

younger or thicker deposits of dark mantle material. Observation and sampling were planned to (1) characterize the rock types of the subfloor and dark mantle units, (2) investigate contact relations exposed in the crater rim and wall, and (3) interpret, if possible, the modes of origin of the units (Sevier, 1972).

GENERAL OBSERVATIONS

The station area is in gently rolling terrain with abundant rocks up to about a meter in size. Larger blocks, up to several meters in size, can be seen to the south on the rim of Steno crater (pans 12, 13). In part, the rocks are concentrated around small craters in the station area, but some concentrations are not apparently related to craters. The rocks are buried to various degrees, from perched on the surface to nearly completely buried. Generally, fillets of sediment are not developed adjacent to the rocks.

Most of the sampling was done near the distinctly raised rim of a blocky 10-m crater (fig. 33). In particular, fragments were collected from two 0.5-m boulders associated with the crater (pans 12, 13). A rake sample (the rake is a sievelike long-handled scoop designed for gathering a representative collection of fragments of

centimeter size and larger from the upper few centimeters of the regolith) was collected from a relatively flat block-free area 15 m east of the blocky crater. The two sample areas represent the extremes of rock concentrations in the station area. Except for one tiny agglutinate fragment, both sample areas yielded only basalt fragments and soil.

Craters in the station area range from several centimeters to tens of meters in diameter. Most are subdued; some are sharp rimmed and blocky. The 10-m crater where rocks were sampled is one of the sharpest and blockiest craters at station 1.

GEOLOGIC DISCUSSION

The basalt-rich surficial material observed and sampled at station 1 is on the ejecta blanket of Steno crater; it represents part of the cluster ejecta (fig. 34). Steno crater is about 600 m in diameter; hence, the maximum depth from which rock might have been excavated is about 120 m. The station area is about one fourth of a crater diameter out from the crater rim. Therefore, the basalt fragments probably represent subfloor basalt from an intermediate depth in Steno crater.

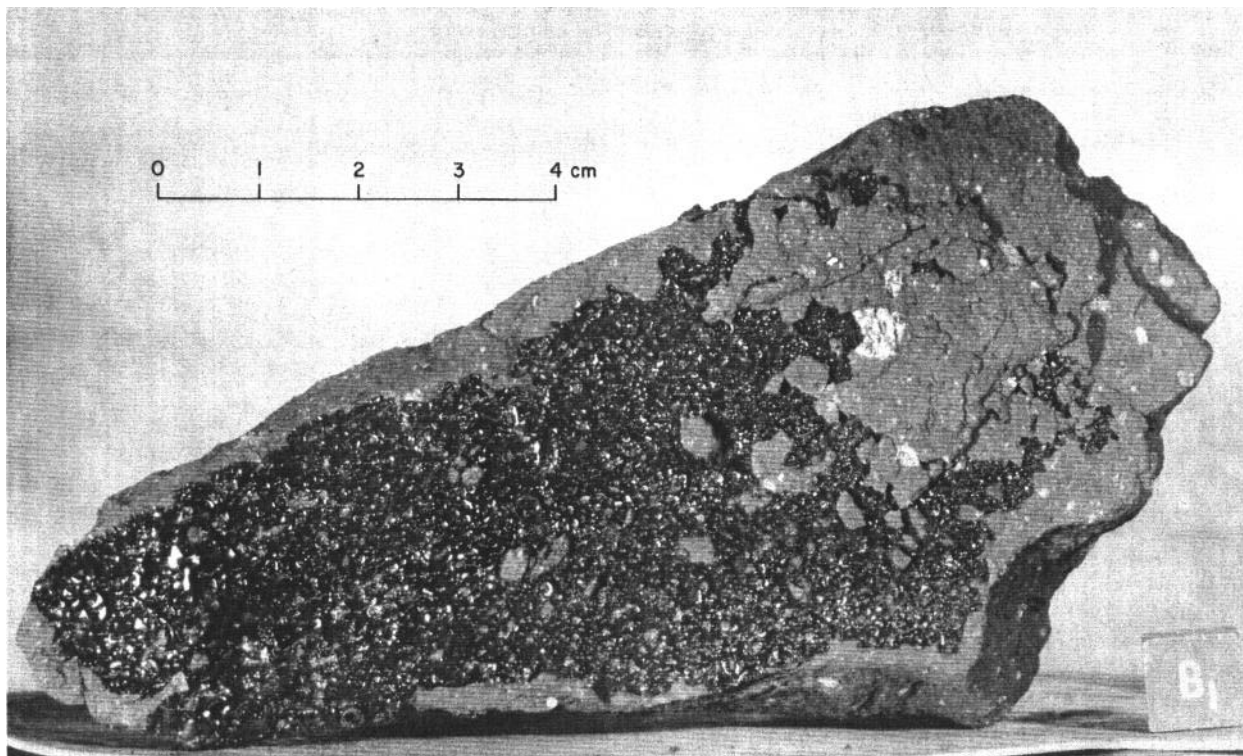


FIGURE 32.-Sample 70295. Weakly lithified polymict breccia. Part of a shiny dark glass vein formed during impact excavation of the rock is exposed on the near surface of the sample. (NASA photograph S-73-17192.)

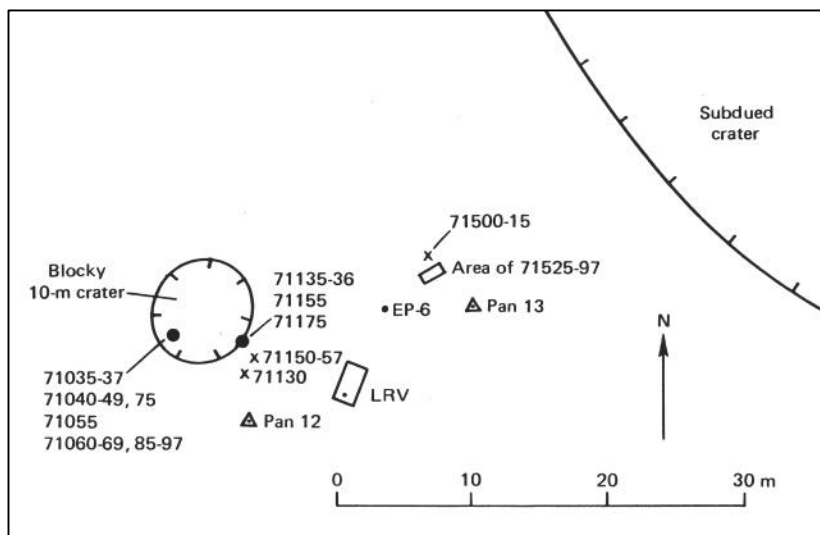


FIGURE 33.-Planimetric map of station 1.

Samples from the two large boulders of the 10-m crater have exposure ages of 102 and 110 m.y. It seems most likely that the boulders were excavated from the subfloor basalt by the impact that formed Steno crater; they were subsequently repositioned by the impact that formed the 10-m crater. Hence, their exposure ages may represent a younger limit for the age of Steno crater. The similarity to exposure ages of 95 to 106 m.y. determined for boulders near the LM suggests that the crater cluster was created approximately 100 m.y. ago. Arvidson and others (1976b) reached a similar conclusion.

On the basis of trace-element distributions, Rhodes and others (1976) concluded that the station 1 basalt samples, although similar in petrography and major element composition, represent at least two separate lava types. The two large boulders, which are the most likely to represent target material excavated for the first time by the Steno crater, are in their group B.

SUMMARY OF SAMPLING

Sample 71035-37

Type: Olivine basalt.

Size: 71035, 8x5x2.5 cm; 71036, 8.5x4x3 cm; 71037, 2.5x2x2 cm.

Weight: 71035, 144.8 g; 71036, 118.4 g; 71037, 14.39 g.

Location: From 0.5-m boulder on southwestern wall of blocky 10-m crater (same boulder as 71055).

Illustrations: Pans 12, 13; figs. 35, 36 (71035, LRL), 37 (71036, LRL), 38 (71037, LRL), 41.

Comments: Sampled boulder is subfloor basalt from the ejecta blanket of Steno crater. It presumably was

repositioned by the impact that formed the 10-m crater.

Petrographic descriptions:

71035, medium-grained vesicular olivine basalt. Sparse olivine.

71036, 71037, medium-grained vesicular olivine(?) basalt.

*Major-element composition:**Chemical analyses of 71035*

SiO ₂	38.25
Al ₂ O ₃	8.77
FeO.....	19.74
MgO.....	7.98
CaO.....	10.87
Na ₂ O.....	.38
K ₂ O.....	.03
TiO ₂	13.06
P ₂ O ₅.....	.10
MnO.....	.29
Cr ₂ O ₃.....	.39
Total.....	100.86

71035, 4 (Rhodes and others, 1976).

Sample 71040-44, 45-49, 75

Type: Sedimentary, unconsolidated (71040-44) and six basalt fragments (71045-49, 75).

Weight: 71040-44, 258.93 g; 71045-49, 75, total 23.617 g.

Depth: 1-2 cm.

Location: In shadowed area on west side of 0.5-m boulder on southwestern wall of blocky 10-m crater.

Illustrations: Pans 12, 13; figures 35, 41.

Comments: Ejecta of blocky 10-m crater. Basalt chips were scooped up with soil sample 71040-44. Sample

71060-69, 85-97 was subsequently scooped from 5 to 6-cm depth at same locality.

Petrographic descriptions:

71040-44, dominantly basalt with minor feldspathic plutonic derivatives and agglutinate.

Components of 90-150-µm fraction of 71041,1 (Heiken and McKay, 1974)

Components	Volume Percent
Agglutinate.....	27.4
Basalt, equigranular.....	12.7
Basalt, variolitic.....	1.0
Breccia:	
Low grade ¹ - brown.....	1.0
Low grade ¹ - colorless.....	1.0
Medium to high grade ²	2.5
Anorthosite.....	--
Cataclastic anorthosite ³	1.0

Components of 90-150-µm fraction of 71041,1(Heiken and McKay, 1974)-Continued

Components	Volume Percent
Norite.....	--
Gabbro.....	--
Plagioclase.....	12.2
Clinopyroxene.....	17.3
Orthopyroxene.....	--
Olivine.....	.5
Ilmenite.....	5.6
Glass:	
Orange.....	3.6
"Black".....	8.1
Colorless.....	2.0
Brown.....	4.1
Gray, "ropy".....	--
Other.....	--
Total number of grains.....	197

1. Metamorphic groups 1-3 of Warner (1972).
2. Metamorphic groups 4-8 of Warner (1972).
3. Includes crushed or shocked feldspar grains.

