MSC 03228

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 15 COARSE FINES (4-10 MM):

SAMPLE CLASSIFICATION, DESCRIPTION AND INVENTORY

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INTRODUCTION

This report presents the results of a particle-by-particle binocular microscopic examination of all of the Apollo 15 4-10 mm fines samples. The primary purpose of this study was to achieve a classification of these particles according to their "macroscopic" lithologic features in order to provide a basis for sample allocations and future study. The relatively large size of these particles renders them too valuable to permit treatment along with the other bulk fines, yet they are too small (and numerous) to practically receive full individual descriptive treatment as given the larger "rock" samples. This examination, classification and description of subgroups represents a compromise treatment. It is hoped that this information will be helpful to those seeking allocations of this material and for the planning of any investigations which require such samples. In most cases and for many types of investigation the individual particles should be large enough to permit the application of more than one type of analysis.

ACKNOWLEDGEMENTS

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SAMPLE NUMBERING

Sample numbering procedures for parent samples are described in the Apollo 15 Lunar Sample Information Catalogue (MSC 03209) (which see). Daughter samples established in the course of this examination were assigned daughter numbers in the usual manner, beginning with 1. For example 15314,1; 15314,2; 15314,3, etc.

SAMPLE LOCATIONS

Sample locations are indicated in Figures 1.-2D. taken from the Apollo 15 Lunar Sample Information Catalogue (MSC 03209). Figure 1. shows the EVA traverses and station locations. Figures 2A.-2D. are representative maps of sample collection stations showing specific sample sites.

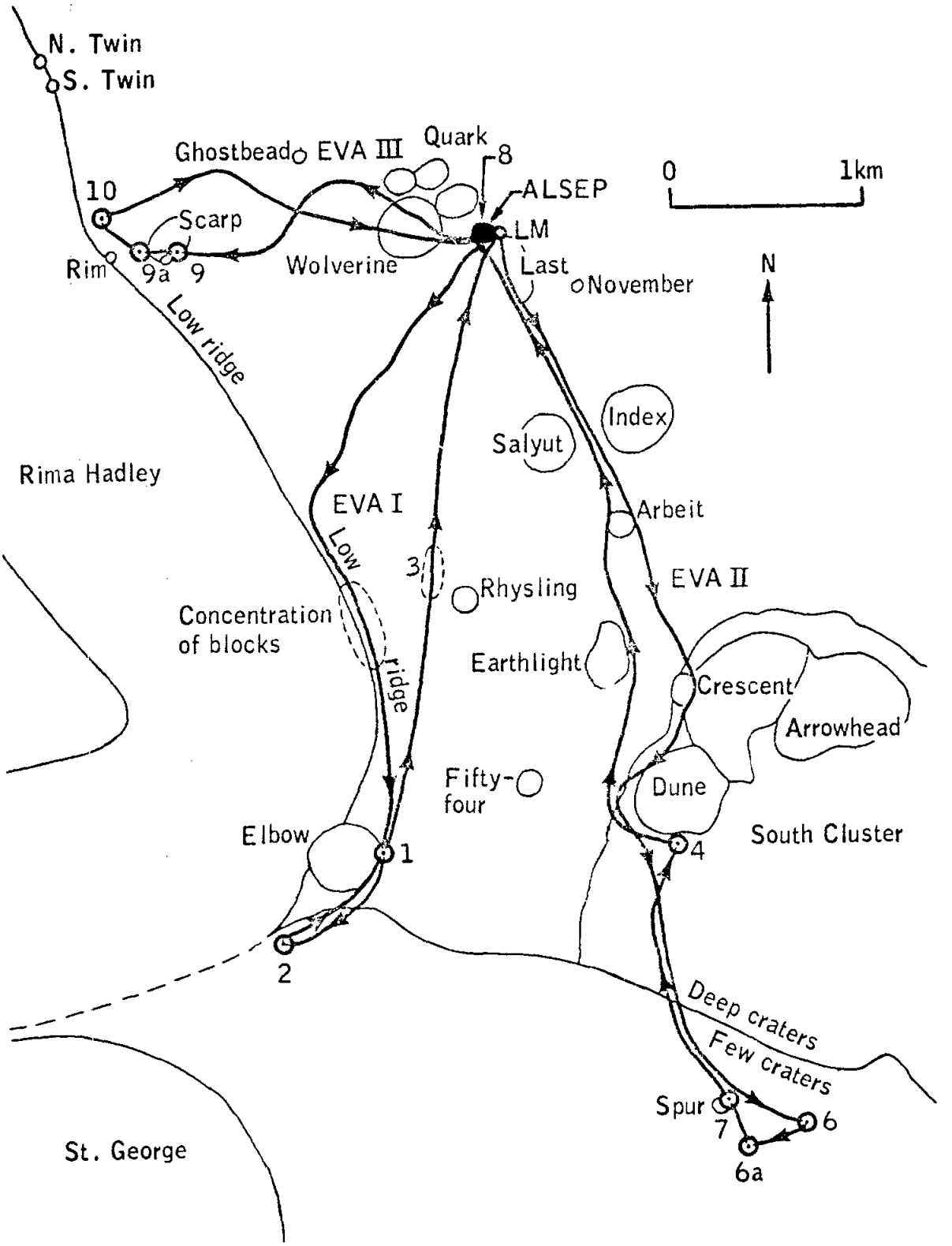


Figure 1. - Map of EVA Traverses Showing Crater Outlines and Sample Collection Stations; Modified from US Geological Survey Interagency Report.

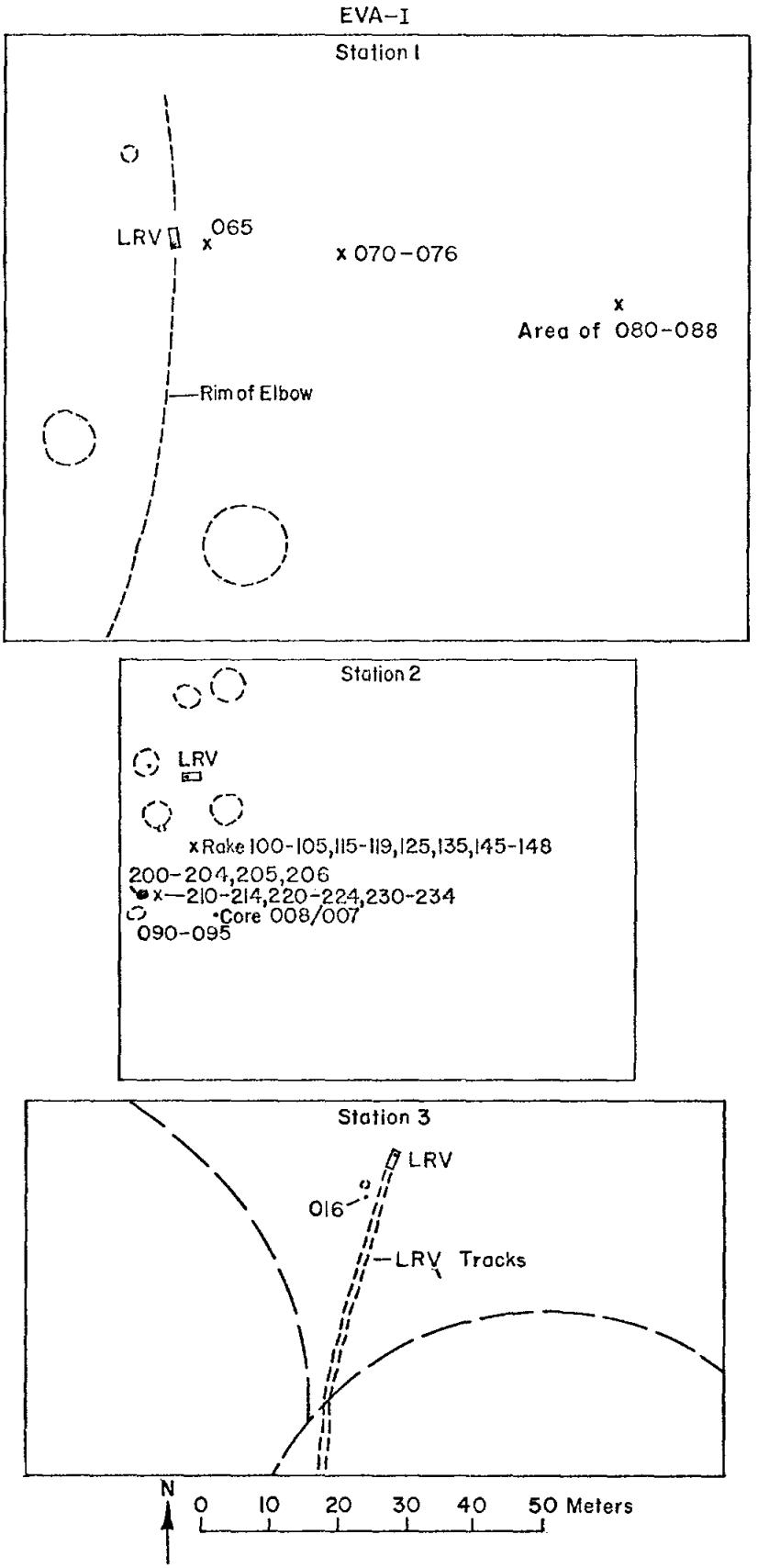


Figure 2 A. - Station Map Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 36.

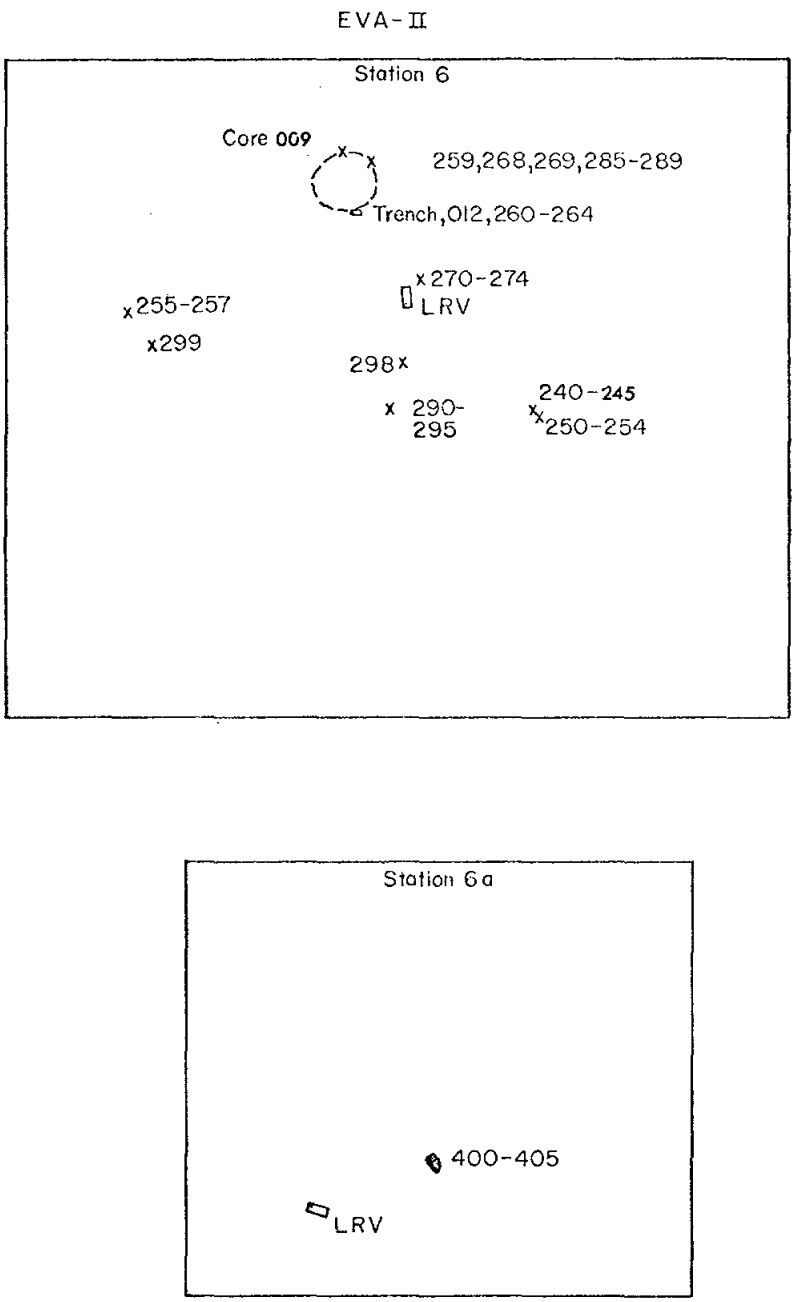


Figure 2B. - Station Map Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 36.

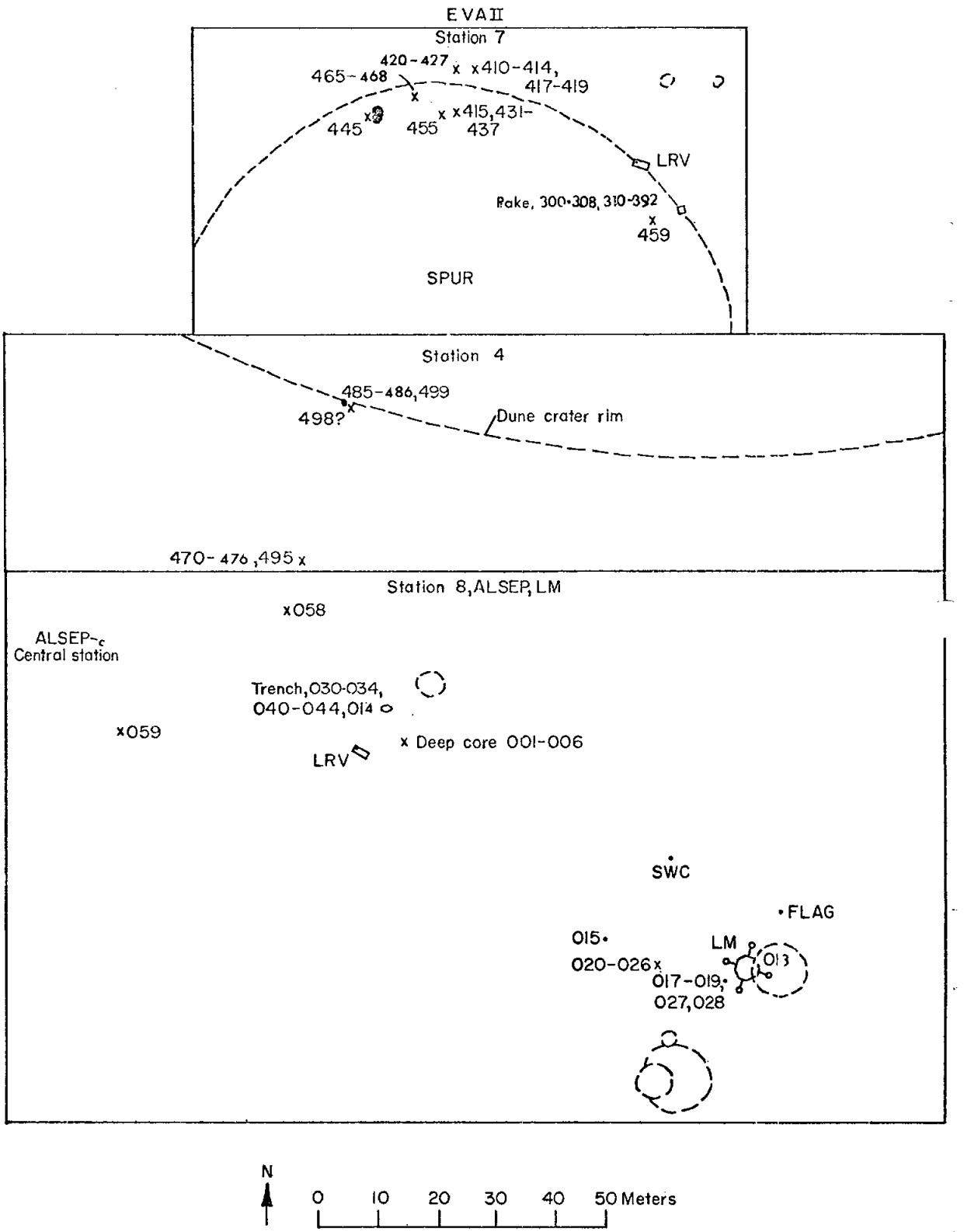
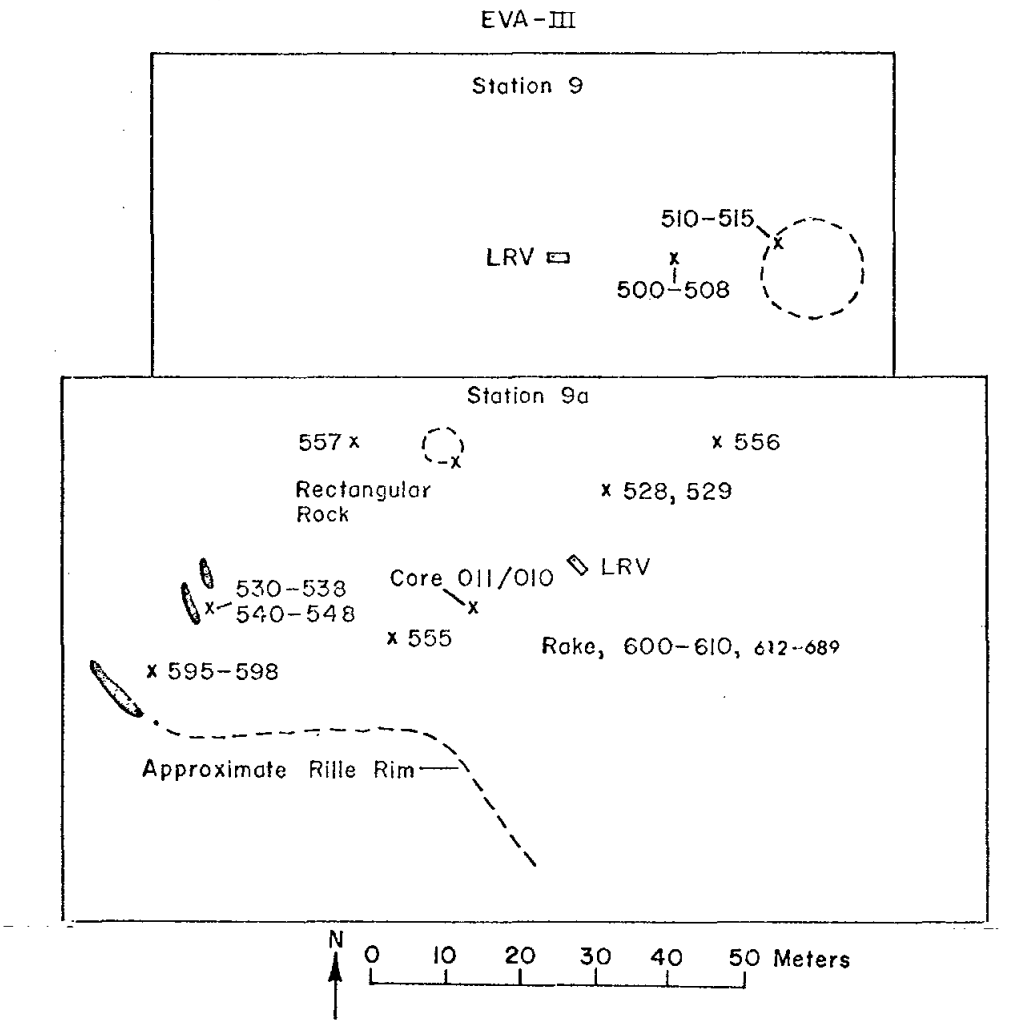


Figure 2 C. - Station Map Showing Sample Collection Sites; Modified From US Geological Survey Interagency Report 36.



