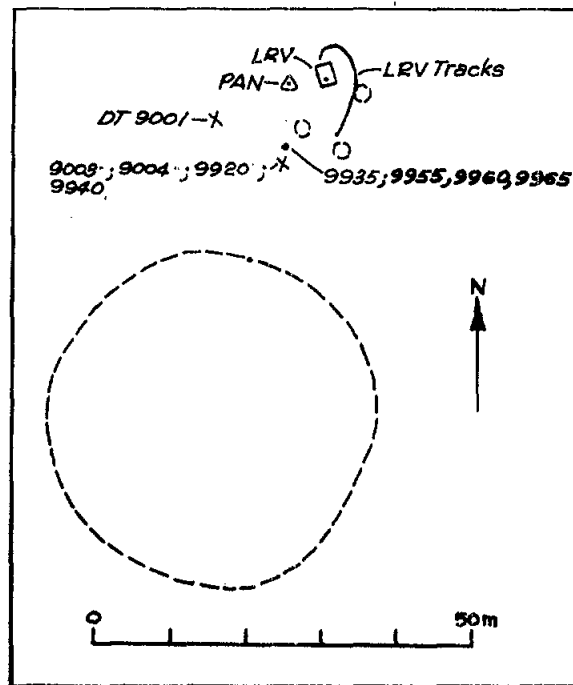


Figure 2G. - Planimetric Sketch Map of Station 9

Figures 2E - 2G. - Station Maps Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 51.

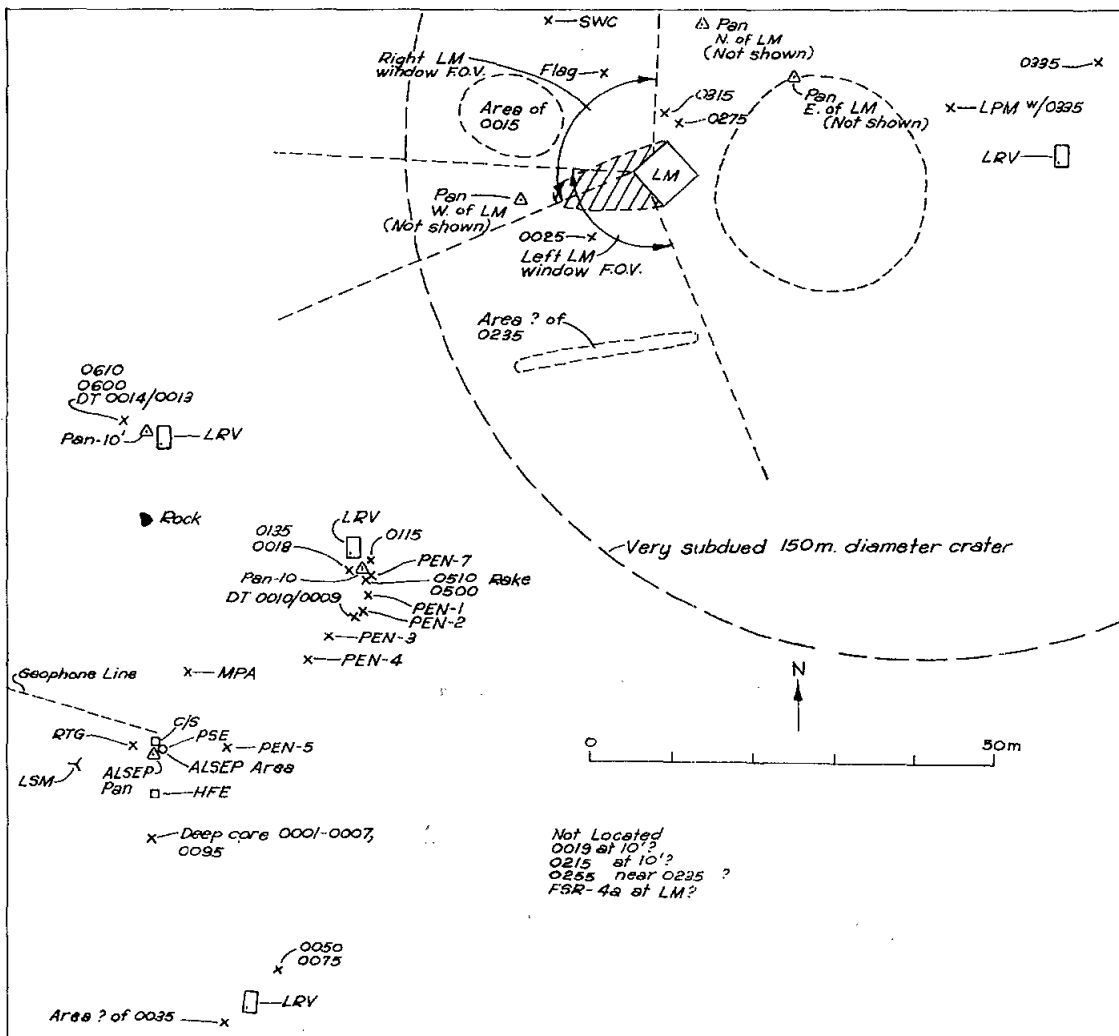


Figure 2H. - Planimetric Sketch Map of LM/ALSEP - Station 10.

Figure 2H. - Station Map Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 51.



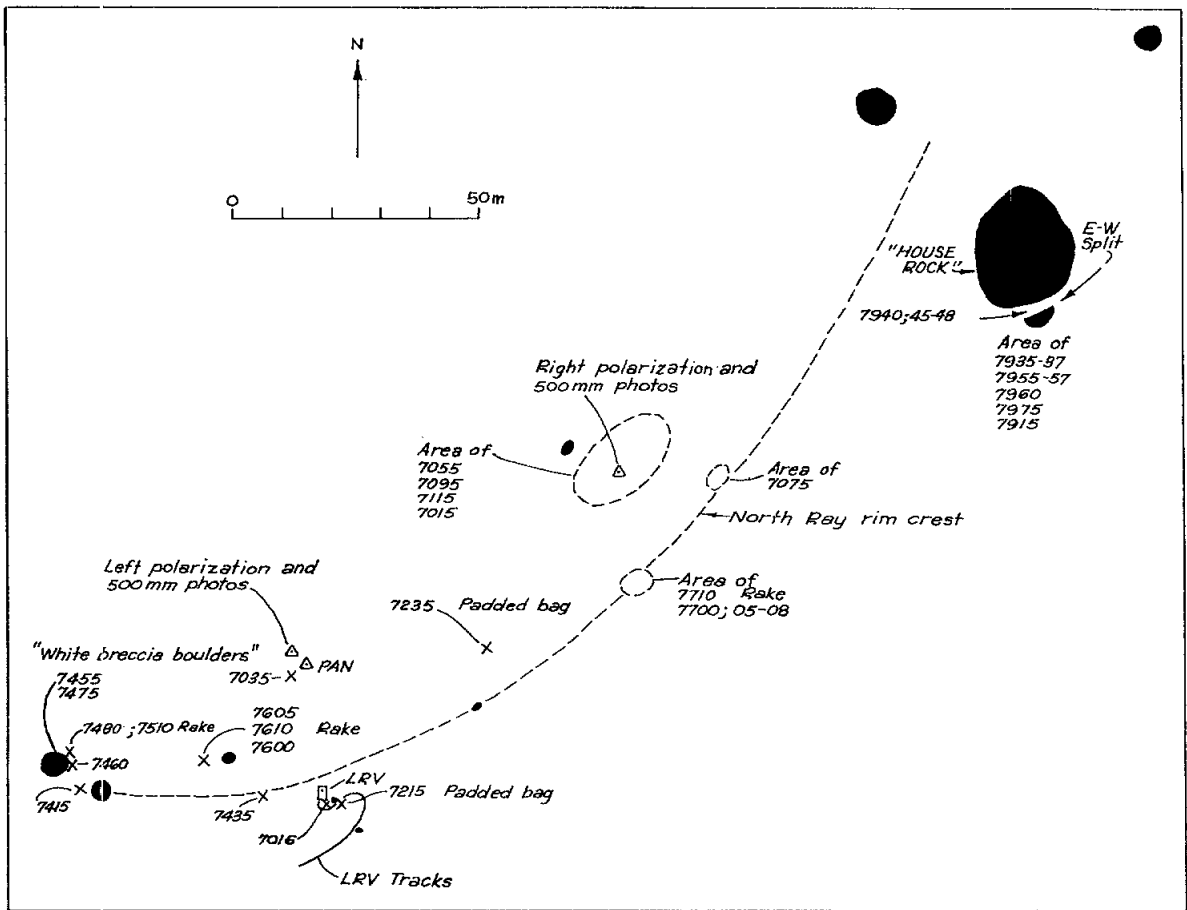


Figure 2I. - Planimetric Sketch Map of Station 11.

Figure 2I. - Station Map Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 51.

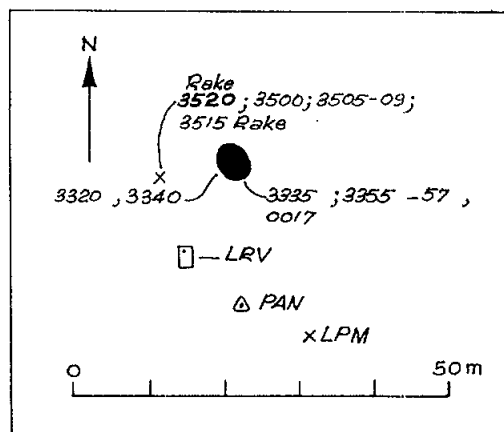


Figure 2J. - Planimetric Sketch Map of Station 13.

Figure 2J. - Station Map Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 51.

## SAMPLE RETURN CONTAINERS

Table IV lists the contents of the sample return containers. The containers that were processed in nitrogen atmosphere processing line (NNPL) are in order: SCB7, SCB4, SCB6, SCB5, SCB1, & SCB3. The containers that were processed in nitrogen atmosphere processing line (SNAP) are in order: SRC2, SRC1, and SCB4.

SRC2 sealed properly on the lunar surface and had a pressure of 82 microns Hg just prior to opening in the nitrogen processing line. SRC1 failed to seal.

The CSVC (core sample vacuum container), containing Core Sample 69001, appears to have been sealed on the Moon and, on removal from SRC2, was placed unopened in a container that is kept evacuated.

TABLE IV. - CONTENTS OF SAMPLE COLLECTION & RETURNED CONTAINERS

<u>SRC 1 (EVA 1)</u>	<u>SAMPLE Net wt (g)</u>	<u>SAMPLE NUMBER (Last 4 digits)</u>
DB 2	604.5	1190, 1195
DB 5	552.9	2230 - 2238
DB 6	480.0	2240 - 2249, 2315
DB 7	1257.0	2250, 2255
DB 9	465.2	2270, 2275
DB 10	278.5	2290, 2295
DB 11	423.4	2280 - 2289, 2305
DB 351	1131.0	0030, 0035
DB 352	473.0	1240 - 1249, 1255
DB 353	194.7	1290, 1295
DB 354	796.7	1500 - 1505
DB 355	283.6	0050 - 0059
DB 356	153.7	1160 - 1164
DB 357	284.2	1220 - 1226
DB 362	257.6	1130, 1135
DB 363	229.3	1140 - 1144
DB 364	559.0	1170, 1175
DB 368	258.5	1280 - 1284
DB 369	271.4	1180 - 1184
DB 371	148.3	1150, 1155 - 1158
DB 372	377.9	1510, 1515 - 1577*
DB 373	263.6	0070, 0075
Loose rock	1804.0	1015
Loose rock	2.62	1017
Residue	64.19	1010
SRC 1            Total	11615.0	
<u>SRC 2 (EVA 2)</u>		
Core 29	583.5	8002
Core 43	584.1	4002
Core 45	635.3	0010
Core 54	759.8	0009
CSV C (Core 34)	558.3	9001
DB 332	588.4	5510 - 5519, 5525 - 5588*
DB 333	618.2	5500 - 5504
DB 338	570.2	6040 - 6044
DB 339	306.6	6080 - 6086
DB 340	1227.0	8110, 8115
DB 341 } DB 342 }	551.1	8410, 8415, 8416
DB 343 & Loose rock	1826.0	8815

\*The numbers with final digits 0-4 not included in this range.

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

<u>SRC 2 (EVA 2)</u>		<u>SAMPLE</u> <u>Net wt (g)</u>	<u>SAMPLE NUMBER</u> <u>(Last 4 digits)</u>
	DB 374	259.3	8120 - 8124
	DB 409	355.2	6070, 6075
	Residue	<u>72.3</u>	8810
SRC 2	Total	9495.0 g	
<u>SCB 1 (EVA 2)</u>			
	Surface sampler	10.0	9003
	Surface sampler	20.0	9004
	DB 004	46.70	0090, 0095
	DB 334	446.0	5710, 5715 - 5795*
	DB 335	19.63	5920, 5925 - 5927
	DB 344	460.8	8840 - 8848
	DB 375	228.6	8820 - 8825
	DB 381	134.6	0110, 0115
	DB 394	1107.0	4430, 4435
	DB 395	852.6	4530, 4535 - 4589*
	DB 396	926.5	4500 - 4509, 4515 - 4519, 4525
	DB 402	271.5	5700 - 5704
	DB 403	113.0	5070, 5075
	DB 404	491.1	5030, 5035
	DB 405	545.7	5310, 5315, 5325 - 5366*
	DB 406	692.7	5900 - 5909, 5915, 5916
	DB 407	354.1	6030 - 6037
	DB 408	1336.0	6050, 6055
	DB 410	1194.0	6090, 6095
	Glass sphere	21.02	5016
	SCB 1 Residue	<u>42.37</u>	5010
SCB 1	Total	9284.00 g	
<u>SCB 3 (EVA 2)</u>			
	DB 336	589.0	5090, 5095
	DB 337	597.9	5050, 5056, 5057
	DB 376	66.37	9920 - 9924
	DB 377	435.4	9940 - 9945
	DB 378	131.7	9930, 9935
	DB 379	508.7	9960 - 9965
	DB 380	79.71	9950, 9955
	DB 397	58.25	4450, 4455
	DB 398	1216.0	4470, 4475 - 4478
	DB 399	345.7	4420 - 4425
	DB 400	480.0	4800 - 4804
	DB 401	412.6	4810 - 4819, 4825 - 4837*

\*The numbers with final digits 0-4 not included in this range.

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

<u>SCB 3 (EVA 2)</u>	SAMPLE Net wt (g)	SAMPLE NUMBER (Last 4 digits)
DB 411	409.7	8510 - 8537*
DB 412	907.1	8500 - 8505
DB 413	23.81	8030, 8035
Loose rock	1802.0	5015
Loose rock	1836.0	0025
Core 36	840.7	8001
Core 38	752.3	4001
Residue	<u>51.91</u>	0020
SCB 3	Total	11554.0
<u>SCB 4 (EVA 3)</u>		
DB 345	388.8	3520, 3521 - 3598*
DB 346	620.5	3500 - 3509, 3515
DB 347	749.7	0610, 0615 - 0679*
DB 348	540.2	0600 - 0604
DB 349	79.20	0510, 0515 - 0535*
DB 350	702.5	0500 - 0504
DB 388	432.4	7700 - 7708
DB 389	238.9	7930, 7935 - 7937
DB 390	174.9	7940 - 7948
DB 391	12.11	7960
DB 392	449.8	7970, 7975
DB 423	693.0	7710 - 7719, 7725 - 7776*
DB 425	176.2	7950, 7955 - 7957
Loose rock	1887.0	0019
Loose rock	2559.0	7915
Residue	<u>180.3</u>	7910
SCB 4	Total	9885.0 g
<u>SCB 5 (EVA 1)</u>		
Loose rock	5574.0	0015
Residue	<u>12.12</u>	0040
SCB 5	Total	5586.0 g
<u>SCB 6 (EVA 3)</u>		
Padded bag 1	276.9	7210
Pagged bag 2	938.3	7230
DB 13	398.6	0210, 0215
DB 15	109.7	0230, 0235
DB 17	889.3	0250, 0255

\*The numbers with final digits 0-4 not included in this range.

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

<u>SCB 6 (EVA 3)</u>	<u>SAMPLE Net wt (g)</u>	<u>SAMPLE NUMBER (Last 4 digits)</u>
DB 331	320.3	0330, 0335
DB 387	233.6	7410, 7415
DB 415	376.7	7430, 7435
DB 416	1159.0	7450, 7455
DB 417	370.2	7460 - 7464
DB 418	175.1	7475
DB 419	269.4	7480 - 7489, 7495
DB 420	467.4	7510 - 7519, 7525 - 7576*
DB 421	457.3	7610, 7615 - 7676*
DB 422	230.7	7600 - 7605
DB 426	351.5	3320 - 3324
DB 427	181.2	3340 - 3344
DB 428	65.4	3335
DB 429	91.73	3350, 3355
DB 430	138.8	0130, 0135
Residue	<u>51.3</u>	
SCB 6          Total	7552. g	

SCB 7 (EVA 3)

DB 18	292.4	0270, 0275
DB 20	789.7	0310, 0315
DB 382	341.4	7030 - 7035
DB 383	240.4	7050, 7055
DB 384	219.9	7070, 7075
DB 385	343.6	7090, 7095
DB 386	257.3	7110, 7115
Loose rock	4307.0	0016
Loose rock	2102.0	0017
Loose rock	1501.0	0018
Loose rock	1194.0	7015
Core tube 27	570.3	0014
Core tube 32	757.3	0013
Residue	<u>459.5</u>	
SCB 7          Total	13376.0 g	

BSLSS (EVA 1&3)

Loose rock	11729.0	1016
Loose rock	16.06	7025
Loose rock	4262.0	7016
Residue	<u>357.6</u>	7020
BSLSS          Total	16365.0 g	

\*The numbers with final digits 0-4 not included in this range.

TABLE IV. - CONTENTS OF SAMPLE COLLECTION & RETURNED CONTAINERS (Concl.)

<u>Bit and Drill Stems (EVA 1)</u>	<u>SAMPLE Net wt (g)</u>	<u>SAMPLE NUMBER (Last 4 digits)</u>
Total	1008.0	0001 - 0007
<u>Total Weight of Sample</u>		
Apollo 16 94 712 g (208.6 lbs)		



## 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 identification photography of rocks.
4. Dusting with a gentle jet of  $N_2$  gas.
5. Orthogonal photography - 4x5 inch color views taken at  $90^\circ$  to one another. The rock is positioned on a rotatable photo stage on a stable face, usually with the longer axis right to left. A laboratory 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 orthogonal 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 and measurement - All coherent rocks weighing more than 50 grams have aluminum foil shells molded around them. At the same time 3 caliper measurements are made (between points photographically documented) for dimensional control of the models. The 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 laboratory orientation cube in conformity with the orthogonal photography orientations. Sixteen stereographic pairs at  $45^\circ$  increments are made with 4x5 or 8x10 inch (depending on rock size) color negatives.

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. The rocks are then photographed with the laboratory orientation cube in view to establish the relationship between laboratory and lunar 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. In special cases, larger reserves are maintained.
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

During this mission the lunar sample processing cabinets were kept at positive nitrogen pressure (1-inch water pressure relative to the room), without any sterilization requirements.

Prior to the arrival of the lunar samples, all processing cabinets and equipment were cleaned to specifications in Cleaning Procedures for Contamination Control (MSC 03243). Materials forming the interiors of the cabinets, and the exteriors of tools and equipment used within the cabinets, are limited to stainless steel, aluminum, Teflon, neoprene rubber, Viton gaskets, polysulfide sealant (NNPL only) and Lexan or glass. All lubrication of screw threads (bolt-top containers, laboratory jacks, etc) is done sparingly with molybdenum disulfide. During processing and storage the lunar sample normally comes in contact with only aluminum, stainless steel, and Teflon. Some samples, mainly fines, may on rare occasions come in contact with the Viton gaskets used to seal certain containers.

The nitrogen atmosphere of the cabinets was monitored for oxygen, argon, hydrogen, methane, carbon dioxide and carbon monoxide. The oxygen level varied from cabinet to cabinet with the highest reading being in the inbound transfer cabinets as expected. In static mode, the oxygen was maintained at less than 10 ppm. During the processing the oxygen varied from 10 to 30 ppm. This mission a DuPont Moisture Analyzer, Model 26-303 was used for the first time. It analyzes water by continuously and quantitatively absorbing the water in the sample line. The water is absorbed on a thin film of phosphorus pentoxide deposited between two electrodes causes them to be highly polarized, and results in electrolysis of the absorbed water into hydrogen and oxygen. This instrument has a dynamic range of 1 to 1000 ppm of water by volume. With the normal operating flow rate, keeping the lines less than 50 ppm was extremely difficult. By using a higher flow rate, as much as twice the normal, a maximum allowable limit of 50 ppm was achieved. The increase in moisture was clearly due to the contribution by the Neoprene gloves when they are in use. It is now suspected that cabinet moisture levels on past missions were higher than the data previously reported.

Particulate monitoring of the clean cabinets consisted of taking fall-out sample over a five-day period. During this time period, at four locations in three different cabinets a total of four particles greater than 50 microns were found.

## CHEMICAL ANALYSES

May-June 1972

By: Rhodes, Bansal, Rodgers, Brannon, Landry

X-ray fluorescence spectrometry was used for measuring major and trace element abundances, with the exception of sodium which was analyzed by atomic absorption spectrography.

The major and minor elements were determined using a fused glass disc prepared by fusing a 280 mg aliquant of the sample with a lanthanum-bearing lithium borate fusing mixture (Norrish and Hutton, 1969). Na was analyzed by atomic absorption analysis on a separate 10-20 mg portion of the sample.

Trace elements (Sr, Rb, Y, Th, Ni, Nb, Zr, Cr) were determined non-destructively 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).

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.

### References:

- Norrish, K., and Chappel, 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		Fines Unsieved 60600	Fines <1 mm 61241	Fines <1 mm 64421	Fines <1 mm 65701	Fines <1 mm 66041	Fines <1 mm 66081	Fines <1 mm 68841	Fines Unsieved 61220	Fines Unsieved 67480	Fines Unsieved 67600	Fines Unsieved 61501
SiO <sub>2</sub>	%	45.35	45.32	44.88	45.03	45.07	45.38	45.08	45.35	44.95	45.28	44.88
TiO <sub>2</sub>	%	0.60	0.57	0.55	0.64	0.64	0.67	0.59	0.49	0.41	0.42	0.56
Al <sub>2</sub> O <sub>3</sub>	%	26.75	27.15	27.60	26.47	26.39	26.22	26.49	28.25	29.01	28.93	26.50
FeO	%	5.49	5.33	5.03	5.87	6.08	5.85	5.65	4.55	4.66	4.09	5.31
MnO	%	0.07	0.07	0.06	0.08	0.08	0.08	0.07	0.06	0.06	0.06	0.07
MgO	%	6.27	5.75	5.35	6.02	6.14	6.39	6.27	5.02	4.20	4.75	6.08
CaO	%	15.46	15.69	15.81	15.29	15.29	15.28	15.30	16.21	16.54	16.40	15.33
Na <sub>2</sub> O	%	0.38	0.55	0.39	0.41	0.38	0.39	0.41	0.42	0.42	0.44	0.41
K <sub>2</sub> O	%	0.11	0.10	0.10	0.12	0.12	0.13	0.11	0.09	0.06	0.07	0.11
P <sub>2</sub> O <sub>5</sub>	%	0.13	0.13	0.13	0.13	0.15	0.13	0.12	0.10	0.13	0.06	0.11
S	%	0.07	0.07	0.07	0.09	0.09	0.09	0.08	0.06	0.03	0.04	0.08
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SUM		100.68	100.73	99.97	100.15	100.43	100.61	100.16	100.60	100.47	100.54	
Sr	ppm	173	175	172	173	167	170	169	182	188	194	167
Rb	ppm	2.9	2.7	2.9	2.9	3.0	3.1	3.1	2.4	1.4	1.3	3.0
Y	ppm	43	37	42	48	44	48	46	31	22	22	40
Th	ppm	1.9	1.2	2.8	1.9	2.6	3.2	2.4	2.6	N.D	1.6	2.2
Zr	ppm	186	162	183	207	197	205	201	131	86	89	177
Nb	ppm	12	9.8	11	13	12	13	13	7.6	5.4	5.4	11
Ni	ppm	293	220	316	356	362	342	296	109	176	111	256
Cr	ppm	770	720	710	820	820	830	780	590	520	540	760

TABLE V.- CHEMICAL ANALYSES

Sample		Crystal- line 60315	Crystal- line 60335	Anor- thosite 61016	Crystal- line 61156	Anor- thosite 61295	Crystal- line 62235	Breccia 63335	Crystal- line 66095	Anor- thosite 67075	Anor- thosite 67955	Crystal- line 68415	Breccia 68815
SiO <sub>2</sub>	%	45.61	46.19	44.15	44.65	45.19	47.04	45.20	44.47	44.80	45.01	45.40	45.10
TiO <sub>2</sub>	%	1.27	0.58	0.20	0.64	0.56	1.21	0.42	0.71	0.09	0.27	0.32	0.49
Al <sub>2</sub> O <sub>3</sub>	%	17.18	25.27	33.19	22.94	28.29	18.69	30.86	23.55	31.54	27.68	28.63	27.15
FeO	%	10.53	4.51	1.40	7.75	4.52	9.45	3.23	7.16	3.41	3.84	4.25	4.75
MnO	%	0.12	0.07	0.02	0.12	0.06	0.11	0.04	0.08	0.06	0.05	0.06	0.06
MgO	%	13.15	8.14	2.51	9.60	4.72	10.14	2.81	8.75	2.42	7.69	4.38	5.88
CaO	%	10.41	14.43	18.30	13.34	16.16	11.52	17.25	13.69	18.09	15.54	16.39	15.45
Na <sub>2</sub> O	%	0.56	0.52	0.34	0.39	0.45	0.48	0.57	0.42	0.26	0.40	0.41	0.42
K <sub>2</sub> O	%	0.35	0.23	0.02	0.11	0.09	0.34	0.05	0.15	0.01	0.05	0.06	0.14
P <sub>2</sub> O <sub>5</sub>	%	0.45	0.19	0.05	0.22	0.10	0.41	0.03	0.24	0.00	0.03	0.07	0.18
S	%	0.14	0.07	0.01	0.12	0.06	0.11	0.03	0.12	0.01	0.01	0.04	0.06
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SUM		99.77	100.20	100.19	99.88	100.20	99.50	100.49	99.34	100.69	100.57	100.01	99.68
Sr	ppm	156	162	179	153	187	165	225	159	144	170	(185)	175
Rb	ppm	9.8	6.4	0.7	2.5	2.3	9.3	1.2	3.9	0.8	0.6	(2.1)	3.4
Y	ppm	142	62	11	64	33	193	11	72	2.5	16	(23)	61
Th	ppm	7.2	3.2	1.7	3.8	1.0	10.5	1.4	2.7	N.D.	1.9	(2.2)	3.7
Zr	ppm	640	281	48	293	143	851	41	322	2.7	59	98	266
Nb	ppm	37	16	2.4	17	8.6	49	3.1	18	N.D.	4.0	5.6	16
Ni	ppm	191	77	39	184	114	248	26	258	<1	108	49	206
Cr	ppm	1460	900	200	960	570	1370	340	1010	420	750	710	690

TABLE VIa. - GAMMA RAY ANALYSES OF APOLLO 16 LUNAR ROCK SAMPLES

SAMPLE NUMBER	WEIGHT (g)	Th (ppm)		U (ppm)		K (weight %)		<sup>26</sup> Al	<sup>22</sup> Na	LABORATORY
								dpm/kg	dpm/kg	
60017,0	2102.0	0.80	±0.20	0.20	±0.04	0.050	±0.015	-	-	ES
60135,0	137.6	0.29	±0.04	0.08	±0.03	0.015	±0.003	159 ±16	41 ±6	ORNL
60255,0	862.6	2.4	±0.2	0.63	±0.12	0.110	±0.002	120 ±6	39 ±3	RCL
60275,0	255.2	2.99	±0.18	0.88	±0.03	0.115	±0.002	129 ±8	48 ±6	RCL
60315,0	787.7	8.56	±0.90	2.34	±0.24	0.318	±0.030	92 ±9	47 ±6	ORNL
60335,0	311.0	2.75	±0.10	0.92	±0.04	0.174	±0.008	140 ±8	43 ±8	RCL
61195,0	587.9	1.1	±0.1	0.31	±0.03	0.057	±0.006	34 ±7	35 ±8	ORNL
62235,0	317.7	9.4	±0.6	2.57	±0.06	0.284	±0.004	137 ±8	50 ±7	RCL
62295,0	250.8	2.8	±0.3	0.74	±0.07	0.055	±0.010	95 ±10	60 ±12	ORNL
55 63355,1	43.55	4.85	±0.18	1.31	±0.06	0.202	±0.005	98 ±6	48 ±4	RCL
64435,0	1059.6	0.10	±0.03	0.03	±0.01	0.010	±0.003	-	-	ES
64476,0	125.14	1.19	±0.08	0.31	±0.03	0.066	±0.002	132 ±11	48 ±5	RCL
65015,0	1802.2	10.0	±2.0	3.0	±0.7	0.40	±0.09	-	-	ES
65055,0	500.9	1.18	±0.07	0.311	±0.019	0.060	±0.004	109 ±6	31 ±4	RCL
66075,0	347.1	2.05	±0.11	0.55	±0.03	0.083	±0.005	149 ±8	39 ±5	RCL
67055,0	221.4	3.69	±0.37	0.98	±0.10	0.162	±0.016	137 ±15	56 ±8	ORNL
67055,0	221.4	3.6	±0.3	0.99	±0.08	0.16	±0.02	116 ±8	43 ±3	RCL
67095,0	339.8	3.89	±0.21	1.18	±0.06	0.195	±0.010	89 ±5	58 ±8	BNW
67115,9	187.48	0.43	±0.07	0.121	±0.011	0.0463	±0.0014	62 ±6	29 ±3	RCL
67475,0	174.1	0.67	±0.08	0.19	±0.02	0.045	±0.007	126 ±9	38 ±3	RCL
68415,1	202.5	1.22	±0.10	0.35	±0.03	0.093	±0.008	159 ±15	47 ±5	BNW
68416,0	175.4	1.24	±0.13	0.34	±0.04	0.083	±0.008	160 ±15	41 ±4	BNW
68815,2	34.49	2.74	±0.14	0.81	±0.03	0.122	±0.003	150 ±30	56 ±11	RCL
69935,0	127.57	2.52	±0.15	0.62	±0.06	0.079	±0.008	153 ±15	41 ±7	BNW
69955,0	75.77	0.14	±0.02	0.038	±0.006	<0.009		76 ±7	35 ±5	BNW

TABLE VIb. - GAMMA RAY ANALYSES OF APOLLO 16 LUNAR FINES SAMPLES

SAMPLE NUMBER	WEIGHT (g)	Th (ppm)	U (ppm)	K (weight %)	<sup>26</sup> Al dpm/kg	<sup>22</sup> Na dpm/kg	LABORATORY
60501,2	116.72	2.2 ±0.3	0.61 ±0.03	0.098 ±0.005	107 ±8	42 ±5	RCL
60501,2	116.72	2.44 ±0.06	0.60 ±0.02	0.106 ±0.005	110 ±5	38 ±2	BNW
61241,28	106.55	1.98 ±0.09	0.51 ±0.02	0.085 ±0.004	183 ±7	62 ±2	BNW
62281,0	107.9	2.10 ±0.17	0.62 ±0.03	0.093 ±0.004	225 ±13	63 ±9	RCL
63501,3	100.13	1.53 ±0.15	0.41 ±0.04	0.0728 ±0.008	220 ±20	55 ±8	ORNL
63501,4	100.05	1.76 ±0.15	0.41 ±0.03	0.074 ±0.003	142 ±7	57 ±2	BNW
64421,3	100.0	2.0 ±0.4	0.62 ±0.04	0.093 ±0.005	111 ±10	39 ±6	RCL
64801,1	126.53	2.23 ±0.22	0.60 ±0.06	0.106 ±0.011	105 ±11	50 ±5	ORNL
66041,4	108.44	2.40 ±0.06	0.70 ±0.04	0.103 ±0.005	151 ±8	40 ±3	BNW
66041,4	108.44	2.5 ±0.4	0.66 ±0.04	0.096 ±0.006	161 ±11	51 ±7	RCL
66041,28	100.00	2.2 ±0.3	0.74 ±0.03	0.102 ±0.005	159 ±10	54 ±6	RCL
66081,25	100.03	2.3 ±0.4	0.70 ±0.03	0.110 ±0.006	102 ±7	44 ±5	RCL
67481,1	100.03	1.12 ±0.09	0.323 ±0.019	0.055 ±0.003	168 ±10	60 ±8	RCL
67941,1	50.71	1.89 ±0.19	0.55 ±0.06	0.106 ±0.011	158 ±20	27 ±5	ORNL
68121,1	99.99	2.63 ±0.08	0.63 ±0.03	0.095 ±0.004	112 ±4	41 ±2	BNW
68501,2	100.03	2.28 ±0.23	0.58 ±0.06	0.0965 ±0.010	84 ±9	38 ±5	ORNL
68501,3	100.03	2.59 ±0.10	0.64 ±0.03	0.092 ±0.003	96 ±3	36 ±2	BNW
69921,1	46.96	2.47 ±0.10	0.67 ±0.03	0.087 ±0.003	305 ±10	86 ±3	BNW

SYMBOLGY FOR TABLES VIa AND VIb

RCL - R. S. Clark and J. E. Keith  
 NASA-Manned Spacecraft Center  
 W. R. Porteneir and M. K. Robbins  
 Brown & Root-Northrop

ORNL - J. S. Eldridge, K. J. Northcutt and  
 G. D. O'Kelley  
 Oak Ridge National Laboratory

ES - Ernest Schonfeld  
 NASA-Manned Spacecraft Center

BNW - L. A. Rancitelli, R. W. Perkins,  
 W. D. Felix and N. A. Wogman  
 Battelle, Pacific Northwest Laboratories



## APOLLO 16 TOTAL CARBON ANALYSIS

BY: Moore and Gibson

DATE: 6/16-23/72

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 from 200 to 300 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<sub>2</sub> in a heated catalyst tube. Moisture was removed by an anhydrous trap before the CO<sub>2</sub> was passed into a LECO Low Carbon Analyzer. The CO<sub>2</sub> was carried by the oxygen stream into a collection trap. After a fixed collection time, the trap was heated and the released CO<sub>2</sub> 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.

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 system was calibrated using the National Bureau of Standards Steel Standard 55e. Samples of this standard, containing from 4 to 70 µg of carbon were analyzed under the same conditions as the lunar 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 1 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 16 TOTAL CARBON ANALYSIS

<u>SAMPLE</u>	<u>SAMPLE NUMBER</u>	<u>TOTAL CARBON CONTENT (<math>\mu\text{gC/g}</math>)</u>	<u>DESCRIPTION</u>
Soils	61221	100 $\pm$ 10 ppm	light colored soil
	61241	110 $\pm$ 10 ppm	dark colored soil
	61501	150 $\pm$ 10 ppm	dark colored soil
	66041	170 $\pm$ 10 ppm	dark colored soil
	66081	170 $\pm$ 10 ppm	dark colored soil
	68501	130 $\pm$ 10 ppm	dark colored soil
Breccias	61295	55 $\pm$ 5 ppm	light gray breccia with fine grained clastic matrix
Rocks	60315,2	6 $\pm$ 1 ppm	crystalline rock
	62235,5	2 $\pm$ 1 ppm	crystalline rock
	67075	5 $\pm$ 1 ppm	crushed or fractured anor- thositic rock
	68416,2	5 $\pm$ 1 ppm	primary igneous rock
	68815,7	6 $\pm$ 2 ppm	glass rock with tubular vesicles

TABLE VIII. - APOLLO 16 NOBLE GAS CONTENTS

BY: Moore, Bouldin, Bogard

DATE: July 1972

SAMPLE	WEIGHT (Mg)	X 10 <sup>-6</sup> cm <sup>3</sup> /g (at STP)					X 10 <sup>-9</sup> cm <sup>3</sup> /g (at STP)		Ratios Corrected for Blanks and Multiplier Discrimination				
		<sup>3</sup> He	<sup>4</sup> He	<sup>22</sup> Ne	<sup>36</sup> Ar	<sup>40</sup> Ar	<sup>84</sup> Kr	<sup>132</sup> Xe	$\frac{^4\text{He}}{^3\text{He}}$	$\frac{^{20}\text{Ne}}{^{22}\text{Ne}}$	$\frac{^{22}\text{Ne}}{^{21}\text{Ne}}$	$\frac{^{36}\text{Ar}}{^{38}\text{Ar}}$	$\frac{^{40}\text{Ar}}{^{36}\text{Ar}}$
61295,6	7.18	1.44	1330	10.4	102	464	91.1	26.6	924	12.1 ±.02	21.6 ±.1	5.29 ±.01	4.56 ±.02

TABLE IX. - SOME TERMS USED FOR ROCK DESCRIPTIONS

<u>CHARACTERISTIC</u>	<u>TERM</u>	<u>DEFINITION AND COMMENT</u>
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 friable coherent	crumbles under touch crumbles under manual pressure 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) <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.)

<u>CHARACTERISTIC</u>	<u>TERM</u>	<u>DEFINITION AND COMMENT</u>
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 <sup>2</sup>
	many	>10/cm <sup>2</sup>

TABLE X. - ABBREVIATIONS USED IN THIN SECTION DESCRIPTIONS

<u>Abbreviation</u>	<u>Term</u>
aggl	agglutinates
ang	angular
anorth	anorthosite
apa	apatite
aug	augite
brn	brown
cpx	clinopyroxene
crst	crystalite
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
opaque	opaque
opx	orthopyroxene
pig	pigeonite
plag	plagioclase
pyrox	pyroxenite
pyrox f	pyroxferroite
pyx	pyroxene
sev	several
sph	spherical
subang	subangular
subrd	subrounded
trid	tridymite
tril	trillite
ulvo	ulvospinel
unident	unidentified
vitro	vitrophyre

## SAMPLE DESCRIPTIONS

All hand specimen, binocular and petrographic microscope descriptions are contained in this section in the general order of sample numbers. Rocks from rake samples are classified and described by lithologic type. The same classification is applied to the other rocks in table II, but the rock names used in the Sample Inventory (table I) and in the individual descriptions are those applied by the individual describers when the descriptions were made.

All of the rocks 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 and breccias. In the breccia descriptions the components are placed in four groups: lithic clasts, mineral clasts, glass clasts, and matrix. 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. Table X lists the abbreviations used in the thin section descriptions.

In the descriptions, as well as in table II, N, E, S, W, T, and B refer to laboratory orientations. The subscript I, shown on the photo cubes, is omitted in the text.

60015

ROCK TYPE: Coarse crystalline  
COLOR: Rock is very light gray (N8-N9)  
Glass is medium dark gray (N4-N5)  
SHAPE: Blocky, angular, rounded one side  
COHERENCE Intergranular: Tough  
Fracturing: Rare, nonpenetrative

WEIGHT: 5574 g  
DIMENSIONS: 28 x 15 x 10 cm

BINOCULAR DESCRIPTION

BY: Wilshire

DATE: 6/7/72

FABRIC: Isotropic  
VARIABILITY: Partly glass-coated  
SURFACE: B is coarsely hackly, T is smooth with 1 mm or less spherical-to-ellipsoidal glass protrusions. A 1 cm zone has "fairy castle" texture with delicate protrusions from glass.  
ZAP PITS: Few on B, W, S, E; many on N, T. In places zaps penetrate covered cavities leaving jagged holes, in other places many penetrate the glass coating and expose white rock beneath.  
CAVITIES: Glass has 30% vesicles to 30 mm, average is 2 mm.  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic	white	85				1
Glass	med dk gray	15				2

NOTES:

1. Mostly glass-covered anorthosite with probably originally coarse grain size. Now intensely shocked, much fractured and hackly on a scale of a few millimeters. Very difficult to determine original grain size, but one relict grain is 12 mm, another is 5 mm. The plagioclase is pulverized in places, coarsely sugary in others, and vitreous with well developed conchoidal fracture (maskelynite?) in others. Plagioclase encloses a trace of dark brown pyroxene (?) blebs to 0.1 mm and a trace of opaques. One cluster of five minute metallic spheres occurs in shattered plagioclase. Contacts with the glass are very sharp and irregular and a thin vein of glass penetrates the white rock.
2. Coating of irregular thickness, up to 1 cm or so, with a number of angular to subround inclusions of white rock. Some are chalky, some finely crystalline, some sugary, and some "cherty" or microcrystalline; all lack mafic minerals. It also contains scarce inclusions of angular plagioclase to 0.5 mm and a trace of silvery metal as spheres and irregular pieces. All of the glass appears devitrified, with especially well developed crystallites near vesicles.



65



SAMPLE 60015

60016

ROCK TYPE: Breccia  
COLOR: Medium to light gray (N5-N7)  
SHAPE: Subround with nearly all rounded corners  
COHERENCE: Intergranular: Friable  
Fracturing: Three irregular, nonpenetrative fractures

WEIGHT: 4307 g  
DIMENSIONS: 13 x 16 x 20 cm

BINOCLAR DESCRIPTION

BY: Ridley

DATE: 5/10/72

FABRIC: Equigranular matrix  
VARIABILITY: Uniform clast distribution  
SURFACE: T 10% dust covered. N 50% dust covered, with one large clast, flat. W 50% dust covered, one craggy corner, one surficial fracture, flat. E 85% dust covered. S 10% light dust covered, smooth except for one large clast mold. B 5% light dust covered, 80% dark dust covered.  
ZAP PITS: N has two large zaps (1 cm, 0.5 cm); both are glass-filled. T has three large zaps, glass-filled (1, 0.5, 0.5 cm). E has one at junction with T. None on S, W, B.  
CAVITIES: Only clast molds, most 0.5 cm. Angular. One cavity on S >3 cm.  
SPECIAL FEATURES: Coarse salt and pepper matrix gives the surface a medium gray color and the very fine grained dust cover gives a light gray color. The matrix is composed principally of finely comminuted lithic fragments with all gradations in both light and dark clasts from unresolved matrix to large angular clasts. Dark clasts slightly dominant, more angular, and attain larger sizes than the others.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic clast I	black	20-30	ang	<0.1	0.1-35	1
Lithic clast II	white	15	ang to subrd	<0.1	0.1-10	2
Mineral clast I	white to colorless	0.5		<0.5	0.1-0.8	3
Mineral clast II	honey	tr		<0.5		4
Mineral clast III	pale yellow-green	tr		<0.5		5

NOTES:

1. Sharp contact with matrix, very dull to resinous luster, and aphyric.
2. Sharp contact with matrix. Fine grained sugary luster. Dominantly shattered feldspar grains. No obvious ferromagnesians.
3. Blocky single crystals of feldspar.
4. Very rare, probably pyroxene.
5. Very rare, probably olivine.

60016

THIN SECTION DESCRIPTION

BY: Ridley

DATE: 6/28/72

SECTION: 60016

SUMMARY: General impression of a breccia that has undergone thermal metamorphism, retaining abundant mineral clasts but converting the matrix into an ophitic, pyrometamorphic texture.

## MATRIX, 85 - 90% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Cpx	50	poik	1-0.5	About 1 mm plates Poikilitic clinopyroxene. Well developed ophitic texture.
Plag	45	anh-subhed	0.05	
Ilm	5			

## MINERAL CLASTS, 10 - 15% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	99	ang	1 -0.5	No indication of shocked plagioclase or incipient melting.
Oliv	0.5	subrded	0.5-0.05	
Metal	0 -0.5	rded	0.3	

ADDITIONAL COMMENTS: Angular plagioclase clasts contrast with small subhedral plagioclase enclosed within clinopyroxene. Abundant ilmenite tends to be concentrated around edges of clinopyroxene poikocrysts. Also abundant metal, occasionally associated with troilite. Rare brown staining associated with metal.

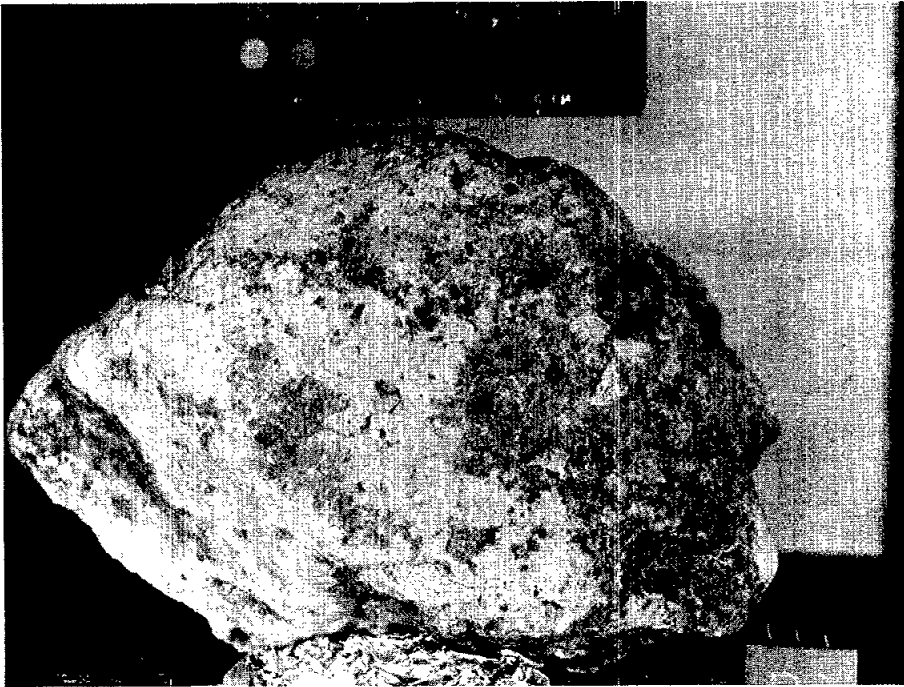
OPAQUES DESCRIPTION

BY: Brett

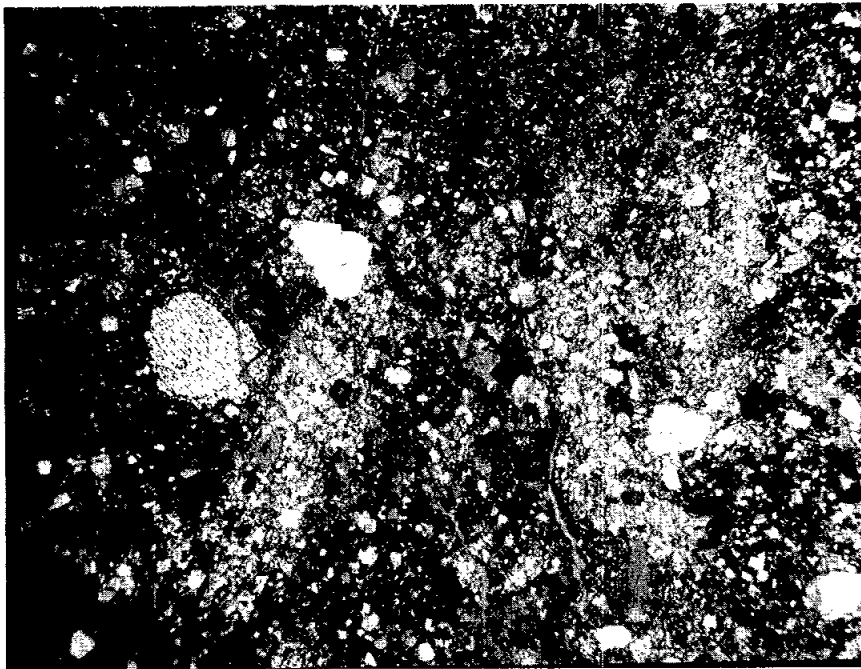
DATE: 6/26/72

SECTION: 60016,14

About 20 rounded grains in the 3 $\mu$ -to-submicron size range of FeS, Fe-Ni and ilmenite were seen in this section. This makes this near the all-time record for low opaque mineral content in a lunar rock.



SAMPLE 60016



SAMPLE 60016,13

WIDTH OF FIELD  $\approx$  4 MM

60017

ROCK TYPE: Breccia, vesiculated  
COLOR: Medium to dark gray (N3-N4)  
SHAPE: Blockly, subangular  
COHERENCE Intergranular: Tough  
Fracturing: No definite sets

WEIGHT: 2102 g  
DIMENSIONS: 18 x 14 x 9 cm

BINOCULAR DESCRIPTION

BY: Simonds & Morrison

DATE: 5/9/72

FABRIC: Inequigranular.

VARIABILITY: Areas of higher vesicle concentration along with coarser grain size. One such area has 3% 1 mm spherical vesicles and 1 mm crystals.

The boundaries of vesicle-rich areas are gradational within 1 mm or less.

SURFACE: B is angular fresh, without zaps. Others are subrounded and are covered with and adhering dust. There is a distinct topographic break between subrounded surface and bottom.

ZAP PITS: Few on T, S, W, E, N; none on B.

CAVITIES: Vesicles range from 1 to 15 mm and have thin glassy linings; the small are spherical; the larger are irregular in shape. Smaller cavities are concentrated on S.

SPECIAL FEATURES: Increase in grain size with degree of vesiculation toward the vesicle walls.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic clast I	white	5	subang to subrd	2.0	1.0 -5	1
Lithic clast II	(N2)	1	rd	1.0	1.0	2
Particle	silver metallic	one of a kind	ang		3.0 -4	3
Matrix	(N3-N4)	95		0.01	0.01-1	4

NOTES:

1. Clast appears to merge into matrix over 0.1 mm, fine grained or cryptocrystal-line.
2. Aphanitic, intermediate between white lithic clasts and matrix.
3. Appears to be coating on N face, could not be recognized in photographs.
4. Cleavage faces of coarser plagioclase indicate grains are equant to lath shape. Occasional 1 mm green mafic silicate seen in coarser areas of the matrix.

60017

THIN SECTION DESCRIPTION

BY: Morrison

DATE: 6/19/72

SECTION: 60017,4

SUMMARY: Recrystallized breccia (hornfels) containing ovoids of basaltic composition and plagioclase clasts showing devitrification textures. Mafic-rich clasts suggest previous generation of brecciation.

## MATRIX, 50% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	40(?)	amoeboid	<0.1	Plag is result of devitrification.
Maf sil	50(?)	blebs	<1 -<0.1	Some skeletal mafics occur. Primary mafic is opx. Some may be clinopyroxene.
Opag(?)	10	irreg	<0.1	Opagues are scattered and irregular. Matrix has vesicles and some compositional banding which may be related to clast boundaries. Rock also has area with anhedral plagioclase and interstitial pyroxene forming igneous texture. Irregular boundary with matrix may represent edge of vesicle.

## MINERAL CLASTS, 25% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag		blocky, subrd to to rd	1-<1	Plagioclase clasts are polycrystalline aggregates showing devitrification textures, i.e. spherulitic(?) intergrowths. Clear of debris in general but some have trains of black, irregularly-shaped opaques.

## LITHIC CLASTS, 15% OF ROCK

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Mafic I		ovoid	1 & <1	Mafic I - ovoid forms consisting primarily of orthopyroxene and plagioclase showing interlocking texture. Accessory opaques. Orthopyroxene is 60-80%. All have reaction rim with matrix. These also occur with plagioclase clasts.

## 60017 (Continued)

THIN SECTION DESCRIPTION

BY: Morrison

DATE: 6/19/72

SECTION: 60017,4 (Continued)

## LITHIC CLASTS (Cont.)

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Mafic II		subang to rd		Mafic II - mafic-rich clasts have composition similar to host breccia but matrix is distinctly more mafic-rich. Boundaries with host are distinct. One shows coarse orthopyroxene (produced by devitrification).

ADDITIONAL COMMENTS: Veinlet penetrates rock and is also recrystallized to acicular mafic mineral. Matrix contains areas which extinguish uniformly but show no discernible compositional differences from host in plain light except for slight differences in total mafic and opaque content.

THIN SECTION DESCRIPTION

BY: Simonds

DATE: 6/19/72

SECTION: 60017,4

SUMMARY: Section shows a finely crystalline matrix (devitrification product) with norite and in anorthosite clasts. The norites have more pyroxenes and opaques than the matrix. Presumably the anorthosite corresponds to the white clasts of the binocular description.

## MATRIX, 75% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	80			Essentially no <10 $\mu$ porosity, but abundant >200 $\mu$ pores (may be plucking). Matrix composition approaches 100% plagioclase in regions of a ten mm <sup>2</sup> .
Pyrox	20	spheres to irreg plates	0.003	
Fe-Ni	tr	rd to ir- reg	0.002	
FeS	tr	irreg next to Fe	0.003	

## 60017 (Continued)

THIN SECTION DESCRIPTION

BY: Simonds

DATE: 6/19/72

SECTION: 60017,4 (Continued)

## MINERAL CLASTS, 25% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	75	rd to subrd	0.1-0.4	Plagioclase, diaplectic, and diaplectic plagioclase glass.
Pyrox	25	equant	0.1-0.2	One pyroxene clast has a core of orthopyroxene, rimmed by orthopyroxene-plagioclase.

## LITHIC CLASTS

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Norite	4	rd	0.1-0.9	50% lath shaped plag, 40% opx, 2% platy ilmenite. The texture is subophitic. Fe-Ni spheres in plagioclase. Clast with matrix giving 3-5 $\mu$ rim of fine plagioclase and pyroxene. Some of the clasts have holes in middle may not be plucking.
Anortho-site	unique	only part in section	5	Sheaves of lath shaped plag up to 0.5 $\mu$ long, interstitial pyroxene (opx?) with grain size of a few microns. The entire clast appears to be devitrified glass because the laths are normal to margin of clast and decrease in size toward matrix.

ADDITIONAL COMMENTS: Most of this is homogeneous, isotropic, but one corner with 60% diaplectic plagioclase layer. Rock lacks any widespread fluidal textures.

OPAQUES DESCRIPTION

BY: Brett

DATE: 6/ /72

SECTION: 60017,4

Opaque mineral content is very low (<0.5%). Grain size is very small, most grains are well below 5 $\mu$  in diameter, few are greater than 10 $\mu$  in largest dimension.

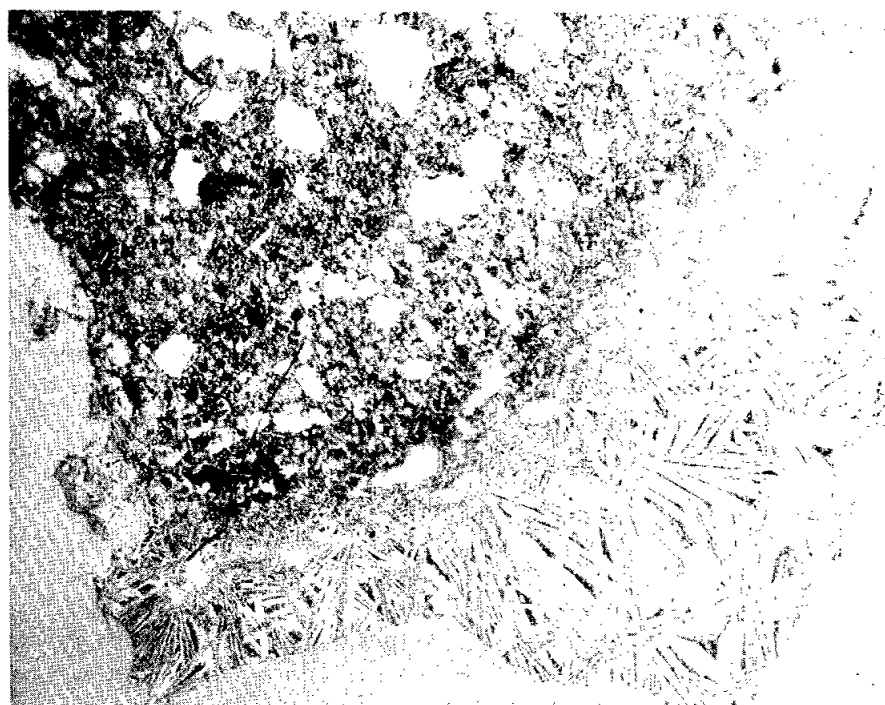
Minerals in order of abundance are 1) Metallic Fe - largely as isolated blobs, also as blebs in troilite. 2) Ilmenite as blebs, rounded lamellae and flames in igneous-looking clasts. 3) Troilite blebs, commonly containing Fe blebs.

Distribution of opaques is fairly homogeneous throughout the section.





SAMPLE 60017



SAMPLE 60017,4

WIDTH OF FIELD  $\approx$  4 MM

60018

ROCK TYPE: Breccia, glass-cemented      WEIGHT: 1501 g  
 COLOR: Medium gray on natural surface (N6)      DIMENSIONS: 19 x 11 x 6-1/2 cm  
 SHAPE: Oblong, subangular - broken  
 COHERENCE Intergranular: Coherent  
                   Fracturing: Two, nonpenetrative

BINOCULAR DESCRIPTION      BY: Wilshire & Stuart-Alexander      DATE: 5/9/72

FABRIC: None  
 VARIABILITY: Irregular distribution of vesicles  
 SURFACE: N is coarsely hackly, S, W, E, T and B are hackly  
 ZAP PITS: None on N, B; few on S, E; many on W, T.  
 CAVITIES: N has few 2 mm vesicles and a few vugs to 1 mm with no crystal linings.  
           All other surfaces: vesicles 0.5 - 4 mm, glazed walls, 2% of surface.  
 SPECIAL FEATURES: A polymict breccia, shattered and injected by glass (or partly melted along fractures).

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	dark gray to milky	10		veins	hairline to 4	1
Lithic I	med dark gray	25	subang to subrd	10	5- 20	2
Lithic II	med gray	tr	subang	10		3
Lithic III	speckled gray	5	subang to subrd		10- 25	4
Lithic IV	white	60	ang to subang	10	<1-100	5
Lithic V	brownish pink	tr	subrd	1		6
Metal	silver (solder-like)	tr	irreg		2- 4	7

NOTES:

1. In veins and matrix, forms youngest matrix of the breccia.
2. Pre-glass matrix of the breccia which now forms fragments with or without enclosed lithic fragments.
3. Aphanitic rock fragments enclosed in darker gray old matrix.
4. Very fine grain 75% gray, 25% white. Encloses a few white lithic fragments, small and sugary.
5. Very fine grain, sugary textured, trace to 3% opaques, mostly equant, some platy, grain size mostly <0.2 mm. About 20-40% light gray grains, rest white. One fragment has two small orangish spinel (?) grains. One has weak foliation of ilmenite (?) plates. Several have large plagioclase grains - irregular to rectangular, milky white to translucent gray, to 7 x 10 mm. Some small dead-white, fractureless grains.
6. Very fine-grained, granulated pyroxene (?).
7. Possibly restricted to glass.

75



SAMPLE 60018

60019

ROCK TYPE: Breccia, glassy matrix      WEIGHT: 1887 g  
COLOR: Medium light gray (N6)      DIMENSIONS: 15 x 15 x 7.5 cm  
SHAPE: Blocky, angular, slightly slabby  
COHERENCE Intergranular: tough  
Fracturing: One short, nonpenetrative

BINOCULAR DESCRIPTION

BY: Agrell & Wilshire

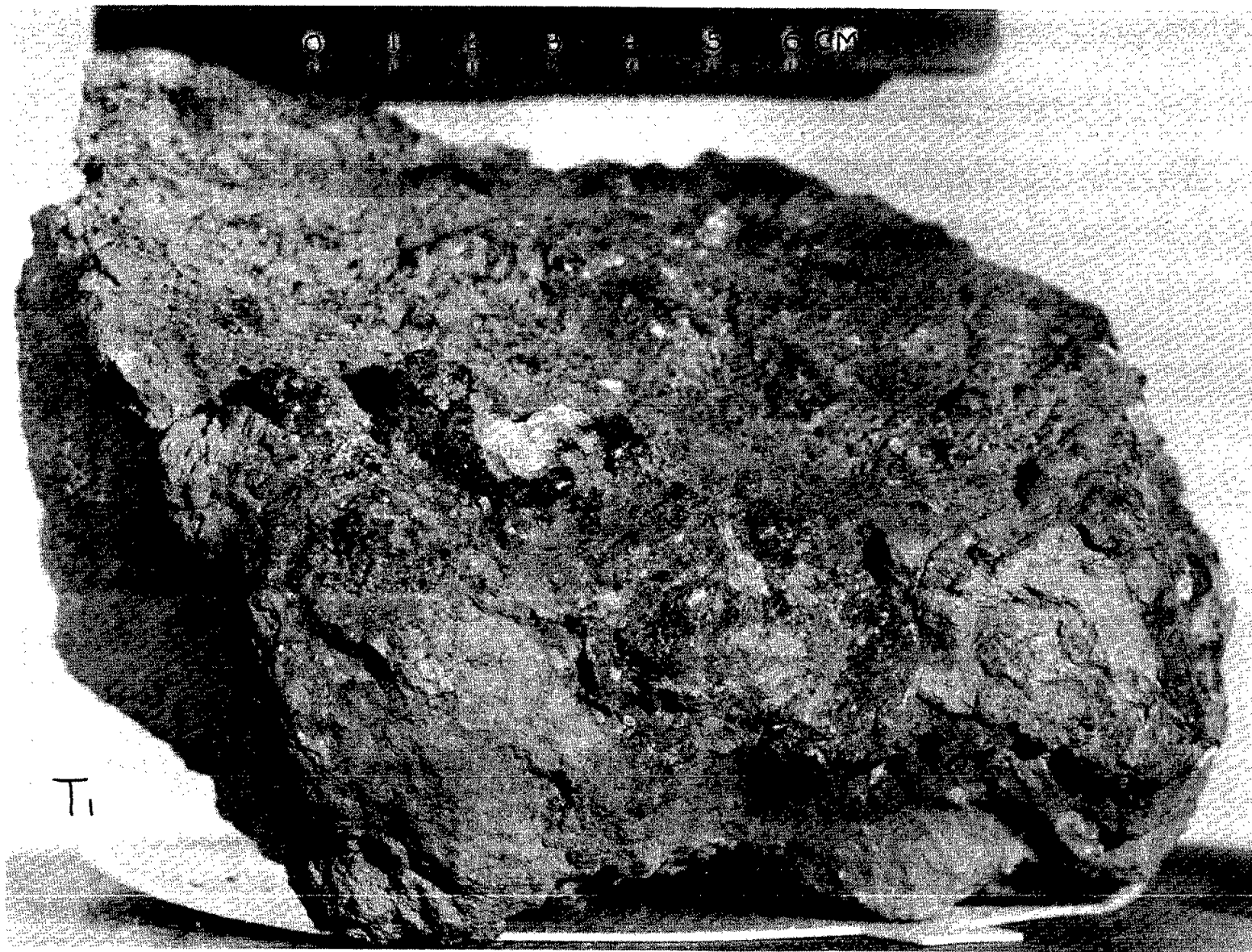
DATE: 5/11/72

FABRIC: Fine breccia  
VARIABILITY: Uncoated surface to glass-coated surface  
SURFACE: T rough with lumpy glass coating. Remainder rough and hackly.  
ZAP PITS: Few on N, W, B; none on E, S, T.  
CAVITIES: In glass coating: 30% are 1-2 mm. A few 0.5 cm vugs. One 1.5 cm open gash type fracture.  
SPECIAL FEATURES: Much of the rock is glass-coated, with the remainder very dusty. This description therefore represents only a small portion of the rock. Beneath the dust coating there are vague indications of pale clasts up to 2 x 2 cm.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	med lt gray	1				1
Lithic I	chalky white to colorless vitreous	<1	ang	0.2	0.1-10	2
Lithic II	salt and pepper	<1	subrd		0.1- 0.5	3
Lithic III	white	20	ang	0.3	0.1- 0.5	4
Lithic IV	dull white	10	subrd	5	1 -20	5
Matrix	med lt gray	70				6

NOTES:

1. Very thin veneer; amber colored on thin edges, glass beads on surface.
2. Large clast in glass coating has a slight foliation. One is sugary. About 20% of glass is peppered by white clasts.
3. In the glass coating.
4. In the rock; speckled with a light gray.
5. Has 10% gray crystals and a weak foliation. Larger clasts in this group.
6. Vitreous appearance.



SAMPLE 60019

60025

ROCK TYPE: Anorthosite cataclastic      WEIGHT: 1836 g  
COLOR: White (N9)      DIMENSIONS: 14 x 10 x 10 cm  
SHAPE: Blocky, subangular  
COHERENCE Intergranular: Moderately coherent  
Fracturing: Several penetrative

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 6/13/72

FABRIC: Cataclastic  
VARIABILITY: Partly glass-coated  
SURFACE: Irregular  
ZAP PITS: Many on N, S, W, E; few on T.  
CAVITIES: There are 10-20% vesicles in glass.  
SPECIAL FEATURES: Proportion of mafic silicates varies from 1% to 15% in different parts of the rock. Minor mylonitization along fractures, which are either local melting or glass injection along fractures. This rock has a cataclastic texture, but may be "igneous" as opposed to clastic.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase	translucent white	90			up to 10	1
Maf sil I	lt yellowish orange (10YR8/6)	tr	irregular	0.2		2
Maf sil II	grayish yellow (5Y 8/4)	2-12	equant, irregular	0.2	0.1-6	3
Maf sil III	dusty yellow (5Y 6/4)	tr			5	4
Maf sil IV	brownish gray (5YR4/1)	tr			2-3	5

NOTES:

1. Plagioclase in various stages of crushing. Relicts are translucent, more finely powdered material is milky white.
2. Pyroxene(?) in clusters to 2 x 0.75 mm which could be large skeletal crystals. Associated with vitreous-appearing plagioclase.
3. More translucent and lustrous than pyroxene (above) and may be olivine. Some patches with granular texture. One is penetrated by fine granular plagioclase band with opaque mineral concentration.
4. Two grains with small opaque inclusions. They may be the same as next above.
5. Three grains, one with a grayish-yellow mineral in it, appear to be good crystals.

60025

THIN SECTION DESCRIPTION

BY: Williams

DATE: 6/28/72

SECTION: 60025,20

SUMMARY: Crushed troctolite with seriate grain size. The large "clasts" are generally monomineralic (plagioclase or orthopyroxene) and are recrystallized to equant anhedral domains about 0.5 mm across. Generally crystals are rounded to subrounded and are fractured on a minute scale. There are sheared zones in which the minerals are smeared into each other. In spite of crushing, the rock retains an indication of the initial grain size in subrounded areas 1-5 mm across which are essentially monomineralic.

100% GROUNDMASS

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	70	rd to anhedral	6 -<0.1	
Oliv	20	anhedral	0.2	
Opx	10	anhedral to tab	4 -<0.1	Opx has exsolution lamellae.
Cpx(?)	tr	anhedral	0.5-<0.1	Cpx is probably pigeonite
Crist(?)	tr	irreg	0.2	Cristobolite(?) is clearly associated with the pyroxene. Opaques are rare.

ADDITIONAL COMMENTS: This holocrystalline rock has 70% plagioclase, 10% orthopyroxene (which shows exsolution). The large "clasts" are monomineralic and are recrystallizing to equant, anhedral domains about 0.5 mm. The grains are rounded to subrounded and are fractured on a minute scale. There are sheared zones in which the minerals are smeared into each other.

60025

OPAQUES DESCRIPTION

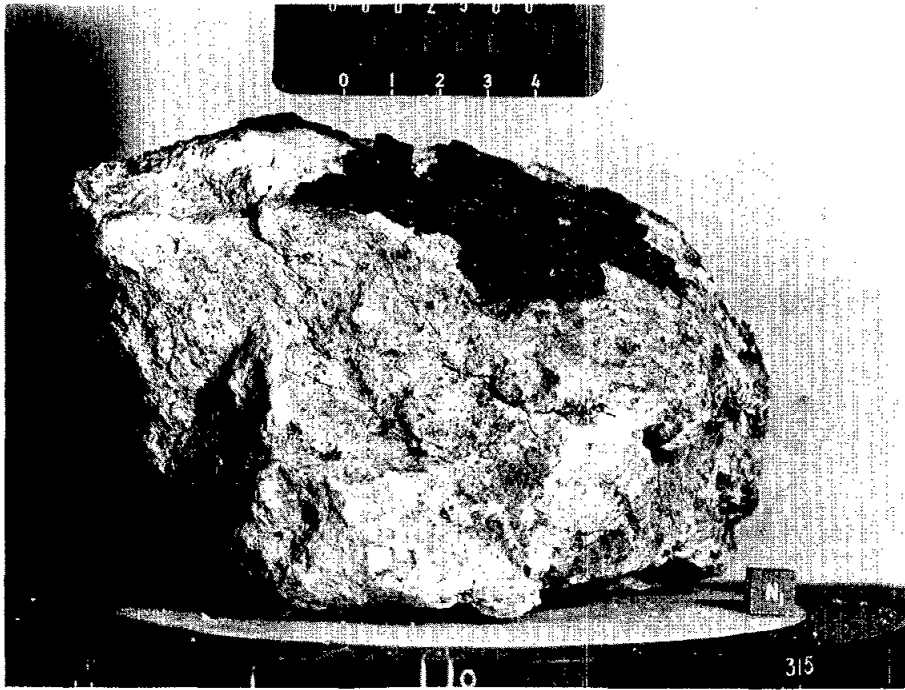
BY: Brett

DATE: 6/23/72

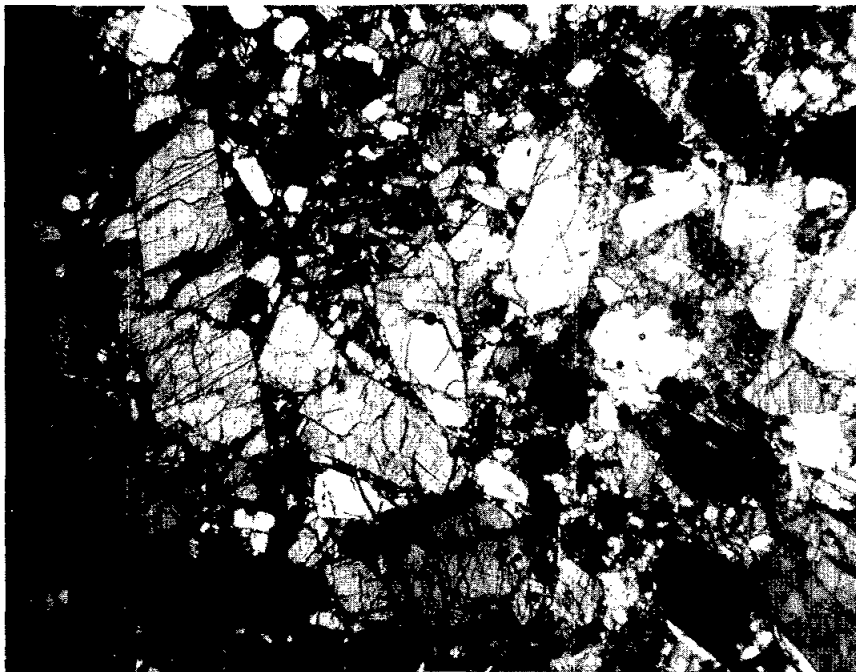
SECTION: 60025,20

Opaque mineral content is less than 0.05% and is composed of:

1. metal and troilite in 5-10 $\mu$  blebs;
2. ilmenite in rounded grains to 10 $\mu$  except for one ulvospinel grain which is about 120 $\mu$  diameter;
3. one battleship gray grain, low reflectivity, reddish-brown in transmitted light (not tranvallite);
4. a few grains (5 to 10) appear to be chrome-spinel which in one case is intergrown with an ulvospinel.



SAMPLE 60025



SAMPLE 60025,21

WIDTH OF FIELD  $\approx$  4 MM



60035

ROCK TYPE: Anorthositic gabbro, crushed

WEIGHT: 318 g

COLOR: Glass (N4), Rock (5Y)

DIMENSION: 14 x 11 x 5 cm

SHAPE: Slab

COHERENCE: Intergranular: Coherent

Fracturing: Few nonpenetrative, one filled with 0.1 mm thick seam of dark glass.

BINOCULAR DESCRIPTION

BY: Agrell & Stuart-Alexander

DATE: 5/23/72

FABRIC: Equigranular

VARIABILITY: Glass coated 70%, exposed rock 30%.

SURFACE: Glass coats 100% of T, 33% of B, 90% of N, 80% of E, 90% of S, and 70% of W.

ZAP PITS: Many on B (both glass and rock); few on W (glassy part), N, E, S; none on T.

CAVITIES: In glass 15%, 0.2-0.75 mm, elongated, smooth channels, 0.5 x 3 cm, broken, pipe-like or due to irregularities in glass where crowded with rock fragments.

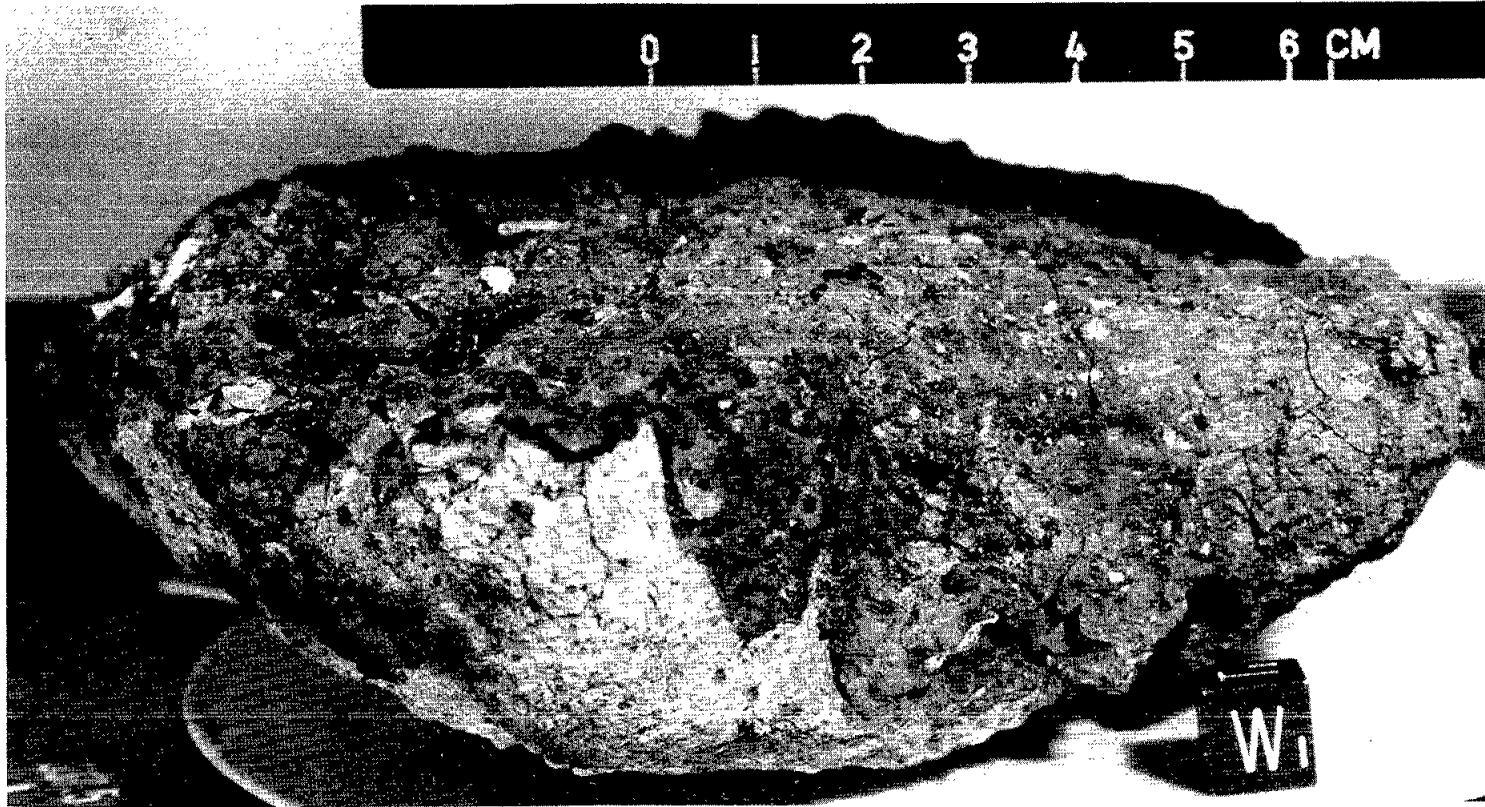
SPECIAL FEATURES: Sample originally had complete glass coating. B surface (upper) is highly zapped glass spalled-off exposing core igneous rock. T Surface (bottom) is completely glass coated with many adherent small clasts (plag-rich, and fine-breccia).

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass coating	pale gray	10	coating		0.1	1
Igneous	creamy white	90	slabby	0.5	0.1-1.0	2

NOTES:

1. The glass coating is dark to eye, and much paler under microscope, devitrified. B (top surface) is 30% 1-5 mm skin of vesicular devitrified pale gray glass, locally pocked with white to cream colored, 0.2-5 mm clasts, ranging from pure fine plagioclase to granulitic rocks with 50% plagioclase and 50% mafic silicate. T (bottom surface) is 98% glass coated, similar color, devitrification and vesicles to other side (B) but fresh surface rough with adherent dust and many rock fragments, 0.1-10 mm average, 1-2 mm 50% gabbroic anorthosites, 50% fine microbreccia, <1% glass spheres. Similar clasts are enclosed in glass, up to 20% (15% light, 5% dark). Glass coating is honeycombed with fractures about 1.5 cm apart, which penetrate to core rock on side surfaces where zapped, more zaps on core than glass. Possibly the fragment was zapped prior to glass coating.
2. 70% white plagioclase; 30% pale gray brown mafic silicate.

82



SAMPLE 60035

60055

ROCK TYPE: Anorthosite, pulverized

WEIGHT: 35.5 g

COLOR: White (N9)

DIMENSIONS: 4 x 3 x 2.5 cm

SHAPE: Subangular

COHERENCE intergranular: Friable

Fracturing: Few, nonpenetrative

BINOCULAR DESCRIPTION

BY: Simonds

DATE: 6/21/72

FABRIC: Granular, isotropic

VARIABILITY: Homogeneous

SURFACE: T-S corner is broken, others dust covered.

ZAP PITS: Obscured by dust.

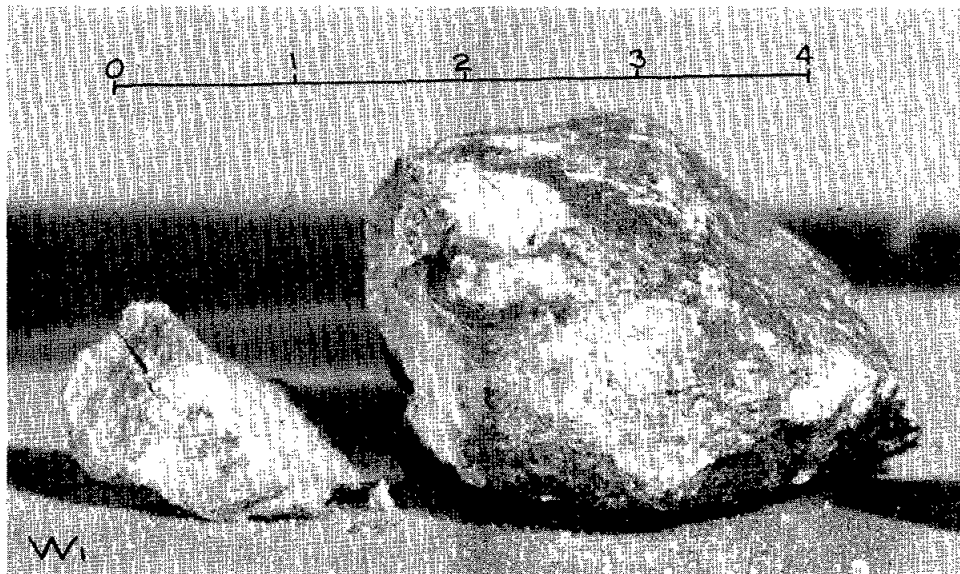
CAVITIES: None

SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	white (N9)	100		<0.1	<2.5	1

NOTES:

1. Ninety-nine percent plagioclase or at least colorless pyroxene. There is one percent dark mineral (black pyroxene). Most of the larger grains are clean. A region on the T-S corner of 2.5 mm is a cleaved, but disrupted plagioclase crystal.



SAMPLE 60055

60056

ROCK TYPE: Breccia  
 COLOR: Unknown (See Special Features)  
 SHAPE: Subangular  
 COHERENCE Intergranular: Friable  
 Fracturing: None

WEIGHT: 16.1 g  
 DIMENSIONS: 3 x 2 x 2 cm

BINOCULAR DESCRIPTION

BY: Simonds

DATE: 6/21/72

FABRIC: Unknown  
 VARIABILITY: Unknown  
 SURFACE: Unknown  
 ZAP PITS: Unknown  
 CAVITIES: Unknown  
 SPECIAL FEATURES: Rock is mainly completely covered with dust but black clasts and gray clasts show through dust.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Maf sil	unknown					I
Lithic I	black (N1)	5(?)	ang		<1.0	
Lithic II	gray (N6)	5(?)	subrd		<0.5	

## NOTES:

I. Covered by light gray dust.

60057

ROCK TYPE: Anorthosite, pulverized  
 COLOR: White (N9)  
 SHAPE: Subangular  
 COHERENCE Intergranular: Friable  
 Fracturing: None

WEIGHT: 3.1 g  
 DIMENSIONS: 1.5 x 0.5 x 0.5 cm  
 (largest fragment)

BINOCULAR DESCRIPTION

BY: Simonds

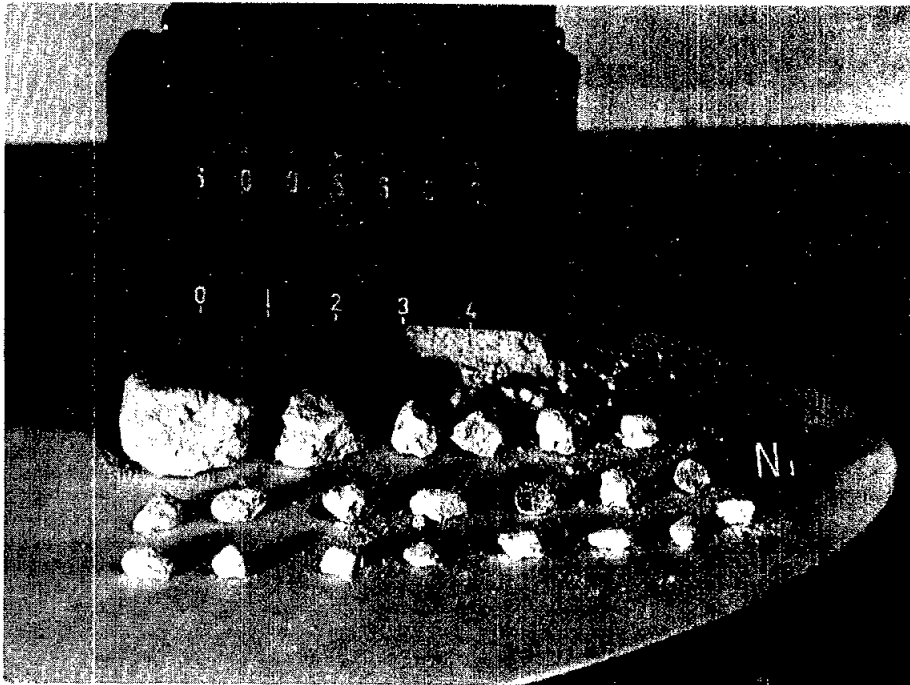
DATE: 6/21/72

FABRIC: Granular, isotropic  
 VARIABILITY: Homogeneous  
 SURFACE: Broken or obscured by clinging dust.  
 ZAP PITS: None noted  
 CAVITIES: None  
 SPECIAL FEATURES: None

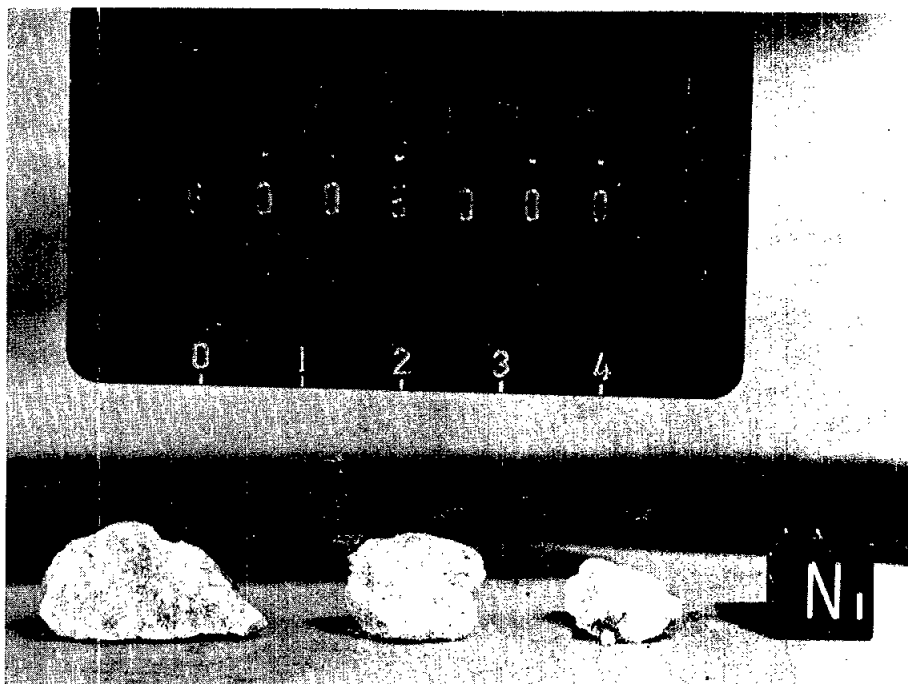
<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	white (N9)	100			<1.0	I

## NOTES:

I. Similar to 60055.



SAMPLE 60056



SAMPLE 60057, 58 & 59

60058

ROCK TYPE: Breccia, granular gray  
COLOR: Gray (N7)  
SHAPE: Rounded  
COHERENCE Intergranular: Friable  
Fracturing: None

WEIGHT: 2.1 g  
DIMENSIONS: up to  
0.3 x 0.3 x 0.3 cm

BINOCULAR DESCRIPTION

BY: Simonds

DATE: 6/21/72

FABRIC: Isotropic, granular  
VARIABILITY: Unknown  
SURFACE: Dust covered  
ZAP PITS: Dust covered  
CAVITIES: None obvious

SPECIAL FEATURES: Rock is largely broken up and can is filled with dust covered round fragments and a few dust-covered black things.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	white(?)	90				
Lithic	black	10			0.2	

60059

ROCK TYPE: Anorthosite, pulverized  
COLOR: White (N9)  
SHAPE: Rounded  
COHERENCE Intergranular: Friable  
Fracturing: None

WEIGHT: 1.1 g  
DIMENSIONS: 0.4 x 0.4 x 0.4 cm

BINOCULAR DESCRIPTION

BY: Simonds

DATE: 6/21/72

Same features as 60055

60075

ROCK TYPE: Breccia

WEIGHT: 184 g

COLOR: White (N8-N9)

DIMENSIONS: 16 pieces

SHAPE: Broken pieces

COHERENCE Intergranular: Very friable  
Fracturing: Few, penetrative

BINOCULAR DESCRIPTION

BY: Wilshire

DATE: 6/9/72

FABRIC: Breccia

VARIABILITY: None

SURFACE: Irregular; hackly on broken surfaces (clast molds)

ZAP PITS: A few are preserved on the largest fragment.

CAVITIES: None

SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic I	med dk gray	3-4	subang	1	1-2	1
Lithic II	white to lt gray	1-2	subang, subrd	2	1-5	2
Matrix	white	95				3

NOTES:

1. Aphanitic to subvitreous.
2. Finely crystalline, tough to sugary; moderately coherent. Coarser fragment has a trace of pale brown pyroxene.
3. Mostly fine powder; material that can be resolved is about equal proportions of gray aphanitic lithic fragments and angular plagioclase. Traces of reddish-brown mineral and metal fragments.



88

SAMPLE 60075



60095

ROCK TYPE: Glass WEIGHT: 46.6 g  
 COLOR: Grayish black (N2); yellow-green to light brown on thin edge DIMENSIONS: 3.8 x 3.4 x 3.4 cm  
 SHAPE: Ellipsoid  
 COHERENCE Intergranular: Tough  
 Fracturing: Cooling cracks on surface and in vesicles; few, nonpenetrative.