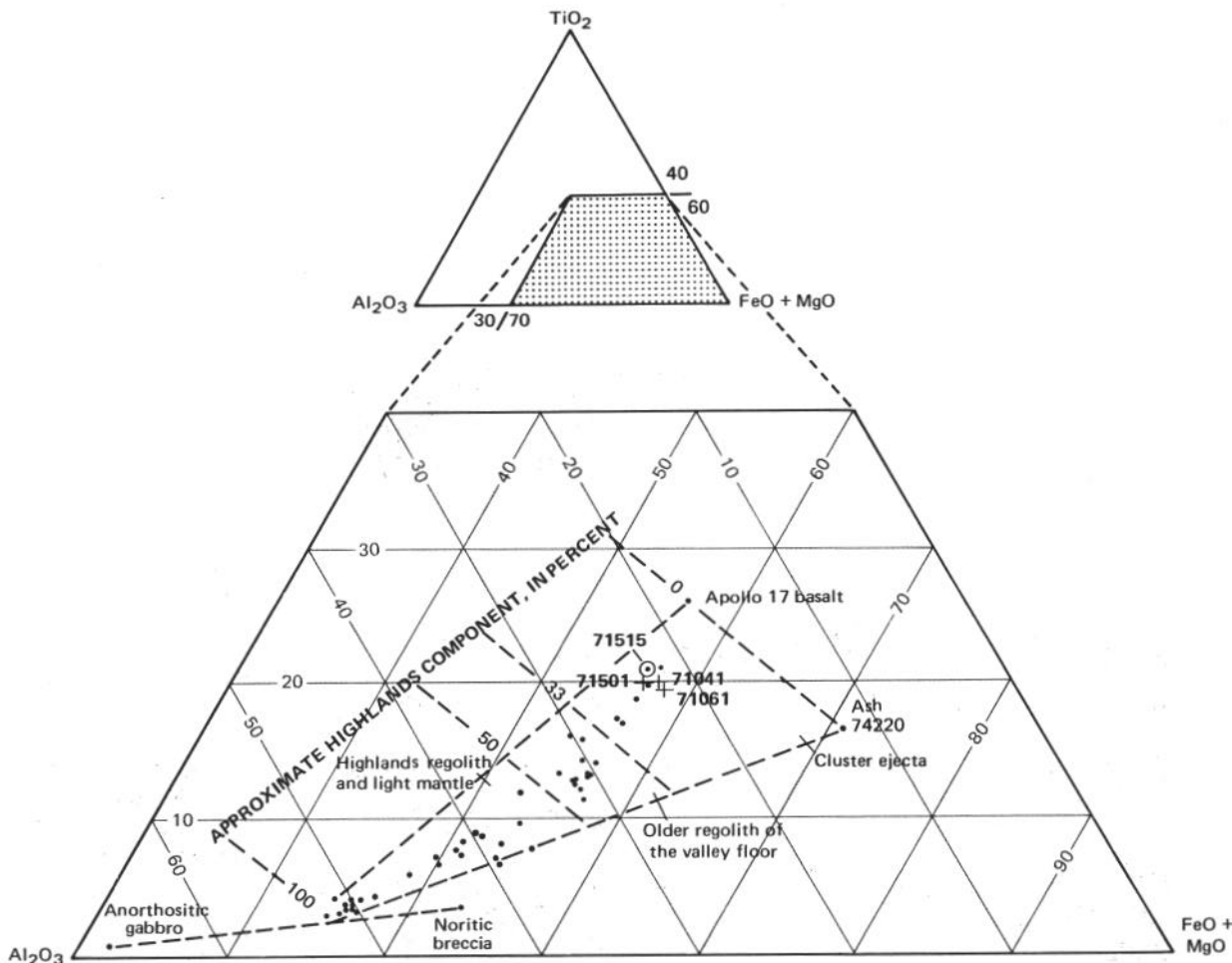


FIGURE 34.-Relative amounts of TiO₂, Al₂O₃, and FeO + MgO in sediment samples from station 1 (crosses) and agglutinate fragment 71515 (circle) in comparison with sediment samples from rest of traverse region (dots). Apollo 17, basalt, anorthositic gabbro, and noritic breccia values from Rhodes and others (1974).

71045, medium-grained vesicular porphyritic olivine basalt. Aggregates of clinopyroxene-ilmenite in an ophitic groundmass of plagioclase, clinopyroxene, ilmenite, and accessory minerals.

Major-element composition:

Chemical analyses of 71041

SiO ₂	39.74
Al ₂ O ₃	10.80
FeO.....	17.73
MgO.....	9.72
CaO.....	10.72
Na ₂ O.....	.35
K ₂ O.....	.08

Chemical analysis of 71041-Continued

TiO ₂	9.57
P ₂ O ₅.....	.07
MnO.....	.24
Cr ₂ O ₃.....	.47
Total.....	99.49

71041, 3 (Apollo 17 PET, 1973).

Sample 71055

Type: Olivine(?) basalt.

Size: 19.5x9.5x2.5 cm.

Weight: 669.6 g.

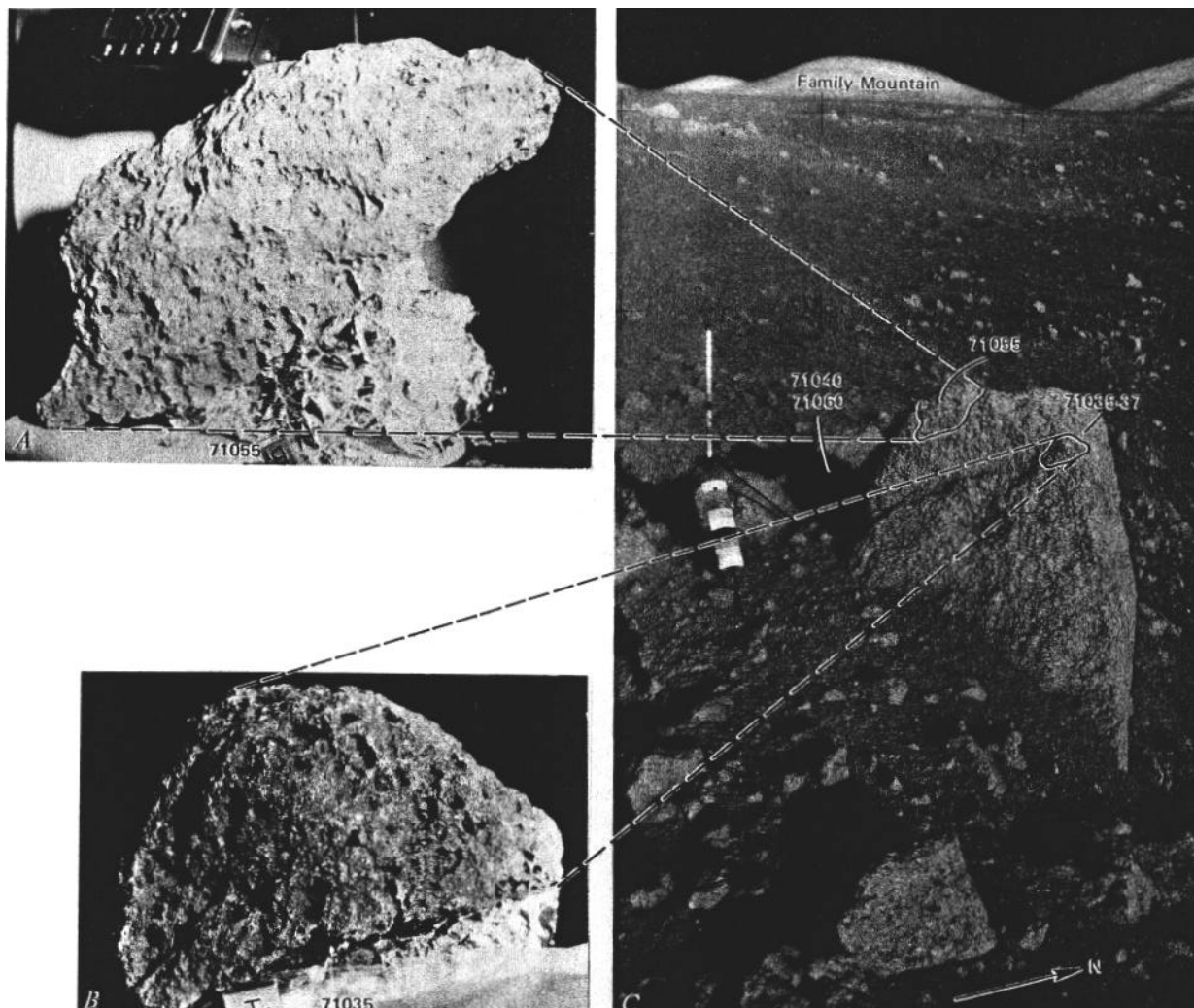


FIGURE 35.-A, Sample 71055 with reconstructed lunar surface orientation and lighting (LRL polaroid photograph). B, Sample 71035 with reconstructed lunar surface orientation and lighting (NASA photograph S-73-17804); C, Samples 71035 and 71055 before collection from 0.5-m boulder in southwest wall of blocky 10-m crater. Samples 71040-49, 75 and 71060-69, 85, 97 collected in shadowed area adjacent to boulder. (NASA photograph AS17-136-20739.)

Location: From 0.5-m boulder on southwestern wall of blocky 10-m crater (same boulder as 71035).

Illustrations: Pans 12, 13; figures 35, 39 (photomicrograph), 41.

Comments: Sampled boulder is subfloor basalt reexcavated from the Steno ejecta blanket by the impact that formed the 10-m crater.

Petrographic description: Medium-grained vesicular olivine(?) basalt with a locally plumose groundmass of plagioclase, clinopyroxene, ilmenite, and accessory minerals.