Explanation for station maps

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

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

TABLE I. Sample inventory of Apollo 15 4-10 mm fines. See Table II and text for general descriptions of rock types.

SAMPLE NUMBER	# PARTICLES	MASS (g)	ROCK TYPE	SAMPLE LOCATION	PAGE
15024,1	10	2.64	microbreccia (1)	Lunar Module	18
15024,2	2	0.28	non-mare (5)	"	18
15024,3	1	0.15	agglutinate (3)	"	18
15024,4	2	0.41	basalt (9)	"	18
15034,1	2	0.78	basalt (8)	Sta 8-ALSEP	18
15034,2	5	1.00	microbreccia (1)	"	19
15034,3	5	1.47	microbreccia (1)	"	20
15044,1	4	0.84	microbreccia (1)	"	20
15044,2	1	0.18	basalt (8)	"	20
15074,1	3	1.03	basalt (9)	Sta 1-Elbow	20
15084,1	1	0.33	basalt (9)	"	22
15104,1	5	0.79	microbreccia (1)	Sta 2-St. George	23
15104,2	1	0.21	non-mare (5)	"	23
15204,1	1	0.08	microbreccia (1)	"	23
15214,1	2	0.14	microbreccia (2)	"	23
15224,1	5	0.79	microbreccia (1)	"	24
15224,2	7	2.33	microbreccia (1)	"	24
15224,3	8	1.14	agglutinate (3)	"	24
15224,4	1	0.16	ultrabasic (7)	"	25
15224,5	1	0.20	basalt (12)	"	26
15224,6	1	0.25	non-mare (5)	"	26
15234,1	5	0.85	agglutinate (3)	"	26
15234,2	2	0.16	non-mare (5)	"	26
15244,1	47	7.21	microbreccia (1)	Sta 6-Front	27
15244,2	59	8.05	microbreccia (1)	"	28
15244,3	6	0.99	microbreccia (1)	"	29
15244,4	5	0.38	microbreccia (2)	"	30
15244,5	44	7.76	agglutinate (3)	"	31
15244,6	18	3.03	microbreccia (1)	"	32
15254,1	4	0.53	microbreccia (1)	"	33
15264,1	8	0.87	microbreccia (1)	Sta 6-Front	34
15264,2	4	0.46	microbreccia (1)	"	34
15264,3	3	0.32	agglutinate (3)	"	34
15264,4	1	0.28	basalt (9)	"	35

TABLE I. (cont.) Sample inventory of Apollo 15 4-10 mm fines.

SAMPLE NUMBER	# PARTICLES	MASS (g)	ROCK TYPE	SAMPLE LOCATION	PAGE
15264,5	1	0.33	non-mare (5)	Sta 6-Front	36
15274,1	5	1.27	1 and 3	"	37
15274,2	2	0.41	non-mare (5)	"	37
15274,3	1	0.17	basalt (9)	"	37
15274,4	1	0.17	basalt (12)	"	38
15284,1	40	13.39	microbreccia (2)	Sta 6a-Front	39
15284,2	3	1.73	microbreccia (2)	"	40
15284,3	78	21.59	microbreccia (1)	"	41
15284,4	1	0.52	microbreccia (1)	"	41
15294,1	24	8.02	microbreccia (2)	Sta 6-Front	42
15294,2	5	0.95	microbreccia (1)	"	43
15294,3	2	0.38	agglutinate (3)	"	43
15294,4	1	0.07	basalt (8)	"	43
15294,5	1	0.08	basalt (9)	"	45
15294,6	1	0.16	non-mare (5)	"	46
15304,1	7	2.51	microbreccia (2)	Sta 7-Spur	47
15304,2	4	0.66	microbreccia (2)	"	48
15304,3	6	1.12	microbreccia (1)	"	48
15304,4	4	0.33	agglutinate (3)	"	49
15304,5	3	1.98	non-mare (5)	"	49
15314,1	3	0.24	green glass (6)	"	49
15314,2	5	0.57	basalt (8)	"	50
15314,3	1	0.23	basalt (8)	"	51
15314,4	9	2.01	non-mare (5)	"	52
15314,5	8	1.49	microbreccia (2)	"	52
15314,6	4	1.17	microbreccia (2)	"	52
15314,7	4	0.34	microbreccia (1)	"	53
15314,8	2	0.19	agglutinate (3)	"	53
15314,9	2	0.19	microbreccia (1), (6)	"	53
15314,10	1	0.10	basalt (12)	"	54
15314,11	2	0.37	non-mare (5)	"	55
15314,12	3	0.35	glass (4)	"	56
15404,1	9	1.86	microbreccia (1)	Sta 6a-Front	56
15404,2	13	4.63	microbreccia (2)	"	56
15404,3	3	1.04	basalt (12)	"	57
15404,4	1	0.11	glass (4)	"	57
15404,5	1	0.17	basalt (9)	"	58
15414,1	7	1.58	microbreccia (1)	Sta 7-Spur	58
15414,2	1	0.27	basalt (12)	"	59
15414,3	1	0.17	basalt (12)	"	60

TABLE I. (cont.) Sample inventory of Apollo 15 4-10 mm fines.

SAMPLE NUMBER	# PARTICLES	MASS (g)	ROCK TYPE	SAMPLE LOCATION	PAGE
15424	unclassified:		all actually 4 mm.		60
15434,1	26	4.09	glass (4)	Sta 7-Spur	61
15434,2	30	5.99	microbreccia (1)	"	62
15434,3	22	4.89	agglutinate (3)	"	63
15434,4	11	2.52	basalt (8)	"	63
15434,5	12	2.92	non-mare (5)	"	65
15434,6	1	0.11	gabbro (11)	"	66
15434,7	17	3.63	basalt (12)	"	67
15434,8	1	0.32	non-mare (5)	"	68
15474,1	7	2.91	basalt (9)	Sta 4-Dune	69
15474,2	2	0.24	non-mare (5)	"	69
15474,3	1	0.14	microbreccia (2)	"	69
15474,4	1	0.18	basalt (9)	"	70
15504,1	11	3.60	microbreccia (1)	Sta 9-Scarp	70
15514,1	1	0.07	microbreccia (2)	"	71
15514,2	1	0.33	basalt (8)	"	71
15514,3	1	0.22	basalt (9)	"	72
15514,4	1	0.16	basalt (9)	"	73
15534,1	4	2.15	basalt (10)	Sta 9a-Rille	74
15534,2	10	2.65	basalt (8)	"	75
15534,3	2	0.32	microbreccia (2)	"	76
15564,1	132	32.83	microbreccia (1)	"	76
15564,2	10	2.73	microbreccia (1)	"	77
15564,3	2	0.50	microbreccia (1)	"	78
15564,4	1	0.28	agglutinate (3)	"	78
15564,5	9	1.11	basalt (8)	"	79
15564,6	4	0.94	basalt (9)	"	80
15564,7	4	0.83	basalt (10)	"	81
15564,8	2	0.29	microbreccia (2)	"	82
15604,1	10	3.25	basalt (10)	"	83
15604,2	3	1.49	basalt (9)	"	84
15604,3	12	5.12	basalt (9)	"	85
15604,4	2	0.95	basalt (9)	"	86
15604,5	2	0.41	basalt (8)	"	87
15604,6	12	3.39	microbreccia (1)	"	88
15604,7	3	0.47	agglutinate (3)	"	88

CLASSIFICATION PROCEDURES

Samples described in this report were initially processed according to procedures and within the environment as described in the Apollo 15 Lunar Sample Information Catalogue (MSC 03209) (which see). For the purpose of the classification presented here the 4-10 mm fines samples were examined through the windows of the nitrogen atmosphere processing cabinets utilizing binocular microscopes. Samples were lightly dusted with the N_2 gas jet prior to examination. Each sample was then examined in bulk and subsequently separated into several subgroups (daughter samples) on the basis of observable lithologic differences.

In most cases classifications are based on textural and/or mineralogical features and are thus limited by the resolution of the microscope and some uncertainty in identification of phases and textures through such "macroscopic" observation. Clearly mistakes in classification are present, and within a given daughter sample there well may be particles which, on thin section examination, would prove to belong in some other group. Placement in a given category is probably 75-90% certain in most cases. In a few cases the uncertainty is greater, in others, even lower (better).

In all, 12 subgroups or classifications were established. These are briefly outlined in Table II and described more fully below. As individual variations are common the individual sample description should be checked for the fullest description.

1. Friable Microbreccias

These particles are friable (disaggregate with gentle pressure) medium gray microbreccias with visible clasts of various kinds embedded in a very fine-grained matrix. Clasts include various lithic types, including basalts, non-mare rocks and other microbreccias. Various mineral clasts may be present, including pyroxene, plagioclase and olivine. Clasts and spherules of glass are occasionally present, usually dark in color, rarely green. Minor amounts of an unidentified red mineral are occasionally present. Within a given parent sample, friable microbreccias are sometimes divided into two or more daughter samples on the basis of the character and/or abundance of recognizable clasts (see sample desciptions). Some of these particles have thin splash coatings of dark-colored glass on one or more surfaces.

2. Coherent Microbreccias (Recrystallized?)

These microbreccias are characterized by their strong intergranular coherence and granular matrices, probably the result of recrystallization. Clast types and variations are similar to those of group 1. Some of these particles, strictly speaking, are crystalline rocks. However, cataclastic textures are plainly visible in the angularity of clasts. Their dark gray matrices (relative to most clasts) readily distinguish them from non-mare crystalline rocks with brecciated textures (group 5).

3. Agglutinates

These particles consist of two or more particles (generally group 1 or 2 types) welded together by dark brownish-gray to yellowish-brown vesicular glass, which also coats one or more surfaces of the particles. Shapes are highly irregular.

4. Glass

These particles are entirely glass or consist of at least 75% glass of variable character, usually dark in color. Particle shapes vary from angular blocky (with conchoidal fracture) to twisted, ropey. One spherule was found. Some of these particles may well be partially or wholly devitrified. Still others may be microcrystalline basalts, mistakenly identified.

5. Non-Mare Crystalline Rocks

These particles are typically plagioclase-rich and light in color in shades of white, tan, or gray. Textures appear non-igneous, as though recrystallized cataclastic. Various detailed rock types occur, depending on the nature and abundance of mafics is often equivocal, and such names as norite (opx) and troctolite (olivine) should be liberally interpreted. In general opaques show low abundance (1% or so).

6. Green Glass Agglomerates

These unique particles consist of light apple green glass spherules and spherules and angular clasts contained in a friable lighter green matrix. Although only one daughter sample (15314,1) was found, such materials were rarely seen as clasts in gray microbreccias (15314,9).

7. "Ultrabasic" Rock

This is a unique pyroxene-olivine assemblage represented by only one particle (15224,4). See the sample description for further details.

8. Basalts

These are typical mare basalts with dark-colored pyroxenes and igneous textures varying from intergranular to ophitic. Olivine is often present but is <5%. Grain size ranges from fine basaltic to diabasic. Modal variations occur as do variations in the size and abundance of vugs and vesicles. See individual sample descriptions for fuller details.

9. Olivine Basalts and Diabases

These are similar to the above except for the abundance of olivine. All have >10% olivine, many >20%.

10. Vesicular Basalts

These particles are distinguished from the above because they appear to be virtually identical in all macroscopic respects to rock 15606. Large (2-5 mm) nearly spherical vesicles comprise some 20-30% of the rock.

11. Gabbro

A unique particle, similar in many respects to group 8 except for its coarse grain size ($\sim$1 mm); pyroxene is cinnamon brown. See 15434,6.

12. Microcrystalline Basalts

These particles are classified with considerable uncertainty, due to their very fine-grained character. They are dark gray in color and have a dull luster on fresh surfaces, unlike most of the glasses. In some cases a granularity is barely recognizable. Vesicles are sometimes present. They are presumed to be very fine-grained basalts, but in fact some may well be devitrified glass.

TABLE II Lithologic classifications of 4-10 mm particles (Apollo 15). See text and individual sample descriptions for fuller description of rock types.

ROCK TYPE NO.	GENERAL LITHOLOGY
1	Friable microbreccias with visible clasts of various types; some have thin partial coating of dark glass.
2	Coherent microbreccias with apparently crystalline matrices, presumably recrystallized; visible clasts of various types.
3	Agglutinates comprised of type 1 or 2 microbreccias welded together by dark vesicular glass.
4	Glasses or glass-rich particles, dark in color; shape variable: some ropey, others blocky; conchoidal fracture typical.
5	Crystalline rocks of "non-mare" character; generally feldspar-rich; mafica include light-colored pyroxene (presumably orthopyroxene) and/or olivine; non-igneous textures.
6	Agglomerates of light apple-green glass spherules and angular fragments; fine matrix also light green in color.
7	Crystalline rock consisting of pyroxene and olivine, plus accessory phases; ultrabasic character.
8	Basaltic rocks with various igneous textures; generally <5% visible olivine.
9	Basaltic rocks with various igneous textures and >10% visible olivine (many have >20% olivine).
10	Vesicular basalts very similar to rock 15606; vesicles are spherical, 2-5 mm.
11	Gabbro with cinnamon-brown pyroxene; plagioclase/pyroxene ratio ~1:2; <2% opaques.

12 Very fine-grained (microcrystalline) dark gray rocks with dull lustre on fresh surfaces; probably microcrystalline basalts; some could be devitrified glass. Identity uncertain.

SAMPLE DESCRIPTIONS

The following pages contain descriptions, based on binocular microscopic observation, of all daughter samples established as a result of this examination. For each the total weight of the daughter sample is given along with the number of particles in the daughter sample. In so far as many daughter samples are similar to others, references are frequently made to other samples for full descriptions. The sample descriptions appear in numerical order. Photographs of representative particles are shown for many samples (those with an asterisk (*) by the sample number). A millimeter scale is present in most photographs.

It should be noted that many mineral identifications as well as estimated modal abundances are tentative, as none of these samples were examined in thin section for this report.

Following this section is a summary of observations and interpretations along with a population study based on the >900 individual particles examined in this study.

SAMPLE 15024,1

Rock Type: Microbreccia
No. of Particles: 10 / Weight: 2.64 g

Remarks
Essentially identical to 15244,2, which see for description.

SAMPLE 15024,2

Rock Type: Crystalline Rock (non-mare)
No. of Particles: 2 / Weight: 0.28 g

Remarks
These particles are essentially similar to 15434,5, which see for description.

SAMPLE 15024,3

Rock Type: Agglutinate
No. of Particles: 1 / Weight: 0.15 g

Remarks
See 15244,5 for description.

SAMPLE 15024,4

Rock Type: Olivine Basalt
No. of Particles: 2 / Weight: 0.41 g

Remarks
These particles are very similar to 15604,3, which see for description.

SAMPLE 15034,1

Rock Type: Granular Basalt
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Light brown
Special Features: Vugs
No. of Particles: 2 / Weight: 0.78 g

Remarks

Medium to coarse-grained granular basalt with equigranular xenomorphic-granular texture. Anhedral cinnamon-brown pyroxene (~ 60%), subhedral to anhedral white plagioclase (~ 40%), greenish-yellow olivine (~ 1%), minor opaques. Vugs (~ 1 mm) are present into which project euhedral prisms of brown pyroxene and white blades of plagioclase. Mean grain size 0.25-0.5 mm.

SAMPLE 15034,2 *

Rock Type: Microbreccia
Coherence(intergranular): Friable to coherent
Shape: Subrounded to rounded
Surface: Smooth to very finely granular
Color: Medium gray
Special Features: None
No. of Particles: 5 / Weight: 1.00 g

Remarks

Medium-gray friable to coherent microbreccia consisting of lithic, mineral, and glass fragments of varied size and shape contained in a very fine-grained matrix. Lithic fragments are not abundant, and include granular basalts and feldspar-rich lithic materials. One particle contains a noteworthy large (3 X 5 mm) lithic clast rich in pale green material, either olivine or glass.