BINOCULAR DESCRIPTION BY: Bass DATE: 6/6/72

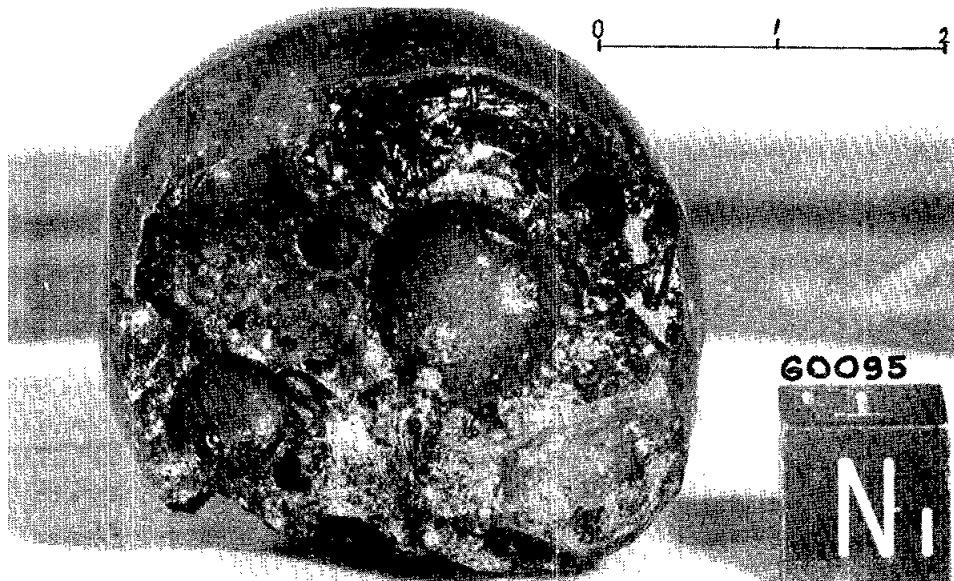
FABRIC: Isotropic, glassy  
 VARIABILITY: Fractures  
 SURFACE: N and B have hackly-to-irregular fractures exposing numerous vesicles; others are glassy, smooth, and spheroidal.  
 ZAP PITS: Few on all faces. They are well-developed and range from slightly shattered light spots to full-fledged zap pits. The spall zones show all degrees of detachment.  
 CAVITIES: Total 5-10%; spherical vesicles ranging from <1 to 11 mm, rare irregular cavities, open shrinkage cracks (very minor), and dimples where metal fell out.  
 SPECIAL FEATURES: N and B are fresh fractures; cooling cracks are irregular and minor; no fracture sets. Minor soil on N and B, especially near their edges; also in zap pits on outer surface. Chilled glass spheroid, almost exactly spherical; vesicles are mostly internal and are only rarely coalesced. Larger vesicles may be surrounded by a few tiny ones which appear in the spherulitic zone around the large vesicle. Irregular internal cavities are rare. Very few vesicles and irregular holes are exposed on outer surface and have sharp edges where exposed. The holes present are mainly dimples from which metal was dislodged or vesicles which were zapped open. Some metal formed internally in glass or vesicles and a minor amount arrived as spatter from an external source, as did the dark gray glass spheres. A few angular glass particles are present on the surface but they are barely adhering.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	grayish black, yellow-green, med brown	97	spheroid			1
Spherulites	med gray	1	spherulites and coalesced spherulites		0.1	2
Devitrified glass(?)	med gray	1	thin skin		<0.1	3
Plagioclase	white to lt gray	tr	equant, irregular		<(2 x 1)	4
Metal	gray to yellow	<1	spheroids, lenses, films	0.5	<1.5	5

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass spheres	dk gray or black	tr	spheroids	<0.5	up to 1+	6
Glass particles	gray or yellow-green	tr	equant, irregular		<0.5	7

**NOTES:**

1. Dominant component; grayish black in bulk; where light can reflect internally or pass through spall zones, cracks, and thin walls of vesicles, it is yellow-green except on B, where it may be medium brown or yellow-green.
2. Opaque, stony luster, form complete shells around smaller vesicles, partial shells around larger vesicles, where spherical shape and varying degrees of coalescence can be seen.
3. Outer skin of specimen: luster is similar to that of spherulites, but the skin appears to be of uniform thickness and not a series of coalesced spheres.
4. Two opaque-to-translucent grains, shocked or recrystallized on N and B, gradational to host or sharply defined.
5. Several modes of occurrence: spheroids, lenses, or films on interior surfaces of vesicles, may pluck out leaving dimples. Surfaces of metal often minutely knobby or irregular; one large film in vesicle is 1.5 x 0.5 mm. Lenses, spheroids and rare filmy spatter are on outer surface; often partially embedded, leave dimples where dislodged; two coalesced spheroids give dumbbell appearance.
6. Attached to and coalesced with outer surface of specimen to varying degrees, but generally stand clear above surface. One large spheroid was broken off almost flush with the surface of the specimen.
7. Attached to outer surface of specimen; barely embedded and not necessarily strongly attached, but have survived handling.



60115

ROCK TYPE: Breccia, glass cemented      WEIGHT: 133 g  
COLOR: Medium gray (N4)      DIMENSIONS: 11 x 3.5 x 2 cm  
SHAPE: Rough triangular prism  
COHERENCE Intergranular: Tough  
Fracturing: At least **three** penetrative sets

BINOCULAR DESCRIPTION

BY: Williams

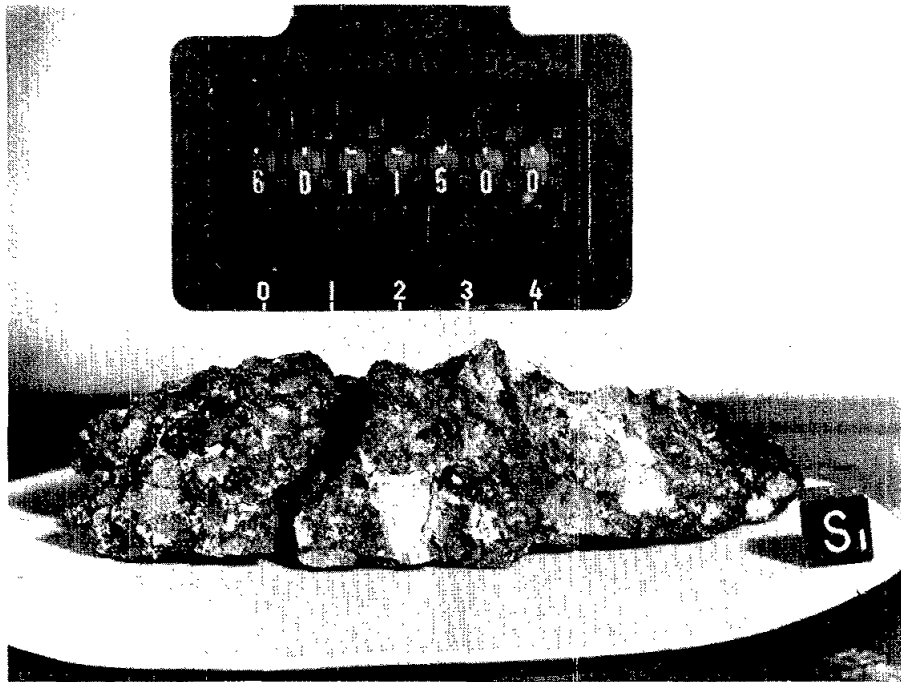
DATE: 6/7/72

FABRIC: Breccia  
VARIABILITY: Clast population is locally variable.  
SURFACE: All surfaces are rough except B, which is smooth. Brownish dust present on N surface.  
ZAP PITS: None on all surfaces.  
CAVITIES: About 1% vesicles associated with glassy material, some have projecting plagioclase and metal crystals.  
SPECIAL FEATURES: This is a very highly recrystallized breccia. The chips 60115,1 and 60115,2 are essentially identical in surface morphology and petrography. The rock fractures and crumbles rather readily along the fracture patterns.

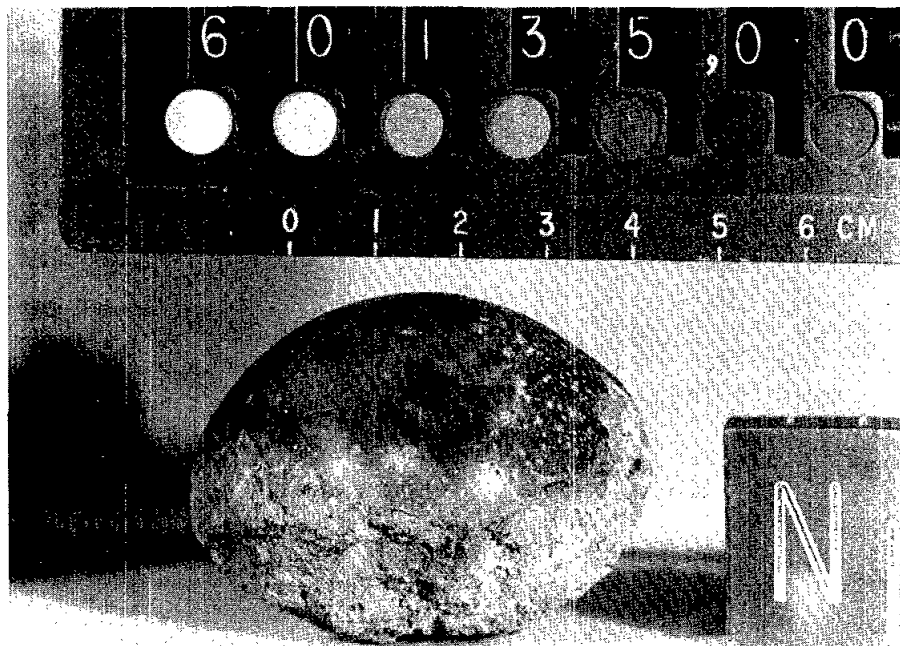
<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Clasts I	med gray	65			<0.1-15	1
Glass	gray-black, med gray	10				2
Clasts II	white	20		1	0.1-15	3
Clasts III	light gray	5	subrd		<0.1-10	4
Iron	silvery	tr	spher to irreg		<0.1- 0.2	5
Sulphide	yellow	tr	square		<0.1-0.1	

NOTES:

1. Aphanitic medium gray material.
2. Apparently cements the rock. Contains vesicles.
3. Aphanitic with occasional cleavages and fractures. If anything, it appears that the glass and Clast I make up what would be called matrix. The only mineral seen is plagioclase (?).
4. Aphanitic.
5. Usually associated with glass.



SAMPLE 60115



SAMPLE 60135

60135

ROCK TYPE: Crystalline rock, glass-coated    WEIGHT: 138 g  
COLOR: Glass - medium dark gray (N3-N4)    DIMENSIONS: 5.5 x 4.5 x 4 cm  
          Rock - light olive gray (5Y61)  
SHAPE: Oblate ellipsoid, well-rounded  
COHERENCE Intergranular: Tough  
          Fracturing: Local and nonpenetrative

BINOCULAR DESCRIPTION

BY: Agrell & Stuart-Alexander    DATE: 5/22/72

FABRIC: Glass-coated crystalline rock  
VARIABILITY: 50% glass covered  
SURFACE: Glass surface smooth, rock surface hackly  
ZAP PITS: Many on S, W, N (W half), T (N half); few on E, T (S half), and N (E half); none on B.  
CAVITIES: Glass has 1-2% vesicles of 0.2 mm diameter. 1% miarolitic cavities in rock.  
SPECIAL FEATURES: Lower surface of the glass (against the rock) is wrinkled. A number of vesicles occur between the glass and the host rock. A few vesicles are exposed on glass surface. The devitrified colorless glass that seams the crystalline rock is highly vesicular. Some is drawn out in linear rope-like forms, enclosing lenses of undeformed feldspathic rock. Possibly glass once completely enveloped rounded rock.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	dark gray	5			1 -2 thickness	1
Metal (?)	silver gray	tr	hemispheres	<0.1		2
Plagioclase	white	60	tabular	3	0.2-7	
Gray mineral	vitreous gray	40	interstitial	0.2	0.1-5	3
Metal, sulphide		tr				

NOTES:

1. Appears devitrified to microcrystalline feldspar crystals.
2. Stuck to outer surface of the glass.
3. In the body of the rock and also in miarolitic cavities where they are larger.

60215

ROCK TYPE: Anorthositic cataclasite  
COLOR: White (N9), soil coating olive gray (5Y)  
SHAPE: Blocky, 1/2 rounded  
COHERENCE Intergranular: Coherent  
Fracturing: Penetrative, several sets

WEIGHT: 386 g  
DIMENSIONS: 8 x 7 x 6 cm

BINOCULAR DESCRIPTION

BY: Agrell

DATE: 5/24/72

FABRIC: Microbreccia

VARIABILITY: 15% dark adhering glass; 75% white homogeneous cataclasite.

SURFACE: Finest hackly. All surfaces of rock except glass are finely coated with dust, which in certain parts emphasizes cataclastic structure.

ZAP PITS: Many on N; few on B, T, and E; none on S, E, and W. Colorless glass linings.

CAVITIES: 20% vesicles in glass portion.

SPECIAL FEATURES: This rock is a highly crushed anorthosite - some vague indication of planar shear. Dust adheres more to the small breccia fragments than to the matrix.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	gray	10	vesicular lumps & sheets			1
Clasts in glass I	gray white	1	rnd		2-3	2
Clasts in glass II	dark gray		ang	0.1		3
Anorthosite	white	90	blocky	0.5	0.1-4	4

NOTES:

1. Devitrified to 0.4 mm plagioclase and contains 20% of 1-5 mm diameter vesicles.
2. Plagioclase 60, mafic silicate 40.
3. Small angular dark clasts appear in some areas, close to core rock.
4. Angular fragments of fine grained anorthosite (70%), closely packed together in a slightly darker matrix (20%) (possibly partly pyroxene), and 10% porcelainous white wavy seams.

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/21/72

SECTION: 60215,2 and ,13

SUMMARY: Unrecrystallized anorthosite breccia, but with no spinel and with no isotropic glass except on one edge and remarkably few if any pores. The lithic clasts are all recrystallized and contrast strongly with the dominant unrecrystallized mineral clasts. The breccia is almost monomict, but at least two sources are indicated.

## MINERAL CLASTS (INCLUDING ROCK MATRIX), 97% OF ROCK

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	99.8	equant blocky	<0.1-6	Plagioclase varies from unshocked, to undulatory, to bent, to pressure-twinned (includes gridiron twinning), to highly shocked. Recrystallization is present within intensely deformed bands of a few large plagioclase clasts. Brecciated zones or bands in the largest grain give "mortar" texture, and rotated blocks in some such bands would, on recrystallization, give polygonalized bands of the type seen in 15415. May contain mafic inclusions, but in general is remarkably free of them. Derived from relatively coarse, almost pure anorthosite.
Mafics	0.2	irreg to equant, blocky	<0.1-0.15	Mafics are mainly orthopyroxene; 1 grain of olivine; several augite grains in one shocked and partly recrystallized clast; rare grains show first-order red interference colors and may be olivine or clinopyroxene. Orthopyroxene may show a faint to distinct lamellar structure.
Opagues	tr	irreg to	<0.01-0.04	

NOTE: No extremely fine-grained matrix of type produced during recrystallization. Instead plagioclase fragments are seriate to smallest sizes and all but the smallest grains are well defined. If there is any bimodality, the coarser mode would include only a few, large, shattered grains.

## LITHIC CLASTS, 3% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
"Chert"	70	ovoid to subrd	to 2.4	"Chert" is extremely fine-grained (average 0.001 to 0.002 mm), fairly equigranular, with a few grains up to 0.01 mm and, in some clasts, large irregular, highly shocked and partially recrystallized plagioclase relics.

## 60215 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/21/72

SECTION: 60215,2 and ,13 (Continued)

Mafic relics are rare. A few clasts contain very minor plag laths up to 0.01 mm long, and very rarely the laths are subparallel. The "chert" grades to "maskelynite" in two clasts. This and the relict plagioclase indicate that the "chert" is finely recrystallized plagioclase. It generally has a brown tinge, the intensity of which correlates directly with the abundance of mafic crystals of the same size range as the feldspar (0.001-0.002 mm). The "chert" appears to be devitrified plagioclase glass different somehow from those diaplectic glasses with a high degree of structural memory which devitrify to fibrous aggregates. I suggest that the "chert" is devitrified glass which was shocked to a melt stage with small, disoriented domains of structural memory, and that this process was aided in varying degrees by mafics which lowered the melting point. One "chert" contains an ovoid opaque grain, one of the only two opaque grains seen in the rock.

"Maske- 25 subrd to 4  
lynite"

Fibrous devitrification products (no isotropic glass left). Evidence from 61016 suggests that the fibrous "maskelynite" represents the devitrification of shock-melted plagioclase totally devoid of structural memory (i.e., like a thermal melt). Therefore, fibrous "maskelynite" was initially more intensely shocked than "chert", to which it grades.

LITHIC CLASTS (Continued)

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
--------------	--------------------	--------------	------------------	-----------------

In one clast the "maskelynite" and "chert" occupy large clear areas separated by "interstitial" micropoikilitic pyroxene(?) that extinguished in large patches. The gross appearance of the clast is that of a distorted but topologically preserved granular texture.



## 60215 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/21/72

SECTION: 60215,2 and ,13 (Continued)

Note that the patchy extinguishing, micropoikilitic pyroxene(?) of the type just mentioned is seen only in that "maskelynite" grain, in a few "chert" grains, and in the finely brecciated zones of a few shocked and recrystallized plagioclase clasts. Like the "chert" and "maskelynite", the micropoikilitic pyroxene reflects a degree of recrystallization not seen within most plagioclase clasts, and totally absent from 60215 as a rock specimen.

Mafic	5.	ovoid to blocky, subrd	0.1 to 1	Mafic and opaque-rich clasts enclosing randomly oriented, thin plagioclase laths with scalloped edges. These clasts may be recrystallized glass or highly recrystallized microbreccias.
Ultra-mafic	tr	inreg	to 0.2	Pigeonite ophitically enclosing minor plagioclase laths. These clasts may be exceptionally mafic variants of the mafic lithic clasts. Only two examples seen.

## GLASS CLASTS, TRACE OF ROCK

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Grayish brown	100	ovoid	0.15x 0.11	The grayish brown glass clasts are patchily devitrified.

60215

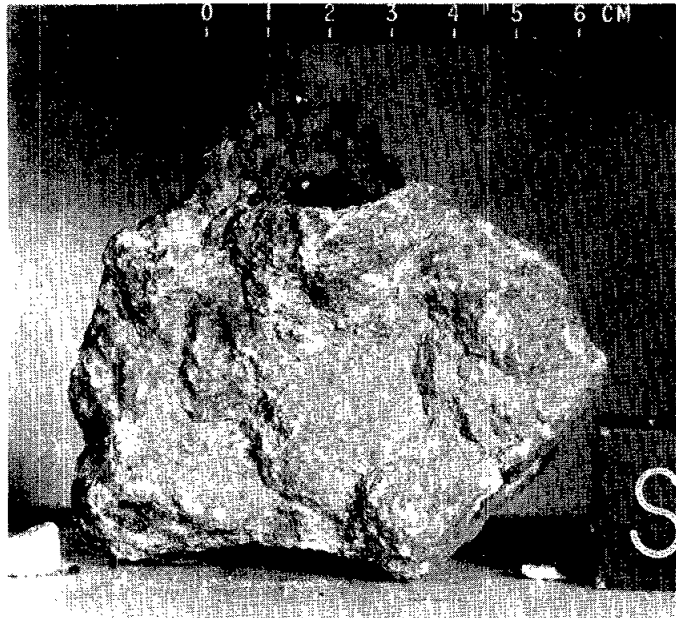
OPAQUES DESCRIPTION

BY: Brett

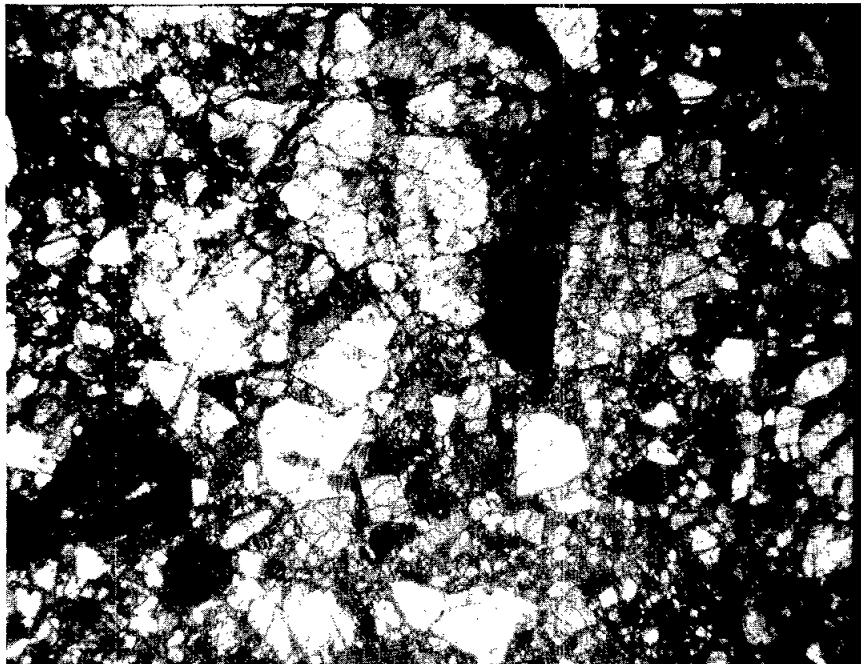
DATE: 6/20/72

SECTION: 60215,13 and , 2

**SUMMARY:** Opaque mineral content is extremely low (<0.01%). The section is large yet total number of opaque grains is less than 20. One or two rounded ilmenite grains, the rest are rounded troilite and metal grains in the micron size range.



SAMPLE 60215



SAMPLE 60215,2

WIDTH OF FIELD  $\approx$  4 MM

60235

ROCK TYPE: Crystalline  
 (recrystallized anorthositic breccia)

WEIGHT: 70.1 g  
 DIMENSIONS: 6 x 3.5 x 3.3 cm

COLOR: Medium gray (N5)  
 SHAPE: Angular, blocky  
 COHERENCE Intergranular: Tough  
 Fracturing: At least three penetrative sets subparallel to B, T and W

BINOCULAR DESCRIPTION

BY: Bass & Williams

DATE: 6/6/72

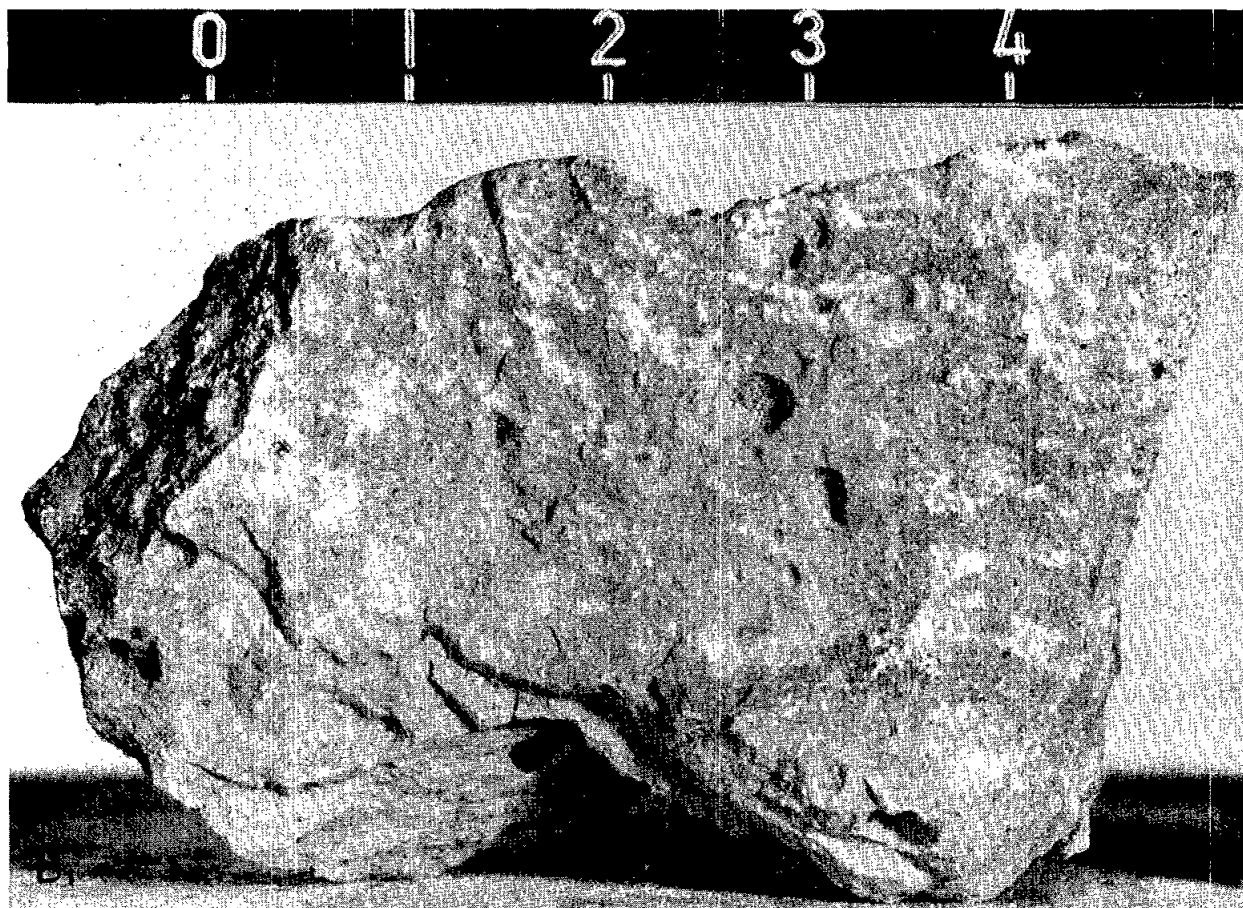
FABRIC: Isotropic, mainly equigranular, minor relict large fragments  
 VARIABILITY: Mainly in surface morphology  
 SURFACE: T (N side) and N are knobby; S and B are smooth with some soil cover; W which is slightly irregular, is a joint surface; E is hackly; less than 5% glass on T; none elsewhere. Sample is bounded mainly by fractures.  
 ZAP PITS: Few on all surfaces; glass linings are rare. Pits are preserved mainly as opaque white spall zones.  
 CAVITIES: Approximately 1% vugs, vesicles and open joints (rare). Some have crystal linings. Some ovoid holes may be dimples from which metal was dislodged.  
 SPECIAL FEATURES: Soil cover is extensive on all surfaces and has olive tint. In large vug on N, in addition to soil, there is also a soft, white earthy coating in places, distinct from normal soil. The entire N surface is an irregular, knobby surface coated with drusy feldspar and traces of metal. The knobs in some cases appear to be relict feldspar clasts. Re-entrants are present and cannot have been formed by fracture. Evidence suggests formation as a large vug due to reduction of volume of host rock during sintering and recrystallization. Original vug must have been several cm in diameter. Remnant of similar vug on south edge of bottom.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	med gray	>90	equant to lath	<0.1	<0.1- 0.5	1
Feldspar clasts	white to med gray	<10	equant, blocky, ang to rd	1.5	<1 -10	2
Spinel(?)	red	tr	equant	0.1		3
Metal	gray	<0.1	ovoid to spherical		up to 2.5x2	4
Sulfide(?)	yellow, metallic	tr	film on vesicle surface			5
Mineral	reddish brown	tr				6
?	black	tr		0.1		7

60235 (Continued)

NOTES:

1. Apparently recrystallized feldspathic material, with few or no mafics; random laths (best seen on vesicle walls).
2. Large relics which are either clasts in a breccia or unshattered crystals in an anorthosite. Color varies with state of shock and transparency.
3. Occurs in matrix and as two crystals on surface of drusy feldspar in vug on W.
4. Spheroids, which may be incomplete, leave void in the ovoid cavity which it occupies. Surfaces are minutely rough and the largest one is striated or scratched.
5. Associated with gray metal and tiny black spots.
6. May be oxidized Fe, in some cases, possibly crushed spinel(?); seen in vug, on surface of spall zone of zap pit, and in matrix.
7. Two tiny black spots; one on B is vitreous (glass?), the other is in large vug exposed on N.



SAMPLE 60235

60255

ROCK TYPE: Black glassy breccia with  
angular white clasts.

WEIGHT: 871 g

DIMENSIONS: 12 x 9 x 7 cm

COLOR: Olive gray (5Y3/2)

SHAPE: Blocky subangular

COHERENCE Intergranular: Tough

Fracturing: Few, nonpenetrative

BINOCULAR DESCRIPTION

BY: Warner

DATE: 6/6/72

FABRIC: Breccia, isotropic

VARIABILITY: None

SURFACE: Hackly, very dusty. Two generations of glass splash cover N-E-B  
corner and part of N face.

ZAP PITS: Few on S, W, B, T, none on N and N-E-B corner.

CAVITIES: One percent, vugs with drusy lining which tend to form along fractures.

SPECIAL FEATURES: Black glass matrix; angular white plagioclase clasts; two  
generations of vesicular glass splash on one face.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	black	85				1
Plagioclase	milky white	12	ang	1	0.5-4	2
Mafic	yellow-green	3	ang	2	1-3	2

NOTES:

1. Matrix is different in two places: On N face it is a fine grained aggregate of black, acicular and plate-like crystals. On T face it is an aggregate of black glass.
2. Clast

60255

THIN SECTION DESCRIPTION

BY: Butler

DATE: 7/25/72

SECTION: 60255,14

SUMMARY: This section shows a multiple generation breccia that is composed of lithic clasts of recrystallized (glass-free) gabbroic anorthosite, of glass clasts and spheres, and of mineral clasts in a cryptocrystalline and confused matrix of small mineral grains and turbid glass. The overall composition appears to be that of gabbroic anorthosite. Rust stain surrounds some opaques.

## MATRIX, 28% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	85	subang equant	<0.1	Continuous size gradation in size of mineral clasts from the largest to below microscopic resolution in the matrix. Opaques from trains and loose aggregates of fine flakes.
Mafic	15	subang equant	<0.1	
Opaque	<1		<0.1	

## MINERAL CLASTS, 20% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	85	subang equant	to 0.7	Two opaque grains show rust stains on the adjacent silicates. The mafic minerals appear to represent both cpx and opx with possibly some olivine.
Mafic	15	subang equant	to 0.3	
Opaque	<1	irreg	0.15	

## 60255 (Continued)

THIN SECTION DESCRIPTION

BY: Butler

DATE: 7/25/72

SECTION: 60255, 14 (Continued)

## LITHIC CLASTS, 50% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Anorth	10	rd	to 1.5	Crushed gabbroic anorthosite clasts contain roughly 80% plag clasts (to 0.2 mm commonly) and 20% mafics (generally fine-grained, 0.02 mm). Some of the plag is lath-shaped, which suggests recrystallization. These and the anorthositic clasts have neither glass nor brown turbid areas. Some of the anorthosite clasts are probably shocked plag grains. The one basaltic clast present is about 65% plag (in aligned 0.2 mm long laths) with the rest interstitial opx(?). Shock effects are absent.
Gabbroic anorth	89	rd	to 4	
Basalt	1	rd	1.3	

## GLASS CLASTS, 2% OF ROCK

<u>COLOR</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Orange- brown	10	subrd	0.1	Orange-brown glass is clear, but the brown glass is turbid and filled with mineral fragments, which range in size to below resolution. Brown glass with flow lines forms a short sinuous vein. Some of the glass spheres have partially reacted with matrix; others have smooth edges.
Brown	70	irreg		
Colorless	10	rd	0.3	
Pale green	10	rd	0.2	

60255

OPAQUES DESCRIPTION

BY: Brett

DATE: 6/27/72

SECTION: 60255,13

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	<0.5	see comments	to 0.15	Metal and troilite in rounded to sub-rounded grains; many metal grains are ragged. Larger troilite grains are fractured. Some metal and troilite at grain boundaries with largely planar faces where they abut plagioclase laths.
FeS	<0.5	see comments	to 0.15	
Ilmenite	<1.0	see comments	to 0.2	

60255

OPAQUES DESCRIPTION

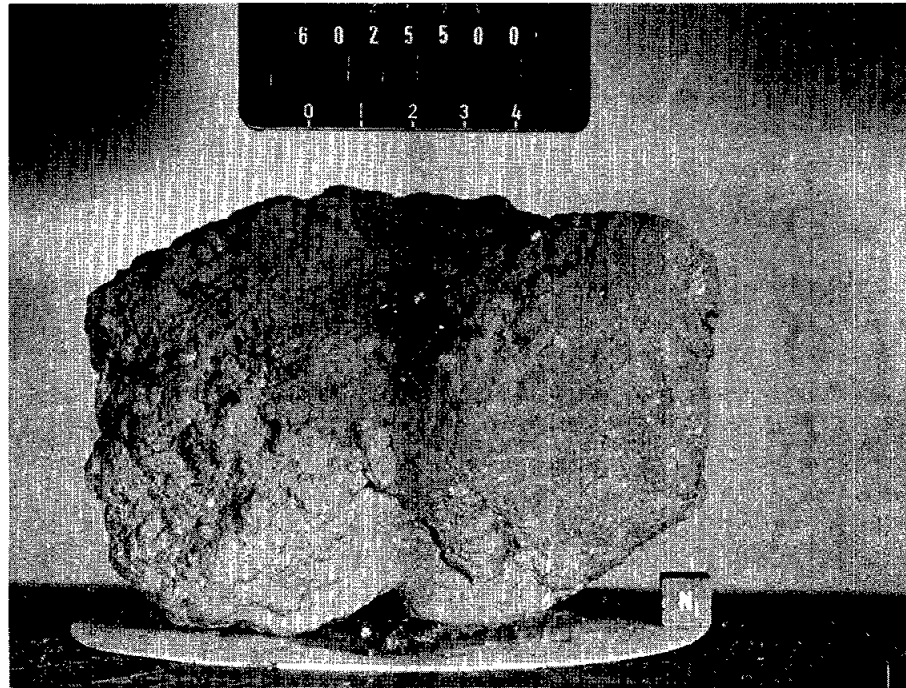
BY: Brett

DATE: 6/26/72

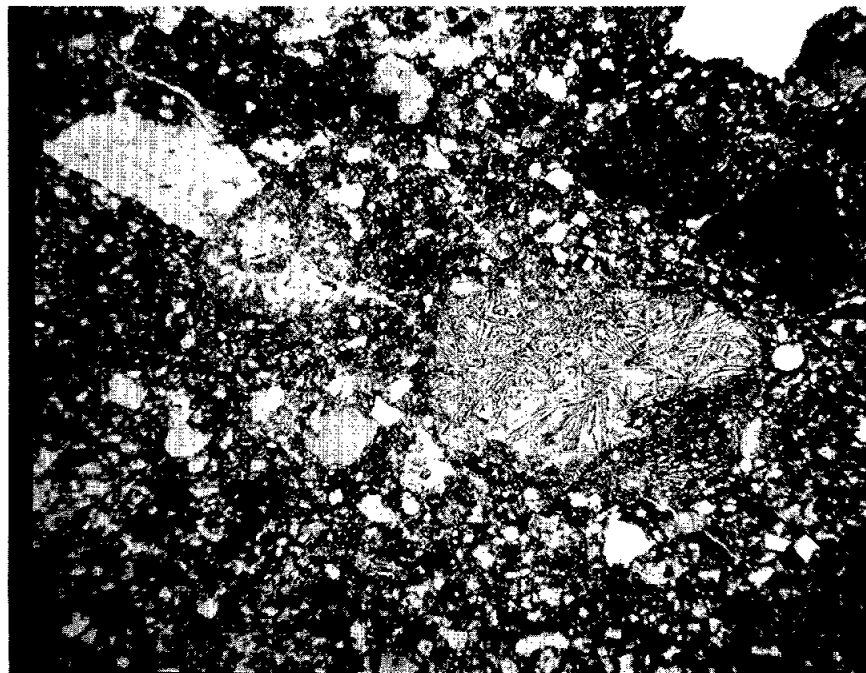
SECTION: 60255,14

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	<0.5	ragged	to 0.2	Metal and troilite grains tend to occur in clumps, with little or no metal in troilite, and vice versa.
FeS	<0.2	rd to irreg	to 0.2	
Ilmenite	<0.5	largely rd	to 0.15	Ilmenite and ulvospinel commonly rounded and fractured (at least larger grains). All minerals range in size at least to the micron range. Several metal grains have what appears to be limonite staining (goethite?) surrounding them.
Ulvo-spinel	<0.5	largely rd	to 0.15	
Goethite(?) tr				





SAMPLE 60255



SAMPLE 60255,14

WIDTH OF FIELD  $\approx$  4 MM

60275

ROCK TYPE: Breccia  
COLOR: Medium gray (N5)  
SHAPE: Subround. A few craggy areas  
COHERENCE Intergranular: Friable  
Fracturing: Nonpenetrative, fairly common, but restricted to glass coating

WEIGHT: 255 g  
DIMENSIONS: 8 x 7 x 5 cm

BINOCULAR DESCRIPTION

BY: Ridley

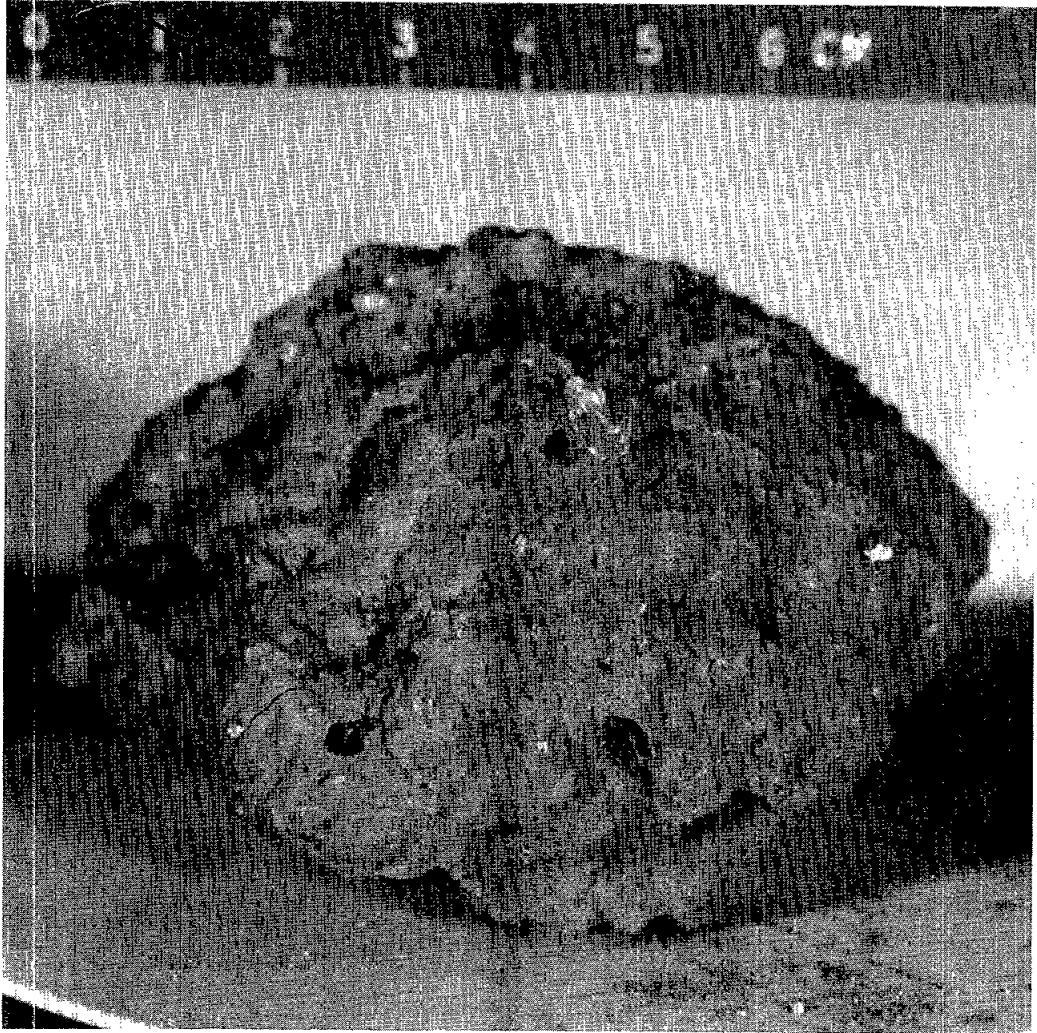
DATE: 5/15/72

FABRIC: Fine-grained, equigranular  
VARIABILITY: Color dominantly medium gray with occasional black areas.  
SURFACE: S is 95% fine dust covered; almost flat, N is dust covered, irregular, partly glass covered 0.5-1 cm vesicles. Black glass coating on all surfaces.  
ZAP PITS: Few on E, none on others. E also has least dust cover. Zap pits all glass lined.  
CAVITIES: Round, elliptical and irregular, smooth walled vesicles. Common on all surfaces. Restricted to glass coating. Average >80% of glass surface.  
SPECIAL FEATURES: This rock is very dust covered on all surfaces and hence difficult to characterize. Lithic component appears to be dominantly feldspar, no mafic silicate identified. Occasional fragments of single feldspar crystals in matrix.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic	white to lt gray	10-25	rd to ang	0.1	<0.1-1	1
Matrix	gray	75-90		<0.1		2

NOTES:

1. Several elongate clasts appear to be oriented. Proportion of clasts is very variable. Some large areas ( $\approx 5 \text{ cm}^2$ ) appear to be white beneath extensive dust cover and suggest the presence of very large white clasts.
2. Featureless matrix with a rather crystalline appearance.



SAMPLE 60275

60315

ROCK TYPE: Hornfelsed diabase or basalt porphyry  
WEIGHT: 787 g  
DIMENSIONS: 14 x 10.5 x 4 cm  
COLOR: Medium light gray, near(N6)  
SHAPE: Slabby, angular to subangular  
COHERENCE Intergranular: Tough  
Fracturing: Numerous, nonpenetrative, all orientations,  
0.5 cm to several cm spacing.

BINOCULAR DESCRIPTION

BY: Bass

DATE: 5/12/72

FABRIC: Inequigranular; relict diabasic or porphyritic texture.

VARIABILITY: Locally abundant cavities along joints

SURFACE: Smooth to minutely granulated; B and S are flat joint surfaces; others are composite, controlled by intersection of joints which vary from subparallel to moderately oblique to the face. Moderate to extensive soil coat, heaviest on S.

ZAP PITS: Many on T; few on all others; pits have prominent opaque white shatter zones which often peel or spall as flakes; glass lining commonly colorless or very light brown, but dark in some large pits. T approaches saturation (>50% pits). Soil in some pits; on S some pits penetrate and postdate soil coat.

CAVITIES: Less than 0.1%; one (<0.5 mm) spherical cavity with glass (?) walls. Many hackly surfaced, spheroidal cavities are probably molds of dislodged metal spheres; elongate, lenticular cavities along some joints, up to 1.5 cm long.

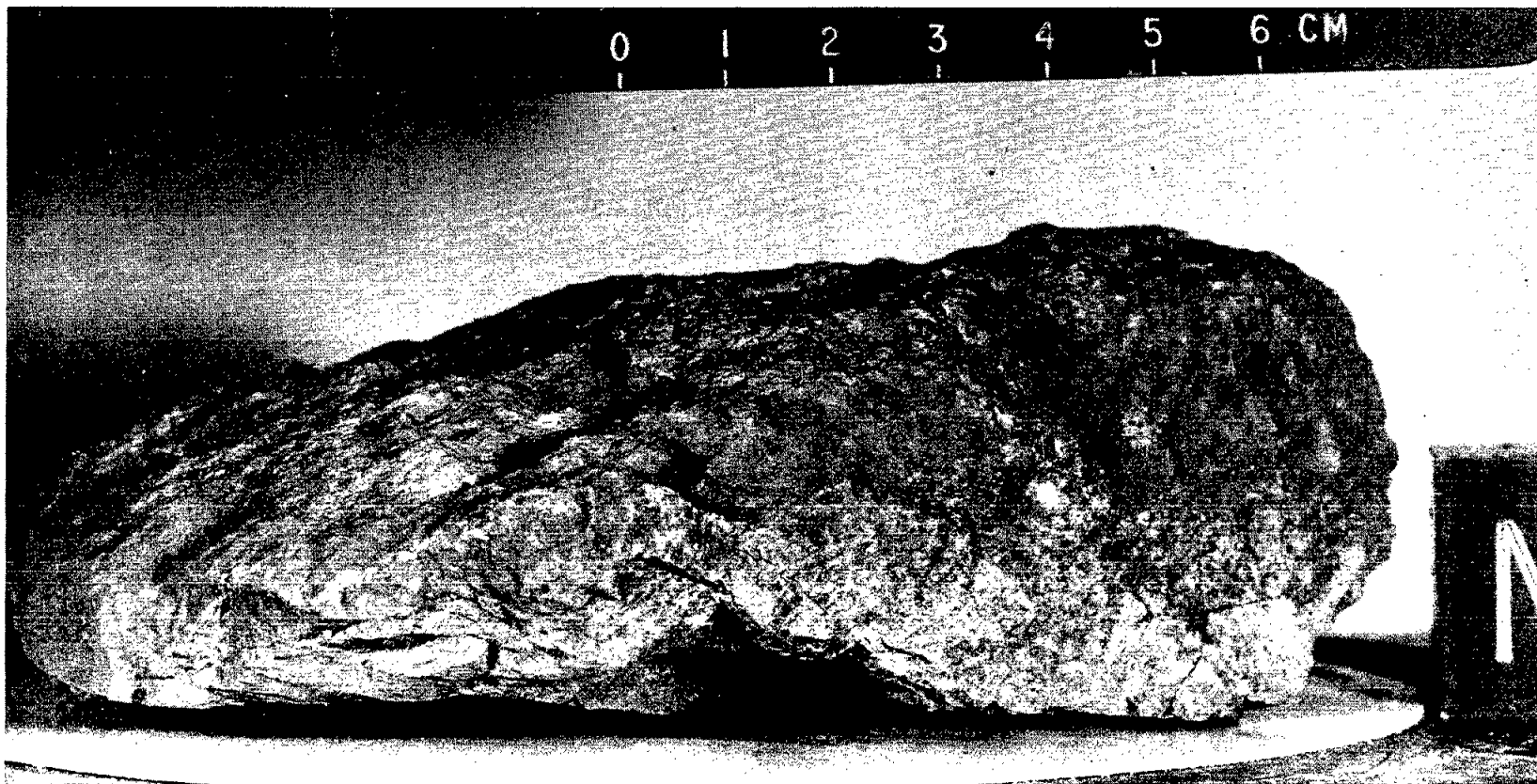
SPECIAL FEATURES: Apparently a recrystallized igneous rock; relict diabasic or porphyritic texture best seen on B. Numerous fairly widely spaced, orthogonal and oblique, planar, usually nonpenetrative fractures control the roughly slabby shape. A more numerous set is subparallel T and B. A more widely spaced set is roughly NE-SW and NW-SE, steeply inclined to T and B. No veins or glass coat (one light green, angular, transparent surface feature may be glass, which contains a broken vesicle). Moderate to extensive soil cover on all faces but B; heaviest on S and N. No clear soil line, unless it is simply the edges of B. Metal spheres, some with botryoidal surfaces, fail to fill the cavities they occupy. Very coherent rock.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Silicate I	lt gray	>50		<0.1	up to 4	1
Silicate II	dk gray	<50		<0.1		2
Metallic	gray & yellow	1%	spheroidal	<1	up to 1.5	3

NOTES:

1. Vitreous to granular (?) grains are hard to see except in one tiny fresh fracture. Here feldspar (?) grains are visible and appear to be recrystallized random laths from 2 x 1 to 4 x 1 mm.

109



SAMPLE 60315

## 60315 (Continued)

## NOTES:

2. Matrix between laths; appears to be made of very fine grains of mafic minerals and possible metal; rarely appears to be a very fine web of minute dark veins (glass?).
3. Mainly gray metal spheroids (in some cases a botryoidal mass of coalescing spheroids), generally in a cavity which the metal often fails to fill. Exposed surface may be round, smoothly sculptured, or finely irregular or frittered; often coated by dust. Minor number of yellow metallic grains with minutely irregular surfaces; may be tarnished metal or sulfide. The metal grains are generally smooth on B, which suggests that the surface irregularities on T result from the intense bombardment which produced the abundant zap pits on T.

60315,1

ROCK TYPE: Crystalline

WEIGHT:

COLOR: Greenish gray (5GY6/1)

DIMENSIONS: Fragment of 60315,0

SHAPE: Very angular - chipped from a boulder.

COHERENCE Intergranular: Tough

Fracturing: None

BINOCULAR DESCRIPTION

BY: Jackson &amp; Wilshire

DATE: 5/10/72

FABRIC: Sugary

VARIABILITY: None

SURFACE: Pitted on original surface. Broken surface is hackly.

ZAP PITS: None on B; many on others. All &lt;0.5 mm.

CAVITIES: No vesicles on this piece, but parent rock has many.

SPECIAL FEATURES: Appears representative of the parent rock which is quite homogeneous.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	grayish white	45	irreg to lath-like	1	0.5-2	1
Maf sil	med-dark gray	50	irreg patches	1		2
Glass(?)	yellowish	tr	rd	0.5		
Metal	silvery with yellow hue	<5	variable, some spheres	<0.5	<1	3

## NOTES:

1. Plagioclase? Probably aggregates, not single grains.
2. These are sugary, crystalline aggregates (less than 0.1 mm grain size) which fill the areas between the plagioclase.
3. Color ranges from silver to pyrrhotite-color.

60315

THIN SECTION DESCRIPTION

BY: Wilshire

DATE: 6/9/72

SECTION: 60315,2

SUMMARY: A very mafic metaclastic rock with a well-developed poikiloblastic texture. Orthopyroxene and clinopyroxene poikiloblasts contain abundant inclusions. Areas between poikiloblasts have a granoblastic texture grading to intergranular with increasing abundance of plagioclase laths.

## 100% GROUNDMASS

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	10	laths	0.04-0.2	Texture: Coarse poikiloblastic texture with orthopyroxene, and to a lesser extent clinopyroxene poikiloblastically enclosing plagioclase laths, corroded olivine, ilmenite(?) and metal, and broken, irregular mineral and lithic debris. Interstitial areas between poikiloblasts are occupied by granoblastic aggregates of clinopyroxene, orthopyroxene, plagioclase, ragged olivine, branching arrays of ilmenite(?) and equant metal; mineral and lithic debris are also present in interstitial areas. Plagioclase in interstitial areas is sometimes in stubby euhedral, and in places laths are sufficiently developed that the texture appears intergranular. Plagioclase, whether in poikiloblasts or interstices and whether of irregular or euhedral shape, has strong normal zoning. Some clinopyroxene poikiloblasts are twinned.
Plag	5	irreg		
Cpx	20	irreg	0.05-1.3	
Oliv	5	irreg	0.05-0.3	
Opx	55	rd to prism	to 2.2	
Oxides	3	elong	0.05-0.4	
Metal	1	spheres	0.05-0.2	Lithic fragments are all granoblastic or granoblastic-polygonal; three are composed almost entirely of plagioclase, one has olivine and clinopyroxene, and one has clinopyroxene only.
Lithic	1	rd to ang	0.4 -0.6	
Glass(?) tr				Glass(?) is deep reddish brown.

60315

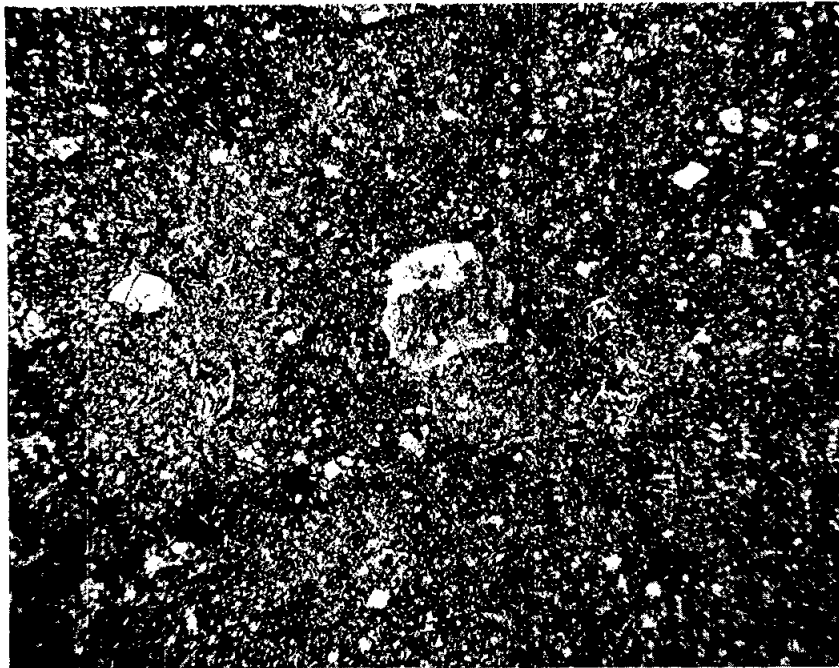
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/27/72

SECTION: 60315,2

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilm	2	see comments	to 0.25	Ilmenite and ulvospinel largely at grain boundaries with planar faces where it adjoins plagioclase laths. Ilmenite laths are rare. A few rare examples of ulvospinel laths in ilmenite. Average grain size of opaque minerals is about 0.02 mm, but range is large.
Uivo	0.5	see comments	to 0.15	
Fe-Ni	<0.5	ragged, subrd	to 0.25	
FeS	<0.3		to 0.15	



SAMPLE 60315,15

WIDTH OF FIELD  $\approx$  4 MM |



60335

ROCK TYPE: Breccia, completely recrystallized      WEIGHT: 318 g  
 COLOR: Medium gray (N5)      DIMENSION: 10 x 6 x 5 cm  
 SHAPE: Blocky, rectangular  
 COHERENCE Intergranular: Tough  
 Fracturing: Two penetrative systems, parallel and perpendicular  
 to N (appears to be jointing).

BINOCULAR DESCRIPTION

BY: Horz

DATE: 5/24/72

FABRIC: Isotropic

VARIABILITY: Homogeneous

SURFACE: Surfaces are relatively smooth; depending on pit densities they are subrounded to angular.

ZAP PITS: Many on N; few on E and W; many to few on S and B; none on T.

CAVITIES: Vugs, 0.5-3 mm occasionally very deep (5 mm); they tend to occur in clusters and cover about 2-5% of the total surface area.

SPECIAL FEATURES: 1. A holocrystalline rock with "igneous" texture and pronounced vug population. However, the grain size as well as ratio of plagioclase to mafic minerals may either vary abruptly or in a more gradual way commonly over 1/2 cm distance. The distribution of "dark" versus "light" areas is distinctly patchy; the dark areas are also more fine grained and contain 90% of N5 feldspar, and all colored minerals except light brown and light green pyroxenes(?). This specimen is highly recrystallized breccia, and recrystallization has progressed so far that it is impossible to say what is the original "matrix" and which are old "clasts." However, one clast (about 1 cm long) is recognizable and resembles the dark, fine grained portions. The vugs seem to preferentially occur in the coarser areas.

2. Metal particles are very abundant; one spherule is 5 mm in diameter.

3. Surface history may be very complicated, because there are vastly differing crater densities from side to side and even on one side and there are a variety of fracturing events. Nevertheless, surface T seems to have been shielded throughout the rock's lifetime.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase	N9 - N5	80	subhedral to granular	0.2	0.1-5	1
Mafic silicate I	yellowish green (10GY)	15	equigranular	0.2	0.1-3	2
Mafic silicate II	light brown (5YR)	3	equigranular	0.2	0.1-0.3	3
Mafic silicate III	light green	>1	equigranular	0.2	0.1-0.3	4
Mineral	brown-red	tr	rnd	0.1	<0.2	5
Metal	metallic	1	spherules, irregular	0.2	0.1-6	6
Opaque	bronze	tr	spheres, irregular	0.2	0.1-0.5	7
Opaques	black	1	granular	0.1	-.1-0.2	8

## 60335 (Continued)

## NOTES:

1. Translucent or milky white plagioclase and dark-gray plagioclase (N5).  
Different feldspars?
2. Pyroxene in both coarse and fine grained parts.
3. Pyroxene, mostly associated with coarse grained parts.
4. Olivine (?) or darker green pyroxene (like the yellow green pyroxene?).
5. Rusty brown, dull luster.
6. Metallic spherules; also interstitial, irregular particles.
7. Metal (?) or sulphides (?).
8. Ilmenite and other opaques.

60335

THIN SECTION DESCRIPTION

BY: Hörz &amp; Williams

DATE: 6/28/72

SECTION: 60335,13

SUMMARY: Troctolite, with generally intersertal texture but locally variable to diabasic and granular, contains plagioclase xenocrysts, and breccia and troctolite xenoliths. Possibly impact melt.

## HOST ROCK, 75% OF ROCK

<u>PHASE</u>	<u>% OF HOST</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	70	euhed to anhed	1 ->0.1	Holocrystalline with intersertal texture.
Oliv	25	anhed	1 - 0.1	Olivine often has plag inclusions or is penetrated by laths.
Cpx(?)	≈1	irreg	>0.1	Clinopyroxene(?) surrounds olivine.
Meso- stasis	3-4	interstitial	0.2->0.1	Mesostasis consists of interstitial glass which is partly devitrified, and contains a number of extremely small crystals and bubbles.

## XENOCRYSTS, 5% OF ROCK

<u>PHASE</u>	<u>% OF XENOCRYSTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	100	ang	0.5-2	Big plagioclase inclusion with patchy or undulatory extinction, with some indication of possible resorption. The host rock is finer-grained around these xenocrysts.

60335 (Continued)

THIN SECTION DESCRIPTION

BY: Hörz &amp; Williams

DATE: 6/28/72

SECTION: 60335,13

## XENOLITHS, 20% OF ROCK

<u>PHASE</u>	<u>% OF XENOLITHS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Trocto- lite	1 (one large one)	subrd	4	The troctolite has 95% plagioclase and 5% olivine with equigranular texture, grain size $\approx 0.5$ mm.
Breccia	95	rd - irreg	0.2-2	Fine-grained breccias containing plagioclase clasts (angular, $>0.1$ mm) but mostly composed at 60-95% plagioclase ( $>>0.1$ mm) and poikilitic pyroxene, 0-40% ( $>>0.1$ mm). Breccias are completely crystalline and show different types. Plagioclase crystals grow from the host rock into clasts. A zone about 0.5 mm wide of decreased grain size in the host surrounds the clasts. In places the texture of some breccias undergoes a continuous transition to that of the host rock.

60335

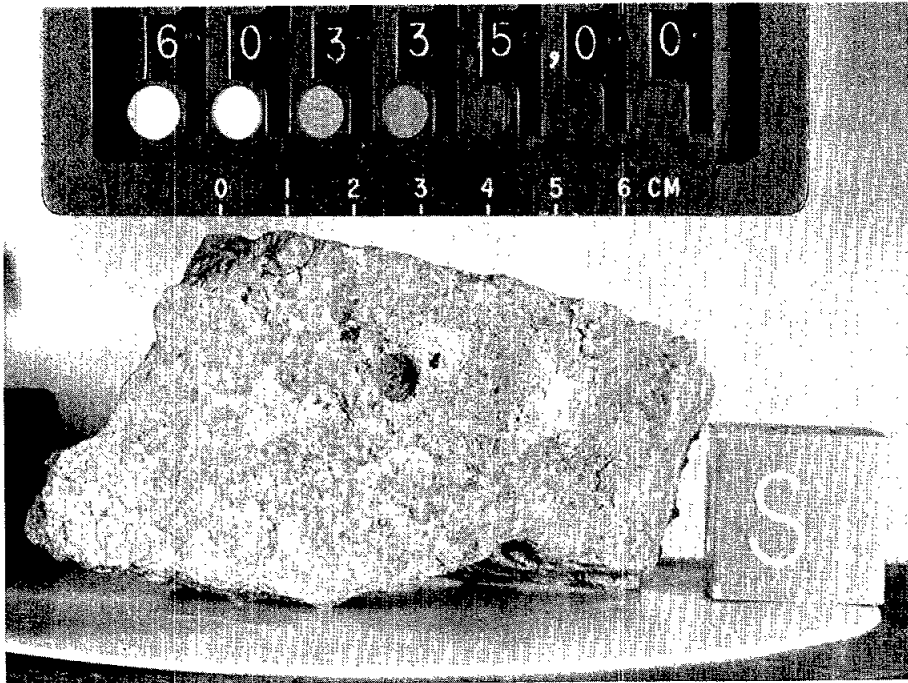
OPAQUES DESCRIPTION

BY: Brett

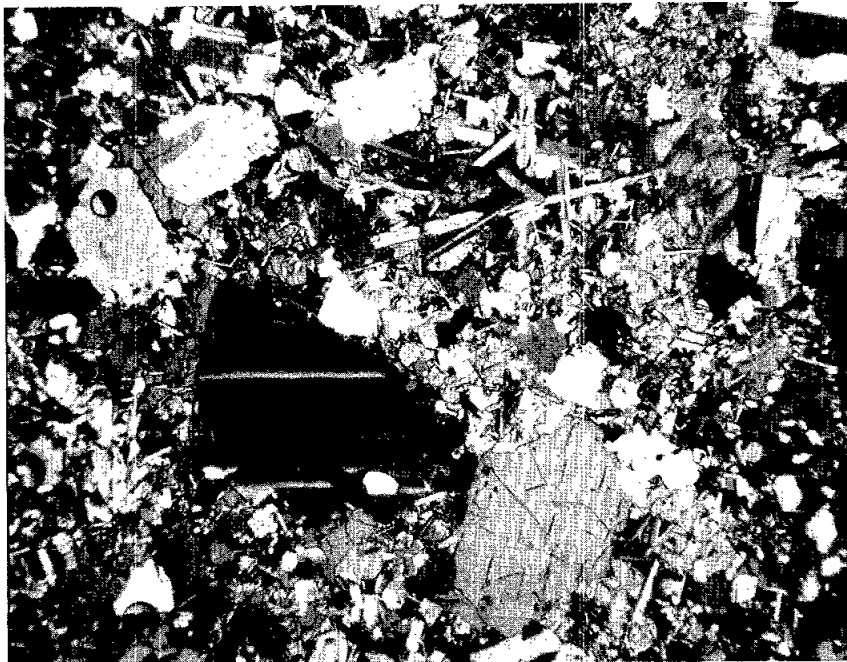
DATE: 6/20/72

SECTION: 60335,13

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilm	<1	laths, irreg	to 0.25	Total opaque mineral content less than 1%. Larger ilmenite grains are irregular laths, some with ragged borders. Smaller laths (up to $300\mu$ in length but less than $10\mu$ wide) are not ragged. Small (to $20\mu$ ) somewhat stubbly skeletal ilmenite grains occur.
Fe-Ni Troil-	<0.5 <0.5		to 0.25 to 0.05	The large metal and troilite grains tend to be ragged, the smaller areas are both ragged and bleb-like. Metal and troilite occurs as micron to submicron sized grains in pyroxene and plagioclase.



SAMPLE 60335



SAMPLE 60335,13

WIDTH OF FIELD  $\approx$  4 MM

60515-19; 60525-27; 60528,29; 60535

DESCRIPTION: Rake Sample BY: Phinney DATE: June 8, 1972

60515-9

WHITE, GRANULATED, ANORTHOSITE ROCKS

Subrounded to angular, moderately coherent, white (N9) to very light gray (N8), granular, or sugary, plagioclase-rich rocks. Plagioclase is more white and powdery in some areas but a few larger and clearer grains occur. Most surfaces show white to clear glass-lined zap pits. 60515 contains a few (5%) grains of yellow to honey-brown pyroxenes and shiny metallic fragments. Remainder of fragments show no obvious ferromagnesian minerals. 60519 probably broke away from 60517 but the chip is too fragile to fit back onto 60517 exactly.

60525-7

GRAY, TOUGH, FINE-GRAINED, CRYSTALLINE ROCKS

Subangular to angular, very coherent, medium gray (N5), fine-grained (almost aphanitic), crystalline rocks which are probably recrystallized breccia. Matrix seems to contain three shades of gray to olive gray material which may represent different minerals. Small (0.1 mm) bits of metal also occur in the matrix. 60525 contains many rounded white clasts up to 1 or 2 mm in diameter. It also contains one aphanitic gray clast and one green clast. 60527 contains one plagioclase clast and is coated with a highly vesicular material which was originally probably glass but is now medium gray (N5) to medium dark gray (N4), aphanitic, crystalline material. 60526 contains no obvious clasts. One vesicle was found in each of 60526 and 60527.

60528, 29

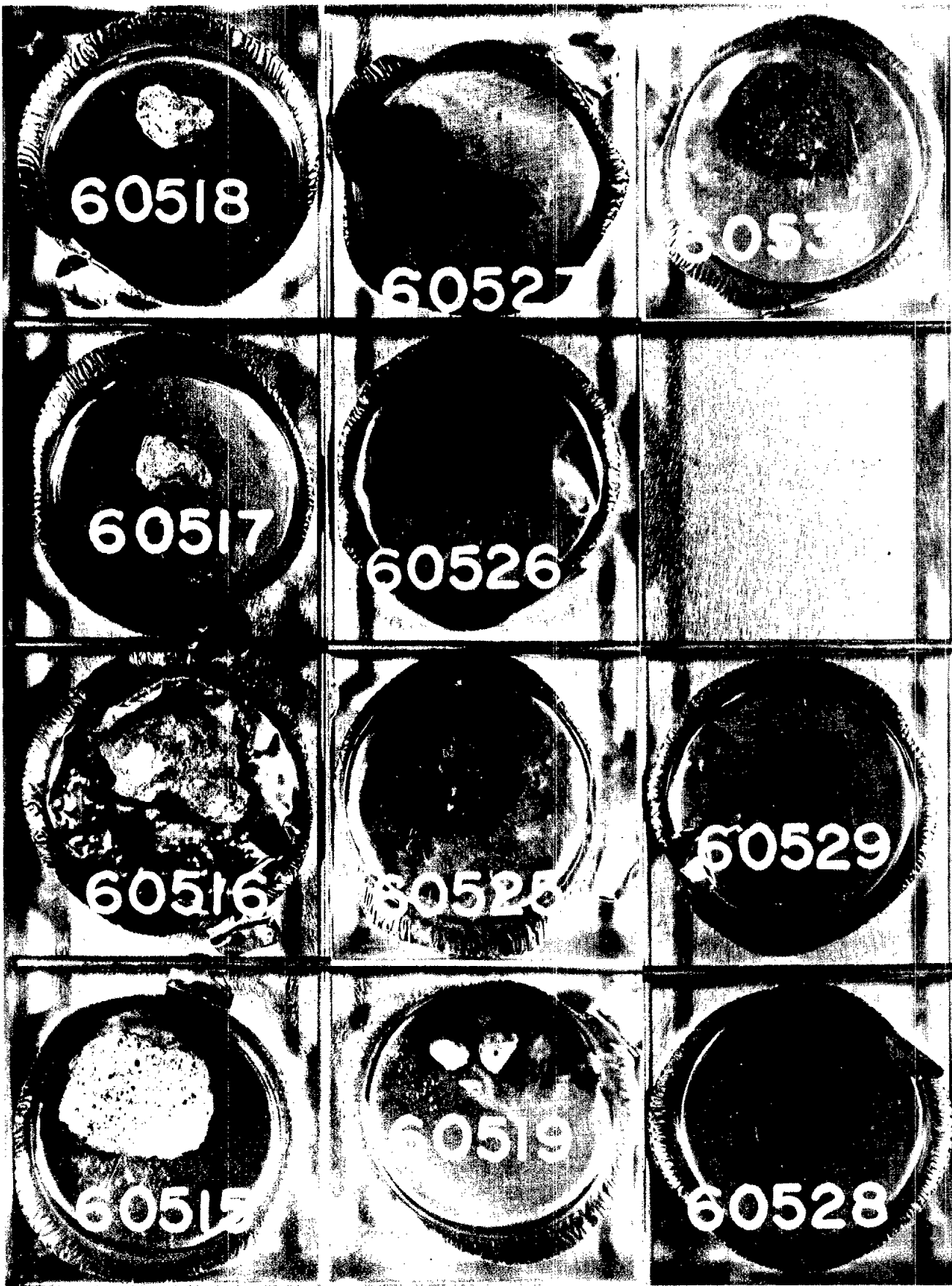
GRAY, VESICULAR GLASS

Highly vesicular, medium gray (N5) to medium dark gray (N4) glass which appears to have devitrified. Small fragments with metallic luster occur sporadically in the glass. White clasts occur in the outer parts of the glass and consist almost entirely of plagioclase except for one in 60528 which contains about 50% brown mafic silicate. Dust on the surface of 60528 is stratified from white next to the glass to usual tan color above it. Both white and tan dust occurs in the vesicles. 60529 does not show these distinctions in the dust which is all tan.

60535

LIGHT GRAY, MODERATELY FRIABLE, CLASTIC BRECCIA

Rounded to subrounded, moderately coherent, light gray (N7) to medium light gray (N6) breccia with many white clasts up to 2 mm in diameter. A few light gray clasts containing white and gray to brown minerals and some darker gray aphanitic clasts occur also in the 1 to 2 mm size. Matrix is a salt and pepper texture as though it were ground up clast material. Surfaces have abundant glass-lined zap pits and one surface has a greenish glass splash.



60518

60527

60536

60517

60526

60516

60525

60529

60515

60519

60528

60615-19; 60625-29; 60635-39, 60645-49; 60655-59; 60665-69; 60675-79

DESCRIPTION: Rake Sample BY: Wilshire & Morrison DATE: June 14, 1972

60615-18; 60625-27; 60635,36

#### GRAY, TOUGH, FINE-GRAINED, CRYSTALLINE ROCKS

Subangular to subrounded, gray, tough, fine-grained crystalline rock. 60615 through 27 contain angular plagioclase fragments and are annealed clastic rocks. Some contain vugs; others are net-veined. 60635 is very vuggy and contains plagioclase laths up to 3 mm (most are 1 mm or less) as over 80% of rock. It also contains ~10% dark brown pyroxene, 1% pale tan mafic silicate, and opaques. 60636 is highly vesicular, fine-grained, annealed and plagioclase-rich. It also contains ~10% pale yellow-green mineral of 2 mm grain size, 5% deep brown material in fine sugary aggregates 5 mm across.

60619; 60628,29

#### WHITE, MODERATELY FRIABLE TO COHERENT, GRANULAR ANORTHO-SITE

Subrounded, white, moderately friable, crushed anorthositic material. Finely powdered white material with angular areas of translucent gray plagioclase. Rocks seem to be somewhat annealed. 60628 contains traces of a pale yellow-green mineral.

60637-39

#### LIGHT GRAY, MODERATELY COHERENT, CLASTIC-MATRIX BRECCIA

Medium light gray to light gray, moderately coherent, clastic-matrix breccia containing white and gray clasts which grade in size into the matrix which consists of more ground up clast material. Scarce yellow-green clasts also occur. Clasts in 60637 and 38 are no larger than 1 to 2 mm. 60639 contains white and gray lithic clasts up to 1 cm; most are white, fine-grained and sugary. In addition it contains a 7 x 6 x 5 cm clast of anorthosite which appears to be intruded by a 1.5 x 1.0 cm zone of basalt that may have a chilled margin. Basalt occurs also as clasts up to 3 mm of ophitic reddish brown pyroxene with 35% lath-shaped crystals up to 0.3 mm long. There is also a pale yellow-green mafic silicate which together with the brown pyroxene make up 60% of basalt. Ilmenite plates up to 1 mm long make up 5%.

60645-49; 60655-59

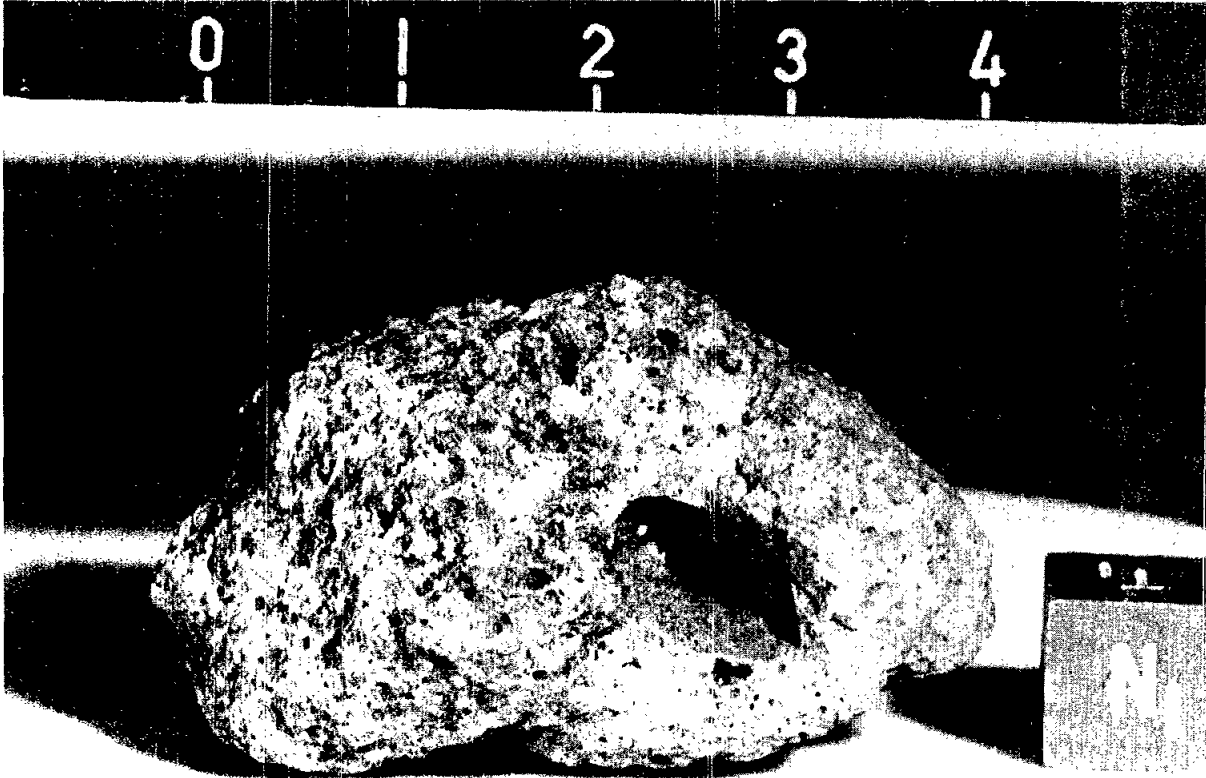
#### HETEROGENEOUS, GRAY AND WHITE BRECCIAS

White sugary clasts up to 4 mm across make up 5 to 20% of the rocks and occur in a medium gray to dark gray subvitreous matrix. Net veins of glass crossing all boundaries is common. 60659 contains larger clasts up to 1.7 x 0.8 cm. Its matrix appears more vitreous and contains crushed spinel and sugary, green clasts.

60665-69, 60675-79

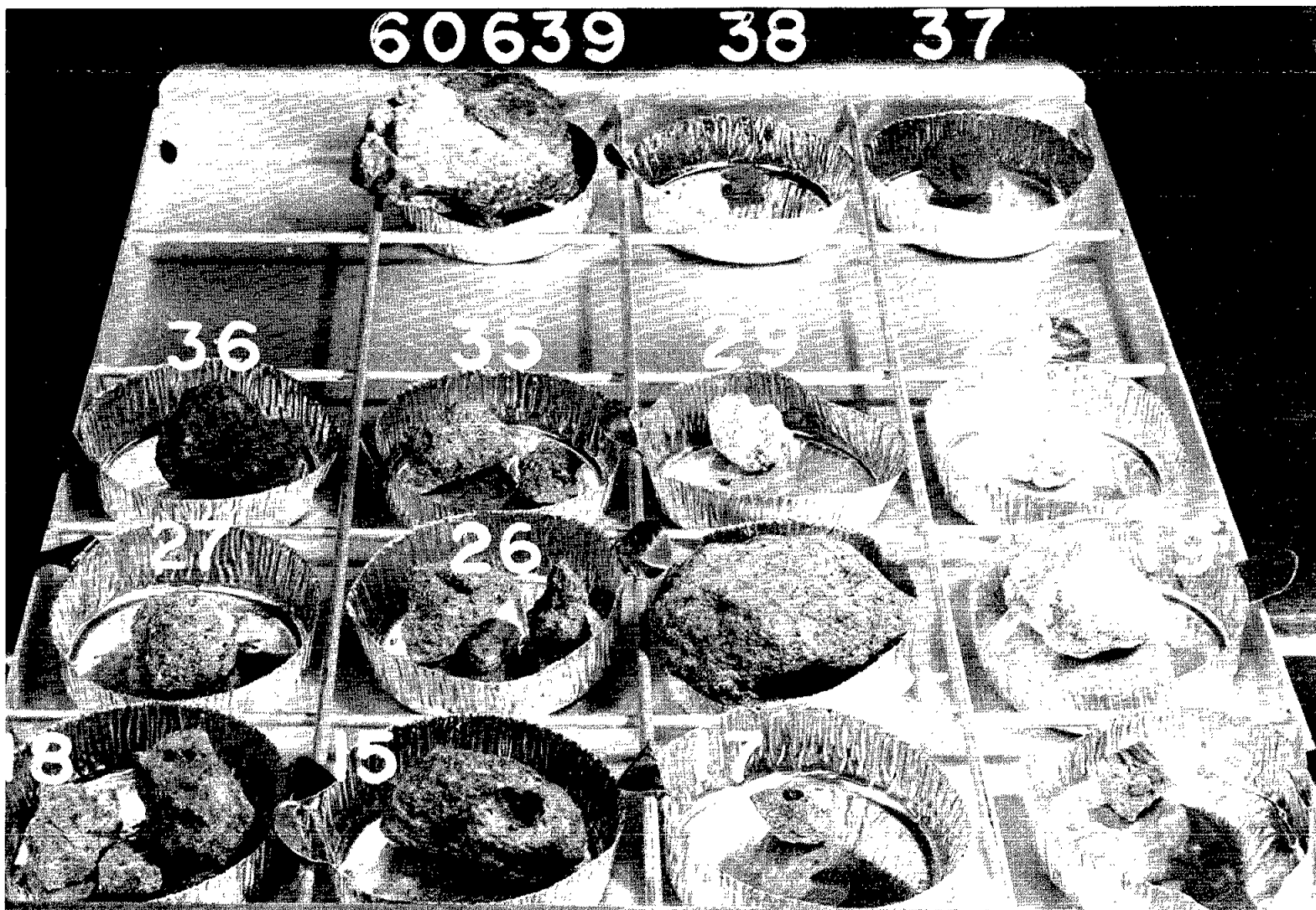
GRAY, VESICULAR GLASS

Gray, vesicular glass comprises 75% or more of these fragments. The remainder is white to light gray fine-grained inclusions.



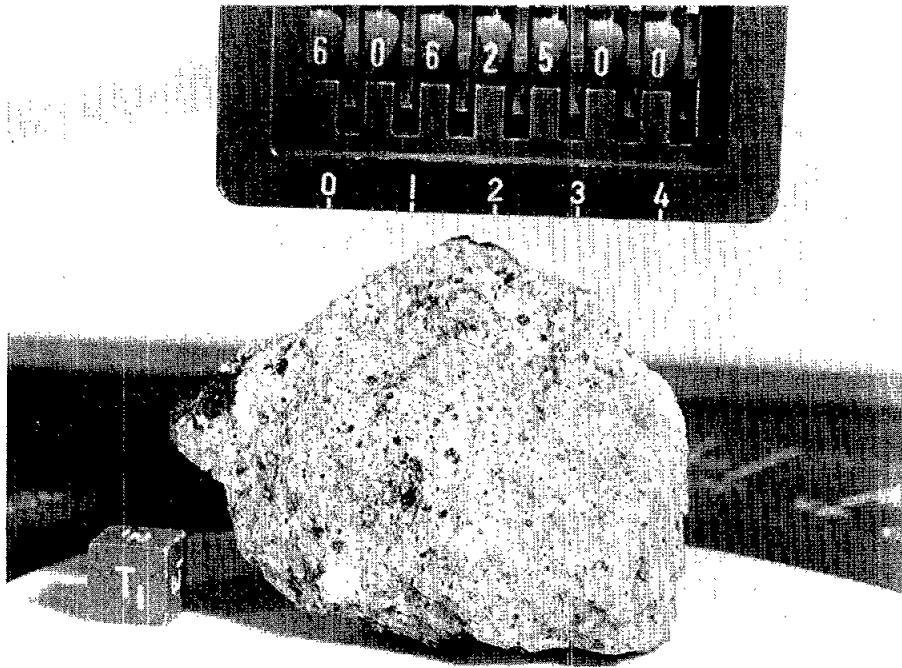
SAMPLE 60615



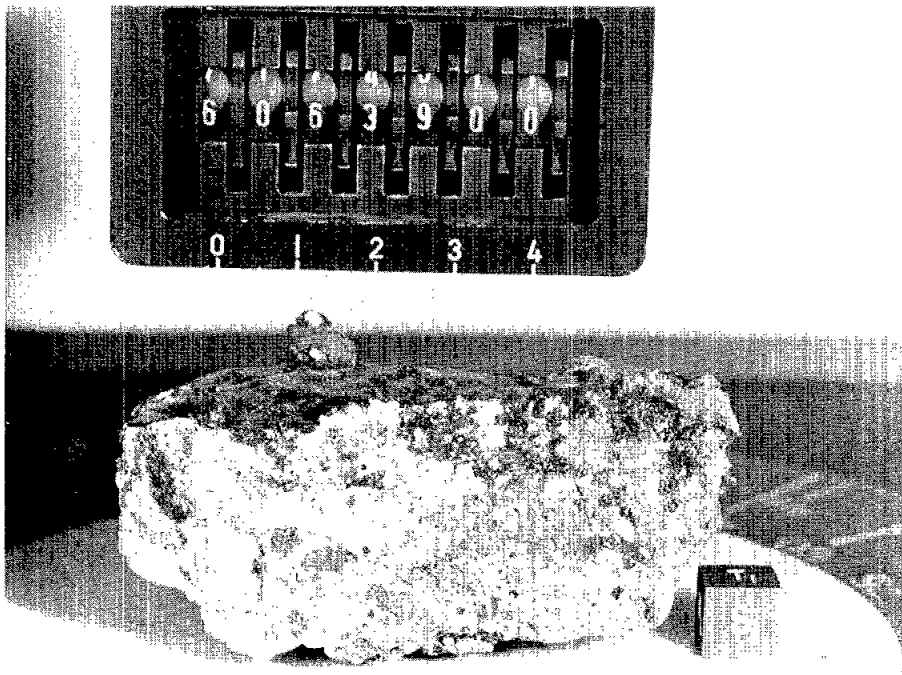


121

RAKE SAMPLE 60615-19,25-29,35-39



SAMPLE 60625



SAMPLE 60639



RAKE SAMPLE 60645-49,55-59,65-69 &amp; 75-79

61015

ROCK TYPE: Breccia, veined

WEIGHT: 1789 g

COLOR: Medium gray (N4-N5)

DIMENSIONS: 15 x 12 x 10 cm

SHAPE: Blocky, subangular

COHERENCE Intergranular: Tough

Fracturing: Some nonpenetrative in the glass. The penetrative fractures in the rock are healed by glass.

BINOCULAR DESCRIPTION

BY: Reid & Wilshire

DATE: 5/19/72

FABRIC: Gray breccia veined by white material

VARIABILITY: Partial coating of vesicular glass

SURFACE: Glass covers about 75% of S and 65% of B.

ZAP PITS: Many on N, T; few on E; none on S, B, W.

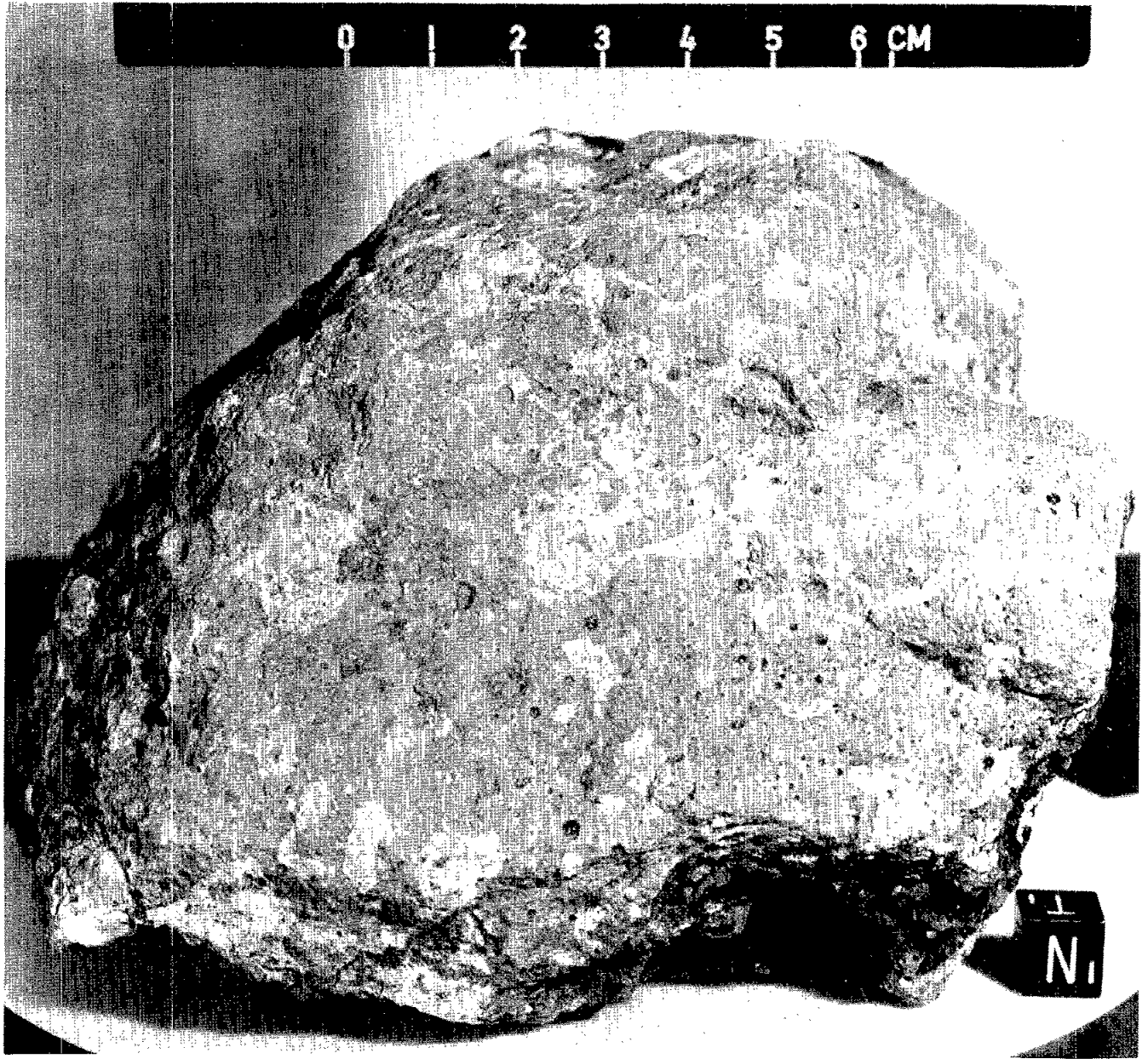
CAVITIES: None

SPECIAL FEATURES: Unusual net veining

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Veins	white	25				1
Gray component	medium gray	70		0.2	<0.1- 1	2
Lithic fragments	white	5	ang to subrd	5	1.0-10	3
Glass	black	<5				4

NOTES:

1. Net veins in gray breccia. Veins are from <0.1 to 5 mm thick and consist of 70-80% white feldspar, some tubular, mostly angular, to 2-3 mm; <1% irregular black opaque grains, <1% honey yellow, angular grains to 0.3 mm. Remainder may be finely divided mafic silicate and/or plagioclase. The net veins enclose angular blocks and slivers of gray component in a jigsaw pattern.
2. About 50% anhedral white (probably feldspar) and 50% partly brownish and partly dark gray material. The dark gray material may be glassy and appears to be uniform.
3. Looks same as veins. 80% or more white feldspar. Opaques are rare.
4. Contains angular white fragments 1-3 mm. Vesicles are flattened parallel to surface. The glass is about 1 mm thick, and has many fractures.



SAMPLE 61015

61015

THIN SECTION DESCRIPTION

BY: Ridley

DATE: 6/28/72

SECTION: 61015,5

SUMMARY: Matrix is very fine-grained, overall sub-diabasic, and occasionally sub-poikiloblastic. May be shock melt, with only partly resorbed feldspar. Groundmass dominated by pyroxene and fine feldspar laths. White patches are exclusively anorthosite showing cataclastic textures.

Compare with the binocular description: gray matrix, white veins and clasts, and the percentage of dark-to-light varies widely throughout rock.

## MATRIX, 75% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Pyrox	40	irreg	to 1	---
Plag	55	blocky-lath	to 0.5	Two feldspar generations. One blocky up to 0.5 mm and is always larger than groundmass feldspar. Main feldspar is lath-like with size up to 0.1 x 0.005 mm and often is enclosed within pyroxene. Areas occur within the matrix of the same material but are finer grained. One 3 x 3 mm patch is very fine-grained with feldspar clasts and a spherical metal grain. Few small irregular cavities.
Metal	4	irreg	to 0.4	---
FeS	1	irreg		---

## MINERAL CLASTS, 10% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Pink spinel	5	irreg	0.35	One pink spinel showing signs of resorption. Very thin clear rim to grain which may be anisotropic. Two large metal grains are partly rimmed by a reddish-brown stain.
Feldspar	80	subang	0.5	---
Pyrox	15	subrd		---

## 61015 (Continued)

THIN SECTION DESCRIPTION

BY: Ridley

DATE: 6/28/72

SECTION: 61015,5 (Continued)

## LITHIC CLASTS, 15% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Anorth	100	subrd and vein-like	5-3	Anorthosite clasts are elongated in places. At one locality the clast appears to be dike-like into the matrix. Several clasts are actually interconnected by thin dike-like apophyses. Interstitial patches of brown to brownish-gray glass (may be slightly devitrified mesostasis glass). Anorthositic clasts composed of fractured and deformed grains of plagioclase (avg size: 0.3-0.5 mm, maximum: 1 mm) and very rare olivine. All clasts show signs of cataclasis, particularly along grain boundaries, giving a mylonitized feldspathic matrix.

61015

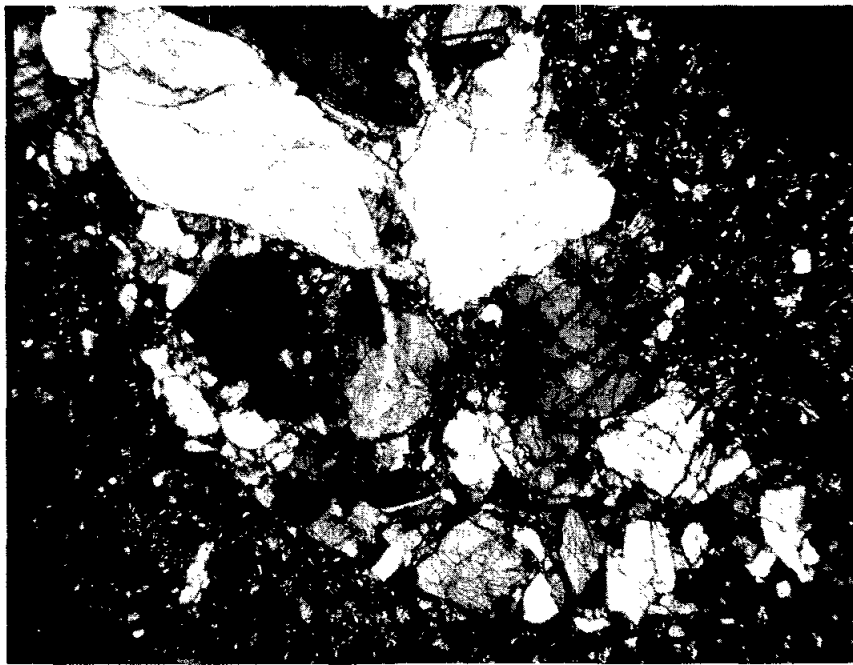
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/26/72

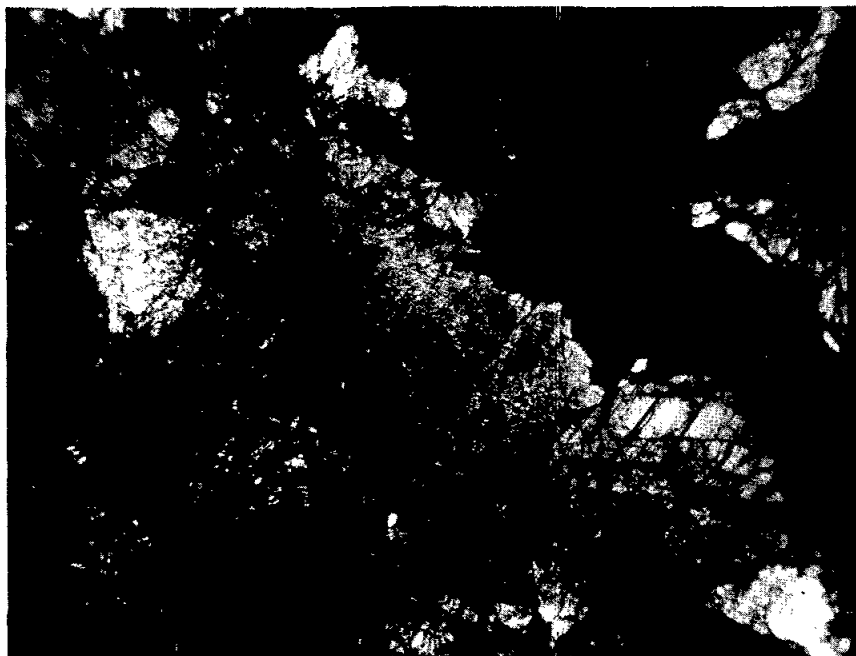
SECTION: 61015,5 ,6 ,7 and ,8

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni FeS	<0.5 <0.2	subrd subrd	to 0.4 to 0.4	Opaque mineral content low, no oxide phase seen in this preliminary examination. Metal and troilite in ragged, subrounded grains up to 400 $\mu$ diameter, but averaging about 20 $\mu$ .
Schreibersite	tr			One large metal grain has metal-schreibersite, eutectic-like intergrowth.