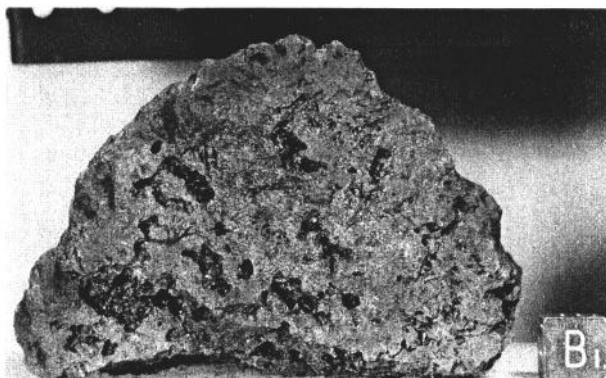


FIGURE 36.-Sample 71035. Medium-grained vesicular basalt. (NASA photograph S-73-15672.)

Major-element composition:

Chemical analyses of 71055

SiO ₂	38.14
Al ₂ O ₃	8.62
FeO.....	19.20
MgO.....	9.04
CaO.....	10.77
Na ₂ O.....	.31
K ₂ O.....	.06
TiO ₂	13.41
P ₂ O ₅.....	.08
MnO.....	.26
Cr ₂ O ₃.....	.41
Total	100.30

71055, 51 (Rose and others, 1974).

Age: Rb-Sr isochron: 71055, 3.64±0.09 b.y. (Terra and others, 1974a).

Exposure age: Kr-Kr: 71055, 110±7 m.y. (Arvidson and others, 1976b).

Sample 71060-64, 65-69, 85-89, 95-97

Type: Sedimentary, unconsolidated (71060-64) and 13 basalt fragments (71065-69, 85-89, 95-97).

Weight: 71060-64, 506.48 g; 71065-69, 85-89, 95-97, total 78.235 g.

Depth: 5-6 cm.

Location: In shadowed area on west side of 0.5-m boulder on southwestern wall of blocky 10-m crater.

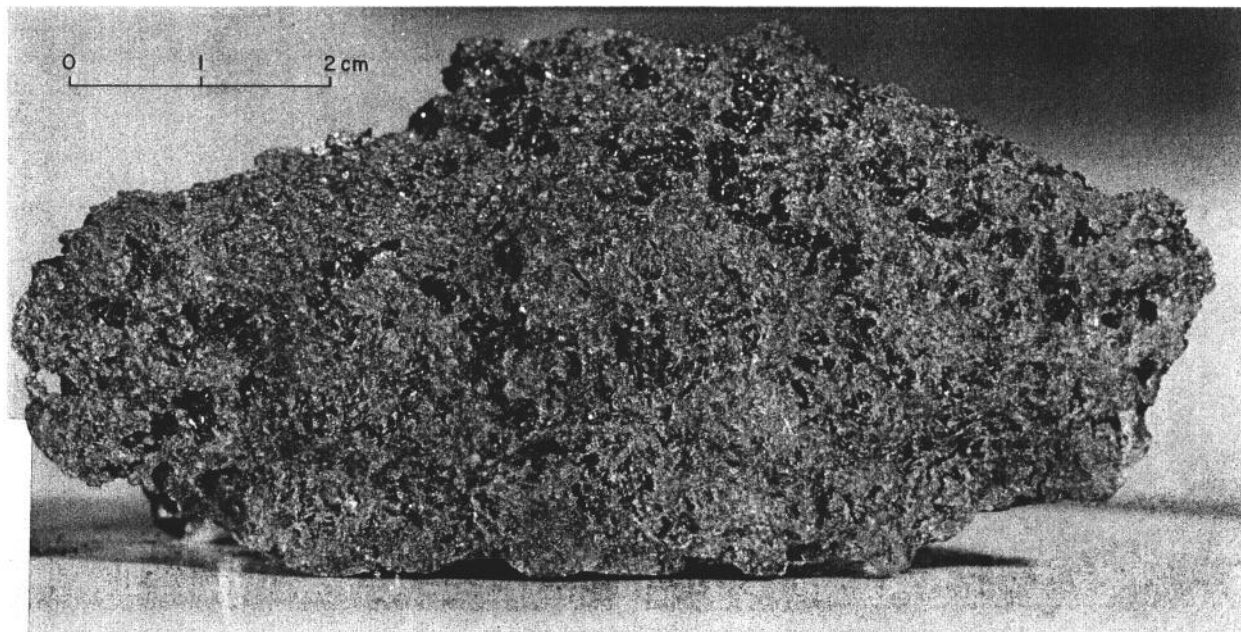


FIGURE 37.-Sample 71036. Medium-grained vesicular olivine(?) basalt. Pyroxene and ilmenite crystals line cavities. (NASA photograph S-73-15675.)

Illustrations: Pans 12, 13; figures 35, 40 (71065, LRL), 41.

Comments: Ejecta of blocky 10-m crater. Basalt chips were scooped up with sediment 71060-64. Sample 71040-49, 75 was previously scooped from 1 to 2-cm depth at same locality.

Petrographic descriptions: 71060-64, Dominantly basalt fragments.

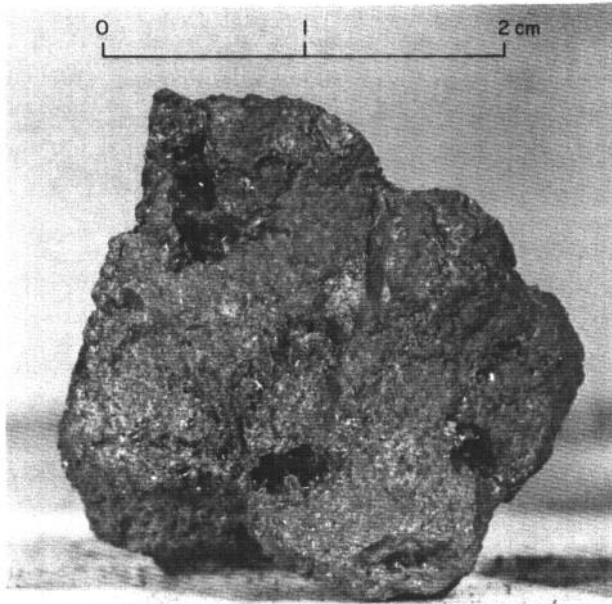


FIGURE 38.-Sample 71037. Medium-grained vesicular olivine(?) basalt. (NASA photograph S-73-15697.1)

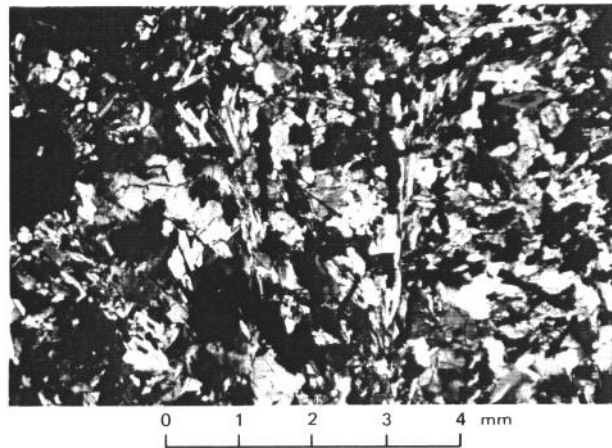


FIGURE 39.-Sample 71055. Photomicrograph showing plumose intergrowths of plagioclase, clinopyroxene, and ilmenite. Crossed polarizers.

Components of 90-150-um fraction of 71061,1 (Heiken and McKay, 1974)

Components	Volume Percent
Agglutinate.....	9.3
Basalt, equigranular.....	19.6
Basalt, variolitic	
Breccia:	
Low grade ¹ - brown.....	3.6
Low grade ¹ - colorless.....	.6
Medium to high grade ²	1.6
Anorthosite.....	.3
Cataclastic anorthosite ³	--
Norite.....	--
Gabbro.....	--
Plagioclase.....	17.3
Clinopyroxene.....	21.0
Orthopyroxene.....	--
Olivine.....	--
Ilmenite.....	4.6
Glass:	
Orange.....	6.3
"Black".....	9.6
Colorless.....	1.3
Brown.....	4.6
Gray, "ropy".....	--
Other.....	--
Total number of grains.....	300

1. Metamorphic groups 1-3 of Warner (1972).
2. Metamorphic groups 4-8 of Warner (1972).
3. Includes crushed or shocked feldspar grains.

71065, fine-grained olivine basalt.

71066, aphanitic olivine basalt.

Major-element composition:

Chemical analyses of 71061

SiO ₂	40.09
Al ₂ O ₃	10.70
FeO.....	17.85
MgO.....	9.92
CaO.....	10.59
Na ₂ O.....	.36
K ₂ O.....	.08
TiO ₂	9.32
P ₂ O ₅ ³.....	.07
MnO.....	.24
Cr ₂ O ₃.....	.49
Total	99.71

70161, 3 (Apollo 17 PET, 1973).

Sample 71130-31, 35, 36

Type: Sedimentary, unconsolidated (71130-34) and olivine basalt fragments (71135, 36).

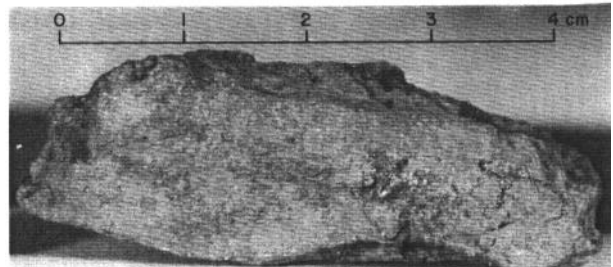


FIGURE 40.-Sample 71065. Fine-grained olivine basalt. (NASA photograph 5-73-16932.)

Size: 71135, 6x4.5x1.5 cm; 71136, 4x2x2 cm.

Weight: 71130-34, 144.03 g; 71135, 36.85 g; 71136, 25.39 g.

Location: 71135 and 71136 chipped from 0.5-m boulder on southeast rim of 10-m blocky crater; 71130-34, sediment from near the boulder.

Illustrations: Pans 12, 13; figures 41, 42 (71135, LRL), 43 (71136, LRL).

