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APOLLO-11 LUNAR SAMPLE INFORMATION CATALOGUE (REVISED)

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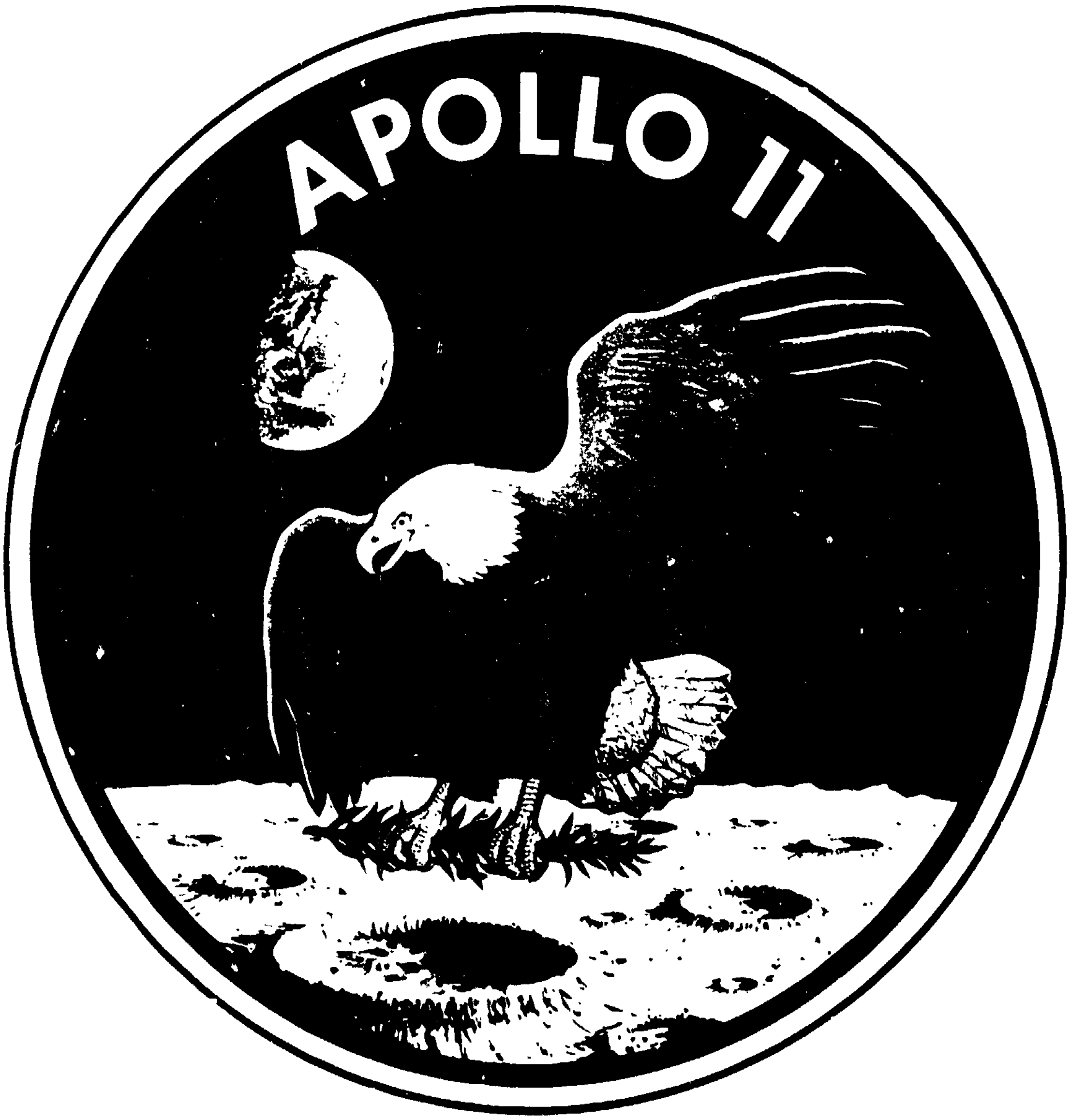
APOLLO 11

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PREFACE TO THE SECOND EDITION

The rock and soil samples returned to earth by the crew of Apollo 11 are historically unique in two respects. Not only were they the first documented rock samples returned from an extra-terrestrial body, but they were also the subjects of the first concentrated effort by the world's scientific community to fully characterize a suite of rock samples.

With the return of the Apollo 11 samples, a team of scientists, the Preliminary Examination Team (PET)*, was formed and given the task of characterizing the rocks and soils. Their task was to sort, classify and describe the samples so that they could be allocated to an eager group of principal investigators prior to the return of Apollo 12. Five weeks after the samples were received in the LRL, the first Apollo 11 Sample Catalogue was compiled and published.

In June of 1975, the Apollo 11 Re-examination Team was formed to compile data for a revised Apollo 11 Sample Information Catalogue. The basic aim of this group was to re-examine the Apollo 11 samples applying the experience gained during five subsequent missions, document them, and publish this information along with historical, chemical and age data in a revised catalogue.

The first step in the re-examination process was a thorough search of all available documentation pertaining to the early processing of the samples. Because of the short time allotted to Preliminary Examination, this type of information was sketchy, at best, and for the most part, non-existent. What information could be obtained was summarized into a sample history for each generic sample. During this part of the re-examination process any contaminating conditions that were peculiar to a certain rock or group of rocks which had been documented or could be inferred, was compiled.

Next, a listing of the chemical and age data for each generic sample was compiled from analyses published as of June 1976. In instances where no chemical data was available, an allocation from the sample was scheduled so that major element analyses could be obtained.

Pristine samples were examined in a nitrogen processing cabinet where they were dusted, photographed (one to six views) and described with a binocular microscope. An attempt was made to reconstruct the original rock (or a part of it) from the remaining pristine pieces and existing documentation, and to locate these pieces on photographs taken by the PET before splitting.

In some cases this was successful; in other cases, the low percentage of remaining sample and the lack of rock subdivision photography made reconstruction of the rock pieces impossible. Because the photographs taken

*For definitions of terms and acronyms, see Appendix A.

during the PET examinations were of dusty rocks, few pieces could be "fitted" into the original rock photographs with any reasonable degree of confidence.

All rocks larger than 5gm. currently stored in the Returned Sample Laboratory were examined in the same manner as above. Before these samples were repackaged, they were viewed by the person who made the binocular description of the pristine samples to insure consistency.

Thin sections of the rocks were examined, described and photographed, and a modal analysis was performed.

This catalogue should serve as a reference and an aid in dealing with the Apollo 11 sample items within. It should provide the user with all of the information available as of June 1976. It is sincerely hoped that this revised edition of the Apollo 11 Sample Information Catalogue will prove to be useful until the passage of time and the advancement of science have made it obsolete.

Additional information concerning the Apollo 11 samples and their processing history may be found in the Curator's files. Especially useful are the sample data packs that include considerable photographic documentation.

ACKNOWLEDGMENTS

Frank E. Kramer, David B. Twedell and Wayne J.A. Walton, Jr. (NSI) comprise the Re-examination Team, which originated and compiled most of the information contained within this catalogue. Jill Geeslin, Carol Schwarz and Judy Mensing (NSI) processed and described the returned samples. Waltine Bourgeois (NSI) compiled the chemical, age and bibliographical data. Leila Smith (NSI) did most of the sample history research. Patrick Butler, Jr. (NASA) was the Curatorial Representative for the project and served as principal editor. Jeffrey L. Warner, Gary E. Lofgren, Charles Meyer, Jr., and David S. McKay (NASA) served as technical advisors and editors.

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GENERAL MISSION INFORMATION

The primary objectives of the Apollo 11 mission were to land men on the lunar surface, to collect lunar materials for study, and to return both crew and samples safely to earth. The crew of Apollo 11 consisted of Neil A. Armstrong, Commander; Michael Collins, Command Module Pilot; and Edwin E. Aldrin, Jr., Lunar Module Pilot. The following is a summary of the Apollo 11 mission. More detailed information may be found in the Apollo 11 Mission Report (NASA SP-238).

The space vehicle was launched from Kennedy Space Center, Florida, at 08:32:00 a.m.,e.s.t., July 16, 1969, and was inserted into lunar orbit approximately 76 hours later. After a rest period, Armstrong and Aldrin entered the lunar module to prepare for descent. The command and service modules were then separated from the lunar module (Eagle). Descent orbit insertion was performed at approximately 1 1/2 hours after separation and power descent to the lunar surface began approximately 1 hour later.

The Eagle landed in the Sea of Tranquility at 3:17 p.m.,e.s.t., July 20 (Fig. 1). The landing site was on a gently sloping mare just west of a young ray crater approximately 200 meters in diameter (Fig. 2). During the first 2 hours on the surface, the astronauts performed a postlanding check-out of all lunar module systems, ate their first meal on the moon and elected to perform the surface operations earlier than planned. Armstrong egressed through the forward hatch and deployed the Modularized Equipment Stowage Assembly (MESA), located in the descent stage. A camera in the MESA provided live television coverage of Armstrong descending the ladder to the surface, with first contact made at 9:56 p.m.,e.s.t., July 20, 1969. Aldrin followed soon thereafter, and both crewmen used the initial period on the surface to become used to the reduced gravity conditions. The Contingency Sample was taken from the surface, and a television camera was deployed so that most of the lunar module was included in the field of view (Fig. 2). The crewmen took numerous photographs, erected the U.S. flag, and deployed the scientific experiments, which included a solar wind detector, a passive seismometer, and a laser reflector. Aldrin spent considerable time evaluating his ability to operate and move about, and despite the limitations imposed by the pressurized suit, he was able to move rapidly and with confidence. Approximately 20 kilograms of rock and particulate material were collected to be returned to earth. The crew had spent a total of 2 hours and 14 minutes exploration time on the lunar surface.

The ascent preparation was conducted, and the ascent stage lifted off the surface at 1:02 p.m.,e.s.t., July 21. After a rendezvous sequence, the two spacecrafts were docked at 5:02 p.m.,e.s.t., July 21. Following transfer of the crewmen, the ascent stage was jettisoned, and the command and service module was prepared for trans-earth injection. The entry

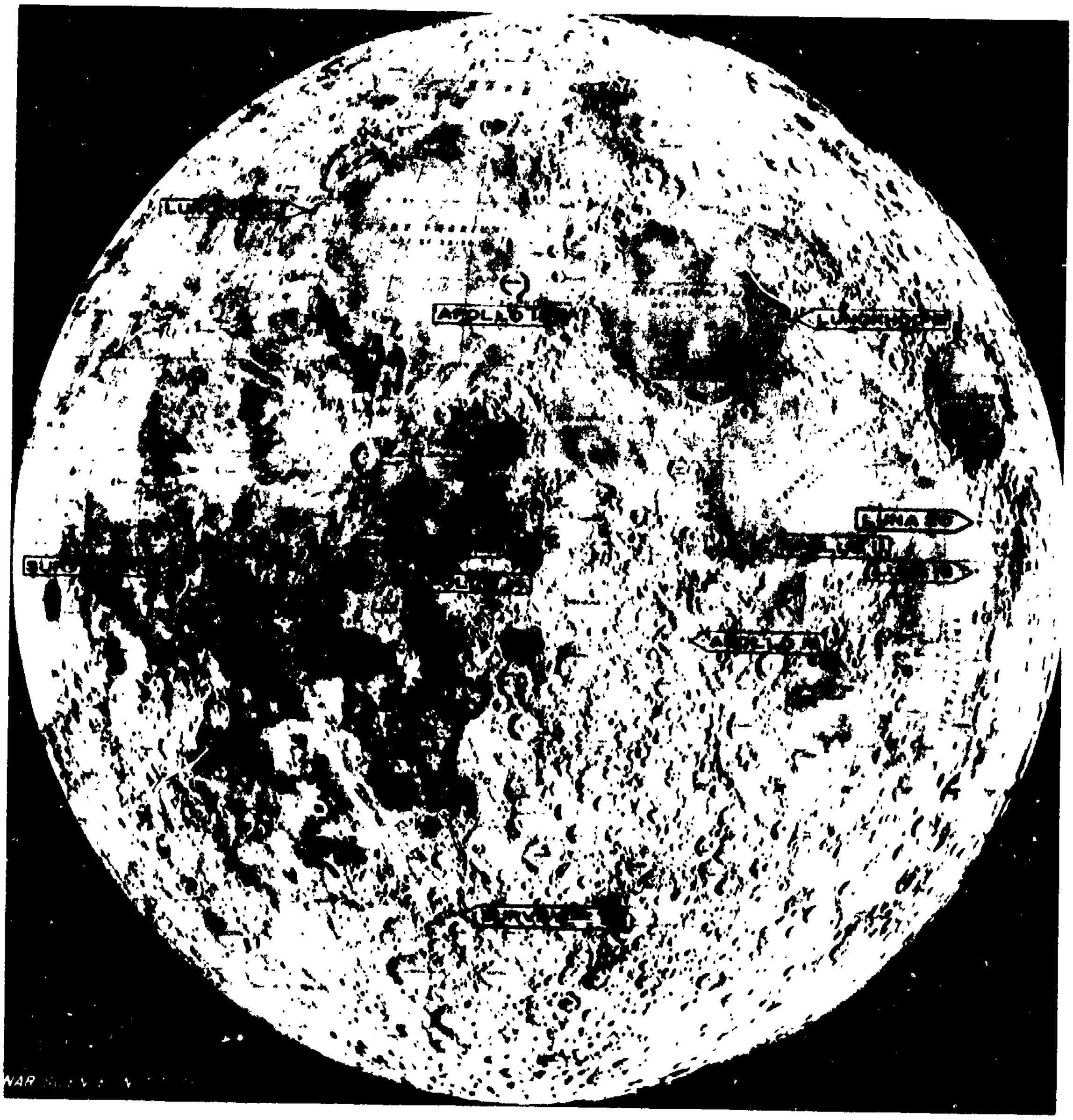

Fig.I: USAF lunar reference mosaic showing all Apollo, Luna, Surveyor and Lunokhod landing sites. Scale = 1:10,000,000 (S-76-25839)

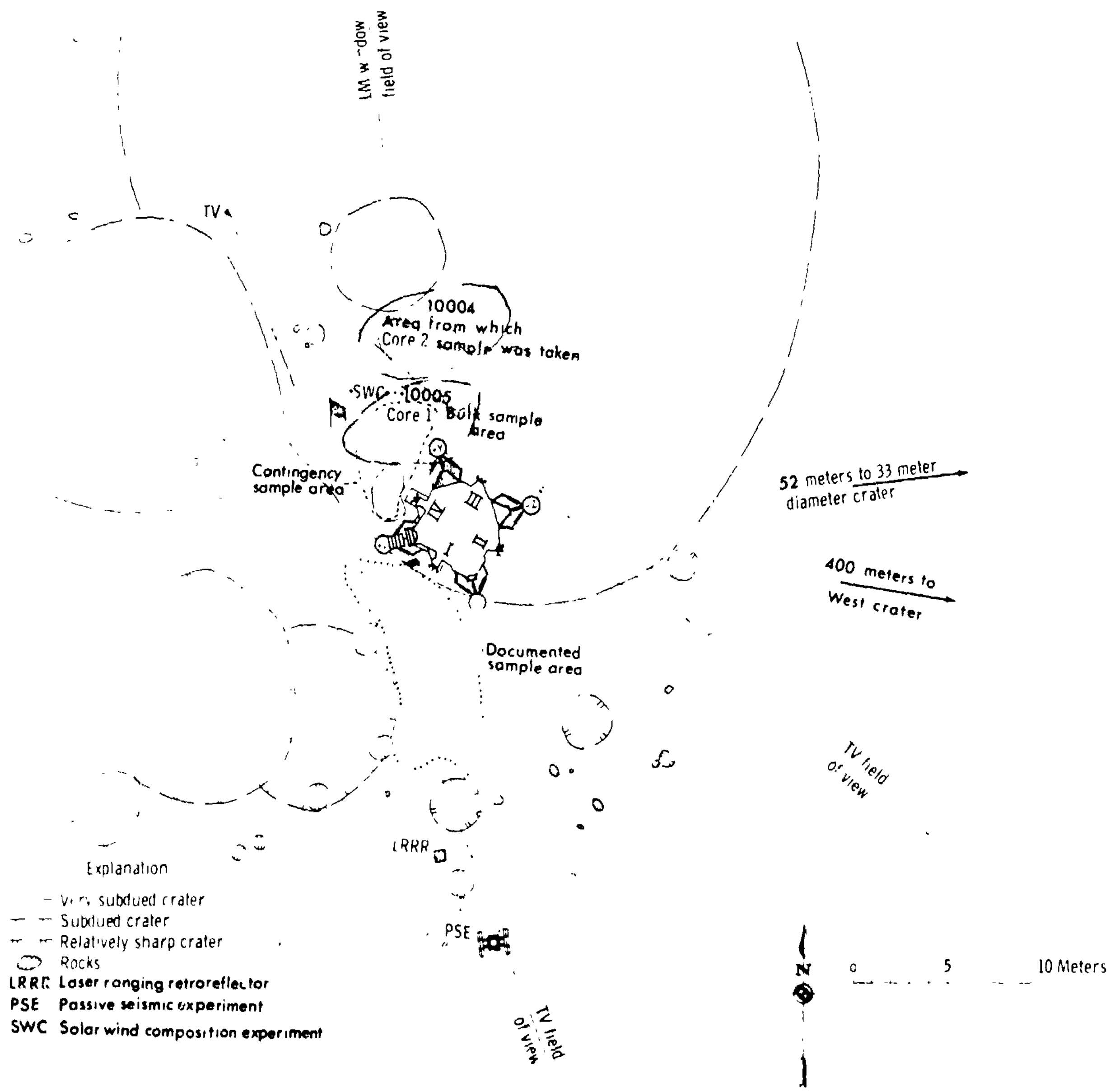

Fig-2 Sample location for Apollo 11 landing site phase was normal, and the command module landed in the Pacific Ocean at 12:01 p.m.,e.s.t., July 24.

The samples were retrieved from the spacecraft after recovery on board the U.S.S. Hornet and were transferred into the Mobile Quarantine Facility (MQF). Inside the MQF the sample containers were enclosed in plastic bags, to insure biological containment, and were passed to the outside of the MQF through a surface sterilization procedure and lock. The samples were flown to Jonston Island where they were transferred on board two separate jet aircrafts for transport to the Manned Spacecraft Center and the Lunar Receiving Laboratory (LRL). One of the sample return containers, the second box collected (documented sample) was on board the first aircraft to arrive at Ellington Air Force Base, Houston, Texas. The sample was carried to the Lunar Receiving Laboratory in a motor van, and was introduced into the Crew Reception Area of the LRL. The second aircraft arrived at Ellington Air Force Base a few hours later with the first sample return container filled on the lunar surface (bulk sample) and with the contingency sample. These samples were also brought to the LRL by motor van and introduced into the Crew Reception Area.

SAMPLE COLLECTING TOOLS AND CONTAINERS

The Apollo 11 crewmembers used the following sample-collection tools and containers to obtain samples of the lunar surface. The tools were designed of material rugged enough to do the job, yet light enough to conform to the weight and space limitations of the lunar module stowage area. The limitations imposed on the movements of a crewman while wearing a pressurized space suit also had to be considered; therefore, the tools were designed with quick-disconnect fittings to enable the crewman to attach or detach components with a minimum of difficulty. Knurled or roughened areas were provided on many tools to improve the crewman's grasp. Prime consideration was given to the selection of the metals and lubricants used in the construction of the tools to avoid elements and isotopes that might contribute to serious geochemical contamination (such as lead, strontium, etc.).

The two Apollo lunar sample return containers (ALSRC, Fig. 3) were portable, sealable aluminum containers; each container weighed approximately 6.8 kilograms, measured 20.3x26.7x44.5 centimeters and had a capacity of 0.023 cubic meters. They were lined with York stainless steel mesh and Teflon. Prior to the lunar landing, these containers housed the core tubes and other related equipment. On the lunar surface, the astronauts opened, filled, and closed the containers. Three seals on the hinged lids (one of indium and two of Viton) preserved the samples in the vacuum environment during transportation back to the Lunar Receiving Laboratory. Upon return to the LRL, readings were taken to determine the atmospheric pressure inside the sample container. Both ALSRC's had internal pressures of 170 microns; proof a substantial negative pressure was maintained during transfer of samples from the lunar surface back to earth.

The hammer (Fig. 4) was made of tool steel suitable for impact use. The head was coated with vacuum-deposited aluminum to minimize solar heating. The handle was offset slightly so that the astronaut could strike a square blow despite the encumbrance of his pressurized space suit. The end of the hammerhead opposite the striking surface was shaped for use as a pick or chisel; with the extension handle attached, it could be used solely for driving the core tubes into the surface by striking the end of the extension handle.

The tongs (Fig. 5) were made of anodized aluminum (No. 606 T6) and were used to retrieve samples of pebble size and larger. This tool consisted of a set of opposed, spring-loaded fingers attached to a 66-centimeter handle. The tongs were operated by squeezing the handles to actuate the cable that opened the fingers.

The extension handle (Fig. 6) was used to increase the astronaut's reach by adding 58.4 centimeters of handle length to various tools. The lower end of the extension handle had a quick-disconnect mount and lock for tool attachment. The upper end was fitted with a sliding tee handle to facilitate any torquing operations.

The large scoop (Fig. 7) was made of anodized aluminum (No. 6061 T6) and had an appearance similar to the bucket of a power shovel. The scoop and its handle measured 39.4 centimeters, and could be extended an additional 58.4 centimeters using the extension handle. The large scoop was used in the lunar extravehicular activity to collect the bulk sample.

Two core tubes (Fig. 8) were made of anodized aluminum (No. 6061 T6) and were used to obtain samples from the lunar surface in a manner such that any possible near-surface stratigraphy would be preserved. The core tubes are 41.3 centimeters long and would be attached to the extension handle. Two tubes, each containing a sample, were capped and placed in the documented sample return container.

The contingency sample container (Fig. 9) consisted of a small Teflon bag, resembling an oversized sandwich bag, and a jointed aluminum handle approximately 84.5 centimeters long in its fixed extended position. The bag measured 5.2x12.7x17.8 centimeters. The contingency sample container was used to obtain a lunar sample during the early stages of the extravehicular activity. This sample was intended to provide at least a small amount of lunar material for return to earth if it were necessary to terminate the surface portion of the mission early.

Fig. 3: Sample Return Container (ALSRC) with Rocks

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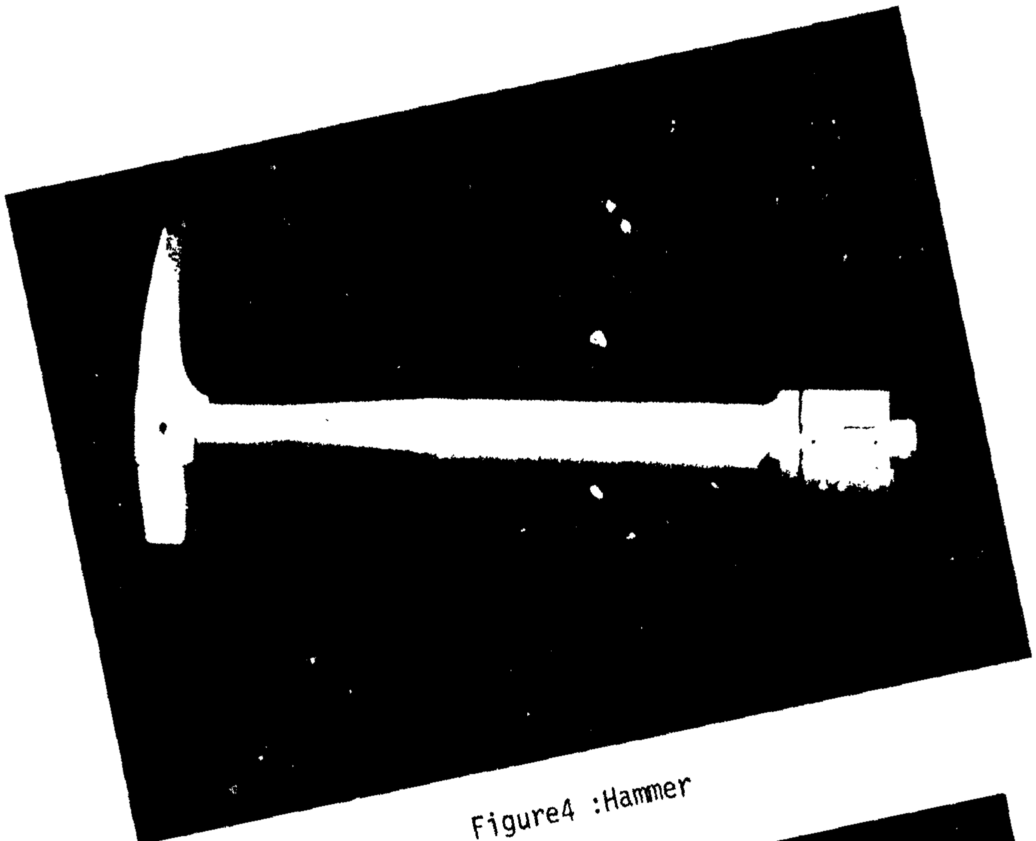

Figure4 :Hammer

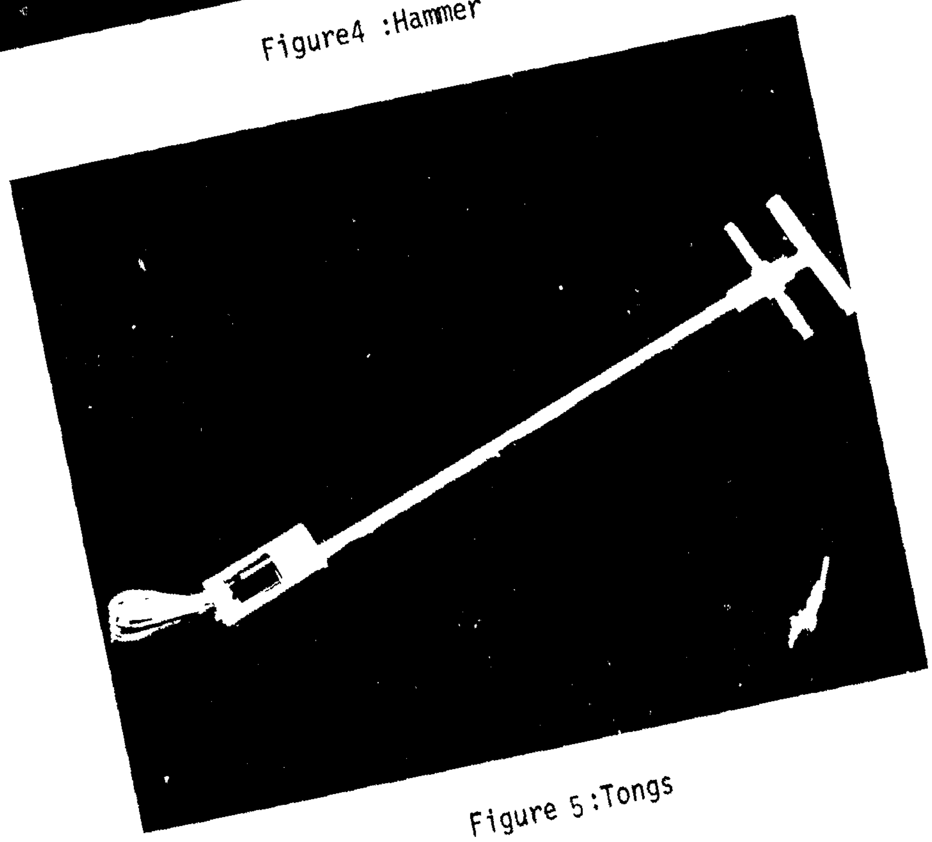

Figure 5:Tongs

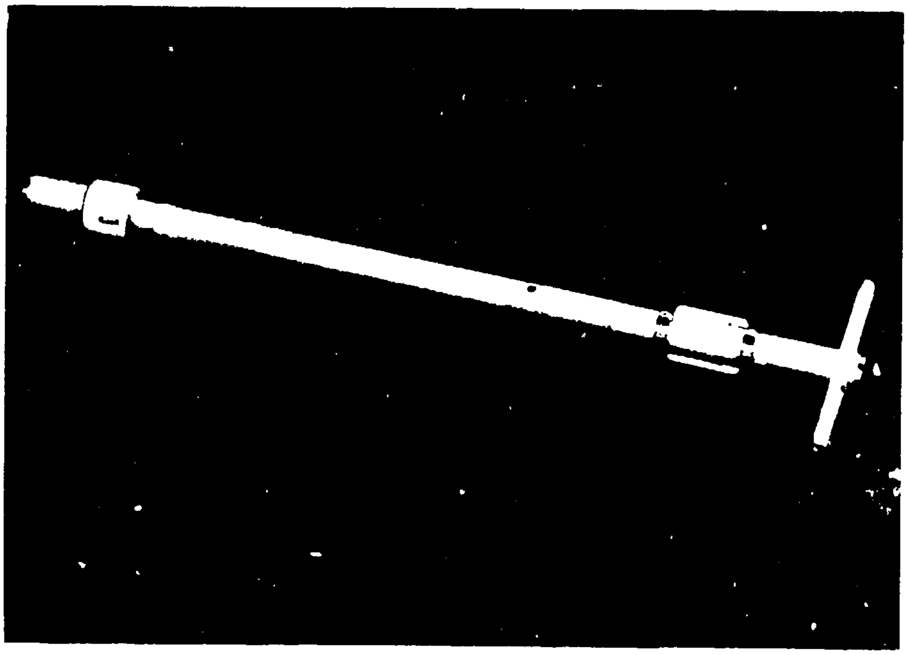

Figure 6 :Extension handle

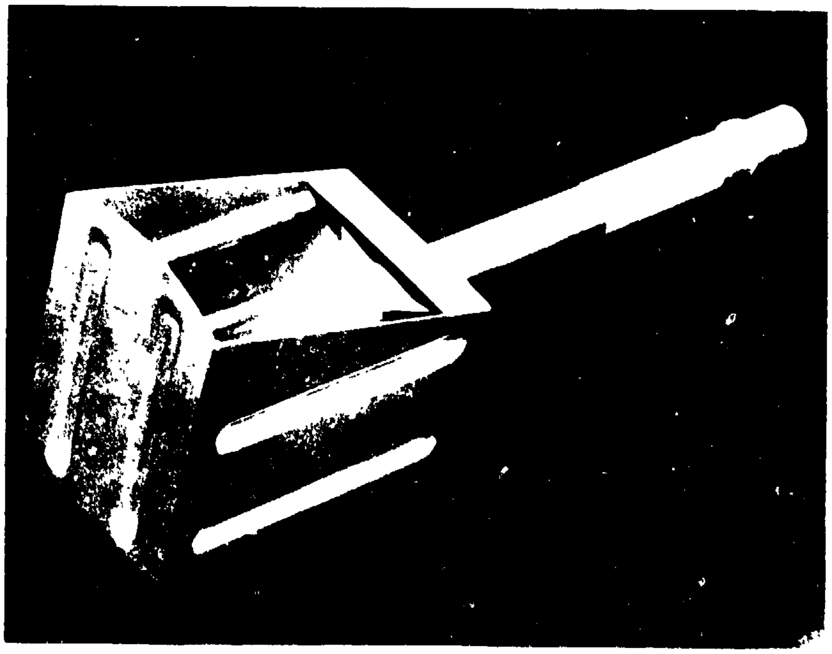

Figure 7:Large scoop

Fig. 8: Core Tubes

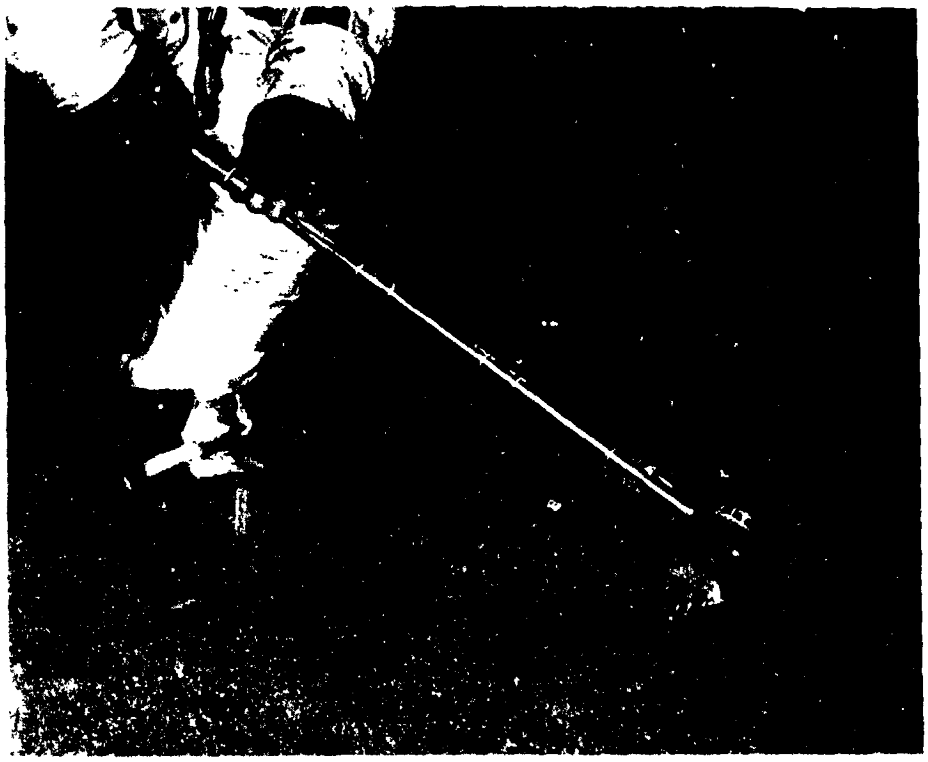

Fig. 9: Contingency Sampler

SAMPLE COLLECTION AND RETURN

The contingency sample was taken in full view of the sequence camera just outside Quad IV of the lunar module (Fig. 2) and took about 3 minutes 35 seconds to collect. The sample bag was filled with two scoops for a total of approximately 1 kilogram. The areas scooped have been accurately located on a pre-extravehicular lunar module window photograph from study of the sequence film data. Both scoops included small rock fragments visible on the surface from the lunar module windows prior to sampling. The handle of the scoop apparatus was shoved by Armstrong 15 to 20 centimeters into the surface very near the area of the first contingency scoop. The ease of penetration in this place may be, in part, a result of disturbance to the regolith by scooping. The contingency sample container was stowed in a Beta-cloth bag during the return trip and accompanied the astronauts to the Crew Reception Area of the LRL.

The bulk sample consisted of 15 kg of rock and soil, loaded into one of the ALSRC's. A total of 14 minutes was required by Armstrong to collect the bulk sample. Five minutes was spent sealing the box. Armstrong went out of the television field of view three times during bulk sampling, twice to the left for a total of 1 minute 11 seconds and once to the right for 35 seconds. Seventeen or 18 scoop motions were made in full view of the television camera, and at least five were made within the field view of the sequence camera. The total number of scoops was 22 or 23. Nine trips back to the MESA were made to empty the scoop. The average number of scoop motions to fill the scoop was two and one-half. The ALSRC was sealed on the lunar surface and accompanied the astronauts into the MQF aboard the U.S.S. Hornet. The bulk sample ALSRC was flown from the MQF to Hawaii where it was transferred to a range instrumentation aircraft for transfer to Houston.

The two core-tube samples were collected by Aldrin in 5 minutes 50 seconds Both were taken in the vicinity of the Solar Wind Composition Experiment.

The documented sample consisted of approximately 20 selected, but unphotographed, grab samples (about 6 kilograms) collected by Armstrong in the final three and one-half minutes of the extra-vehicular activity. Collection of these specimens was made out to a distance of 10 to 15 meters in the area south of the +Z-axis footpod near the east rim of the large double crater. Armstrong was out of the television field of view to the west 25 percent of the time during this activity.

The two core tubes were single-layered in the Documented Sample ALSRC and the container was sealed on the lunar surface.

After splashdown the ALSRC was flown to Jonston Island where it and the mission films were placed aboard a C-141 aircraft and flown to Houston.

EARLY PROCESSING HISTORY

The Documented Sample ALSRC was transferred from the Crew Reception Area to the Sample Laboratory on July 25 and introduced into the atmospheric decontamination cabinetry system. The sealed documented sample box entered the F-201 vacuum system July 26, with the F-201 chamber pressure at approximately 7 x 10^{-6} torr. The box was opened after an unsuccessful attempt was made to analyze the atmosphere in the box by mass spectrometry through a probe inserted in the box end. The Lunar Sample Preliminary Examination Team made their initial inspection of the box contents after the Teflon bag containing the samples had been cut and peeled back. (Fig. 3) A few hours later, the first rock, sample 10003, was selected for gamma counting in the Radiation Counting Laboratory (RCL). See Table 2 for a description of the contents of the Documented Sample ALSRC.

The two core tubes and selected fines were next transferred to the Biological Preparation Laboratory. Later, one of the core tube samples, sample 10004, was opened and inspected and found to have a missing cap and the follower improperly inserted, but the sample was intact. More detailed information concerning the core samples may be found in the Lunar Core Catalogue (Duke and Nagle, 1974).

The Gas Reaction Cell (GRC) was intended to be used to determine whether violent reactions occurred when lunar material was exposed to various atmospheric gases. The cell was transferred to PCTL, but inspection of the cell in the PCTL indicated that the port cover had been broken during handling, exposing the sample to nitrogen. The remaining portion of the gas reaction tests (exposure to oxygen, carbon dioxide and water vapor) was performed, and there was no apparent change in the sample.

During subsequent sample description and splitting operations in F-201, a leak developed rapidly in one of the gloves, and the interstitial glove pressure went to atmospheric, but the pressure in F-201 is believed not to have risen above approximately 2 centimeters of mercury. Samples in F-201 at that time were 10017, 10018, 10019, and 10020. Some other samples, not yet numbered were in a vacuum beaker that had two bolts loose, and other samples were safely inside vacuum-sealed beakers that were properly sealed. It was necessary to sterilize the entire system with dry heat in order to replace the damaged gloves without violating the biological containment. After the gloves were replaced, the system was pumped down to operating pressures and processing of the samples from the documented box was continued. Sample 10020 was removed from the vacuum system after sterilization, placed in a glass vacuum jar, and placed where it could be viewed by the Lunar Sample Analysis Planning Team and visitors.

The Bulk Sample, ALSRC (#1003), contained most of the rocks and fines returned from the Apollo 11 mission. (See Table 2) This sample box was transferred into the first vacuum lock of the F-201 vacuum system, but after the glove accident (See p.15) it was decided to use the nitrogen cabinets in the Biological Preparation Laboratory for the opening and processing of the samples from the bulk box.

The bulk box was transferred into the nitrogen atmosphere cabinets in the Biological Preparation Laboratory on August 2. The bulk box samples were examined, described, photographed, and chipped in the Biological Preparation Laboratory, and chips were transferred to the PCTL for more detailed description. Most of the samples from the bulk box were maintained in the nitrogen cabinetry in the Biological Preparation Laboratory until the end of sample quarantine.

The contingency sample was transferred from the Crew Reception Area to the PCTL on July 27, where it was placed inside the nitrogen atmosphere cabinetry. The contingency sample was opened, and an initial inspection of the sample was made. The largest rock from the contingency sample, sample 10021, was transferred to the RCL. All rocks and fragments greater than 1 centimeter in size were removed from the contingency sample, and given sample numbers (See Table 2). Most of the contingency sample remained within the nitrogen atmosphere of the PCTL cabinetry until the end of sample quarantine. However, the contingency sample container was exposed to cabin atmosphere during storage and transportation back to earth. It was not opened, however.

TABLE I - APOLLO 11
Generic Sample Listings with Original Weights

Sample #	Original Wt.	Description	Returned Container
10001	181.9	Fines	ALSRC 1004
10002	5629.	Rocks & Fines	ALSRC 1003
10003	213.	Basalt	ALSRC 1004
10004	44.8	Core	ALSRC 1004
10005	53.4	Core	ALSRC 1004
10008	89.	Fines	ALSRC 1004
10009	112.	Breccia	ALSRC 1004
10010	491.	Fines	Cont. Bag
10011	82.6	Fines	ALSRC 1004
10014	50.	Fines	ALSRC 1004
10015	.396	Gas Reaction Cell	ALSRC 1004
10017	973.	Basalt	ALSRC 1004
10018	213.	Breccia	ALSRC 1004
10019	297.	Breccia	ALSRC 1004
10020	425.	Basalt	ALSRC 1004
10021	250.	Breccia	Cont. Bag
10022	95.59	Basalt	Cont. Bag
10023	66.	Breccia	Cont. Bag
10024	68.12	Basalt	Cont. Bag
10025	8.59	Breccia	Cont. Bag
10026	9.3	Breccia	Cont. Bag
10027	8.87	Breccia	Cont. Bag
10028	3.53	Breccia	Cont. Bag
10029	5.53	Basalt	Cont. Bag
10030	1.81	Breccia	Cont. Bag
10031	2.70	Basalt	Cont. Bag
10032	3.13	Basalt	Cont. Bag
10033	1.12	Fines	Cont. Bag
10044	247.5	Basalt	ALSRC 1003
10045	185.5	Basalt	ALSRC 1003
10046	663.	Breccia	ALSRC 1003
10047	138.	Basalt	ALSRC 1003
10048	579.	Breccia	ALSRC 1003
10049	193.	Basalt	ALSRC 1003
10050	114.5	Basalt	ALSRC 1003
10054	202.1	Fines	ALSRC 1003
10056	186.	Breccia	ALSRC 1003
10057	919.	Basalt	ALSRC 1003
10058	282.	Basalt	ALSRC 1003
10059	188.	Breccia	ALSRC 1003
10060	722.	Breccia	ALSRC 1004

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(TABLE I - cont'd)

Sample #	Original Wt.	Description	Returned Container
10061	346.	Breccia	ALSRC 1004
10062	78.5	Basalt	ALSRC 1004
10063	148.	Breccia	ALSRC 1004
10064	65.	Breccia	ALSRC 1004
10065	347.	Breccia	ALSRC 1004
10066	40.	Breccia	ALSRC 1004
10067	69.3	Breccia	ALSRC 1004
10068	218.	Breccia	ALSRC 1004
10069	119.5	Basalt	ALSRC 1004
10070	64.	Breccia	ALSRC 1004
10071	189.5	Basalt	ALSRC 1004
10072	447.	Gabbro	ALSRC 1004
10073	124.5	Breccia	ALSRC 1004
10074	55.5	Breccia	ALSRC 1004
10075	53.	Breccia	ALSRC 1004
10082	50.5	Breccia	ALSRC 1004
10084	3830.0	Fines	ALSRC 1003
10085	569.0	Fines	ALSRC 1003
10086	823.0	Fines	ALSRC 1003
10087	17.4	Chips and Fines	ALSRC 1003
10089	50.	Fines	ALSRC 1003
10090	12.	Fines	ALSRC 1003
10091	23.9	Breccia	ALSRC 1003
10092	46.0	Basalt	ALSRC 1003
10093	26.0	Breccia	ALSRC 1004
10094	25.0	Breccia	ALSRC 1004

TOTALS

1) Contingency Sample .... 1015.29 gm
2) ALSRC 1003 .... 14897.4 gm
3) ALSRC 1004 .... 5824.8 gm
4) ALSRC 1004 .... 98.596 gm

TOTAL AP-11 SAMPLE RETURNED ...... 21336.086 gm

TABLE 2

Contents of Sample Collection and Return Containers

	Net Sample Wt.(gms)	Sample Numbers
ALSRC 1004		
Core Tube #2	44.8	10004
Core Tube #1	53.4	10005
Gas Reaction Cell	0.396	10015
Loose Fines	403.5 (Combined)	10001 10008 10011 10014
Loose Rocks		
Basalt, coherent	213.0	10003
Breccia, friable	112.0	10009
Basalt, coherent	973.0	10017
Breccia, tough	213.0	10018
Breccia, tough	297.0	10019
Basalt, coherent	425.0	10020
Breccia, tough	722.0	10060
Breccia, friable	346.0	10061
Gabbro, coherent	78.5	10062
Breccia, tough	148.0	10063
Breccia, mod.coherent	65.0	10064
Breccia, tough	347.0	10065
Breccia, mod.friable	40.0	10066
Breccia, tough	69.3	10067
Breccia, tough	218.0	10068
Basalt, friable	119.5	10069
Breccia, mod.friable	64.0	10070
Basalt, friable	189.5	10071
Gabbro, friable	447.0	10072
Breccia, friable	124.5	10073
Breccia, tough	55.5	10074
Breccia, tough	53.0	10075
Breccia, mod.coherent	50.5	10082
Breccia, coherent	26.0	10093
Breccia, coherent	25.0	10094
TOTAL ALSRC 1004	5923.396 gms	

(TABLE 2 - cont'd)

	Net Sample Wt.(gms)	Sample Numbers
ALSRC 1003		
Loose Fines	5629.	10002
	202.1	10054
	3830.0	10084
	569.0	10085
	823.0	10086
	17.4	10087
	50.0	10089
	12.0	10090
	23.9	10091
Loose Rocks		
Basalt, friable	247.5	10044
Basalt, coherent	185.5	10045
Breccia, Mod.friable	663.0	10046
Basalt, Mod.friable	138.0	10047
Breccia, coherent	579.0	10048
Basalt, friable	193.0	10049
Basalt, Mod.coherent	114.5	10050
Breccia, tough	186.0	1[illegible]56
Basalt, coherent	919.0	10057
Basalt, friable	282.0	10058
Breccia, friable	188.0	10059
Basalt, tough	46.0	10092
TOTAL ALSRC 1003	14897.4	
Contingency Sample Bag		
Loose Fines	492.12 (Combined)	10010 10033
Loose Rocks		
Breccia, tough	250.0	10021
Basalt, coherent	95.59	10022
Breccia, tough	66.0	10023
Basalt, friable	68.12	10024
Breccia, slightly friable	8.59	10025
Breccia, tough	9.3	10026
Breccia, tough	8.87	10027
Breccia, Mod.tough	3.53	10028
Basalt, coherent	5.53	10029

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(TABLE 2 - cont'd)

	Net Sample Wt.(gms)	Sample Numbers
(Loose Rocks, cont'd)		
Breccia, tough	1.81	10030
Basalt, coherent	2.70	10031
Basalt, coherent	3.13	10032
TOTAL CONTINGENCY SAMPLE	1015.29	
TOTAL MISSION	21836.086	

PROCESSING LABORATORIES

VACUUM LABORATORY (F-201)

Figures 10 and 11 show detailed views of the vacuum system used in processing the samples returned in ALSRC #1004, the Documented Sample Container (see Table 2). The system was used for sample photography, microscopic examination, sample weight determinations (beam balance) and gas analysis. The cabinet was kept under hard (0.133 mN/m^2 or 10^{-6} torr) vacuum.

Upon entering the atmospheric sterilization cabinets, the ALSRC was subjected to a nitrogen purge, then washed twice in a peracetic acid solution and rinsed twice with deionized water. This was repeated before the container was dried with hot nitrogen. This procedure was repeated for items leaving the system.

Upon removal from the ALSRC container, samples were weighed, brushed off, photographed, placed in vacuum containers and stored in the sample carousel. The carousel was kept closed off from the main chamber, to prevent contamination of all samples during a possible glove rupture. The sample carousel could be detached from the glove chamber, and was intended to be kept under its own vacuum indefinitely.

During the processing of the samples, a leak developed in one of the gloves causing the interstitial glove to go to atmospheric pressure. However, the pressure inside F-201 was believed not to have risen above 2 cm. of mercury. Samples in F-201 at the time were 10017, 10018, 10019, and 10020.

BIOLOGICAL PREPARATION LABORATORY (BIO-PREP)

The Bio-Prep Lab consisted of several glove cabinets, connected together and filled with nitrogen (Fig. 12).

The Bio-Prep Lab was not originally going to be used to process samples other than for biological experiments, but due to the glove rupture in F-201, the samples contained in ALSRC 1003, the Bulk Sample Container, were processed in the Bio-Prep Lab.

PHYSICAL CHEMICAL TESTING LABORATORY (PCTL)

PCTL was used for the petrographic study and chemical analyses of small subsamples. It consisted of six nitrogen atmosphere processing cabinets that housed an X-ray diffractometer, X-ray fluorescence analysis unit, an optical ommision spectrograph, and three petrographic microscopes. There was little control over extraneous materials, since only small samples were handled in this cabinet system and materials such as refractive index oils were kept inside the cabinets.

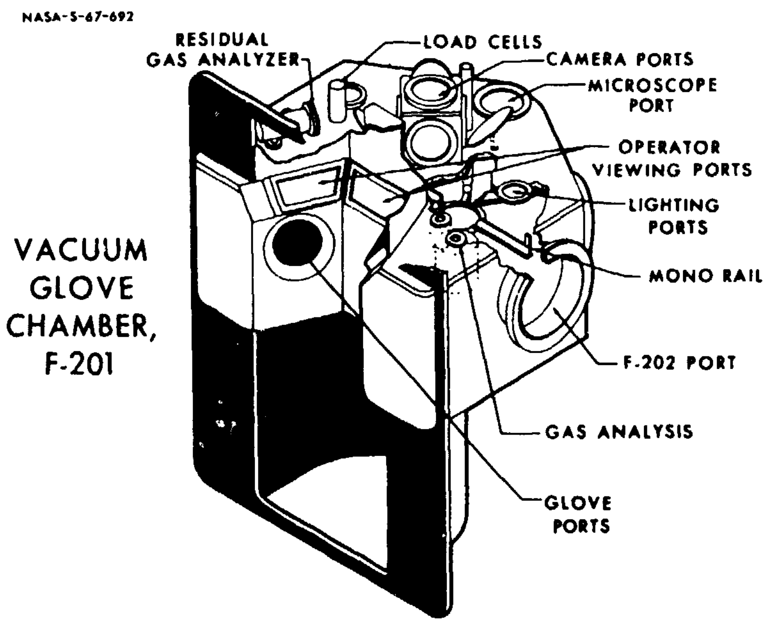

Fig. 10: F-201 System

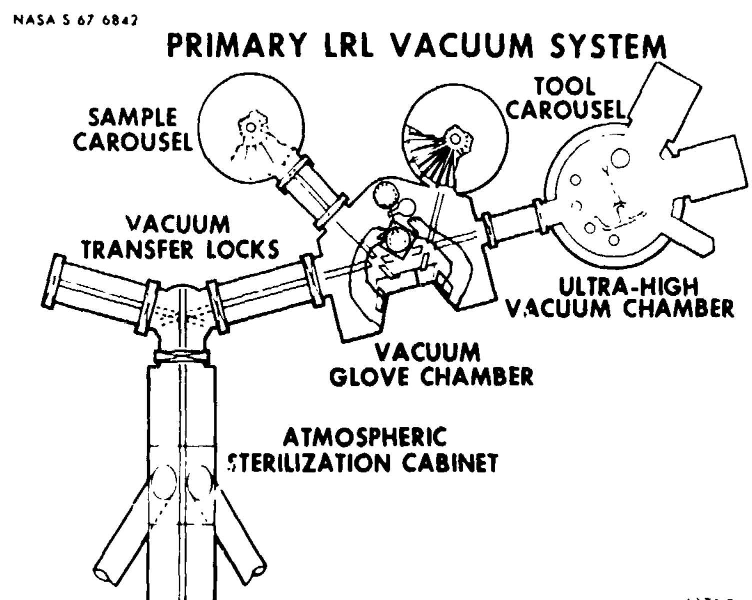

Fig. 11: F-201 System

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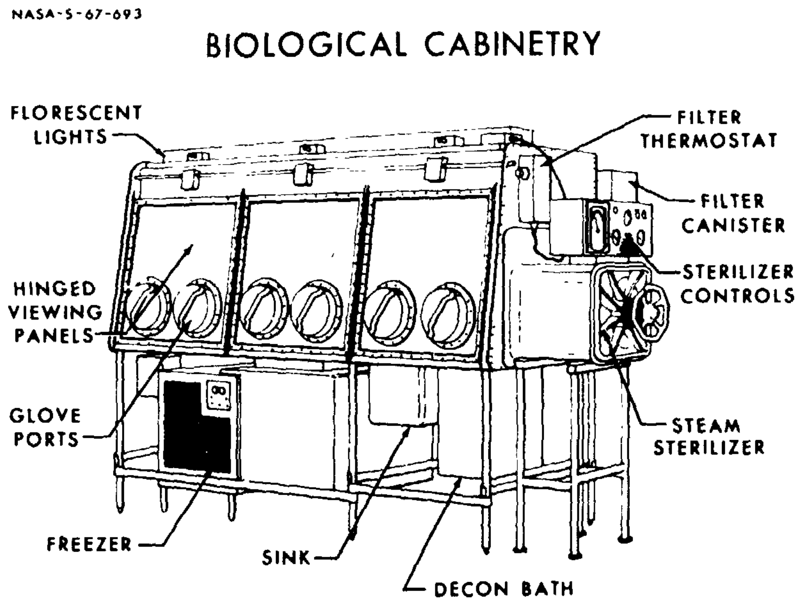

Fig. 12: Bio-Prep Lab

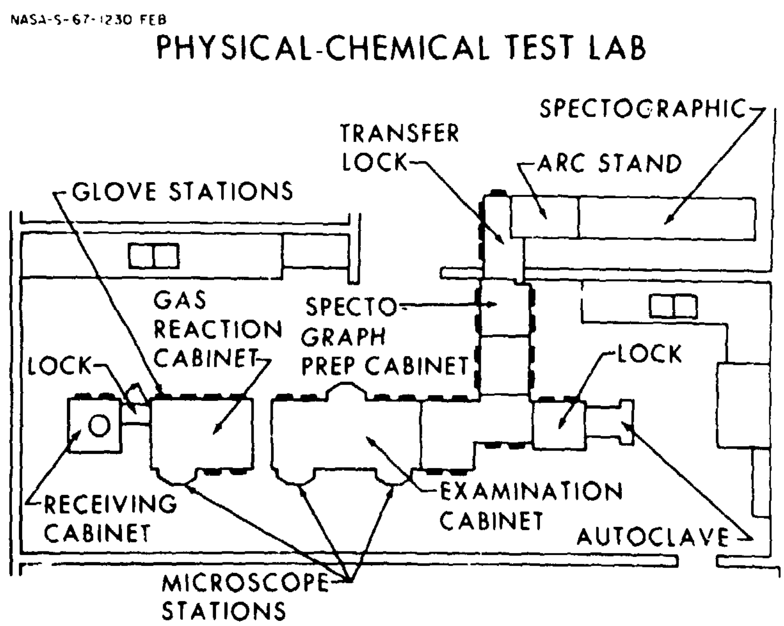

Fig. 13: Physical-Chemical Test Lab.

At first, sample splits removed from rocks in the F-201 and Bio-Prep Labs, were examined and analyzed in PCTL. Later in the mission processing, the Contingency Sample was transferred to PCTL for initial photography and description. Early principal investigator allocations were made in PCTL.

SAMPLE PACKAGING LABORATORY (SPL)

The Sample Packaging Laboratory was set up during Apollo 11 to process samples for distribution to Principal Investigators after the preliminary examination work was completed.

All chipping and other rock splitting operations (except sawing) were performed in nitrogen processing cabinets similar to the present SSPL. Rock sawing was accomplished on a wiresaw in open air. During sawing operations, samples were handled by stainless steel tongs, teflon overgloves, and bare hands*

SAMPLE STORAGE AND PREPARATION LABORATORY (SSPL)

SSPL is the present sample processing laboratory. All samples processed in this lab are done so in a nitrogen atmosphere. Any sample placed in storage or sent to a principal investigator must have three levels of protection. This usually constitutes a hard container, and two teflon bags, all three sealed in nitrogen.

Rock sawing is presently accomplished using a cleaned, nitrogen atmosphere bandsaw as opposed to an open-air wiresaw. This laboratory has been used to prepare all pristine Apollo 11 samples subsequent to the initial mission processing.

RETURNED SAMPLE PROCESSING LABORATORY (RSPL)

RSPL is set up to process samples that have been returned by principal investigators. Most samples are examined and repackaged in air on a laminar flow bench. All samples must have three levels of protection before storage.

Some samples in RSPL are processed in nitrogen glove cabinets. These are usually returned display samples, which are candidates for transfer to SSPL pristine storage.

THIN SECTION LABORATORY (TSL)

For Apollo 11 many of the thin sections were produced in the laboratories of principal investigators. The curator's office presently has facilities

*Personal communication with J.E. Townsend for producing thin sections for both the curator's library, and for principal investigators upon request.

Information concerning procedures and materials used in the Thin Section Laboratory may be obtained from the Curator.

GEOLOGIC SETTING (from LSPET, 1969)

Apollo 11 landed approximately 20 kilometers south-southwest of the crater Sabine D in the southwestern part of Mare Tranquillitatis. The landing site is 41.5 kilometers north-northeast of the eastern promontory of the Kant Plateau, the nearest highland region. Apollo 11 landed approximately 25 kilometers south-southeast of the Surveyor V Spacecraft landing site and 68 kilometers southwest of the crater formed by the Ranger VIII impact.

The southern part of Mare Tranquillitatis is crossed by relatively faint north-northwest trending rays, and prominent secondary craters associated with the crater Theophilus, 420 kilometers southeast of the landing site. About 15 kilometers west of the landing site is a fairly prominent north-northeast trending ray. The crater with which this ray is associated is not definitely known, but it may be Alfraganus, 160 kilometers to the southwest, or Tycho, about 1500 kilometers to the southwest. Neither the north-northeast nor any of the north-northwest trending rays cross the landing site. They are sufficiently close, however, that it is possible that some material from Theophilus, Alfraganus, or Tycho occurs in the vicinity of the lunar module. Other distant craters, especially the crater Moltke which lies 40 kilometers to the southeast, may also be the source of fragments lying near the lunar module. Some potential distant sources of fragments are in the highlands and some in the maria.

A hill of terra material protrudes above the mare surface 52 kilometers east-southeast of the landing site. This suggests that the mare material is very thin in this region, perhaps no more than a few hundred meters thick. Craters more than a kilometer across, such as Sabine D and Sabine E, may have been excavated partly in pre-mare rocks. Pre-mare rock fragments ejected from these craters may occur in the vicinity of the lunar module.

The major topographic features in the landing area are large craters a few hundred meters across, four of which are broad subdued features and the fifth is West Crater, located 400 meters east of the landing point. West Crater is a sharp-rimmed, rayed crater about 180 meters in diameter and 30 meters deep with a blocky-ejecta apron extending almost symetrically outward to a distance of about 250 meters. Rays of blocky ejecta extend further west, probably past the landing site. Near the lunar module, the surface is pock-marked by numerous small craters and strewn with fragmental debris, part of which may have been derived from West Crater. A boulder field north of the lunar module (described by the crew and shown in photographs taken by the crew) is probably part of a blocky ray.

All of the craters in the immediate vicinity of the lunar module have rims and floors of relatively fine-grained material and appear to be excavated entirely in the regolith. A pile of blocks and coarse rubble forms a peak on the floor of the 33-meter crater east of the lunar module but the walls and rim of this crater have the same texture as the regolith elsewhere. West Crater is about 30 meters deep and has a coarse blocky rim.

Among the smaller craters, both sharp raised-rim craters and relatively subdued craters are common. They range in size from a few centimeters to 20 meters. A slightly subdued, raised-rim crater (Armstrong's 70- to 80- foot crater) 33 meters in diameter and 4 meters deep occurs about 60 meters east of the lunar module, and a double crater (Armstrong's doublet), about 12 meters long and 6 meters wide, lies 10 meters southwest of the lunar module at 260° azimuth.

The walls and floors of most of the craters are smooth and uninterrupted by either outcrops or conspicuous stratification. There are rocks present in the 33-meter crater that are larger than any of those seen on the surface in the vicinity of the lunar module. With this exception, there is no apparent correlation between the location of blocks and the smaller craters near the lunar module.

The surface of the mare near the landing site is unusually rough. Television pictures show a greater abundance of coarse fragmental debris than at any of the four Surveyor landing sites on the maria except that of Surveyor I. It is likely that the observed fragments and the samples returned to earth have been derived from varying depths beneath the original mare surface and have had widely different histories of exposure on the lunar surface.

The lunar module footpads penetrated a maximum of 7 to 8 centimeters. The astronaut's boots left prints generally from 3 millimeters to 2 to 3 centimeters deep. As the astronauts walked, they noted that their boot tread was preserved in their footprints, and that angles of 70 degrees were maintained in the print walls. The surface, where disturbed by walking, tended to break into slabs, cracking out as far as 12 to 15 centimeters from the edge of footprints.

The regolith is weak and relatively easily trenched to depths of several centimeters. Surface material was easily dislodged by kicking. Before the lunar module landed, at an altitude somewhat less than 30 meters, dust was observed moving away from the center of the descent-propulsion-system blast.

When the flagpole and drive tubes were pressed into the surface, they penetrated with ease to 10 to 12 centimeters. However, at that depth the regolith was not strong enough to hold the core tubes upright. A hammer was needed to drive them to depths of 15 to 20 centimeters.* At places, rocks were encountered by the scoop and by the various tubes and rods pressed into the subsurface.

Coarse fragments in the vicinity of the lunar module exhibited a wide variety of shapes and were embedded in varying degrees in the fine mat of the regolith (Armstrong, comment). Armstrong took time during the television panorama to point out several rocks west of the television camera, one of which was tabular and standing on edge, protruding 30 centimeters above the surface. During the postmission debriefing, Armstrong described another rock as resembling a distributor cap. When dislodged, the cap was found to be the exposed top of a much larger rock, the buried part of which was much larger and more angular in form. Strewn fields of angular blocks, many more than one-half meter long occur north and west of the lunar module. In general, the rocks collected tended to be rounded on top and flat or angular on the bottom.

The strength of rock fragments ranged from friable to hard, and was difficult for the crew in some cases to distinguish aggregates or clods of fine debris from rocks. Armstrong suggested that West Crater was the source for these boulder fields and may be the source for any of the rocks in the immediate vicinity of the lunar module.

SAMPLE SURFACE DOCUMENTATION

An attempt was made by PET members to locate and document Apollo 11 samples in EVA photographs. However, because of the time constraints placed on the astronauts, very few photographs were taken of samples as they lay on the lunar surface. Subsequently, tentative identification of some samples were made from photographs taken from the LEM viewports.

*It was subsequently determined that the design of the core bit led to the jamming of material in the core. The bits were subsequently redesigned for greater penetration.

The Apollo 11 preliminary science report (NASA SP-214) documents what data and photographs were available, but offers little concrete proof of documented samples as they lay on the lunar surface.

PETROLOGY

A total of 48 rocks were returned along with fines material in the three sample return containers. Pieces smaller than 10mm are classified as fines.

SURFACE FEATURES

During preliminary examination one surface feature of the rocks that was most noticeable was the rounding of one or more edges and corners. Many of the rocks had one flat surface, with the remaining sides rounded. This rounding appeared to be more pronounced in the softer, more friable breccias than in the crystalline rocks (LSPET, 1969).

Two other types of surface features occur on the Apollo 11 rocks. These are glass-lined pits and glassy spatters not necessarily associated with pits.

Most glass-lined pits are less than one millimeter in diameter, but they have been found as large as 4mm (10063,1). Impacts that would produce the larger pits usually break the rocks apart and the pits are not preserved. The rocks generally show pitting in the rounded surfaces but not on the flat sides. The glass lining the pits is bright-reflecting and commonly uneven and botryoidal.

The pits are generally surrounded by whitish haloes which are at least partially attributable to intense microfracturing of minerals. This whitening does not appear to penetrate more than 1mm below the surface of the rock (LSPET, 1969) and tends to give the surfaces of the crystalline rocks a lighter color than the interiors.

In addition to glassy pits, thin glass crusts occur that appear to be the result of spattering. These crusts are generally less than 1mm thick. Taken together, these features make up what is known as patina.

BASALTS

All of the basalts returned are volcanic in origin and probably represent surface or near surface lavas. The term "volcanic" carries no connotation regarding impact generated or triggered volcanism versus volcanism in the common terrestrial sense.

The rocks contain pyrogenic mineral assemblages and gas cavities suggesting that they crystallized from melts. The major minerals can be assigned to known rock-forming mineral groups. The unique chemistry of the magmas has resulted in mineral ratios different from known terrestrial volcanic liquids, yet not significantly different (at least in the major elements) from some terrestrial cumulates (LSPET, 1969).

The Preliminary Examination Team (LSPET, 1969) divided the crystalline rocks into fine-grained (Type A) and coarse-grained (Type B). Grain sizes of Type A rocks (fine-grained) range from 0.05 to 0.2 mm. A typical mode (10017) is pyroxene, 44%; plagioclase, 24%; opaques (mainly ilmenite), 24%; mesostasis, 8%. Grain sizes of Type B rocks (coarse-grained) vary from 0.2 to 0.3 mm. A typical mode (10044) is pyroxene, 47%; plagioclase, 34%; opaques, 12%; cristobalite, 3%; and, mesostasis, 4%.

James and Jackson (1970) and James and Wright (1972) have classified the crystalline rocks as ilmenite basalts following the rather loose definition of basalt by Holmes (1920). They divided these further, on the basis of texture, into three sub-groups. These are, 1) intersertal; 2) fine-grained ophitic; and, 3) medium-grained ophitic.

Basically, the intersertal basalts correspond to some of the LSPET (1969) fine-grained (Type A) rocks. The fine-grained ophitic basalts correspond to the remainder of the fine-grained rocks. The medium-grained ophitic basalts correspond to the coarse-grained (Type B) rocks.

Tera et al. (1970) and others have classified the crystalline rocks chemically on the basis of potassium content. Generally, the high-k (>0.20%K) rocks have intersertal textures and the low-k (<0.20%K) have ophitic textures.

The Apollo 11 Re-examination Team classified the crystalline rocks according to the following scheme: All crystalline rocks observed were called basalts. When the accessory materials olivine or cristobalite were found in the samples, respective modifiers were prefixed (i.e. cristobalite basalt, olivine basalt). If neither was observed, the presence of abundant vesicles was noted (vesicular basalt). If a particular sample was non-vesicular, the grain size (fine or medium) was used as a modifier.

A summary of the Apollo 11 crystalline rock classifications is shown in Table 3.

BRECCIAS

The breccia samples returned by Apollo 11 are mixtures of fragments, various kinds of rocks, minerals, and glass, and are grey to dark grey in color. Most breccias are fine-grained, with fragments smaller than 1 cm in diameter.

TABLE 3

Apollo 11 Basalt Classification

Sample	Re-Examination Team	James & Jackson (1970)	PET	K-Content*
	Hand Speciman	Thin Section		
10003	Cristobalite Basalt	Med.Grained Ophitic Basalt	B	Low-K
10017	Vesicular Basalt	Intersertal Basalt	A	High-K
10020	Ves.Olivine Basalt	Fine Grained Ophitic Basalt	A	Low-K
10022	Vesicular Basalt	Intersertal Basalt	A	High-K
10024	Vesicular Basalt	Intersertal Basalt	A	High-K
10029	Med.Grained Basalt	Med.Grained Ophitic Basalt	B	------
10031	Vesicular Basalt	--------------------------	A	------
10032	Fine Grained Basalt	--------------------------	A	Low-K
10044	Cristobalite Basalt	Med.Grained Ophitic Basalt	B	Low-K
10045	Olivine Basalt	Fine Grained Ophitic Basalt	A	Low-K
10047	Cristobalite Basalt	Med.Grained Ophitic Basalt	B	Low-K
10049	Fine Grained Basalt	Intersertal Basalt	A	High-K
10050	Cristobalite Basalt	Med.Grained Ophitic Basalt	B	Low-K
10057	Vesicular Basalt	Intersertal Basalt	A	High-K
10058	Cristobalite Basalt	Med.Grained Ophitic Basalt	B	Low-K
10062	Olivine Basalt	Fine Grained Ophitic Basalt	A	Low-K
10069	Vesicular Basalt	Intersertal Basalt	A	High-K
10071	Fine Grained Basalt	Intersertal Basalt	A	High-K
10072	Vesicular Basalt	Intersertal Basalt	A	High-K
10092	Olivine Basalt	--------------------------	-	------

*After Tera et.al., (1970) and others

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The term "matrix" refers to material that is too fine-grained to be resolved by whatever optical means are employed, be it a petrographic microscope, a binocular microscope or the unaided eye. Clasts are those fragments that can be resolved from the matrix through differences in color, texture or composition. The types and abundances of clasts found in the Apollo 11 breccias are summarized in Table 4. It can be seen from Table 4 that many clast types (white, brown, salt & pepper, brown & white) are dissimilar to the crystalline rocks collected at the Apollo 11 site and probably represent ejecta from distant impact sides.

The matrix consists largely of glass particles and mineral fragments. Much of the glass has undergone some devitrification, which gives the matrix an overall turbid appearance in thin section.

Because the chemical composition of the soils and breccias are similar (but not identical) it was assumed by LSPET (1969) that the breccias were some sort of lithified soil, and lithification by shock was put forward as a mechanism. This mechanism was favored by King et al. (1970), Mason et al. (1970), Quaide and Bunch (1970), Shoemaker et al. (1970), Wood et al. (1970). Other investigations have proposed lithification by thermal welding [Smith et al. (1970); Duke et al. (1970); McKay et al. (1970); and McKay and Morrison (1971)]. A third hypothesis proposed by Chao et al. (1971) suggests that breccias are formed by low level shock compaction of soil located some distance from the point of impact and near the base of the regolith.

SOILS

Soil samples were obtained from the Contingency, Documented and Bulk Samples, all of which were taken within 30m of the lunar module (Fig. 2).

The Contingency Samples soils were collected along with the rocks using the special Contingency Sampler (Fig. 9), in which rocks and soils were collected simultaneously by scooping. Except for the drive tube samples, the only soil present in the Documented Sample was what adhered to the rocks. This soil was admixed with material produced by the crumbling and spalling of the rocks. The soils present in the Bulk Sample were collected by scooping into the regolith using the large scoop (Fig. 7).

During Preliminary Examination, fines samples from the Contingency, Documented, Bulk and Core samples were sieved and the results plotted as cumulative-weight percent curve (Fig. 14).

Since apparently a scoop was not used in collection of the documented samples, the fines (10011) with the rocks probably consist of a mixture of soil that adhered to the rocks with material abraided from the rocks in transit, especially from the friable breccias. On the other hand,

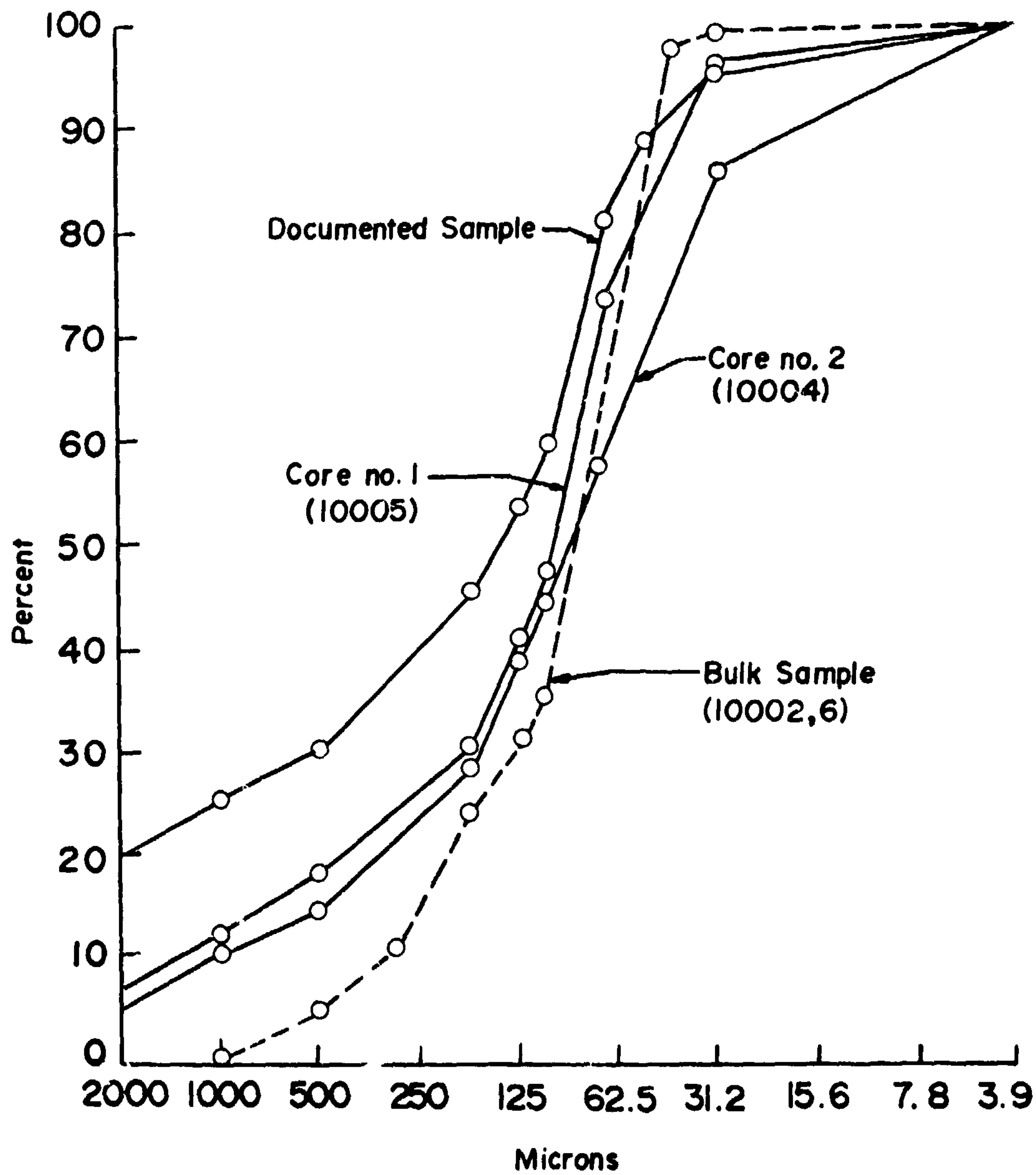


Figure 14. Cumulative Weight-Percent of some AP-11 fines.

the bulk and contingency fines were collected by scooping and probably contain only a small proportion of rock material abraided in transit.

Soils from Apollo 11 contain the following components, given in order of abundance:

1) Igneous rock and mineral fragments. These occur as black to grey basalt fragments with densities of greater than 3.32 gm/cm^2 (Heiken, 1975). Mineralogically and texturally these fragments are similar to the basalts collected at the Apollo 11 landing site (LSPET, 1969). Most of the mineral fragments found in the soils are comminution products of the basalts: ilmenite, pyroxene, plagioclase, olivine and chrome spinel (Heiken, 1975). Small amounts of cristobalite and alkali feldspar have also been reported (Agrell et al., 1970; VonEngelhardt et al., 1970.)

2) Breccia fragments. These occur as tabular to equant, subrounded to subangular fragments with densities of 2.9-3.1 gm/cm^3 (Heiken, 1975). The breccia fragments are composed of basalt, glass, mineral and previous breccia fragments (LSPET, 1969). It has been proposed by Agrell et al. (1970), Chao et al. (1971), and others that the breccia fragments are a result of soil lithification, but there is not a direct correspondence of soil modes to breccia modes (Duke et al., 1970). It has been postulated by Heiken (1975) that the breccias are most probably a mixture of freshly comminuted rock and soil from impact craters.

3) Glass spheres. 1-mm to 3-mm-diameter glass spheres make up a minor (1-5%) but thoroughly studied soil constituent. Most are spherical, but some occur in ovoid to dumbbell shapes. Various colors are exhibited with a predominance of pale amber (2.2-2.6 gm/cm^3), dark amber (2.7-3.2 gm/cm^3), red brown (3.0-3.32 gm/cm^3), and pale yellow, pale green or colorless (2.2-2.6 gm/cm^3) spheres (Duke et al., 1970; Agrell et al., 1970). Many spheres are devitrified; some of the larger spheres have the larger vesicles. Many spheres exhibit flare patterns. Some sphere surfaces are coated with imbedded particulate matter or spattered droplets of glass, Fe, Fe-Ni and troilite (McKay et al., 1970; Agrell et al., 1970) and some surfaces show evidence of micro-meteorite impacts (zap pits).

4) Microanorthositic fragments. Small, angular fragments of plagioclase (An_{95}) with small ilmenite and rutile inclusions are described by Agrell et al., (1970) and Wood et al., (1970).

The origin for these fragments may be the lunar highlands or mare regions with anorthite-rich basalt flows (Heiken, 1975).

5) Meteoritic material. Only a trace of identifiable meteoritic material has been identified in the Apollo 11 soils. Rare metal grains, some with microcratered surfaces, are present. They are composed of some single-crystal kamacite and taenite and a hexahedrite with kamacite and zoned taenite (Agrell et.al., 1970; Goldstein et al., 1970).

There is agreement among investigators that the Apollo 11 soils were formed by meteorite comminution of fine-grained basalt and coherent breccia. Agglutinate grains and most glassy particles were formed by melting of rock and soil by impact processes. It is possible that some of the glass spheres have a pyroclastic origin, but they are very minor soil constituents (Heiken, 1975).

CORES (from LSPET, 1969)

Two core samples, each 2 centimeters in diameter, were returned: core tube 1 (10005) contained 10 centimeters, and core tube 2 (10004) contained 13.5 centimeters of material. The cores are composed predominantly of particles with diameters from 1 millimeter to 30 micrometers, with admixed angular rock fragments, crystal fragments, glass spherules, and aggregates of glass and lithic fragments in the coarser-sized fraction. Both the material in the tubes and the fines in general are medium to dark grey with a tinge of brown. When prodded with a small spatula, the material disintegrates particle by particle or forms extremely fragile ephemeral units of subangular blocky shapes.

Neither core sample shows obvious grain-size stratification. The core from tube 2 has a slightly lighter zone about 6 centimeters from the top surface which is 2 to 5 millimeters thick with a sharp upper boundary and a gradational lower boundary. This lighter zone is not megascopically different in grain size or texture from the dark material.