SAMPLE 61015,5

WIDTH OF FIELD  $\approx$  4 MM



SAMPLE 61015,17

WIDTH OF FIELD  $\approx$  4 MM





## 61016 (Continued)

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
(I) surface	light gray	<5			<1	1
(I) interior	medium gray	85			aphanitic	2
(IIa)	dark gray	1				3
(IIb)	dk to med gray	10				4
(IIc)	lt to med gray	2				5
Spinel(?)	red to red- brown	<0.1	equant to blocky to irreg		<0.2	6
Metal	gray metallic	<<0.1	films and spheroids		<0.2	7

## NOTES:

1. Light gray, mottled with dull white, uncommonly colorless; forms outer 3-5 mm of shocked anorthosite; opaque, but not due to shock (which produces bright white color); probably derived from shocked plagioclase which went through a glassy state (see 2.); devitrification occurred by heating followed by slow cooling, one cleavage seen (<<1 mm).
2. Translucent-to-transparent medium gray glass derived from plagioclase; no cleavages; beautiful conchoidal fracture is common; probably maskelynite, but may be structurally much more disordered than most diaplectic maskelynite. Deep gray color probably related to transparency; locally grades to light gray or colorless.
3. Outer 3-4 mm of glass coat on B, plus much of glass coat on N and S, and uncommon veins in (I). Glass has conchoidal fracture, no microphenocrysts, but contains minor unmelted relics like (I) interior, less commonly like (I) surface. Locally light gray or almost colorless (see mated daughter fragment broken off of B).
4. Most abundant component of (I), sharply bounded against (IIa); 30-40% equant, anhedral, opaque white plagioclase microphenocrysts (about 0.1 mm) in dark gray glass (conchoidal fracture); many unmelted relics of (I) interior (up to 6 mm, or more); rare unmelted red or red-brown spinel relics (>0.1 mm). Toward interior of rock percentage of plagioclase microphenocrysts increases to as much as 60%. Grades to (I) surface of main part of rock sharply (over 1 mm or less), but never contacts (I) interior of main rocks. Rare dark gray veins of glass project from (IIb) into (I).
5. Local areas, (largest on T and N) of dense, cherty, devitrified glass; coherent, but with hackly surface as if finely fractured; inclusions of (I) surface, but not (I) interior, and of red or red-brown spinel relics. Occurs within millimeters of (IIb), but never in contact with it; their relations are unknown.
6. Red to red-brown and in some cases yellowish particles, which is probably spinel, is primary in (I), unmelted and reprecipitated relics in (II). Color may vary with composition or state of shock.
7. One spheroid on surface of B; 1 or 2 spheroids in vug exposed on T; films or flat particles in soil cover on B.

131



SAMPLE 61016

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/23/72

SECTION: 61016,13 and ,15

SUMMARY: Shocked anorthosite or almost monomict anorthosite breccia; the only "foreign" component is the lithic material whose origin is uncertain. The sections contain about 8 mm of highly shocked plagioclase which grades to pure maskelynite. The gradational zone of mixed maskelynite and shocked plagioclase is 1.5 to 2.5 mm wide. The shocked plagioclase zone appears opaque white to light gray in hand specimen, in contrast to the transparent, medium gray, and vitreous maskelynite which probably constitutes the bulk of the interior of 61016. The outer part of the shocked plagioclase zone is seamed by devitrified maskelynite (plagioclase melt) which was probably formed *in situ*. Puzzlingly, this "melt", which represents the extreme state of shock-induced structural disorder, is associated with shocked birefringent plagioclase. The intermediate state of disorder (isotropic maskelynite with structural memory) is missing in this zone, and exists by itself in the interior of the specimen.

## MATRIX, 2% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Devitri- fied maske- lynite	100	veins & seams	width: 0.1-0.3	This phase forms seams which appear once to have been fluid. They are seen only in section 15 on the side opposite the bulk of the maskelynite (section 13 lacks this side) and represent essentially pure plagioclase melt formed either in place or injected from the outside. Where ovoid vesicles (up to 0.2 x 0.1 mm) are present, the seams are entirely devitrified; where the seams retain undevitrified maskelynite, no bubble is present. The devitrification products are fibrous, often radial. Where remnant maskelynite is present, the devitrified fringes are spherulitic, and discrete spherulites embay the remnant glass as rounded botryoidal protrusions. Within the remnant glass, birefringent stellate clusters of fibers appear which are probably centers of incipient devitrification. This type of devitrification is seen only in the maskelynite which gives independent evidence of having been fluid and probably devoid of structural memory. The bulk of the maskelynite, at the other end of the

61016 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/23/72

SECTION: 61016, 13 and ,15 (Continued)

MATRIX, 2% OF ROCK (Continued)

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
				section, grades to shocked plagioclase by increase of birefringent webs and patches, but shows no fibrous devitrification. The fibrous, devitrified maskelynite clasts in soils and breccias from practically all Apollo missions must have gone through a melt state.

MINERAL CLASTS, 97% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	80	blocky, subang to subrd	to 4.6	Plagioclase is extremely shocked. One or two sets of lenticular deformation lamellae occur in many crystals, including those extensively to almost wholly converted to maskelynite. Twinning is very rare, and apparently was destroyed by shock if originally present. The most common type of twinning seen is a vague, distorted gridiron type. Some cracks in plagioclase (and in maskelynite) appear to be lined by mafic films or amoeboid patches of opaque material.
Mafic	I	blocky to elongate	to 0.9	Shattered to highly shocked (wavy extinction). Mainly orthopyroxene (commonly lamellar), with lesser augite and olivine, and one grain of subcalcic augite or pigeonite. Elongate shapes and distribution of mafics suggest that they were minor components in an anorthosite; some of them are still included within large remnant plagioclase grains; others (section 13) appear to have been interstitial.

## 61016 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/23/72

SECTION: 61016,13 and ,15 Continued

## MINERAL CLASTS, 97% OF ROCK (Continued)

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Maskely-nite	15			Grades to plagioclase by gradual increase of birefringent patches. Probably constitutes the bulk of the interior in 61016. Inclusions of various sorts were inherited from the parent - plagioclase, mafic grains, parallel opaque rods, high relief, highly birefringent material in parallel cracks that may be relict cleavages, and low relief inclusions similar to the "antiperthite" in plagioclase.

## LITHIC CLASTS, 1% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Brown clast	100	blocky to ovoid to vein-like	2.7 x 0.1 (max)	Very fine-grained; brownish color is due largely to disseminated tiny mafic(?) grains and irregular high-relief opaque particles (opaque minerals or holes). Between crossed polarizers the clasts vary from chert-like (microgranular) to patchy (similar to devitrified glass). Some of the bodies are sharp and discrete, but some are smeared and grade out to vein-like extensions. These clasts are the only component inconsistent with an origin of 61016 as a shocked crystalline anorthosite or monomict breccia. Perhaps they are not foreign but arise somehow from relatively mafic areas by shock-related processes of comminution or of melting and crystallization.

61016

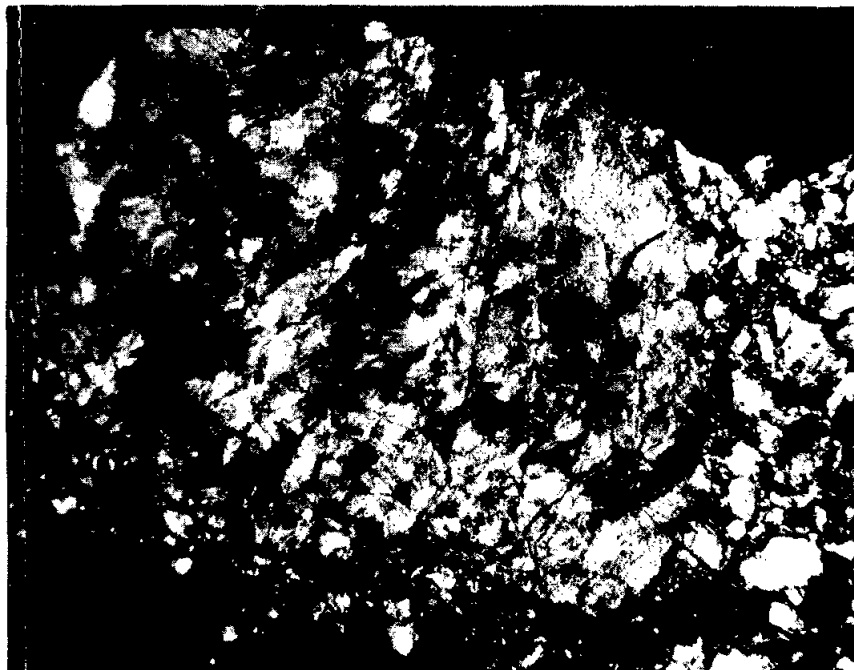
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/26/72

SECTION: 61016,13

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilmenite	tr	rd	to 0.005	Opaque content is surely less than 0.005%. One 5 $\mu$ ilmenite grain and 2 or 3 smaller ones, one each of 3 $\mu$ troilite metal grains and perhaps 10 submicron grains of these phases.
Fe-Ni	tr	rd	to 0.003	
FeS	tr	rd	to 0.003	



SAMPLE 61016,13

WIDTH OF FIELD  $\approx$  4 MM

61135

ROCK TYPE: Breccia  
 COLOR: Light gray (N7)  
 SHAPE: Subangular, equidimensional  
 COHERENCE Intergranular: Friable  
 Fracturing: Few, nonpenetrative

WEIGHT: 245 g  
 DIMENSIONS: 6.5 x 5.5 x 8 cm  
 and  
 Three fragments  
 2 cm to 4 cm

BINOCULAR DESCRIPTION

BY: Butler & Simonds

DATE: 5/24/72

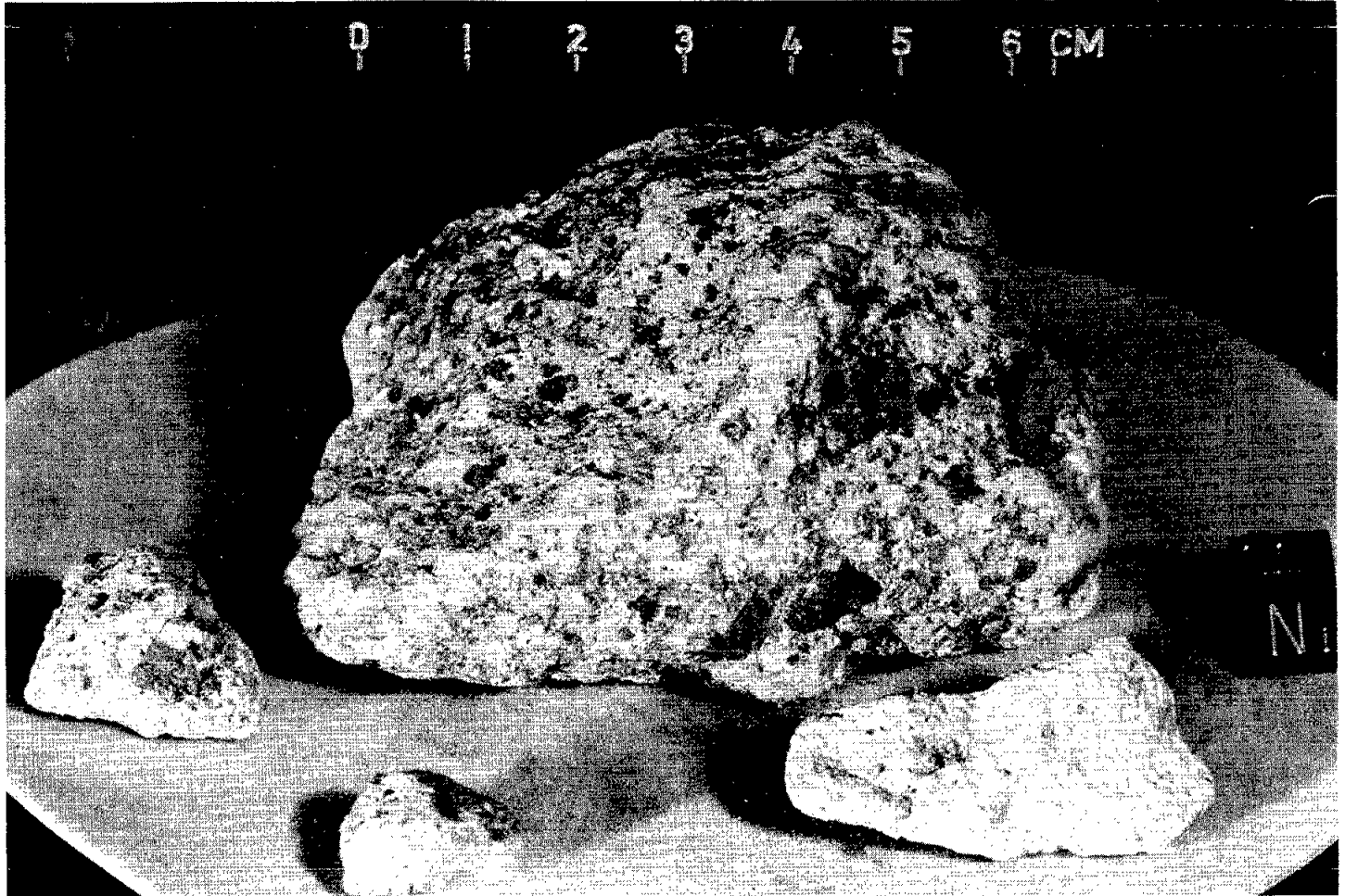
FABRIC: Homogeneous  
 VARIABILITY: None  
 SURFACE: Original surfaces are rounded and knobby; fresh-broken surfaces (E, and B, 1/2 W corner) are hackly.  
 ZAP PITS: Few on T, W, S, B; none on N, E. Pits are very penetrative, tubular, with hemispherical bottoms and botryoidal glass linings.  
 CAVITIES: None  
 SPECIAL FEATURES: Small fragments look typical of rock.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	lt gray (N7)	88			<0.1	1
Lithic	dk gray (N3)	10	subang, columnar	0.3	0.1 -15	2
Plagioclase	milky white (N9)	2		0.2		3
Glass	dk greenish yellow (10Y 6/6)	tr		2		4
Maf sil	lt brown (5YR 6/4)	tr	subang	2		
Metal	orange-red	tr			<0.05	5

NOTES:

1. Cleavage flashes, probably granulated mineral grains, mostly plagioclase. Minute dark gray-black specks, some of which may be same as black lithic clasts and some may be opaques.
2. Aphanitic, sugary, irregularly vesicular, sharp contact with matrix.
3. Some are vitreous.
4. Vitreous luster.
5. Tarnished look.





SAMPLE 61135

61155

ROCK TYPE: Breccia  
 COLOR: Medium light gray (N6)  
 SHAPE: Blocky, elongate, angular  
 COHERENCE Intergranular: Moderately coherent  
 Fracturing: Nonpenetrative, breaks easily

WEIGHT: 47.6 g  
 DIMENSION: 6 x 7 x 2.5 cm

BINOCULAR DESCRIPTION

BY: Wilshire

DATE: 5/24/72

FABRIC: Breccia

VARIABILITY: None

SURFACE: B has 2 x 5 mm slickensided surface; broken faces coarsely hackly, natural faces finely hackly, pitted.

ZAP PITS: None on B; few on W and E; many on S and T; many on unbroken part of N with a few on broken part.

CAVITIES: None

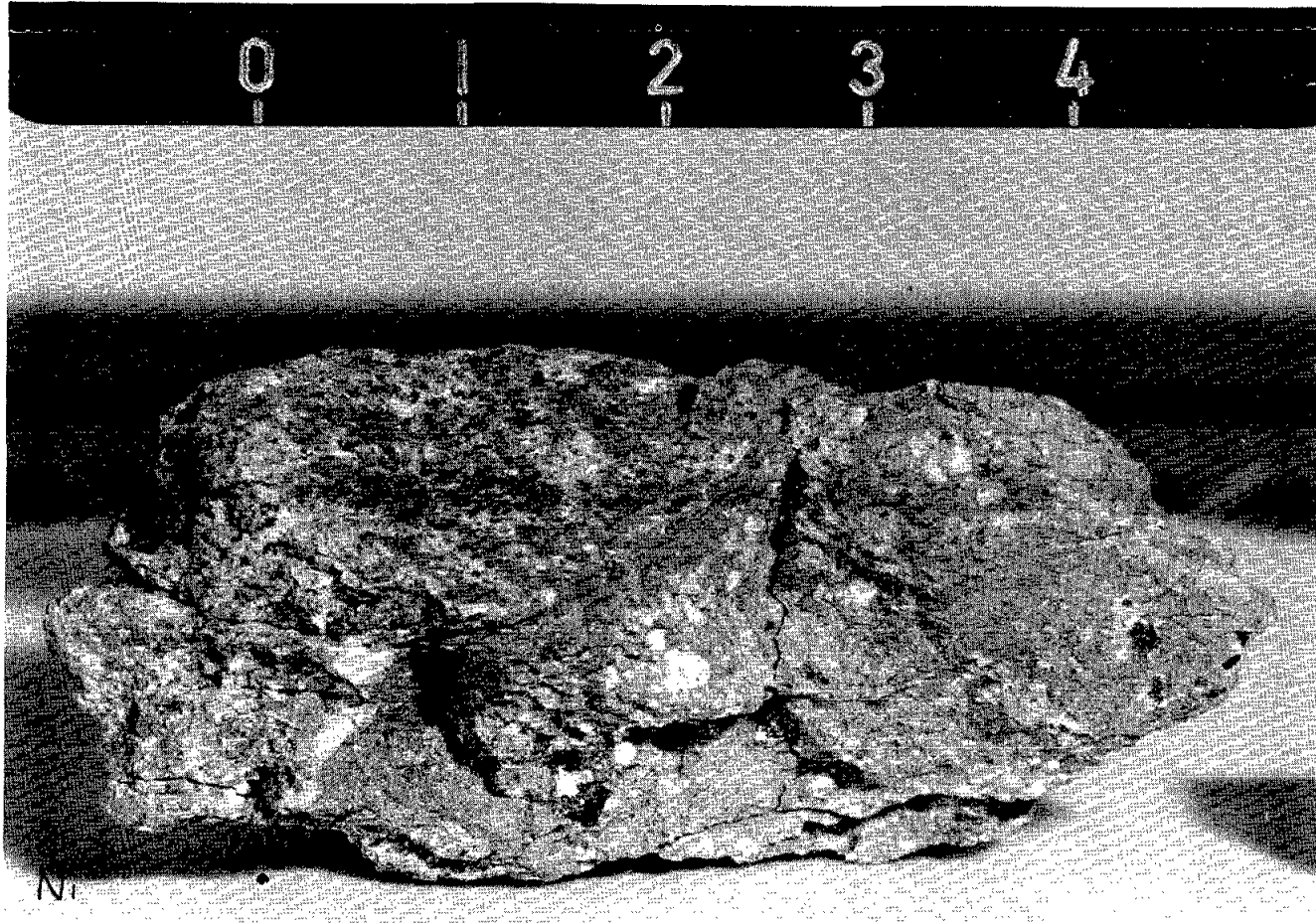
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	white to black	2				1
Metal	silver to yellowish	1	spheres to irregular	0.75	0.5-2	2
Lithic I	white to yellowish	25	blocky, ang	2.5	<1-8	3
Matrix (Lithic II)	medium light gray	70		0.1		4
Dark Lithic III	dark gray	2				5

## NOTES:

1. Short (2-5 mm), thin, irregular veins, which cut clasts and matrix alike, and whose color depends on host.
2. Some metal-lined spherical cavities (sphere fell out?). One broken sphere is distinctly zoned, with a silver core and a yellowish rind; possible tiny silicate patches in metal.
3. White clasts, many with irregular shape, not sharply bounded; others have sharp contacts with matrix. Small ones mostly pure white, fine-grained plagioclase(?). Large ones have variable proportions of yellow green mineral, mostly less than 10%, but the yellowish-white clast has 20% along with 5% or so gray pyroxene(?). One clast with yellow-green mineral and a trace of tiny pink spinel(?) grains. Another has a 2 x 4 mm patch of dull gray material with a pinkish color. Some clasts are sugary, but they are likely fragmental than annealed.
4. Salt and pepper texture, about 60:40 white to light gray plus brownish gray, but variable with occasional plagioclase laths. Probably annealed. Larger pieces are angular fragments of feldspar and a fine yellow-green pyroxene(?). A few small patches (<1 mm) of sugary yellow-green mineral.
5. Thin film of aphanitic material adhering to B face over 1 x 2 cm area. Sample was apparently fractured close to a boundary of this and the main rock.

139



SAMPLE 61155

61156

ROCK TYPE: Breccia, annealed

WEIGHT: 58.5 g

COLOR: Medium gray (N5)

DIMENSIONS: 4 x 2.7 x 2.5 cm

SHAPE: Blocky, angular

COHERENCE Intergranular: Tough  
Fracturing: Few, nonpenetrative

**BINOCULAR DESCRIPTION**

BY: Wilshire & Stuart-  
Alexander

DATE: 5/24/72

FABRIC: Breccia

VARIABILITY: Irregularly distributed vugs

SURFACE: Finely hackly

ZAP PITS: Many on S, T, and W; few on N, B, and E

CAVITIES: 1% irregular vugs, 0.5 mm and less

SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic	light gray	15	subrnd		22 x 20	1
Matrix	medium gray	85				2

**NOTES:**

1. One clast, only part of it left at edge of rock. Clast is a crushed feldspathic rock with angular pieces of gray plagioclase to 1.5 mm and 20-25% very pale yellow brown mineral. Remainder is more finely crushed (from 1 mm down) plagioclase; probably annealed. Trace of opaque specks. Tiny tube-like cavities.
2. Salt and pepper texture, about 50:50 white and gray. Very finely crystalline, annealed. A few percent tiny plagioclase laths, 1% elongate opaque grains. Trace of silvery metal.

61156

THIN SECTION DESCRIPTION

BY: M. N. Bass

DATE: 6/26/72

SECTION: 61156,5

SUMMARY: Recrystallized olivine norite breccia.

## MATRIX, 86% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Opx	21.4	equant to ovoid		Orthopyroxene poikiloblasts enclosing plagioclase.
Plag in Opx	17.4	lath to anhedral		
Olivine	13.6	anhedral		Olivine - anhedral, possibly poikiloblastic; forms equant grains in interstitial plagioclase; several grains may extinguish together.
Plag enclosing olivine & interstitial to Opx	44.2			
Metal	1.2	ovoid to spheroid		Metal spheroids - minutely ragged edges.
Opauques	2.1	Subhedral to anhedral, equant		
Rutile(?)	0.1	prismatic(?)		Rutile(?) - High refractive index and birefringence, associated with opaques.

## MINERAL RELICS=UNRECRYSTALLIZED GRAINS, 14% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Opx	12.1			Orthopyroxene - main mafic relic; has associated augite in one case, olivine in another. Holes - apparently mostly due to plucking of orthopyroxene relics.
Holes (=Opx)	41.4			
Plag	46.4			

## ADDITIONAL COMMENTS:

Based on 1300 count mode, with direct results as follows:

Opx poikiloblasts	18.4	Holes	5.8 (=plucked Opx relics)
Plag in Opx poikiloblasts	15.0	Metal	1.0
Olivine	11.7	Opauques	1.8
Interstitial Plag enclosing olivine.	38.0	Rutile(?)	0.1
Plag relics	6.5		
Opx relics	1.7		

## 61156 (Continued)

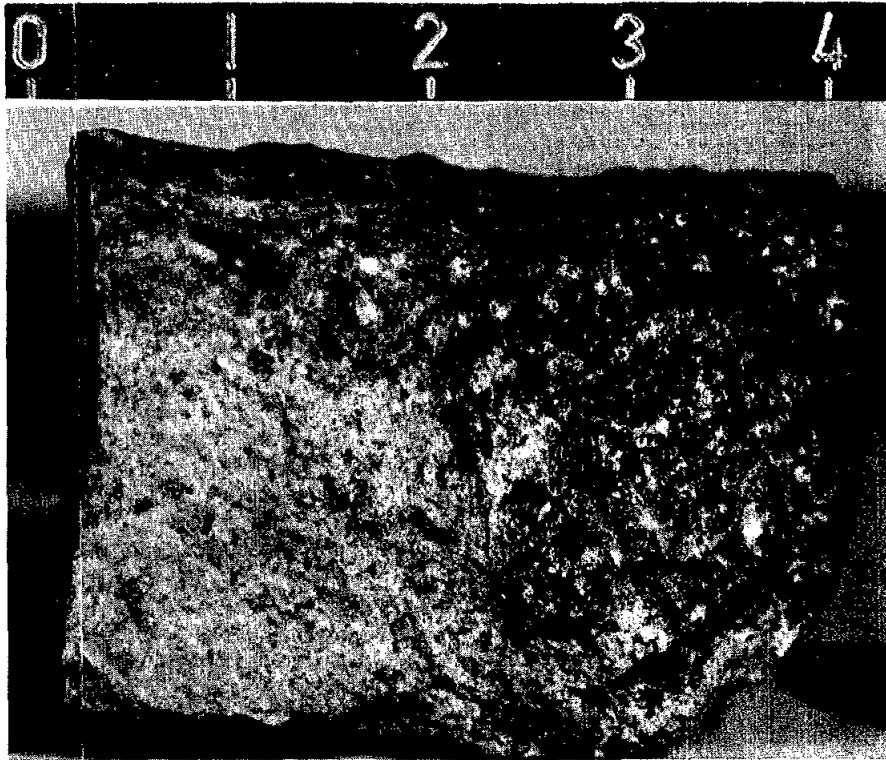
OPAQUES DESCRIPTION

BY: Brett

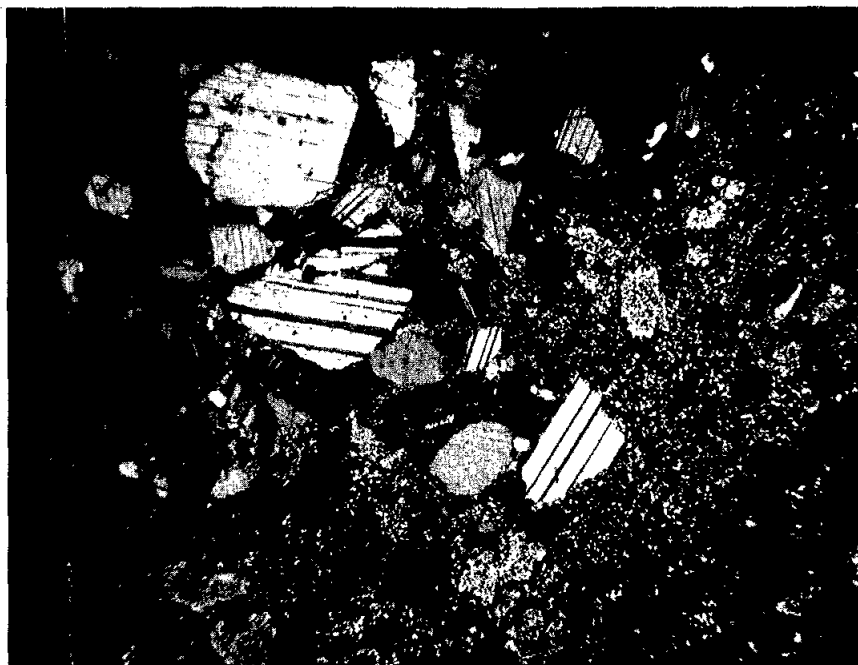
DATE: 6/26/72

SECTION: 61156,5

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni Troilite	1 <0.2	rd, ragged rd	to 0.05 to 0.1	Metal content is high; metal remarkably free of associated troilite.
Ilmenite	1	irreg	to 0.05	Ilmenite in flames, irregular shaped grains, and subrounded, interstitial blebs.
Ulvospinel	tr	rd	to 0.02	A few possible ulvospinel grains occur.



SAMPLE 61156



SAMPLE 61156,6

WIDTH OF FIELD  $\approx$  4 MM

61175

ROCK TYPE: Breccia, grey matrix  
 COLOR: Light grey (N7) to medium light gray (N6)  
 SHAPE: Irregular, subangular  
 COHERENCE Intergranular: Friable  
 Fracturing: Few penetrative, sub-parallel to T.

WEIGHT: 543 g  
 DIMENSION: 10 x 11 x 6 cm

BINOCULAR DESCRIPTION

BY: Ridley & Reid

DATE: 6/2/72

FABRIC:

VARIABILITY: Overall, homogeneous in color, texture.

SURFACE: T is a mature surface. B is a mature with 20% dust cover. N is a broken, fresh surface.

ZAP PITS: Many on T (one is 0.75 cm), B (some are 1 mm); none on N, S, E, W.  
 All pits are glass lined.

CAVITIES: None on T and B.

SPECIAL FEATURES: This rock resembles 60016.

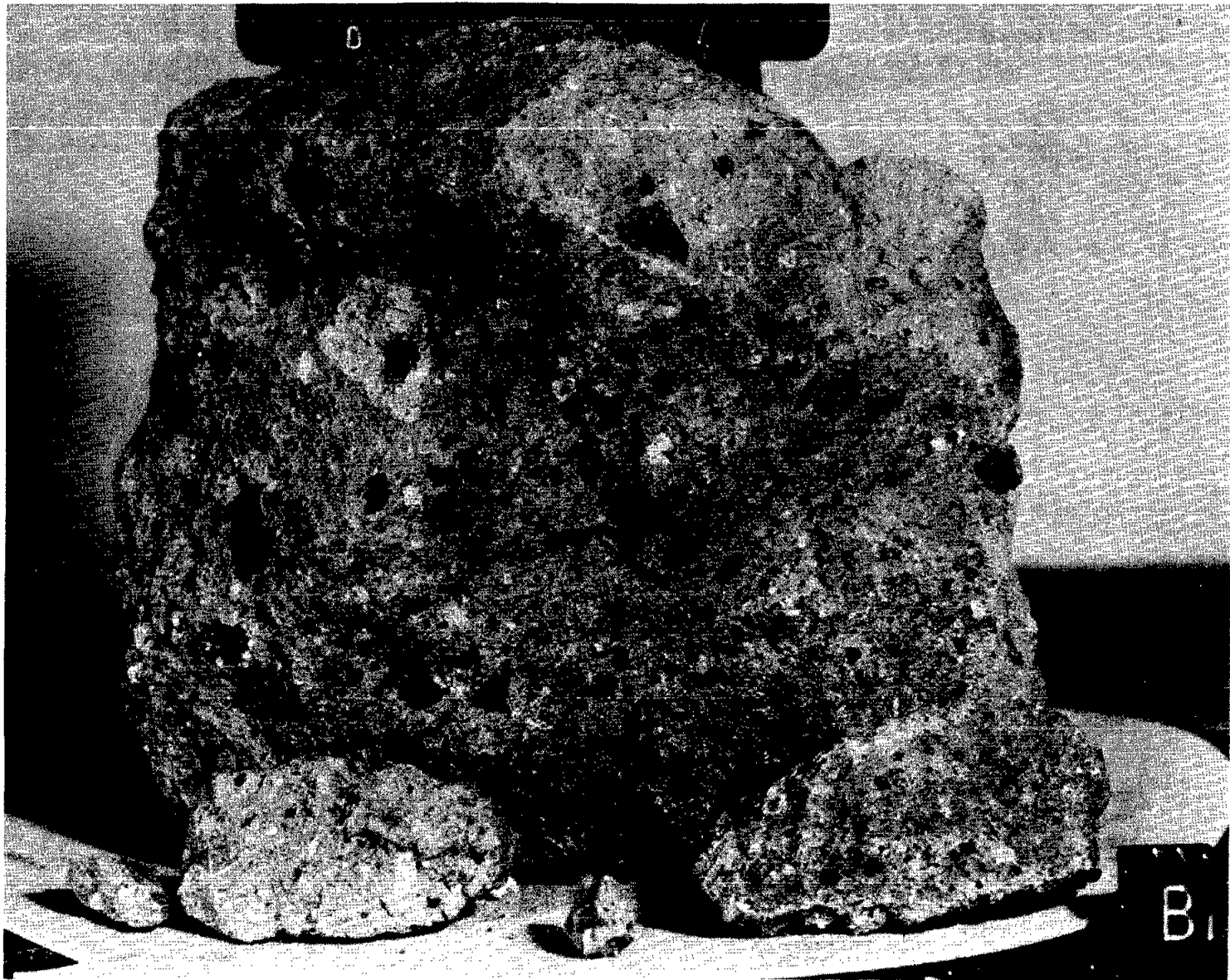
<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Clast I	black	10	ang	0.5	100-0.1	1
Clast II	white	5	ang	2.5	20-1	2
Clast III	white	5	ang	2	5-1	3
Clast IV	white	5	ang	1	5-1	4
Single crystals	pale green to dark green	<1	anhedral	0.1		5
Clast V	white	one	subrnd	5x2		6
Clast VI	dark brown		anhedral		<1	7
Matrix	light gray	75		<0.1		8

NOTES:

1. Most are aphanitic, dull to waxy lustre. Few have rare phenocrysts of a dark brown pyroxene and very rare plagioclase. Clast boundaries are sharp against matrix.
2. 90 - 95% white to vitreous feldspar, 5 - 10% pale green mafic silicate, and less than 1% metal.
3. 70% white to colorless feldspar, 20% brown pyroxene, and 10% pale green mafic silicate (olivine?).
4. 100% fine grained pure white sugary feldspar.
5. Pyroxene (?).
6. 80% vitreous feldspar, 10 - 15% yellow-green mafic silicate with waxy lustre and about 5% salmon-pink vitreous mafic silicate (pyroxene?).
7. Pyroxene (?).
8. Pepper and salt appearance, composed of 80-85% feldspar, and 15-20% light to dark brown pyroxene (cataclastic granular homogeneous up to 0.1 mm). 30% of the matrix is very small clasts less than 1 mm.



145



SAMPLE 61175

61195

ROCK TYPE: Microbreccia, glassy,  
glass coated

WEIGHT: 586 g

DIMENSIONS: 12 x 9 x 6.5 cm

COLOR: Medium gray (N5)

SHAPE: Blocky subangular

COHERENCE Intergranular: Coherent

Fracturing: One penetrative fracture, many in glass cover

BINOCULAR DESCRIPTION

BY: Reid

DATE: 5/22/72

FABRIC: Microbreccia

VARIABILITY: Glass-rich matrix on W end of T; less glass on E end of T but mostly glass covered.

SURFACE: Glass coated: T and E show portion of interior.

ZAP PITS: Many on T; few on N, E, S, and W; none on B.

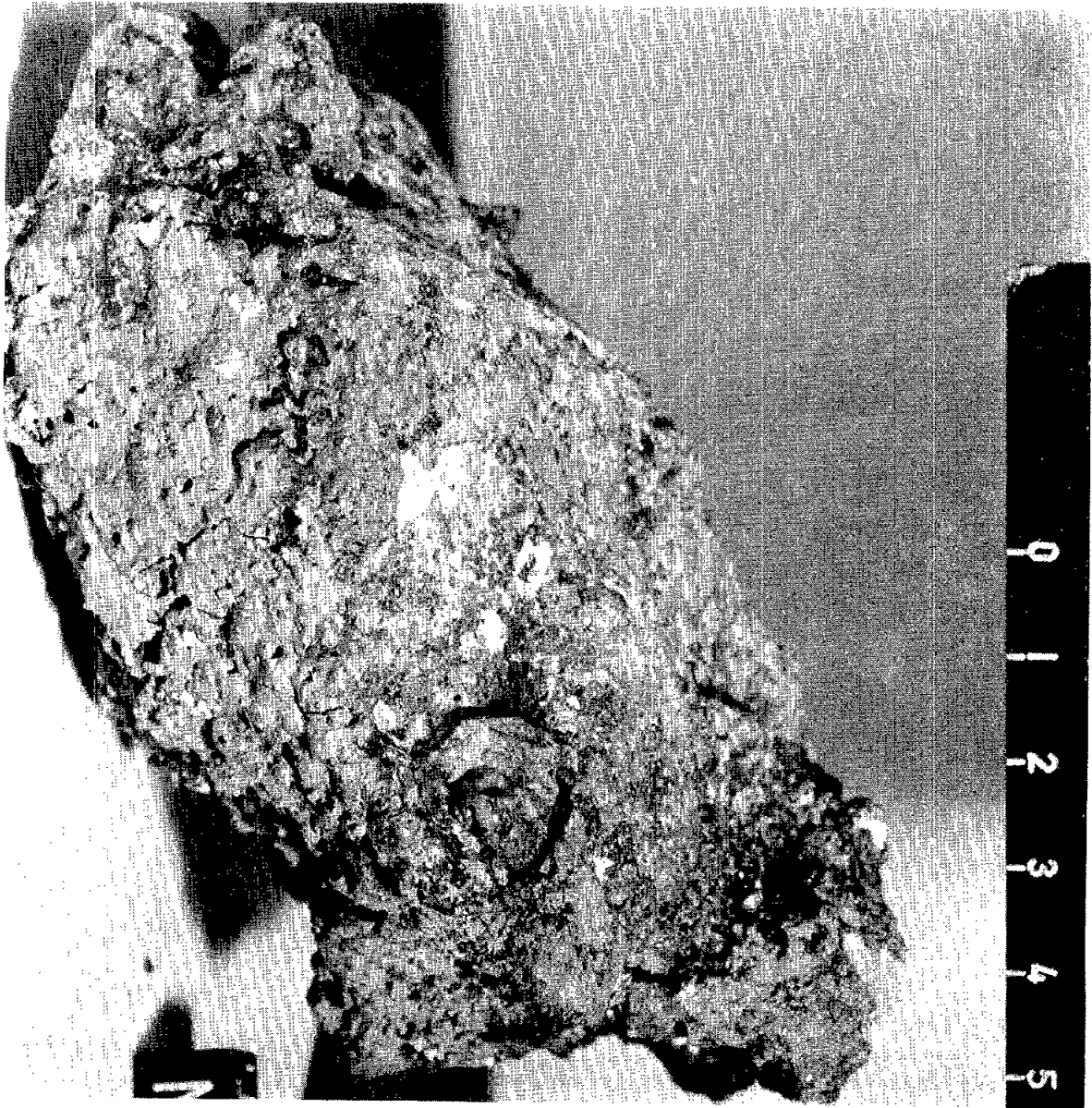
CAVITIES: Flat vesicles in glass coating

SPECIAL FEATURES: Rock is 80-90% glass covered and description is based on poorly exposed surface, which shows feldspathic glassy microbreccia. Green glass is present.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix I	medium gray	30	(?)	<1		1
Clasts	white	25	ang	4	1-15	2
Glass	green	10	ang	3	1-10	3
Matrix II	dark gray	30		1	<1- 5	4
Glass coating	greenish black	5	coating	(thick)		5

NOTES:

1. Crystalline microbreccia with <1 mm clasts in lighter gray matrix. This may be a large clast which contains about 60% feldspar.
2. Contains 80%, or more, white feldspar and a few opaques, which also occur as clasts in the glass coating.
3. Partly vesicular with a slight bluish cast.
4. Breccia matrix is very rich in glass including much green glass.
5. Many inclusions of white clasts. Glass is vesicular.



SAMPLE 61195

61225

ROCK TYPE: Micro-crystalline, hornfelsic (?)  
COLOR: Medium dark gray (N4)  
SHAPE: Subangular, blocky  
COHERENCE Intergranular: Tough  
Fracturing: Few, penetrative

WEIGHT: 3.52 g  
DIMENSION: 1.7 x 1.4 x 1.0 cm

BINOCULAR DESCRIPTION

BY: Stuart-Alexander

DATE: 6/22/72

FABRIC: Isotropic  
VARIABILITY: Heterogeneous cavity distribution  
SURFACE: The only fresh face is N, most of remainder of rock highly dust covered  
N is hackly.  
ZAP PITS: None  
CAVITIES: 0-20%, (inhomogeneously distributed). Total rock is about 5% vugs from  
0.1 mm to 3 mm, elongate to irregular in shape.  
SPECIAL FEATURES: Some vugs lined irregularly with tiny translucent grains and a  
few also with shiny metallic grains. Grains project into vugs and locally  
meet.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Metal	shiny dark gray	1	ang to rnd blobs	<1		1
Matrix	med. dark gray	98				2
Mineral	colorless	<1		1		3

NOTES:

1. Both in the rock and lining vugs. Locally resembles glass except that uneven surfaces are also highly reflective.
2. Aphanatic, locally semitranslucent. Pale gray areas, particularly in vugs; also one area of both dark and pale gray minerals, 0.1 mm in size. Locally rock appears glassy.
3. Transparent minerals, probably plagioclase. One looks like a single crystal, other area may be aggregate of grains.

61226

ROCK TYPE: Plagioclase granulite  
COLOR: White (N9)  
SHAPE: Subangular  
COHERENCE Intergranular: Tough  
Fracturing: None

WEIGHT: 1.53 g  
DIMENSION: 1.2 x 1.1 x 0.8 cm

BINOCULAR DESCRIPTION

BY: Stuart-Alexander

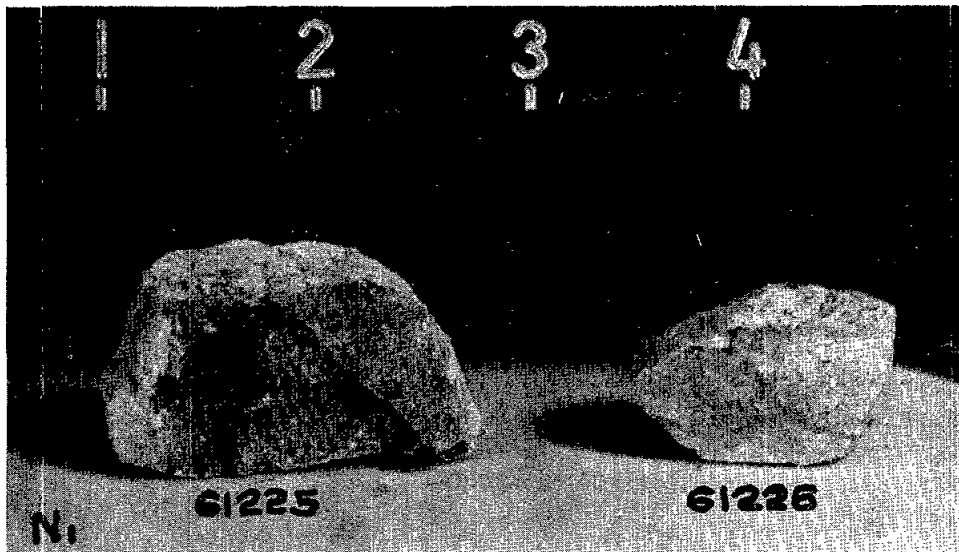
DATE: 6/22/72

FABRIC: Equigranular  
VARIABILITY: Glass coating is inhomogeneous  
SURFACE: 60% glass covered (including dusty glass), 20% dust covered with no obvious glass. Rock is very finely irregular.  
ZAP PITS: None  
CAVITIES: None  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	very dark gray	10				1
Plagioclase	white to colorless	90	equant	0.2		2

NOTES:

1. Probably devitrified. Dust caked on 75-80% of the glass.
2. Mosaic texture of equigranular plagioclase; primarily colorless translucent grains.



61295

ROCK TYPE: Breccia  
 COLOR: Medium gray (N5)  
 SHAPE: Angular, slabby  
 COHERENCE Intergranular: Coherent  
 Fracturing: Scarce, penetrative

WEIGHT: 172 g  
 DIMENSIONS: 11 x 6 x 3 cm

BINOCULAR DESCRIPTION

BY: Hörz &amp; Wilshire

DATE: 5/30/72

FABRIC: Breccia

VARIABILITY: Homogeneous

SURFACE: Irregular, abundant clast molds on T; B is smooth, rounded.

ZAP PITS: Many on B and part of W; none on T, S, E, and N.

CAVITIES: None

SPECIAL FEATURES: Lithic types I and V are most abundant of the lithic clasts.  
 Plagioclase is the most abundant of the mineral clasts.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	med gray	80		<0.1	<0.1- 1	1
Clasts:		18				2
Lithic I	dk gray		ang, blocky	1.5	1 - 2	3
Lithic II	green tinted dk gray		ang, rd	1	3 - 5	4
Lithic III	white		subrd	1	2 - 5	5
Lithic IV	v deep brown		ang	<1	1	6
Lithic V	white		ang, rd	2	1 -15	7
Lithic VI	yellow-green	tr	subang	2	2 - 3	8
Minerals:		2				
Mineral I	white		ang, subrd	1	1 - 2	9
Mineral II	cinnamon		ang	1	1 - 2	10
Mineral III	green		lath	1	1	11

## NOTES:

1. Fine grained, granular, clastic matrix with salt and pepper texture containing light-and-dark components and tiny black glass spherules.
2. All clast types grade gradually into the matrix; matrix defined as <1 mm.
3. Specular luster, very dense, aphanitic; devitrified glass (?).
4. Dull luster, fine grained, some with vesicles.
5. Rare type, gabbroic anorthosite with cinnamon-brown pyroxene; holocrystalline. Pyroxenes in millimeter size range.
6. Rare type with a vitreous luster, possibly glass.
7. Sugary, fine grained, feldspar-rich (anorthositic with variable grain size). Some clasts contain black specks and one clast has a yellow-green mineral.
8. Sugary pyroxene (?), recrystallized (?).
9. Plagioclase; sugary; some display large cleavage faces, but some may be anorthosites.
10. Pyroxene
11. Pyroxene

THIN SECTION DESCRIPTION

BY: Hörz

DATE: 6/28/72

SECTION: 61295,10

**SUMMARY:** This is a clastic breccia with partially recrystallized matrix. It contains an enormous variety of clasts, notably older breccias. There is within the clasts a wide range of recrystallization and annealing textures as well as lithology (basaltic to anorthositic). Thus, it appears that the present breccia incorporates materials from a variety of sources which subsequently have undergone a variety of thermal conditions before being incorporated in the present breccia.

MATRIX, 40% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Glass	20	irreg	0.03-0.1	Matrix shows no fabric, is not strongly recrystallized but cataclastic nature of breccia is preserved. 61295,9 appears to have more and coarser grained feldspar clasts as well as more feldspar in the matrix.
Feldspar	75	equi-granular	0.03-0.1	
Pyroxene	5	lath, equi-granular	0.03-0.1	

MINERAL CLASTS, 20% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Feldspar	80	ang	0.1-1	Mineral detritus is scattered throughout the breccia with a gradational transition into matrix with respect to grain size and mode. Some diaplectic feldspars and feldspar glass. Both ortho and clinopyroxene are present.
Pyrox	20	ang	0.1-0.5	
Olivine	tr	ang	0.1-0.2	
Pink spinel	tr	ang	0.1-0.2	

LITHIC CLASTS, 30% OF ROCK

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Basalt	5	irreg	0.2-0.5	"Basalt," igneous texture; feldspar (60%), feldspar (30%), olivine (10%).
Anorth	10	irreg	0.1-5	"Anorthosite," highly annealed, variations in grain size from clast to clast.
Breccia	80-90	irreg	0.1-5	Enormous variety of breccia clasts displaying various degrees of annealing, glass-content, recrystallization features, etc. Too complex to describe in detail.

## 61295 (Continued)

THIN SECTION DESCRIPTION

BY: Hörz

DATE: 6/28/72

SECTION: 61295,10 (Continued)

## GLASS CLASTS, 10% OF ROCK.

<u>COLOR</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Light tan to brown	5	rounded	.1-.3	Undevitrified fragments of spheres.
Light brown	10	rounded, irreg	.2-2	Flow-banding; partially to completely devitrified.
Plag	5	irreg	.2-1	Feathery devitrification.
Dark brown to black	80	irreg, rounded	.2-2	Partially to completely devitrified. Probably "Matrix" of older breccias, because mineral detritus very abundant.

OPAQUES DESCRIPTION

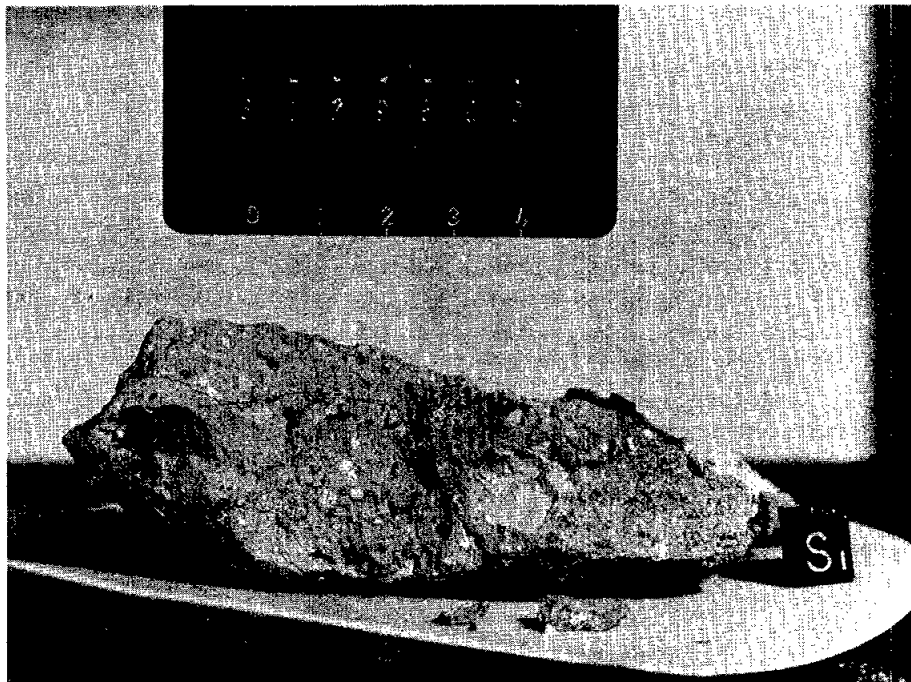
BY: Brett

DATE: 6/21/72

SECTION: 61295,10

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	<1		to 0.5	Metal in angular fragments and subrounded and ragged blebs.
Ilm	<0.5		to 0.3	Ilmenite as subrounded grains, angular and as laths in crystalline clasts. Average grain size of all opaque minerals is about 50 $\mu$ .
FeS	<0.3		to 0.1	FeS as rounded to subrounded to ragged grains.





SAMPLE 61295



SAMPLE 61295,9

WIDTH OF FIELD  $\approx$  4 MM

61515-19; 61525-29; 61535-39; 61545; 61546-49; 61555-59; 61565-67;

61568-69; 61575; 61576-77

DESCRIPTION: Rake Sample BY: Phinney DATE: June 17, 1972

61515-19, 61525-29, 61535-39, 61545

#### LIGHT GRAY, MODERATELY FRIABLE CLASTIC BRECCIA

Rounded to subangular, moderately friable to friable, very light gray to medium light gray, fine-grained, clastic-matrix breccias with about 20% small (approximately 1 mm) clasts of white granular plagioclase and various light gray asphanitic, chert-like fragments. 61515 through 19 are very light gray, rounded to subrounded, friable, and contain a higher proportion of light gray cherty clasts than the remainder of this group. 61525 through 45 are subrounded to subangular, more coherent but still moderately friable, and contain a higher proportion of white clasts than the other samples in this group. The total range of clast types seems similar in both color groups. Matrix material appears to be finely ground clast material. Partial glass coatings occur on 61536 through 45.

61546-49, 61555-59, 61565-67

#### VESICULAR, GRAY GLASS

Irregularly shaped, highly vesicular, gray glass much of which has devitrified. Various sized fragments of white granular plagioclase occur sporadically throughout the glass. 61546 through 57 are largely devitrified to a dull gray, very fine chert-like texture with spectacular dendritic crystal patterns showing in the large vesicles. 61558 through 67 are more shiny with a typical glassy luster.

61568, 69; 61575

#### GRAY, TOUGH, CRYSTALLINE ROCKS

Subangular to subround, very coherent, light gray to medium light gray, crystalline fragments. 61568 and 69 are slightly vesicular with equigranular texture and grain size on the order of 0.1 mm or less. 61568 appears to be a recrystallized breccia with a few relict clasts. 61575 is rather unique in that it has white plagioclase patches which grade into a surrounding light gray material which, in turn, grades into a darker gray glassy material. The glassy material sends out a few veinlets which crosscut the white and light zones. This presents a mosaic pattern with the white material forming the cores of the pattern and the gray filling in around the white.

61576-77

#### PLAGIOCLASE, CRYSTAL AND GRANULAR, ANORTHOSITE

61576 is a single plagioclase grain 2-1/2 cm long with continuous cleavage and a milky white to clear color. One surface has a gray devitrified glass coating. 61577 is the more usual subrounded, friable, white, granular plagioclase with no other obvious phases present.

61536

ROCK TYPE: Breccia, gray-matrix

WEIGHT: 86 g

COLOR: Medium gray (N5)

DIMENSIONS: 5.5 x 5 x 3 cm

SHAPE: Irregular, hemisphere

COHERENCE Intergranular: Tough

Fracturing: One penetrative set parallel to B, and several sets of open joints which are more or less random.

BINOCULAR DESCRIPTION

BY: Williams

DATE: 7/14/72

FABRIC: Breccia

VARIABILITY: Homogeneous

SURFACE: All faces are rough. On B side of N there appears to be slickensides(?) although surface is zapped. T and a part of N are glass coated.

ZAP PITS: Few on B and parts of S, W, and E.

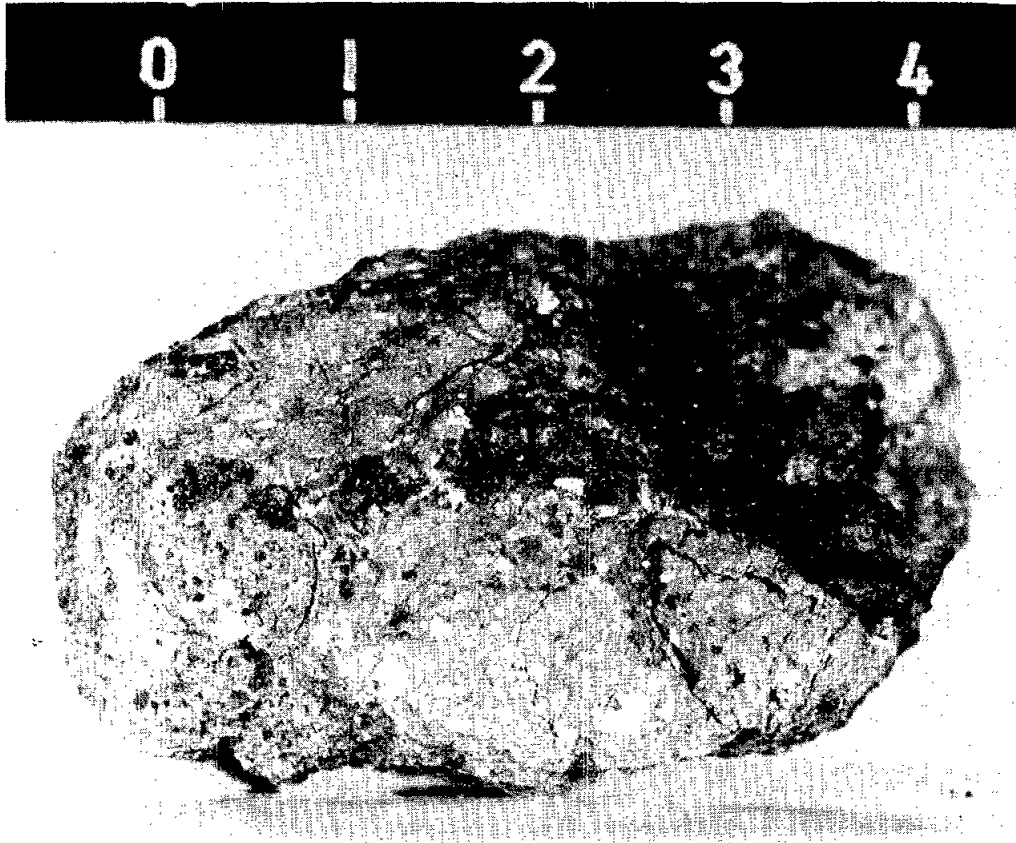
CAVITIES: Twenty-five percent vesicles in glass coating.

SPECIAL FEATURES: None

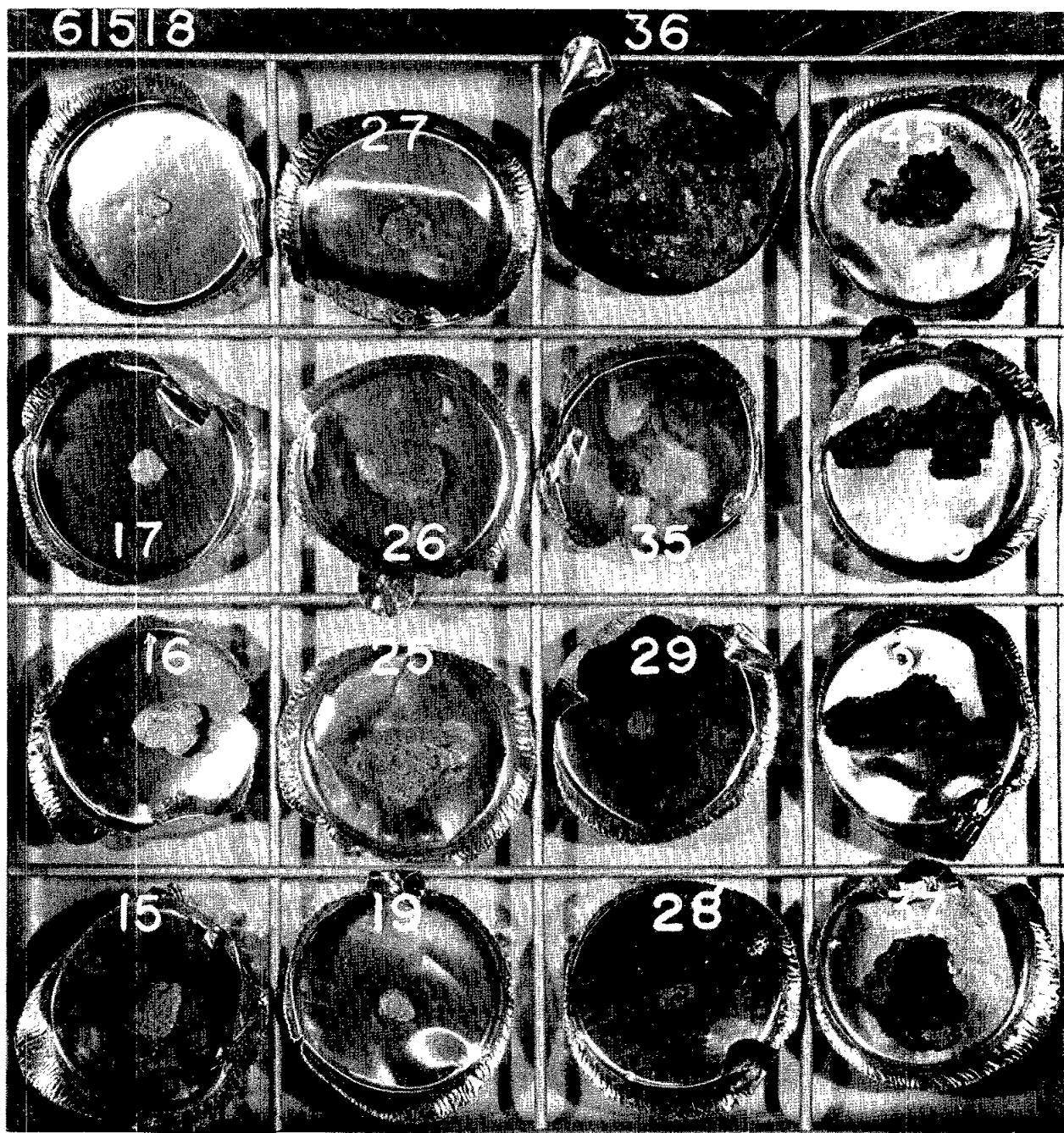
<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	med gray (N5)	50	irreg		<0.1	
Clast	white (N9)	40	rd to ang	1	0.2-20	1
Glass	colorless to greenish and black	10	irreg	2	2 mm thick	2
Mineral	red to yellow to pink	tr	irreg to rd	0.2		3
Opaque	metallic	tr	rd	0.2		4

NOTES:

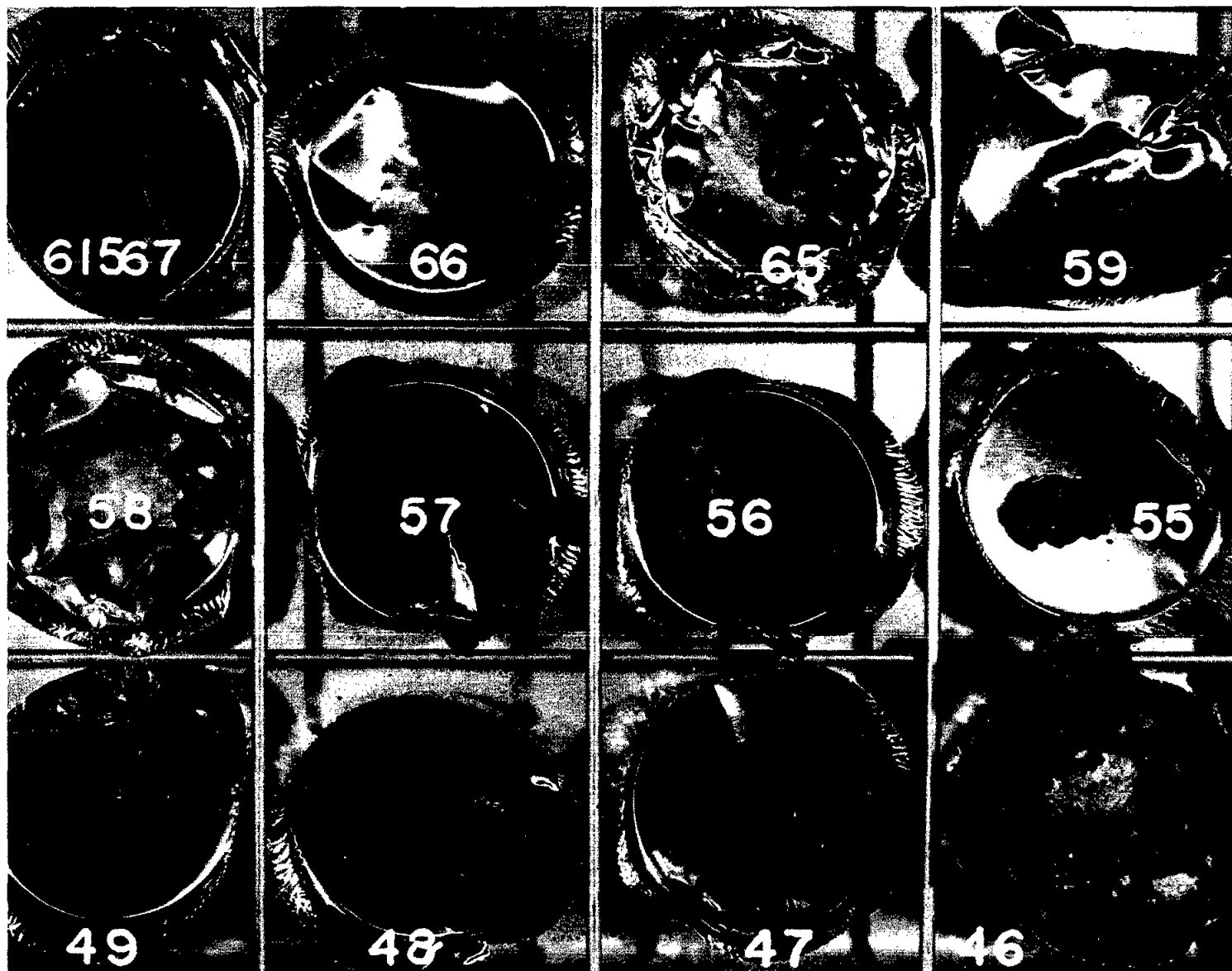
1. Chalky white with about 0.5% of minute dark specks. Some 0.5 mm "cleavage" flashes seen. Almost invariably surrounded by dark glass selvage which occasionally penetrates the clast. Grades right down to size of matrix. Some have a pink color near cracks.
2. Splash on T and parts of S, W, and N. Vesicular, greenish areas may be devitrified.
3. Colors may represent different thickness of same material. It is most common near cracks.
4. Metal or sulfide.



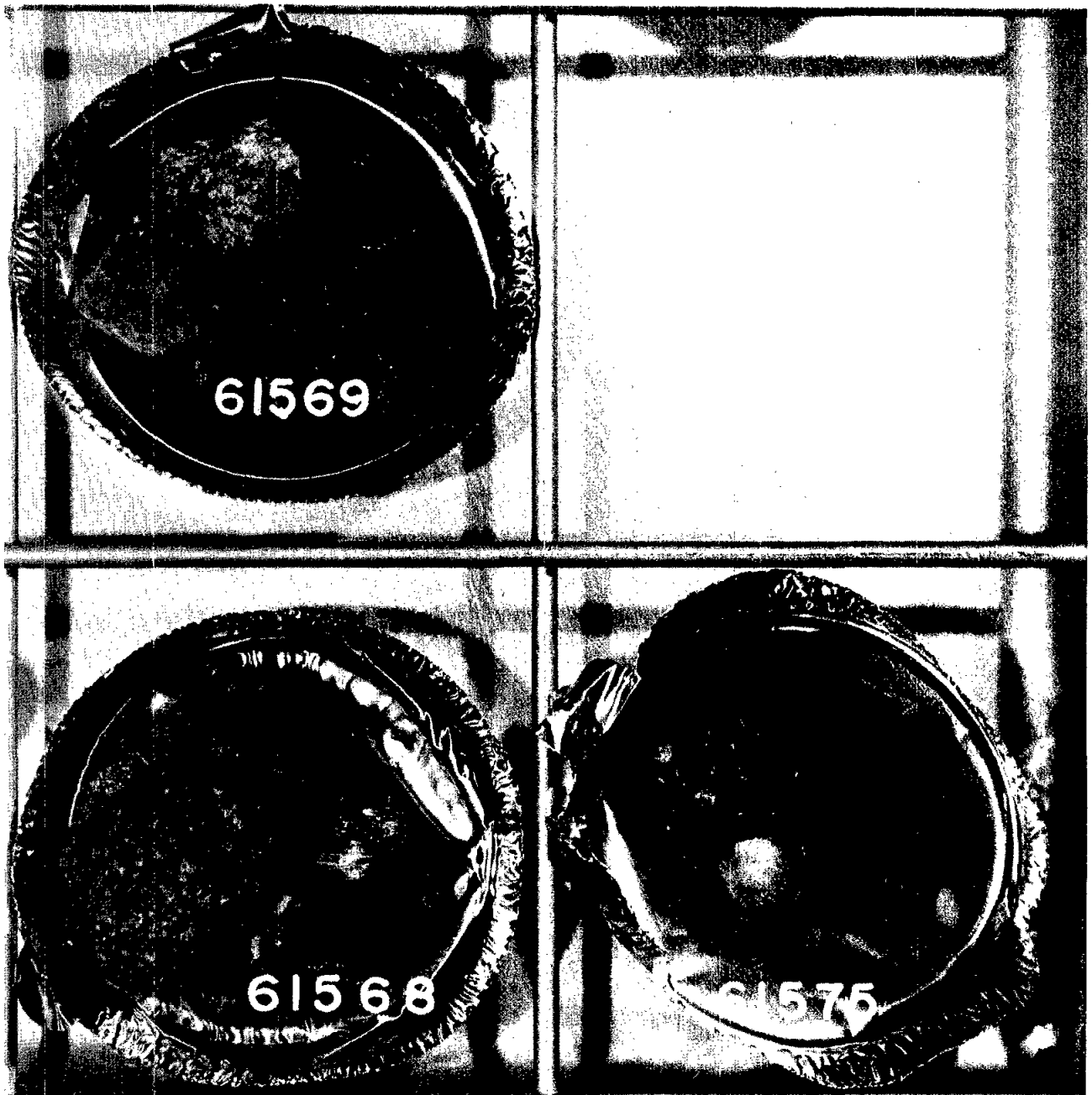
SAMPLE 61536



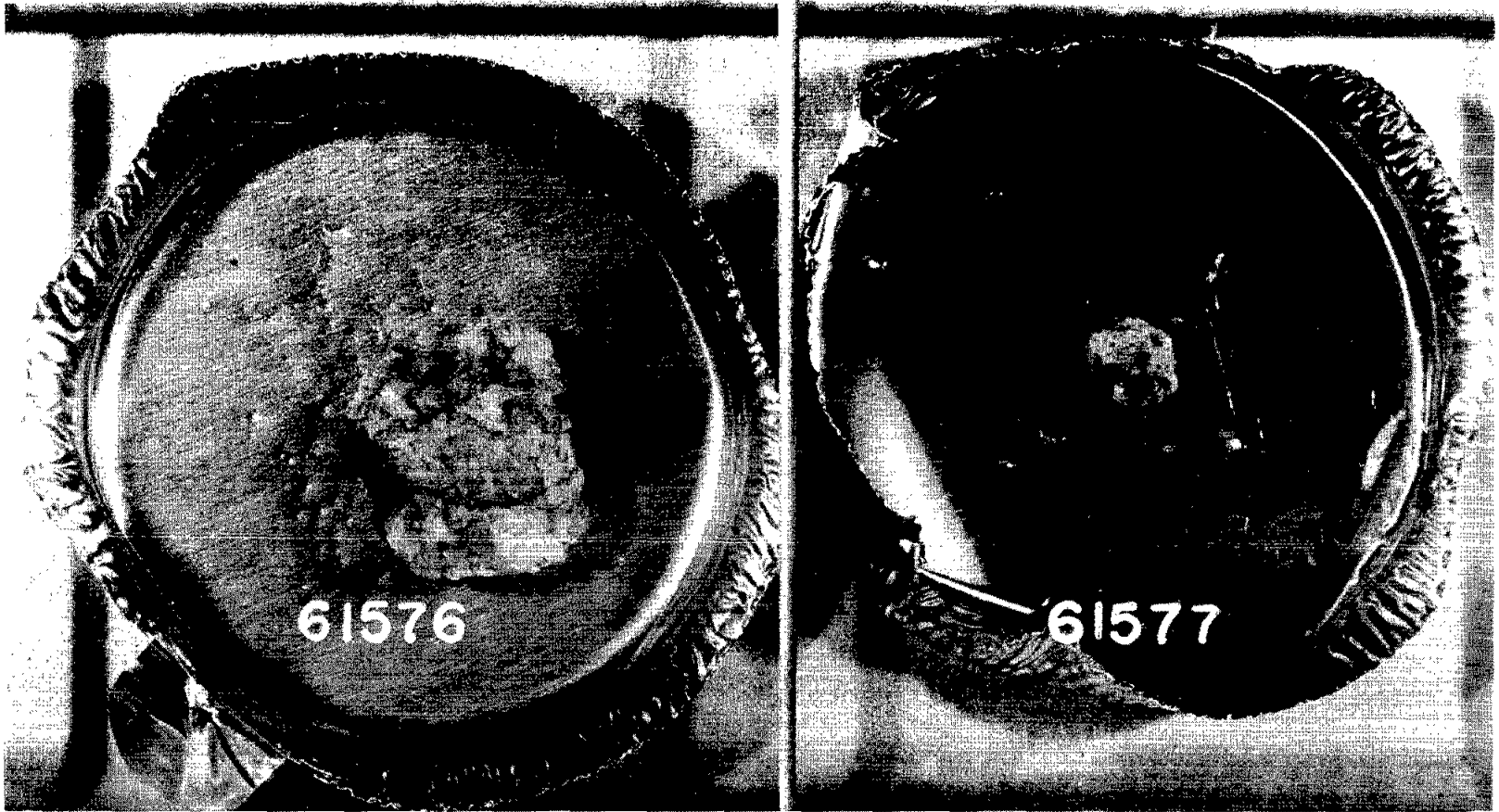
RAKE SAMPLE 61515-19,25-29-35, & 45



RAKE SAMPLE 61546-49,55-59,65-67



RAKE SAMPLE 61568-69, & 75



RAKE SAMPLE 61576-77



62235

ROCK TYPE: Basalt, homogeneous crystalline      WEIGHT: 320 g  
 COLOR: Medium dark gray (N4), olive gray (5Y4/1)      DIMENSIONS 8 x 7 x 5.5 cm  
 SHAPE: Subangular to blocky  
 COHERENCE Intergranular: Tough  
                   Fracturing: No penetrative, one loose flat chip at W end of T

BINOCULAR DESCRIPTION

BY: Reid & Ridley

DATE: 5/24/72

FABRIC: Equigranular, crystalline, homogeneous  
 VARIABILITY: None  
 SURFACE: T has light colored soil on 25% of surface. B has irregular cavities common. N is dusty.  
 ZAP PITS: Few on T, N, E, and S. Many on B. Few on W except in region near B which has many.  
 CAVITIES: T has small irregular cavities (smaller than 1 mm) which are locally more abundant than average. Irregular cavities dominantly perpendicular to T surface.  
 SPECIAL FEATURES: The chip is associated with rock from W end of T. It is similar to the parent, but igneous texture is not as well developed.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Feldspar	white	40	anhedral	1	0.2-2.0	1
Opaque	black, high luster	10	anhedral	0.1	0.1-0.2	
Mafic silicate I	honey-green	5	anhedral	1	0.2-1.5	2
Mafic silicate II	light-green	40	anhedral	1	0.2-1.5	2
Sulphide or metal	yellowish metallic luster	1-2	anhedral	0.1		3

NOTES:

1. Occasional feldspar 2-3 times size of matrix feldspar.
2. Pyroxene appears largely interstitial to feldspar.
3. Sulphide-like color.

62235

THIN SECTION DESCRIPTION

BY: Reid

DATE: 6/28/72

SECTION: 62235,6

SUMMARY: High grade recrystallized breccia. Texture dominated by matrix that has no fine material but has recrystallized to large pyroxene poikiloblasts that enclose feldspar laths. Opaques tend to rim poikiloblasts and may themselves be poikiloblastic. Few clasts of basalts, feldspathic basalts and anorthosite. Contains rounded vesicles and irregular cavities.

## MATRIX, 70% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Pyrox	45	irreg	to 1	Orthopyroxene poikiloblasts sieved by feldspar laths.
Plag	45	lath	0.04	Feldspar laths and clasts.
Metal	7	rded	to 2	Larger grains rounded up to 0.2 mm, smaller irregular most few microns.
Oxide	1	lath		Irreg up to 0.1 mm; few occur enclosing metal.
FeS	2	irreg	to 1	Larger and irregular patches and some laths, smaller needles. Largest are poikiloblastic areas up to 0.3 mm, probably ilmenite.

## MINERAL CLASTS, 20% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	90	subang	to 1	From 1 mm down to very fine angular grains. Larger crystals show some recrystallization.
Mafic	10	ang	0.1	Rare olivine and pyroxene.

## LITHIC CLASTS, 10% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
I	≈20	ang	to 1 x 0.5	Basalt diabasic texture. Feldspar >> pyroxene >> opaque. Contains larger square feldspar phenocrysts or inclusions. Grain size <0.1 mm. Sharp contact with matrix.

## 62235 (Continued)

THIN SECTION DESCRIPTION

BY: Reid

DATE: 6/28/72

SECTION: 62235,6

## LITHIC CLASTS (Continued)

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
II	≈20	subrded	0.5x0.5	Basalt similar above feldspar = pyroxene > opaque > olivine. Opaque greater than clast type I. Grain size <0.1 mm. Graded into matrix.
III	≈20	subrded	1 x1	Feldspathic basalt, feldspar >> orthopyroxene >> opaque - anhedral equant grains.
IV	≈20	subang	7 x0.5	Breccia-anhedral strained feldspar in very fine grained crystalline matrix.
V	≈20	subrded	0.5x5	Annealed brecciated anorthosite, feldspar >> pyroxene > opaque. Slightly poikiloblastic.

62235

OPAQUES DESCRIPTION

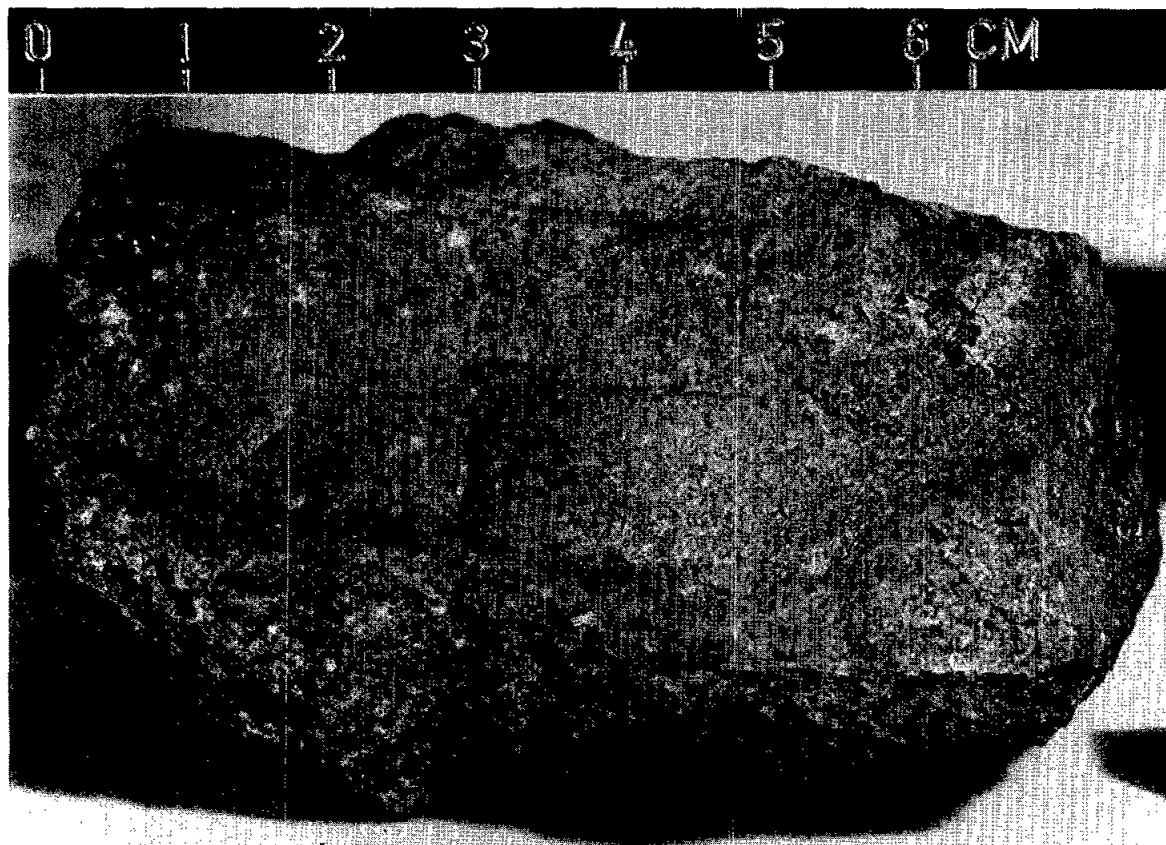
BY: Brett

DATE: 6/26/72

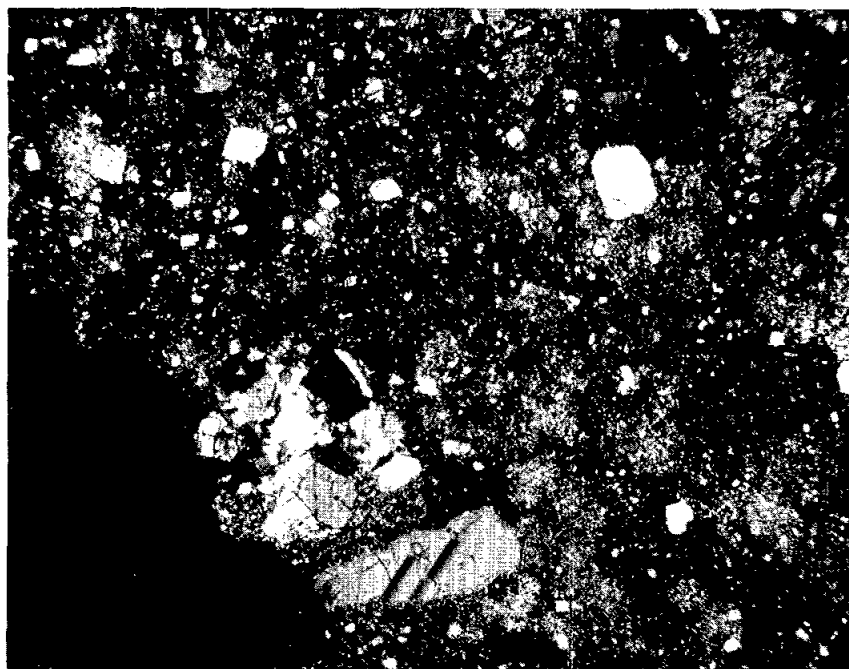
SECTION: 62235,6 and 7

SUMMARY: Rock is exceptionally rich in opaque minerals for an Apollo 16 rock. Troilite and metal show subrounded grains with ragged boundaries. Ilmenite in rare laths and commonly interstitial clumps, whose shape is governed by shape of adjoining phases. Plagioclase laths produce straight boundaries in ilmenite. Ilmenite is rich in silicate inclusions. Grain sizes of opaque minerals range from those given below to 5 $\mu$  or 50 $\mu$ . Average is about 50 $\mu$ .

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	1		to 0.3	---
Ilm	3		to 0.4	---
FeS	<0.5		to 0.15	---



SAMPLE 62235



SAMPLE 62235,6

WIDTH OF FIELD  $\approx$  4 MM

62236

ROCK TYPE: Breccia, anorthositic monomict  
 COLOR: Very light gray (N8)  
 SHAPE: Subangular  
 COHERENCE Intergranular: Coherent to slightly friable  
 Fracturing: Numerous penetrative

WEIGHT: 57.3 g  
 DIMENSION: 4 x 6 x 3 cm

BINOCULAR DESCRIPTION

BY: Lofgren

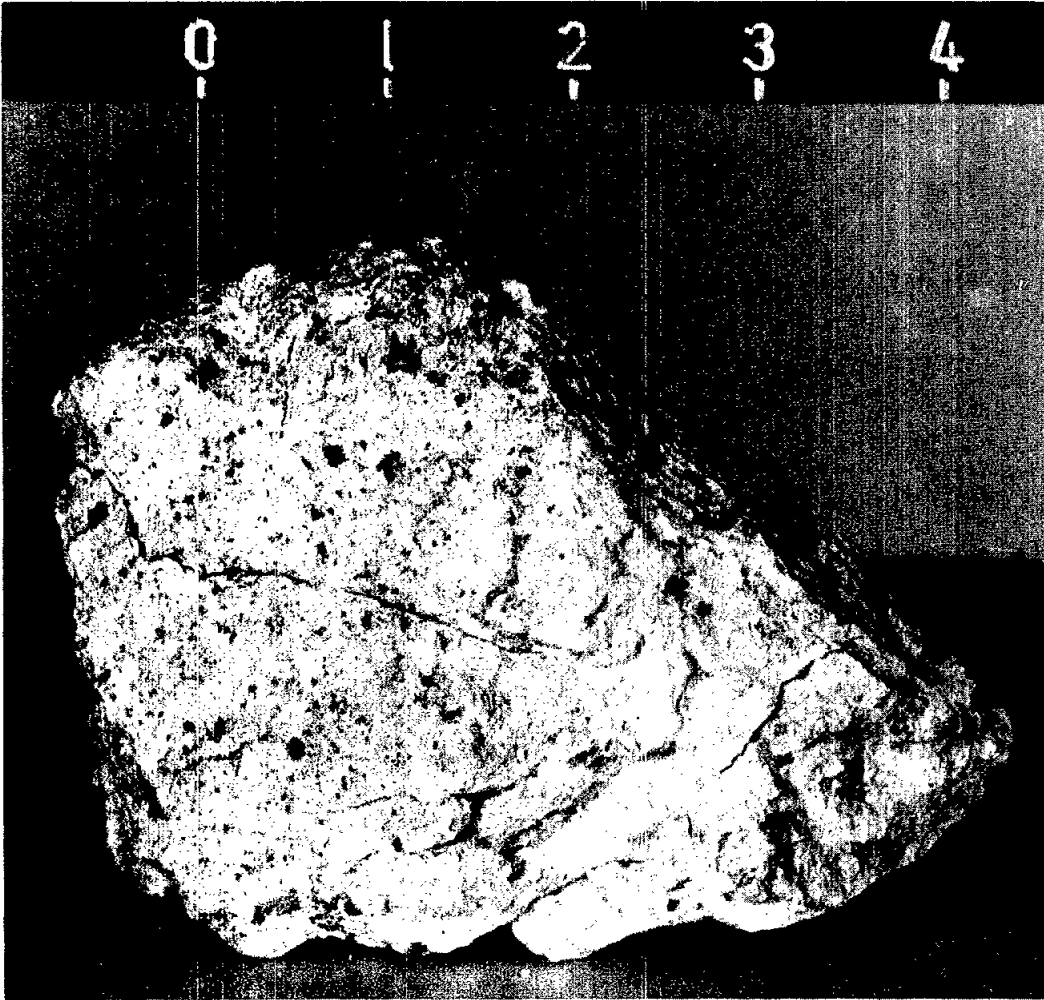
DATE: 5/26/72

FABRIC: Microbreccia  
 VARIABILITY: Generally uniform, mineral fragments have variable distribution  
 SURFACE: Granular  
 ZAP PITS: Few on all (N has fresher more complete craters)  
 CAVITIES: None  
 SPECIAL FEATURES: Cataclastic anorthosite or anorthositic gabbro. 85-95% feldspar counting matrix and mineral fragments. There is a gradation in size between matrix feldspar and the few remaining recognizable feldspar fragments.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	very light gray (N8)	95		<0.1		1
Plagioclase	clear to N8	3	ang, equant	0.5	0.1-2	2
Mafic silicate	pale yellow green	2	ang, equant	1	0.5-2	3
Glass						4
Grains	greenish black (5GY2/1)	<1	blocky, equant	1	<1-4	5
Opacues	black	tr		<0.1		5

## NOTES

1. Ground up feldspar.
2. Not evenly distributed.
3. Pyroxene(?) not evenly distributed
4. Dark, bubbly and clear surface glass associated with zap pits.
5. A few are distributed throughout.



SAMPLE 62236

62237

ROCK TYPE: Microbreccia, monomict anorthosite      WEIGHT: 62.4 g  
 COLOR: Very light gray (N8)      DIMENSIONS: 5 x 4 x 3 cm  
 SHAPE: Subangular, blocky  
 COHERENCE Intergranular: Moderately friable  
 Fracturing: Several penetrative fractures subparallel  
 approximately E-W direction parallel to T.

BINOCULAR DESCRIPTION

BY: Stuart-Alexander &amp; Reid      DATE: 5/26/72

FABRIC: Microbreccia

VARIABILITY: Homogeneous on a gross scale, variable in detail.

SURFACE: S face has three deep penetrative fractures.

ZAP PITS: Few on S and B. None on T, E, W, and N.