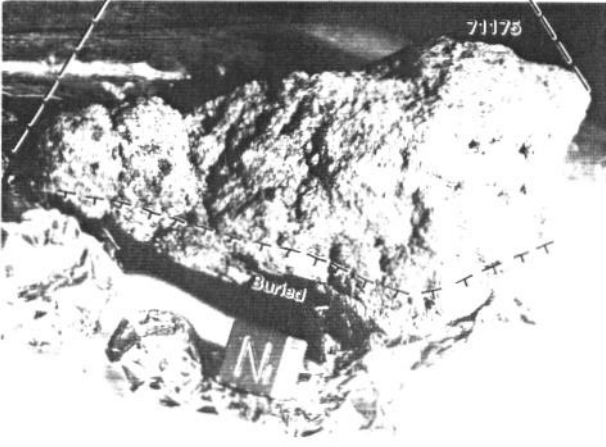
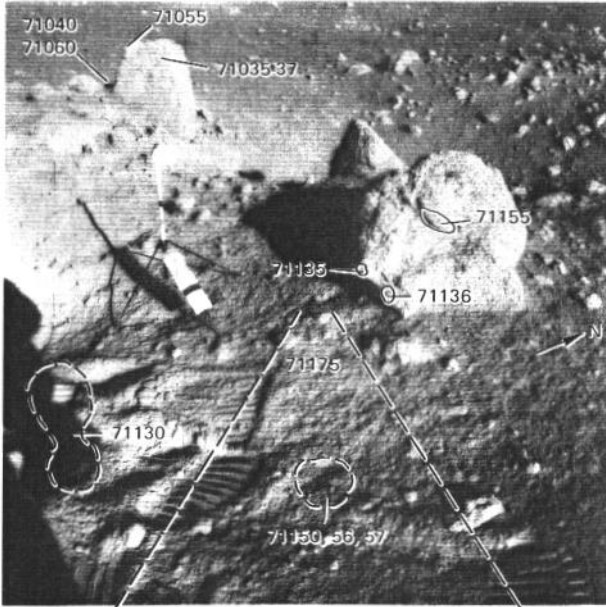


FIGURE 41.--Top, Samples 71135, 71136, 71155 before collection from boulder on southeast rim of blocky 10-m crater. 71135 and 71136 fell to lunar surface, and sediment 71130-34 was scooped up with them. 71175, half-buried near the boulder, is also shown before collection. Samples 71035-37; 71040-49, 75; 71055; 71060-69, 85-97 collected from boulder in upper left and nearby regolith. (NASA photograph AS 17 136-2074 1.) Bottom, LRL view showing 71175 with reconstructed lunar surface orientation and lighting. (NASA photograph S-73-17803.)

Comments: Boulder was reexcavated from the Steno ejecta blanket by the impact that formed the 10-m crater. 71135 and 71136 were knocked off the boulder during hammering; when they were picked up, the underlying sediment (71130-34) was collected with them.

Petrographic descriptions:

71130-34, dominantly basalt with minor agglutinate and breccia fragments.

71135, medium-grained vesicular olivine basalt with a locally plumose groundmass of plagioclase, clinopyroxene, ilmenite, and accessory minerals.

71136, fine-grained vesicular olivine basalt.

Major-element compositions:

Chemical analyses of 71135 and 71136

	1	2
SiO ₂	39.71	40.30
Al ₂ O ₃	10.10	10.21
FeO.....	18.57	18.44
MgO.....	7.31	7.03
CaO.....	11.62	11.73
Na ₂ O.....	.38	.37
K ₂ O.....	.05	.03
TiO ₂	10.74	11.12
P ₂ O ₅.....	.06	.06
MnO.....	.28	.28
Cr ₂ O ₃.....	.31	.28
Total	99.13	99.85

1. 71135, 5 (Rhodes and others, 1976).
2. 70136, 1 (Rhodes and others, 1976).

Exposure Age: Kr-Kr: 71135, 102 m.y. (Arvidson and others, 1976b).

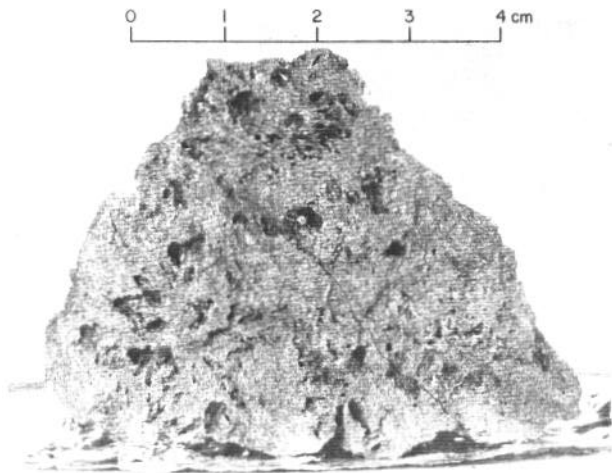


FIGURE 42.--Sample 71135. Medium-grained vesicular olivine basalt. Pyroxene and ilmenite crystals line cavities. (NASA photograph S-73-15686.)

Sample 71150-54, 55-57

Type: Sedimentary, unconsolidated (71150-54), olivine(?) basalt (71155-56), and basalt (71157).

Size: 71155, 5X2.5X2.5 cm; 71156, 2.2x1.5x1 cm; 71157, 1.2x1.0x0.8 cm.

Weight: 71150-54, 63.93 g; 71155, 26.15 g; 71156, 5.42 g; 71157, 1.466 g.

Location: 71155 chipped from the boulder on the southeast rim of the 10-in blocky crater; 71150-54, sediment with two basalt fragments (71156, 71157) from near the boulder.

Illustrations: Pans 12, 13; figures 41, 44 (71155, LRL).

Comments: Boulder was reexcavated from the ejecta blanket of Steno crater by the impact that formed the 10-m crater. 71155 was knocked off the boulder during hammering; when it was picked up, the underlying sediment (71150-54), including two small basalt fragments (71156, 71157), was collected with it.

Petrographic descriptions:

71150-54, dominantly basalt and breccia fragments, minor agglutinate.

71155, fine-grained vesicular olivine(?) basalt.

71156, fine-grained vesicular olivine(?) basalt.

Sample 71175

Type: Olivine basalt.

Size: 8x5x4 cm.

Weight: 207.8 g.

Location: Sample is a cobble from the regolith near the boulder on the southeast rim of the 10-m blocky crater.

Illustrations: Pans 12, 13; figures 41, 45 (LRL).

Comments: Sample was half buried. It is probably part of the ejecta from the 10-m crater.

Petrographic description: Medium-grained vesicular olivine basalt.

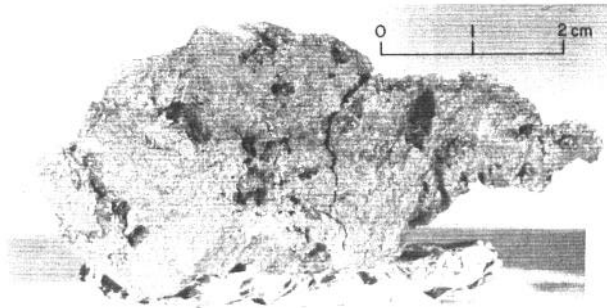


FIGURE 43.- Sample 71136. Fine-grained vesicular olivine basalt. Pyroxene and ilmenite crystals line cavities. (NASA photograph S - 73 - 16424.)

*Major - element composition:**Chemical analyses of 71175*

SiO ₂	37.93
Al ₂ O ₃	8.47
FeO.....	19.37
MgO.....	9.63
CaO.....	9.79
Na ₂ O.....	.38
K ₂ O.....	.04
TiO ₂	13.08
P ₂ O ₅.....	.04
MnO.....	.28
Cr ₂ O ₃.....	.54
Total	99.55

71175, 2 (Rhodes and others, 1976).

Sample 71500-0 1, 05-09, 15

Type: Sedimentary, unconsolidated (71500-04) with five basalt fragments (71505-09) and a glassbonded agglutinate fragment (71515).

Weight: 71500-04, 1,013.79 g; 71505-09 and 71515, 52.57 g.

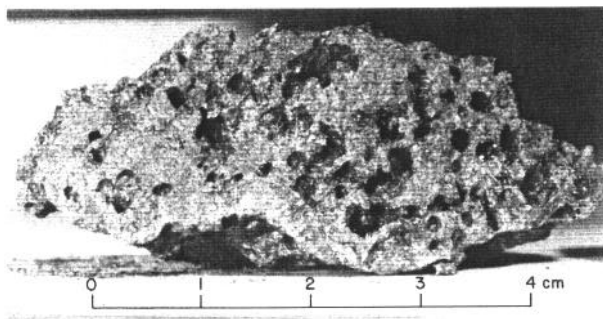


FIGURE 44.-Sample 71155. Fine-grained vesicular olivine (?) basalt. (NASA photograph S-73-1586.)

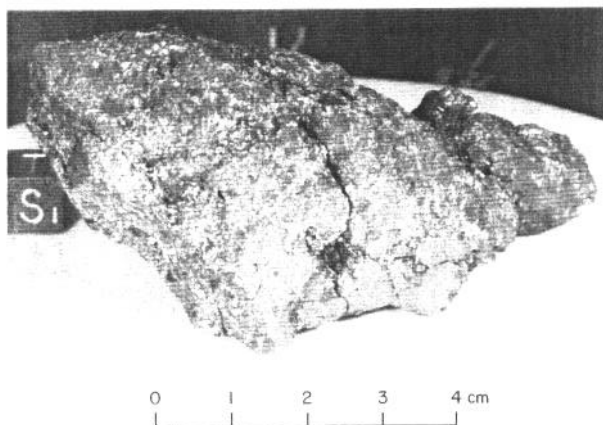


FIGURE 45.-Sample 71175. Medium-grained vesicular olivine basalt. (NASA photograph S-73-15727.)

Location: 15 m east of blocky 10-m crater.

Illustrations: Pans 12, 13; figure 46.

Comments: Sample is unconsolidated sediment collected from the rake sample site; it is regolith developed on Steno crater ejecta. Compositional similarity of agglutinate fragment 71515 to sediment samples (fig. 34) implies that the agglutinate formed from local regolith material.