S-71-59943 Sample 15034,2

SAMPLE 15034,3

Rock type: Glass-coated Microbreccia
Coherence (intergranular): Friable to coherent
Shape: Subangular to subrounded, irregular
Surface: Smooth
Color: Medium to dark gray
Special Features: Glass coating
No. of Particles: 5 / Weight: 1.47 g

Remarks
These particles are essentially identical to microbreccia 15034,2 except for the presence on one or two surfaces of thin splash coatings of vesicular dark brownish-gray to yellowish-brown glass.

SAMPLE 15044,1

Rock Type: Glass coated microbreccia
No. of Particles: 4 / Weight: 0.84 g

Remarks
See 15034,3 for description.

SAMPLE 15044,2

Rock Type: Basalt
No. of Particles: 1 / Weight: 0.18 g

Remarks
See 15034,1 for description.

SAMPLE 15074,1*

Rock Type: Olivine diabase
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Light brown, mottled
Special Features: Olivine phenocrysts
No. of Particles: 3 / Weight: 1.03 g

Remarks

Porphyritic olivine diabase with 3-5 mm tabular subhedral greenish-yellow olivine phenocrysts in a finer matrix (mean grain size ~C.5-1 mm) of subhedral to euhedral lath-like white plagioclase and anhedral equidimensional cinnamon-brown pyroxene plus anhedral ilmenite (?) in an intergranular to subophitic texture.

Approximate mode:
Olivine (~20%)
Pyroxene (~40%)
Plagioclase (~40%)
Ilmenite (~1%)

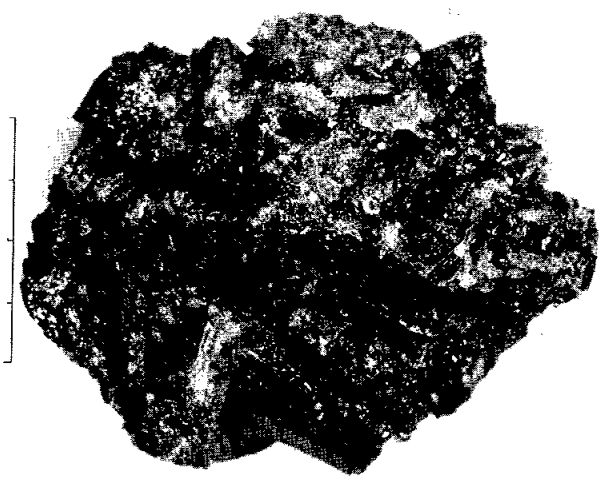
S-71-60187 Sample 15074,1

SAMPLE 15084,1*

Rock Type: Olivine gabbro
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Brown, mottled
Special Features: Euhedral Pyroxene
No. of Particles: 1 / Weight: 0.33 g

Remarks

Similar to 15074,1 except pyroxene coarser, sometimes euhedral (prismatic, up to 5 mm in length). Pyroxene dark cinnamon-brown to orange-brown in color. Mean grain size 2-3 mm. Olivine ~10%, Pyroxene ~50%, Plagioclase ~40%, Opaques ~1%.



S-71-60188 Sample 15084,1

SAMPLE 15104,1

Rock Type: Microbreccia
Coherence (intergranular): Friable to coherent
No. of Particles: 5 / Weight: 0.79 g

Remarks
See 15244,2 and 15244,6 for descriptions of similar types.

SAMPLE 15104,2

Rock Type: Crystalline rock (non-mare)
No. of Particles: 1 / Weight: 0.21 g

Remarks
See 15434,5 for description of similar types.

SAMPLE 15204,1

Rock Type: Microbreccia
Coherence (intergranular): Friable to coherent
Shape: Subrounded
Surface: Very finely granular
Color: Medium gray
Special Features: None
No. of Particles: 1 / Weight: 0.08 g

Remarks
This particle is essentially similar to 15244,2 except that 15204,1 is somewhat more coherent (slightly recrystallized?). See 15244,2 and 15244,1 for more description.

SAMPLE 15214,1

Rock Type: Recrystallized microbreccia
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Light gray
Special Features: None
No. of Particles: 2 / Weight: 0.14 g

Remarks

Tough coherent microbreccias consisting of lithic and mineral clasts set in a fine-grained apparently crystalline matrix. One particle contains lithic clasts of subophitic basalt as well as granular clasts of pale greenish-yellow olivine (?). Among recognizable mineral fragments, plagioclase predominated in both particles. Glass fragments may be present but were not unequivocally identified. One particle has a nearly spherical dark glass bleb (~0.5 mm) adhering to one corner (but not incorporated within the particle itself).

SAMPLE 15224,1

Rock Type: Microbreccia
Coherence (intergranular): Friable
Shape: Subrounded to rounded
Surface: Very finely granular
Special Features: None
No. of Particles: 5 / Weight: 0.79 g

Remarks

These particles are essentially identical to 15244,2 (See 15244,2 and 15244,1 for description).

SAMPLE 15224,2

Rock Type: Glass-coated microbreccias
Coherence (intergranular): Friable
Shape: Subangular to subrounded
Surface: Very finely-granular to smooth
Color: Medium gray
No. of Particles: 7 / Weight: 2.33 g

Remarks

These particles are essentially identical to 15244,6 (which see for description).

SAMPLE 15224,3

Rock Type: Agglutinates
Coherence (intergranular): Friable (breccia) to tough (glass)
Shape: Irregular
Surface: Very finely-granular (breccias) to smooth (glass)
Color: Medium to dark gray
Special Features: Vesicular glass bonding agent to soil breccia particles.
No. of Particles: 8 / Weight: 1.14 g

Remarks

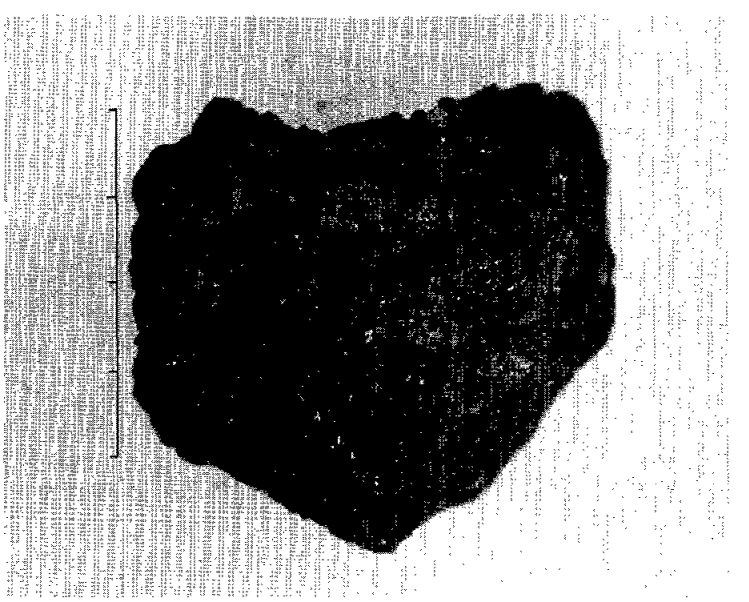
These particles are virtually identical to 15244,5 (which see for description).

SAMPLE 15224,4*

Rock Type: Ultrabasic rock (?)
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Medium to dark gray
Special Features: Olivine abundance; fractured pyroxene
No. of Particles: 1 / Weight: 0.16 g

Remarks

Xenomorphic-granular inequigranular seriate crystalline rock consisting principally of dark gray pyroxene (~60-70%) and greenish-yellow olivine (~30-40%) with minor amounts of other phases including plagioclase (?) and opaques. The pyroxene appears to have abundant close-set parallel fractures (shock deformation?). If mineral identifications are correct the rock is a peridotite or an olivine-bearing pyroxenite.



S-71-59944 Sample 15224,4

SAMPLE 15224,5

Rock Type: Very fine-grained basalt(?)
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Dark gray
Special Features: None
No. of Particles: 1 / Weight: 0.20 g

Remarks
Essentially similar to 15434,7 (which see for description).

SAMPLE 15224,6

Rock Type: Non-mare crystalline rock
Special Features: Olivine represents 5-10% of the rock
No. of Particles: 1 / Weight: 0.25 g

Remarks
This particle is essentially similar to 15434,5 (which see for description).

SAMPLE 15234,1

Rock Type: Agglutinate
No. of Particles: 5 / Weight: 0.85 g

Remarks
See 15244,5 for description.

SAMPLE 15234,2

Rock Type: Crystalline rock (non-mare)
No. of Particles: 2 / Weight: 0.16 g

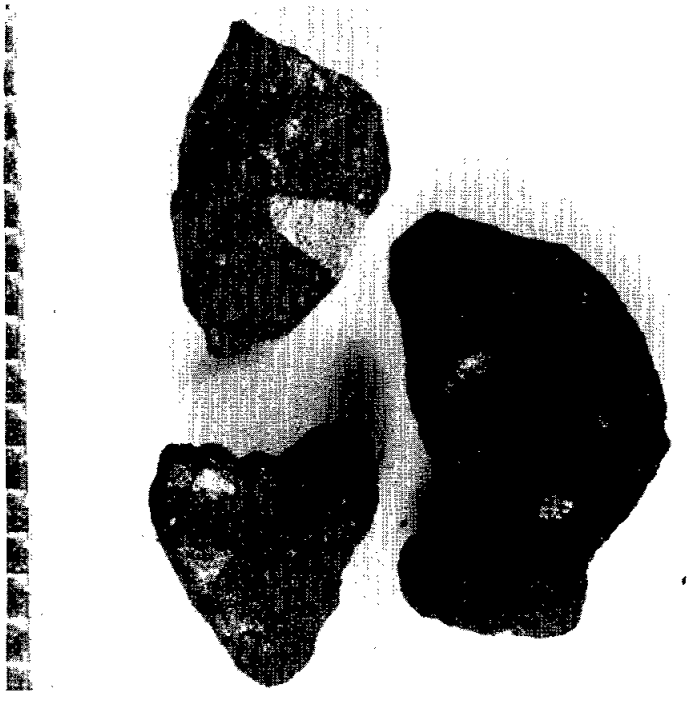
Remarks
See 15434,5 for description of similar type.

SAMPLE 15244,1*

Rock Type: Microbreccia
Coherence (intergranular): Friable
Shape: Subrounded to rounded
Surface: Very finely granular
Color: Medium gray
Special Features: Angular light gray to white lithic fragments, 0.5-2 mm relatively abundant (5-10% of rock) see sample 15244,2.
No. of Particles: 47 / Weight: 7.21 g

Remarks

Gray microbreccias, generally friable (will disaggregate with moderate pressure from forceps), consisting of angular lithic fragments of crystalline feldspathic material, angular dark brown to black glass fragments and spheres, and mineral fragments (chiefly clinopyroxene, olivine (?) and plagioclase) contained in a very fine-grained medium gray friable matrix of undetermined character (probable glass and very fine mineral fragments). Mineral and glass fragments range in size up to ~1 mm (most are smaller). Identifiable clasts (binocular microscope) constitute 10-30% of the rock, the remainder being fine matrix.



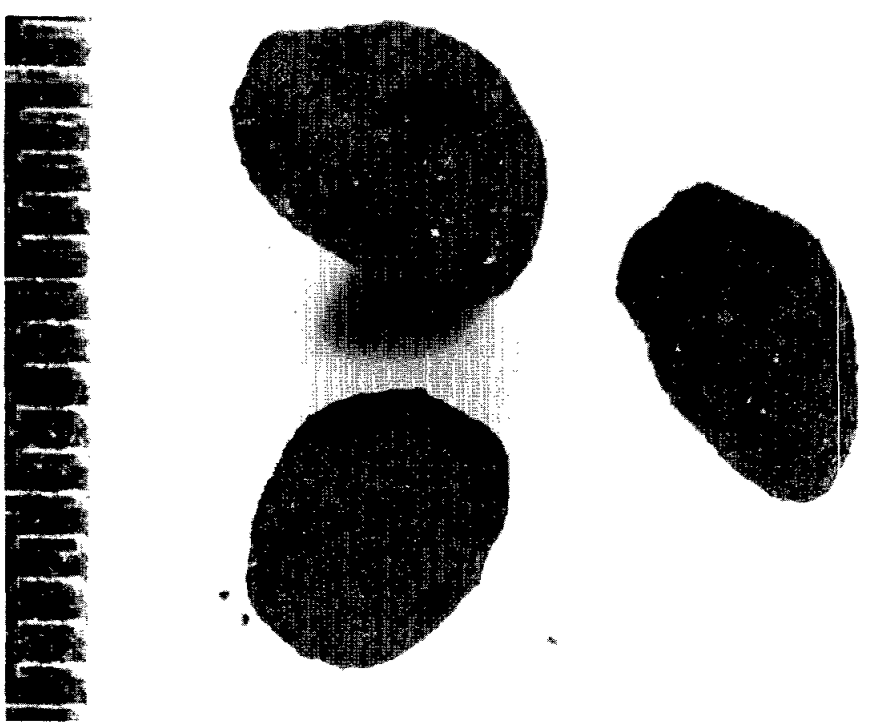
S-71-59631 Sample 15244,1

SAMPLE 15244,2*

Rock Type: Microbreccia
Coherence (intergranular): Friable
Shape: Subrounded to rounded
Surface: Very finely granular
Color: Medium gray
Special Features: None
No. of Particles: 59 / Weight: 8.05 g

Remarks

These particles are essentially identical with the exception of a lower abundance of white clasts. This is an arbitrary and subjective (qualitative) distinction, and the two types doubtless grade into one another. See description of 15244,1. The distinction is made chiefly for those who may wish to study the white clasts in detail.



S-71-59629 Sample 15244,2

SAMPLE 15244,3*

Rock Type: Microbreccia
Coherence (intergranular): Friable
Shape: Subrounded to rounded
Surface: Very finely granular
Color: Medium gray
Special Features: Green glass fragments and spheres: at least one visible in each particle; sizes range from 0.25-1 mm
No. of Particles: 6 / Weight: 0.99 g

Remarks

See descriptions of 15244,1 and 15244,2. These particles are very similar to 15244,1 except for a lower abundance of white clasts and the presence of visible green glass (in 15244,3). They are essentially identical to 15244,2 except for the green glass (not visible in 15244,2). The green glass is not abundant in these particles and probably comprises <2% by volume. This category (15244,3) is established chiefly for those wishing to examine the green glass in detail. (It may be present in other particles of 15244 but was not observed under the binccular microscope).

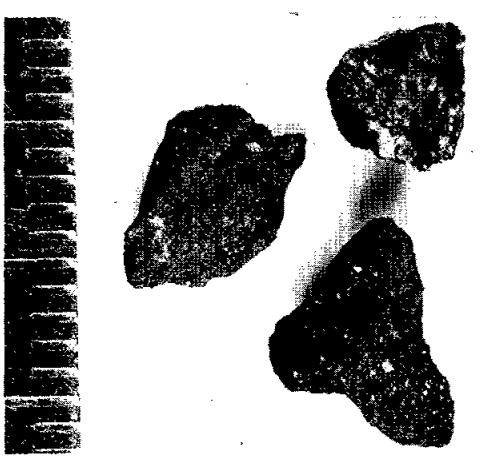
S-71-59616 Sample 15244,3

SAMPLE 15244,4*

Rock Type: Microcreccia (recrystallized?)
Coherence (intergranular): Coherent to tough
Shape: Subangular to subrounded
Surface: Very finely granular
Color: Medium gray
Special Features: Relatively abundant white lithic clasts up to 1 mm in size / Matrix slightly coarser grained than in 15244,1,2 and 3.
No. of Particles: 5 / Weight: 0.38 g

Remarks

Gray microbreccias, coherent, consisting of light gray to white lithic and mineral fragments (feldspathic), and mafic mineral fragments (yellow-brown pyroxene and/or olivine) in a fine-grained coherent matrix. The matrix is too fine-grained for positive identification, but coherence and salt-and-pepper granular appearance suggest it is crystalline. Two of five particles contain visible fragments of a red mineral (unidentified). White feldspathic clasts comprise about 5-25% of the particles and outnumber clasts of other specific types in a given particle.



S-71-59630 Sample 15244,4

SAMPLE 15244,5*

Rock Type: Agglutinate
Coherence (intergranular): Friable (breccia) to tough (glass)
Shape: Irregular
Surface: Glass surfaces smooth, vitreous; soil breccia surfaces very finely granular
Color: Glass - dark brownish-gray to yellowish-brown; Microbreccia - medium gray
Special Features: Glass is vesicular, occurs as coatings and bonding agent to soil breccia particles
No. of Particles: 44 / Weight: 7.76 g

Remarks

These particles consist of friable microbreccia (soil breccia) fragments welded together by dark brownish-gray to yellowish-brown vesicular glass, which also coats 25-50% of the free surface area of the fragments. Glass coatings are generally thin, showing abundant circular "windows". The microbreccias are the same type as 15244,1 and 15244,2 (which see).

S-71-59619 Sample 15244,5

SAMPLE 15244,6*

Rock Type: Glass-coated microbreccias
Coherence: (intergranular): Friable
Shape: Subrounded
Surface: Glass - smooth, vitreous
Color: Glass - dark brownish-gray to yellowish-brown; microbreccia - medium gray
Special Features: Glass coatings
No. of Particles: 18 / Weight: 3.03 g

Remarks

These particles are microbreccias of the same types as 15244,1 and 15244,2 (mostly the latter) with the distinction of having 10-50% of their surfaces covered with a thin coating of vesicular brownish-gray to yellowish-gray glass. Glass coatings are thin, showing abundant circular "windows". Typically one or two surfaces are coated.

S-71-59614 Sample 15244,6

SAMPLE 15254,1*

Rock Type: Microbreccia
No. of Particles: 4 / Weight: 0.53 g

Remarks

These particles are essentially similar to 15244,2 and 15244,6 (which see for descriptions).

One particle is shaped like a half-cone with a convex botton. The convex bottom is greenish-white in color and appears to be a fine-grained mixture of white plagioclase and a pale apple-green phase (glass?). It is not clear whether the whole particle consists of this material and has a dark soil veneer or whether this is a large clast (5mm) in a gray microbreccia.