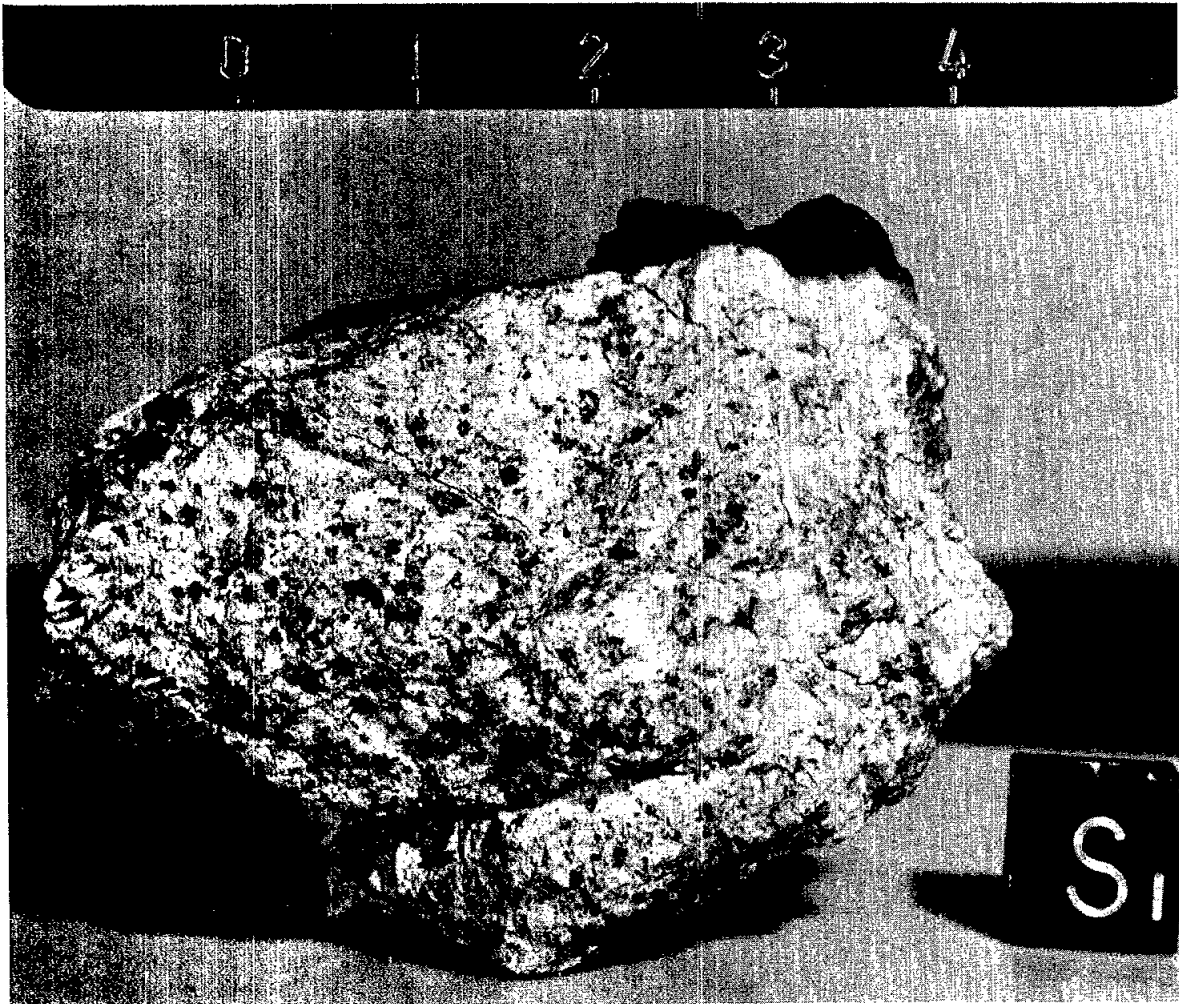
CAVITIES: None

SPECIAL FEATURES: Highly brecciated apparently monomict rock with clots of mafic minerals varying in abundance from areas with approximately 100% feldspar to areas with 70% feldspar. Probably cataclastic feldspars shattered, broken, chalky, doubtful that original texture or grain size is preserved. Very similar to 62236. May also be similar to white portion of 15455.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Feldspar	white	80	ang, irregular	<1	<1-3	1
Mafic silicate(?)	honey yellow	10	equant, anhedral	0.2		2
Oxide(?)	black	2	equant	0.1	0.1-0.2	3
Metal(?)	black	1	elongate	0.1		4
Pyroxene 2(?)	greenish black	1	equant	0.5	<0.1-2	
Veins	medium gray	<1	20mm long x .1mm			5

## NOTES:

1. Chalky white, sugary.
2. Inhomogeneously distributed, tends to occur in clots. Some aggregates appear as angular clasts. Probably pyroxene.
3. Shiny, almost metallic luster.
4. Flat, elongate grains with metallic luster; metal or sulphide(?).
5. Very thin glassy(?) veins and/or healed fractures running approximately E to W.



SAMPLE 62237



62245

ROCK TYPE: Hornfels  
COLOR: Medium dark gray (N4)  
SHAPE: Angular  
COHERENCE Intergranular: Tough  
Fracturing: None

WEIGHT: 6.0 g  
DIMENSIONS: 1.6 x 2.0 x 1.5 cm

BINOCULAR DESCRIPTION

BY: Simonds & Ridley

DATE: 6/17/72

FABRIC: Dense and isotropic  
VARIABILITY: Homogeneous  
SURFACE: North appears fresh, smoothly broken with conchoidal fractures.  
ZAP PITS: None on N; many on all other faces.  
CAVITIES: None  
SPECIAL FEATURES: The rock is an extremely fine grained (<0.1 mm) hornfels.  
Probably mainly plagioclase with some greenish pyroxene.

62246

ROCK TYPE: Anorthosite clast in glass  
COLOR: 50% white (N9)  
SHAPE: Angular, irregular  
COHERENCE Intergranular: Matrix friable, clast coherent  
Fracturing: Clast has planar penetrative jointing, matrix none.

WEIGHT: 4.6 g  
DIMENSIONS: 3.0 x 1.5 x 2.3 cm

BINOCULAR DESCRIPTION

BY: Ridley & Simonds

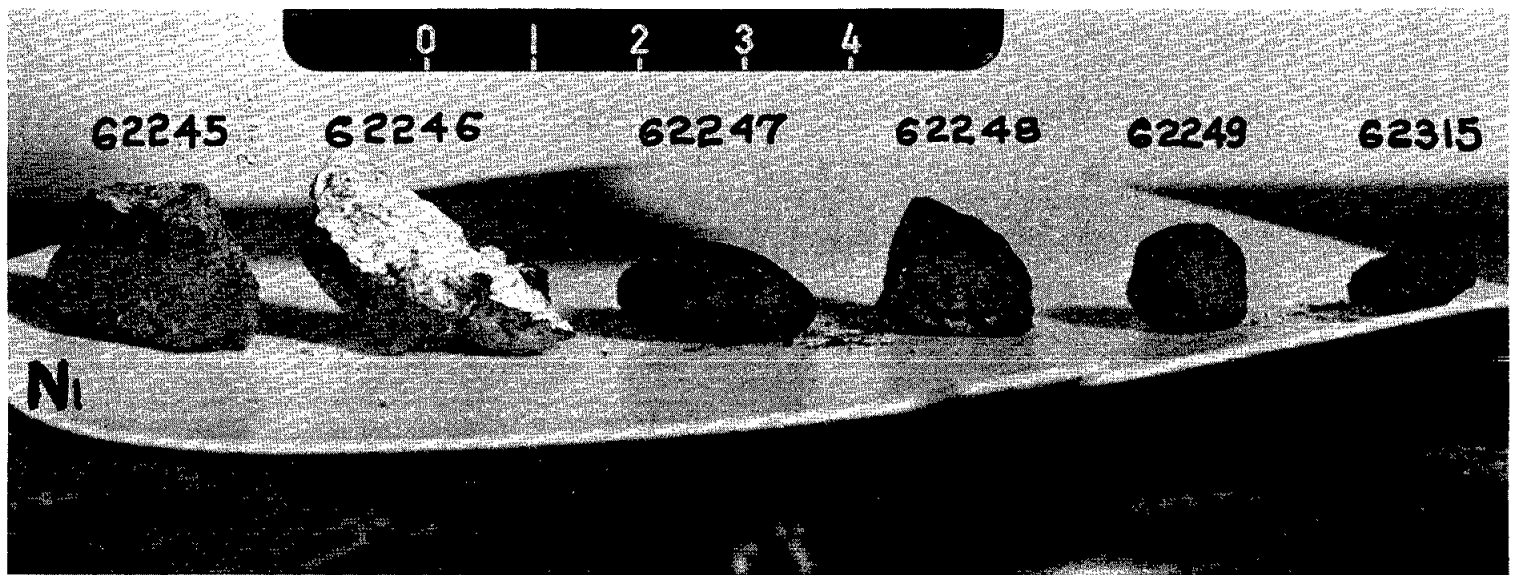
DATE: 6/17/72

FABRIC: Isotropic  
VARIABILITY: The clast is homogeneous, but the matrix is not.  
SURFACE:  
ZAP PITS: Few on glass  
CAVITIES: Matrix - large (3 mm)  
SPECIAL FEATURES: Soil adheres to black vesicular glass. The contact between the glass and the white clast is sharp.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Clast	white	50	planar ang	2x0.5x0.8	1	
Glass	black	50			2	

NOTES:

1. Vitreous luster; made of 0.1 mm plag.
2. No fluidal texture.



RAKE SAMPLE 62245-49, & 62315

62247

ROCK TYPE: Breccia  
COLOR: Olive gray (5Y4/2)  
SHAPE: Rounded, (ellipsoidal)  
COHERENCE Intergranular: Unknown  
Fracturing: None

WEIGHT: 2.1 g  
DIMENSIONS: 1.3 x 1.0 x 0.6 cm

BINOCULAR DESCRIPTION

BY: Ridley & Simonds

DATE: 6/17/72

FABRIC: Unknown  
VARIABILITY: Unknown  
SURFACE: All smoothly rounded  
ZAP PITS: Few on all surfaces  
CAVITIES: Unknown  
SPECIAL FEATURES: Matrix obscured by continuous dust cover

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic clast	white	4?	subang	0.5		1
Plag clast	clear	?		0.2		

NOTES:

1. Sugary, plagioclase-rich.

62248

ROCK TYPE: Breccia  
COLOR: Olive gray (5Y3/2)  
SHAPE: Subrounded  
COHERENCE Intergranular: Friable  
Fracturing: Abundant, planar, nonpenetrative

WEIGHT: 1.6 g  
DIMENSIONS: 1.2 x 2.0 x 0.7 cm

BINOCULAR DESCRIPTION BY: Simonds & Ridley DATE: 6/17/72

FABRIC: Isotropic, granular  
VARIABILITY: None  
SURFACE: E face broken, rest hummocky, glass splatter on one surface.  
ZAP PITS: Too dust covered to be visible.  
CAVITIES: None  
SPECIAL FEATURES: Traces of metallic (or glass) spheres <0.1 mm either on surface or within rock.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	olive-gray	98		<0.1		1
Plag clasts	water clear	1	subang to equant	0.2	0.1-0.3	
Lithic	white	1	subrd	0.2	0.1-0.3	2

NOTES:

1. Fine-grained, individual minerals not recognizable.
2. Granular aggregates. Very small amount of black material in most.

62249

ROCK TYPE: Breccia (light gray matrix)  
COLOR: Olive gray (5Y4/2)  
SHAPE: Subrounded  
COHERENCE Intergranular: Friable  
Fracturing: None

WEIGHT: 1.4 g  
DIMENSIONS: 1.0 x 1.1 x 1.0 cm

BINOCULAR DESCRIPTION BY: Ridley & Simonds DATE: 6/17/72

FABRIC: Equigranular  
VARIABILITY: The portion not obscured by dust is homogeneous.  
SURFACE: All obscured by dust.  
ZAP PITS:  
CAVITIES: None  
SPECIAL FEATURES: So dust covered that little can be seen.

62255

ROCK TYPE: Breccia  
COLOR: Main part of rock white (5N8-9)  
SHAPE: Blocky, subangular  
COHERENCE Intergranular: Moderately coherent  
Fracturing: Penetrative and nonpenetrative, rock fractures easily in white areas.

WEIGHT: 1192 g  
DIMENSIONS: 16 x 9 x 6 cm

BINOCULAR DESCRIPTION

BY: Wilshire

DATE: 5/23/72

FABRIC: Breccia  
VARIABILITY: 15-20% glass coated.  
SURFACE: Coarsely hackly on glass-coated face, finely hackly elsewhere.  
ZAP PITS: Many on N, T (except on glass); None on S; Few on E, W.  
CAVITIES: Glass has about 35% up to 1 cm coalescing vesicles.  
SPECIAL FEATURES: Appears to be crushed white rock that was invaded by dark material (Lithic III) and the whole slightly rebrecciated.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	black to lt brown	10				1
Lithic I	dark gray	5	ang		2-10	2
Lithic II	white	65				3
Lithic III	dark gray	20				4

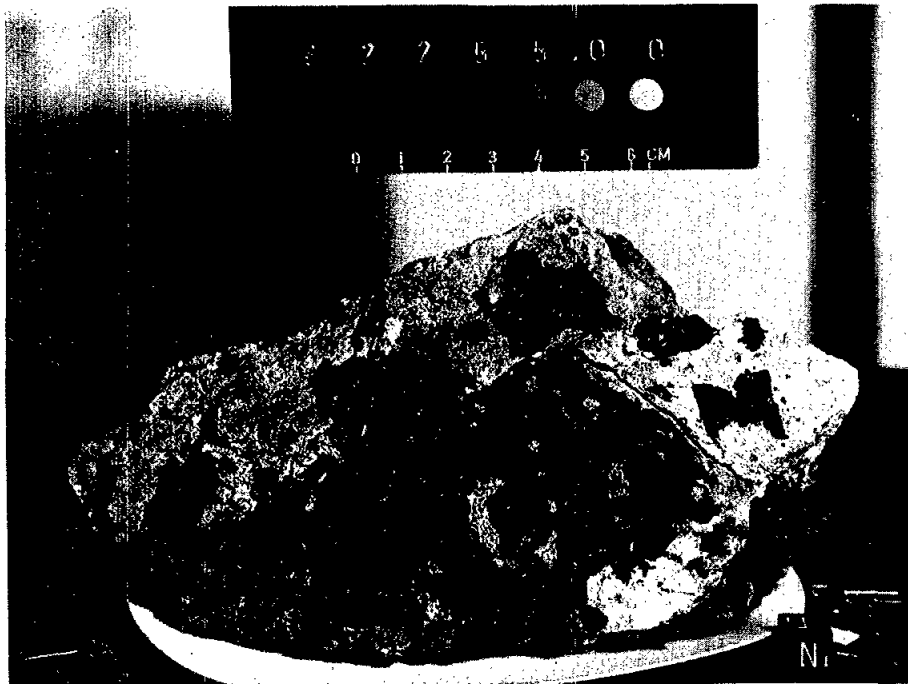
NOTES:

1. Partly coats two surfaces and forms thin (1-3 mm) veins in white rock. Contains abundant inclusions of the white rock. Glass is two-toned on one face, light brown over black. The glass is devitrified near the vesicles and perhaps elsewhere.
2. Aphanitic to finely crystalline clasts isolated in the white component. Some contain small white inclusions.
3. Main part of the rock appears to be a few small, and one or more very large clasts in the Lithic III component. These rocks are mostly powdered, highly feldspathic; dominant grain size <0.1 mm. They contain variable proportions of relict angular mineral and lithic debris, mostly plagioclase, in angular translucent white and gray pieces from <1-11 mm. In one place, a lithic fragment has a 5 mm oikocryst of yellowish brown pyroxene molded on square 1 mm plagioclase. The pyroxene is striated (exsolution lamellae?). Along E side of S face, there is an unusual abundance of relict, unpowdered mineral debris, which is nearly 100% plagioclase. There is one 2 mm thin patch of crushed bottle green pyroxene, but most relict mafic silicate is yellow orthopyroxene (?). Identifiable relicts not more than a few percent mafics. One 5 mm patch contains thin schlieren of broken yellow mineral and very pale pink spinel (?). Scarce metal spheres and pieces.

62255 (Continued)

NOTES CONTINUED:

4. Covers areas on one side to 7 x 7 cm; smaller, irregular areas on S side. Much of this finely crystalline, salt and pepper texture. The texture varies greatly, and parts are aphanitic or vitreous. About 1-2% of metal fragments and spheres (much more than in white rock); some is yellowish and one is striated like pyrite. Contacts of dark gray with white rock are very sharp, very irregular (in places sutured or crenulated). A number of fragments of white rock have been incorporated in the gray, but the opposite relation is also seen, which is like Lithic 1. One very angular slab of dark in white is bordered for 2 cm by a hairline to 1 mm thick vesicular glass vein. An uncoated fracture appears to continue in the white rock beyond the edge of the gray on this line.



SAMPLE 62255

62275

ROCK TYPE: Breccia  
COLOR: White (N9)  
SHAPE: Rectangular, subrounded  
COHERENCE Intergranular: Very friable  
Fracturing: Many nonpenetrative, a few penetrative

WEIGHT: 443 g  
DIMENSIONS: 11 x 7.5 x 5 cm

BINOCULAR DESCRIPTION

BY: Stuart-Alexander

DATE: 5/24/72

FABRIC: Microbreccia (locally fine breccia)

VARIABILITY: Clasts unevenly distributed

SURFACE: Irregular

ZAP PITS: Few on B, N, E, T, none on S, W; however, rock is so friable that small zaps would have spalled off.

CAVITIES: None, except rock slightly porous due to loose grain packing.

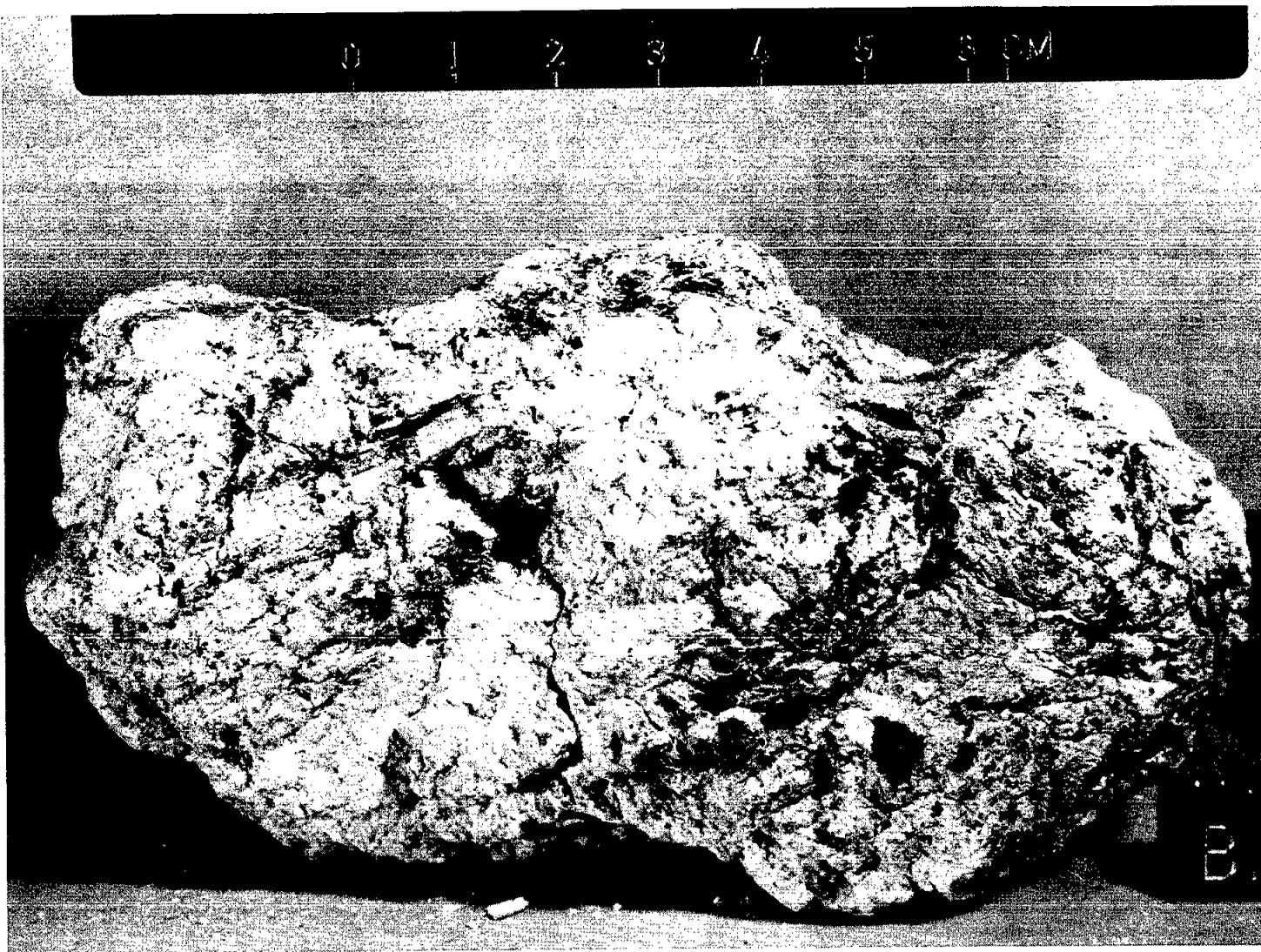
SPECIAL FEATURES: Rock has a crushed, ground, and locally streaked appearance, which is particularly well developed on T.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	white	97				1
Clasts I	pale greenish yellow	<1	ang	1		2
Clasts II	dk gray (N3)	1	ang to rd	0.3	<0.1-24	3
Clasts III	lt gray	1	subrd	2		4
Clasts IV	white	<1		1	<1 - 4	5

NOTES:

1. Dominantly white powdery with some sugary areas and some granules. Relict plagioclase forms up to 1% as 1-2 mm grains. Black minerals, probably opaques, some black clasts 1%; yellow minerals, a trace; pink mineral, spinel (?), a trace.
2. Sugary to granular with clean, sharp contacts, except for one thin vein or fracture coating on N. This is the most unevenly distributed of the clast types.
3. Aphanitic in small clasts. Largest clast is 24 mm long with maximum width of 2 mm. It appears streaked out, and has dark gray areas and medium gray areas, with the latter looking like ground up and powdery versions of the dark gray. These dark and medium areas give a weak banding parallel to the long axis of the clast. Locally it injects the white matrix.
4. Salt and pepper texture, very fine grained and sugary. Contacts are not sharp.
5. Chalky. One large clast has dark 2 mm clast in it.

176



SAMPLE 62275



62275

THIN SECTION DESCRIPTION

BY: Stuart-Alexander

DATE: 6/25/72

SECTION: 62275,3

SUMMARY: Crushed and shocked plagioclase rich rock. Dominant texture is mylonitic with local incipient shock melting. Vein-like dark areas, irregularly distributed, represent crushed mafic-rich, mylonitic, zones.

## MATRIX, 50% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Groundup mineral clasts		ang	<0.01	
Colorless glass(?)		veins	<0.01	

## MINERAL CLASTS, 49% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag		ang ang to rd	0.7 <0.1- 1.7	Plagioclase is crushed, locally highly shocked, going to maskelyenite. Most of the mafics are finely crushed and probably should be included in the "matrix". Percentage hard to estimate partly because locally concentrated.
Olivine } Opx } Cpx }	<1-20 Avg. of 5	ang ang ang	<0.1 <0.1	Olivine is dominant mafic.

## LITHIC CLASTS, 1% OF ROCK

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
l		subang	l	Brownish, devitrified glass(?) with a few percent angular plagioclase fragments.

62275 (Continued)

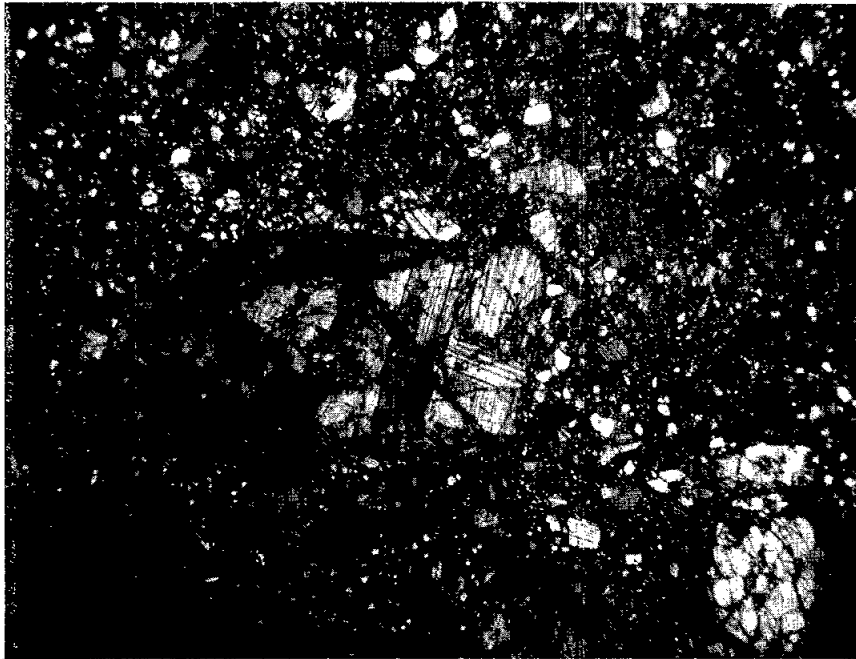
OPAQUE DESCRIPTION

BY: Brett

DATE: 6/21/72

SECTION: 62275,3

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	<0.1	veinlets	To 0.01	As low in opaques as any lunar sample yet seen. Unlike any other lunar rock, metal and troilite are largely in the form of irregular veinlets, to 10 $\mu$ length. Veinlets in any given area of section have quite strong preferred orientation, presumably a function of the fracture pattern. A number of grains of a dull gray phase in reflected light, higher reflectivity than the rock-forming silicates, in transmitted light phase has high relief and birefringence.
FeS	<0.1	veinlets	To 0.01	



SAMPLE 62275,3

WIDTH OF FIELD  $\approx$  4 MM

62295

ROCK TYPE: Crystalline  
COLOR: Medium gray (N5) to dark greenish gray  
(5GY/4/1)  
SHAPE: Angular, blocky  
COHERENCE Intergranular: Tough  
Fracturing: Few nonpenetrative, one eroded out on zapped surface.

WEIGHT: 251 g  
DIMENSIONS: 8.5 x 6.5 x 4 cm

BINOCULAR DESCRIPTION

BY: Simonds & Wilshire

DATE: 5/2/72

FABRIC: Isotropic

VARIABILITY: Plagioclase to mafic ratio varies from place to place. Clots of fine sugary-textured material.

SURFACE: T is hackly; E is subangular; B, E, N, and S are subrounded.

ZAP PITS: Very many on B; many on N, E, S; few on W; none on T. Most pits are lined with botryoidal glass.

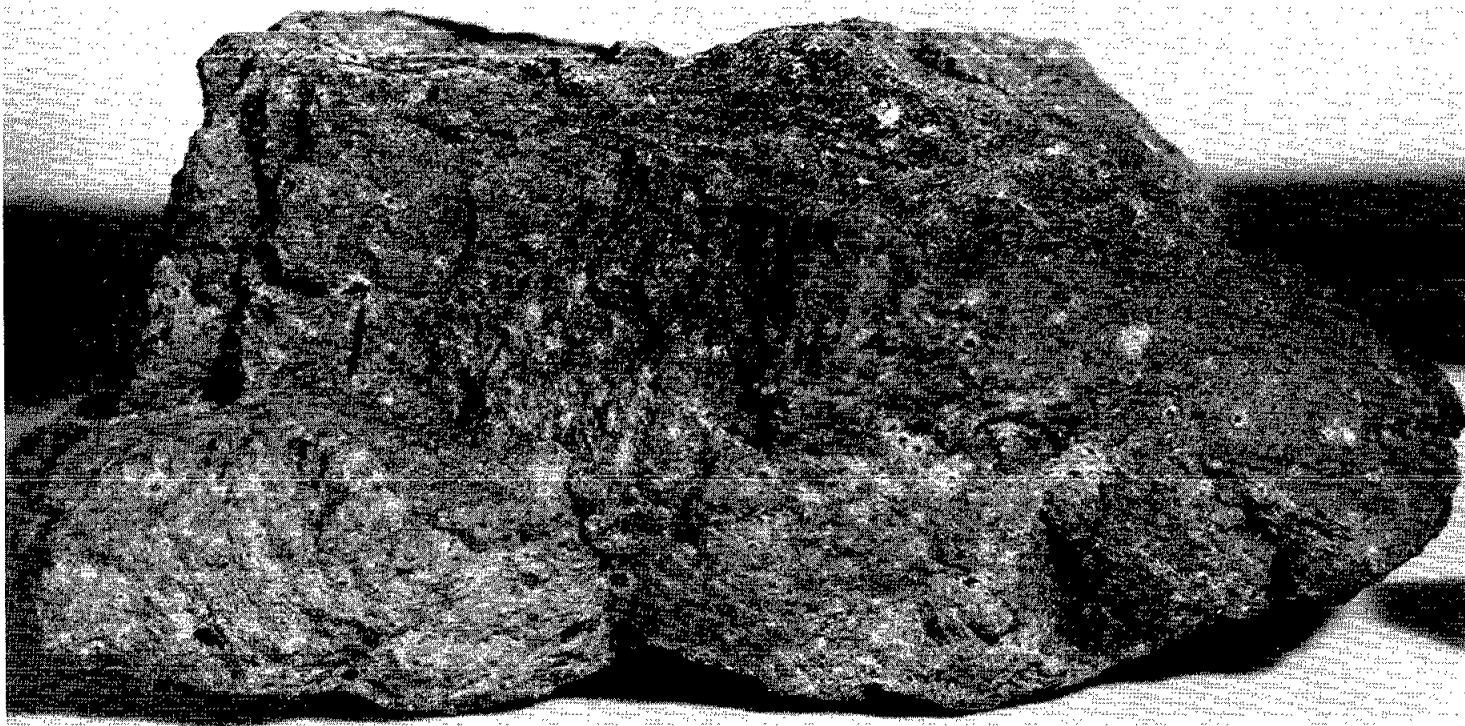
CAVITIES: Two percent irregular miarolitic cavities, 0.5-2 mm, with dominant size 3/4 mm. Spectacular crystal projections into cavities, mostly plagioclase, and a small amount of brown mafic silicate.

SPECIAL FEATURES: Clots of sugary material, 1-2 mm, with grain size 0.1 mm and the color of the bulk of the rock.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Feldspar	clear to white	60	largely prismatic	0.1	<0.1-2	1
Mafic silicate I	pale green (10G6/2)	15	equant to stubby prisms		0.1-1	2
Mafic silicate II	black	25		0.1		3
Metal	silver	tr		<0.01		
Spinel(?)	pink	tr	equant	<0.1		
Lithic or mineral	dark gray	tr	rectangular		2	4

NOTES:

1. Sizes are not seriate; a few large grains but most are small. Local development of 12 mm plagioclase laths.
2. Pale translucent grains; orthopyroxene or olivine.
3. Very fine-grained.
4. Fine, cryptocrystalline material.



SAMPLE 62295

62295

THIN SECTION DESCRIPTION

BY: Simonds

DATE: 6/ /72

SECTION: 62295,2

SUMMARY: The rock is an interstitial norite with a complex micrographic-like intergrowth of plagioclase and orthopyroxene.

## GROUNDMASS, 100% OF ROCK

<u>PHASE</u>	<u>% OF GROUNDMASS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	57	laths	0.8	Dominantly randomly oriented plagioclase laths intergrown with orthopyroxene, with mesostasis interstitial to plagioclase. Some of the equant high relief grains between plagioclase may be olivine, but most is clearly orthopyroxene.
Opx	24	prisms	0.4	The intergrowths of plagioclase and pyroxene are similar to micrographic intergrowth except that the two phases are orthopyroxene and plagioclase. There is rarely more than one pyroxene grain penetrating each plagioclase, but one optically continuous pyroxene may penetrate two or more plagioclases. The long dimension of the pyroxene conforms to the pyroxene's cleavage rather than that of the plagioclase. There are grains of pyroxene in which its cleavage parallels that of the host plagioclase.
Meso-stasis	16	triang patches	0.2	The mesostasis has crystallized to a series of optically parallel grains of a mineral with inclined extinctions which are up to 0.010 mm long and 0.002 mm wide. Some of these sets of grains are plagioclase which is optically continuous with the plagioclase grains adjacent to the patch of mesostasis. The amount of mesostasis varies somewhat over the section.
Isotropic	3	rectangular	0.07	The rectangular isotropic mineral commonly is an inclusion in the plagioclase with the outline of the isotropic mineral not paralleling the cleavage of the plagioclase.

62295

OPAQUES DESCRIPTION

BY: Brett

DATE: 6/22/72

SECTION: 62295,2

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilm	<0.7	irreg laths	avg 0.005	Ilmenite in irregular laths and flames at grain boundaries and in mesostasis-rich areas.
Fe-Ni	<0.2	rd	0.04-0.001	Fe-Ni and troilite in blebs. Metal grains in some cases have ragged edges. They are found at grain boundaries and rarely in mesostasis.
FeS	<0.1	rd	0.03-0.001	



SAMPLE 62295,2

WIDTH OF FIELD  $\approx$  4 MM

62315

ROCK TYPE: Breccia  
COLOR: Olive gray (5Y4/2)

WEIGHT: 0.8 g  
DIMENSIONS: 1.2 x 1 x 0.6 cm

SHAPE: Rounded

COHERENCE: Intergranular: Friable  
Fracturing: Few, non-penetrative

BINOCULAR DESCRIPTION

BY: Ridley & Simonds

DATE: 6/17/72

FABRIC: Isotropic

VARIABILITY: Homogeneous

SURFACE: All faces are hummocky and smooth.

ZAP PITS: None

CAVITIES: None

SPECIAL FEATURES: Recognition difficult due to dust cover.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase	white	1	subang	<0.1		
Lithic	light gray		subang	0.1		1

NOTES:

1. Fine grained with white specks.

FOR PHOTO OF 62315 SEE  
PHOTO WITH SAMPLE 62249  
ON PAGE 170

63335

ROCK TYPE: Breccia  
 COLOR: Medium gray to medium dark gray (N4-N5)  
 SHAPE: All fresh fracture surfaces are angular. One subdued surface.  
 COHERENCE Intergranular: Tough  
 Fracturing: Conchoidal fracture in places

WEIGHT: 65.4 g  
 DIMENSIONS: Three fragments  
 A: 3.5 x 3.7 x 2.0 cm  
 B: 4.0 x 3.2 x 1.3 cm  
 C: 3.0 x 2.4 x 1.8 cm

BINOCULAR DESCRIPTION

BY: Ridley & Stuart-Alexander

DATE: 5/22/72

FABRIC: Fine; breccia

VARIABILITY: A: Variable grain size  
 B: Variable grain size not as pronounced as A  
 C: As in A and B but very patchy

SURFACE: Irregular on all rocks

ZAP PITS: A: Few on B and T; none on others.  
 B: None.

C: Few on B, (glass lined <0.1 mm); none on other surfaces.

CAVITIES: Fragment A has 1%, subrounded to rounded vesicle on surface T with tiny feldspar crystals. Also irregular, elongate vesicles <0.1 mm long, aligned in one direction. Similar features found on fragments B and C.

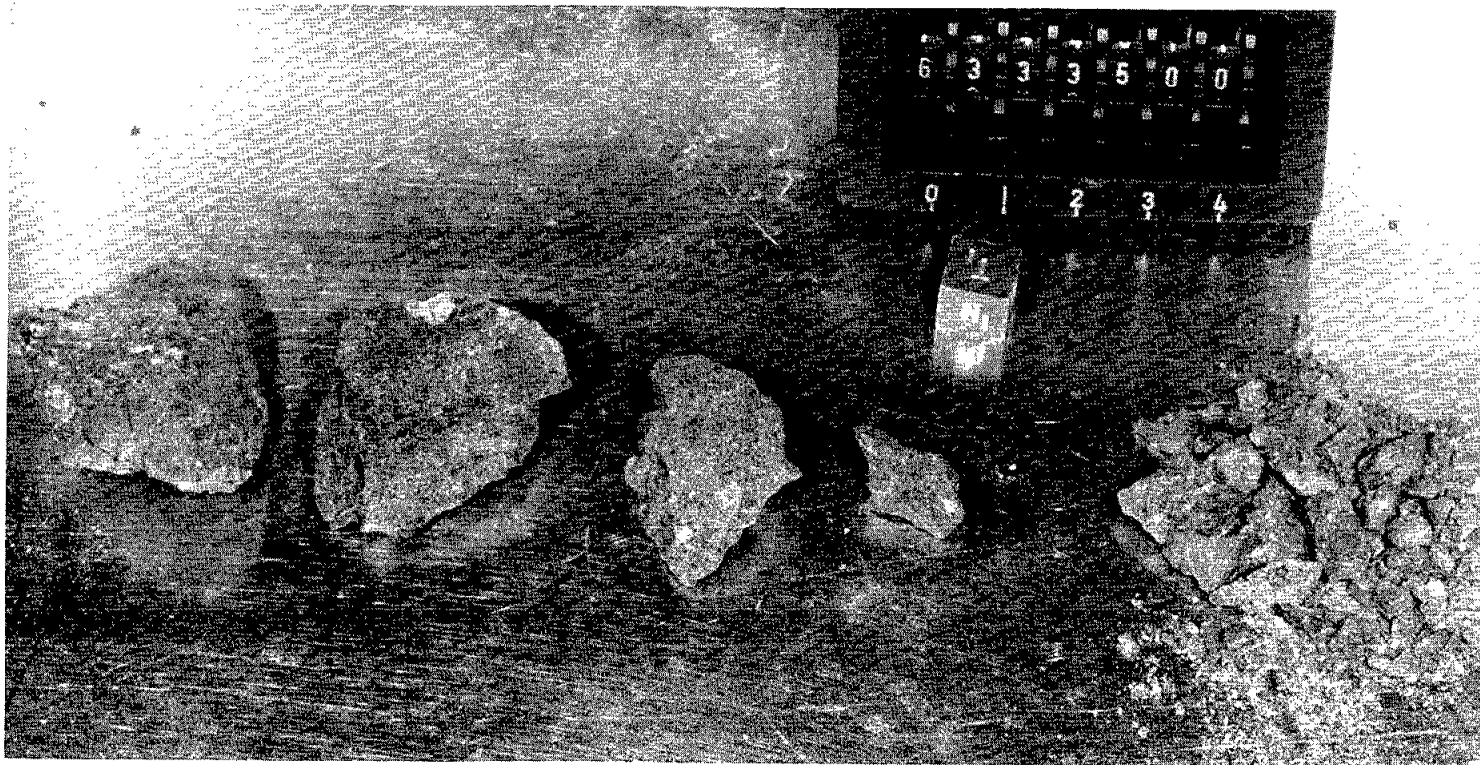
SPECIAL FEATURES: Weathered surface on fragment B is lighter brown-gray than color of broken surface giving it a "rind" effect.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Clasts I	white	A: 3 B: 3 C: 2	ang to subrd	0.1	<0.1- 5	1
Clasts II		B: 5 C: 5	ang to subrd	10	9 -15	2
Matrix		92			aphanit- ic to 0.1	3
Mineral		<0.1	ang		<0.1	4

NOTES:

1. Big clast in fragment B. Composed entirely of white to translucent gray feldspar. Each clast is composed of tightly interlocking feldspar mosaic.
2. Three large dark, aphanitic clasts which are very homogeneous, vesicle-free, and have a blocky fracture. Boundary with matrix is diffuse. Fragment C has a clast 10 mm x 2 mm x 7 mm.
3. Coarser parts have a granular texture with dominantly sugary luster. Finer parts have duller, waxy luster. Dominant mineral probably is feldspar. No other discernible mineral. Very dominant hornfelsic texture.
4. One grain with metallic luster, either metal or sulphide.





SAMPLE 63335

63335

THIN SECTION DESCRIPTION

BY: Stuart-Alexander

DATE: 6/24/72

SECTION: 63335

SUMMARY: Rock is a breccia that has been shock melted, devitrified and/or recrystallized. Degree and style of devitrification and/or recrystallization vary across the rock, probably due both to compositional changes within the original breccia and to localized shock-melt effects. It is very tough, dense appearing rock, probably with locally concentrated vugs, which may be due to plucking.

<u>PHASE</u>	<u>% OF LITHOLOGIC TYPE</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Lithology 1				
Plag	75	radiating laths	to 0.15	Lithology 1 consists of: radiating laths or tabular crystals of plagioclase enclosing a myriad of tiny mafic grains with intersertal olivine grains and intersertal brown glass. Locally sits in a matrix of thin (<0.01 mm) glass veins. In these areas, feldspars are finer grained.
Oliv	<5			
Glass	<1-70	intersertal inclusions	to 0.02	
Cpx(?)	15-20	within feld	<<0.01	
Dark mineral	5	intersertal & inclusions	<0.01	
Lithology 2				
Opx/Oliv	40	blades	to 0.3	Lithology 2 consists of: randomly oriented blades of opx/oliv which are optically oriented (parallel extinction) but looks as if they are composed of dozens of tiny grains in a groundmass of irregular plagioclase(?) patches including tiny cpx(?) grains and mineral X. Relict plagioclase clasts vary from 1 to 40 or more percent, according to area and degree of grinding up and mixing of original clasts.
Plag?	10-30	irreg	?	
Cpx(?)	>20	tiny granulars	to 0.01	
Mineral X	5	granules & blades	to 0.01	
Glass(?)	minor	blebs	to 0.01	
Plag clasts	1-70	ang	to 1	
Lithology 3				
Plag	dominant	ang	<0.1 (avg)	Glass, devitrified, plagioclase-rich, reaction rims around enclosed olivine-rich clasts.
Oliv	minor	subrd	0.1 (max)	

63335

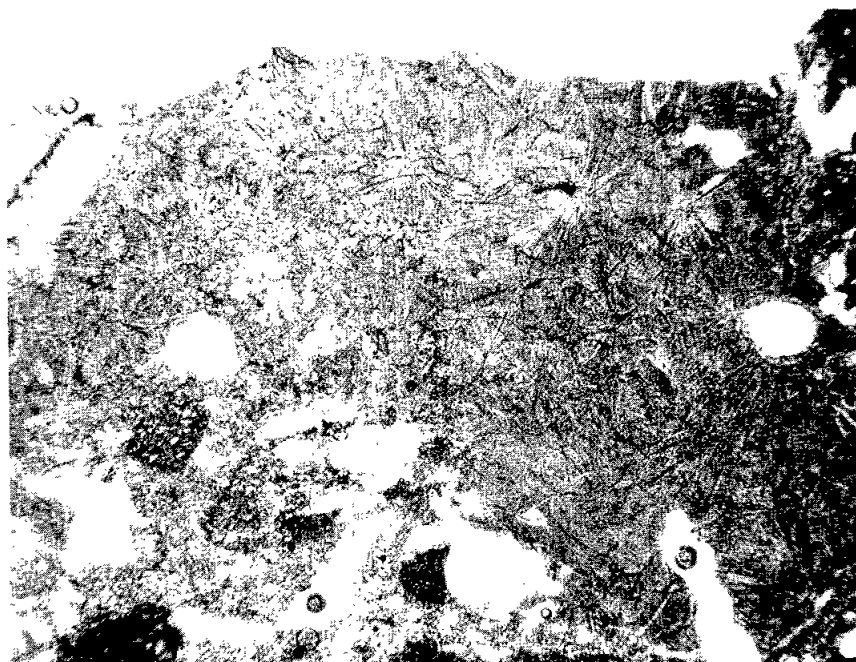
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/23/72

SECTION: 63335,14

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilm	<3		<0.01	In reflected light rock shows spaces around grain boundaries, suggesting incipient sintering only. Ilmenite content is variable through section, grains consists of poorly developed lamellae, flames and blebs commonly less than 5 $\mu$ diameter.
Fe-Ni	<0.1		<0.01	Troilite and metal in blebs commonly less than 3 $\mu$ , some grains to 20 $\mu$ .
FeS	<0.1		<0.01	



SAMPLE 63335,13

WIDTH OF FIELD  $\approx$  4 MM

63355

ROCK TYPE: Breccia  
COLOR: Medium gray (N5)  
SHAPE: Angular, irregular  
COHERENCE Intergranular: Tough  
Fracturing: Badly shattered; many irregular penetrative fractures 1-2 cm long.

WEIGHT: 65.4 g  
DIMENSIONS: 6 x 3 x 3 cm

BINOCULAR DESCRIPTION

BY: Hörz

DATE: 5/23/72

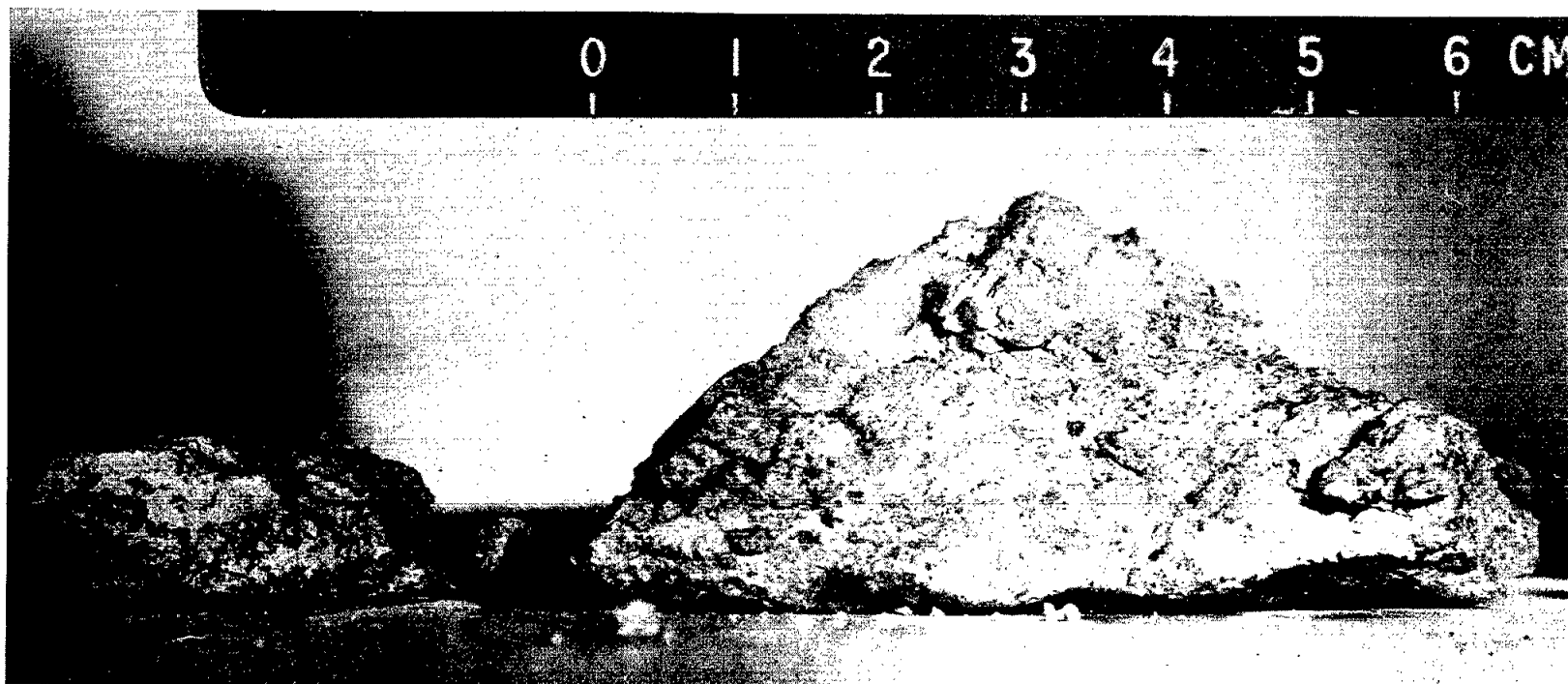
FABRIC: Isotropic  
VARIABILITY: Heterogeneous  
SURFACE: S, clast molds, dust-covered, hummocky (exposed surface). N face has a striated area, roughly 2 cm<sup>2</sup>, reminiscent of slickensides.  
CAVITIES: None  
ZAP PITS: Very few on S; all other sides are unpitted.  
SPECIAL FEATURES: No glass veinlets.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	N5	50		aphan	0.1-aphan	1
Clast type I	dark N3	35-40	ang	5	0.1-10	2
Clast type II	N9	1-2	ang-subrd	3	1 - 5	3
Clast type III	N8	>1	rd	1-2	0.1- 3	4
Clast type IV	red	tr	equidimen- sional	0.5	0.1- 0.5	5

NOTES:

1. Two-phase matrix: light and dark portions, varying amounts, giving matrix salt and pepper appearance. Dark portions have occasionally vitreous luster; degree of recrystallization of matrix is variable.
2. Fine-grained, occasionally vitreous luster, same material as dark matrix phase (i.e., there is continuum of black clasts from 10 mm to aphanitic). Dark "clasts" and dark parts of matrix seem to be harder than white component because they form angular and knobby promontories. A wide range of various stages of recrystallization varying from vitreous to aphanitic is observed.
3. Anorthositic, i.e., pure feldspar; sugary; some are translucent.
4. Transparent vitreous luster, i.e., probably feldspar glass.
5. Spinel(?).

189



SAMPLE 63355

63505

ROCK TYPE: Melted or recrystallized  
anorthosite or anorthositic  
breccia  
WEIGHT: 5.4 g  
DIMENSIONS: 2.0 x 1.6 x 1.2 cm  
COLOR: Dark gray (near N3)  
SHAPE: Blocky, angular to subround  
COHERENCE Intergranular: Tough  
Fracturing: Few, penetrative

BINOCULAR DESCRIPTION

BY: Bass

DATE: 6/2/72

FABRIC: Isotropic inequigranular, microbrecciated  
VARIABILITY: Zap pits; density variable  
SURFACE: B is a smooth to slightly irregular fracture surface; SW, SE and W  
end of N are smooth joint surfaces; others probably fractures or joints.  
Five percent glass on T, none on others.  
ZAP PITS: Few on T; none on other surfaces. Glass colorless to light or medium  
brownish-gray; suggests feldspar-rich rock. SE corner of T is opaque white  
spall zone; may be part of zap pit from impact which broke this specimen  
from parent.  
CAVITIES: Open joints only  
SPECIAL FEATURES: Soil cover on all faces which is brownish gray on T and on  
others is light gray with brownish surface darkening. All faces may be  
joints; definite joints form SE and SW faces (almost normal to T and S;  
a penetrative fracture in the interior parallels SW face, and the recessed  
W end of N is an irregular surface parallel to S). Rock is apparently  
shock-melted gabbroic anorthosite in which the melt is largely devitrified,  
or a recrystallized gabbroic anorthositic breccia. It is highly jointed  
like the tough, dark clasts in many Apollo 16 breccias.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	dark gray	>80		<0.1		1
Feldspar	light gray	>10	irregular	0.5	0.3-1	2
Spinel(?)	dark red	tr	equant, blocky	0.1		3
Mafic(?)	dk gray-brown	tr	blocky	0.5x0.25		4
Metal	gray	tr	films	<0.1		5

NOTES:

1. Lithic, dull luster, rarely vitreous luster; probably devitrified impact melt; cleavage faces are <0.1 mm, in diameter.
2. Translucent to transparent relics whose abundance is hard to estimate.
3. One dull grain in white spall zone on SE corner of T.
4. One grain on recessed W end of N appears to possess a light corona(?); may be unmelted mafic relic.
5. Rare irregular patches on B and elsewhere.

63506

ROCK TYPE: Crystalline  
COLOR: Medium dark gray (N4)  
SHAPE: Ovoid  
COHERENCE Intergranular: Tough  
Fracturing: None

WEIGHT: 4.9 g  
DIMENSIONS: 2 x 2 x 1.5 cm

BINOCULAR DESCRIPTION

BY: Warner

DATE: 6/2/72

FABRIC: Inequigranular  
VARIABILITY: None  
SURFACE: Very dusty, one side is eroded surface.  
ZAP PITS: Few on eroded surface, none on other faces.  
CAVITIES: None  
SPECIAL FEATURES: Rock is holocrystalline, some crystals up to 1.5 mm, however, much of rock consists of <0.2 mm crystals.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase	colorless					
Maf sil	dark					

63507

ROCK TYPE: Soil "breccia"  
COLOR: Olive gray (5Y4/1)  
SHAPE: Blocky, subangular to subround  
COHERENCE Intergranular: Friable (to coherent)  
Fracturing: Few, penetrative

WEIGHT: 2.78 g  
DIMENSIONS: 2.0 x 1.6 x 1.2 cm

BINOCULAR DESCRIPTION

BY: Bass

DATE: 6/2/72

FABRIC: Microbreccia  
VARIABILITY: Glass cover  
SURFACE: Smooth to irregular (granulated on very fine scale); 10% glass on T; 1% glass on B; on T glass is vesiculated, but was so fluid that vesicles broke and edges were rounded by surface tension, leaving smooth, shallow pock marks.  
ZAP PITS: None (unless glass on B really occupies irregular zap pits).  
CAVITIES: None other than normal intergranular porosity of a soil "breccia".  
SPECIAL FEATURES: Irregular fracture at NE corner of B; S side of T is flat joint surface with partial glass coating; other surfaces may be modified joints, but most are probably fractures or abrasion surfaces. Rock is a sintered soil "breccia" or agglutinate. Components are mainly from anorthosite or gabbroic anorthosite or from breccias derived from such rock types.

63507 (Continued)

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	olive gray	98	?		<0.1	1
Feldspar	white	<1	equant, blocky, ang	0.4	0.1-1	2
Glass clasts I	black	<0.1	irregular, equant	0.1	<0.1-0.5	3
Glass ovoid	black	tr	ovoid	0.2x0.15		4
Lithic clast I	dark gray	tr	ang, blocky	0.5		5
Lithic clast II	med gray	tr	ang, blocky	2.5x2		6
Lithic clast III	light gray	tr	ang, blocky	1.5x1		7
Lithic clast IV	black to lt gray	tr	ang, blocky	3 x2		8
Glass(?) clast	brown	tr	irregular, equant	0.1		9
Glass(?)	dk brownish gray	tr	slabby	0.8x0.5 x0.01		10

NOTES:

1. Sintered or impact-consolidated soil. Coherent enough to fracture and to be handled with little loss of fines.
2. Shattered; rare relict pieces large enough to appear locally colorless.
3. Irregularity in part due to tiny vesicles.
4. Single spherule exposed on T.
5. Single clast, apparently devitrified glass.
6. One clast on N, aphanitic, may be shocked plagioclase.
7. Single clast on N, very fine-grained (<0.1 mm), may be shattered plagioclase or recrystallized breccia.
8. Single clast on W, largest in breccia, composed of glass with abundant open vesicles (rounded edges) attached to light or medium gray aphanitic rock.
9. Single clast, similar to glass clasts, but of a distinct brown color; may be mafic grain.
10. Film on S side of T (the glass-coated surface); has brown tinge; one tiny reflection was reddish metallic or adamantine. In terrestrial rock this film might be called manganese oxide. May be slightly oxidized, devitrified glass, although the definite glass elsewhere on this surface is totally dissimilar.



63508

ROCK TYPE: Anorthosite, crushed

WEIGHT: 2.6 g

COLOR: Light bluish (5B7/1)

DIMENSIONS: 2 x 1 x 1 cm

SHAPE: Blocky

COHERENCE Intergranular: Tough

Fracturing: Few, penetrative

BINOCULAR DESCRIPTION

BY: Warner

DATE: 6/2/72

FABRIC: Inequigranular

VARIABILITY: Plagioclase shocked on one corner.

SURFACE: Very dusty.

ZAP PITS: None

CAVITIES: None

SPECIAL FEATURES: A fairly pure anorthosite.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase	colorless	100				

NOTES:

1. Some are white and shocked, others are up to 2 mm cleavage fragments with twinning.

63509

ROCK TYPE: Crystalline

WEIGHT: 2.05 g

COLOR: Medium dark gray (N4)

DIMENSIONS: 1.6 x 1.0 x 1.0 cm

SHAPE: Blocky, angular

COHERENCE Intergranular: Tough

Fracturing: None except external bounding surfaces

BINOCULAR DESCRIPTION

BY: Bass

DATE: 6/2/72

FABRIC: Isotropic, largely equigranular

VARIABILITY: None

SURFACE: Smooth to slightly irregular; 5% glass on NE, none on others except in zap pits. All surfaces appear to be planar joints.

ZAP PITS: Few on all faces; most abundant on N of E, least on W (which also has least soil cover); glass in pits is medium brownish gray; on E edge of T one patch of glass has rolled or curled, and has included tiny clasts -- forms a rough agglutinate patch. Whole E edge of B is white and fractured due to impact.

CAVITIES: None.

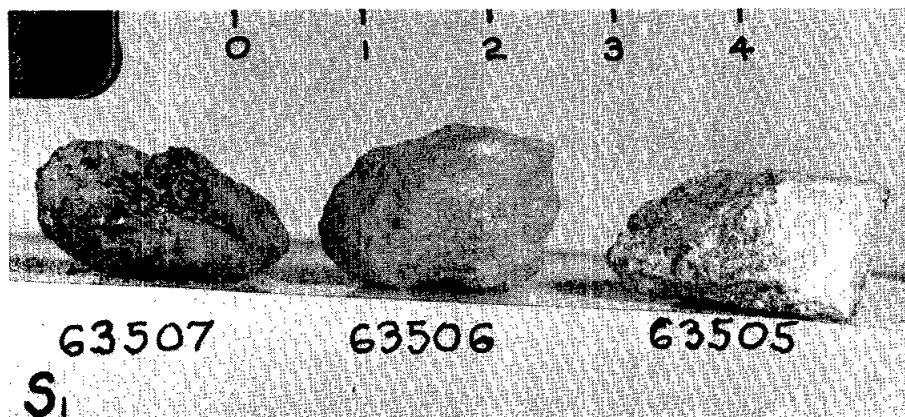
63509 (Continued)

**SPECIAL FEATURES:** Soil cover almost complete on T and B; partial on all other faces (least on W). No clear soil lines unless the edges of T and B are such. All bounding surfaces are joints -- orientations are T, B, W, N side of E, N side of W and S side of E. Relict plagioclase and color suggest derivation from gabbroic anorthosite or breccia of that composition. Highly recrystallized and possibly once largely melted. Parent rock was highly jointed. Closely resembles 63505 except for the relatively small amount of relict plagioclase in 63509. Also similar to many dark cherty clasts in Apollo 16 breccias.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	med to med dk gray	99		<0.1		1
Plagioclase(?)	lt gray to colorless	<0.5	irregular	?		2
Metal	gray	tr	films	0.1		3
Glass	dk gray or brownish gray	tr	films			4

**NOTES:**

1. Cherty looking, very-fine-grained rock; many plagioclase(?) cleavages; possibly recrystallized gabbroic anorthosite, although it may have gone through a melt stage. N side of E has partial glass cover which may be zap pits, but glass seems to grade into matrix; at least on this face, therefore, and possibly throughout, the matrix may be partly vitreous.
2. Patches in matrix on T and at intersection of N side of E, N side of W and T faces; probably unrecrystallized or unmelted relics.
3. On matrix and on soil cover; looks like spatter; most common on T, coats soil on B; and occurs on matrix on N side of E.
4. In zap pits; on N side of E may be a partial coating, possibly due to impact melting of matrix.



63515

ROCK TYPE: Crystalline  
COLOR: Medium dark gray (N4)  
SHAPE: Blocky  
COHERENCE Intergranular: Tough  
Fracturing: None

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

BINOCULAR DESCRIPTION

BY: Warner

DATE: 6/2/72

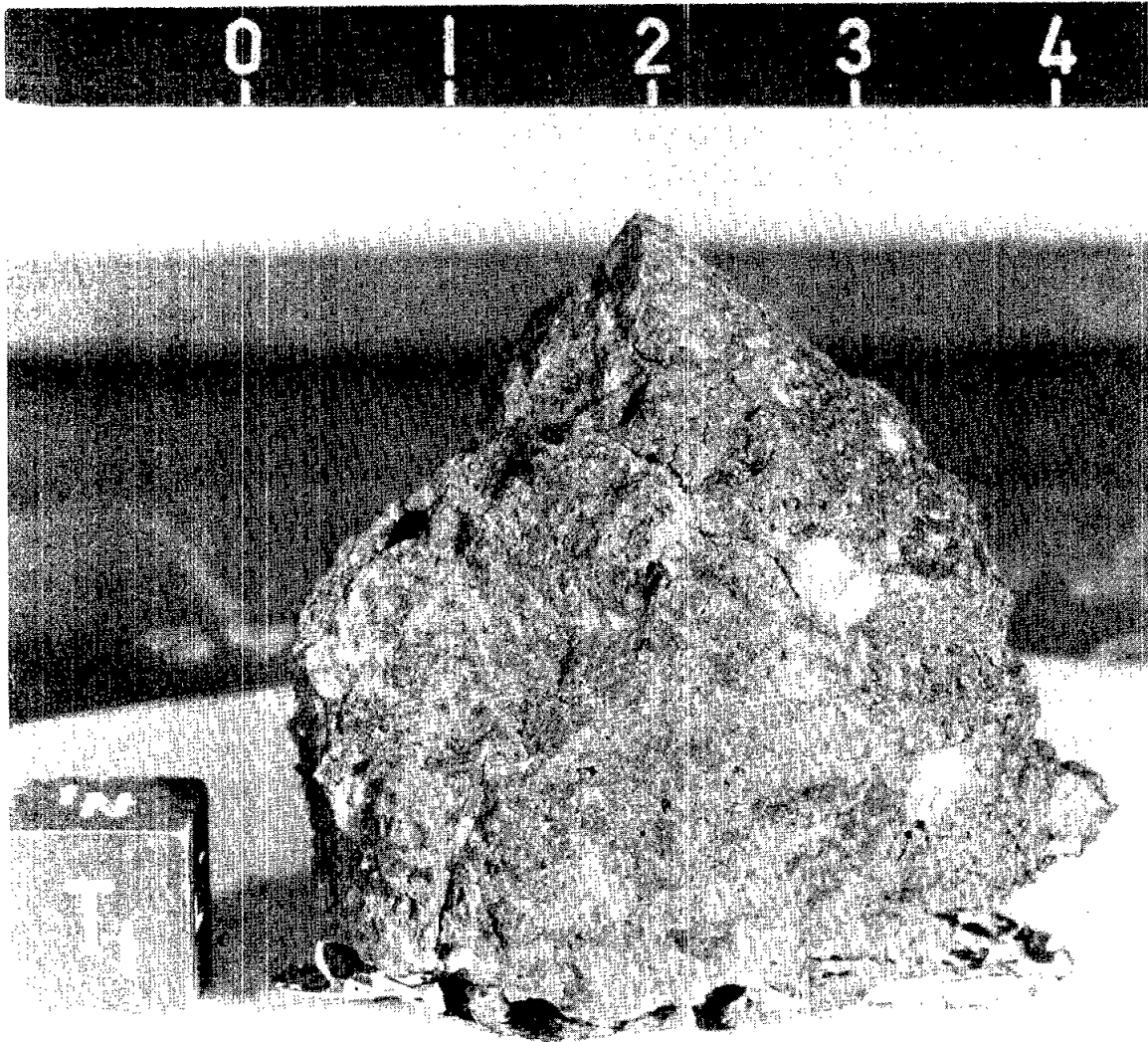
FABRIC: Inequigranular, isotropic, holocrystalline  
VARIABILITY: One clast.  
SURFACE: One side eroded surface.  
ZAP PITS: Few on eroded surface.  
CAVITIES: About 1% of very small cavities.  
SPECIAL FEATURES: One area 2 mm across consists of large colorless plagioclase plus fine-grained white crystals, probably a shocked area and not a clast.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase	colorless	80				I
Pyroxene	dark	20				

NOTES:

1. Most of rock consists of <0.2 mm crystals; however, there are some large crystals, mostly plagioclase, up to 1.5 mm.





SAMPLE 63538

63525-29; 63535-39; 63545-49; 63555-59; 63565-69; 63575-79

63585-89; 63595-98

DESCRIPTION: Rake Sample BY: Lofgren DATE: June 14, 1972

63525-29, 63535-39, 63545-49, 63555-58

#### FINE-GRAINED CRYSTALLINE ROCKS

63525 through 38 are angular, fine-grained and crystalline with a few clasts and generally have few to no zap pits. 63539 through 58 are also fine-grained and crystalline but have many zap pits and are generally more rounded. Some of these may have a granular matrix hidden by zap pits and belong in 63577-95 - a couple do have small amounts of granular material adhering. 63558 has several iron fragments - two of which are ~1 mm diameter spheres.

63559; 63565-69, 63575,76; 63596-98

#### GRAY, VESICULAR GLASS

Dark gray to black, vitreous, vesicular glass enclosing chalky white to translucent clasts and very few fine-grained crystalline clasts. Glass vesicle size ranges from ~1 mm to 2 or 3 cm. All of these samples could be parts of one fragment which broke either in transit or on the lunar surface. 63596, 97 and 98 are large, rounded glassy, to fine-grained, vesicular agglutinates with few to many zap pits. White clasts occur in the matrix.

63577-79, 63585-89, 63595

#### LIGHT GRAY, MODERATELY FRIABLE, CLASTIC-MATRIX BRECCIAS

Moderately coherent breccias with clasts of fine-grained crystalline and aphanitic material. 63577 through 87 have large clasts 0.1 mm to 3 or 4 mm set in a light gray matrix - generally rounded with many zap pits. A few have green translucent clasts. 63588 through 95 have a very light gray to whitish, less coherent matrix and small clasts all less than 1 mm.



RAKE SAMPLE 63525-29, 35-39, 45-49, 55-58



RAKE SAMPLE 63577-79,85-89 &amp; 95

64425

ROCK TYPE: Breccia (black and white rock) WEIGHT: 14.6 g  
COLOR: Very light gray (N8) & DIMENSIONS: 3.5 x 2.5 x 2 cm  
dark gray (N3)  
SHAPE: Tabular, subangular  
COHERENCE Intergranular: Coherent  
Fracturing: Many irregular penetrative fractures

BINOCULAR DESCRIPTION

BY: Reid

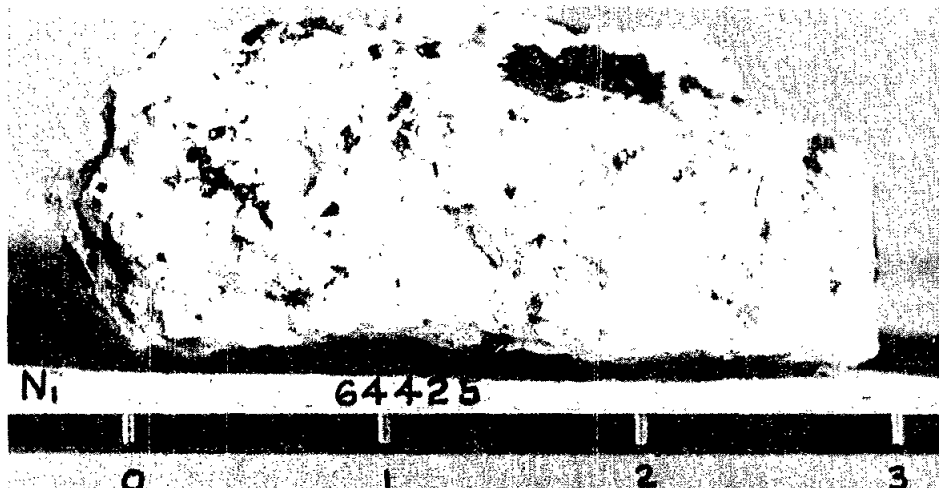
DATE: 6/21/72

FABRIC: Breccia, white matrix, dark irregular clasts  
VARIABILITY: Highly variable; light-to-dark ratio  
SURFACE: None  
ZAP PITS: Many on B; few on T; other faces too small. One 2.5 mm. zap on B  
straddles black-white contact.  
CAVITIES: None  
SPECIAL FEATURES: Similar to Apollo 15 black and white rock but much smaller  
and also has pink spinel. Dark clasts have sharp irregular boundaries  
against white anorthositic matrix, but dark clast have white feldspathic  
clasts just like the matrix and some are crowded with the white clasts  
forming a dark matrix, white clast breccia.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
White matrix	v lt gray (N8)	50	matrix			1
Black clasts	dk gray (N3)	50	clasts		<1-20	2

NOTES:

1. Grain size  $\approx$ 0.1-0.3 mm; 95% chalky white feldspar; 1-2% brown pyroxene(?); 1-2% opaque, and a few 0.1 mm metal grains; very difficult to see grain boundaries, no large crystals noted, probably brecciated.
2. Grain size  $\approx$ 0.1 mm breccia with angular clasts of white feldspathic material (up to 0.5 mm) similar to white matrix of rock. Components of dark clast matrix: light gray feldspar, green-gray mafic, and very-fine-grained dark gray unidentified material. Also on T, black material contains 0.5 x 0.2 mm grain of pink mineral (spinel?). Metal grains up to 0.2 mm. It has dark gray grains up to 0.5 mm, with conchoidal fractures, that may be glass.





64435

ROCK TYPE: Breccia  
COLOR: Very light gray (N8-N9)  
SHAPE: Blocky, subangular to subrounded  
COHERENCE Intergranular: Coherent  
Fracturing: Few penetrative

WEIGHT: 1079 g  
DIMENSION: 12 x 10 x 11 cm

BINOCULAR DESCRIPTION

BY: Ridley

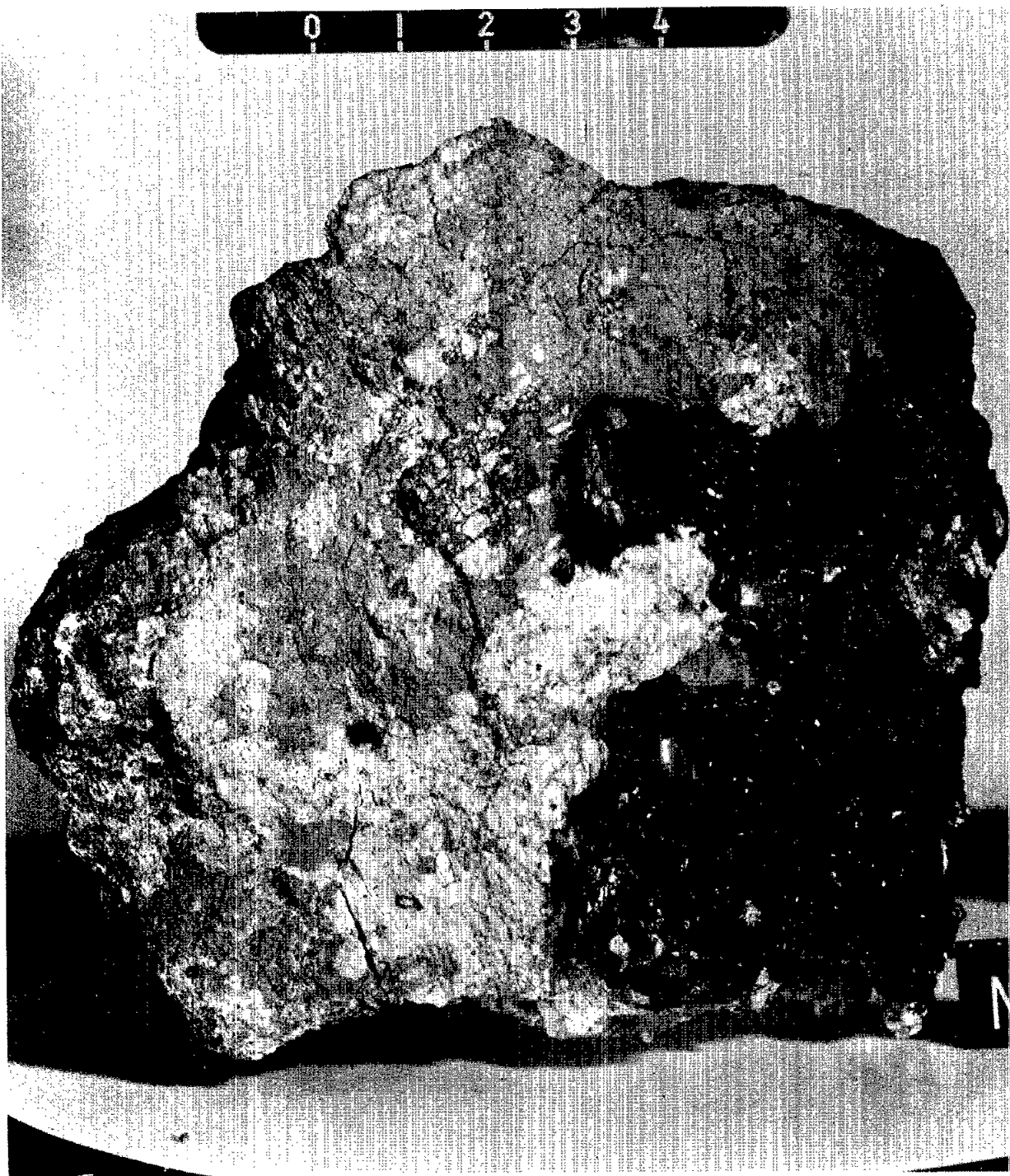
DATE: 6/5/72

FABRIC: Breccia  
VARIABILITY: Partly glass-coated. There are local zones in which the clast-to-matrix ratio becomes very high.  
SURFACE: N is hackly; S, T, B, and E are irregular.  
ZAP PITS: Few on N, B; many on S, T, E.  
CAVITIES: 10-15% vesicles in glass, largest cavity is 0.5 cm. They are rounded to ellipsoidal.  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic I	white	25	ang, subrnd	2	1-5	1
Lithic II	white	25			80x80	2
Matrix	light medium gray	50				3

NOTES:

1. Small clasts in gray matrix have very sharp contacts with gray. No mafic minerals seen. Some boundaries between white clasts and the matrix are indistinct. Here white clasts have "cherty" appearance. Some grayish bands extending into white clasts. Chalky white, very fine-grained occasional sugary textured clasts.
2. One very large clast. Like the small white clasts. 99% feldspar with a trace of metal, and a trace of dark brown mafic silicate(?). Dull to glassy luster.
3. Very fine grained. 20-25% dark is brown mafic silicate(?), 1% black opaque, and the rest is gray feldspar.



SAMPLE 64435

64435

THIN SECTION DESCRIPTION

BY: Ridley

DATE: 6/29/72

SECTION: 64435,6 and ,7

SUMMARY: This rock probably was originally a coarse grained igneous rock composed of plagioclase + orthopyroxene + minor olivine. It was subsequently intruded by pale brown glass and strongly deformed and crushed, giving an overall mylonitized texture. Plagioclase and orthopyroxene tend to occur in bands that may reflect on original mineral layering. At this stage, the intrusive glass may have devitrified. Further injection of brown glass occurred, and there may have been further deformation.

Section 64435,7 is almost identical to 64435,6. The individual bands of plagioclase and orthopyroxene are particularly well developed in 64435,6 in which there is also a contact between this rock type and a finer grained rock, that has a dark brown fluidal texture and encloses fragments of plagioclase. Also encloses a 1.5 mm clast of feldspar-rich basalt(?) with sub-trachytic texture.

MATRIX, 15% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag				Extremely variable. Composed of comminuted particles of orthopyroxene and plagioclase mainly.
Opx				
Oliv				
Metal				

MINERAL CLASTS, 70% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	60	irreg	0.2-1.5	Dominates texture of this rock. Plagioclase occurs in crush bands, individual broken crystals up to 1.5 mm.
Opx	40	irreg	0.2	
				Orthopyroxene + olivine tend also to occur in discrete, but finer grained crush bands.

64435 (Continued)

THIN SECTION DESCRIPTION

BY: Ridley

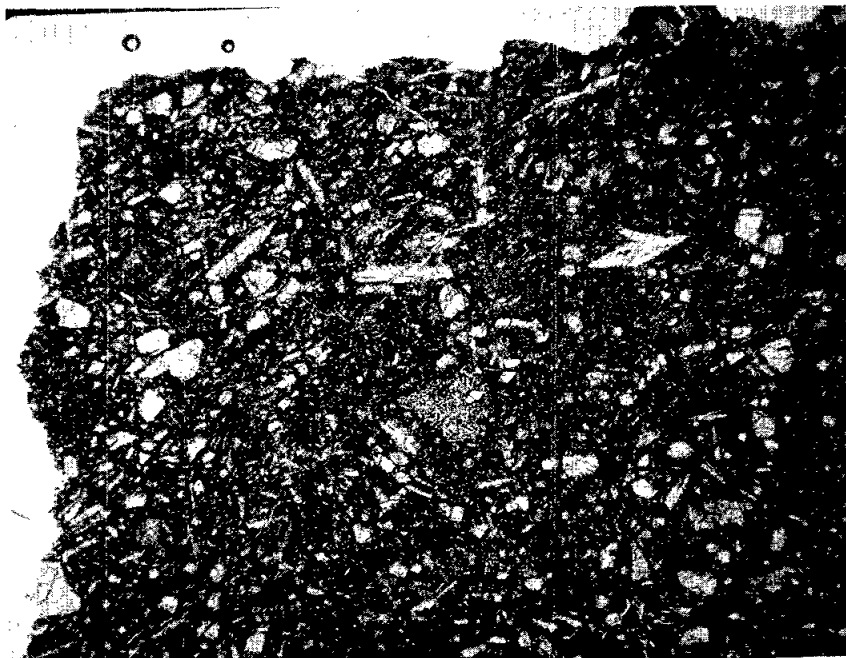
DATE: 6/29/72

SECTION: 64435,6 and ,7 (Continued)

GLASS OR OTHER CLASTS, 15% OF ROCK

<u>COLOR</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Pale brown	100	irreg		Strongly devitrified into a semi-spherulitic mass of plagioclase. Coarse sheaths of plagioclase up to 0.5 mm. Finer sheaths associated with lighter-colored glass. Devitrified glass also encloses two large plagioclase crystals (0.5-0.8 mm). Glass has diffuse boundaries with matrix, has very irregular shape. The veins of pale brown glass intrude mineral, clasts and devitrified glass clast. Veins themselves may be deformed and fractured.

NOTE: Very low opaque and metal content.



SAMPLE 64435,5

WIDTH OF FIELD  $\approx$  4 MM

64435

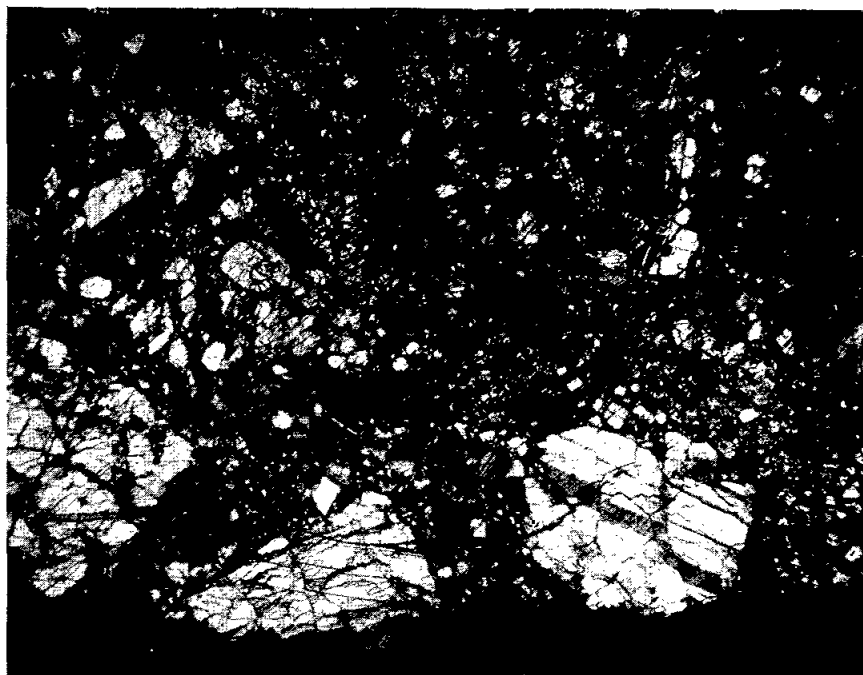
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/20/72

SECTION: 64435,6 and ,7

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	<0.1	ragged	0.02	Opaque mineral content is extremely low even for an Apollo 16 rock. About three ilmenite grains in whole section; no submicron opaques in this rock. A couple of grains of possible ulvospinel.
Troil	<0.1	ragged	0.02	
Ilm	<0.1	ang	0.015	
Ulvo	<0.1	ang	0.015	



SAMPLE 64435,6

WIDTH OF FIELD  $\approx$ 4 MM

64435

THIN SECTION DESCRIPTION

BY: Ridley

DATE: 6/29/72

SECTION: 64435,8

SUMMARY: Rock is a strongly recrystallized hornfels, with partly resorbed mineral and lithic clasts. Amongst the lithic clasts, highly irregularly shaped and diffuse areas of recrystallized feldspar are most abundant.

## MATRIX, 17% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	90	lath	0.1	Well developed plagioclase laths.
Pyrox	8	irreg	<0.01	Probably interstitial pyroxene.
Opaque	2	irreg	<0.001	Abundant interstitial opaque grains.

## MINERAL CLASTS, 25% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	70	irreg	2 -0.1	All minerals show signs of resorption and have diffuse edges. Plagioclase commonly shows signs of shock and recrystallization.
Pyrox	29	subhedral irreg	0.4-0.05	
Oliv	1	irreg	0.1	
Metal	0.1	irreg	0.05	Plagioclase also occurs as lath shaped crystals, (avg size: 0.2 mm) that may be related to the matrix recrystallization and define a weak fluidal texture, and especially around clasts define a pronounced fluidal texture. NOTE: Metal content is about ten times that in 64435,6 and ,7.

## LITHIC CLASTS, 58% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
I	1	rd	1	Feldspathic basalt, with abundant laths, blocky plagioclase.
II	1	rd	0.3	Pyroxene-basalt with abundant orthopyroxene and has about 50% plagioclase.
III	98			Very irregular, diffuse patches of white-to-buff material. Appears to be composed exclusively of strongly recrystallized, and crushed feldspar.

64435 (Continued)

THIN SECTION DESCRIPTION

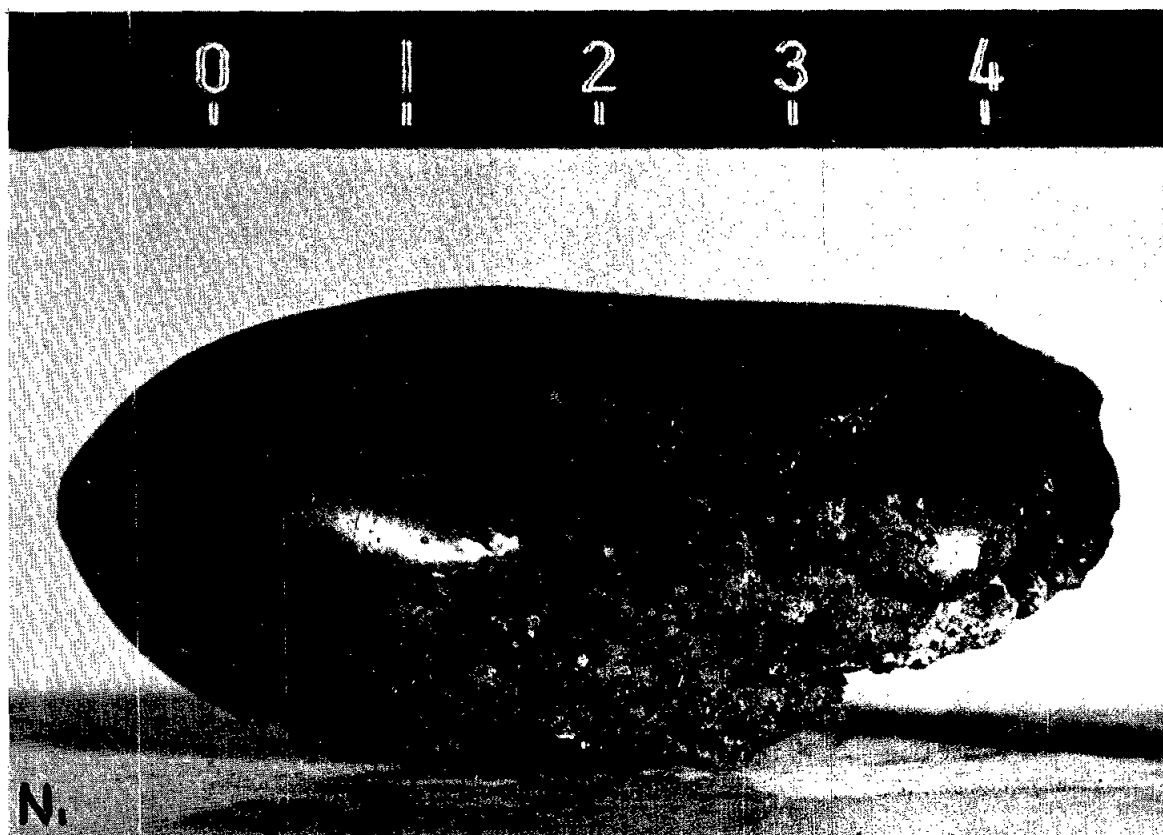
BY: Ridley

DATE: 6/29/72

SECTION: 64435,8 (Continued)

GLASS CLASTS, <1% OF ROCK

<u>COLOR</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Brown	100	irreg	0.05	Glass seems to be similar to the late stage glass intruding 64435,6 and ,7.



SAMPLE 64455

64455

ROCK TYPE: Anorthosite, glass-coated and shocked  
WEIGHT: 56.7 g  
DIMENSIONS: 5.6 x 4.0 x 2.5 cm  
COLOR: Glass-grayish black (N2); anorthosite medium light gray (near N6) to white  
Chip: 1.6 x 1.1 x (0.3-0.8) cm  
SHAPE: Ovoid, rounded  
COHERENCE Intergranular: Coherent  
Fracturing: Few, penetrative in glass, abundant, nonpenetrative in anorthosite

BINOCULAR DESCRIPTION

BY: Bass

DATE: 6/7/72

FABRIC: Isotropic, inequigranular(?)

VARIABILITY: Glass cover, metal distribution on surface of glass, and zap pit frequency

SURFACE: W and B (w end) have irregular-to-hackly fracture; remainder is surface of glass coat, controlled mainly by surface tension. B, where not zapped, has a dull matte surface, which is possibly due to micro-scratches or micro-fractures. B also has faint lines (scratch?) subparallel to length of specimen; no definite metal or glass blobs on this surface. T varies from vitreous to slightly matte (much fresher than B); no zap pits; abundant metal spheres (and lenses?) partly exposed and partly buried; and a few glass blobs attached to and coalesced with surface to varying extents; where extensively coalesced blobs may leave a low, irregular-to-rounded mound (generally more irregular than bulges due to interior vesicles just below the surface - see "cavities"). T is also spotted by light vesicles blue to bluish-gray films which are round and have sharply defined or vague, gradational outlines, much like dried rain drops on a dirty windshield; in the proper lighting the spots are strikingly iridescent. They are believed to be a metal film or, more likely, a cluster of minute metal globules on lenses. Alternatively the spots may be fine glass spray (or sputtered glass) or a sublimate of unknown type. The films are restricted to the exterior surface. They are soft and retain streaks where scraped.

ZAP PITS: B has few to abundant. Abundance is concentrated mainly in central and W parts of B; saturated in these areas. Other faces have none; none seen on fresh fractures of glass or on the anorthosite core of the specimen.

CAVITIES: Five percent vesicles in glass; open fractures in glass; locally cavernous contact between glass and anorthosite. Vesicles from 0.5 to 8 mm diameter; equant to elongate; elongate ones seen in broken edge of glass on S edge of B (up to 6 x 3 mm) seem to conform to surface of specimen; generally larger toward outer surface, smaller toward inner surface. Smooth large holes or dimples on T appear to be large vesicles which burst. Elsewhere on T, vague low circular humps may be interior vesicles which have deformed but not disrupted the exterior surface. No metal definitely identified in vesicles.

SPECIAL FEATURES: Irregular cracks in glass, no sets; abundant joints in anorthosite, spacing less than 1 mm, suggestion of 2 or 3 orthogonal sets, but locally appear to be tangential to glass coat; this fine jointing gives laminated or lineated appearance to anorthosite locally. Moderate soil cover on B and W and in holes on T; elsewhere only faint dustiness at most.



## 64455 (Continued)

**SPECIAL FEATURES:** Two veins injected from glass coat into anorthosite; one exposed on one S side of B is discontinuous, 5 x 0.3 mm, tapers to point; other on W is 1.5 mm long, and has rounded edges. The feldspar was not strongly heated or recrystallized. W end is fractured and soil covered but not zapped.

**NOTES ON CHIP:** Probably from fractured W end of parent. Mainly glass coating, with minor adhering anorthosite. Illustrates generally weak bonding between glass coat and anorthosite. Where anorthosite is absent inner surface of glass is covered with sharp, irregular ridges which appear to be, not walls of open vesicles, but sharply-tapered veins which injected into cracks in the anorthosite but could not penetrate far.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plag (anorthosite)	white, lt gray	>50	platy(?)	<0.1	<0.1-0.5	1
Spinel(?)	med brown	tr	equant	<0.1		2
Black material	black	tr	equant			3
Sulfide	yellow metallic	tr	equant, rd	<0.2		4
Glass	grayish black	<50				5
Metals	lt yellow to gray	tr	spheroid, lenticular	0.1	<0.1-0.5	6
Plagioclase	colorless to lt gray	tr	irregular, equant	≈0.1(?)		7
Glass	dk gray	tr	spheroid or dumbbell	≈0.5-1	0.3-1.5	8

**NOTES:**

1. Shocked, unrecrystallized, vitreous-to-pearly luster on cleavages; shocked cleavages may control closely spaced jointing in anorthosite.
2. Two shocked grains in anorthosite; may be mafics.
3. Tiny spots on surface of anorthosite; not certain whether spots are in or on the surface of the anorthosite; may be tiny fragments of adhering glass.
4. One ovoid in anorthosite, exposed on B.
5. Vesicular (see discussion of cavities); mainly vitreous, but some suggestion (especially on broken edges on W and B) of devitrification on interior edge, but this is not certain. In highly zapped areas of B has bronzy brown color and semi-metallic luster. One cracked area on W has light yellow-green color. Sharply bounded against anorthosite; bonding is weak to moderately strong; where glass and anorthosite have parted (W and W end of B) the separation may be at contact, or, where jointing in anorthosite is intense, within the anorthosite (see note on "chip" under Special Features).
6. Only on T, sometimes in aligned rows like spatter. Generally tarnished to light yellow; none seen in glass; only uncertainly suggested on interior surfaces of vesicles in glass.
7. Vague white or colorless patches in the glass coating; probably unmelted relics brought in with the glass and unrelated to the anorthosite core.
8. Glass blobs which hit surface of glass coat in flight and coalesced with it to moderate or great extent. Only one dumbbell seen (3 x 1 mm).

64475

ROCK TYPE: Breccia  
COLOR: Medium light gray (N6) with  
white areas

WEIGHT: 1032 g  
DIMENSIONS: 12 x 10.5 x 6 cm

Note: There is no clean surface.

SHAPE: Blocky, subangular

COHERENCE Intergranular: Coherent  
Fracturing: Few, nonpenetrative

BINOCULAR DESCRIPTION

BY: Stuart-Alexander

DATE: 6/5/72

FABRIC: Banded breccia

VARIABILITY: Heterogeneous clast distribution and textural relationships

SURFACE: Hackly

ZAP PITS: Many on B; few on S, E; none on T, W, N.