Petrographic descriptions:

71500-04, dominantly basalt and breccia fragments with minor agglutinates.

Components of 90-150 μ m fraction of 71501.1 (Heiken arid McKay, 1974)

Components	Volume Percent
Agglutinate.....	35.0
Basalt, equigranular.....	24.6
Basalt, variolitic	
Breccia:	
Low grade ¹ - brown.....	2.3
Low grade ¹ - colorless.....	.6
Medium to high grade ²	2.3
Anorthosite.....	--
Cataclastic anorthosite ³	--
Norite.....	--
Gabbro.....	--
Plagioclase.....	5.0
Clinopyroxene.....	17.3
Orthopyroxene.....	.6
Olivine.....	--
Ilmenite.....	8.0
Glass:	
Orange.....	1.3
"Black".....	1.3
Colorless.....	.6
Brown.....	.3
Gray, "ropy".....	--
Other.....	--
Total number of grains.....	300

1. Metamorphic groups 1-3 of Warner (1972).
2. Metamorphic groups 4-8 of Warner (1972).
3. Includes crushed or shocked feldspar grains.

71505, medium-grained olivine basalt.

71506, coarse-grained olivine basalt.

Major element composition:

Chemical analyses of 71501, 71509, 71515

	1	2	3
SiO ₂	39.82	--	--
Al ₂ O ₃	11.13	7.3	11.2
FeO.....	17.41	20.6	18.2
MgO.....	9.51	10.3	9.3
CaO.....	10.85	9.6	10.4
Na ₂ O.....	.32	.314	.37
K ₂ O.....	.07	.054	.065
TiO ₂	9.52	13.7	10.3
P ₂ O ₅.....	.06	--	--
MnO.....	.25	.258	.222
Cr ₂ O ₃.....	.46	.647	.458
Total	100.29	100.004	99.02

1. 70135, 33 (Apollo 17 PET, 1973).
2. 70135, 41 (Warner and others, 1975a).
3. 70135, 27 (Laul and others, 1975).

Samples 71525-29, 35_39, 45-49, 55-59, 65-69, 75-79, 85-89, 95-97

Type: 38 rake fragments, all basalt.

Weight: Total, 2,220.16 g; range, 2.113 to 415.4 g.

Location: 15 m east of blocky 10-m crater.

Illustrations: Pans 12, 13; figures 46, 47-54 (LRL), 55 (photomicrograph), 56-63 (LRL).

Comments: Subfloor basalt fragments from regolith developed on Steno crater ejecta.

Petrographic descriptions:

- 71525, fine-grained basalt.
- 71526, fine-grained basalt.
- 71528, fine-grained basalt.
- 71529, fine-grained vesicular basalt.
- 71535, fine-grained vesicular basalt.
- 71536, medium-grained basalt.
- 71537, aphanitic basalt.
- 71538, fine-grained basalt.
- 71539, fine-grained basalt.
- 71545, fine-grained basalt.
- 71546, fine-grained vesicular basalt.
- 71547, fine-grained vesicular basalt.
- 71548, medium-grained vesicular basalt.
- 71549, medium-grained basalt.
- 71556, medium-grained vesicular basalt.
- 71557, medium-grained basalt.
- 71558, medium-grained vesicular olivine basalt.

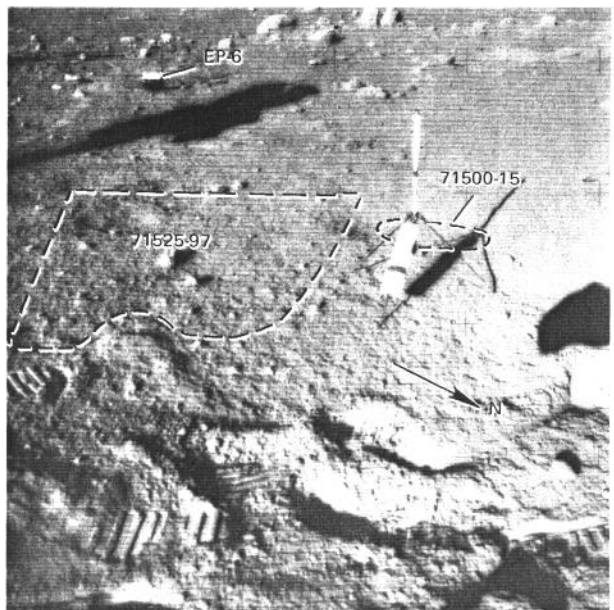


FIGURE 46.--Approximate locations of rake sample (71525-97) and associated sediment sample (71500-15), before collection. (NASA photograph AS17-136-20742.)

- 71559, medium-grained basalt.
 71565, medium-grained vesicular olivine basalt with a subophitic(?) groundmass.
 71566, medium-grained vesicular basalt.
 71567, medium-grained vesicular olivine basalt.
 71568, medium-grained olivine basalt.
 71569, fine-grained olivine basalt. Micropheno crystals of olivine in an intergranular groundmass of plagioclase, clinopyroxene, ilmenite, and accessory minerals.
 71576, fine-grained olivine basalt.
 71577, fine-grained vesicular olivine basalt.
 71578, fine-grained vesicular olivine basalt.
 71579, fine-grained vesicular basalt.
 71585, fine-grained vesicular olivine basalt.
 71586, fine-grained olivine basalt.
 71587, fine-grained vesicular olivine basalt.
 71588, fine-grained olivine basalt.
 71589, fine-grained olivine basalt.

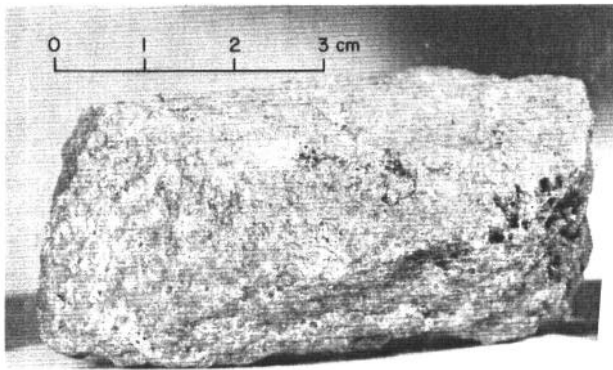


FIGURE 47-Sample 71546. Fine-grained vesicular basalt. (NASA photograph S-73-16131.)

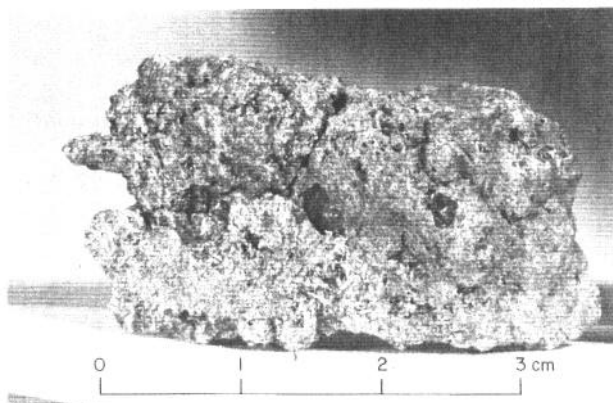


FIGURE 48 -Sample 71548. Medium - grained vesicular basalt. Pyroxene and ilmenite crystals line cavities. (NASA photograph S-73-16136.)

- 71595, fine-grained olivine basalt.
 71596, fine-grained olivine basalt.
 71597, medium-grained vesicular olivine basalt.

Major- element compositions:

Chemical analyses of 71546, 71566, 71567, 71569, 71577

	1	2	3	4	5	6	7
SiO ₂	39.14	39.27	38.06	39.97	39.4	39.7	39.18
Al ₂ O ₃	8.91	9.22	8.59	9.08	8.58	8.83	8.92
FeO.....	19.11	18.73	19.40	18.85	18.9	18.9	18.90
MgO.....	8.34	8.40	8.83	7.66	8.47	8.06	8.15
CaO.....	10.79	10.89	10.57	11.27	10.58	10.92	10.95
Na ₂ O.....	.40	.40	.38	.41	.388	.40	.39
K ₂ O.....	.05	.03	.03	.06	.067	.06	.06
TiO ₂	12.33	12.01	12.98	11.57	12.18	11.88	12.04
P ₂ O ₅.....	.05	.03	.02	.06	.066	.06	.05
MnO.....	.028	.27	.28	.28	.245	.26	.28
Cr ₂ O ₃.....	.41	.38	.43	.36	.465	.41	.41
Total	99.81	99.63	99.57	99.57	99.341	99.48	99.33

1. 71546,5 (Rhodes and others, 1976).
2. 71566,10 (Rhodes and others, 1976).
3. 71567,9 (Rhodes and others, 1976).
4. 71569,11 (Rhodes and others, 1976).
5. 71569,24 (Wanke and others, 1975).
6. Average of 4 and 5.
7. 71577,4 ((Rhodes and others, 1976).

Exposure age: Kr-Kr: 71569, 134 m.y. (Arvidson, 1976b).

**STATION LRV-1
LOCATION**

Station LRV-1 is located approximately 250 m east of Bronte crater (fig. 7C) near a small fresh crater 10 to 15 m in diameter (fig. 64).

OBJECTIVES

LRV-1 was an unscheduled stop to sample ejecta from the 10-15-to crater.

GENERAL OBSERVATIONS

The station area is in generally flat terrain that rises to the west. Craters are sparse, subdued, and generally

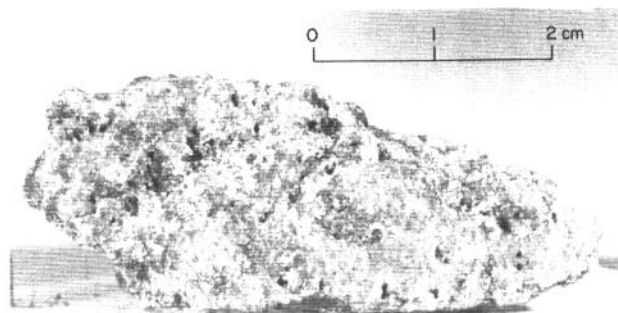


FIGURE 49 - Sample 71556. Medium - grained vesicular basalt. (NASA photograph S-73-16239.)

without blocks. They range in size from a few centimeters to about 30 m in diameter. The sampling was done in a ray associated with one of the rare blockrimmed craters in the area. Blocks from this crater range in size from a few tenths of a meter or less in the sample area (fig. 65) to about 1 meter at the crater rim (fig. 64). Most of the blocks are perched on the surface; they do not appear to be filleted or dust covered.