MINERALOGY

Clinopyroxene - Clinopyroxene occurs in all of the rocks examined. The most widespread variety is cinnamon brown to resin brown in hand specimens and pale reddish brown to pinkish brown to nearly colorless in thin section. Little or no pleochroism is associated with the crystals. The habit of clinopyroxene in the crystalline rocks is generally stubby prismatic or anhedral, with some sheaf-like intergrowths with feldspar also being present. Some crystals are strongly zoned from the center outward as indicated in increasing positive optic angle from near 0° to near 50° together with increasing refractive index and intensity of color.

Rare pale yellow crystals of pyroxferrite occur as overgrowths and interstitial crystals to the pyroxene crystals, and in cavities in several of the more coarsely crystalline rocks.

Olivine - Olivine from Fo_{65} to Fo_{75} is a subordinate phenocrysitic constituent of several of the finer crystalline rocks, and occurs sporadically as crystal fragments in the breccias and dust. It is clear pale greenish yellow in the crystalline rocks but may range in color from greenish yellow through honey yellow and orange yellow in the breccias and dust. Much of the olivine occurs as anhedral cores in pyroxene crystals.

Plagioclase - Plagioclase is likewise widespread but generally subordinate in amounts to the ferromagnesian minerals. It is calcic, mostly between An_{70} and An_{90}, with some compositional zoning in some rocks. The habit is commonly tabular and plate-shaped, with lamellar twinning parallel and transverse to the plates. Interstitial, anhedral, poorly twinned crystals also occur in many of the basaltic rocks.

Ilmenite - Ilmenite is present in relatively large amounts in the crystalline rocks. It occurs as lathes and well-formed skeletal crystals. Ilmenite is also common in the breccias and soil as a constituent of the lithic fragments and as isolated crystal fragments. Many of the larger crystals show exsolution of chromite, rutile and many have armalcolite cores or inclusions.

Cristobalite - Cristobalite is present as thin clear coatings, and occurs in cavities and fills interstices between plagioclase plates in some of the coarser crystalline rocks. Microscopically it is characterized by a crackly surface and complex twinning.

Troilite - Troilite occurs in small amounts as rounded masses in interstices between plagioclase, clinopyroxene, or ilmenite of some coarser crystalline rocks. Most masses contain small blebs of native iron.

Native iron - Native iron occurs as scattered blebs up to 10 microns diameter within the troilite masses. Occasional isolated masses of iron are also present.

Other minerals - Several other accessory minerals occur in crystalline rocks which include chromian ulvospinel, ulvospinel, apatite, K-feldspar, whitlockite, tranquillityite, zirconolite, and baddeleyite.

For further description and reference, see Frondel, J.W. Lunar Mineralogy. New York, (1975) 323 pp.

Apollo 11 Sample Degradation History

There are two basic areas of sample degradation to be considered in Apollo 11: 1) Sample contamination during collection and transportation of samples back to earth; and, 2) Laboratory contamination during original processing.

Tools used on the lunar surface for sample collection (hammer, tongs, etc.) were stored in two different configurations in the Modularized Equipment Storage Assembly (MESA). Core tubes, solar wind experiment, and teflon storage and collection bags, were cleaned to high standards (Apollo 11, 12 & 13 Organic Contamination Monitoring History) MSC-04350 and vacuum sealed in the ALSRC containers at the Lunar Receiving Laboratory. All other large tools (scoops, tongs, etc.) were cleaned to spacecraft cleaning levels. These levels were reported as being equivalent to laboratory cleaning levels used on LRL tools (personal conversation with W.A. Parkan). However, all tools not sealed in the ALSRC were hand checked in a clean room environment, prior to loading into the MESA. At this time it is possible that the hand tools could have been handled by someone without gloves.

On the lunar surface, the astronauts probably handled a few of the larger samples without using any tools. EVA suits worn by Armstrong and Aldrin were cleaned only to a visual cleaning requirement. This meant that they were probably the "dirtiest" item to come in contact with any samples at that point in the mission. Spacesuit out-gassing may have been another minor contributor to surface contamination. Lunar surface contamination from exhaust emissions of the lunar module may have occurred during landing.

Since all rocks and soils were collected in a small radius around the LEM, it is possible that residue from the descent engine contaminated certain surface samples. This possibility has been studied and documented, (Murphy et al., 1970). However, no direct conclusions were reached.

In the LRL, cabinets in which lunar samples were to be processed were cleaned with alcohol and flushed with freon. This was repeated several times to ensure no biological contamination of the samples. During the quarantine period, containers or tools transferred into any cabinet system in the LRL were flushed with peracitic acid and were put through a dry heat sterilization process. The amount of heating was not any different from the daytime temperatures on the moon. No cases were recorded of peracitic acid leaking through a container onto a sample.

The samples came in contact with teflon, aluminum and stainless steel, and were exposed to indium (used for sealing containers) and molybdenum disulfide (used as a lubricant). In addition to this, samples processed in PCTL were exposed to open Mettler balances, and immersion oils used in petrographic work. Samples in SPL were sawed in open air.

Many samples repackaged during re-examination had been packaged in Bel-Art products, (polyethylene and polystyrene) which were labeled with gummed labels, and written on with ball point pens. These products, if exposed to samples, could have added greatly to sample contamination.

In the present SSPL, samples only come in contact with stainless steel, teflon and aluminum. Xylan is used as a lubricant in the place of molybdenum disulfide.

During this re-examination, samples were re-packaged and old packaging was noted in the data packs.

All tools which touch samples, are cleaned to a CP-7* level. Most containers which samples are stored in, are also cleaned to a CP-7* level. All processing cabinets used for lunar samples, are cleaned to a CP-1* level.

SAMPLE RE-EXAMINATION

BINOCULAR DESCRIPTION PROCEDURE

In general, the largest remaining subsample was selected for the description of the lithology. Special emphasis was placed on the mineralic and clast components of the rock.

Breccia clasts were measured, classified and described (see Table 4) and abundances of the various clast types were visually estimated. The identification, abundances and grain sizes of the basalt components were coordinated with the thin section descriptions. The orientations used in the photographs and in the binocular descriptions are arbitrary and do not reflect the orientation on the moon.

*Contamination Control Procedures (MSC-03243)

For the most part, information contained in the binocular descriptions was generated during re-examination. However, sample descriptions generated during PET were reviewed and any information that conflicted with, or could not be observed during re-examination was annotated by placing a semi-colon (;) between the re-examined descriptive and the PET descriptive. For example: If the part of the rock restudied had no fractures, but a note in the Preliminary Examination stated that fractures were present parallel to an elongated face, it would be presented in the following manner in the binocular descriptions:

Fracturing - Absent; Few fractures parallel to elongated face (PET).

All terms used in the binocular descriptions are listed below:

CHARACTERISTIC	TERM	DEFINITION AND COMMENT
Cavities		Not to include merely surface related features such as clast molds.
	vugs	
	vesicles	projecting or lining materials
	crystals	
Coherence		
Intergranular:		grain-to-grain coherence
	very friable	crumbles under manual pressure
	friable	crumbles under manual pressure
	coherent	must be struck to disaggregate grains
	tough	breaks across grains rather than around them
Fracturing:		terms combined as needed for a full description
	absent	
	few	
	numerous	
	non-penetrative	
	penetrative	visible on opposing sides
Component		igneous rocks, breccia and fines as applicable
	mafic silicate	all colored translucent minerals; mainly pyroxene and olivines
	plagioclase	light grey and white (if shocked)

CHARACTERISTIC	TERM	DEFINITION AND COMMENT
	ilmenite	black opaque submetallic
	opaque	used when opaques other than ilmenite are present but quantitatively inseparable
	pyroxene	amber to honey brown to dark brown
	mafic	aphanitic material (under binocular microscope) <0.05 mm; sometimes referred to as mesostasis
	clast	see clast descriptions for details of various clast lithologies
	glass	dark green to black noncrystalline silicate material
Fabric		to include texture
	isotropic	
	anisotropic	
	laminated	
	equigranular	
	inequigranular	
	porphyritic	
	seriate	
	microbreccia	<1mm average clast size
	fine breccia	1-5mm average clast size
	breccia	>5mm average clast size
Surface		specific faces may be referenced by the laboratory orientation cube face designation
	irregular	
	granulated	
	smooth	
	hackly	generally a freshly broken surface
	glass covered(%)	e.g., glass 30% of E and 10% of T
	grooved	for slickenside-like surfaces
Variability*		any difference in any characteristic from one part to another, e.g.,grain size, lithology, mineralogy

*The variability term homogeneous, when used in reference to breccias, refers to no major variation between distribution and abundance of clast material or major components.

CHARACTERISTIC	TERM	DEFINITION AND COMMENT
Zap Pit	none	none seen in quick scan
	few	$<10/cm^2$
	many	$>10/cm^2$

Table -4- BRECCIA CLASTS

Clast Type	Examples Found In	Abundance(%)	Clast Size Range(mm)	Minerals (app) %	Grain Size(mm)	Grain Shape
White (Fig.15)	10009,10018,10019,10021, 10023,10025,10026,10027, 10028,10046,10048,10056, 10059,10060,10061,10063, 10064,10065,10066,10067, 10068,10070,10073,10074, 10075,10082,10093,10094	<1% - 20%	<.1mm-4mm	Plagioclase 100%	<.1-.3	Euhedral to aphanitic
Basalt (Fig.16)	10018,10019,10021,10023, 10026,10027,10030,10048, 10056,10060,10061,10063, 10064,10065,10066,10067, 10068,10070,10073,10075, 10082,10093,10094	<1-10	.3-40 Avg=8	Pyroxene 40% Plagioclase 40% Ilmenite 10% Mesostasis 10%	.08-.4	Euhedral to subhedral- (pyroxene, plagioclase) Elongated platy (ilmen- ite)
Salt & Pepper (Fig.17)	10009,10018,10019,10021, 10023,10026,10027,10030, 10048,10056,10061,10064, 10065,10067,10068,10070, 10073,10075,10093,10094	<1-5	.3-3 Avg=2	Plagioclase 75% Ilmenite 25%	<1-.2	Elongated platy (ilmen- ite) Crushed aphanitic (plagioclase)
Grey (Fig.18)	10046,10060,10063,10064, 10065,10066,10067,10068, 10070,10075,10093,10094	<1-5	2-3	Pyroxene 60% Plagioclase 40%	<.1-.3	Euhedral to subhedral
Grey & White (Fig.19)	10028,10030,10060,10061, 10065,10068,10074,10082, 10093	<1-8	2-3	Pyroxene 50% Plagioclase 50%	<.1-.3	Euhedral (pyroxene) aphanitic (plagioclase)
Brown	10019,10023,10027,10046, 10048,10060,10063,10067, 10070,10074,10075	<1-2	<1-2	Honey Brown Pyroxene 100	<.1	Crushed appearance
Green (Fig.20)	10063,10068	<1	<1-1.5	Olivine-100	<.1-.4	Euhedral to crushed
Black	10064,10067	1	<1-2	Aphanitic glass	<.01	Aphanitic
Lithic (Fig.21)	10075	<1	2	Aphanitic	<.01	Relic Clast

Clast Type	Examples Found In	Abundance(%)	Clast Size Range(mm)	Minerals (app) %	Grain Size(mm)	Grain Shape
Brown & White (Fig. 22)	10093	<1	2.5x3.5	Honey Brown Pyroxene (50%) Plagioclase (50%)	.4-.9	Euhedral pyroxene and plagioclase

Fig. 15: White clast from 10060,5. Width of field 7.3 mm
(S-76-25890)

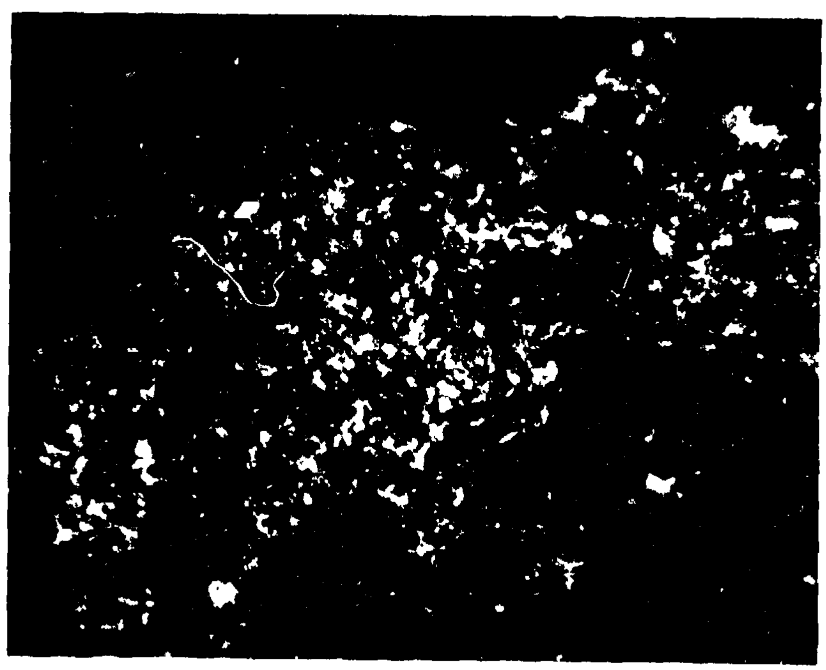


Fig. 16: Basalt clast from 10048,0. Width of field 7.3 mm
(S-76-25618)

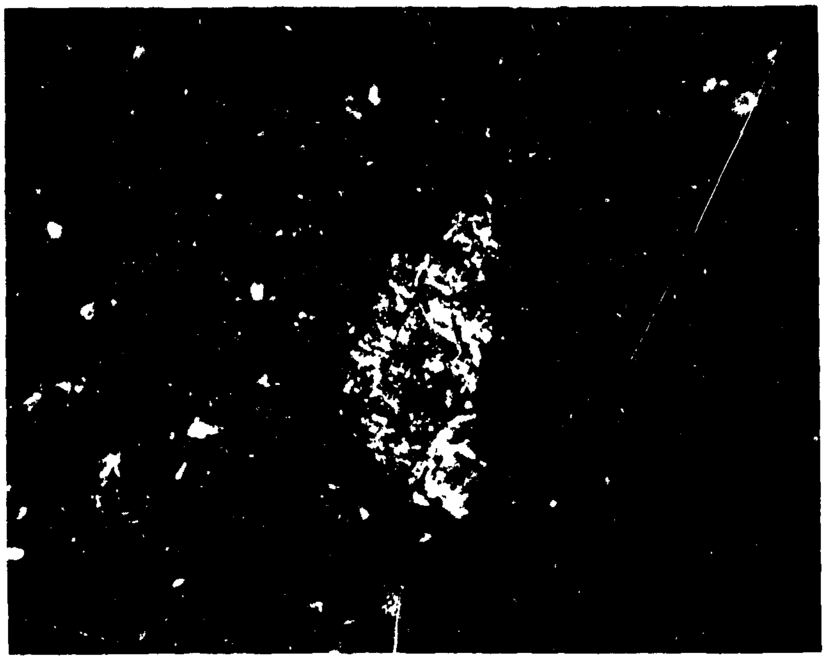


Fig. 17: Salt & Pepper Clast from 10048,0. Width of field 7.3 mm (S-76-25619)

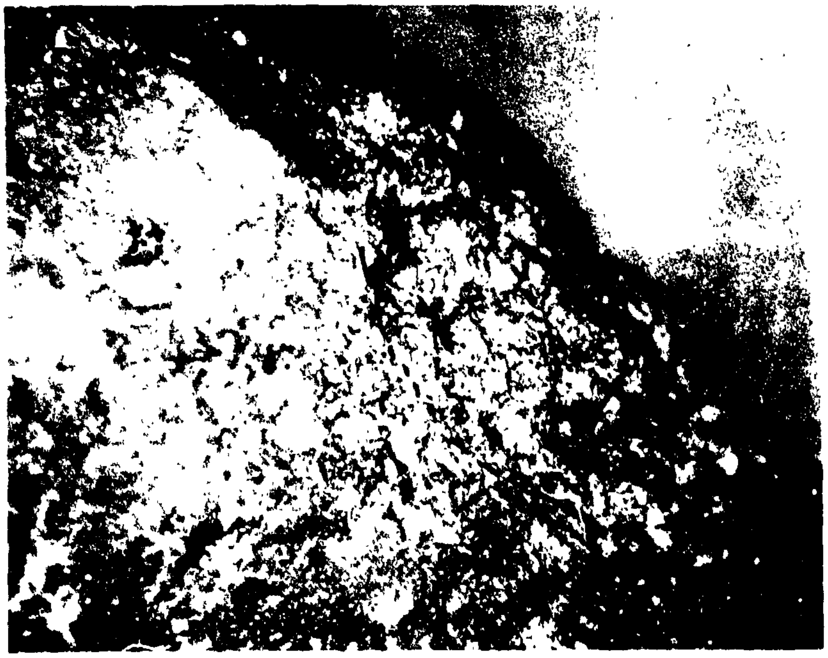


Fig. 18: Grey clast from 10063,1. Width of field 14.8 mm (S-76-26838)

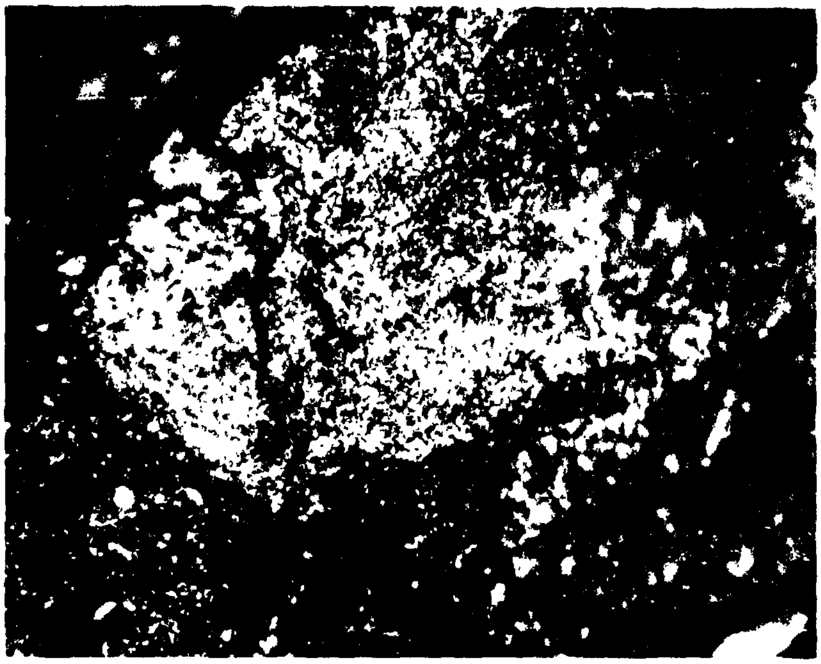


Fig. 19: Grey & White clast from 10063,1. Width of field 7.3 mm
(S-76-26839)

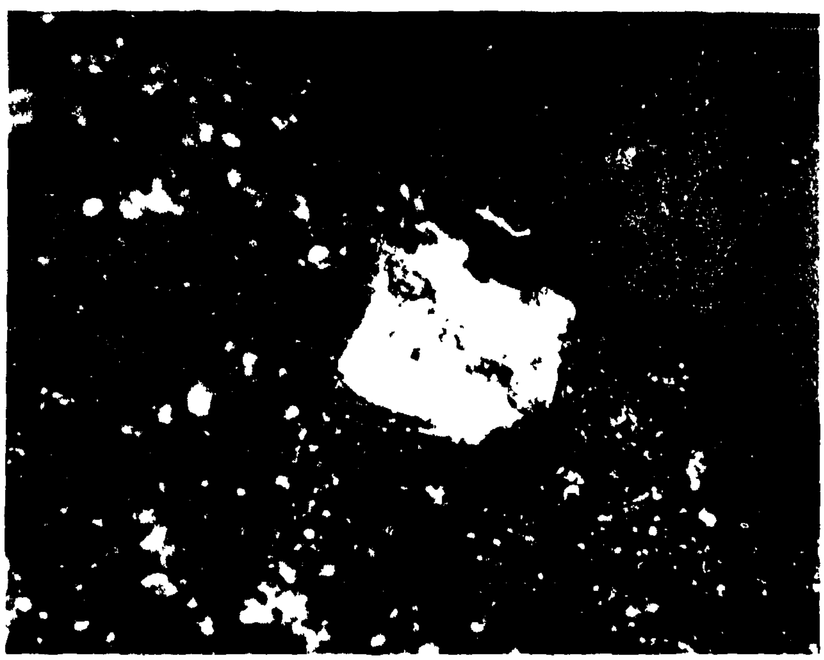


Fig. 20: Green clast from 10063,1. Width of field 7.3 mm.
(S-76-26837)

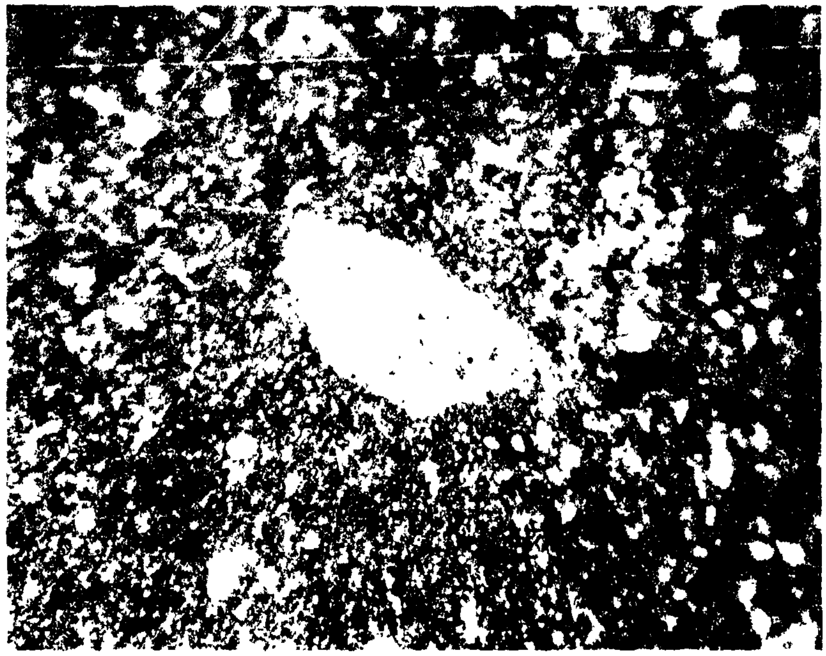


Fig. 21: Lithic clast from 10060,5. Width of field 7.3 mm
(S-76-25891)

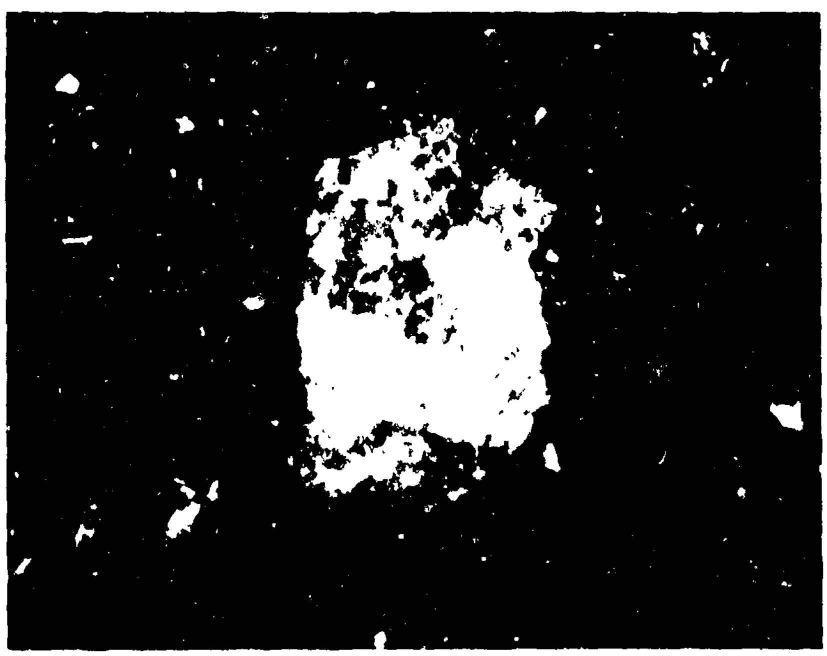


Fig. 22: Brown & White clast from 10093,0. Width of field 7.3 mm
(S-76-25991)

THIN SECTION DESCRIPTION PROCEDURE

Each thin section description and modal analysis appearing in this catalogue is given for a specific section but the summary and comments are based on examination of all available sections. The modal analyses are based on 200-400 point counts, the number depending on the apparent heterogeneity of the sample. The modal analyses reported always represent void-free analyses owing to the variability in the number, size, and distribution of voids.

For the size characterization the maximum dimension of each crystal was used. Identification of the phases was solely by optical properties. No attempts were made to identify the specific pyroxene or plagioclase composition present. No oil immersion microscopy was done and no attempt was made to identify any of the very fine grained materials.

GENERAL DESCRIPTION OF AN APOLLO 11 BRECCIA IN THIN SECTION

Since the overall characteristics of all the Apollo 11 breccias are very similar, a generalized description and definition of terms is given below. For specific samples, only those characteristics that deviate from the general description will be noted.

Apollo 11 breccias are characterized by having a dark to light brown matrix which is rich in slightly to moderately devitrified glass. In most cases the material is very turbid and contains small crystallites, many too small to be resolved.

The following definitions will be used in describing all breccia samples:

<u>Matrix</u> - The matrix of the section is that material in which the glass-rich phases occurs along with small (<0.001mm) crystalline products. No attempts were made to resolve the phases present in the matrix.

<u>Mineral Clasts</u> - Those shards of crystalline material which contain one mineral phase plus or minus exsolution lamallae, zoning, etc. Grains with two or more phases are considered a crystalline lithic clast rather than a mineral clast.

<u>Lithic Clasts</u> - In order to simplify the designation of the various types of lithic clasts possible in any one section, they are divided into two groups. The first group is designated small (<1mm) and are not further defined. The second group is designated large (>1mm) and each has a few remarks to better define the clast components and any other pertinent information. The exact number of the large clasts is given,

whereas only a relative abundance is given for the small clasts.

Due to the heterogeneous nature of breccias, one or even several thin sections cannot give precise percentages of phases present. Therefore, in order not to stress unduly the measured values of the phases present in the sections, semi-quantitative values are used. These values are defined below:

Relative Value	Approximate % of Type Present in Section
Very abundant	>50%
Abundant	30-50%
Moderate	20-30%
Few	10-20%
Present	<10%

In the majority of the breccias, the matrix forms a more or less continuous array and hosts all other phases present. The matrix is a semiopaque glass-rich phase that shows no flow structure but always shows some degree of devitrification. Included in the matrix are numerous rounded and irregular lithic clasts. These clasts are randomly located and isolated from one another. Many breccias have a wide variety of clasts while others have a very limited representation. Interdispersed with the lithic clasts are mineral clasts. The major phase represented is usually clinopyroxene. It occurs as irregular to blocky shards which usually show some degree of shock deformation. The crystals, for the most part, show only slight to no evidence of reaction with the enclosing matrix. Plagioclase and ilmenite also occur in most sections, but usually to a lesser degree. The third major phase is the glass shards which occur as spherical to irregular masses. Many contain bubbles, flow lines and fractures. The color usually is some shade of yellow or orange, but colorless, white and greenish-brown masses also occur. Some glass coatings on vesicle walls and near the outer surfaces also occur.

GENERAL DESCRIPTION OF AN APOLLO 11 BASALT IN THIN SECTION

The designations and classifications of the basalts follow the following scheme. Five major types of basalts are recognized. A generalized description is given in the table below along with the samples which fall under each of the groups:

TYPE	GENERAL DESCRIPTION	SAMPLES
Intersertal-one population of plagioclase	Intergrown network of pyroxene and ilmenite with plagioclase, mesostasis interstitial to network. High mesostasis content.	10017 10049 10057 10069

(Basalt description - cont'd)

TYPE	GENERAL DESCRIPTION	SAMPLES
Intersertal - Two populations of plagioclase	Network of pyroxene phenocrysts intergrown with large anhedral ilmenite. Interstially to the network are tablets of plagioclase, anhedral plagioclase, and mesostasis. High mesostasis content.	10022 10024 10032 10071 10072
Subophitic	Plagioclase laths are interstitial to and enclosed in the pyroxene host.	10029 10044 10047 10050 10058
Ophitic	Plagioclase laths occur enclosed in the pyroxene host with minor plagioclase as interstitial void fillings.	10020 10045 10062
Intermediate Ophitic/Subophitic	In part typical ophitic plus grading to subophitic.	10003

Grain size and minor mineralogy can vary within each type, but the major characteristics remain the same. No attempts were made to determine any of the phases in the mesostasis.

SAMPLE HISTORIES

A summary of the processing, laboratories and operation, special handling and any unusual contaminating conditions is presented for each generic sample. In addition, an abbreviated sequence of laboratory destinations is presented for each pristine subsample. This indicates which laboratory and hence type of potential contaminants could be associated with the existing sample. More detailed information may be found in the Curator's files.

CHEMICAL DATA

These values were obtained by using all valid data available in the lunar data base.* The data base was checked for accuracy and a number of errors were eliminated. Before averaging, redundant and suspect values were removed according to the general rules:

1. Preliminary examination data were removed.

2. Runs at temperatures other than ambient were removed.

3. Results after acid leaching were removed.

4. Analyses of individual mineral fractions or phenocrysts were removed.

5. Data for samples listed by the author as probably contaminated were removed.

6. Where the same data was repeated by the same author or other authors only the most recent value was retained.

7. Possible decimal errors were checked and corrected if sufficient information was available to make a valid change.

8. Element to oxide calculations were checked and corrected where this type of an error was indicated.

Unusual values that were not removed by at least one of these rules were kept. In some cases the range of two values was large, but there was no obvious reason for eliminating either of the values.

*Compiled by and available from the Curator's Office. The data base contains published chemical, isotopic, modal, and age data for all lunar samples.

10001

Generic 10001 was assigned to the Documented Sample ALSRC(#1004). Most of the material in the Documented Sample consisted of rocks that were assigned new generic numbers (see Table 1).

The fines were generated as a result of the crumbling and spalling of the rocks. 10001,8 was sieved during re-examination for coarse fines material (larger than 4 mm) and these samples were described.

HISTORY AND PRESENT STATUS OF SAMPLES - 10-4-76

10001 was processed in the Vac Lab. It was later re-examined and sieved in SSPL. One rock was separated from 10001 during re-examination and was assigned the new generic number 10094.

PRISTINE SAMPLES (All samples VAC - SSPL)

6	0.45 gm	>4 mm chips and fines.
7	1.58 gm	>4 mm chips and fines.
3	45.22 gm	>4 mm chips and fines.
12	6.68 gm	3-4 mm chips split from 10C01,8 during sieving. No pits or patina.
14	10.47 gm	Fragment. No pits or patina. Large salt and pepper and basalt clasts.
15	2.14 gm	Breccia chip with same description as ,14.
16	0.30 gm	Breccia chip with same description as ,14.
18	10.04 gm	Vesicular basalt piece. Few pits on 2 surfaces. Typical AP-11 basalt components and percentages.
19	6.83 gm	Breccia chip. No pits or patina. Large amount of brown clast material.
20	6.20 gm	Breccia chip. Many pits on 3 surfaces. Small clast population.
21	3.29 gm	Breccia chip. Many pits on 2 surfaces. Clasts include white, brown and basalt.

22	4.14 gm	Breccia chip. Few pits on 1 surface. No patina. Small clast population.
23	4.46 gm	Breccia chip. No pits or patina. Friable with small percent of white and basalt clasts.
24	1.04 gm	Breccia chip. Few pits on one surface. One large basalt clast present.
25	1.66 gm	Breccia chip. No pits or patina. Hackly surface with small amount of vesicular glass.
26	4.99 gm	17 Breccia chips. 4-10 mm. No pits or patina. Large clast population.
27	1.66 gm	4 Breccia chips. 4-10 mm. No pits or patina. Large clast population.

NO RETURNED SAMPLES >5 gm .

NO CHEMICAL ANALYSES OR AGE DATES.

10002

10002 was the number assigned to the rocks and soils in the Bulk Sample (ALSRC #1003, 14897.4 gm). The rocks were removed from the container and given new generic numbers (see Table 2). A portion of the soils was sieved during PET and the sieve fractions were assigned new generic numbers. (Table 2).

At the onset of Re-examination, there were still some "soils" left in 10002. One of these (10002,26 - 750 gm) was sieved for material >4 mm. These coarse fines were described using a binocular microscope, for individual inclusion in the catalogue.

SIEVE ANALYSIS of Sample 10002,26 - Weight Sieved: 476.0 gm

Sieve	Wt. (gm)
>10 mm	18.48
4-10 mm	7.63
2-4 mm	10.96
1-2 mm	14.65
<1 mm	424.5

HISTORY AND PRESENT STATUS OF SAMPLES - 10/13/76

10002 was originally processed in the Bio Prep Lab, and remaining pristine samples were re-examined in SSPL. Two rocks were split from 10002 during re-examination and were given the new generic numbers 10092 and 10093. There is no documented evidence that any pristine sample presently in 10002 was processed in any other laboratory.

PRISTINE SAMPLES:

7	844.3 gm	<1mm Fines
16	161.44 gm	<1mm Fines
21	39.73 gm	1-3mm Fines
24	76.96 gm	<1mm Fines
25	25.65 gm	<1mm Fines
28	0.27 gm	<1mm Fines
29	4.47 gm	1-3mm Fines
30	7.80 gm	1-3mm Fines
31	15.04 gm	1-3mm Fines
33	19.35 gm	<1mm Fines

34	2.95 gm	<1mm Fines
37	88.43 gm	<1mm Fines
39	25.40 gm	<1mm Fines
40	19.42 gm	<1mm Fines
41	4.35 gm	<1mm Fines
42	0.25 gm	<1mm Fines
45	0.50 gm	<1mm Fines
46	0.89 gm	1-3mm Fines
54	15.58 gm	1-3mm Fines
86	248.71 gm	Unsieved Fines
88	0.78 gm	Glassy piece. Few pits present.
89	10.96 gm	2-4mm Fines sieved from 10002,26
90	14.65 gm	1-2mm Fines sieved from 10002,26
91	240.5 gm	<1mm Fines. From 10002,26
92	184.0 gm	<1mm Fines.
93	0.15 gm	Glass chip. Patina on all surfaces. Some pits present.
94	0.12 gm	Breccia chip. Large white clast present.
95	0.35 gm	Fractured breccia chip. Glassy with few pits.
96	0.75 gm	Two basalt chips. Few pits present on both chips.
97	0.32 gm	Breccia fragment with very glassy matrix. No pits observed.
98	0.84 gm	Four fine-grained basalt chips. Pitting is present on all pieces.
99	4.28 gm	14 Breccia chips. Pitting is present on the larger chips.
103	2.21 gm	Basalt chip. No pits observed.
104	1.83 gm	Basalt chip. No pits observed.
105	2.20 gm	Breccia chip. Many large pits present.
106	1.97 gm	Breccia chip. Pits present on one surface. Low clast population.
107	0.65 gm	Breccia chip. No pits observed. Low clast population.

108	1.53	gm	Breccia chip. No pits.
109	1.66	gm	Breccia chip. A few pits present on one surface. Low clast population.
110	1.54	gm	Fine-grained basalt chip. Few chips present on two surfaces. Vesicles comprise 5% of surface.
111	4.71	gm	Breccia chip. Patina present on all surfaces. Pitting present on one. Large clast population.
126	0.01	gm	>1mm Fines.
127	0.41	gm	>1mm Fines.
1000	25.73	gm	>1mm Fines.
1001	5.45	gm	>1mm Fines.
1002	101.19	gm	>1mm Fines.

NO RETURNED SAMPLES (>75gm)

COARSE FINES DESCRIPTION

SAMPLE: 10002,88 NUMBER OF PARTICLES: 1 WT.(gm): .78

COHERENCE: Tough

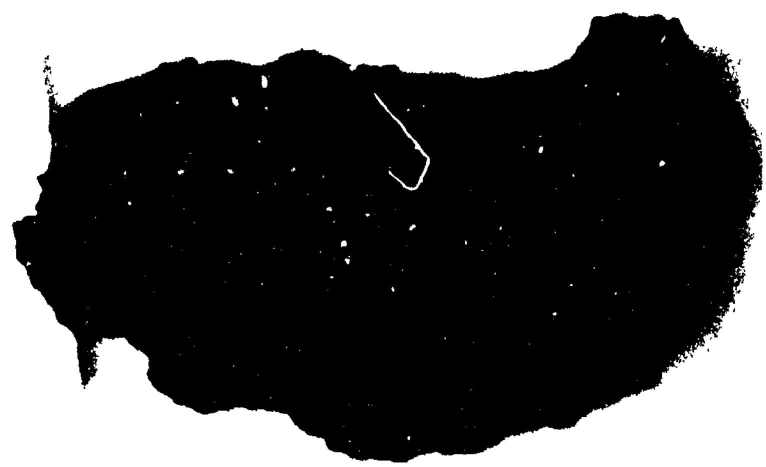
SHAPE: Angular to subangular

SURFACE: 1 fracture. Small amount of pits.

COLOR: Dark gray

MINERALOGY: Black opaque glass enclosing small white clasts.

REMARKS: Aphanitic texture, equigranular, isometric.



COARSE FINES DESCRIPTION

SAMPLE: 10002,93 NUMBER OF PARTICLES: 1 WT.(gm): .15

COHERENCE: Tough

SHAPE: Subangular to subrounded

SURFACE: Aphanitic texture. Some patina on all surfaces. Small number of pits.

COLOR: Dark gray

MINERALOGY: Black opaque glass enclosing small white clasts.

COARSE FINES DESCRIPTION

SAMPLE: 10002,94 NUMBER OF PARTICLES: 1 WT.(gm): .12

COHERENCF: Moderately friable

SHAPE: Subangular to subrounded

SURFACE: No pits on any surface. Glass coating on 2 surfaces. <.5mm thick.

COLOR: Light gray to white

MINERALOGY: Fine breccia: 60% crushed plagioclase, 25% matrix (aphanitic), 15% dark mineral (pyroxene, ilmenite, black glass)

REMARKS: Sample has high clast population. Resembles 10056. Mostly plagioclase clasts with matrix.

COARSE FINES DESCRIPTION

SAMPLE: 10002,95 NUMBER OF PARTICLES: 2 WT.(gm): .35

COHERENCE: Fractured

SHAPE: Angular

SURFACE: Fracturing lined with vitreous glass. Some pits on a few faces.

COLOR: Medium light to dark gray

MINERALOGY: Microbreccia: Clasts mostly crushed plagioclase. A few basalt clasts are present. High glass content.

REMARKS: Could be classified as an agglutinate. Basic mineralogy is the same as 10046 or 10059.

COARSE FINES DESCRIPTION

SAMPLE: 10002,96 NUMBER OF PARTICLES: 2 WT.(gm): .75

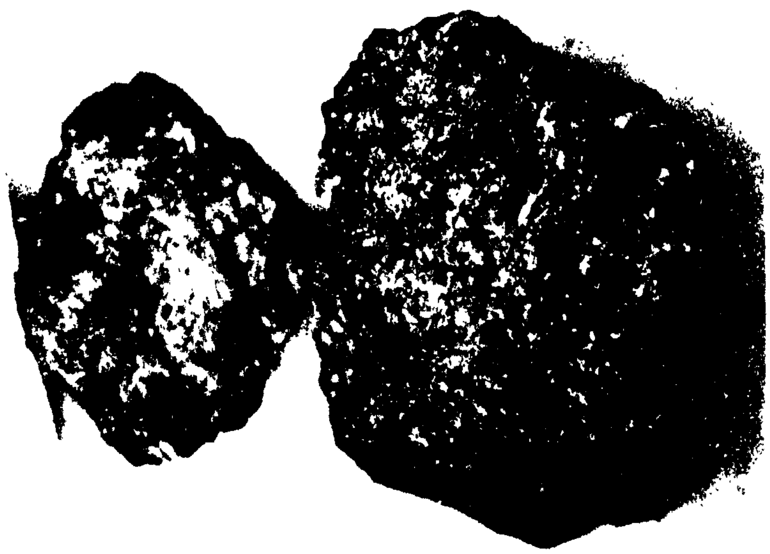
COHERENCE: Tough

SHAPE: Rounded to subrounded

SURFACE: Some small pits on several surfaces. No penetrative fractures.

COLOR: Medium light gray

MINERALOGY: Basalt: Anhedral pyroxene 65%, euhedral to subhedral plagioclase 25%, mesostasis 10%.



COARSE FINES DESCRIPTION

SAMPLE: 10002,97 NUMBER OF PARTICLES: 1 Wt.(gm): .32

COHERENCE: Moderately coherent

SHAPE: Angular

SURFACE: Rough. No pits, but patinated on several surfaces. Surface has several large cavities.

COLOR: Medium dark gray

MINERALOGY: Microbreccia: Aphanitic glass matrix with one large basalt clast, and several areas of brown vitreous material.

REMARKS: Unlike any other Apollo 11 breccia. Matrix structure resembles 10002,88.

COARSE FINES DESCRIPTION

SAMPLE: 10002,98 NUMBER OF PARTICLES: 4 WT.(gm): .84

COHERENCE: Coherent

SHAPE: Subangular to subrounded

SURFACE: Surface on all pieces is pitted, with no patina. Some small <1mm vesicles. Texture is isometric, fine grained, equigranular.

COLOR: Medium dark gray

MINERALOGY. Basalt: 50% pyroxene, 25% plagioclase, 10% ilmenite, 15% mesostasis.

REMARKS: Resembles 10057

COARSE FINES DESCRIPTION

SAMPLE: 10002,99 NUMBER OF PARTICLES: 14 WT.(gm): 4.28

COHERENCE: Coherent

SHAPE: Angular to subangular

SURFACE: Some small pits (<1mm) on larger pieces

COLOR: Medium dark gray

MINERALOGY: Microbreccia: Typical matrix enclosing white and basalt clasts.

REMARKS: One chip has a small amount of glass coating.

COARSE FINES DESCRIPTION

SAMPLE: 10002,103 NUMBER OF PARTICLES: 1 WT.(gm): 2.21

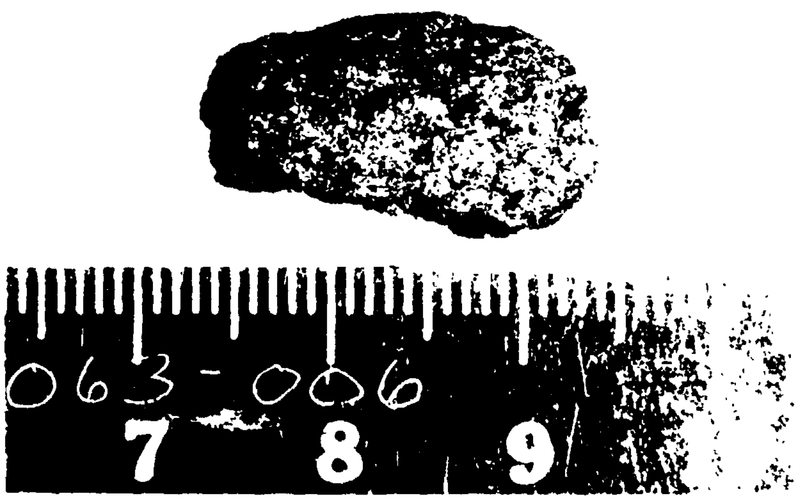
COHERENCE: Tough

SHAPE: Subrounded

SURFACE: Irregular. Some patina is present, but no pitting was observed. Some small (<1mm) vesicles are present.

COLOR: Medium light gray

MINERALOGY: Basalt: 50% brown pyroxene, 40% plagioclase, 10% opaques.



COARSE FINES DESCRIPTION

SAMPLE: 10002,104 NUMBER OF PARTICLES: 1 WT.(gm): 1.83

COHERENCE: Moderately friable

SHAPE: Subangular

SURFACE: Rough. Patination was observed on all surfaces. No pits.

COLOR: Medium light gray

MINERALOGY: Basalt: 60% brown pyroxene, 25% plagioclase and 15% opaques.

COARSE FINES DESCRIPTION

SAMPLE: 10002,105 NUMBER OF PARTICLES: 1 WT.(gm): 2.20

COHERENCE: Friable

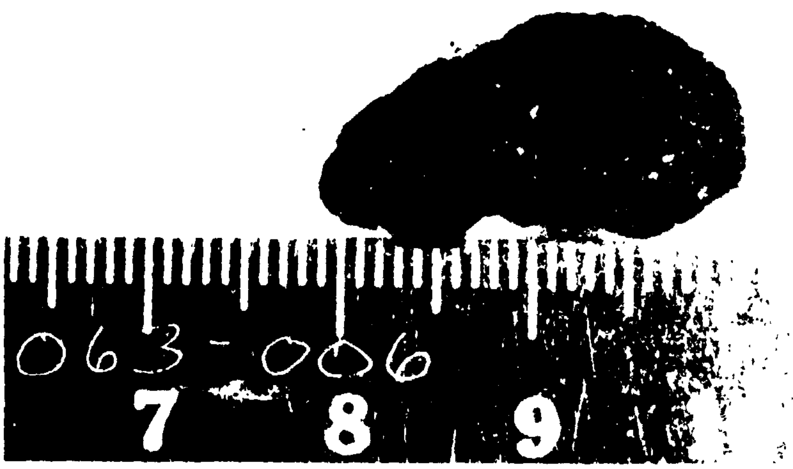
SHAPE: Subangular

SURFACE: Irregular. Several large pits present. Some penetrative fractures.

COLOR: Medium dark gray

MINERALOGY: Microbreccia: Typical breccia matrix enclosing white and basalt clasts.

REMARKS: Large pits are a special feature.



COARSE FINES DESCRIPTION

SAMPLE: 10002,106 NUMBER OF PARTICLES: 1 WT.(gm): 1.97

COHERENCE: Moderately friable

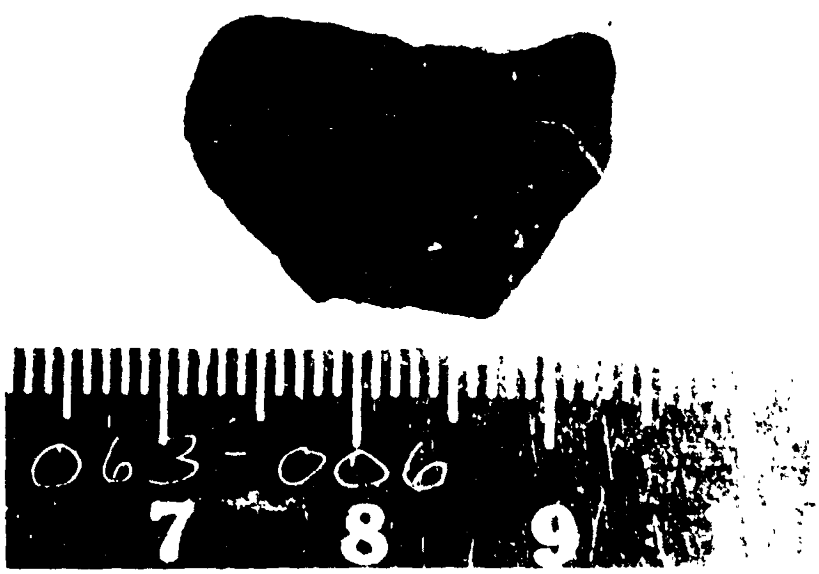
SHAPE: Subangular

SURFACE: Smooth to irregular. Few pits present on one surface.

COLOR: Medium dark gray

MINERALOGY: Microbreccia: Typical breccia matrix enclosing white clasts.

REMARKS: Very small clast population.



COARSE FINES DESCRIPTION

SAMPLE: 10002,107 NUMBER OF PARTICLES: 1 WT.(gm): .65

COHERENCE: Moderately friable

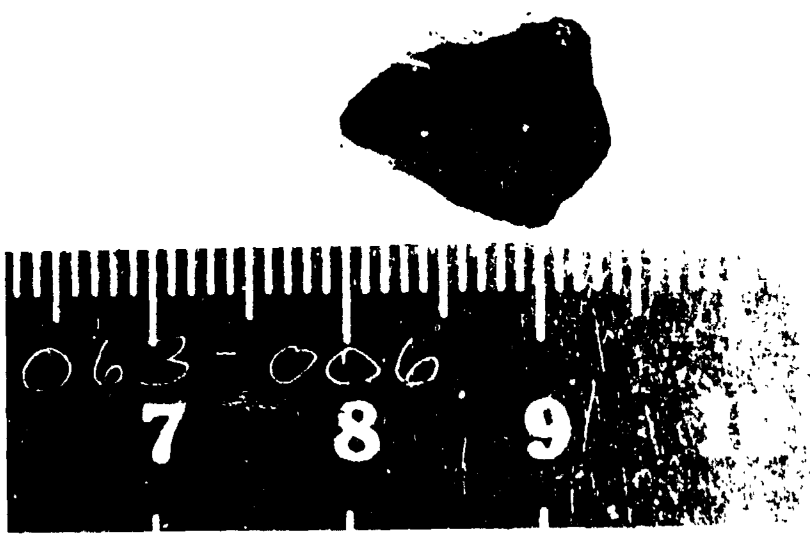
SHAPE: Subangular

SURFACE: Smooth to irregular with no pits or patina

COLOR: Medium dark gray

MINERALOGY: Microbreccia: Typical breccia matrix enclosing small white and basalt clasts.

REMARKS: Small clast population.



COARSE FINES DESCRIPTION

SAMPLE: 10002,108 NUMBER OF PARTICLES: 1 WT.(gm): 1.53

COHERENCE: Moderately friable

SHAPE: Angular to subangular

SURFACE: Irregular to rough. Some patina is present but no pits.

COLOR: Medium dark gray

MINERALOGY: Microbreccia: Typical breccia matrix enclosing small white and basalt clasts.

REMARKS: Small glass spherules present on surface inspection. Small clast population.

COARSE FINES DESCRIPTION

SAMPLE: 10002,109 NUMBER OF PARTICLES: 1 WT.(gm): 1.66

COHERENCE: Moderately friable

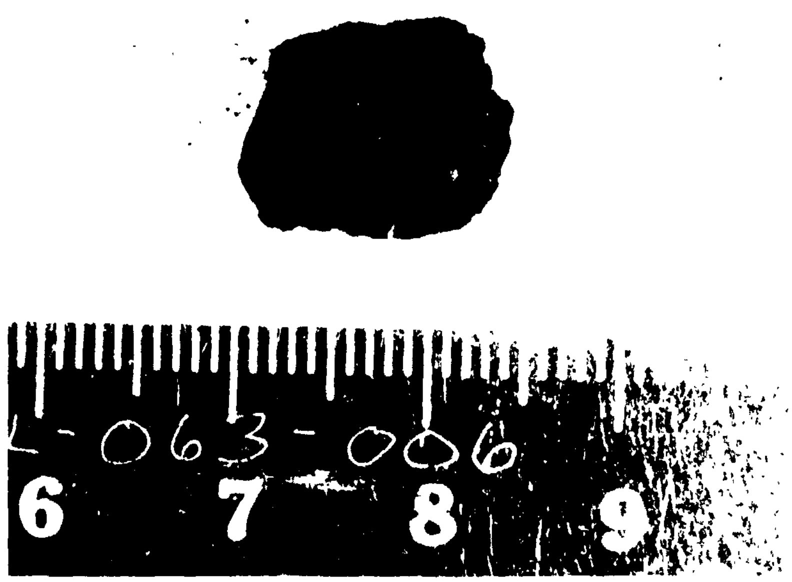
SHAPE: Subangular

SURFACE: Smooth to irregular. A few pits are present on one surface.

COLOR: Medium dark gray

MINERALOGY: Microbreccia: Typical breccia matrix enclosing small white and basalt clasts.

REMARKS: Small clast population



COARSE FINES DESCRIPTION

SAMPLE: 10002,110 NUMBER OF PARTICLES: 1 WT.(gm): 1.54

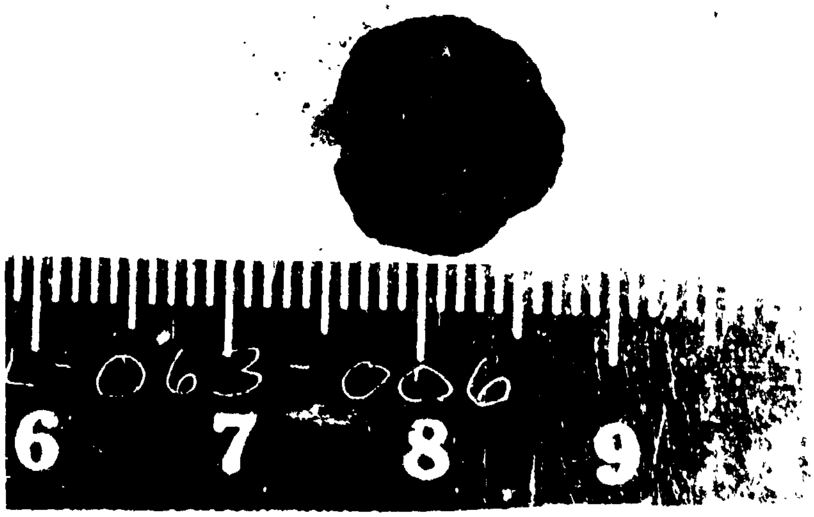
COHERENCE: Tough

SHAPE: Angular

SURFACE: Irregular. Few pits present on two surfaces. 5% vesicles surface coverage.

COLOR: Medium light gray

MINERALOGY: Basalt: Aphanitic pyroxene, plagioclase and ilmenite.



COARSE FINES DESCRIPTION

SAMPLE: 10002,111 NUMBER OF PARTICLES: 1 WT.(gm): 4.71

COHERENCE: Moderately friable

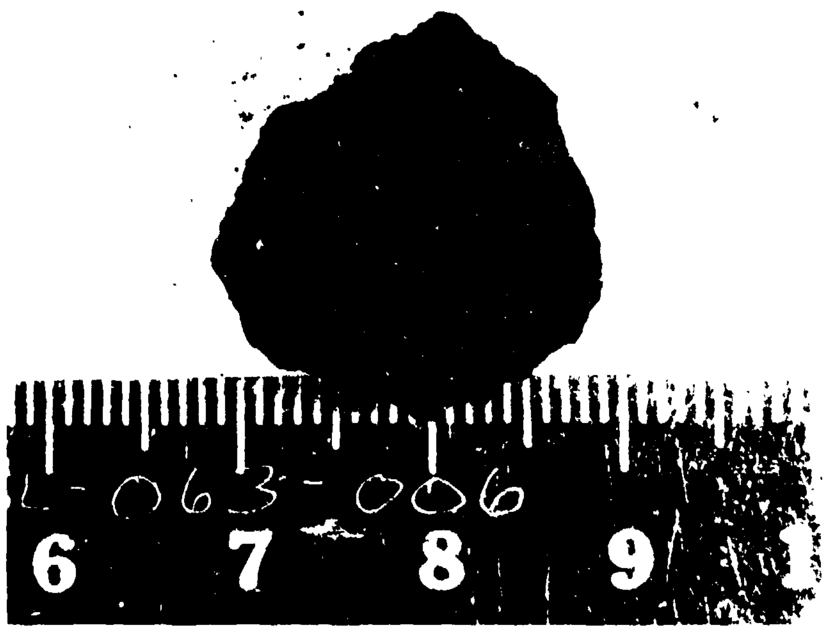
SHAPE: Subrounded

SURFACE: Irregular to rough. Patina present on all surfaces. Pitting is present on one.

COLOR: Medium dark gray

MINERALOGY: Microbreccia: Typical breccia matrix enclosing white, basalt and gray clasts.

REMARKS: Large clast population



RETURNED SAMPLES: None

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
TiO_2	1	7.010	PCT	0
FeO	1	15.95	PCT	0
CaO	1	12.03	PCT	0
K_2O	2	.130	PCT	.012
H	1	.84	CC/G	0
Th	1	1.92	PPM	0
U	1	.49	PPM	0
C	2	210.0	PPM	40.0
N	1	125.0	PPM	0
S	1	.107	PCT	0

Analysts: Stoenner et al., (1970); O'Kelly et al., (1970); Stoenner et al., (1970); Kaplan et al., (1970); Moore et al., (1970).

No Age References

10003,0
Original PET Photo
(S-69-45193)

10003,25
(S-76-25546)

10003

Sample 10003 is a Cristobalite Basalt which originally weighed 213 gm, and measured 7x4.5x3.5 cm. Its shape was originally described by PET as subangular to blocky, with its color being light brown to "salt and pepper". Sample was returned in the Documented Sample ALSRC (#1004).

BINOCULAR DESCRIPTION BY: Kramer DATE: 6/09/76

ROCK TYPE: Cristobalite basalt SAMPLE: 10003,12 WEIGHT: 19.5 gm

COLOR: Light brown to salt & pepper DIMENSIONS: 3 x 2 x 1.5 cm

SHAPE: Subrounded

COHERENCE: Intergranular - coherent
Fracturing - absent

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: Homogeneous

SURFACE: Slightly granulated; splattered with various glasses and covered with pits (PET)

ZAP PITS: Few; size range of 1mm (PET)

CAVITIES: 5% of surface covered with vugs. Many are lined with plagioclase.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
$Pyroxene_1$	Resinous brown to black	50	Equant	0.3	0.1-0.5
$Plagioclase_2$	Milky	40	Lathlike	0.3	0.1-0.5
$Ilmenite_3$	Metallic black	10	Variable	0.2	0.05-0.3

1) Two types; amber and dark brown (approximately 50-50 distribution)
2) Dominant in vugs
3) Identified by cleavage and luster

SECTION 10003,49 Width of field: 1.39 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/09/76

SECTION: 10003,49

SUMMARY: Medium-grained subophiti basalt composed of clinopyroxene, two generatior f plagioclase, ilmenite with subordinate cristobal te mesostasis. Large subhedral to anhedral crystals clinopyroxene form an interlocking network with euhedral tablets of plagioclase and subhedral ilmenite. Many of the ilmenite crystals are somewhat skeletal in their development.

PHASE	% OF SECTION	SHAPE	SIZE(MM)
Pyrox	44	Subhedral to anhedral	0.2-0.3
Plag	30	Euhedral to anhedral	0.01-0.1
Opaq	20	Subhedral to skeletal	0.02-0.15
Cris	3	Anhedral	0.1-0.5
Meso	3	Irregular	0.001-0.1

COMMENTS:

Pyroxene - The clinopyroxene forms large light brown subhedral to anhedral crystals. The crystals form an almost continuous interlocking array with the other phases present as interstitial members or as part of the array. Many of the crystals show some reaction has taken place between phases. Many of the crystals are zoned and have uneven extinctions. A well-developed cleavage pattern is present in many crystals. A few crystals show simple twinning. More than one type of pyroxene may be present in the rock.

Plagioclase - Two distinct types of plagioclase occur in the rock. The first type occurs as euhedral tablets which appear as rectangular sharp crystals in the section. Twinning is sharp and the crystal outline is well defined.

The second type of crystals formed are larger ill-defined anhedral masses which form interstitially to the crystalline phases. The twinning is poorly defined and extinctions are irregular.

Many of the first type are grouped into somewhat radiating masses within the rock. These groups are somewhat isolated in the pyroxene array and tend to form localized concentrations.

Opaques - The crystals of ilmenite in the rock form subhedral to almost euhedral crystals with some skeletal development. Many crystals have several discernable forms present in the same crystal. Many crystals have rutile and chromite exsolutions. A majority of the crystals are more or less equant. Small rounded masses of armalcolite are present in a few crystals.

Small rounded masses of troilite and troilite with iron-nickel are also present in the rock. These masses are randomly scattered throughout the rock.

Cristobalite - Small anhedral masses of cristobalite occur as interstitial masses in the crystalline network. It, together with the brown glass-rich mesostasis and the anhedral plagioclase form all the void filling phases.

TEXTURE: Medium-grained subophitic basalt consisting of an interlocking network of subhedral pyroxene, small euhedral tablets of plagioclase and subhedral ilmenite crystals. Large anhedral plagioclase crystals, anhedral cristobalite and masses of mesostasis occur interstitially to the crystalline network. Troilite masses occur both as inclusions in the pyroxene and associated with the mesostasis.

Selected References: Ross et al. (1970), Haggerty et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 10/4/76

10003 was the first rock removed from the bulk sample box in the vacuum laboratory. It was sent for gamma-ray counting almost immediately, returned to Vac Lab and chipped for PET. It was sawed and chipped in SPL for allocation.

PRISTINE SAMPLES (all VAC-RCL-VAC-SPL-SSPL)

9	9.33	gm	Chip. One sawed surface. One surface with 1/2 cm^2 glassy spatter. All others appear fresh.
12	19.55	gm	Chip. One lunar exposed surface. All others appear fresh.
25	117.00	gm	Piece. Pitted on T, N. Patina on W face. All others fresh. 5.4x3x4.4 cm.
134	1.22	gm	Chips and fines. Largest chip is 1 cm.
135	3.70	gm	3 chips. Largest two have two lunar exposed surfaces each. Smallest chip is fresh.
136	0.11	gm	Chips and fines.

RETURNED SAMPLES

38	4.544	gm	1 large (2x1.5x1.5cm) chip with four sawed faces plus two smaller chips. No pits observed.
74	5.39	gm	Chip. Three sawed faces. No pits. 1.7x1.5x1.5 cm.
119	3.234	gm	Chip. 1.3x1.2x1 cm. Two sawed faces. No pits.

CHEMICAL ANALYSES

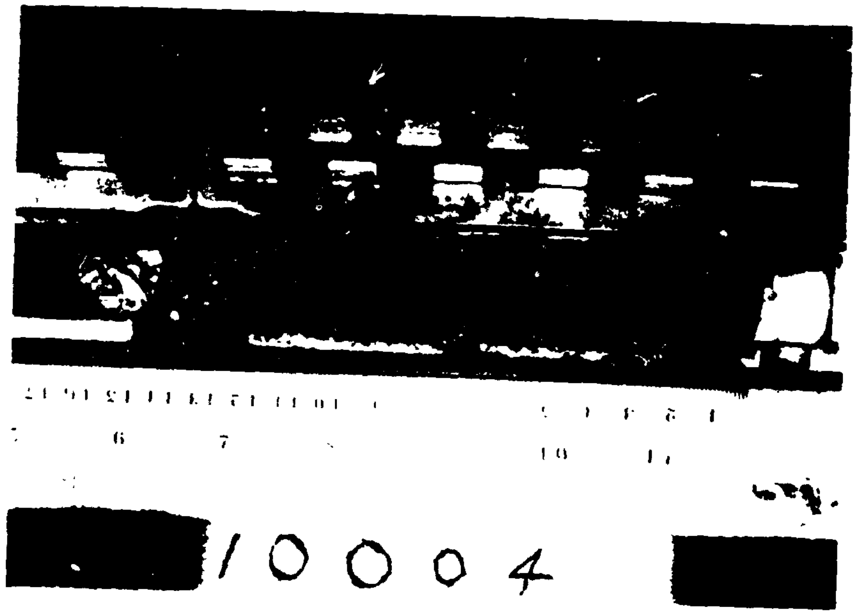
Element	Number of Analyses	Mean	Units	Range
SiO_2	3	38.62	PCT	1.96
Al_2O_3	4	10.32	PCT	1.36
TiO_2	3	11.45	PCT	1.5
FeO	3	19.76	PCT	.12
MnO	4	.29	PCT	.108
MgO	3	7.33	PCT	1.43
CaO	3	11.25	PCT	.61
Na_2O	4	.510	PCT	.486
K_2O	8	.054	PCT	.010
P_2O_5	1	.12	PCT	0
Li	1	9.0	PPM	0
Rb	3	.710	PPM	.5
Cs	1	.022	PPM	0
Be	1	1.5	PPM	0
Sr	3	153.97	PPM	9.2
Ba	3	162.0	PPM	114.
Sc	2	84.0	PPM	20.0
V	2	72.5	PPM	19.
Cr_2O_3	3	.25	PCT	.069
Co	2	14.55	PPM	.9
Ni	1	2.70	PPM	0
Cu	1	6.7	PPM	0.
Y	2	112.5	PPM	1.0
Zr	3	416.33	PPM	251.
Nb	1	21.0	PPM	0
Hf	1	11.6	PPM	0
La	4	14.32	PPM	1.5
Ce	3	41.27	PPM	8.5

CHEMICAL ANALYSES

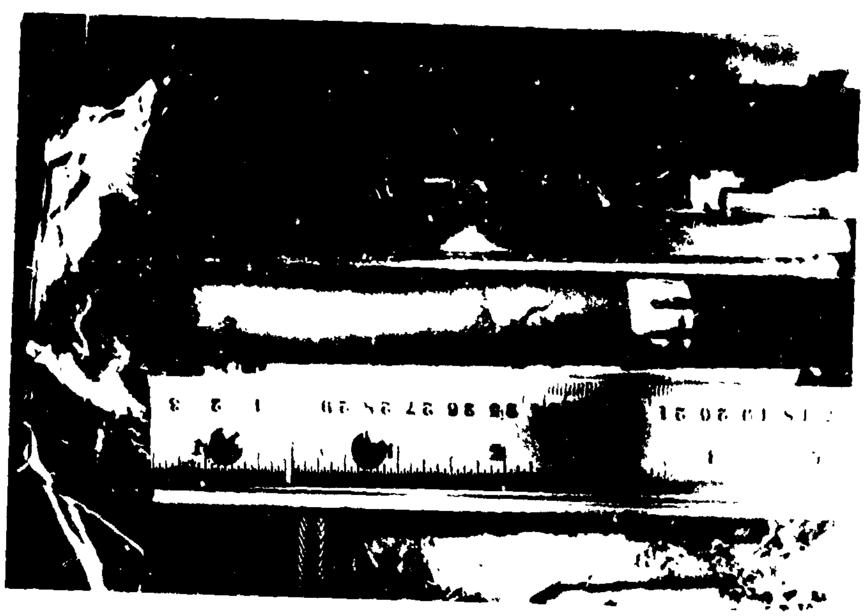
Element	Number of Analyses	Mean	Units	Range
Nd	2	40.4	PPM	4.2
Sm	3	13.37	PPM	1.0
Eu	3	1.80	PPM	.08
Gd	2	18.0	PPM	2.0
Tb	2	3.38	PPM	.24
Dy	2	22.0	PPM	.8
Ho	2	3.85	PPM	.3
Er	2	12.7	PPM	1.4
Yb	3	13.4	PPM	3.4
Lu	3	1.77	PPM	1.62
Th	5	1.01	PPM	.2
U	5	.27	PPM	.060
Ga	1	4.7	PPM	0
Pb	1	.495	PPM	0
O	1	38.1	PCT	0
S	1	.18	PCT	0

Analysts: Compston et al., (1970); Ehmann & Morgan, (1970); Rose et al., (1970); Goles et al., (1970); Annell & Helz, (1970); Gast et al., (1970); O'Kelly et al., (1970); Perkins et al., (1970); Bochsler et al., (1971); Eberhardt et al., (1971); Stettler et al., (1974); Haskin et al., (1970); Tatsumoto (1970); Wrigley & Quaide, (1970).

Age References: Eberhardt (1971b); Turner (1970); Hintenberger et al., (1971); Stettler et al., (1974); O'Kelly et al., (1970); Boschler (1971b); Perkins (1970); Tatsumoto (1970).



10004,0
Original PET Photo
(S-69-45536)



10005,0
Original PET Photo
(S-69-45048)

10004

Sample 10004 consists of soil material which came from the second drive tube. It was taken from a location 20 feet northwest of the Lunar Module (LM). It penetrated to a depth of 13.5 cm, recovering 44.8 gm of material.

10004 was opened in the Bio-Prep Lab. It was determined that the material inside the drive tube had moved substantially due to the improper placement of a Teflon follower.

Due to the biological testing during the Lunar quarantine, one-half of the drive tube material was removed for study. As a result, little observational data exists as it was neither x-rayed nor dissected. It was reported that 10004 had a slightly lighter 2-5mm thick zone about 6 cm from the top of the core, which had a sharp upper boundary and a gradational lower boundary.

During PET examination, some of the material in 10004 was sieved (Fig. 15). However, the amount of material sieved is unknown and the sieve fractions obtained have been consumed in biological experiments.

HISTORY AND PRESENT STATUS OF SAMPLES - 10/6/76

10004 was removed from the ALSRC 1004 in the Vac Lab. It was then transferred to the Bio-Prep Lab where it was opened and allocated to the Bio Pool.

0	14.954	gm	Core remainder. Vac-BP
15	0.157	gm	Fines. Vac-BP
16	0.157	gm	Fines. Vac-BP
37	2.15	gm	Core overflow. Vac-BP
38	0.44	gm	Fines. Vac-BP

Returned Samples - The largest returned sample is ,37 (2.15gm). The rest are less than 1gm in weight.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
FeO	5	15.49	PCT	1.16
MnO	5	.209	PPM	.013
Li	2	19.0	PPM	2.0
Os	2	.016	PPM	.016
Hg	1	3.0	PPB	0
U	3	5.47	PPM	10.8
Te	1	.1	PPM	0
F	2	372.5	PPM	295.0
Cl	2	27.5	PPM	21.0
Br	1	.048	PPM	0

Analysts: Finkel et al., (1971); Reed & Jovanovic, (1971); Reed et al., (1971).

No Age References

10005

Sample 10005 consists of regolith material which came from the first drive tube. The sample was taken approximately 10 feet from the second drive tube, 10004. (Both were approximately 20 feet northwest of the Lunar Module.) It penetrated to a depth of 10cm, recovering 53.4 gm of material.

Like 10004, it was opened in the Bio-Prep Lab where one-half of the sample was removed for biological testing. It was not x-rayed or dissected. There was no evidence, however, of stratigraphic disturbance caused by movement of the material inside the drive tube. It showed weak coherence and was fractured in places.

During PET examination, some of the material in 10005 was sieved (fig. 15). However, the amount of material sieved is unknown and the sieve fractions obtained have been consumed in Biological experiments.

HISTORY AND PRESENT STATUS OF SAMPLES - 10/13/76

10005 was removed from ALSRC #1004 in the Vac Lab. It was then transferred to the Bio-Prep Lab where it was opened and allocated to the Bio-Pool.

PRISTINE SAMPLES

0	5.798	gm	Core remainder VAC-BP-SSPL
6	0.18	gm	Fines VAC-BP-SSPL
54	0.80	gm	Fines VAC-BP-SSPL

The largest returned sample is ,33 (12.378 gm). The rest are less than 1gm in weight.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Al_2O_3	1	13.98	PCT	0
TiO_2	1	8.01	PCT	0
FeO	5	15.98	PCT	1.8
MnO	4	.213	PCT	.006
CaO	1	12.31	PCT	0
Na_2O	1	.441	PCT	0
Ba	1	140.	PPM	0
Sc	1	62.	PPM	0
V	1	66.	PPM	0
Cr_2O_3	1	.297	PCT	0
Co	1	32.0	PPM	0
Zr	1	340.	PPM	0
Hf	1	8.	PPM	0
La	1	15.5	PPM	0
Sm	1	11.9	PPM	0
Eu	1	2.1	PPM	0
Yb	1	11.1	PPM	0
Lu	1	1.6	PPM	0
Th	1	.8	PPM	0

Analysts: Wakita et al., (1970); Finkel et al., (1971).

No Age References

10008

10008 was the generic number given to the Bio-Pool fines from the Documented Sample ALSRC. It was separated from the rocks in the Vac Lab and transferred to PCTL for splitting and allocation.

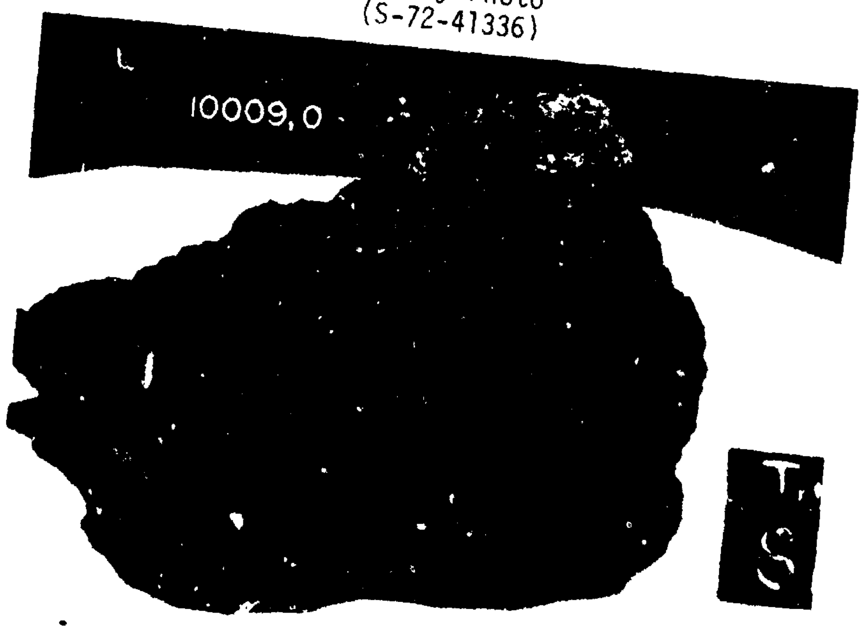
PRISTINE SAMPLES

5	5.10 gm	Fines.	VAC - PCTL - SSPL
9	0.015 gm	Fines.	VAC - PCTL - SSPL

NO RETURNED SAMPLES

NO CHEMICAL ANALYSES OR AGE DATES

10009,0
Display Photo
(S-72-41336)



10009,0
(S-75-31108)

10009

Sample 10009 is a microbreccia which originally weighed 112gm, and measured 5 x 5 x 4 cm. Sample is medium dark grey in color and hemi-pyramidal in shape. Sample was returned in ALSRC 1004 (Documented Sample Container). No PET description was generated for this sample.

BINOCULAR DESCRIPTION BY: Twedell DATE: 9-4-75

ROCK TYPE: Microbreccia SAMPLE: 10009,0 WEIGHT: 95gm

COLOR: Medium dark grey DIMENSIONS: 5 x 5 x 4 cm.

SHAPE: Hemi-pyramidal, irregular

COHERENCE: Intergranular - friable
Fracturing - absent

FABRIC/TEXTURE: Anisotropic/Microbreccia

VARIABILITY: Homogeneous

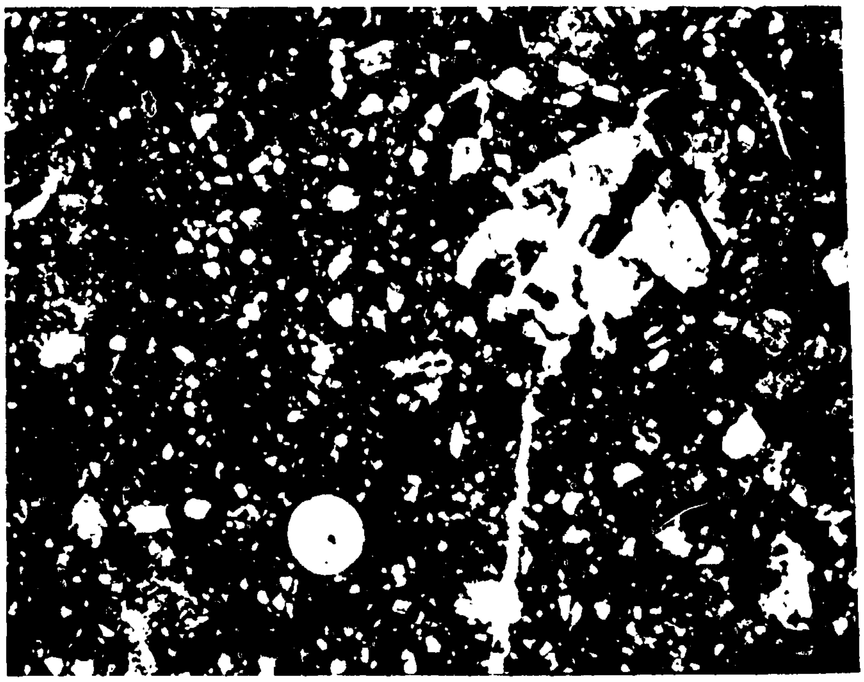
SURFACE: Hackly, has appearance of a shatter cone.

ZAP PITS: Glassy splitting on surface, but no apparent pits.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Matrix	Med.Dk.Grey	98%	Irregular	----	----
White Clast	White	1%	Rounded	.15mm	.1-2mm
Salt & Pepper	Blk. & Wh.	1%	Rounded	.5mm	.1-1mm

SPECIAL FEATURES: The hackly surface seems to project from a point. Sample is probably a shatter cone.



SECTION: 10009,7 Width of Field: 2.72mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/22/76

SUMMARY: Highly devitrified typical breccia with a high glass-clast content. Some anorthrositic clasts are present and contain small anhedral pyroxene crystals. Lithic clasts are relatively rare.

Matrix 41% of Rock

Phase	% Section	Shape	Size (mm)	Comments
Dark brown	100%	--	< 0.001	Abundant cryptocrystalline phases, discontinuous

Mineral Clasts 21% Rock

Phase	Relative Abundance	Shape	Size (mm)
Clinopyroxene[1]	Very abundant	Angular	0.001-0.3
Plagioclase[2]	few	Blocky	0.001-0.05
Opaques[3]	few	Blocky to Skeletal	0.001-0.08

ORIGINAL PAGE IS OF POOR QUALITY

1) Poor optical properties; approximately 85% of clasts
2) Few scattered; poorly formed approximately 5% of clasts
3) Most in clasts; few isolated blocky, 10% of clasts

Lithic Clasts 17% of Rock

Type	Relative Abundance	Shape	Size (mm)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large$_4$	Two present	Irregular	>1.0

4) a. Coarse-grained basalt with large pyroxene crystals, tabular plagioclase with minor ilmenite.

b. Polygranular plagioclase with small olivine/pyroxene crystals; typical anorthositic fragment.