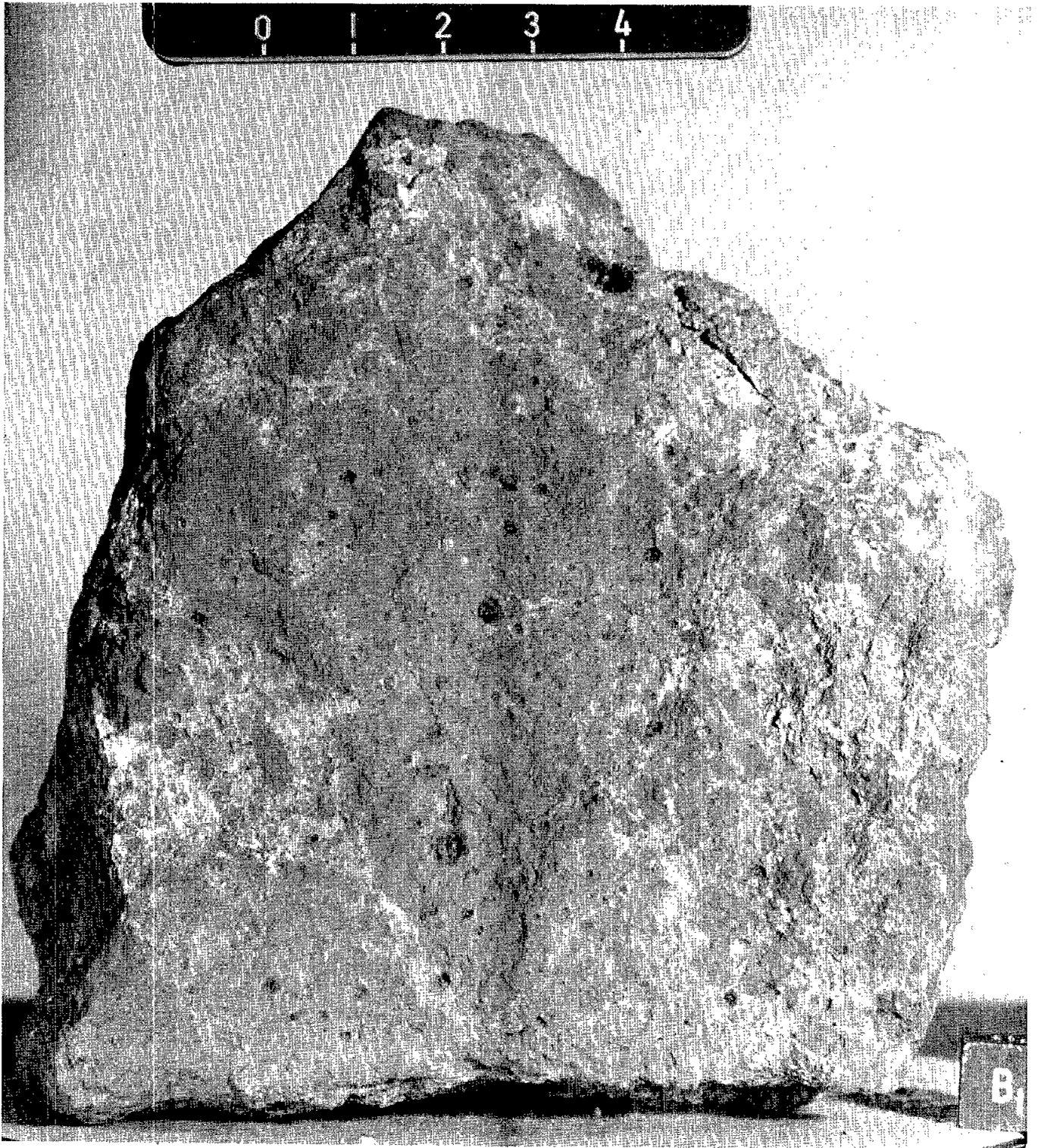
CAVITIES: None in most areas, possible glass veins have a few <1 mm vugs.

SPECIAL FEATURES: Predominant relation is that the dark component forms clasts in a white matrix although contacts are variable. In other areas, however, white component comprises rounded clasts in a dark matrix. Dark clasts are subrounded to rounded; contacts vary from very sharp and clean to highly irregular and even gradational. In places the white material has clearly been injected into the dark and both have been streaked out, giving a localized banding effect (see T face). Original clast shapes and sizes seem to have been destroyed.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic (Matrix?)	white	45				1
Lithic (Clasts)	med gray (N5)	55	subrd to rd		1-70	2

NOTES:

1. Varies from porcelain-like (annealed) to locally powdery and chalky-to-translucent. In some crystalline areas there is granular plagioclase and others there is granular plagioclase with minor light-brown mafic silicate (pyroxene?). There is also <1% dark specks (opaques?), a trace of yellow-green mafic, and locally thin net veining of vitreous-looking dark material.
2. Varies from very-fine-grained, salt and pepper texture to aphanitic-to-glassy. Glass contains trace of metal fragments <1 mm. Also, locally contains white clasts up to 5 mm. Where glassy, looks black to locally very dark green.



SAMPLE 64475

64476

ROCK TYPE: Breccia, white matrix  
COLOR: Matrix, white (N9) clasts, dark green (N3)  
SHAPE: Roughly lenticular  
COHERENCE Intergranular: Tough  
Fracturing: Few non-penetrative

WEIGHT: 125 g  
DIMENSIONS: 7 x 5 x 4 cm

BINOCULAR DESCRIPTION

BY: Williams

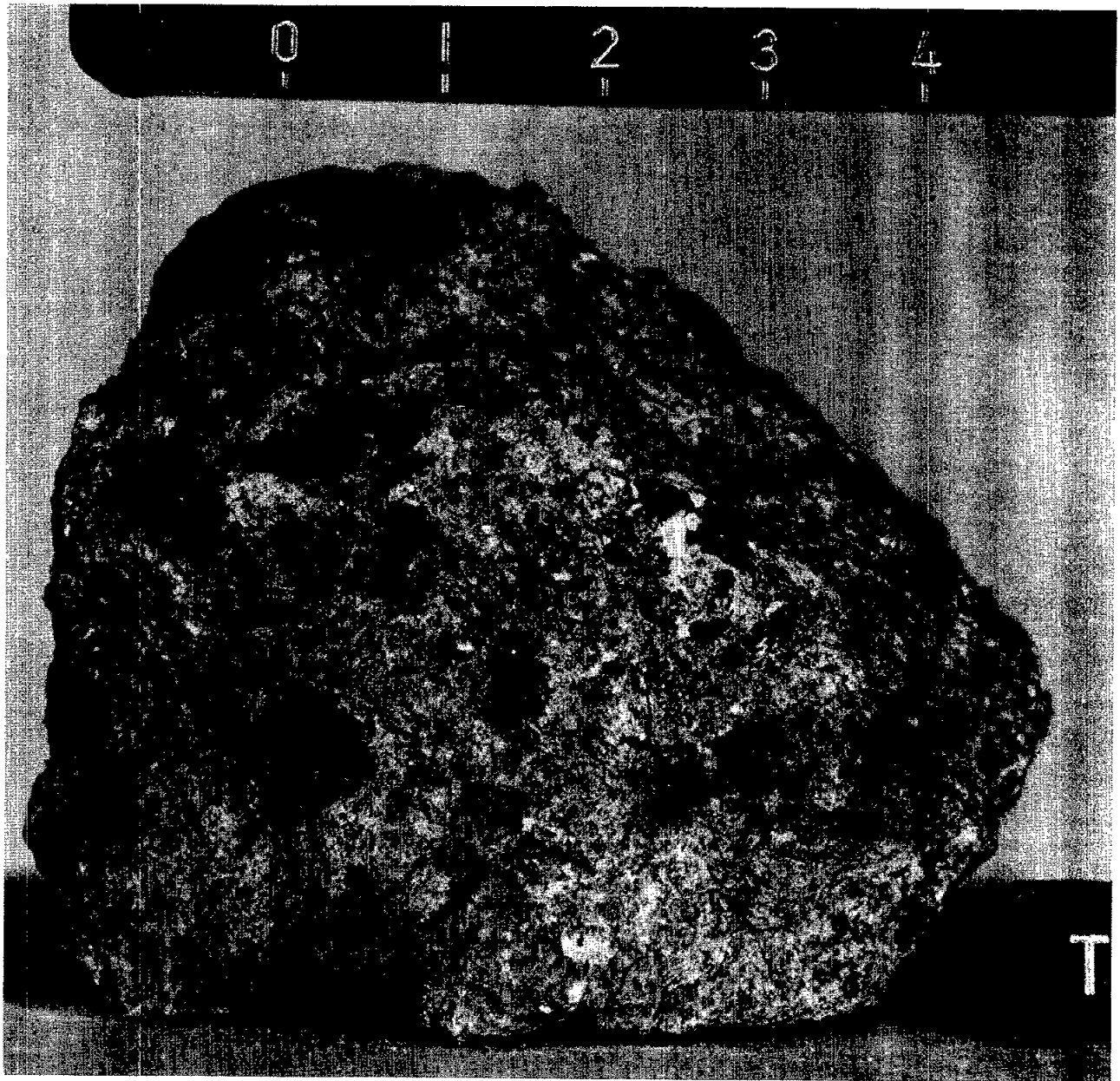
DATE: 6/16/72

FABRIC: Breccia  
VARIABILITY: Abundance of clasts population variable  
SURFACE: All hackly  
ZAP PITS: Few on T, S, E; none on others. Zaps are lined by colorless glass.  
CAVITIES: Less than 1% open crack.  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	white (N9)	80				1
Clast I	light gray (N7)	15	ang and irreg	4	1-20	2
Clast II	medium gray (N5)	2	ang and irreg	2	1-10	3
Clast III	medium dark gray (N4)	3	ang and irreg	2	1-5	4

NOTES:

1. Fine-grained, chalky, no crystals seen, but may actually be 1 mm grains which are now chalky, rare (<1%) black specks, and some very light gray areas which look like "ghost" clasts. Irregularly distributed 1 mm translucent anhedral crystals are present in matrix.
2. Salt and pepper texture. Contains up to 40% of chalky white clasts angular to rounded and from 0.2-1 mm which look like matrix.
3. Salt and pepper texture. Contains some clasts as Clast I up to 40%.
4. Salt and pepper texture. Contains only about 10% of white clasts. Has a few dark gray (N3) glass veins or areas (about 2%). A few metal spheres noted in these clasts (about 0.5 mm diameter with rough surface). All clasts appear to have a sharp contact with matrix; however, these contacts are extremely irregular with stringers of clast matrix and visa versa. One case of a clast stratigraphy with white clast in Clast II and in Clast III noted in matrix. In a few places, a thin 0.1 mm selvage is present in the clast at its contacts with matrix.



SAMPLE 64476

64477

ROCK TYPE: Breccia  
COLOR: Medium gray (N5)  
SHAPE: Subround, blocky, elongate  
COHERENCE Intergranular: Coherent  
Fracturing: Few, penetrative

WEIGHT: 19.3 g  
DIMENSIONS: Four fragments, largest  
is 3.5 x 2.3 x 1.1 cm

BINOCULAR DESCRIPTION

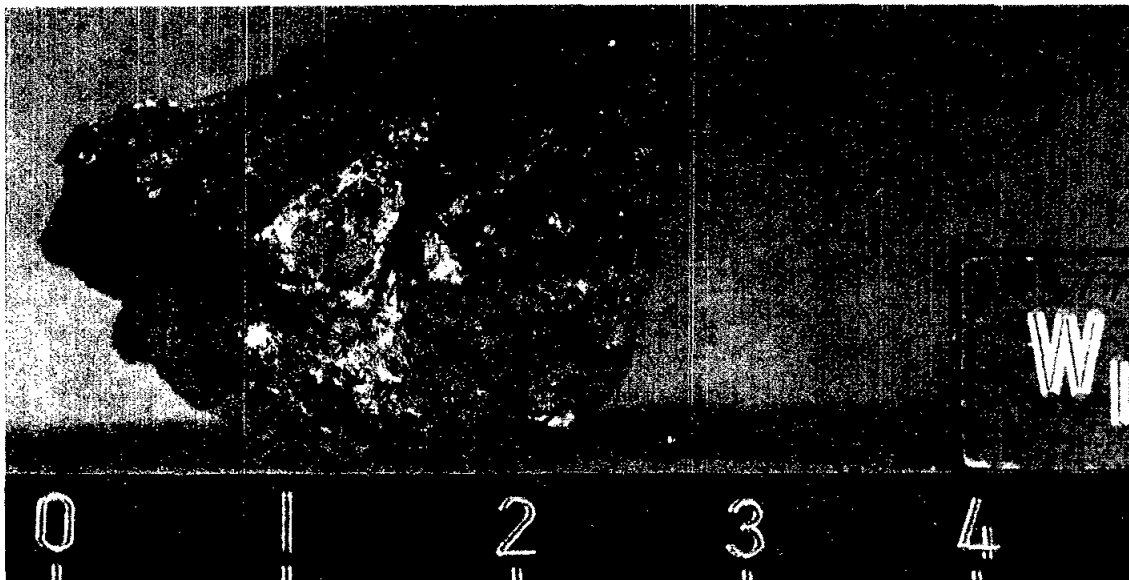
BY: Stuart-Alexander DATE: 6/7/72

FABRIC: Breccia  
VARIABILITY: Glass inhomogeneously distributed  
SURFACE: Broken surface hackly, others finely irregular  
ZAP PITS: Many on T, B, S; None on N(?), W, E.  
CAVITIES: None  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic	white	20	subrd, elongate	1	<1-8	1
Glass	v dk gray	10				2
Matrix	med gray	70				3

NOTES:

1. The sugary clasts are fine-grained, granular plagioclase with traces of a pale yellow mineral and black specks.
2. 0.5 mm thick glass veins and blobs. Blobs are on order of 0.1-0.2 mm and less.
3. Aphanitic, composed of indistinct areas of gray, white, and greenish material. Trace of pink spinel(?).



64478

ROCK TYPE: Breccia, glass cemented  
COLOR: Medium dark gray (N4)  
SHAPE: Roughly cubic  
COHERENCE Intergranular: Coherent  
Fracturing: None

WEIGHT: 12.3 g  
DIMENSION: 2.5 x 2 x 1 cm

BINOCULAR DESCRIPTION

BY: Williams & Wilshire

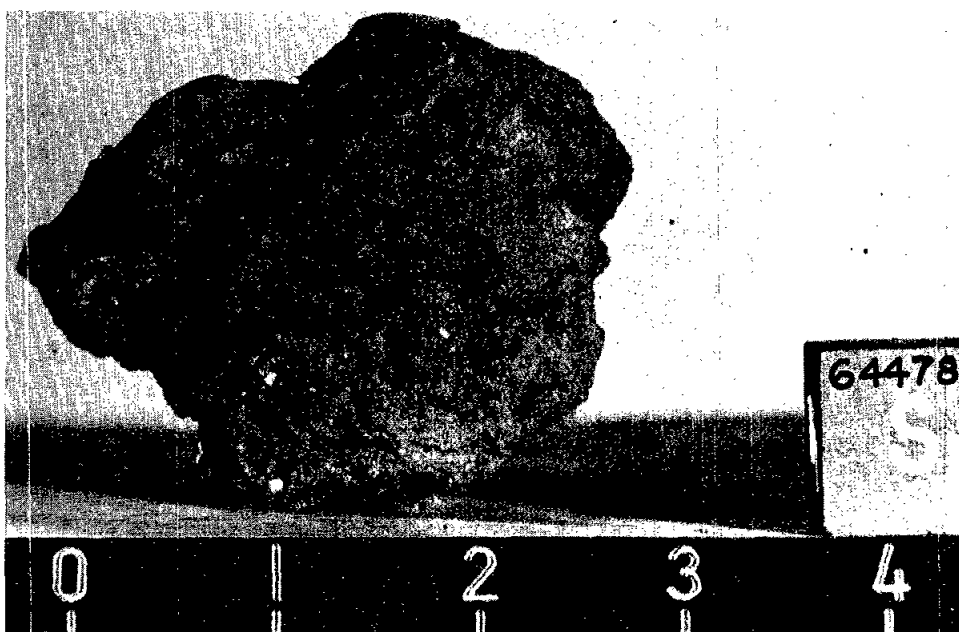
DATE: 6/7/72

FABRIC: Breccia  
VARIABILITY: Homogeneous  
SURFACE: Very dusty. Irregular, knobby  
ZAP PITS: None  
CAVITIES: Vesicles, very small, (0.1 mm) in vein up to 60% in some of glass.  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass I	black	55				1
Lithic	medium dark gray	40	rnd		-10	2
Glass II	black	5				3

NOTES:

1. Possibly forms veins penetrating the rock. Very finely vesicular. Contains fine-grained chalky white clasts down to 0.1 mm in 5% of the glass. Glass may be devitrified.
2. Contains 0.1-1.5 mm white and light gray clasts, average size 1 mm, in aphanitic gray matrix.
3. About 1 mm thick, has much larger vesicles than Glass I. May be devitrified.



64535-39; 64545-49; 64555-59; 64565-69; 64575-79; 64585-89

DESCRIPTION: Rake Sample BY: Phinney DATE: June 15, 1972

64535-39, 64545-49, 64555-58

#### HETEROGENEOUS, GRAY AND WHITE BRECCIA

Angular to subrounded gray and white breccias. Generally, they consist of a white, friable, anorthositic matrix containing irregularly shaped, subangular, coherent, gray, aphanitic fragments which themselves contain small, (1-2 mm) white clasts. In some, e.g., 64535, the white material comprises up to 90% of the sample. In others, e.g., 64538, the black material comprises up to 90% of the sample. The white material has varying degrees of friability and varies from white and powdery in some areas to clear and granular in others. The gray material, in general, has a dull, almost-glassy appearance as though devitrified. In some cases flashes from small crystals can be seen but it is not clear whether these result from small crystals of debris or from devitrification. In some instances the white material appears to form irregular intrusions into the gray and includes small (1-5 mm) fragments of gray. But in other instances the relations seem reversed. This ambiguity is well-displayed in 64537 where there are intrusions of white into gray and vice versa as well as inclusions of white in gray and vice versa. The white and gray patterns in this specimen form a zebra-stripe pattern.

64559; 64565-69; 64575-79; 64585, 86

#### GRAY, COHERENT, FINE-GRAINED CRYSTALLINE ROCKS

Highly variable, angular to subangular groups characterized by a light gray to medium gray, coherent, fine-grained, cherty to sugary matrix which makes up nearly all of each rock. These were probably all breccias originally, but have attained various degrees of devitrification and/or recrystallization. Some are very fine grained with only a few tiny flashes indicating crystals. There are probably, in large part, devitrified or partially crystallized glass containing a few clastic particles (64565,66; 64579; 64586). Some have a more chert-like matrix (64577) and others contain obvious white clasts (64555; 64578) about 1 mm in size. In some specimens there are rare, <1 mm, clasts of white, light gray, and tan. Veinlets of dark glass occur in a few. 64576 and 64586 have a strongly adhering coat of white soil-like material. A few are moderately vesicular (64565; 64567; 64569; 64575; 64579). In general, the variations within this entire group are too continuous to warrant any further arbitrary breakdown on the basis of binocular microscope descriptions.



64587, 88

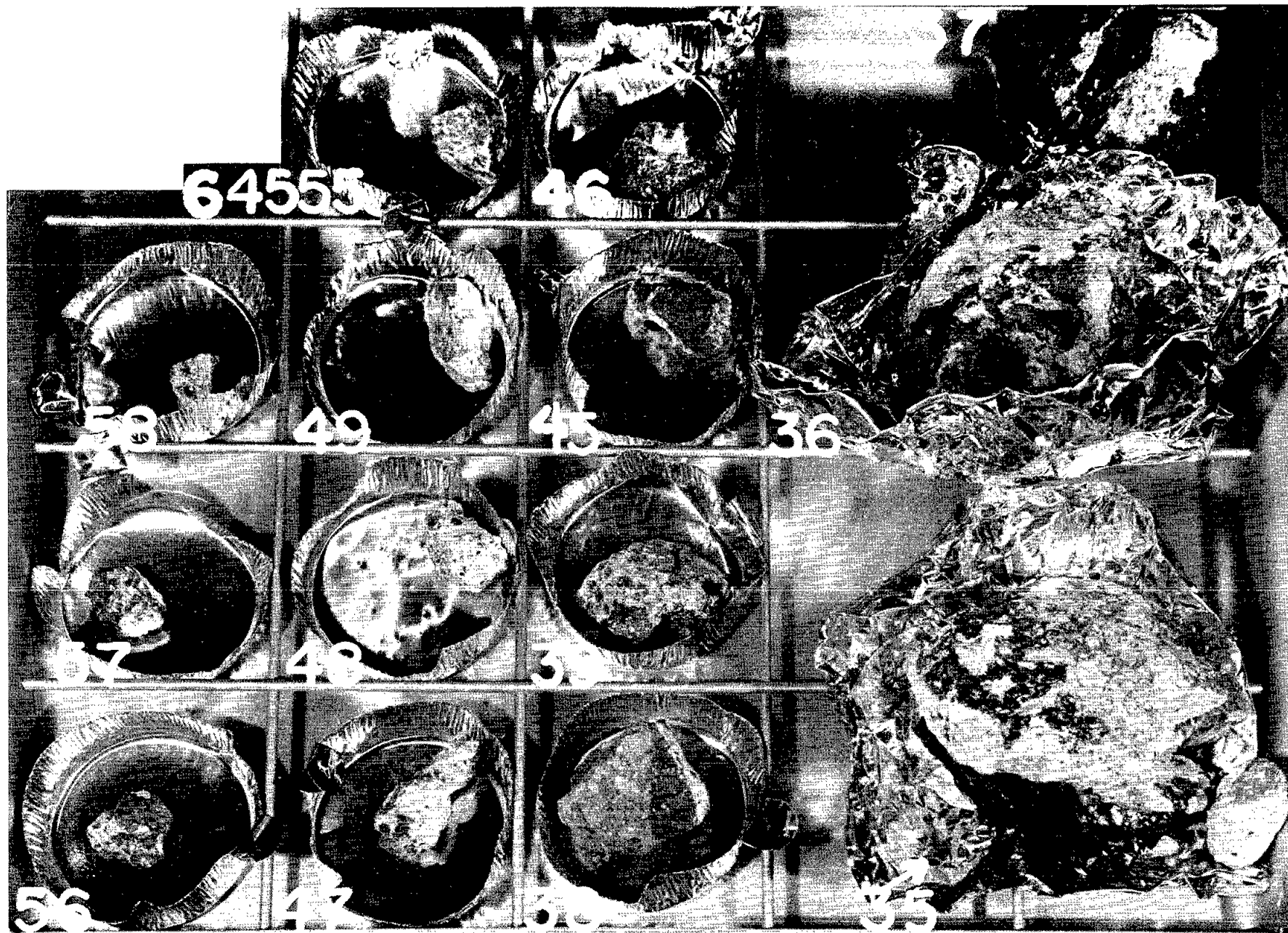
**LIGHT GRAY, MODERATELY FRIABLE, CLASTIC BRECCIA**

Rounded, moderately friable, light gray, fine-grained (~0.1 mm), clastic matrix breccia containing white through gray mineral and lithic clasts, up to about 1 mm, protruding from the matrix. 64587 has a vesicular, black glass coating and a slightly more coherent matrix than 64588.

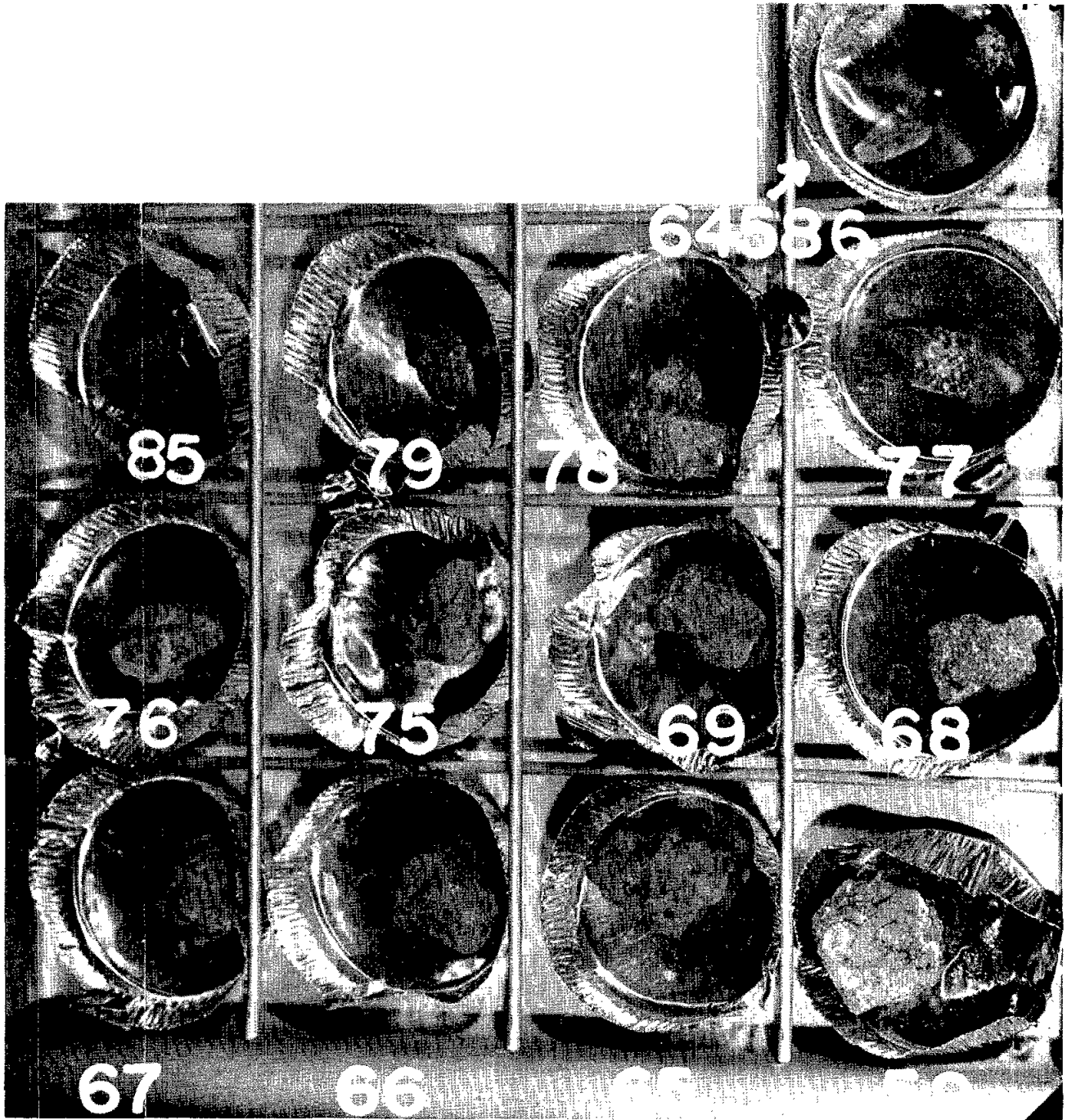
64589

**ANORTHOSITE**

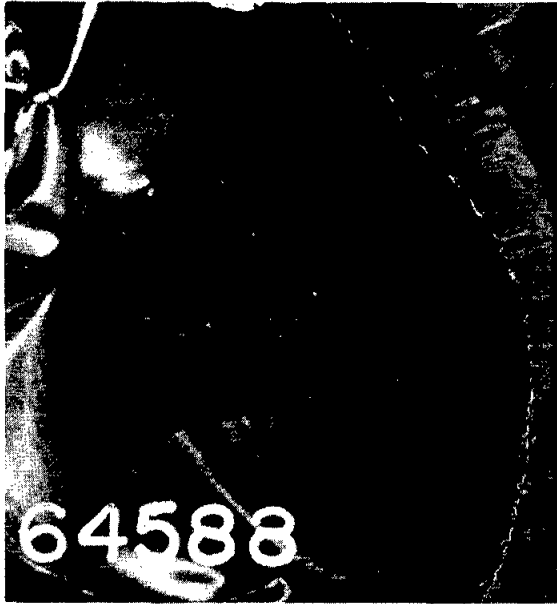
Angular, moderately coherent, white anorthosite. No other material but plagioclase present. On the basis of reflections and cleavage faces the individual crystals are several millimeters long. Some are relatively clear but, in general, they are white.



RAKE SAMPLE 64535-39, 45-49, 55-58



Rake Sample 64559.65-69,75-79,85 & 86



RAKE SAMPLE  
64588



RAKE SAMPLE  
64587



RAKE SAMPLE 64589

64815-19; 64825-29; 64835-37

DESCRIPTION: Rake Sample BY: Wilshire DATE: June 16, 1972

64815

CRUSHED ULTRAMAFIC ROCK

Slabby, angular, 3 x 3 x 1 cm, unusually mafic rock with only 20% plagioclase. It is thoroughly crushed and locally annealed. Mafic silicates include small olivines, abundant yellow-green pyroxene, locally zoned to brown pyroxene (on one side, the brown pyroxene is more abundant than the yellow), forming about 75 to 80% of the rock; olivine is probably less than 5%. Ilmenite(?) forms about 3%.

64816-18

GRAY, TOUGH, FINE-GRAINED, CRYSTALLINE ROCKS

Angular, tough, gray sugary-textured, metaclastic rocks with a few irregular millimeter-size lumps of plagioclase. 64816 and 17 have metal, the smaller one has a few spheres, one rusted. Much of the metallic material appears yellowish. 64818 is a dark, finely-crystalline breccia with about 10% white clasts to 1 cm. Small clasts are milky and one large, 5-cm, probable clast of crushed white rock is attached to one side. Rock is a cataclasite with abundant relict angular plagioclase in a powdered matrix.

64819

WHITE, FINE-GRAINED ANORTHOSITE

Subrounded, friable, white, very finely-crystalline rock partly enveloped by gray glass. Rock contains a trace of yellow-green mineral. Despite fine sugary appearance, there are 4-5 mm cleavage flakes.

64825-29, 64835-37

LIGHT GRAY, FRIABLE, CLASTIC BRECCIA

Soft, rounded to subrounded, friable, light brownish gray, clastic-matrix breccia containing a small proportion of small white, gray and dark lithic clasts; plagioclase, brown and yellow-green pyroxene debris; and a small proportion of glass spheres and fragments. Most lithic clasts are fine sugary white or aphanitic dark. There is one small fragment of crushed ilmenite, brown pyroxene and plagioclase.



RAKE SAMPLE 64815-19,25-29,35-37

65015

ROCK TYPE: Crystalline  
COLOR: Light olive gray (5Y6/1)  
SHAPE: Blocky, angular  
COHERENCE Intergranular: Tough  
Fracturing: Absent

WEIGHT: 1802 g  
DIMENSIONS: 19 x 9 x 10 cm

BINOCULAR DESCRIPTION

BY: Warner

DATE: 5/31/72

FABRIC: Isotropic, homogeneous, crystalline

VARIABILITY: Homogeneous

SURFACE: Smooth

ZAP PITS: Many on N and W; none on E. Excellent soil line ring crosses on S, B, and T.

CAVITIES: Possibly a single 1 mm vug.

SPECIAL FEATURES: Excellent soil line ring; several subparallel 1 mm x 2 cm "veins", which may be crushed zones, are on S and T.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase	colorless	70	lath			1
Maf sil		28	equant			2
Metal	silver	1	sphere		1 -2	
Spinel(?)	red	1	equant	0.2	0.1-0.5	

NOTES:

1. Clear plagioclase up to 2 mm across with twinning. Large 2 x 10 mm blocky areas consisting of granular plagioclase, and 0.3 mm granular plagioclase areas.
2. Two types present: 27% of yellow-green 1 mm mafic and 26% of brown mafics ranging from 0.1 to 1.5 mm.

65015

THIN SECTION DESCRIPTION

BY: Butler

DATE: 7/25/72

SECTION: 65015,13

**SUMMARY:** This section probably represents a monomict breccia produced from a gabbroic anorthosite, which had a grain size of 1-2 mm at least. The degree of crushing was not uniform over the area of the section resulting in areas of very fine-grained plagioclase and pyroxene with other areas of millimeter sized grains. The poikilitic pyroxene may represent recrystallization of incomplete crushing. Notable are the abundant, relatively large rounded opaque grains and their association with vugs.

## MATRIX, 30% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	70	equant to lath-like		Matrix occurs as 1-2 mm patches, roughly equant, with fine-grained plag and pyrox. In some patches the plag is in small laths and shows microdiabasic texture with pyrox. The matrix is composed of areas that show only very nebulous common extinction at most.
Pyrox	29	equant to columnar	0.05	
Opagues	1	shredded in loose aggre		

## MINERAL CLASTS, 68% OF ROCK

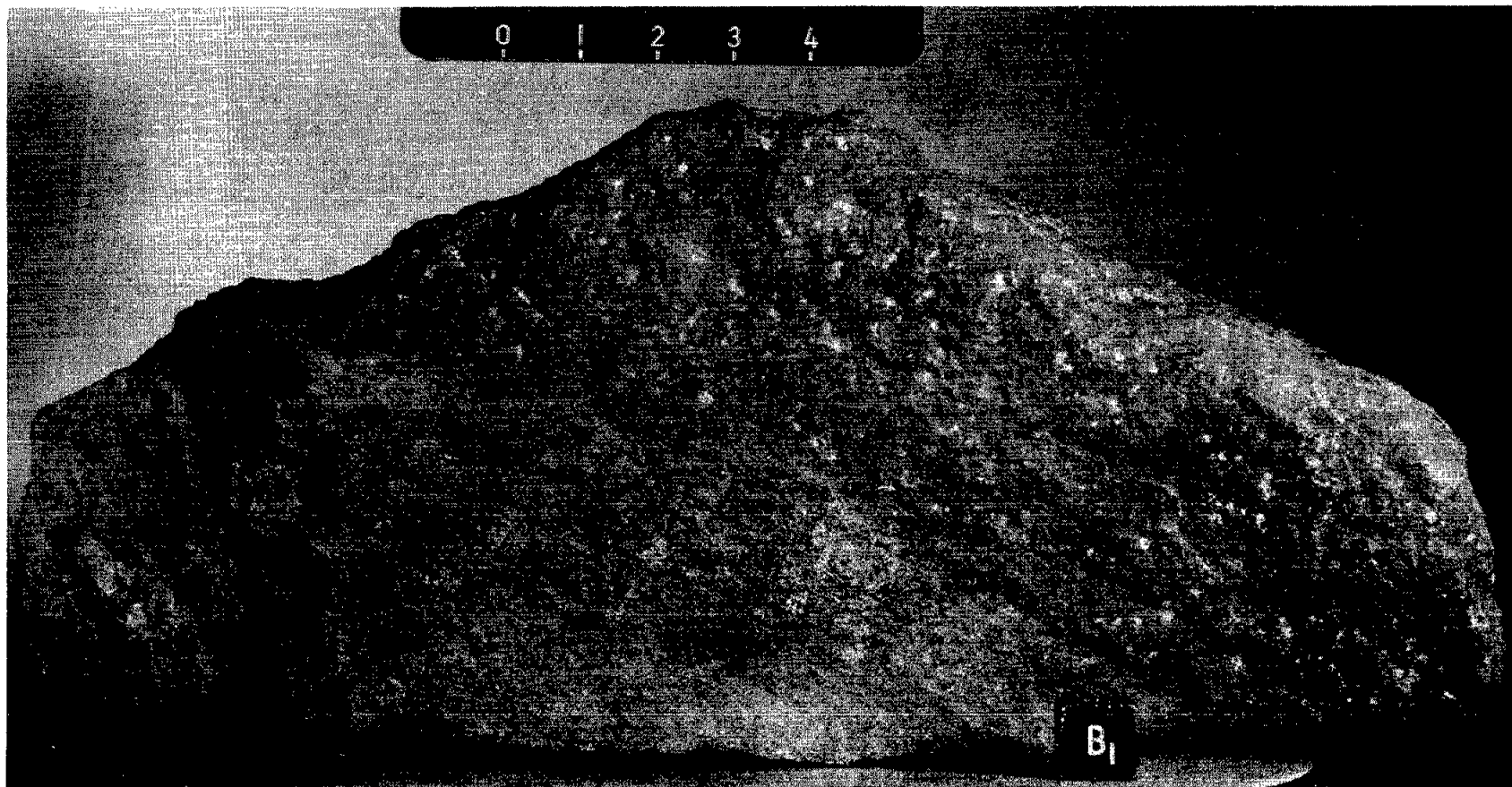
<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Opx	30	columnar anhed	1 avg	Opx poikilitically contains equant plag grains, which average 0.05 mm. Pyrox shows higher biref than opx, but is of same poikilitic texture. Opagues are ragged where in contact with rock and rounded bordering vugs.
Pyrox	1		1 avg	
Plag	63	equant, rectang subhed	to 1	
Opagues	1	rd	0.3 avg	

## LITHIC CLASTS, 2% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Gabbroic anorth	100	anhed	0.5	Aggregates of several plag grains intergrown with subordinate pyroxene probably represent portions of the original rock that escaped severe crushing.



225



SAMPLE 65015

65015,13

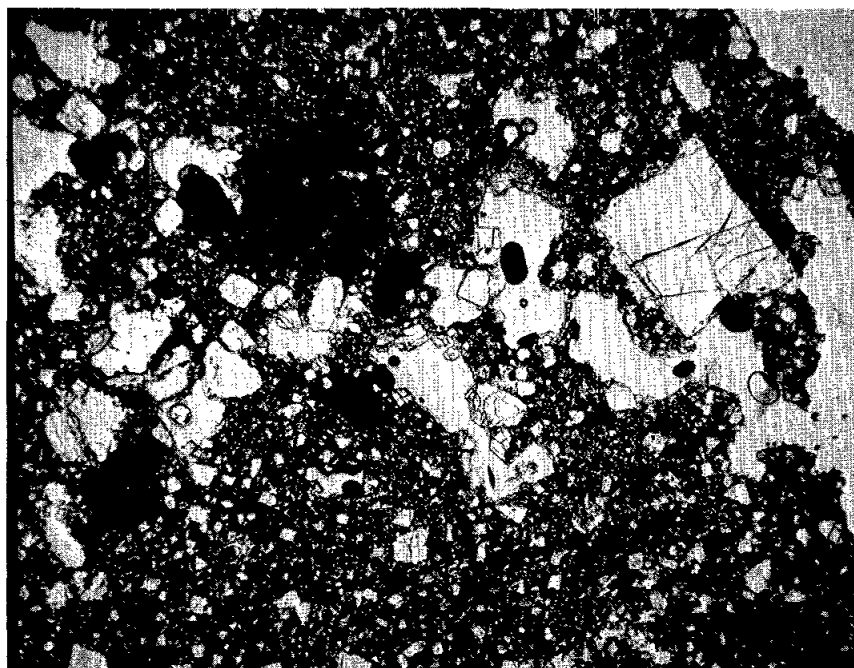
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/27/72

SECTION: 65015,13

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilmenite	1.5	see comments	<0.3	Oxides occur largely interstitial to other phases, morphology controlled largely by that of the other phases, although some ilmenite laths occur. Some large (300-400μ) rounded Fe-Ni troilite grains are present. Metal may have ragged edges and be rimmed with troilite.
Ulvo-spinel	<0.2	see comments	<0.3	
Fe-Ni	1.0	see comments	<0.3	
FeS	<1.0	see comments	<0.3	
Armalcolite(?)	tr		<0.4	



RAKE SAMPLE 65015,13

WIDTH OF FIELD ≈ 4 MM

ROCK TYPE: Broken, hollow glass sphere      WEIGHT: 21.0 g  
COLOR: Bottle green (5G3/2)      DIMENSIONS: 3.2 cm diameter  
SHAPE: Spherical with 1.5 cm lump on one side  
COHERENCE Intergranular: None  
Fracturing: Few penetrative

BINOCULAR DESCRIPTION

BY: Wilshire &amp; Morrison

DATE: 6/5/72

FABRIC: None

VARIABILITY: None

SURFACE: Interior surface very smooth, scarce metal spheres protrude. Exterior very smooth, many metal spheres protrude and a few glass spheres. Outer surface finely scratched.

ZAP PITS: None

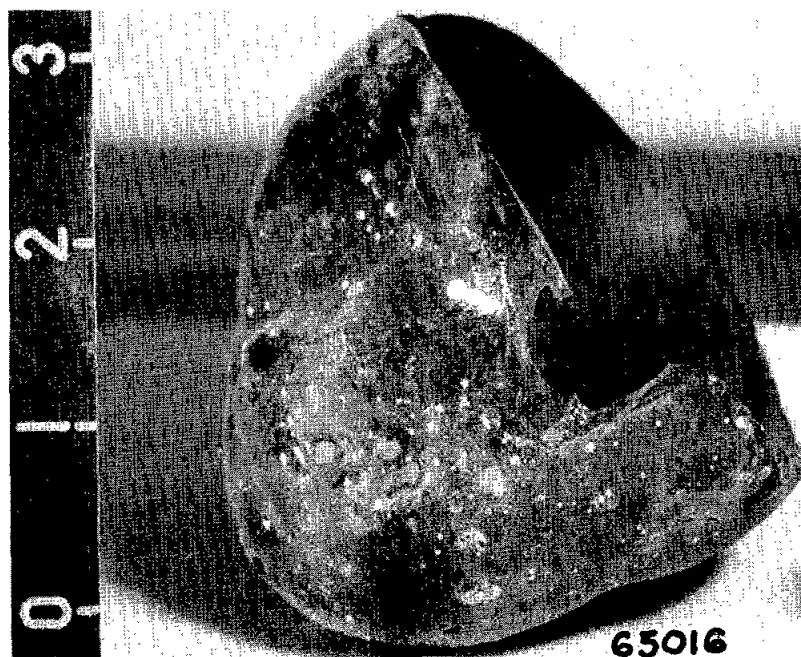
CAVITIES: One large; 2% vesicles <1 mm-2 mm inside, up to 3 mm on exterior surface.

SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Metal		3-4	spherical	0.5	0.1-1	1
Glass	green	93				2
Lithic(?)		tr				3
Mineral(?)	milky white	tr	rd to ang			4

NOTES:

1. About half buried in glass; many more on exterior than interior surface.
2. Devitrified around vesicles and over the 15 mm lump (inside of glass sphere only). A few percent, locally to 50%, bubbles in glass.
3. Possible inclusion, completely coated by glass; 15 mm lump.
4. Possible feldspar inclusions? Three long strips 0.5 mm wide form a hook-shaped pattern 12 mm long.



65035

ROCK TYPE: Breccia  
COLOR: White matrix (N9); medium dark gray clasts, (N4)  
SHAPE: Rounded, slab  
COHERENCE Intergranular: Friable to weakly coherent  
Fracturing: Few, nonpenetrative

WEIGHT: 446 g  
DIMENSIONS: 12 x 8.5 x 4.5 cm

BINOCULAR DESCRIPTION BY: Stuart-Alexander & Wilshire DATE: 6/5/72

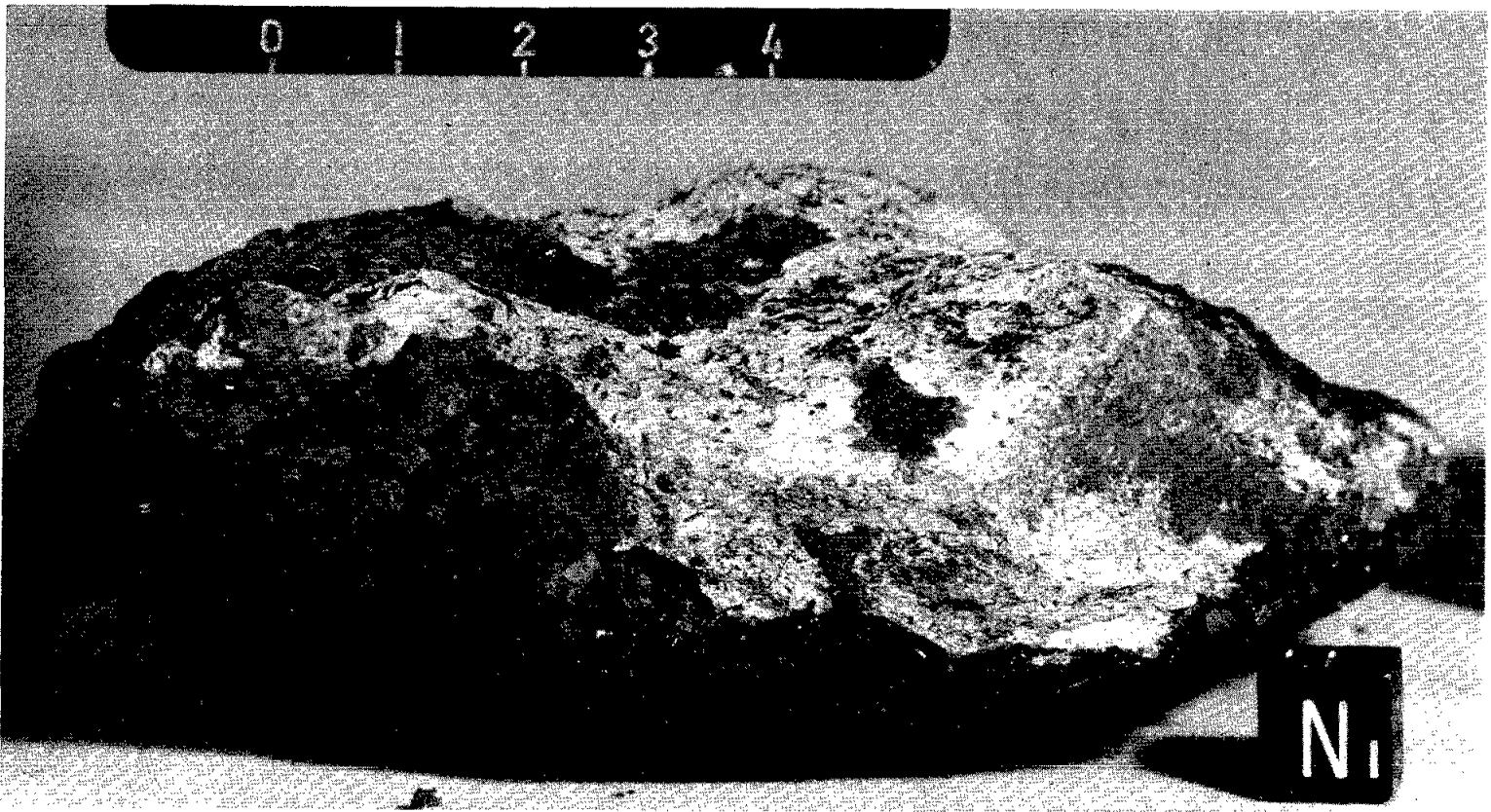
FABRIC: Breccia  
VARIABILITY: Partly glass-coated  
SURFACE: Almost all glass coated except for faces T and W; these are finely hackly.  
ZAP PITS: Many on T; none on others.  
CAVITIES: None in white, dark has <1 mm elongate cavities; glass has 1% vesicles 0.5 mm-1 cm.  
SPECIAL FEATURES: In some places the contacts between white and dark are very sharp and straight, but in others the contacts highly irregular with narrow white veins injecting dark material on a scale up to 5 mm. Locally injection produces a jig-saw pattern of white in dark.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic	med dk gray (N4)	25	irregular		0.2-65	1
Glass	dk gray (N3)	15				2
Metal	silver	<1	round blebs			3
Matrix	white	60				4

NOTES:

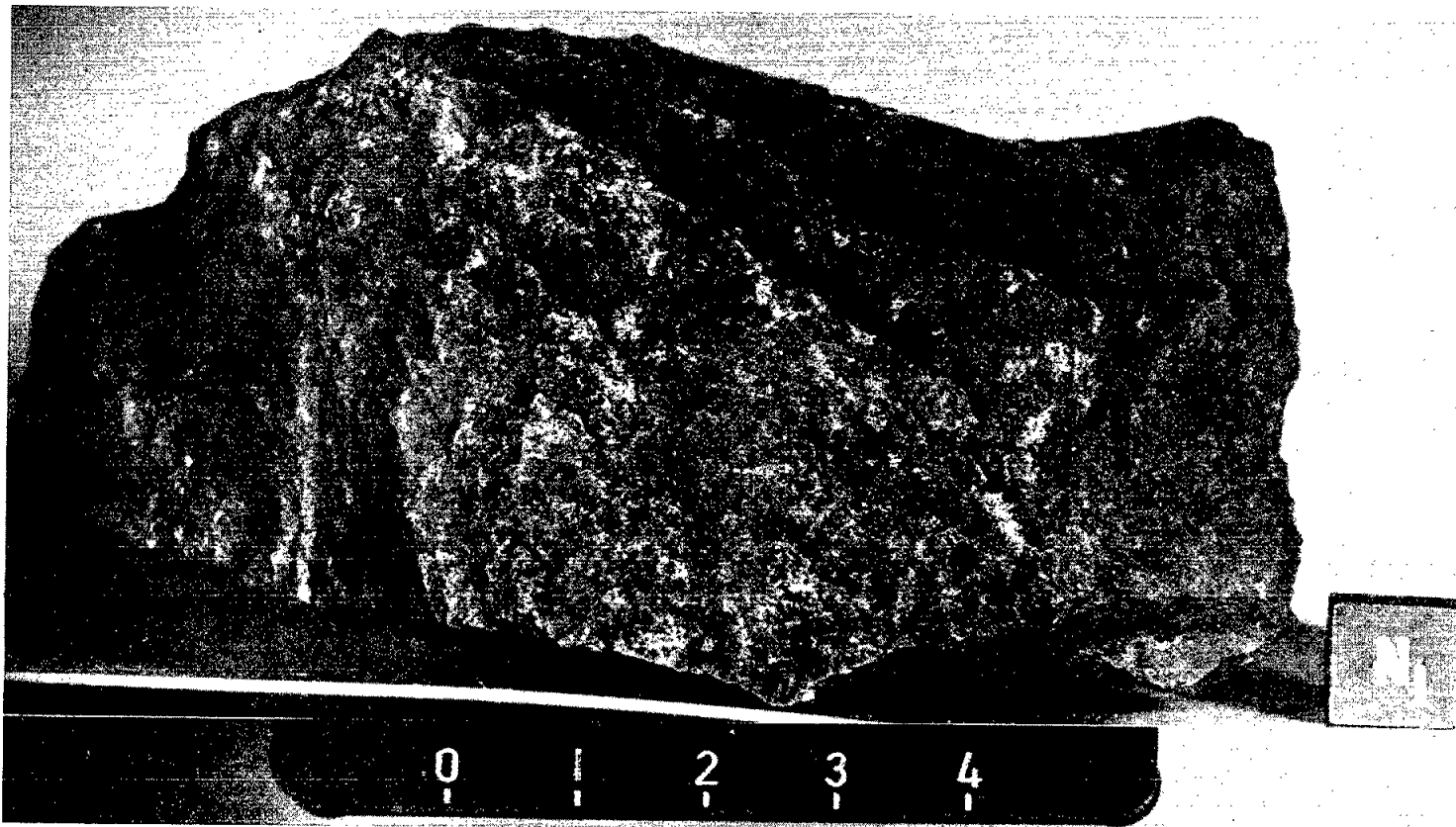
1. Aphanitic, with 1-2% milky white inclusions, to 1 mm. Some have smeared, indistinct contacts; others have sharp contacts. One 1.4 mm sugary yellowish-green fragment and trace of small metal spheres in the aphanitic gray material which grades outward. Elongate cavities in the gray material are concentrated near, and aligned parallel to the glass -- Lithic 1 contact.
2. Part is very smooth, except for a few 1 mm bubbles which are both convex and concave (on flattened metal spheres), very locally concentrated and variable in size from <0.1 mm to 0.8 mm. The rest is hackly and dusty; it looks ropy beneath dust. It becomes devitrified in the vesicles.
3. In glass; some are strung out like strings of beads.
4. Fine powder to white porcelain-looking (annealed?) with approximately 2% dark specks. Trace of very pale yellow mineral.

229



SAMPLE 65035





SAMPLE 65055

65056

ROCK TYPE: Glass agglutinate  
COLOR: Dark gray (N3)  
SHAPE: Bloby glass septum  
COHERENCE Intergranular: Tough  
Fracturing: None

WEIGHT: 64.8 g  
DIMENSIONS: 7 x 4 x 4 cm

BINOCULAR DESCRIPTION

BY: Warner

DATE: 6/6/72

FABRIC: Isotropic, glass

VARIABILITY: None

SURFACE: Dust covered (smooth) rock is glassy.

ZAP PITS: None

CAVITIES: Seventy percent smooth-walled vesicles.

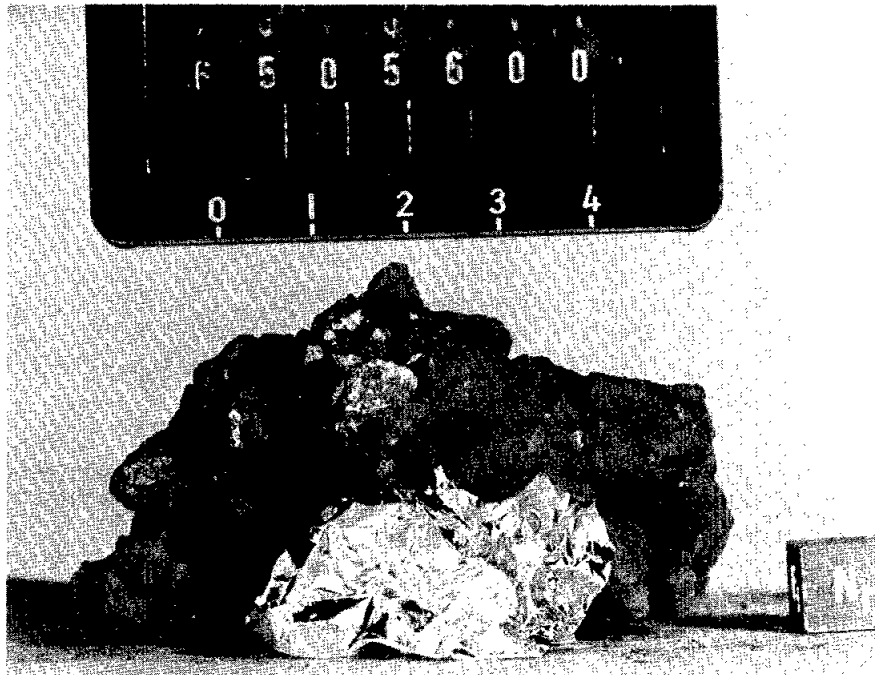
SPECIAL FEATURES: The rock is broken into two pieces that fit together; the rock is a contorted septum of vesicular black glass containing crystalline, anorthositic clasts.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	black	25				
Lithic clasts	white	5	rd	4	1-5	1
Vesicles		70	ellipsoidal	6	4-20	2

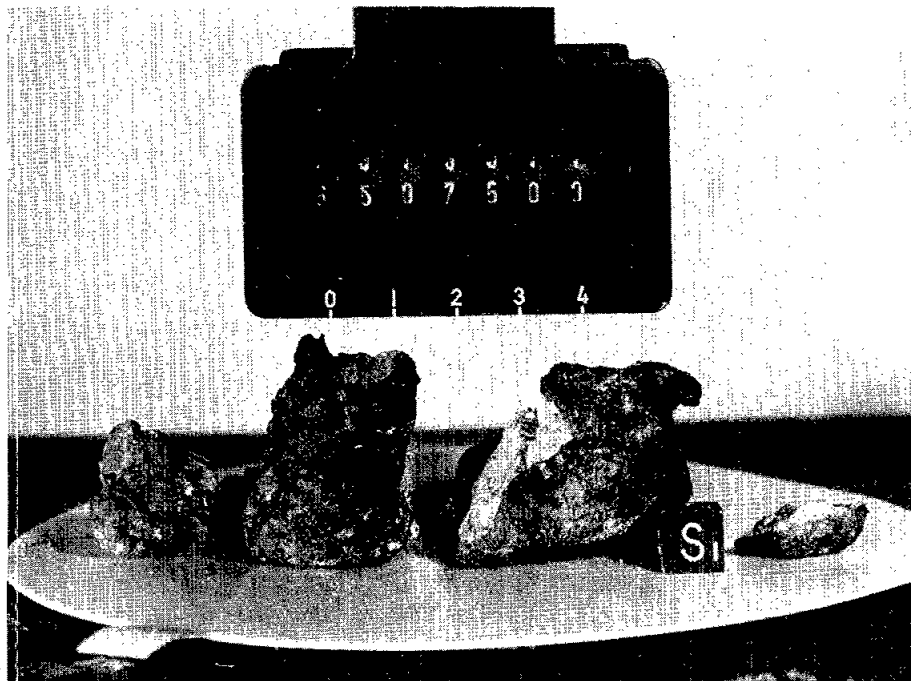
NOTES:

1. Anorthosite and norite
2. Vesicles intersect





SAMPLE 65056



SAMPLE 65075

65075

ROCK TYPE: Breccia, granular matrix  
 COLOR: Greenish gray (5G7/1)  
 SHAPE: Angular  
 COHERENCE Intergranular: Friable  
 Fracturing: Abundant and penetrative, planar

WEIGHT: 108 g  
 DIMENSIONS: 4 fragments  
 The largest is  
 5 x 4 x 4 cm

BINOCULAR DESCRIPTION

BY: Simonds

DATE: 6/6/72

FABRIC: Isotropic, granular

VARIABILITY: Matrix and clast population varies in mafic mineral content by as much as 3 times from place to place.

SURFACE: (for , l only) frothy to dense glass on E, B, S and part of T; fresh broken surfaces on W and N.

ZAP PITS: (on , l) few on B, none on others. Zaps are seen on flat glass surface as smooth lined pits with spall zones.

CAVITIES: 3-70% of glass coating. The one matrix is micritic and has green pyroxenes protruding into it.

SPECIAL FEATURES: The matrix is unusually inhomogeneous, and the distinction between granular clasts and granular matrix is not clear. The inhomogeneity indicates that this breccia is polymeric.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	greenish gray (5G7/1)				0.1-0.5	1
Lithic I	white (N9)	5	ang, irreg		4-10	2
Lithic II	medium gray	2	rnded to subrnded		-3	3
Lithic III	very light gray	2	subrnded, elongate			4
Lithic IV	light gray		one large subang, unique equant clast			5

## NOTES:

1. Granular transparent plagioclase is main component, trace of opaques including one platy ilmenite grain. Green mafic silicate to plagioclase ratio varies from 1:3 to 1:1. Content of black mafic silicate ranges from 1-10%. One metal sphere with rough mottled surface. "Rust" flecks 0.1-0.5 mm, red and yellow halo of stain on adjacent silicates, but is 5% on most surfaces. Matrix has fluidal appearance around one dense sugary anorthosite clast. Matrix lacks powdery material, virtually all grains are resolvable. The matrix is patchy with regions of homogeneous composition of up to 5 mm. Boundaries between patches are gradational over less than 1mm.
2. Coarse grained anorthosite, trace of opaques including platy ilmenite. Grains are water clear. Fragments have many parallel fractures, some of which form clast-matrix boundary. Degree of fracturing variable in individual clasts.
3. Mostly transparent plagioclase, a few % black mafic silicate, possibly gray pyroxene.
4. Fine-grained granular rock with a few % 0.1 mm dark mafic silicates. Looks like white breccia fragment.
5. Sugary 0.1 mm grains, most are equant; a few are platy. Looks like recrystallized anorthosite with a low % black mafic silicate or opaques.

65095

ROCK TYPE: Breccia, anorthosite  
COLOR: White (N9); brownish black (5YR2/1) glass  
SHAPE: Equidimensional and irregular  
COHERENCE Intergranular: Friable  
Fracturing: Few, penetrative, irregular

WEIGHT: 560 g  
DIMENSION: 8 x 7 x 6 cm

BINOCULAR DESCRIPTION

BY: Butler

DATE: 6/5/72

FABRIC: Isotropic  
VARIABILITY: Thick glass (5% of sample) over a homogeneous anorthosite.  
SURFACE: Vesicular glass covers 90% of T, 80% of N, 75% of W, 30% of E, 15% of B and 10% of S.  
ZAP PITS: Few on B (toward E), S (at E side); none on N, T, E; W was not observed. Pits are irregular and have pale grayish-orange glassing linings.  
CAVITIES: None in anorthosite; 50% vesicles in glass.  
SPECIAL FEATURES: The vesicular black glass is 5-10 mm thick where it coats the rock. Its contact with the rock is sharp, angular, and irregular. The glass also includes fragments of the rock up to 5 mm (visible on N). The glass apparently coated freshly broken rock and engulfed some of it. A few angular fragments of glass like the coating glass are in the rock matrix. Several fragments have fallen from the rock, 0.5 g and less. One is a dark gray clast.

<u>COMPONENT.</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Clast	dark gray (N3)	30	subang	1	0.5-3	1
Plagioclase	very light gray (N8)	10	subang	0.5		2
Glass	brownish black (5YR2/1)	5				3
Matrix	white (N9)	55				4
Mafic silicate	yellow-brown	tr	columnar	0.5		
Spinel	blood red	tr		0.2		5
Limonite	orange	tr		0.2		6
Opaques	red orange	tr		0.2		

NOTES:

1. Aphanitic, with vitreous luster and granular appearance.
2. Translucent.
3. Vesicular coating and several clasts.
4. Speckled with minute grains which range from pale gray and glass to black. Matrix is probably plagioclase.
5. In dispersed groups over several mm that may define clasts rich in spinel.
6. Stains white matrix.

65095

THIN SECTION DESCRIPTION

BY: Butler

DATE: 6/28/72

SECTION: 65095,13 ,14 ,15

SUMMARY: Crushed anorthosite (a monomict breccia). Uniform mineralogy on a fine scale suggests an origin by brecciation of a single lithology. The lithic clasts are therefore areas that were less severely comminuted. The mafic mineral content appears to be somewhat less than 10% of the rock.

## MATRIX, 79% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	90	equant, subrded	0.01-0.1	The mafic silicate (high index, moderate birefracton, colorless) occurs in open patches of minute blebs, interstitial to plag. Common extinction over areas to 0.1 mm indicates relicts of larger grains.
Mafic sil	10	irreg pat- ches	to 0.1	
Opaque	1	irreg flakes and patches		

## MINERAL CLASTS, 15% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	98	subrd and stubby columnar	to 0.5	Most grains are strained or shattered.
Opx(?)	2	anhed equant	to 0.2	

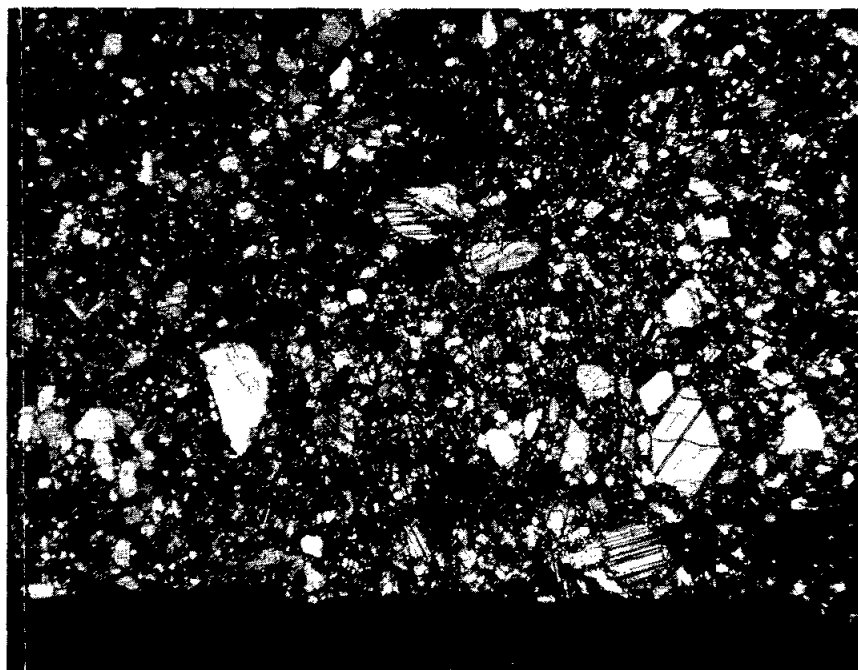
## LITHIC CLASTS, 5% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Anorth	100		to 2	Clasts are defined by more or less compact aggregates of plag grains, which have the same sizes as the mineral clasts.

65095 (Continued)

GLASS CLASTS, 1% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Colorless	5	irreg or equant patches	0.2	Colorless glass contains plag debris. Low index.
Devit	95	equant patches and irreg		Devitrified glass is represented by several patches. Plag laths and at one edge of the sections where a several mm wide rim has lath-like crystallites of plag as matrix to plag fragments.



SAMPLE 65095,13

WIDTH OF FIELD  $\approx$  4 MM

65095

OPAQUES DESCRIPTION

BY: Brett

DATE: 6/23/72

SECTION: 65095, 13

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	<0.1	see comments		Metal and troilite commonly extremely fragile <5 $\mu$ , ragged to rounded.
FeS	<0.1	see comments		
Ilm	$\approx$ 1	see comments		Ilmenite in two generations: (1) somewhat rounded, commonly fractured grains to 150 $\mu$ (2) poorly formed lamellae ranging to rounded grains, commonly no longer than 10 $\mu$ long. Latter are certainly a product of recrystallization.



SAMPLE 65095

65315

ROCK TYPE: Breccia, glass coated anorthositic monomict  
COLOR: Bluish white (N8)      WEIGHT: 300 g  
SHAPE: subangular      DIMENSIONS: 10 x 6 x 4 cm  
COHERENCE Intergranular: Coherent  
Fracturing: Few penetrative

BINOCULAR DESCRIPTION

BY: Lofgren

DATE: 6/5/72

FABRIC: Micro-breccia

VARIABILITY: Rock is uniform with irregularly distributed surface glass

SURFACE: Granular

ZAP PITS: Few on N, none on others. The pits usually have clear glass lining but some have colored glass and are usually not as deep. One large deep zap pit with clear and dark glass on T surface is 8 mm diameter by 5 mm deep.

CAVITIES: None

SPECIAL FEATURES: No obvious pyroxene grains.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	(N8)	50		<0.1		1
Plagioclase	white to translucent (N8)	45	rnd to ang		0.5-2	2
Glass-coating surface	black	5	of surface			3
Aphanitic clast	black	<1	ang			4

NOTES:

1. Fine-grained.
2. Wide size range that grades into matrix. The translucent grains are the more angular ones and the white (more chalky) grains are the more rounded.
3. Dense black glass coating 0.5 mm to 6 mm thick, with white fragments in it. Sharp contact with rock.
4. This is the only clast observed. It is on face W.

65315

THIN SECTION DESCRIPTION

BY: Lofgren

DATE: 6/28/72

SECTION: 65315,4

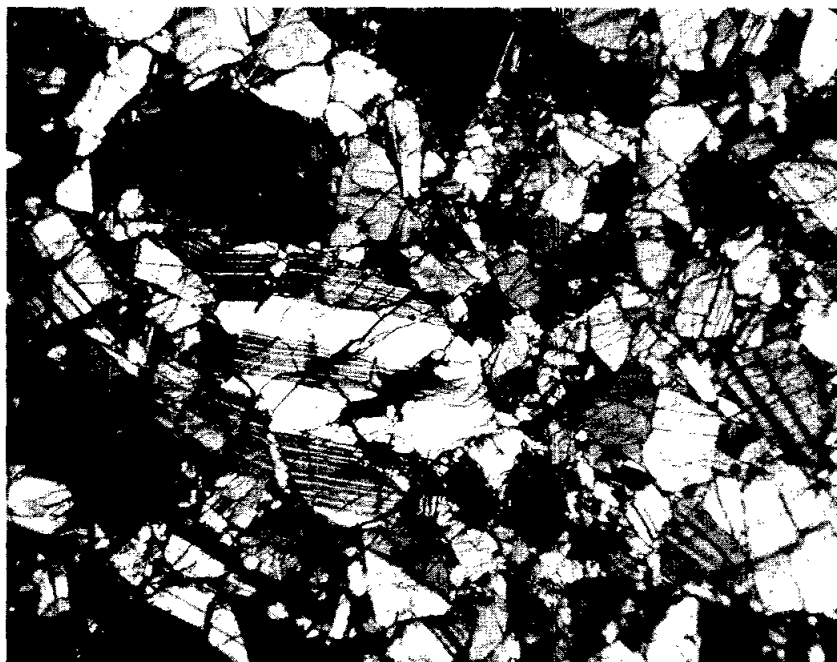
SUMMARY: Anorthositic monomict breccia. Rock is simply ground up igneous plagioclase, with possibly one or two clinopyroxene grains (section is a little thick, making identification difficult).

MATRIX, 25% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	100	subang	<0.1	Just fine-grained plagioclase.

MINERAL CLASTS, 75% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	100	ang to subang	0.1-1	Highly fractured, bent and offset twin lamellae. No maskelynite evident.



SAMPLE 65315,4

WIDTH OF FIELD  $\approx$  4 MM



65315

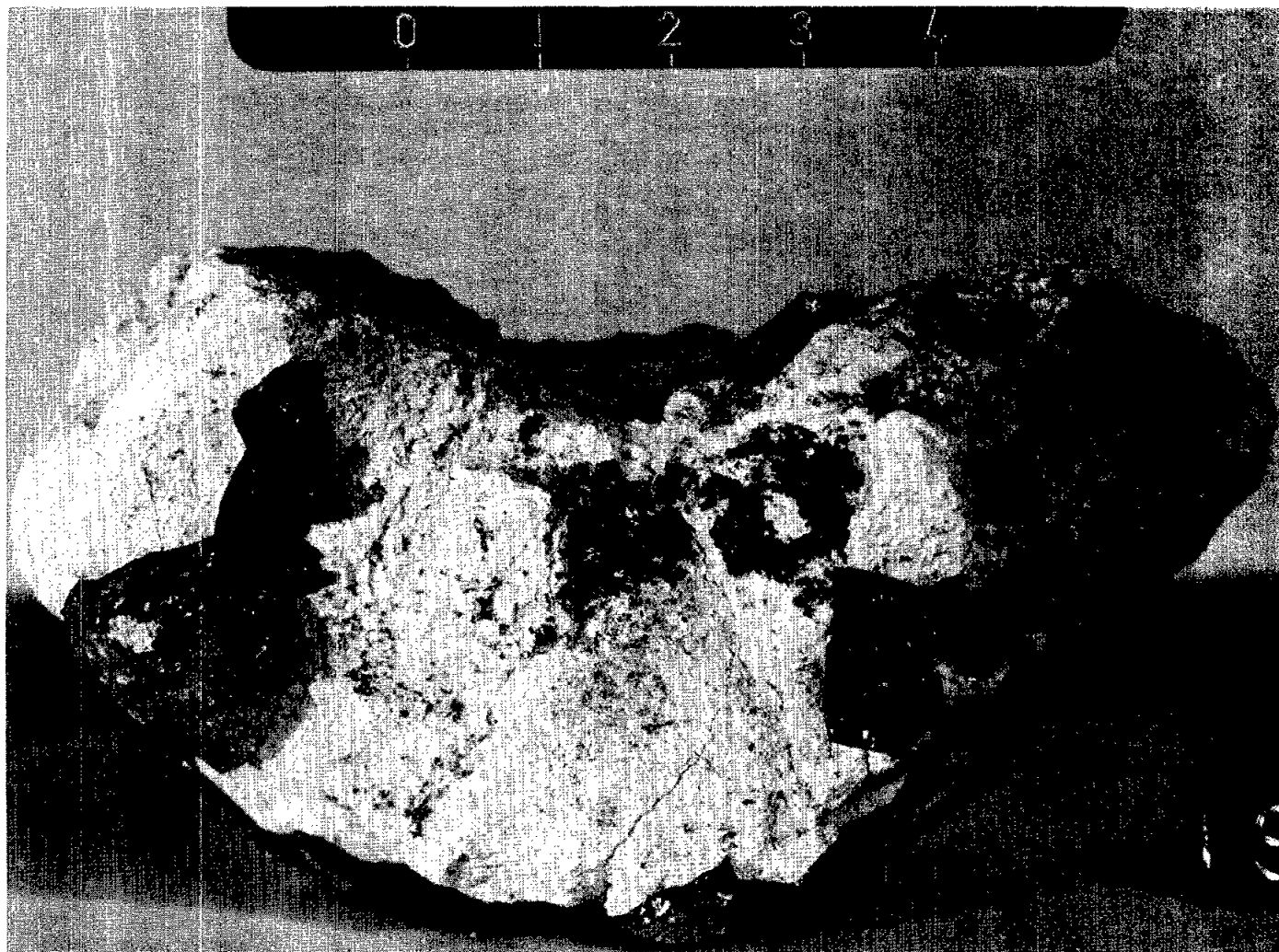
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/23/72

SECTION: 65315,4

SUMMARY: Opaque mineral content is virtually negligible. One  $20\mu$  ilmenite grain, a couple of  $5\mu$  Fe-Ni and troilite grains. All grains are rounded.



SAMPLE 65315

65325-29; 65335,36; 65337-39, 65345-47; 65348,49; 65355,56;

65357-59; 65365,66

DESCRIPTION: Rake Sample BY: Phinney DATE: June 16, 1972

65325-29; 65335, 36

#### WHITE, GRANULATED, ANORTHOSITE ROCKS

Subangular to subrounded, friable, white, brecciated plagioclase with a few remnant flakes of gray glass coatings on the surfaces of some. Texture is powdery to granular with a few clear, rounded to subangular, plagioclase grains up to about 1 mm in the powdery to granular matrix. A few irregularly-shaped, gray, chert-like areas occur in 65326. In some cases they appear to be clasts but in others they have the shapes of small intrusions. These may represent small volumes of melted plagioclase which has subsequently crystallized or devitrified. There are essentially no other minerals but plagioclase present. A few isolated metallic grains occur in 65325 along with some associated rust-like material. One grain of a light yellowish green silicate occurs in 65327.

65337-39, 65345-47

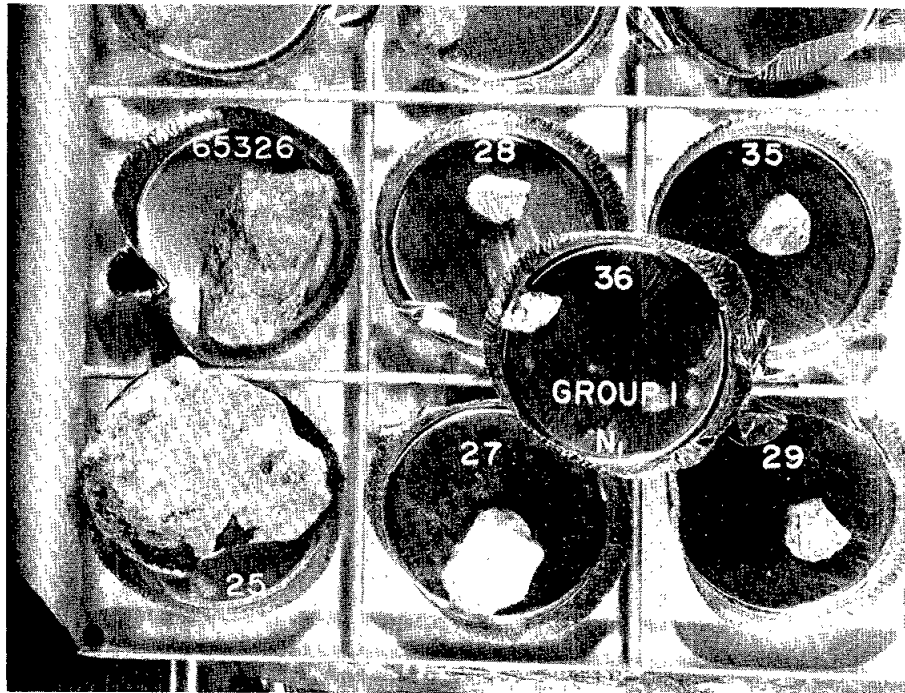
#### LIGHT GRAY, FRIABLE, CLASTIC BRECCIA

Subrounded, very friable, very light gray, fine-grained, clastic matrix breccias containing small (1 mm) clast of predominantly white, granulated plagioclase and light gray, fine-grained, chert-like material. In addition, there are rare clasts of medium gray glass and green material. The matrix appears to be a more finely ground version of the clasts.

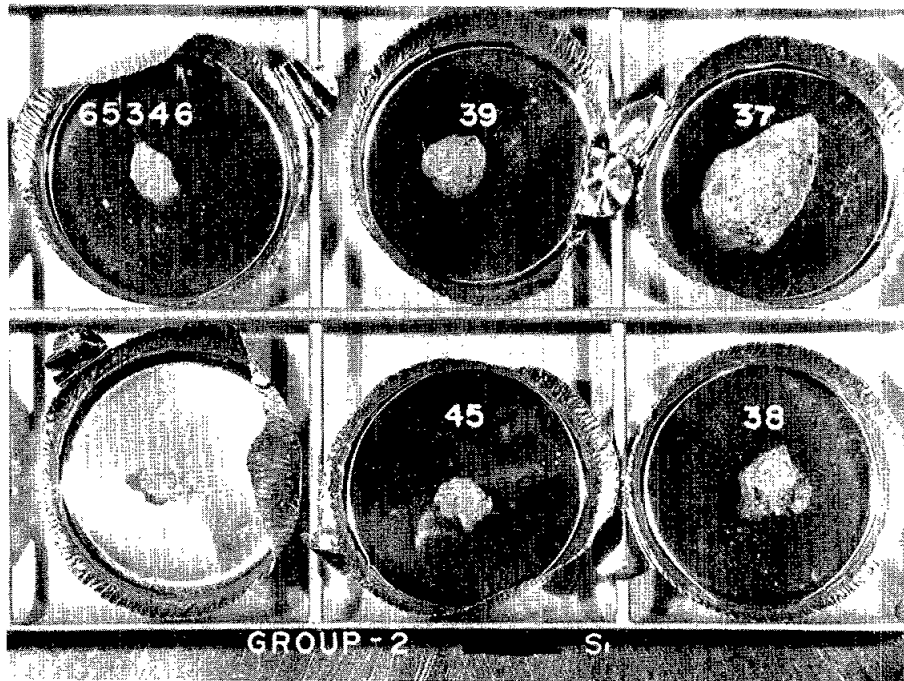
65348, 49; 65355, 56

#### GRAY, VESICULAR GLASS

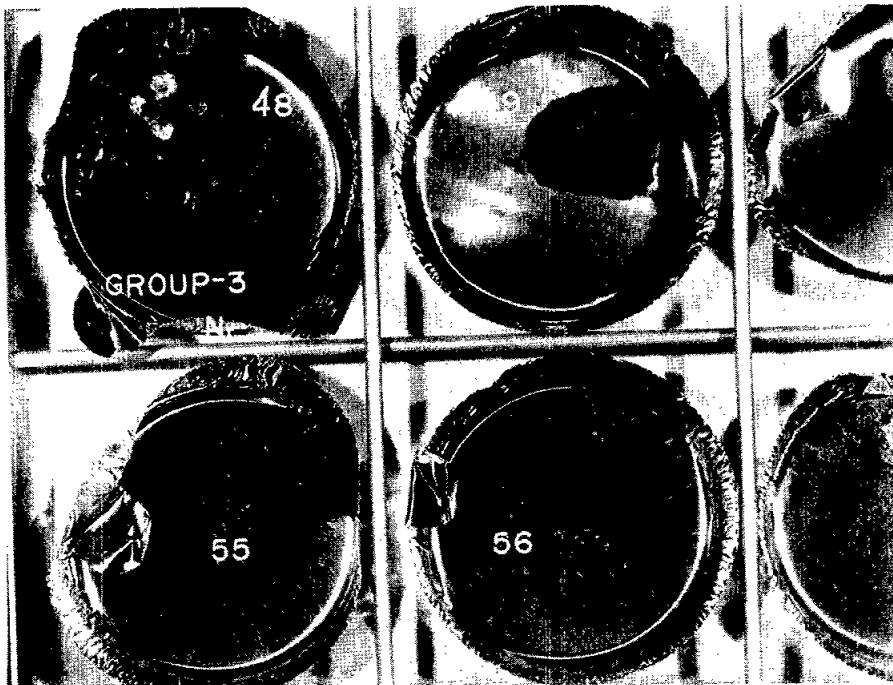
Irregularly shaped, coherent, dark gray, vesicular glass which is probably devitrified judging by the dull gray luster and fine chert-like appearance. White granular plagioclase fragments of various sizes occur sporadically throughout each sample.



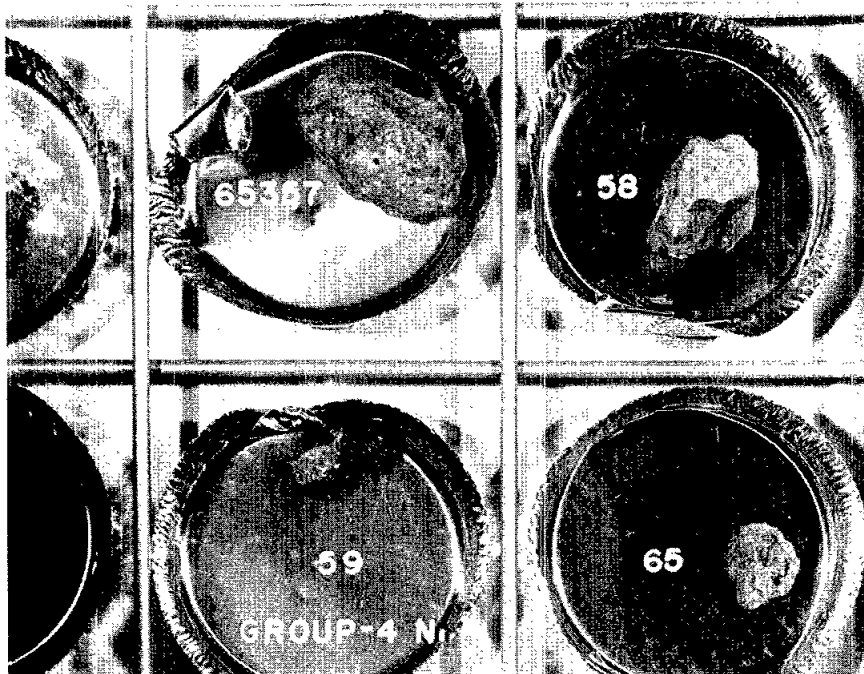
RAKE SAMPLE 65325-29,35 & 36



RAKE SAMPLE 65337-39,45-47



RAKE SAMPLE 65348 & 49,55 & 56



RAKE SAMPLE 65357-59 & 65

65357-59, 65365

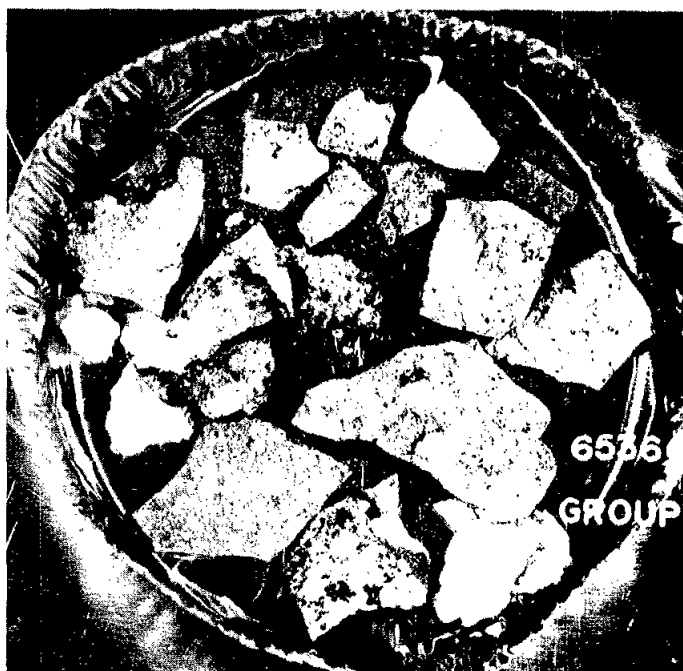
GRAY, TOUGH, FINE-GRAINED, CRYSTALLINE ROCKS

Highly variable group of crystalline rocks ranging from very light gray to medium light gray and fine-grained, chert-like to granular. 65357 contains a fine (0.1 mm) sugary mixture of white and very light yellow grains with a few streaks of black opaques. Zap pits on this sample have a very light green glass lining. 65358 contains vesicles in a coarse chert-like mixture of various shades of light gray. 65359 is partially black glass-coated, white, granular plagioclase with one angular clast of cherty, light gray material and another area where gray material similar to 65365 is irregularly mixed with white granular plagioclase. One area of rust around a metal fragment occurs in this sample. 65365 is highly shattered and fractured gray material which was probably originally fine-grained and recrystallized.

65366

GRAY, FLAT FRAGMENTS OF GLASS

Several flat, gray fragments of glass which have broken away from the glass surface coating on the white granulated anorthositic (65325-36) rocks. On all fragments, white granular material coats one side while the other is relatively smooth gray glass with a few raised droplets of gray glass plus sporadic inclusions of white granular plagioclase.



SAMPLE 65366

65515-19; 65525-29; 65535-39; 65545-49; 65555-59; 65565-69; 65575-79;

65585-87; 65588

DESCRIPTION

BY: Phinney

DATE: June 17, 1972

65515-19, 65525-29, 65535-39, 65545-49, 65555-59, 65565-69, 65575-79

SOIL CLODS

Rounded, very friable, yellowish gray (5Y 8/1) to light olive-gray (5Y 6/1) clods of soil. Several clods have broken during handling. Most material is too fine grained to describe (FO.1 mm) but a few fragments in the clods are a bit larger and consist of irregular to spherically shaped metal, angular, white to clear plagioclase grains with flat cleavage faces, and rounded to angular, very light gray to medium light gray, very fine grained, chert-like fragments some of which may be glass.

65585-87

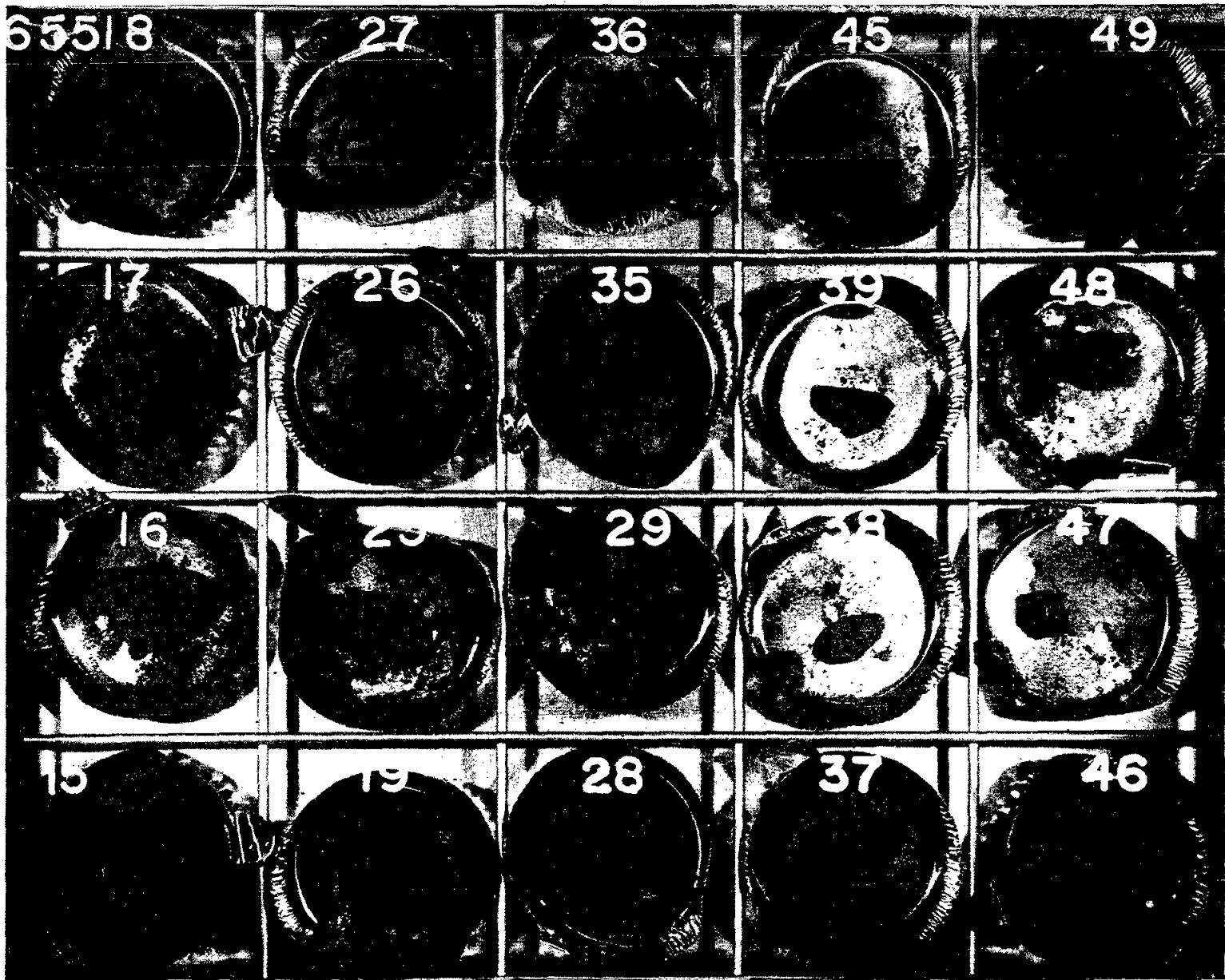
GRAY, VESICULAR, GLASSY AGGLUTINATES

Irregularly shaped, vesicular, glassy agglutinates which consist of rather clear greenish to grayish glass with inclusions of light gray breccia fragments. The glass is more greenish where there are concentrations of bubbles within the glass. The gray breccias contain a light gray clastic matrix with clasts of various shades of white through gray. In general the glass of 65586 seems to be a darker gray than that of the other two samples in this group.