SUMMARY OF SAMPLING

Sample 72130-34, 35

Type: Sedimentary, unconsolidated (72130-34), and basalt cataclasite (72135).

Size: 72135, 8x6x5.5 cm.

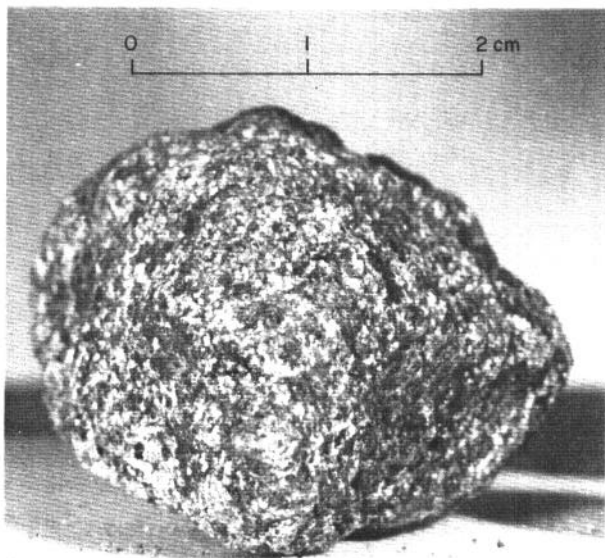


FIGURE 50.-Sample 71557. Medium-grained basalt. (NASA photograph S-73-16245.)

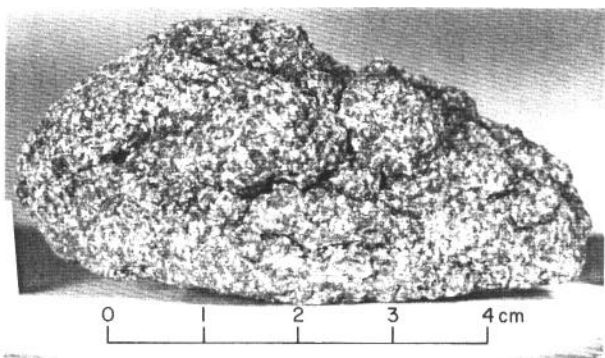


FIGURE 51.-Sample 71559. Medium-grained basalt. (NASA photograph S-73-16456.)

Weight: 72130-34, 220.47 g; 72135, 336.9 g.

Location: 72135 and associated sediment (72130-34) were collected about three-fourths of a crater diameter out from the rim of the 10-15-m crater.

Illustrations: Figures 64, 65, 66 (LRL).

Comments: Sample 72135 is a fragment of subfloor basalt that may have been excavated from the regolith by the impact that formed the fresh 10-15-m crater. Its cataclastic texture presumably resulted from an impact, possibly but not necessarily the one that formed the nearby small crater.

Petrographic description: 72135, variolitic olivine basalt cataclasite. Fragmental matrix dominant, but some glass present.

STATION LRV-2

LOCATION

Station LRV-2 is located on a narrow tongue of the light mantle approximately 1.6 km west of Horatio crater and about 1.2 km west of station LRV-1 (fig. 7C).

OBSERVATIONS

Station LRV-2 was a planned LRV stop to sample and photograph the light mantle.

GENERAL OBSERVATIONS

The station area is generally flat with scattered 1-10-m craters (fig. 67). Blocks are sparse and range in size from a few centimeters to a few tenths of a meter.

The craters are subdued and relatively free of block. The astronauts noted a higher albedo in the crater walls and rims than on darker parts of the valley floor. They also reported some crater rims with fragments of "instant rock" (regolith breccia).

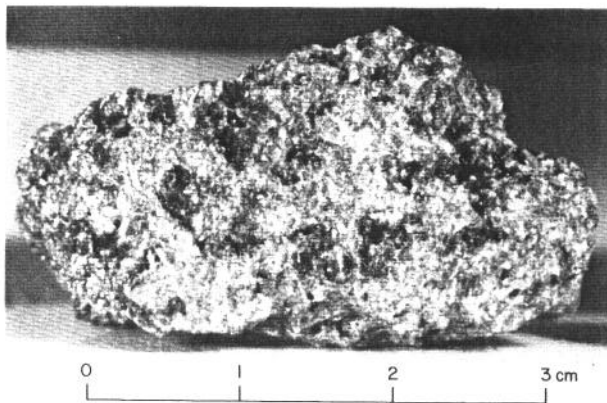


FIGURE 52.-Sample 71565. Medium-grained vesicular olivine basalt. (NASA photograph S-73-16451.)

SUMMARY OF SAMPLING

Sample 72140-44, 45

Type: Sedimentary, unconsolidated (72140-44) and small included breccia fragment, (72145).

Size: 72145, 1.3x1.3x1 cm.

Weight: 72140-44, 350-83 g; 72145, 1.25 g.

Locotion: From the rim of a small crater approximately 5 in diameter. The small rock (72145) collected with the sediment (72140-44) has not been located

in photographs of the sample area.

Illustrations: Figure 67.

Comments: The material sampled represents light mantle material probably ejected from the nearby 5-m crater. Its composition reflects the presence of appreciably more highlands material than is in the dark sediment of the valley floor (fig. 68). However, admixed basaltic sediment, from the valley floor is much more abundant than in light-mantle samples from stations closer to the South Massif.

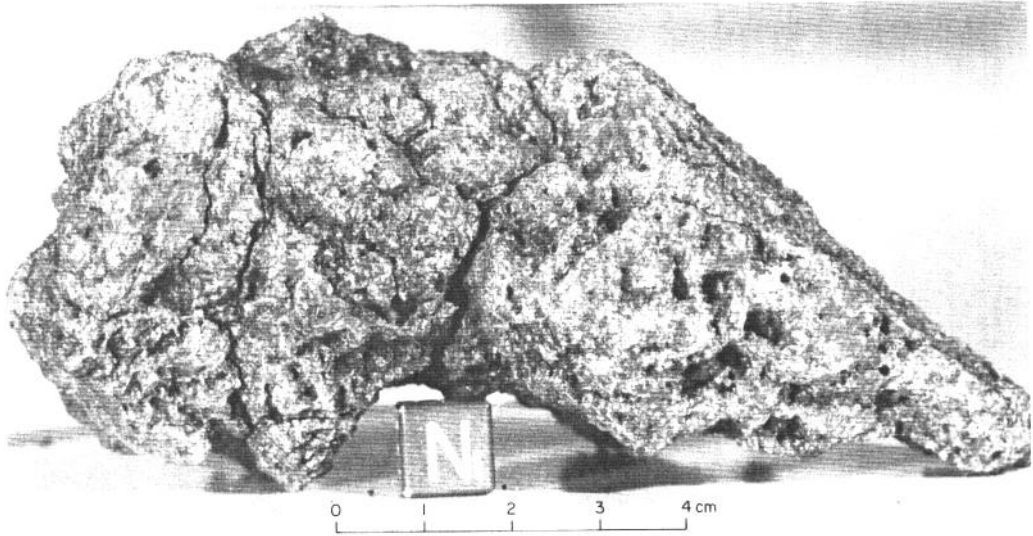


FIGURE 53-Sample 71566. Medium-grained vesicular basalt. (NASA photograph S-73-16461.)

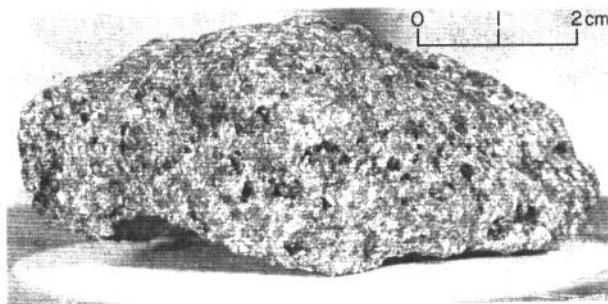


FIGURE 54.-Sample 71567. Medium-grained vesicular olivine basalt. (NASA photograph S-73-16458.)

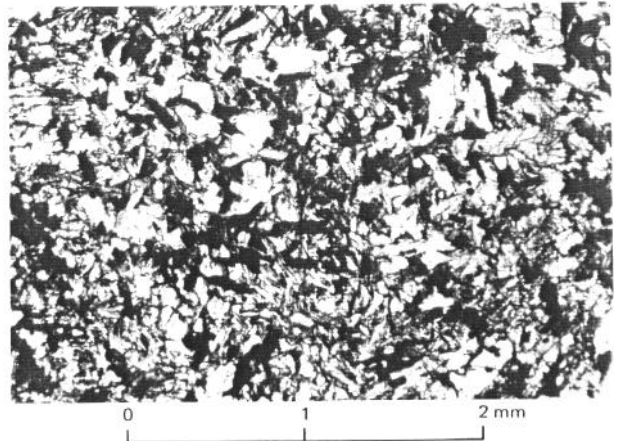


FIGURE 55.-Sample 71569. Photomicrograph showing microphenocrysts of olivine in intergranular groundmass of clinopyroxene, plagioclase and ilmenite. Crossed polarizers.

Petrographic description: 72140-44, dominantly basalt and glass fragments with some agglutinate and breccia.

Components of 90 - 150 um fraction of 72141,15 (Heiken and McKay, 1974)

Components	Volume Percent
Agglutinate.....	50.6
Basalt, equigranular.....	6.6
Basalt, variolitic.....	.6
Breccia:	
Low grade ¹ - brown.....	4.0
Low grade ¹ - colorless.....	4.0
Medium to high grade ²	1.6
Anorthosite.....	--
Cataclastic anorthosite ³	1.3
Norite.....	.3
Gabbro.....	.3

Components of 90 - 150 um fraction of 72141,15 (Heiken and McKay, 1974) - Continued

Components	Volume Percent
Plagioclase.....	9.0
Clinopyroxene.....	7.0
Orthopyroxene.....	--
Olivine.....	--
Ilmenite.....	.6
Glass:	
Orange.....	1.3
"Black".....	5.0
Colorless.....	1.6
Brown.....	3.9
Gray, "ropy" ³	1.3
Other.....	--
Total number of grains.....	300

1. Metamorphic groups 1-3 of Warner (1972).
2. Metamorphic groups 4-8 of Warner (1972).
3. Includes crushed or shocked feldspar grains.