Glass Clasts 21% of Rock

Type	Relative Abundance	Shape	Size (mm)
Yellow-orange$_5$	Very abundant	Spherical to irregular	0.001-0.4
Colorless$_6$	few	Angular	0.001-0.1
Brown orange$_7$	few	Irregular	0.1 -0.4

5) Mostly spherical; partly devitrified
6) Some devitrification
7) Some crystal fragments included

HISTORY AND PRESENT STATUS OF SAMPLES - 10/7/76

10009 was not split during early processing in the Vac Lab or SPL. It was first subdivided in SSPL on 9-5-75 during re-examination.

PRISTINE SAMPLES:

0	90.77 gm	Rock. See binocular description.
1	12.19 gm	Three chips. No pits were observed on any, but could have easily been eroded away. The largest chip has one vuggy glass surface.
2	7.39 gm	Chips and fines. No pits observed on any chips.

NO RETURNED SAMPLES.

NO CHEMICAL ANALYSES OR AGE DATES.

C-8

10010

10010 was the generic number assigned to the Contingency Sample. The twelve rocks, >1 cm or so, in the contingency samples were assigned new generic numbers (10021 through 10032, Table 2). About 106 gm of the 491 gm of fines remaining were sieved. In late 1969 about 393 gm of 10010 was renumbered 10084 (the sample number for <1 mm fines from the bulk sample, 10002). In 1977 these samples were changed back to 10010 in the subsample range 66 through 125, see below.

<u>PRISTINE SAMPLES:</u> (All PCTL - SSPL)

7	0.60	gm	Fines.
10	30.26	gm	Fines.
19	0.11	gm	1 small anorthosite breccia chip. Some small dark clasts (may be pyroxene).
22	0.146	gm	2 small basalt chips. Largest chip is aphantic in texture, the small chip has a coarser grain.
27	0.83	gm	Fines.
39	42.41	gm	Fines. >60 <35 mesh.
40	34.98	gm	Fines.>100 <60 mesh.
41	3.63	gm	Fines.>200<100 mesh.
45	0.04	gm	Fines.
50	0.43	gm	Fines.
55	0.49	gm	Fines.
56	1.30	gm	Fines.
66	36.35	gm	Fines.
67	55.66	gm	Fines.
68	40.05	gm	Fines.
69	64.23	gm	Fines.
70	45.27	gm	Fines.
71	0.65	gm	Fines.
72	37.38	gm	Fines.
73	0.82	gm	Fines.

76	1.50	gm	Fines.
80	0.50	gm	Fines
81	0.50	gm	Fines.
82	0.54	gm	Fines.
83	0.54	gm	Fines.
84	0.53	gm	Fines
85	0.52	gm	Fines.
86	0.55	gm	Fines.
87	0.56	gm	Fines.
88	0.52	gm	Fines.
89	0.51	gm	Fines.
90	0.49	gm	Fines.
91	0.51	gm	Fines.
92	0.57	gm	Fines.
93	1.03	gm	Fines.
94	1.02	gm	Fines.
95	1.02	gm	Fines.
96	1.01	gm	Fines.
97	0.98	gm	Fines
98	1.00	gm	Fines.
99	1.00	gm	Fines.
100	1.06	gm	Fines.
101	1.02	gm	Fines.
102	1.02	gm	Fines.
103	1.02	gm	Fines.
104	1.00	gm	Fines.
105	0.50	gm	Fines.
106	0.50	gm	Fines.
107	1.99	gm	Fines.
108	2.01	gm	Fines.
109	2.01	gm	Fines.
110	1.99	gm	Fines.

111	1.99	gm	Fines.	PCTL-BP-SSPL
112	2.01	gm	Fines.	PCTL-BP-SSPL
113	2.00	gm	Fines.	PCTL-BP-SSPL
115	2.01	gm	Fines.	PCTL-BP-SSPL
116	1.99	gm	Fines.	PCTL-BP-SSPL
117	1.99	gm	Fines.	PCTL-BP-SSPL
118	2.01	gm	Fines.	PCTL-BP-SSPL
119	2.00	gm	Fines.	PCTL-BP-SSPL
120	2.00	gm	Fines.	PCTL-BP-SSPL
121	2.00	gm	Fines.	PCTL-BP-SSPL
122	2.00	gm	Fines.	PCTL-BP-SSPL
123	2.00	gm	Fines.	PCTL-BP-SSPL
124	2.04	gm	Fines.	PCTL-BP-SSPL
125	1.96	gm	Fines.	PCTL-BP-SSPL

RETURNED SAMPLES:

74	16.699	gm	Fines.

NO CHEMICAL ANALYSES OR AGE DATES.

10011

10011 was the generic assigned to a part of the fines recovered from the Documented Sample. They were generated as a result of the crumbling and spalling of the Documented Sample rocks in the Vac Lab.

HISTORY AND PRESENT STATUS OF SAMPLES 7/1/76

10011 was returned in ALSRC #1004 (Documented Sample Container) and processed in the Vac Lab. It was re-examined in SSPL. There is no evidence of processing in other laboratories.

PRISTINE SAMPLES (All VAC-SSPL)

6	0.57	gm	Breccia chips and fines.
7	0.27	gm	Breccia chips and fines.
11	0.59	gm	Fines.
14	0.72	gm	Fines.
15	0.43	gm	Fines.
17	3.99	gm	Fines.
28	25.14	gm	Fines.
32	20.20	gm	Small breccia chips and fines.

NO RETURNED SAMPLES (>5 gm)

NO CHEMICAL ANALYSES OR AGE DATES

10015

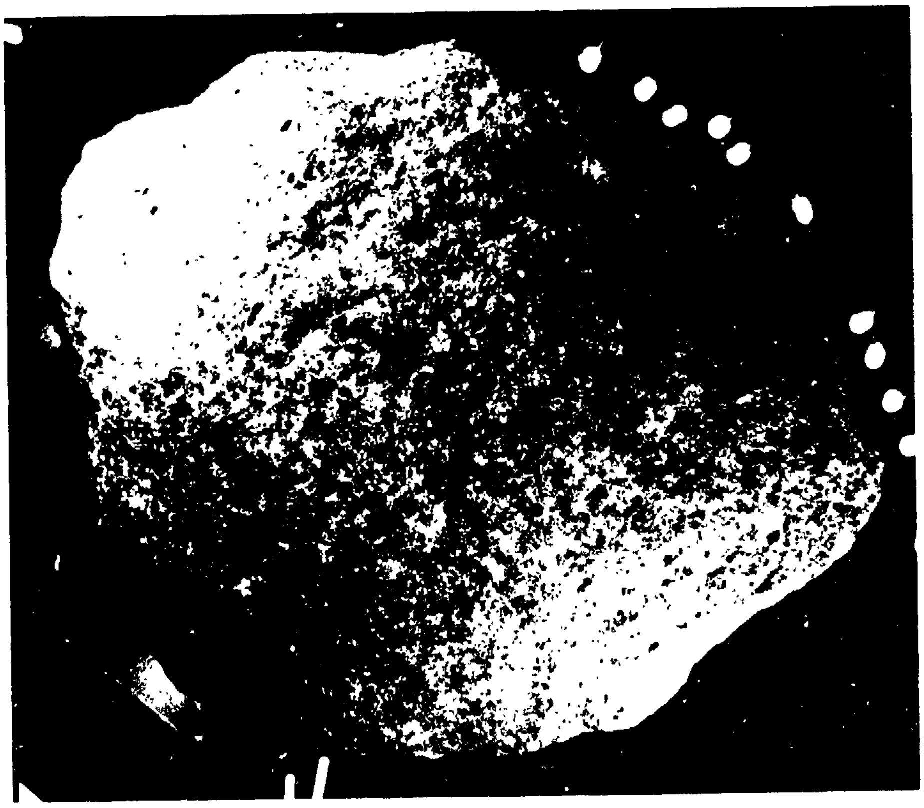
10015 was the generic number assigned to the lunar material recovered from the Gas Reaction Cell when the sample first entered the vacuum system of the LRL.

PRISTINE SAMPLES:

17	0.02 gm	Fines.
21	0.01 gm	Fines.
28	0.10 gm	Fines.
29	0.01 gm	Fines.

NO RETURNED SAMPLES

NO CHEMICAL ANALYSES OR AGE DATES



10017,0

Original PET Photo
(S-69-45783)

2 cm

10017
(S-75-20212)
* SAO - Sample Arbitrary Orientation

10017

Sample 10017 is a vesicular basalt which originally weighed 973 gm, and measured 16x11x6 cm. The sample is described as being black and white on fresh surfaces to steel grey on sawed. Sample was returned in ALSRC #1004 (Documented Sample Container).

BINOCULAR DESCRIPTIONS BY: Kramer DATE: 8/1/75

ROCK TYPE: Vesicular basalt SAMPLE: 10017,15 WEIGHT: 197.4 gm

COLOR: Finely Salt and Pepper (fresh) DIMENSIONS: 8x6x4.5 cm.
Steel Grey (sawed)

SHAPE: Sub-rounded

COHERENCE: Intergranular - coherent
Fracturing - Two large penetrative fractures parallel to E_1-W_1. Slight non-penetrative fracturing parallel to T_1-B_1.

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: There is some difference in relative abundances of the various mineral components from place to place within the sample.

SURFACE: Irregular (both fresh and exposed)

ZAP PITS: Few on E_1, S_1; 1-3mm diameter (PET)

CAVITIES: 15-20% of fresh surface covered by small (<2mm) vugs. The vugs are glass-lined and approximately 1/3 are irregular in shape.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Pyroxene[1]	Light Honey Yellow	40	Equant	.2	.01-.3
Plagioclase	Milky White	40	Lathlike	.6	.2-.8
Ilmenite	Black	15	Equant	.2	.1-.4
Mesostasis[2]	Black	5	---------	----------	

1) Difficult to distinguish from plagioclase on color.
2) Difficult to distinguish from fine-grained ilmenite.

SECTION 10017,82 Width of field 2.22 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/19/75

SECTION: 10017,82

SUMMARY:

Fine-grained, poikilitic, vesicular basalt composed of clinopyroxene, plagioclase, two generations of ilmenite and subordinate opaques and mesostasis. The pyroxene and ilmenite crystals are much finer than the crystals of the plagioclase. The majority of all the crystals are anhedral. Some preferred orientation in the plagioclase crystals is present.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	44	Subhedral to anhedral	0.04-0.12
Plag	24	Tabular to anhedral	0.2-2.0
Opaq	24	Subhedral to anhedral	0.03-0.1
Meso	8	Irregular	-------

COMMENTS:

Pyroxene - Pale brown to nearly clear anhedral crystals of clinopyroxene surround the large plagioclase crystals. Some smaller euhedral crystals are found within a few of the crystals of plagioclase. Some zoning is present, but it is not pronounced. Some small subhedral crystals exhibit clear cleavage traces, simple twinning, and appear to have formed at a different stage of crystallization from the majority of the clinopyroxene.

Plagioclase - Small tabular crystals of plagioclase form distinct groupings, while the majority of the plagioclase, in the section, forms anhedral crystals in the interstercies formed by the pyroxene-ilmenite network. Twinning in the crystals is common and pronounced.

Opaques - Two generations of ilmenite occur in the section. The first forms small lath-like to skeletal lath-like crystals. The second type forms large, blocky, anhedral crystals which have a sieve texture and many re-entrants which are filled by the two silicate minerals.

Isolated masses of troilite and troilite with iron-nickel are found throughout the section. Some are associated near ilmenite crystals while others are isolated along the boundaries between the silicate phases. Occasional iron-nickel vein fillings are observed in the fractures within the silicates.

Mesostasis - Isolated irregular masses of a glass-rich phase occupy boundary voids between adjacent silicate phases. The size of the masses are from 0.05 to 0.1mm. The masses are very turbid and distinct crystals were not observed.

B.M. French et al., (1970) have described 10017,16 in some detail. Their modal analysis was: Clinopyroxene, 49.7%; plagioclase, 18.0%; ilmenite, 23.9%; and, mesostasis, 8.3%; which is in good agreement with the above analysis.

TEXTURE: The rock consists of a random network of intergrown clinopyroxene and ilmenite crystals. Plagioclase and glassy mesostasis occur interstitial to the pyroxene-ilmenite network. The overall texture is poikilitic. The plagioclase crystals display a moderate alignment suggesting flow within the crystallizing lava. Vesicles are rimmed by small clinopyroxene crystals. Sharp boundaries occur between all phases except the mesostasis.

SELECTED REFERENCES: Adler et al. (1970), Brown et al. (1970), Dence et al. (1970), French et al. (1970), Kushiro and Nakamura (1970), Mason and Wilson (1970), Reid et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES 10-12-76

10017 was removed from ALSRC #1004 and processed in the Vac Lab. It was one of the samples in F-201 at the time of the glove rupture. A 400 gm piece was sent to PCTL for analyses. A portion of this rock (subsample number unknown) was sawed in SPL. All remaining pristine subsamples were re-examined in SSPL.

PRISTINE SAMPLES:

15	197.46	gms	Largest piece. Three surfaces are lunar exposed with pits and patina. All other surfaces are fresh. VAC-SSPL
74	105.93	gms	14 sawed chips. Many have 3-5 sawed surfaces. 11 of them have one lunar exposed surface. VAC-PCTL-SPL-SSPL
81	91.0	gms	1 piece pitted on N_1T face. All others fresh and dust free. Ex-display sample. VAC-SSPL
85	12.54	gms	Chips and fines. Several medium (c.25gm) chips, many with patina and pits.VAC-SSPL
88	1.41	gms	Chips and fines. Largest chips are 3-5mm, some with lunar exposed surfaces. VAC-SSPL
96	6.84	gms	Small chips and fines representative of sample. VAC-SSPL
280	13.07	gms	Chip. Split from subsample 15. One lunar exposed surface. All others are fresh. VAC-SSPL
281	6.66	gms	Chips and fines. Split from subsample 15. Two large (>1 gram) chips with lunar exposed surface. VAC-SSPL
282	0.12	gms	Small fresh chips and fines. Subsamples 89 and 90 were combined to make up this subsample. VAC-SSPL
283	1.59	gms	Small chips and fines. Split from subsample 74. No exposed surfaces. VAC-PCTL-SPL-SSPL

RETURNED SAMPLES:

50	5.05	gms	Chip. One sawed, two pitted and three fresh surfaces.
64	11.09	gms	Chip. Six sawed surfaces. 3x1x1 cm.
76	7.00	gms	Chips and fines. Largest chip is 2x2x0.5 cm with two sawed, two pitted and two fresh surfaces.
159	8.23	gms	Chip. One fresh surface, all others are patinated. Pits are few.
180	13.23	gms	Chip. 1.5x1.5x2cm. Six sawed surfaces. Impregnated with epoxy.

CHEMICAL ANALYSES

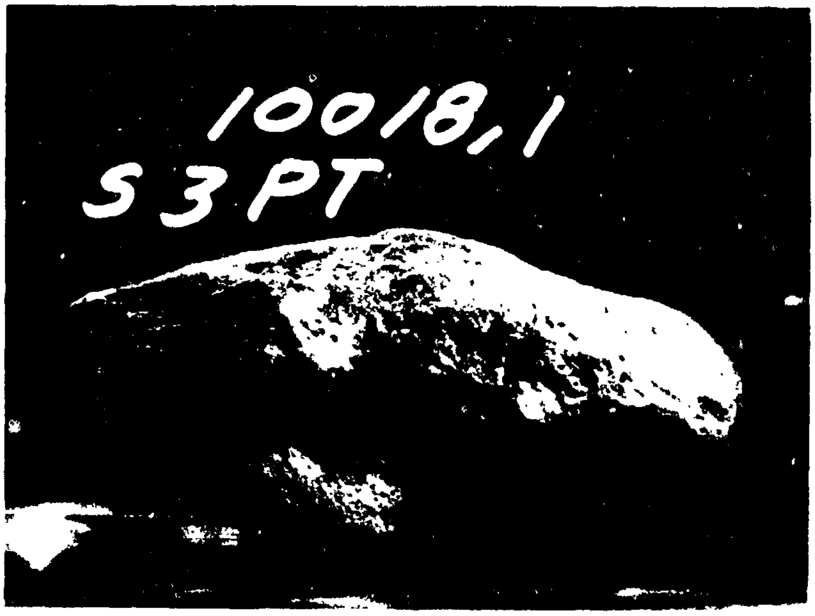
Element	Number of Analyses	Mean	Units	Range
SiO_2	6	41.34	PCT	3.33
Al_2O_3	7	7.85	PCT	.907
TiO_2	7	11.68	PCT	2.5
FeO	7	19.55	PCT	5.21
MnO	7	.235	PCT	.089
MgO	5	7.76	PCT	.448
CaO	6	10.74	PCT	1.19
Na_2O	9	.490	PCT	.050
K_2O	13	.290	PCT	.089
P_2O_5	3	.167	PCT	.02
H	1	.47	PPM	0
Li	6	19.35	PPM	6.7
Rb	12	5.66	PPM	2.4
Cs	5	.154	PPM	.066
Sr	9	157.72	PPM	74.8
Ba	10	261.39	PPM	150.0
Sc	5	80.26	PPM	25.5
V	4	66.62	PPM	54.0

Element	Number of Analyses	Mean	Units	Range
Cr_2O_3	5	.354	PCT	.073
Co	7	30.7	PPM	20.5
Ni	2	36.26	PPM	47.54
Cu	3	10.10	PPM	4.8
Zn	2	33.	PPM	30.0
Y	4	168.75	PPM	25.0
Zr	4	695.0	PPM	965.
Nb	1	27.4	PPM	0
Pd	1	.001	PPM	0
Ag	1	.016	PPM	0
Cd	2	.056	PPM	.024
Ta	3	2.8	PPM	3.8
W	1	.4	PPM	0
Hf	4	17.72	PPM	12.5
Os	1	.22	PPM	0
Ir	1	.001	PPM	0
Au	2	.004	PPM	.007
Hg	1	.013	PPM	0
La	4	24.95	PPM	5.6
Ce	5	75.98	PPM	20.0
Pr	2	10.10	PPM	5.6
Nd	4	64.40	PPM	16.
Sm	6	22.11	PPM	6.1
Eu	6	2.24	PPM	.86
Gd	4	19.45	PPM	11.0
Tb	4	4.49	PPM	1.62
Dy	5	29.34	PPM	17.
Ho	3	6.17	PPM	4.5
Er	4	18.27	PPM	8.
Tm	1	3.0	PPM	0

Element	Number of Analyses	Mean	Units	Range
Yb	6	17.85	PPM	6.5
Lu	6	2.98	PPM	2.88
Th	9	3.70	PPM	2.45
U	9	.698	PPM	.65
B	1	.7	PPM	0
Ga	3	4.43	PPM	1.10
In	3	.070	PPM	.137
Tl	1	.006	PPM	0
C	1	100.	PPM	0
Ge	1	1.0	PPM	0
Pb	2	1.62	PPM	.113
Bi	1	.001	PPM	0
O	1	40.7	PCT	0
S	3	.22	PCT	.02
Se	1	.215	PPM	0
Te	1	.117	PPM	0
F	2	164.5	PPM	173.
Cl	3	13.43	PPM	2.8
Br	3	.155	PPM	.12
I	2	.242	PPM	.475

Analysts: Compston et al., (1970); Goles et al., (1970); Maxwell et al., (1970); Wakita et al., (1970); Wanke et al., (1970); Willis et al., (1972); Gast et al., (1970); Gibson & Johnson (1971); Marti et al., (1970); Murthy et al., (1970); O'Kelly et al., (1970); Perkins et al., (1970); Philpotts & Schnetzler, (1970); Tera et al., (1970); Reed & Jovanovic, (1970); Reed & Jovanovic, (1971); Anders et al., (1971); Papanastassiou et al., (1970); Eberhardt et al., (1974); Shedlovsky et al., (1970); Goles, (1971); Silver, (1970); Tatsumoto, (1970).

Age References: D'Amico et al., (1970); Turner, (1970); Hintenberger et al., (1971); Armstrong & Alsmiller, (1971); O'Kelly et al., (1970); Boschler (1971a); Marti et al., (1970); Perkins (1970); Eberhardt et al.,(1974); Silver (1970); Tatsumoto (1970); Papanastassiou (1970); Papanastassiou et al., (1971); Crozaz et al., (1970).



10018,1
Original PET Photo
(S-69-46005)

10018,0
(S-75-30226)

10018

Sample 10018 is a rounded, dark grey, fine breccia that originally weighed 213 gm., and measured 8x5x4 cm. Sample was returned in ALSRC #1004.

BINOCULAR DESCRIPTION BY: Twedell DATE: 8/6/75

ROCK TYPE: Fine Breccia SAMPLE: 10018,0 WEIGHT: 215 gm

COLOR: Dark Grey (fresh & exposed) DIMENSIONS: 8x6x4 cm.

SHAPE: Rounded

COHERENCE: Intergranular - tough
Fracturing - few, non-penetrative

FABRIC/TEXTURE: Anisotropic/Fine Breccia

VARIABILITY: Homogeneous

SURFACE: Slightly irregular; patch of vesicular glass near narrow end (PET).

ZAP PITS: Few pits on T_1 surface only. Pits are glass lined up to 4 mm in size.

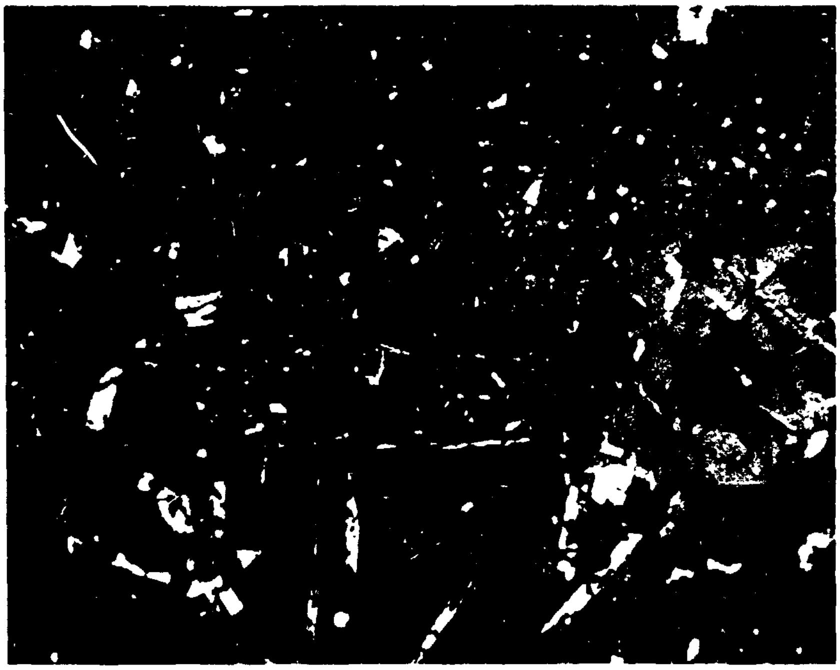
CAVITIES: None

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Matrix	Dk.Grey	97-98	-----------	<.1	-
Salt & Pepper $Clast_1$	Black & White	<1	Subrounded	1-1.5	<1-2
White $Clast_2$	White	<1	Subangular to subrounded	1	1-2.5
Basaltic $Clast_3$	White & Hon.Brown	1-2	Angular to subangular	1-5	1-10

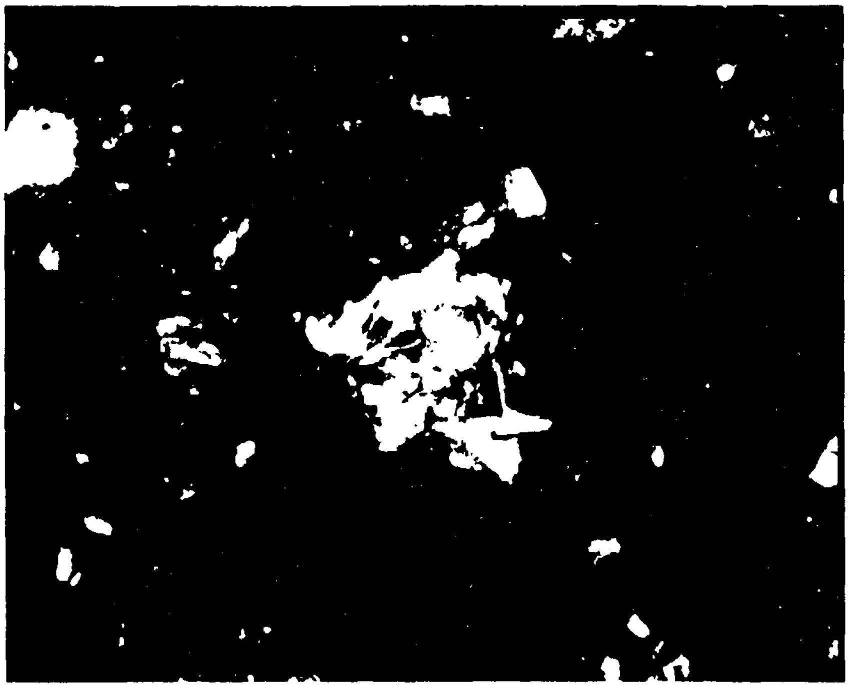
1) Salt & pepper clast is aphanitic in texture. It has an even distribution of light and dark material.

2) White clast has a powdered sugar texture. Clasts are evenly distributed throughout the rock. It appears to be approximately 90% plagioclase.

3) Basaltic clast consists of 35% plagioclase, 30% ilmenite and 35% pyroxene.



Section 10018,32 Width of field 1.39 mm reflected light



Section 10018,32 Width of field 1.39 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/22/76

SECTION: 10018,32

SUMMARY: Slightly devitrified typical breccia with only moderate amounts of clasts present. Many of the lithic clasts are crushed and granulated. The rock appears to be a high glass breccia with minor crystalline inclusions.

Matrix 78% of Rock

Phase	% Section	Shape	Size (mm)	Comments:
Dark brown nearly opaque	100%	-----	<0.001	Very high turbid glass content; some cryptocrystalline phases.

Mineral Clasts 7% of Rock

Phase	Relative Abundance	Shape	Size (mm)
Clinopyroxene$_1$	Very abundant	Angular	0.001-0.4
Plagioclase$_2$	Few	Blocky	0.001-0.2
Opaques$_3$	Moderate	Lath-like to skeletal	0.001-0.2

1) Highly granulated to single crystals
2) Normal, sharp twins
3) Isolated, most large crystals in clasts

Lithic Clasts 13% of Rock

Type	Relative Abundance	Shape	Size (mm)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large$_4$	Six present	Rounded to irregular	>1.0

4) a. Coarse grained basalt composed of clinopyroxene, plagioclase, and ilmenite.

b. Coarse grained basalt with brown pyroxene crystals, somewhat granulated.

c. Coarse grained basalt with part of the clast showing melting and subsequent devitrification.

d. Coarse grained basalt composed of clinopyroxene, plagioclase and ilmenite.

e. Coarse grained basalt composed of clinopyroxene, plagioclase, and ilmenite.

f. Coarse grained basalt similar to (b).

Glass Clast 2% of Rock

Type	Relative Abundance	Shape	Size (mm)
Yellow-Orange 5	Very abundant	Spherical to irregular	0.001-0.2
Colorless 6	Moderate	Spherical to angular	0.001-0.3
Red-Orange 7	Few	Spherical	0.05

5) Some devitrification; mostly angular.
6) Bubbles and some devitrification; mostly angular.
7) One piece.

Selected References: Chao et al. (1970), Dence et al. (1970), Reid et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES 10/12/76

10018 was removed from ALSRC #1004 and originally processed in the Vac Lab. It was in the F-201 system at the time of the glove rupture. A small chip was transferred to PCTL for PET analyses. At some time, a small portion of the sample was sawed in SPL. Most of the original sample is intact and was re-examined in SSPL.

PRISTINE SAMPLES:

0	199.40	gm	Rock. It has pits and patina on one large face. All other faces are non-exposed. VAC-SSPL
2	1.87	gm	Chips. It consists of one large chip (1.5gm) with no sawed or exposed surfaces, some < 5mm chips and some fines. VAC-PCTL-SSPL
16	3.17	gm	<1mm fines. VAC-SPL-SSPL
17	3.70	gm	Three large sawed chips and two unsawed chips. None of the pieces show evidence of pitting or patination. Sample was probably removed

from lunar bottom of the mother rock. VAC-SPL-SSPL

RETURNED SAMPLES:

24	25.25 gm	Fresh chip. One small (1.5mm) pyroxene clast not previously noted.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	4	42.46	PCT	1.29
Al_2O_3	4	12.48	PCT	2.07
TiO_2	4	8.25	PCT	1.50
FeO	4	16.4	PCT	3.21
MnO	5	.194	PCT	.084
MgO	3	8.18	PCT	.665
CaO	3	11.97	PCT	.70
Na_2O	4	.492	PCT	.068
K_2O	4	.170	PCT	.020
P_2O_5	1	.15	PCT	0
Li	2	12.65	PPM	1.3
Rb	3	3.68	PPM	.19
Be	1	1.8	PPM	0
Sr	4	158.78	PPM	85.0
Ba	4	218.75	PPM	105.0
Sc	4	63.52	PPM	10.2
V	3	59.33	PPM	16.0
Cr_2O_3	5	.291	PCT	.067
Co	5	32.88	PPM	4.10
Ni	3	255.67	PPM	173.0
Cu	2	22.0	PPM	20.00

Element	Number of Analyses	Mean	Units	Range
Zn	2	38.5	PPM	31.0
Y	2	101.5	PPM	9.0
Zr	4	356.75	PPM	101.0
Nb	2	22.	PPM	6.0
Ta	3	1.53	PPM	.3
Hf	3	12.43	PPM	2.4
Au	1	5.00	PPB	0
La	5	18.16	PPM	9.0
Ce	5	61.56	PPM	19.2
Nd	3	44.8	PPM	31.0
Sm	4	14.4	PPM	3.1
Eu	4	1.80	PPM	.19
Pr	1	11.0	PPM	0
Gd	1	20.5	PPM	0
Tb	3	3.44	PPM	1.48
Dy	2	20.4	PPM	2.8
Ho	2	5.05	PPM	.5
Er	1	12.8	PPM	0
Yb	4	12.38	PPM	4.1
Lu	4	1.74	PPM	.74
Th	3	2.81	PPM	1.42
U	4	.585	PPM	.08
Ga	2	4.2	PPM	.4
In	1	.36	PPM	0
O	2	40.4	PCT	.6
S	1	.15	PCT	0
F	1	101.0	PPM	0
Cl	1	16.5	PPM	0

Analysts: Compston et al., (1970); Ehmann & Morgan, (1970); Goles et al., (1970); Wanke et al., (1970); O'Hara et al., (1974); Annell & Helz, (1970); Philpotts & Schnetzler, (1970); O'Kelly et al., (1970); Wanke et al., (1972).

No Age References

10019,1
Original PET Photo
(S-69-45977)

1cm

10019,1
(S-76-23357)

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OF POOR QUALITY

10019

Sample 10019 is a rounded, medium dark grey, fine breccia. It originally weighed 297gm, and was 7x4x4cm. This sample was returned in ALSRC #1004. (Documented Sample Container)

BINOCULAR DESCRIPTION BY: Twedell DATE: 9/8/75

ROCK TYPE: Fine breccia SAMPLE: 10019,31 WEIGHT: 29 gm

COLOR: Medium dark grey DIMENSIONS: 3 x 2.5 x 2.5 cm

SHAPE: Rounded; subangular to subrounded (PET)

COHERENCE: Intergranular - tough (coherent)
Fracturing - few, non-penetrative

FABRIC/TEXTURE: Anisotropic/Fine breccia

VARIABILITY: Homogeneous

SURFACE: Smooth and rounded on pitted surfaces, irregular on fresh surfaces B_1 and W_1. E_1 has been wire-sawed.

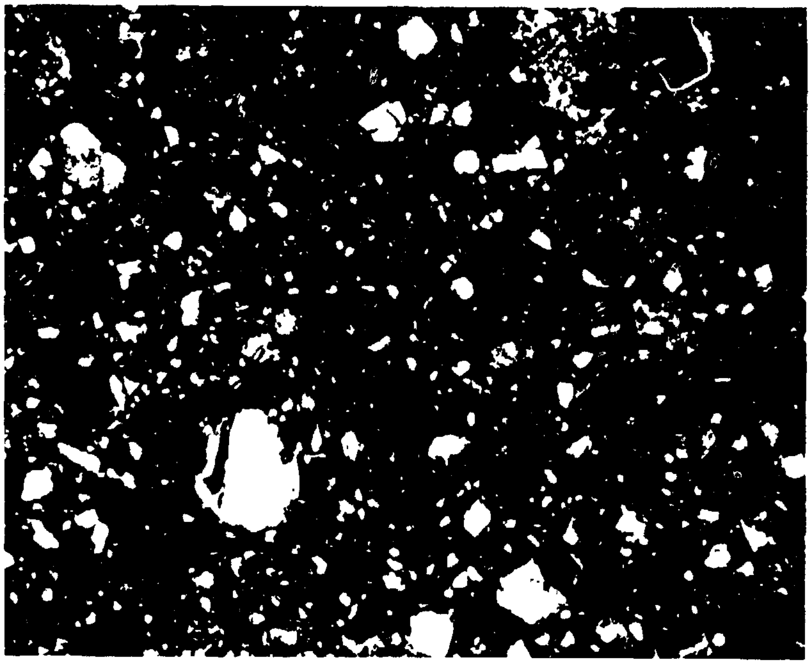
ZAP PITS: Many on S_1. Few on T_1, E_1, N_1. None on B_1, W_1. Pits are glass lined.

CAVITIES: None

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Basalt Clast[1]	Honey Brn & White	2	Rounded - subrounded	1.5	1-3
Salt & Pepper Clast	Blk & White	1-2	Rounded to subrounded	2	1-5
White Clast	White	1	Irregular - subrounded	1	1-1.5
Matrix	Med.Dk.Grey	96	------------------	---	-----
Brown Clast[2]	Hon.Brown	1	Subangular	.5	1

1) Opaque material could be ilmenite
2) There are only a few of these clasts on the S_1 surface (See below)

SPECIAL FEATURES: This sample resembles 10066 in all components. Surface is sparsely covered with glassy spatter. Some glass on the surface is honey brown in color, with some small brown clasts (1mm) which have a crushed glass appearance.



SECTION: 10019,33 Width of field 2.72 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/22/76

SUMMARY: Partly devitrified typical breccia with a fairly low lithic clast content. The lithic clasts present are relatively small as compared to many of the other Apollo 11 breccias. The rock shows a number of strain characteristics.

MATRIX 55% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Dark Brown	100	-----	<0.001	Glass-rich with many cryptocrystalline phases; some suggestion of minor flow

MINERAL CLASTS 30% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE(MM)
Clinopyroxene[1]	Very abundant	Equant to irregular	0.001-0.5
Plagioclase[2]	Abundant	Tabular to irregular	0.001-0.2
Opaques[3]	Few	Blocky to skeletal	0.001-0.2

1) Most highly strained
2) Most show fair to good twin planes
3) Most in clast, some shards in matrix

LITHIC CLASTS 10% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE(MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Two present	Rounded to irregular	>1.0

4) a. Coarse-grained basalt consisting of large pyroxene crystals with high skeletal ilmenite crystals and subhedral plagi lase.

b. Coarse-grained basalt consisting of very narrow plagioclase tablets with large pyroxene crystals and minor ilmenite.

GLASS CLASTS 5% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE(MM)
Yellow-Orange[5]	Very abundant	Spherical to irregular	0.001-0.5
Colorless[6]	Few	Spherical to irregular	0.001-0.2

5) Approximately half spherical masses-half angular; many dendritic crystals.
6) Mostly angular

Selected References: Keil et al. (1970)

HISTORY AND PRESENT STATUS OF SAMPLES - 6/22/76

10019 was removed from ALSRC #1004 and originally processed in the Vac Lab. It was one of the rocks in F-201 at the time of the glove rupture. Approximately 55gm were sent to PCTL for PET analyses. The larger piece was, at one time, chipped and sawed in SPL. The remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES: (All VAC-SPL-SSPL)

1	167.042 gm	Piece. Five surfaces are pitted, one is fresh. Ex-display piece.

30	33.323	gm	Piece. One surface is pitted, the others are fresh. Ex-display piece.
31	29.55	gm	Piece. Four surfaces are pitted, two are fresh.
77	11.12	gm	Consisting of three large chips. One chip has patches of glassy spatter.
80	0.85	gm	Chips and fines.

RETURNED SAMPLES: None

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	16	42.67	PCT	9.98
Al_2O_3	14	10.71	PCT	5.63
TiO_2	12	8.10	PCT	2.54
FeO	12	16.32	PCT	6.86
MnO	13	.265	PCT	.11
MgO	11	6.48	PCT	2.46
CaO	15	14.06	PCT	8.24
Na_2O	14	.527	PCT	.58
K_2O	7	.140	PCT	.05
Cr_2O_3	8	.270	PCT	.24
Li	1	13.14	PPM	0
Rb	2	3.35	PPM	0.9
Cs	1	0.23	PPM	0
Sr	1	166.4	PPM	0
Ba	2	242.5	PPM	15.0
Sc	3	62.03	PPM	3.10
V	2	56.5	PPM	13.0
Co	3	33.70	PPM	3.40

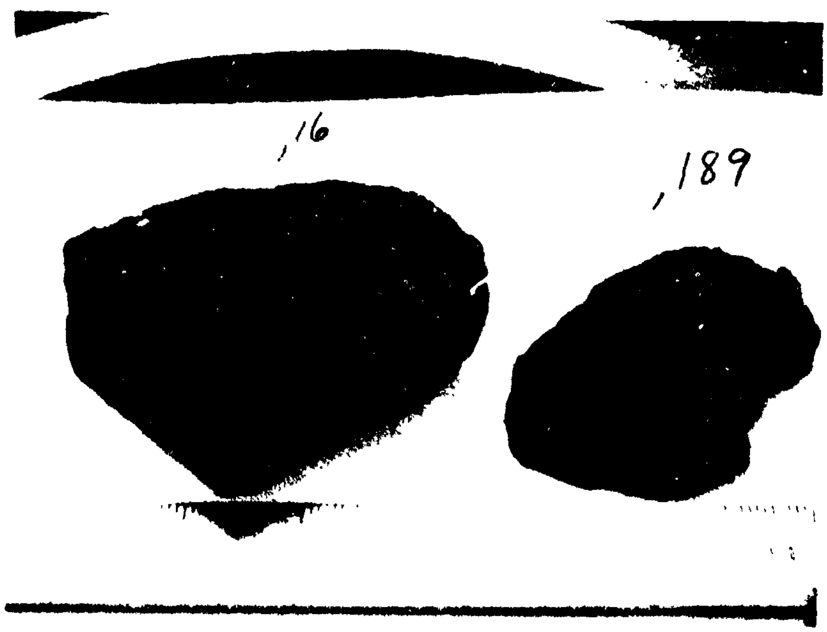
Element	Number of Analyses	Mean	Units	Range
Ni	1	157.16	PPM	0
Y	1	91.00	PPM	0
Zr	3	478.3	PPM	125.0
Hf	3	11.63	PPM	2.90
La	3	14.91	PPM	1.20
Ce	3	55.66	PPM	8.00
Nd	1	42.00	PPM	0
Sm	3	12.98	PPM	2.25
Eu	3	16.32	PPM	6.86
Gd	1	20.5	PPM	0
Tb	2	3.24	PPM	1.13
Dy	2	18.00	PPM	0.1
Ho	3	5.5	PPM	0.9
Er	1	14.10	PPM	0
Yb	3	11.7	PPM	1.4
Lu	3	1.64	PPM	.40
Th	2	2.40	PPM	1.00
U	3	.427	PPM	.13
I	1	073	PPM	0
In	1	5.20	PPB	0
Os	2	4.50	PPB	5.5
Pr	1	7.9	PPM	0
Tb	2	3.24	PPM	1.13
O	1	39.90	PCT	0

Analysts: Ehmann and Morgan (1970); Goles (1970a); Goles (1970b); Rose et al., (1970); Wakita et al., (1970); O'Hara (1974); Reed and Jovanovic (1970); Gopalan (1970); O'Kelly et al., (1970); Lovering and Butterfield (1970); Lovering and Hughes (1971).

No Age References

10020,0
Original PET Photo
(S-69-46481)

1 cm



10020
(S-76-25459)

10020

Sample 10020 is an irregular, medium dark grey, vesicular olivine basalt. This sample originally weighed 425 gm and measured 6x5x4 cm. Sample was returned in ALSRC #1004. (Documented Sample Container)

BINOCULAR DESCRIPTION BY: Twedell DATE: 6/10/76

ROCK TYPE: Vesicular Olivine Basalt SAMPLE: 10020,16 WEIGHT: 94 gm

COLOR: Medium dark grey DIMENSIONS: 4.5 x 3.5 x 1.5 cm

SHAPE: Irregular

COHERENCE: Intergranular - Tough
Fracturing - Absent

FABRIC/TEXTURE: Isotropic/Fine grained equigranular

VARIABILITY: Homogeneous

SURFACE: 3 sawed faces and one face partially sawed. Patina on all other surfaces.

ZAP PITS: Many on T_1, none on others.

CAVITIES: Approximately 5% surface coverage up to 2mm in diameter. Cavities are crystal lined.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Plagioclase	White	30	Subrounded-subangular	<.1	<.1-.2
Pyroxene	Dark	50	Subangular	<.1	<.1
Ilmenite	Black	16	Platy	<.1	<.1
Olivine	Green	4	Subangular	<.3	<.1-.9

Special Features: Sample not as fine-grained as 10049. Large olivine crystals are also present.

SECTION: 10020,31 Width of field: 2.22 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/10/76

SUMMARY: Fine-grained vesicular ophitic basalt composed of clinopyroxene, two generations of plagioclase, two generations of ilmenite with subordinate chromian ulvospinel, troilite-iron nickel, olivine, and cristobalite. The pyroxene forms large subhedral to anhedral crystals with lath-like to anhedral ilmenite crystals in a continuous network. Interstitial to these phases are subhedral to anhedral crystals of plagioclase and cristobalite, with minor glass rich mesostasis. Some of the plagioclase crystals are slightly bent and somewhat skeletal.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	51	Subhedral to anhedral	0.2-1.0
Plag	30	Tabular to anhedral	0.01-0.1
Opaq	11	Lath-like to anhedral	0.1-0.3
Oliv	5	Blocky, anhedral	0.02-1.2
Chr.Ulvo	1	Euhedral to subhedral	0.1-0.2

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Cris	2	Subhedral to anhedral	0.05-0.1
Voids		Rounded to irregular	0.2-0.6

COMMENTS:

Pyroxene - The pyroxene occurs as large pale brown to nearly colorless subhedral to anhedral crystal masses. Occasionally a pyroxene crystal is found within an olivine crystal or vice-versa. A well developed cleavage pattern is found in the more subhedral grains. Crystals of plagioclase and ilmenite occur within the pyroxene crystals and between them.

Plagioclase - Small subhedral crystals of plagioclase occur in the section associated with larger anhedral masses of plagioclase. The anhedral crystals form interstitial void fillings in the pyroxene-ilmenite network. Some bending of the subhedral crystals is present. Many of the larger crystals are somewhat skeletal in development. The smaller more euhedral crystals showed sharp twin planes while the larger interstitial crystals showed only faint to none.

Olivine - Small to large blocky anhedral crystals of olivine are scattered throughout the section. All are fresh crystals with small pyroxene rims. Some crystals contain small pyroxene crystals.

Opaques - The phases comprising the opaques are ilmenite, chromian ulvospinel, and troilite-iron nickel. Ulvospinel has been reported from this rock (Haggerty et al., 1970), but none was noted in this section.

Two generations of ilmenite are present in the section. The crystals occur as small lath-like crystal sections and also as large somewhat skeletal anhedral crystals. The larger crystals are by far more abundant.

Associated with the ilmenite are isolated euhedral to subhedral crystals of chromian ulvospinel. Approximately 10% of the total opaques in the section are chromian ulvospinel. One well defined octahedron is completely enclosed in a pyroxene crystal which is itself enclosed in a larger olivine crystal.

Small masses of troilite-iron nickel are present, but are rather sparse. A few veins of iron-nickel metal are found in some of the silicate phases.

TEXTURE: Interlocking subhedral to anhedral crystals of pyroxene intergrown with two generations of ilmenite and two generations of plagioclase crystals. Interstitial to this network are masses of plagioclase, cristobalite and mesostasis. The texture is ophitic.

Some vesicles (approximately 1%) are present in the section, but none of the crystals are seen to be growing into the voids.

Selected References: Albee and Chodos (1970), Chao et al. (1970), Dence et al. (1970), Haggerty et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 6/15/76

10020 was removed from ALSRC #1004 and originally processed in the Vac Lab. It was one of the samples in F-201 at the time of the glove rupture. A small portion was sent to PCTL for PET analyses; the remainder was sawed in SPL. Samples were re-examined in SSPL.

PRISTINE SAMPLES: (All VAC-SPL-SSPL)

15	.31	gm	Fines.
16	94.00	gm	Piece. Three saw surfaces.
60	.49	gm	Fines.
189	31.59	gm	Piece with 1 saw surface. No pits or patina on rock surface. 5x3x1.5 cm.
190	2.43	gm	Small chips and fines from ,189 & ,16.

RETURNED SAMPLES:

3	6.01	gm	Sawed piece. Some pitting on one surface. Three sawed surfaces.
5	10.54	gm	Sawed piece. Five sawed surfaces. Pitting present but rare.
6	20.32	gm	Sawed piece. Three surfaces are sawed, one is pitted.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	2	40.72	PCT	1.56
Al_2O_3	3	10.57	PCT	1.03
TiO_2	5	10.08	PCT	3.75
FeO	4	18.46	PCT	1.62
MnO	5	.2615	PCT	.022
MgO	2	8.06	PCT	.45
CaO	3	11.69	PCT	.91
Na_2O	6	.372	PCT	.019
K_2O	4	.057	PCT	.016
P_2O_5	2	.118	PCT	.085
Cr_2O_3	4	.3514	PCT	.0685
Li	1	5.00	PPM	0
Rb	5	.72	PPM	.124
Be	1	2.00	PPM	0
Sr	3	149.5	PPM	5.3
Ba	2	86.55	PPM	18.9
Sc	3	91.3	PPM	13.0
V	1	59.0	PPM	0
Co	3	19.66	PPM	3.0
Cu	2	5.135	PPM	2.87
Zu	2	1.69	PPM	.81
Y	1	130	PPM	0
Zr	2	310	PPM	100
Nb	1	36	PPM	0
Mo	2	.32	PPM	.16
Cd	1	6.37	PPB	0
Ta	3	1.53	PPM	1.1
W	1	.13	PPM	0

10020

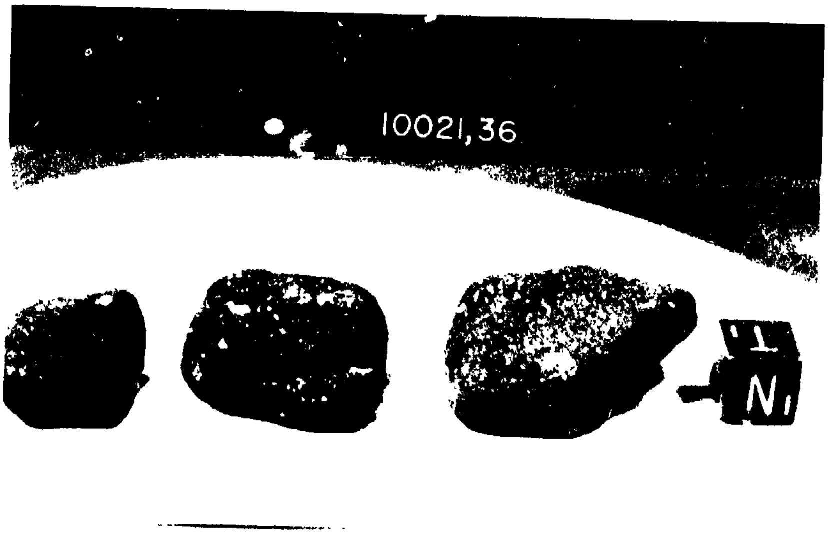
Element	Number of Analyses	Mean	Units	Range
Hf	2	7.4	PPM	1.6
Ir	1	.03	PPB	0
La	4	7.7	PPM	1.8
Ce	4	27.58	PPM	9.1
Pr	1	8.7	PPM	0
Nd	2	35.5	PPM	9.0
Sm	3	9.64	PPM	.47
Eu	5	1.57	PPM	.35
Gd	2	16.5	PPM	1.0
Tb	3	2.89	PPM	1.4
Dy	4	17.22	PPM	2.2
Ho	2	5.0	PPM	4.0
Er	2	9.5	PPM	1.0
Tm	1	1.2	PPM	0
Yb	4	8.19	PPM	3.37
Lu	4	1.45	PPM	.09
Th	2	1.08	PPM	.82
U	3	.184	PPM	.08
B	1	1.00	PPM	0
Ga	2	2.7	PPM	1.6
In	1	.0146	PPM	0
Tl	1	.33	PPB	0
C	1	100	PPM	0
Pb	1	.36	PPM	0
N	1	40	PPM	0
As	2	.045	PPM	.030
Sb	1	.01	PPM	0
Bi	1	.15	PPB	0
S	1	.17	PCT	0
Se	2	.325	PPM	.15

Element	Number of Analyses	Mean	Units	Range
Te	1	.013	PPM	0
F	1	85	PPM	0
Cl	1	150	PPM	0

Analysts: Ganapathy et al., (1970); Morrison et al., (1970); Turekian & Kharkar, (1970); Maxwell et al., (1970); Kharkar and Turekian, (1971); Gast (1970); Haskin (1970); Wanless (1970); Tatsumoto (1970); Hurley & Pinson (1970); Papanastassiou (1970); Rosholt & Tatsumoto (1970).

Age References: Wanless (1970); Eberhardt (1971b); Tatsumoto (1970).

10021,0
Original PET Photo
(S-69-45226)



10021,36
(S-75-31372)

10021

Sample 10021 is a rounded, medium light grey breccia. This sample originally weighed 250 gm and was returned in the Contingency Sample Bag.

BINOCULAR DESCRIPTION BY: Twedell DATE: 9/11/75

ROCK TYPE: Breccia SAMPLE: 10021,36 WEIGHT: 66 gm

COLOR: Medium light grey DIMENSIONS: 7.5x6x3.5 cm

SHAPE: Rounded to sub-rounded

COHERENCE: Intergranular - coherent
Fracturing - absent

FABRIC/TEXTURE: Anisotropic/Breccia

VARIABILITY: Homogeneous

SURFACE: Rounded and relatively smooth on exposed surfaces. Surface is covered lightly with brown glassy spatter and opaque material. Glass cover is <1% of any one surface.

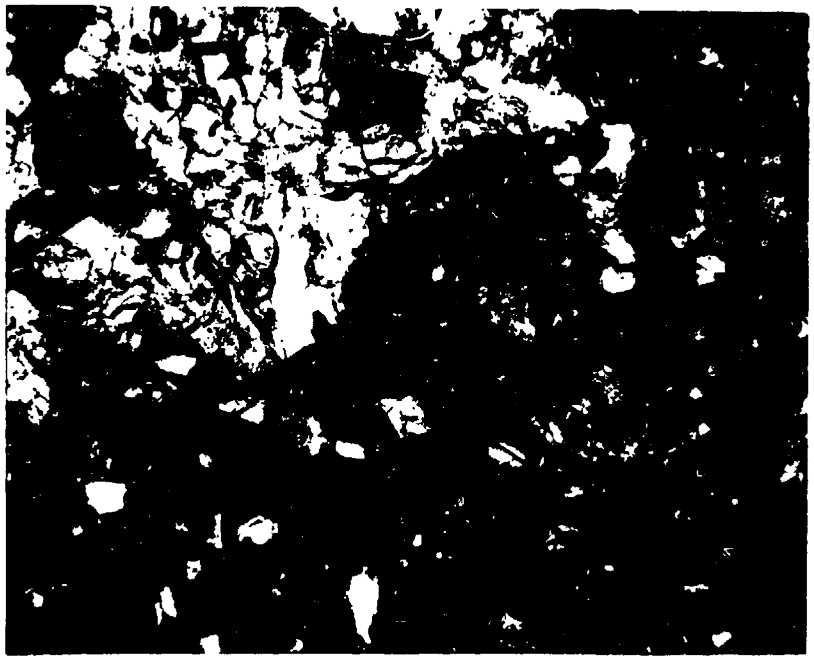
ZAP PITS: Many on E_1, few on T_1 and W_1, none on B_1, S_1, N_1. Pits are glass lined and range up to 1mm in diameter.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	RANGE
Matrix	Med.Dk.Grey	96	Rounded		
Basalt Clast	Hon.Brn. Blk.& Wh.	2-3	Irregular to sub-rounded	2-3mm	<1-6mm
Salt & Pepper Clast	Blk.& Wh.	1-2	Rounded to sub-rounded	1mm	<1-3mm
White Clast	White	1	Irregular	0.5mm	<1mm

Special Features:

Although this rock resembles 10019, and 10023 mineralogically, it has one distinguishing feature. The surface has a light coat of brown glass which the other samples do not have. The glass is only on the exterior surfaces, and does not appear to be on any fresh surface. Glass covers less than 1% of any surface.



SECTION: 10021,29 Width of field 1.39 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/22/76

SUMMARY: Partly devitrified typical breccia with a relatively low amount of glass fragments. All the lithic clasts are small and a majority of the mineral clasts are plagioclase.

MATRIX 50% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Dk.Brown	100	--------	<0.001	Glass-rich enclosing small lithic clasts and abundant mineral clasts; partly devitrified.

MINERAL CLASTS 19% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Pyroxene_1$	Very abundant	Angular to irregular	0.001-0.2
$Plagioclase_2$	Moderate	Blocky to irregular	0.001-0.1
$Opaques_3$	Few	Blocky to skeletal	0.001-0.2

1) Mostly very small, ill defined crystals.
2) Good twin planes; some with uneven extinctions.
3) Mostly in clasts; a few shards in matrix.

LITHIC CLASTS 19% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Six present	Rounded to irregular	>1.0

4) a. Coarse-grained basalt composed of pyroxene, plagioclase and ilmenite.

b. Glass-rich matrix hosting small crystallites of pyroxene and plagioclase.

c. Fine-grained basalt composed of pyroxene, plagioclase and ilmenite.

d. Fine-grained basalt composed of pyroxene, plagioclase and ilmenite.

e. Coarse-grained basalt composed of pyroxene, plagioclase and ilmenite.

f. Crystal aggragation of pyroxene and plagioclase with some glass in the matrix.

GLASS CLAST 19% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Angular to spherical	0.001-0.3
Colorless[6]	Few	Angular	0.001-0.5

5) Mostly angular fragments with a few spherical masses.

6) Partly devitrified; no spherical masses.

Selected References: Fredriksson et al. (1970)

HISTORY AND PRESENT STATUS OF SAMPLES - 10/13/76

10021 was removed from the Contingency Sample Container and processed in PCTL. A large piece was sent to RCL for gamma-ray counting. Pristine samples were re-examined in SSPL.

PRISTINE SAMPLES: (All PCTL-RCL-SSPL)

10	5.61	gm	Chips and fines.
37	1.37	gm	1-2mm fines.
38	2.29	gm	Less than 1mm fines.
39	2.05	gm	Less than 1mm fines.

41	34.52	gm	15-20 small chips. Few are pitted. Sample exposed to air; has some rust.
79	14.81	gm	Chip. One pitted surface.
80	7.87	gm	Chip. One pitted surface.
81	6.41	gm	Chip. Two pitted surfaces.
82	0.63	gm	Chips and fines from ,79 ,80 ,81.
83	1.73	gm	Chip. All surfaces fresh. One surface has large basaltic clast.

RETURNED SAMPLES: None

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	2	43.26	PCT	2.67
Al_2O_3	3	12.83	PCT	.63
TiO_2	4	7.72	PCT	3.00
FeO	3	16.08	PCT	1.15
MnO	5	.210	PCT	.027
MgO	1	8.29	PCT	0
CaO	2	12.10	PCT	2.66
Na_2O	3	.466	PCT	.005
K_2O	3	.196	PCT	.020
Li	1	13.	PPM	0
Rb	2	4.02	PPM	.03
Be	1	2.0	PPM	0
Sr	2	147.5	PPM	35.0
Ba	4	292.75	PPM	139.0
Sc	4	66.9	PPM	10.2
V	3	64.0	PPM	14.0
Cr_2O_3	4	.310	PCT	.077
Co	4	30.4	PPM	6.0

Element	Number of Analyses	Mean	Units	Range
Ni	1	184.	PPM	0
Cu	1	12.0	PPM	0
Zn	1	24.0	PPM	0
Y	1	113.0	PPM	0
Zr	3	324.67	PPM	174.0
Nb	1	28.0	PPM	0
Mo	1	.2	PPM	0
Ag	1	.36	PPM	0
Ta	3	1.6	PPM	.4
Hf	3	12.63	PPM	1.2
Ir	1	.008	PPM	0
Au	2	.003	PPM	.002
La	5	18.64	PPM	4.5
Ce	4	54.62	PPM	12.7
Nd	1	48.9	PPM	0
Sm	5	13.96	PPM	6.2
Eu	5	1.88	PPM	.2
Tb	3	3.47	PPM	1.1
Dy	4	22.8	PPM	4.3
Ho	2	6.45	PPM	.9
Er	1	13.0	PPM	0
Yb	4	12.38	PPM	4.6
Lu	4	2.11	PPM	.26
Th	1	2.5	PPM	0
U	2	.505	PPM	.17
Ga	2	5.05	PPM	.9
In	2	25.01	PPM	49.98
Ge	1	.41	PPM	0
As	1	.050	PPM	0
O	1	41.8	PCT	0

Element	Number of Analyses	Mean	Units	Range
Se	1	.17	PPM	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970); Turekian & Kharkar, (1970); Kharkar & Turekian, (1971); Annell & Helz, (1970); O'Kelly et al., (1970); Philpotts & Schnetzler, (1970); Wasson & Baedecker, (1970).

Age References: Hintenberger (1971).

10022,0
Original PET Photo 1 cm

10022,108
(S-76-25426)

10022

Sample 10022 is a medium dark grey vesicular basalt. This sample originally weighed 95 gm and measured 5x4x3 cm. Sample was returned in the Contingency Sample Bag.

BINOCULAR DESCRIPTION BY: Twedell DATE: 6/15/76

ROCK TYPE: Vesicular basalt SAMPLE: 10022,31 WEIGHT: 20.9 gm

COLOR: Medium dark grey DIMENSIONS: 2.4 x 2.2 x 2.2 cm

SHAPE: Irregular

COHERENCE: Intergranular - tough
Fracturing - absent

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: Homogeneous

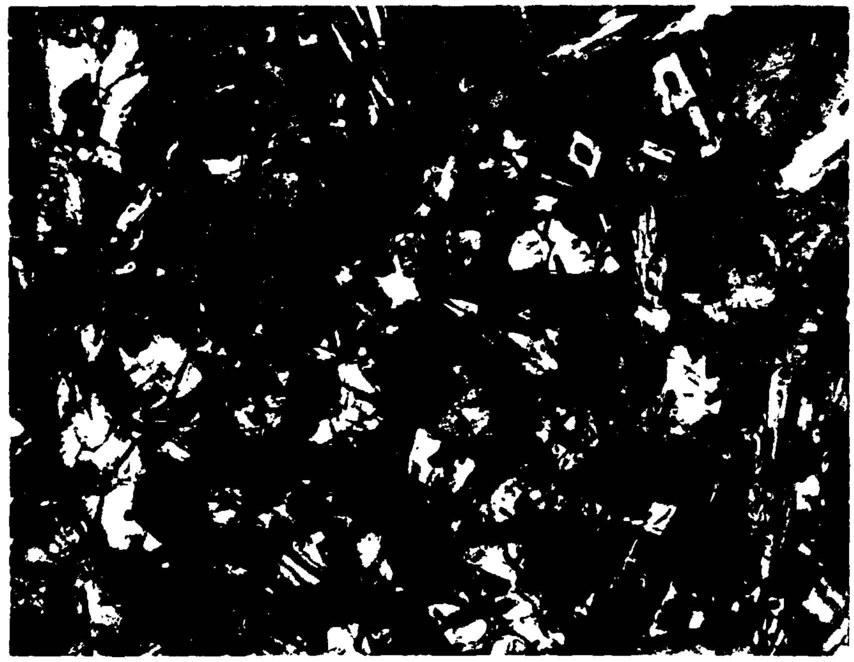
SURFACE: Irregular, but dust free. Some patina present.

ZAP PITS: One surface has a few pits.

CAVITIES: Vesicles cover 20% of surface. Cavities are crystal lined.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Pyroxene$_1$	Dark Brown	60	Subhedral	.2	<.1-.3
Plagioclase$_2$	White	25	Lathy to euhedral	<.1	<.1-.1
Ilmenite$_3$	Black	15	Anhedral	<.1	<.1

1) Range from dark honey brown to vitreous black.
2) Clear and translucent (crushed) crystals.
3) Platy semi-opaque crystals.



SECTION 10022,57   Width of field 1.39 mm plane light

THIN SECTION DESCRIPTION   BY: Walton   DATE: 6/15/76

SUMMARY: Fine-grained vesicular intersertal basalt composed of clinopyroxene, plagioclase and ilmenite with subordinate mesostasis. The crystals of plagioclase are, for the most part, tabular which appear in the section as thin narrow acicular crystals with poor optical characteristics. Masses of anhedral plagioclase occur as interstitial void fillings in the pyroxene-ilmenite network. Also filling voids in the network are small masses of glass-rich mesostasis.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	43	Anhedral, irregular	0.01-0.1
Plag	11	Anhedral to acicular	0.01-0.3
Opaq	39	Subhedral to skeletal	0.001-0.8
Meso	7	Irregular	0.001-0.05

COMMENTS:

Pyroxene - Small pale brown to nearly clear anhedral crystals of pyroxene forms an almost continuous network with the larger ilmenite crystals in the rock. This network then hosts all other phases present. Many of the pyroxene crystals are polygranular, but appear as a monocrystal in plane light. Many of the vesicles are lined with very fractured pyroxene crystals. Many of the subhedral crystals of ilmenite are wholly enclosed in pyroxene crystals.

Plagioclase - The plagioclase crystals in this rock differ somewhat from the typical Apollo 11 intersertal basalt. Nearly every crystal is anhedral and occurs as interstitial void fillings in the pyroxene-ilmenite network. In section, however, many of the crystals appear as acicular crystals sometimes with glass centers. No well defined crystal could be found. Isolated crystals are rare to absent. The twinning is poor and extinctions uneven. A few fan-shaped masses are present, but again are not composed of euhedral crystals.

Isolated patches of a glass-rich mesostasis also occur as an interstitial component in the network. The color is a dark brown. Many of the masses occur near or at a plagioclase-pyroxene interface. The masses are turbid and very irregular in shape.

Opaques - Ilmenite makes up, by far, the most abundant opaque mineral in the rock. Two generations of crystals are present in the rock. The first type forms larger skeletal crystals with several of the crystals having chromite and rutile exsolutions. These crystals are very erose and the embayments are predominately filled with pyroxene.

The second type forms smaller lath-like crystals, some of which are quite thin. In section many of these appear as long thin acicular crystals. Several of these crystals are bent and broken.

TEXTURE: Fine-grained intersertal basalt consisting of a network of pyroxene crystals that are intergrown with larger skeletal ilmenite crystals. Interstitial to this network are crystals of plagioclase and masses of mesostasis. Small subhedral to nearly euhedral crystals of ilmenite occur included in some of the pyroxene grains. The plagioclase is all or nearly all interstitial while appearing as long acicular crystals in the section. Contacts are sharp between all phases.

Selected References: Cameron (1970), Kushiro and Nakamura (1970), Smith, J.V. et al. (1970), Weill et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 10/13/76

10022 was removed from the Contingency Sample Container and processed in PCTL. At some time, the sample, or a portion of the sample, was sawed in SPL. Samples were re-examined in SSPL.

PRISTINE SAMPLES:

108	8.01 gm	Chip. Pitted on two surfaces. PCTL-SPL-SSPL
114	1.69 gm	Fines. PCTL-SPL-SSPL

RETURNED SAMPLES:

31	21.88 gm	Chip. Pitted on two surfaces. Has been heated to 525°C. Possible silicone grease contamination.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	3	41.6	PCT	3.1
Al_2O_3	4	8.19	PCT	.872
TiO_2	3	12.24	PCT	.48
FeO	4	18.97	PCT	2.06
MnO	4	.23	PCT	.028
MgO	2	7.27	PCT	.943
CaO	2	10.52	PCT	.35
Na_2O	3	.439	PCT	.110
K_2O	3	.280	PCT	.035
Li	1	11.5	PPM	0
Rb	4	5.73	PPM	.43
Cs	1	.2	PPM	0
Sr	4	166.48	PPM	9.0
Ba	4	248.75	PPM	57.0

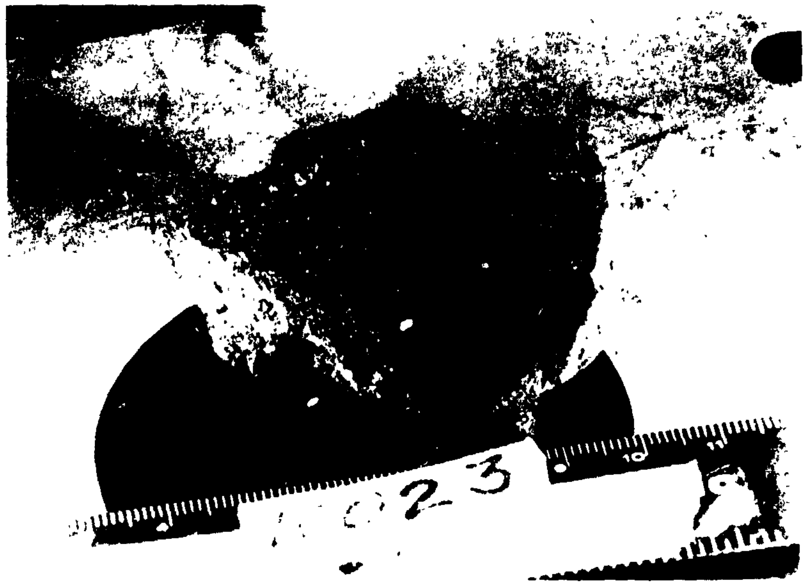
Element	Number of Analyses	Mean	Units	Range
Sc	3	76.97	PPM	2.30
V	2	79.50	PPM	19.0
Cr_2O_3	4	.342	PCT	.041
Co	3	29.27	PPM	.80
Ni	1	9.98	PPM	0
Cu	1	5.1	PPM	0
Zn	1	2.9	PPM	0
Y	1	230.0	PPM	0
Zr	2	360.0	PPM	460.
Ag	1	.002	PPM	0
Ta	3	1.27	PPM	.8
Hf	3	19.73	PPM	3.4
Au	1	.001	PPM	0
La	3	25.37	PPM	2.6
Ce	3	76.63	PPM	12.5
Nd	1	65.	PPM	0
Sm	3	20.2	PPM	2.1
Eu	3	2.14	PPM	.25
Gd	1	23.9	PPM	0
Tb	3	4.91	PPM	1.2
Dy	2	30.05	PPM	.1
Ho	3	8.37	PPM	2.7
Er	1	15.8	PPM	0
Yb	4	15.85	PPM	14.
Lu	3	2.55	PPM	.22
U	2	.735	PPM	.13
Ga	1	2.9	PPM	0
In	1	.008	PPM	0
As	1	.063	PPM	0
Sb	1	.006	PPM	0

10022

Element	Number of Analyses	Mean	Units	Range
O	1	39.3	PCT	0
Se	1	.7	PPM	0
Cl	1	19.3	PPM	0
Br	1	.129	PPM	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970); Rose et al., (1970); Haskin et al., (1970); Murthy et al., (1970); Gopalon et al., (1970); Hurley et al., (1970); Ehmann and Morgan, (1970).

Age References: Turner (1970); Eberhardt (1971b).



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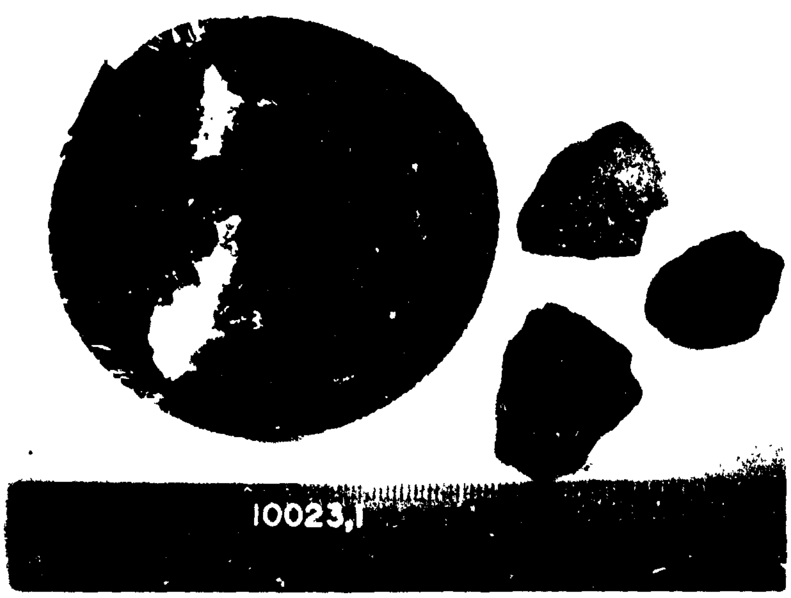
Original PET Photo
(S-69-45393)



10023,1
(S-75-31694)

10023

Sample 10023 is a sub-rounded,medium dark grey, fine breccia. This sample originally weighed 66gm and measured 6x4x2cm. It was returned in the Contingency Sample bag.

BINOCULAR DESCRIPTION BY: Twedell DATE: 9/12/75

ROCK TYPE: Fine breccia SAMPLE: 10023,2 WEIGHT: 19 gm.

COLOR: Medium dark grey DIMENSIONS: Four chips

SHAPE: Rounded to sub-rounded

COHERENCE: Intergranular - coherent
Fracturing - few, non-penetrative; rock is micro-fractured (PET).

FABRIC/TEXTURE: Anisotropic/Fine Breccia

VARIABILITY: Homogeneous

SURFACE: Surface is rounded on exposed surface to sub-rounded on fresh surface (see special features); one side is a flat fracture surface (PET)

ZAP PITS: Many on T_1, few on E_1, none on W_1, N_1, S_1, B_1. Pits are glass lined up to 1.5mm in diameter.

CAVITIES: None

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Matrix	Med.Dk.Grey	97	Rounded	---	---
Basalt Clast$_1$	Honey Brn. Blk. & Wh.	1	Subrounded to rounded	1mm	.5-1.5mm
White$_2$	White	1	Rounded to irregular	1mm	.8-1.5mm
Salt & Pepper$_3$	Blk. & Wh.	<1	Rounded	1mm	1mm
Brown Clast$_4$	Brown	<1	Irregular	Only 1	

1) Same type of clast as seen in 10021, 10019.
2) See special features
3) Opaque material is in elongated laths.
4) The only one visible on the sample has a granular appearance. It

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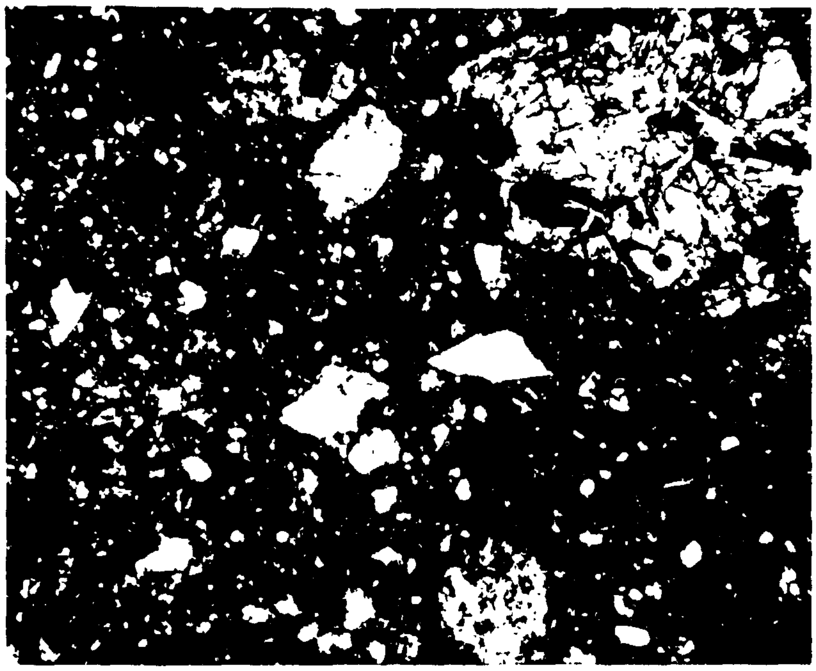
does not appear to be crushed glass. Clast has a smaller white clast contained within it.

SPECIAL FEATURES: Brown glassy spatter covers about 5% of surface area. Small amounts of green glass appear in isolated areas of fresh surface. Three types of white clasts occur: 1) pure white; 2) white with brown glass; and, 3) white with green glass. In all cases, the white component is granular to powdered.



SECTION: 10023,42 Width of field 2.72 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/23/76

SUMMARY: Partly devitrified typical breccia with a low lithic clast content. Numerous mineral fragments are present, some of which are subhedral. Most of the lithic clasts present are large with only a few small clasts present.

MATRIX 50% OF ROCK

PHASE	% SECTION	SHAPE	SIZE (MM)	COMMENTS:
Dark Brown	100	-----	<0.001	High glass content with some devitrification.

MINERAL CLASTS 43% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene[1]	Very abundant	Angular to irregular	0.001-0.3
Plagioclase[2]	Few	Blocky to irregular	0.001-0.2
Opaques[3]	Few	Skeletal to irregular	0.001-0.1

1) Most show poor extinctions.
2) Some good twins; mostly poor optical characteristics.
3) Very small crystals with a few large fragments.

LITHIC CLASTS 2% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Few	Rounded to irregular	.001-1.0
Large[4]	10 present	Rounded to irregular	>1.0

4) a. Fine-grained subophitic basalt composed of clinopyroxene, plagioclase, and ilmenite.

b. Coarse-grained intersertal basalt composed of clinopyroxene, plagioclase, ilmenite and mesostasis.

c. Fine-grained basalt composed of clinopyroxene, plagioclase and ilmenite.

d. Fine-grained basalt composed of clinopyroxene, plagioclase and ilmenite.

e. Fine-grained basalt composed of clinopyroxene, plagioclase and ilmenite.

f. Coarse-grained basalt composed of clinopyroxene, plagioclase and ilmenite.

g. Coarse-grained basalt composed of clinopyroxene, plagioclase and ilmenite.

h. Coarse-grained basalt composed of clinopyroxene, plagioclase and ilmenite.

i. Glass-rich matrix with small pyroxene dendrites.

j. Composed of small crystal fragments in a partly glassy matrix.

GLASS CLASTS 5% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Angular to spherical	0.001-0.6

5) Most fragments with only a few spherical masses.

HISTORY AND PRESENT STATUS OF SAMPLES - 10/13/76

10023 was removed from the Contingency Sample Container and processed in PCTL. Samples were re-examined in SSPL.

PRISTINE SAMPLES:

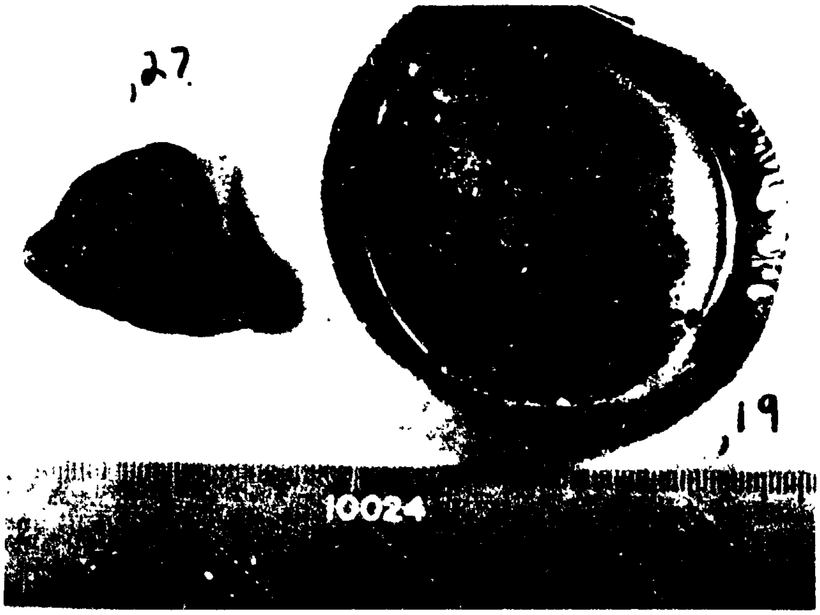
1	16.57 gm	Three large chips, small chips and fines. Two of the large chips are pitted. PCTL-SSPL
16	1.06 gm	Fines. PCTL-SSPL

RETURNED SAMPLES:

2	19.53 gm	Piece. Pitted on two surfaces.

NO CHEMICAL ANALYSES OR AGE DATES

10024,0
Original PET Photo
(S-69-46030)



10024
(S-75-31693)

10024

Sample 10024 is a sub-angular, medium light grey, fine grained basalt. This sample originally weighed 68gm and measured 5x4x2.5cm. It was returned in the Contingency Sample Container.