65588

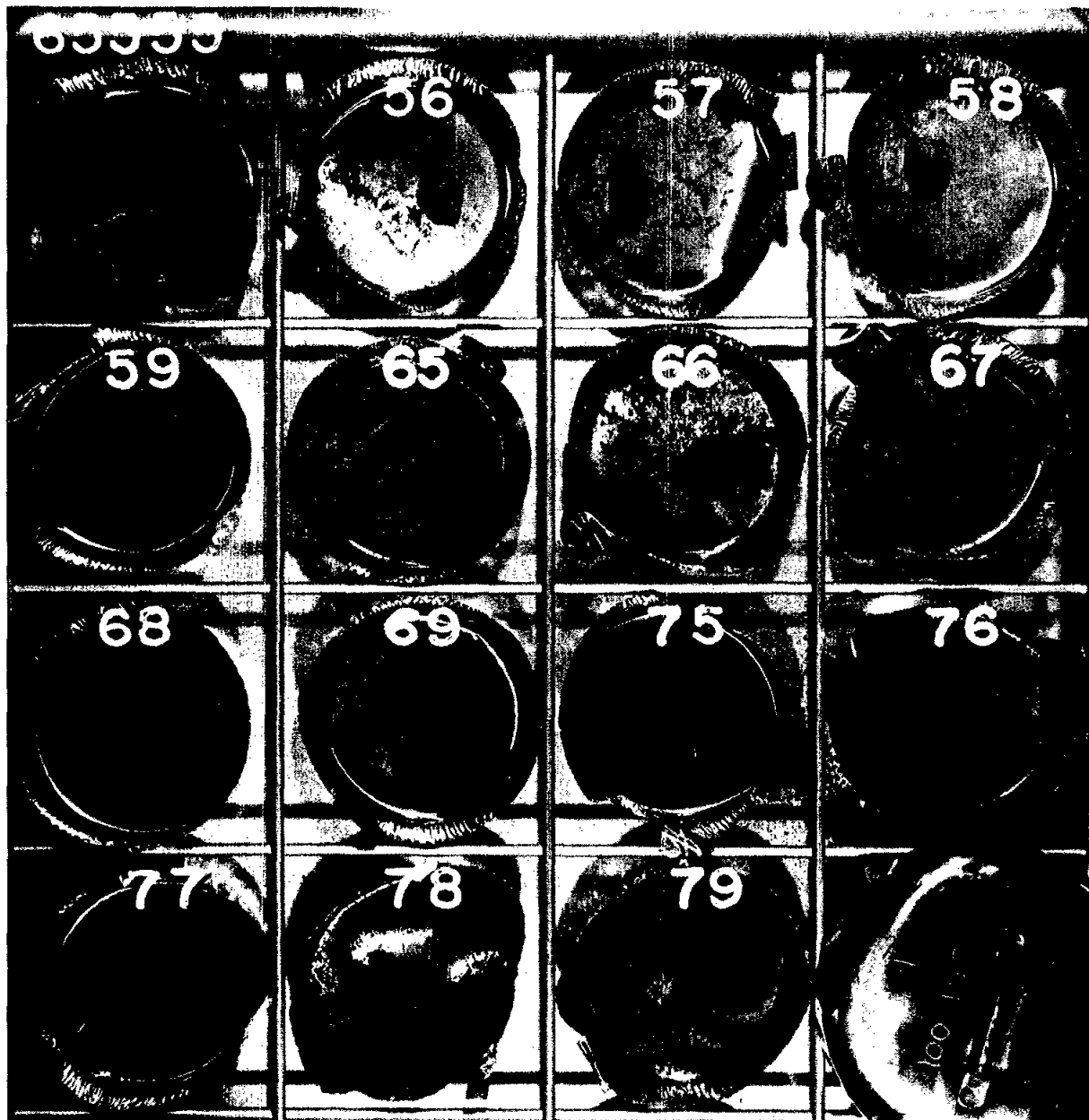
WHITE, GRANULAR PLAGIOCLASE

Subangular, moderately coherent, white to very light gray, granular material with a thick strongly adhering coating of light gray soil on most. One flat face which may have been a joint or fracture surface has a thin (0.1 mm or less) coating of gray glass. In the few places it can be observed, the rock seems to consist of white granular plagioclase with a few included fragments of fine grained, medium light gray, chert-like material.



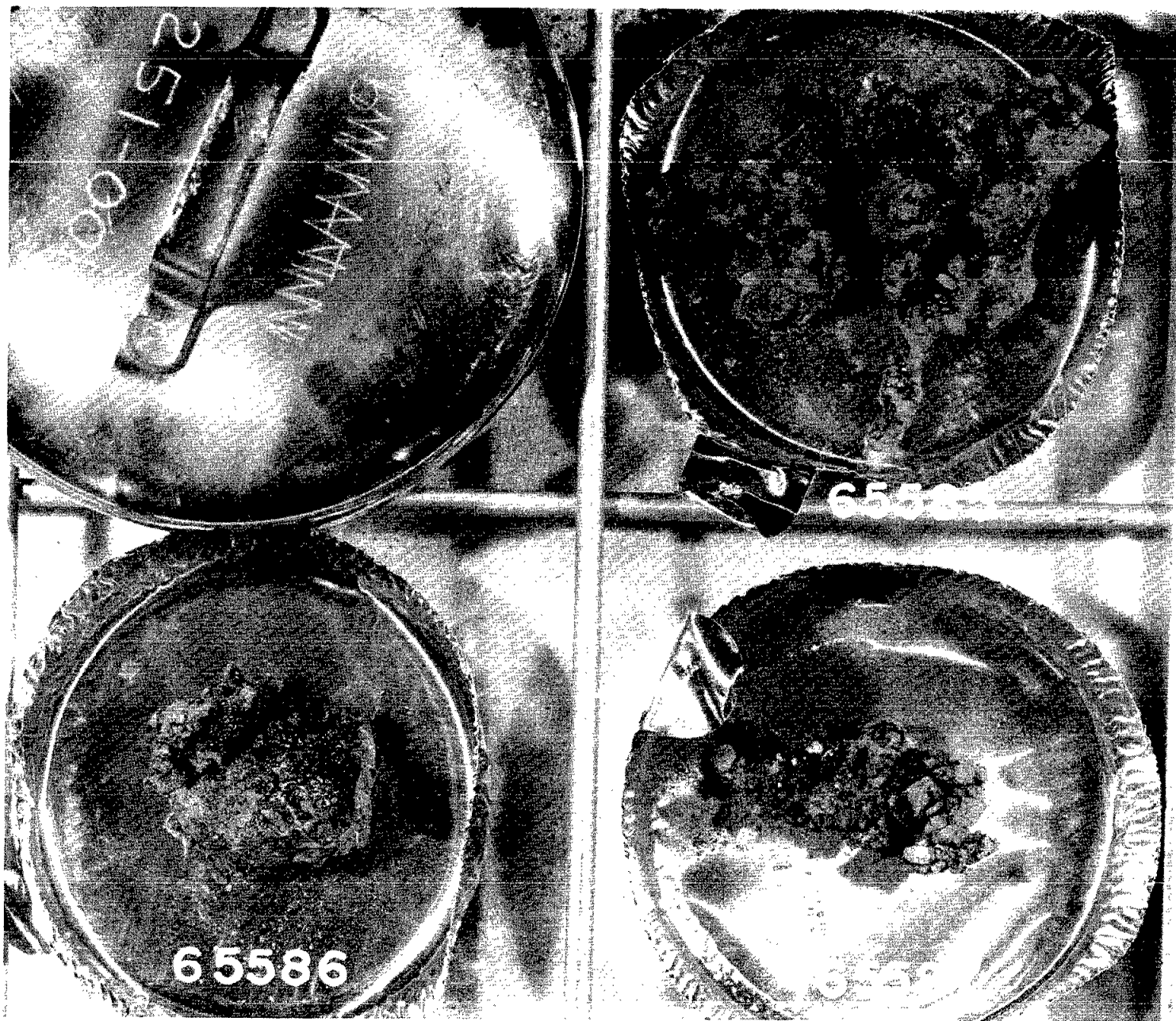
247

RAKE SAMPLE 65515-19,25-29,35-39,45-49

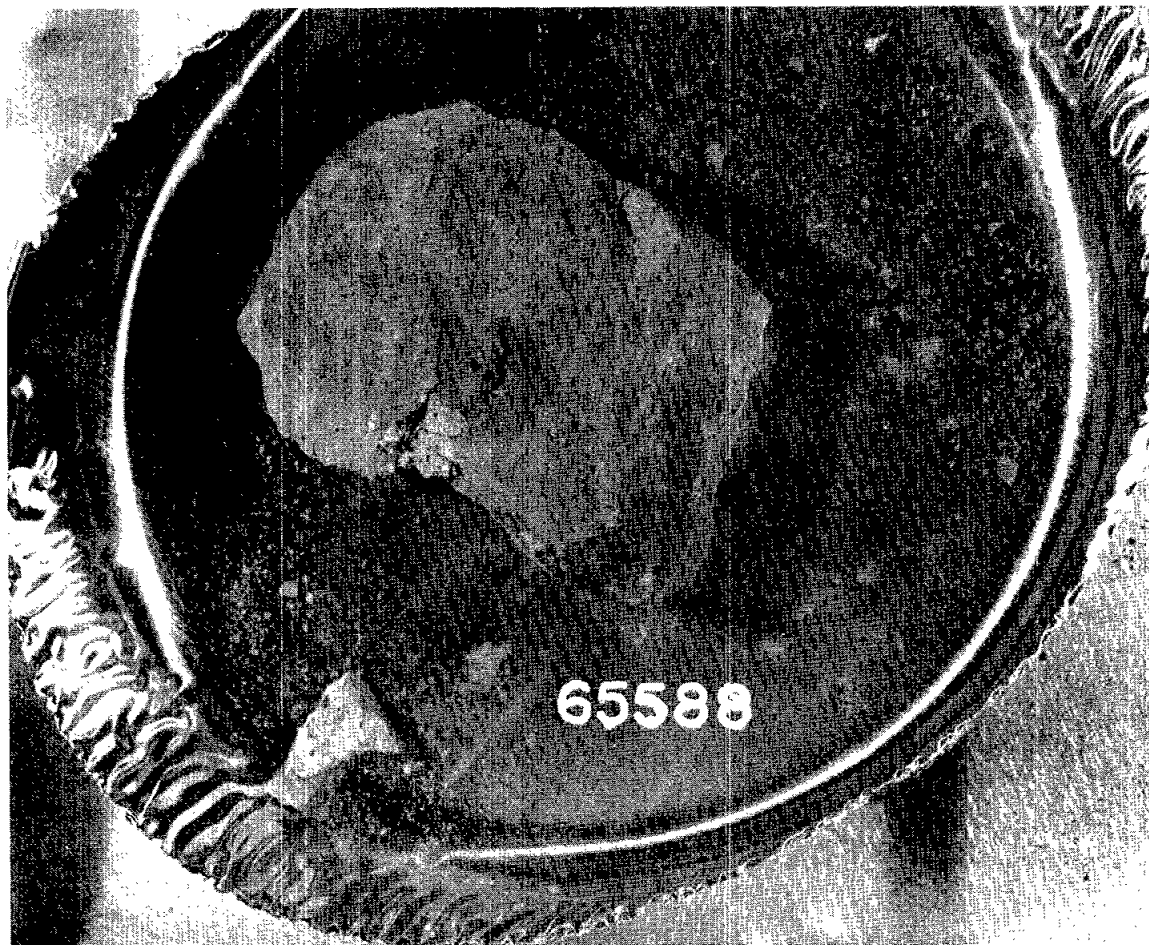


RAKE SAMPLE 65555-59,65-69,75-79





RAKE SAMPLE 65585-87



RAKE SAMPLE 65588

65715-19; 65725-29; 65735-39; 65745-49; 65755-59; 65765-69;  
65775-79; 65785-89; 65795

DESCRIPTION: Rake Sample BY: Phinney DATE: June 16, 1972

65715-19; 65725-29; 65735-39; 65745-49; 65755,56

LIGHT GRAY, MODERATELY FRIABLE, CLASTIC BRECCIA

Subrounded to subangular, moderately friable, very light gray to light gray, fine-grained, clastic matrix breccias with about 20% small (generally about 1 mm, but up to 3 mm) clasts of white granular plagioclase and various light gray, aphanitic, chert-like fragments. There are a very few clasts of light green and tan colors. Samples numbered below 65745 have very light gray matrices but those from 65745 to 56 have a light gray matrix. The clast population appears to be similar regardless of the matrix color.

65757-59; 65765, 66

HETEROGENEOUS, GRAY AND WHITE BRECCIA

Angular, gray and white breccias. Gray material is coherent and very fine-grained (aphanitic for the most part) and has a dull, almost-glassy luster, as though devitrified. The white material is friable, powdery to granular plagioclase. In some fragments the white makes up over 90% of the sample (65759), in others the gray makes up 90% (65757). In some cases the gray appears to be the matrix with the white as clasts (65757); but in others the white appears to be the matrix and the black as clasts (65759).

65767-69; 65775, 76

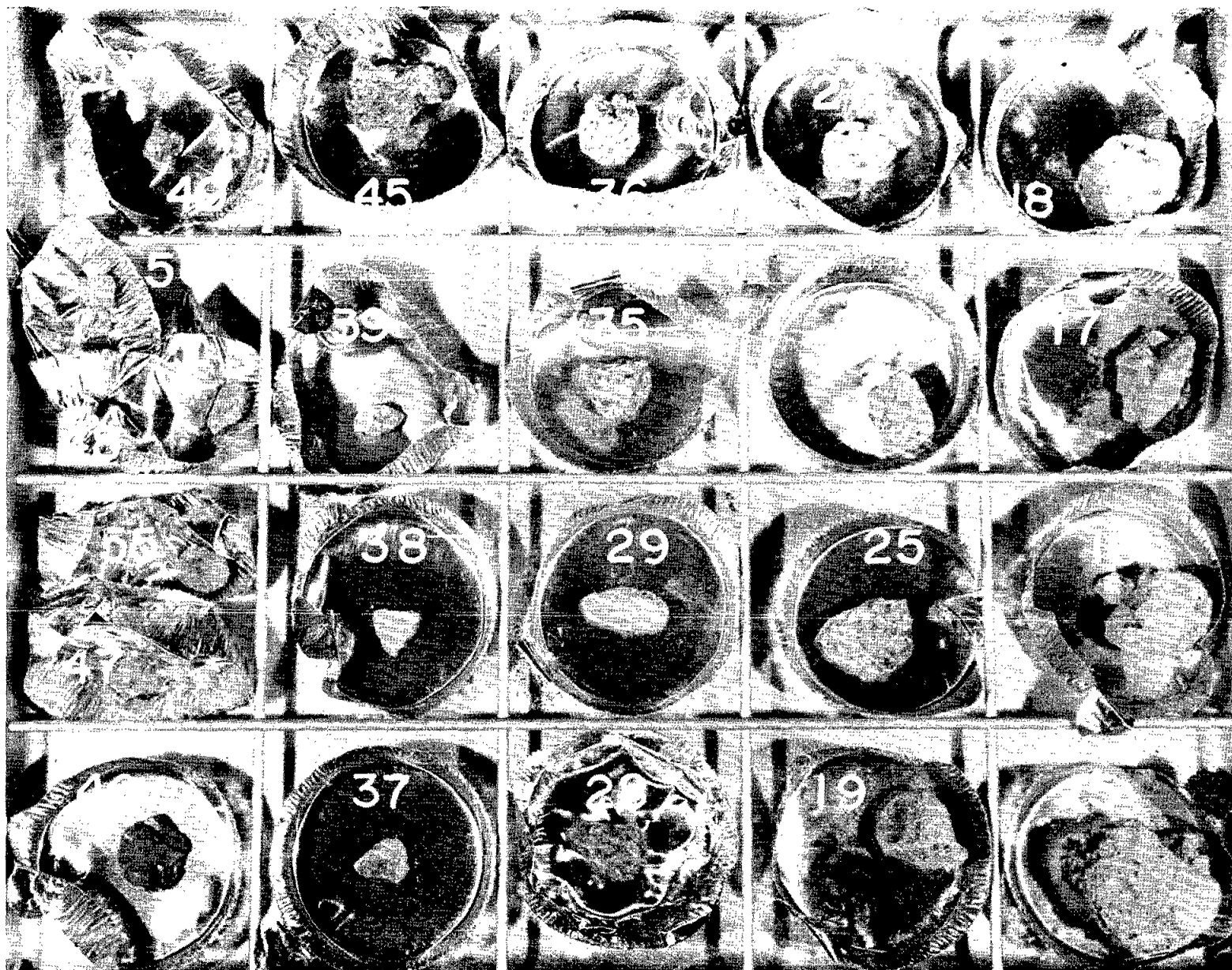
GRAY, GLASSY AGGLUTINATES

Dark gray, glassy agglutinates with clasts of various sizes of white, granular material irregularly distributed throughout the vesicular glass. Samples numbered 65768 through 76 may have rock fragments as cores but the vesicular glass containing white fragments is all that can be observed.

65777-79; 65785

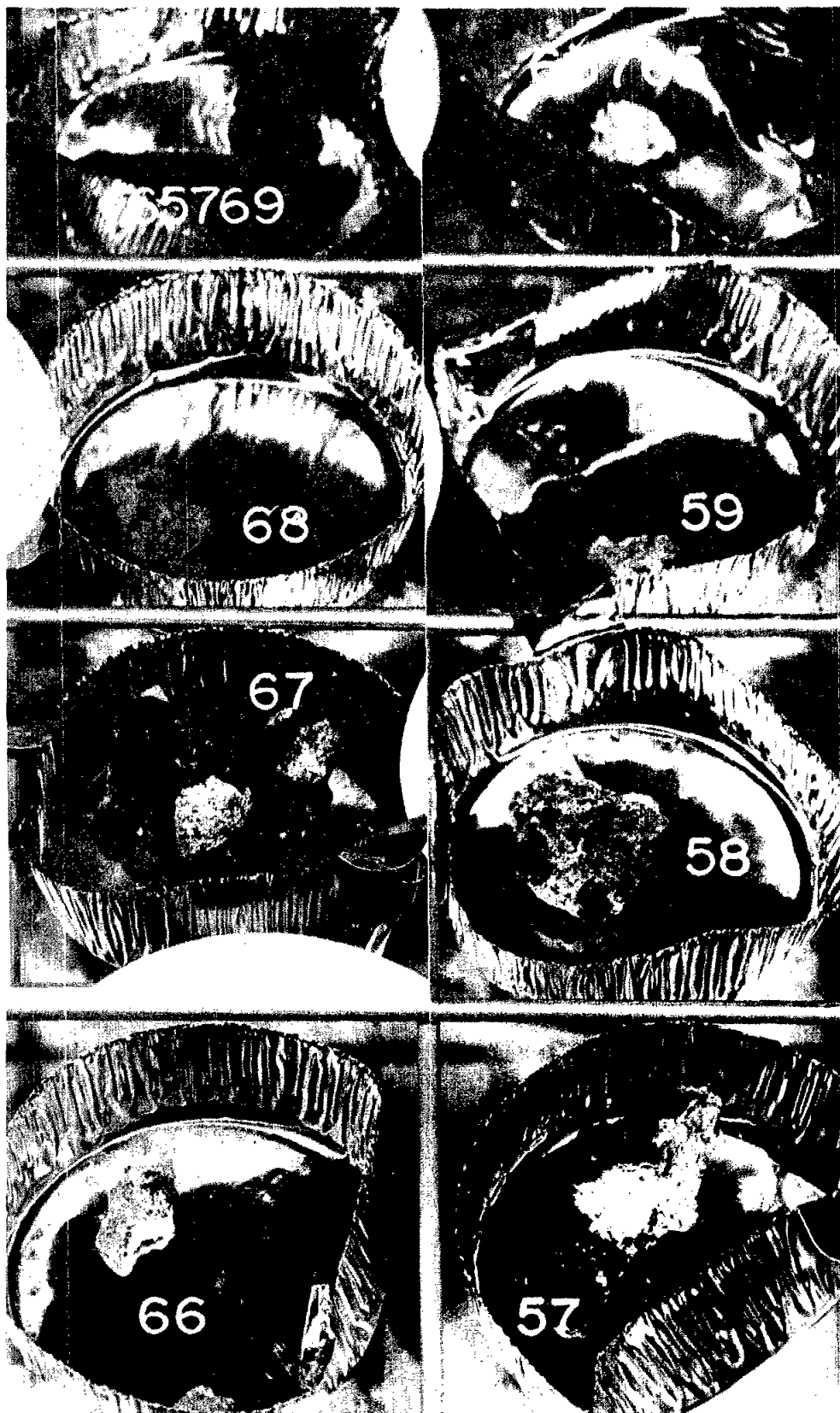
GRAY, TOUGH, FINE-GRAINED, CRYSTALLINE ROCKS

Highly variable group of angular to subangular, very coherent, light gray to light medium gray, crystalline rocks with chert-like through sugary to granular textures. Several rust spots occur on 65779. There is a strongly adhering light gray soil coating on 65779. These were probably all breccias originally but have attained various degrees of devitrification or recrystallization. Further breakdown of this group is rather arbitrary on the basis of binocular microscope descriptions.

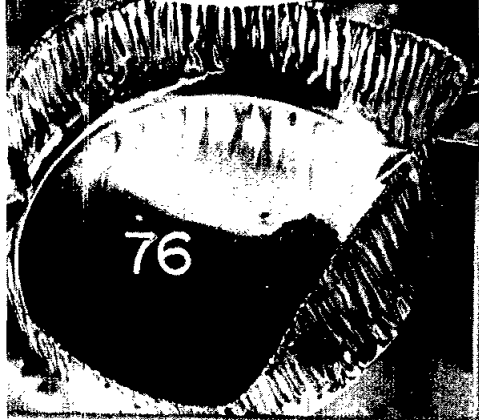
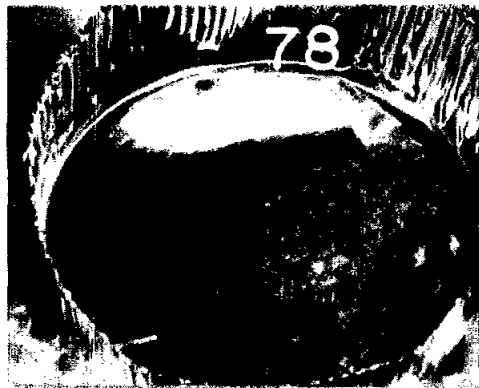
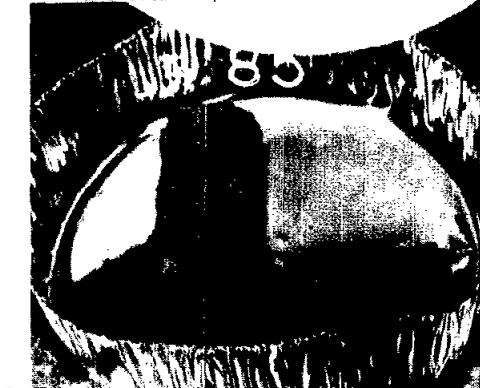


252

RAKE SAMPLE 65715-19,25-29,35-39,45-49,55 & 56



RAKE SAMPLE 65757-59,65-69



RAKE SAMPLE 65775-79,85-87



65786-88

GRAY, COHERENT, CLASTIC-MATRIX BRECCIA

Angular, coherent, but highly fractured, light medium gray, clastic-matrix breccias with about 20%, 1-2 mm white clasts. This group is much more coherent than 65715-56 and contains a higher proportion of white clasts. Partial coatings of black glass occur on 65786 and 65788. Apparently this is a somewhat recrystallized version of 65715-56.

65789

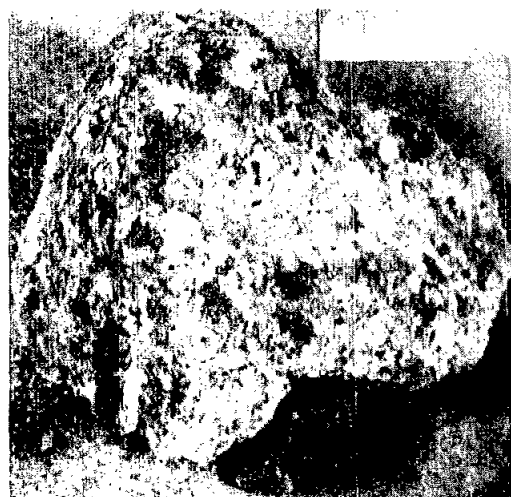
WHITE, GRANULAR ANORTHOSITE

Angular, coherent, white, fine-grained textured anorthosite. No other minerals noted besides plagioclase. Minor amount of black glass splashes occur on the surface.

65795

FINE-GRAINED, GABBROIC ANORTHOSITE

Subrounded, fairly coherent, white, anorthositic rock containing 80 to 90% plagioclase, generally as laths up to 1 mm long. Additionally there is 5 to 10% yellow equant grains of mafic silicate up to 0.5 mm across, a few percent black opaques and honey-brown silicates about 0.1 mm in size. The equant yellow grains are concentrated up to about 20% in a few areas. A few (<1%) vugs occur. Texture is somewhat granular as though crushed but overall it would appear that the rock had crystallized from a melt.



65925-27

DESCRIPTION: Rake Sample

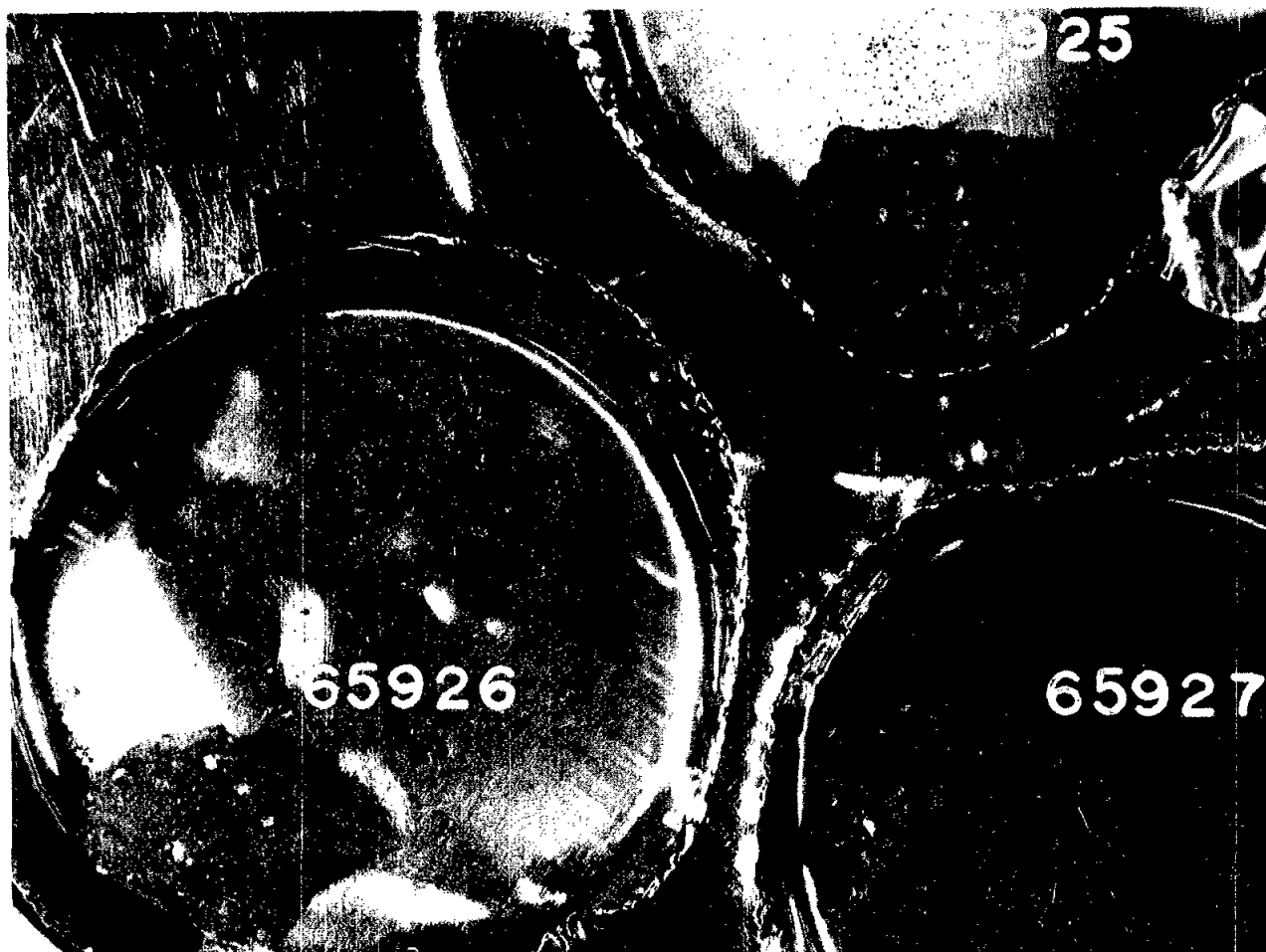
BY: Phinney

DATE: June 16, 1972

65925-27

LIGHT GRAY, MODERATELY FRIABLE, CLASTIC BRECCIA

All fragments are of identically the same material. Angular to sub-angular, moderately coherent but still somewhat friable, light gray, clastic-matrix breccia with about 20% small (up to 1 mm) subangular clasts of white, granular, plagioclase and gray, aphanitic, chert-like fragments; and a few rounded clasts of gray glass. Matrix is same material as clasts but more finely crushed. Surfaces appear relatively fresh.



RAKE SAMPLE 65925-27



ROCK TYPE: Breccia  
 COLOR: Light gray (N7)  
 SHAPE: Blocky, subrounded  
 COHERENCE Intergranular: Moderately coherent  
 Fracturing: Few, nonpenetrative

WEIGHT: 211 g  
 DIMENSIONS: 9 x 6 x 3.5 cm

BINOCULAR DESCRIPTION

BY: Wilshire

DATE: 6/2/72

FABRIC: Breccia  
 VARIABILITY: Local glass selvage  
 SURFACE: Finely hackly  
 ZAP PITS: Many on all surfaces  
 CAVITIES: None  
 SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic I	white	13	blocky, ang to subrd	5	<1-38	1
Lithic II	med to dark gray	13	blocky, ang to subrd		<1-14	2
Lithic III	pale greenish gray	tr	blocky, subrd		1- 2	3
Glass	dark brown	3				4
Matrix	light gray	70				5

## NOTES:

1. Largest is cataclastic anorthosite containing relict light gray plagioclase to 3 mm; about 5% pale yellow mineral to 1.5 mm (but shattered) and about 5% light gray mineral a little darker than the relict plagioclase. The mafic silicates(?) are not evenly distributed but they may be only apparent and the result of crushing. Yellow mineral has tiny opaque inclusions. A 1.7 cm clast on W is 55-60% pragioclase from 1 mm stubby rectangular to 2.5 mm elongate rectangular enclosed by 40-45% deep honey-colored pyroxene oikocrysts to at least 3 mm (one may be 6 mm across). Pyroxene encloses a trace of opaques, and is locally striated (exsolution lamellae?). A few irregular 0.1 mm-0.2 mm cavities occur in both pyroxene and plagioclase. On T there is a 9 mm clast, nearly completely shattered, but with one 2 mm relict of plagioclase and about 15% or so crushed, pale yellow mineral. Small clasts are mostly crushed white plagioclase with sugary to chalky texture.
2. Very finely crystalline to aphanitic, a few look vitreous. Some have small white clasts with a "cherty" appearance. Scarce small cavities.
3. Fine sugary aggregate of pyroxene(?).
4. Very thin film coating part of N. Has much adhering dust; much cracked.
5. Composed of light and dark lithic debris (considerably higher proportion of dark aphanitic debris below 1 mm) in seriate size arrangement to the limits of resolution. Mineral debris from 1 mm down includes plagioclase (dominant), yellow-green mineral, scarce <0.1 mm black glass spheres (partly buried in matrix), and trace of very pale brown pyroxene (?). Most of the matrix components are too small to resolve.

66035

THIN SECTION DESCRIPTION

BY: Stuart-Alexander

DATE: 6/23/72

SECTION: 66035,2

SUMMARY: This specimen is a multilithologic breccia with no obvious melting or recrystallization at this stage. However, many of the lithic clasts have undergone a variety of previous histories, including metamorphism, shock, and recrystallization from a shock melt. The single crystal clasts may have been shocked at this stage or prior to incorporation in this rock.

## MATRIX, 20% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	45	ang	0.1	
Pyx	35	ang to granules	<0.1	Probably both clino- and orthopyroxene present.
?	20	too fine-grained to identify		Questionable material probably finely ground fragments that are the same as the remainder of the rock.

## MINERAL CLASTS, 25% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	Dominant	ang	1.2	Plagioclase ranges from simple broken grains to highly shocked and stressed grains, even maskelynite.
Cpx		subrd to ang	0.2	
Olivine Spinel Opaque	tr	ang ang		

## LITHIC CLASTS, 54% OF ROCK

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Breccia I		subang - subrd	1	Brown matrix (devitrified glass(?)) with plagioclase and/or olivine clasts.
Breccia II		subrd	1.5	Plagioclase and olivine clasts in ground up matrix of the same.

66035 (Continued)

THIN SECTION DESCRIPTION

BY: Stuart-Alexander

DATE: 6/23/72

SECTION: 66035,2 (Continued)

LITHIC CLASTS (Continued)

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Breccia III			4	Minor (<20%) plagioclase and olivine clasts in a finely recrystallized matrix of plagioclase laths and clinopyroxene granules. One large clast rimmed by glass; also encloses rounded clast of granulite texture composed of plagioclase and clinopyroxene. Although the groundmass pyroxene seems to be in granules, it also seems to be oriented within sweeping, irregular areas, plagioclase-rich.
Breccia IV		subrd	5	Very dark matrix (high opaque content(?)) composed of tiny unoriented plagioclase laths and olivine granules, plus TL dark (almost black) material. Clasts of plagioclase, olivine, and lithic feldspar hornfels. Hornfels and granulites most with less than 10% olivine and/or pyroxene.

GLASS CLASTS, 1% OF ROCK

<u>COLOR</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Brown 1		well rd	<0.5	
Brown 2		rd to irreg	0.5	Devitrified glass ? Brown in plain light, but wavy, radial extinction patterns under crossed nicols.

ADDITIONAL COMMENTS: Breccia type III is very similar to the present rock except that it does not contain the variety of lithic clasts. Sizes given are maximum sizes in these thin sections and are undoubtedly small for rock as a whole. Percentages are averages for this thin section only, and are probably not representative of the rock. Other clast types undoubtedly occur.

66035

OPAQUES DESCRIPTION

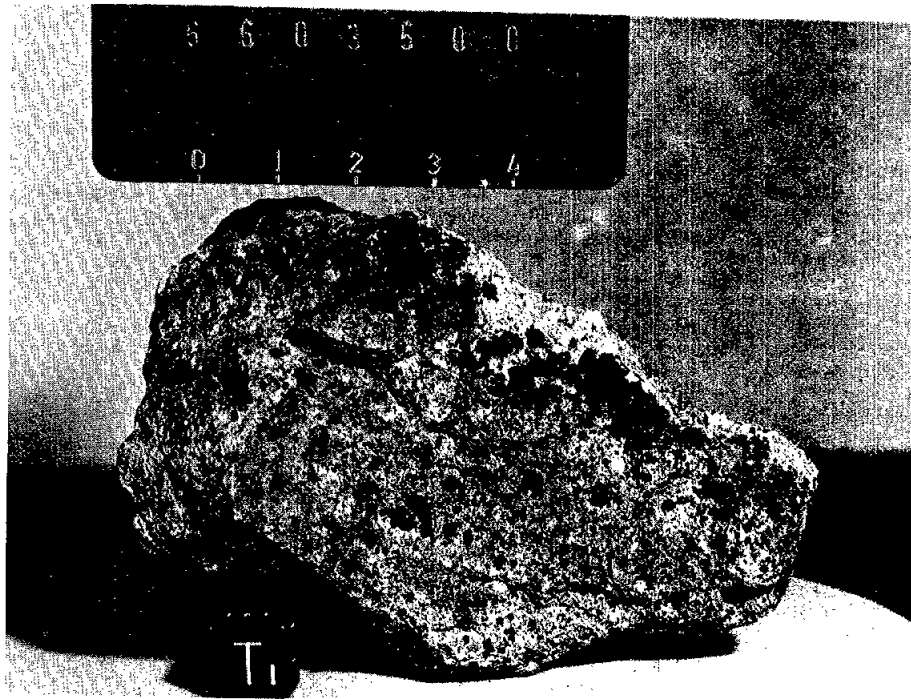
BY: Brett

DATE: 6/ /72

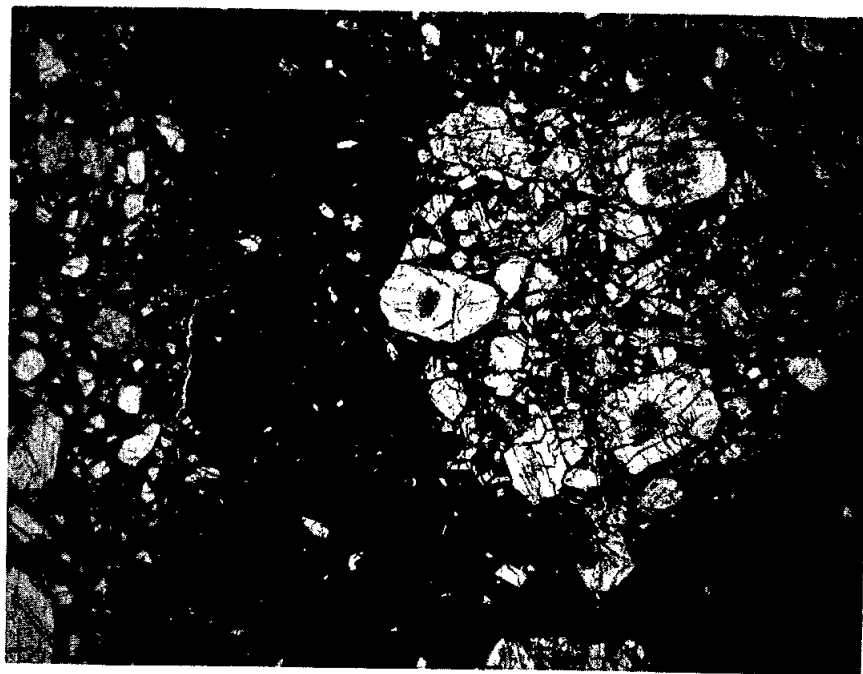
SECTION: 66035,2

SUMMARY: Rare ilmenite grains exhibit twin lamellae. Opaque content is highly variable throughout the section, some areas being extremely poor in opaques, others being rich in metal grains, and still others in ilmenite. These comments apply to both clasts and matrix. Ilmenite grains are irregular in shape and commonly fractured except in some clasts comparatively rich in ilmenite in which the ilmenite occurs in laths about 10 $\mu$  long. These clasts show a fairly high degree of crystallinity in the silicates. A couple of metal grains show the "limonitic" staining seen in 66095 and one grain has a 2 $\mu$  or so zone of goethite partially surrounding it.

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilm	<1	laths to rd	to 0.1	All minerals occur in a spectrum of sizes to below limits of resolution at 1000X.
Troilite	<0.5	ragged to subrd to blebs	to 0.05	Troilite occurs both with and without metal inclusions.
Fe-Ni	<0.5	as for troilite	to 0.15	
Schreibersite	tr	see below	0.005	Schreibersite(?) occurs as lamellae in a couple of metal grains, approximately 5 $\mu$ by 1 $\mu$ .
X	tr	ang	0.005	
Armalcolite	<0.1	ang	to 0.05	Rare "armalcolite" grains show even rarer twinning relationship. A one grain (5 $\mu$ ) of a battleship gray phase (X) occurs in which lamellae of a light gray pleochroic phase (armalcolite(?)) occurs.



SAMPLE 66035



SAMPLE 66035,2

WIDTH OF FIELD  $\approx$  4 MM

66036

ROCK TYPE: Breccia  
 COLOR: Light gray (N7)  
 SHAPE: Angular to subrounded  
 COHERENCE Intergranular: Friable  
 Fracturing: Few, penetrative

WEIGHT: 4.4 g  
 DIMENSIONS: 2.5 x 2 x 2.5 cm

BINOCULAR DESCRIPTION

BY: Hörz

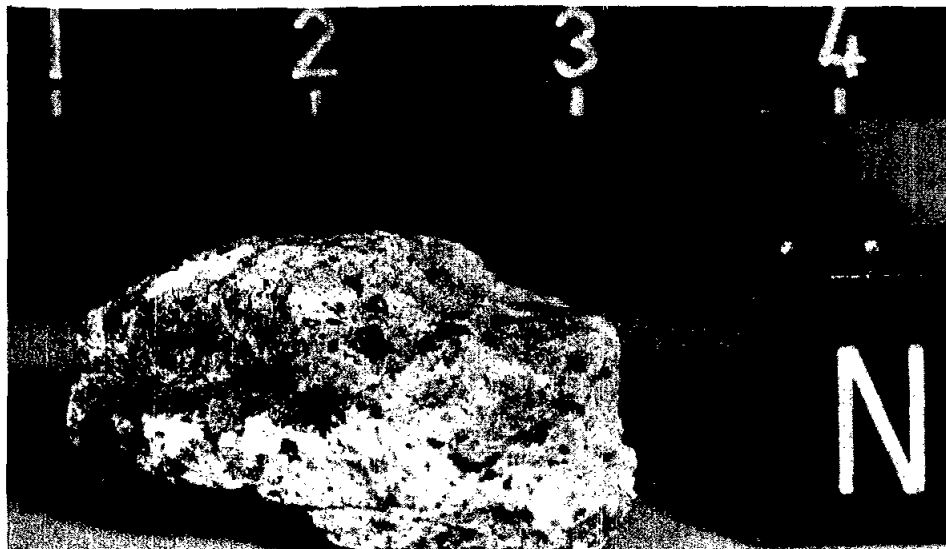
DATE: 6/8/72

FABRIC: Fine breccia, polymict  
 VARIABILITY: Homogeneous  
 SURFACE: Irregular, hackly  
 ZAP PITS: Few on all sides  
 CAVITIES: None  
 SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	N7	75		0.01	0.01-1	1
Clast I	N8	1	irregular, ang	1	1 -2	2
Clast II	N3,N2	15	ang to rd	1-2	1 -5	3
Plag	N8	5	ang	1	1 -3	4
Maf sil I	Y10	tr	ang	0.5	0.1 -1	5
Maf sil II	5YR	tr	ang	0.5	0.1 -1	6

## NOTES:

1. Clastic, sugary; 90% feldspar, 10% dark.
2. Crystalline anorthositic gabbro (80% plagioclase, 20% brown pyroxene).
3. Aphanitic; clast material ranging in luster from truly vitreous to specular-dull. It is dark glass in various stages of devitrification.
4. Both as coarse single crystals as well as sugary cataclastic aggregates.
5. Pyroxene, olivine(?)
6. Brown pyroxene



SAMPLE 66036

66037

ROCK TYPE: Breccia  
 COLOR: Medium light gray (N6)  
 SHAPE: Subangular  
 COHERENCE Intergranular: Moderately coherent  
 Fracturing: Few, nonpenetrative

WEIGHT: 3.7 g  
 DIMENSIONS: 2.5 x 1.5 x 0.75 cm

BINOCULAR DESCRIPTION

BY: Wilshire

DATE: 5/30/72

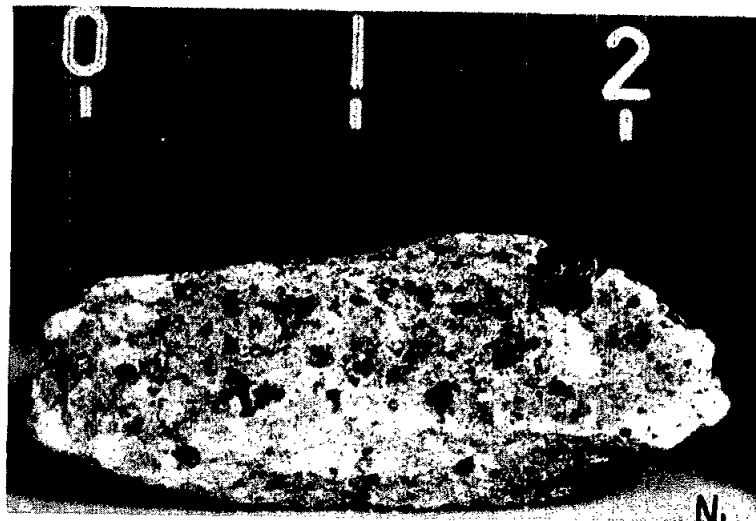
FABRIC: Breccia  
 VARIABILITY: None  
 SURFACE: Finely hackly  
 ZAP PITS: All faces zapped (few?)  
 CAVITIES: None

SPECIAL FEATURES: Zapped all over, thus rock 66037 cannot have come off the large rock 66035 with which it was returned. Rock 66037 looks much like it though, except no glass definitely seen in rock 66035 and no representatives of the >1 cm white rocks seen in 66037.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic I	dark gray	10-15	ang, blocky		>0.1-5	1
Lithic II	white	5	ang, blocky		3	2
Lithic III	light brown	tr	ang, blocky		1	3
Glass	green, black	tr	ang, blocky		1	4
Matrix	med light gray	80-85			>1	5

NOTES:

1. Some vesicular, all aphanitic.
2. Cataclastic feldspar-rich rocks.
3. Rare, sugary pale brown mineral.
4. Scarce pale green glass (?), deep brownish black glass.
5. Contains light and dark lithic clasts to resolution, mineral, and possibly glass debris.



SAMPLE 66037

66055

ROCK TYPE: Breccia, white matrix  
WEIGHT: 1306 g  
COLOR: Matrix: very light gray (N7) to light gray (N8). Clasts: medium gray (N4) to medium dark gray (N5)  
DIMENSION: 12 x 12 x 9.5 cm  
SHAPE: Irregular, sub-angular  
COHERENCE Intergranular: Coherent  
Fracturing: E face has a set of N-S penetrative fractures parallel to T.

BINOCULAR DESCRIPTION BY: Reid & Ridley DATE: 6/1/72

**FABRIC:**

**VARIABILITY:** Size range of clasts variable.

**SURFACE:** B is dusty.

**ZAP PITS:** Many on S; few on T, W, B, N; none on E.

**CAVITIES:** None

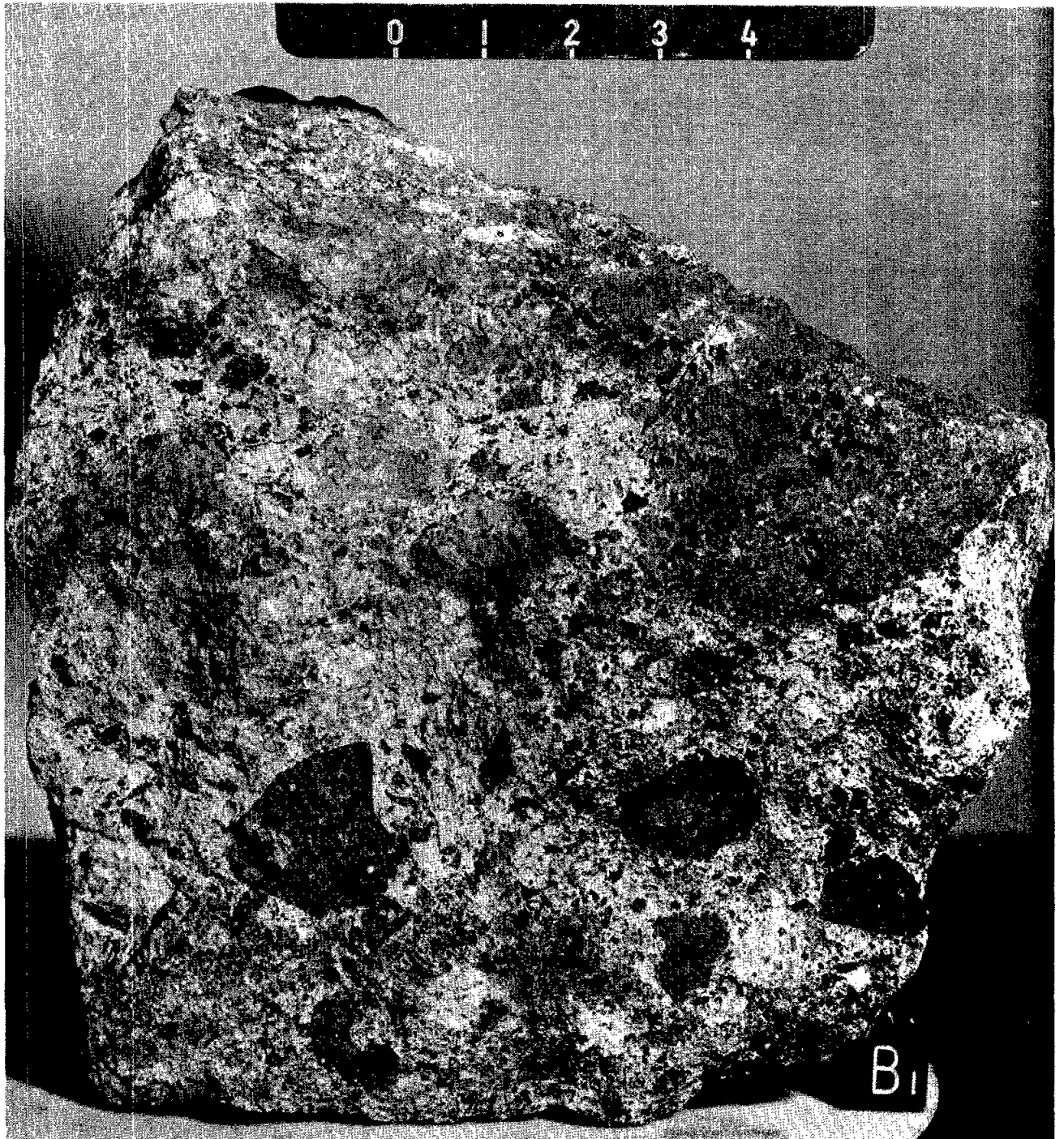
**SPECIAL FEATURES:** Black clasts commonly include troilite and/or metal with "rusty" alteration. Similar features in white clasts within black clasts. "Rusty" altered metal and/or troilite in matrix. The dominant texture is distinct dark gray clasts in a white matrix, but these dark clasts contain small white clasts similar to the matrix and the white matrix is full of small dark clasts.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Dark clasts I	medium to dark gray		ang		<0.1-50x30	1
Matrix	white			0.1	<0.1-1	2
Clast II	white	5	ang		0.1-2	3
Clast III	white	1	subrounded	10x10 mm		4

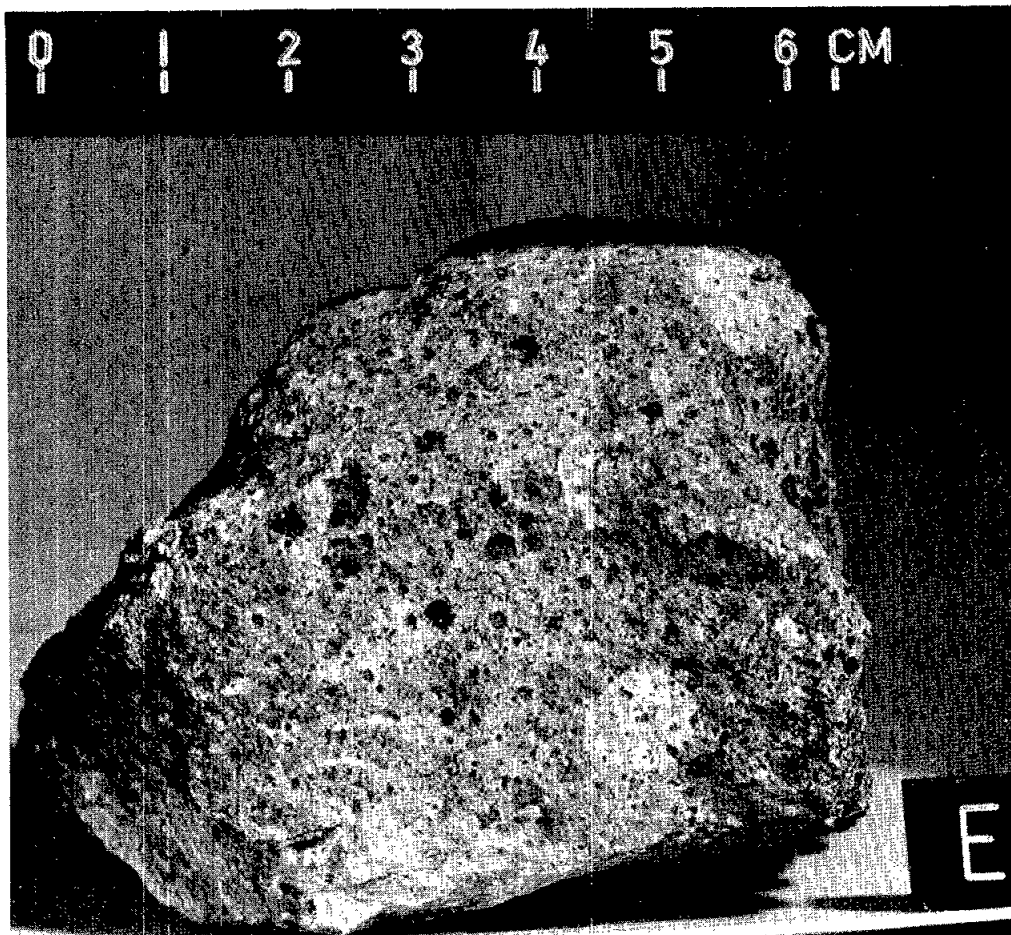
**NOTES:**

1. Sharp boundaries, fine grained, include irregular whitish clasts. Black clasts show some variation in texture and color. Several are in the 1 mm to 10 mm size range.
2. 70% feldspar (fine-grained, white, sugary lustre); 20% pale, yellowish-green mineral (anhedral, fine-grained); 5% black mineral. Matrix has a cataclastic texture.
3. Restricted to within black clasts. Similar to white matrix, contains about 70% feldspar.
4. Discrete single white clast on E side: grain size 0.2 mm, within white matrix: more ferromag. (lighter colored) than matrix.





SAMPLE 66055



SAMPLE 66075

66075

ROCK TYPE: Breccia  
COLOR: Light gray (N7)  
SHAPE: Subangular to subrounded  
COHERENCE Intergranular: Coherent  
Fracturing: Few, nonpenetrative

WEIGHT: 347 g  
DIMENSIONS: 6.5 x 8 x 5 cm

BINOCULAR DESCRIPTION

BY: Agrell & Stuart-Alexander DATE: 5/15/72

FABRIC: Seriate, fine breccia  
VARIABILITY: Nearly uniform distribution of clasts  
SURFACE: B is hackly; N and W are granular with small areas of thin botryoidal glass coating; remainder is granular  
ZAP PITS: Many on N, T, and S; few on W and E (more near T); none on B  
CAVITIES: Very few  
SPECIAL FEATURES: Zap pits saturate T, but are absent on B and the lower parts of some side surfaces.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	light gray	65		0.1		1
Clasts I	dark gray	15	ang	0.3	0.1- 5	2
Clasts II	pale gray	10	ang	0.2	0.1- 5	3
Clasts III	white	10	rd to ang	1	0.1-10	4
Clasts IV	gray to off-white	1	ang	15		5
Glass	pale green	tr	subang		1	
Mineral	pink	tr			0.1	6
Maf sil	pale yellow	tr	ang		0.5	7

NOTES:

1. Consist of single crystal clasts 0.1 mm, and the rest is aphanitic.
2. Most are aphanitic, some have micro-vesicles, some are sugary.
3. Flaky with occasional plagioclase clasts 0.1 mm.
4. Coarsely granular, vitreous to chalky, microcrystalline plagioclase.
5. Dark gray matrix, off-white rounded inclusions, radial open crack system and some random cracks.
6. Spinel(?)
7. Olivine(?)



## 66095 (Continued)

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Feldspar I	lt to med gray	>90	equant	<1		1
Feldspar II	med gray	1	equant, blocky	1	<1- 5	2
Feldspar III	white	2	irregular to equant, blocky	1.5	<1- 2.5	3
Feldspar IV	white		equant to lenticular	1.5	<1-15	4
Feldspar V	colorless	<1	irregular to equant, blocky	<1	<1- 3.5	5
Glass veins	black	4	lenticular	≈5x0.5		6
Devit glass(?)	dk gray		equant, blocky	0.1		7
Metal	gray	≈0.5	spherical to slabby	<0.1		8
Glass coating	med to dk gray	2				9
Limonite	brown, red- brown, red, yellow-brown, orange	tr tr	films and spots			10

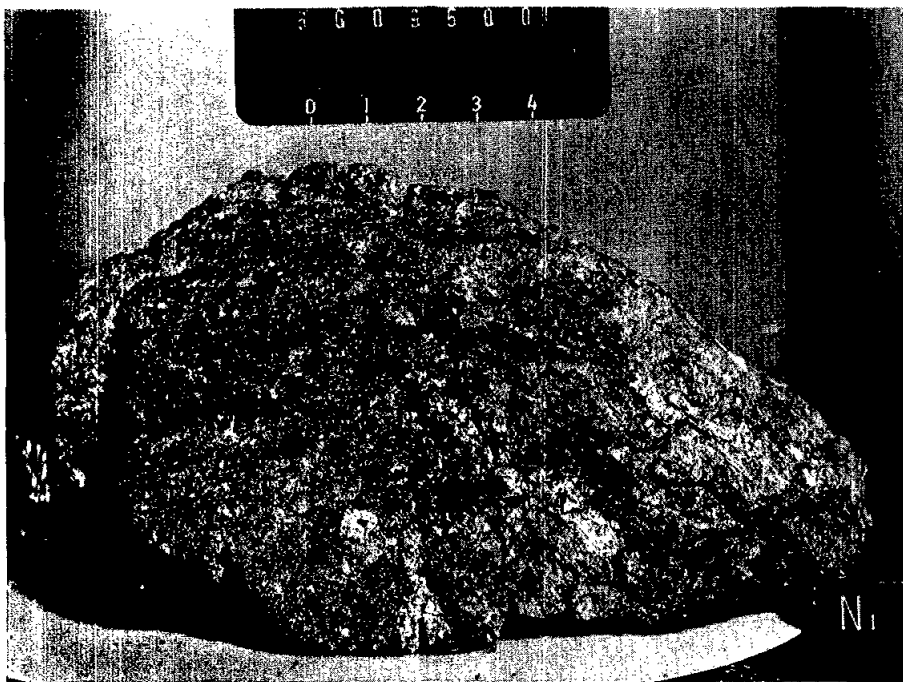
## NOTES:

1. Opaque due to shattering, cleavages uncommon, <0.1 mm; mainly light gray equant patches in darker gray "matrix"; overall mottled appearance.
2. Opaque to translucent, gradational to main feldspar or sharply bounded; strongly developed joints, often in one or two sets.
3. Translucent to opaque, often show cleavage, vitreous.
4. Opaque, earthy, highly shattered like corona around a zap pit, but they are found in interior of rock.
5. Vitreous, largest shows 3.5 x 3.5 mm area with coherent cleavage reflections.
6. Mostly irregular lenticular veins less than 8 mm long and less than 0.5 mm wide. Rarely vesicular; vesicles empty and no rust or other alteration associated with them. Commonly associated with metal; both vein and metal may be slickensided but they are generally tightly bonded to host rock. Random orientations, often rootless, do not appear to be injected; may have formed *in situ*. On E (66095,1) very thin (0.1 mm), elongate black glass veins occupy anastomosing joints subparallel to B; these may be injected.
7. On N, dull luster not part of a vein; may be finely shattered mafic. If so, it is the only sign of mafic mineral in the rock other than tiny dark specks.
8. Occurs in host rock or along sides of glass veins. Flattened metal fragments may be grooved or striated, as if older than last shock event, during which it was flattened from original more spherical shape. Films along sides of veins may be of same age as vein or older. Two spheres in glass coating on B. In interior, (on S, T, and N) recognizable metal increases toward N; toward S, it is more oxidized to limonite.

66095 (Continued)

NOTES:

9. On B, almost wholly at N side of E edge of 66095,0; vesicular (up to 2 mm) spherical vesicles; grades sharply to host over <1 mm; adjacent to host it is dull and devitrified; and contains two (possibly more) untarnished, gray metal spheres.
10. Earthy lustered films and spots, either alone, or coating metal or glass(?), (or other dark material of uncertain nature). Not all metal is associated with limonite which occurs in host or associated with glass veins. There is occasionally an orange or yellow-orange stain to shocked feldspar around limonite spots. This stain is most common and highly developed on T and S near zapped lower part of S. It is rarely transparent and has a deep blood-red internal reflection like hematite. Mobility of alteration is further indicated by earthy film ( $\approx 0.01$  mm thick) on flat, glass-coated, somewhat slickensided exposed joint surface, about  $1 \times 0.4$  cm, on bottom edge of NW part of specimen. The film is zoned, progressively outward toward B, from yellow-brown to deeper yellow-brown to deep brown, like tarnish or films seen on joint surfaces in volcanic rocks exposed to fumarolic gases. One limonite spot occurs in center of glass zap pit on B (probably under glass, but it is difficult to be sure).



SAMPLE 66095

66095

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/24/72

SECTION: 66095, 12 and , 11

SUMMARY: Shock melted breccia contains highly recrystallized to shocked, unannealed relics. Variability of relics suggest original breccia was polymict and that the melt crystallized to rock with ophitic texture. "Goethite" stains appear as areas surrounding metal grains. Relics do not include mafic clasts which suggest plagioclase should be on liquidets of melted matrix. This expectation agrees with the presence of minor plagioclase microphenocrysts in ophitic groundmass. Post-crystallization shock events produced vague, very fine-grained seams and patches of microbreccia, and caused local shear, which allowed induce melting along cracks, thus producing isolated, rootless lenses of glass.

## GROUNDMASS, 88% OF ROCK

<u>PHASE</u>	<u>% OF GROUND MASS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	56.9	euhed laths	0.008x0.002 to 0.064x0.008	Plagioclase is weakly zoned and randomly oriented.
Oliv(?) and py- roxene(?)	39.4	subhed, tabulate, poiki- litic	0.12x0.24x0.04 0.16x0.16x0.05	
Opaque	2.0	anhed	0.003-0.03	Metal peripherally oxidized to orange-brown or red-brown material which, where pure, shows a very fine-grained aggregate extinction; was mobile and stains the grain boundaries of surrounding shocked material. Larger metal grains are ovoid to ahnedral; locally is fine- grained, interstitial. There is some suggestion that metal tends to occur in relatively fine-grained areas. Also oc- curs as thin veins or seams, in some case associated with glass.
Metal and "goe- thite"	1.2	ovoid to anhed	0.44x0.06 to 0.01x0.01	
Glass	0.5	lenses		Dusty gray, isotropic to devit- rified with or without micro- vesicles and tiny angular clasts. Dust is opaque, either randomly scattered or in aggre- gates elongated normal to the

## 66095 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/24/72

SECTION: 66095,12 and ,11 (Continued)

## GROUNDMASS (Continued)

<u>PHASE</u>	<u>% OF GROUND MASS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
				length of the seam. Locally contains lenses of metal(?) which may occupy whole width or seam. These glass seams pinch out within the section; and are not associated with the exposed zapped surfaces which may occupy the whole width of the seam. They probably correspond to the rootless veins seen under the binocular microscope, and are probably the "needle-like black crystals" cited by the astronauts on the lunar surface.

## PHENOCRYSTS, 0.2% OF ROCK

<u>PHASE</u>	<u>% OF PHENOCRYSTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	100	euhed	to 0.17x0.04	

## RELICT CLASTS, 10.6% OF ROCK

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Gabbro-anorth	51.3	irreg to ovoid	4.0x3.4 others 1.13x 0.65 and smaller	Polygonal (granoblastic) inequigranular (large relict plag clasts or phenocrysts, depending on original nature of rock); mafics are mainly polygonal but also anhedral, interstitial, though not poikiloblastic; plag is rarely elongate (stubby laths). By decrease of mafics grades to anorthosite.



## 66095 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/24/72

SECTION: 66095, 12 and , 11 (Continued)

## RELICT CLASTS (Continued)

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	38.1	blocky, subrd to ovoid	0.90x0.40 to 0.04x0.03	Single crystals or a few without mafics or very few mafics, commonly shattered, undulatory (i.e., shock effects not totally annealed even in this melted rock); by increase in number of plag crystals grades to anorthosite.
Anorth	2.7	ovoid to blocky subrd	0.70x0.37 to 0.20x0.15	Mostly inequigranular, strained plagioclase aggregates; less commonly polygonal (granoblastic), totally recrystallized aggregates with few or no mafics.
Maskelyn- ite bear- ing breccia	8.0	blocky, rd	1.03x1.21	About 2/3 is a single grain of fibrous, devitrified maskelynite; remainder is highly recrystallized microbreccia.
Basalt	1.0	blocky, subang	0.26x0.35, 0.24x0.15	Two clasts seen, not encountered in modal count; essentially intergranular diabase, more or less like a relatively coarse version of the groundmass.

**ADDITIONAL COMMENTS (General):** Rock has ophitic texture with relict (unmelted mineral and lithic clasts, plus metal and "goethite" formed *in situ*. Vague patches and seams of very fine-grained material may be incompletely melted relics of breccia matrix or, more likely, later breccia from imposed on this rock after it crystallized and cooled. The metal bodies have a crude tendency to occur in such very fine-grained areas. The later events which produced such breccia probably also produced most or all of the rootless glass seams. Highly shattered and "stained" (glass injected?) edge of section (better seen in section 12) is probably the exposed, zapped surface of 66095.

66095

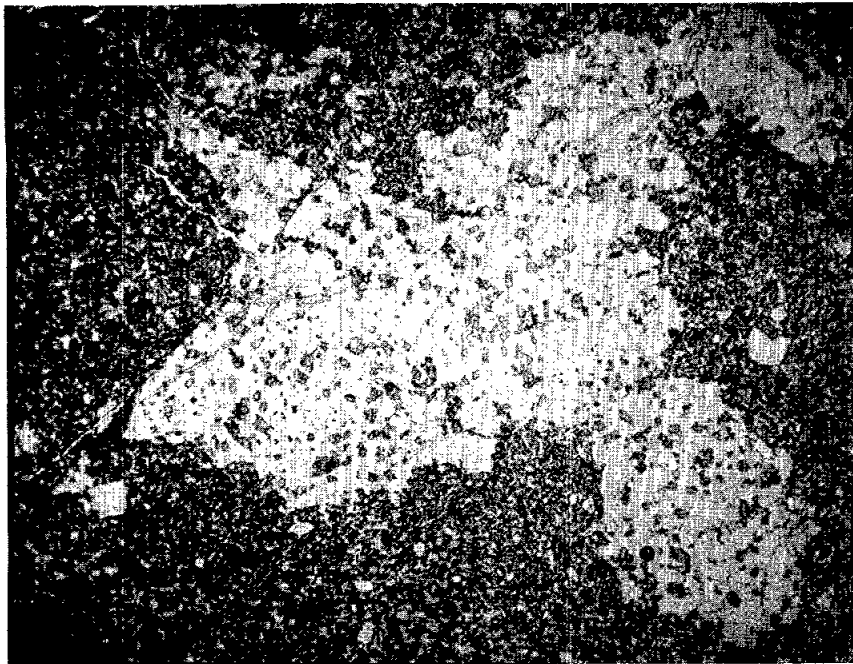
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/26/72

SECTION: 66095, 12 and , 11

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	1	ragged, subrd	to 0.35	Metal and troilite in ragged subrounded grains from several hundred microns diameter down to a few microns. Metal and troilite contents are high for lunar breccias. Rust-like stains surround many metal grains in a halo up to several metal grains diameters thick. Many metal grains contain an extremely thin or partial coating of rust staining which appears to have formed after the specimen was polished.
FeS	<0.5	ragged, subrd	to 0.2	
Ilm	1	blebs and lamellae	0.002-0.01	Ilmenite in blebs, squashed prisms and lamellae in groundmass from 2 to 10 $\mu$ maximum dimensions.
Goethite	tr	largely as rims	to 0.015	Rare goethite veins up to 2 $\mu$ wide (very rare) surround portions of the metal masses somewhat removed from the metal.
Schreibersite	tr			Schreibersite occurs as eutectic-like intergrowths in one large metal grain.



SAMPLE 66095

WIDTH OF FIELD  $\approx$  4 MM

67015

ROCK TYPE: Breccia  
 COLOR: Medium light gray matrix (N6),  
 locally medium gray (N5) where  
 clasts abundant and large  
 SHAPE: Blocky, subangular  
 COHERENCE Intergranular: Friable to coherent  
 Fracturing: Few, nonpenetrative; rock has broken into a number  
 of pieces since receipt and seems to be continuing  
 to do so.

WEIGHT: 1194 g  
 DIMENSIONS: 13 x 10 x 8 cm

BINOCULAR DESCRIPTION

BY: Bass

DATE: 5/15/72

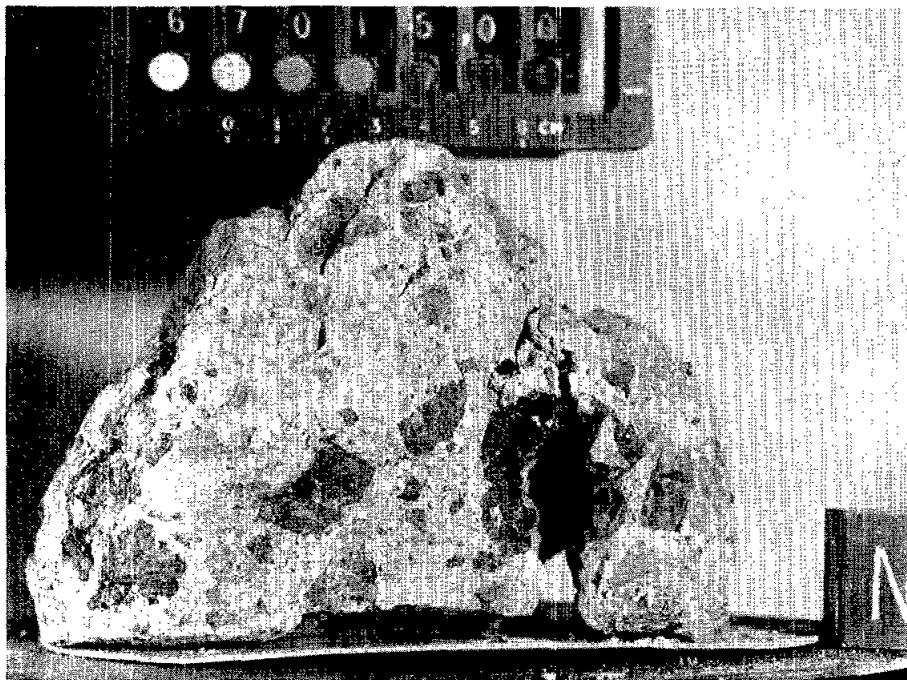
FABRIC: Isotropic, seriate breccia.  
 VARIABILITY: None overall, locally variable because of large clasts.  
 SURFACE: Irregular to smooth; smooth along exposed fractures in tough clasts.  
 ZAP PITS: None  
 CAVITIES: Only open fractures.  
 SPECIAL FEATURES: Polymict, glass-free unrecrystallized breccia, matrix highly  
 feldspathic; clasts include shocked rocks and/or breccias; some of darker  
 clasts are cherty and may be an earlier generation of recrystallized breccia;  
 mafics are rare unless some dark clasts are shocked mafic grains or aggregates.  
 No igneous textures. Two fracture sets: (1) strike E-W, dip 30° to N,  
 several members slightly open, nonpenetrative, 5 to 20 mm spacing; (2) single  
 joint of S near edge of B, nonpenetrative, slightly irregular; (3) open joints  
 restricted to tough clasts, random orientation. Minor soil cover on all but  
 W which was formed during handling; soil in some clast molds, especially on S.  
 No soil line.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic I	dk gray	3	blocky, ang to subang rarely slabby	5	0.5-30	1
Lithic II	med gray	8	blocky, ang to subang	3-10	0.5-40	2
Lithic III	lt gray	1	equant, rd	15		3
Plag	colorless to lt gray	5	equant, irreg, ang, to subrd	1	0.1- 6	4
Maf sil	lt brown to greenish brown	0.1	blocky, ang	0.2	0.1- 0.5	5
Red	red	0.01	blocky, ang	0.1		6
Opaque	dk bronze colored	0.01	films			7
Matrix	med lt gray	80			1	8

67015 (Continued)

NOTES:

1. These fragments are variable but generally are dense and microcrystalline with rare vitreous cleavages up to 0.5 mm. Some fragments contain irregular to blocky plagioclase, and one contains a red spinel grain. They are generally tough and jointed. The large ones are uncommonly highly fractured and hackly. They could be shocked mafics, dark recrystallized breccia fragments, or (unlikely) aphanitic igneous rocks. Some clasts tend to break to crude lenses which suggests a crude planar structure.
2. Variable, mostly translucent, feldspar-rich material with variable amounts of mafic grains; less commonly microcrystalline, cherty-looking; a few have salt and pepper texture, one of these has hard ovoid cherty inclusions. Lenticular chips suggest joints controlled by foliation.
3. Mainly very fine-grained feldspar matrix with minor medium gray clasts; red spinel in clasts and matrix. Lighter than matrix of specimen as a whole.
4. Shattered to intact fragments which rarely include light brown or greenish-brown mafic grains, probably pyroxene or possibly olivine, in which case feldspar shows brown tinge; seriate to matrix.
5. Pyroxene (?), olivine (?) in matrix or included in feldspar.
6. In matrix and in Lithics I and III; probably spinel.
7. Bronze, dark-colored films which spot 25 x 25 mm, faintly slickensided surface on W.
8. Mainly feldspar with minor dark clasts, accessory pyroxene(?) or olivine(?) and spinel(?).



SAMPLE 67015

67015

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/19/72

SECTION: 67015,8

SUMMARY: This is a section of a dark gray clast, which is highly recrystallized, clast-poor "breccia" of anorthositic or gabbroic anorthositic composition. Several features are worthy of note: (1) the commonly subround-to-ovoid shapes of mineral clasts; (2) the only moderately recrystallized, shocked feldspar in a highly recrystallized matrix; (3) the sharp distinct clast outlines in a highly recrystallized matrix; (4) the embayed outlines of lithic clasts; and (5) the absence of mafics in some anorthosite clasts (their place being taken by matrix). These features are unusual in the highly recrystallized matrix, in which some clasts are blurred almost beyond recognition.

## MATRIX, 65% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Mineral	50	equant to lath-shaped	0.01	Contains abundant equant and lath-shaped feldspar and mafics(?); includes large clast(?) with outlines too blurred to follow, seen mainly by generally lighter color and relative abundance of laths; has crude micro-polygonal structure, due to equant grains embedded in a dark brown matrix. May be devitrified shock melt.
Brown	50	?		

ADDITIONAL COMMENTS: Both in the matrix and in clasts the opaque globules and grains have minutely ragged edges and in most cases grade out to a halo of interstitial, dark, opaque material in the groundmass. Not sure whether the dark material is diffusing out from the globule or grains or accreting onto it.

At least three generations of breccia are recognized (including the host rock 67015).

## MINERAL CLASTS, 30% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Type I	70	blocky to subrd	<0.01 to 0.03	Both Types I and II contain much more plagioclase than mafics. Plagioclase is mainly unshocked, and varies to highly shocked or shattered (variable recrystallization, generally not complete). Olivine is generally unshocked.
Type II	10	blocky to subrd	0.03 to 0.1	
Oliv	3	ovoid to ang	0.03 to 0.55x0.4	
Plag	10	ovoid to ang	0.03 to 0.3x0.25	

## 67015 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/19/72

SECTION: 67015,8 (Continued)

## MINERAL CLASTS (Continued)

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Devit mas- kelynite	2	ang to subrd	0.03 to 0.3x0.2	Maskelynite is highly recrystallized.
Opaque	3	spherical to blocky	0.03 to 0.1	Opagues are mainly metal globules, with lesser blocky anhedral grains; globules are generally clustered and may coalesce. No pyroxene was identified.

## LITHIC CLASTS, 5% OF ROCK

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Breccia	85	irreg to blocky	0.2x0.3 to 0.35x1.4	Breccias are of medium-to-low color index, anorthositic, recrystallized. They include clasts of devitrified glass and devitrified maskelynite.
Anorth	15		0.2x0.2 to 0.25x0.4	Anorthosites are granoblastic; one is essentially a shocked anorthosite, now converted to a polygranular devitrified maskelynite mosaic. Another has extremely zoned feldspar grains. Both anorthosites and brec- cias may be embayed and "cavernous" due to seams of material like the host matrix. In anorthosites this material occupies the position nor- mally taken by mafics and suggests interstitial melting.
"Basalt"	tr	ovoid	0.12x0.08	The "basalt" may be a glass ovoid reheated to the liquid regime from which it crystallized as from a nor- mal magma.

## GLASS CLASTS, TRACE

<u>PHASE</u>	<u>% OF GLASS CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Light gray- ish brown	100	ovoid	0.4x0.3	One devitrified ovoid.

67015

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/19/72

SECTION: 67015,9

SUMMARY: This section shows a medium gray clast, which is recrystallized multi-generation gabbroic anorthositic breccia. Clast outlines are intact. No remnant isotropic glass, but much devitrified glass. No clinopyroxene was found; mafics appear to be olivine and orthopyroxene.

## MATRIX, 40% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	97-98		<0.05 avg	Matrix is mainly feldspar; coherent and recrystallized, but grain shapes are not blurred.
Mafic	2- 3		0.025	In one high-color-index lithic clast, which was originally glassy, there are minute highly skeletal olivine prisms.

## MINERAL CLASTS, 20% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	97	equant, ang to subrd	0.05 to 0.63x0.48	Plag is mainly unshocked or mildly so, but much of it is shattered, undulatory; rarely bent; both twinned and untwinned.
Mafics	3	equant, ang	0.05 to 0.17x0.12	Mafics are mainly olivine and orthopyroxene; no clinopyroxene identified.
Opaques	tr	anhed to blocky	up to 1.8x1.0	
Spinel	tr (1 grain)	blocky, ang	0.09x0.04	

## LITHIC CLASTS, 40% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Anorthositic to gabbroic	12	blocky, subrd	0.1 to 1.4x0.8	Anorthosite varies to gabbro with increase of mafics; plagioclase is generally xenoblastic, rarely lath-shaped; mafics (oliv and opx) are ovoid to poikilitic; two occurrences of reaction rim or mantle of pyroxene(?) around olivine core. Rare "diabasic" anorthosite similar to 68415 and 68416.

## 67015 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/19/72

SECTION: 67015,9 (Continued)

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Med color index	25	blocky, subang	1.9x1.9 max	Medium and high color index: recrystallized breccias and recrystallized glass with unmelted relics; very finely micro-poikilitic pyroxene(?) in matrices of some lithic clasts; rare clasts of recrystallized maskelynite within some breccia clasts; counting main specimen (67015), can find four generations of breccias in breccia. Metal sphere in one clast; pyroxene with exsolution lamellae in another. Faint lamination in one clast.
High color index	63	blocky, ang to subrd	2.1x1.7 max	

## GLASS CLASTS, TRACE

<u>PHASE</u>	<u>% OF GLASS CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Brown color	100	ovoid to irreg	0.12x0.08 max	No isotropic glass; composed of devitrified glass with unmelted relics, and grade into lithic clasts as glass becomes darker and relics increase.

67015

OPAQUES DESCRIPTION

BY: Brett

DATE: 6/20/72

SECTION: 67015,9

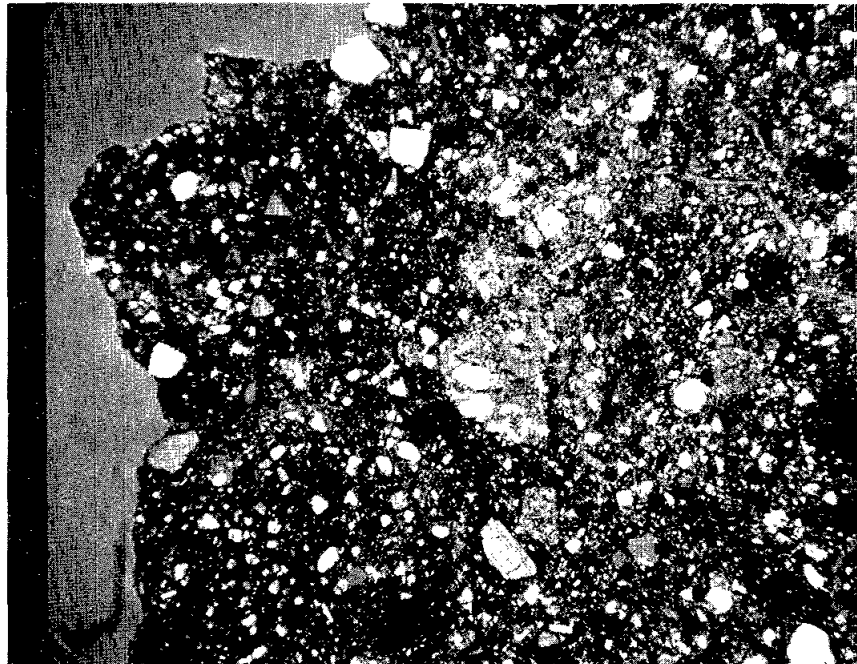
<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	<0.5	ragged	to 0.75	Troilite is relatively Fe free.
FeS	<0.2	ragged	to 0.2	
Ulvo	<0.5	ragged	to 0.3	Ulvospinel is the dominant oxide by far, contains rare ilmenite lamellae and possibly a couple of small ilmenite grains elsewhere in section.
Ilm	<0.1	lath	0.05	
X	<0.01	irreg	0.04	X phase is battleship gray with yellow-brown interval reflection, high birefringence in transmitted light, isotropic to slightly anisotropic in transmitted light.





SAMPLE 67015,8

WIDTH OF FIELD  $\approx$  4 MM



SAMPLE 67015,10

WIDTH OF FIELD  $\approx$  4 MM

67015

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/19/72

SECTION: 67015,10

SUMMARY: This section represents the matrix part of rock and is an unrecrystallized polymict anorthositic breccia. Clast outlines often vague due to lack of color contrast, not due to recrystallization. Lithic clasts are generally highly recrystallized; mineral clasts relatively unshocked and unrecrystallized.

## MATRIX, 75% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fld and mafic	95+	equant	<0.03 avg 0.002	Seriate, distinct from mineral clasts as regards size. Mafic grains often have fuzzy fringe of fine dusty opaques (metal forming <i>in situ</i> (?); fringe is generally incomplete, possibly due to fragmentation of an earlier grain with a complete fringe. Lenticular pressure(?) twins in one clinopyroxene(?) grain; the narrower or "guest" set is sharp and the lamellae are up to 0.012 mm wide. The only "basaltic" texture was seen in a single ovoid grain (0.3 mm) in a light breccia clast. This grain has random, ragged laths with intergranular mafics and opaques. It may be devitrified glass.
Opaque	<5	irreg, elongate	0.005	Opaques appear to be interstitial, with highly irregular shapes.

## MINERAL CLASTS, 15-20% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	97	equant blocky	0.03 to 0.35x 0.22	Mainly plagioclase, unshocked to mildly undulatory, twinned or untwinned, rarely zoned, with minor ovoid mafic inclusions; uncommonly twin lamella are bent; rarely the plagioclase is highly shocked or mildly recrystallized.
Mafic	2-3	equant blocky	0.03 to 0.35x 0.22	Olivine, augite, orthopyroxene, pigeonite, and subcalcic augite (all are present, as estimated from 2v and birefringence).
Opaque	<1	equant blocky	0.13x0.15 max	

## 67015 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/19/72

SECTION: 67015,10 (Continued)

## MINERAL CLASTS (Continued)

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Recrys- tallized maske- lynite	tr	equant blocky	0.60x0.33 max	Augite is more abundant than the other pyroxenes. Fibrous recrystallized maskelynite is grain.
Spinel	tr	blocky	0.04x0.028	One grain of spinel was observed.

## LITHIC CLASTS, 5-8% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Anortho- site			0.24x0.18 max	Sharp but difficultly discernible outlines due to lack of color contrast.
Gabbroic anortho- site			0.4x0.4	Anorthosite is granoblastic, polygonal to xenoblastic, grades to gabbroic anorthosite with appearance and increase of mafics (generally ovoid, droplet-shaped, or irregular).
Light breccia			1.85x2.40 max	Breccias vary from mafic poor (like host matrix) to mafic-rich. They are often quite inequigranular. One moderately dark breccia has a faint lamination due to alignment of feldspar clasts. Some dark breccia clasts are highly recrystallized, though clast outlines remain sharp.
Dark breccia			1.0 x1.35	

## GLASS CLASTS, TRACE

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Brownish color	100	irreg	0.20x0.16	One devitrified grain with plagioclase inclusions; other less certain grains of similar material.

67015

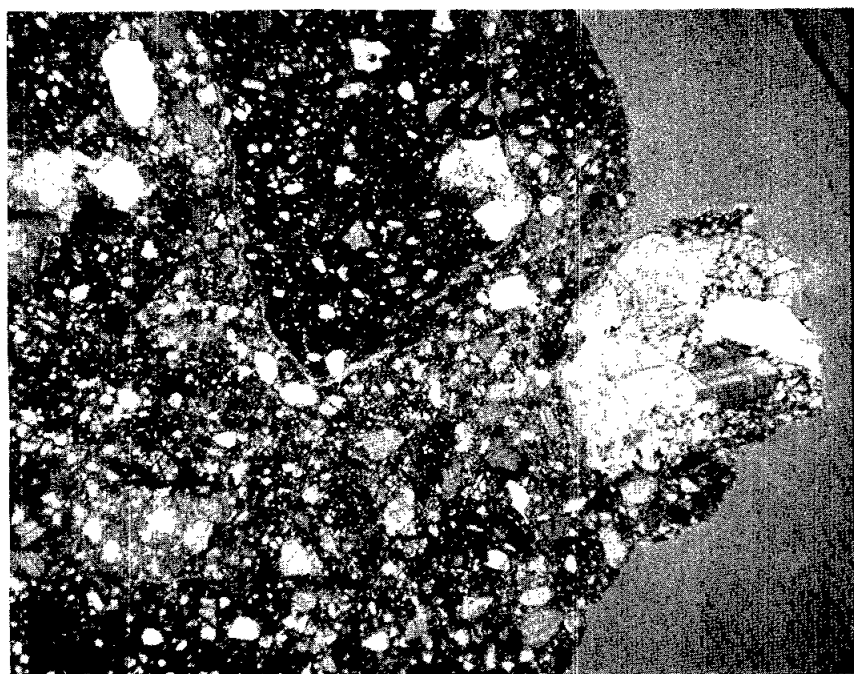
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/8/72

SECTION: 67015,10

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilm	<1	subrd to lamellar	<0.001 to 0.1	Opaque minerals in fine dust to less than 1 $\mu$ in size. Small (<10 $\mu$ )
Fe	<0.3	subrd to rd	<0.001 to 0.04	ilmenites tend to approximate lamellae.
FeS	<0.2	subrd to rd	<0.001 to 0.03	Battleship gray phase of low reflectivity compared to ilmenite translucent off-white in transmitted light, high birefringence in 2 or 3 grains up to 20 $\mu$ .



SAMPLE 67015,26

WIDTH OF FIELD  $\approx$  4 MM

67016

ROCK TYPE: Breccia  
COLOR: Light gray (N7)  
SHAPE: Subrounded. Blocky with joint faces.

WEIGHT: 4262 g  
DIMENSIONS: 25 x 15 x 10 cm

COHERENCE Intergranular: Moderately coherent  
Fracturing: Moderate number, penetrative

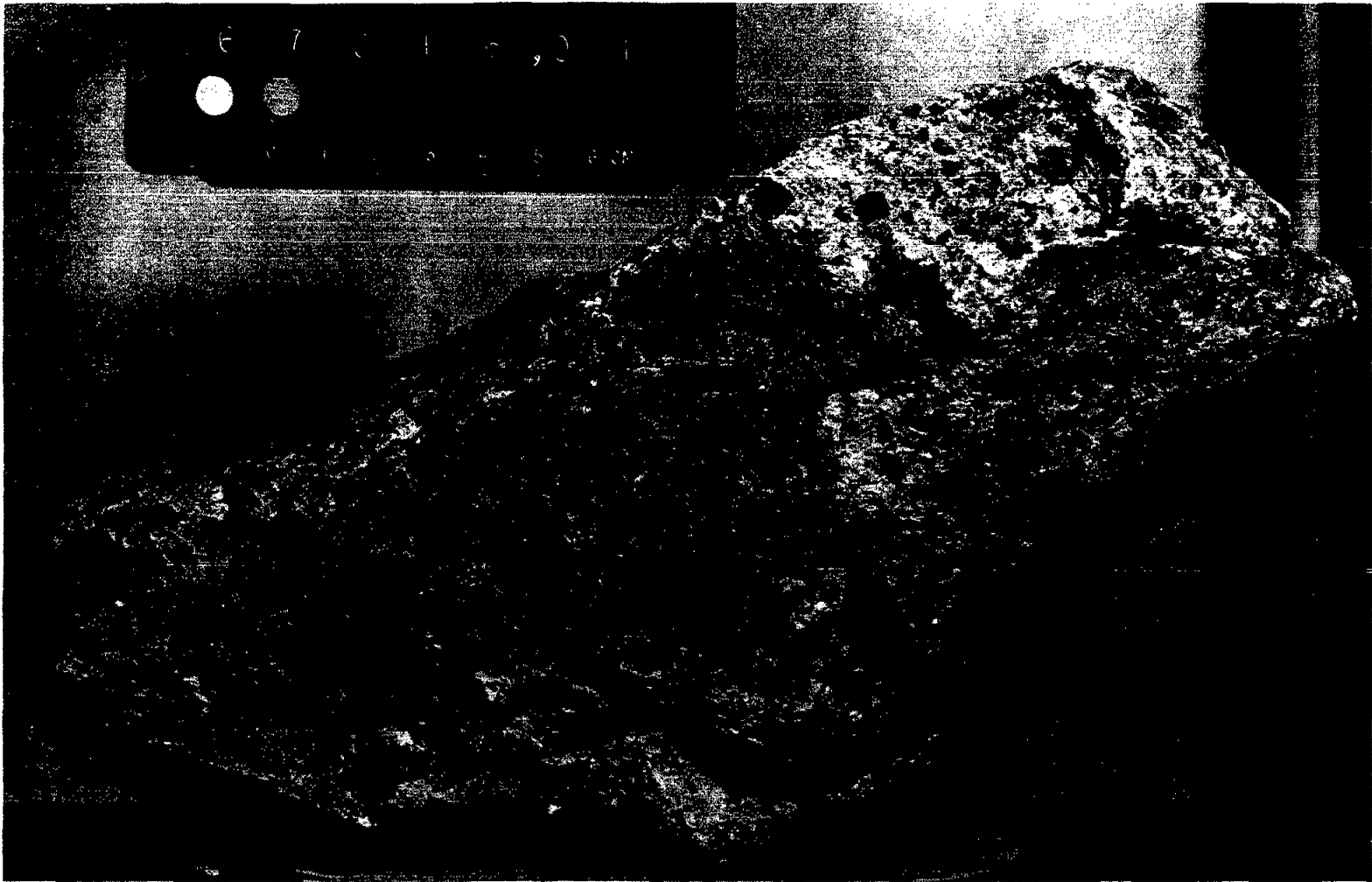
BINOCULAR DESCRIPTION BY: Stuart-Alexander & Wilshire DATE: 6/1/72

FABRIC: Breccia  
VARIABILITY: Inhomogeneous distribution of clast types and sizes.  
SURFACE: Irregular; broken faces are hackly.  
ZAP PITS: Many on S, B, N, T; none on E, W (except unbroken part which has many).  
CAVITIES: None  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic I	dark gray to med light gray	25	subang to subrd, blocky to irregular	5	<1-60	1
Lithic II	v light gray to greenish gray	tr	blocky, ang to rd		<1-6	2
Lithic III	white	5	rd	3	<1-3	3
Lithic IV	white	tr	rd	4	4-20	4
Matrix	light gray	70				5

NOTES:

1. Aphanitic. Lighter gray fragments commonly have indistinct borders. Large clast (60 mm) has rounded to slabby very fine-grained white inclusion. Smaller dark ones also enclose white fragments. Dark clasts have streaked two-tone gray color, or patchy two-tone gray, possibly due to fracturing.
2. A few, hard, finely crystalline clasts, one with 2 mm light gray plagioclase and <0.1 mm yellow-green fragments.
3. Largest clast contains rounded clumps of plagioclase grains, chalky-white fragments and angular pieces of plagioclase. Smaller clasts are chalky white.
4. Two clasts seen. One contains 4 mm plagioclase grains (5%) in a mosaic of finely crystalline white plagioclase ( $\pm 40\%$ ) and pale yellow mineral ( $\pm 35\%$ ). This is shot through with dendritic dark material (20%) possibly glass, possibly with some metal.
5. Very fine-grained, sugary to powdery. Composed of light and dark lithic fragments seriate from clast size down and mineral debris including plagioclase, traces of opaque minerals, pale pink spinel, yellow-green mineral and dark reddish-brown mineral.