S-71-60189 Sample 15254,1

SAMPLE 15264,1

Rock Type: Microbreccia
Coherence (intergranular): Friable
Shape: Subrounded to round
Surface: Very finely granular
Color: Medium gray
Special Features: None
No. of Particles: 8 / Weight: 0.87 g

Remarks
These particles are virtually identical to 15244,2. See 15244,2 and 15244,1 for description.

SAMPLE 15264,2

Rock Type: Glass-coated microbreccia
Coherence (intergranular): Friable
Shape: Subrounded
Surface: Breccia - very finely granular; Glass - smooth, vitreous
Color: Medium gray
Special Features: Glass coatings
No. of Particles: 4 / Weight: 0.46 g

Remarks
These particles are virtually identical to 15244,6 (which see for description).

SAMPLE 15264,3

Rock Type: Agglutinate
Coherence (intergranular): Friable (breccia) to tough (glass)
Shape: Irregular
Surface: Breccias - very finely granular; Glass - smooth, vitreous
Color: Medium to dark gray
Special Features: Vesicular glass bonding agent to soil breccia particles.
No. of Particles: 3 / Weight: 0.32 g

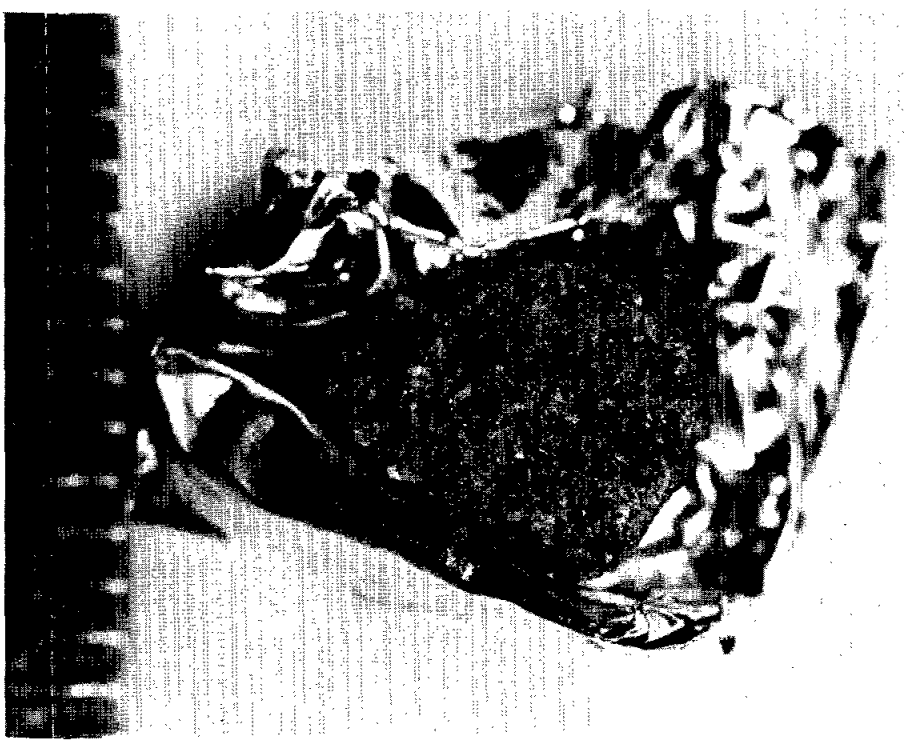
Remarks
These particles are virtually identical to 15244,5 (which see for description).

SAMPLE 15264,4*

Rock Type: Olivine basalt
Coherence (intergrangular): Tough
Shape: Subangular
Surface: Hackly
Color: Light grayish-brown
Special Features: Olivine abundance
No. of Particles: 1 / Weight: 0.28 g

Remarks

Course grained (~ 0.5 mm) olivine basalt with granular to subophitic texture. Subhedral white plagioclase (~ 35-40%) anhedral to euhedral cinnamon to pale brown pyroxene (~ 45%), anhedral greenish-yellow olivine (~ 15%), opaques (~ 2-3%). Vugs are not present.



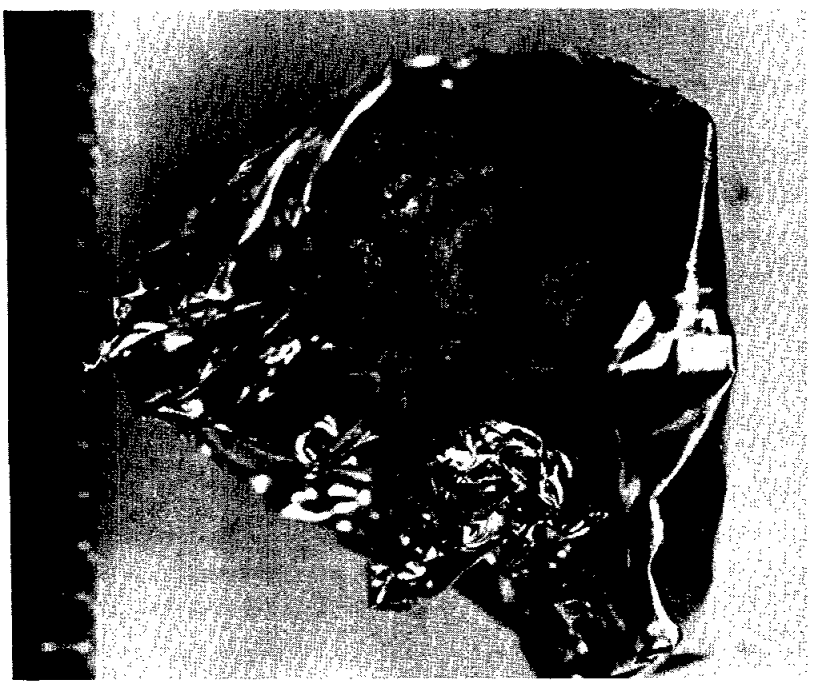
S-71 59942 Sample 15264,4

SAMPLE 15264,5*

Rock Type: Recrystallized troctolite microbreccia (?)
Coherence (intergranular): Tough
Shape: Subangular
Color: Greenish White
Special Features: Dark brown glass coating on one surface
No. of Particles: 1 / Weight: 0.33 g

Remarks

Identification uncertain; crystalline rock with inequigranular seriate xenomorphic-granular texture consisting of ~50-60% milky white plagioclase and ~40-45% of a pale apple green material (olivine?). Accessory minute opaques are also present (<1%). Texture suggests a recrystallized microbreccia; the mineralogy (if correctly identified) implies a troctolite composition.



S-71-59931 Sample 15264,5

SAMPLE 15274,1

Rock Type: Microbreccias and Agglutinates
No. of Particles: 5 / Weight: 1.27 g

Remarks
See 15244,5 and 15244,6 for descriptions.

SAMPLE 15274,2

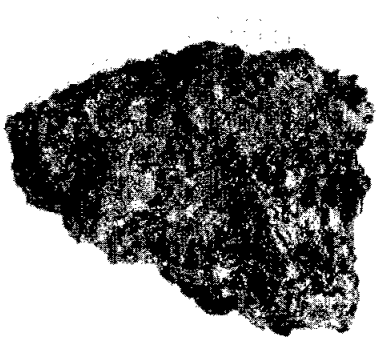
Rock Type: Crystalline rock (non-mare)
No. of Particles: 2 / Weight: 0.41 g

Remarks
See 15434,5 for description.

SAMPLE 15274,3*

Rock Type: Olivine basalt
No. of Particles: 1 / Weight: 0.17 g

Remarks
See 15564,6 for description of essentially similar type. Mean grain size ~0.5 mm. Olivine ~20%.



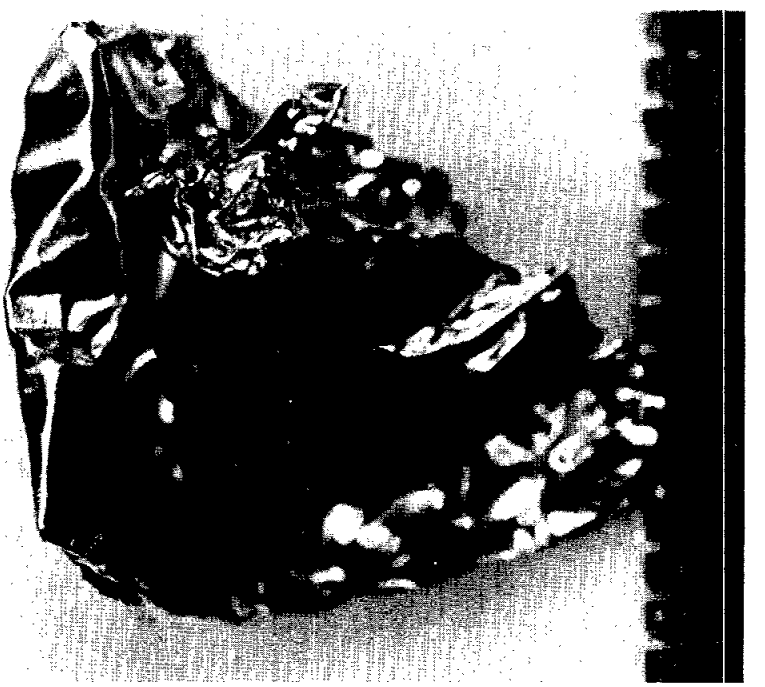
S-71-60190 Sample 15274,3

SAMPLE 15274,4*

Rock Type: Basalt
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Dark gray
Special Features: None
No. of Particles: 1 / Weight: 0.17 g

Remarks

Fine-grained basalt. Light gray plagioclase is subordinate to dark gray pyroxene. Grain size too small for elucidation of texture or mode.



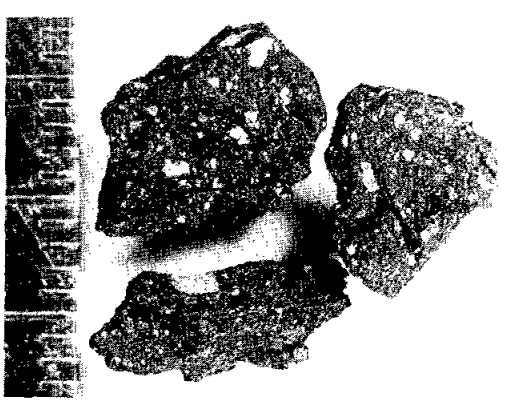
S-71-60562 Sample 15274,4

SAMPLE 15284,1*

Rock Type: Microbeccia (recrystallized?)
Coherence (intergranular): Tough
Shape: Angular to subangular
Surface: Hackly
Color: Dark gray, speckled with white
Special Features: Abundant clasts of variable character - most clasts > 1 mm are white feldspar - rich lithic types or pale colored basalt lithic fragments.
No. of Particles: 40 / Weight: 13.39 g

Remarks

Very coherent microbreccias consisting of angular to rounded lithic and mineral clasts in a dark gray crystalline matrix. Most clasts are lighter colored than the matrix. Most clasts larger than 1 mm are white plagioclase-rich lithic types or pale-colored basaltic lithic fragments. Other recognizable clasts include pale yellow to brownish-orange pyroxene, greenish yellow olivine (?) opaques (ilmenite?), and a red mineral (rare). Light colored feldspathic clasts out number all other types combined by at least 5 to 1 in most cases. Some appear to be pure plagioclase, others feldspar-rich lithic fragments with subordinate amounts of pale tan pyroxene and/or yellow-green olivine (?) plus minute opaques. Some clasts are themselves microbreccias, generally rich in plagioclase. Visible clasts represent from about 15-40% of the rock, the remainder is matrix. The matrix has a visible granularity, and appears to be crystalline. This together with the strong coherence of the particles suggests moderate to extensive recystallization of the matrix.



S-71-59621 Sample 15284,1

SAMPLE 15284,2*

Rock Type: Microbreccia (recrystallized?)
Coherence (intergranular): Tough
Shape: Angular to subangular
Surface: Hackly
Color: Dark gray, speckled with white
Special Features: Contain large (2-6 mm) lithic clasts of light colored basalt (see description below)
No. of Particles: 3 / Weight: 1.73 g

BASALT CLASTS
Rock Type: Basalt
Texture: Subophitic
Grain Size (mean): 0.5 mm
Minerals Recognized, With Approximate Abundances:
(1) Plagioclase, euhedral to subhedral laths, white (50%)
(2) Clinopyroxene, euhedral, pale brown (45%)
(3) Olivine, euhedral, pale yellow (2%)
(4) Opaque (ilmenite probably), euhedral to subhedral, irregular to lath-shaped (3%)
Color: Pale tan, speckled

Remarks

These particles are essentially identical to those in 15284,1 (which see). They are classified separately only on the basis of possessing large basalt lithic clasts for those who wish to study these in detail.

S-71-59622 Sample 15284,2

SAMPLE 15284,3

Rock Type: Microbreccia
Coherence (intergranular): Coherent to friable
Shape: Subrounded to rounded
Surface: Very finely granular
Color: Medium gray
Special Features: None
No. of Particles: 78 / Weight: 21.59 g

Remarks

Medium gray microbreccias, generally friable to coherent (will disaggregate under moderate to firm pressure of the forceps), consisting of angular to rounded lithic and mineral fragments in a very fine-grained matrix of undetermined character (probably glass and very fine mineral fragments). Angular fragments and spheres of dark glass are also present. Recognizable lithic clasts include fine-grained basalt, plagioclase-rich rock types (including anorthosite), and micobreccias (some identical to 15284,1). Identifiable mineral fragments include pale to cinnamon brown pyroxene, plagioclase, yellow to yellow-green olivine (?) and opaques (ilmenite mostly). Light colored clasts (feldspathic) are the most abundant single type but represent <50% of total clast population. Typical particles consist of ~10-25% visible clasts, the remainder is matrix. These particles very closely resemble 15244,2 but may be slightly more coherent (they do not differ in appearance). A few particles have thin splash coatings of dark glass on 10-40% of their surface area.

SAMPLE 15284,4*

Rock Type: Microbreccia
Special Features: Green crystalline lithic clasts, ~5 mm
No. of Particles: 1 / Weight: 0.52 g

Remarks

This particle is identical to 15284,3 types (which see), with the distinction of having a large (~5mm) lithic clast of special character. Identification is not certain, but the dominant phase in the clast is probably either olivine or green glass. The former is considered most likely. The clast is pistacchio green in color, is granular, has local grains of a darker green color. Very small amounts of other phases are present, including ~1% of minute opaques and ~1% of a light gray mineral (pyroxene?). The

clast very much resembles some terrestrial dunites and for this reason olivine is the perferred identification.

NOTE

This particle should be studied in detail to determine its mineralogy and petrology.

S-71-59613 Sample 15284,4

SAMPLE 15294,1

Rock Type: Microbreccia (recrystallized?)
No. of Particles: 24 / Weight: 8.02 g

Remarks

These particles are identical to 15284,1 (which see for description). About $\frac{1}{2}$ of these particles have thin splash coating of dark grayish brown to yellowish brown vesicular glass on one or more faces.

SAMPLE 15294,2

Rock Type: Microbreccia (friable)
No of Particles: 5 / Weight: 0.95 g

Remarks
These particles are identical to 15244,2. (See 15244,1 and 15244,2 for description).

SAMPLE 15294,3

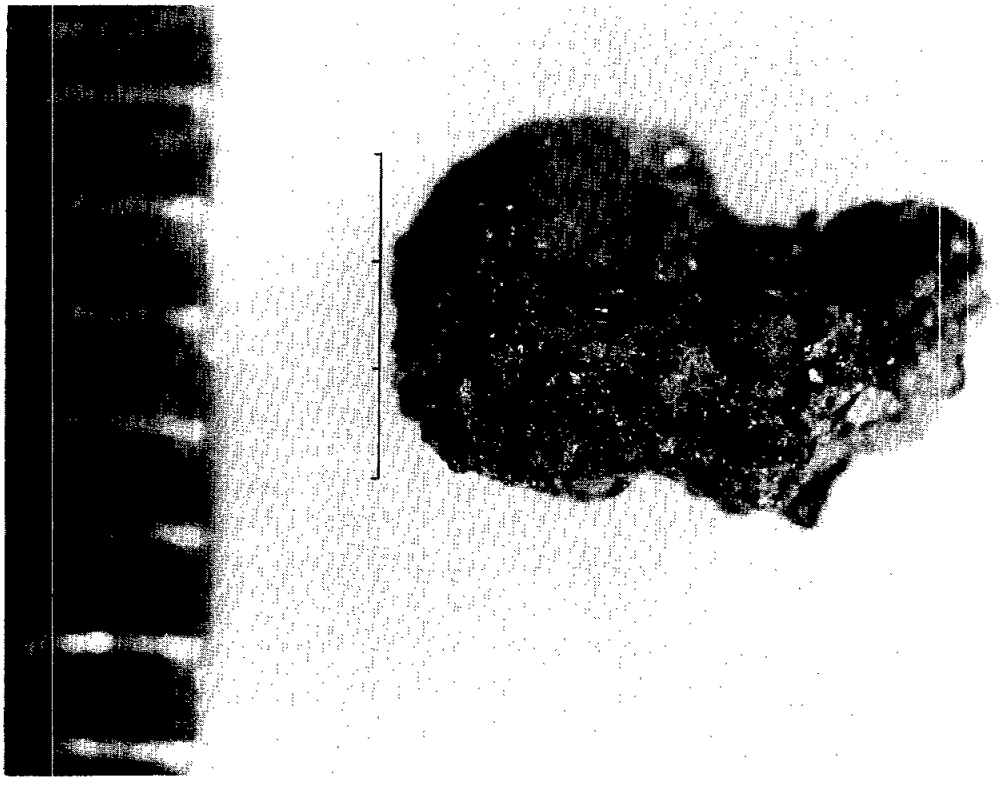
Rock Type: Agglutinate
No. of Particles: 2 / Weight: 0.38 g

Remarks
These particles are identical to 15244,5 (which see for description).