Major-element composition:

Chemical analyses of 72141

	1	2	3
SiO ₂	43.11	43.0	43.1
Al ₂ O ₃	16.10	15.78	15.94
FeO.....	13.45	13.35	13.40
MgO.....	10.25	9.88	10.06
CaO.....	11.83	11.8	11.8
Na ₂ O.....	.40	.402	.40
K ₂ O.....	.12	.106	.11
TiO ₂	4.37	4.39	4.38
P ₂ O ₅.....	.10	.096	.10
MnO.....	.19	.176	.18
Cr ₂ O ₃.....	.37	.346	.36
Total	100.29	99.326	99.83

1. 72141, 9 (Rose and others, 1974).
2. 72141, 22 (Wanke and others, 1974).
3. Average of 1 and 2.

STATION LRV-3

LOCATION

Station LRV-3 is approximately 500 m west of station LRV-2 and 2.2 km west of Horatio crater in

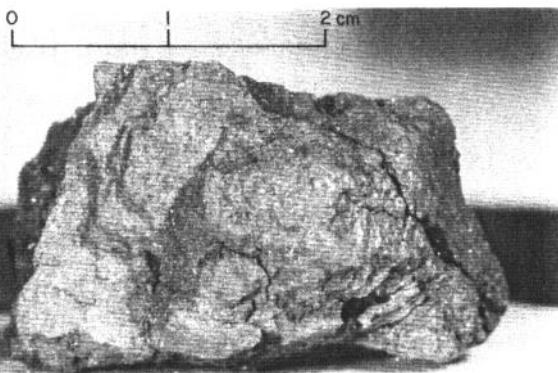


FIGURE 56.-Sample 71576. Fine-grained olivine basalt. (NASA photograph S-73-16617.)

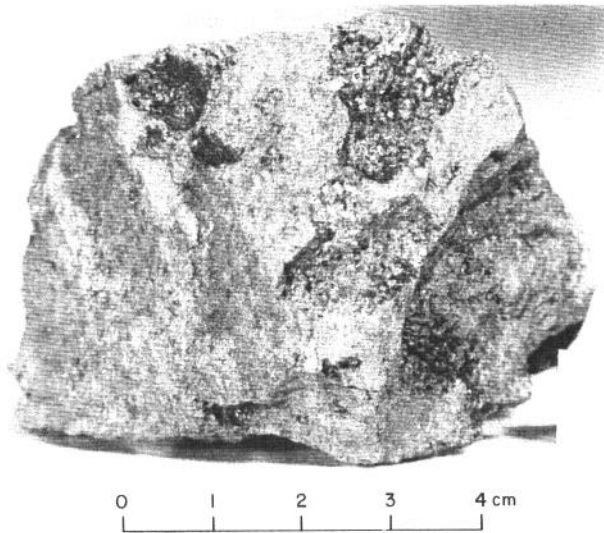


FIGURE 57.-Sample 71577. Fine-grained vesicular olivine basalt. (NASA photograph S-73-16589.1.)

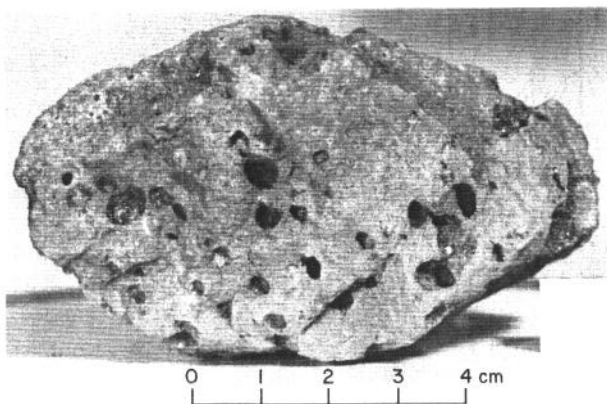


FIGURE 58.-Sample 71578. Fine-grained vesicular olivine basalt. (NASA photograph S-73-16592.)

Tortilla Flat, the dark area between the main body of light mantle and the finger of light mantle to the southeast (figs. 6, 7A; pl. 2).

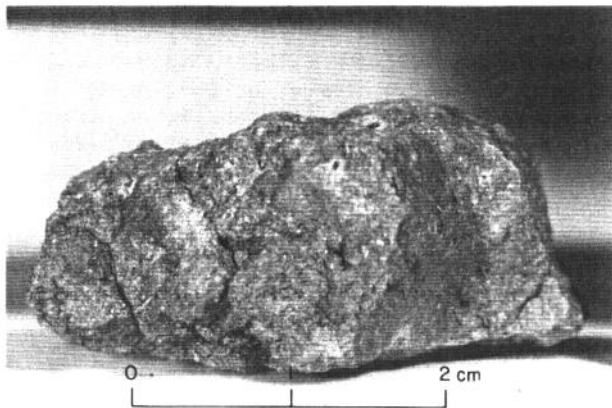


FIGURE 59. - Sample 71586. Fine-grained olivine basalt. (NASA photograph S-73-16594.)

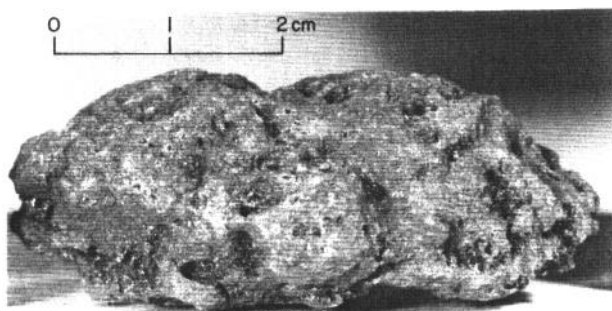


FIGURE 60.-Sample 71587. Fine-grained vesicular olivine basalt. Pyroxene and ilmenite crystals line cavities. (NASA photograph S-73-16598.)

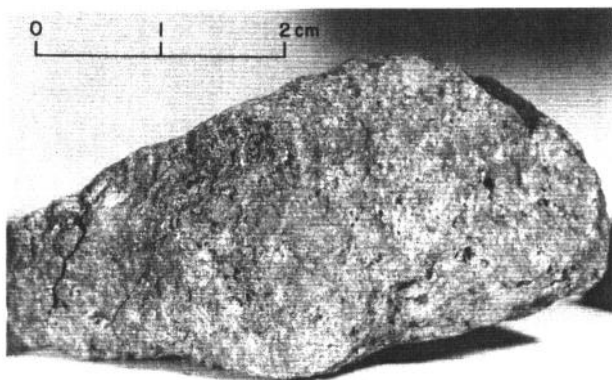


FIGURE 61.-Sample 71588. Fine-grained olivine basalt. (NASA photograph S-73-16602.)

OBJECTIVES

Station LRV-3 was a planned LRV stop to sample and photograph the dark mantle.

GENERAL OBSERVATIONS

The station area is flat with scattered craters up to 10 m in diameter (fig. 69) that are widely spaced and generally have subdued, relatively block-free rims. However, clods are present on the rims of a few craters smaller than 3 m. The surface between craters is smooth but has a pitted "raindrop" texture. Scattered small blocks range in size from a few centimeters to a few tenths of a meter.

SUMMARY OF SAMPLING

Sample 72150, 55

Type: Sedimentary, unconsolidated (72150) and olivine

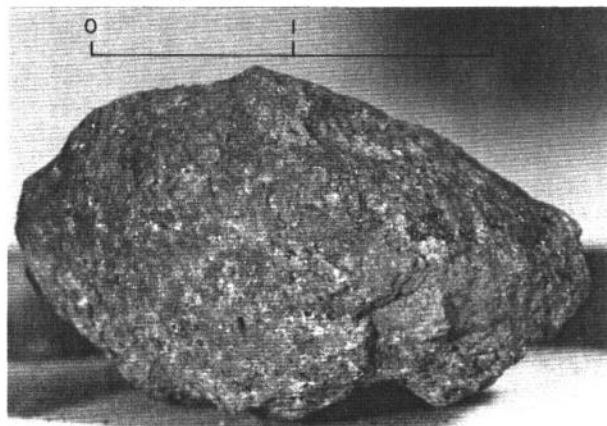


FIGURE 62.-Sample 71595. Fine-grained olivine basalt. (NASA photograph S-73-16608.)

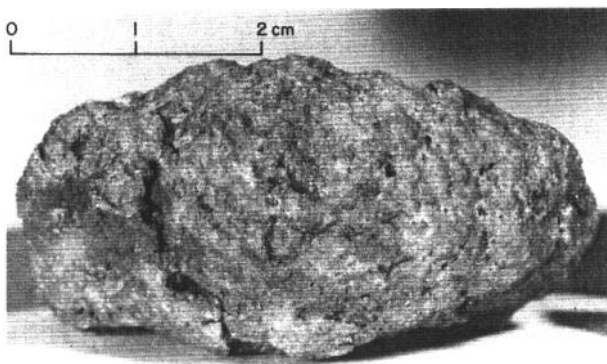


FIGURE 63.-Sample 71596. Fine-grained olivine basalt. (NASA photograph S-73-16613.)

basalt (72155).

Size: 72155, 7x5x4 cm.

Weight: 72150, 53.29 g; 72155, 238.5 g.

Location: Station LRV-3, between two tongues of the light mantle.