BINOCULAR DESCRIPTION BY: Twedell DATE: 6/8/76

ROCK TYPE: Vesicular basalt SAMPLE: 10024,27 WEIGHT: 20.43 gm

COLOR: Medium light grey DIMENSIONS: 3.2 x 2.4 x 1.3 cm

SHAPE: Angular to sub-angular

COHERENCE: Intergranular - friable
Fracturing - few, non-penetrative

FABRIC/TEXTURE: Isotropic equigranular

VARIABILITY: Homogeneous

SURFACE: Surface is granulated; Flat fracture surface on one side (PET)

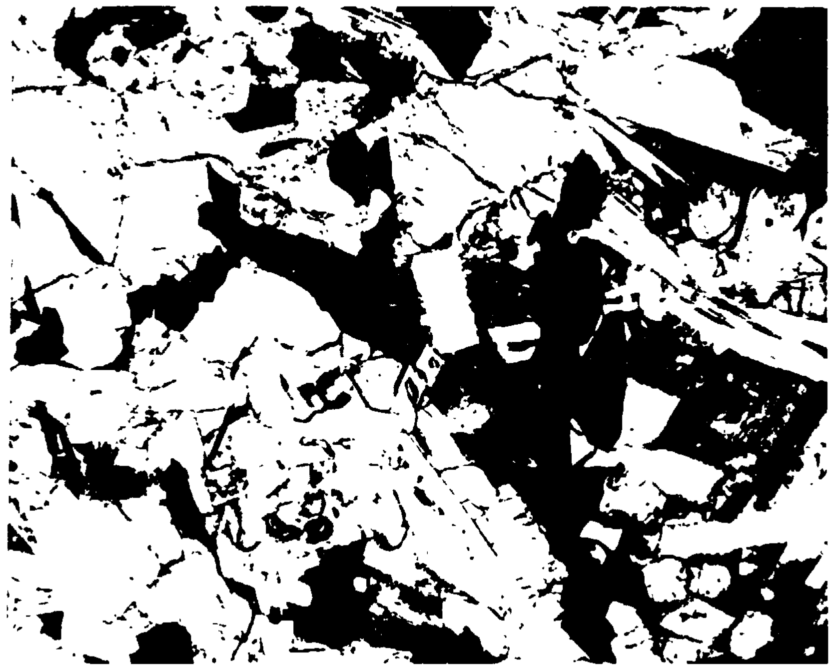
ZAP PITS: Few on T_1, N_1. None on S_1, W_1, E_1, B_1. Pits are glass lined, up to 1mm in diameter.

CAVITIES: Surface is vuggy on both fresh and exterior surfaces. Vugs cover approximately 25% of rocks surface area. Glass droplets occur inside some of the vugs.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Plagioclase	White	30	Angular	.2	.1-.4
Pyroxene	Brown	30	Angular	.3	.1-.5
$Black_1$	Black	25	Rounded	.3	.1-.5
Ilmenite	Black	15	Angular	.3	<.1-.3

1) Vitreous appearance, probably glass.

SPECIAL FEATURES: There are some dark grey crystals protruding from the vug walls.



SECTION 10024,29 Width of field 1.39 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/8/76

SECTION: 10024,29

SUMMARY: Fine grained intersertal basalt composed of clinopyroxene, plagioclase, and ilmenite with subordinate mesostasis. Few of the crystals in the section show well defined crystal faces and most are somewhat rounded at the edges. Several groups of radially clustered, acicular pyroxene-plagioclase intergrowths are also present. Glassy cores are present in some of the crystals as well as a glass-rich mesostasis between adjacent crystalline phases.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	45	Anhedral, irregular	0.1-0.8
Plag	22	Anhedral to acicular	0.2-0.9
Opaq	23	Anhedral to subhedral	0.01-0.4
Meso	10	Irregular	0.01-0.03

COMMENTS:

Pyroxene - The pyroxene forms pale brown anhedral crystals which host the other phases present. Well developed cleavage is found in many crystals, while fracturing is present in all the crystals. No marked zoning, but occasional twinning is present. The crystals make up an almost continuous array with many areas consisting of only polygranular pyroxene. All contacts with the other crystalline phases are sharp and the mesostasis present in the section usually occurs between adjacent pyroxene crystals.

The mesostasis forms dark brown poorly defined irregular masses throughout the section. The boundaries between the crystalline phases and the mesostasis are ill defined and the glassy material appears to have filled interstitial openings in the other phases. Some devitrification has taken place as the masses are very turbid.

Plagioclase - Two major types of plagioclase occur in the rock. The larger anhedral crystals are skeletal, poorly formed and form interstitial masses between the pyroxene crystals. The smaller acicular crystals are lath-like and may have hollow centers filled with a glassy phase. These crystals form intergrowths with acicular pyroxene crystals in more or less fan-shaped manner. Many of the terminations are quite splintery. Small crystals of an apatite-like phase is present associated with the plagioclase. This phase was not identified.

Opaques - The primary opaque phase present in the rock is ilmenite. It forms skeletal crystals which are scattered throughout the section. Few terminations are present on any crystals. Some chromite exsolutions are present. Most of the crystals of ilmenite are very erose and the embayments filled with pyroxene. A few lath-like subhedral crystals are present. These are smaller and far more uncommon than the larger skeletal crystals.

Many masses of troilite with and without iron-nickel inclusions are found scattered throughout the section.

Kushiro and Nakamura, (1970) have reported large crystals of cristobalite from this rock. None of the sections examined could confirm their observation. Several small areas of the mesostasis had what appeared to be small silica inclusions but these were not confirmed.

TEXTURE: Nearly equigranular intersertal basalt consisting of a network of pyroxene that is intergrown with large skeletal crystals of ilmenite. Occurring interstitial to this network are plagioclase tablets that are intergrown with the edges of the pyroxene, acicular pyroxene-plagioclase intergrowth, small subhedral crystals of ilmenite, and anhedral masses of plagioclase and mesostasis. Contacts are sharp between crystalline phases.

HISTORY AND PRESENT STATUS OF SAMPLES - 10/18/76

10024 was removed from the Contingency Sample bag in PCTL. The sample was split in PCTL and was later re-examined in SSPL.

PRISTINE SAMPLES: (All PCTL-SSPL)

7	0.01	gm	Less than 1mm fines.
19	7.22	gm	Two large pieces plus small chips and fines. There are no pitted surfaces.
27	20.427	gm	Piece with one pitted surface.

RETURNED SAMPLES:

17	10.59	gm	Piece with no pitted surfaces.

CHEMICAL ANALYSES

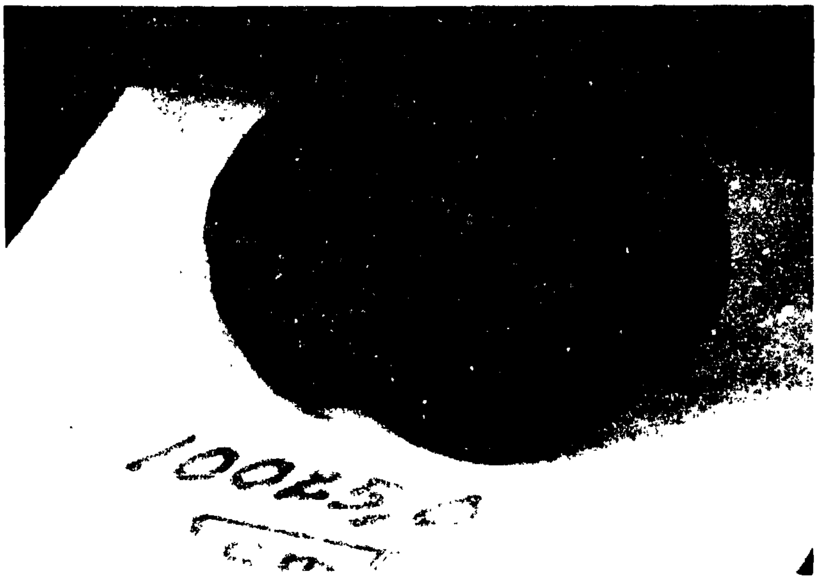
Element	Number of Analyses	Mean	Units	Range
SiO_2	3	39.61	PCT	1.25
Al_2O_3	4	8.32	PCT	1.75
TiO_2	3	12.54	PCT	1.3
FeO	3	19.26	PCT	1.31
MnO	3	.231	PCT	.028
MgO	3	7.59	PCT	.981
CaO	3	10.2	PCT	.726
Na_2O	3	.489	PCT	.06
K_2O	4	.303	PCT	.059
P_2O_5	1	.2	PCT	0

Element	Number of Analyses	Mean	Units	Range
Rb	5	5.99	PPM	.72
Sr	3	173.7	PPM	17.5
Ba	3	255.0	PPM	140.
Sc	1	76.2	PPM	0
V	2	60.5	PPM	47.
Cr_2O_3	3	.372	PCT	.065
Co	2	30.2	PPM	3.6
Ni	1	20.04	PPM	0
Cu	1	16.0	PPM	0
Zn	1	14.0	PPM	0
Y	1	168.0	PPM	0
Zr	2	512.5	PPM	275.
Nb	1	25.	PPM	0
Ta	1	2.4	PPM	0
Hf	1	20.0	PPM	0
La	2	31.0	PPM	16.
Ce	3	86.87	PPM	32.
Pr	1	12.0	PPM	0
Nd	2	60.55	PPM	11.1
Sm	2	21.3	PPM	4.2
Eu	1	2.21	PPM	0
Gd	1	28.6	PPM	0
Dy	1	33.6	PPM	0
Ho	1	8.1	PPM	0
Er	1	19.3	PPM	0
Yb	2	18.1	PPM	0
Lu	1	3.2	PPM	0
Th	1	4.1	PPM	0
U	1	.67	PPM	0
Ga	1	5.0	PPM	0

Element	Number of Analyses	Mean	Units	Range
O	1	38.9	PCT	0
S	1	.22	PCT	0

Analysts: Compston et al., (1970); Ehmann & Morgan, (1970); Rose et al., (1970); Goles et al.,(1970); Gopalon et al., (1970); Philpotts & Schnetzler, (1970); Papanastassiou & Wasserburg, (1971); Hurley & Pinson, (1970).

Age References: Turner, (1970); Eberhardt (1971b); Papanastassiou et al., (1971).



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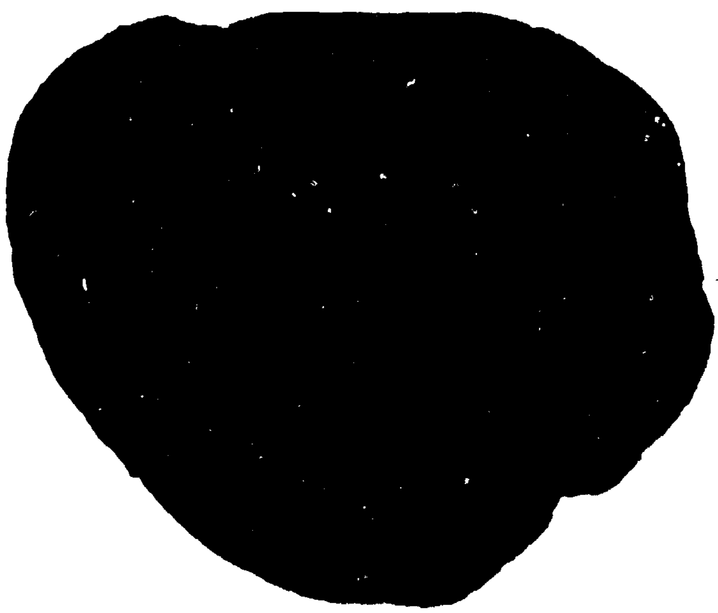
Original PET Photo
(S-69-46066)



10025,3
(S-75-32638)

10025

Sample 10025 is a sub-rounded, dark grey microbreccia. This sample originally weighed 9gm and measured 3x3x1cm. It was returned in the Contingency Sample bag.

BINOCULAR DESCRIPTION BY: Kramer and Schwarz DATE: 10/3/75

ROCK TYPE: Microbreccia SAMPLE: 10025,3 WEIGHT: 8.06 gm

COLOR: Dark Grey DIMENSIONS: 2.5 x 2 x 1.5 cm

SHAPE: Sub-rounded

COHERENCE: Intergranular - slightly friable
Fracturing - few fractures, penetrative

FABRIC/TEXTURE: Anisotropic/Microbreccia

VARIABILITY: Homogeneous

SURFACE: Smooth, rounded

ZAP PITS: Few on B_1 and S_1 faces, some glass lined; all sides have glass pits (PET).

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Matrix	Dk.Grey	98	-----	---	---
White Clasts	White	1	Angular	.25	<.5
Glass Spherules	Dark	1	Spheres	.25	<.5

SPECIAL FEATURES:

Matrix immediately surrounding pits is raised with respect to the non-pitted matrix, i.e., they show high relief.

THIN SECTION DESCRIPTION:

There was no thin section for the generic 10025 at the onset of secondary examination. Due to the small amount of remaining sample (8.06gm), it was judged unwise to remove a chip for thin sections.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/29/76

10025 was removed from the Contingency Sample bag in PCTL and was split in PCTL. It was later re-examined in RSPL.

PRISTINE SAMPLES:

None

RETURNED SAMPLES:

3	8.06 gm	Piece. Two pitted surfaces.

NO CHEMICAL ANALYSES OR AGE DATES.

10026,0
Original PET Photo
(S-69-46078)

10026,10
(S-75-32595)

10026

Sample 10026 is a sub-angular, grey microbreccia. The sample originally weighed 9gm and measured 2.5x2x1.5cm. Sample was returned in the Contingency Sample bag.

BINOCULAR DESCRIPTION BY: Kramer and Schwarz DATE: 10/6/75

ROCK TYPE: Microbreccia SAMPLE: 10026,10 WEIGHT: 8.47 gm

COLOR: Grey DIMENSIONS: 2.5 x 2 x 1.5 cm

SHAPE: Sub-angular/sub-rounded; a faint layering can be observed parallel to the flat surface (PET).

COHERENCE: Intergranular - coherent
Fracturing - absent; two sets of faint fine fractures best seen on flat surface (PET).

FABRIC/TEXTURE: Anisotropic/Microbreccia

VARIABILITY: Homogeneous

SURFACE: Irregular

ZAP PITS: Glass lined, approximately 10 pits/cm^2

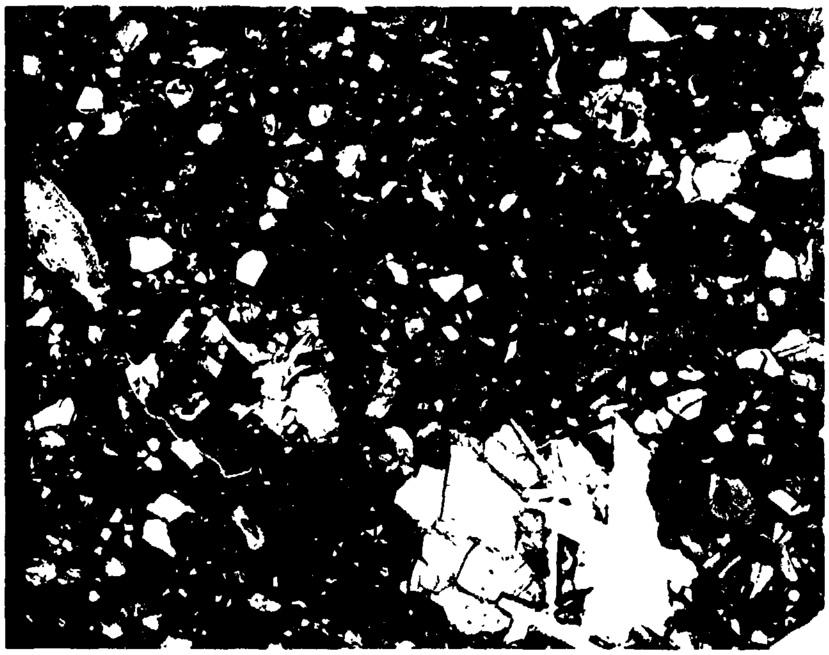
CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Matrix	Grey	90	-----	---	----
White Clast$_1$	White	5	Angular	0.5	.25-1
Salt & Pepper Clast	White & Dark	3	Angular	0.5	.5 -1
Basalt Clast$_2$	Lt. Grey	2	Angular	0.4	-----

1) Plagioclase (crushed).
2) Remains of basalt clast, on edge of E_1 face (fresh surface).

SPECIAL FEATURES:

Color of pyroxene varies from light orange-brown crushed pyroxene to red-dark brown individual crystals to brown crystals associated with plagioclase clasts.



SECTION: 10026,17 Width of field 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/24/76

SUMMARY: Highly devitrified typical breccia with a relatively high percentage of mineral clasts. The section is light in color due to the high number of the mineral clasts and the lower percentage of matrix.

MATRIX 47% OF ROCK

PHASE	% SECTION	SHAPE	SIZE (MM)	COMMENTS:
Lt.Brown	100	-----	<0.001	Discontinuous; high glass content; large amount of devitrification.

MINERAL CLASTS 30% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene$_1$	Very abundant	Angular to irregular	0.001-0.3
Plagioclase$_2$	Abundant	Blocky to irregular	0.001-0.2
Opaques$_3$	Moderate	Blocky to irregular	0.001-0.4

1) Many extinctions; highly fractured

2) Sharp twin planes to nearly glass
3) High percentage in matrix; some in clasts.

LITHIC CLASTS 18% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Five present	Rounded to irregular	>1.0

4) a. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

b. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.

c. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

d. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

e. Fine-grained glass-rich matrix hosting crystal fragments and rock fragments.

GLASS CLASTS 5% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Spherical to angular	0.001-1.2
Colorless[6]	Moderate	Angular	0.001-0.5

5) One yellow sphere 1.2mm in diameter; most are only partial spheres; few shards present.
6) All shards, no spheres; some bubbles.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/24/76

10026 was removed from the Contingency Sample bag in PCTL. The sample was later split in RSPL and was re-examined in RSPL. There are no pristine samples remaining.

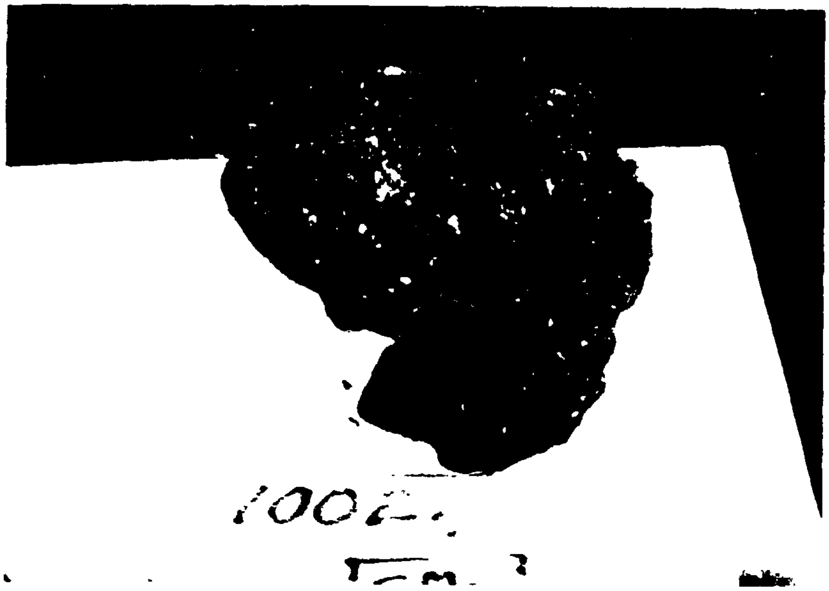
PRISTINE SAMPLES:

None

RETURNED SAMPLES:

10 8.46 gm Piece. Pics on five faces.

NO CHEMICAL ANALYSES OR AGE DATES



10027,0
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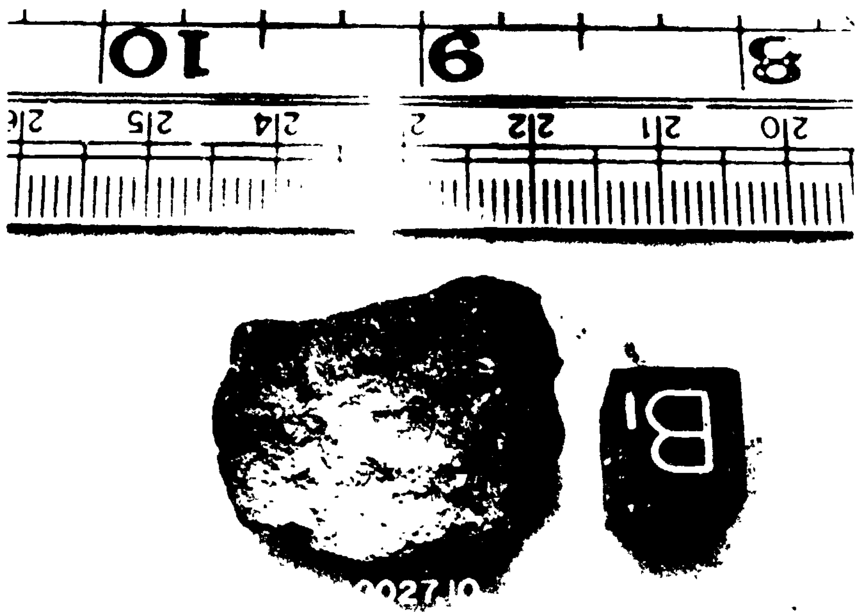


10027,10
(S-75-32190)

10027

Sample 10027 is a subrounded, grey microbreccia that originally weighed 8gm and measured 3.5x2x1cm. This sample was originally returned in the Contingency Sample bag.

BINOCULAR DESCRIPTION BY: Kramer and Schwarz DATE: 10/8/75

ROCK TYPE: Microbreccia SAMPLE: 10027,10 WEIGHT: 7.578 gm

COLOR: Grey DIMENSIONS: 2.5x1.7x1.4 cm

SHAPE: Subrounded

COHERENCE: Intergranular - moderately coherent
Fracturing - absent

FABRIC/TEXTURE: Anisotropic/Micro-breccia; suggestion of lineation locally (PET).

VARIABILITY: Homogeneous

SURFACE: Irregular

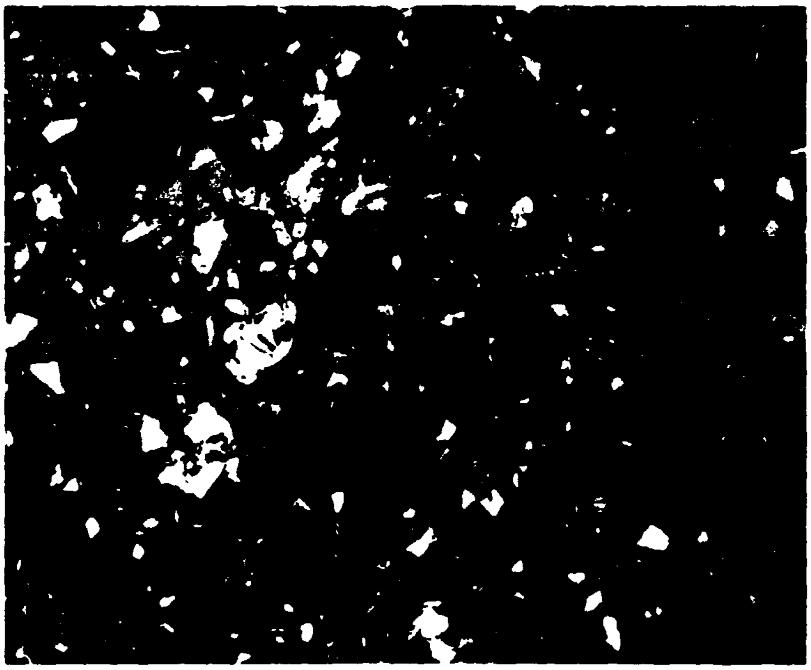
ZAP PITS: Few. Many on B_1 and N_1. Pits are irregular and occasionally frothy.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Matrix	Grey	90	-----------	-----	-----
White Clast$_1$	White	5	Angular	.5	.25-1
Basalt Clast$_2$	Wh/Brn	2	Subrounded	1	.5-5
Salt & Pepper Clast	Wh/Dark	2	Subrounded	.5	.25-2
Glass Spheres	Black	1	Spherical	.25	<.5
Brown Clast$_3$	Lt.to Dk.Brown	<1	Subangular	.25	<.5

1) Plagioclase is crushed.
2) One clast on N face is elongated, approximately 5x2 mm. Others are smaller.
3) Occur as crystals and clasts, varying in color from light crushed clasts to darker brown crystals.

10027



SECTION: 10027,36 Width of field 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/25/76

SUMMARY: Partly devitrified typical breccia with a very pale brown matrix. The color of the matrix is much lighter than for most of the other Apollo 11 breccias. Numerous mineral fragments are scattered throughout with a few lithic clasts.

MATRIX 60% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Light Brown	100	-----	<0.001	High glass content; color varies [illegible] medium to very [illegible]le brown.

MINERAL CLASTS 24% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene[1]	Very abundant	Angular to irregular	0.001-0.5
Plagioclase[2]	Few	Blocky to irregular	0.001-0.2
Opaques[3]	Moderate	Subhedral to skeletal	0.001-0.2

1) Most are very small and all show poor extinctions.
2) Small blocky crystals with fair twins.
3) Some subhedral, some blocky, a few skeletal; most in matrix, some in clasts.

LITHIC CLASTS 12% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Two present	Rounded to irregular	>1.0

4) a. Coarse-grained basalt composed of pyroxene, plagioclase and ilmenite.

   b. Coarse-grained basalt composed of pyroxene, plagioclase and ilmenite.

GLASS CLAST 4% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Spherical to angular	0.001-0.6
Colorless[6]	Few	Angular	0.001-0.1

5) Almost all as spheres or part spheres, a few shards.
6) Almost no devitrification; some fracturing.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/25/76

10027 was removed from the Contingency Sample bag and split in PCTL. It was re-examined in RSPL as there are no pristine samples remaining.

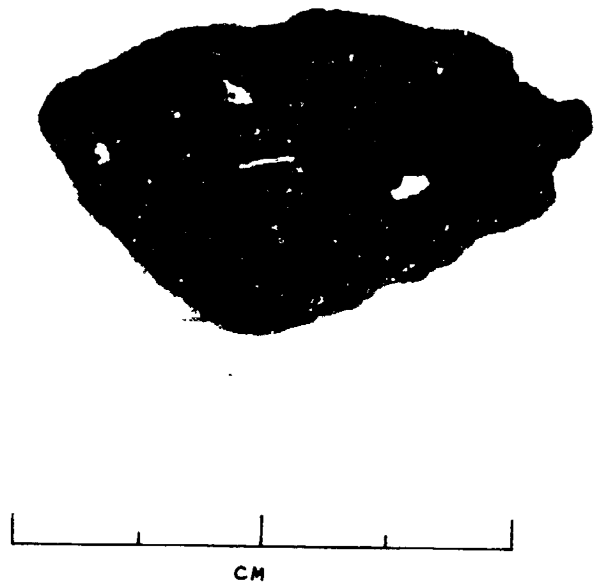
PRISTINE SAMPLES:

None

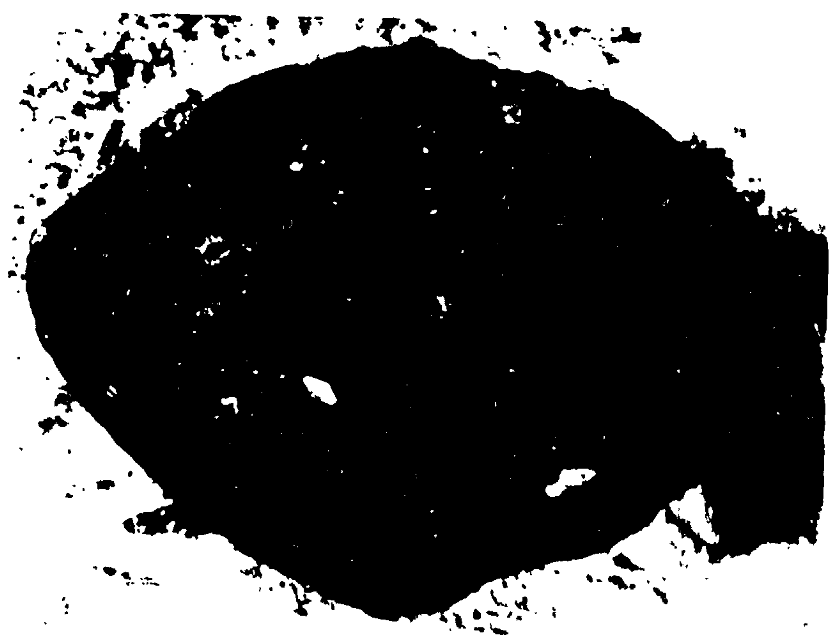
RETURNED SAMPLES:

0 7.58 gm Piece. Pitted on three faces.

NO CHEMICAL ANALYSES OR AGE DATES



10028,0
Original PET Photo
(S-69-46040)



10028,0
(S-76-21148)

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10028

Sample 10028 is a subangular to subrounded, medium light grey microbreccia. This sample originally weighed 3gm and measured 2.5x2x1cm. Sample was returned in the Contingency Sample Container.

BINOCULAR DESCRIPTION BY: Twedell DATE: 1/15/76

ROCK TYPE: Microbreccia SAMPLE: 10028,0 WEIGHT: 3.43 gm

COLOR: Medium light grey DIMENSIONS: 2.3 x 1.8 x 1.0 cm

SHAPE: Subangular to subrounded

COHERENCE: Intergranular - moderately coherent
Fracturing - one penetrative fracture on T_1 face

FABRIC/TEXTURE: Anisotropic/Microbreccia

VARIABILITY: Homogeneous

SURFACE: Smooth on all surfaces.

ZAP PITS: Many on T_1. Few on N_1, S_1, W_1, E_1. None on B_1. Average size is 1mm or less. Pits are glass lined.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Med.Lt.Grey	98	-----	---	-----
Grey & White	Grey/White	1	Angular	3x2	One Clast
White	White	<1	Angular to subangular	.25	<1.5

SPECIAL FEATURES: This sample has an unusually high number of large pits on the T_1 face. The average is about 1mm. This is large in size for this small a sample. Some areas of brown glassy spatter on T_1 face. None on others. Only a few small clasts exist. Powdery white in texture.

NOTE: This sample has no basalt or salt and pepper clasts, making it different from most Apollo 11 breccias.

THIN SECTION DESCRIPTION

There was no thin section for the generic 10028 at the onset of re-examination. Due to the small amount of sample in the generic (3.40gm) it was judged unwise to remove a chip for thin sections.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/28/76

10028 was removed from the Contingency Sample bag and split in PCTL. It was re-examined in SSPL.

PRISTINE SAMPLES:

0 3.40 gm Piece. Pitted on five surfaces.

NO RETURNED SAMPLES

CHEMICAL ANALYSES

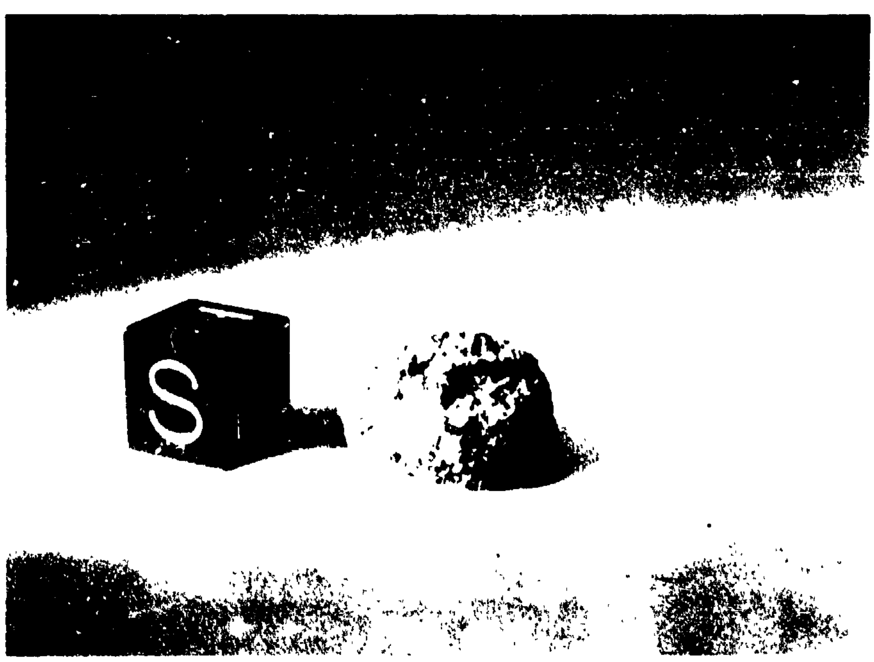
Element	Number of Analyses	Mean	Units	Range
Hg	1	.17	PPB	0

Analysts: Reed et al., (1971).

No Age References

10029,0

Original PET Photo
(S-69-45748)



10029,13
(S-75-33060)

10029

Sample 10029 is a sub-angular, medium grey, medium-grained basalt. This sample originally weighed 5gm and measured 1.5x1.5x1cm. Sample was originally returned in the Contingency Sample Container.

BINOCULAR DESCRIPTION BY: Geeslin/Kramer/Walton DATE: 6/10/76

ROCK TYPE: Med.Grained Basalt SAMPLE: 10029,13 WEIGHT: 3.375gm

COLOR: Medium grey DIMENSIONS: 1.0x0.5x0.5 cm

SHAPE: Laboratory shaped into hemi-ellipsoid (one sawed face).

COHERENCE: Intergranular - coherent
Fracturing - None

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: Homogeneous

SURFACE: All surfaces fairly smooth.

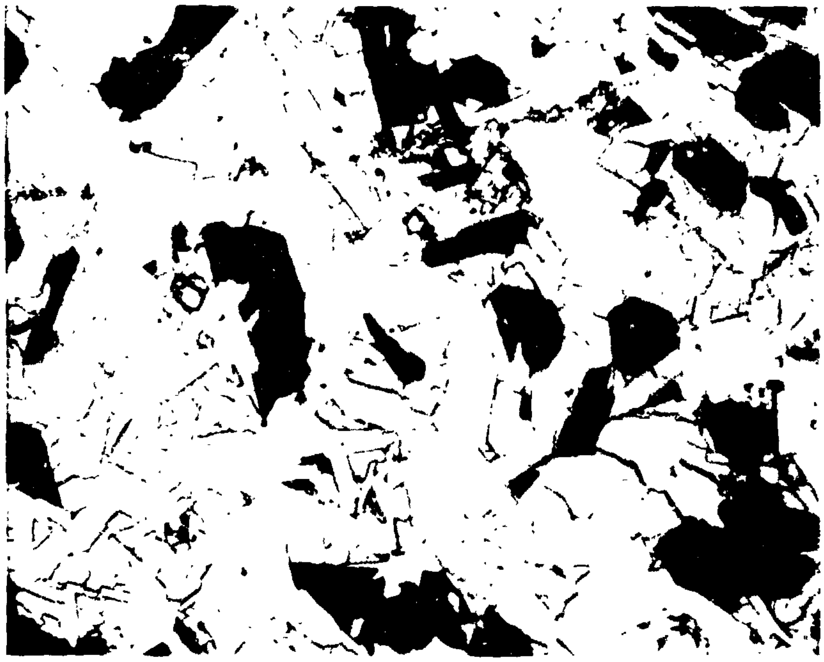
ZAP PITS: Few on N face

CAVITIES: Vugs on W_1 and T_1 face. Total surface area covered by vugs is 0.5%. Vugs average 1mm radius and contain euhedral white and brown crystals.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	RANGE
Plagioclase	White to grey	30	Sugary to tabular	.33	.05-.8
Ilmenite	Sub-metallic	15	Subhedral blocky	.8	.1-.2
Pyroxene	Orange-Yellow	4	Granulated	.5	.1-1
Pyroxene	Brown	49	Subhedral blocky	.3	.05-.5
Olivine	Lt.Green	<1	Rounded	.5	.5
Orange	Rust	2	Non-crystalline	1	.5-1

SPECIAL FEATURES:

Orange blotches that look like rust. Probably oxidation degradation of the sample.



SECTION: 10029,17 Width of Field 2.19mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/10/76

SUMMARY: Fine-grained subophitic basalt composed of clinopyroxene, two generations of plagioclase, ilmenite with subordinate mesostasis. Large anhedral crystals of clinopyroxene host the smaller somewhat grouped plagioclase crystals and scattered subhedral to skeletal ilmenite crystals. Many cracks exist in the section which are filled with partly devitrified glass.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	53	Anhedral, irregular	0.3-1.8
Plag	32	Euhedral to anhedral	0.01-0.9
Opaq	14	Subhedral to skeletal	0.01-0.8
Meso	1	Irregular	0.001-0.1

COMMENTS:

Pyroxene - The clinopyroxene forms large anhedral interlocking crystals which host the other phases present. Many of the crystals show zoning and some exsolution. A few crystals contain small cores of olivine. Approximately one-third of the crystals in the section show only a weak cleavage or fracture pattern. A few of the crystals are twinned. Almost all of the crystals show uneven extinctions.

Plagioclase - Two generations of plagioclase occur in the rock. The first type consists of small euhedral tablets which appear in the sections as well defined rectangular crystal sections. These tablets are somewhat grouped and form distinct units within the pyroxene array. The twinning is well pronounced and the interfaces sharp. The second type consists of larger anhedral masses that form interstitial void fillings in the pyroxene array. These crystals show poor twinning and extinctions are uneven. This type of plagioclase is most often associated with the mesostasis present in the rock. The mesostasis is light brown in color. Several cracks in the rock are also filled with the glass-rich mesostasis.

Opaques - The ilmenite present in the rock forms small subhedral crystals which are somewhat skeletal grading to larger poikilitic skeletal crystals. Many of the crystals contain silicate inclusions, mostly pyroxene. The ilmenite, euhedral tablets of plagioclase and the clinopyroxene form the basic structure array of the rock. Small masses of troilite and troilite with iron-nickel are also present in the section. These masses form interstitial masses between silicate grains. Some of the troilite is associated with the ilmenite, but most is isolated in the pyroxene rich ground mass.

TEXTURE: Fine-grained subophitic basalt consisting of pyroxene, two generations of plagioclase, ilmenite and minor mesostasis. The pyroxene-euhedral plagioclase-ilmenite form the host array with the anhedral plagioclase and mesostasis filling the void areas in the array. All phases are in sharp contact with all other phases.

HISTORY AND PRESENT STATUS OF SAMPLES - 10/25/76

10029 was removed from the Contingency Sample Container and processed in PCTL. The largest chip was later split and re-examined in RSPL.

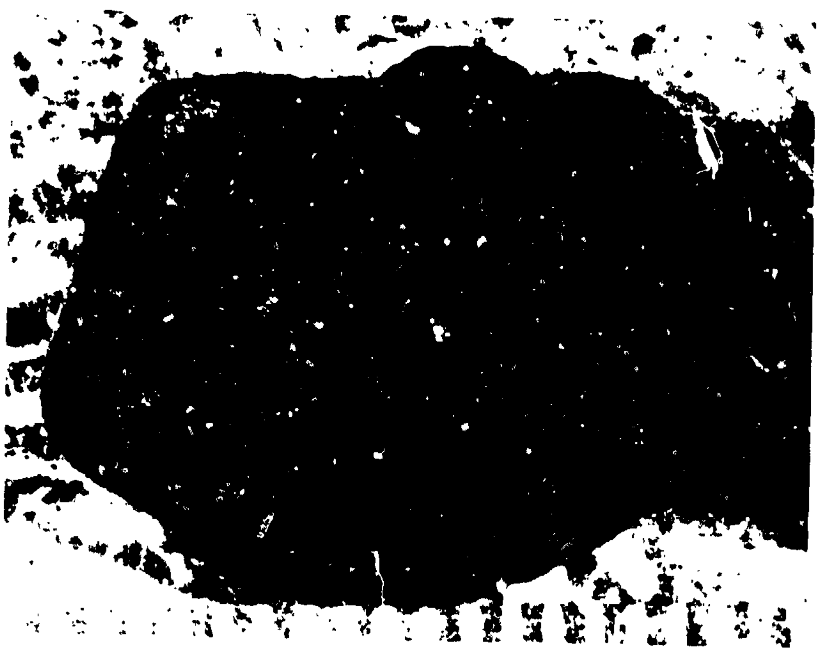
PRISTINE SAMPLES - None

RETURNED SAMPLES:

13 2.87gm Chip with a few pits on one surface. PCTL-SSPL

NO CHEMICAL ANALYSES OR AGE DATES PUBLISHED

10030,0
(S-69-46057)
Original PET Photo



10030,5
(S-76-21142)

10030

Sample 10030 is a subangular to subrounded, medium dark grey microbreccia. This sample originally weighed 2gm and measured 1.5x1.0x0.8 cm. Sample was returned in the Contingency Sample Container.

BINOCULAR DESCRIPTION BY: Twedell DATE: 1/15/76

ROCK TYPE: Microbreccia SAMPLE: 10030,5 WEIGHT: 1.76 gm

COLOR: Medium dark grey DIMENSIONS: 1 x 1 x 0.8 cm

SHAPE: Subangular to subrounded

COHERENCE: Intergranular - coherent
Fracturing - absent

FABRIC/TEXTURE: Anisotropic/Microbreccia

VARIABILITY: Homogeneous

SURFACE: Smooth on T_1-S_1, irregular on all others.

ZAP PITS: Few on T_1. None on any others. Pits are glass lined, <1mm in diameter.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Med.Dk.Grey	99	-----	-----	-----
Grey & White $Clast_1$	Grey/White	<1	Subangular to subrounded	0.5	<1.0
Basalt Clast	Black/White and Brown	1	Angular	0.7	<1.2
Salt & Pepper Clast	Black/White	<1	Angular	0.5	<1.0

1) Texture is aphanitic. Even distribution of dark and light minerals.

THIN SECTION DESCRIPTION

There were no thin sections for the generic 10030 at the onset of re-examination. Due to the small size of the total generic (1.76g), it was judged unwise to remove a chip for thin sections.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/28/76

10030 was removed from the Contingency Sample Container and processed in PCTL. The only remaining pristine sample was re-examined in SSPL.

PRISTINE SAMPLES:

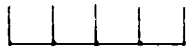
5	1.76 gm	Chip. One lightly pitted surface. PCTL-SSPL

NO RETURNED SAMPLES

NO CHEMICAL ANALYSES

NO AGE DATES

10031,0
Original PET Photo
(No NASA Number)



cm (appx)

10031,0
(S-76-21144)

10031

Sample 10031 is an angular to subangular, medium dark grey, medium-grained basalt. This sample originally weighed 3gm and measured 2 x 1.5 x 0.5 cm. Sample was returned in the Contingency Sample container.

BINOCULAR DESCRIPTION BY: Twedell DATE: 1/16/76

ROCK TYPE: Vesicular basalt SAMPLE: 10031,0 WEIGHT: 1.70 gm

COLOR: Medium dark grey DIMENSIONS: 1.9 x 1.2 x 1 cm

SHAPE: Angular to subangular

COHERENCE: Intergranular - tough
Fracturing - absent

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: Homogeneous

SURFACE: All surfaces are rough.

ZAP PITS: Absent

CAVITIES: 5% of surface as vesicles and vugs. Average size is <1mm. Largest vesicle is 2mm.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Pyroxene	Dk.Brown	60	Subhedral	.1	<.5
Plagioclase	White	20	Blocky	.1	<.5
Opaque	Black	15	Platy	.05	<.2

COMMENTS: Four phases were noted by Harmon (PET). 1) Light green equigranular mineral, evenly distributed throughout the fines. 2) A highly reflective phase that appeared to be glass. 3) The groundmass material which appeared to be dust similar to the contingency sample; and, 4) Amber mineral phase, generally equigranular. These phases were taken from the fines with 10031,0 and not the rock itself.

THIN SECTION DESCRIPTION

There was no Thin Section made for generic 10031 at the onset of re-examination. The only sample of the generic (1.70gm) was judged too small for a thin section allocation.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/30/76

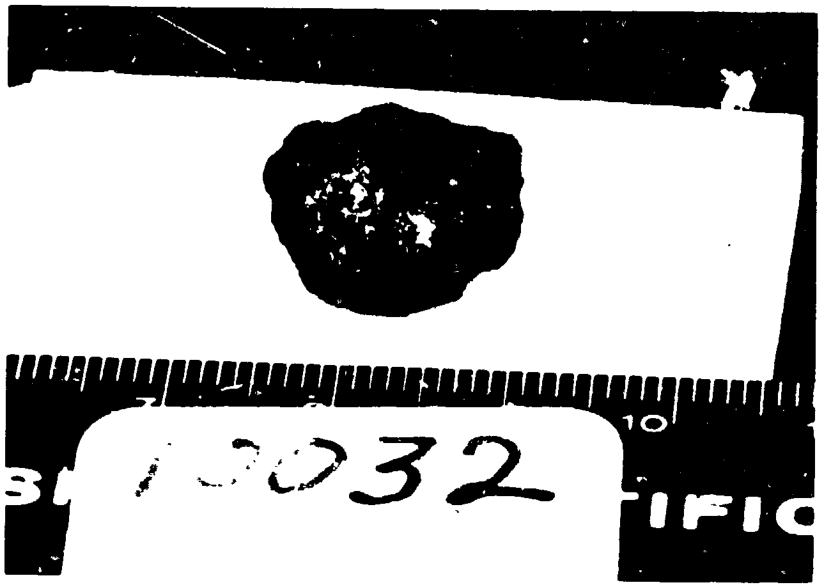
10031 was removed from the Contingency Sample Container and examined in PCTL. No splits were ever made from the rock. It was re-examined in SSPL.

PRISTINE SAMPLE:

0 1.70 gm Piece with no pitted surfaces.

NO RETURNED SAMPLES

NO CHEMICAL ANALYSES OR AGE DATES



10032,0

Original PET Photo
(S-69-46006)

10032,20
(S-75-31697)

10032

Sample 10032 is an angular to subangular, medium light grey, fine-grained basalt. This sample originally weighed 3gm and measured 2x1.5x0.5 cm. Sample was returned in the Contingency Sample container.

BINOCULAR DESCRIPTION BY: Twedell & Geeslin DATE: 9/23/75

ROCK TYPE: Fine-grained basalt SAMPLE: 10032,20 WEIGHT: 3.1 gm

COLOR: Medium light grey DIMENSIONS: 2 x 1.5 x 0.5 cm

SHAPE: Angular to sub-angular

COHERENCE: Intergranular - coherent
Fracturing - absent

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: Homogeneous

SURFACE: Irregular due to cavities.

ZAP PITS: Absent

CAVITIES: Approximately 7% surface coverage. Average size is <1mm. Cavities are well defined.

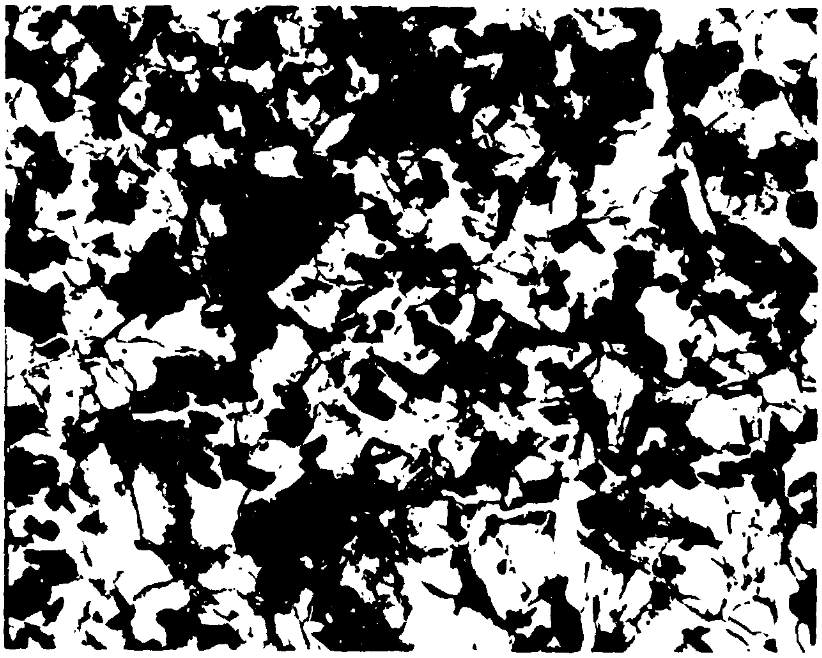
COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	RANGE
Plagioclase$_1$	White	45	Crystalline to aphenitic	.3	.05-.5
Pyroxene$_2$	Hon.Brown to dark	20-25	Crystalline	.1	<.1-.3
Green$_3$	Dk.Green	8-10	Rounded	.1	<.1-.2
Dark$_4$	Black	20-25	Platy	<.1	.1-.1

1) Comes in three forms. A crystalline material, a shocked material, and a fine white material.
2) Well defined pyroxene crystals.
3) Extremely dark green material, probably either olivine or dark pyroxene.
4) Some appears to be devitrified black glass. Some is semi-opaque material which is associated with the white crushed material.

Opaque is platy ilmenite. Approximately 50% opaque and 50% lustrous material.

SPECIAL FEATURES:

The dark brown component appears in only one large area on the surface. It has a well defined crystal structure.



SECTION: 10032,26 Width of field 2.72 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/9/76

SUMMARY: Fine-grained intersertal basalt composed of clinopyroxene, plagioclase, and ilmenite with subordinate mesostasis. Most of the crystals are poorly formed except for the ilmenite which forms well defined subhedral crystals. Some skeletal development is also evident in the ilmenite, but to a lesser degree than in other Apollo 11 intersertal basalts. All of the plagioclase occurs as interstitial void fillings with no free standing crystals.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	53	Anhedral, irregular	0.05-0.2
Plag	21	Anhedral	0.01-0.3
Opaq	16	Subhedral to anhedral	0.005-0.3
Meso	10	-------	---------

COMMENTS:

Pyroxene - the clinopyroxene forms somewhat larger anhedral crystals which host the other phases. The color is pale brown with some crystals having a yellowish cast. Many of the crystals are zoned and optical characteristics are poor. All crystals are fresh and contacts are sharp.

Plagioclase - Unlike many intersertal basalts, this rock contains only interstitial plagioclase crystals. None of the more tabular crystals appear to have formed. The masses of plagioclase are all anhedral and irregular. They fill the void spaces in the pyroxene-ilmenite network. Very few twin planes are evident and extinctions are irregular. Some smaller, more well defined crystals are present in the rock, but these are far more uncommon than the larger poorly formed crystals. Also associated in the interstitial position are rather large masses of a brownish glass-rich mesostasis. The masses are very turbid and the boundaries are indistinct. The masses are associated more often in the pyroxene crystals than with the plagioclase crystals.

Opaques - Unlike many intersertal basalts, this rock has far less skeletal ilmenite than usual. Most of the crystals are subhedral with some nearly euhedral lathes. The crystals are nearly equant to slightly elongated. Only occasional masses of skeletal growth is encountered. Much of the ilmenite is somewhat grouped and occurs as distinct patches within the rock. Scattered throughout the section are small masses of troilite and troilite with iron-nickel. The masses are small and sparse.

TEXTURE: Fine grained intersertal basalt consisting of a network of nearly equigranular pyroxene crystals that are intergrown with subhedral ilmenite prisms. Occurring interstitial to the pyroxene-ilmenite network are anhedral masses of plagioclase, a few nearly enhedral ilmenite prisms and irregular patches of mesostasis. Most of the crystals show poor optical characteristics.

HISTORY AND PRESENT STATUS OF SAMPLES - 11/1/76

10032 was removed from the Contingency Sample container and split in PCTL. It was later re-examined and split in RSPL.

PRISTINE SAMPLES:

None

RETURNED SAMPLES:

20	3.1	gm	Chip. Stored in a curator safe in a plastic pill box before going to RSPL.
21	.001	gm	Fines from ,20. Stored in returned sample lab. Has never been sent to any P.I.

NO CHEMICAL ANALYSES OR AGE DATES

10037

10037 was the generic number assigned to the half of the drive tube material (10004 and 10005) obtained for biological analyses. There are no pristine samples remaining and less than 1gm was ever returned from the Bio-Pool.

10044

10044,0
Original PET Photo
(S-69-45539)

cm

10044,54
(S-75-31692)

10044

Sample 10044 is an angular to sub-angular, grey and white, cristobalite basalt. This sample originally weighed 247gm. and measured 7x4x3cm. It was returned in ALSRC #1003 (Bulk Sample container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 9/18/75

ROCK TYPE: Cristobalite Basalt SAMPLE: 10044,59 WEIGHT: 25 gm.

COLOR: Grey & White DIMENSIONS: 4 x 3.5 x 1.5 cm.

SHAPE: Angular to sub-angular; rounded but rough on surface texture (PET).

COHERENCE: Intergranular - friable
Fracturing - absent; some elongate openings or fractures --look like semi-healed fractures. Width of fractures variable, in some places almost vuggy (PET).

FABRIC/TEXTURE: Isotropic; structures-many open circles, irregular, not straight, some are discontinuous, definite lines of weakness (PET)/Equigranular; Granular-Holocrystalline (PET).

VARIABILITY: Homogeneous

SURFACE: Irregular

ZAP PITS: None observed

CAVITIES: Approximately 5% surface coverage, <2mm in diameter.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Pyroxene	Pink to Red	35	Anhedral	0.5	1
Plagioclase	White	45	Anhedral to laths	0.5	1
Opaques	Black	20	Rounded to subrounded	0.5	1

SECTION: 10044,55 Width of field 2.72mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 9/18/75

SUMMARY: Medium-grained subophitic basalt composed of clinopyroxene, plagioclase, ilmenite with subordinate cristobalite, pyroxferroite and mesostasis. Large anhedral crystals of clinopyroxene host the other phases present. Many of the pyroxene crystals exhibit polygranularity.

Many of the plagioclase, ilmenite and cristobalite crystals show parallel facial development. The ilmenite occurs in rather large skeletal crystals associated with chromian ulvospinel, troilite and iron-nickel metal.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	47	Subhedral to anhedral	0.4-1.4
Plag	34	Blocky to tabular	0.1-0.9
Cris	3	Subhedral to anhedral	0.2-1.2
Opaq	12	Skeletal to anhedral	0.08-0.9
Meso	4	-------------------	--------

COMMENTS:

Pyroxene - At least two types of pyroxene occur in section. One is pinkish in color with a poor cleavage pattern while the other is reddish and has a well developed cleavage pattern. All crystals have wavy extinctions and are more or less polygranular. Occasional small masses of pyroxferroite also occur with the pyroxene. Chao et al., (1970) reported the new mineral pyroxferrite from 10044.

Plagioclase forms tabular crystals which show sharp twin planes. The crystals are somewhat grouped into radiating groups.

Cristobalite occurs as interstitial void fillings between the plagioclase and pyroxene crystals.

The major opaque phase in the section is ilmenite. The crystals are moderately large and only occasional small shards are encountered. The crystals are very skeletal. Troilite and troilite with iron-nickel inclusions form small masses in the section. Several crystals of chromian ulvospinel also occur in the section.

The mesostasis consists of a brownish glass-rich phase which fills interstitial voids in the silicate network. The glass is very turbid.

Bailey et al. (1970) have reported modal analyses for 10044,74; 10044,41; and 10044,44,1 which is in agreement with the above analysis. They also reported finding apatite and K-feldspar with possible olivine and rutile in their sections, but none were observed in this section.

Cameron (1970) reported on a yttrium-zirconium silicate in 10044,50.

Fuchs (1970) has reported apatite in 10044,48.

TEXTURE: Nearly equigranular subophitic with large scattered crystals of ilmenite. Little to no indication of shock is present. All crystals are fresh and in sharp contact with each other.

Selected References: Agrell et al., (1970), Albee and Chodos (1970), Bailey et al., (1970), Cameron (1970), Smith, J.V. et al.,(1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 4/20/76

10044 was removed from the Bulk Sample Container (ALSRC #1003) and processed in the Bio-Prep Lab. A chip was sent to PCTL for splitting and PET description and analysis. A portion was sent to the Bio-Pool for biological analyses. The rock was sawed in SPL. The remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES:

14	16.07	gm	Fines. PCTL-SPL-SSPL
15	39.65	gm	Three large chips plus small chips and fines. PCTL-SPL-SSPL
54	48.0	gm	Chip with one sawed surface. Was display sample kept in a nearly hermetic display container for 4 1/2 years. PCTL-SPL-Display-SSPL
59	24.14	gm	Representative chip with no pitted or sawn surfaces. PCTL-SPL-SSPL

RETURNED SAMPLES:

36	11.121	gm	Chip.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	6	43.19	PCT	5.13
Al_2O_3	6	10.72	PCT	2.45
TiO_2	8	9.10	PCT	4.09
FeO	9	15.76	PCT	19.36
MnO	9	.266	PCT	.056
MgO	5	6.11	PCT	.886
CaO	7	11.49	PCT	5.59
Na_2O	9	.472	PCT	.079
K_2O	8	.116	PCT	.066
P_2O_5	3	.063	PCT	.04
Li	3	11.77	PPM	4.5
Rb	5	1.75	PPM	4.49
Cs	1	.034	PPM	0
Sr	3	186.7	PPM	94.

C-3

Element	Number of Analyses	Mean	Units	Range
Ba	7	149.1	PPM	163.
Sc	6	95.7	PPM	12.3
V	3	45.5	PPM	34.
Cr_2O_3	8	.213	PCT	.063
Co	6	12.72	PPM	4.5
Ni	2	5.50	PPM	2.99
Cu	3	5.73	PPM	5.0
Zn	1	3.0	PPM	0
Y	2	163.5	PPM	33.
Zr	4	501.5	PPM	414.
Nb	1	21.	PPM	0
Mo	1	.03	PPM	0
Ag	1	.2	PPM	0
Ta	4	2.12	PPM	1.2
W	1	.24	PPM	0
Hf	5	13.86	PPM	4.5
Au	1	.02	PPM	0
Hg	1	.001	PPM	0
La	5	11.41	PPM	4.65
Ce	4	52.4	PPM	48.4
Nd	1	50.0	PPM	4.65
Sn	4	16.07	PPM	7.3
Eu	4	2.76	PPM	.36
Gd	1	24.0	PPM	0
Tb	3	4.91	PPM	.61
Dy	2	26.05	PPM	3.1
Ho	1	5.67	PPM	0
Yb	6	13.58	PPM	6.5
Lu	5	1.89	PPM	.85
Th	2	.99	PPM	.02

Element	Number of Analyses	Mean	Units	Range
U	2	.24	PPM	.08
B	1	1.2	PPM	0
Ga	1	5.1	PPM	0
Ln	1	.003	PPM	0
C	1	102.	PPM	0
Ge	1	1.0	PPM	0
N	1	98.0	PPM	0
As	1	.05	PPM	0
O	1	41.5	PCT	0
S	2	.12	PCT	.12
Se	1	.23	PPM	0
F	2	142.5	PPM	119.
Cl	1	14.7	PPM	0
Br	1	.19	PPM	0
I	1	.48	PPM	0

Analysts: Agrell et al., (1970); Engel & Engel, (1970); Goles et al., (1970); Wakita et al., (1970); Wanke et al., (1970); Dymek et al., (1975); Turekian & Kharkar, (1970); Kharkar & Turekian, (1971); Engel et al., (1971); Tera et al., (1970); Murthy et al., (1970); Reed & Jovanovic, (1970); Brown et al., (1970); Papanastassiou et al., (1970); Moore et al., (1970); Meyer, (1972).

Age References: Turner (1970); Hintenberger et al., (1971); Eberhardt et al., (1970); Papanastassicu et al., (1970).

10045,0
Original PET Photo
(S-69-45601)

1 cm.

10045,19
(S-75-31797)

ORIGINAL PAGE I.
OF POOR QUALITY

10045

Sample 10045 is an angular to sub-angular, medium dark grey, olivine basalt. This sample originally weighed 185gm and measured 4x3x2.5cm. Sample was returned in ALSRC #1003. (Bulk Sample Container)

BINOCULAR DESCRIPTION BY: Twedell DATE: 9/18/75

ROCK TYPE: Olivine basalt SAMPLE: 10045,19 WEIGHT: 100.4 gm

COLOR: Medium dark grey DIMENSIONS: 4 x 2.5 x 2 cm

SHAPE: Angular to sub-angular

COHERENCE: Intergranular - coherent
Fracturing - few, non-penetrative, fairly wide in places, mostly in middle; numerous in middle of rock, vary in width. Some open to wide cavities (PET)

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: Homogeneous

SURFACE: Surfaces are irregular on fresh, to smooth on exposed surfaces.

ZAP PITS: Many on T_1, W_1, B_1, edge. None on E_1, S_1, N_1.

CAVITIES: 20% of surface covered by vugs. Half of vugs are glass lined. Average size is approximately 1.5 to 2mm, some vesicular cavities make up approximately 10% total surface area (PET).

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	RANGE
Plagioclase[1]	White	30-35	Lathy	.1	<.05-.2
Pyroxene	Dark Brown	35	Anhedral	.3	.2-.4
Dark[2]	Black	20-22	Anhedral to amorphous	.1	.05-.3
Olivine	Light Green	8	Euhedral	.2	.1-.4

1) Clear to chalky white
2) 10-12% opaque; 10-8% glass

SPECIAL FEATURES: High % of vugs plus fine grained texture as opposed to 10044. White powdery material adhering to outer surface, especially on W_1, T_1 surfaces. Sample also seems to have a higher percentage of dark minerals than 10044.

SECTION: 10045,17 Width of field 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 5/28/76

SUMMARY: Medium-grained ophitic basalt composed of clinopyroxene, two generations of plagioclase, two generations of ilmenite with subordinate chromian ulvospinel, troilite-iron nickel, olivine, cristobalite, and mesostasis. The pyroxene forms large anhedral to irregular crystals with lath-like to anhedral ilmenite crystals in a continuous network. Interstitial to these phases are subhedral to anhedral crystals of plagioclase and cristobalite with minor glass-rich mesostasis. Some of the plagioclase crystals are slightly bent and somewhat skeletal.

PHASE	% OF SECTION	SHAPE	SIZE(MM)
Pyrox	52	Anhedral to irregular	0.05-0.4
Plag	22	Tabular to anhedral	0.1-0.3
Opaq	17	Lath-like to anhedral	0.05-0.4
Oliv	3	Subhedral to anhedral	0.05-0.4
Chr.Ulvo	2	Irregular to rounded	0.02-0.08
Cris	2	Anhedral, blocky	0.01-0.1
Meso	2	Irregular	0.01-0.2

COMMENTS:

Pyroxene - The pyroxene occurs as large pale brown anhedral crystal masses. In sharp contact with the pyroxene are subhedral to anhedral crystals of olivine. A few crystals exhibit a well defined cleavage pattern, while most show only traces of cleavage with predominant fracture patterns. Crystals of plagioclase, ilmenite and cristobalite occur within and between the pyroxene crystals.

Plagioclase - Large to small tabular crystals of plagioclase occur as groups and as isolated crystals within the pyroxene network. Larger anhedral crystals of plagioclase also occur as masses within the network. Some bending of the tabular crystals is present. Many of the larger crystals are somewhat skeletal in development. All crystals showed well developed twin planes, with the sharpest twins seen in the smaller crystals.

Olivine - Small to large blocky subhedral to anhedral crystals of olivine are scattered throughout the section. The crystals are fresh except for small reaction rims of pyroxene. A few crystals clearly show residual crystal faces in sharp contact with the pyroxene.

Opaques - The phases comprising the opaques are ilmenite, troilite, troilite-iron nickel, and chromian ulvospinel.

Two generations of ilmenite are present in the section. The crystals occur as small lath-like crystal sections and also as large somewhat skeletal anhedral crystals. The larger crystals are far more abundant.

Many of the large crystals of ilmenite have associated armalcolite and/or exsolved chromite. Many of the armalcolite lamallae are transected by exsolution of chromite which produce microfaults in the lamallae. Associated with the ilmenite are anhedral crystals of chromian ulvospinel. The crystals are grouped into small areas of the section where three or more masses are concentrated. In a few cases large isolated masses are seen in the silicate network. Many of the crystals have small borders of ilmenite and are completely encased by ilmenite.

Isolated masses of troilite and troilite with iron-nickel occur in the silicate network. Several cracks in the silicate minerals are filled by iron-nickel metal.

Cristobalite - Isolated small masses of cristobalite are found between adjacent pyroxene crystals. The masses appear to be randomly distributed throughout the section.

Small amounts of a light brown to colorless mesostasis occurs in the section. Some birefringence is present, but no phases were identified in the masses. Some mixing of the mesostasis with a silica phase may be present as the index of refraction varies within the masses.

TEXTURE: Interlocking anhedral crystals of pyroxene intergrown with two generations of ilmenite, two generations of plagioclase and subordinate other phases. Interstitial to this network are masses of plagioclase, cristobalite and mesostasis.

Selected References: Agrell et al., (1970), Brown et al., (1970), Keil et al., (1970), Simpson and Bowie (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 5/28/76

10045 was removed from the Bulk Sample Container (ALSRC #1003) and processed in the Bio-Prep Lab. A 13gm chip was sent to PCTL for analysis. Remaining pristine samples were re-examined in SSPL. A large piece was sent to RCL.

PRISTINE SAMPLES:

1	2.02	gm	This piece does not have the same lithologic features as other 10045 subsamples. It is believed to be part of 10047 or 10044, but neither could be substantiated. It was assigned the number 10999,103.BP-PCTL-SSPL
3	0.159	gm	Small chips and fines. BP-PCTL-SSPL
18	5.91	gm	Small chips and fines. BP-SSPL
19	100.9	gm	Piece. Pitted on three surfaces. BP-SSPL-RCL-SSPL
74	6.02	gm	Piece. It was labeled 10047,1 but was matched with 10045 PET photos and assigned to 10045. No pitted surfaces. BP-PCTL-SSPL
77	14.68	gm	Piece. Split from ,18. One pitted surface. BP-SSPL

RETURNED SAMPLES:

47	9.74	gm	Piece with no pitted surfaces.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	4	40.99	PCT	4.28
Al_2O_3	4	10.53	PCT	3.49
TiO_2	3	11.39	PCT	.66
FeO	6	16.02	PCT	3.67
MnO	4	.272	PCT	.020
MgO	3	8.32	PCT	1.39
CaO	3	11.32	PCT	.023
Na_2O	3	.356	PCT	.012
K_2O	5	.052	PCT	.014
P_2O_5	2	.07	PCT	.06
Rb	5	1.03	PPM	1.28
Sr	4	133.92	PPM	36.
Ba	6	117.23	PPM	355.
Sc	3	81.9	PPM	12.3
V	2	100.5	PPM	5.
Cr_2O_3	5	.388	PCT	.131
Co	4	20.57	PPM	8.4
Ni	2	6.99	PPM	5.97
Cu	2	6.10	PPM	.200
Zn	3	6.63	PPM	11.1
Y	2	79.	PPM	12.
Zr	3	254.33	PPM	156.
Nb	2	13.0	PPM	2.
Ag	1	.005	PPM	0
Ta	2	1.9	PPM	.2
Hf	3	7.73	PPM	2.5
Au	1	.2	PPB	0
La	4	9.1	PPM	9.3

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Ce	3	27.17	PPM	9.5
Pr	1	6.	PPM	0
Nd	2	19.05	PPM	4.1
Sm	3	9.19	PPM	1.43
Eu	3	1.5	PPM	.09
Gd	1	13.2	PPM	0
Tb	2	2.02	PPM	.23
Dy	2	14.95	PPM	.9
Ho	1	2.8	PPM	0
Er	1	9.7	PPM	0
Yb	4	6.99	PPM	8.85
Lu	3	1.34	PPM	.28
Th	3	1.00	PPM	1.45
U	1	.17	PPM	0
Ga	2	3.5	PPM	1.0
In	1	.014	PPM	0
Pb	1	.482	PPM	0
As	1	.073	PPM	0
Sb	1	.007	PPM	0
S	2	.145	PCT	.01
Se	1	.8	PPM	0
Cl	1	6.8	PPM	0
Br	1	.056	PPM	0

Analysts: Agrell et al., (1970); Compston et al., (1970); Wakita et al., (1970); Goles et al., (1970); Haskin et al., (1970); Murthy et al., (1970); Brown et al., (1970); Silver, (1970).

Age References: Ekerhardt (1971); Silver (1970).

10046,0
Original PET Photo
(S-69-45621)

cm

10046,193,194
(S-75-33425)

10046

Sample 10046 is a sub-angular, dark grey, fine breccia. This sample originally weighed 663gm, and measured 10x7.5x8cm. Sample was returned in ALSRC #1003. (Bulk Sample Container)

BINOCULAR DESCRIPTION BY: Kramer DATE: 11/8/75

ROCK TYPE: Fine Breccia SAMPLE: 10046,193 WEIGHT: 120 gm

COLOR: Dark grey DIMENSIONS: 5.0 x 4.5 x 2.8 cm

SHAPE: Sub-angular

COHERENCE: Intergranular - moderately friable
Fracturing - absent

FABRIC/TEXTURE: Anisotropic/Fine breccia

VARIABILITY: Homogeneous

SURFACE: Hackly and irregular

ZAP PITS: E_1, few. Others, none.

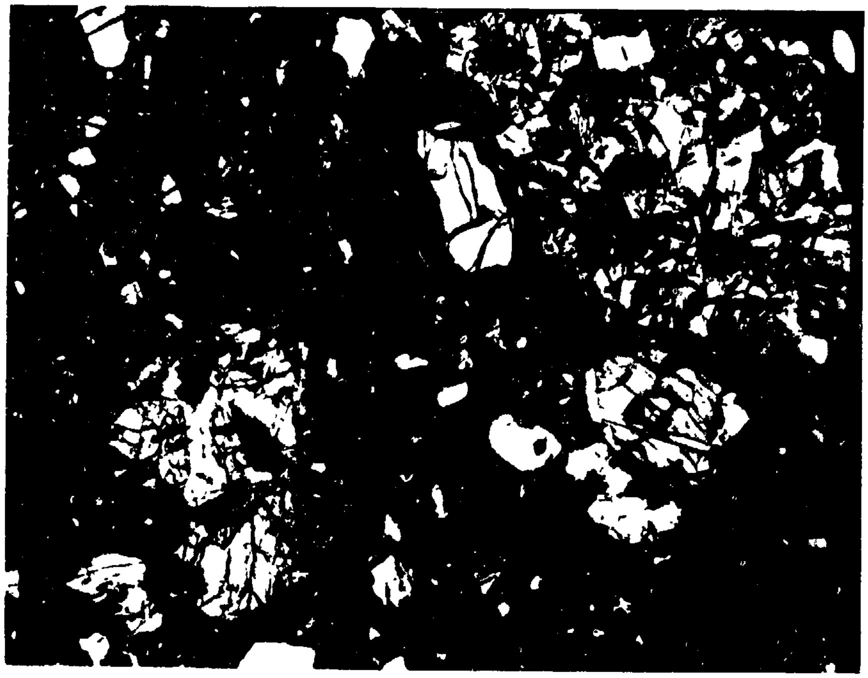
CAVITIES: Few - less than 2% of surface. Some are lined with glass and/or crystals.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Dk.Grey	90	---------	----	-----
White Clast$_1$	White	3	Angular	1.0	0.05-1.5
Brown Clast$_2$	Honey Brn.	1	Sub-rounded	0.8	0.05-4.0
Glass Spherules	Black	<1	Sub-rounded	0.5	<0.8
Basalt Clast	Lt.Grey	5	Sub-angular	2.0	.1-2.5

1) Single grains and aggregates of plagioclase (many crushed or shocked).
2) Brown pyroxene.

SPECIAL FEATURES:

There are small patches of black, glassy spatter on several subsamples.



Section 10046,53 Width of field: 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/29/76

SECTION: 10046,56

SUMMARY: Partly devitrified typical breccia with a relatively high glass content. Several large lithic clasts are present which show a large diversity in composition and type. The matrix is not as continuous as in other Apollo 11 breccias. The array is interrupted by the numerous mineral and lithic clasts.

MATRIX 50% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Dark Brown	100	-----	<0.001	High glass content; numerous small crystallites; somewhat discontinuous.

MINERAL CLASTS 30% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Pyroxene_1$	Very abundant	Angular to irregular	0.001-0.2
$Plagioclase_2$	Present	Blocky to irregular	0.001-0.1
$Opaques_3$	Few	Blocky to skeletal	0.001-0.2

1) Some exsolution and zoning; fair to poor extinctions.
2) Very scarce; a few shards; fair to good twins.
3) Most in clasts; some fragments in matrix.

LITHIC CLASTS 10% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
$Large_4$	Nine present	Rounded to irregular	>1.0

4) a. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.

b. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

c. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

d. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

e. Fine-grained intersertal basalt consisting of pyroxene, plagioclase, ilmenite and mesostasis.

f. Crystal aggregation consisting of large skeletal crystals of ilmenite with small pyroxene, plagioclase and ilmenite crystals; some glass in matrix.

g. Coarse-grained basalt which appears to be crushed as the crystals of pyroxene and plagioclase are polygranulated. Some ilmenite is present.

h. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.

i. Fine-grained with high glass content with several mineral clasts; matrix yellow-brown.

GLASS CLASTS 10% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange$_5$	Very abundant	Spherical to angular	0.001-0.3

5) Many spherical, ovoid and part spheres plus angular shards; most show little devitrification; some bubbles present.

Selected References: Adler et al., (1970), Dence et al., (1970); Essene et al., (1970), Lovering and Ware (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 6/29/76

10046 was removed from the Bulk Fines Container (ALSRC #1003) and split in the Bio Prep Lab. A 6.5gm chip was sent to PCTL for PET analysis. The parent rock was sawed and chipped in SPL. Remaining pristine samples were re-examined in SSPL. NOTE: There is a statement in the sample history data that this sample was originally contaminated in the Bio-Prep Lab.

PRISTINE SAMPLES:

12	0.17	gm	Fines. BP-SSPL
14	0.149	gm	Three small chips. Largest is 2.5.xmm. BP-SSPL
15	7.92	gm	Chips and fines. There are four chips larger than 1mm. BP-SSPL
67	7.27	gm	Chips and fines. The largest chip is 1x1x0.5cm. There is a small basalt chip in this sample. At some time during early processing, this sample was cross-contaminated with a basalt. BP-SSPL
68	5.55	gm	Chips and fines. BP-SSPL
193	120.18	gm	5.5x4.5x3.5cm piece. Mated with ,194. Two sawed faces (S_1, B_1). E_1 has a few pits. Other surfaces are fresh. BP-SPL-SSPL-RCL-SSPL
194	113.42	gm	6.5x6x3cm piece. Mated with ,193. One sawed face (N_1, E_1). One pitted face (few on S-W_1). Other surfaces are fresh. BP-SPL-SSPL
195	27.25	gm	5x4x1cm sawed end piece. B_1 is sawed. T_1 has patina but no pits. Large brown clast (4cm) on T_1. BP-SPL-SSPL
196	17.83	gm	4x2x1.5cm sawed piece. T_1, B_1, and E_1 are sawed. Others are fresh. BP-SPL-SSPL
197	30.60	gm	6 sawed chips. Shaped pieces with two to five sawed faces. No pitted surfaces. BP-SPL-SSPL

198	24.00	gm	Five large chips. Three have pits on one side. BP-SPL-SSPL
199	17.02	gm	<.25 small chips. Not dusted. BP-SPL-SSPL
200	39.70	gm	Chips and fines. BP-SPL-SSPL

RETURNED SAMPLES:

9	12.869	gm	Three chips. Largest chip has pitted surface.
46	15.328	gm	Fresh chip.
152	13.282	gm	Surface chip. E_1 is pitted.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	44.07	PCT	0
Al_2O_3	1	11.71	PCT	0
TiO_2	2	8.17	PCT	.668
FeO	3	16.0	PCT	1.54
MnO	2	.209	PCT	.017
MgO	1	9.12	PCT	0
CaO	2	13.01	PCT	1.4
Na_2O	3	.544	PCT	.188
K_2O	2	.2	PCT	.010
P_2O_5	1	.229	PCT	0
H	1	55.0	PPM	0
Li	1	16.0	PPM	0
Rb	1	3.6	PPM	0
Cs	1	.2	PPM	0
Be	1	6.0	PPM	0
Sr	2	167.5	PPM	5.0
Ba	2	249.5	PPM	61.0
Sc	3	69.0	PPM	8.0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
V	1	68.0	PPM	0
Cr_2O_3	3	.303	PCT	.026
Co	3	33.0	PPM	15.0
Ni	1	70.01	PPM	0
Cu	1	9.7	PPM	0
Zn	1	30.0	PPM	0
Y	1	190.	PPM	0
Zr	1	620.0	PPM	0
Nb	1	38.0	PPM	0
Mo	2	.365	PPM	.67
Pd	1	.1	PPM	0
Ag	1	.02	PPM	0
Cd	1	.8	PPM	0
Ta	3	1.63	PPM	.4
W	1	.35	PPM	0
Hf	3	11.8	PPM	2.4
Re	2	.400	PPB	.500
Os	2	.500	PPB	.520
Ir	1	.012	PPM	0
Au	1	2.8	PPB	0
La	1	23.0	PPM	0
Ce	4	63.82	PPM	25.7
Pr	1	20.0	PPM	0
Nd	2	55.1	PPM	9.8
Sm	3	15.8	PPM	10.3
Eu	3	1.98	PPM	.06
Gd	1	20.75	PPM	1.5
Tb	1	4.5	PPM	0

CHEMICAL ANALYSES

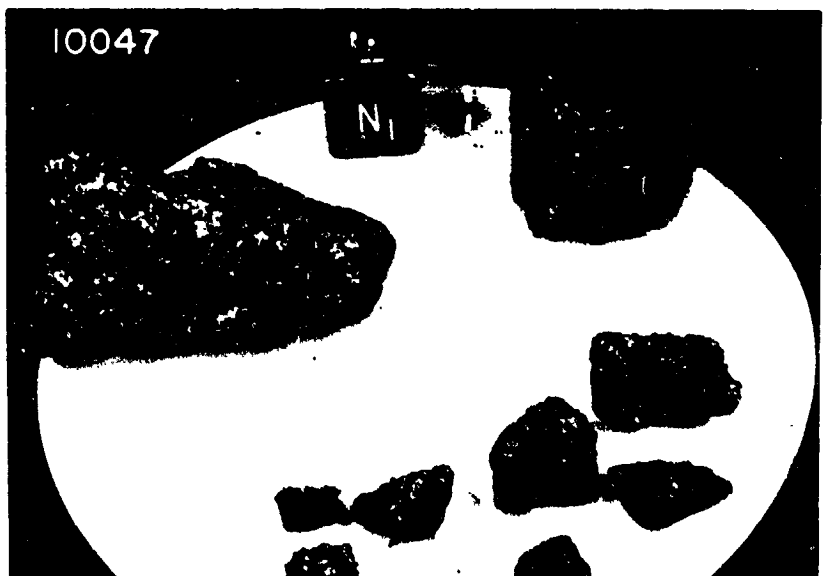
Element	Number of Analyses	Mean	Units	Range
Dy	3	24.93	PPM	10.1
Ho	1	9.0	PPM	0
Er	2	18.9	PPM	8.2
Tm	1	1.6	PPM	0
Yb	3	12.98	PPM	11.3
Lu	3	1.64	PPM	.73
Th	1	2.8	PPM	0
U	1	.58	PPM	0
B	1	9.0	PPM	0
Ga	2	5.15	PPM	.5
In	2	.048	PPM	.064
Ge	1	.39	PPM	0
Pb	1	2.0	PPM	0
N	1	260.0	PPM	0
As	2	.05	PPM	0
Sb	1	.005	PPM	0
Se	1	.4	PPM	0
F	1	220.	PPM	0
Cl	1	520.0	PPM	0
Br	1	.2	PPM	0

Analysts: Morrison et al., (1970); Turekian & Kharkar, (1970); Kharkar & Turekian, (1971); O'Hara et al., (1974); Philpotts & Schnetzler, (1970); Friedman et al., (1970); Lovering & Butterfield, (1970); Lovering & Hughes, (1970); Wasson & Baedecker, (1970).