SAMPLE 15294,4*

Rock Type: Basalt
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Light brown, speckled
Special Features: No vugs or vesicles
No. of Particles: 1 / Weight: 0.07 g

Remarks
Holocrystalline basalt with subophitic to intergranular texture, mean grain size 0.25 mm.
Minerals Identified, With Approximate Abundances:
(1) Plagioclase, euhedral to subhedral, blocky to lath shaped (60%) (white)
(2) Clinopyroxene, cinnamon brown to chocolate brown, anhedral (40%)
(3) Olivine (?) greenish yellow, anhedral, equidimensional (< 1%)
(4) Opaque (probably ilmenite), anhedral (<1%).



S-71-59626 Sample 15294,4

SAMPLE 15294,5*

Rock Type: Olivine (?) Basalt
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Pale tan
Special Features: Penetrative fracture filled by vein of dark cinnamon brown material (probably glass).
No. of Particles: 1 / Weight: 0.08 g

Remarks

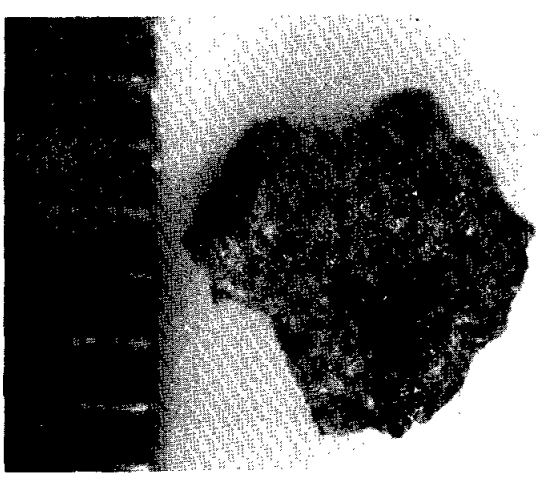
Holocrystalline basalt with equigranular xenomorphic granular texture. Minerals indentified, with approximate abundances:

(1) Plagioclase, white to colorless, subhedral to anhedral (35%)
(2) Pyroxene, pale tan, anhedral (40%)
(3) Olivine (?) pale yellow, anhedral (20%)
(4) Opaque (ilmenite?), anhedral (5%)

This rock is unusual compared to most lunar basalts in the following respects:

(1) High olivine content
(2) Low plagioclase content
(3) Pale color

Mean grain size 0.25 mm



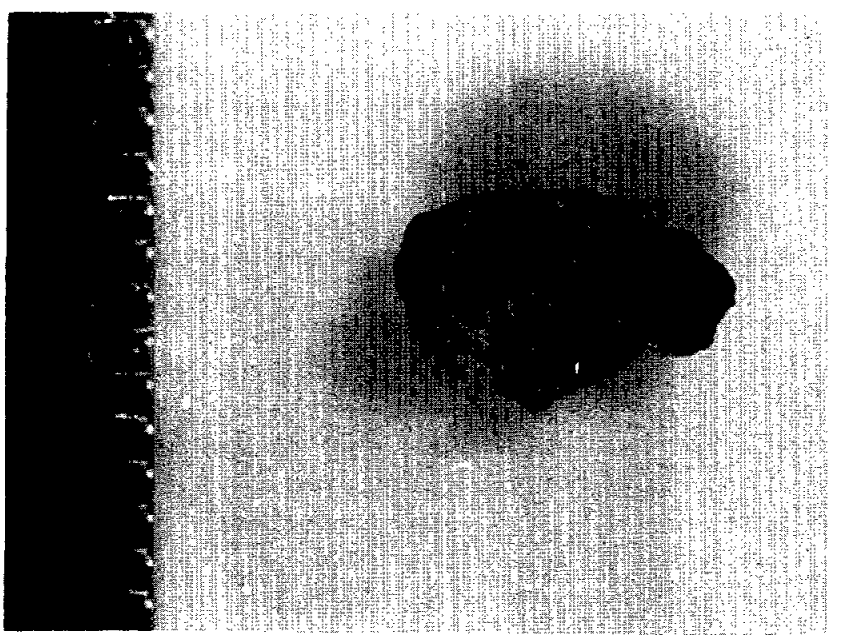
S-71-59615 Sample 15294,5

SAMPLE 15294,6*

Rock Type: Recrystallized norite microbreccia
Coherence (intergranular): Tough
Shape: Subrounded
Surface: Hackly
Color: Light tannish-gray
Special Features: Vugs
No. of Particles: 1 / Weight: 0.16 g

Remarks

Crystalline rock with xenomorphic-granular seriate texture; a few vugs are present. Minerals identified, with approximate abundances:
(1) Plagioclase, white to grayish-white, anhedral (40%)
(2) Pyroxene (ortho?), very pale tannish-gray, anhedral (55%)
(3) Olivine (?) pale greenish-yellow anhedral (5%)
(4) Opaques, black, anhedral, very minute (<1%)
(5) Red mineral, anhedral (<1%)
The texture is fine-grained and difficult to discern, but the seriate, xenomorphic-granular character suggests a recrystallized cataclastic texture. Looks like many of the norite breccias from the Apollo 14 coarse fines. The olivine (?) grains are generally relatively large (~1mm).



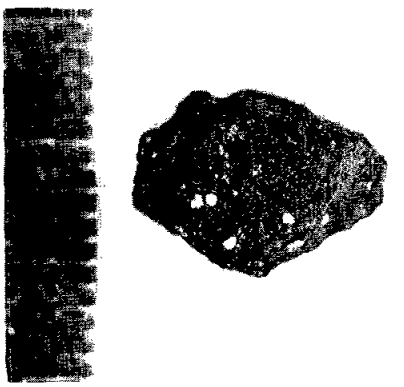
S-71-59618 Sample 15294,6

SAMPLE 15304,1*

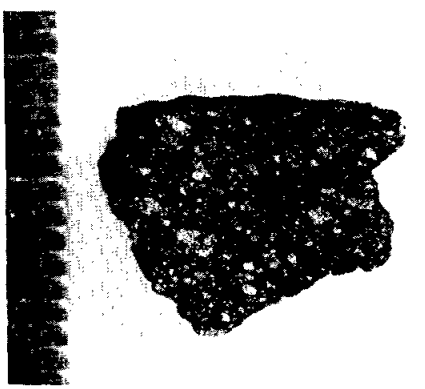
Rock Type: Microbreccia (recrystallized)
Coherence (intergranular): Tough
Shape: Angular to subangular
Surface: Hackly
Color: Dark gray, speckled with white
Special Features: Green glass
No. of Particles: 7 / Weight: 2.51 g

Remarks

These particles are essentially identical to 15284,1 except that these contain a higher abundance of red mineral and a notable abundance of green glass (angular fragments and spherules), 2-5%. (See 15284,1 for a fuller general description).



S-71-59929 Sample 15304,1



S-71-59920 Sample 15304,1

SAMPLE 15304,2

Rock Type: Recrystallized Microbreccia, glass coated
No. of Particles: 4 / Weight: 0.66 g

Remarks

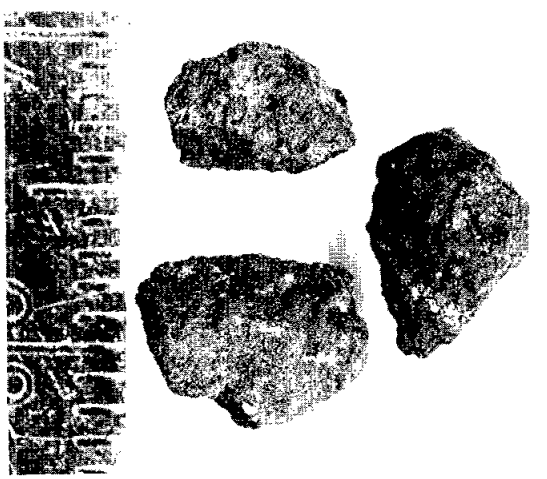
These particles are essentially identical to 15304,1 except that they have thin splash coatings of dark brownish-gray vesicular glass on one or more surfaces. (See 15304,1 and 15284,1 for fuller description).

SAMPLE 15304,3*

Rock Type: Microbreccia
Coherence (intergranular): Friable to coherent
Shape: Subangular to subrounded
Surface: Very finely granular
Color: Medium gray
Special Features: Green glass spherules and fragments
No. of Particles: 6 / Weight: 1.12 g

Remarks

These particles are essentially similar to 15434,2 except these contain a notable abundance (~2-5%) of visible green glass fragments and spherules. See 15434,2 for a more complete description.



S-71-59928 Sample 15304,3

SAMPLE 15304,4

Rock Type: Agglutinates
Coherence (intergranular): Friable
Shape: Irregular
Surface: Finely granular to smooth, irregular
Color: Medium to dark gray
Special Features: None
No. of Particles: 4 / Weight: 0.33 g

Remarks

These are agglutinates consisting of two or more friable microbreccia particles (type of 15304,3) welded together by dark brownish-gray to yellowish-brown vesicular glass.

SAMPLE 15304,5

Rock Type: Crystalline rock (non-mare)
Coherence (intergranular): Tough
Shape: Subrounded
Surface: Hackly
Color: Light tannish-gray
Special Features: None
No. of Particles: 3 / Weight: 1.98 g

Remarks

These particles are essentially identical to 15434,5 which see for description.

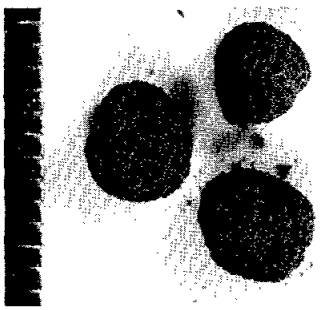
SAMPLE 15314,1*

Rock Type: Green glass agglomerate or microbreccia
Coherence (intergranular): Friable
Shape: Well rounded
Surface: Finely granular
Color: Apple green
Special Features: High abundance of green glass (90-100%)
No. of Particles: 3 / Weight: 0.24 g

Remarks

These unique particles consist of abundant medium to dark green glass spherules (0.1-0.5 mm diameter) in a pale green fine-grained friable matrix (probably comminuted green glass). Visible green spherules comprise about 20% of the particles, the rest matrix.

Material other than green glass is not recognizable, but may exist in the matrix.



S-71-59927 Sample 15314,1

SAMPLE 15314,2*

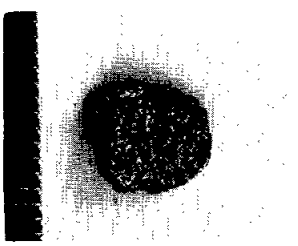
Rock Type: Diabase
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Tan, mottled
Special Features: None
No. of Particles: 5 / Weight: 0.57 g

Remarks

Coarse-grained (0.5-1.0 mm) basalt or diabase with subophitic texture, consisting of the following recognizable minerals:

(1) Plagioclase, subhedral, tabular to lath-shaped, white, 1 mm in length (~40%)
(2) Pyroxene, anhedral, tan to reddish-brown (~45%)
(3) Olivine, anhedral, yellow (~5%)
(4) Ilmenite(?), anhedral (~2-5%)

No vugs are present.



S-71-59926 Sample 15314,2

SAMPLE 15314,3*

Rock Type: Basalt
Coherence (intergranular): Tough
Shape: Subrounded
Surface: Hackly
Color: Dark brownish gray
Special Features: None
No. of Particles: 1 / Weight: 0.23 g

Remarks

Medium-grained vuggy basalt with inequigranular texture. Mean grain size is 0.25 mm; most grains are anhedral. One large euhedral to subhedral plagioclase lath (0.25 x 3.0 mm) is visible. Rock consists of white to gray plagioclase (~40%) and dark gray and cinnamon-brown pyroxene (~60%). Accessories include opaques and olivine (?).

S-71-59925 Sample 15314,3

SAMPLE 15314,4

Rock Type: Crystalline rocks (non-mare)
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Medium to light tannish gray
Special Features: None
No. of Particles: 9 / Weight: 2.01 g

Remarks

These particles are essentially similar to 15434,5 which see for description.

SAMPLE 15314,5

Rock Type: Microbreccia (recrystallized)
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Dark gray, speckled with white
Special Features: Green glass
No. of Particles: 8 / Weight: 1.49 g

Remarks

These particles are essentially similar to 15284,1 except that they contain a higher abundance of green glass fragments and spherules. (~1%). (See 15284,1 for a fuller description).

SAMPLE 15314,6

Rock Type: Recrystallized microbreccias (glass coated)
Special Features: Glass coatings
No. of Particles: 4 / Weight: 1.17 g

Remarks

These particles are essentially identical to 15314,5 except that they have thin splash coatings of dark brownish-gray vesicular glass on one or more surfaces.

SAMPLE 15314,7

Rock Type: Microbreccia
Coherence (intergranular): Friable
Shape: Subrounded to rounded
Surface: Very finely granular
Color: Medium gray
Special Features: None
No. of Particles: 4 / Weight: 0.34 g

Remarks

These particles are essentially similar to 15434,2 which see for description. Two of the 4 particles contain visible green glass spheres and/or fragments (<1%).

SAMPLE 15314,8

Rock Type: Agglutinate
Coherence (intergranular): Friable
Shape: Irregular
Surface: Glass - smooth; Microbreccia - very finely granular
Color: Medium to dark gray
Special Features: None
No. of Particles: 2 / Weight: 0.19 g

Remarks

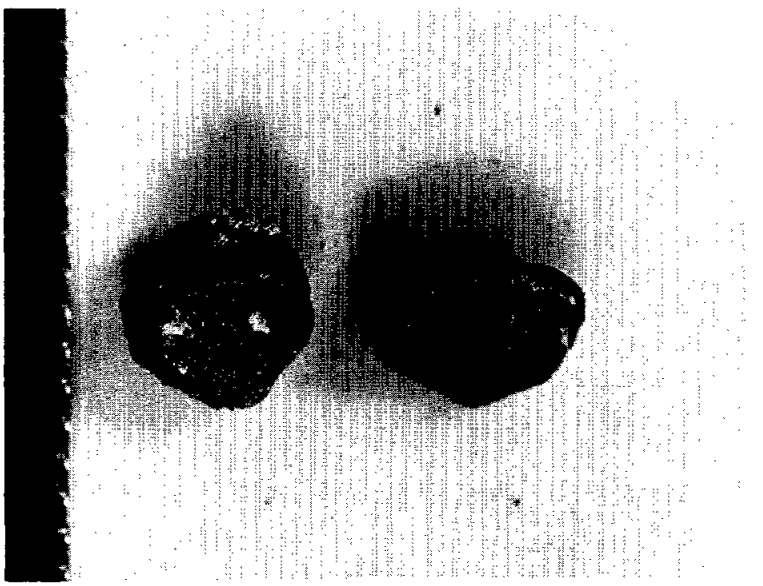
These particles consist of two or more particles of 15314,7 type plus loose soil welded together by dark brownish-gray vesicular glass.

SAMPLE 15314,9*

Rock Type: Microbreccia
Coherence (intergranular): Friable
Shape: Subrounded
Surface: Very finely granular
Color: Medium gray
Special Features: Clasts of green glass microbreccia (15314,1 type).
No. of Particles: 2 / Weight: 0.19 g

Remarks

These particles are similar to 15314,7, except for the presence of clasts (3-4 mm) of green glass microbreccias like 15314,1. One of these clasts contains within it a 1 mm angular feldspathic clast.



S-71-59923 Sample 15314,9

SAMPLE 15314,10

Rock Type: Vesicular basalt
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Dark gray
Special Features: Vesicles
No. of Particles: 1 / Weight: 0.10 g

Remarks

A very fine-grained highly vesicular basalt (?). Grain size too small for identification. Vesicles (0.2-1.0 mm) comprise 10-15% of the particle.

SAMPLE 15314,11*

Rock Type: "Anorthosite"
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: White
Special Features: Plagioclase abundance
No. of Particles: 2 / Weight: 0.37 g

Remarks

These particles are plagioclase-rich (>90%) lithic types with non-igneous textures. Textures appear inequigranular seriate, suggest recrystallized breccias. Plagioclase is chalky white in appearance (shocked?). One particle appears to be 100% plagioclase, the other has ~10% of pale yellowish-tan pyroxene (?) and <1% opaques.

S-71-59921 Sample 15314,11

SAMPLE 15314,12

Rock Type: Glass or glass-rich particles
Coherence (intergranular): Tough
Shape: Irregular, subangular
Surface: Smooth
Color: Medium to dark gray
Special Features: None
No. of Particles: 3 / Weight: 0.35 g

Remarks

These particles are essentially similar to 15434,1, which see for description. Two of the particles are ropy, one blocky.

SAMPLE 15404,1

Rock Type: Microbreccia
Coherence (intergranular): Coherent
Shape: Subrounded to rounded
Surface: Very finely granular
Color: Medium gray
Special Features: None
No. of Particles: 9 / Weight: 1.86 g

Remarks

These particles are essentially similar to 15284,3, which see for description.

SAMPLE 15404,2

Rock Type: Recrystallized Microbreccia (?)
Coherence (intergranular): Tough
Shape: Angular to subangular
Surface: Hackly
Color: Dark gray
Special Features: Vugs
No. of Particles: 13 / Weight: 4.63 g

Remarks

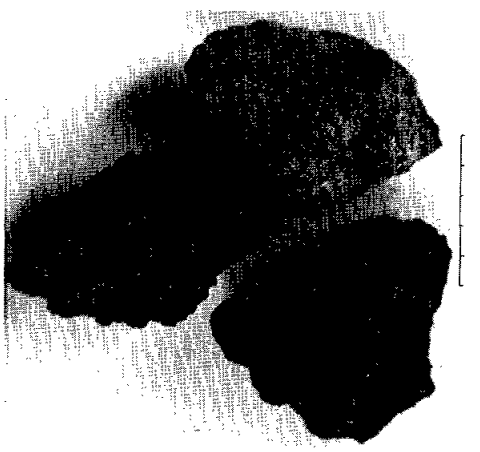
These particles are very fine-grained crystalline types, most with visible clasts (mostly of white, feldspathic character). The clasts are generally angular; some are irregular in shape. The matrix is dark gray, appears to be crystalline although no phases are identifiable. Small ($\sim$0.5 mm) vugs are present in most particles. With the exception of the clasts, they resemble very fine-grained basalts. They are probably recrystallized microbreccias, but identification is not certain.