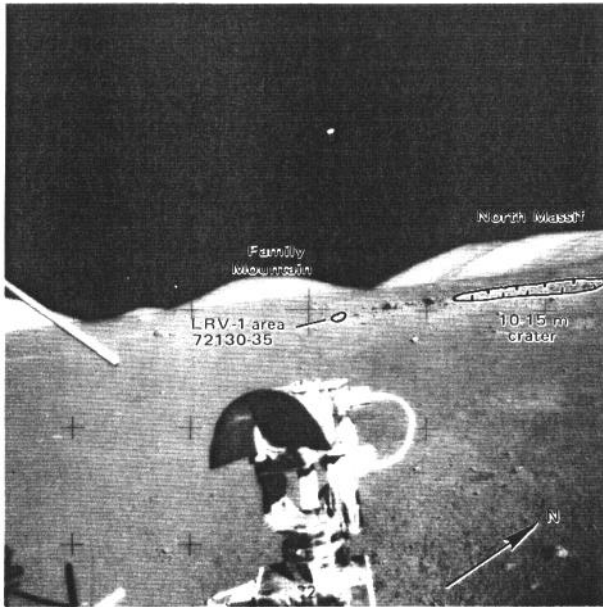


FIGURE 64. - View from LRV toward station LRV-1 area showing sample 72130-35 area in ejecta of blocky 10-15-m crater. (NASA photograph AS17-135-20623.)

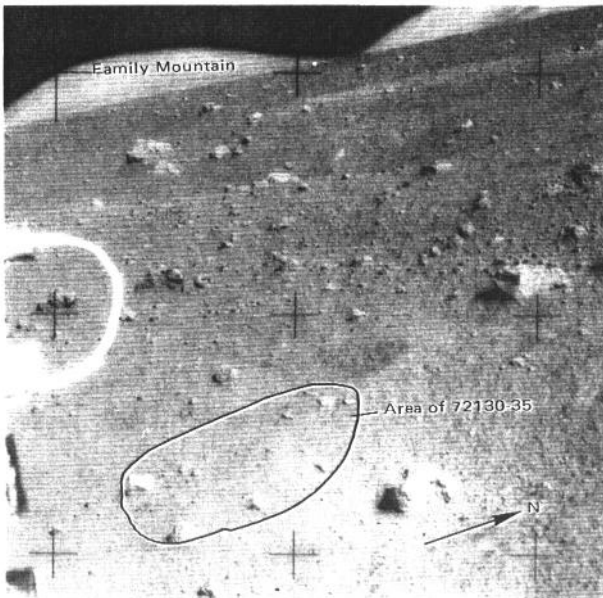


FIGURE 65. - 2130-35 sample area; exact sample location is not known (NASA photograph AS 17-135-20625.)

Illustrations: Figures 69, 70 (72155, LRL).

Comments: Collected from the smooth flat, intercrater surface; the rock (72155) is not clearly related to any nearby crater. It is a fragment of subfloor basalt from the regolith.

Petrographic descriptions:

Components of 90 - 150 - μ m fraction of 72150,2 (Heiken and McKay, 1117-4)

Components	Volume Percent
Agglutinate.....	52.6
Basalt, equigranular.....	8.3
Basalt, variolitic.....	1.3
Breccia:	
Low grade ¹ - brown.....	5.3
Low grade ¹ - colorless.....	1.6
Medium to high grade ²	4.0
Anorthosite.....	--
Cataclastic anorthite ³.....	.3
Norite.....	--
Gabbro.....	--
Plagioclase.....	5.3
Clinopyroxene.....	5.3
Orthopyroxene.....	--
Olivine.....	--
Ilmenite.....	.6
Glass:..	
Orange.....	3.9
"Black".....	5.3
Colorless.....	1.3
Brown.....	2.8
Gray, "ropy".....	.6
Other.....	.3
Total number of grains.....	300

1. Metamorphic groups 1-3 of Warner (1972).
2. Metamorphic groups 4-8 of Warner (1972).
3. Includes crushed or shocked feldspar grains.

72155, fine-grained vesicular olivine basalt with a variolitic groundmass.

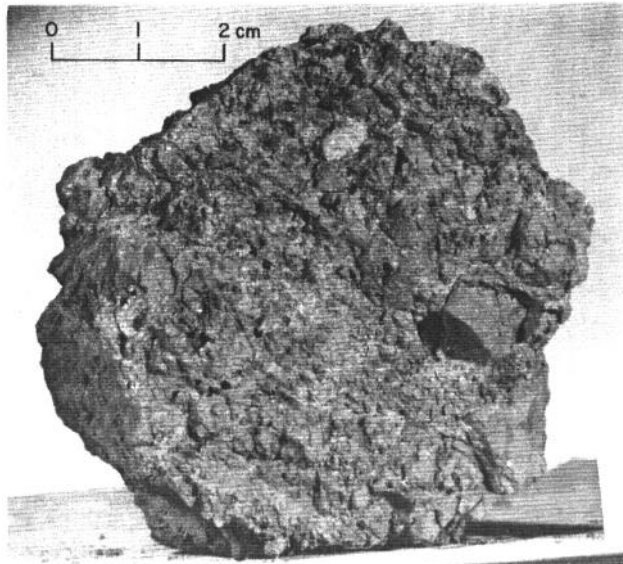


FIGURE 66. - Sample 72135. Olivine basalt cataclastite. (NASA photograph S-73-16206.)

Major-element composition:

Chemical analyses of 72155			
	1	2	3
SiO ₂	38.67	38.9	38.78
Al ₂ O ₃	8.64	8.54	8.59
FeO.....	18.77	19.4	19.08
MgO.....	8.47	8.72	8.60
CaO.....	10.69	10.42	10.56
Na ₂ O.....	.40	.384	.39
K ₂ O.....	.07	.067	.07
TiO ₂	12.32	12.23	12.28
P ₂ O ₅.....	.05	.071	.06
MnO.....	.28	.252	.27
Cr ₂ O ₃.....	.43	.468	.45
Total	98.79	99.452	99.13

1. 72155, 23 (Rose and others, 1976).
2. 72155, 30 (Wanke and others, 1975).
3. Average of 1 and 2.

Sample 72160 -64

Type: Sedimentary, unconsolidated.

Weight: 250.00 g.

Depth: 1-2 cm.

Location: From the smooth flat intercrater surface near sample 72155.

Illustrations: Figure 66.

Comments: The composition of the unconsolidated sediment indicates that station LRV-3 is in the older regolith of the valley floor (fig. 71) beyond the limits of the younger, basalt-rich cluster ejecta.

Petrographic description: 72160-64, dominantly dark fine-grained breccia fragments and agglutinate with some feldspathic breccia.

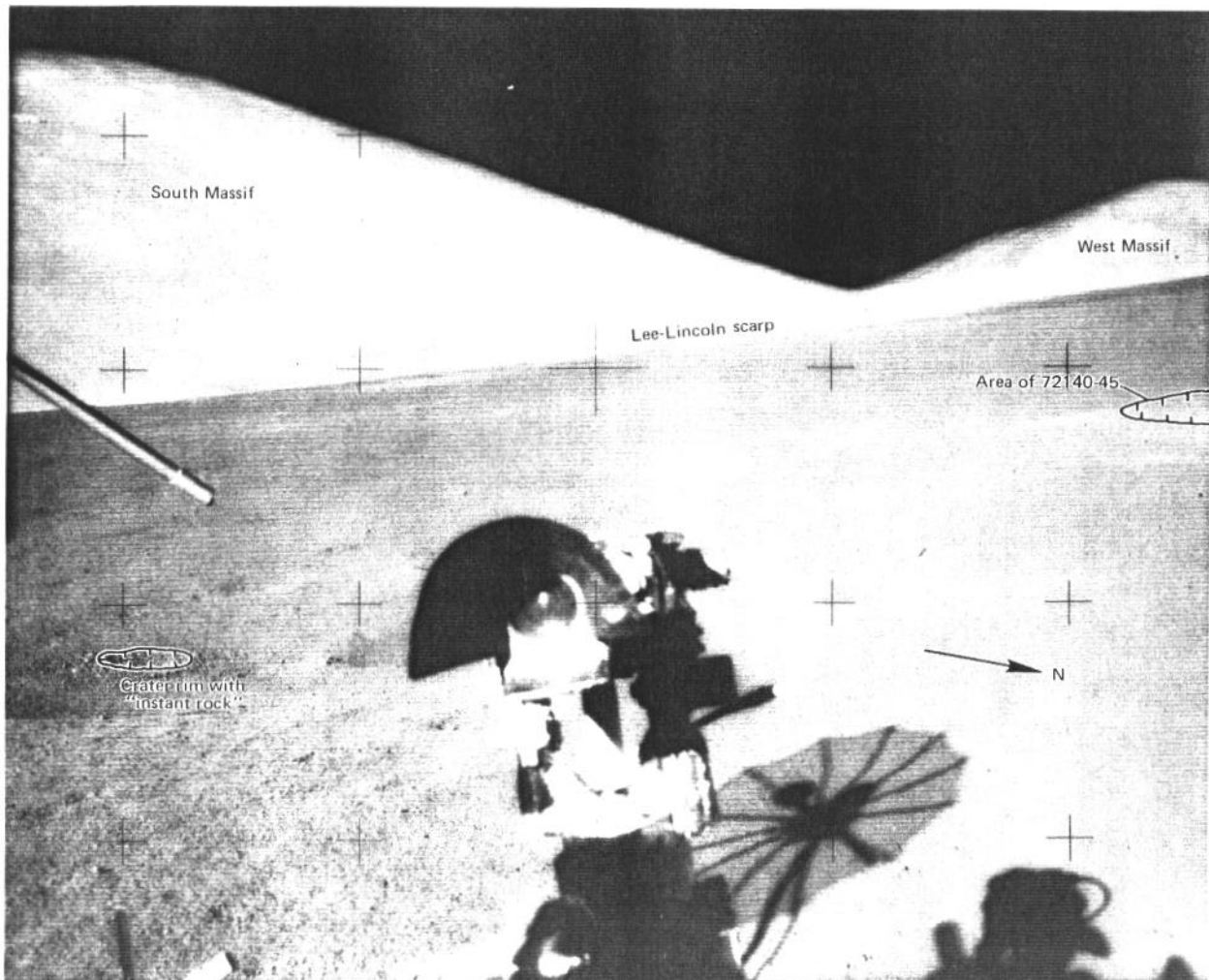


FIGURE 67, - Approximate location of samples 72140-45 before collection at station LRV-2. (NASA photograph AS 17-135-20641.)