No Age References

10047,0 1 cm.

Original PET Photo
(S-69-45632)



10047 1 cm.
(S-75-26511)

10047

Sample 10047 is an angular, pinkish grey, Cristobalite Basalt. This sample originally weighed 138gm, and measured 6.5x4x3.5cm. It was returned in ALSRC container #1003.(Bulk Sample Container)

BINOCULAR DESCRIPTION BY: Kramer DATE: 6/14/76

ROCK TYPE: Cristobalite Basalt SAMPLE: 10047,58 WEIGHT: 19.44 gm

COLOR: Pinkish grey DIMENSIONS: 3 x 2 x 1.5 cm

SHAPE: Angular

COHERENCE: Intergranular - coherent
Fracturing - few, non-penetrative

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: Homogeneous

SURFACE: Granulated

ZAP PITS: T_1, few. Others - none

CAVITIES: Absent; irregular shaped vugs up to several mm in size are common. Freshly broken surface shows no vugs (PET).

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Olivine	Green	<3	Equant	.8	.5-1.0
Pyroxene	Brown	>50	Equant	.2	.1-.25
Plagioclase	Milky	<40	Lathlike	.2	.1-.3
Ilmenite	Metallic	10-15	Platy	.2	.02-.6

SECTION: 10047,47 Width of Field 2.22mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/11/76

SUMMARY: Medium grained subophitic basalt composed of clinopyroxene, two generations of plagioclase, ilmenite with subordinate cristobalite pyroxferroite and mesostasis. Large anhedral crystals of clinopyroxene host the other phases present. Many of the clinopyroxene crystals are polygranular while appearing as a single crystal in plane polarized light.

Many of the plagioclase, ilmenite and cristobalite crystals show parallel facial development. The ilmenite crystals are highly skeletal.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	48	Anhedral to irregular	0.1-2.5
Plag	35	Euhedral to anhedral	0.05-0.0
Cris	7	Anhedral	0.1-0.9
Opaq	9	Subhedral to skeletal	0.9-2.5
Meso	1	---------------------	0.001-0.13

COMMENTS:

Pyroxene - The clinopyroxene forms large pinkish tan anhedral crystals. Many of the crystals have been granulated while retaining the monocrystalline appearance. These crystals form the host medium for all other phases present.

The extinctions are, for the most part, poor with few grains giving sharp extinction points. Almost all crystals show a pronounced fracture pattern with minor cleavage parting developed. A few crystals show a well developed cleavage pattern.

Small crystals of pyroxferroite are associated as overgrowths on the pyroxene crystals. These crystals form sharp contacts with the pyroxene. Many of the fractures in the pyroxene continue through the adjacent pyroxferroite overgrowth. The pyroxferroite masses are scattered throughout the section and no localized concentration was noted.

Plagioclase - Two generations of plagioclase occur in the rock. The first type are euhedral tablets which appear in the section as equant to acicular crystals. The crystals show well developed twin planes and extinctions are sharp. There appears to be a preferred orientation to the crystals yet there is only minor clustering.

The second type of crystals represented in the rock forms interstitial masses between the pyroxene-ilmenite-plagioclase network. The masses are larger than the euhedral crystals and show poorer twin planes and extinctions are patchy. This later formed plagioclase is most often associated with the mesostasis that occurs in the rock. The mesostasis is light brown in color and very turbid.

Cristobalite - A relatively large amount of cristobalite occurs in this section. Chao et al. (1970) found 4.5% in another section of this rock. This section may, therefore, be atypical. The anhedral masses are all as interstitial fillings between other crystalline phases.

Opaques - As is usual for Apollo 11 basalts, the most common opaque mineral present in the rock is ilmenite. The crystals form subhedral to skeletal masses scattered throughout the rock. The subhedral crystals are associated with plagioclase and cristobalite while the skeletal crystals form in the plagioclase-pyroxene network.

Small masses of troilite and troilite with iron-nickel inclusions are also present. These form only a very small percentage of the opaque phases present. Most of the masses occur with or near the ilmenite crystals.

TEXTURE: Subophitic medium-grained basalt consisting of pyroxene, two generations of plagioclase, ilmenite, and cristobalite with minor other phases. Only moderate shock effects are evident in the section. Contacts are sharp and little to no interreaction between phases was noted.

Selected References: Chao et al. (1970), Dence et al. (1970), Essene et al. (1970), Lovering and Ware (1970), Ross et al. (1970)

HISTORY AND PRESENT STATUS OF SAMPLES - 10/29/76

10047 was removed from the Bulk Sample Container (ALSRC #1003), split and organically contaminated in the Bio-Prep Lab. A 6gm chip was sent to PCTL for PET analysis. During re-examination in SSPL, this sample (10047,1) was found to be mis-labeled. A mixup occurred in PCTL on 8-15-69. 10044,1; 10045,1; and 10047,1 were in the same cabinet. It has been shown that the sample labeled 10047,1 is actually 10045,1.

PRISTINE SAMPLES:

58	19.44	gm	Piece. Two surfaces show patina, but no pits. All other surfaces are fresh.
59	8.78	gm	Bandsaw fines.
60	0.11	gm	Fines.
93	10.20	gm	Nine chips. Five are fresh, two have one sawed surface each. Two have patinated surfaces.
94	8.44	gm	Chips and fines.
171	0.19	gm	Dust.

RETURNED SAMPLES:

27	10.97	gm	Chip. One patinated surface.
54	11.07	gm	Chips and fines. Two chips have sawed surface. Many have pitted surfaces.
56	6.08	gm	Chip. All surfaces are fresh.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	4	42.92	PCT	3.94
Al_2O_3	6	10.05	PCT	1.32
TiO_2	6	9.69	PCT	2.34
FeO	4	19.59	PCT	1.84

Element	Number of Analyses	Mean	Units	Range
MnO	4	.291	PCT	.050
MgO	4	5.84	PCT	.43
CaO	5	11.99	PCT	2.73
Na_2O	5	.444	PCT	.051
K_2O	4	.096	PCT	.039
P_2O_5	1	.11	PCT	0
Li	1	16.31	PPM	0
Rb	4	1.129	PPM	.61
Cs	2	.052	PPM	.015
Sr	3	198.9	PPM	15.7
Ba	2	179.0	PPM	182.0
Sc	2	98.5	PPM	13.0
V	3	47.0	PPM	52.
Cr_2O_3	4	.204	PCT	.055
Co	5	14.32	PPM	5.
Ni	1	20.04	PPM	0
Cu	1	16.00	PPM	0
Zn	2	7.4	PPM	11.2
Y	1	134.0	PPM	0
Zr	2	384.5	PPM	101.
Nb	1	23.0	PPM	0
Pd	1	.002	PPM	0
Ag	1	1.89	PPB	0
Cd	1	3.40	PPB	0
Ta	1	2.6	PPM	0
Hf	2	14.35	PPM	2.3
Re	1	.020	PPB	0
Os	1	.260	PPB	0
Ir	1	.005	PPB	0
Au	1	.029	PPB	0

Element	Number of Analyses	Mean	Units	Range
La	3	13.77	PPM	10.0
Ce	2	47.0	PPM	2.
Pr	1	13.0	PPM	0
Nd	1	36.	PPM	0
Sm	2	18.53	PPM	.75
Eu	2	2.63	PPM	.16
Tb	1	4.1	PPM	0
Ho	1	7.9	PPM	0
Yb	2	18.1	PPM	.2
Lu	2	2.59	PPM	.58
Th	3	1.11	PPM	1.4
U	2	.192	PPM	.064
Ga	1	4.0	PPM	0
In	1	2.80	PPB	0
Tl	1	.28	PPB	0
Pb	1	.769	PPM	0
Bi	1	.16	PPB	0
O	1	40.10	PCT	0
S	1	.18	PCT	0
Se	1	.25	PPM	0
Te	1	.013	PPM	0
F	1	193.0	PPM	0
Cl	1	14.4	PPM	0
Br	2	.18	PPM	.301
I	1	.016	PPM	0

Analysts: Compston et al., (1970); Ehmann & Morgan, (1970); Rose et al., (1970); Wakita et al., (1970); Ganapathy et al., (1970); Goles et al., (1970); Gopalon et al., (1970); Reed & Jovanovic, (1970); Hurley & Pinson, (1970); Anders et al., (1971); Lovering & Butterfield, (1970); Silver, (1970); Wakita et al., (1970).

Age References: Stettler et al., (1974); Boschler, (1971b); Marti et al., (1970); Eberhardt, (1971b); Silver, (19'0); Crozaz et al., (1970).

10048,0
Original PET Photo
(S-69-45672)

cm

10048,0
(S-76-25615)

10048

Sample 10048 is a rounded to subrounded, medium light grey, fine breccia. This sample originally weighed 579gm and measured 13x8x7cm. Sample was returned in ALSRC #1003 (Bulk Sample Container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 5/25/76

ROCK TYPE: Fine Breccia SAMPLE: 10048,0 WEIGHT: 172 gm

COLOR: Medium light grey DIMENSIONS: 7 x 3 x 4.2 cm

SHAPE: Rounded to subrounded

COHERENCE: intergranular - coherent
Fracturing - few, non-penetrative; one main fracture visible, parallel to long axis (PET).

FABRIC/TEXTURE: Anisotropic/Fine Breccia

VARIABILITY: Homogeneous

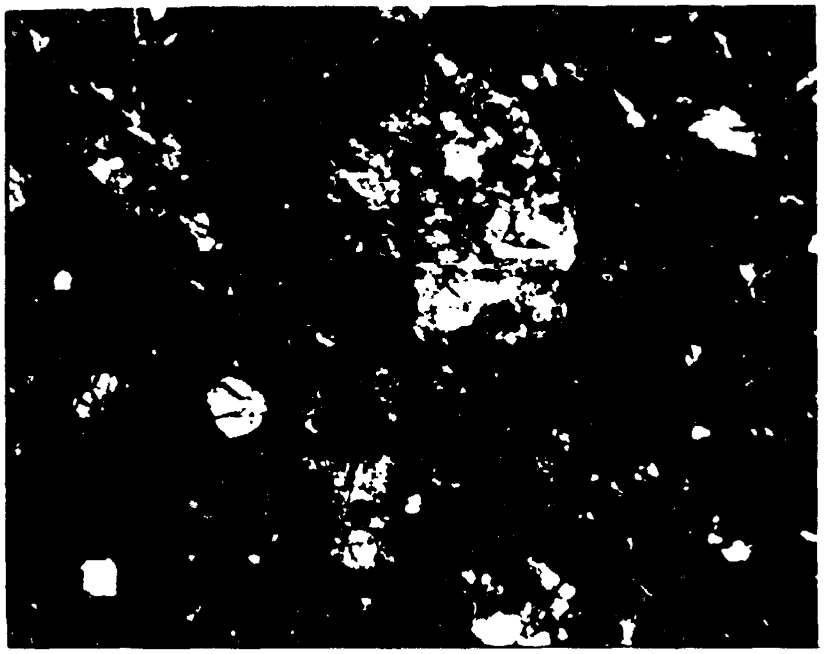
SURFACE: Sawed surface on T_1 and B_1. Smooth on E_1 and T_1.

ZAP PITS: Many on T_1, few on E_1, none on others. (Glass lined up to 2mm in diameter)

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Med.Lt.Grey	96	-----	---	-----
Basalt $Clast_1$	Honey Brn. and White	2	Irregular	2	1-8
Salt & Pepper $Clast_2$	Blk/White	1	Angular	.5	.2-2
White $Clast_3$	White	<1	Angular	.1	<.1-.3
Brown $Clast_4$	Brown	<1	Angular	.2	<.1-.4

1) Plagioclase 50%, Pyroxene 35%, Ilmenite 15%.
2) Platy elongated ilmenite 30%, semi-opaque and crushed plagioclase 70%.
3) Crushed plagioclase.
4) Appears to be composed of pyroxene crystals.



SECTION: 10048,33 Width of field 2.72mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 7/15/76

SUMMARY: Partly devitrified typical breccia with a low clast content. Several basaltic clasts occur as large inclusions in the matrix. Most of the matrix has undergone only slight devitrification.

MATRIX 67% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Dark Brown	100	-----	<0.001	High glass content; slightly devitrified.

MINERAL CLASTS 19% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene$_1$	Very abundant	Angular to irregular	0.001-0.6
Plagioclase$_2$	Present	Blocky to irregular	0.001-0.1
Opaques$_3$	Moderate	Skeletal to irregular	0.001-0.1

1) Several show zoning; most highly fractured.
2) Few shards; most show some twin planes.
X 3) Small blocky to skeletal masses; widely dispersed throughout matrix.

LITHIC CLAST 13% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Six present	Rounded to irregular	>1.0

4) a. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

b. Very fine-grained basalt with small crystals of pyroxene and ilmenite with probable plagioclase.

c. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

d. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

e. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.

f. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

GLASS CLASTS 1% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Angular to spherical	0.001-1.0
White[6]	Few	Angular to spherical	0.001-0.5

5) One large piece with fine-grained inclusions; only a few spheres or part spheres.
6) A few sparse fragments of spheres; some devitrification.

SAMPLE HISTORY AND PRESENT STATUS OF SAMPLES - 10/29/76

10048 was removed from ALSRC #1003, split, and organically contaminated in the Bio-Prep Lab. It was later sawed and chipped in SPL. Remaining pristine samples were re-examined in SSPL. A large piece was sent to RCL.

PRISTINE SAMPLES: (All BP-SPL-SSPL)

0	172.	gm	Breccia piece. Two sawed surfaces on B_1 and part of T_1. Pits on part of T_1. 7 x 3 x 4.2 cm.
49	66.	gm	Piece. Pitted on one face. Patina on five. -RCL-
51	41.	gm	Piece. Mated to ,70. One pitted surface. Small amount of patina. 3.5 x 5 x 4 cm.
56	1.42	gm	Small breccia chips. No pits.
57	.67	gm	Fines.
58	1.37	gm	Fines.
60	.42	gm	Fines.
62	5.75	gm	Fines.
63	1.14	gm	Fines.
64	1.61	gm	Fines.
68	.28	gm	Fines.
69	38.	gm	Piece. Two sawed surfaces. 1 pitted surface. Small amount of patina. 3.5 x 4 x 3 cm.
70	31.	gm	Piece. One pitted surface mated to ,51. Small amount of patina. 2.5 x 4.2 x 3.5 cm.
71	10.	gm	One small piece. No pits or patina. 3 x 2 x 1.5 cm.

RETURNED SAMPLES:

9	49.79	gm	40 chips. Largest is 1 x 0.5 x 0.1 cm. Some chips have pitted surfaces.
22	18.34	gm	Chip. One pitted surface.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	2	40.46	PCT	3.48
Al_2O_3	4	12.40	PCT	1.56
TiO_2	3	8.77	PCT	1.33
FeO	2	16.34	PCT	1.28

CHEMICAL ANALYSES

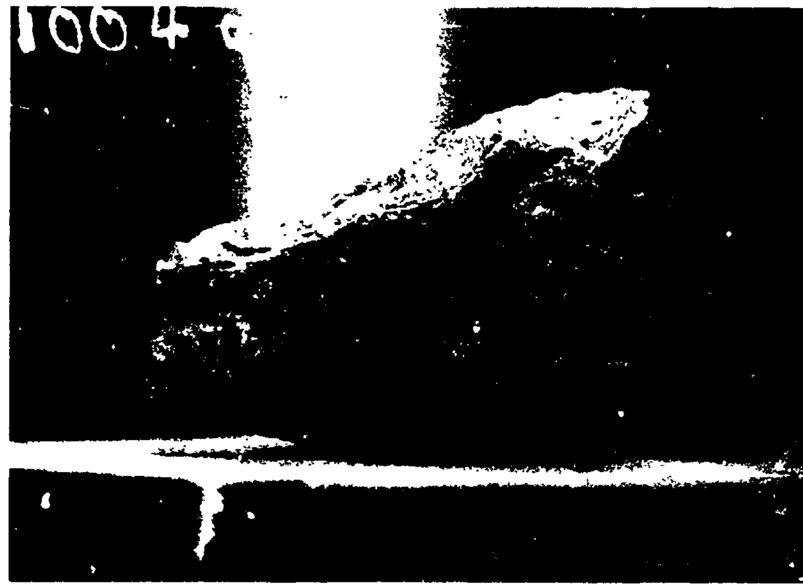
Element	Number of Analyses	Mean	Units	Range
MnO	3	.214	PCT	.019
MgO	2	7.17	PCT	.743
CaO	3	11.03	PCT	.91
Na_2O	3	.476	PCT	.039
K_2O	2	.17	PCT	.0001
Rb	2	4.16	PPM	.01
Cs	2	.126	PPM	.004
Sr	1	190.0	PPM	0
Ba	2	183.5	PPM	33.0
Sc	2	64.25	PPM	3 10
V	1	67.0	PPM	0
Cr_2O_3	3	.304	PCT	.031
Co	3	34.0	PPM	2.8
Ni	2	185.6	PPM	56.8
Cu	2	10.14	PPM	1.91
Zn	2	29.4	PPM	1.6
Zr	1	240.0	PPM	0
Pd	1	.013	PPM	0
Ag	2	.02	PPM	.007
Cd	1	.078	PPM	0
Ta	2	1.85	PPM	.1
Hf	2	13.1	PPM	2.8
Ir	2	.009	PPM	.004
Au	3	.002	PPM	.001
La	2	19.2	PPM	3.80
Ce	2	47.4	PPM	18.6
Nd	1	40.0	PPM	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Sm	2	14.05	PPM	1.7
Eu	2	1.93	PPM	.04
Gd	1	19.8	PPM	0
Tb	2	3.6	PPM	.40
Dy	1	24.95	PPM	0
Ho	2	4.65	PPM	.1
Er	1	14.0	PPM	0
Yb	2	13.82	PPM	2.75
Lu	2	1.98	PPM	.15
U	1	.69	PPM	0
Ga	3	5.65	PPM	.7
Ln	3	.112	PPM	.12
Tl	1	2.83	PPB	0
Ge	1	.35	PPM	0
Sb	1	8.80	PPB	0
Bi	1	1.62	PPB	0
O	1	39.8	PCT	0
Se	1	1.6	PPM	0
Te	1	.072	PPM	0
Cl	1	65.4	PPM	0
Br	2	.132	PPM	.013

Analysts: Ehmann & Morgan, (1970); Rose et al., (1970); Ganapathy et al., (1970); Goles et al., (1970); Haskin et al., (1970); Turekian & Kharkar, (1970); Wasson & Baedecker, (1970).

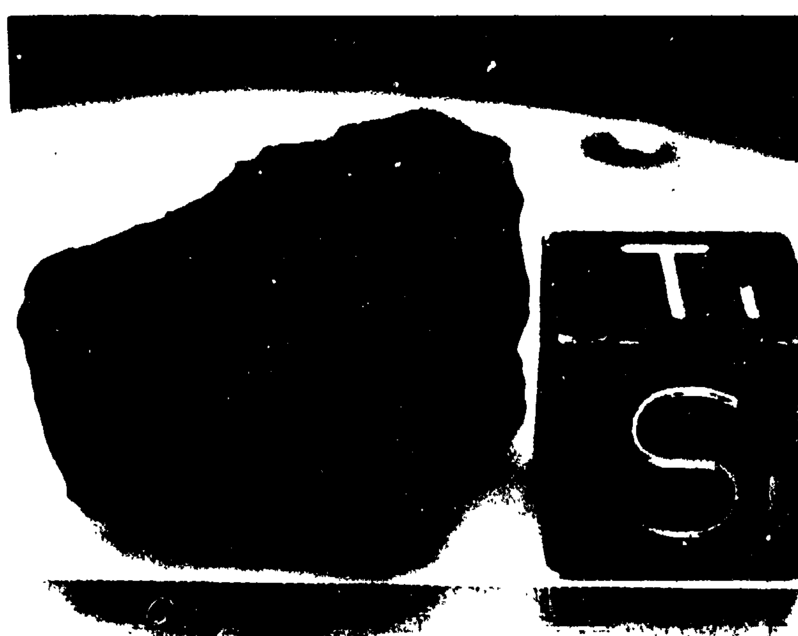
No Age References



10049,0

Original PET Photo
(S-69-45702)

2 cm.



10049,0
(S-76-25446)

10049

Sample 10049 is an angular, dark grey, fine grained basalt. This sample originally weighed 193gm and measured 6.5x3.5x10cm. It was originally returned in ALSRC #1003 (Bulk Sample Container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 5/19/76

ROCK TYPE: Fine Grained Basalt SAMPLE: 10049,0 WEIGHT: 141 gm

COLOR: Dark Grey DIMENSIONS: 4.8 x 4 x 3.5 cm

SHAPE: Angular

COHERENCE: Intergranular - tough
Fracturing - few, non-penetrative

FABRIC/TEXTURE: Isotropic/Equigranular, very fine grained.

VARIABILITY: Homogeneous

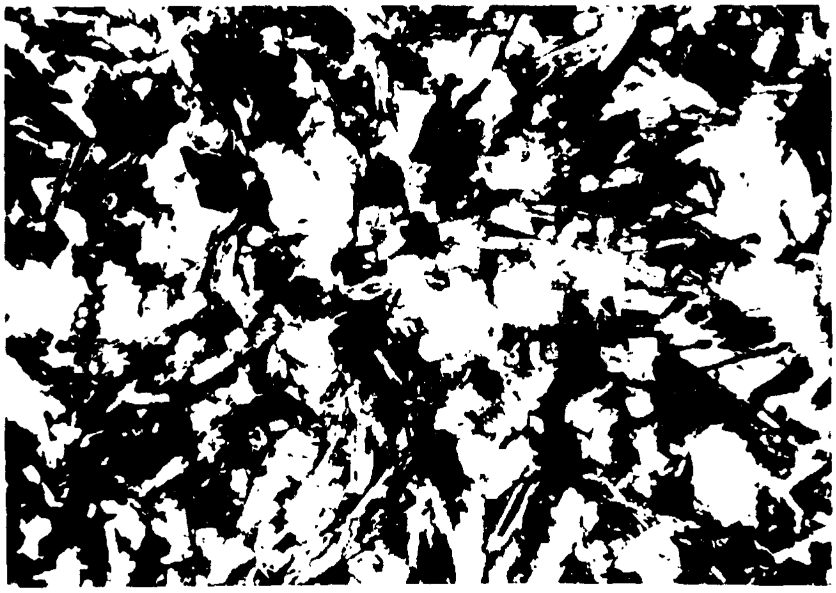
SURFACE: Irregular on all surfaces. A white aphanitic coating surrounds the pitted areas only.

ZAP PITS: Many on B_1, few on T_1, N_1, W_1. None on E_1, S_1. Pits are glass lined up to 0.8mm in diameter.

CAVITIES: 10% total surface average <.6mm in diameter, some crystal lined, some smooth.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Plagioclase	White	20	Subangular - subrounded	<.1	<.1
$Ilmenite_1$	Black	20	Angular - subangular	<.1	<.1
Pyroxene	Black	60	Subrounded	<.1	<.1

1) Appears to be semi-opaque platy crystals.



SECTION: 10049,39 Width of field 2.22mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 11/15/75

SECTION: 10049,39

SUMMARY: Fine-grained vesicular intersertal basalt with a pyroxene-ilmenite network hosting smaller plagioclase crystals and abundant mesostasis. Most of the silicate crystals are poorly formed and optical characteristics are poor. A few euhedral pyroxene crystals are present, but are scattered. The ilmenite occurs in crystals of two generations. One generation is composed of small euhedral laths and the other as large subhedral laths with irregular boundaries. Many of the larger ilmenite crystals contain silicate or glassy inclusions and have a somewhat sieve texture.

Throughout the section are masses and stringers of a glass-rich mesostasis. It is brownish in color and is very turbid. Many of the ilmenite crystals are surrounded by the mesostasis. Some minor devitrification has taken place.

PHASE	% SECTION	SHAPE	SIZE (MM)
Pyrox	47	Subhedral to euhedral	0.05-0.2
Plag	18	Tabular to anhedral	0.01-0.2
Opaq	17	Subhedral to euhedral	0.001-0.2
Meso	18	Irregular	---------
Mafic	--	Rods	0.01-0.2

COMMENTS:

Pyroxene - Pale brown to colorless subhedral to euhedral crystals of pyroxene enclose the smaller plagioclase and ilmenite crystals. Some euhedral crystals, hexagonal in outline, are scattered randomly in the section. They show poor optical characteristics, but do have sharper grain boundaries. The larger subhedral crystals show some zoning, and all the crystals are highly fractured. Most of the grain boundaries are poorly defined. Due to the poor optical characteristics of the pyroxene crystals, no exact determination of the type of pyroxene could be made.

Plagioclase - Small tabular crystals of plagioclase occur interdispersed with blocky anhedral crystals forming interstitial fillings within the pyroxene-ilmenite network. The optical characteristics are, for the most part, poor. Some of the smaller tabular crystals have retained sharp twin planes.

The plagioclase grains tend to have sharper and more well defined grain boundaries than do the pyroxenes. The crystals are randomly scattered throughout the section.

Opaques and Mesostasis - The major opaque phase in the rock is ilmenite. Two generations of crystals are present. The smaller euhedral laths are widely scattered throughout the section while the larger subhedral laths are somewhat more grouped. The larger crystals contain glass and silicate inclusions and the boundaries are very irregular. Many of the crystals are bent and some are broken. Many of the crystals are surrounded by the glass-rich mesostasis.

Much of the mesostasis is present as stringers or as isolated masses filling interstices in the silicate-ilmenite network. There appears to be a preference for the mesostasis to form near or around the larger ilmenite crystals.

Isolated patches of troilite and troilite with iron-nickel are also present, but only in moderate amounts. Also present are numerous spherical to irregular vesicles which are up to 0.3 mm in diameter.

TEXTURE: The rock consists of a random network of intergrown pyroxene and ilmenite crystals. Plagioclase and mesostasis occurs interstitial to this network. The pyroxene forms subhedral to euhedral crystals but they lack well defined optical characteristics. The numerous vesicules are rimmed, for the most part, by finely divided pyroxene crystals. The texture is intersertal. Boundaries are sharp to diffuse.

Selected References: Cameron (1970)

HISTORY AND PRESENT STATUS OF SAMPLES - 10/29/76

10049 was removed from ALSRC #1003, split and organically contaminated (due to a large amount of handling) in the Bio-Prep Lab. A 2gm chip was sent to PCTL for PET analysis. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES:

35	1.18	gm	Medium size chips. All chips range from 3-7mm, 35 chips total. BP-SSPL
36	.19	gm	Small chips. All <3mm in size but greater than 1mm. BP-SSPL
37	.43	gm	Fines. Homogeneous. BP-SSPL
38	.42	gm	Fines. Homogeneous. BP-SSPL

NO RETURNED SAMPLES

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	3	41.69	PCT	1.78
Al_2O_3	2	9.00	PCT	.997
TiO_2	4	9.42	PCT	4.13
FeO	3	17.0	PCT	4.03

CHEMICAL ANALYSES

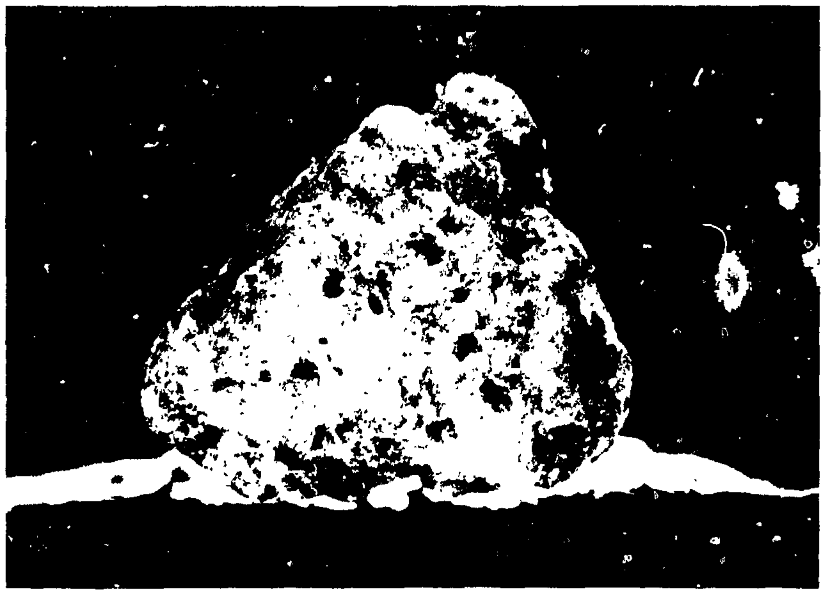
Element	Number of Analyses	Mean	Units	Range
MnO	4	.228	PCT	.043
MgO	2	7.16	PCT	.265
CaO	3	10.19	PCT	2.185
Na_2O	5	.511	PCT	.054
K_2O	4	.317	PCT	.085
Rb	1	6.2	PPM	0
Cs	1	.177	PPM	0
Sr	2	170.4	PPM	19.2
Ba	2	266.0	PPM	128.
Sc	2	83.45	PPM	5.1
Cr_2O_3	3	.304	PCT	.034
Co	2	23.5	PPM	1.0
Mo	1	.055	PPM	0
Ag	1	.064	PPM	0
Ta	2	1.95	PPM	.1
Hf	1	17.3	PPM	0
Au	1	4.70	PPB	3.60
La	4	26.45	PPM	4.2
Ce	3	90.63	PPM	46.9
Nd	2	60.95	PPM	3.7
Sm	4	16.82	PPM	9.5
Eu	4	2.15	PPM	.19
Gd	1	29.3	PPM	0
Tb	1	5.46	PPM	0
Dy	3	31.67	PPM	2.8
Er	1	20.9	PPM	0
Yb	3	16.93	PPM	6.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Lu	2	2.52	PPM	.13
Th	1	4.03	PPM	0
U	2	.777	PPM	.074
Ga	1	4.3	PPM	0
In	1	.016	PPM	0
C	2	70.	PPM	0
Ge	1	.001	PPM	0
N	1	116.	PPM	0
As	1	.05	PPM	0
O	1	41.0	PCT	0
S	1	.22	PCT	0
Se	1	.2	PPM	0

Analysts: Rose et al., (1970); Wanke et al., (1971); Turekian & Kharkar, (1970); Kharkar & Turekian, (1971); Gast et al., (1970); Kaplan et al., (1970); Moore et al., (1970).

Age References: Hintenberger et al., (1971); Burnett et al., (1975); Eberhardt (1971).



10050,0

2 cm.

Original PET Photo
(S-69-45731)

10050,0
(S-76-21349)

10050

Sample 10050 is an angular, medium light grey, Cristobalite basalt. This sample originally weighed 114gm and measured 5x4x3.2cm. Sample was returned in ALSRC #1003 (Bulk Sample Container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 1/19/76

ROCK TYPE: Cristobalite Basalt SAMPLE: 10050,0 WEIGHT: 28.53 gm

COLOR: Medium light grey DIMENSIONS: 3.5 x 3.2 x 2 cm

SHAPE: Angular

COHERENCE: Intergranular - Moderately coherent
Fracturing - Few, non-penetrative

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: Homogeneous

SURFACE: Rough

ZAP PITS: Absent

CAVITIES: 25% cavities throughout sample. Average size is about 1-1.5mm.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Pyroxene	Dk.Brown to Dk.Grn.	60	Subhedral	0.1	<.1-.7
Plagioclase	White	30	Anhedral	0.1	<.1-.7
Ilmenite	Black	10	Subhedral	0.1	<.1-.7

SECTION: 10050,36 Width of field 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/16/76

SUMMARY: Nearly equigranular subophitic basalt composed of clinopyroxene, two generations of plagioclase, ilmenite with subordinate cristobalite, troilite-iron nickel, chromium ulvospinel and mesostasis. Large anhedral crystals of pyroxene host the other phases present. Many of these crystals are polygranular while appearing as a single crystal in plane polarized light.

The plagioclase crystals are more or less grouped and scattered throughout the pyroxene host. Some small euhedral crystals of plagioclase are included in the pyroxene crystals.

The ilmenite crystals are large and highly skeletal. Many of the crystals have chromite and rutile exsolution lamallae. A few of the crystalline masses are made up of many smaller crystals giving a polygranular texture to the crystal.

PHASE	% SECTION	SHAPE	SIZE (MM)
Pyrox	55	Anhedral, irregular	0.4-1.3
Plag	28	Euhedral to anhedral	0.2-1.0
Opaq	11	Subhedral to skeletal	0.2-1.0
Cris	5	Anhedral	0.1-0.4
Meso	1	Irregular	0.05-0.4

COMMENTS:

Pyroxene - Large anhedral crystals of clinopyroxene form a nearly continuous array and host all other phases present. The crystals show sharp to distinct extinctions with moderate zoning. Small euhedral to anhedral crystals of olivine are present in several crystals. Many of the crystals are granulated while retaining the monocrystalline appearance. Almost all crystals show a pronounced fracture pattern with only a minor cleavage pattern developed. A few crystals show simple twins, but this is rare.

Plagioclase - Two generations of plagioclase occur in the rock. The first type consists of euhedral tablets which appear in the section as equant to acicular crystals. The crystals show well developed twin planes, sharp extinctions, and minor clustering.

The second type of crystals represented in the rock forms interstitial masses between the pyroxene-ilmenite-plagioclase network. The crystals are larger than the first type and show poor optical characteristics.

A possible third generation may be present and is represented by very small, sharp, isolated euhedral crystals completely enclosed in the pyroxene. These crystals may belong to the first generation or may represent a completely independent generation.

Associated with the second generation of plagioclase crystals are small irregular masses of glass-rich mesostasis. The color is light to dark brown. Some devitrification has taken place, but no phases were determined.

Cristobalite - Randomly scattered throughout the section are anhedral crystals of cristobalite. The grains are found between adjacent pyroxene-plagioclase crystals or between two grains of pyroxene. The later case is the more common.

Opaques - The most abundant opaque in the rock is ilmenite which occurs as subhedral to skeletal crystal masses scattered throughout the rock. The lath-like crystals tend to form near the crystals of plagioclase and cristobalite. The skeletal crystals are randomly scattered in the silicate network. Some rutile and chromite ex-solutions are present.

Associated with the ilmenite are crystals of troilite and troilite with iron-nickel. The masses are small and widely distributed.

A few small groups of chromium ulvospinel are also in the rock. These small masses are associated with small masses of ilmenite. The crystals are very rounded and irregular in shape.

TEXTURE: Subophitic medium-grained basalt consisting of pyroxene, two generations of plagioclase, ilmenite and cristobalite with minor other phases. Contacts are sharp and little to no interreaction between phases is present.

Selected References: Frondel et al. (1970), Ross et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 10/29/76

10050 was removed from ALSRC #1003 and split in the Bio-Prep Lab. A small chip was sent to PCTL for PET analysis. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES: (All BP-SSPL)

0	28.53	gm	Piece. No pitting observed.
1	2.40	gm	Chip. No pits.
15	4.05	gm	Chips and fines.
16	11.64	gm	Chips and fines.
146	11.12	gm	Chips and fines split from ,0.

RETURNED SAMPLES:

11	7.06	gm	Chip. Three pitted surfaces.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	3	41.05	PCT	3.53
Al_2O_3	5	10.21	PCT	2.12
TiO_2	4	12.16	PCT	1.83
FeO	3	18.12	PCT	2.05
MnO	3	.273	PCT	.034
MgO	3	8.65	PCT	3.65
CaO	5	11.56	PCT	1.26
Na_2O	5	.403	PCT	.106
K_2O	4	.066	PCT	.030
Li	1	11.00	PPM	0
Rb	4	.723	PPM	.150
Cs	2	.027	PPM	.003
Sr	3	166.7	PPM	48.8
Ba	2	80.50	PPM	23.
Sc	2	90.70	PPM	3.6
V	3	107.50	PPM	19.0
Cr_2O_3	3	.333	PCT	.040
Co	3	15.93	PPM	5.40
Cu	1	15.20	PPM	0
Zn	1	1.75	PPM	0
Y	1	104.00	PPM	0
Zr	1	520.00	PPM	0
Pd	1	.001	PPM	0
Ag	1	1.42	PPB	0
Cd	1	2.56	PPB	0
Ta	1	2.2	PPM	0
Hf	2	11.05	PPM	4.9
Ir	1	.010	PPB	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Au	1	.030	PPB	0
La	2	7.70	PPM	1.
Ce	2	35.50	PPM	3.
Pr	1	6.20	PPM	0
Nd	1	36.00	PPM	0
Sm	2	13.45	PPM	3.3
Eu	2	2.08	PPM	.15
Gd	1	19.90	PPM	0
Tb	2	3.20	PPM	2.2
Dy	1	28.00	PPM	0
Ho	2	4.75	PPM	.3
Yb	3	8.90	PPM	10.2
Lu	2	1.88	PPM	.16
Th	2	1.17	PPM	1.27
U	2	.183	PPM	.054
Ga	1	4.41	PPM	0
In	1	.004	PPM	0
Tl	1	.330	PPB	0
C	1	64.00	PPM	0
Pb	1	.29	PPM	0
N	1	30.00	PPM	0
Bi	1	.160	PPB	0
O	1	40.50	PCT	0
Te	1	.011	PPM	0
Br	1	.010	PPM	0

Analysts: Ehmann & Morgan, (1970); Rose et al., (1970); Wakita et al, (1970); Ganapathy et al., (1970); Goles et al., (1970); Tera et al, (1970); Gapalon et al., (1970); Papanastassiou et al., (1970); Moore et al., (1970); Tatsumoto, (1970); Anders et al., (1970).

Age References: Armstrong and Alsmiller (1971); Eberhardt (1971b); Tatsumoto (1970).

10054

10054 is the generic number assigned to the chips sample allocated to the Bio-Pool. It was composed of 10050,0 (76 gms.), 10051,0 (365 gms) and 10052,0 (155 gms) from the Bulk Sample container (ALSRC #1003). These rocks were placed together and crushed to fines. The composite sample was processed in the Bio-Prep Lab and allocated in PCTL. Remaining pristine samples were re-examined in SSPL.

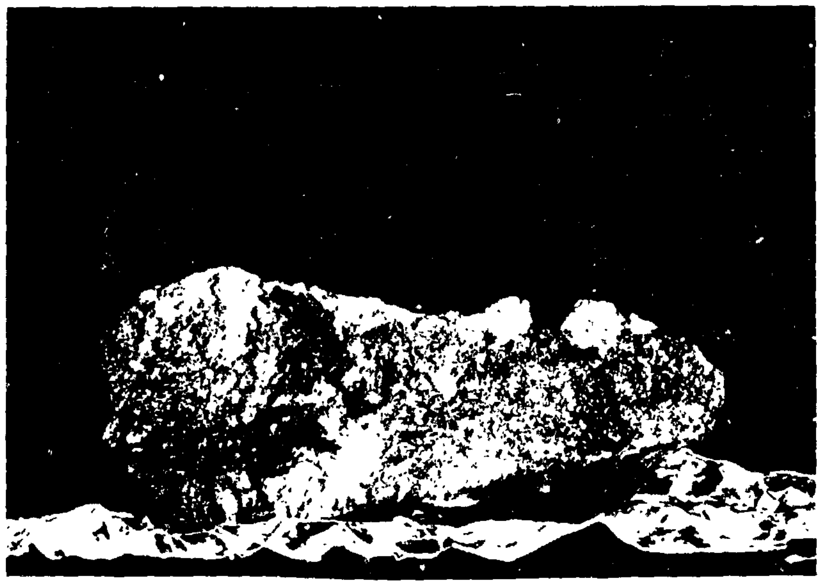
PRISTINE SAMPLES (All BP-PCTL-SSPL)

1	6.89 gm	Fines
43	10.63 gm	Fines
44	0.15 gm	Fines

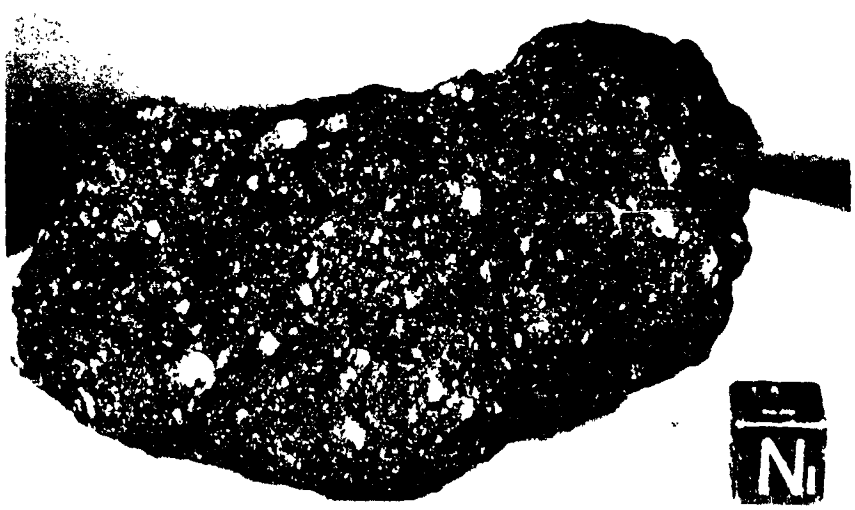
RETURNED SAMPLES

32	76.62 gm	Fines
33	79.55 gm	Fines

NO CHEMICAL ANALYSES OR AGE DATES



10056,0
Original PET Photo
(S-69-46182)



10056,14
(S-75-32575)

10055

Sample 10056 is an angular to sub-angular, medium dark grey, microbreccia. This sample originally weighed 186gm and measured 9.5x4.5x3cm. Sample was returned in ALSRC #1003 (Bulk Sample Container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 10/3/75

ROCK TYPE: Microbreccia SAMPLE: 10056,14 WEIGHT: 174.95gm

COLOR: Medium dark grey DIMENSIONS: 9.2 x 4.5 x 2.8 cm

SHAPE: Angular to subangular; shaped like one-half of a flat-iron broken longitudinally (PET)

COHERENCE: Intergranular - tough
Fracturing - few, non-penetrative, some glass lined

FABRIC/TEXTURE: Anisotropic/Microbreccia

VARIABILITY: Homogeneous

SURFACE: Surface is irregular to smooth, with a good size portion of fresh surface. S_1 and part of B_1 have a partial (<1mm thick) glass coating.

ZAP PITS: Many on part of T_1, many on N_1, few on E_1, B_1, none on W_1, S_1. Pits are glass lined <1mm in diameter; Pits occur on all sides of specimen (PET).

CAVITIES: Vuggy on glass surface (S_1) with some cavities along the fractures on B_1.

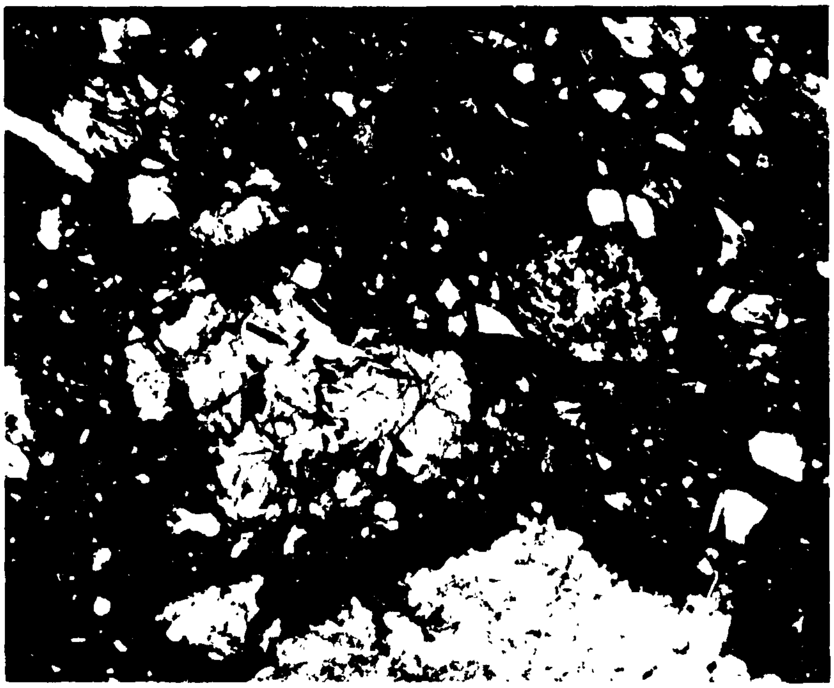
COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Matrix	Med.Dk. Grey	70	Angular to subangular	---	-----
White $Clast_1$	White	23	Angular to subrounded	<1	<1-1
Basalt $Clast_2$	Hon.Brn. & White	2	Angular to subangular	4	4-10
Salt & Pepper $Clast_3$	Blk/White	5	Angular to subangular	2.5	2-5

1) Evenly distributed throughout the sample. Appears to be crushed plagioclase.
2) Honey brown pyroxene with white plagioclase and opaque ilmenite. Possibly some cristobalite.

3) Appears to be the same as the basalt clast without the pyroxene component. Evenly distributed throughout the rock.

SPECIAL FEATURES:

Sample has a high clast population, a majority of which is <1mm. This is most evident on fresh surfaces. Small areas of brown glassy spatter on exterior surfaces of sample. Most spatter has a sugary texture.



SECTION: 10056,26 Width of field 2.72mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 7/14/76

SECTION: 10056,26 and 10056,27

SUMMARY: Partly devitrified typical breccia with a high mineral clast content. Numerous large lithic clasts are also present. The rock is a recrystallized breccia with abundant crystallites and mineral clasts in the matrix.

MATRIX 66% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Dark Brown	100	-----	<0.001	High glass content with a very large number of small crystallites.

MINERAL CLASTS 27% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene[1]	Very abundant	Angular to irregular	0.001-0.4
Plagioclase[2]	Present	Blocky to irregular	0.001-0.2
Ilmenite[3]	Moderate	Skeletal to blocky	0.001-0.2

1) Most show zoning; poor optical characteristics.
2) Few shards; poor twins and extinctions.
3) Most skeletal; most in clasts.

LITHIC CLASTS 5% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Eleven present	Rounded to irregular	>1.0

4) a. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite. Most crystals gave poor optical characteristics.

b. Coarse-grained basalt with off-set faults in the plagioclase giving the twin planes a "kinked" appearance.

c. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.

d. Glass-rich matrix hosting small irregular plagioclase crystals.

e. Fine-grained and glass-rich matrix hosting small crystal fragments and glass fragments.

f. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite. Most crystals gave poor optical characteristics.

g. Coarse-grained basalt with only a small amount of opaques present.

h. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

i. Glass-rich matrix hosting small rectangular to equant plagioclase crystals.

j. Partly devitrified glass with numerous unresolvable crystallites.

k. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

GLASS CLASTS 2% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Angular to spherical	0.001-0.9
Dark Red[6]	Present	Angular to spherical	0.001-0.2
White[7]	Present	Angular	0.001-0.6

5) One large dark orange sphere; glass coating along one edge of section; some immiscible mixtures; mostly fragments.
6) Part spheres and a few fragments.
7) All fragments; some devitrification.

HISTORY AND PRESENT STATUS OF SAMPLES - 10/29/76

10056 was removed from ALSRC #1003 and split in the Bio-Prep Lab. A 0.35gm chip was sent to PCTL for PET analysis. The parent rock was split in SPL for allocation. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES: (All BP-SPL-SSPL)

12	0.37	gm	Small chip (.37gm) representative of the sample. No pits or patina.
14	174.0	gm	Large surface piece. Four pitted surfaces.
42	3.0	gm	Small chips found in packaging of subsample 14. Ten small chips and fines. No pits observed.

NO RETURNED SAMPLES

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
W	1	.15	PPM	0
Hf	4	13.02	PPM	5.3
Ir	1	.130	PPB	0
Au	2	.0008	PPM	.0003

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
La	3	11.77	PPM	2.0
Ce	4	45.92	PPM	42.3
Pr	1	12.0	PPM	0
Nd	1	57.0	PPM	0
Sm	3	17.3	PPM	11.9
Eu	4	2.78	PPM	.6
Gd	1	24.0	PPM	0
Tb	2	5.20	PPM	.4
Dy	2	35.75	PPM	8.5
Ho	2	7.75	PPM	2.5
Er	1	27.0	PPM	0
Tm	1	2.1	PPM	0
Yb	4	14.2	PPM	11.7
Lu	4	1.88	PPM	1.30
Th	1	1.4	PPM	0
U	2	.195	PPM	.03
B	1	2.0	PPM	0
Ga	2	4.65	PPM	.7
In	2	.032	PPM	.057
Ge	2	.62	PPM	1.16
Sn	1	.3	PPM	0
Pb	1	1.2	PPM	0
N	1	70.00	PPM	0
As	2	.04	PPM	.02
Sb	1	5.00	PPB	0
O	1	41.3	PCT	0
SiO_2	2	42.78	PCT	.85
Al_2O_3	3	11.02	PCT	.76

CHEMICAL ANALYSES

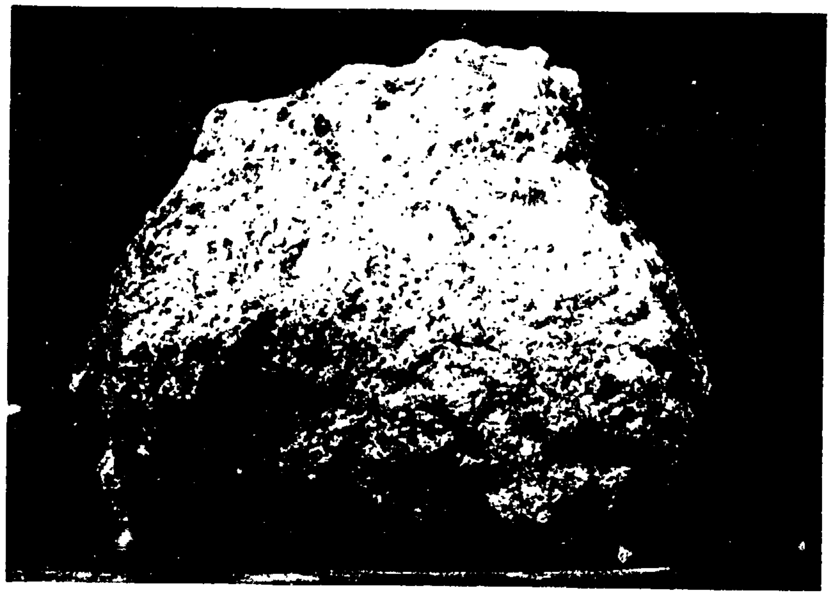
Element	Number of Analyses	Mean	Units	Range
TiO_2	4	4.34	PCT	3.84
FeO	4	17.91	PCT	2.32
MnO	3	.260	PCT	.013
MgO	2	5.55	PCT	1.82
CaO	3	13.66	PCT	2.94
Na_2O	3	.42	PCT	.076
K_2O	1	.113	PCT	0
P_2O_5	1	.07	PCT	0
Li	1	16.0	PPM	0
Rb	1	2.0	PPM	0
Cs	1	.06	PPM	0
Be	1	3.0	PPM	0
Sr	1	160.	PPM	0
Ba	2	170.	PPM	140.0
Sc	4	99.4	PPM	17.4
V	2	51.5	PPM	9.0
Cr_2O_3	4	.200	PCT	.019
Co	3	13.63	PPM	3.10
Ni	2	32.50	PPM	34.97
Cu	1	3.8	PPM	0
Zn	1	2.7	PPM	0
Y	1	180.0	PPM	0
Zr	1	34.0	PPM	0
Nb	1	34.	PPM	0
Mo	2	.215	PPM	.37
Pd	1	.1	PPM	0
Ag	1	.2	PPM	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Cd	1	.9	PPM	0
Ta	4	2.05	PPM	1.0
F	1	30.0	PPM	0
Cl	1	16.	PPM	0
Br	1	.06	PPM	0

Analysts: Ehmann & Morgan, (1970); Morrison et al., (1970); Goles et al., (1970); Kharkar & Turekian, (1971); Wasson & Baedecker, (1970)

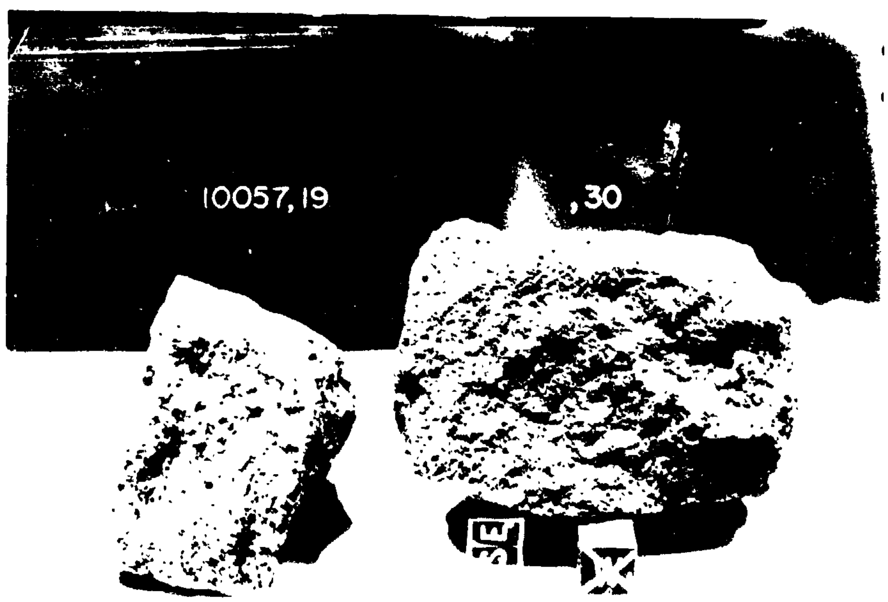
No Age References



10057,0

1 cm.

Original PET Photo
(S-69-46294)



10057,19 & ,30
(S-75-33296)

10057

Sample 10057 is a subangular, dark grey, vesicular basalt. This sample originally weighed 919gm and measured 11x10x6cm. It was originally returned in ALSRC #1003 (Bulk Sample Container).

BINOCULAR DESCRIPTION BY: Kramer DATE: 11/21/75

ROCK TYPE: Vesicular basalt SAMPLE: 10057,30 WEIGHT: 230 gm

COLOR: Dark grey DIMENSIONS: 7 x 5 x 3.5 cm

SHAPE: Subangular; triangular to trapezoidal (PET)

COHERENCE: Intergranular - tough
Fracturing - none; two sets of fractures 70° apart (PET)

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: None

SURFACE: All are vesicular - irregular

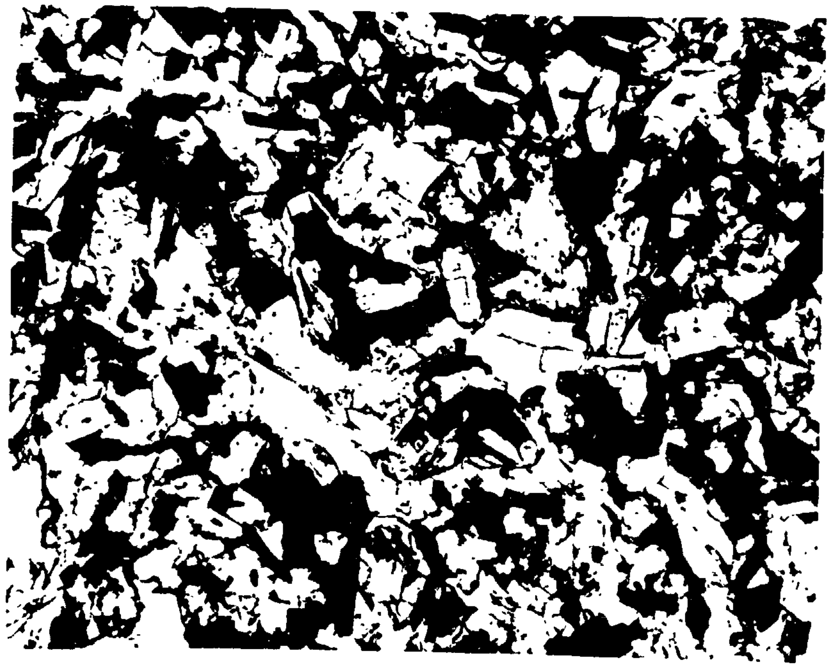
ZAP PITS: Many, all faces; some pits are filled with yellowish-brown glass (PET).

CAVITIES: 60% of fresh surface composed of vesicles. Lined with pyroxene and opaques.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Plagioclase	Milky Wh.	25	Lathlike to subhedral	.2	.05-.5
Pyroxene	Brown	60	Blocky	.1	.01-.2
Opaques[1]	Metallic Blk.	15	Tabular	.1	.01-.2

1) Mostly ilmenite.

SPECIAL FEATURES: Some small patches (<2cm) of black glassy spatter noted on several exterior surfaces.



Section: 10057,81 Width of field: 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 10/14/75

SUMMARY: Fine-grained vesicular basalt composed of clinopyroxene, plagioclase, and ilmenite with subordinate troilite, iron-nickel, and mesostasis. The pyroxene forms small subhedral to anhedral crystals and forms a network with the ilmenite. Interstitial to this network, anhedral crystal masses of plagioclase and glassy mesostasis form an intersertal texture. All crystals are in random orientation.

PHASE	% SECTION	SHAPE	SIZE (MM)
Pyrox	41	Subhedral to anhedral	0.05-0.2
Plag	23	Anhedral	0.01-0.4
Opaq	17	Lath-like to subhedral	0.01-0.2
Meso	19	Irregular	0.05-0.2
Vesicles	--	Round to irregular	0.1-0.3

COMMENTS:

Pyroxene - Pale brown to clear subhedral to anhedral crystals of clinopyroxene are intergrown with plagioclase and ilmenite. Most of the pyroxene crystals are highly fractured and only occasionally show well developed cleavage patterns. Sharp contacts are present between all pyroxene crystals and the other phases present.

Plagioclase - Small tabular crystals of plagioclase predominate as the interstitial mineral within the pyroxene-ilmenite network. Also included in the interstices are anhedral, blocky crystals of plagioclase. The tabular type show well developed twin planes while the blocky crystals show poor development or none at all. Many of the crystals have glass or silicate inclusions. The crystals are randomly scattered throughout the rock with no preferred orientation.

Opaques - Two populations of ilmenite crystals occur in the rock. The first type are large lath-like crystals which grade to smaller subhedral somewhat skeletal crystals. Many of the crystals contain silicate inclusions. These two types tend to merge and grade from one type to the other.

Associated with the ilmenite are small (0.005-0.01mm) masses of troilite with iron-nickel inclusions. Isolated larger masses of troilite (0.-1-0.09mm) without iron-nickel inclusions occur between the crystals of pyroxene.

Mesostasis - Irregular patches of pale brown to clear glass rich mesostasis occur throughout the rock. The masses have a "bubbly" appearance and are made up of irregular patches of devitrified phases intermixed with the glassy phase. No identification of the phases present was made. The patches fill void areas between adjacent crystalline phases. The contacts with these phases are sharp and no reaction with the glass phase was noted.

TEXTURE: Intersertal basalt consisting of a random network of subhedral pyroxene and ilmenite with interstitial anhedral plagioclase and mesostasis. Some graduation in the development of the ilmenite crystals is present. A similar graduation is also noted in the plagioclase development. The vesicles tend to be rimmed by small pyroxene aggregates. All contacts between phases are sharp.

Selected References: Essene et al. (1970), Lovering et al. (1970), Reid et al. (1970), Haggerty et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 10/17/76

10057 was removed from the Bulk Sample container (ALSRC #1003) and split in the Bio-Prep Lab. The sample was sawed and chipped in SPL. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES: (All BP-RCL-BP-SPL-SSPL)

17	26.38	gm	Chips and fines. Largest chips are less than 0.5gm.
19	167.77	gm	Sawed piece. Three surfaces were sawed, two are pitted and one is fresh.
30	230.0	gm	Pitted piece. Three surfaces are pitted, three are fresh.
84	5.16	gm	Chips and fines. This subsample appears to be a sorting of ilmenite-lined vesicles.
98	.29	gm	Two sawed chips.
99	1.68	gm	Sawed piece. 1 x 1 x 0.5 cm.
100	1.23	gm	Sawed piece. 1 x 1 x 0.3 cm.
101	3.40	gm	Slab piece. Five sawed and one fresh surface. 3 x 1 x 0.5 cm.
102	11.99	gm	Slab piece. Four sawed, one pitted and one fresh surface.
103	8.16	gm	Slab piece. Five sawed and one fresh surface. 2 x 1 x 1 cm.
104	27.40	gm	Slab piece. Four sawed and two fresh surfaces. 4 x 4 x 1 cm.
105	32.70	gm	Slab piece. Three sawed and three fresh surfaces. 5 x 3 x 1 cm.
106	.40	gm	Sawed chips.
141	14.29	gm	Small chips. All have some pitted surfaces.

RETURNED SAMPLES:

9	7.888	gm	Sawed chips. Most have pitted surfaces.
13	9.117	gm	Two chips. Both have some pits.
14	6.587	gm	Two chips. Both have pitted surfaces.
28	12.17	gm	Chip. 3 x 1.5 x 1 cm. One pitted surface.
74	7.41	gm	Two chips. Both have pitted surfaces.
204	38.05	gm	Chips and fines.
212	5.821	gm	Chip. Few pits.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Ta	3	1.63	PPM	.8
W	2	.425	PPM	.01
Hf	4	16.75	PPM	3.1
Re	1	.0015	PPM	0
Os	1	.020	PPB	0
Ir	3	.043	PPB	.091
Au	5	1.67	PPB	6.39
La	8	26.54	PPM	7.9
Ce	5	76.72	PPM	13.4
Pr	2	15.5	PPM	13.
Nd	4	64.5	PPM	9.
Sm	7	19.73	PPM	9.7
Eu	7	2.14	PPM	.7
Gd	3	27.33	PPM	4.
Tb	4	5.65	PPM	2.
Dy	6	33.93	PPM	18.
Ho	3	6.63	PPM	2.5
Er	3	22.33	PPM	16.
Tm	1	2.3	PPM	0
Yb	7	17.11	PPM	20.
Lu	5	2.44	PPM	.55
Th	6	3.67	PPM	1.23
U	7	.772	PPM	.500
B	2	2.4	PPM	3.2
Ga	5	4.66	PPM	1.7
In	4	.0197	PPM	.067
Tl	1	1.109	PPB	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
C	1	16.0	PPM	0
Ge	3	.79	PPM	1.23
Sn	1	.6	PPM	0
Pb	2	2.34	PPM	1.32
SiO_2	5	41.61	PCT	6.20
Al_2O_3	7	8.42	PCT	3.28
TiO_2	9	10.86	PCT	4.34
FeO	7	19.08	PCT	2.19
MnO	10	.230	PCT	.084
MgO	5	7.02	PCT	1.52
CaO	8	11.07	PCT	4.20
Na_2O	8	.515	PCT	.142
K_2O	12	.296	PCT	.254
P_2O_5	2	.132	PCT	.076
H	2	.13	CC/G	.06
Li	4	14.50	PPM	11.00
Rb	8	5.24	PPM	2.62
Cs	5	.194	PPM	.051
Be	2	2.90	PPM	.8
Sr	6	142.22	PPM	90.00
Ba	6	309.67	PPM	232.
Sc	6	89.33	PPM	15.00
V	4	55.00	PPM	25.
Cr_2O_3	7	.342	PCT	.101
Co	8	26.7	PPM	9.
Ni	5	16.22	PPM	33.87
Cu	5	6.00	PPM	7.48

CHEMICAL ANALYSES

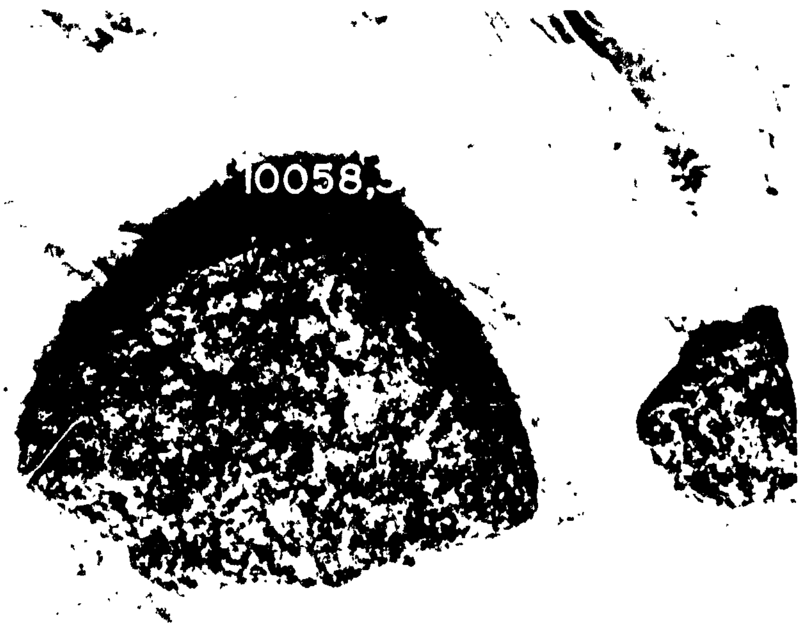
Element	Number of Analyses	Mean	Units	Range
Zn	3	2.12	PPM	1.19
Y	4	201.25	PPM	85.0
Zr	4	621.25	PPM	250.0
Nb	2	35.5	PPM	13.
Mo	2	.25	PPM	.3
Pd	3	.039	PPM	.09
Ag	4	.025	PPM	.051
Cd	3	.302	PPM	.897
N	1	70.	PPM	0
As	2	.045	PPM	.01
Sb	1	.005	PPM	0
Bi	1	.270	PPB	0
O	2	40.4	PCT	0
S	1	.228	PCT	0
Se	2	.150	PPM	.061
Te	1	.008	PPM	0
F	3	82.67	PPM	20.
Cl	2	31.	PPM	38.
Br	2	.063	PPM	.075

Analysts: Begemann et al., (1970); Engel and Engel, (1970); Morrison et al., (1970); Wanke et al., (1970); Smales et al., (1971); Ganapathy et al., (1970); Kharkar & Turekian, (1971); Stoenner et al., (1971); Annell & Helz, (1970); Turekian & Kharkar, (1970); Engel, (1971); O'Kelly et al., (1970) Wanless et al., (1970); Stoenner et al., (1970); Papanastassiou et al., (1970); Anders et al., (1971); Lovering & Butterfield, (1970); Haskin et al., (1970); Perkins et al., (1970); Tatsumoto, (1970); Wrigley & Quaide, (1970); Wasson & Baedecker, (1970); Kaplan et al., (1970); Wanke et al., (1972).
Age References: Hintengerger et al., (1971); Armstrong & Alsmiller (1971); O'Kelly et al.,(1970); Boschler (1971); Marti et al., (1970); Perkins (1970); Wanless (1970); Tatsumoto (1970); Papanastassiou (1970) Crozaz et al.,(1970).

10058,0

Original PET Photo
(S-69-46309)

1 cm.



10058,34
(S-76-21354)

2 cm.

10058

Sample 10058 is an angular to sub-rounded, white to dark brown, olivine basalt. This sample originally weighed 282gm and measured 5.5x5.5x5cm. It was originally returned in ALSRC #1003.

BINOCULAR DESCRIPTION BY: Twedell DATE: 6/3/76

ROCK TYPE: Medium grained basalt SAMPLE: 10058,3 WEIGHT: 173 gm

COLOR: White and dark brown DIMENSIONS: Chips and fines

SHAPE: Angular to sub-rounded

COHERENCE: Intergranular - friable
Fracturing - absent; one fracture surface (PET)

FABRIC/TEXTURE: Isotropic/Equigranular; Holocrystalline (PET)

VARIABILITY: Homogeneous

SURFACE: Most surfaces are smooth.

ZAP PITS: None

CAVITIES: About 2% of surface is vuggy.

COMPONENT	COLOR	% OF ROCK		SIZE(MM) DOM.	RANGE
Plagioclase$_1$	White	45	Subangular to sub-rounded	.5	.25-.8
Pyroxene$_2$	Honey Brn.	30	Angular to subangular	.3	.2-.5
Dark/or/Black$_3$	Brn/Blk	25	Rounded to elongated	.5	.4-.8

1) Ranges from crystalline to powder white. Possibly some cristobalite.
2) Most crystals are in good condition. Not much evidence of shock.
3) Probably ilmenite and some pyroxene.

SECTION: 10058,51 Width of field 2.72mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/3/76

SUMMARY: Medium-grained subophitic basalt composed of large anhedral crystals of clinopyroxene, two generations of plagioclase, a ilmenite with subordinate cristobalite, pyroxferroite and mesostasis. The large crystals of pyroxene host all other phases present. The pyroxene is highly zoned. The ilmenite crystals are very skeletal.

PHASE	% SECTION	SHAPE	SIZE (MM)
Pyrox	44	Anhedral, irregular	0.1-2.5
Plag	37	Subhedral to anhedral	0.05-1.7
Opaq	13	Subhedral to skeletal	0.2-1.8
Cris	5	Anhedral	0.2-1.1
Meso	1	Irregular	0.05-0.2

COMMENTS:

Pyroxene - Large anhedral highly zoned crystals of clinopyroxene form an almost continuous array. The extinctions are, for the most part, poor with few grains giving sharp extinction points. Almost all crystals show a pronounced fracture pattern with minor cleavage/parting developed. Some crystals have sharp, well defined cleavage patterns.

Small crystals of pyroxferroite are associated as overgrowths on the pyroxene crystals. These crystals form sharp contacts with the pyroxene. Many of the fractures in the pyroxene continue through the adjacent pyroxferroite overgrowth. The pyroxferroite crystals are scattered throughout the section and no localized concentration was noted.

Plagioclase - Two generations of plagioclase occur in the rock. The first generation consists of long tabular crystals and appears in the section either as well defined rectangular or acicular crystals. The second generation occurs as anhedral void fillings in the pyroxene-ilmenite-plagioclase network. The first generation crystals are clearly grouped into masses within the rock. Some areas contain no plagioclase while others have a heavy concentration. All the first generation crystal exhibit sharp twin planes and extinctions. The second generation crystals show much poorer optical characteristics.

Isolated, yet closely related to the plagioclase masses, are areas of colorless to pale brown mesostasis. Some devitrification of the glass has taken place.

Cristobalite - Large anhedral crystals of cristobalite occur as interstitial fillings in the voids within the silicate network.

Opaques - The most common opaque mineral present in the rock is ilmenite. The crystals are subhedral to very skeletal and are scattered throughout the section. Many of the crystals have finger-like projections forming a very erose crystal.

Associated with the ilmenite are small masses of troilite, troilite with iron-nickel and baddeleyite. The masses of troilite are more often isolated and not directly associated with the ilmenite. The troilite with iron-nickel and the baddeleyite are, however, found intergrown with the ilmenite. The size of the troilite and troilite with iron-nickel is from 0.01-0.2mm while the baddeleyite forms a few small (0.05mm) masses.

TEXTURE: Subophitic medium-grained basalt consisting of pyroxene, two generations of plagioclase, ilmenite and cristobalite with minor other phases. The presence of baddeleyite is unusual for Apollo 11 basalts. Contacts are sharp and little to no interreaction between phases is present.

Selected References: Brown et al. (1970), Cameron (1970), Simpson and Bowie (1970)

HISTORY AND PRESENT STATUS OF SAMPLES - 6/3/76

10058 was removed from the Bulk Sample container (ALSRC #1003) and split in the Bio-Prep Lab. A 2gm chip was sent to PCTL for PET analysis. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES: (All BP-SSPL)

2	1.20	gm	Chip. No pitted surface.
3	173.0	gm	Large chips and fines. No pitted surfaces observed.
15	9.24	gm	Fine fines.
16	5.85	gm	Fine fines.
17	14.06	gm	Fine fines.
18	16.21	gm	Fine fines.
19	6.88	gm	Fine fines.
34	23.53	gm	Chip. No pitted surfaces.

RETURNED SAMPLES:

109	11.79	gm	Chip. One sawed surface. One pitted surface.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	4	40.78	PCT	2.34
Al_2O_3	5	10.85	PCT	1.6
TiO_2	4	10.13	PCT	1.55
FeO	4	18.55	PCT	2.25

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
MnO	4	.257	PCT	.060
MgO	4	6.12	PCT	.663
CaO	5	12.37	PCT	4.39
Na_2O	6	.423	PCT	.065
K_2O	6	.097	PCT	.042
P_2O_5	1	.055	PCT	0
Li	2	8.70	PPM	5.40
Rb	5	1.01	PPM	.620
Cs	3	.121	PPM	.273
Be	1	1.5	PPM	0
Sr	4	194.32	PPM	46.3
Ba	5	126.8	PPM	27.00
Sc	3	87.27	PPM	13.20
V	2	59.50	PPM	37.0
Cr_2O_3	4	.233	PCT	.053
Cr	1	1960.	PPM	0
Co	3	13.93	PPM	1.00
Ni	1	79.99	PPM	0
Cu	1	7.10	PPM	0
Zn	1	9.3	PPM	0
Y	1	150.0	PPM	0
Zr	4	278.50	PPM	190.
Nb	1	47.	PPM	0
Mo	1	.4	PPM	0
Pd	1	.2	RPM	0
Ag	1	.07	PPM	0
Cd	1	.7	PPM	0
Ta	2	1.3	PPM	.6

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
W	1	.36	PPM	0
Hf	3	10.82	PPM	4.74
Au	1	.720	PPB	0
La	3	13.1	PPM	4.5
Ce	3	41.4	PPM	6.
Pr	1	13.0	PPM	0
Nd	2	56.5	PPM	30.8
Sm	3	17.73	PPM	8.
Eu	4	2.34	PPM	1.4
Gd	2	22.8	PPM	1.6
Tb	2	4.45	PPM	1.9
Dy	2	33.0	PPM	12.0
Ho	2	7.25	PPM	3.5
Er	2	26.15	PPM	19.7
Tm	1	2.0	PPM	0
Yb	4	14.12	PPM	17.0
Lu	3	2.13	PPM	.36
Th	1	1.1	PPM	0
U	2	.19	PPM	.02
B	1	2.	PPM	0
Ga	2	4.55	PPM	.5
In	2	.392	PPM	.415
Ge	2	.63	PPM	1.14
Sn	1	1.2	PPM	0
Pb	1	3.	PPM	0
N	1	40.	PPM	0
As	1	.07	PPM	0
Sb	1	.01	PPM	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
O	1	39.9	PCT	0
F	1	50.	PPM	0
Cl	1	50.	PPM	0
Br	1	.3	PPM	0

Analysts: Ehmann & Morgan, (1970); Morrison et al., (1970); Rose et al, (1970); Goles et al., (1970); Tera et al., (1970); Gast et al., (1970); Murthy et al., (1970); Hurley & Pinson, (1970); Ehmann et al., (1975); Wasson & Baedecker, (1970).

Age References: Eberhardt (1971b); Papanastassiou (1970); Papanastassiou et al., (1971); Crozaz et al., (1970).

10059,0
Original PET Photo
(S-69-49205)

cm

10059,1,82,83,84
(S-76-21410)

10059

10059 is a medium dark grey, microbreccia that originally weighed 188gm. It was returned in ALSRC #1003 (Bulk Sample container). There was no PET description generated for this sample.

BINOCULAR DESCRIPTION BY: Twedell DATE: 1/22/76

ROCK TYPE: Microbreccia SAMPLE: 10059,1 WEIGHT: 24 gm

COLOR: Medium dark grey DIMENSIONS: 3 x 2 x 1.5 cm

SHAPE: Rounded to subrounded

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

FABRIC/TEXTURE: Anisotropic/Microbreccia

VARIABILITY: Homogeneous

SURFACE: Smooth on exterior surfaces to irregular on fresh.

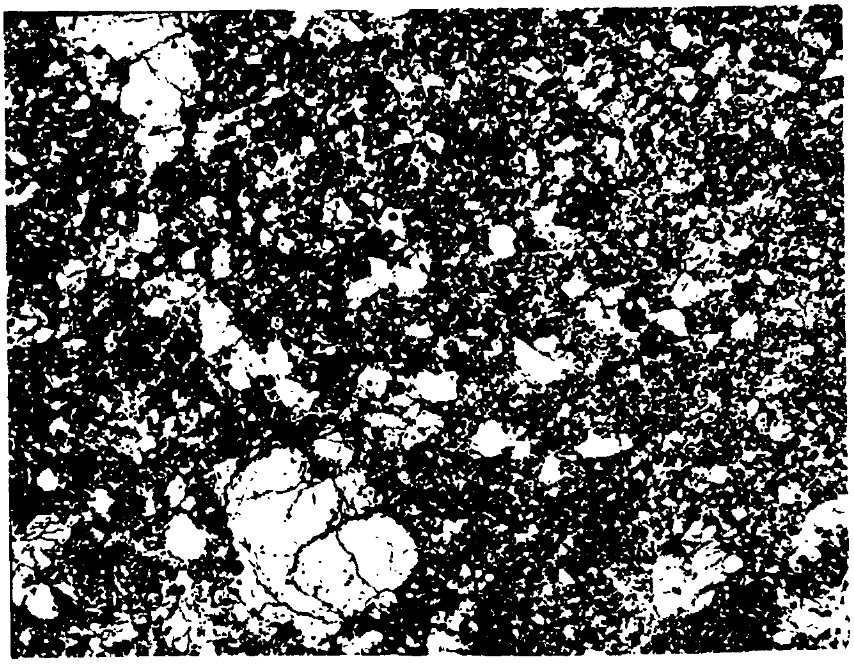
ZAP PITS: Many on one surface of each of the 4 largest pieces, none on all other surfaces. Pits are glass lined, up to 1mm in diameter.