SAMPLE 15404,3*

Rock Type: Basalt
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Dark gray
Special Features: None
No. of Particles: 3 / Weight: 1.04 g

Remarks

Very fine-grained basalts. Grain size too small for mineral identification. Small (~0.25 mm) vugs are present but not abundant. Identification uncertain.



S-71-60181 Sample 15404,3

SAMPLE 15404,4

Rock Type: Vesicular glass
Coherence (intergranular): Tough
Shape: Subangular
Surface: Smooth, vitreous
Color: Dark gray
Special Features: Basalt clast
No. of Particles: 1 / Weight: 0.11 g

Remarks

This particle is a dark gray vesicular glass (possible devitrified). Vesicles are few in number but large (up to 1 mm). A 4 mm inclusion of granular olivine basalt is present (grain size ~0.5 mm).

SAMPLE 15404,5*

Rock Type: Olivine diabase
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Light gray, mottled
Special Features: Olivine abundance (~30%)
No. of Particles: 1 / Weight: 0.17 g

Remarks

Diabase or coarse-grained basalt (mean grain size ~1 mm) with intergranular texture. The following minerals are identified:
(1) Olivine, anhedral, greenish-yellow (~30%)
(2) Pyroxene, anhedral, gray to tan (~40%)
(3) Plagioclase, subhedral to euhedral, lath-shaped, white (~30%)
(4) Opaques (ilmenite?) subhedral platy to anhedral (~1%)
A few vugs (~1 mm) are present.
This particles is noteworthy for the abundance of greenish-yellow phase, presumably olivine.

S-71-60182 Sample 15404,5

SAMPLE 15414,1

Rock Type: Microbreccia
No. of Particles: 7 / Weight: 1.58 g

Remarks

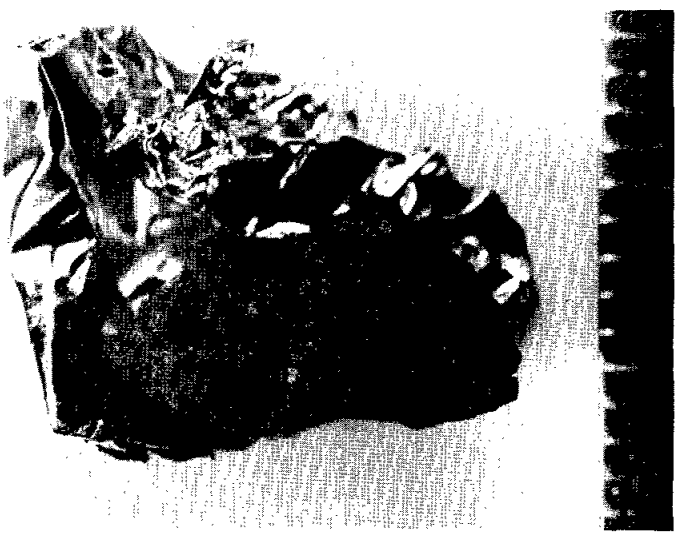
Essentially similar to 15434,2 (which see for fuller description). Some of these particles have typical glass splash coatings.

SAMPLE 15414,2*

Rock Type: Vesicular basalt
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Medium gray
Special Features: Vesicles
No. of Particles: 1 / Weight: 0.27 g

Remarks

Very fine grained vesicular basalt. Grain size too small for certain identification. Vesicles up to 1 mm diameter represent 10-15% of the volume of the rock.



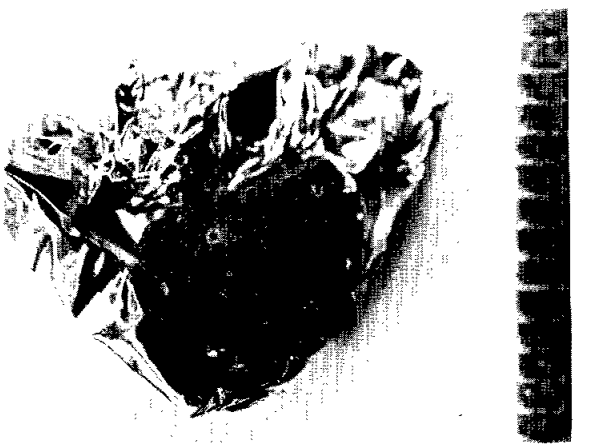
S-71-60564 Sample 15414,2

SAMPLE 15414,3*

Rock Type: Basalt (?)
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Dark gray
Special Features: None
No. of Particles: 1 / Weight: 0.17 g

Remarks

Very fine-grained dark gray crystalline (?) rock. Minerals not identifiable. Probably basalt.



S-71-60561 Sample 15414,3

SAMPLE 15424

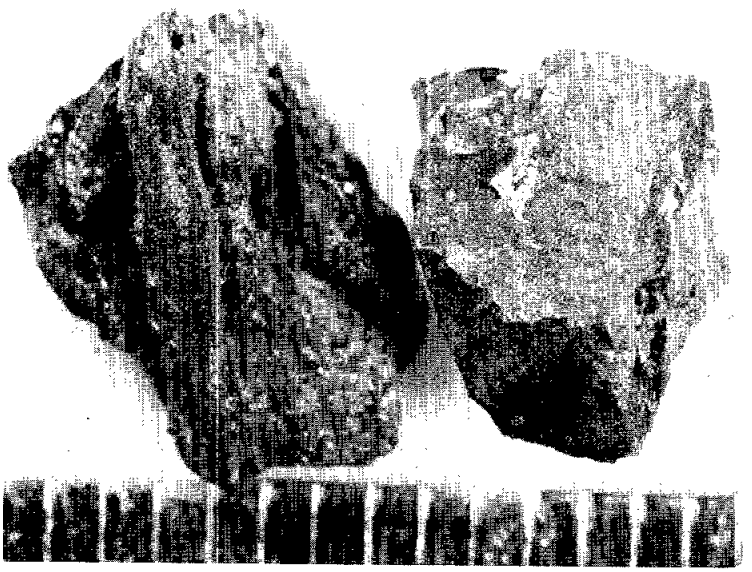
NOTE
All particles in this sample are <4 mm. Apparently disaggregated in handling.

SAMPLE 15434,1*

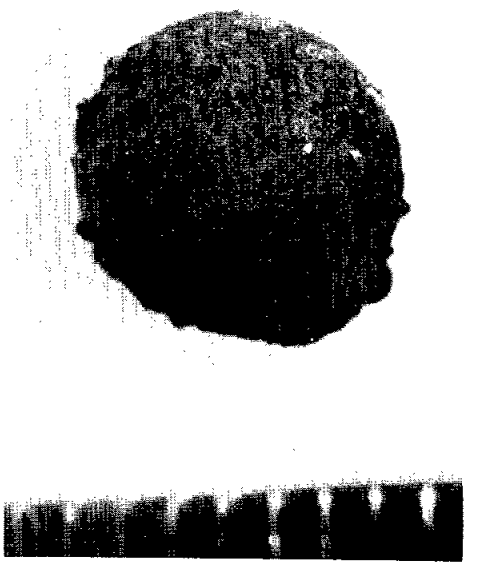
Rock Type: Glass or Glass-rich particles
Coherence (intergranular): Tough
Shape: Subangular to ropey (one shpere)
Surface: Smooth
Color: Dark gray, brownish gray, black
Special Features: Vitreous lustre on freshly broken surfaces, conchoidal fracture.
No. of Particles: 26 / Weight: 4.09 g

Remarks

These particles appear to be fragments of nearly pure glass or mixed materials consisting of at least 75% of glass. Most particles have fine soil material adhering to some surfaces. Some particles are blocky, apparently honogeneous, detailed shapes due to conchoidal fracture. Others are ropey in character with twisted shapes. There is a distinct possibility that some of these particles are extremely fine-grained basalts or are at least deritrified. The adhering soil renders it difficult to elucidate their internal character. However, under the binocular microscope no crystallites or granularity are visible on fresh broken surfaces. One particle is a spherule with a knobby surface.



S-71-59625 Sample 15434,1



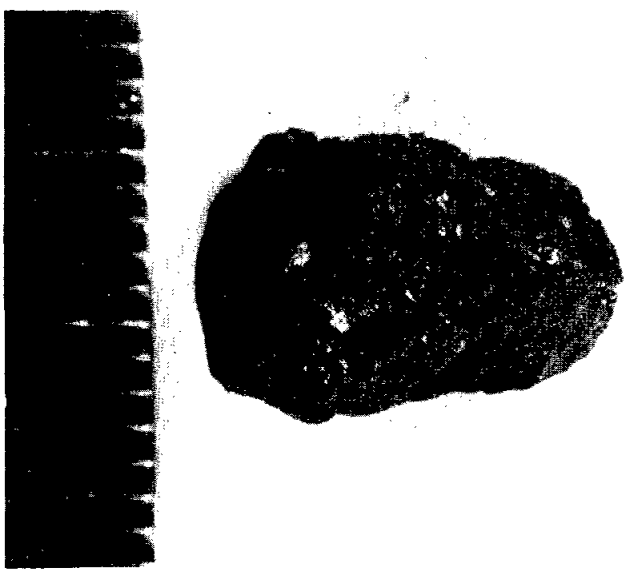
S-71-59627 Sample 15434,1

SAMPLE 15434,2*

Rock Type: Microbreccia
Coherence (intergranular): Friable to coherent
Shape: Subrounded to rounded
Surface: Very finely granular
Color: Medium gray
Special Features: None
No. of Particles: 30 / Weight: 5.99 g

Remarks

Most particles partially coated with very fine soil (even after dusting) making classification uncertain in some instances. The particles are typically heterogeneous on a fine scale (<1 mm), consist of glass, mineral, and lithic fragments of various sizes and shapes set in very fine grained matrices which range in coherence from friable to coherent (possibly reflecting variable extent of recrystallization). Clast identification difficult due to fine soil coating. Mineral fragments recognized include pyroxene (brown to cinnamon) plagioclase (white) and olivine (?) (yellow to yellowish-green). Glass fragments range in color from black to brown to yellow to green (rare).



S-71-59628 Sample 15434,2

SAMPLE 15434,3

Rock Type: Agglutinates
Coherence (intergranular): Friable to coherent
Shape: Angular to subangular, irregular
Surface: Smooth to very finely granular
Color: Medium gray
Special Features: Mixed particles, welded together
No. of Particles: 22 / Weight: 4.89 g

Remarks

Mixed particles consisting of several smaller particles loosely bonded (welded?) together by dark glass. Most recognizable components are microbreccias and dark glass fragments; some crystalline lithic fragments are doubtless present within the agglutinates, but their detailed character is not discernable under binocular examination. Much fine soil adheres to the particles and is incorporated within them. The bonding glass is not abundant and is generally not vesicular.

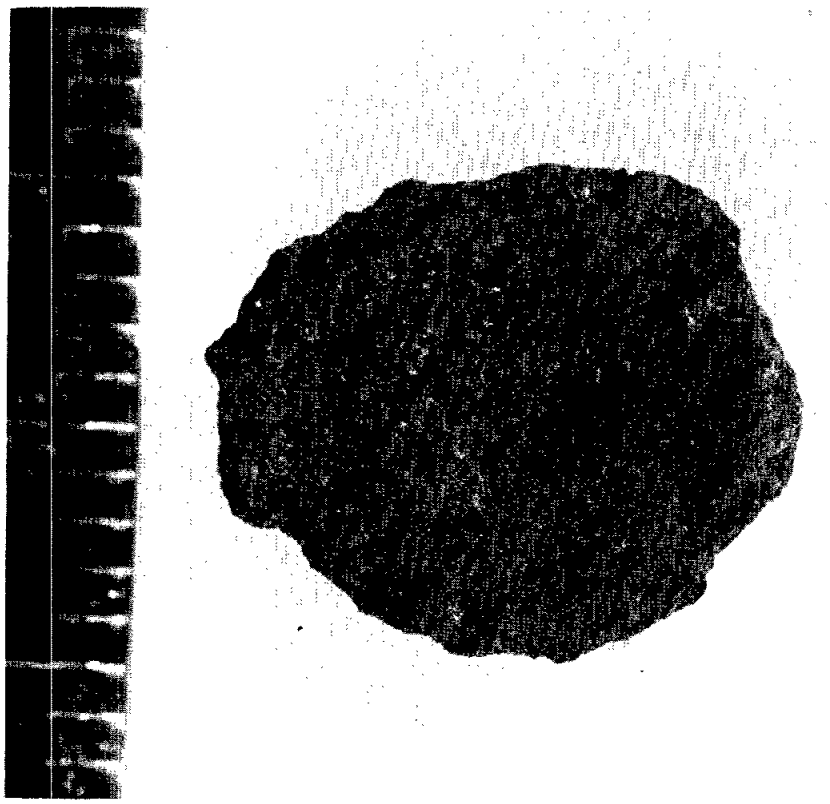
SAMPLE 15434,4*

Rock Type: Basalt
Coherence (intergranular): Tough
Shape: Subrounded
Surface: Hackly (partially dust coated)
Color: Dark gray, speckled
Special Features: Vugs (a few)
No. of Particles: 11 / Weight: 2.52 g

Remarks

Holocrystalline basalt with equigranular texture. A small number of vugs (< 1 mm) are present. Mean grain size is 0.25 mm. Recognizable minerals with approximate abundances include:

(1) Plagioclase, white subhedral to euhedral, lath shaped (40%)
(2) Pyroxene (clino) dark brownish-gray, anhedral (60%)
(3) Olivine (?), greenish-yellow, anhedral (< 1%)
(4) Cinnamon-brown mineral (pyroxene or pyroxferroite?), anhedral (<< 1%)
(5) Opaques, anhedral, minute (<1%)



S-71-59632 Sample 15434,4

SAMPLE 15434,5*

Rock Type: Crystalline rock (non-mare)
Coherence (intergranular): Tough
Shape; Subangular to subrounded
Surface: Hackly
Color: Medium to light gray or tan
Special Features: Non-igneous textures (see remarks)
No. of Particles: 12 / Weight: 2.92 g

Remarks:

Crystalline rocks of non-mare character. Textures are equigranular to inequigranular seriate; all are xenomorphic-granular. Textures do not look igneous, but look like recrystallized cataclastic. In some particles angular mineral grain shapes are visible. White to light gray plagioclase, gray to tan pyroxene are major minerals, with plagioclase clearly predominant; accessory yellow-green olivine occasionally is present. The opaque content generally appears low. These may include recrystallized noritic microbreccias and related types. Grain size is variable but characteristically small (except for occasional mineral fragments is generally ~ 0.25 mm).

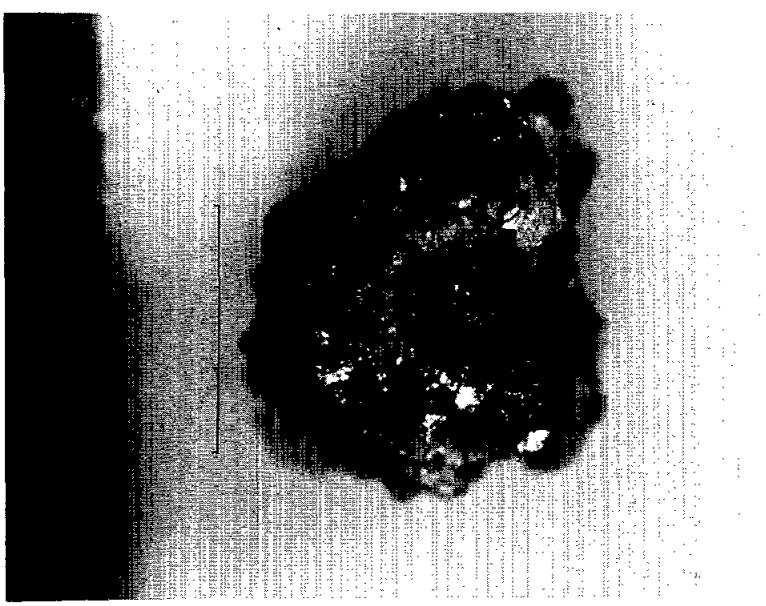
S-71-59623 Sample 15434,5

SAMPLE 15434,6*

Rock Type: Gabbro (mare affinity)
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Brown (speckled)
Special Features: None
No. of Particles: 1 / Weight: 0.11 g

Remarks

Holocrystalline fine-grained gabbro (mean grain size ~1 mm) with equigranular texture. Tabular subhedral white plagioclase and cinnamon brown clinopyroxene are major phases. A yellow-brown mineral is also present, probably another clinopyroxene. Minor amount of yellow olivine may be present (<5%). Plagioclase/pyroxene ratio 1:2. Opaque content is low (<2%).



S-71-59932 Sample 15434,6

SAMPLE 15434,7*

Rock Type: Crystalline rock (fine-grained basalt?)
Coherence (intergranular): Tough
Shape: Angular to subangular
Surface: Smooth
Color: Dark to medium gray
Special Features: Very fine grain size
No. of Particles: 17 / Weight: 3.63 g

Remarks

Extremely fine grained rocks, identity not completely certain. Grain size approaches limits of resolution of the binocular microscope; in some a granularity is visible. Many particles possess a small number of vesicles. Luster on fresh broken surfaces is dull, not vitreous. These are probably very fine grained basalts.