286

SAMPLE 67016

67025

ROCK TYPE: Anorthosite  
COLOR: Yellowish gray (5Y 8/1)  
SHAPE: Blocky, angular, slightly flattened  
COHERENCE Intergranular: Coherent to tough  
Fracturing: Few, nonpenetrative

WEIGHT: 16.1 g  
DIMENSIONS: 3.7 x 3.4 x 2.0 cm

BINOCULAR DESCRIPTION

BY: Bass

DATE: 5/31/72

FABRIC: Isotropic, microgranular

VARIABILITY: Glass coating and zap pit density are variable.

SURFACE: Smooth; irregular where glass coated. B has no glass; T has 60-70% glass cover.

ZAP PITS: Many on B; few on T.

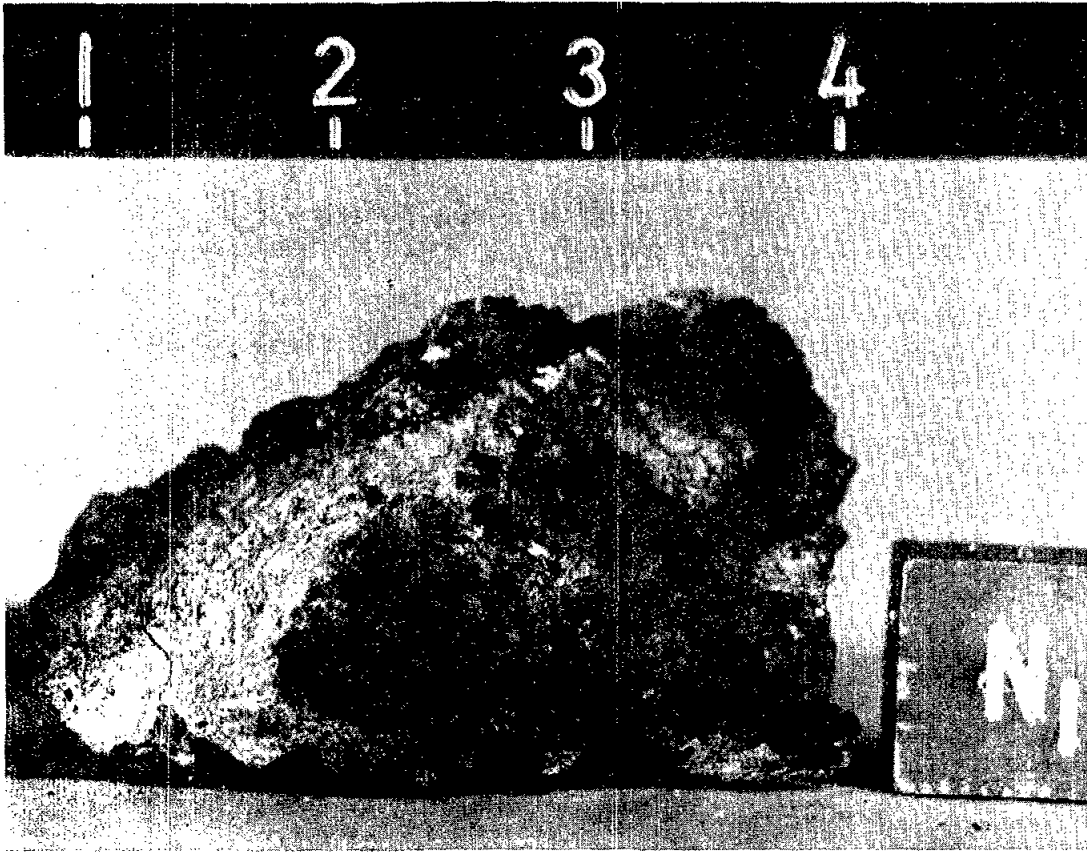
CAVITIES: Open fractures; irregular cavities and minor spherical vesicles in glass coating.

SPECIAL FEATURES: Irregular to planar, nonpenetrative fractures show no obvious sets; largest fracture is the glass coated half of T, which lacks both zap pits and soil cover. Olive-gray soil cover seen only on the other half of T and on the highly zapped part of B. Rock is highly shocked anorthosite (or gabbroic anorthosite); glass coatings grade into host and apparently formed from it by melting.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase (?)	yellowish gray	90	equant	<0.1		1
"Matrix"	light gray	5		<0.1		2
Spinel(?)	red to red-brown	<0.5	equant, blocky		<0.2	3
Devitrified glass	dark gray	5				4

NOTES:

1. Equant patches up to 1 mm diameter with tiny glistening cleavages; generally opaque (due to shattering), rarely colorless.
2. "Matrix" between plagioclase patches.
3. Shattered grains among plagioclase and unmelted relics in glass.
4. Dull-lustered coatings on the two intersecting surfaces forming T. One has few zap pits, minor soil cover, irregular and spherical vesicles and may be original outer surface or a thick vein; other half has no zap pits or soil cover, only elongate, irregular cavities, and appears to be an injected vein or melted walls of joint. Both glass coatings grade rapidly into host rock by color gradation and by injection into host rock of numerous short veins, usually less than 0.5 mm long.



SAMPLE 67025



67035

ROCK TYPE: Breccia, incoherent  
COLOR: Very light gray (N6-7)  
SHAPE: Subrounded before breaking  
COHERENCE Intergranular: Friable  
Fracturing: Numerous, nonpenetrative

WEIGHT: 245 g  
DIMENSIONS: Rock is broken, 3 large  
fragments to 6 cm, 10  
fragments about 1 cm

BINOCULAR DESCRIPTION

BY: Wilshire & Morrison

DATE: 5/16/72

FABRIC: None

VARIABILITY: None

SURFACE: No original surface is identifiable. Finely hackly, coarsely hackly  
on broken surfaces due to clast molds.

ZAP PITS: None

CAVITIES: None

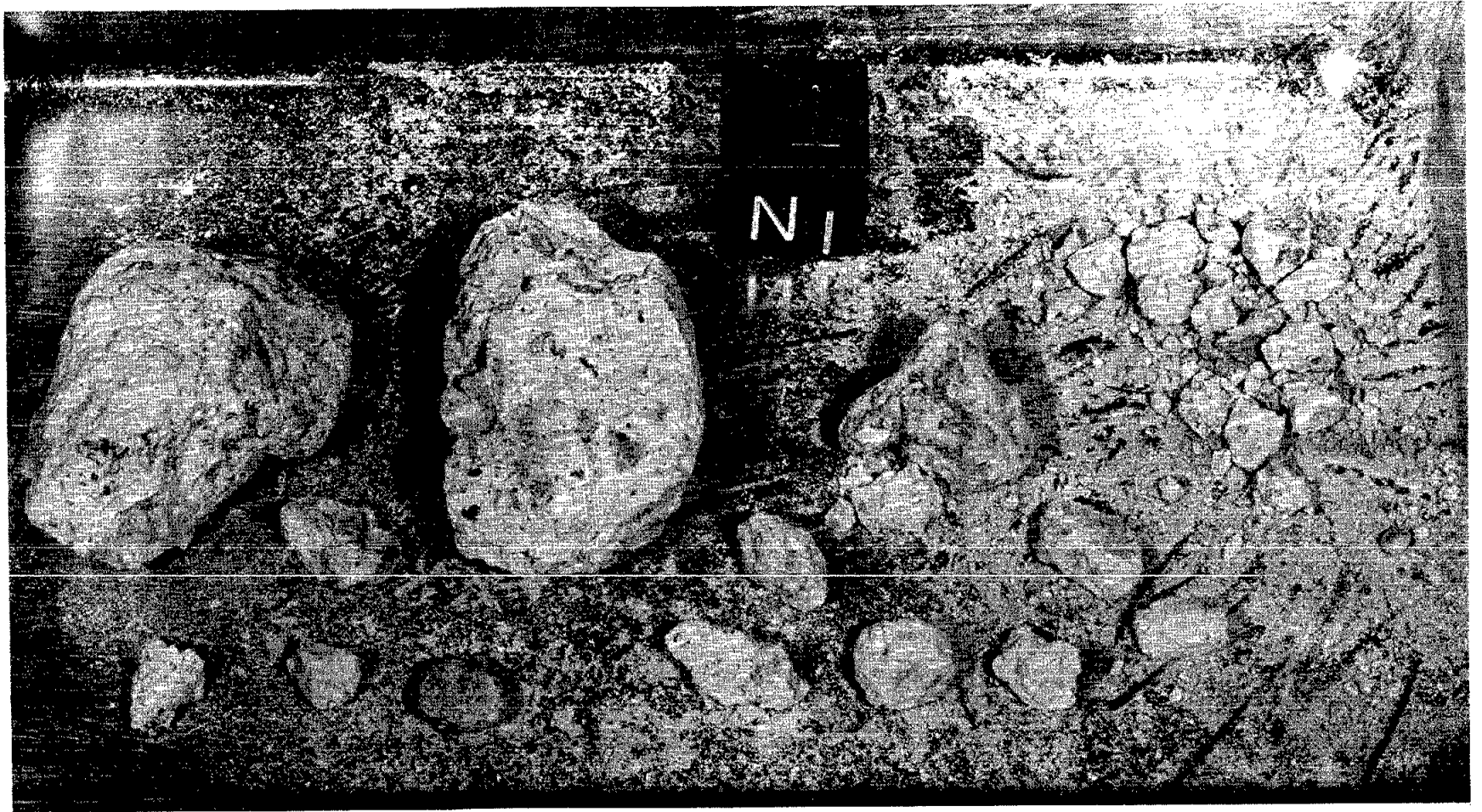
SPECIAL FEATURES: There appears to be crude banding at one end of largest piece;  
a thin wedge, 3 cm long x 5 mm wide, has much less resolvable debris than the  
surrounding matrix. No sign of clast-matrix reaction.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic I	dark gray	10	subang to subrd	1	<1 - 10	1
Lithic II	very light gray	4	subang		6 - 7	2
Lithic III	white with dark streak	1	subang		5	3
Matrix	very light gray	85	angular	0.1	<0.1- 1	4

NOTES:

1. Aphanitic. Smaller ones tend to be more angular than larger ones.
2. Only two seen, but there may be more that are obscured by matrix. Very hard, fine, sugary texture, very low colored mineral content. Coarser grained than lithic (I) clasts.
3. Only one seen. Fine sugary white rock cut by 1 mm thick dark gray vein, which itself encloses a sugary, very pale yellow aggregate 1 mm long.
4. 20-25% angular material is resolvable and the remainder is very fine white powder. Coarser debris is mostly angular plagioclase and dark aphanitic lithic fragments. One piece of gray plagioclase 1 mm across encloses a red spinel (?) grain. Other matrix debris includes trace amount of red spinel (?), yellow-green pyroxene (?). Opaques are very scarce tiny specks.

290



SAMPLE 67035

67055

ROCK TYPE: Breccia, coarse clastic  
white matrix

WEIGHT: 222 g

DIMENSIONS: 7 x 6 x 6 cm

COLOR: Clasts are black and white (N4-N9)

SHAPE: Blocky, subrounded

COHERENCE Intergranular: Friable

Fracturing: None - penetrative

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 6/12/72

FABRIC: Breccia

VARIABILITY: Clast population variable in size (seriate) but homogeneous in type with few exceptions.

SURFACE: Surfaces are hackly because of abundance of clast molds.

ZAP PITS: Few occur on N face, others were not looked at because of friability.

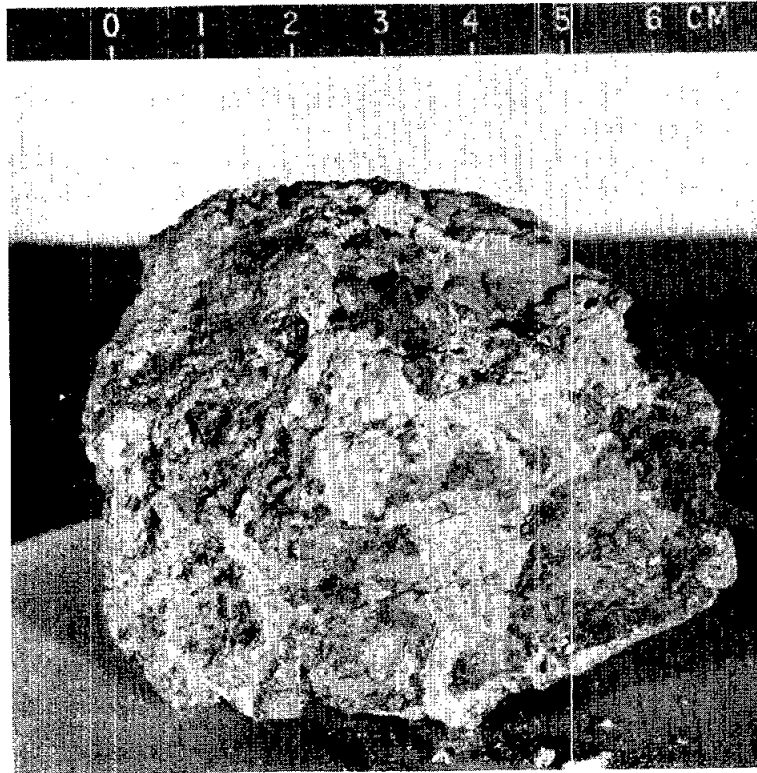
CAVITIES: No vesicles or vugs.

SPECIAL FEATURES: This breccia appears to have formed by the breakup of the medium gray material represented by the Clast type, and then the energetic introduction of matrix material, which may be of a different bulk chemistry. The gray clasts may represent a previous generation of breccia formation.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Clasts I	med dk gray (N4)	55	blocky subang	10-20	<1-50	1
Clasts II	med to lt gray (N6-N7)	1-2(?)	rd blocky	2- 3	to 5	2
Matrix	white (N9)	40		<1		3

NOTES:

1. Medium gray cryptocrystalline clasts, several contain rounded yellow-green clasts which may be crushed olivine; largest such clast is 3 mm in diameter. Most of the gray clasts have some vugs. Also have areas which appear debris-rich and less cryptocrystalline. Also some have clasts which appear to be identical to matrix. Some have large pieces of metal. Also most have translucent plagioclase inclusions. Matrix appears to be veining these clasts in some areas.
2. Vitreous, a possible variant of Clast , because some have rims of the same color.
3. Seriate grain size up to 1 mm. Composed of: 85% plagioclase (mostly crushed, but some translucent islands); 10% of Clasts and ; <1% metallic fragments; trace of spinel; trace of yellow-green mafic (olivine) as inclusions in Clast trace of brown mafic (pyroxene or spinel?).



SAMPLE 67055

67075

ROCK TYPE: Anorthosite  
COLOR: White (N9)  
SHAPE: Rounded fragments  
COHERENCE Intergranular: Very friable  
Fracturing: Numerous, penetrative, and irregular

WEIGHT: 219 g  
DIMENSIONS: Fragments up to 4 cm

BINOCULAR DESCRIPTION

BY: Butler

DATE: 5/17/72

FABRIC: Isotropic, equigranular  
VARIABILITY: Homogeneous mineral distribution  
SURFACE: Mostly freshly broken and knobby with protruding mineral grains  
ZAP PITS: None  
CAVITIES: None  
SPECIAL FEATURES: Thin section chip has somewhat greater concentration of both mafic silicates than most of rock.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plag	gray to colorless	20	columnar subrd	0.2	0.1-1.5	1
Maf sil I	med greenish yellow (10Y 7/4)	5	rd	0.2	0.1-1	2
Maf sil II	grayish orange (10YR 7/4)	2	rd	0.1	0.1-2	3
Glass?	dark gray (N3)	<1	rd	0.5	0.2-4	4
Maf sil III	very dark red-brown	<1	flaky and columnar	<0.1	0.2	5
Opaque Matrix	black white	0.5 72	flaky	<0.1		6 7

NOTES:

1. Vitreous
2. Olivine, granulated
3. Pyroxene, granulated
4. Mostly as loose fragments in tray, but some glass is with the white fragments.
5. Has a metallic luster.
6. Fine flakes disseminated through the rock and concentrated in and around mafic silicates.
7. Some cleavage reflections. Probably mainly shocked and granulated plagioclase.

SUMMARY: This rock appears to be the result of breaking and grinding of anorthosites. The lithic clasts are remnants of the original rocks and give an idea of its texture. The grain sizes of these clasts are less than that suggested by mineral clasts for which there are 0.6 mm examples of both orthopyroxene and plagioclase. Two anorthositic lithologies appear to be represented by this breccia, one with less orthopyroxene than the other.

67075

THIN SECTION DESCRIPTION

BY: Butler

DATE: 6/25/72

SECTION: 67075,2 and ,3

## MATRIX, 75% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	96	equant	<0.1	Patches and streaks of matrix are either finer grained or have more orthopyroxene than other parts.
Opx	3	equant	<0.1	
Opa	1	equant	<0.1	

Opaques all appear to be gray spinel(?) in subhedral equant grains. Grain size reaches 0.3 mm, average 0.01 mm.

## MINERAL CLASTS, 10% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	97	subang	to 0.6	The orthopyroxene mineral grains are concentrated in the orthopyroxene-rich matrix areas.
Opx	3	subang	to 0.6	

## LITHIC CLASTS, 15% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Anorth	100	equant	0.4	Typical clasts are: 95% plag, which is anhedral, equant, and averages 0.2 mm in size; 3% opx, which is rounded, intergranular, and averages 0.02 mm; 2% opaque, which is subhedral, and averages 0.01 mm. One clast on the edge of the section is 2.4 mm across.

OPAQUES DESCRIPTION

BY: Brett

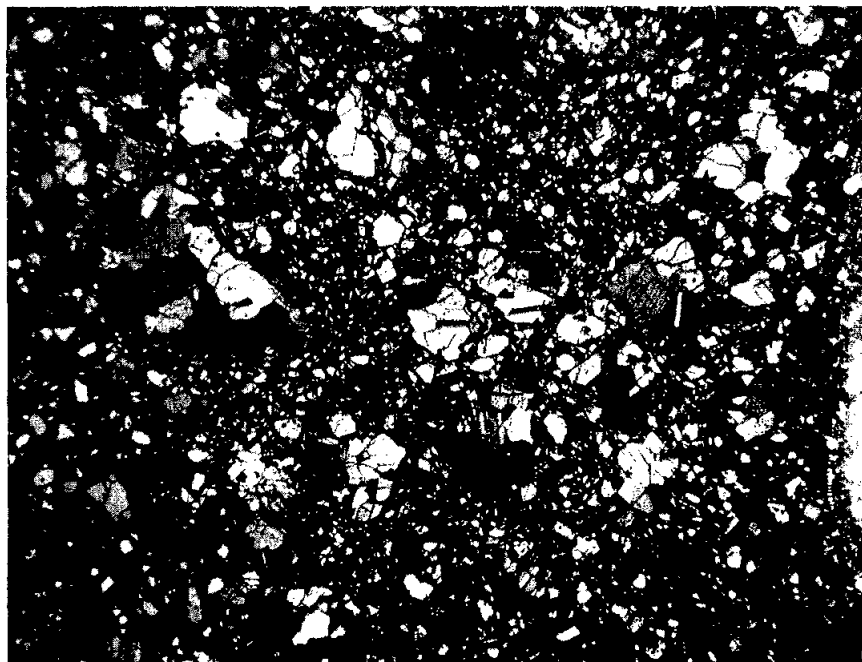
DATE: 6/20/72

SECTION: 67075,2

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilm	<1	rd	to 0.04	Opaque content relatively low for Apollo 16 rock. Well-rounded ilmenite in matrix, also rarely included in large pyroxene and plagioclase grains.
Fe-Ni FeS	<0.1 <0.1	blebs rd	to 0.005 to 0.005	Metal and troilite both in matrix and as rare inclusions in above silicates. These minerals also occur as rare 1μ wide veins and strings of blebs along fractures in plagioclase and pyroxene.



SAMPLE 67075



SAMPLE 67075,3

WIDTH OF FIELD  $\approx$  4 MM

ROCK TYPE: Breccia, glass coated  
 COLOR: Glass: Black (Nil)  
 Rock: Greenish gray (5GY7/1)

WEIGHT: 340 g.  
 DIMENSIONS: 10.5 x 5.5 x 5 cm

SHAPE: Blocky, subangular

COHERENCE Intergranular: Tough  
 Fracturing: Few, penetrative

BINOCULAR DESCRIPTION

BY: Warner

DATE: 6/1/72

FABRIC: Breccia

VARIABILITY: Breccia is homogeneous except for large clasts and glass coating.

SURFACE: Hackly with 75% black glass coating on all faces.

ZAP PITS: None

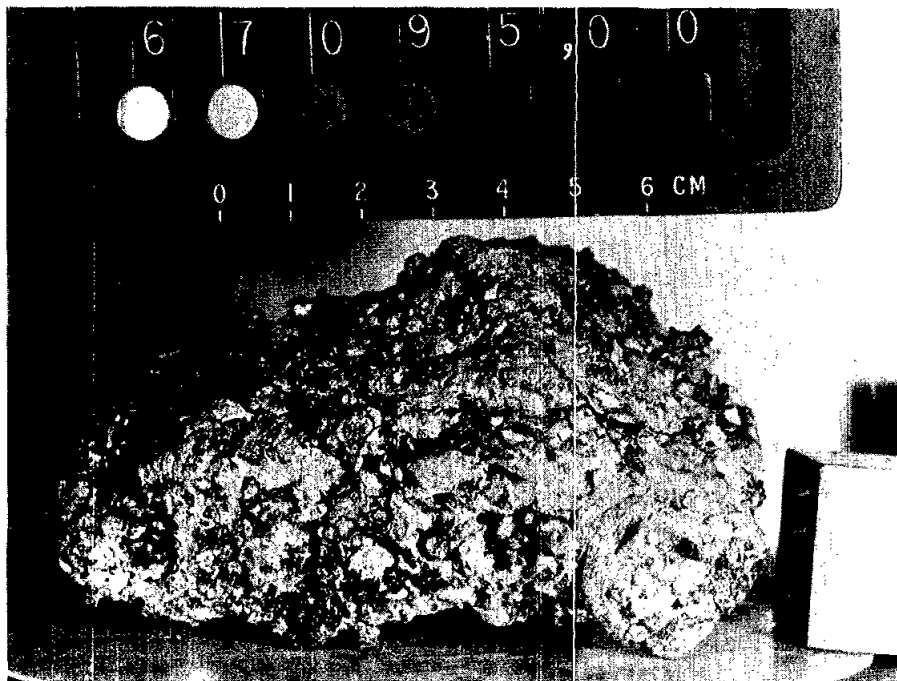
CAVITIES: Very rough surface but there are no cavities per se.

SPECIAL FEATURES: Fractures in two orthogonal sets; glass coating is thick (up to 3 mm), has a conchoidal fracture, vitreous luster, and very few vesicles and inclusions; no metal spherules.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	med gray	89			<0.05	
Plag clast	white	3	equant	0.2	0.1 - 1	
Norite clasts	white	8	equant		3 - 15	1

NOTES:

1. Clast constituents are about 1 mm in size.



SAMPLE 67095



67115

ROCK TYPE: Breccia  
 COLOR: Medium light gray (N6)  
 SHAPE: Angular  
 COHERENCE Intergranular: Friable  
 Fracturing: Penetrative, irregular, shattered appearance

WEIGHT: 240 g  
 DIMENSIONS: 5 x 6 x 7 cm

BINOCULAR DESCRIPTION BY: Horz & Stuart-Alexander DATE: 5/19/72

FABRIC: Inequigranular fine breccia.

VARIABILITY: Heterogeneous, based on clasts

SURFACE: S is hackly with 30% smooth glass cover, N is 60% glass covered;  
 T is 80% glass, hackly and irregular; T has a tannish (10 YR) dust coating;  
 generally the whole rock is dusty.

ZAP PITS: Many on S; few on N; none (?) on T. All zap pits are glass-lined  
 and very small (>0.2 mm).

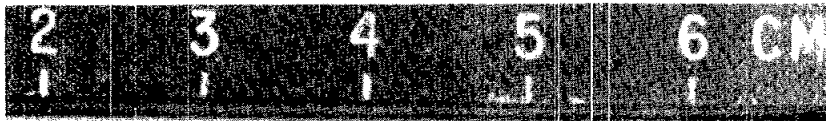
CAVITIES: None

SPECIAL FEATURES: Glass surface is up to 3 mm thick, contains flow structures,  
 and ranges in color from green (where thin) to black (where thick). The glass  
 has white feldspathic inclusions. One prominent, penetrative dense glass vein-  
 let on S is about 30 mm long and 1 mm wide. There is also some glass spatter  
 on surfaces, which has green color and is associated with thick glass coating.  
 Chip 67115,01 was also inspected: There seem to be no significant differences  
 from 67115,0. Chip 67115,02 was not inspected: Megascopically it is identi-  
 cal to 67115,0.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	N6	80		<0.1	aphanit- ic to 1	1
Big dark clast	N3	10	subrd	4	3 -8	2
Small clasts I	N3	3-5	highly ang	<2		3
Small clasts II	5G1	<1	ang & slabby	1		4
Small clasts III	N7	1-2	ang	1	<0.5-4	5
Small clasts IV	N3-N4	<1	subrd	1		6
Small clasts V	brown	tr	ang	<1		7
Clast	pure white	<1	ang	3		8

NOTES:

1. White, aphanitic, <0.1 mm feldspathic material with dark species composing 0-5% of the matrix.
2. Aphanitic
3. Aphanitic
4. Two types of glass, one dark and one lighter gray and more equant.
5. Aphanitic, dull luster
6. Crystalline, lithic; light to dark minerals 50:50 (feldspar:mafic (?) of olivine or pyroxene).
7. Pyroxene?
8. Sugary texture, feldspathic, trace of black opaques.



SAMPLE 67115

67415

ROCK TYPE: Breccia, Anorthosite  
monomict

WEIGHT: 175 g

DIMENSIONS: 20 fragments >1 cm

COLOR: Very light gray (N8)

Largest is 4 x 3 x 3 cm

SHAPE: Rounded

COHERENCE Intergranular: Very friable

Fracturing: Few nonpenetrative

BINOCULAR DESCRIPTION

BY: Lofgren

DATE: 5/25/72

FABRIC: Fine breccia

VARIABILITY: Uniform

SURFACE: Granular, gray dust covered in places

ZAP PITS: None

CAVITIES: Clast molds

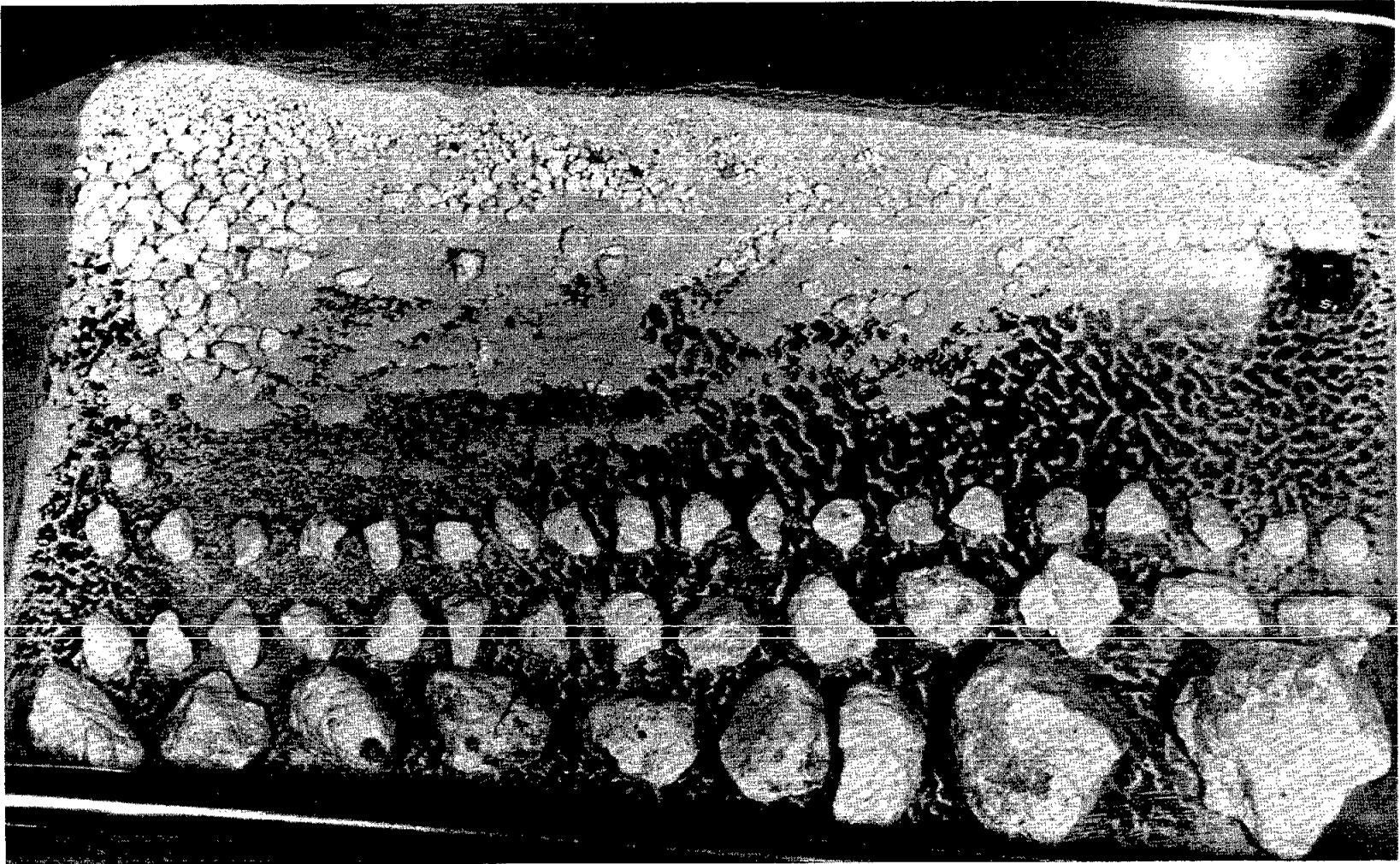
SPECIAL FEATURES: Rock is anorthosite cataclasite.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	N8	85		<0.1		i
Pyroxene	5GY 7/2	5	anhedral, ang	0.1	0.05-0.5	
Plagioclase	trans- parent	8	anhedral, ang	1	0.5 -2	
Anorthosite fragments	N8-N9	4	subang	7		
Opagues	black	tr	anhedral	<0.1		
Red spinel	rose	tr	anhedral		0.1 -0.5	

NOTES:

1. Finely ground plagioclase and pyroxene.

300



SAMPLE 67415

67435

ROCK TYPE: Breccia  
COLOR: Medium gray (N4)  
SHAPE: Subrounded, blocky, slightly slabby  
COHERENCE Intergranular: Coherent  
Fracturing: Some penetrative fractures

WEIGHT: 353 g  
DIMENSIONS: 9.5 x 8 x 5 cm

BINOCULAR DESCRIPTION BY: Stuart-Alexander & Wilshire DATE: 5/22/72

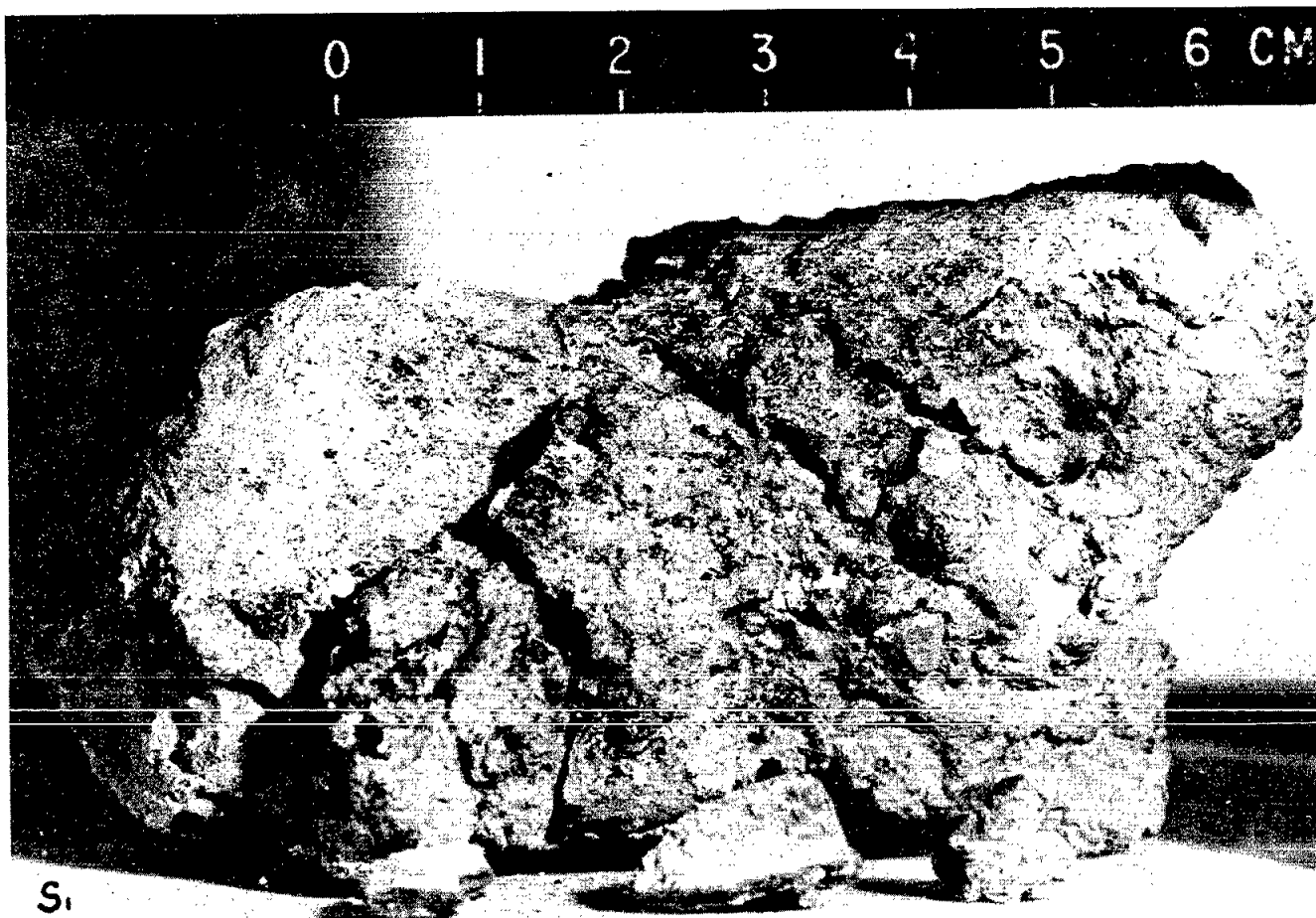
FABRIC: Breccia  
VARIABILITY: Fifty percent of rock is glass-coated.  
SURFACE: Hackly to very irregular; very dusty  
ZAP PITS: Few on T, B, S and W; none on N, E.  
CAVITIES: Glass coating has 5% of 5-10 mm vesicles. Locally abundance is up to 10%.  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	green to black	25				1
Matrix	med dk gray (N3)	65		<0.1		2
Lithic	white	10	ang to subrd	2	<1.8	3
Metal	silver	tr	spherical	0.1		4

NOTES:

1. Coating on surface. Generally black but green on thin edge. Contains small white fragments.
2. Very finely crystalline with tiny feldspar laths (?). Irregular vugs or vesicles are present.
3. Most are chalky white with black specks (opaques?). Some have resolvable broken grains of plagioclase up to 1 mm. Largest clast is 5% deep red spinel (?) to 1 mm; 65% plagioclase, partly sugary; 15% gray mineral ferromagnesian sillicate (?); 15% translucent mineral with a pale green color which may be pyroxene or plagioclase with green pyroxene inclusions.
4. The only one seen projects from E.

302



SAMPLE 67435

67435

THIN SECTION DESCRIPTION

BY: Stuart-Alexander

DATE: 6/25/72

SECTION: 67435,17; ,15 and ,14

SUMMARY: (All are from surface glass chip with part of the underlying white clast with red grains.) A finely recrystallized breccia, shock melted along at least one edge. This glass, partly devitrified, appears to grade into the breccia in 67435,17.

## MATRIX, 50% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Section 17 Glass				Section 17 consists of 75% partly devitrified, glass in spherules.
Section 15 Mafic pyrox	65	irreg, poik	0.2	Section 15 has recrystallized matrix. Randomly oriented plagioclase within poikilitic mafic.
Plag	35	laths	0.05	
Opaque Glass(?)	2-3 <1	intersertal		
Mafic	10?	irreg granules	0.02	

## MINERAL CLASTS, 25% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	>70	ang to subrd	1.1	Plagioclase is most have thin reaction rims with glass.
Oliv	<30	ang	2 - 0.15x0.25	
Spinel	tr	ang		

## LITHIC CLASTS, 25% OF ROCK

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
I		subrd	1.8	Angular to subrounded plagioclase clasts in a very fine-grained mosaic of plagioclase with 25-30 tiny mafic granules (which are mainly olivine).
II		one clast in section 14	0.8	Section consists primarily of a unique clast in this rock. Large (<2.5 mm) poikilitic plagioclase hosting olivine (1 mm) and spinel (0.5 mm). Spinel is unevenly distributed. Clast is granulated at the edges.

67435 (Continued)

THIN SECTION DESCRIPTION

BY: Stuart-Alexander

DATE: 6/25/72

SECTION: 67435,17; ,15 and ,14 (Continued)

ADDITIONAL COMMENTS:

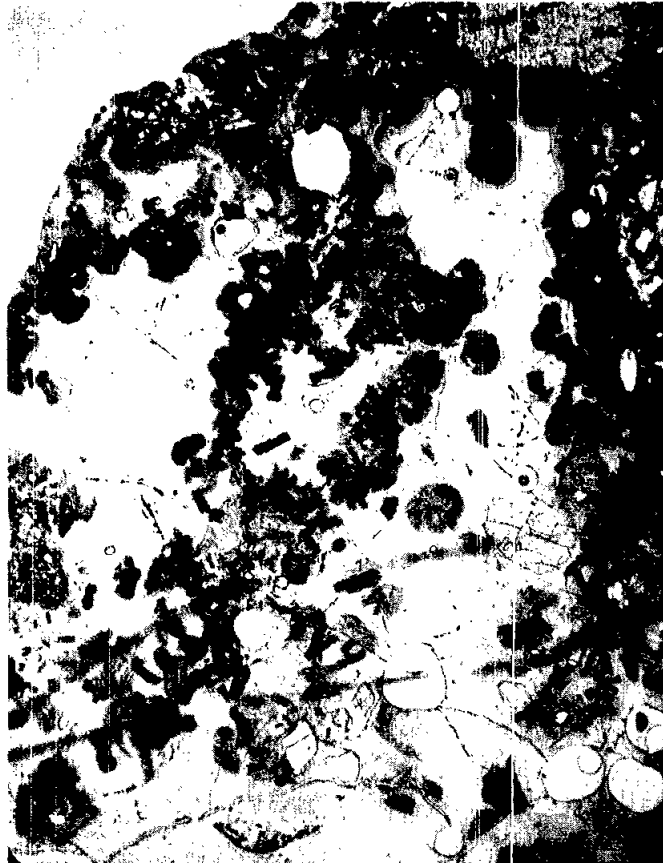
Section 17 is mainly glass.

Section 15 is no glass, but recrystallized groundmass.

Section 14 is primarily one clast with minor matrix like that in section 15.

Clast is poikilitic plagioclase hosting equant grains of olivine and spinel.  
Sizes shown are maximum sizes.

NOTE: Other lithic clasts are <1% of the rock.



SAMPLE 67435,17

WIDTH OF FIELD  $\approx$  4 MM



67435

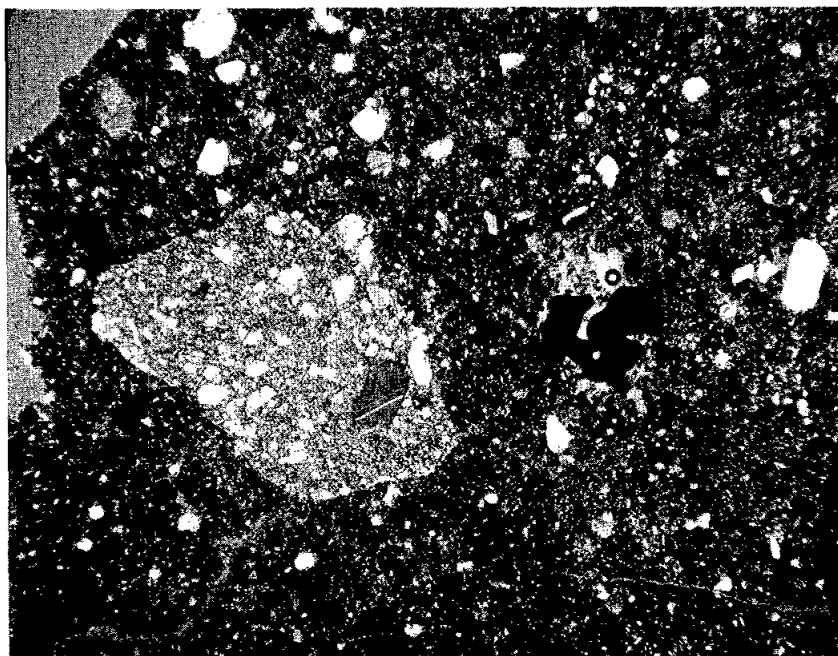
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/26/72

SECTION: 67435,14

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilm	<0.2	irreg	0.01 av	Ilmenite occurs in flames, irregular laths, and blebs.
Fe-Ni	<0.2	subrd, ragged	to 0.3	In clast with red grains (spinel or garnet), the only opaque mineral is Fe-Ni to about 40 $\mu$ rounded grains at grain boundaries of silicates. Also occur as narrow veins to about 40 $\mu$ long. There is no other opaque phase in the matrix; opaque abundance is heterogeneous.
FeS	tr	subrd, ragged	to 0.02	
X	tr	ragged and brecciated	0.01	Phase X has low reflectivity, is battle-ship gray, red internal reflection, red brown semi-translucent in transmitted light, apparently isotropic.



SAMPLE 67435,15

WIDTH OF FIELD  $\approx$  4 MM

67455

ROCK TYPE: Breccia  
COLOR: White (N9) to greyish white (N9-N8)  
SHAPE: Blocky, subrounded, broken  
COHERENCE Intergranular: Very friable  
Fracturing: Nonpenetrative

WEIGHT: 942 g  
DIMENSIONS: Many frag-  
ments. The largest is  
7 x 5 x 5 cm.

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 5/23/72

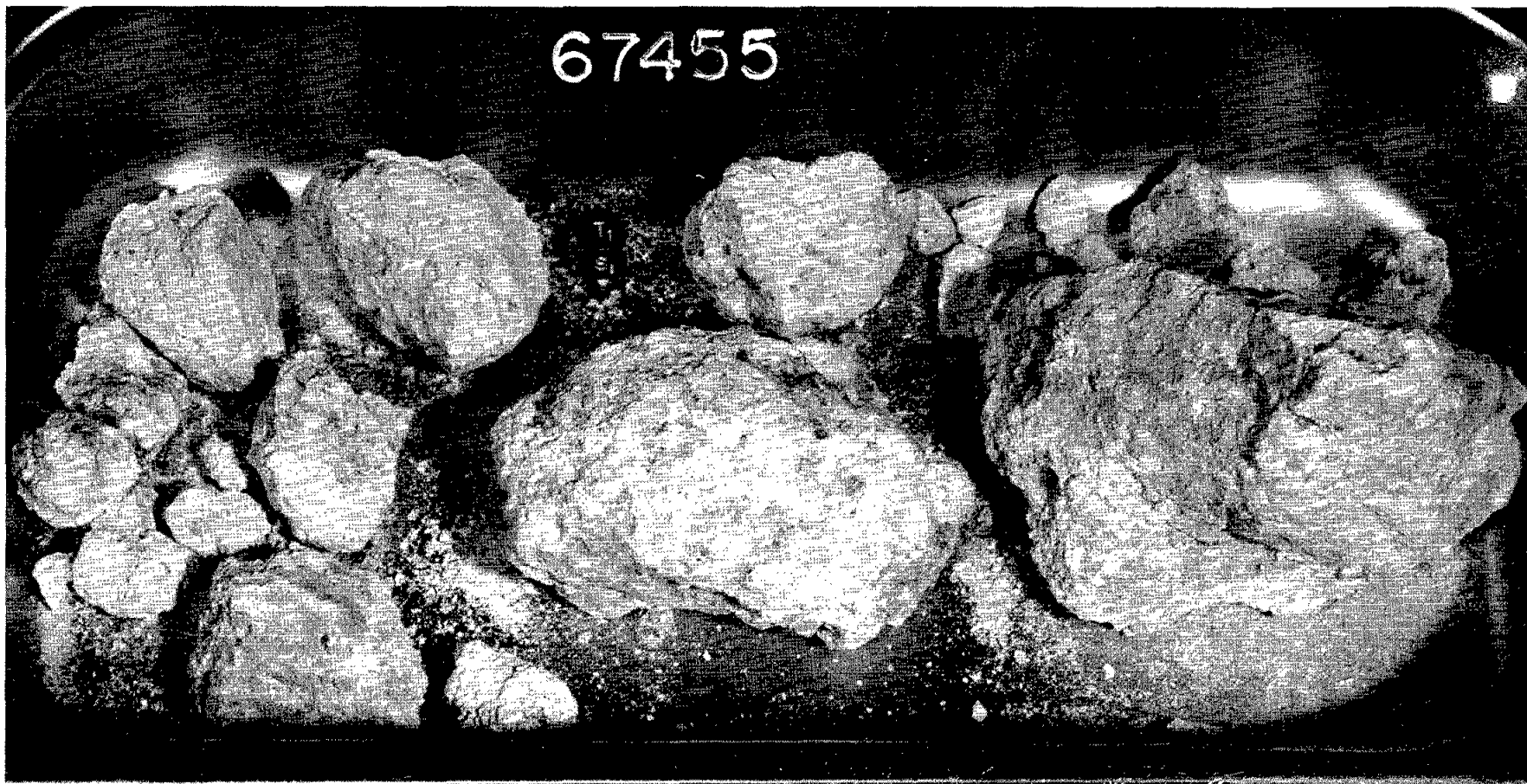
FABRIC: Breccia  
VARIABILITY: None  
SURFACE: Coated by very fine powder so true surface covered; rough, ir-  
regular, many clast molds.  
ZAP PITS: None  
CAVITIES: None  
SPECIAL FEATURES: The black gray clasts are common as smaller particles  
in matrix and only rarely occur as large clasts.

<u>COMPONENT</u>	<u>COLOR</u>	<u>ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Clast I	chalky white	40	blocky	5	2-10	1
Clast II	black grey	10	subrded blocky	1-2	to 10	2
Matrix	gray white	50	seriate	1		3

NOTES:

1. Composed of crushed feldspar plus a grayish white component that could be a pyroxene 90:10 to 80:20 feldspar; pyroxene(?). One clast of this type has a trace of dull red spinel(?). Occasional clasts are a little darker gray.
2. Subvitreous glassy or crypto-crystalline, one such clast seen of 1 cm size but abundant as 1-2 mm particles.
3. The matrix appears to have a higher percentage black gray particles and clasts than occurs as 1-2 mm and larger clasts. These appear as dark grey rounded to subrounded particles. The matrix in general is a mixture of this component plus crushed feldspar in varying proportions from place to place. The matrix appears to net-vein around the ground white clasts. Rock may have been shattered following incorporation of white clasts in grey matrix. The matrix is difficult to distinguish because of the view of the rock.

67455



SAMPLE 67455

67475

ROCK TYPE: Breccia, monomict

COLOR: Gray (N5-N4)

SHAPE: Blocky

COHERENCE Intergranular; Tough

Fracturing: Several non-penetrative, one sub-parallel set.

WEIGHT: 175 g

DIMENSIONS: 6 x 6 x 4.5 cm

BINOCULAR DESCRIPTION

BY: Agrell & Stuart-Alexander DATE: 5/23/72

FABRIC: Fine breccia

VARIABILITY: Thin white skin on some surfaces.

SURFACE: Fresh surface is microgranular, outer surface is rough, fracture coatings have white skin.

ZAP PITS: None on N, E, B, W; few on T, S.

CAVITIES: About 1% lensoid cavities.

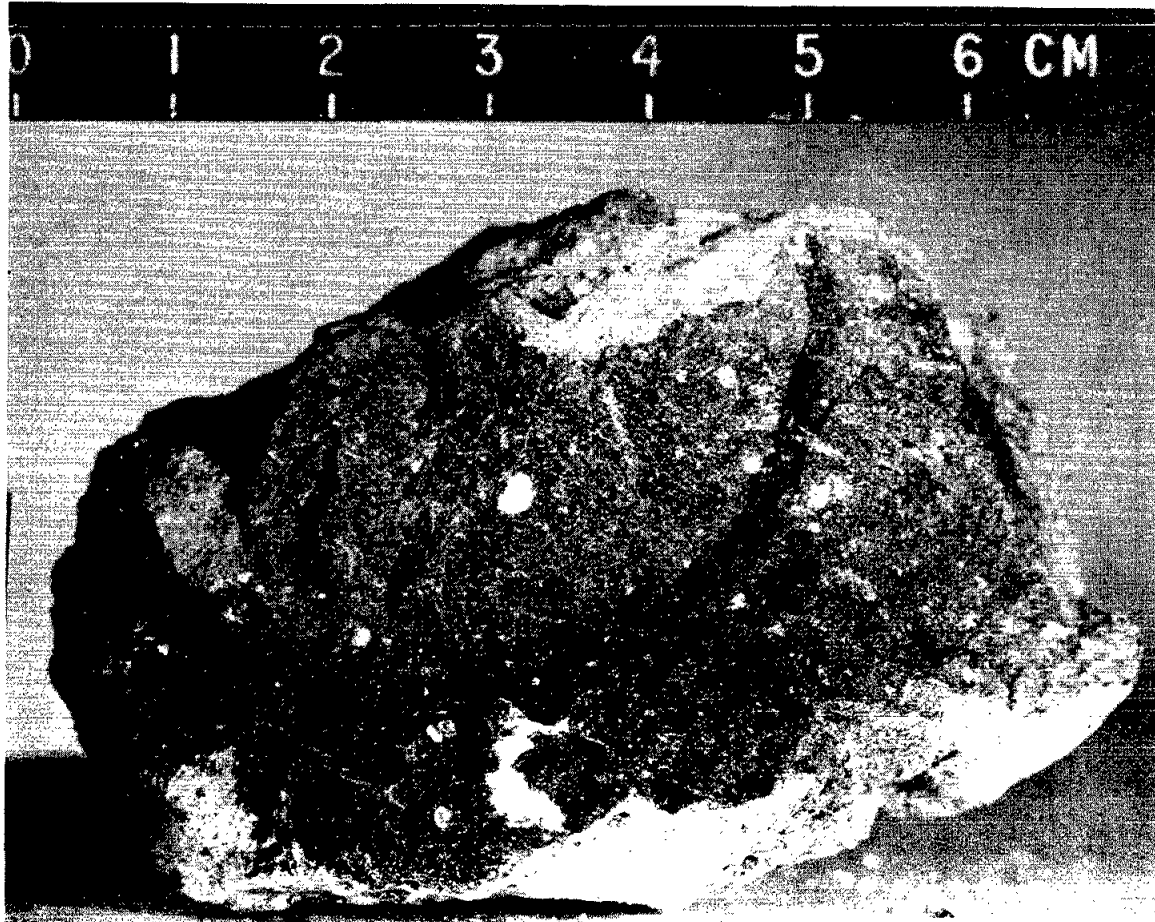
SPECIAL FEATURES: SW corner of N face has a small area of fine white matrix breccia that invades the main body of rock. The bulk of the rock is essentially a highly crushed uniform crystalline rock.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Clasts	N4-N5	80	ang, subang	2	0.3-3	1
Matrix	N4	20			0.1	2
Fracture coating	white	<0.1				3
Clast I	gray	one	subrnd	5		4
Clast II	white	one		7		5
Bronzy		<0.1				6
Opaque		tr				

NOTES:

1. Microcrystalline with 1% chalky clasts, 1% plagioclase (0.1 mm) and 1% other clasts.
2. Vague impression of flow round fragments.
3. Thin white coating on latest fractures.
4. Flow banded sub-parallel plagioclase laths in dull microcrystalline matrix.
5. Irregular shape white sugary clast composed of 85% plagioclase, and 15% gray mafic silicate mineral.
6. Sulphide (?).

309



SAMPLE 67475

67485

ROCK TYPE: Aphanitic crystalline  
COLOR: Medium gray (N5)  
SHAPE: Angular, tubular  
COHERENCE Intergranular: Tough  
Fracturing: Nonpenetrative

WEIGHT: 6.6 g  
DIMENSIONS: 3 x 1.5 x 1 cm

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 6/16/72

FABRIC: Isotropic  
VARIABILITY: None  
SURFACE: None  
ZAP PITS: None  
CAVITIES: Scarce vugs  
SPECIAL FEATURES: The rock is microcrystalline and sugary, with a few areas consisting of powdery, milky-white material.

67486

ROCK TYPE: Glass  
COLOR: Medium dark gray (N4)  
SHAPE: Irregular  
COHERENCE Intergranular: None  
Fracturing: None

WEIGHT: 5.8 g  
DIMENSIONS: 2.5 x 2 x 1.5 cm

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 6/16/72

FABRIC: Glassy  
VARIABILITY: None  
SURFACE: None  
ZAP PITS: None  
CAVITIES: Vesicles  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	dark gray					1
Lithic	white				4x5	2

NOTES:

1. Devitrified around vesicles.
2. One powdery white lithic inclusion.



67487

ROCK TYPE: Aphanitic crystalline  
COLOR: Medium dark gray (N4)  
SHAPE: Blocky angular  
COHERENCE Intergranular: Tough  
Fracturing: Nonpenetrative

WEIGHT: 2.7 g  
DIMENSIONS:

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 6/16/72

FABRIC: Isotropic  
VARIABILITY: None  
SURFACE: None  
ZAP PITS: None  
CAVITIES: Rare vugs  
SPECIAL FEATURES: Microcrystalline rock

67488

ROCK TYPE: Aphanitic crystalline  
COLOR: Olive gray (5Y6/1)  
SHAPE: Angular, somewhat tubular  
COHERENCE Intergranular: Tough  
Fracturing: None

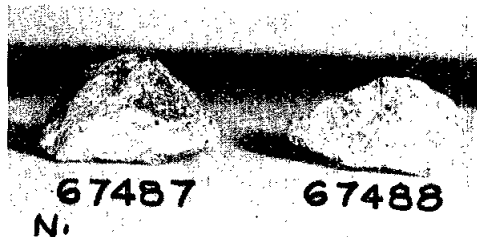
WEIGHT: 2.3 g  
DIMENSIONS: 2 x 1.5 x 1 cm

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 6/16/72

FABRIC: isotropic  
ZAP PITS: Present on one side only  
CAVITIES: None  
SPECIAL FEATURES: Very dusty; but has very fine sugary texture with a few small cleavage flashes. Possible white coating is beneath dust.



67489

ROCK TYPE: Aphanitic crystalline

WEIGHT: 2.1 g

COLOR: Dark gray (N4)

DIMENSIONS: 1.5 x 1.5 x 1 cm

SHAPE: Blocky, subangular

COHERENCE Intergranular: Tough

Fracturing: Nonpenetrative

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 6/16/72

FABRIC: Isotropic

VARIABILITY: None

SURFACE: None

ZAP PITS: Some present

CAVITIES: Vugs

SPECIAL FEATURES: Rock is mainly aphanitic with 0.025-0.050 mm cleavage flashes and scarce pale yellow mineral grains. Plagioclase is up to 0.3 mm.

67495

ROCK TYPE: Breccia

WEIGHT: 1.3 g

COLOR: Gray (N8)

DIMENSIONS: 1 cm diameter

SHAPE: Round

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 6/16/72

Dusty but apparently this is an aphanitic clast in gray matrix breccia.





67515-19; 67525-29; 67535-39; 67545-49; 67555-59; 67565-69; 67575,76

DESCRIPTION: Rake Sample BY: Warner DATE: June 16, 1972

67515-19, 67525-29, 67535-39, 67545-48

#### WHITE, GRANULATED, ANORTHOSITIC ROCKS

Rounded to subrounded, friable, white, sugary, plagioclase-rich rocks which contain millimeter-sized gray aphanitic to black glassy areas (clasts?). There are a few honey-brown pyroxene grains up to millimeter size and some areas (several millimeters across) that are speckled with black dots <0.1 mm in diameter. White plagioclase grains occur in the more sugary matrix. Some specimens have zap pits with colorless, bumpy glass linings.

67549; 67555, 56

#### HETEROGENEOUS, GRAY AND WHITE BRECCIA

Subrounded, moderately friable, gray and white breccia. Gray areas are aphanitic to glassy and appear both as clasts a few centimeters across and as veins in the white material which is similar to rocks 67515-48. Proportions of white and gray are variable. Although in 67549 and 55 the gray appears to be clasts, in 67556 the gray appears to intrude the white.

67557, 58

#### LIGHT GRAY, MODERATELY FRIABLE, CLASTIC BRECCIA

Subrounded, moderately friable, light gray to medium light gray, clastic-matrix breccia with many types of clasts including white, granular anorthosite and gray material. In 67557 there is a clast of 67558. Clast size ranges up to several millimeters.

67559; 67565, 66

#### GRAY, TOUGH, CRYSTALLINE ROCKS

Variable group of subangular, tough, light gray, crystalline rocks composed mostly of plagioclase. 67559 contains over 70% plagioclase as laths up to 2 x 10 mm and about 30% yellow-green pyroxene about 1 mm in an interlocking texture. 67565 has a vuggy sugary texture containing some pyroxene crystals a few as brown prisms up to 2 x 4 mm. 67566 has a sugary texture with 0.5 mm grain size and a few large (2 - 6 mm) plagioclase crystals with irregular borders.

67567-69; 67575, 76

#### DARK GRAY, VESICULAR GLASS

Dark gray, vesicular glass with white clasts. 67576 has higher content of clasts than others and appears somewhat devitrified.



RAKE SAMPLE 67515-19, 25-29, 35-39, &amp; 45-48



RAKE SAMPLE 67549, 55-59, 65-69, 75 & 76

67510 TRAY 2

67605

ROCK TYPE: Breccia, white matrix  
COLOR: Very light gray (N8)  
SHAPE: Rounded triangular prism  
COHERENCE Intergranular: Moderate  
Fracturing: One crack seen

WEIGHT: 44.5 g  
DIMENSIONS: 3.5 x 3 x 3 cm

BINOCULAR DESCRIPTION

BY: Williams

DATE: 6/23/72

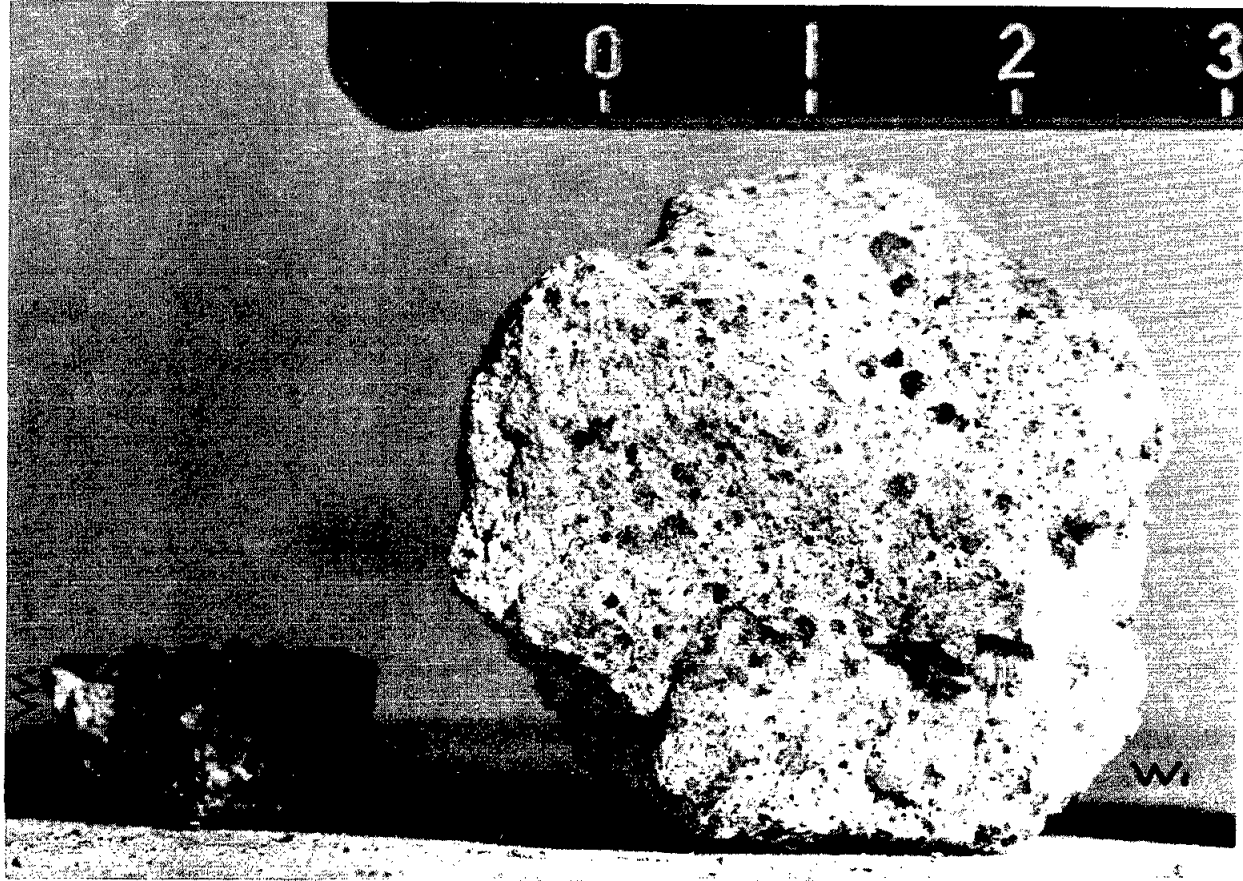
FABRIC: Breccia  
VARIABILITY: Homogeneous  
SURFACE: All are rounded and smooth except for zaps and clast molds.  
ZAP PITS: All have few to many. They are lined with greenish to brownish glass.  
CAVITIES: Only one 1.5 mm possible vesicle or very deep zap.  
SPECIAL FEATURES: Clasts grade in size down into matrix.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	very light gray (N8)	40		<0.1		1
Clast I	medium light gray (N3)	5	ang		1-10	2
Clast II	medium dark gray (N4)	20	rnd-subrnd	1	0.1-3	3
Plagioclase	white (N9)	35	rnd-subrnd	0.5	0.1-3	4
Mafic silicate	yellow-green	<1	rnd	0.2		5
Glass	greenish-brownish	<1				6

NOTES:

1. Chalky white material.
2. Aphanitic gray shows parting.
3. Aphanitic
4. Cleavage and parting observed.
5. Possibly olivine or pyroxene.
6. Associated with zaps or eroded zaps.

317



SAMPLE 67605

67615-19; 67625-29; 67635-39; 67645-49; 67655-59; 67665-69; 67675, 76

DESCRIPTION: Rake Sample BY: Morrison & Phinney DATE: June 15, 1972

67615-19, 67625, 67668, 67676

#### GRAY, TOUGH, FINE-GRAINED, CRYSTALLINE ROCKS

Angular, tough, very light-gray to gray, fine-grained, crystalline, plagioclase-rich rocks. Texture is generally annealed with grains about 0.2 mm but containing a few grains up to 1mm. 67617 contains some areas which are granulated to produce a white to milky matrix in which there are angular, vitreous, gray clasts which are derived from the host rock. 67618 has some glass veins. 67619 and 25 have partial coatings of white matrix breccia as in 67638 through 59. 67668 consists primarily of a mottling of irregularly-shaped gray spots about 1 to 3 mm across in a crushed white matrix containing perhaps 20% very pale brown to yellow mafic silicate. It is coherent but somewhat fractured.

67626-29, 67675

#### GRAY, VESICULAR GLASS

Irregularly-shaped, gray, vesicular glass containing plagioclase-rich fragments. 67629 shows some devitrification of glass. 67675 is a strip of taffy-like glass.

67635-37

#### WHITE, GRANULATED, ANORTHOSITIC ROCKS

Angular to subrounded, moderately coherent, white, granular, anorthositic rocks. A small amount of finely crushed yellow mafic silicate occurs in 67635. A gash-vein structure in 67636 is filled with a mafic mineral. 67637 has 1 mm angular plagioclase grains in a crushed matrix of white material which is probably plagioclase

67638,39; 67645-49; 67655-59; 67665,66,69

#### WHITE, MODERATELY FRIABLE TO FRIABLE, CLASTIC-MATRIX BRECCIAS

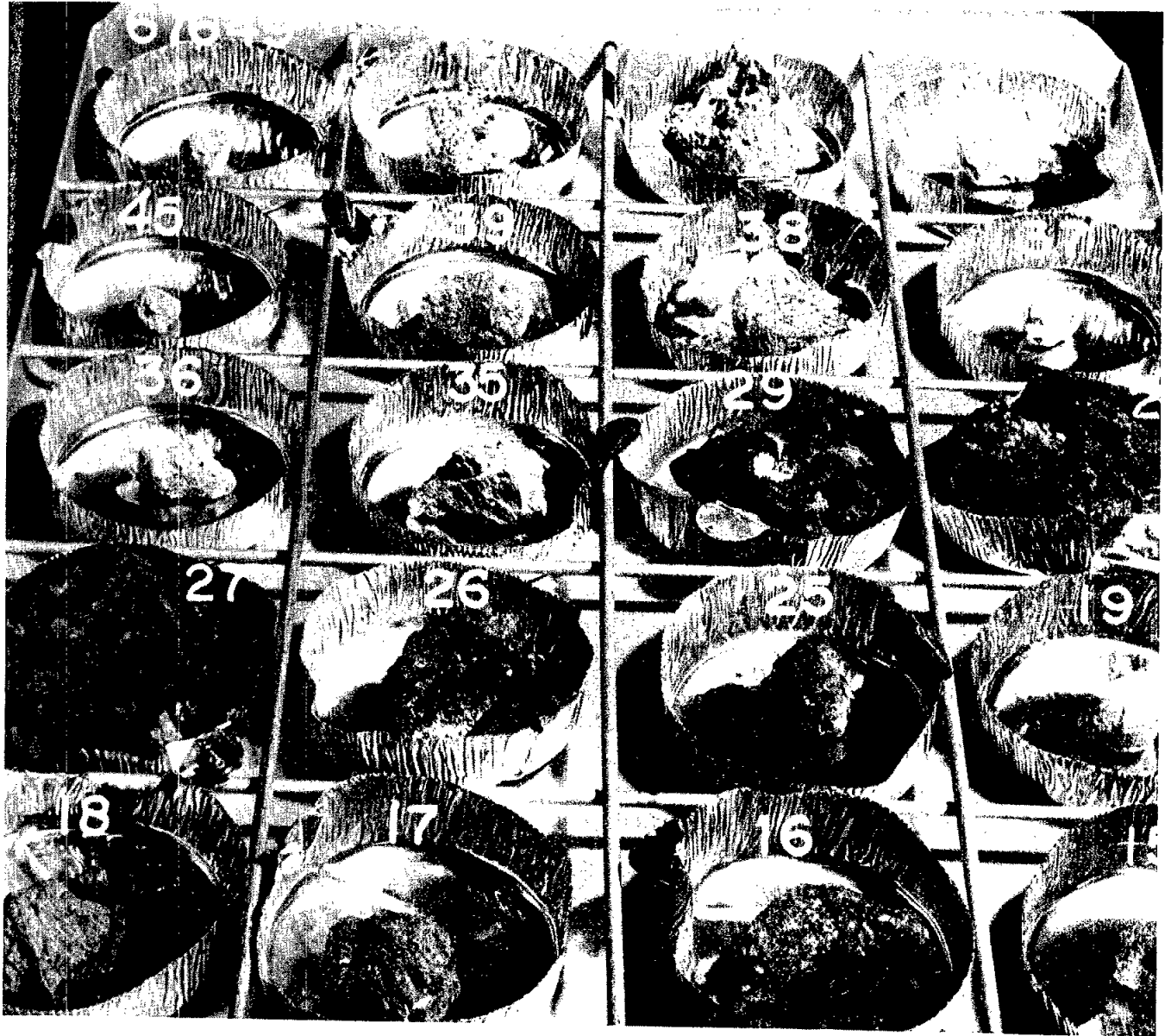
Rounded to subrounded, moderately friable, white to very light gray, clastic-matrix breccias with 20 to 30% tabular, rounded clasts of the 67615-25 type up to 5 mm across. White matrix consists of crushed plagioclase plus rare pyroxene fragments. 67647 contains a clast of breccia with a pale gray-brown matrix. 67659 contains a matrix which is slightly more gray than the remainder of the group. 67669 contains a large (10 x 10 x 3 mm) silicate (mostly brown pyroxene) and <1% opaques. The basalt clast contains a glass vein that terminates at the edge of the clast. 67665 is darker gray and more friable than the remainder of this group and contains a clast of the whiter breccia. 67666 contains clasts which resemble 67635-37.



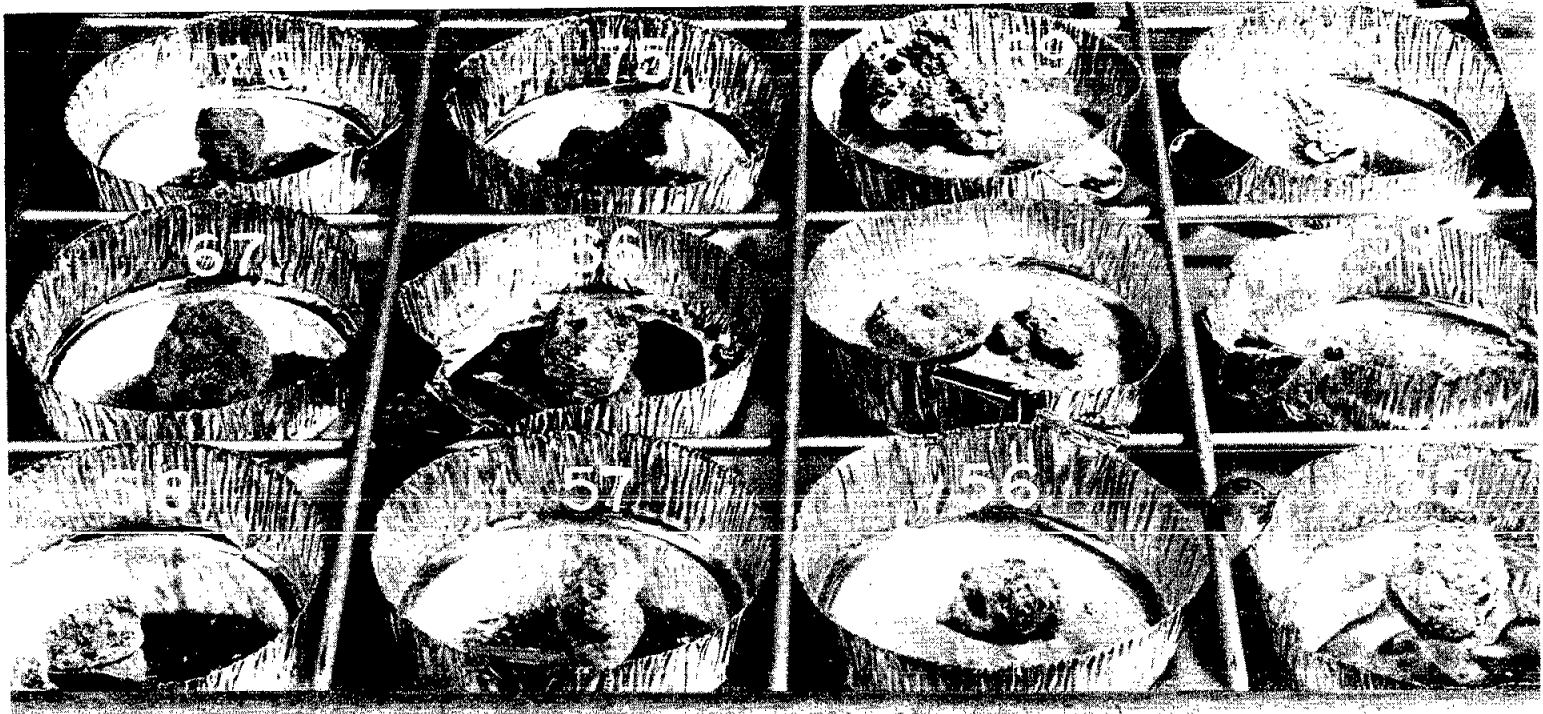
67667

CRUSHED ULTRAMAFIC ROCK

Angular, blocky, granulated, igneous(?) rock containing about 15% plagioclase, 2% opaques, and the remainder of mafic silicates. This rock resembles 64815.



RAKE SAMPLE 67615-19,25-29,35-39,45-49



RAKE SAMPLE 67655-59,65-69,75 & 76



67715-19; 67725-29; 67735-39; 67745-49; 67755-59; 67765-69; 67775,76

DESCRIPTION: Rake Sample BY: Wilshire & Morrison DATE: June 16, 1972

67715-19; 67725,26

#### HETEROGENEOUS, GRAY AND WHITE BRECCIA

Medium gray to dark gray, fine-grained, aphanitic matrix containing a few percent white, crushed, plagioclase clasts up to 7 mm but generally about 1 to 2 mm. All have adhering coat of friable white breccia.

67727-29

#### VESICULAR GLASS

Gray, vesicular glass, in part devitrified, with inclusions of blocky white fragments up to 6 mm across some of which contain 15 to 20% mafic silicates.

67735-39; 67745-48

#### GRAY, TOUGH, FINE-GRAINED, CRYSTALLINE ROCKS

Medium gray to dark gray, tough, aphanitic to fine-grained (1 mm) crystalline rocks. All are probably recrystallized clastic rocks. 67736 contains a few cavities up to 3 mm, a trace of yellow-green minerals and red spinel. 67746 and 47 have sugary texture with about 50% yellow-green mafic silicate 0.5 to 1.5 mm, 20 to 50% plagioclase up to 1.0 mm, up to 30% gray and brown minerals, and 1% opaque. 67748 contains gray sugary clasts in a slightly lighter gray very fine-grained matrix. Some clasts are net veined by matrix material.

67749; 67755-59; 67765-69; 67775,76

#### WHITE, MODERATELY FRIABLE, CLASTIC-MATRIX BRECCIAS

White to very light gray moderately friable to friable, clastic-matrix breccia with light gray to medium gray, aphanitic to sugary, fine-grained clasts ranging in size from <1 mm up to 2 cm. Plagioclase also occurs as clasts. From 10 to 40% of rock is clasts.



RAKE SAMPLE 67715-19,25-29,35-39,45-48



RAKE SAMPLE 67749,55-59,65-69,75 & 76

67915

ROCK TYPE: Breccia  
 COLOR: Matrix, medium gray (N4-N5)  
 Clasts, very light gray (N7-N8)  
 SHAPE: Blocky, subangular, broken  
 COHERENCE Intergranular: Tough  
 Fracturing: Well developed penetrative fractures which are 1 mm to several mm apart and parallel to broken surface.

WEIGHT: 255 g  
 DIMENSIONS: 21 x 16 x 9 cm

BINOCULAR DESCRIPTION

BY: Head & Wilshire

DATE: 5/15/72

FABRIC: None  
 VARIABILITY: None  
 SURFACE: Hackly on B (freshly broken surface)  
 ZAP PITS: Many on N, E, T; few on S, W(?); none on B  
 CAVITIES: None  
 SPECIAL FEATURES: The rock is a shattered breccia, the youngest event being represented by net veins of glass that cross both clasts and matrix.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	lt med gray on thin edge	5				1
Lithic I	lt gray	45				2
Lithic II	white to v lt gray	40	blocky to subang	3	1-170	3
Lithic III	med lt gray	1	subrd		22	4
Lithic IV	white	tr	subang to blocky	1		5
Maf sil	pale bottle green, pale brownish green, pale yellow		subang to blocky	0.5-1		6
Metallic	silvery	tr	subang to blocky			7

NOTES:

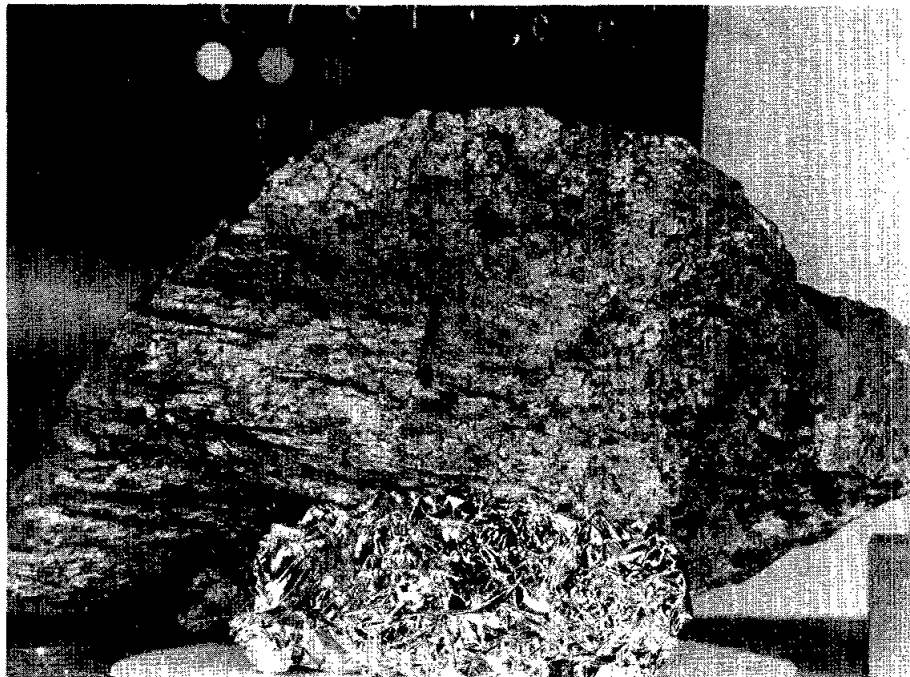
1. Forms net veins 0.2-0.4 mm thick and spaced 1-2 cm. These veins cross both large clasts and matrix.
2. This is the old matrix of the breccia. It forms clasts (<1 mm to 1 cm across) in the glass. Between widely spaced glass net veins, it is a normal aphanitic to very finely crystalline matrix containing angular fragments of plagioclase and perhaps light colored lithic fragments up to 1 mm. Veins of this matrix also penetrate some clasts as veins.
3. White fragments that are 1 cm and smaller are seriate. Sugary cataclastites are very fine grained, with larger pale gray and colorless angular pieces of plagioclase (?). Ten percent of fragments have pale yellow mineral which

## 67915 (Continued)

### NOTES:

appears to be fragmented olivine. Large clasts are very fine grained sugary, with relict pieces of light gray plagioclase (?) up to 2 mm. Clasts also have pale yellow mineral, which in larger fragments is darker in color; trace of medium gray mineral and opaques; light yellow mineral is more yellow than green; forms patches to 2 mm across (2-10%) and varies from place to place (percentage may be higher because lighter when finer grained). In places, net veins of glass within white clast are very closely spaced forming a jig-saw breccia. Trace of pale bottle green mineral (orthopyroxene?).

4. A single breccia fragment that is a little lighter gray than old matrix. It is aphanitic and contains light colored sugary lithic clasts 4 mm across with small percentage of pale yellow mineral. It also contains some plagioclase fragments.
5. Sugary fragments 5-7% black opaque mineral, 10% pale pink mineral.
6. Sugary fragments, probably pyroxene (green) and olivine (yellow).
7. Associated with glass.



SAMPLE 67915

67935

ROCK TYPE: Breccia  
COLOR: Grayish white (5B7/1)  
SHAPE: Angular, slabby  
COHERENCE Intergranular: Coherent  
Fracturing: Penetrative (shattered). One set consists of four fractures.

WEIGHT: 109 g  
DIMENSIONS: 4.5 x 6.5 x 2 cm

BINOCULAR DESCRIPTION

BY: Morrison & Horz

DATE: 5/19/72

FABRIC: Granular cataclastic  
VARIABILITY: Homogeneous  
SURFACE: B and T are uneven  
ZAP PITS: Many on B, none on others  
CAVITIES: None

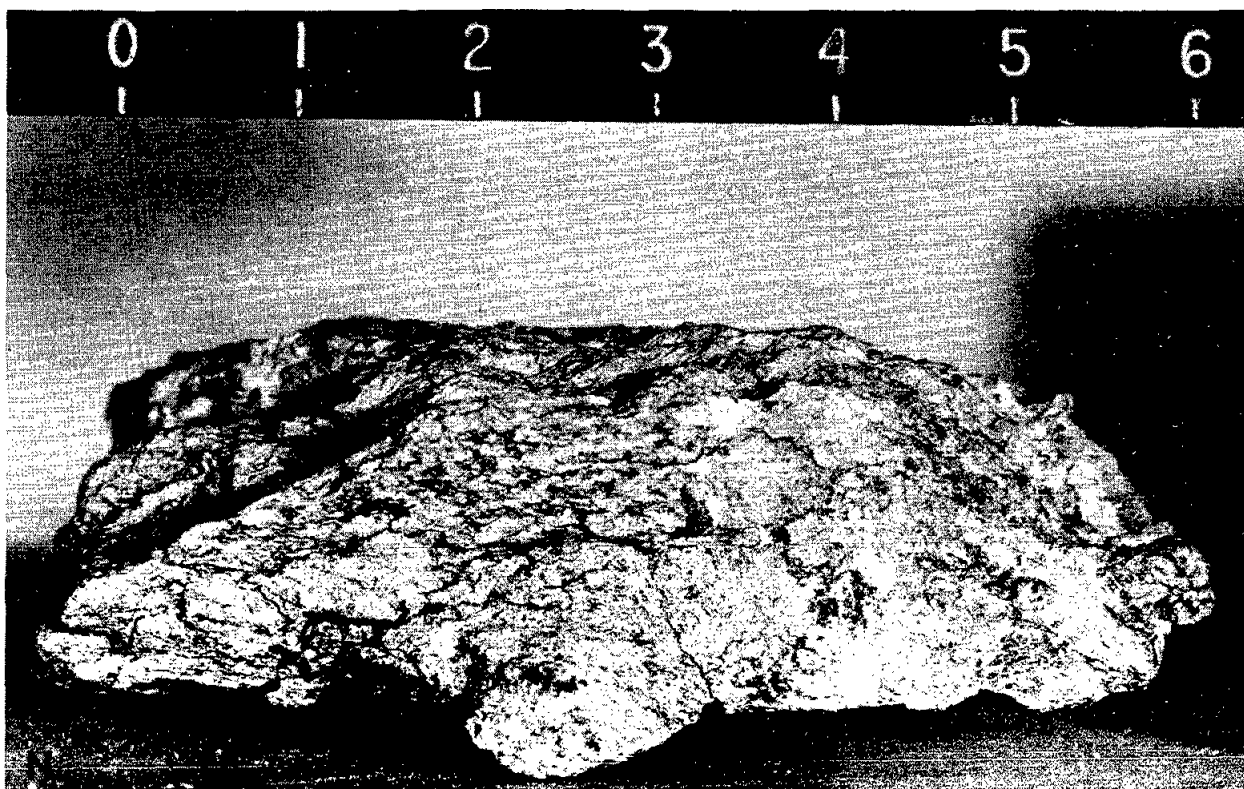
SPECIAL FEATURES: This is a cataclastically deformed crystalline rock. The recrystallized matrix is webbed by a multitude of dark and dense glass veinlets, <1 mm thick, which postdate the metamorphic phase of this breccia. The metal is not associated with the glass veinlets.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	5B	>90		1		1
Clasts I	milky white	>5	irreg to rectang	3	<1-5	2
Clasts II	milky white	>5	irreg to rectang	3	1-5	3
Metal	black	tr	rd to subrd	1	1-2	4
Mineral	red-pink	tr		0.2		5

**NOTES:**

1. Granular mixture of crushed feldspar and vitreous gray material, (relicts of feldspar?). A gradual transition from white to gray areas exists; occasionally less transition is sharp. The matrix also contains pyroxene (about 5-10%).
2. Granulated, feldspathic with greenish-yellow crystals, orthopyroxene (?)(15%). These are crystalline rocks with superposed cataclasis.
3. Feldspathic inclusions with no orthopyroxene.
4. Metallic inclusions.
5. Spinel (?)

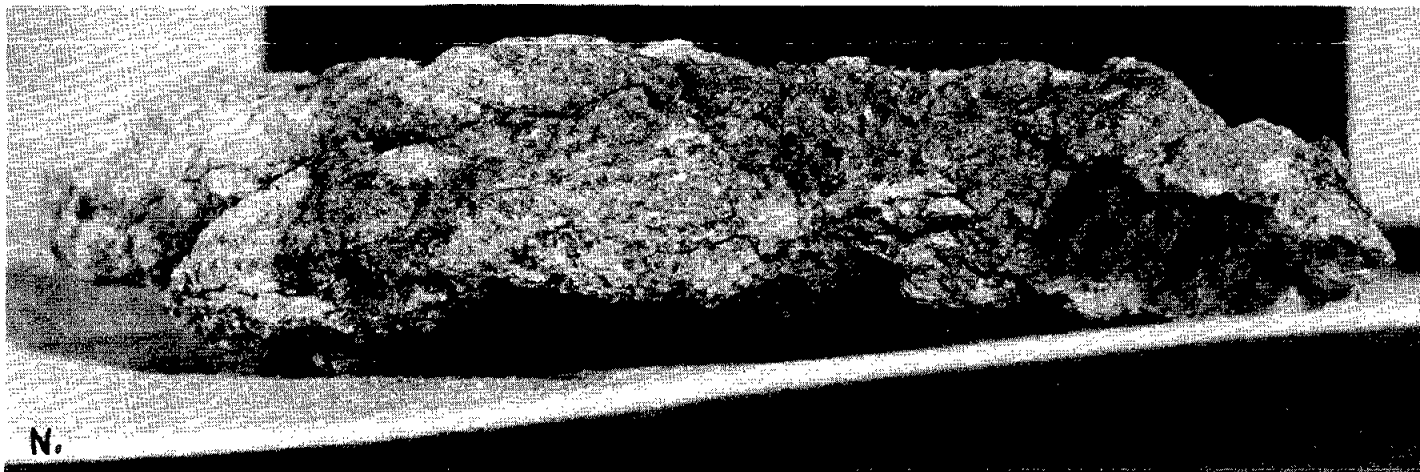
327



SAMPLE 67935







SAMPLE 67936



SAMPLE 67937

67937

ROCK TYPE: Breccia  
 COLOR: Medium gray (N5)  
 SHAPE: Angular, slabby  
 COHERENCE Intergranular: Coherent  
 Fracturing: Two penetrative sets

WEIGHT: 59.7 g  
 DIMENSIONS: 7.5 x 5 x 2 cm

BINOCULAR DESCRIPTION BY: Williams & Horz DATE: 5/22/72

FABRIC: Isotropic  
 VARIABILITY: Heterogeneous  
 SURFACE: All surfaces are hackly  
 ZAP PITS: Few on T; none on others.  
 CAVITIES: None  
 SPECIAL FEATURES: Glass veins (5Y2/1 - 5Y4/1) up to 1 mm wide and 1 cm long are abundant. These cut through matrix and clasts and are thus the youngest feature. Mineral types I to III occur in matrix and clast type I only.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	N5	90		apha- nitic	aphanit- ic to 0.1	1
Clast type I	N4	5	irregular	1 -2	aphanit- ic to 10	2
Clast type II	N8	2	ang	8	5 -10	3
Clast type III	N9	1	ang to subrd	1	0.1- 2	4
Mineral type I	silvery	>1	irregular	0.5	0.1- 1	5
Mineral type II	bronze	1	irregular	0.5	0.1- 1	6
Mineral type III	red	tr	equidimen- sional	0.2	0.1- 0.5	7

NOTES:

1. Two phase mixture of white sugary feldspar and very dark gray, specular material (possible glass). Abundance of the two is about equal but they have a patchy distribution.
2. Similar to matrix, but black and white phase is 70:30 and more shattered.
3. Mostly plagioclase with some dark areas of possible glass.
4. Pure plagioclase, sugary.
5. Silvery-metallic. One metal spherule is inside the rock.
6. Irregular interstitial blobs (probably sulfides).
7. Spinel? One grain is within a metal sphere and two others are in the matrix.