CAVITIES: Absent

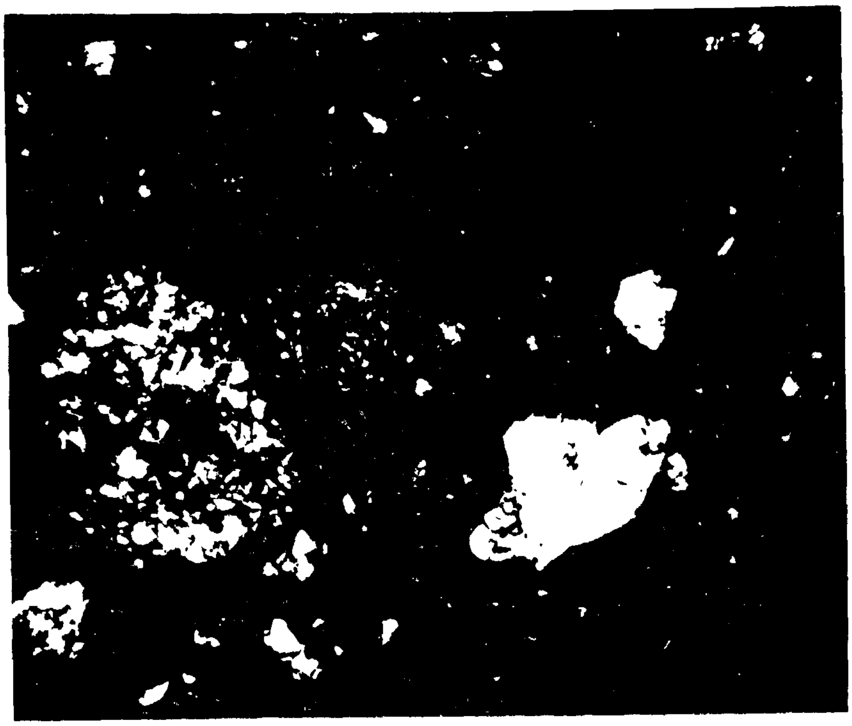
COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	RANGE
$Matrix_1$	Med.Dk.Grey	99	-----	---	------
Wnite $Clast_2$	White	1	Angular	0.6	.25-1.0

1) Loosely powdered soil breccia.
2) Crushed in texture, no crystal faces.

NOTE: Sample was separated into three larger pieces. All pieces (,1 ,83 ,84) fit into this description.



Section 10059,41 Width of field 2.72 mm reflected light



Section 10059,41 Width of field 2.72 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/24/76

SECTION: 10059,41

SUMMARY: Slightly devitrified typical breccia with relatively low lithic clast content. The matrix is very dark and nearly opaque.

MATRIX 79% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Very dark brown	100	-----	<0.001	Very high glass content; very little devitrification.

MINERAL CLASTS 14% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene$_1$	Very abundant	Angular to irregular	0.001-0.6
Plagioclase$_2$	Present	Blocky to irregular	0.001-0.05
Opaques$_3$	Few	Skeletal to blocky	0.001-0.1

1) Predominant phase present; poor extinctions.
2) Very rare; a few small shards.
3) Scarce; a few present in matrix.

LITHIC CLASTS 3% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large$_4$	Five present	Rounded to irregular	>1.0

4) a. Fine-grained basalt composed of pyroxene, plagioclase and ilmenite.
   b. Coarse-grained basalt composed of pyroxene, plagioclase and ilmenite.
   c. Crystal aggragate composed of pyroxene and plagioclase with some glass in the matrix.
   d. Coarse-grained basalt composed of pyroxene, plagioclase and ilmenite.
   e. Fine-grained basalt composed of pyroxene, plagioclase and ilmenite.

GLASS CLASTS 4% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Angular to spherical	0.001-0.4
Red-Orange[6]	Abundant	Spherical to angular	0.001-0.3

5) Mostly angular shards only a few part spheres.
6) Mostly spheres, broken spheres with occasional angular pieces.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/24/76

10059 was removed from the Bulk Sample container (ALSRC #1003) in the Bio-Prep Lab. It was then transferred to PCTL where it was split for PET analysis. It was then sent to SPL where it was wiresawed and allocated. The sample was described in SSPL during the Apollo 11 re-examination.

PRISTINE SAMPLES: (All BP-PCTL-SPL-SSPL)

1	10.2?	gm	Chip. One pitted surface.
82	24.52	gm	Chips and fines.
83	12.77	gm	Chip. One pitted surface.
84	6.22	gm	Chip. One pitted surface.

RETURNED SAMPLES:

8	13.34	gm	Chips and coarse fines. Three largest chips have one pitted surface each.
10	4.40	gm	Chip. 1.0x1.5x2.0 cm. Two pitted surfaces.
24	14.25	gm	Chip. One sawed surface. No pits.
63	11.62	gm	Chip. 2.5x2.0x2.0 cm. Two sawed and one pitted surface. This sample contains one small breccia chip that does not belong with this generic.
9004	14.25	gm	Chips. One chip (2.0x2.0x1.0cm) has two sawed and two pitted surfaces. Another chip (1.0x1.0x1.0cm) has 1 sawed and 1 pitted surface.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	3	41.87	PCT	1.54
Al_2O_3	5	12.56	PCT	.85
TiO_2	3	8.19	PCT	.584
FeO	3	17.09	PCT	1.87
MnO	5	.220	PCT	.071
MgO	3	8.46	PCT	1.16
CaO	4	11.82	PCT	1.54
Na_2O	5	.486	PCT	.046
K_2O	4	.18	PCT	.031
Li	2	12.95	PPM	1.9
Rb	5	3.54	PPM	1.2
Cs	2	.123	PPM	.006
Be	1	1.70	PPM	0
Sr	3	147.7	PPM	43.1
Ba	5	210.8	PPM	45.0
Sc	4	65.65	PPM	6.9
V	4	62.75	PPM	30.0
Cr_2O_3	4	.317	PCT	.070
Co	3	36.0	PPM	8.0
Ni	2	261.	PPM	78.0
Cu	1	21.	PPM	0
Zn	1	29.	PPM	0
Y	2	146.0	PPM	88.0
Zr	3	448.	PPM	285.0
Nb	1	18.	PPM	0
Ag	1	.009	PPM	0
Ta	1	1.6	PPM	0
Hf	2	13.0	PPM	3.0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
La	4	18.49	PPM	1.15
Ce	2	62.5	PPM	7.0
Nd	1	51.0	PPM	0
Sm	4	15.09	PPM	2.25
Eu	4	2.00	PPM	.32
Tb	2	4.10	PPM	.8
Dy	1	25.0	PPM	0
Ho	1	5.5	PPM	0
Yb	4	12.41	PPM	3.15
Lu	3	1.92	PPM	.07
Th	1	4.2	PPM	0
U	1	.52	PPM	0
Ga	1	4.6	PPM	0
O	1	40.0	PCT	0
F	1	90.0	PPM	0

Analysts: Ehmann & Morgan, (1970); Wakita et al., (1970); Smales et al., (1971); Goles et al., (1970); Annell & Helz, (1970); Tera et al., (1970); Papanastassiou et al., (1970); Kharkar & Turekian, (1971).

No Age References

10060,0
Original PET Photo
(S-69-46497)

10060,5
(S-76-25888)

10060

Sample 10060 is a rounded to sub-rounded, medium dark grey, fine breccia. This sample originally weighed 722 gm and measured 5 x 5 x 4.5 cm. It was originally returned in ALSRC # 1004 (Documented Sample Container).

BINOCULAR DESCRIPTIONS BY: Twedell DATE: 5-27-76

ROCK TYPE: Fine Breccia SAMPLE: 10060,5 WEIGHT: 112 gm

COLOR: Med. dark grey DIMENSIONS: 3.5 x 4.3 x 2.6 cm

SHAPE: Rounded to sub-rounded; angular/tabular with dreikanter appearance (PET)

COHERENCE: Intergranular - coherent
Fracturing - few - non-penetrative; planar fractures occur parallel to flattest side (PET)

FABRIC/ TEXTURE: Anisotropic/Fine Breccia

VARIABILITY: Homogeneous

SURFACE: Smooth on pitted surface to irregular on non-pitted surfaces; Granular (PET).

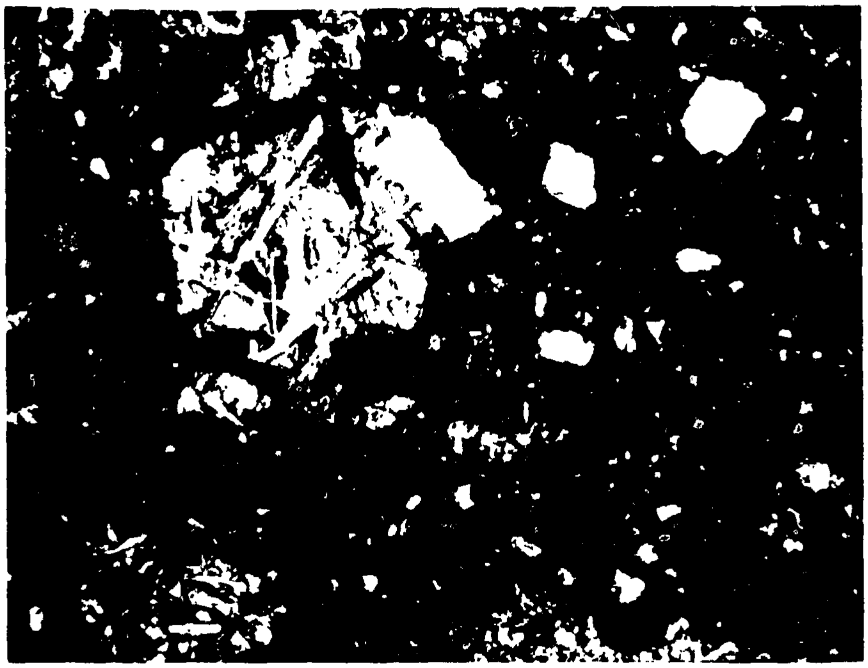
ZAP PITS: Few on E_1, T_1, N_1, B_1. None on any others. Pits are glass lined, up to 2.5 mm in diameter.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Med.Dk.Grey	97%	-	-	- - -
Basalt Clast	Brn/Wht/Blk	1%	Angular	2	.5-5.
White Clast	White	<1%	Angular	.9	.2-.3
Brown $Clast_1$	Brown	<1%	Angular	<.1	<.1-.2
Grey & White Clast	Blk & Wht	<1%	Angular	<.1	2.1
Grey $Clast_2$	Grey	<1%	Angular	<.1	<.1

1) Crushed proxene

2) Only one on surface



SECTION 10060,49 Width of field 2.72 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6-23-76

SUMMARY: Partly devitrified typical breccia with several large clasts. The matrix appears to be filled with cryptocrystalline material and shards of the clasts present. Minor variation in the amount of devitrification is seen from one part of the section to another.

Matrix 57% of Rock

PHASE	% Section	Shape	Size (mm)	Comments:
Dk.Brown	100%	-	< 0.001	High glass content with abundant cryptocrystalline material.

Mineral Clasts 21% of Rock

Phase	Relative Abundance	Shape	Size (mm)
Pyroxene 1	Very abundant	Angular to irregular	0.001-0.3

Plagioclase$_2$	Few	Blocky to irregular	0.001-0.2
Opaques$_3$	Few	Skeletal to irregular	0.001-0.3

1) Poor extinctions and highly fragmented.
2) Poor optical characteristics.
3) Most in clasts.

Lithic Clasts 19% of Rock

Type	Relative Abundance	Shape	Size (mm)
Small	Very Abundant	Rounded to irregular	0.001-1.0
Large$_4$	Eight present	Rounded to irregular	>1.0

4) a. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite with a glass coating.

b. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

c. Glass- ic matrix hosting small pyroxene and plagioclase crystallites.

d. Random array of plagioclase crystals hosting small euhedral pyroxene/olivine crystals.

e. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

f. ine-grained basalt composed of pyroxene, plagioclase and ienite.

g. Crystal aggregation consisting of pyroxene, plagioclase and ilmenite with a minimum glass phase.

h. Fine-grained glass-rich matirx hosting small mineral fragments and small rock fragments.

Glass Clasts 3% of Rock

Type	Relative Abundance	Shape	Size (mm)
Yellow-Orange$_5$	Very abundant	Angular to spherical	0.001-0.4
Red-Orange$_6$	Moderate	Angular to spherical	0.001-0.1
Colorless$_7$	Present	Angular	0.001-0.5

5) Mostly angular shards: few part spheres.
6) Mostly angular shards; a few spherical masses.
7) Rare: only a few shards.

Selected References: Agrell et al. (1970), Cameron (1970).

HISTORY AND PRESENT STATE OF SAMPLES - 6/25/76

10060 was removed from the Documented Sample container and split in the Vac Lab. A 2 gm. sample was sent to PCTL for PET analysis. A 582 gm. piece was transferred to the Bio Prep Lab for preparation of a 479 gm display sample. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES (all VAC-BP-SSPL)

5	112.	gm	Piece.	Few pits on four surfaces. See binocular description.
42	2.30	gm	Chip.	1.4 x 1.2 x 1.0 cm. No pits or patina.
47	2.56	gm	Fines.	
48	1.90	gm	Fines.	

RETURNED SAMPLES

38	28.52	gm	Chip.	Pitted on two surfaces.
46	4.99	gm	Three Chips.	Largest chip is pitted on one surface.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	7	42.17	PCT	4.8
Al_2O_3	9	11.43	PCT	2.02
TiO_2	8	8.65	PCT	1.48
FeO	8	17.10	PCT	2.72
MnO	7	.211	PCT	.057
MgO	7	8.01	PCT	2.43

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
CaO	6	12.62	PCT	4.19
Na_2O	7	.484	PCT	.054
K_2O	6	.188	PCT	.045
P_2O_5	2	.104	PCT	.068
H	1	22.0	PPM	0
Li	2	8.7	PPM	3.40
Rb	4	4.33	PPM	1.00
Cs	2	.195	PPM	.01
Be	1	3.00	PPM	0
Sr	4	172.75	PPM	16.0
Ba	5	215.6	PPM	88.0
Sc	5	66.9	PPM	9.50
V	4	65.0	PPM	36.0
Cr_2O_3	7	.314	PCT	.143
Co	6	29.92	PPM	4.60
Ni	3	129.74	PPM	91.99
Cu	3	8.7	PPM	5.00
Zn	3	27.33	PPM	5.00
Y	2	168.5	PPM	83.0
Zr	5	434.82	PPM	635.0
Nb	2	30.5	PPM	29.00
Mo	1	.7	PPM	0
Pd	1	.006	PPM	0
Ag	1	.01	PPM	0
Cd	1	.3	PPM	0
Ta	4	1.86	PPM	.4
W	1	.35	PPM	0
Hf	5	12.79	PPM	2.0

CHEMICAL ANALYSES

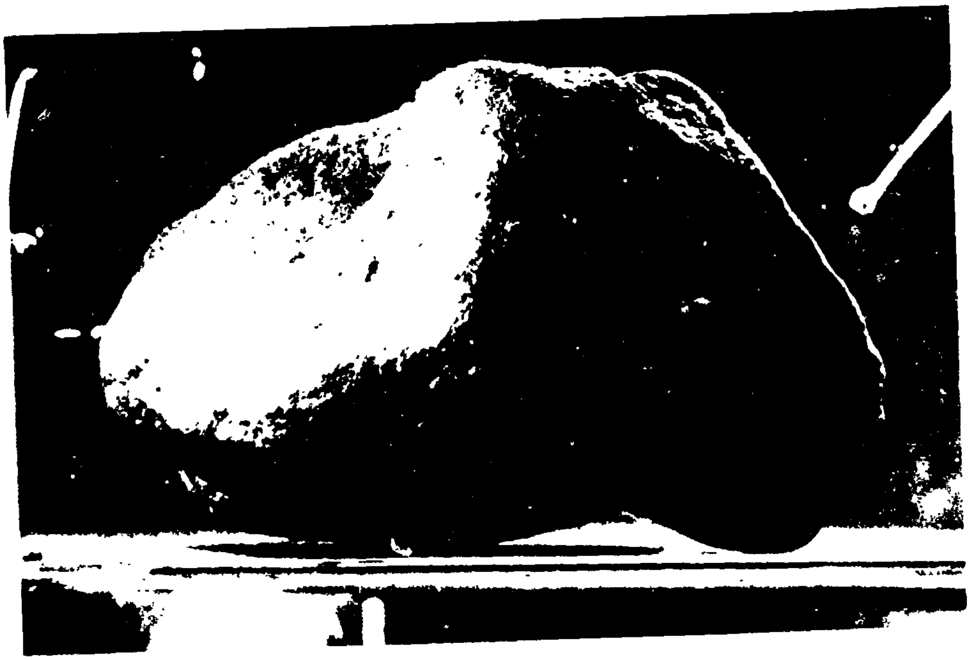
Element	Number of Analyses	Mean	Units	Range
Ir	1	5.40	PPB	0
Au	1	1.40	PPB	0
La	7	20.67	PPM	7.3
Ce	7	59.36	PPM	6.0
Pr	1	13.0	PPM	0
Nd	4	55.75	PPM	37.00
Sm	7	16.69	PPM	10.2
Eu	7	2.00	PPM	.99
Gd	2	26.00	PPM	4.0
Tb	6	4.23	PPM	3.11
Dy	5	27.84	PPM	19.3
Ho	5	6.56	PPM	5.20
Er	3	20.17	PPM	15.5
Tm	1	1.8	PPM	0
Yb	7	14.13	PPM	11.1
Lu	7	1.91	PPM	.73
Th	2	2.51	PPM	.976
U	4	.586	PPM	.153
B	1	3.0	PPM	0
Ga	3	5.0	PPM	.5
In	3	.711	PPM	1.10
C	1	135.0	PPM	0
Ge	3	.68	PPM	1.16
Pb	2	2.43	PPM	1.14
N	1	20.0	PPM	0
As	2	.05	PPM	.08
Sb	1	.005	PPM	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
O	3	41.0	PCT	1.10
S	2	.131	PCT	.038
Se	1	.9	PPM	0
F	1	80.0	PPM	0
Cl	1	15.5	PPM	0
Br	1	.3	PPM	0

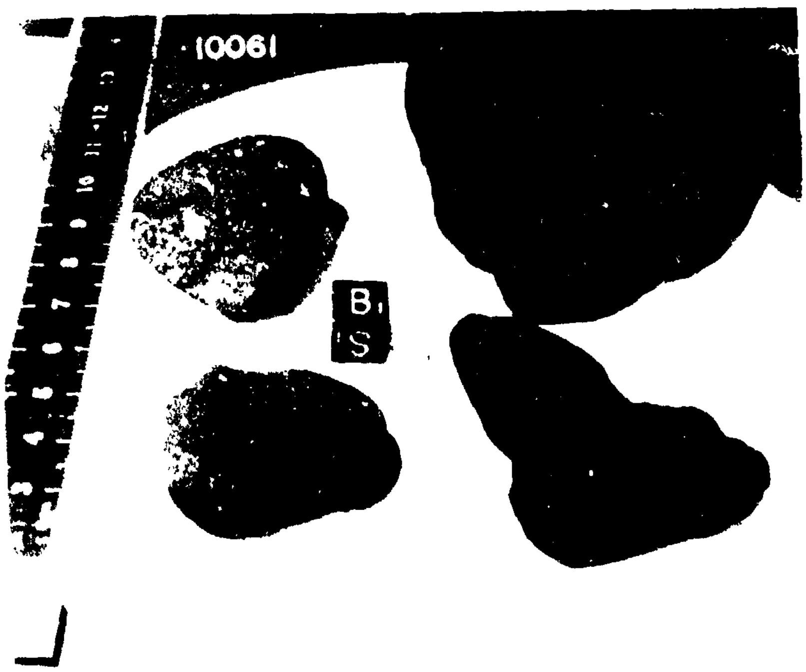
Analysts: Agrell et al., (1970); Ehmann & Morgan, (1970); Goles et al., (1970); Morrison et al., (1970); Rose et al., (1970); Wanke et al., (1970); Smales et al., (1971); Smales et al., (1970); Philpotts & Schnetzler, (1970); Friedman et al., (1970); Brown et al., (1970); Wasson & Baedecker (1970); Haskin et al., (1970); Kaplan et al., (1970).

Age References: Silver (1970)



10061,0
Original PET Photo
(S-69-46506)

2 cm



10061,18,41,43,131
(S-75-34230)

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10061

Sample 10061 is a sub-angular, medium grey, fine breccia. This sample originally weighed 346gm and measured 9x8.5x8.7cm. It was returned in ALSRC #1004 (Documented Sample container).

BINOCULAR DESCRIPTION BY: Kramer DATE: 6/24/76

ROCK TYPE: Fine Breccia SAMPLE: 10061,18 WEIGHT: 82 gm

COLOR: Medium grey DIMENSIONS: 5.8 x 3.5 x 2 cm

SHAPE: Sub-angular

COHERENCE: Intergranular - friable (granulated)
Fracturing - absent

FABRIC/TEXTURE: Anisotropic/Fine Breccia

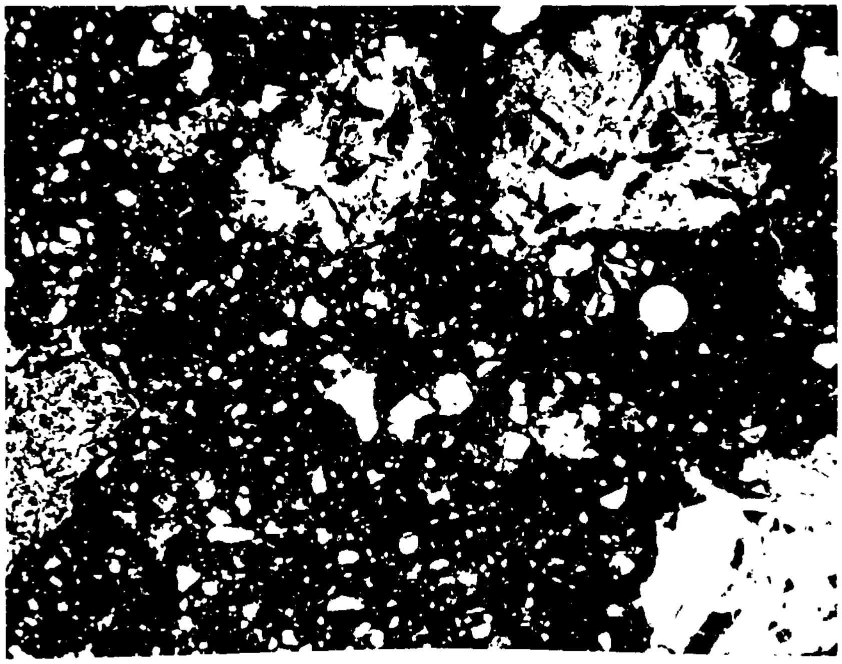
VARIABILITY: Homogeneous

SURFACE: Granulated

ZAP PITS: Few - T_1

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Matrix	Med.Grey	90	-----	---	-----
Salt & Pepper Clast	Blk/Wh	<1	Angular	1.5	0.05-2.0
Basalt Clast	Med.Grey	2	Sub-angular	2.	0.05-3.0
Grey & White Clast	Grey/Wh	3	Sub-rounded	0.5	0.01-7.0
White Clast	White	5	Angular	0.5	0.01-1.



SECTION: 10061,28 Width of field 2.72mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/24/76

SUMMARY: Partly devitrified breccia with a pronounced change in the matrix from one part of the section to another. Approximately one half of the section has a nearly colorless to pale brown glass-rich phase, while the other half has the more usual dark brown nearly opaque phase.

MATRIX 60% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Colorless to pale brown	50	-----	<0.001	High glass content plus numerous small crystallites; translucent to transparent.
Dark brown	50	-----	<0.001	High glass content; typical breccia matrix.

MINERAL CLASTS 14% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene [1]	Very abundant	Angular to irregular	0.001-0.4
Plagioclase[2]	Few	Blocky to irregular	0.001-0.2
Opaques[3]	Few	Skeletal to irregular	0.001-0.4

1) Mostly angular shards; poor optical characteristics.
2) Blocky with some twins still observable.
3) Most in clasts.

LITHIC CLASTS 13% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Four present	Rounded to irregular	>1.0

4) a. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   b. Random array of plagioclase crystals hosting small anhedral pyroxene/olivine crystals.
   c. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   d. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.

GLASS CLASTS 6% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Angular to spherical	0.001-0.5
Brown-Yellow[6]	One present	Spherical	0.5
Colorless[7]	Few	Angular	0.001-0.4

5) Mostly angular shards, some part spheres.
6) Two immiscible glasses in a single droplet.
7) All shards, some with bubbles.

Selected References: Keil et al. (1970)

HISTORY AND PRESENT STATUS OF SAMPLES - 6/24/76

10061 was removed from the Documented Sample container (ALSRC #1004) and split in the Vac Lab. Some loose chips were sent to PCTL for PET analysis. Sample was split and allocated in SPL. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES:

2	6.08	gm	Chips and fines. Largest chip is less than 1gm. VAC-PCTL-SSPL
18	81.76	gm	Large piece. Pitting on T_1. VAC-SPL-SSPL
41	30.18	gm	Large angular piece. No pitting observed. VAC-SPL-SSPL-RCL-SSPL
43	23.71	gm	Large piece with some pitting on N_1. VAC-SPL-SSPL
44	17.62	gm	Large piece with some pitting on T_1. VAC-SPL-SSPL
48	12.73	gm	Chips and fines. No chips are larger than 0.25gm. VAC-SPL-SSPL
128	13.54	gm	Large chip. No pits. VAC-SPL-SSPL
129	8.69	gm	Chips and fines. Largest chips are less than 0.5gm. VAC-SPL-SSPL
130	14.11	gm	Three chips. All have some exterior surface, but no pits were observed. VAC-SPL-SSPL
131	20.13	gm	Surface piece. B_1 is pitted. VAC-SPL-SSPL
132	5.72	gm	Three interior chips. Largest is 3.58gm. VAC-SPL-SSPL

RETURNED SAMPLES:

42	11.20	gm	Chip. No pits observed.
50	4.89	gm	Chip. No pits observed.
76	5.32	gm	Chip. No pits observed.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	2	41.15	PCT	1.44
Al_2O_3	4	13.10	PCT	1.17
TiO_2	3	8.17	PCT	2.00
FeO	2	16.35	PCT	.2
MnO	3	.214	PCT	.048
MgO	2	8.8	PCT	1.95
CaO	2	11.30	PCT	1.33
Na_2O	3	.487	PCT	.042
K_2O	1	.18	PCT	0
P_2O_5	1	.14	PCT	0
H	2	1.95	CC/G	1.1
Li	2	7.5	PPM	7.0
Rb	3	3.70	PPM	.59
Cs	1	.146	PPM	0
Be	1	2.40	PPM	0
Sr	2	148.05	PPM	36.1
Ba	3	219.33	PPM	142.0
Sc	2	63.3	PPM	7.4
V	3	58.0	PPM	46.0
Cr_2O_3	3	.322	PCT	.117
Co	4	31.48	PPM	12.0
Ni	2	205.5	PPM	71.0
Cu	3	21.0	PPM	9.0
Zn	3	31.07	PPM	10.0
Y	2	105.5	PPM	5.0
Zr	3	325.0	PPM	153.0
Nb	3	28.33	PPM	26.0
Pd	1	7.00	PPB	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Ag	1	.163	PPM	0
Cd	1	.106	PPM	0
Hf	1	13.10	PPM	0
Ir	1	9.18	PPB	0
Au	1	3.42	PPB	0
Hg	1	120.	PPB	0
La	3	19.27	PPM	6.20
Ce	2	42.6	PPM	11.6
Pr	1	15.00	PPM	0
Nd	1	20.	PPM	0
Sm	1	13.2	PPM	0
Eu	1	1.78	PPM	0
Tb	1	3.40	PPM	0
Ho	1	3.7	PPM	0
Yb	1	13.1	PPM	0
Lu	1	1.94	PPM	0
Th	3	2.60	PPM	0
U	3	.638	PPM	0
Ga	3	5.33	PPM	0
Ln	1	1.43	PPM	0
Tl	1	2.70	PPB	0
C	2	221.5	PPM	81.0
Pb	1	1.74	PPM	0
Bi	1	2.79	PPB	0
O	1	41.70	PCT	0
S	1	.150	PCT	0
Te	1	.073	PPM	0

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CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
F	1	342.0	PPM	0
Cl	1	7.54	PPM	0
Br	2	.253	PPM	.014

Analysts: Compston et al., (1970); Ehmann & Morgan, (1970); Ganapathy et al., (1970); Goles et al., (1970); Annell & Helz, (1970); D'amico et al., (1970); Reed & Jovanovic, (1970); Morrison et al., (1970); Herzog & Herman, (1970); Tatsumoto, (1970); Epstein & Taylor, (1970); Epstein & Taylor, (1971).

Age References: Tatsumoto (1970).

10062,0

Original PET Photo
(S-69-46521)

1 cm.

10062,13
(S-76-21516)

1 cm.

C-4

10062

Sample 10062 is a sub-angular, dark grey, olivine basalt. This sample originally weighed 79gm and measured 7x6x2 cm. It was originally returned in ALSRC #1004 (Documented Sample container).

BINOCULAR DESCRIPTION BY: Kramer DATE: 1/27/76

ROCK TYPE: Olivine basalt SAMPLE: 10062,13 WEIGHT: 25.38 gm

COLOR: Dark grey DIMENSIONS: 4 x 2.5 x 1.7 cm

SHAPE: Sub-angular (broken)

COHERENCE: Intergranular - coherent
Fracturing - absent; few (PET)

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: Homogeneous

SURFACE: T_1 irregular; rough (PET)
B_1 (fresh) irregular; rough (PET)

ZAP PITS: Few on T_1, none on others. Pits are glass lined, up to 1mm in diameter.

CAVITIES: Vesicles cover 10% of surface.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Plagioclase	Milk White	30	Blocky to lathy	0.4	0.05-0.7
Pyroxene	Brown	47	Blocky	0.3	<0.5
Ilmenite	Black	20	Subhedral	0.1	0.01-0.3
Olivine	Green	3	Equant	0.6	0.2-0.8

SPECIAL FEATURES: Vesicles are lined with primarily the same relative quantities of minerals as the bulk rock.

SECTION: 10062,39 Width of field: 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 5/27/76

SUMMARY: Fine-grained ophitic basalt composed of clinopyroxene, two generations of plagioclase, two generations of ilmenite with subordinate olivine, troilite,iron-nickel and mesostasis. The pyroxene forms large anhedral crystals with lath-like to anhedral crystals of ilmenite in a continuous network. Interstitial to these phases are subhedral to anhedral crystals of plagioclase with minor glass-rich mesostasis. Isolated within the network are anhedral crystals of olivine.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	45	Anhedral	0.01-0.8
Plag	33	Tabular to anhedral	0.08-0.8
Oliv	4	Blocky, anhedral	0.001-0.3
Opaq	16	Lath-like to anhedral	0.05-1.0
Meso	2	Irregular	0.001-0.1

COMMENTS:

Pyroxene - Pinkish tan to light brown anhedral crystals of clinopyroxene together with the ilmenite crystals form an almost continuous array hosting the other phases present. The crystals of pyroxene show little cleavage pattern and almost no suggestion of crystal faces. Occasional feathery masses occur between plagioclase crystals. Most of the extinctions are irregular to patchy.

Plagioclase - Small subhedral crystals of plagioclase occur in the section associated with larger anhedral masses of plagioclase. The anhedral crystals form interstitial void fillings in the pyroxene-ilmenite network. Many of the larger crystals are somewhat skeletal in development. The smaller crystals show sharp to moderate twin planes while the larger crystals show little to none.

Olivine - Small to large blocky anhedral crystal masses of olivine are scattered throughout the section. All are fresh crystals with small pyroxene rims. Several of the crystals occur as small cores in some of the pyroxene crystals.

Mesostasis - Small amounts of an almost colorless to slightly brownish glass-rich mesostasis phase occurs usually between the plagioclase crystals and the adjacent pyroxene crystals. No phases were determined and the amounts were small.

Opaques - The opaque phases represented in the section are ilmenite and troilite-iron nickel. Carter, J.L. and MacGregor, I.D. (1970) have reported armalcolite and chromian ulvospinel from this rock. Neither of these phases were seen in this investigation.

Two generations of ilmenite are present in the section. The crystals occur as small lath-like crystal sections and also as large somewhat skeletal anhedral crystals. Both types occur in nearly equal amounts. Some rutile and chromite exsolutions are present in the larger crystals.

Small masses of troilite-iron nickel are present, but are rather sparse. A few masses of just troilite are also present.

TEXTURE: Interlocking anhedral crystals of pyroxene intergrown with two generations of ilmenite and two generations of plagioclase crystals in an ophitic texture. Interstitial to this network are masses of plagioclase and mesostasis.

Selected References: Carter and MacGregor (1970)

HISTORY AND PRESENT STATUS OF SAMPLES - 5/27/76

10062 was removed from the Documented Sample container (ALSRC #1004) and split in the Vac Lab. A 10gm chip was sent to PCTL for PET analysis. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES: (All VAC-SSPL)

14	1.67 gm	Chips and fines. Largest chip has 1 pitted surface. Remainder of chips have 1 or no pitted surfaces. No sawed surfaces on any chips.
13	25.33 gm	Largest chip is described in binocular description. Next largest chip has 2 pitted surfaces. Remainder of chips have no pitted surfaces.

RETURNED SAMPLES:

33	8.13 gm	Chip. Two pitted surfaces. Some chisel marks. Other surfaces are fresh.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	3	39.04	PCT	1.29
Al_2O_3	4	10.44	PCT	2.09
TiO_2	5	10.10	PCT	4.75
FeO	5	18.05	PCT	3.86
MnO	5	.251	PCT	.105
MgO	2	7.14	PCT	.13
CaO	4	12.02	PCT	1.54
Na_2O	6	.416	PCT	.042
K_2O	6	.070	PCT	.062
P_2O_5	1	.12	PCT	0
Rb	3	.844	PPM	.08

CHEMICAL ANALYSES

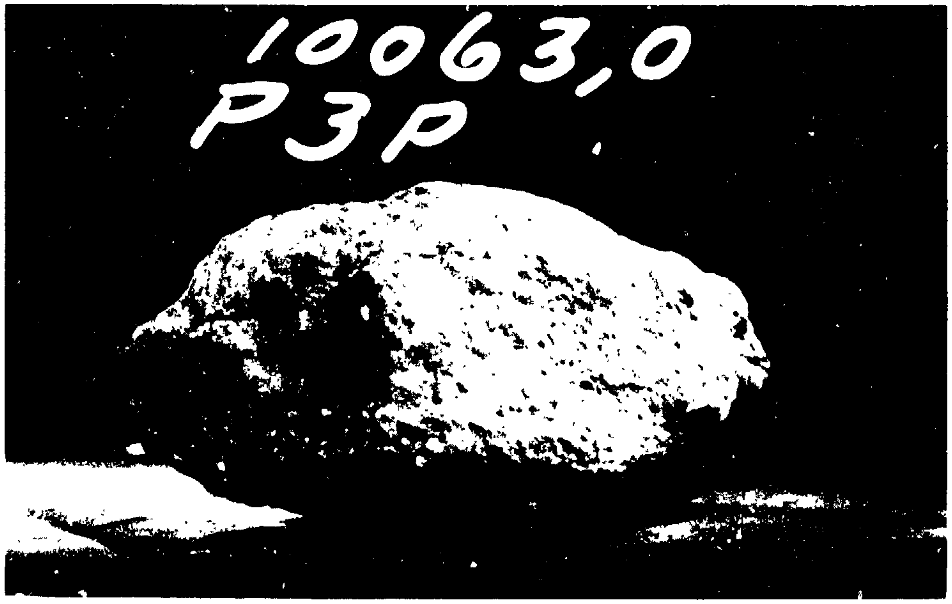
Element	Number of Analyses	Mean	Units	Range
Cs	1	.032	PPM	0
Sr	3	193.4	PPM	6.5
Ba	3	168.0	PPM	96.0
Sc	3	78.9	PPM	11.3
V	1	75.0	PPM	0
Cr_2O_3	4	.227	PCT	.059
Co	3	13.27	PPM	.8
Ni	1	15.01	PPM	0
Cu	1	4.0	PPM	0
Y	1	103.0	PPM	0
Zr	2	304.5	PPM	29.
Mo	1	.16	PPM	0
Ag	1	.071	PPM	0
Ta	3	1.5	PPM	.8
Hf	3	11.23	PPM	1.9
Au	1	.006	PPM	0
La	4	12.9	PPM	3.0
Ce	5	41.72	PPM	10.4
Nd	2	38.7	PPM	2.4
Sm	5	11.75	PPM	6.0
Eu	5	2.04	PPM	.4
Gd	2	18.15	PPM	.1
Tb	1	3.3	PPM	0
Dy	4	21.9	PPM	4.2
Ho	1	4.4	PPM	0
Er	2	12.3	PPM	1.0
Yb	5	10.24	PPM	7.2
Lu	5	1.6	PPM	1.07

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Th	1	.9	PPM	0
U	3	.267	PPM	.03
Ga	1	3.0	PPM	0
As	1	.05	PPM	0
O	1	38.0	PCT	0
S	1	.16	PCT	0
Se	1	.23	PPM	0

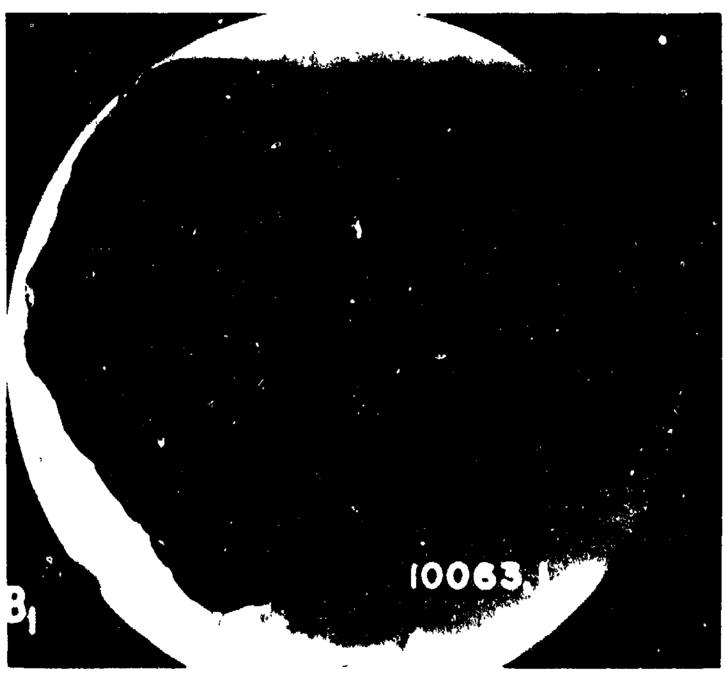
Analysts: Compston et al., (1970); Ehmann & Morgan, (1970); Rose et al., (1970); Goles et al., (1970); Turckian & Kharkar, (1970); Kharkar & Turekian, (1971); Gast et al., (1970); Philpotts & Schnetzler, (1970).

Age References: Turner (1970); Eberhardt (1971b).



10063,0
Original PET Photo
(S-69-46524)

2 cm



10063,1
(S-75-30489)

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10063

Sample 10063 is a sub-angular, dark grey, breccia. This sample originally weighed 148gm and measured 7x6.5x3.5cm. It was originally returned in ALSRC #1004 (Documented Sample container).

BINOCULAR DESCRIPTION BY: Kramer DATE: 8/12/75

ROCK TYPE: Breccia SAMPLE: 10063,1 WEIGHT: 128 gm

COLOR: Dark grey (fresh and exposed) DIMENSIONS: 7.5 x 5.7 x 3 cm

SHAPE: Subangular; subrounded (PET)

COHERENCE: Intergranular - coherent
Fracturing - one penetrative set parallel to T_1-B_1. One penetrative fracture parallel to E_1-W_1.

FABRIC/TEXTURE: Anisotropic/Breccia

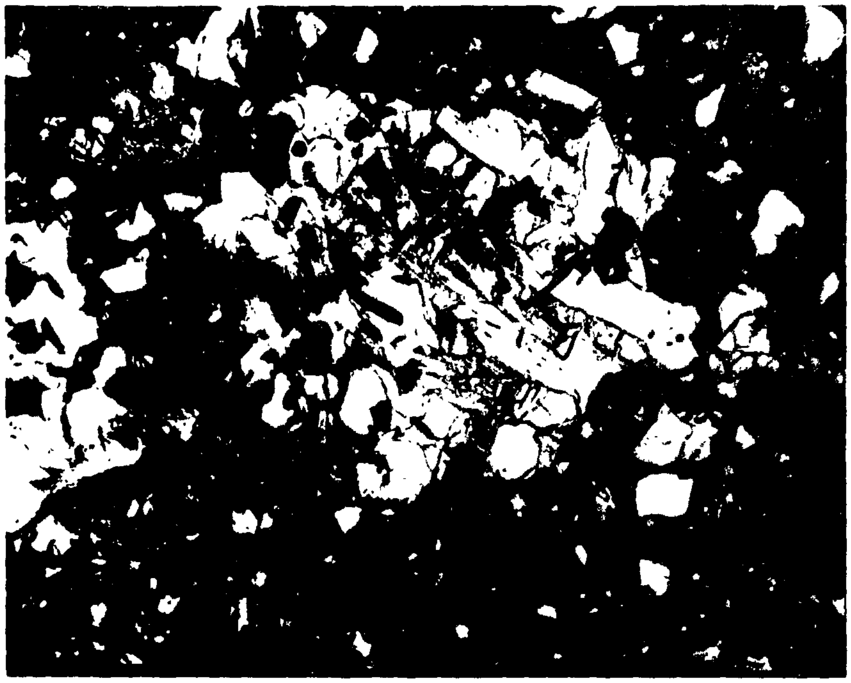
VARIABILITY: Large (3cm) basalt clast on one face

SURFACE: Hackly

ZAP PITS: Many pits on all faces except part of S_1. Pits are glass lined, up to 3mm in diameter.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Matrix	Dark Grey	80	Aphanitic	---	-----
White Clast	White	10	Angular to subrounded	1	<.01-3
Basalt Clast	Light Grey	5	Subrounded	10	.1-30
Grey Clast	Med.Grey	1	Subrounded	1	.5-1.5
Green Clast	Apple Green	<1	Angular	1	.5-10
Brown Clast	Honey Brown	<1	Rounded	3	1-15



SECTION: 10063,17 Width of field 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/24/76

SUMMARY: Partly devitrified typical breccia with a relatively high glass clast content. Very few spherical glass clasts are present. Almost all the glass is as fractured shards with minor devitrification.

MATRIX 53% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Dark Brown	100	-----	<0.001	High glass content; many small crystallites.

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MINERAL CLASTS 20% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Pyroxene_1$	Very abundant	Blocky to irregular	0.001-0.4
$Plagioclase_2$	Moderate	Blocky to irregular	0.001-0.2
$Opaques_3$	Few	Skeletal to irregular	0.001-0.4

1) Mostly as angular shards; poor optical characteristics.
2) Mostly shocked with few sharp twin planes.
3) Several large in matrix; many in clasts.

LITHIC CLASTS 20% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
$Large_4$	Six present	Rounded to irregular	>1.0

4) a. Fine-grained intersertal basalt with small euhedral pyroxene and larger plagioclase crystals.
   b. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   c. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   d. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   e. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   f. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.

GLASS CLASTS 7% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Yellow\text{-}Orange_5$	Very abundant	Angular to spherical	0.001-0.2
$Colorless_6$	Moderate	Angular	0.001-0.5

5) Very few spheres or part spheres; some devitrification.
6) Several large fragments; some devitrification.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/24/76

10063 was removed from the Documented Sample container (ALSRC #1004) and split in the Vac Lab. It was later re-examined and split in SSPL.

PRISTINE SAMPLES: (All VAC-SSPL)

1	128.01	gm	Large piece. All sides are pitted. Part of S_1 is fresh.
14	0.37	gm	One small chip found when sample was opened.
15	9.98	gm	Chip taken from subsample 1. Pitted on T_1.
16	1.42	gm	Chips and fines. All interior.

NO RETURNED SAMPLES

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	43.43	PCT	0
Al_2O_3	2	13.04	PCT	1.13
TiO_2	1	8.841	PCT	0
FeO	1	16.85	PCT	0
MnO	2	.215	PCT	.011
MgO	1	7.79	PCT	0
CaO	1	13.57	PCT	0
Na_2O	1	.456	PCT	0
Sc	1	62.20	PPM	0
V	1	90.0	PPM	0
Co	1	35.20	PPM	0
Cu	1	16.0	PPM	0
Zr	1	490.00	PPM	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Hf	1	13.10	PPM	0
La	1	16.70	PPM	0
Sm	1	12.90	PPM	0
Eu	1	1.83	PPM	0
Ho	1	4.70	PPM	0
Yb	1	11.0	PPM	0
Lu	1	1.76	PPM	0
U	1	.51	PPM	0
O	1	41.90	PCT	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970); Compston et al., (1970)

No Age References

10064,0
Original PET Photo
(S-69-46621)

cm

10064,6
(S-76-20400)

10064

Sample 10064 is an angular, dark to light grey, fine breccia. This sample originally weighed 65gm and measured 6x3x2.5cm. It was originally returned in ALSRC #1004 (Documented Sample container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 12/16/75

ROCK TYPE: Fine Breccia SAMPLE: 10064,6 WEIGHT: 51 gm

COLOR: Dark to light grey DIMENSIONS: 5 x 3.5 x 2.5 cm

SHAPE: Angular

COHERENCE: Intergranular - moderately coherent
Fracturing - many penetrative

FABRIC/TEXTURE: Isotropic/Fine Breccia

VARIABILITY: Homogeneous

SURFACE: Smooth on exposed (T_1) face to angular on fresh surface (B_1).

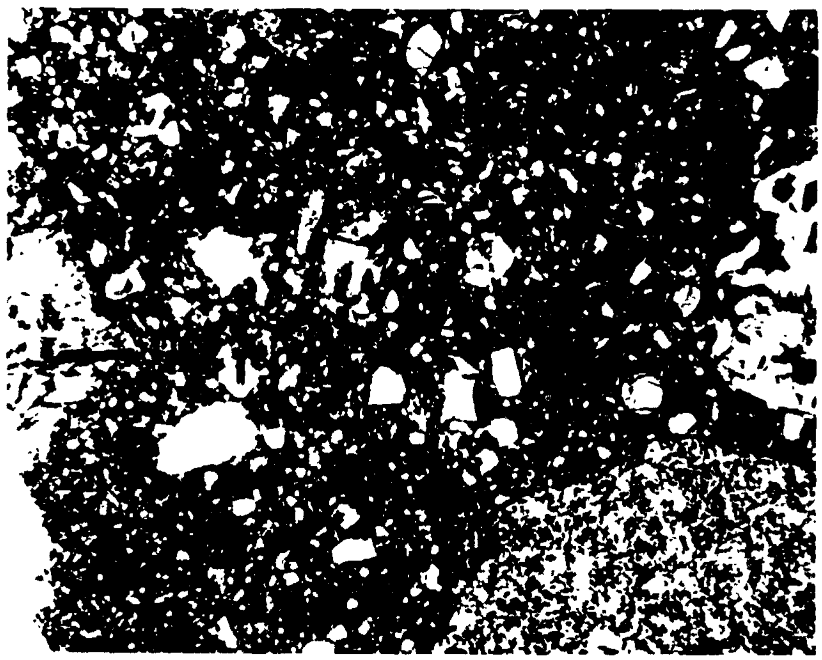
ZAP PITS: Many on T_1, few on S_1, W_1, none on others. Some pits on T_1 are glass lined and are up to 3mm in size.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Dk.Grey	90	-----	---	-----
Basalt Clast	Med.Grey	1	Subrounded to angular	3.0	1.0-8.0
Grey Clast$_1$	Med.Grey	1	Subangular	2.0	0.5-8.0
Salt & Pepper Clast	Lt.Grey	<1	Subrounded	1.5	1.0-2.2
Black Clast	Dk.Grey	1	Subrounded	4.0	3.0-6.0
Mineral Clast$_2$	White to amber	5	Angular to subrounded	2.0	.05-2.0

1) Smaller grain size than basalt clast.
2) Single and compound grains of pyroxene and plagioclase.

SPECIAL FEATURES: High population of glass lined pits is an interesting feature of this sample. This sample is also highly fractured, with a high % of penetrative fractures.



SECTION: 10064,25 Width of field 2.72mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/2/76

SUMMARY: Highly devitrified typical breccia with a high glass clast content. Several anorthositic clasts are present, which is unusual. Far fewer large crystal clasts occur than in the typical breccia. The rock is a recrystallized breccia with a high crystalline lithic clast content.

MATRIX 32% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Dark Brown	100	-----	<0.001	High glass content with many cryptocrystalline phases.

MINERAL CLASTS 29% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Clinopyroxene1	Very abundant	Angular	0.001-0.2
Plagioclase2	Moderate	Blocky	0.05-0.2
Opaques3	Few	Tabular to skeletal	

1) Most in the 0.001-0.1 range.
2) Highly shocked.
3) Most in clasts, some shards in matrix.

LITHIC CLASTS 20% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded	0.001-1.0
Large4	Four present	Rounded to angular	>1.0

4) a. Fine-grained subophitic basalt composed of clinopyroxene, plagioclase and ilmenite.
   b. Very fine-grained basalt, nearly opaque, with abundant dendritic crystals. Only pyroxene, plagioclase, and ilmenite could be confirmed, but other phases may be present and are just too small for resolution.
   c. Medium-grained subophitic basalt composed of clinopyroxene, plagioclase and ilmenite.
   d. Composed of a glass-rich matrix hosting crystalline clasts, mineral fragments and glass shards. Typical fine-grained fragment, similar to the host rock.

GLASS CLAST 19% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange5	Very abundant	Spherical to irregular	0.001-1.8
Greenish Yellow/Brown6	Few	Irregular	0.2-0.5
White to Colorless7	Moderate	Irregular	0.2-0.6

5) Majority are spheres, many with bubbles.
6) Two pieces.
7) Many bubbles.

HISTORY AND PRESENT STATUS OF SAMPLES - 7/13/76

10064 was removed from the Documented Sample container (ALSRC #1004) and split in the Vac Lab. A 1.45gm chip was sent to PCTL for PET analysis. Remaining pristine samples were re-examined and split in SSPL.

PRISTINE SAMPLES: (All VAC-SSPL)

6	37.01	gm	Pitted surface piece. Parts of two surfaces are fresh.
18	8.31	gm	Pitted surface piece. Three fresh surfaces are present.
19	2.01	gm	Chip. Two surfaces are pitted.
22	0.26	gm	Chips. Three fresh and one pitted chip.
23	0.80	gm	Chips and fines.

NO RETURNED SAMPLES

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	41.50	PCT	0
Al_2O_3	2	11.06	PCT	.19
TiO_2	1	9.34	PCT	0
FeO	1	16.47	PCT	0
MnO	1	.207	PCT	0
MgO	1	7.13	PCT	0
CaO	1	11.96	PCT	0
Na_2O	1	.492	PCT	0
Ba	1	290.0	PPM	0
Sc	1	60.5	PPM	0

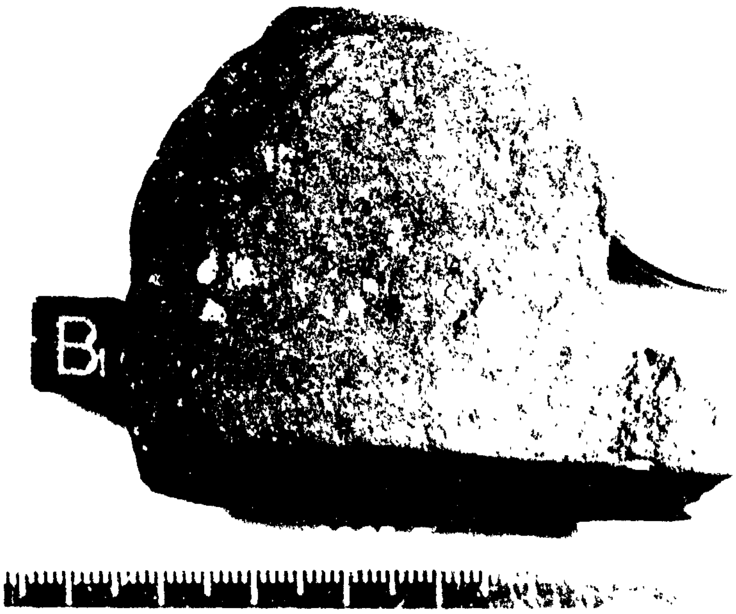
CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
V	1	73.0	PPM	0
Co	1	29.0	PPM	0
Zr	1	520.00	PPM	0
Ta	1	1.70	PPM	0
Hf	1	13.9	PPM	0
La	1	19.6	PPM	0
Ce	1	59.0	PPM	0
Sm	1	15.50	PPM	0
Eu	1	1.77	PPM	0
Tb	1	3.70	PPM	0
Ho	1	5.50	PPM	0
Yb	1	14.8	PPM	0
Lu	1	2.46	PPM	0
U	1	.65	PPM	0
O	1	40.50	PCT	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970); Compston et al., (1970).

No Age References

10065,0
Original PET Photo
(S-69-46623)



10065,7
(S-76-22546)

10065

Sample 10065 is an irregular, medium dark grey, microbreccia. This sample originally weighed 347gm and measured 8.2x7.8x5.8cm. Sample was originally returned in ALSRC #1004 (Documented Sample Container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 2/2 /76

ROCK TYPE: Microbreccia SAMPLE: 10065,7 WEIGHT: 147 gm

COLOR: Medium dark grey DIMENSIONS: 6 x 6.5 x 5 cm

SHAPE: Irregular; rounded on upper side, flat on bottom (PET).

COHERENCE: Intergranular - coherent
Fracturing - few, non-penetrative

FABRIC/TEXTURE: Anisotropic/Microbreccia

VARIABILITY: Homogeneous

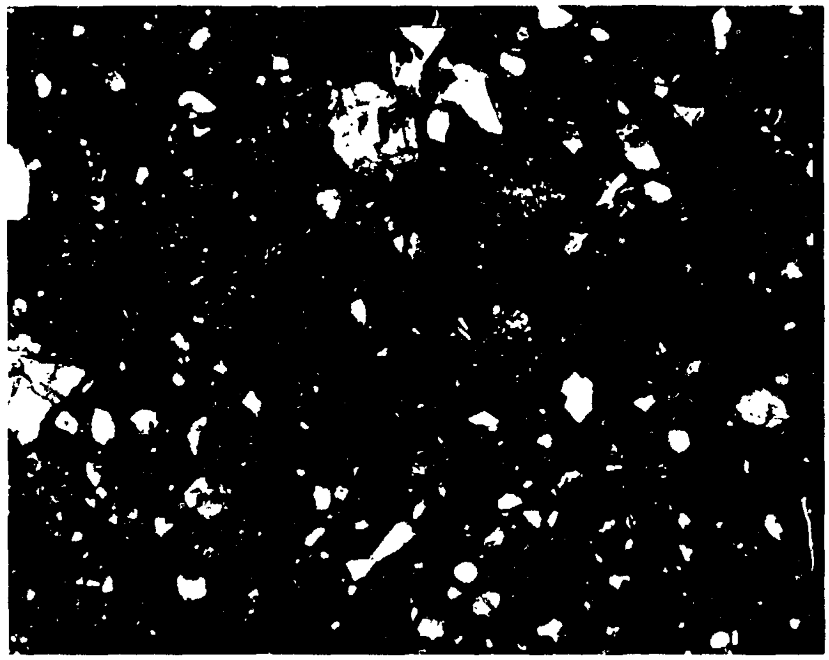
SURFACE: Smooth on exposed to rough on fresh surfaces. S_1 is a sawed surface.

ZAP PITS: Many on T_1, N_1 and E_1. None on W_1 or B_1. Pits are glass lined, ranging from <1-2mm.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Matrix	Med.Dk.Grey	98	-----	---	------
Grey & White Clast$_1$		1	Angular	.2-.5	1.5-.2
White Clast$_2$	White	<1	Angular-subrounded	.2-.3	<.1-.3
Grey Clast$_3$	Dk.Grey	<1	Angular-subrounded	.3-.7	1-.2
Salt & Pepper Clast	Blk/White	<1	Subangular-subrounded	.1-.3	.1-.5
Basalt Clast	Brown, Blk/White	<1	Angular-subangular	.2	.1-.3

1) 50/50 distribution of dark and light component. Clast has ophitic texture.
2) Crushed plagioclase.
3) Fine grained equigranular, submetallic lustre.



SECTION: 10065,27   Width of field 2.72mm plane light

THIN SECTION DESCRIPTION   BY: Walton   DATE: 6/24/76

SECTION: 10065,21

SUMMARY: Relatively highly devitrified typical breccia with a high mineral clast content. Much of the matrix has undergone some degree of devitrification.

MATRIX 48% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Dark Brown	100	-----	<0.001	High glass content with numerous crystallites.

MINERAL CLASTS 36% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene[1]	Very abundant	Angular to irregular	0.001-0.3
Plagioclase[2]	Few	Blocky to irregular	0.001-0.1
Opaques[3]	Few	Angular to irregular	0.001-0.3

1) Highly strained; highly fractured.
2) Poor twin planes; uneven extinctions.
3) Few in matrix, most in clasts.

LITHIC CLASTS 12% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Five present	Rounded to irregular	>1.0

4) a. Glass-rich matrix with small crystals of plagioclase and pyroxene.
   b. Fine-grained glass-rich matrix with mineral fragments and rock fragments.
   c. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   d. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   e. Random array of plagioclase crystals with small euhedral crystals of pyroxene/olivine.

GLASS CLASTS 4% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Angular to spherical	0.001-0.8
Colorless[6]	Few	Angular to spherical	0.001-0.1

5) Mostly shards and broken spherical masses.
6) A few spheres, mostly angular.

Selected References: Dence et al. (1970)

HISTORY AND PRESENT STATUS OF SAMPLES - 6/24/76

10065 was removed from the Documented Sample container (ALSRC #1004) and split in the Vac Lab. It was later sawed in SPL. Remaining pristine samples were re-examined in SSPL. A large piece was sent to RCL and returned.

PRISTINE SAMPLES: (All VAC-SPL-SSPL)

7	147.188 gm	Piece. 6.5 x 6 x 5 cm. Pitted on three surfaces. Sawed on one surface. -RCL-
49	29.38 gm	Piece. One sawed surface. Others are pitted.
119	53.10 gm	Large chips and fines. Some chips have pitted surfaces.

RETURNED SAMPLES:

18	5.79 gm	Chip. One pitted surface.
30	7.08 gm	Piece. Six sawed surfaces.
39	13.64 gm	Three chips. All have sawed surfaces. All have one pitted surface.
43	7.83 gm	Five chips. All have sawed surfaces. Three have one pitted surface.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	41.29	PCT	0
Al_2O_3	1	12.47	PCT	0
TiO_2	1	7.84	PCT	0
FeO	1	16.85	PCT	0
MnO	2	.224	PCT	.050

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
MgO	1	8.29	PCT	0
CaO	1	13.15	PCT	0
Na_2O	1	.485	PCT	0
K_2O	2	.173	PCT	.008
Li	1	12.00	PPM	0
Rb	3	3.41	PPM	.94
Be	1	2.2	PPM	0
Sr	3	157.83	PPM	0
Ba	3	226.67	PPM	60.0
Sc	2	65.8	PPM	6.4
V	2	70.5	PPM	27.0
Cr_2O_3	2	.313	PCT	.073
Co	2	30.8	PPM	1.60
Ni	1	169.0	PPM	0
Cu	1	14.0	PPM	0
Zn	1	23.0	PPM	0
Y	1	103.0	PPM	0
Zr	1	390.0	PPM	0
Nb	1	25.00	PPM	0
Ta	1	2.1	PPM	0
Hf	1	12.1	PPM	0
La	2	16.9	PPM	1.80
Ce	1	63.0	PPM	0
Sm	1	14.60	PPM	0
Eu	1	1.73	PPM	0
Tb	1	4.0	PPM	0
Ho	1	6.7	PPM	0
Yb	1	14.5	PPM	0

CHEMICAL ANALYSES

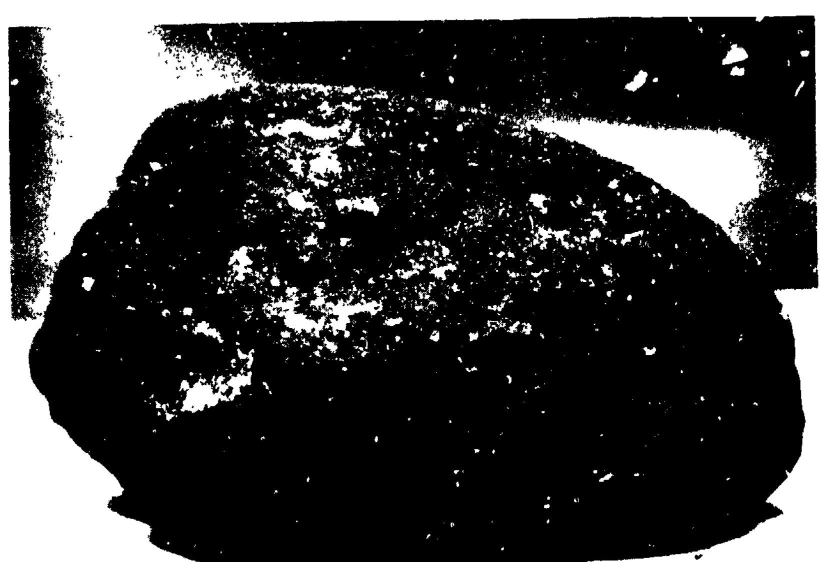
Element	Number of Analyses	Mean	Units	Range
Lu	1	2.01	PPM	0
U	1	.54	PPM	0
Ga	1	5.0	PPM	0
C	1	262.0	PPM	0
O	1	41.6	PCT	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970); Annell & Helz, (1970); Murthy et al., (1970); Wanless et al., (1970); Epstein & Taylor (1970).

No Age References

10066,0
Original PET Photo
(S-69-46632)

cm



10066,1
(S-75-31112)

10066

Sample 10066 is a rounded, dark grey, fine breccia. This sample originally weighed 40gm and measured 5.5x4.2x3.0cm. It was originally returned in ALSRC #1004 (Documented Sample Container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 9/3/75

ROCK TYPE: Fine breccia SAMPLE: 10066,1 WEIGHT: 37.34 gm

COLOR: Dark grey DIMENSIONS: 4.2 x 4 x 2.9 cm (measured at maximum)

SHAPE: Rounded

COHERENCE: Intergranular - moderately friable
Fracturing - absent; some small fractures nearly parallel to surface - spalling (PET)

FABRIC/TEXTURE: Anisotropic/Fine breccia

VARIABILITY: Homogeneous

SURFACE: Smooth

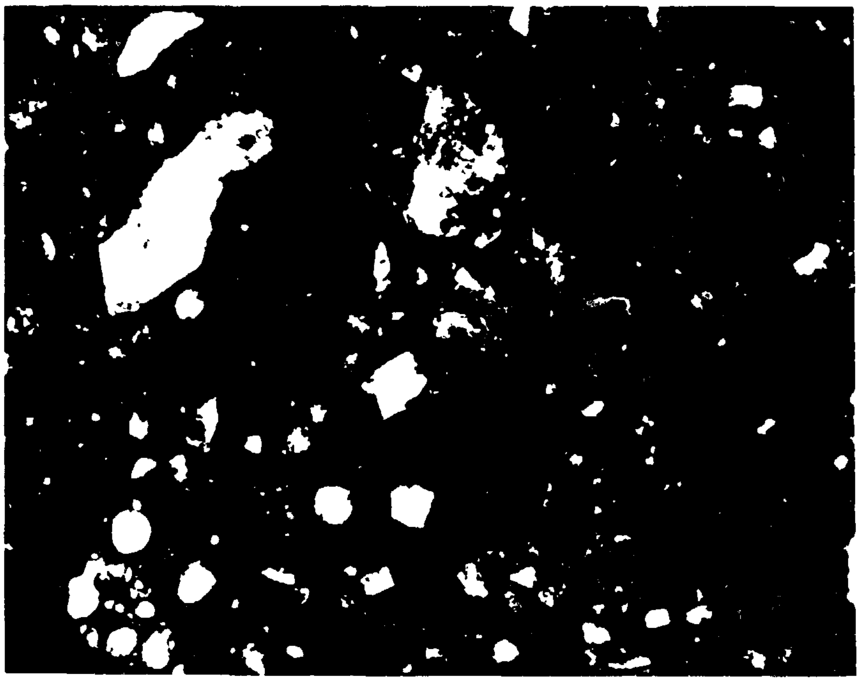
ZAP PITS: T_1-few. None apparent on any other surfaces. Pits could easily have been eroded due to moderate friability of sample.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Matrix	Dark Grey	97	-----	---	-----
Basalt Clast	Hon.Brown Black/White	1	Rounded	1	.1-1
Grey Clast$_1$	Light Grey	1	Rounded to sub-angular	1	<3
White Clast$_2$	White	1	Rounded	.8	<1

1) Plagioclase is shocked.
2) Crushed anorthositic clast.

SPECIAL FEATURES: There are areas on the sample which appear to have glassy spatter. The surface seems to also have approximately 1% coverage of opaques.



SECTION: 10066,20 Width of field 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/25/76

SUMMARY: Partly devitrified typical breccia with numerous types of glass clasts. Description made on five small chips.

MATRIX 64% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Dark Brown	100	-----	<0.001	High glass content with some crystallites

MINERAL CLASTS 14% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Pyroxene_1$	Very abundant	Angular to irregular	0.001-0.1
$Plagioclase_2$	Present	Blocky to irregular	0.001-0.1
$Opaques_3$	Few	Subhedral to irregular	0.001-0.2

1) Highly strained crystals; highly fractured.
2) Poor extinctions and twinning.
3) Very small fragments in matrix; larger in clasts.

LITHIC CLASTS 16% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
$Large_4$	One present	Irregular	>1.0

4) Pinkish pyroxene with ilmenite; high mesostasis and little to no plagioclase visible.

GLASS CLASTS 6% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Yellow\text{-}Orange_5$	Very abundant	Irregular to spherical	0.001-0.4
$Dark\ Brown_6$	Present	Spherical	0.3
$White_7$	Present	Irregular	0.1

5) Mostly shards with some part spheres and a few spheres; many with bubbles and partly devitrified.
6) One sphere has small (0.05mm) clear glass spheres; immiscible glasses with some pyroxene inclusions.
7) One irregular mass has flow lines and bubbles with some pyroxene inclusions.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/25/76

10066 was removed from the Documented Sample container (ALSRC #1004) in the Vac Lab. It was later split in SPL. Remaining pristine samples were re-examined and split in SSPL.

PRISTINE SAMPLES:

1 37.0 gm Piece. Pits on T_1 (few).

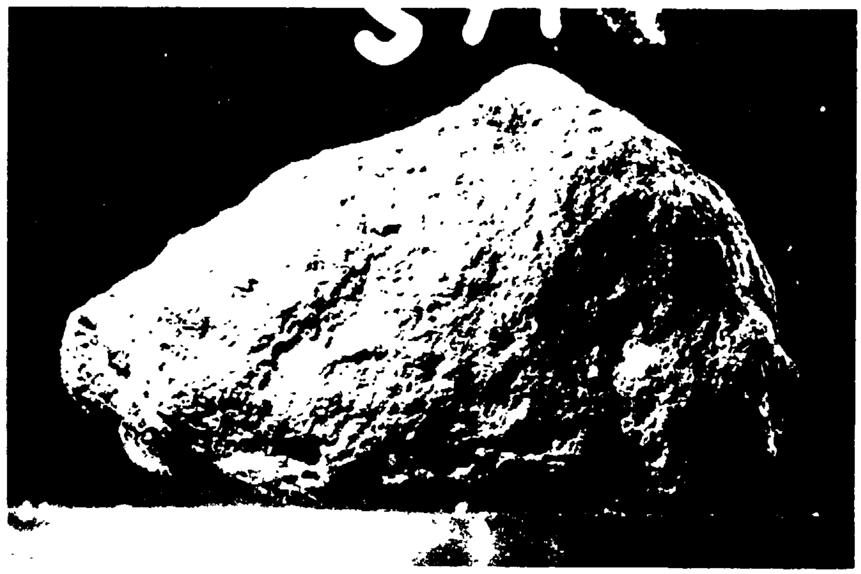
NO RETURNED SAMPLES

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	43.21	PCT	0
Al_2O_3	2	13.51	PCT	0
TiO_2	1	8.17	PCT	0
FeO	1	16.47	PCT	0
MnO	1	.205	PCT	0
MgO	2	7.96	PCT	.663
CaO	1	12.03	PCT	0
Na_2O	1	.461	PCT	0
Sc	1	60.3	PPM	0
V	1	59.0	PPM	0
Co	1	33.8	PPM	0
Ta	1	2.1	PPM	0
Hf	1	10.6	PPM	0
La	1	17.4	PPM	0
Ce	1	62.0	PPM	0
Sm	1	15.1	PPM	0
Eu	1	1.7	PPM	0
Tb	1	2.8	PPM	0
Ho	1	6.5	PPM	0
Yb	1	11.8	PPM	0
Lu	1	1.9	PPM	0
U	1	.56	PPM	0
O	1	41.0	PCT	0

Analysts: Ehmann & Morgan (1970); Goles et al., (1970).

No Age References



10067,0
Original PET Photo
(S-69-46643)

1cm

10067,3
(S-76-21923)

1cm

10067

Sample 10067 is a sub-angular, dark grey microbreccia. This sample originally weighed 69 gms and measured 5 x 3 x 3 cm. It was originally returned in ALSRC #1004 (Documented Sample Container)

BINOCULAR DESCRIPTION BY: Kramer DATE: 1-28-76

ROCK TYPE: Microbreccia SAMPLE: 10067,3 WEIGHT: 46.83gm

COLOR: Dark Grey DIMENSIONS: 4 x 3 x 3 cm

SHAPE: Sub-angular (broken)

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

FABRIC/TEXTURE: Anisotropic/Microbreccia

VARIABILITY: Homogeneous

SURFACE: All faces irregular; rough and knobby (PET)

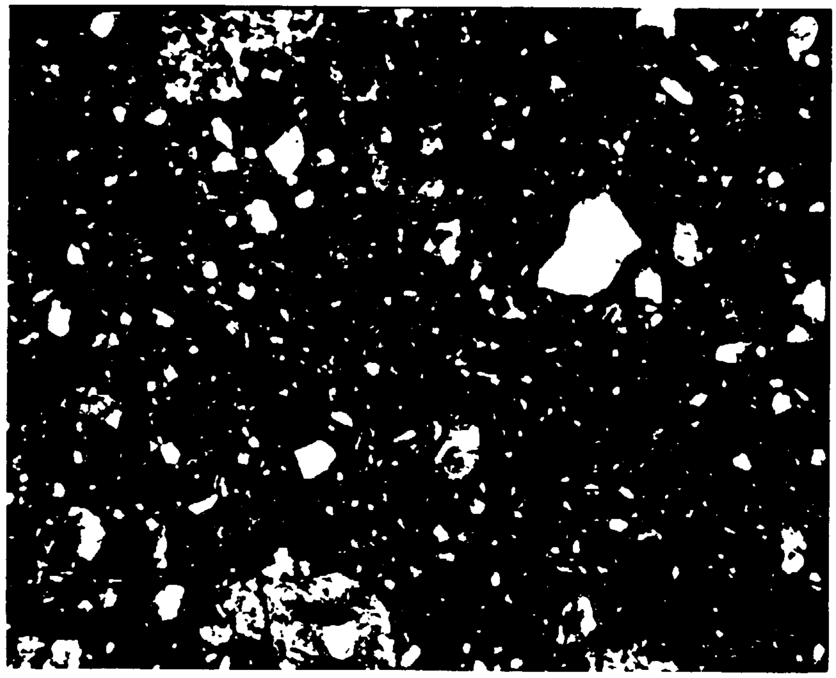
ZAP PITS: Few on all but B_1. B_1 has none.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Dark Grey	81	- - -	- - -	- - - -
Basalt Clast	Lt. Grey	5	Sub-angular	1.0	.5-3.5
Salt & Pepper Clast	Lt. Grey	3	Sub-angular	.8	.1-2.5
Grey Clast	Med. Grey	2	Sub-rounded	.8	.1-1.5
White Clast	White	7	Angular to sub-rounded	.5	.05-1.5
Black Clast[1]	Black	1	Sub-angular	2	.5-2.5
Brown Clast	Brown	<1	Sub-rounded	1.5	.1-3.0

1) Appears to be a glass-rich clast.

Special Features: Glassy spatter (1 cm^2) on W_1.



SECTION: 10067,10 Width of field 2.72 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6-25-76

SUMMARY: Partly devitrified breccia with a relatively low glass clast content. Most of the lithic clasts are small and well rounded. No really large clasts are present in the section.

MATRIX 62% OF ROCK

TYPE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Dark Brown	100	- - -	<0.001	High glass content: not a well defined phase

MINERAL CLASTS 26% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Pyroxene_1$	Very Abundant	Angular to irregular	0.001-0.5
$Plagioclase_2$	Few	Blocky to irregular	0.001-0.3
$Opaques_3$	Few	Angular to skeletal	0.001-0.3

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1) Most as angular shards with poor optical characteristics
2) Blocky crystals with fair to poor twinning
3) Mostly in clasts; some isolated shards

LITHIC CLASTS 10% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	rounded to irregular	0.001-1.0
Large$_4$	One present	irregular	> 1.0

4) Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.

GLASS CLASTS 2% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange$_5$	Very abundant	angular to spherical	0.001-0.3
Colorless$_6$	Few	angular	0.001-0.2

5) Many small spheres; most large pieces shards; some with partial devitrification

6) All shards; some bubbles

Selected References: Carter and MacGregor (1970), Keil et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 6/25/76

10067 was removed from the Documented Sample container (ALSRC 1004) and split in the Vac Lab. Pristine samples were re-examined in SSPL.

PRISTINE SAMPLES:		(All VAC-SSPL)
3	46.83 gm	Piece. Pitted on five surfaces.
12	0.93 gm	Chips and fines. Some chips have pitted surface.

RETURNED SAMPLES:

9001	7.97 gm	Two chips. Larger chip is pitted on one surface. Smaller chip has no pits.

10067

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	44.07	PCT	0
Al_2O_3	2	13.80	PCT	0
TiO_2	1	8.84	PCT	0
FeO	1	17.88	PCT	0
MnO	1	.235	PCT	0
MgO	2	10.11	PCT	3.65
CaO	1	12.17	PCT	0
Na_2O	1	.484	PCT	0
Sc	1	66.00	PPM	0
V	1	71.0	PPM	0
Co	1	35.90	PPM	0
Ta	1	2.10	PPM	0
Hf	1	15.40	PPM	0
La	1	20.10	PPM	0
Ce	1	68.10	PPM	0
Sm	1	16.70	PPM	0
Eu	1	2.40	PPM	0
Tb	1	3.10	PPM	0
Ho	1	7.50	PPM	0
Yb	1	13.8	PPM	0
Lu	1	2.2	PPM	0
U	1	.54	PPM	0
O	1	41.6	PCT	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970).

No Age References

10068,0
Original PET Photo
(S-69-46656)

2 cm

10068,5
(S-76-22545)

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10068

Sample 10068 is a subangular to subrounded, medium dark grey, microbreccia. This sample originally weighed 218 gm and measured 14x5x4 cm. The sample was originally returned in ALSRC Container #1004.

BINOCULAR DESCRIPTION BY: Twedell DATE: 2-17-76

ROCK TYPE: Microbreccia SAMPLE: 10068,5 WEIGHT: 96.7 gm

COLOR: Medium Dark Grey DIMENSIONS: 5.3 x 4 x 2.2 cm

SHAPE: Subangular-Subrounded

COHERENCE: Intergranular - coherent
Fracturing - Absent; Micro-fracturing present parallel to surface. (PET)

VARIABILITY: Homogeneous

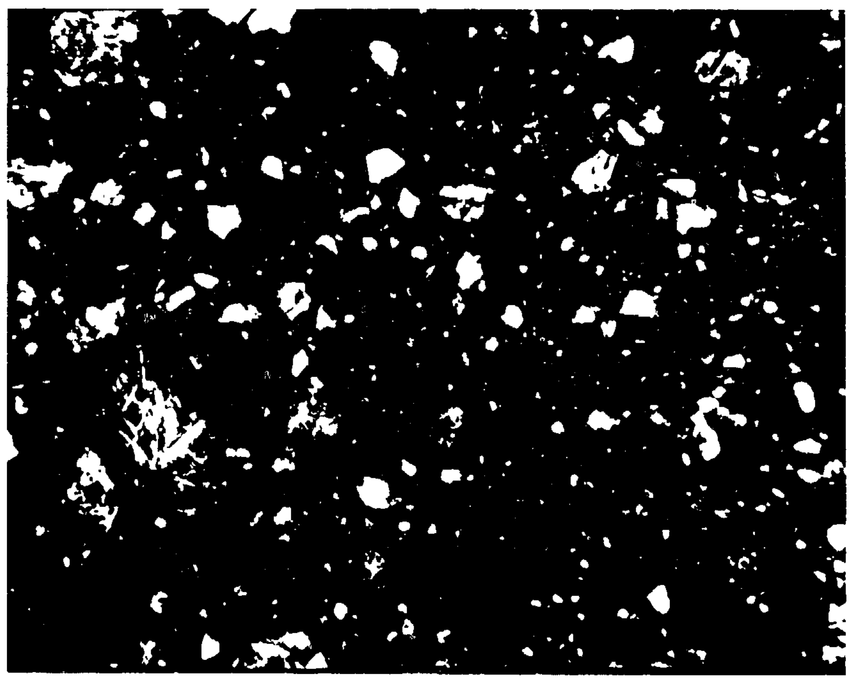
SURFACE: Smooth on pitted surfaces, slightly irregular on fresh surfaces. Overall blocky appearance. Glassy spatter in places.