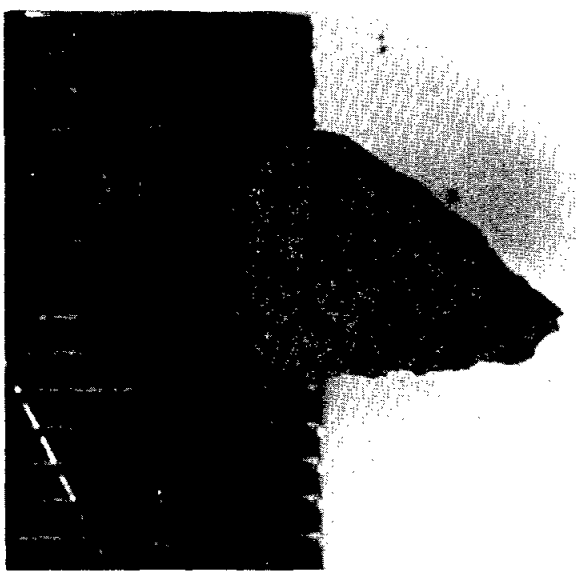
S-71-59933 Sample 15434,7

SAMPLE 15434,8*

Rock Type: Crystalline rock (non-mare)
Coherence (intergranular): Tough
Shape: Subrounded
Surface: Hackly
Color: Light yellowish gray
Special Features: High olivine content
No. of Particles: 1 / Weight: 0.32 g

Remarks

This particle is essentially similar to those in 15434,5 (which see for description). However, greenish-yellow olivine is unusually abundant, constituting 20-30% of the mode.



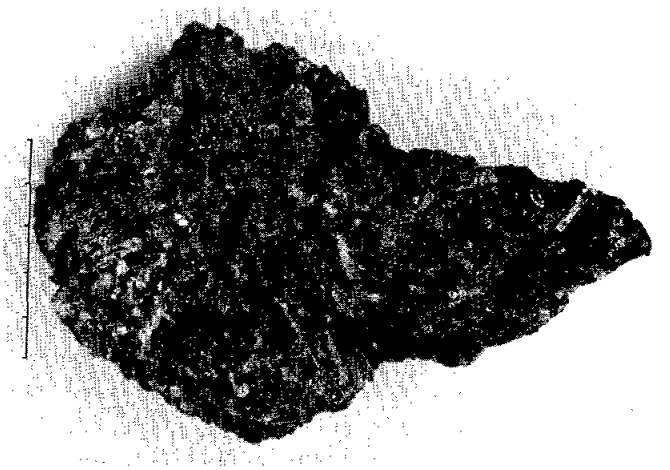
S-71-59930 Sample 15434,8

SAMPLE 15474,1*

Rock Type: Olivine diabase
No. of Particles: 7 / Weight: 2.91 g

Remarks

See 15074,1 for description of essentially identical type. One of these particles is 8 x 25 mm.



S-71-60560 Sample 15474,1

SAMPLE 15474,2

Rock Type: "Anorthosite"
No. of Particles: 2 / Weight: 0.24 g

Remarks

See 15314,11 for description of essentially similar type. One of these particles is essentially 100% plagioclase, the other has ~5% light gray pyroxene plus opaques.

SAMPLE 15474,3

Rock Type: Recrystallized microbreccia
No. of Particles: 1 / Weight: 0.14 g

Remark

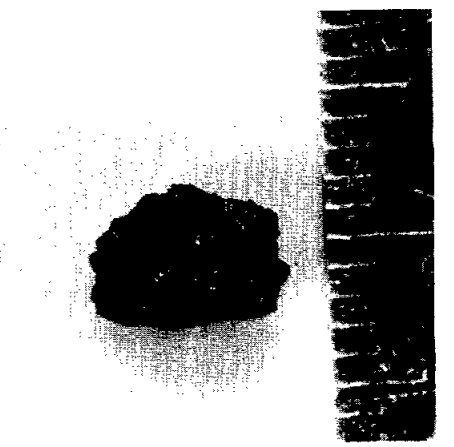
See 15244,4 for description of essentially similar type.

SAMPLE 15474,4*

Rock Type: Porphyritic olivine basalt (?)
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Dark gray
Special Features: Orange-yellow olivine (?) phenocrysts.
No. of Particles: 1 / Weight: 0.18 g

Remarks

Porphyritic cyrstalline rock consisting of orange-yellow olivine (?) phenocrysts (anhedral, 0.5-1 mm) in a very fine-grained dark gray matrix. Matrix phases not identifiable. Identification uncertain.



S-71-60559 Sample 15474,4

SAMPLE 15504,1

Rock Type: Microbreccias
No. of Particles: 11 / Weight: 3.60 g

Remarks

See 15244,2 and 15244,6 for descriptions of essentially similar types.

SAMPLE 15514,1

Rock Type: Glass-coated microbreccia
No. of Particles: 1 / Weight: 0.07 g

Remarks

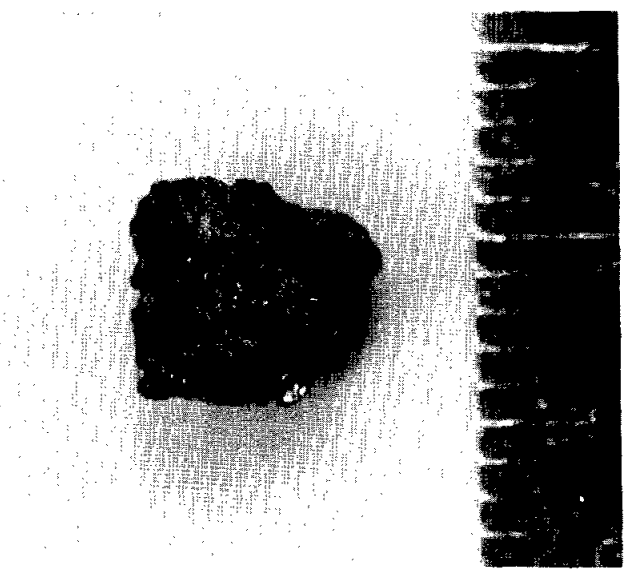
See 15244,4 for description of essentially similar type. This particle has a thin dark vesicular glass splash coating on part of its surface.

SAMPLE 15514,2*

Rock Type: Diabase
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Brown
Special Features: None
No. of Particles: 1 / Weight: 0.33 g

Remarks

Granular diabase or coarse basalt (0.5-1.0 mm grain size) with subhedral white plagioclase laths and anhedral equidimensional dark brown to orange-brown pyroxene.



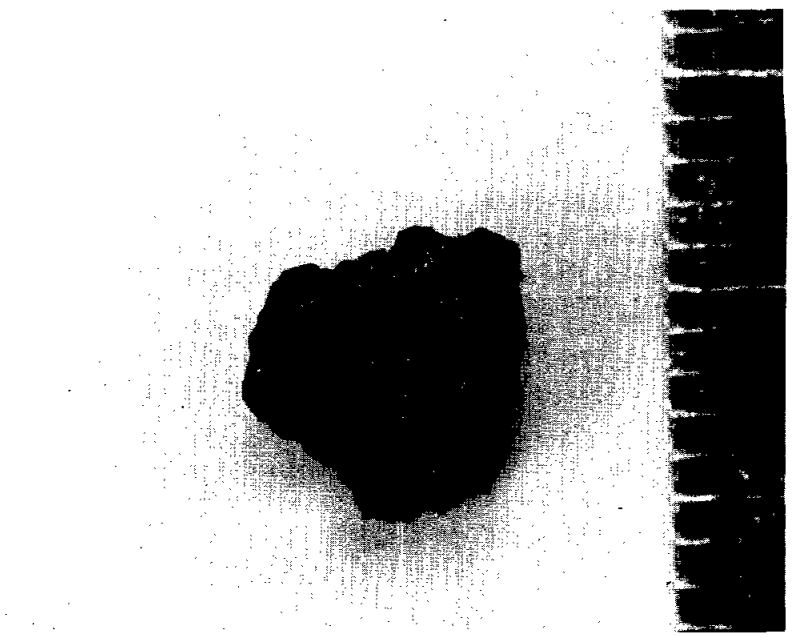
S-71-60558 Sample 15514,2

SAMPLE 15514,3*

Rock Type: Vesicular basalt
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Light brown
Special Features: None
No. of Particles: 1 / Weight: 0.22 g

Remarks

Vesicular fine-grained microporphyritic basalt. Has anhedral phenocrysts (0.5 mm) of honey yellow olivine (?) in a very fine matrix of white to gray plagioclase laths and anhedral brownish-gray pyroxene.



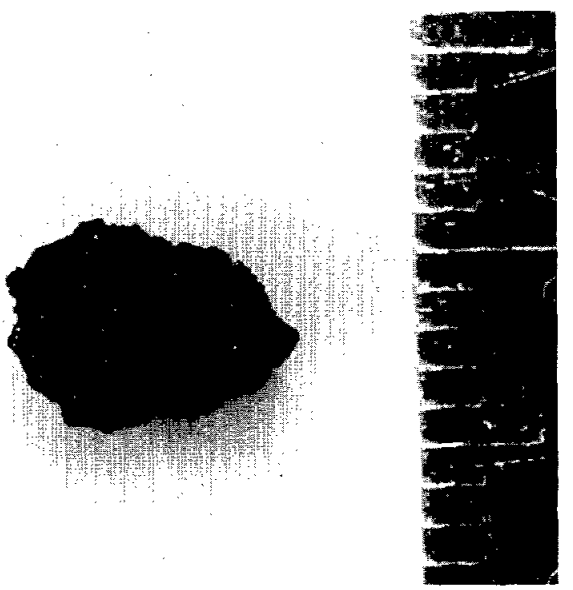
S-71-60563 Sample 15514,3

SAMPLE 15514,4*

Rock Type: Hyalocrystalline basalt
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Dark gray
Special Features: Glassy matrix
No. of Particles: 1 / Weight: 0.16 g

Remarks

Hyalocrystalline microporphyritic basalt consisting of yellow-green olivine (?) grains in a dark glassy (?) matrix. A few vugs and vesicles are present.



S-71-60557 Sample 15514,4

SAMPLE 15534,1*

Rock Type: Vesicular basalt
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Light Brown
Special Features: Large spherical vesicles
No. of Particles: 4 / Weight: 2.15 g

Remarks

These particles are essentially identical to 15564,7, which see for description.

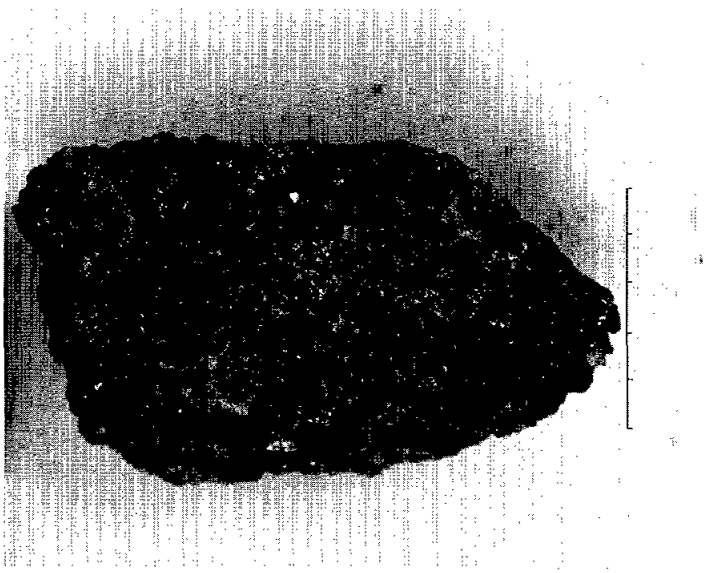
S-71-60184 Sample 15534,1

SAMPLE 15534,2*

Rock Type: Basalt (diabase)
Coherence (intergranular). Tough
Shape: Subangular to subrounded
Surface: Hackly
Color: Medium to light gray
Special Features: Vugs
No. of Particles: 10 / Weight: 2.65 g

Remarks

These particles are essentially similar to 15564,5, which see for description.



S-71-60183 Sample 15534,2

SAMPLE 15534,3

Rock Type: Recrystallized microbreccias
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Special Features: Glass coating
No. of Particles: 2 / Weight: 0.32 g

Remarks

These particles are essentially similar to 15244,4, which see for description. Thin splash coatings of dark gray vesicular glass are present on one or more surfaces.

SAMPLE 15564,1

Rock Type: Microbreccias
Coherence (intergranular): Friable to coherent
Shape: Subrounded to rounded
Surface: Smooth to very finely granular
Color: Medium gray
Special Features: None
No. of Particles: 132 / Weight: 32.83 g

Remarks

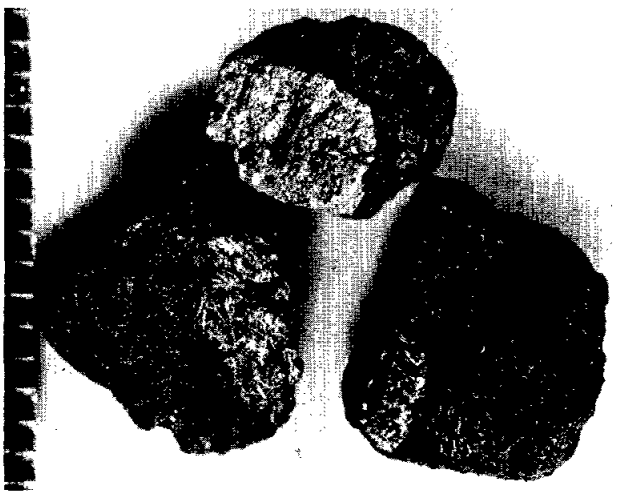
Friable to coherent microbreccias consisting of a wide variety of clast types contained in a medium gray very fine-grained matrix. Visible clasts represent typically 10-30% of a given particle, vary in shape from angular to rounded, and include glass, mineral, and lithic fragments. Recognizable lithic clasts are largely basaltic with a variety of textures (granular to ophitic) (see 15564,5-7 for description of basalt types); norite-anorthosite clasts are scarce as are microbreccia clasts. Mineral clasts include white plagioclase, yellow, orange, brown and cinnamon pyroxene, and yellow-green olivine. Glasses are dark brown, orange and green (rare) and occur both as angular fragments and as spherules. In this sample clasts are generally <2 mm in size (most <1 mm).

SAMPLE 15564,2*

Rock Type: Microbreccia
Coherence (intergranular): Friable to coherent
Shape: Subrounded to rounded
Surface: Smooth to very finely granular
Color: Medium gray
Special Features: Large lithic (basaltic) clasts (2-5 mm)
No. of Particles: 10 / Weight: 2.73 g

Remarks

These particles are identical in character to 15564,1 (which see for description) except that they contain large (2-5 mm) separable basalt lithic fragments: (See 15564,5-7 for basalt descriptions).



S-71-59934 Sample 15564,2

SAMPLE 15564,3

Rock Type: Microbreccia
Coherence (intergranular): Friable to coherent
Shape: Subrounded
Surface: Smooth
Color: Medium gray
Special Features: Vesicular glass coating on 1 surface
No. of Particles: 2 / Weight: 0.50 g

Remarks

These particles are identical in character to 15564,1 (which see for description) except for the presence on one surface of a thin splash coating of dark-gray to black vesicular glass.

SAMPLE 15564,4

Rock Type: Agglutinate
Coherence (intergranular): Coherent
Shape: Subangular, irregular
Surface: Very finely granular to smooth
Color: Medium gray, mottled
Special Features: None
No. of Particles: 1 / Weight: 0.28 g

Remarks

This particle is an agglutinate consisting of several smaller particles of microbreccia (see 15564,1) welded together by dark, grayish-brown vesicular glass.

SAMPLE 15564,5*

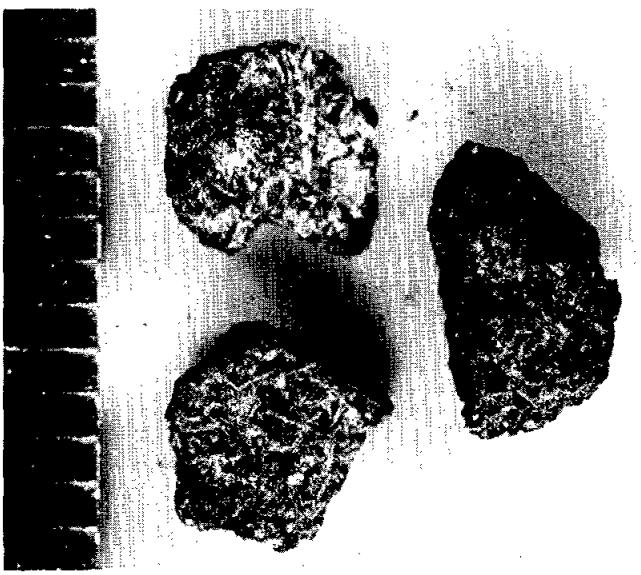
Rock Type: Basalt (diabase)
Coherence (intergranular): Tough
Shape: Subangular to subrounded
Surface: Hackly
Color: Medium to light gray
Special Features: Vugs
No. of Particles: 9 / Weight: 1.11 g

Remarks

Holocrystalline coarse-grained subophitic basalt (or diabase). The following minerals are recognizable under the binocular microscope (with approximate abundances):

(1) Plagioclase, white, euhedral lath-shaped, up to 1mm in length (~45%)
(2) Pyroxene, grayish-brown to yellowish-brown, anhedral (45-50%)
(3) Olivine, greenish-yellow, anhedral to subhedral (~5%)
(4) Opaques, black, very minute (<2%)

Plagioclase laths are 0.5 to 1 mm in length: pyroxene and olivine grains 0.5 to 1 mm. A few small (0.2-0.5 mm) vugs are present.