67945

ROCK TYPE: Metaclastic  
COLOR: Medium light gray (N6)  
SHAPE: Subangular, slabby  
COHERENCE Intergranular: Coherent  
Fracturing: Penetrative; breaks fairly easily

WEIGHT: 4.4 g  
DIMENSIONS: 2.5 x 1.5 x 0.5 cm

BINOCULAR DESCRIPTION

BY: Wilshire

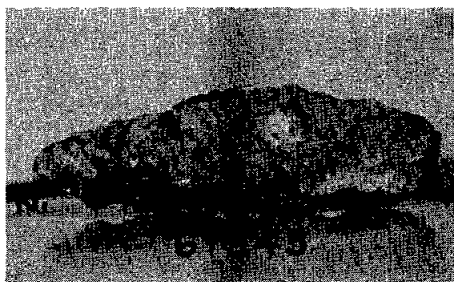
DATE: 5/31/72

FABRIC: None  
VARIABILITY: Remnants of glass selvage  
SURFACE: Hackly  
ZAP PITS: Few on one of the flat faces  
CAVITIES: None  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase (?)	med light gray	5			3-5	1
Matrix	light gray	85				2
Metal	silver	tr	sphere		<0.1	3
Glass	very dark brown	10				4

NOTES:

1. Two grains of translucent gray material visible on partly glass-coated side of rock.
2. Salt and pepper texture, grain size <0.1mm; composed of about equal parts of white plagioclase (?) and light gray and pale brownish pyroxene (?) with 2-3% tiny opaques; trace of red spinel, trace of light green pyroxene (?). Spinel and green pyroxene are angular fragments; trace of yellow metal (?) in the rock.
3. Attached to outer surface of rock.
4. Partly coats one surface.



67946

ROCK TYPE: Breccia  
COLOR: Medium dark gray (N4)  
SHAPE: Angular, blocky  
COHERENCE Intergranular: Tough  
Fracturing: None

WEIGHT: 3.2 g  
DIMENSIONS: 1.6 x 1 x 1 cm

BINOCULAR DESCRIPTION

BY: Wilshire

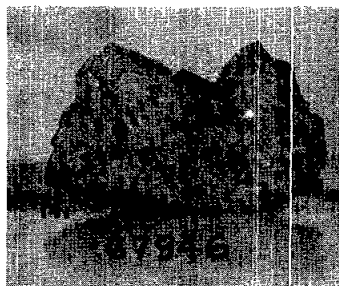
DATE: 5/31/72

FABRIC: Breccia  
VARIABILITY: None  
SURFACE: Hackly  
ZAP PITS: Few on one face  
CAVITIES: Five percent vesicles 1-4 mm (all on one end); felted crystal lining;  
1 x 1 mm flat crystal faces in vesicle wall with crystals projecting.  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic	white	2	subang	2	1	
Matrix	dark med gray	98			2	

NOTES:

1. One very fine-grained clast with tiny opaque specks in salt and pepper texture.
2. Vesicular dark matrix, spherulitic or coarse variolite texture near vesicles and along one large face. Stellate clusters of lath-shaped crystals 1 to 1.5 mm. All have the bluish-gray color of the body of the rock. Texture is aphanitic near the clast.



67947

ROCK TYPE: Breccia  
COLOR: Light gray (N6-N7)  
SHAPE: Angular, slabby  
COHERENCE Intergranular: Coherent  
Fracturing: Many penetrative, breaks easily along them

WEIGHT: 2.4 g  
DIMENSIONS: 2.4 x 1.2 x 0.5 cm

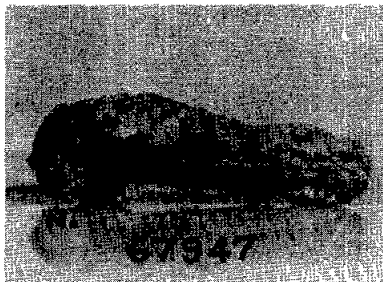
BINOCULAR DESCRIPTION BY: Wilshire & Stuart-Alexander DATE: 5/31/72

FABRIC: Breccia  
VARIABILITY: None  
SURFACE: Hackly  
ZAP PITS: None  
CAVITIES: One percent, very small (<0.1 mm)  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Lithic I	white	5	angular, blocky	<1	1- 3	1
Lithic II	white	80			18	2
Matrix	med dark gray	15				3

NOTES:

1. Very fine grained with a trace of opaque.
2. Fine-grained annealed (?) clastic rock with translucent gray and white plagioclase (?) and brownish-gray pyroxene (?). Irregular grains laced with finely powdered zones. Patches of 1 mm sugary white plagioclase. Trace of silver metal sphere. Relict translucent gray plagioclase up to 2 mm.
3. Aphanitic to vitreous with a small percent of tiny cavities.



67948

ROCK TYPE: Crystalline  
COLOR: Yellowish gray (N7-5Y8/1)  
SHAPE: Angular, blocky  
COHERENCE Intergranular: Tough  
Fracturing: None

WEIGHT: 1.6 g  
DIMENSIONS: 1.6 x 1 x 0.75 cm

BINOCULAR DESCRIPTION

BY: Wilshire & Stuart-Alexander

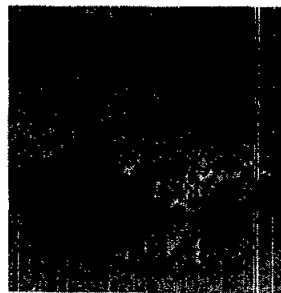
DATE: 5/31/72

FABRIC: Isotropic  
VARIABILITY: Homogeneous  
SURFACE: Hackly  
ZAP PITS: None  
CAVITIES: One irregular cavity  
SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Mafic sil I	honey yellow	30	equant	0.5	0.2-0.5	1
Plagioclase	white to gray	70			<0.5	2
Mafic sil II	med brown	1	equant	<0.1		3
Opaque	black	1	equant	<0.1		4

NOTES:

1. Pyroxene (?), olivine (?), in clusters of crushed material, possibly recrystallized. Appear less crushed on one side of rock than other.
2. Larger grains are translucent gray. Smaller ones are sugary white. Original grain size probably at least 0.5 mm.
3. Pyroxene (?).
4. Forms inclusions in plagioclase and maybe in the yellow mineral.



67955

ROCK TYPE: Breccia  
 COLOR: Dark gray (N8)  
 SHAPE: Subangular  
 COHERENCE Intergranular: Friable  
 Fracturing: Irregular, nonpenetrative

WEIGHT: 163 g  
 DIMENSIONS: 4 fragments  
 3 to 6 cm long

BINOCULAR DESCRIPTION BY: Stuart-Alexander & Simonds DATE: 5/16/72

FABRIC: None  
 VARIABILITY: All four fragments are similar, with two having more glass than the others.  
 SURFACE: Broken surfaces are irregular to hackly  
 ZAP PITS: Many on original surfaces, but poorly preserved due to friability of rock.  
 CAVITIES: Less than 5% unevenly distributed, unlined cracks.  
 SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	N5-N6	5-25	veins		0.5- 4	1
Clasts	N9	70-90	subrd	1.5	0.1-20	2
Matrix	N7	5			<0.1	3

## NOTES:

1. Dense veins or matrix. Subvitreous. Fragments 1 & 3 have 5% and 2 & 4 have about 25% glass, which is present as veins (wider in 2 & 4).
2. Fine-grained to cryptocrystalline (typical grain size is <0.1 mm). Most are sugary with up to 25% pale yellow mineral (pyroxene?) and up to 2% opaque. Small clasts occur in equant to tabular shapes, but larger ones are irregular.
3. Cryptocrystalline, dense; forms brick-and-mortar texture with smaller white material. May be old matrix, (is definitely older than glass).

67955

THIN SECTION DESCRIPTION BY: Stuart-Alexander DATE: 6/26/72

SECTION: 67955,6 and ,7

SUMMARY: A shocked monolithologic rock, now a calaclasite or mylonite with abundant shock effects, particularly in plagioclase, and minor glass.

## MATRIX, 35% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag		ang	<0.1	Same material as the clasts and presumably in the same proportions.
Ol		ang	<0.1	
Pyx		ang	<0.1	Sizes given are maximum sizes.

## 67955 (Continued)

THIN SECTION DESCRIPTION

BY: Stuart-Alexander

DATE: 6/26/72

SECTION: 67955,6 and ,7

## MINERAL &amp; LITHIC CLASTS, 64% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Lithic		subrd	>2.5	Anhedral plagioclase and round olivine with reaction rims of pyroxene is in poikilitic irregular grains, hosting plagioclase. Pyroxene seems to be mainly pigeonitic clinopyroxene. Most plagioclase grains are anhedral, interlocking; or equant within pyroxene.
Plag	75	ang to	0.6	Mineral clasts are simply the same material as the lithic clasts, except ground up more finely. Pyroxene dominant over olivine by about 4 or 5 to 1.
Ol	5			
Pyx	20	ang	0.1-0.5	
Opaque	<1			

## GLASS CLASTS, 1% OF ROCK

<u>COLOR</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Brown		veins(?)		Encloses essentially unreacted olivine grains and seems to be finely devitrified. Thin (<0.05 mm) selvage of apparent reaction along one edge of the glass in a few places.



## 67955 (Continued)

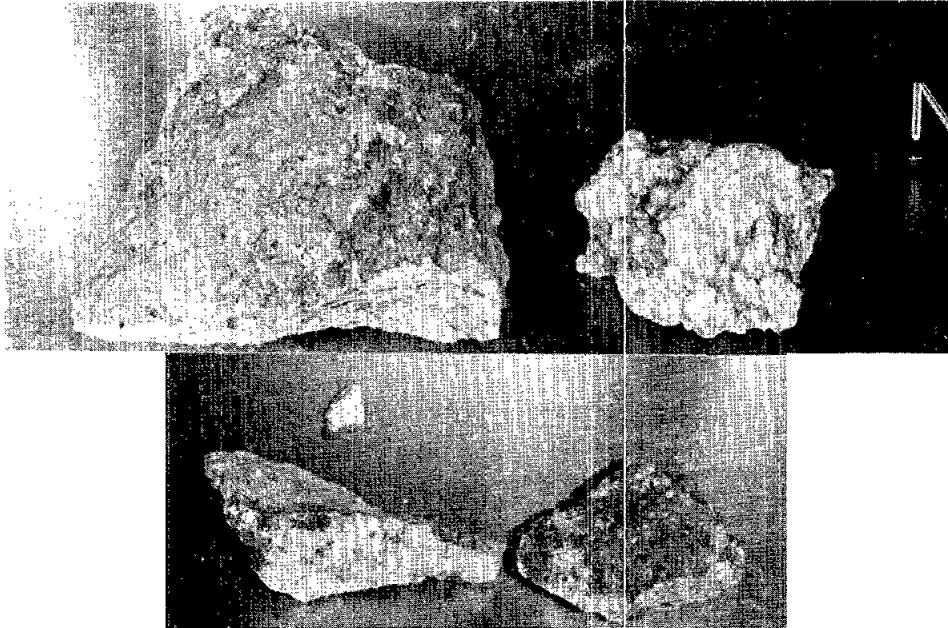
OPAQUES DESCRIPTION

BY: Brett

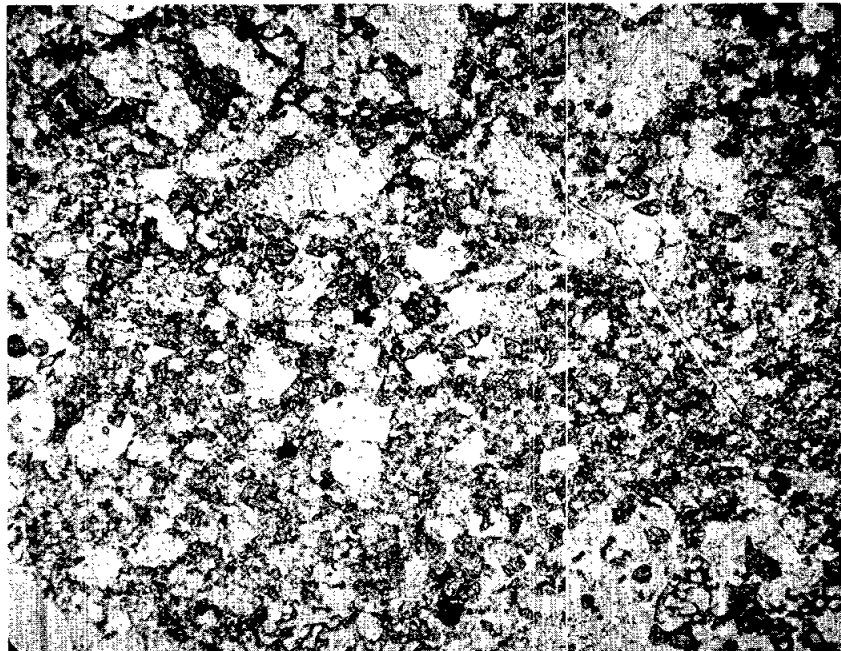
DATE: 6/20/72

SECTION: 67955,6,7

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	<1	ang to ragged	To 0.05	Unlike many of the other breccias, most opaque grains are in the size range 20-50 $\mu$ and there appear to be few if any tiny opaque mineral grains.
FeS	<1	ang to ragged	To 0.05	Troilite is subordinate to Fe and rarely contains Fe inclusions. Opaque minerals are rarely included within other minerals.
Ulvospinel	<0.5	ang to ragged	To 0.01	Low Fe ulvospinel is the dominant oxide. It shows no evidence of subsolidus reactions.
X	tr			Phase X is battleship gray about 50 $\mu$ , isotropic; it contains lamellae in 3 directions of a cream isotropic or weakly anisotropic phase. What appears to be the same cream mineral is locally associated with ulvospinel.
Y	tr			



SAMPLE 67955



SAMPLE 67955,6

WIDTH OF FIELD  $\approx$  4 MM

67956

ROCK TYPE: Crystalline  
 COLOR: Light gray (N6-N7)  
 SHAPE: Blocky, subangular  
 COHERENCE Intergranular: Tough  
 Fracturing: Few, nonpenetrative

WEIGHT: 3.7 g  
 DIMENSIONS: 1.5 x 1.3 x 1.0 cm

BINOCULAR DESCRIPTION

BY: Head & Wilshire

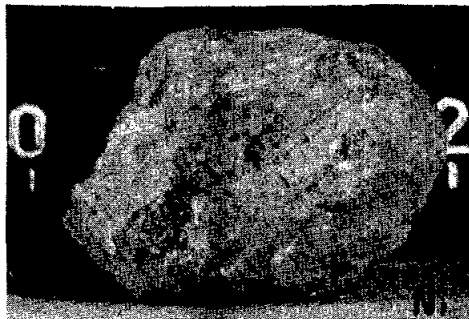
DATE: 5/17/72

FABRIC: Partly crushed rock  
 VARIABILITY: None  
 SURFACE: Finely hackly; small amount of glass adhering to N  
 ZAP PITS: Few on N, none on all others.  
 CAVITIES: 1-2% irregular shaped vugs, 0.1-2 mm across with small needle-like crystals projecting into them.  
 SPECIAL FEATURES: None

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Maf sil I	yellow-green	25	equant to irreg	0.2	<0.1-1	1
Silicate	med gray	45	equant to irreg	1	0.2-2	2
Plagioclase	v lt gray to colorless	30		<0.1	<0.1-1	3
Opaque	black	1	platy	0.1	<0.1-0.3	4
Maf sil II	v pale translucent brown	<1	equant	<0.1-0.2		5

NOTES:

1. Conchoidal fracture on large pieces; broken up, darker color in larger pieces. Appears that the original grain size was about 1 mm, then crushed and mixed with crushed plagioclase for smaller present sizes. Probably olivine.
2. Appears to be plagioclase, but is locally glassy and in places contains an abundance of opaque minerals unusual for plagioclase. Some lighter gray ones are definitely plagioclase laced by white crushed zones.
3. Mostly finely crushed plagioclase. Local lath development which appears to partly enclose crushed olivine.
4. Probably ilmenite.
5. Pyroxene (?) intergrown with ilmenite.



SAMPLE 67956

67957

ROCK TYPE: Breccia

WEIGHT: 1.7 g

COLOR: Grayish olive (10Y4/2) to  
medium dark gray (N4)

DIMENSIONS: 1.5 x 1.2 x 1 cm

SHAPE: Subangular

COHERENCE Intergranular: Tough

Fracturing: Several, neither systematic nor penetrative

BINOCULAR DESCRIPTION

BY: Simonds

DATE: 5/22/72

FABRIC: Crystalline isotropic

VARIABILITY: Homogeneous

SURFACE: B is subrounded and all others angular to subangular.

ZAP PITS: Many on B; few on others.

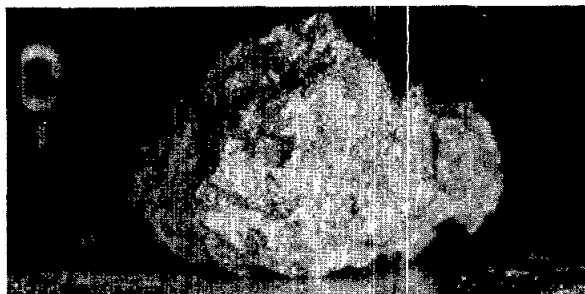
CAVITIES: Five percent angular to subrounded and dust covered. Boundaries are part of fractures, seem to be widened portions of the fractures.

SPECIAL FEATURES: A possible fractured glass coating on a portion of T.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	10Y4/2 - N4	97		<0.01		1
Clast I	N8	3	subrd equant	2		2
Clast II	N1	only one observed	needle or flake	0.5		3
Clast III	metallic	<1	subrd	0.5		4

NOTES:

1. Flint-like luster, sub-conchoidal fracture. There are some possible variations in color of matrix varying from N4 to N6. A few large plagioclase crystals near cavities.
2. Granular to flinty luster, grains <0.1 mm.
3. Glassy luster and conchoidal fracturing.
4. Color variable as if tarnished.



SAMPLE 67957

67975

ROCK TYPE: Breccia  
COLOR: Medium light gray (N6)  
SHAPE: Botryoidal glass, enclosing  
a blocky rock at one end  
COHERENCE Intergranular: Friable  
Fracturing: None in rock, penetrative in glass

WEIGHT: 447 g  
DIMENSIONS: 11.5 x 8 x 7 cm

BINOCULAR DESCRIPTION

BY: Stuart-Alexander

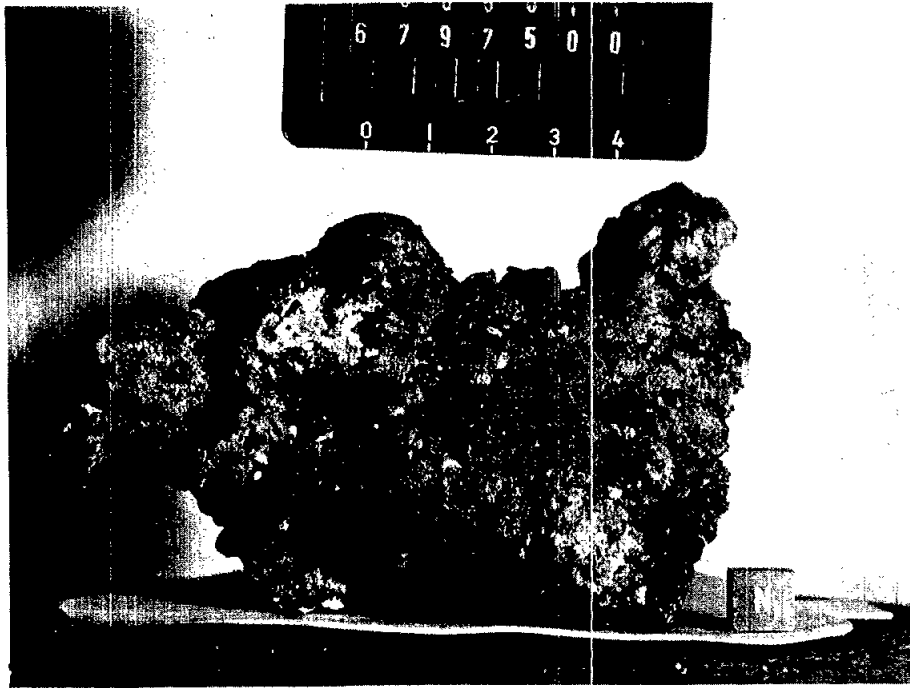
DATE: 5/23/72

FABRIC: Fine breccia  
VARIABILITY: Inhomogeneously distributed clasts  
SURFACE: Seventy percent glass covered (see special features)  
ZAP PITS: Glass has none except a few on T. Rock has few on N and W. Rock looks as if it was zapped before becoming glass-coated.  
CAVITIES: None in rock, glass has 25% vesicles and glass bubbles up to 1 cm.  
SPECIAL FEATURES: S has a 4 cm long area of relatively smooth, shiny black glass that has a copper-colored cast as light is reflected.

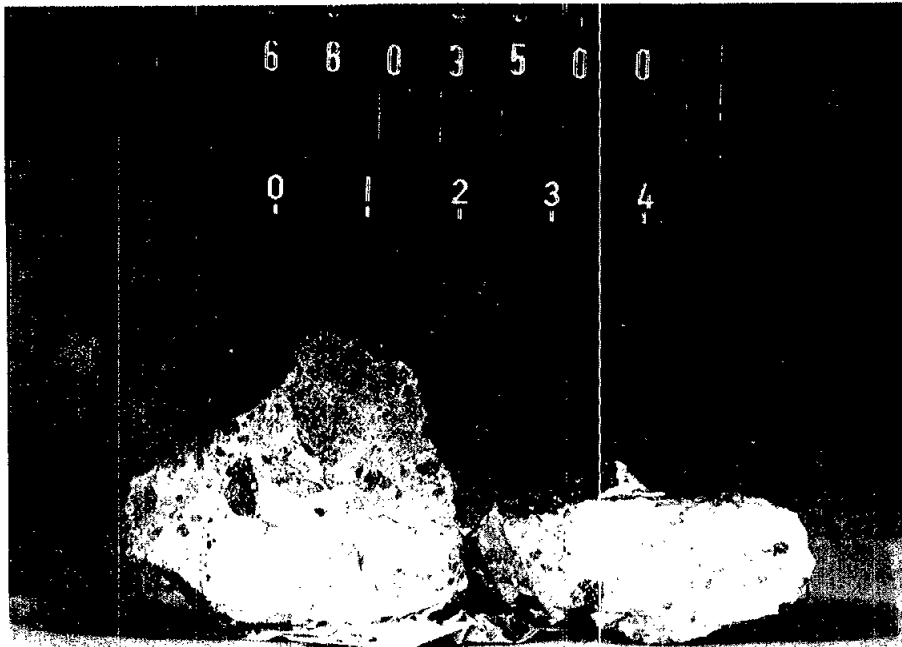
<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Glass	dark gray (N3)	75				1
Matrix	light gray	24		<0.1		2
Clast I	dark gray	1	subang	0.5	<0.1-2	3
Clast II	light gray	tr	subrd		2	4
Clasts III	white	1	ang to subrd	<1	<0.1-7	5

**NOTES:**

1. Dark and very very finely crystalline in most places, glassy elsewhere. Rock fragments up to 1 cm adhere to the surface. Glass is largely a froth of bubbles, with lots of burst ones at the surface and even broken bubbles plastered against the enclosed rock. A felted mat of very fine crystals lines the larger vesicles.
2. Finely granular or sugary. Contains 25% white translucent plagioclase and <5% dark areas, which are both clasts and opaques.
3. Aphanitic to very finely crystalline.
4. Salt and pepper texture, very finely granular.
5. Crystalline to granular and one or two very chalky clasts. Plagioclase has a translucent to greenish cast on large grains. Some clasts are single plagioclase crystals. Longest clast has a 4 mm long plagioclase grain.



SAMPLE 67975



SAMPLE 68035

68035

ROCK TYPE: Breccia, white matrix

WEIGHT: 20.7 g

COLOR: White (N9)

DIMENSION: 3 x 3 x 3 cm

SHAPE: Subrounded

COHERENCE Intergranular: Tough

Fracturing: Penetrative with several, glass filled

BINOCULAR DESCRIPTION

BY: Simonds

DATE: 6/8/72

FABRIC: Isotopic granular

VARIABILITY: Clast distribution varies

SURFACE: Smooth glass on B with unique color mottling. Color ranges from blues to turquoises to yellow browns. Color zone boundaries tend to parallel flow structure in the glass. Iron droplets are set in glass surface with halos a fraction of a millimeter wide of a color lighter than glass outside the halo. Some iron beads have a series of halos around them. Surface tends to mar easily.

ZAP PITS: Many on T, S with pits lined with white cloudy botryoidal glass; few on N, E, W; none on B.

CAVITIES: 10% in glass spatter, none in breccia itself

SPECIAL FEATURES: Rock consists of two pieces: a breccia and glass spatter. The glass is separated from breccia along a planar surface. There is a train of dark clasts ranging from black glass to granular plagioclase cutting across S edge of broken surface.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	white (N9)	68			0.1	1
Plagioclase	clear grey to white (N7-N9)	10	subang, subrnd	0.3	0.1-1	2
Pyroxene	yellow green	3	subrnd	0.3	0.2-0.8	3
Lithic I	black	9	subang, ang		0.5-2	4
Lithic II	medium grey	10	subang		0.5-3	5

NOTES:

1. White with black specks (less than 0.01 mm) of opaques and mafic silicates. Only a trace of recognizable green mafic-silicate (pyroxene). Exceptionally cohesive for a white matrix breccia.
2. Single mineral grains and possible anorthosite fragments. Appears to be broken and fractured on fine scale.
3. Fractured grains with one having 5% opaque inclusions.
4. Black glass breccia with white inclusions which do not have as glassy a lusture as the clasts or white granular plagioclase. Fragments look like 68115.
5. Granular crystalline breccia, one large fragment has both blue plagioclase clasts and lithic I type clast.

68115

ROCK TYPE: Breccia WEIGHT: 1190 g  
 COLOR: Medium gray to medium dark gray DIMENSIONS: 15 x 8.5 x 9.5 cm  
 (N4-N5)  
 SHAPE: Blocky subangular  
 COHERENCE Intergranular: Tough  
 Fracturing: See Special Features

BINOCULAR DESCRIPTION BY: Simonds & Hörz DATE: 5/16/72

FABRIC: Isotropic breccia  
 VARIABILITY: Homogeneous, glassy  
 SURFACE: E to S has very frothy glass; B is fresh with 50% frothy glass and 50% dense fractured glass.  
 ZAP PITS: Many on all surfaces except for none on B.  
 CAVITIES: Inhomogeneously distributed, 75% to 1%. Areas of low percent range from spherical to amoeboid shape. The highly vesiculated material is frothy.  
 SPECIAL FEATURES: Rock fractured into conchoidal 1 mm segments. The dominant fracture system parallel to T. Separation between fracture surfaces is 1 mm. Most of fracture surfaces show simple conchoidal fractures, but locally surface shows filaments of glass which taper thinly outward toward the center of cavity, as if rock was separated along fractures while the glass was still tacky.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Clasts I	white	10	subang to subrd, subeven in matrix, some laths	1	0.5-5	1
Clast II	N7		clast subrd		5	2
Clast III	N6	5	subrd			3
Matrix	N4	85				4
Spinel	pink	tr				5

NOTES:

1. Vitreous luster, conchoidal fracture blends into dark matrix over about 1 mm. Some are sugary white throughout and extremely microfractured crystals or glass. Inhomogeneously distributed throughout rock. Portions of these clasts have a sugary texture with dark specks, probably opaques. There is continuous spectrum in texture from sugary to vitreous and water-clear or smoky material with conchoidal fracture. The contacts between clasts and matrix is not sharp (gradational over <1 mm).
2. Only one clast. Stubby to lath-shaped plagioclase in a dark vitreous matrix. Traces of pink spinel. Speckled or leopard texture looks like microperlite. The white material could be plagioclase or glass. The matrix is a dark glass. Contact of leopard textured rock and matrix gradational over 1-2 mm.
3. Spark aphanitic gradational contact over 1 mm. <0.1 mm crystalline and sugary.



## 68115 (Continued)

## NOTES:

4. Conchoidal fracture, glassy to resinous, inhomogeneous on scale of 0.1 mm, varies from light to dark gray. Lacks the hard sheen of obsidian and is more resinous suggesting a partial crystalline character.
5. In the back matrix of Clast II.

## 68115

THIN SECTION DESCRIPTION

BY: Simonds

DATE: 6/7/72

SECTION: 68115,4

**SUMMARY:** This rock is heavily shocked with a variety of clast types; indication that it is a multiple stage polymict breccia. The event forming the breccia melted material which then flowed between clasts. However, the amount of glass visible in this is much less than is anticipated from the hand specimen appearance.

## MATRIX, 35% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Glass	35	elongate swirls	0.3	Glass is inhomogeneous ranging from dark brown to water-clear.
Large voids	5	rd	0.2-0.4	Contacts with mineral clasts are diffuse.
Plag	50	irreg	<0.1	
Pyx	10	irreg	<0.1	Some water clear glass is devitrified to irregularly extinguishing plagioclase.

## MINERAL CLASTS, 15% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	90	subang	0.1-0.5	Plagioclase is badly shocked, parts of some grains are maskelynite.
Cpx I	10	subang	0.2	Clinopyroxene I is water clear.
Cpx II	tr		0.1	Clinopyroxene II is dark brown with abundant

## 68115 (Continued)

## LITHIC CLASTS, 50% OF ROCK

<u>TYPE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Breccia I	40	subrd	0.1-2	Breccia I - Darker than II. Very fine grained, clasts less well digested into matrix. Plagioclase is not lath shaped. Up to 25% shocked plagioclase and pyroxene clasts.
Breccia II	60	subrd	0.1-2	Breccia II - Dark gray clasts with pyroxene. Pyroxene twice as abundant as plagioclase. Pyroxene is equant; plagioclase lath shaped. Up to 5% of minerals shocked.
Breccia III (unique clast)				Breccia III - Dominantly dark red, nearly opaque matrix with angular, broken-up clinopyroxenes as clasts up to 0.3 mm across. Devitrified grains <0.1μ and equant.

ADDITIONAL COMMENTS: A possible alignment of clasts and fluidal structures in glass approximately parallel to long axes of thin section. The glass swirls are irregular and in some areas show constriction between mineral clasts with ring-like patterns where flow has been up and then back down through plane of section.

## 68115,3

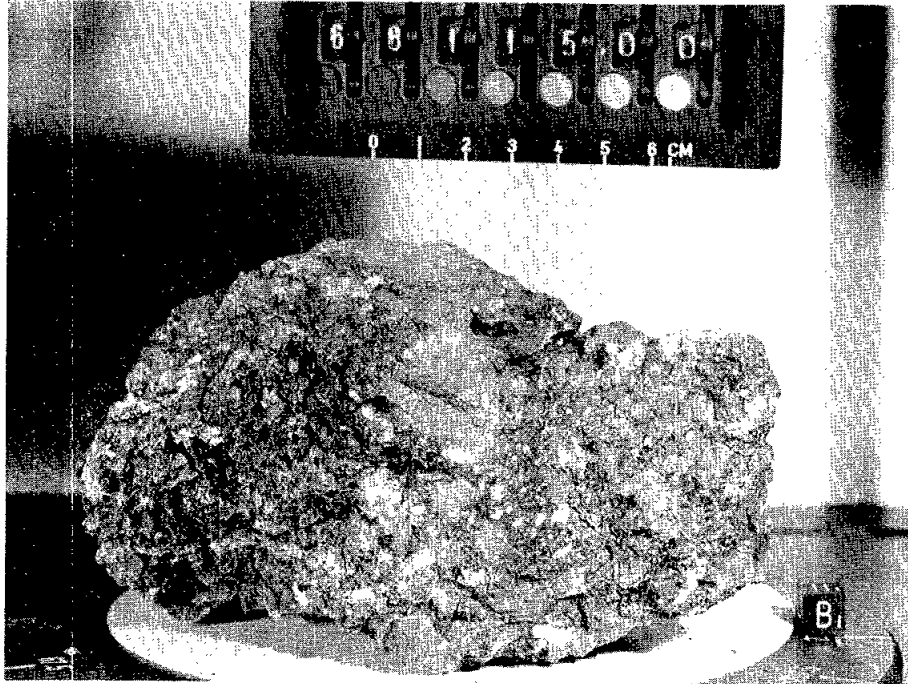
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/8/72

## SECTION: 68115,3

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe	<0.7	irreg ragged	<0.001	Distribution of opaques is very heterogeneous. Some areas are almost opaque free. Size ranges down to <1 μ, below microscopic resolution.
Troilite	<0.5	irreg ragged	0.001-0.2	
Ilm	<0.5	rd to ang	0.001-0.1	Phase X, of which 3 or 4 grains occur, is battleship gray, lower reflexivity than ilmenite, and isotropic.
Armalcolite	tr	rd to ang	0.01-0.05	
X	tr	rd to ang	0.01-0.05	
Y	tr	subrd	0.05	Phase Y is battleship gray, isotropic in reflected light, yellow brown high birefringence in transmitted light (zircon or thin tranquillite(?)). Occurs with "armalcolite".



SAMPLE 68115



SAMPLE 68115,3

WIDTH OF FIELD  $\approx$  4 MM

68115

OPAQUES DESCRIPTION

BY: Brett

DATE: 6/6/72

SECTION: 68115,4

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Fe-Ni	<1	rd to irreg	to 0.2	Opaque content is highly variable from clast to clast and within the matrix. Some areas are virtually devoid of opaque phases, other are richer especially in Fe-Ni. Grain size of all opaques is commonly <10 $\mu$ , Fe-Ni grains up to several hundred microns occur. Morphology of most opaque grains is scalloped, bleb-like, subrounded to rarely angular and lath-like (ilm).
FeS	<0.5	rd to irreg	<0.01	
Ilm	<0.5	rd to lath-like	<0.01	
Armalco- lite(?)	<0.1	rd	<0.01	The phase termed armalcolite has high reflection pleochroism - light gray to brown-blue gray. One grain of about 75 $\mu$ shows complex relationships, showing laths and irregular, shaped crystals. The brownish pleochroism is unlike Apollo 11 armalcolite. Perhaps the mineral is the Zr armalcolite mentioned by some authors. A few small metal grains are included within this grain.

68415,1

ROCK TYPE: Anorthositic gabbro

COLOR: Greenish-gray (5GY)

SHAPE: Top: rounded

COHERENCE (intergranular: Tough

Fracturing: Penetrative (few and small)

WEIGHT: 203 g

DIMENSIONS: 6 x 8 x 10 cm

Larger of 2 pieces

(Original rock is 371 g and

4 x 6 x 15 cm)

BINOULAR DESCRIPTION

BY: Horz

DATE: 6/21/72

FABRIC: Isotropic, equigranular

VARIABILITY: Patchy on a 10-20 mm scale

SURFACE: Fresh fractures are smooth on 10 mm scale and irregular, hackly on 1 mm scale; cratered areas are rounded off.

ZAP PITS: Many on T, N, S, and E; none on B, W.

CAVITIES: Vugs, 0-5%, 0.1 to 2 mm in size, occur in clusters and trains.

SPECIAL FEATURES: 1. Crystalline rock; no clear cut inclusions and clasts observed; however, patchy distribution of light and dark colored parts is suggestive of almost completely resorbed clasts; thus it is probably not of genuine igneous origin.  
2. Beautiful, water-clear, tabular and/or stubby plagioclase crystals in vugs; no pyroxenes were observed in vugs.  
3. Occasionally exceptionally large feldspars (1-3 mm, total 2-5%) of irregular outlines, resembling fractured detritus.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase	translucent to gray (5GY)	85	equigranular	0.2	0.1-2	
Mafic silicate	brown-yellow	10	lath, equigranular	0.2	0.1-1	1
Opaque I	black	2	tabular, granular	>0.1	>0.1-.2	2
Opaque II	metal	tr	spheres	0.1	>0.1-5	3

NOTES:

1. Pyroxene
2. Ilmenite
3. Only 3 spheres observed.

68415,2

ROCK TYPE: Crystalline

WEIGHT: 168 g

COLOR: Light gray (N7)

DIMENSIONS: 10 x 5 x 3.5 cm

SHAPE: Subround, broken

COHERENCE Intergranular: Tough

Fracturing: Minor nonpenetrative, 3 penetrative fractures on fresh face.

BINOCULAR DESCRIPTION

BY: Agrell & Wilshire

DATE: 5/16/72

FABRIC: Isotropic, finely crystalline

VARIABILITY: 15 x 20 mm patch of coarser grain size.

SURFACE: T, W, N, S are fine hackly; B, E, are fresh.

ZAP PITS: Many on N, S, W, T; none on E, B.

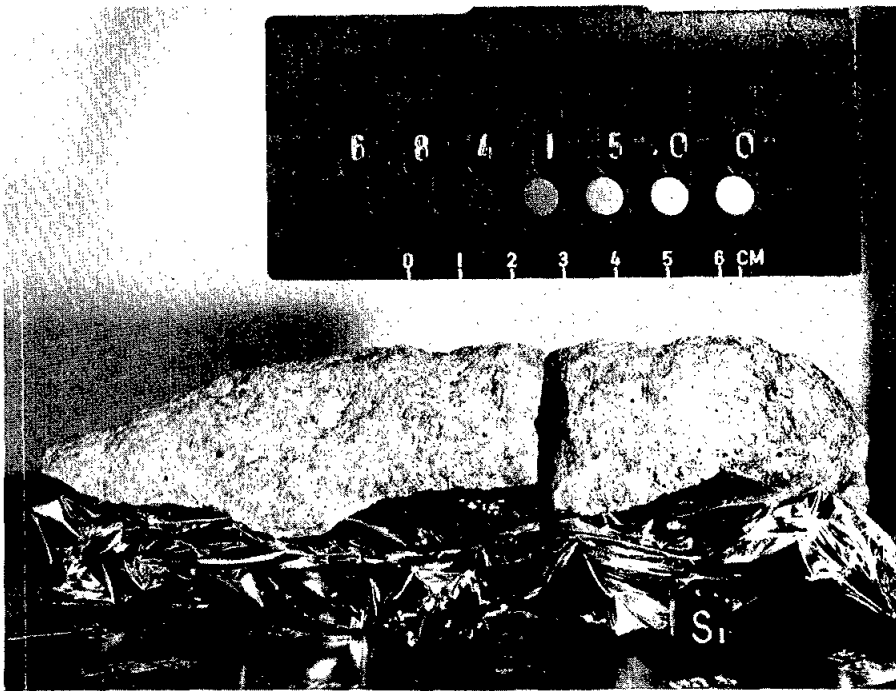
CAVITIES: Mariolitic cavities, <0.5%, unevenly distributed, 1/2 mm diameter projecting white plagioclase.

SPECIAL FEATURES: Coarse patch has 10% voids. The large drusy cavity area is just the same as the small mariolitic cavities except for the yellowish pyroxene (?).

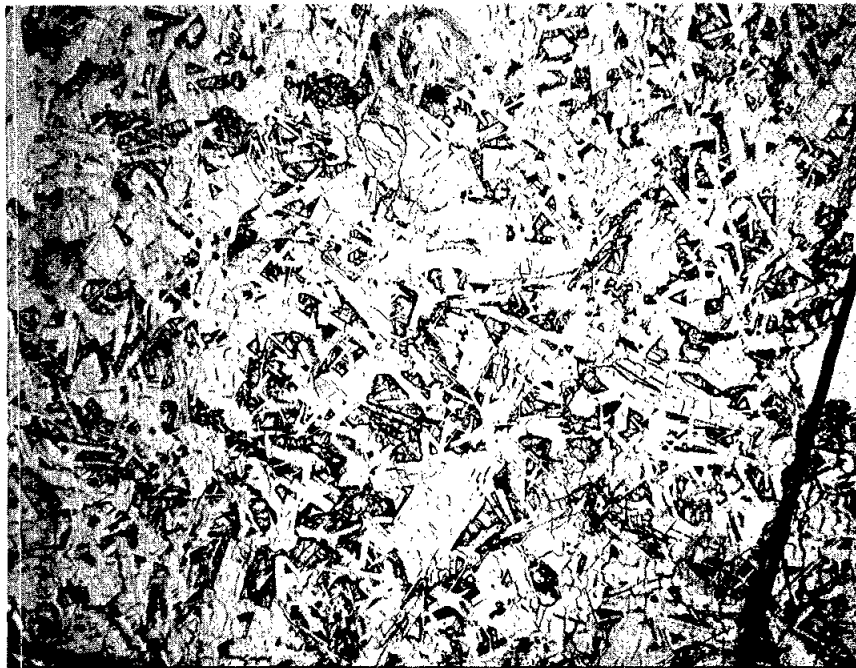
<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plagioclase	vitreous pale gray	55	elongate	0.3	0.2-3.0	1
Mafic silicate	pale brownish gray	40	irreg	0.2	0.2-0.3	2
Opaque I	bronze	tr	irreg moulded	0.2		3
Opagues II	black	tr	equart		<0.1	
Coarse patch	very light green	3	irreg	15x20		4

**NOTES:**

1. May be higher percentage if next component is actually partly plagioclase. Large ones are laths.
2. Material lies between the plagioclase laths and is slightly less vitreous than the plagioclase and has a pale brown tint. Some may be plagioclase.
3. Possibly sulfide.
4. 55% glassy gray-white, 35% yellowish gray, and 10% voids. The glassy gray-white is mainly 1-3 mm translucent plates and some 1-2 mm needles with crystal terminations. A few stubby 1-2 mm prisms have conchoidal fractures (quartz?). The yellowish gray is mostly yellow translucent interstitial pyroxene(?), some reddish brown interstitial pyroxene(?), opaque black inclusions in the yellow pyroxene, and black plates (ilmenite?) associated with the brown pyroxene.



SAMPLE 68415



SAMPLE 68415,9

WIDTH OF FIELD  $\approx$  4 MM

68415

THIN SECTION DESCRIPTION

BY: Wilshire

DATE: 6/7/72

SECTION: 68415

SUMMARY: Texturally inhomogeneous, ophitic-interstitial plagioclase-rich igneous rock. The sections do not include the sparsely distributed large irregular plagioclase lumps that are seen in hand specimen. Post-crystallization shock effects (local) include shattering of plagioclase and conversion of it to maskelynite with preservation of texture.

TEXTURE: Ophitic, to poorly developed interstitial texture. Texturally inhomogeneous: a 2.7 x 0.6 mm strip of fine-grained ophitic rock, bordered on one side by 0.5 mm plagioclase oriented at high angle to fine-grained strip. This is followed outward by a zone in which 0.5 mm plagioclase laths are parallel to fine-grained strip. Local shocked zones, intense fracturing of plagioclase, a small amount converted to maskelynite, pyroxene intact.

MATRIX, 100% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	76.6	lath	<0.1-1.2	
Cpx	18.0	irreg	<0.1-0.4	
Olivine	2.1	irreg	<0.1-0.5	
Meso Opauques	} 3.3			
Maf sil	tr	irreg		

ADDITIONAL COMMENTS: Mode based on 1000 counts, 2 sections. "Mesostasis" includes equant to irregular opaques, a little brown glass, cristobalite, usually as hemispheres, and unidentified minute phases.

One grain of "mafic silicate", distinct pinkish tint, anisotropic.



68415

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/22/72

SECTION: 68415,8 and ,9

**SUMMARY:** Aphyric or slightly porphyritic olivine-bearing gabbroic anorthosite of igneous origin. Not noritic in the usual sense, although the pyroxenes are largely low in Ca (pigeonite). Modal cristobalite present; no sign of spinel or any Al-rich phase other than plagioclase and the late glassy residuum. No sign of plagioclase clasts or unmelted relics from some earlier stage. Cognate xenolith suggests magma body was large enough to form early crust which was subsequently shattered and incorporated in remaining liquid which cooled more slowly than the crust to give a coarser grained rock.

**TEXTURE:** Diabasic, intergranular to subophitic. Olivine and pyroxene play identical textural roles. Plagioclase is essentially senate and the separation of the phenocrysts is arbitrary and questionable.

Fine-grained cognate inclusions: diabasic intergranular; plagioclase (0.04 x 0.013 mm) to (0.18 x 0.04 mm); inclusion is ovoid (3.1 x 0.35 mm), and on one side the host plagioclase is perpendicular to the surface of the inclusions (in section 8 these feldspars enclose almost no pyroxene); in section 9 the host rock immediately adjacent to the perpendicular feldspars has strongly oriented plagioclase parallel to the length of the inclusion and thus oriented normal to those feldspars oriented normal to the inclusion.

In section 9 there is a subtle gradation of average grain size from relatively fine-grained (along the straight edge of the section) to relatively coarser grained (on the side of the section with an irregular edge). The cognate xenolith in both sections lies in the finer-grained rock.

MATRIX, 99% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	79.6	subhed lath	0.085x0.020 to 0.91x 0.23	Fresh, minor opaque and devitrified glass(?) inclusions; mild normal zoning; rarely the outer zones are sharply separated from cores which are euhedral to sub-rounded. One radial cluster in section 8; otherwise no evidence of variolitic or spherulitic texture.
Pyrox	15.2	anhed, irreg	0.63x0.18 (max), av $\approx$ 0.2	Dominantly pigeonite, zoned to minor subcalcic-augite and augite; extinction patchy. One grain may be orthopyroxene. Faint smoky color. Optical continuity in one case extends among isolated grains over a distance of 1.35 mm.

## 68415 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/22/72

SECTION: 68415,8 and ,9 (Continued)

## MATRIX (Continued)

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Olivine	1.9	anhed, irreg	0.95x0.25 (max), av $\approx$ 0.2	Much like pyroxene, but almost colorless.
Opaque	1.3	equant, anhed to euhed	0.008 to (0.10x 0.05)	Rarely translucent brown (including one euhedral hexagon); interstitial and as irregular blebs in residuum.
Residuum	1.5	interstitial		Colorless or very light brown glass; generally isotropic but may show faint patchy birefringence; minor to abundant opaque blebs; rarely contains opaque spheres which may be immiscible Fe-rich melt. Generally dusty with inclusions too small to identify.
Cristobalite	0.6	interstitial		Blocky, weakly birefringent; seen better in section 8.

## PHENOCRYSTS, 1% OF ROCK

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	100	subhed lath	0.2x1 av	

**ADDITIONAL COMMENTS:** Zap pit: one corner of section 8 is coated by a 0.01 to 0.03 mm, smooth surfaced, sharply bounded film of light brown glass; immediately under the glass film a 0.75 mm "hump" of diabase contains isotropic maskelynite rather than plagioclase; the maskelynite gives way sharply to highly shattered plagioclase; the shattered zone is about 2.1 mm wide, concentric to the maskelynite "hump". Near the maskelynite the shattering is intense (in both plagioclase and pyroxene) decreasing gradually outward to where the shattered zone gives way fairly rapidly and sharply to essentially unshattered or mildly shattered rock. Immediately below the maskelynite the plagioclase is locally not only finely shattered but intensely shocked. This shock zone tapers from the full width of the maskelynite zone outward to a "point", as if it is the cross-section of a cone pointing away from the maskelynite.

68415 (Continued)

THIN SECTION DESCRIPTION

BY: Bass

DATE: 6/22/72

SECTION: 68415,8 and ,9 (Continued)

**ADDITIONAL COMMENTS:** Near but outside the maskelynite, and within the shatter zones, there are patches of chocolate brown isotropic glass which tend to be largely interstitial, as if formed from pyroxene-rich areas. These probably represent shock melt formed independently of the zap pit, probably as the innermost portions of a shock melted glass coat which formerly mantled a large part of this side of the specimen. The glass is mildly shattered and probably antedates the zap pit. The zap pit is probably a product of prolonged zapping which removes the former glass coat.

In section 9 neither maskelynite nor glass is present, but the shatter zone is visible.

68415

OPAQUES DESCRIPTION

BY: Brett

DATE: 6/10/72

SECTION: 68415,8 and ,9

**SUMMARY:** Important findings are: (1) low abundance of opaques, (2) presence of armalcolite (?) (pleochroic gray - brown gray) and, (3) peppering of tiny opaque inclusions in silicates.

**TEXTURE:** Opaque. Most grains larger than 10 microns are at grain boundaries and in mesostasis. Metal and troilite and rare ilmenite occur as inclusions in plagioclase and pyroxene. Dendritic texture of ilmenite and rarely metal occurs in the mesostasis.

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilm	<1	laths	to 0.2	Opaque content lower than any lunar crystalline rock yet examined. Metal and troilite almost as abundant as ilmenite, but total opaques less than 1 percent. 1250X magnification shows peppering of opaques (mainly metal and troilite) throughout section, grain size <1μ, included in plagioclase and pyroxene grains both irregularly and as a line of inclusions. This does not occur in other lunar crystalline rocks I have seen.
Fe-Ni	<1	anhed & blebs	to 0.05	
FeS	<1	anhed & blebs	to 0.05	
Ulvo-spinel	<0.5	anhed	to 0.05	
Armalcolite(?)	<0.2	anhed	to 0.05	
X	<0.1	lath	0.1	Phase X is one lamella of a semi-opaque gray phase with strong red internal reflection. The phase is brown-red and anisotropic in transmitted light.

68416

ROCK TYPE: Allivalite  
WEIGHT: 179 g  
COLOR: Pale gray (N7)  
DIMENSIONS: 6 x 4.5 x 3 cm  
SHAPE: Roughly tabular with some external  
surfaces rounded and others planar  
COHERENCE Intergranular: Tough  
Fracturing: Few, non-penetrative

BINOCULAR DESCRIPTION

BY: Williams

DATE: 5/16/72

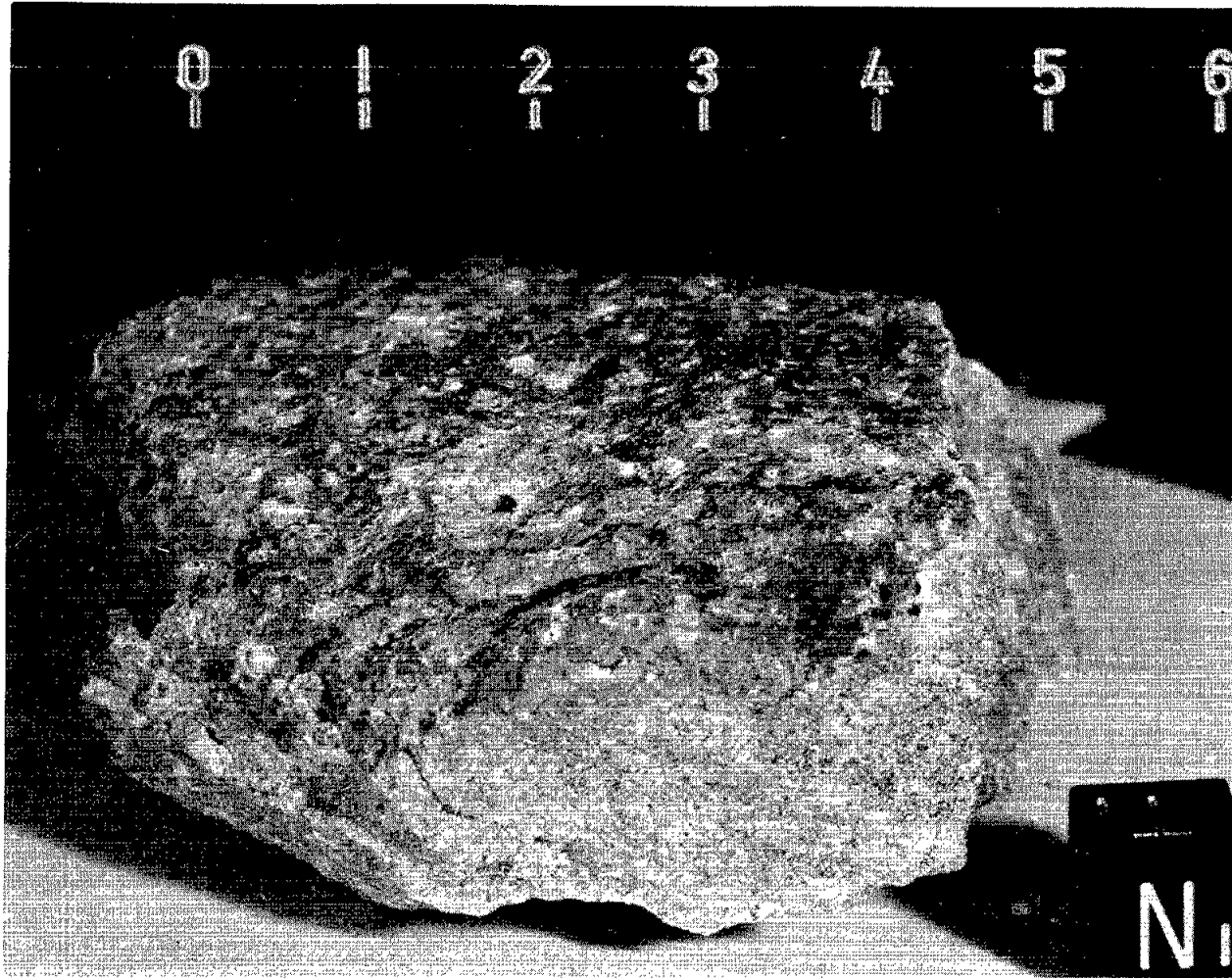
FABRIC: Equigranular  
VARIABILITY: Generally homogeneous except for several plagioclase megacrysts and a somewhat patchy distribution of the yellowish green mineral.  
SURFACE: N, W and B are granulated. E is 1/2 granulated and 1/2 knobby and pitted; T and S are knobby and pitted.  
ZAP PITS: Few on T, S, and E (1/2 of face); none on others  
CAVITIES: Five percent bounded by crystal faces. Some plagioclase crystals project into cavities.  
SPECIAL FEATURES: A chip of this rock has a exterior surface with one glass lined zap pit. This chip represents the average mineralogy and texture of the parent sample. It is 1 x 1.5 x 1 cm.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Plag I	colorless	30	tabular	1.5	1 -5	1
Plag II	white	50	equant	0.2	0.1-1	
Maf sil I	pale yellow green	20	equant	0.5	0.1-1	2
Maf sil II	red brown	1	equant	0.2	0.3	3
Opaque I	black	1	elongate	0.1		4
Opaque II	black metallic	tr	platy	1		5
Opaque III	steel blue metal	tr	hemi- spherical	0.2		6

NOTES:

1. One megacryst is 7 mm x 7 mm. Another is 4 mm and circular in section.
2. Olivine (?)
3. Pyroxene(?) associated with opaque.
4. Evenly distributed, interstitial.
5. Only one, which is possibly glass, on S.
6. Only one, on S.

357



SAMPLE 68416

68416

THIN SECTION DESCRIPTION

BY: Williams

DATE: 6/22/72

SECTION: 68416,5

SUMMARY: The rock is a holocrystalline gabbroic anorthosite with intergranular texture and appears to be a good igneous rock. Plagioclase megacrysts are possibly xenocrysts.

TEXTURE: The rock is a mesh work of plagioclase crystals with interstitial pyroxene. 68416,6 is essentially the same as 63416,5.

## MATRIX, 95% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	74	lath	0.1 up to 0.7	All plagioclases are unzoned, and in one small patch it appears to be slightly shocked.
Pyx	20	irreg	up to 0.3	Both a clino- and orthopyroxene are present and are invariably zoned and closely associated with each other with clino- rimming orthopyroxene.
Ol	1	equant	up to 0.3	The olivine is invariably in the cores of the pyroxenes.
Opq	tr	irreg	up to 0.02	The opaques are enclosed in the pyroxene or interstitial.
Meso- stasis	tr	irreg	up to 0.02	The glassy material is highly charged with bubbles or inclusions. The distribution of the ferromags is irregular and the grain size increases near a cavity.

## PHENOCRYSTS, 5% OF ROCK

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag		lath	1x0.2 to 2.5x0.5	

ADDITIONAL COMMENTS: The rock contains 5% plagioclase megacrysts which are up to 2.5 x 0.5 mm, 74% plagioclase laths from 0.1 to 0.7 mm long, 20% interstitial pyroxenes up to 0.3 mm, 1% olivine, and traces of opaques and mesostasis glasses.

68416

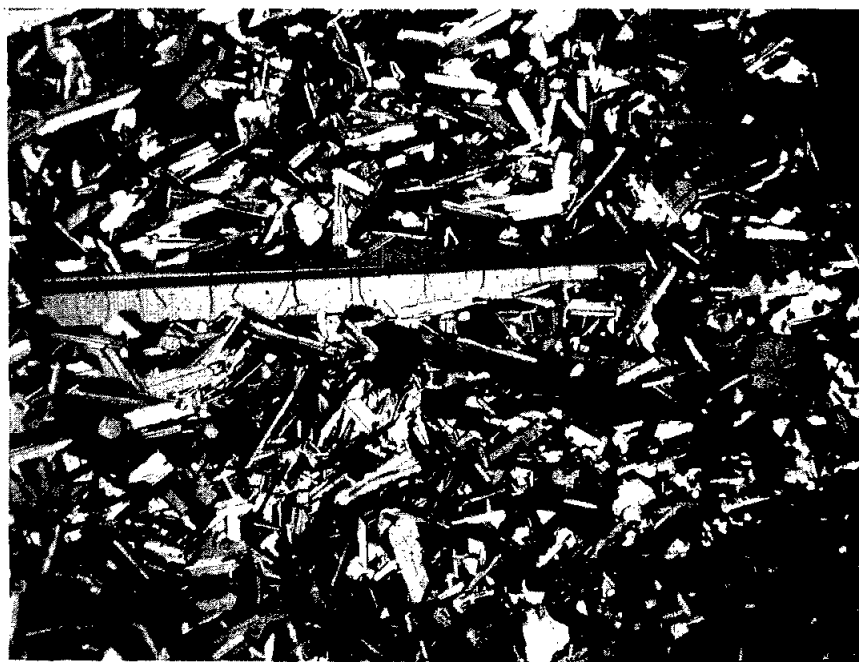
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/26/72

SECTION: 68416,5

<u>PHASE</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Ilm	<1	laths	0.03 av, to 0.15	Rock is remarkably similar to 68415,9 (from the same boulder) in opaque mineralogy. Total opaques less than 1 percent. 1250X magnification show peppering of opaques in the submicron size range (largely metal and troilite) throughout the section, in inclusions and lines of inclusions in silicate phases.
Fe-Ni	<0.5	anhed masses and anhed blebs	0.03 av, to 0.1	
FeS	<0.2	anhed masses and anhed blebs	0.02 av	
Ulvo- spinel	<1	anhed to euhed	0.02 av, to 0.1	
Armalco- lite(?)	tr	anhed	0.02	Ulvospinel is possibly more abundant in this rock than in 68415, two or three armalcolite(?) grains; in one case in mutual boundary texture with ilmenite; in another as laths and mutual boundary texture with ulvospinel. These two surely must be incompatible which makes me question the "armalcolite" tentative identification.



SAMPLE 68416,6

WIDTH OF FIELD  $\approx$  4 MM

68505

ROCK TYPE: Breccia  
 COLOR: Dark gray (N3)  
 SHAPE: Angular  
 COHERENCE Intergranular: Tough  
 Fracturing: None

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

BINOCULAR DESCRIPTION

BY: Hörz

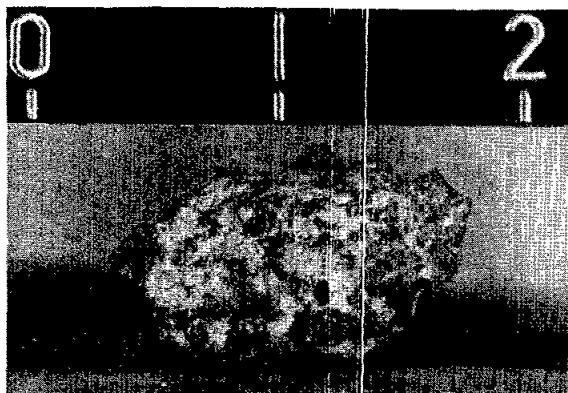
DATE: 6/8/72

FABRIC: Isotropic  
 VARIABILITY: Homogeneous  
 SURFACE: Irregular, hackly, (very dusty).  
 ZAP PITS: Very dusty; few on T.  
 CAVITIES: Vugs, 10-15%  
 SPECIAL FEATURES: One large metal inclusion displays crystal faces. It is a very coarse, polycrystalline aggregate.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	N3	75-80		0.01	1 to apha- nitic	1
Plagioclase	N8	20-25	irregular, subrd	1	0.1-3	
Lithic clast	N8	0.5	irregular	1	0.1-2	2
Opaque I	metallic	1	equidimens- ional to rd	0.5	0.1-1	3
Opaque II	red-brownish	tr	rd	0.1		4
Mineral	orange	tr	irregular	0.1		5

## NOTES:

1. Dark, glassy matrix is recrystallized.
2. Lithic clast (80% feldspar, approximately 20% greenish-yellowish pyroxene).
3. Metal (Fe?); no sulfide.
4. Rusty halo around one metal sphere, sphere itself is oxidized and rusty.
5. Rust?



SAMPLE 68505



68515-19; 68525-29; 68535-37

DESCRIPTION: Rake Sample

BY: Lofgren

DATE: June 15, 1972

68515-19, 68528

### HETEROGENEOUS, GRAY AND WHITE BRECCIA

In some areas these consist of fine-grained, aphanitic gray matrix with abundant white friable, granulated clasts of various sizes. The large white granular areas contain small gray clasts. A coating of vitreous black to gray-green vesicular glass containing granular plagioclase fragments coats the rocks. Vesicles range up to 2-4 cm. Glass on these fragments is similar to group one glass.

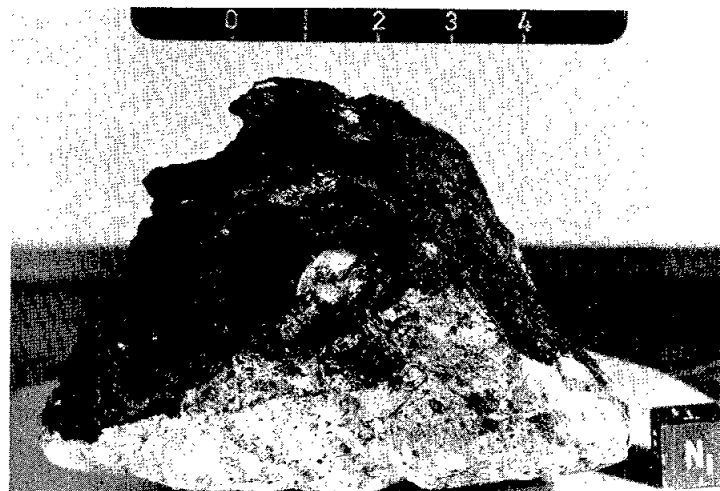
68525-27, 68535-37

### GRAY, TOUGH, FINE-GRAINED, CRYSTALLINE ROCKS (two about 1-3 cm and one 5 x 3 cm)

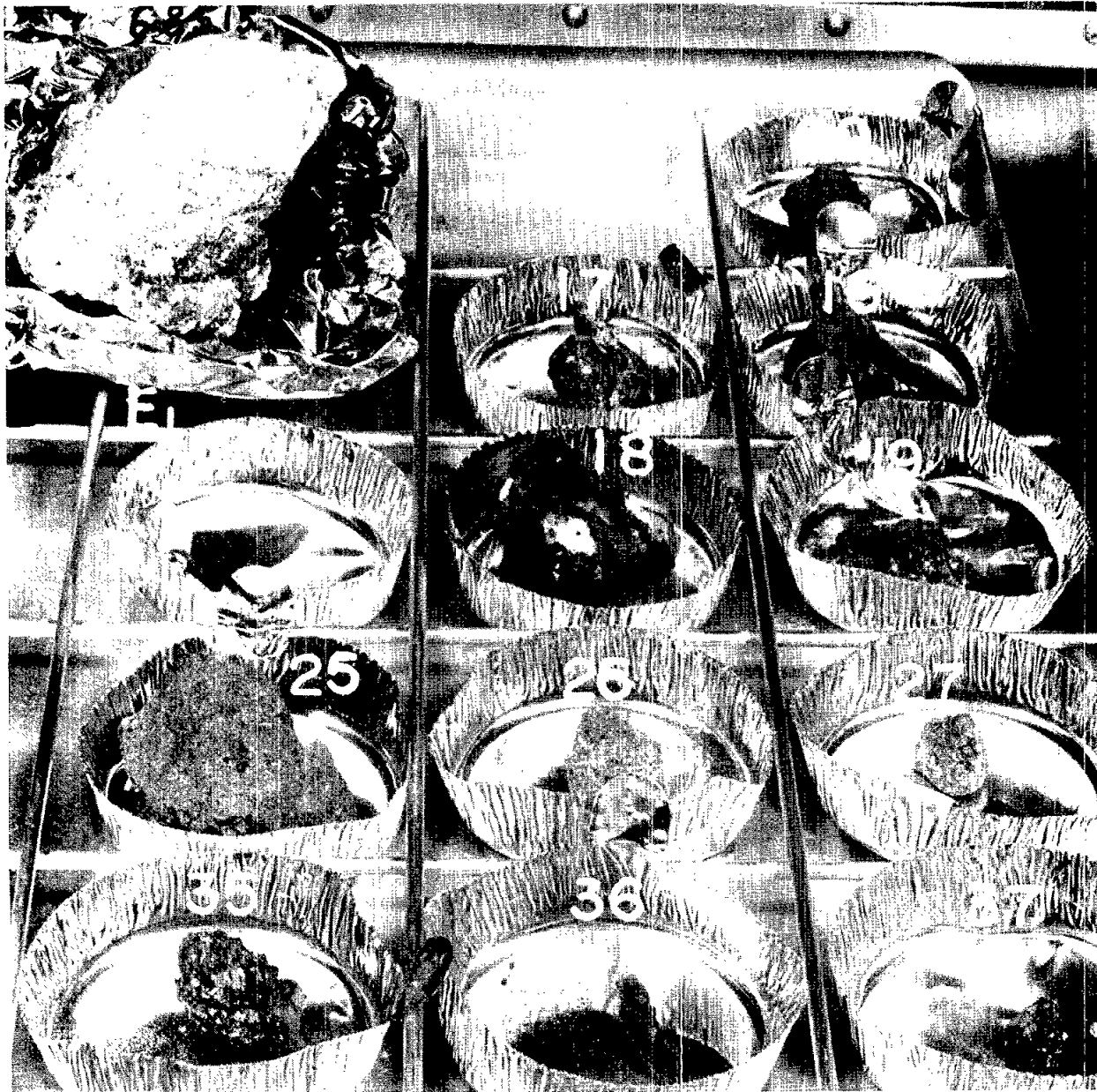
68525 and 26 are medium fine-grained (~1-2 mm) crystalline rocks - composed mostly of feldspar with very little mafic mineral. 68525 is finer grained (<1 mm) with uniform texture and one obvious dark fragment on flat surface. It has one zap pit about to spall off and irregularly distributed vesicles from 1 mm to 2 cm in diameter. There is rust colored material on vesicle walls. It has a higher percentage of mafic minerals than 68525 and 26. 68535, 36 and 37 have glass coatings of gray vesicular glass containing white and translucent feldspar clasts.

68529

Dust covered glassy fragment which probably fits into one of the above groups.



SAMPLE 68515



RAKE SAMPLE 68515-19,25-29,35-37

68815

ROCK TYPE: Breccia  
COLOR: Medium dark gray (N3-N4)  
SHAPE: Subrounded  
COHERENCE Intergranular: Tough  
Fracturing: One penetrative; very few nonpenetrative

WEIGHT: 1789 g  
DIMENSIONS: 5 x 15 x 21 cm

BINOCULAR DESCRIPTION

BY: Lofgren

DATE: 5/11/72

FABRIC: Fine breccia

VARIABILITY: Matrix uniform, clast and vesicle distribution is highly variable.

SURFACE: B is hackly, freshly broken. All other surfaces are smooth.

ZAP PITS: Many on all surfaces except B which has none.

CAVITIES: Large wormy shaped, 2-8 cm, irregularly distributed vesicles comprise 10% of the rock. They are smooth walled and lined by very small (<0.1 mm) crystals. Smaller vesicles (<1-5 mm) which surround the large vesicles are smooth walled and crystal lined, similar to large ones. Large portions of matrix have no vesicles at all. A few small vesicles appear to occur away from large vesicles, but could be related to large vesicles in unobserved third dimension. Vesicles grade into vugs.

SPECIAL FEATURES: Bulk of description done on B, which is the fresh fracture surface produced by the crew. This chip (68815,2) has typical matrix and white aphanitic clasts, but does not have the 2 cm vesicles nor the crystal-line matrix typically adjacent to the large vesicles. The one 1 cm vesicle does show a very slight coarsening immediately adjacent to the matrix. There is one lensoidal clast (15 x 7 mm) that appears to be igneous rock, with the grain size 1/2 mm, plagioclase is translucent and comprises 85% of clast, the other 15% consist of a mineral dark gray to black. There are traces of a violet mineral, (five grains (0.5-1.5 mm)). About 20% of the grains in the clast have been ground up.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	gray (N3-N4)	80		aphan		1
Lithic clasts I	white (5B9/1)	7	subang to subrd	2.5	2-25	2
Lithic clasts II	greenish gray (5Y6/1)	3	subang to subrd		5-40	3
Metallic particles	silvery	1	rd to subang	1		4
Dark gray	N3	9	rd		10-40	5

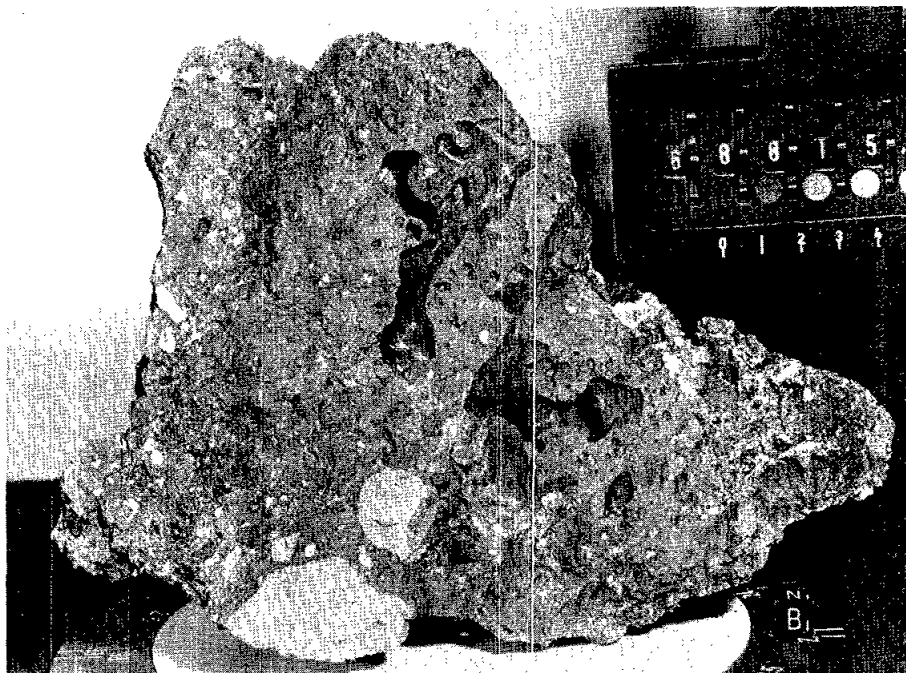
NOTES:

1. Aphanitic away from vesicles but within approximately 5 mm of large vesicles the matrix is comprised of crystals (up to 0.5 mm) which are lath-to-equant in shape. Locally are areas of short linear cooling fractures.
2. Aphanitic internally, translucent in thin slice. Some clasts have sharp boundaries, some have gradational contacts with matrix.

68815 (Continued)

NOTES:

3. Three clasts in this group, probably all igneous (ultramafic ?) with varying degrees of cataclastic deformation.
  - a. Largest clast: Nondescript sugary appearance; two main components, a translucent gray (25%) and more sugary yellowish-gray (75%) has a trace of angular metallic particles. One veinlet (0.1 mm wide) is filled with dark gray material. Ultramafic rock (?).
  - b. Middle-sized clast: Yellowish-greenish-gray mineral, tabular to round with fuzzy outline (40%) light gray anhedral translucent material (45-50%) medium to dark gray (probably not opaque) (10%). Uniformly distribution of components. Weakly developed linear element in yellowish-greenish component.
  - c. Smallest clast: Like clast b.
4. Spherical outlines when on vesicle walls. Angular to subangular when they occur in the matrix. Uniformly distributed throughout matrix although rare.
5. Aphanitic, difficult to distinguish from matrix.



SAMPLE 68815

68815

THIN SECTION DESCRIPTION

BY: Lofgren

DATE: 6/28/72

SECTION: 68815,4

SUMMARY: This rock is most probably a nearly completely melted breccia of anorthositic gabbro composition which has crystallized to a very fine grain crystalline rock with several remnant grains that did not melt.

## MATRIX, 90% OF ROCK

<u>PHASE</u>	<u>% OF MATRIX</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	30	prismatic	<0.1	The matrix is a complex mixture of glass in various stages of devitrification. The glass is not uniform composition and the phases crystallizing from the glass vary considerably in proportion from spot to spot. Some areas are exclusively prismatic and spherulitic plagioclase. Other areas show high concentration of pyroxene. There is only 10% true glass left.
Cpx	35	equant	<0.1	
Devitrified glass	35	-	-	

## MINERAL CLASTS, 10% OF ROCK

<u>PHASE</u>	<u>% OF CLASTS</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>	<u>COMMENTS</u>
Plag	90	subrd	0.1 to 0.5	Plagioclase fragments are not single crystals but are composed of fine-grained feathering plagioclase. .
Cpx	10	subrd	0.1	

68815

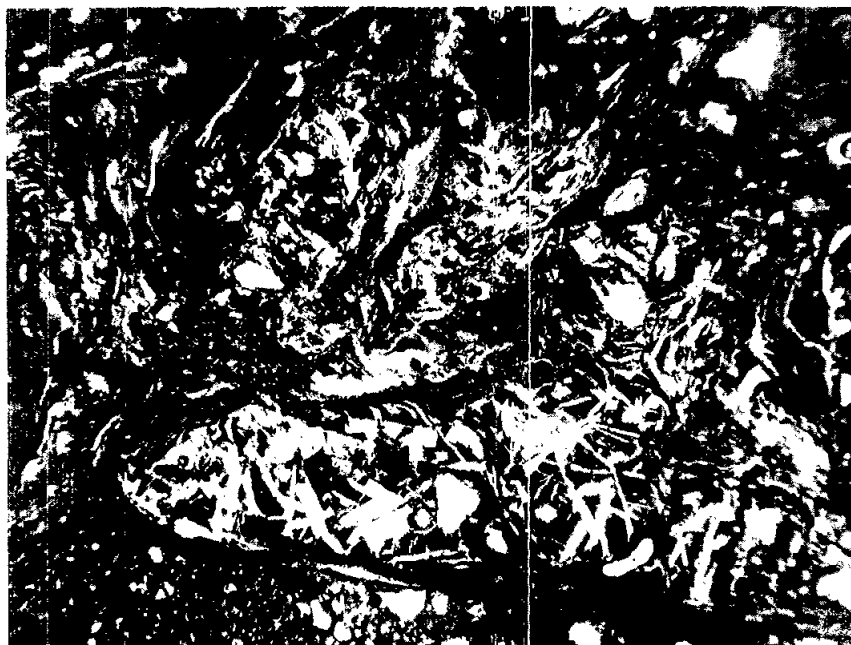
OPAQUES DESCRIPTION

BY: Brett

DATE: 6/8/72

SECTION: 68815,4

Opaques, in order of abundance, are Fe-Ni, troilite, ilmenite, and armalcolite(?). Opaque minerals are more abundant in the crystalline portion of the section and are rarer in the glass, where they occur largely as spherules from 50 microns to less than one micron. In the more crystalline portion of the rock, metal and troilite occur as discrete, somewhat rounded grains with ragged outline, in the usual textural relationship except that troilite rimming the large metal grains is unusually common. Metal grains are up to 250 microns in size, troilite to 75 microns, ilmenite is rare and occurs largely as angular grains. High power (500X) microscopy shows that the section has disseminated opaques of less than one micron scattered throughout. The opaques are difficult to identify. Total opaque minerals are less than one percent. Armalcolite(?) occurs in one grain about 40 microns across. A couple of metal grains contain elongated inclusions of schreibersite(?) or else as irresolvably fine-grained Fe-FeS intergrowth.



SAMPLE 68815,4

WIDTH OF FIELD  $\approx$  4 MM

69935

ROCK TYPE: Breccia  
 COLOR: Medium dark gray  
 SHAPE: Tabular, angular  
 COHERENCE Intergranular: Tough  
 Fracturing: Nonpenetrative but tension fractures are pervasive

WEIGHT: 128 g  
 DIMENSIONS: 9 x 6 x 3 cm

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 6/20/72

FABRIC: Breccia  
 VARIABILITY: Matrix variable in degree of vitrification and in clast contents.  
 SURFACE: Uneven  
 ZAP PITS: Top is heavily pitted, has both steady-state and production surfaces, see photo 39377. Top shows pronounced weathering also.  
 CAVITIES: Five percent vesicles.  
 SPECIAL FEATURES: Metal in dark gray aphanitic-to-vitreous clast; clast-free areas of matrix is not crushed. These areas are free of minor fractures whereas areas where zaps occur, fractures are more common. Crater density on top occurs in two regions: one is steady-state, the other a production surface. Both are excellent surfaces for counting zaps.

Matrix varies from medium gray clast-rich regions to dark gray, aphanitic areas with no clasts. These have relatively sharp contacts but may represent varying degrees of vitrification of common parents.

Also, as seen on B, a sinuous clast borders an aphanitic fragment which is internally variable. The bordering clast merges into dark gray glass in some areas which then appears to merge into medium gray clast-rich areas.

All matrix materials appear to be very glassy. Primary variable is feldspar clast which ranges from 10% or less to about 50% in medium gray areas.

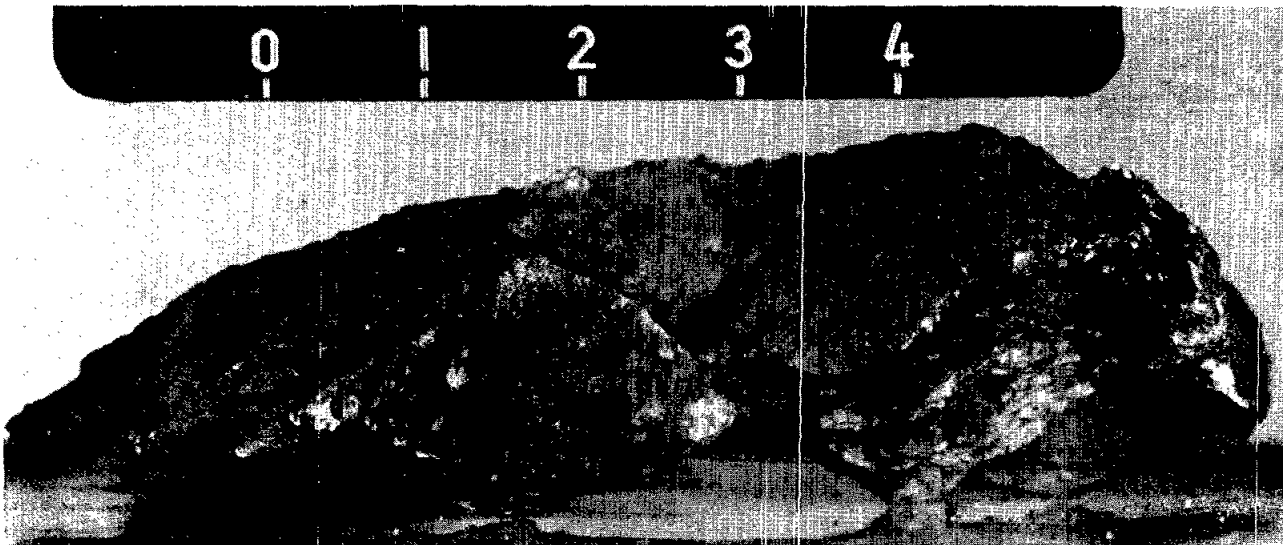
The cratered surface of this rock should not be destroyed before examination.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Feldspar aggregates	white	15	blocky, subhed	2	10 - <0.1	1
Feldspar and mafic aggregates		<1	rd		1 - 2	2
Spinel I	red	tr		?	0.2-<0.2	3
Spinel II	deep ruby red	tr	spherical	0.2		
Metal	silvery	<1	spherical		0.1-<0.1	4
Metal?	rusty red	<1	spherule		0.1?	5

69935 (Continued)

NOTES:

1. Sugary textured crushed, appears to have reaction rims. These may vary from lithic fragments to crushed matrix crystals.
2. Yellowish in color and may be more mafic than the feldspar aggregates.
3. Spinel A occurs in matrix in trace amounts. Spinel B is very deep red and contained in feldspathic clast. Spinel B may be corundum.
4. Not rusted most abundant in dark gray aphanitic areas.
5. Appears to be a rusty metal spherule. Rust appears to be confined to certain areas of rock and also occurs on top.



SAMPLE 69935



69945

ROCK TYPE: Crystalline (hornfels)  
 COLOR: Medium gray (N5)  
 SHAPE: Angular  
 COHERENCE Intergranular: Tough  
 Fracturing: Absent

WEIGHT: 6.9 g  
 DIMENSIONS: 3 x 1.5 x 1 cm

BINOCULAR DESCRIPTION

BY: Phinney & Morrison

DATE: 6/8/72

FABRIC: Isotropic, equigranular

VARIABILITY: None

SURFACE: Fresh, hackly. Small glass splash is on S.

ZAP PITS: Few on promontory at top left tip of S, none elsewhere.

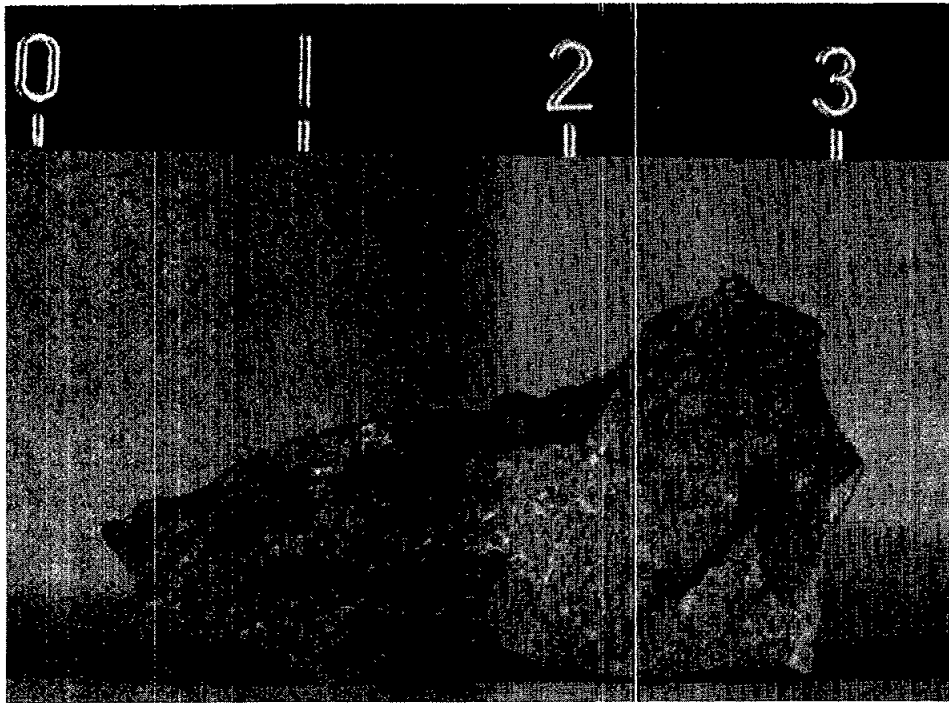
CAVITIES: Four vugs from 0.1 to 0.4 mm on N.

SPECIAL FEATURES: A white coating on E appears to be soil-like rather than an alteration or a chemical deposit (see photo 40137). Rock matrix appears to consist of patches 0.1 to 1.0 mm of various shades of gray and is probably recrystallized.

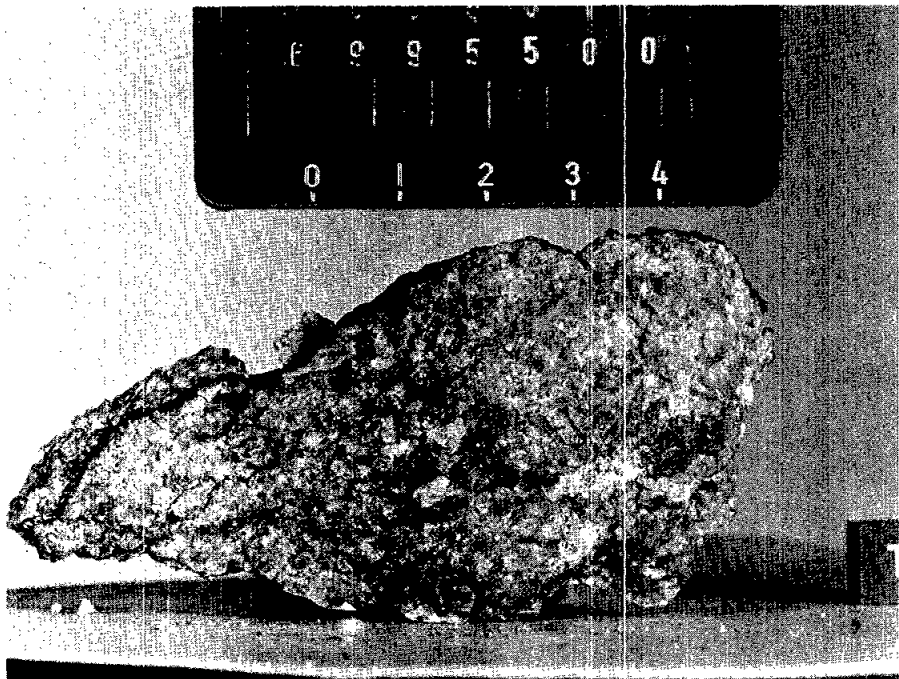
<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Matrix	med gray (N5)	>99		<0.1	<0.1-0.3	1
Clast	dark gray	tr	elongate, ang	3 clasts: (0.8, 0.5, 0.2)		2
Maf sil	green	tr	rd	0.1	0.1	3
Opaque I	black	tr	equant	<0.1	<0.1	
Opaque II	yellow (metallic luster)	one grain	equant		0.1	4

NOTES:

1. Grains appear to be equant. Texture is quartzite-like.
2. Poorly defined darker gray areas which are probably ghost clasts.
3. Clasts or pheoncrysts of olivine?
4. Contains angular fractures or cleavage faces.



SAMPLE 69945



SAMPLE 69955

69955

ROCK TYPE: Anorthosite  
COLOR: Medium light gray (N6)  
SHAPE: Angular, wedge-shaped  
COHERENCE Intergranular: Tough

WEIGHT: 75.9 g  
DIMENSIONS: 2 x 6 x 9 cm

Fracturing: Irregular, penetrative

BINOCULAR DESCRIPTION

BY: Hörz

DATE: 6/20/72

FABRIC: None

VARIABILITY: Isotropic

SURFACE: T is hackly, irregular

ZAP PITS: None on all sides

CAVITIES: None

SPECIAL FEATURES: Two small grains studied with oil-immersion technique under petrographic microscope: feathery recrystallization products (feldspar lath); isotropic areas (diaplectic?) however, most of it is transparent plagioclase. Glass content in binocular description may be under-estimated.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Feldspar	N6	95		3	1 -7	1
Glass	N2	2				2
Opaque	N2	tr	tabular	1	0.5-2	3
Pyroxene	yellow-brown	tr	?	1	0.5-2	4
Opaque	N2	2	irregular	1	0.5-2	5

NOTES:

1. Translucent to grayish; hackly; cracked and fractured (conchoidal fractures), no cleavage planes, grayish - whitish colored tones depend on degree of fracturing, some milky, highly fractured areas.
2. Dark glass vein.
3. Ilmenite(?) tabular, equigranular.
4. Pyroxene, brown-yellow.
5. Devitrified, dark glass, dull luster.

69965

ROCK TYPE: Breccia, glass veined

WEIGHT: 1.12 g

COLOR: Gray (N5)

DIMENSIONS: 2 x 1.5 x 1 cm

SHAPE: Very irregular

COHERENCE Intergranular: Poor to moderate

Fracturing: Pervasive disruption

BINOCULAR DESCRIPTION

BY: Morrison

DATE: 6/8/72

FABRIC: None

VARIABILITY: Rock fragments are uniform in character

SURFACE: B face is glass-coated, all others consist of glass-united breccia fragments.

ZAP PITS: None

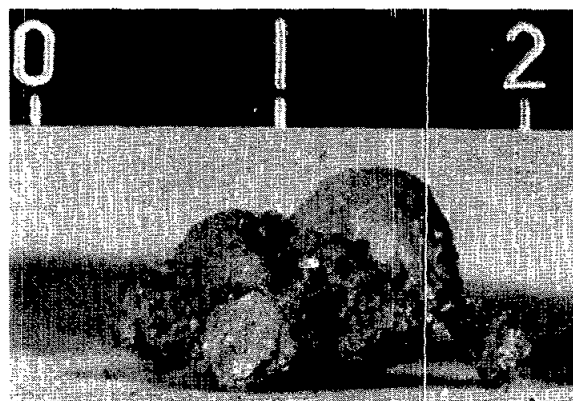
CAVITIES: None in rocks, some vesicles in glass on B face.

SPECIAL FEATURES: This sample consists of a breccia fragment or fragments which have been disrupted along fracture planes. Glass has been injected along some of these. The bottom face is a glass coating from which vein material is derived, rock fragments may be "regolith breccia" rock type.

<u>COMPONENT</u>	<u>COLOR</u>	<u>% OF ROCK</u>	<u>SHAPE</u>	<u>SIZE (mm)</u>		<u>NOTE</u>
				<u>Dom.</u>	<u>Range</u>	
Clasts	white	10	ang	0.5	0.1-0.8	1
Matrix	gray	90				2

NOTES:

1. Lithic, none >1 mm seen.
2. Fine grained and homogeneous. Includes some vitreous gray fragments.



SAMPLE 69965