ZAP PITS: Many on E_1, N_1, and B_1. None on others. Pits are glass lined, approximately 0.3mm in diameter.

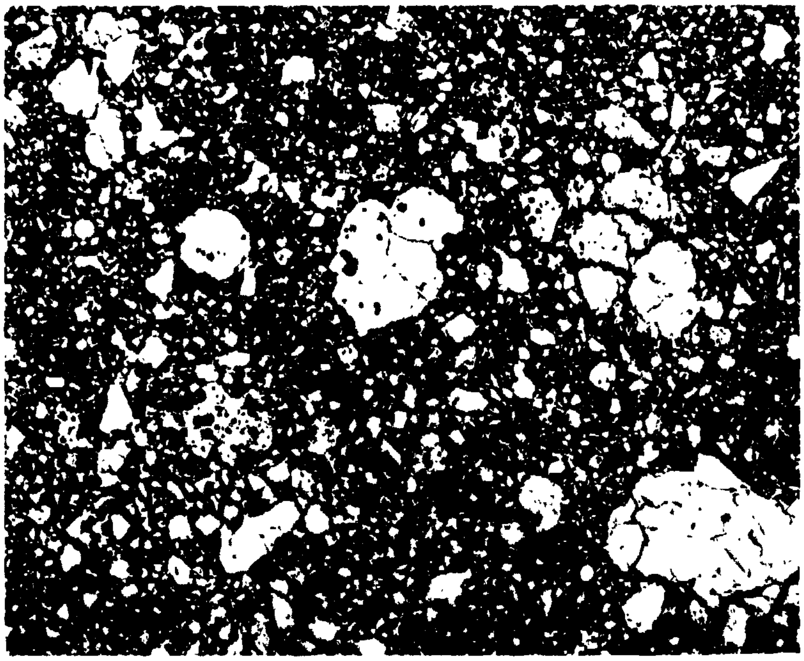
CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Med.Dk.Grey	97			
Green $Clast_1$	Green	<1	Angular-subangular	.3	.2-.3
White $Clast_2$	White	<1	Angular	.1	<.1
Grey $Clast_3$	Lt. Grey	<1	Subangular-Subrounded	.4	.2-.5
Basalt $Clast_4$	White Brn/Blk	<1	Angular-Subrounded	.4	.2-.6
Grey & White $Clast_5$	Grey/White	<1	Angular-Subrounded	.2	.1-.2
Salt & Pepper Clast	Blk/White	<1	Subangular	.3	.2-.4

1) Elongated tabular crystals (olivine?)
2) Powdered sugar texture, crushed anorthosite.
3) Submetallic luster. Very fine grained.
4) Plagioclase, ilmenite and pyroxene grains; even distribution, equigranular.
5) Equigranular. Very fine grained.



SECTION: 10068,35 Width of field 2.72mm plane light



SECTION: 10068,35 Width of field 2.72mm reflected light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/28/76

SUMMARY: Partly devitrified typical breccia with a very dark matrix phase. The matrix is mainly an opaque black phase with part of it grading to a very dark brown. Very few fragments of ilmenite are found in the matrix; all of the major fragments are in the lithic clasts.

MATRIX 51% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Black to dark brown	100%	-----	<0.001	High glass content very patchy and grades to dark brown.

MINERAL CLASTS 28% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene[1]	Very abundant	Angular to irregular	0.001-0.3
Plagioclase[2]	Few	Blocky to irregular	0.001-0.3
Opaques[3]	Present	Irregular	0.001-0.1

1) Many of the fragments are zoned; highly fractured.
2) Many very small fragments; one large fragment.
3) A very few isolated in matrix; almost all in clasts.

LITHIC CLASTS 17% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Four present	Rounded to irregular	>1.0

4) a. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   b. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   c. Fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   d. Glass rich matrix enclosing small crystallites of pyroxene and plagioclase.

GLASS CLASTS 4% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Spherical to angular	0.001-0.3

5) Approximately half spheres or part sphere and half angular shards.

Selected References: Keil (1970)

HISTORY AND PRESENT STATUS OF SAMPLES - 6/28/76

10068 was removed from the Documented Sample container (ALSRC #1004) and split in the Vac Lab. A 100mg sample was sent to PCTL for PET analysis. Remaining pristine samples were re-examined and split in SSPL.

PRISTINE SAMPLES: (All VAC-SSPL)

5	96.70	gm	Piece. Three sides are pitted. The others are fresh.
10	2.88	gm	Chips and fines.
84	35.51	gm	Piece. One surface is pitted.
85	16.54	gm	Three chips. Pits on largest piece.
86	5.26	gm	Fines.

RETURNED SAMPLES:

12	5.92	gm	Chip. No sawed or pitted surfaces.
31	4.55	gm	Chips and fines. Largest chip is 1.0 cm. No sawed surfaces or pits.
33	5.46	gm	Chip. No sawed or pitted surfaces.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	41.29	PCT	0
Al_2O_3	2	12.18	PCT	.57
TiO_2	1	7.84	PCT	0
FeO	1	16.47	PCT	0
MnO	2	.225	PCT	.071
MgO	1	6.47	PCT	0
CaO	1	12.17	PCT	0
Na_2O	1	.442	PCT	0
Li	1	14.0	PPM	0
Rb	1	3.3	PPM	0
Be	1	1.9	PPM	0

Element	Number of Analyses	Mean	Units	Range
Sr	2	147.75	PPM	35.5
Ba	2	200.0	PPM	100.
Sc	2	65.95	PPM	10.1
V	2	52.0	PPM	12.0
Cr_2O_3	2	.328	PCT	.104
Co	2	32.35	PPM	1.30
Ni	1	205.0	PPM	0
Cu	2	13.5	PPM	3.0
Zn	1	22.0	PPM	0
Y	1	108.0	PPM	0
Zr	2	591.0	PPM	218.00
Nb	1	31.0	PPM	0
Ta	1	1.8	PPM	0
Hf	1	11.0	PPM	0
La	2	18.7	PPM	4.60
Ce	1	60.0	PPM	0
Sm	1	14.4	PPM	0
Eu	1	1.8	PPM	0
Tb	1	3.60	PPM	0
Ho	1	6.6	PPM	0
Yb	1	12.2	PPM	0
Lu	1	2.6	PPM	0
U	1	.61	PPM	0
Ga	1	4.70	PPM	0
C	1	165.0	PPM	0
O	1	40.3	PCT	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970); Annell & Helz, (1970); Wanless et al., (1970); Epstein & Taylor, (1971).

Age References: Turner, (1971).

10069,0
Original PET Photo
(S-69-46661)

1 cm.

10069,4
(S-76-23287)

10069

Sample 10069 is an angular, medium dark grey, vesicular basalt. This sample originally weighed 119 gm. and measured 7 x 5 x 5 cm. It was originally returned in ALSRC #1004 (Documented Sample container).

BINOCULAR DESCRIPTIONS BY: Twedell DATE: 2-24-76

ROCK TYPE: Vesicular Basalt SAMPLE: 10069,4 WEIGHT: 64 gm.

COLOR: Medium dark grey DIMENSIONS: 5.5 x 4.7 x 3.2 cm.

SHAPE: Angular

COHERENCE: intergranular - friable
fracturing - absent; irregular, mainly re-healed (PET).

VARIABILITY: Homogeneous

FABRIC/TEXTURE: Isotropic/Equigranular

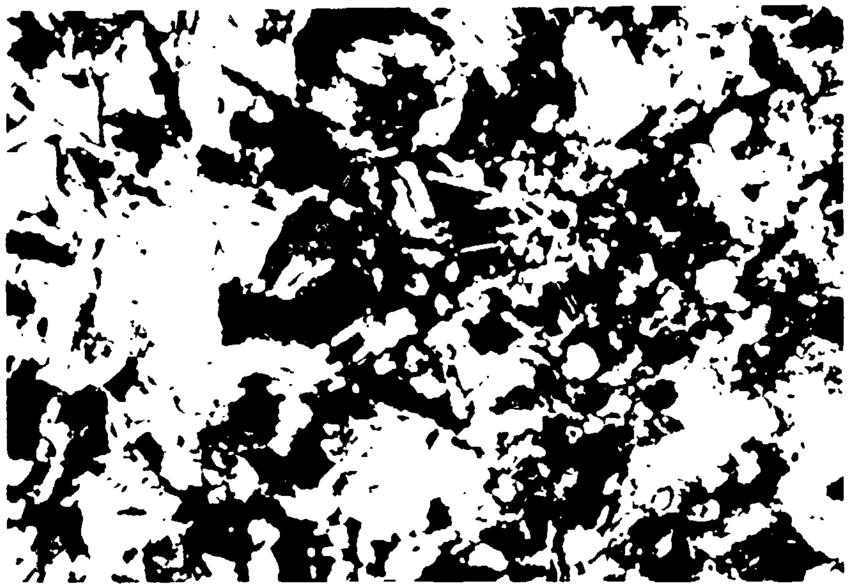
SURFACE: All surfaces are covered with an adhering soil.

ZAP PITS: Few on B_1, none on all others. Pits are glass lined up to 1 mm in diameter.

CAVITIES: 15% surface coverage. Vesicles are smooth and glass lined. Some are lined with crystals.

COMPONENT	COLOR	% of ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Plagioclase	White	30%	Angular to sub-angular	<0.1	0.1-<0.1
$Ilmenite_1$	Black	15%	Angular	0.1	<0.1-1.2
$Pyroxene_2$	Black	55%	subangular to Subrounded	<0.1	<0.1

1) Long platy crystals, approximately 0.1 mm in length.
2) Pyroxene appears to be welded in with the plagioclase crystals.



SECTION: 10069,37 Width of Field: 2.2mm Plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 2-28-76

SECTION: 10069,37

SUMMARY: Fine-grained poikilitic, vesicular basalt composed of clinopyroxene, plagioclase, two generations of ilmenite and subordinate opaques and mesostasis. Some coarseness variation is present in the rock. Approximately one half of the section 10069,33 is a coarse textured equivalent of the remainder of the section. In the coarser portion, the plagioclase crystals are from 0.6mm to 1.2mm in size as compared to 0.08-0.8 for the finer portion. The ilmenite in the coarser portion forms more equant anhedral crystals and are relatively large.

PHASE	% SECTION	SHAPE	SIZE (MM)
Pyrox	46	Euhedral to anhedral	0.03-0.08
Plag	23	Anhedral, interstitial	0.08-0.8
Opaq	14	Subhedral to anhedral	0.01-0.2
Meso	17	Irregular	
Vesicles		Rounded to irregular	0.5-1.5

COMMENTS:

Pyroxene - small pale brown euhedral to anhedral crystals of clinopyroxene enclose the larger plagioclase crystals. The crystals exhibit uneven extinctions and zoning is present in many crystals. Small subhedral crystals of what appears to be apatite occur in some crystals. The composition of this phase was, however, not verified.

Plagioclase - the poikilitic plagioclase crystals are large and show ill defined twin planes and extinctions. Much of the plagioclase forms feature-less patches which are enclosed in the pyroxene-ilmenite network. The optical characteristics suggest that the composition varies to some degree, but there is no marked zoning. In section 10069,33 large subhedral crystals of plagioclase exhibiting well defined twin planes and extinctions were noted. It is assumed these represent a different generation of crystal development than the plagioclase in the rest of the section.

Opaques - the subhedral to anhedral crystals of ilmenite are randomly scattered throughout the rock. A few of the crystals have rutile and chromite exsolutions. Most of the crystals show some degree of skeletal growth.

Two distinct generations of crystals are present. The first are the subhedral lath-like crystals which form smaller isolated crystals. The other generation is far more skeletal and anhedral. Many have a sieve texture with glass and silicate inclusions.

Small (0.05-0.06 mm) masses of troilite and troilite with iron-nickel are scattered throughout the rock. Most of the larger masses are essentially troilite. Several spherical masses are present in the section suggesting formation of the masses while there was yet a silicate rich liquid.

Mesostasis - interstitial glassy masses with a turbid appearance occur between the silicate phases. These glassy patches are nearly colorless to brown in color. No extensive devitrification has taken place in any of the masses. A few masses contain what appear to be small cristobalite crystals. This was not comfirmed, however.

TEXTURE: The rock consists of a random network of intergrown clinopyroxene and ilmenite crystals. Plagioclase and glassy mesostasis occur interstitial to this network. The overall texture is poikilitic intersertal. No preferred orientation was determined for any of the phases present. The occurrence of a much coarser-grained material near the edge of one section could suggest that this rock represents a chilled margin of a larger body of material.

Carter and MacGregor (1970) have reported on section 10069,30. Their modal analysis gave clinopyroxene 56%, plagioclase 19%, opaques 24%, and mesostasis 1% which varies considerably from the above analysis.

Selected References: Carter and MacGregor (1970), Dence et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 5/20/76

10069 was removed from the Documented Sample container (ALSRC # 1004) and split in the Vac Lab. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES: (All VAC-SSPL)

4	64.92 gm	Few pits on one surface
5	10.08 gm	Chips and fines.

RETURNED SAMPLES

31	6.71 gm	No sawed or pitted surfaces.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	39.15	PCT	0
Al_2O_3	2	7.09	PCT	.189
TiO_2	1	12.01	PCT	0
FeO	1	18.14	PCT	0
MnO	3	.275	PCT	.102
MgO	1	6.13	PCT	0
CaO	2	10.0	PCT	.136
Na_2O	2	.475	PCT	.034
K_2O	2	.285	PCT	.017
Li	2	17.6	PPM	.8

CHEMICAL ANALYSES

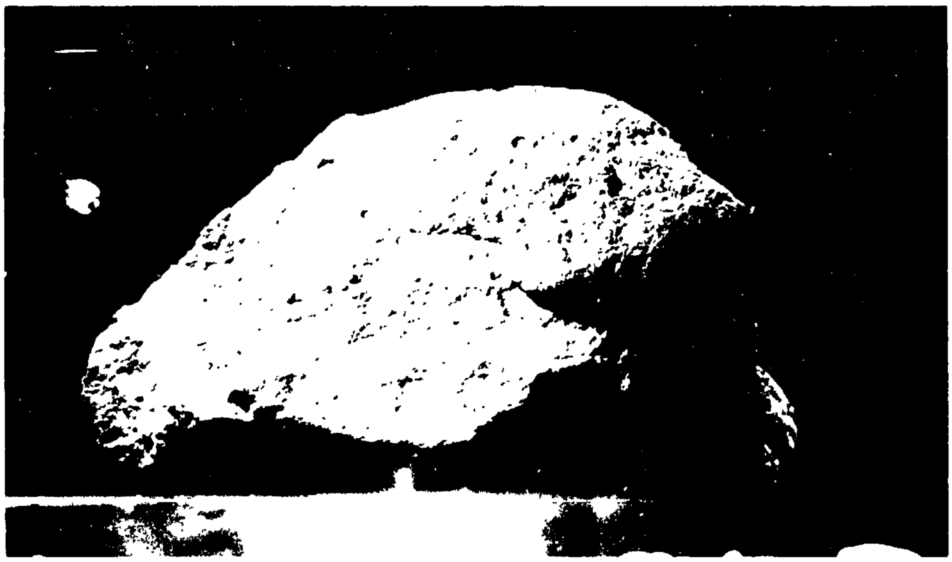
Element	Number of Analyses	Mean	Units	Range
Rb	5	5.60	PPM	.231
Cs	1	.163	PPM	0
Be	2	2.75	PPM	1.1
Sr	3	150.2	PPM	35.0
Ba	4	308.75	PPM	170.
Sc	3	81.47	PPM	21.6
V	2	79.5	PPM	15.
Cr_2O_3	2	.357	PCT	.092
Cr	1	2270.	PPM	0
Co	3	28.00	PPM	4.
Ni	1	6.7	PPM	0
Cu	2	10.35	PPM	3.3
Y	1	164.0	PPM	0
Zr	4	560.75	PPM	135.
Nb	1	20.0	PPM	0
Ta	1	2.7	PPM	0
Hf	3	15.6	PPM	9.0
Re	1	.001	PPM	0
Os	1	.800	PPB	0
La	2	25.35	PPM	3.3
Ce	1	65.0	PPM	0
Sm	1	18.0	PPM	0
Eu	2	2.12	PPM	.16
Tb	1	4.8	PPM	0
Ho	1	6.9	PPM	0
Yb	1	20.8	PPM	0
Lu	1	2.67	PPM	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
U	1	.78	PPM	0
Ca	1	4.9	PPM	0
O	1	37.6	PCT	0

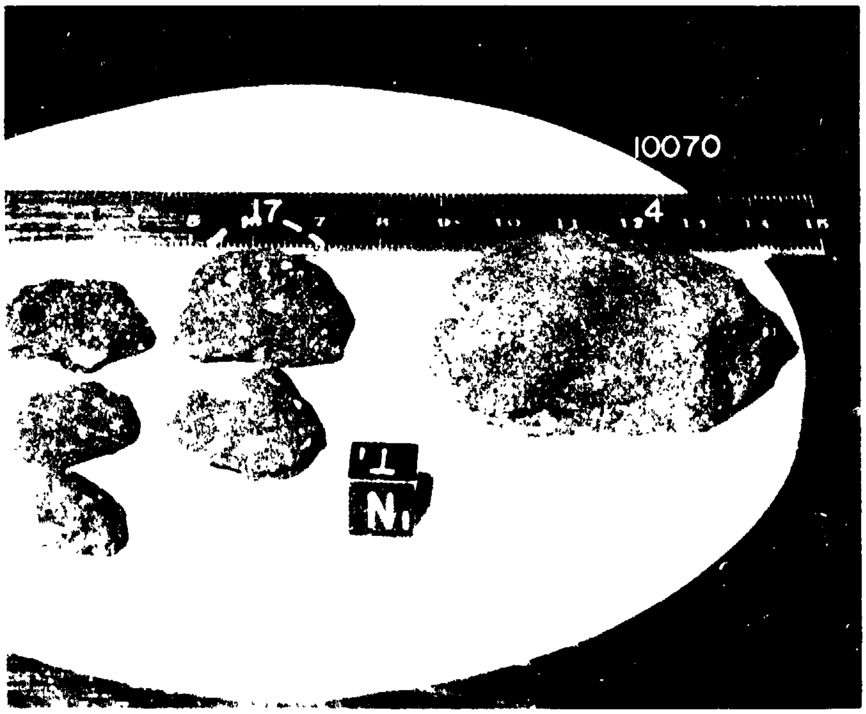
Analysts: Ehmann & Morgan, (1970); Goles et al., (1970); Annell & Helz, (1970); Tera et al., (1970); Murthy et al., (1970); Pappanastassiou et al., (1970); Sievers et al., (1970); Ehmann et al., (1975); Turekian & Kharkar, (1970); Lovering & Butterfield, (1970).

Age References: Boschler (1971); Eberhardt (1971); Pappanastassiou (1970)



10070,0
Original PET Photo
(S-69-47311)

1cm



10070,4,17
(S-75-34246)

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10070

Sample 10070 is a subangular, dark grey, fine breccia. This sample originally weighed 64 gm, and measured 5.7 x 3.2 x 3.2cm. It was originally returned in ALSRC #1004 (Documented Sample Container).

BINOCULAR DESCRIPTIONS BY: Kramer DATE: 12-5-75

ROCK TYPE: Fine Breccia* SAMPLE: 10070,4 WEIGHT: 38.15 gm

COLOR: Dark Grey DIMENSIONS: 5 x 3 x 2 cm

SHAPE: Subangular

COHERENCE: Intergranular - moderately friable
Fracturing - absent

FABRIC/TEXTURE: Anisotropic/Fine Breccia

VARIABILITY: Homogeneous

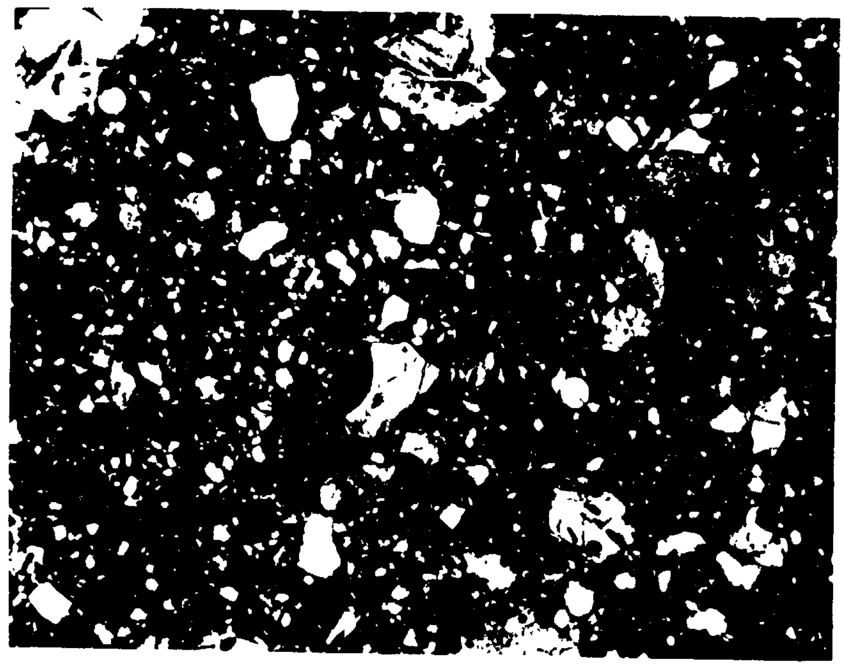
SURFACE: Irregular

ZAP PITS: N_1 & S_1 - many, others none.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	(SIZE MM) DOM.	RANGE
Matrix	Dk.Grey	88	- -	--	--
Basalt Clast	Lt.Grey	2	Subrounded	2.0	0.5-2.3
Grey Clast	Med.Grey	2	Subrounded	1.5	0.5-5.0
Salt & Pepper Clast	Blk & White	2	Subrounded	2.0	0.05-2.5
Glass Spherules	Black	2	Round	.25	0.01-1.2
White Clast	White	2	Angular to Subrounded	1.0	0.01-1.5
Brown Clast	Brown	2	Angular to Subrounded	1.0	.01-1.5

*Original PET description of 10070,2 (3.82 gm) was apparently done on a mislabelled sample. The description of 10070 was done on a basalt fragment. This was discovered during re-examination of the sample.



SECTION: 10070,22 Width of field: 2.72 mm Plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6-25-76

SECTION: 10070,22

SUMMARY: Partly devitrified typical breccia with many small lithic clasts but very few large clasts. Many of the mineral fragments are crushed and highly fractured.

Matrix 55% of Rock

PHASE	% OF SECTION	SHAPE	SIZE (MM)	COMMENTS:
Dark Brown	100%	-	< 0.001	High glass content; some devitrification.

Mineral Clasts 29% of Rock

Phase	Relative Abundance	Shape	Size (mm)
Pyroxene$_1$	Very Abundant	Angular to irregular	0.001-0.2

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Plagioclase[2]	Present	Blocky to irregular	0.001-0.2
Opaques[3]	Few	Rounded to euhedral	0.001-0.2

1) Some grains show twinning, exsolution and fair cleavage development.

2) Many polygranulated, fair to poor twinning, others no twinning visible.

3) Several small euhedral crystals and rounded fragments in matrix; many larger crystals in clasts.

Lithic Clasts 18% of Rock

Type	Relative Abundance	Shape	Size (mm)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	One Present	Irregular	>1.0

4) a. Coarse-grained basalt with large plagioclase crystals (many with glass inclusions), pyroxene crystals (some with olivine inclusions) and ilmenite.

Glass Clasts 5% of Rock

Type	Relative Abundance	Shape	Size (mm)
Yellow-Orange	Very abundant	Irregular to spherical	0.001-0.9

5) Apparently half spheres or part spheres and half angular shards; some devitrification and bubbles.

HISTORY AND PRESENT STATUS OF SAMPLES 6-28-76

10070 was removed from the Documented Sample container (ALSRC # 1004) and split in the Vac Lab. A chip was sent to PCTL where a mixup occurred. The chip described in PCTL (10070,2) was a basalt chip and this description appeared in the first catalogue (1969). The discrepancy was discovered during re-examination in RSPL. Remaining pristine subsamples were re-examined in SSPL.

PRISTINE SAMPLES

4	38.15 gm	Large surface piece. N_1&S_1 are pitted. Other surfaces are fresh.

17	20.28 gm	Five surface chips. All have one pitted surface.
18	9.64 gm	Chips and fines. Largest chip is about 1/2 gm.

RETURNED SAMPLES - None

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	44.07	PCT	0
Al_2O_3	2	13.80	PCT	.75
TiO_2	1	8.34	PCT	0
FeO	1	16.21	PCT	0
MnO	1	.196	PCT	0
MgO	1	8.62	PCT	0
CaO	1	12.31	PCT	0
Na_2O	1	.504	PCT	0
Ba	1	310.0	PPM	0
Sc	1	57.4	PPM	0
V	1	82.0	PPM	0
Cr_2O_3	1	.272	PPM	0
Co	1	37.3	PPM	0
Cu	1	12.0	PPM	0
Zr	1	360.0	PPM	0
Ta	1	1.0	PPM	0
Hf	1	12.8	PPM	0
La	2	16.85	PPM	0
Ce	1	56.0	PPM	0
Sm	1	13.1	PPM	0
Eu	1	1.74	PPM	0

CHEMICAL ANALYSES

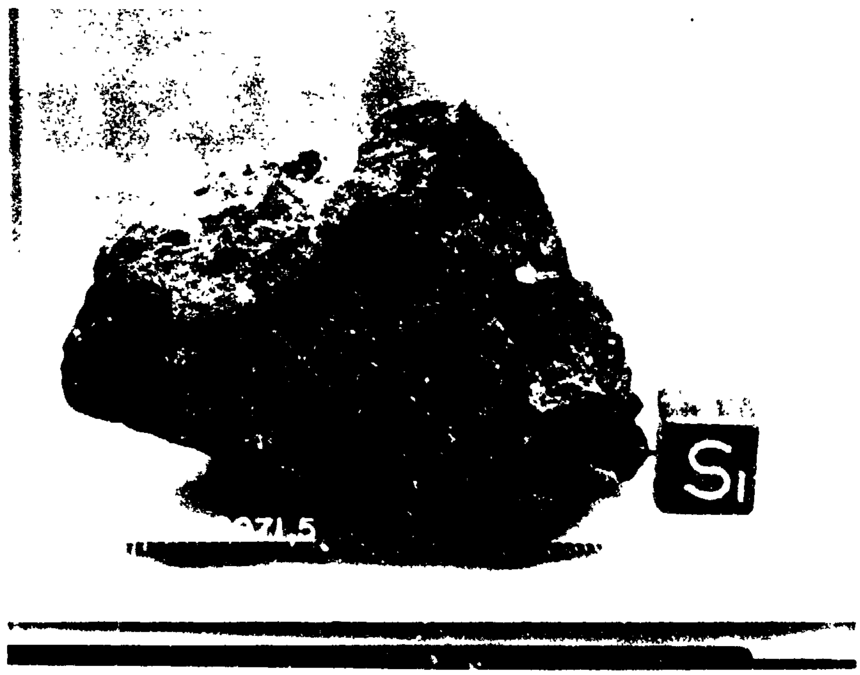
Element	Number of Analyses	Mean	Units	Range
Tb	1	3.10	PPM	0
Ho	1	5.80	PPM	0
Yb	1	14.0	PPM	0
Lu	1	1.80	PPM	0
U	1	.62	PPM	0
O	1	43.40	PCT	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970).

Age References: Eberhardt (1971b).

10071,0 1 cm.

Original PET Photo
(S-69-47292)



10071,5
(S-76-22607)

10071

Sample 10071 is an angular medium light grey, fine grained basalt. This sample originally weighed 190 gm and measured 10 x 4.5 x 3.8 cm. It was originally returned in ALSRC # 1004 (Documented Sample Container).

BINOCULAR DESCRIPTIONS BY: Twedell DATE: 6-9-76

ROCK TYPE: Fine Grained Basalt SAMPLE: 10071,5 WEIGHT: 117. gm

COLOR: Medium light grey DIMENSIONS: 5.5 x 4.5 x 3.8 cm

SHAPE: Angular

COHERENCE: Intergranular - friable
Fracturing - Absent

FABRIC/TEXTURE: Isotropic/Equigranular - fine grained.

VARIABILITY: Homogeneous

SURFACE: All surfaces have a small amount of adhering soil. E_1 is a fresh surface.

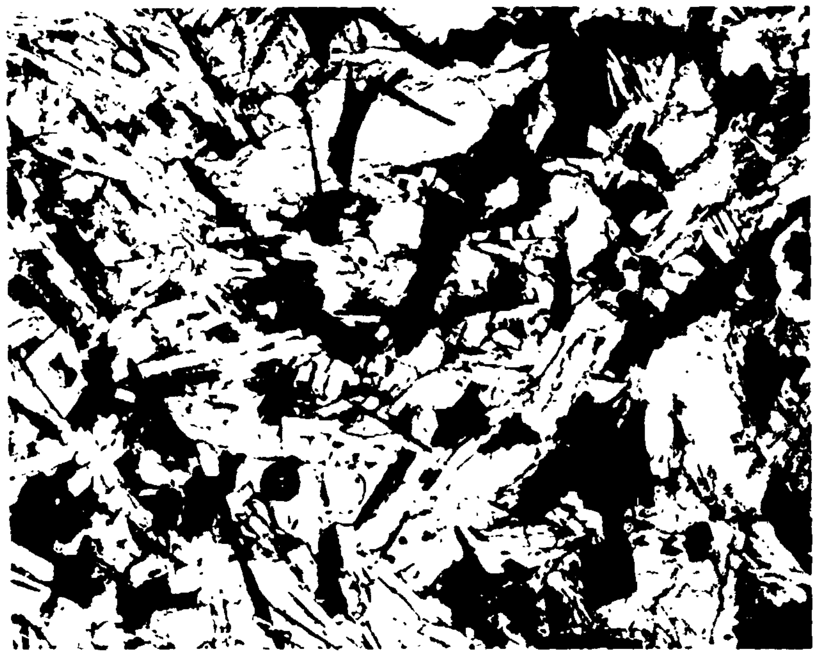
ZAP PITS: Many on all but E_1. None on E_1. Pits are glass lined up to .5 mm.

CAVITIES: 20% Vesicular surface coverage.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Pyroxene$_1$	Blk to Drk. Brn.	58%	Angular to subangular	<.1	<.1
Plagioclase$_2$	White	5%	---	<.1	<.1
Plagioclase$_3$	White	20%	Angular	<.1	<.1
Black$_4$	Black	10%	Platy	<.1	<.1-.2

1) Dark honey brown to black crystals are well defined inside vesicles.
2) Powdered white texture.
3) Crystalline in appearance.
4) Large platy crystals appear to be ilmenite. Usually associated with powdery white plagioclase.

Special Features: This sample differs from most Apollo 11 basalts in that it has a high number of large vesicles throughout its' surface; Olivine is sparse but large and conspicuous up to 1mm. <1% of rock (PET).



SECTION 10071,34 Width of field: 1.39 mm. Plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 9-9-76

SECTION: 10071,34

SUMMARY: Medium-grained intersertal basalt composed of clinopyroxene, plagioclase, and ilmenite with subordinate mesostasis. Many of the plagioclase crystals form somewhat radiating masses. Both the ilmenite and the plagioclase are rather skeletal in development. There is glass present in some of the crystals plus a glass-rich mesostasis between the crystalline phases.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	45	Anhedral, irregular	0.1 - 0.8
Plag	26.5	Anhedral to skeletal	0.01- 0.6

Opaq	24.5	Anhedral to Subhedral	0.001-0.8
Meso	4	Irregular	0.001-0.3

COMMENTS:

Pyroxene - The clinopyroxene forms large pinkish tan anhedral crystals which form an almost continuous array within the rock. Grouped within the array are somewhat radiating masses of plagioclase crystals. The pyroxene crystals show some degree of zoning and only a very poor cleavage pattern. Most crystals have a well developed fracture pattern. A few crystals have olivine inclusions.

Plagioclase - Two major types of plagioclase crystals occur within the rock. The larger anhedral are skeletal, poorly formed, and form intersertal masses between the pyroxene crystals. The smaller more tabular crystals are more blocky and some have hollow centers which are filled with glass. Some lineation within this type of crystal is seen, but it is not pronounced.

Intermingled among the pyroxene and plagioclase crystals are patches of a glass-rich mesostasis. The color varies from nearly colorless to a brown.

Opaques - Two generations of ilmenite crystals are present in the rock. The first generation crystals are larger, highly skeletal and rather blocky in appearance. Most have a sieve texture with the silicate phases filling the holes in the crystal. Several of the crystals show rutile and chromite exsolutions.

The second generation crystals are small lath-like subhedral crystals. These are far less common than the first generation crystals. Several of this second generation crystal also show slight skeletal development.

Scattered throughout the section are small masses (0.005-0.1mm) of troilite and troilite with iron-nickel. Many of these masses are associated with the ilmenite, while others are isolated in the silicate network.

TEXTURE: Somewhat prophyritic intersertal basalt consisting of a network of pyroxene phenocrysts that are intergrown with large anhedral ilmenite prisms. Occurring interstitial to the pyroxene-ilmenite, and masses of mesostasis. Contacts are snarp, for the most part, but many edges are very erose and uneven.

NOTE: Some textural variation was noted in this rock. See Drake and Weill (1971) for further discussion.

Additional References: Haggerty et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 6-9-76

10071 was removed from the Documented Sample container (ALSRC # 1004) and split in the Vac Lab. A 12 gm chip was sent to PCTL for PET analysis. This chip was then sent to the Gas Analysis Lab. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES (all VAC-SSPL)

5	115.65 gm piece. Pitted on five surfaces.
7	15.34 gm consisting of 2 large pieces, chips and fines No pitted surfaces.

RETURNED SAMPLES

11	13.28 gm chip. Four surfaces are pitted.
13	5.51 gm chip. Three pitted surfaces.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	2	41.53	PCT	1.34
Al_2O_3	3	8.02	PCT	.491
TiO_2	2	12.01	PCT	.66
FeO	2	18.05	PCT	2.25
MnO	2	.242	PCT	.075
MgO	1	7.30	PCT	0
CaO	1	10.07	PCT	0
Na_2O	3	.477	PCT	.112
K_2O	3	.307	PCT	.057
Li	1	17.0	PPM	0

CHEMICAL ANALYSES

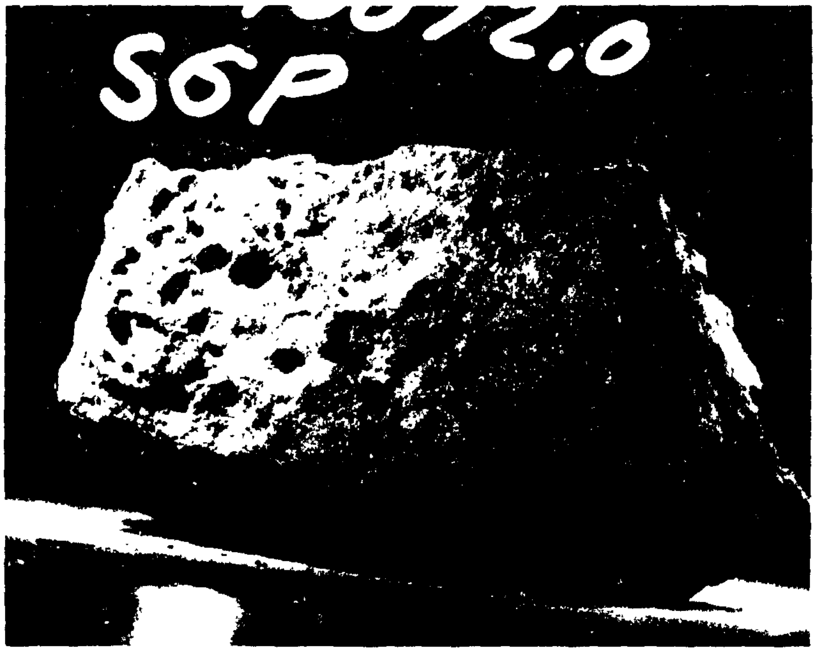
Element	Number of Analyses	Mean	Units	Range
Rb	3	5.71	PPM	.73
Cs	1	.17	PPM	0
Be	1	3.0	PPM	0
Sr	3	157.2	PPM	30.6
Ba	5	359.0	PPM	220.
Sc	4	79.91	PPM	24.55
V	3	86.33	PPM	14.
Cr_2O_3	3	.359	PCT	.134
Cr	1	2290.	PPM	0
Co	4	28.64	PPM	6.55
Ni	1	7.0	PPM	0
Cu	2	12.5	PPM	3.0
Y	1	162.0	PPM	0
Zr	4	494.7	PPM	434.
Nb	1	24.0	PPM	0
Ta	2	2.05	PPM	.1
Hf	3	17.15	PPM	3.35
La	4	26.06	PPM	6.15
Ce	3	81.83	PPM	6.0
Nd	1	64.5	PPM	0
Sm	3	20.23	PPM	4.7
Eu	4	2.14	PPM	.3
Gd	1	29.3	PPM	0
Tb	2	4.88	PPM	1.65
Dy	2	32.25	PPM	2.5
Ho	2	8.6	PPM	1.2
Er	1	21.3	PPM	0
Yb	3	18.98	PPM	5.15

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Lu	3	2.8	PPM	.63
Th	1	3.36	PPM	0
U	3	.730	PPM	.219
Ga	1	4.8	PPM	0
Pb	1	1.69	PPM	0
O	1	40.3	PPM	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970); Annell & Helz, (1970); Gast et al., (1970); Wanless et al., (1970); Stettler et al., (1973); Stettler et al., (1974); Papanastassiou et al., (1970); Eberhardt et al., (1974); Ehmann et al., (1975); Tatsumoto, (1970).

Age References: Stettler et al., (1973); Stettler et al., (1974); Armstrong and Alsmiller (1971); Boschler,(1971b); Marti et al., (1970); Wanless, (1970); Eberhardt et al., (1974); Eberhardt,(1971b); Tatsumoto,(1970); Papanastassiou, (1970).



10072,0 1 cm.
Original PET Photo
(S-69-47387)

10072,80
(S-76-22596)

10072

Sample 10072 is an angular medium light grey vesicular Basalt. This sample originally weighed 447 gms, and measured 10 x 8 x 4 cm. It was originally returned in ALSRC # 1004 (Documented Sample container).

BINOCULAR DESCRIPTIONS BY: Twedell DATE: 2-26-76

ROCK TYPE: Vesicular Basalt SAMPLE 10072,80 WEIGHT: 173 gm

COLOR: Medium light grey DIMENSIONS: 6.2 x 5.9 x 4.0cm

SHAPE: Angular

COHERENCE: Intergranular - friable
Fracturing - absent

FABRIC/TEXTURE: Isotropic/Equigranular, fine-grained

VARIABILITY: Homogeneous

SURFACE: Surface areas are well covered with vesicles which range in size up to 1 cm in diameter.

ZAP PITS: Few on N_1, none on all others.

CAVITIES: 40% surface coverage. Inside walls of vesicles are smooth, with very few well defined crystals.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
$Pyroxene_1$	Brown	50	Angular to sub-angular	<.1	<.1
$Plagioclase_2$	White	30	Sub-angular to sub-rounded	<.1	<.1
$Black_3$	Black	10	Sub-rounded	<.1	<.1
Semi-$opaques_4$	Dark	10	Elongated	.1	<.1-.3

1) Honey brown to almost black.
2) Two types of plagioclase; one is crystalline, the other is shocked plagioclase associated with ilmenite.
3) Probably part pyroxene and part mesostasis.
4) Elongated platy crystals have the appearance of ilmenite.

SECTION 10072,43 Width of field 2.22 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/1/76

SECTION: 10072,43

SUMMARY: Fine grained, vesicular intersertal basalt composed of clinopyroxene, plagioclase and ilmenite. All crystals in the section show some degree of deformation with many highly fractured and broken crystals. Few of the crystals show well defined crystal faces and most are somewhat rounded at the edges. Many groups of radially acicular pyroxene-plagioclase intergrowths are also present. These fan-shaped masses tend to be found near the voids in the section. There is glass present in some of the crystals plus a glass-rich mesostasis between the crystalline phases.

PHASE	% OF SECTION	SHAPE	SIZE (MM)
Pyrox	49	Anhedral to irregular	0.1 -0.8
Plag	25	Anhedral to acicular	0.01-0.6
Opaq	20	Anhedral to euhedral	0.001-0.8
Meso	6	- - -	0.001-0.3

COMMENTS:

Pyroxene - The clinopyroxene forms large anhedral crystals which host the smaller plagioclase and ilmenite crystals. The crystals are highly granulated while giving the appearance of a monocrystal. The color of the crystals is a light pinkish tan with some crystals having a yellowish cast. Many of the vesicles are lined with very fractured pyroxene crystals.

Near many of the vesicles, radiating clusters of acicular pyroxene crystals, some associated with acicular plagioclase crystals, occur which form fan-shaped masses. These masses of crystals form discrete units within the rock.

Plagioclase - Two major types of plagioclase occur in the rock. The larger anhedral crystals are skeletal, poorly formed and form interstitial masses between the pyroxene crystals. The smaller acicular crystals are lath-like and many have hollow centers filled with a glassy phase. These crystals form intergrowths with acicular pyroxene crystals in fan-shaped masses.

Intermingled among the pyroxene and plagioclase crystals are patches of glass-rich material. This glassy mesostasis forms irregular patches and void fillings. The color varies from clear to brown. The masses are more or less evenly dispensed throughout the rock.

Opaques - The major opaque phase in the section is ilmenite. Two generations of crystals are present in the rock. The first type forms very skeletal crystals which contain inclusions of the silicate minerals. These crystals are subhedral in part, but most have lost their original form. The majority of the crystals are lath-like and appear as acicular blades in the section. A few of the larger crystals contain small rutile exsolutions.

Small masses of troilite and troilite with iron nickel inclusions are also present in the section. These form small 0.001 mm to 0.2 mm masses and are for the most part isolated in the silicate crystal assemblage.

TEXTURE: Porphyritic intersertal basalt consisting of a network of pyroxene phenocrysts that are intergrown with large, anhedral ilmenite prisms. Occurring interstitial to the pyroxene-ilmenite network are plagioclase tablets that are intergrown with the edges of the pyroxene phenocrysts, acicular pyroxene-plagioclase intergrowths, small euhedral ilmenite crystals, and anhedral masses of mesostasis and plagioclase. Contacts are sharp, for the most part, but some edges are very erose and uneven.

Selected References: Haggerty et al. (1970), Kushiro and Nakamura (1970), Simpson and Bowie (1970), Smith, J.W. et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES - 6-28-76

10072 was removed from the Documented Samples container (ALSRC #1004) and split in the Vac Lab. A 29 gm chip was sent to PCTL for PET analysis. The remainder was sent to RCL for gamma ray counting. Upon its return, this piece was split further in the Vac Lab. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES: (All VAC-RCL-VAC-SSPL)

19	40.26 gm	Eight chips. No pitted surfaces.
80	143.92 gm	Piece. One surface is pitted
139	28.28 gm	Eleven chips from ,80. No pits on any pieces.

RETURNED SAMPLES:

15	15.30 gm	Chip. One pitted surface.
41	21.65 gm	Piece. Previously listed as 10018,24.
109	6.78 gm	Two pieces. All surfaces are fresh.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	3	40.64	PCT	.70
Al_2O_3	4	8.01	PCT	1.04
TiO_2	4	12.17	PCT	2.33
FeO	3	19.65	PCT	.43
MnO	4	.244	PCT	.068
MgO	3	7.48	PCT	.741

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
CaO	4	11.49	PCT	4.06
Na_2O	4	.504	PCT	.121
K_2O	6	.284	PCT	.149
P_2O_5	3	.170	PCT	.030
H	1	.76	CC/G	0
Li	3	15.0	PPM	2.
Rb	6	5.58	PPM	.98
Cs	2	.230	PPM	.141
Be	3	3.133	PPM	1.3
Sr	5	154.76	PPM	38.6
Ba	3	343.	PPM	130.0
Sc	3	86.3	PPM	19.0
V	4	60.5	PPM	60.
Cr_2O_3	4	.364	PCT	.085
Co	6	28.7	PPM	22.8
Ni	5	15.42	PPM	24.99
Cu	5	14.44	PPM	17.06
Zn	5	13.71	PPM	32.28
Y	4	185.5	PPM	95.
Zr	4	551.75	PPM	260.
Nb	3	31.0	PPM	22.
Mo	1	.4	PPM	0
Pd	2	.052	PPM	.097
Cd	3	.340	PPM	.994
Ta	2	3.4	PPM	3.2
W	1	.42	PPM	0
Hf	2	15.0	PPM	6.0
Os	1	.004	PPM	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Ir	2	.200	PPB	.400
Au	3	.100	PPB	.060
Hg	1	5.50	PPB	0
La	4	31.42	PPM	20.3
Ce	3	86.33	PPM	27.
Pr	2	18.0	PPM	4.
Nd	3	62.67	PPM	39.
Sm	3	22.3	PPM	10.1
Eu	3	2.09	PPM	.2
Gd	2	28.5	PPM	5.
Tb	3	4.7	PPM	3.8
Dy	2	38.1	PPM	13.8
Ho	2	8.4	PPM	3.2
Er	2	25.5	PPM	19.
Tm	1	2.8	PPM	0
Yb	4	16.4	PPM	26.
Lu	3	3.28	PPM	2.76
Th	7	3.51	PPM	2.0
U	4	.699	PPM	.357
B	1	4.0	PPM	0
Ga	5	4.49	PPM	.9
In	1	.052	PPM	0
Tl	1	.920	PPB	0
Ge	2	.58	PPM	1.04
Sn	1	.4	PPM	0
Pb	2	2.30	PPM	1.40
W	1	110.	PPM	0

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CHEMICAL ANALYSES

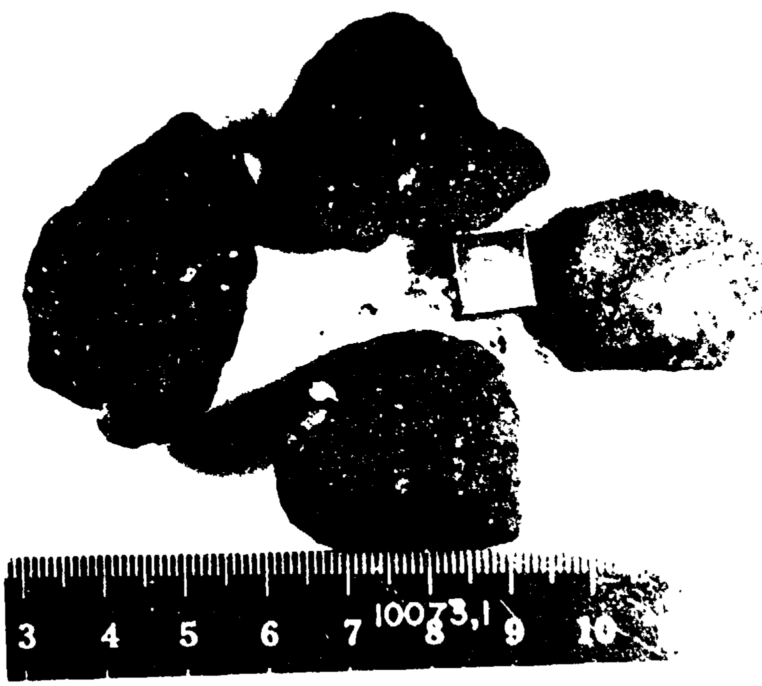
Element	Number of Analyses	Mean	Units	Range
As	1	.05	PPM	0
Sb	1	.01	PPM	0
Bi	1	.730	PPB	0
S	2	.235	PCT	.01
Se	1	.188	PPM	0
F	1	271.0	PPM	0
Cl	1	14.	PPM	0
Br	3	.102	PPM	.164
I	1	.37	PPM	0

Analysts: Compston et al., (1970); Maxwell et al., (1970); Morrison et al., (1970); Ganapathy et al., (1970); Annell & Helz, (1970); Gopalon et al., (1970); O'Kelly et al., (1970); Hurley & Pinson, (1970); Anders et al., (1971); Reed & Jovanovic, (1970); Wasson & Baedecker, (1970); Haskin et al., (1970); Herzog & Herman, (1970); Silver, (1970); Wrigley & Quaide, (1970).

Age References: D'Amico et al., (1970); Turner (1970); O'Kelly et al., (1970); Eberhardt (1970); Silver (1970).

10073,0
Original PET Photo
(S-69-47290)

cm



10073,1
(S-76-22592)

10073

Sample 10073 is a rounded medium dark grey microbreccia. This sample originally weighed 125 gm, and measured 5 x 3 x 2 cm. It was originally returned in ALSRC # 1004 (Documented Sample container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 2/27/76

ROCK TYPE: Microbreccia SAMPLE: 10073,1 WEIGHT: 68.0 gm

COLOR: Medium dark grey DIMENSIONS: Four subequal pieces

SHAPE: Rounded

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

FABRIC/TEXTURE: Anisotropic/Microbreccia

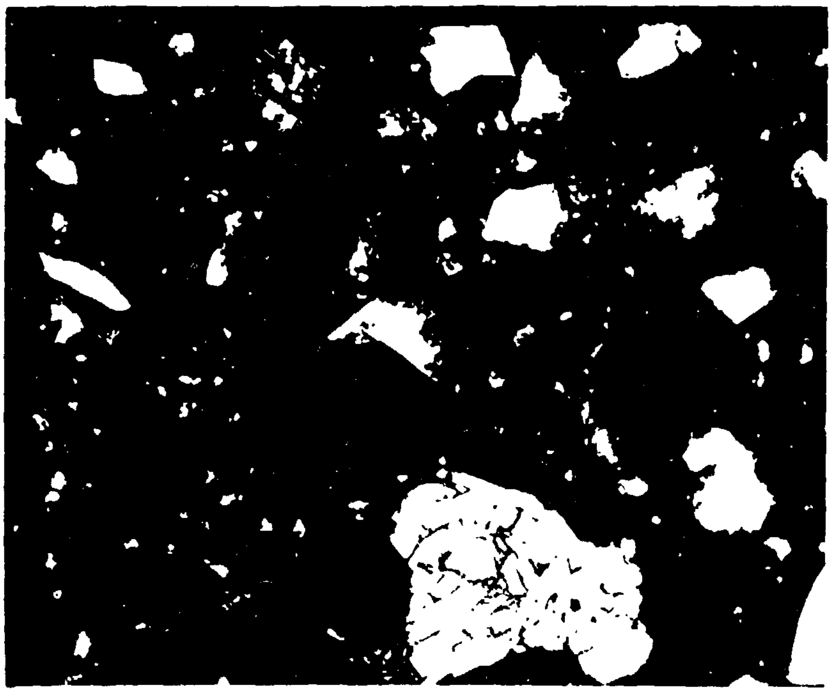
VARIABILITY: Homogeneous

SURFACE: Smooth and rounded on exposed (pitted) surfaces, to angular on fresh surfaces.

ZAP PITS: Few on T_1 face of largest piece. None on any other pieces. Pits are glass lined up to 1.2mm in diameter.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Dk Grey	98	- -		
White Clast	White	<1	Sub-angular	0.9	0.2-1.0
Basalt Clast	Honey Brown Black/White	1	Sub-rounded	1	0.6-3.0
Salt/Pepper Clast	Black/White	<1	Sub-rounded	0.8	0.4-1.5



SECTION 10073,27 Width of field 1.39 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/29/76

SECTION: 10073,27

SUMMARY: Partly devitrified typical breccia with a low lithic clast content. Approximately one quarter of the section has a light brown matrix while the remainder of the section has a dark brown matrix. There is a higher concentration of mineral clasts in the lighter brown matrix than the darker.

MATRIX 58% OF ROCK

PHASE	% SECTION	SHAPE	SIZE (MM)	COMMENTS:
Dark Brown	75	- -	<0.001	High glass content: light brown has higher mineral clast content.
Light Brown	25	- -	<0.001	

MINERAL CLASTS 29% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Pyroxene_1$	Very abundant	Angular to irregular	0.001-0.6

Plagioclase[2]	Moderate	Blocky to irregular	0.001-0.4
Opaques[3]	Few	Blocky to skeletal	0.001-0.4

1) Strained fragments; poor optical characteristics
2) Locally abundant; not evenly distributed
3) Large blocky fragments; crystal more skeletal in clasts

LITHIC CLASTS 8% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE(MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Six present	Rounded to irregular	>1.0

4) a. Fine-grained glass-rich matrix with mineral and rock fragments.
   b. Coarse-grained basalt consisting of pyroxene, plagioclase and ilmenite.
   c. Fine-grained glass-rich matrix with mineral and rock fragments.
   d. Glass-rich matrix enclosing small crystallites of pyroxene and plagioclase.
   e. Coarse-grained basalt which appears to have been crushed. Mineral identification difficult.
   f. Fine-grained mineral aggregate of pyroxene and plagioclase with some glass in the matrix.

GLASS CLASTS 5% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Irregular to spherical	0.001-0.5
Pale Yellow-White[6]	Moderate	Spherical to irregular	0.001-0.8

5) Most angular shards; few spheres
6) Several spheres; more devitrification than other type glass.

Selected References: Fredriksson et al. (1970).

HISTORY AND PRESENT STATUS OF SAMPLES 6/29/76

10073 was removed from the Documented Sample container (ALSRC # 1004) and split in the Vac Lab. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES: (All VAC-SSPL)

1	68.40 gm	Four pieces. Few pits on one piece; None on others.
2	10.90 gm	Chips and fines.

NO RETURNED SAMPLES

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	43.85	PCT	0
Al_2O_3	2	13.98	PCT	.38
TiO_2	1	8.17	PCT	0
FeO	1	16.21	PCT	0
MnO	2	.223	PCT	.039
MgO	1	7.79	PCT	0
CaO	1	12.45	PCT	0
Na_2O	3	.459	PCT	.038
K_2O	2	.144	PCT	.0001
Li	1	11.0	PPM	0
Rb	3	2.61	PPM	.79
Cs	1	.098	PPM	0
Be	1	2.10	PPM	0
Sr	2	163.75	PPM	7.5
Ba	2	207.5	PPM	65.0
Sc	2	63.0	PPM	2.0
V	2	74.0	PPM	16.0
Cr_2O_3	2	.309	PCT	.063
Co	2	30.05	PPM	2.10

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Ni	1	199.	PPM	0
Cu	2	16.5	PPM	5.0
Zn	1	23.	PPM	0
Y	1	89.	PPM	0
Zr	1	322.0	PPM	0
Nb	1	14.0	PPM	0
Ag	1	.163	PPM	0
Ta	1	1.6	PPM	0
Hf	1	8.9	PPM	0
La	2	16.9	PPM	8.2
Ce	2	47.25	PPM	1.50
Nd	1	35.4	PPM	0
Sm	2	11.95	PPM	.9
Eu	2	1.65	PPM	.1
Gd	1	15.9	PPM	0
Dy	1	18.3	PPM	0
Ho	1	5.0	PPM	0
Er	1	11.4	PPM	0
Yb	2	9.15	PPM	3.9
Lu	2	1.66	PPM	.2
U	1	.45	PPM	0
Ga	1	3.70	PPM	0
O	1	41.40	PCT	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970); Annell & Helz, (1970); Gast et al., (1970); Gibson & Johnson, (1971); Ganapathy et al., (1970).

No Age References

10074,0
Original PET Photo
(S-69-47372)

1cm

10074,1
(S-76-20395)

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10074

Sample 10074 is an angular, medium dark grey microbreccia. This sample originally weighed 56 gm. and measured 8.2 x 4.6 x 3.8cm. The sample was originally returned in ALSRC # 1004 (Documented Sample container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 12/24/75

ROCK TYPE: Microbreccia SAMPLE: 10074,1 WEIGHT: 55 gm

COLOR: Medium dark grey DIMENSIONS: 6 x 4 x 3 cm.

SAHPE: Angular

COHERENCE: Intergranular - Coherent
Fracturing - Few penetrative, few non-penetrative

FABRIC/TEXTURE: Anisotropic/Microbreccia

VARIABILITY: Homogeneous

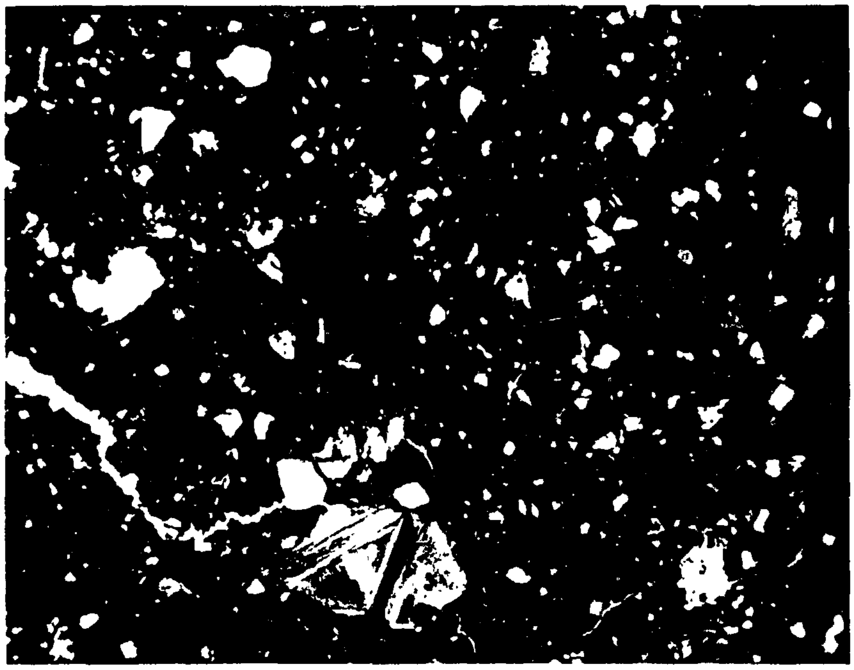
SURFACE: Smooth on B_1 to hackly on W_1-N_1. Some glass coating on T_1 face.

ZAP PITS: None apparent on any face.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Med.Dark Grey	96	- -	-	- -
Brown Clast	Lt.Brown	2	Angular to sub-angular	0.6	<0.1-1.0
White Clast	White	1	Subangular to subrounded	1.0	<0.1-2.5
Grey & White Clast	Dk. Grey & White	1	Subangular to subrounded	<1.0	<0.1-1.0

Special Features: This sample has an unusual amount of honey brown mineral clasts which are very few or non-existent in other samples; There are 4 or 5 fractures that are filled with a vesicular black glass. The glass texture is like black scoria. The filled fractures have more than one orientation. The glass filling is 3-5mm thick. (PET).



SECTION: 10074,7 Width of field 2.72 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/30/76

SECTION: 10074,7

SUMMARY: Partly devitrified typical breccia with a relatively low lithic clast content. All the lithic clasts present are relatively small with no large clasts.

MATRIX 61% OF ROCK

PHASE	% OF SECTION	SHAPE	SIZE (MM)	COMMENTS:
Dark Brown	100	- -	< 0.001	High glass content; very turbid full of small crystallites.

MINERAL CLASTS 33% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Pyroxene_1$	Very abundant	Angular to irregular	0.001-0.6
$Plagioclase_2$	Few	Blocky to irregular	0.001-0.1
$Opaques_3$	Few	Blocky to irregular	0.001-C.3

1) Poor optical characteristics.
2) Widely scattered; poor optics.
3) Large, blocky in matrix; dendritic in clasts.

LITHIC CLASTS 3% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large	None		<1.0

GLASS CLASTS 3% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Yellow\text{-}Orange_4$	Very abundant	Angular to spherical	0.001-0.4
$Colorless_5$	Moderate	Angular to spherical	0.001-0.5

4) Most angular shards; many irregular masses.
5) Some spheres, most shards, many blocky.

HISTORY AND PRESENT STATUS OF SAMPLES 6/30-76

10074 was removed from the Documented Sample container (ALSRC # 1004) in the Vac Lab. It was used in the magnetics experiment. It was then split in SPL. Re aining pristine subsamples were re-examined in SSPL.

PRISTINE SAMPLES: (VAC-SPL-SSPL)

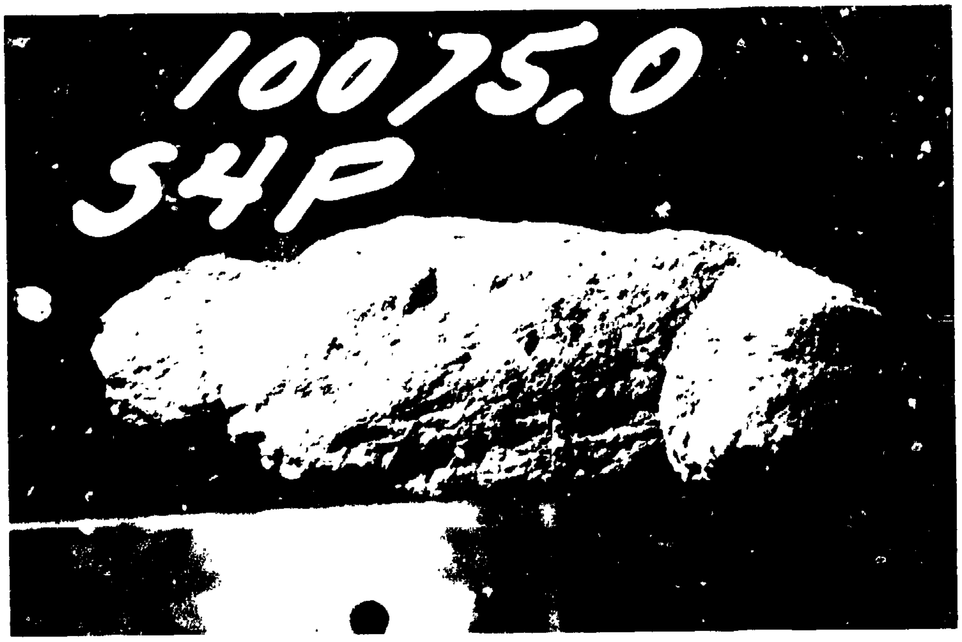
1	55.01 gm	Parent rock.
4	0.54 gm	One small chip. No pits.

NO RETURNED SAMPLES

CHEMICAL ANALYSES

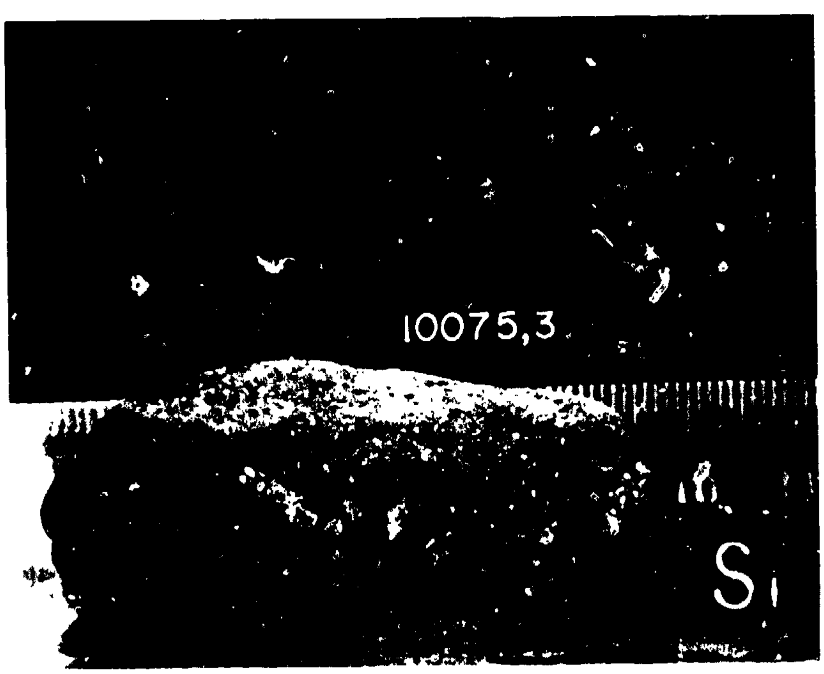
Element	Number of Analyses	Mean	Units	Range
SiO_2	1	41.29	PCT	0
Al_2O_3	2	14.36	PCT	2.26
TiO_2	1	7.84	PCT	0
FeO	1	15.31	PCT	0
MnO	1	.183	PCT	0
MgO	1	6.80	PCT	0
CaO	1	13.01	PCT	0
Na_2O	1	.506	PCT	0
Ba	1	280.0	PPM	0
Sc	1	53.7	PPM	0
V	1	78.0	PPM	0
Co	1	30.90	PPM	0
Cu	1	10.00	PPM	0
Zr	1	500.0	PPM	0
Ta	1	1.0	PPM	0
Hf	1	11.9	PPM	0
La	1	13.8	PPM	0
Ce	2	50.75	PPM	8.5
Sm	1	11.50	PPM	0
Eu	1	1.73	PPM	0
Tb	1	2.80	PPM	0
Ho	1	5.0	PPM	0
Yb	1	12.0	PPM	0
Lu	1	1.7	PPM	0
U	1	.49	PPM	0
O	1	42.10	PCT	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970); Gast et al., (1970).
No Age References



10075,0
Original PET Photo
(S-69-47362)

2 cm



10075,3
(S-76-20321)

10075

Sample 10075 is a sub-angular, medium grey, fine breccia. This sample originally weighed 53gm and measured 8x10x3.2cm. It was originally returned in ALSRC #1004 (Documented Sample container).

BINOCULAR DESCRIPTION BY: Kramer DATE: 1/2/76

ROCK TYPE: Fine Breccia SAMPLE: 10075,3 WEIGHT: 36.29gm

COLOR: Medium Grey DIMENSIONS: 5.5 x 3 x 3 cm

SHAPE: Sub-angular

COHERENCE: Intergranular - coherent
Fracturing - absent

FABRIC/TEXTURE: Anisotropic/Fine Breccia

VARIABILITY: Homogeneous

SURFACE: N_1 has two areas which are smoothed with striations. The areas look like slickensides. Other faces are hackly.

ZAP PITS. T_1, S_1 - many. N_1 - few. Others - none.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	RANGE
Matrix	Med.Grey	93	-----	--	-----
Basalt Clast	Grey	2	Sub-rounded	2.0	.5-1.0
Grey Clast$_1$	Med.Grey	1	Sub-rounded	1.0	.05-3.0
Salt & Pepper Clast	Blk/White	<1	Sub-rounded	1.0	.5-1.3
Mineral Clast	Dk.Brown & White	3	Angular to subrounded	0.5	<2
Lithic Clast$_2$	Med.Grey	<1	Angular	2	--

1) Lighter colored than matrix.
2) On E_1, there is a breccia clast (welded breccia).

SECTION: 10075,14 Width of field 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/30/76

SUMMARY: Partly devitrified typical breccia with several interesting large lithic clasts. Most are poikilitic with either plagioclase or pyroxene as the host and pyroxene or olivine as the included crystals.

MATRIX 55% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Brown to pale brown	100	-----	<0.001	High glass content; translucent to nearly transparent

MINERAL CLASTS 21% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene[1]	Very abundant	Angular to irregular	0.001-0.3
Plagioclase[2]	Moderate	Blocky to irregular	0.001-0.2
Opaques[3]	Few	Blocky to skeletal	0.001-0.1

1) Highly fractured; poor optical characteristics.
2) Many show no twin planes; some polygranular.
3) Most in matrix; few in clasts.

LITHIC CLASTS 19% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large[4]	Four present	Rounded to irregular	>1.0

4) a. Very fine-grained black matrix hosting mineral and rock fragments. Matrix is opaque. Many small ilmenite crystals in matrix.
   b. Fine-grained yellow brown semitranslucent matrix hosting numerous mineral fragments.
   c. Large poikilitic pyroxene crystals hosting small olivine crystals.
   d. Crushed random array of plagioclase crystals hosting small irregular masses of pyroxene.

GLASS CLASTS 5% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Spherical to irregular	0.001-0.2
Colorless[6]	Abundant	Angular	0.001-0.3

5) Almost all spheres or part spheres; few shards.
6) All angular shards some large; no spheres present; some devitrification.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/30/76

10075 was removed from the Documented Sample container (ALSRC #1004) and split in the Vac Lab. Remaining pristine samples were re-examined in SSPL.

PRISTINE SAMPLES:

3	36.29 gm	Parent breccia. For description see F-8.
11	0.12 gm	Small representative chip sent for thin section.

RETURNED SAMPLES

None

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	42.36	PCT	0
Al_2O_3	2	14.64	PCT	1.32
TiO_2	1	7.51	PCT	0
FeO	1	15.57	PCT	0
MnO	1	.200	PCT	0
MgO	1	7.79	PCT	0
CaO	1	11.89	PCT	0
Na_2O	1	.452	PCT	0
Ba	1	430.0	PPM	0
Sc	1	56.8	PPM	0
V	1	85.0	PPM	0
Co	1	28.7	PPM	0
Cu	1	10.0	PPM	0
Zr	1	390.0	PPM	0
Ta	1	1.4	PPM	0
Hf	1	8.8	PPM	0
La	1	14.9	PPM	0
Ce	2	48.25	PPM	3.50
Sm	1	11.5	PPM	0
Eu	1	1.62	PPM	0
Tb	1	3.1	PPM	0
Ho	1	5.4	PPM	0
Yb	1	11.2	PPM	0
Lu	1	1.89	PPM	0
U	1	.52	PPM	0
O	1	40.40	PCT	0

Analysts: Ehmann & Morgan, (1970); Goles et al., (1970).

No Age References

10082,1
(S-76-20463)
No PET Photo

10082

Sample 10082 is a rounded to subrounded, dark grey to black, microbreccia. This sample originally weighed 50gm, and was returned in ALSRC #1004 (Documented Sample container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 1/6/76

ROCK TYPE: Microbreccia SAMPLE: 10082,1 WEIGHT: 48 gm

COLOR: Dark grey/black DIMENSIONS: 4.5 x 3 x 2.6 cm

SHAPE: Rounded to subrounded

COHERENCE: Intergranular - Moderately coherent
Fracturing - Few, non-penetrative

FABRIC/TEXTURE: Anisotropic/Microbreccia

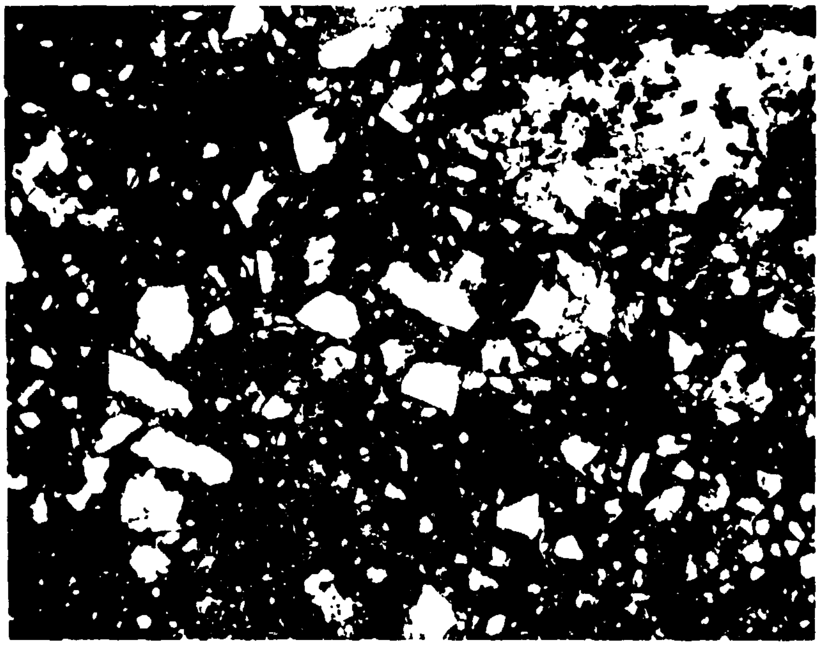
VARIABILITY: Homogeneous

SURFACE: Small patches of black glass coating on the S_1 face.

ZAP PITS: Many on B_1. Few on E_1, T_1. None on N_1, S_1. Pits are glass lined and are <1mm in size.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Matrix	Dk.Grey to Black	97	-----	---	------
Basalt Clast	Blk/White and Brown	2	Angular to subangular	<1	<1-3
White	White	<1	Rounded to angular	.8	<1
Grey & White	Dk.Grey	<1	Rounded to angular	.8	<1



SECTION: 10082,8 Width of field 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 6/29/76

SUMMARY: Partly devitrified typical breccia with no large lithic clasts. The section consists of only two small chips and is the only section available. Due to the small size of the chips, the larger clasts may have been excluded.

MATRIX 59% OF ROCK

PHASE	% SECTION	SHAPE	SIZE(MM)	COMMENTS:
Light to medium brown	100	-----	<0.001	High glass content with many crystal agments and crys- llites.

MINERAL CLASTS 21% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Pyroxene[1]	Very abundant	Angular to irregular	0.001-0.4
Plagioclase[2]	Few	Irregular to blocky	0.001-0.2
Opaques[3]	Moderate	Skeletal to blocky	0.001-0.2

1) Fractured; poor optical characteristics
2) Poor twinning; poor optics
3) Some large troilite; most skeletal ilmenite

LITHIC CLASTS 12% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large	None	-----	>1.0

GLASS CLASTS 8% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[4]	Very abundant	Spherical to angular	0.001-0.2
Greenish Yellow[5]	Two pieces	Blocky to irregular	0.4-0.5

4) Approximately half spheres and half shards; some devitrification.
5) Irregular piece hosting colorless glass masses; blocky piece with bubbles and some devitrification.

HISTORY AND PRESENT STATUS OF SAMPLES - 6/29/76

10082 was removed from the Documented Sample container (ALSRC #1004) and split in the Vac Lab. Remaining subsamples were re-examined in SSPL.

PRISTINE SAMPLES: (VAC-SSPL)

1	48.0	gm	Piece. Four pitted surfaces.
5	0.5	gm	Chips and fines.

NO RETURNED SAMPLES

NO CHEMICAL OR AGE DATES.

10084

10084 was the generic number assigned to the <1mm sieve fraction of the Bulk Sample fines (ALSRC #1003). These samples were removed from the container and split in the Bio-Prep Lab. Subsamples of 10084 were not physically re-examined. This sample originally weighed 3830 gm.