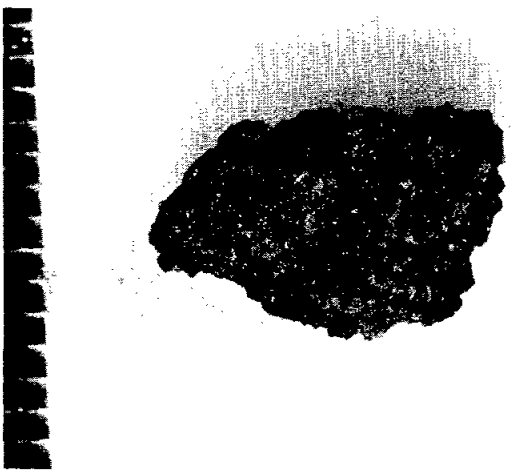
S-71-59936 Sample 15564,5

SAMPLE 15564,6*

Rock Type: Olivine basalt (microgabbro)
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Tan, Mottled
Special Features: None
No. of Particles: 4 / Weight: 0.94 g

Remarks

Medium to coarse-grained basalt or microgabbro with equigranular xenomorphic-granular texture with the following approximate mode:
(1) Plagioclase, white (~40-50%)
(2) Pyroxene, cinnamon brown to light brown (~40-45%)
(3) Olivine, greenish-yellow (~5-20%)
(4) Opaques, black, minute (~2%)
Two particles have a mean grain size of 0.2-0.5 mm, the other ~1 mm. Small (0.5-1 mm) vugs are present in all 3 particles.



S-71-59935 Sample 15564,6

SAMPLE 15564,7*

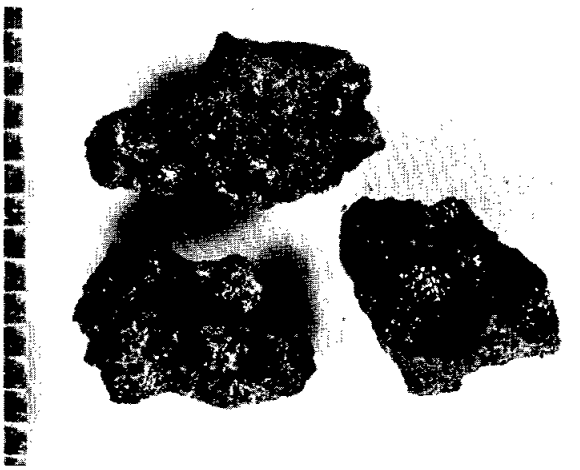
Rock Type: Vesicular Basalt
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Light brown
Special Features: Large (2-5 mm) spherical vesicles.
No. of Particles: 4 / Weight: 0.83 g

Remarks

Fine-grained (~ 0.1 to 0.2 mm) highly vesicular equigranular subophitic to granular basalt with white subhedral lath-like plagioclase (~45%), yellow-brown to tan euhedral pyroxene (~45%), greenish-yellow olivine (~5%) and opaques (~ 25%). Vesicles are remarkably spherical and seem to occupy approximately 20-30% by volume of the rock. Some vesicles are lined with a higher concentration of dark minerals (most opaques, some pyroxene) than the mode for the rock. Minerals are tangential to the vesicle wall, do not protrude into the cavities.

NOTE

Probably very similar if not identical to rock 15606.



S-71-59940 Sample 15564,7

SAMPLE 15564,8

Rock Type: Crystalline microbreccia (?)
Coherence (intergranular): Tough
Shape: Rounded
Surface: Hackly
Color: Dark gray, mottled
Special Features: Crystallinity
No. of Particles: 2 / Weight: 0.29 g

Remarks

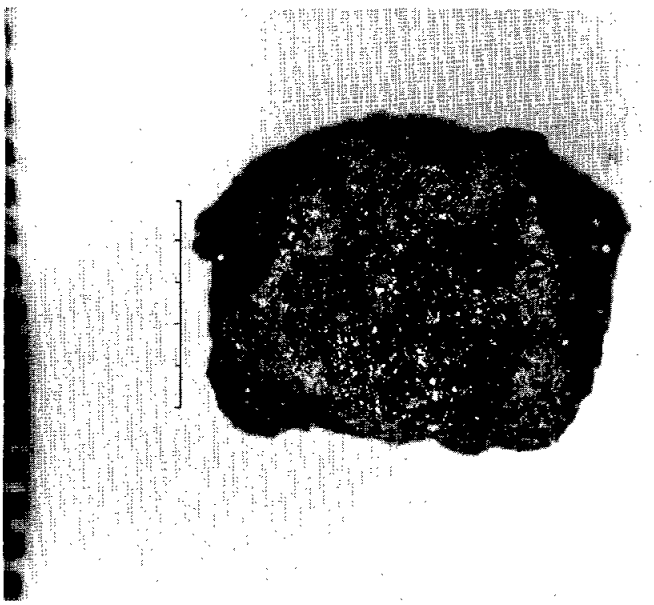
Fine-grained inequigranular seriate crystalline rock with non-igneous texture. Has the appearance of a well-recrystallized microbreccia. Plagioclase (anhedral, white) and an unidentified dark gray mineral (pyroxene?) comprise roughly equal parts. These particles definitely appear to be crystalline but are distinctly different in texture and modal mineralogy from the basalts from this collection site (see 15564,5-7).

SAMPLE 15604,1*

Rock Type: Vesicular basalt
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Light brown
Special Features: Large (up to 5 mm) spherical vesicles
No. of Particles: 10 / Weight: 3.25 g

Remarks

Fine - to medium-grained (0.2-0.5) vesicular basalt. These particles are essentially identical to 15564,7 (which see for description).



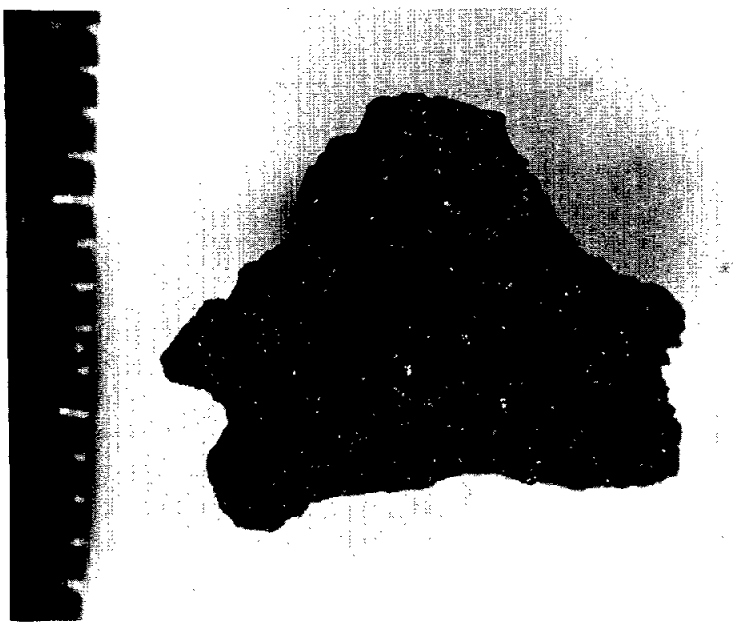
S-71-59937 Sample 15604,1

SAMPLE 15604,2*

Rock Type: Vesicular porphyritic olivine basalt
Coherence (intergranular): Tough
Shape: Angular
Surface: Hackly
Color: Dark gray
Special Features: Vesicles and olivine phenocrysts
No. of Particles: 3 / Weight: 1.49 g

Remarks

Very fine grained (<0.1 mm) vesicular porphyritic olivine basalt. Vesicles are typically 1 mm and nearly spherical. Anhedral equidimensional greenish-yellow olivine phenocrysts (up to 1 mm) set in a very fine-grained ground-mass of white plagioclase, grayish-brown pyroxene (?) and black ilmenite(?). Modal abundances are not estimable. Phenocrysts comprise 5-10% of the rock. Vesicles occupy 5-10% of the volume.



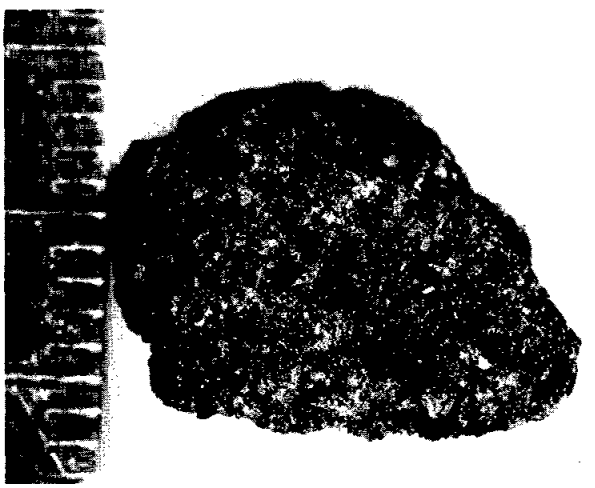
S-71-59939 Sample 15604,2

SAMPLE 15604,3*

Rock Type: Olivine basalt (microgabbro)
Coherence (intergranular): Tough
Shape: Subangular to subrounded
Surface: Hackly
Color: Grayish tan
Special Features: Vugs
No. of Particles: 12 / Weight: 5.12 g

Remarks

Medium to coarse grained olivine basalt (diabase or microgabbro) (mean grain size~0.5-1.0 mm) with granular to subophitic texture.
(1) Plagioclase, white, subhedral tabular to anhedral (~40-45%)
(2) Pyroxene, grayish-brown to yellowish-brown, anhedral (~45-50%)
(3) Olivine, greenish-yellow, anhedral (~5-15%)
(4) Opaques, anhedral, minute (1-2%)
Vugs up to 1 mm are present but not abundant. Euhedral brown pyroxene protrudes into some.
These particles are similar to 15564,6.



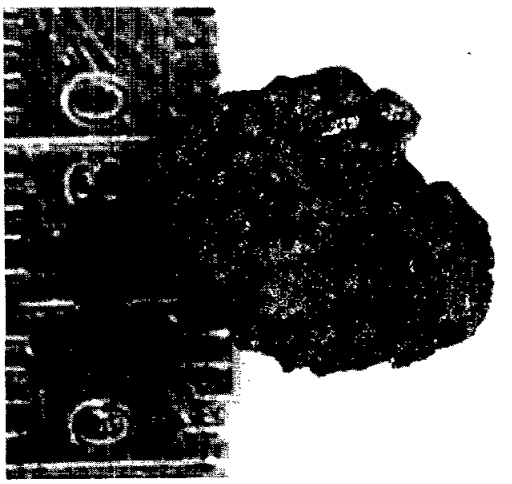
S-71-59938 Sample 15604,3

SAMPLE 15604,4*

Rock Type: Olivine basalt (diabase)
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Dark gray
Special Features: Vugs with euhedral brown pyroxene crystals.
No. of Particles: 2 / Weight: 0.95 g

Remarks

Vuggy olivine basalt or diabase (mean grain size ~0.5 mm) characterized by abundant (20-30%) anhedral equidimensional olivine phenocrysts (0.5 to 1 mm)(greenish-yellow color) in a fine matrix (~0.1 to 0.4 mm) of white plagioclase and gray pyroxene. Protruding into the vugs are large (0.5 x 2 mm) euhedral prisms of brown pyroxene. Overall mode difficult to estimate but plagioclase/pyroxene ratio probably ~1:1.



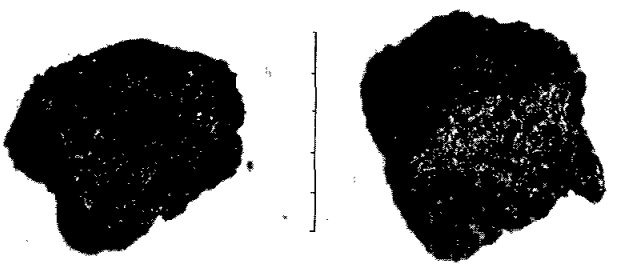
S-71-59941 Sample 15604,4

SAMPLE 15604,5*

Rock Type: Basalt
Coherence (intergranular): Tough
Shape: Subangular
Surface: Hackly
Color: Dark gray
Special Features: None
No. of Particles: 2 / Weight: 0.41 g

Remarks

Fine-grained granular basalt (grain size <0.3 mm) with subhedral white plagioclase (lath-shaped)(~30%) anhedral dark gray pyroxene (~65%), anhedral yellow-green olivine (~3%) and opaques (~2%).



S-71-59945 Sample 15604,5

SAMPLE 15604,6

Rock Type: Microbreccia
Coherence (intergranular): Friable to coherent
Shape: Subrounded to round
Surface: Smooth to very finely granular
Special Features: None
No. of Particles: 12 / Weight: 3.39 g

Remarks

These particles are identical to 15564,1 (which see for description). A few have glass splash coatings like 15564,3.

SAMPLE 15604,7

Rock Type: Agglutinate
Coherence (intergranular): Coherent to friable
Shape: Irregular
Surface: Smooth to irregular
Color: Medium to dark gray
Special Features: None
No. of Particles: 3 / Weight: 0.47 g

Remarks

These particles are similar to 15564,4 (which see for description).

POPULATION STUDY

Although macroscopic and binocular examination permits only tentative identification of minerals and rock types in lunar materials, certain preliminary conclusions can be drawn from the classification of coarse fines reported here as regards the distribution of rock types and their relation to major selenologic features of the Hadley-Apennine region. Three selenologic terranes have been distinguished at the Apollo 15 landing site: (i) the Apennine Front, a major mountain range comprised of a chain of massifs which are interpreted as uplifted fault blocks attributed to the Imbrium impact; (ii) a mare plain (bordered on the south by the Apennine Front and cut by Hadley Rille to the west), interpreted as a series of horizontal lava flows; and (iii) a low N-W trending ridge interpreted as possible broad diffuse ray from Aristillus or Autolycus [1].

In Table III is shown the distribution of 4-10mm particles according to general rock type and terrane. Certain general features of rock type distribution are readily apparent. Of particles collected at Apennine Front stations 6.3% were identified as non-mare type materials (Types 5-7), mostly norite-anorthosites and related rocks. By contrast <1% of particles from Hadley Rille and the mare display non-mare characteristics. Conversely only 7.7% of Front particles are basaltic (Types 8-12), and really only 3.7% if Type 12 (identity uncertain) particles are excluded. Rille and mare particles on the other hand are ~30% basalt. This distinction is further emphasized by the observation that soil breccias and agglutinates (Types 1-3) from the Front stations commonly contain notable quantities of feldspathic (non-mare) clasts and very few recognizable basalt clasts, whereas just the opposite is typical of such particles from Rille and mare stations.

The total number of particles from stations situated on the ridge is not great enough to be statistically meaningful. However, for what it's worth, the distribution of types here seems to more closely resemble the samples from the Front (especially station 6) than it does the Rille or mare samples. This is consistent with the observations of the soils made by LSPET [2], which support (but do not conclusively prove) the interpretation of the ridge as a ray from Aristillus or Autolycus by Carr and El Baz [3].

Samples from all three terranes are dominated by microbreccias (and agglutinates), which represent from 68-81% of the particles. Thus the abundance of "degraded" particles, which presumably reflects the maturity of the regolith in part, at the Apollo 15 landing site is similar to the Apollo 11, 12 and Luna 16 sites (see [4] and [5]) and notably lower than at the Apollo 14 site (96%) [6]. It has been suggested that some of the source rocks (from which the soil particles are derived), such as the stratified rocks visible in the upper slopes of Hadley Delta, may themselves be breccias [1, 2]. The relatively high abundance of coherent (recrystallized) microbreccias among the Front samples supports this contention. The low abundance of such Type 2 particles from the Rille and mare sites (com-

pared to friable microbreccias) suggests the local regolith is not thick enough to provide the necessary annealing environment.

In summary, this population study shows the distribution of particle types to be consistent with previous interpretations of the selenological characteristics and structures of the region, based on observations of large scale features. Clearly, detailed studies of these valuable coarse fines samples will further substantiate or disprove these tentative conclusions in addition to providing much valuable information and other interpretations of the selenologic history of the complex Hadley-Apennine region.

TABLE III. Distribution of Apollo 15 4-10 mm particles among three selenological terranes according to rock type. (See Table II and text for general descriptions of rock types.) Figures in parentheses are percents of total number of particles for that terrane.

	SELENOLOGICAL TERRANE					
ROCK TYPE	APENNINE FRONT[1]		HADLEY RILLE AND MARE[2]		RIDGE OR RAY[3]	
1	311	(49.4)	167	(65.6)	24	(75.0)
2	110	(17.5)	6	(2.4)	-	
3	90	(14.3)	4	(1.6)	1	(3.1)
4	30	(4.8)	-		-	
5	35	(5.6)	2	(0.8)	2	(6.3)
6	3	(0.5)	-		-	
7	1	(0.2)	-		-	
8	18	(2.9)	22	(8.7)	3	(9.4)
9	4	(0.6)	35	(13.8)	2	(6.2)
10	-		18	(7.1)	-	
11	1	(0.2)	-		-	
12	25	(4.0)	-		-	
Total No. Particles	628	(100.0)	254	(100.0)	32	(100.0)

1. Stations 2 (St. George), 6 (Front), 6a (Front), 7 (Spur).

2. Stations 1 (Elbow), 4 (Dune), 9 (Scarp), 9a (Rille).

3. Stations LM and 8 (ALSEP)

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[3] Carr, M. H. and El Baz, F. (1971) U. S. Geologic Survey Map 1723, U. S. Geologic Survey, Wash., D.C.

[4] Marvin U. B., Wood J. A., Taylor G. J., Reid J. B., Jr., Powell B. N., Dickey J. S., Jr., and Bower J. (1971), Relative proportions and probable sources of rock fragments in the Apollo 12 soil samples, Proc. Second Lunar Sci. Conf., Geochim. et Cosmochim. Acta, Suppl. 2, vol. 1, 679-699.

[5] Wood J. A., Reid J. B., Jr, Taylor G. J. and Marvin U. B. (1971) Petrological character of the Luna 16 sample from Mare Fecunditatis, Meteoritics, v. 6, 181-193.

[6] Powell B. N. (1972) in preparation.