PRISTINE SAMPLES: (All BP-SSPL)

7	5.10	gm	Fines
36	10.90	gm	Fines
95	5.04	gm	Fines
137	1.85	gm	Fines
159	232.7	gm	Fines
160	19.89	gm	Fines
162	4.77	gm	Fines
163	22.25	gm	Fines
164	60.60	gm	Fines
165	652.8	gm	Fines
168	.06	gm	Fines
169	1.23	gm	Fines
246	.15	gm	Fines

RETURNED SAMPLES:

24	6.773	gm	Fines				
27	10.581	gm	Fines				
43	9.31	gm	Fines				
70	8.113	gm	Fines				
83	5.012	gm	Fines				
93	8.386	gm	Fines	627	17.928	gm	Fines
94	10.436	gm	Fines	628	12.663	gm	Fines
135	6.77	gm	Fines	789	8.555	gm	Fines
149	10.01	gm	Fines	798	6.418	gm	Fines
152	9.772	gm	Fines	851	14.423	gm	Fines
155	10.622	gm	Fines	908	14.102	gm	Fines
157	10.00	gm	Fines	993	6.218	gm	Fines
158	10.037	gm	Fines	995	10.139	gm	Fines
161	28.578	gm	Fines	999	8.309	gm	Fines
170	10.081	gm	Fines	1050	6.572	gm	Fines
244	8.553	gm	Fines	1225	8.00	gm	Fines
532	6.646	gm	Fines	1226	7.00	gm	Fines
534	7.072	gm	Fines	1467	6.435	gm	Fines

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	27	42.55	PCT	6.70
Al_2O_3	28	13.47	PCT	12.44
TiO_2	29	7.71	PCT	6.18
FeO	33	15.16	PCT	15.66
MnO	32	.208	PCT	.103
MgO	28	7.98	PCT	1.33
CaO	25	11.99	PCT	2.52
Na_2O	29	.445	PCT	.183
K_2O	65	.147	PCT	.111
P_2O_5	12	.140	PCT	.271
H	1	1.20	CC/G	0
Li	12	11.31	PPM	9.0
Rb	43	3.17	PPM	5.60
Cs	11	.187	PPM	.104
Be	5	2.10	PPM	2.9
Sr	40	168.72	PPM	130.0
Ba	41	183.29	PPM	280.0
Sc	16	64.00	PPM	34.0
V	9	63.78	PPM	72.0
Cr_2O_3	27	.316	PCT	.561
Co	19	29.66	PPM	26.0
Ni	20	199.57	PPM	251.42
Cu	11	11.74	PPM	25.10
Zn	11	24.92	PPM	22.5
Y	9	109.78	PPM	93.0
Zr	15	324.62	PPM	187.0
Nb	5	22.28	PPM	15.0
Mo	3	.683	PPM	.650

Element	Number of Analyses	Mean	Units	Range
Ru	1	.6	PPM	0
Rh	1	.1	PPM	0
Pd	3	.021	PPM	.030
Ag	5	.056	PPM	.126
Cd	6	.347	PPM	1.56
Ta	11	1.57	PPM	1.7
W	3	.823	PPM	1.78
Hf	15	9.96	PPM	5.30
Re	6	6.30	PPB	11.0
Os	4	.043	PPM	.134
Ir	5	.008	PPM	.003
Au	9	.009	PPM	.039
Hg	6	.002	PPM	.005
La	17	18.37	PPM	22.8
Ce	16	49.85	PPM	40.5
Pr	8	7.82	PPM	15.0
Nd	12	42.63	PPM	30.0
Sm	18	12.28	PPM	9.6
Eu	19	1.88	PPM	1.67
Gd	10	16.10	PPM	7.70
Tb	15	3.32	PPM	6.80
Dy	15	19.76	PPM	13.3
Ho	11	5.73	PPM	7.8
Er	8	14.38	PPM	23.5
Tm	6	1.53	PPM	.7
Yb	18	10.83	PPM	14.1
Lu	17	1.72	PPM	2.4
Th	16	2.36	PPM	2.7
U	18	.608	PPM	.77
B	5	3.51	PPM	6.97

Element	Number of Analyses	Mean	Units	Range
Ga	11	4.95	PPM	4.70
In	8	.902	PPM	1.05
Tl	3	.003	PPM	.003
C	2	140.5	PPM	17.0
Ge	6	.731	PPM	1.01
Pb	5	2.91	PPM	4.61
Sn	1	.7	PPM	0
N	1	110.0	PPM	0
As	5	.067	PPM	.07
Sb	4	.018	PPM	.058
Bi	2	.002	PPM	.0004
O	7	41.59	PCT	3.100
S	7	.110	PCT	.090
Se	7	.376	PPM	.66
Te	3	.486	PPM	1.393
F	6	271.00	PPM	826.0
Cl	7	35.70	PPM	72.3
Br	8	.240	PPM	.532
I	4	.399	PPM	.680

Analysts: Agrell et al., (1970); Frondel et al., (1970); Haramura et al.,(1970); Compston et al., (1970); Ehmann & Morgan, (1970); Engel & Engel, (1970); Goles et al., (1970); Maxwell et al., (1970); Morrison et al., (1970); Rose et al., (1970); Smales et al., (1970); Wakita et al., (1970); Wanke et al., (1970); Mason et al., (1971); Kim et al., (1971); Bouchet et al., (1971); Vobecky et al., (1971); Ehmann & Morgan, (1972); Willis et al., (1972); Hubbard et al., (1972); LSPET, (1973); Begemann et al., (1970); Ganapathy et al., (1970); Shedlovsky et al., (1970); Rhodes et al., (1975); Boynton et al., (1975); Turekian & Kharkar, (1970); Kharkar & Turekian, (1971); Haskin et al., (1970); Gast et al., (1970); Gopalon et al., (1970); Murthy et al., (1970); Perkins et al., (1970); Philpotts & Schnetzler, (1970); Tera et al., (1970); Travesi, et al., (1971); Basford, (1974); Murthy et al., (1973); Evensen et al., (1973); Annell & Helz, (1970); Reed & Jovanovic, (1970); Reed & Jovanovic, (1971); Smales et al., (1971); Cliff et al., (1971); Papanastassiou et al., (1970); Laul et al.,(1970).

Morgan et al., (1972); Goles, (1971); Chyi & Ehmann, (1973); Lovering & Butterfield, (1970); Lovering & Hughes, (1971); Wasson & Baedecker, (1970); Reed et al., (1970); Hess et al., (1971); Abdel-Rassoul et al., (1971); Fields et al., (1970); Silver, (1970); Wrigley & Quaide, (1970); Crozaz et al., (1970); Turkevich et al., (1971); Wrigley, (1971); Eugster, (1971); Epstein & Taylor, (1970); Kaplan et al., (1970); Kohman et al., (1970); Wanke et al., (1972).

Age References: Armstrong and Alsmiller, (1971); Marti et al., (1970); Perkins, (1970); Basford, (1974); Gopalan, (1970); Silver, (1970); Tatsumoto, (1970); Huey et al., (1971).

10085

10085 was the generic number assigned to the < 1mm sieve fraction of the Bul. Sample fines. They were removed from ALSRC #1003 and sieved in the Bio-Prep Lab. Upon re-examination in SSPL, it was noted that many subsamples of 10085 are > 1mm in size. The larger subsamples of this generic were re-sieved in RSPL and the > 4mm coarse fines were described.

COARSE FINES DESCRIPTION

SAMPLE: 10085,37 NUMBER OF PARTICLES: 1 WEIGHT(GM): .501

COHERENCE: Coherent

SHAPE: Rounded

SURFACE: Not pitted. Saw mark on one side.

COLOR: Grey

MINERALOGY: Microbreccia fragment with basaltic clasts 5 to 7mm in diameter and white clasts <1mm to 4mm in diameter.

COARSE FINES DESCRIPTION

SAMPLE: 10085,722 NUMBER OF PARTICLES: 3 WT.(gm): 1.268

COHERENCE: Coherent

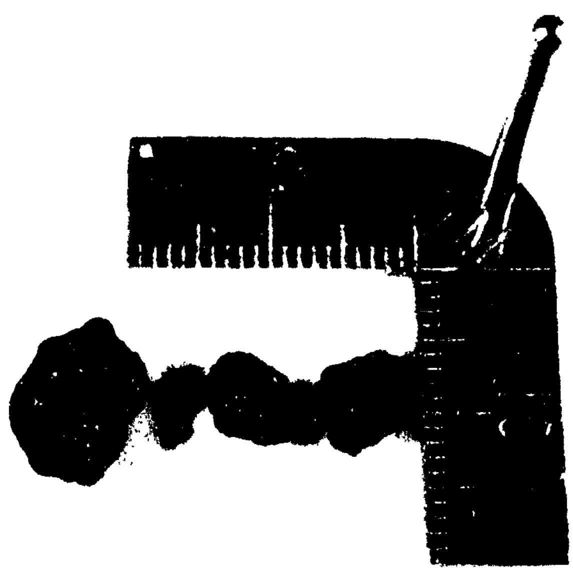
SHAPE: 3 fragments of irregular shape

SURFACE: Granulated to semi-fresh

COLOR: Medium grey

MINERALOGY: Contains olivine, pinkish brown pyroxene, white to clear plagioclase, and ilmenite.

REMARKS: 3 micro-gabbroic fragments with crystal lined vugs.



C-5

COARSE FINES DESCRIPTION

SAMPLE: 10085,723 NUMBER OF PARTICLES: 1 WT.(gm): .545

COHERENCE: Coherent

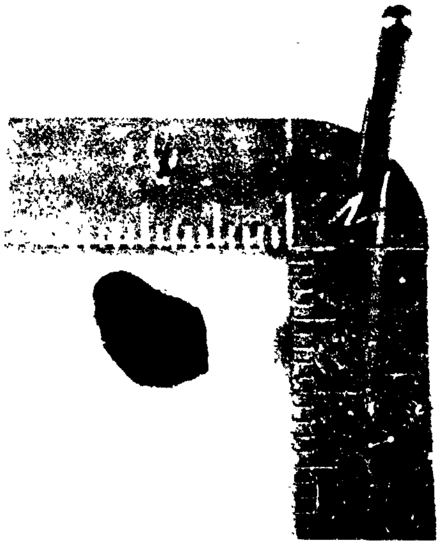
SHAPE: Irregular

SURFACE: Fairly fresh appearing

COLOR: Medium grey

MINERALOGY: White to clear plagioclase, reddish brown pyroxene, ilmenite.

REMARKS: Micro-gabbroic fragments w/o vugs.



COARSE FINES DESCRIPTION

SAMPLE: 10085,724 NUMBER OF PARTICLES: 1 WT.(gm): .078

COHERENCE: Coherent

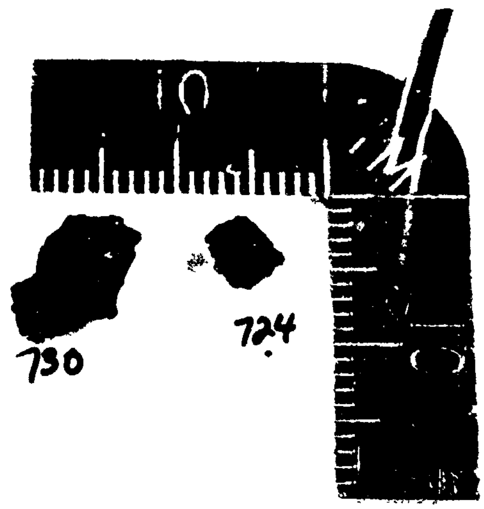
SHAPE: Jagged

SURFACE: Vesicular

COLOR: Black

MINERALOGY: Glass

REMARKS: Black, shiny vesicular glass



COARSE FINES DESCRIPTION

SAMPLE: 10085,725 NUMBER OF PARTICLES: 1 WT.(gm): .039

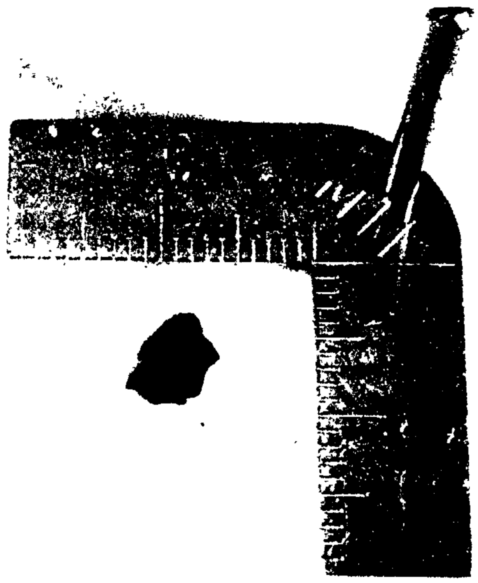
COHERENCE: Friable

SHAPE: Rounded

SURFACE: Smooth

COLOR: Black

MINERALOGY: Soil breccia black matrix glass (no clasts)



COARSE FINES DESCRIPTION

SAMPLE: 10085,726 NUMBER OF PARTICLES: 3 WT.(gm): .349

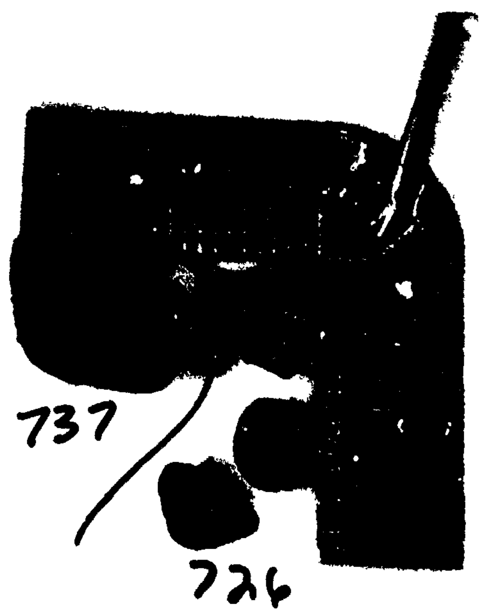
COHERENCE: Friable

SHAPE: Rounded

SURFACE: Not pitted

COLOR: Dark grey

MINERALOGY: Glass matrix with a few white clasts <1 mm in diameter.



COARSE FINES DESCRIPTION

SAMPLE: 10085,727 NUMBER OF PARTICLES: 2 WT.(gm): .240

COHERENCE: Coherent

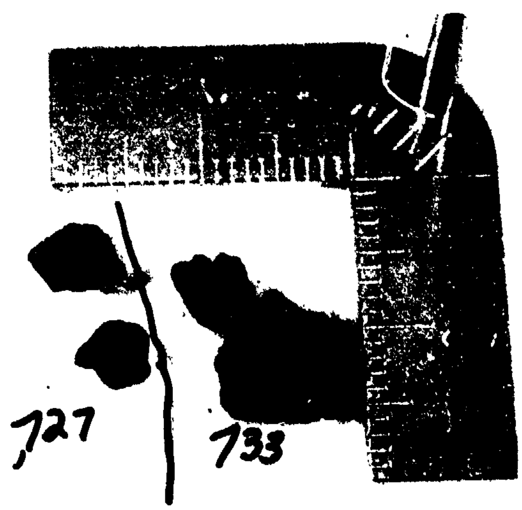
SHAPE: Irregular

SURFACE: Granulated to semi-fresh

COLOR: Dark grey

MINERALOGY: Ilmenite, plagioclase and pyroxene

REMARKS: Vuggy fine-grained microgabbro(ilmenite in vugs).



COARSE FINES DESCRIPTION

SAMPLE: 10085,728 NUMBER OF PARTICLES: 3 WT.(gm): .546

COHERENCE: Coherent

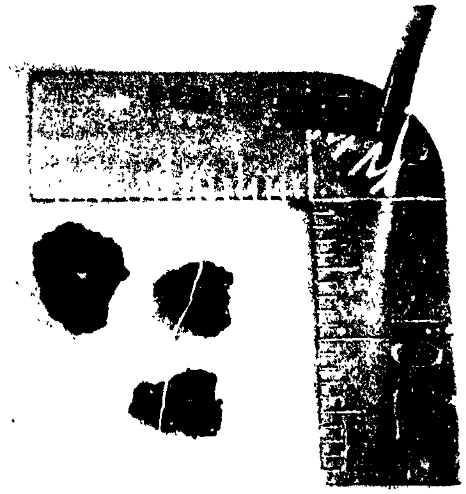
SHAPE: Irregular

SURFACE: Fresh to semi-fresh

COLOR: Light grey

MINERALOGY: Plagioclase, ilmenite, and reddish-brown pyroxene and olivine on two fragments.

REMARKS: Micro-gabbro; two of the fragments have a green mineral (probably olivine). One does not.



COARSE FINES DESCRIPTION

SAMPLE: 10085,729 NUMBER OF PARTICLES: 1 WT.(gm): .176

COHERENCE: Coherent

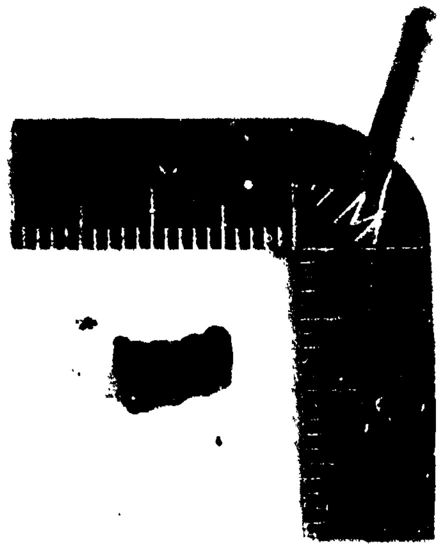
SHAPE: Rectangular prism (approximately)

SURFACE: Granulated on one end. Other surfaces semi-fresh. Vesicular

COLOR: Dark grey

MINERALOGY: Plagioclase, ilmenite, pyroxene

REMARKS: Vesicular basaltic fragments or ilmenite lines the vesicules.



COARSE FINES DESCRIPTION

SAMPLES: 10085,730 NUMBER OF PARTICLES: 1 WT.(gm): .321

COHERENCE: Coherent

SHAPE: Jagged

SURFACE: Vesicular

COLOR: Black

MINERALOGY: Glass

REMARKS: Black, shiny vesicular glass.

COARSE FINES DESCRIPTION

SAMPLE: 10085,731 NUMBER OF PARTICLES: 1 WT.(gm): .150

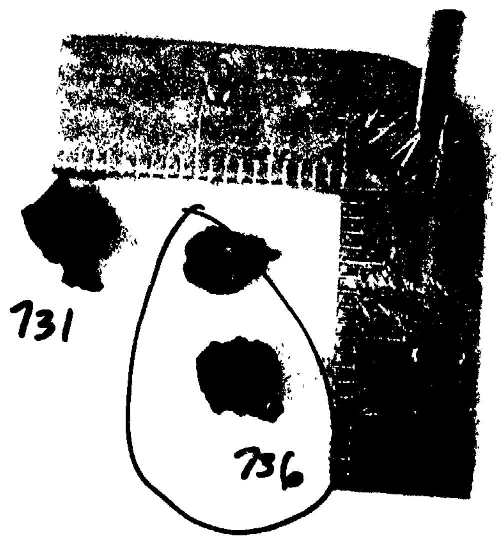
COHERENCE: Coherent

SHAPE: Irregular

SURFACE: One surface topped with shiny vesicular glass, other surfaces jagged.

COLOR: Grey with black glass

MINERALOGY: Coherent soil breccia with a few white clasts <1mm. Shiny, black vesicular glass on one surface.



COARSE FINES DESCRIPTION

SAMPLE: 10085,733 NUMBER OF PARTICLES: 2 WT.(gm): .589

COHERENCE: Coherent

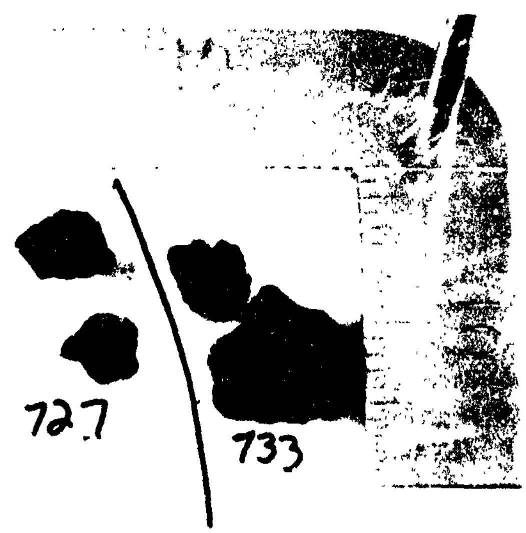
SHAPE: Irregular

SURFACE: Granulated to pitted. Finely vesicular

COLOR: Dark grey

MINERALOGY: Ilmenite, plagioclase, pyroxene

REMARKS: Vuggy fine grained microgábbro (ilmenite in vugs).



COARSE FINES DESCRIPTION

SAMPLE: 10085,734 NUMBER OF PARTICLES: 1 WT.(gm): .144

COHERENCE: Coherent

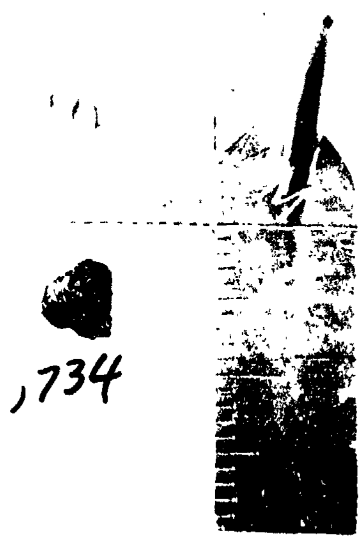
SHAPE: Trapezoidal prism

SURFACE: Highly granulated to semi-fresh. One surface has patina.

COLOR: Light grey

MINERALOGY: Ilmenite, plagioclase, reddish-brown pyroxene that looks like olivine (<1 mm)

REMARKS: Microgabbroic fragment.



COARSE FINES DESCRIPTION

SAMPLE: 10085,735 NUMBER OF PARTICLES: 1 WT.(gm): .095

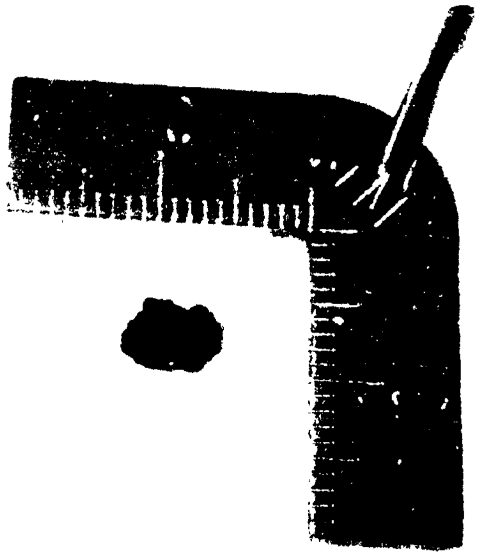
COHERENCE: Coherent

SHAPE: Irregular

SURFACE: Rough

COLOR: Black

MINERALOGY: Dull black glass with one clast <1 mm



COARSE FINES DESCRIPTION

SAMPLE: 10085,736 NUMBER OF PARTICLES: 2 WT.(gm): .262

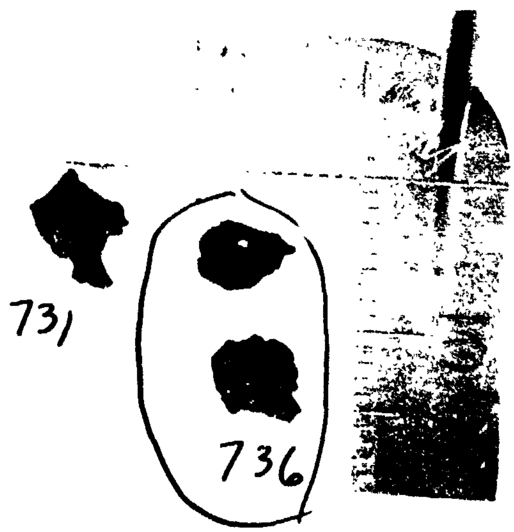
COHERENCE: Coherent

SHAPE: Irregular

SURFACE: Each has one surface rough with black shiny vesicular glass.

COLOR: Grey with black glass

MINERALOGY: Coherent soil breccia fragments with a few white clasts <1 mm. Shiny, black vesicular glass on one surface of each fragment.



COARSE FINES DESCRIPTION

SAMPLE: 10085,737 NUMBER OF PARTICLES: 1 WT.(gm): .758

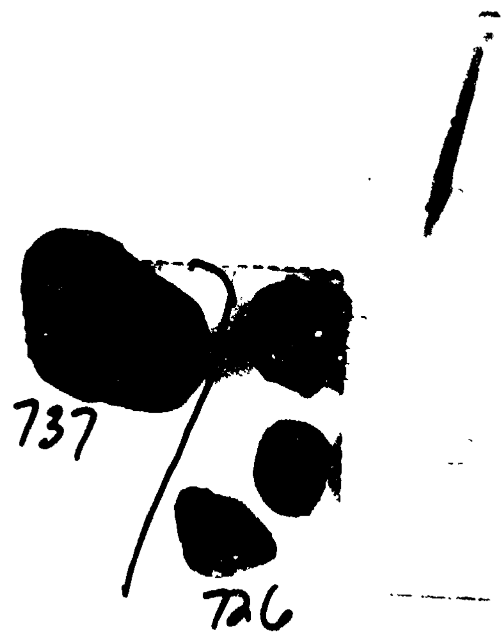
COHERENCE: Friable

SHAPE: Rounded

SURFACE: Not pitted

COLOR: Dark grey

MINERALOGY: Glass matrix with a few white clasts <1 mm in diameter.



COARSE FINES DESCRIPTION

SAMPLE: 10087,739 NUMBER OF PARTICLES: 1 WT.(gm): .179

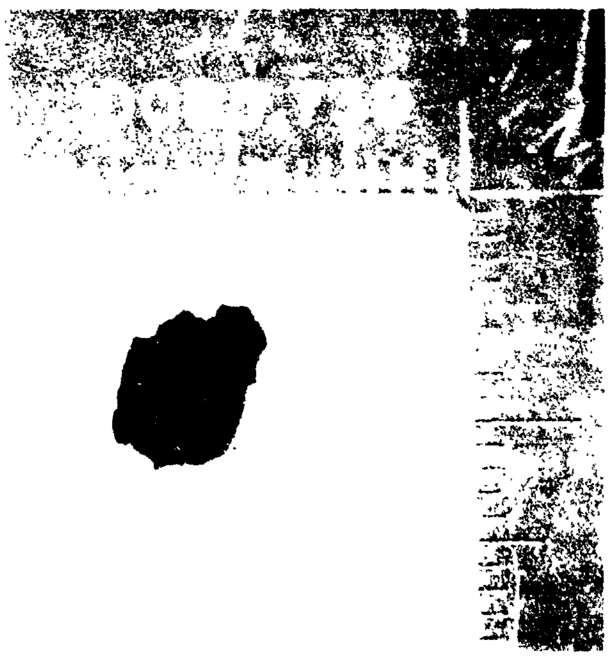
COHERENCE: Coherent

SHAPE: Semi-domed

SURFACE: One surface covered with vesicular black glass; the other surface is fractured.

COLOR: Glass black, breccia grey

MINERALOGY: Coherent soil breccia with white clasts <1mm topped on one side with vesicular black glass.



COARSE FINES DESCRIPTION

SAMPLE: 10085,740 NUMBER OF PARTICLES: 2 WT.(gm): .687

COHERENT: Coherent

SHAPE: Rounded

SURFACE: Exposed, with some patina.

COLOR: Medium grey

MINERALOGY: Ilmenite, plagioclase, reddish brown pyroxene.

REMARKS: Microgabbroic fragments with a few ilmenite lined vugs.

COARSE FINES DESCRIPTION

SAMPLE: 10085,741 NUMBER OF PARTICLES: 1 WT.(gm): .266

COHERENCE: Coherent

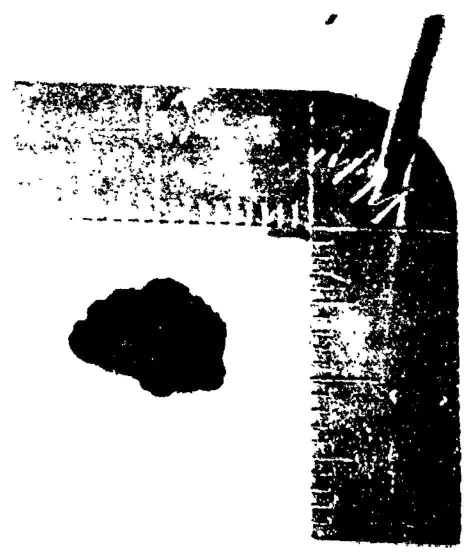
SHAPE: Irregular and jagged-flat

SURFACE: Pitted on one side, fresh looking on the other.

COLOR: Dark grey

MINERALOGY: Ilmenite, plagioclase, pyroxene

REMARKS: Vesicular-vuggy basalt



COARSE FINES DESCRIPTION

SAMPLE: 10085,742 NUMBER OF PARTICLES: 1 WT.(gm): .274

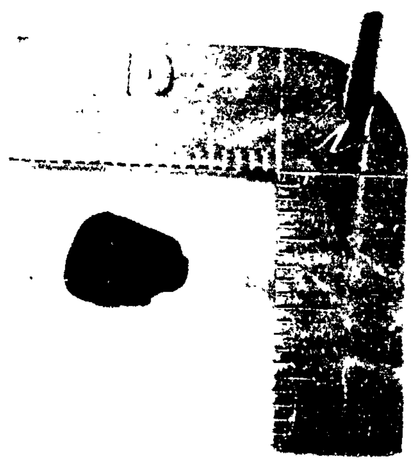
COHERENCE: Friable

SHAPE: Rounded pyramid

SURFACE: Two pits on one surface.

COLOR: Dark grey

MINERALOGY: Soil breccia with a few white clasts >1mm.



COARSE FINES DESCRIPTION

SAMPLE: 10085,744 NUMBER OF PARTICLES: 1 WT.(gm): .105

COHERENCE: Coherent

SHAPE: Irregular

SURFACE: Vesicular

COLOR: Black

MINERALOGY: Black vesicular glass, dull in some places, shiny in others.

COARSE FINES DESCRIPTION

SAMPLE: 10085,745 NUMBER OF PARTICLES: 1 WT.(gm): .655

COHERENCE: Coherent

SHAPE: Rounded

SURFACE: Granulated with some patina.

COLOR: Dark grey

MINERALOGY: Ilmenite, plagioclase, pyroxene

REMARKS: Vuggy, basaltic fragment.(Basalt to microgabbro in grain size)

COARSE FINES DESCRIPTION

SAMPLE: 10085,746 NUMBER OF PARTICLES: 2 WT.(gm): .728

COHERENCE: Coherent

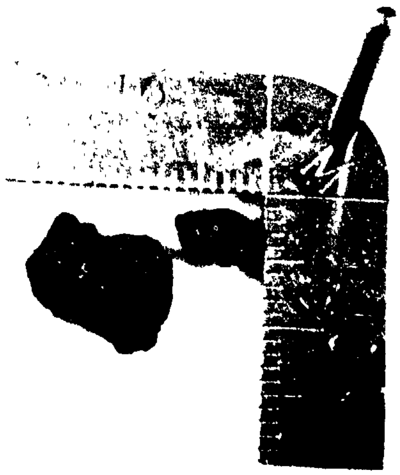
SHAPE: The largest in fragment is prismatic, disc-like. The smaller one is non-descript, irregular.

SURFACE: The larger one has pits on one surface. Other surfaces have granulation and patina. The smaller fragment also has some patina.

COLOR: Medium grey

MINERALOGY: Ilmenite, reddish brown pyroxene, plagioclase

REMARKS: Two microgabbroic fragments.



COARSE FINES DESCRIPTION

SAMPLE: 10085,753 NUMBER OF PARTICLES: 1 WT.(gm): .7912

COHERENCE: Moderately coherent

SHAPE: Sub-rounded

SURFACE: Smooth-all surfaces appear to be fresh except for some glassy splatter.

COLOR: Dark grey

MINERALOGY: Breccia with following clast types present: White clast, grey and white clast, salt and pepper clast and glass spherules. One clast is a grey and white, combined with a salt and pepper clast.

COARSE FINES DESCRIPTION

SAMPLE: 10085,754 NUMBER OF PARTICLES: 1 WT.(gm): .5941

COHERENCE: Tough

SHAPE: Angular

SURFACE: All surfaces fresh

COLOR: Dark grey

MINERALOGY: Approximately 70% dark minerals and 30% light

REMARKS: Very fine grained vesicular basalt. Vesicles comprise only about 5% of the surface area. Grain size is too small to determine exact percentages of components present.

COARSE FINES DESCRIPTION

SAMPLE: 10085,755 NUMBER OF PARTICLES: 3 WT.(gm): .2774

COHERENCE: Coherent

SHAPE: Equant, rounded

SURFACE: Fresh where not glass coated.

COLOR: Dark grey

MINERALOGY: Glass coated breccias:

1. Glass is vesicular, black.
2. 2 pieces consist of rounded dark grey breccias containing mostly mineral clasts .1-.4mm except one large salt and pepper clast 4 mm long. Glass coating on one side only.
3. 1 piece is 60% vesicular glass matrix enclosing grey and white clasts and a dark grey vesicular glassy breccia with a few white clasts.

COARSE FINES DESCRIPTION

SAMPLE: 10085,756 NUMBER OF PARTICLES: 1 WT.(gm): .2593

COHERENCE: Coherent

SHAPE: Equant, sub-rounded

SURFACE: Fresh

COLOR: Medium grey

MINERALOGY: Medium grain basalt

55-60% brown pyroxene
30-35% plagioclase
25% ilmenite

Grain size for all minerals ~.5mm

COARSE FINES DESCRIPTION

SAMPLE: 10085,757 NUMBER OF PARTICLES: 1 WT.(gm): 0.946

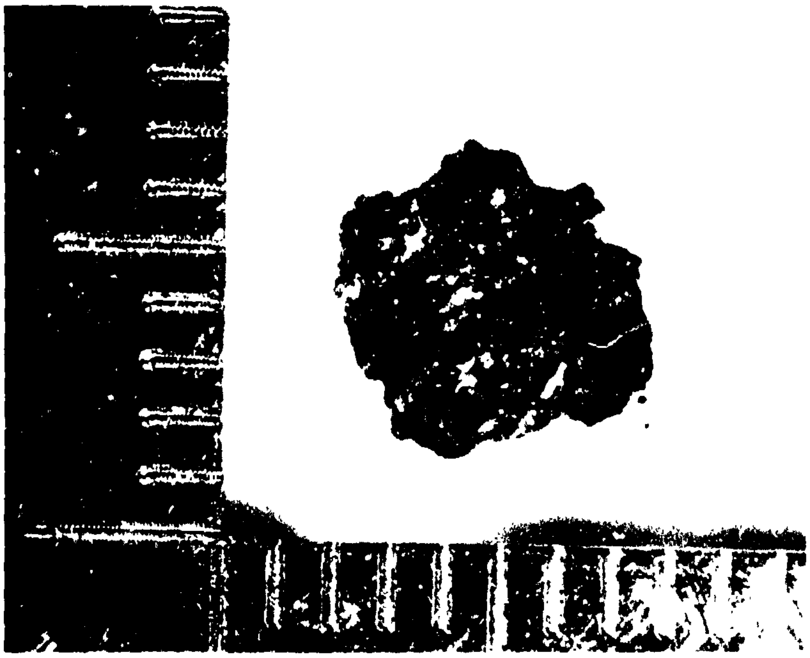
COHERENCE: Coherent

SHAPE: Equant, angular

SURFACE: Fresh on all but one side

COLOR: Medium grey

MINERALOGY: Metamorphosed breccia
-Lineation of white clasts in medium grey matrix.
-One side covered with splashed glass and patina, but zap pits not observed.



COARSE FINES DESCRIPTION

SAMPLE: 10085,758 NUMBER OF PARTICLES: 2 WT.(gm): .4840

COHERENCE: Coherent

SHAPE: Equant, sub-angular.

SURFACE: Some fresh, some more rounded with patina but no zap pits.

COLOR: Medium grey

MINERALOGY: Fine grain basalt:

1 piece finer grained with larger crystals of ilmenite and pale green transparent plagioclase about .2mm long. Well formed cinnamon crystals also present. <5% vugs
70% pyroxene
20% plagioclase
10% ilmenite

1 piece larger grained bladed ilmenites, brown pyroxenes; elongated plagioclase crystals up to .8mm, >5% vugs.
60-65% pyroxene
25% plagioclase
10-15% ilmenite

COARSE FINES DESCRIPTION

SAMPLE: 10085,759 NUMBER OF PARTICLES: 1 WT.(gm): .0987

COHERENCE: Coherent

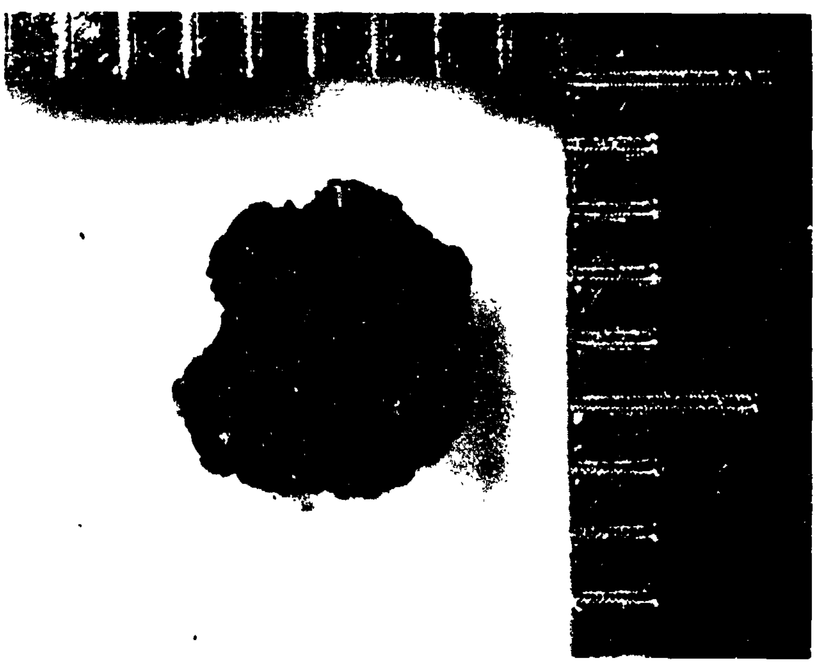
SHAPE: Sub-rounded

SURFACE: Fresh, small amount of patina, vugs ~5%.

COLOR: Medium grey

MINERALOGY: Medium grain basalt:
Elongated plagioclase crystals (.4mm), some large pale green transparent plagioclase, equant brown pyroxene (.1mm), some ilmenites (.5mm).

70-80% shocked pyroxene
10-15% enhedral ilmenite
Remainder plagioclase



COARSE FINES DESCRIPTION

SAMPLE: 10085,760 NUMBER OF PARTICLES: 1 WT.(gm): .5154

COHERENCE: Moderately coherent

SHAPE: Sub-rounded

SURFACE: Appears patina-covered all over. 2 faces have zap pits ∿.5mm.

COLOR: Dark grey

MINERALOGY: Fine matrix (soil breccia) containing mineral clasts ∿.2mm and larger grey basalt clasts (1.5-2mm).

COARSE FINES DESCRIPTION

SAMPLE: 10085,761 NUMBER OF PARTICLES: 2 WT.(gm): .3191

COHERENCE: Coherent

SHAPE: Angular

SURFACE: On each piece is one weathered surface containing whitened plagioclase and more rounded appearance, and light patina. Vugs <5%, zap pits on 1 piece.

COLOR: Medium grey

MINERALOGY: First piece: 55% known pyroxene, 30% plagioclase, 15% ilmenite. Grain size is 0.1-0.2mm.

Second piece: 50-55% pyroxene, 35-40% plagioclase, remainder - ilmenite. Frier grained than first piece.

REMARKS: Fine grain basalt, fractured in several directions.

PRISTINE SAMPLES:

40	2.09	gm	Fines
45	1.03	gm	Fines
101	26.08	gm	Fines
102	0.83	gm	Fines
103	4.96	m	Fines
104	171.95	gm	1-3mm Fines
105	28.19	gm	Fines
106	79.78	gm	Fines
141	1.22	gm	Fines
142	0.39	gm	Fines
143	2.44	gm	Fines
144	7.61	gm	Fines
145	4.05	gm	Fines

RETURNED SAMPLES:

10	7.308	gm	Fines
14	5.906	gm	Fines
20	9.822	gm	Fines
23	9.707	gm	Fines
146	14.394	gm	Fines
236	5.515	gm	Fines
256	7.729	gm	Fines
374	10.34	gm	Fines

723-726 Individually described in preceeding pages.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	42.13	PCT	0
Al_2O_3	1	13.64	PCT	0
TiO_2	1	7.69	PCT	0
FeO	1	15.29	PCT	0
MnO	1	.21	PCT	0
MgO	1	7.38	PCT	0
CaO	1	11.32	PCT	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Na_2O	1	.54	PCT	0
K_2O	1	.16	PCT	0
P_2O_5	1	.1	PCT	0
Rb	2	2.98	PPM	.034
Sr	1	159.0	PPM	0
Ba	2	195.5	PPM	123.
Cr_2O_3	1	.33	PCT	0
Ni	1	150.0	PPM	0
Cu	1	16.	PPM	0
Zn	1	19.	PPM	0
Y	1	124.	PPM	0
Zr	1	351.0	PPM	0
Nb	1	15.0	PPM	0
S	1	.31	PCT	0

Analysts: Brown et al., (1970); Papanastassiou et al., (1970); Compston et al., (1970).

No Age References

10086

10086 was the generic number assigned to a portion of the Bulk Sample fines (ALSRC #1003). It was removed from the ALSRC and split in the Bio-Prep Lab. There are no remaining pristine samples. Returned samples were not physically re-examined. This sample originally weighed 823 gm.

RETURNED SAMPLES:

5	49.033 gm	Fines
13	5.70 gm	Fines
14	5.00 gm	Fines
46	23.386 gm	Fines
89	15.643 gm	Fines
90	11.455 gm	Fines
91	11.17 gm	Fines
92	13.196 gm	Fines
98	10.617 gm	Fines
164	10.421 gm	Fines
166	13.229 gm	Fines
167	21.10 gm	Fines
170	32.043 gm	Fines
171	8.00 gm	Fines
183	34.779 gm	Fines
184	54.337 gm	Fines
185	11.278 gm	Fines
200	9.956 gm	Fines

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
SiO_2	1	44.92	PCT	0
Al_2O_3	1	9.82	PCT	0
TiO_2	1	9.34	PCT	0
FeO	1	13.38	PCT	0
MnO	2	.217	PCT	.007
MgO	1	8.29	PCT	0
CaO	1	8.96	PCT	0

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Na_2O	1	.224	PCT	0
K_2O	1	.144	PCT	0
P_2O_5	1	.043	PCT	0
H	1	1.2	PPM	0
Li	1	4.9	PPM	0
Rb	1	13.	PPM	0
Cs	1	.24	PPM	0
Be	1	1.3	PPM	0
Sr	1	42.	PPM	0
Ba	1	170.	PPM	0
V	1	11.	PPM	0
Cr_2O_3	1	.248	PCT	0
Co	1	12.	PPM	0
Ni	1	56.03	PPM	0
Y	1	11.	PPM	0
Zr	1	140.	PPM	0
Nb	1	10.	PPM	0
Ag	1	3.9	PPM	0
La	1	.67	PPM	0
Ce	1	7.3	PPM	0
B	1	.71	PPM	0
Ga	1	3.9	PPM	0
C	5	137.25	PPM	202.
Ge	1	1.3	PPM	0
N	3	91.67	PPM	133.
As	1	.57	PPM	0
S	4	.044	PCT	.066

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
F	1	3.5	PPM	0
Cl	1	.91	PPM	0

Analysts: Oro et al., (1970); Engel & Engel,(1970); Moore et al., (1970); Kaplan et al., (1970); Kvenvolden et al., (1970); Murphy et al., (1970).

No Age References

10087

10087 was the generic number assigned to a portion of 10011 (Bulk Sample fines) in the Bio-Prep Lab. There are no pristine samples remaining and no returned samples larger than 2 gm. This sample originally weighed 17.4 gm.

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
C	1	133.0	PPM	0

Analysts: Epstein & Taylor, (1970).

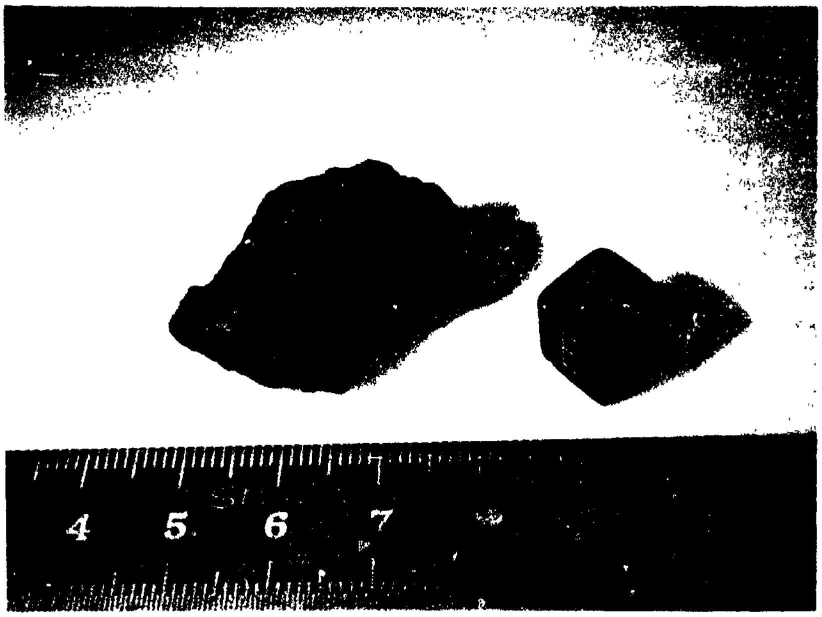
No Age References

10089

10089 was the generic number assigned to a small portion of the Bulk Sample fines which were sieved and allocated to P.I.'s in the Bio-Prep Lab. No pristine samples are available. This sample originally weighed 50 gm.

RETURNED SAMPLES:

2	21.76 gm	Fines.



10091,26
(S-76-25552)
No PET Photo

10091

Sample 10091 is an angular to sub-angular, medium dark grey, breccia. This sample originally weighed 24 gm and presently measures 4.2x3x2 cm. It was originally returned in ALSRC #1003 (Bulk Sample container).

BINOCULAR DESCRIPTIONS BY: Geeslin DATE: 7/9/76

ROCK TYPE: Breccia SAMPLE: 10091,26 WEIGHT: 10.41gm

COLOR: Medium dark grey DIMENSIONS: 4.2 x 3 x 2 cm

SHAPE: Angular to subangular

COHERENCE: Intergranular - fairly coherent
Fracturing - absent

FABRIC/TEXTURE: Anisotropic/Breccia

VARIABILITY: Homogeneous

SURFACE: Edges fairly sharp and not rounded. Some patina on T_1, N_1, faces.

ZAP PITS: Few on T_1-N_1.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	SIZE (MM) RANGE
Basalt Clast$_1$	Black, White/Brn	10	Angular to rounded	3	2-5
Matrix	Dk.Grey	90	------------------	---------	

1) Pyroxene, plagioclase and ilmenite. All crystallites, even distribution.

THIN SECTION DESCRIPTION

There was no thin section for the generics 10091 available at the onset of Secondary Examination. It was judged that the remaining sample (10.41 gm) should not be chipped for a thin section allocation.

HISTORY AND PRESENT STATUS OF SAMPLES - 7/12/76

10091 was removed from the Bulk Sample container (ALSRC #1003) and split in the Bio-Prep Lab. There are no remaining pristine samples. The one remaining returned sample was re-examined in RSPL.

PRISTINE SAMPLES:

None

RETURNED SAMPLES:

36 10.41 gm Chip. One face has a few pits.

CHEMICAL ANALYSES

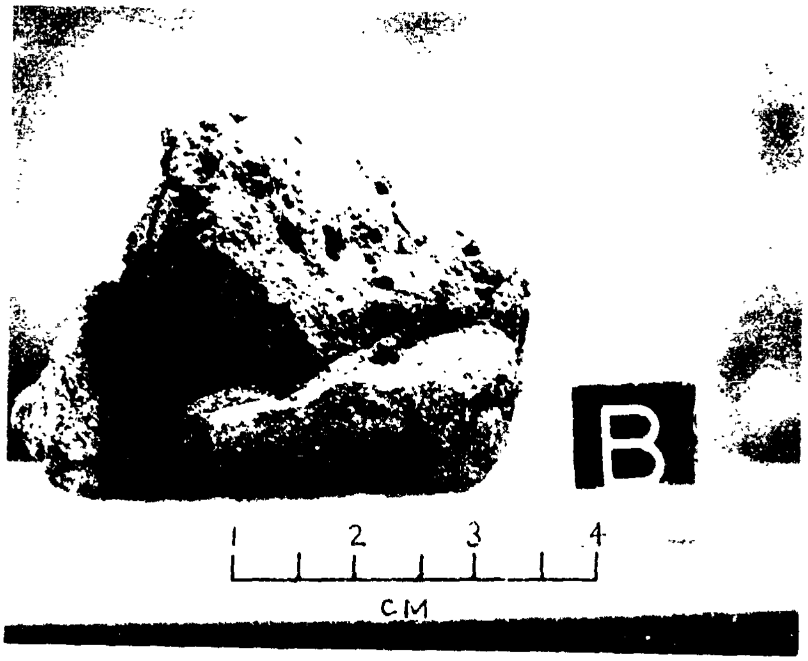
Element	Number of Analyses	Mean	Units	Range
SiO_2	2	40.64	PCT	4.27
Al_2O_3	2	11.62	PCT	6.62
TiO_2	2	8.84	PCT	2.50
FeO	2	17.37	PCT	3.86
MnO	2	.194	PCT	.129
MgO	2	7.05	PCT	1.16
CaO	2	10.49	PCT	4.78
Na_2O	2	.198	PCT	.305
K_2O	2	.211	PCT	.133
P_2O_5	2	.041	PCT	.032
H	2	.21	PPM	.020
Li	2	3.90	PPM	.4
Rb	2	10.00	PPM	6.0
Cs	2	.550	PPM	.67

CHEMICAL ANALYSES

Element	Number of Analyses	Mean	Units	Range
Sr	2	41.00	PPM	2.0
Ba	2	64.00	PPM	92.0
V	2	28.00	PPM	6.0
Cr_2O_3	2	.285	PCT	.044
Co	2	11.8	PPM	4.4
Ni	2	290.0	PPM	260.0
Y	2	1.35	PPM	.100
Zr	2	23.5	PPM	17.00
Nb	2	2.05	PPM	.5
Ag	2	2.0	PPM	2.0
La	2	.535	PPM	.39
Ce	2	1.90	PPM	1.80
B	2	.37	PPM	.52
Ga	2	2.3	PPM	1.4
Tl	1	2.70	PPB	0
C	1	6.0	PPM	0
Ge	2	.875	PPM	.85
N	1	15.00	PPM	0
As	2	.335	PPM	.110
S	2	.245	PCT	.07
F	2	3.05	PPM	1.3
Cl	2	2.65	PPM	1.3

Analysts: Oro et al., (1970).

No Age References



10092,0
(S-76-25872)
No PET Photo

10092

Sample 10092 is an angular, medium light grey, olivine basalt. This sample originally was numbered 10002,22, but due to its size was given a new generic number during re-examination in SSPL. The sample was returned in ALSRC #1003 (Bulk Sample container).

BINOCULAR DESCRIPTION BY: Twedell DATE: 6/2/76

ROCK TYPE: Olivine Basalt SAMPLE: 10092,0 WEIGHT: 46 gm

COLOR: Medium light grey DIMENSIONS: 3 x 4.2 x 2.6 cm

SHAPE: Angular

COHERENCE: Intergranular - Tough
Fracturing - Few, non-penetrative, one penetrative

FABRIC/TEXTURE: Isotropic/Equigranular

VARIABILITY: Homogeneous

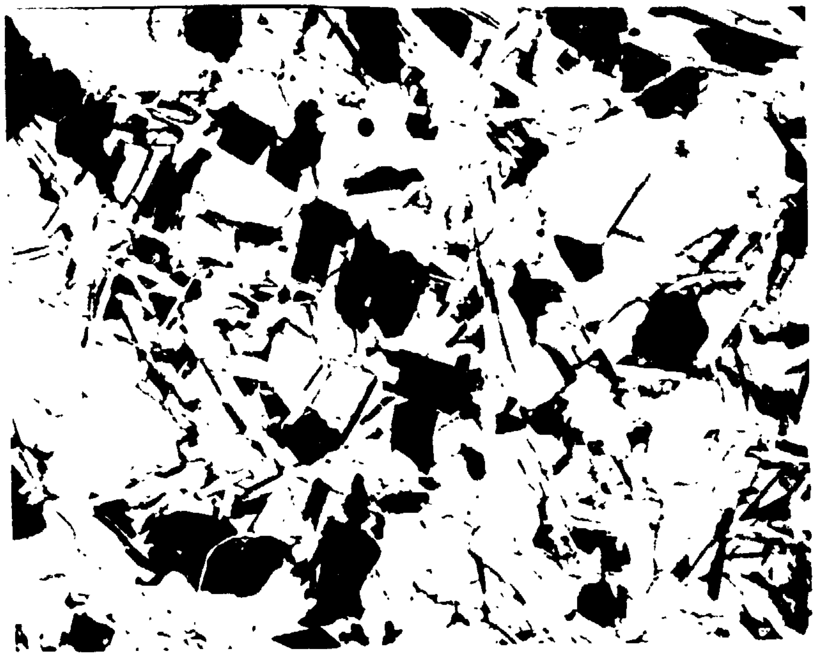
SURFACE: Surface is irregular and well coated with patina. One fresh surface on B_1 face.

ZAP PITS: Many on T_1, N_1. Few on B_1. None on any other. Pits are glass lined, up to .8mm in diameter.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE(MM) DOM.	SIZE(MM) RANGE
Olivine[1]	Green	3	Euhedral	.09	<.08-.2
Pyroxene[2]	Honey Brown to Dark	45	Euhedral	.1	<.05-.3
Plagioclase[3]	White	40	Euhedral to aphinitic	.1	<.01-.2
Ilmenite	Black	8	Platy	.09	<.1-.1
Mesostasis	Black	4		<.08	<.1

1) Appears in small groups throughout sample.
2) Well defined crystals.
3) Ranges in texture from crystalline to crushed.

10092



SECTION: 10092,5 Width of field 1.39mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 7/15/76

SUMMARY: Fine-grained subcphitic basalt composed of clinopyroxene, two generations of plagioclase, and ilmenite with subordinate olivine and mesostasis. Large anhedral crystals of clinopyroxene host the other phases present.

PHASE	% SECTION	SHAPE	SIZE (MM)
Pyrox	48	Anhedral to irregular	0.01-0.9
Plag	29	Euhedral to anhedral	0.01-0.4
Ol	5	Anhedral	0.2-0.8
Opaq	15	Subhedral to skeletal	0.01-0.4
Meso	3	---------------------	0.001-0.1

COMMENTS:

Pyroxene - The clinopyroxene forms large anhedral pinkish tan masses which host the other phases present. The extinctions, for the most part, are uneven and zoning is present. Only a few show any cleavage traces.

An unidentified brown mineral was present. It occurred as isolated grains and near ilmenite crystals. No cleavage was seen and it was nonisotropic.

Plagioclase - Two generations of plagioclase occur in the rock. The first type consists of euhedral tablets which appear in the sections as equant acicular crystals. The crystals show well developed twin planes and extinctions are sharp.

The second type of plagioclase crystals represented in the rock forms interstitial masses between the pyroxene-plagioclase-ilmenite network. The masses are larger than the euhedral crystals and show poor twin planes and extinctions are uneven. This later formed plagioclase is most often associated with the mesostasis that occurs in the rock. The mesostasis is light brown in color and very turbid.

Olivine - Large to small masses of olivine grading to pyroxene occur in the section. A well developed fracture pattern, color difference and indices easily distinguish it from the adjacent pyroxene. The masses are more or less concentrated in one part of the section and are not uniformly distributed.

Opaques - The most common opaque mineral present in the rock is ilmenite. The crystals form subhedral to skeletal masses scattered throughout the rock. Most of the crystals show rutile exsolutions.

Small masses of troilite and troilite with iron-nickel inclusions are also present. These form only a very small percentage of the total opaques present.

TEXTURE: Subophitic fine-grained basalt consisting of pyroxene, two generations of plagioclase, ilmenite, olivine and mesostasis. Only moderate shock effects are evident. Contacts are all sharp and the only interreaction is the olivine to pyroxene gradation.

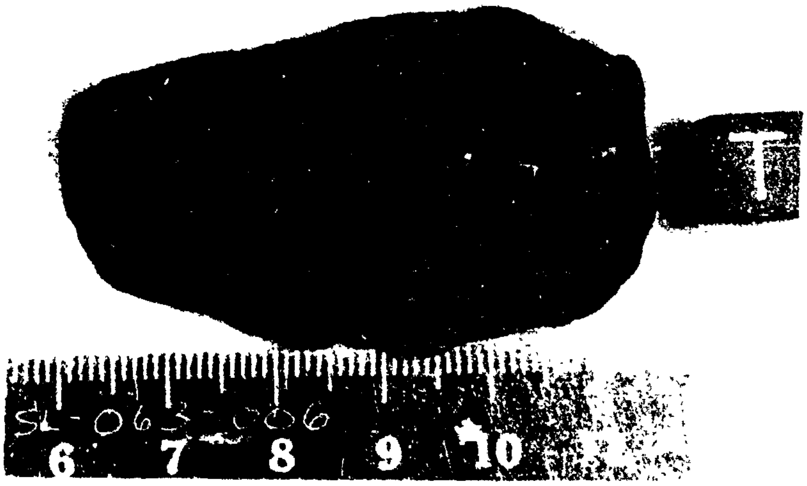
HISTORY AND PRESENT STATUS OF SAMPLES - 7/15/76

10092 was split from 10002 (Bulk Sample generic) during re-examination in SSPL. Allocations were made for chemical analyses and thin sections.

PRISTINE SAMPLES: (VAC-SSPL)

0	28.63 gm	Rock. Three pitted surfaces. One fresh surface.
1	16.32 gm	Piece. Two pitted surfaces.

NO RETURNED SAMPLES.



10093,0
(S-76-25989)
No PET Photo

10093

Sample 10093 is a subangular, medium dark grey, fine breccia. This sample was originally part of 10002,22 but was given a new generic number during re-examination. It was returned in ALSRC #1003 (Bulk Sample container).

BINOCULAR DESCRIPTIONS BY: Twedell DATE: 6/16/76

ROCK TYPE: Fine Breccia SAMPLE: 10093,0 WEIGHT: 25.85 gm

COLOR: Medium Dark Grey DIMENSIONS: 5 x 2.8 x 1.3

SHAPE: Subangular

COHERENCE: Intergranular - coherent
Fracturing - few, non-penatrative

FRABIC/TEXTURE: Anisotropic/Fine Breccia.

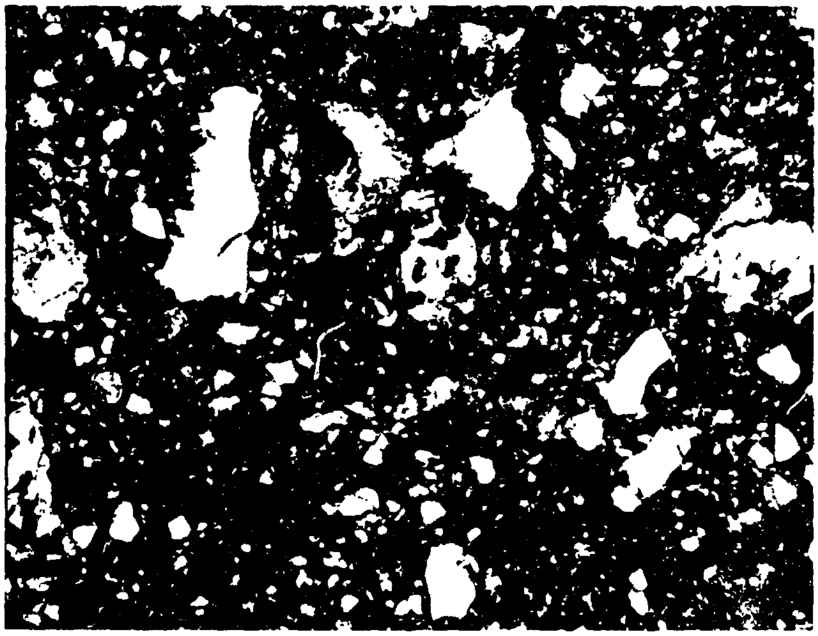
VARIABILITY: Homogeneous

SURFACE: No patina on any surfaces. Surface is rough on S_1, smooth on E_1 & W_1.

ZAP PITS: Many on E_1, few on N_1, and S_1, none on any others. Pits are glass lined up to .8 mm in size.

CAVITIES: Absent.

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Med. dk. grey	98%	- -	-	-
Basalt clast	Honey brown, black & white	1%	Angular to sub-rounded	1	1-2
White clast	White	<1%	Subangular to subrounded	.8	.7-1
Brown & White clast	Honey brown & white	<1%	Angular	5	--
Salt & Pepper clast	Black & white	<1%	Angular to sub-rounded	.8	.3-1.0
Grey clast	Submetallic	<1%	Subrounded	.5	



SECTION: 10093,5 Width of field 1.35 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 7/15/76

SECTION: 10093,5

SUMMARY: Partly devitrified typical breccia with aboundant crystallites in the matrix. Over one half of the matrix is composed of small crystallites giving the overall appearance of the matrix a light brown coloration.

MATRIX 75% OF ROCK

PHASE	% OF SECTION	SHAPE	SIZE (MM)	COMMENTS
Lt to dk brn	100%	- -	<0.001	Moderate glass content; high crystallite content.

MINERAL CLASTS 12% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE(mm)
$Pyroxene_1$	Very abundant	Angular to irregular	0.001-0.4
$Plagioclase_2$	Moderate	Blocky to irregular	0.001-0.4

Opaques[3]	Few	Skeletal to blocky	0.001-0.1

1) Many show poor optical characteristics; mainly smaller fragments.
2) A few large shards; most show good twin planes.
3) A few larger blocky crystals; numerous small fragments in matrix.

LITHIC CLASTS 9% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Round to irregular	0.001-1.0
Large[4]	One present	Irregular	>1.0

4) A fine-grained basalt consisting of pyroxene, plagioclase and ilmenite.

GLASS CLASTS 4 % OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[5]	Very abundant	Angular to spherical	0.001-0.6
White[6]	Few	Angular to spherical	0.001-0.3

5) Approximately half angular shards and half spheres or part spheres: some devitrification.

6) Mostly angular shards; a few part spheres.

HISTORY AND PRESENT STATUS OF SAMPLES 7/15/76

10093 was part of 10002,22 (Bulk Sample generic processed in the Bio-Prep Lab.) Upon re-examination in SSPL it was assigned its own generic number and allocations were made for thin sections and chemical analysis.

PRISTINE SAMPLES

0	24.17 gm	Rock. Three pitted surfaces. VAC-SSPL

NO RETURNED SAMPLES

10094,0
(S-76-25993)
No PET Photo

10094

Sample 10094 is a subangular to subrounded, medium dark grey, breccia. This sample was originally part of 10001,9, but was given a new generic number during re-examination. The sample was returned in ALSRC # 1003 (Bulk Sample container).

BINOCULAR DESCRIPTIONS BY: Twedell DATE: 9/19/76

ROCK TYPE: Breccia SAMPLE: 10044,59 WEIGHT: 25 gm

COLOR: Medium dark grey DIMENSIONS: 3 x 2.5 x 2.3

SHAPE: Subrounded - subangular

COHERENCE: Intergranular - coherent
Fracturing - few penetrative, few non-penetrative.

FABRIC/TEXTURE: Ansotropic/Breccia.

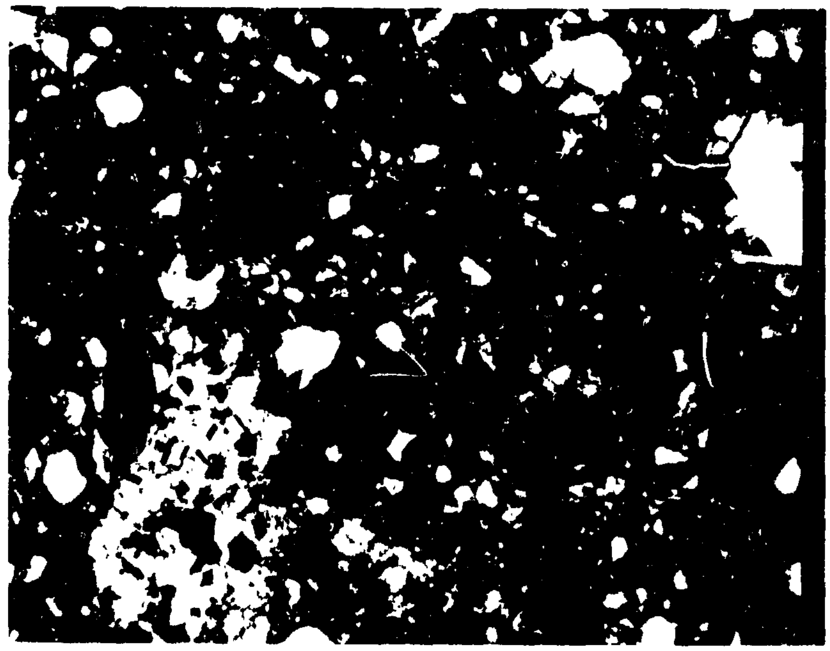
VARIABILITY: Homogeneous

SURFACE: Irregular due to numerous fractures. Some small patches of patina on several surfaces.

ZAP PITS: Many on S_1, T_1; few on E_1, W_1 and N_1. None on B. Pits are glass lined up to 4 mm in diameter.

CAVITIES: Absent

COMPONENT	COLOR	% OF ROCK	SHAPE	SIZE (MM) DOM.	RANGE
Matrix	Med dk grey	97%	- -	-	-
Basalt clast	Brn Wht Blk	<1%	Angular	2	<1-6
Grey clast	Grey	1%	Subangular	1	<1-3
White clast	White	<1%	Angular	2	<1-8
Salt & Pepper clast	Blk & white	1%	Angular	5	<1-11



SECTION: 10094,6 Width of field 1.39 mm plane light

THIN SECTION DESCRIPTION BY: Walton DATE: 7/16/76

SECTION: 10094,6

SUMMARY: Partly devitrified typical breccia with no large lithic clasts. Numerous small lithic clasts are present. Since the section is very small, the exclusion of large clasts may be a result of the sampling and be atypical for the rock.

MATRIX 69% OF ROCK

PHASE	% OF SECTION	SHAPE	SIZE (MM)	COMMENTS
Dark brown	100%	- -	<0.001	High glass content plus numerous crystallites.

MINERAL CLASTS 13% OF ROCK

PHASE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
$Pyroxene_1$	Very abundant	Angular to irregular	0.001-0.3

Plagioclase[2]	Moderate	Blocky to irregular	0.001-0.3
Opaques[3]	Few	Skeletal to blocky	0.001-0.1

1) Poor optical characteristics: some zoning.
2) Fair to good twins; few large pieces.
3) Most in clasts; numerous small fragment in matrix.

LITHIC CLASTS 13% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Small	Very abundant	Rounded to irregular	0.001-1.0
Large	None	- -	>1.0

GLASS CLASTS 5% OF ROCK

TYPE	RELATIVE ABUNDANCE	SHAPE	SIZE (MM)
Yellow-Orange[4]	Very abundant	Spherical to angular	0.001-0.3
White[5]	Moderate	Angular to spherical	0.001-0.4

4) Almost all spheres or part spheres; some large angular shards.
5) Almost all angular shards; some spheres and part spheres; some devitrification.

HISTORY AND PRESENT STATUS OF SAMPLES 7/16/76

10094 was part of 10001,9 (Bulk Sample generic processed in the Bio-prep. Upon re-examination in SSPL, it was assigned its own generic number and allocations were made for thin sections and chemical analysis.

PRISTINE SAMPLES

0	24.23 gm	Rock. Pitted on all but one surface.
4	0.54 gm	Chips and fines.

NO RETURNED SAMPLES

Appendix A
Definition of Terms and Acronyms

ALSRC	- Apollo Lunar Sample Return Container.
Bio-Prep Lab	- Biological Preparation Laboratory. This lab processed the Bulk Sample and prepared aliquots for biological testing and analysis.
EVA	- Extravehicular Activity.
JSC	- Johnson Space Center, Houston, Texas.
LCL	- Lunar Curatorial Laboratory. This is the present location for sample processing and storage.
LM	- Lunar Module.
LRL	- Lunar Receiving Laboratory. This is the overall term for the individual laboratories that first received and processed the Apollo 11 samples.
MESA	- Modularized Equipment Stowage Assembly.
Min.Sep.Lab.	- Mineral Separation Laboratory.
MQF	- Mobile Quarantine Facility.
NASA	- National Aeronautics and Space Administration.
NSI	- Northrop Services Incorporated.
PCTL	- Physical-Chemical Testing Laboratory. This Lab processed the Contingency Sample and performed detailed descriptions and analyses of the Apollo 11 rocks and soils.
PET	- Preliminary Examination Team.
Pristine Samples	- For Apollo 11, those samples which have not been previously allocated as exposed to highly degrading contaminants.
RCL	- Radiation Counting Laboratory.
Returned Samples	- Consists of samples that have been allocated to Principle Investigators, analyzed (degraded) and returned.
RSPL	- The Laboratory where the returned samples are presently stored and processed.
SSPL	- The Laboratory where pristine samples are currently stored and processed.

TSL	- Thin Section Laboratory.
Vac.Lab(F-201)	- Vacuum Laboratory. This Lab processed the Documented Sample and the drive tubes.

APPENDIX B--PHOTO INDEX

SAMPLE NUMBER	PHOTO NUMBER	TYPE VIEW	COLOR OR BLK/WHITE
10003,0	S-69-45005 S-69-45006 S-69-45007 S-69-45008 S-69-45009	Stereo	B/W
10003,0	S-69-45010 S-69-45011 S-69-45014 S-69-45016 S-69-45019 S-69-45021 S-69-45022 S-69-45025 S-69-45027	Rock	B/W
10003,0	S-69-45066 S-69-45067 S-69-45068 S-69-45069 S-69-45070 S-69-45071	Microscope view	B/W
10003,0	S-69-45077 S-69-45078 S-69-45079 S-69-45080 S-69-45081 S-69-45082 S-69-45083 S-69-45084 S-69-45085	Fines	B/W
10003,0	S-69-45124 S-69-45125 S-69-45126 S-69-45127 S-69-45128 S-69-45129 S-69-45130 S-69-45131 S-69-45132 S-69-45133	RCL Sample	B/W
10003,0	S-69-45191 S-69-45192 S-69-45193	ALSRC	B/W
10003,0	S-69-45402 S-69-45403 S-69-45404	Stereo	B/W
10003,0	S-69-59274 S-69-59287 S-69-59288 S-69-59289 S-69-59290 S-69-59291	Thin Section	B/W
10003,37	S-70-49473 S-70-49474	Thin Section	B/W
10003,47	S-70-50549 S-70-50552	Thin Section	B/W
10003	S-75-28696 S-75-28697 S-75-28698 S-75-28699	Rock Reconstruc	C
10003,49	S-75-30939 S-75-30940 S-75-30941	Thin Section	C
10003,38,71,119	S-76-20468 S-76-20469	Processing	C
10003,25	S-76-25338 S-76-25339 S-76-25340 S-76-25545	Processing	C
10003,25	S-76-25546 S-76-25547	Processing	C
10003,49	S-76-26304 S-76-26305	Thin Section	B/W
10004	S-69-45105 S-69-45106 S-69-45107 S-69-45108 S-69-45109 S-69-45110 S-69-45111 S-69-45112 S-69-45113 S-69-45114 S-69-45115 S-69-45116 S-69-45117 S-69-45118 S-69-45119 S-69-45120 S-69-45121 S-69-45122 S-69-45123 S-69-45535 S-69-45536 S-69-45537	Core Tube	B/W
10005	S-69-45244 S-69-45245 S-69-45246 S-69-45247 S-69-45248 S-69-45249 S-69-45250 S-69-45251 S-69-45252 S-69-45253 S-69-45254 S-69-45255	Core Tube	B/W
10009,0	S-75-31104 S-75-31105 S-75-31106 S-75-31107 S-75-31108 S-75-31109	Ortho	C
10009,12	S-75-31361	Rock Processing	C
10009,7	S-76-25830 S-76-26296	Thin Section	B/W
10010	S-69-45405 S-69-45406 S-69-45407 S-69-45408 S-69-45409 S-69-45410 S-69-45411 S-69-45412	Glass Spheres	B/W
10015	S-69-45062 S-69-45063 S-69-45064 S-69-45065	Microscope view	B/W
	S-69-45194 S-69-45195 S-69-45196 S-69-45197 S-69-45198 S-69-45199 S-69-45200	Powder	B/W
10017	S-69-45214	F-201	B/W
10017,19,20	S-69-45217	F-201	B/W

10017	S-69-45222	F-201	B/W
	S-69-45370 S-69-45371	RCL Sample	B/W
10017,.0	S-69-45373 S-69-45374	F-201	B/W
10017	S-69-45375 S-69-45376 S-69-45377 S-69-45378 S-69-45379	F-201	B/W
10017	S-69-47558 S-69-47559 S-69-47560 S-69-47561 S-69-47562 S-69-47563 S-69-47564 S-69-47565 S-69-47566 S-69-47567 S-69-47568 S-69-47569 S-69-47570 S-69-47571 S-69-47572 S-69-47573 S-69-47574 S-69-47575	Stereo & Post-Split	B/W
10017	S-69-48453 S-69-48454 S-69-48455 S-69-48456 S-69-48457	Mug Shot	B/W
10017	S-69-49232 S-69-49234 S-69-49235 S-69-49236 S-69-49243 S-69-49244 S-69-49245	Rock	B/W
10017	S-69-53961 S-69-53962 S-69-53963 S-69-53964	Thin Section	B/W
10017,16	S-69-53982 S-69-53983 S-69-53984 S-69-53985 S-69-54023	Thin Section	B/W
10017,15	S-69-54058 S-69-54059	Thin Section	B/W
10017,16	S-69-54062 S-69-54063 S-69-54065	Thin Section	B/W
10017,15	S-69-54066	Thin Section	B/W
10017	S-69-54089 S-69-59252 S-69-59333	Thin Section	B/W
10017,61	S-70-48930 S-70-48931	Thin Section	C
10017	S-70-49222 S-70-49223	Thin Section	B/W
10017,20	S-70-49230 S-70-49231	Thin Section	B/W
10017,15	S-70-49868 S-70-49869	Thin Section	B/W
10017,62	S-70-49872 S-70-49873	Thin Section	B/W
10017,59	S-70-49878 S-70-49879	Thin Section	B/W
10017	S-70-49973 S-70-49974	Thin Section	B/W
10017	S-75-30209 S-75-30210 S-75-30211 S-75-30212 S-75-30213 S-75-30214 S-75-30215	Rock Processing	C
10017,82	S-75-30942	Thin Section	C
10017	S-76-21149 S-76-21150	Rock Processing	C
10017,81	S-76-25451 S-76-25452 S-76-25453 S-76-25454	Ortho	C
10017,96	S-76-25457	Rock	C
10017,82	S-76-26302 S-76-26303	Thin Section	B/W
10018,19,20	S-69-45215 S-69-45216 S-69-45217 S-69-45218 S-69-45219	F-201-Chip	B/W
10018,19,20	S-69-45256 S-69-45257 S-69-4525[illegible] S-69-45259 S-69-45260 S-69-45261 S-69-45262 S-69-45263 S-69-45264 S-69-45265 S-69-45266 S-69-45267 S-69-45268 S-69-45269 S-69-45270 S-69-45271 S-69-45272 S-69-45273 S-69-45274 S-69-45275 S-69-45276 S-69-45277 S-69-45278 S-69-45279 S-69-45280 S-69-45281 S-69-45282 S-69-45283	Mug Shot	B/W
10018,19	S-69-45976 S-69-45977 S-69-45978 S-69-45979 S-69-45980 S-69-45981 S-69-45982 S-69-45983 S-69-45984 S-69-45985 S-69-45986 S-69-45987 S-69-45988 S-69-45989 S-69-45990 S-69-45991 S-69-45992 S-69-45993 S-69-45994 S-69-45995 S-69-45996 S-69-45997 S-69-45998	Mug Shot	B/W

10018,19	S-69-45999 S-69-45600 S-69-45601 S-69-45602 S-69-45603 S-69-45604 S-69-45605	Mug Shot	B/W
10018,20	S-69-54003 S-69-54004	Thin Section	B/W
10018	S-69-54009 S-69-54010 S-69-54015 S-69-54017	Thin Section	B/W
10018,32	S-69-54081 S-69-54086 S-69-54087	Thin Section	B/W
10018	S-69-59361 S-69-59396 S-69-59397 S-69-59403 S-69-59414 S-69-59415 S-69-59538	Thin Section	B/W
	S-70-48932 S-70-48933	Thin Section	C
10018,27	S-70-49218 S-70-49219	Thin Section	B/W
10018,26	S-70-49886 S-70-49887	Thin Section	B/W
10018	S-74-22918 S-74-22919 S-74-22920 S-74-22921	Rock Display	B/W
10018,2,16	S-75-30221	Ortho	C
10018	S-75-30222 S-75-30223 S-75-30224 S-75-30225 S-75-30226 S-75-30227 S-75-30228	Ortho	C
10018,17	S-75-30537	Sawed Surface	C
10018	S-75-30539	Ortho	C
10018,32	S-75-30943	Thin Section	C
10018,24	S-76-21352 S-76-21353	Rock Processing	C
10018,32	S-76-26310 S-76-26312	Thin Section	B/W
10019	S-69-45220 S-69-45221	F-201	B/W
10019	S-69-46255 S-69-46256 S-69-46257 S-69-46258 S-69-46259 S-69-46260 S-69-46261 S-69-46262 S-69-46263 S-69-46264 S-69-46265 S-69-46266 S-69-46267 S-69-46268 S-69-46269 S-69-46270 S-69-46330 S-69-46331 S-69-46332 S-69-46333	Stereo	B/W
10019	S-69-53966	Thin Section	B/W
10019	S-69-54037 S-69-54038 S-69-54040 S-69-54041 S-69-54060 S-69-54061	Thin Section	B/W
10019,2	S-70-19237 S-70-19238	Thin Section	C
10019	S-70-48934 S-70-48935	Thin Section	C
10019	S-70-49975 S-70-49976	Thin Section	B/W
10019,17	S-70-50547 S-70-50548	Thin Section	B/W
10019,1	S-74-27033	Rock Display	B/W
10019,30	S-74-27036	Rock Display	B/W
10019	S-75-31360 S-75-31361 S-75-31362 S-75-31363 S-75-31364 S-75-31365 S-75-31366 S-75-31367	Rock Processing	C
10019,1	S-76-23354 S-76-23355 S-76-23356 S-76-23357 S-76-23358 S-76-23359	Ortho	B/W
10019,30,80	S-76-23360	Rock	C
10019,33	S-76-26276 S-76-26277 S-76-26278	Thin Section	B/W
10020	S-69-45214 S-69-45224 S-69-45368 S-69-45369 S-69-45372	F-201	B/W
10020,2	S-69-46479 S-69-46480 S-69-46481	Stereo	B/W
10020	S-69-47332 S-69-47333 S-69-47334 S-69-47335 S-69-47340 S-69-47341 S-69-47342 S-69-47343 S-69-47344 S-69-47345	Stereo	B/W
10020,28	S-69-54014	Thin Section	B/W
10020	S-69-59272 S-69-59284 S-69-59340 S-69-59345	Thin Section	B/W
10020,57	S-70-18177 S-70-18178 S-70-18179	Rock Display	C
10020	S-70-48936 S-70-48937 S-70-48938 S-70-48939 S-70-48940 S-70-48941 S-70-48946 S-70-48947	Thin Section	C
10020	S-70-49214 S-70-49215	Thin Section	B/W

10020,52	S-70-50543	Thin Section	B/W
	S-70-50544		
	S-70-50545		
	S-70-50546		
10020,57	S-73-17980	Display Case	B/W
	S-73-17985		
	S-73-17986		
10020,189	S-76-25459	Rock	C
	S-76-25469		
10020,6,3,5	S-76-25879	Rock	C
	S-76-25880		
10020,31	S-76-26292	Thin Section	B/W
	S-76-26293		
10021	S-69-45225	RCL Sample	B/W
	S-69-45226		
	S-69-45227		
	S-69-45421		
10021	S-69-59235	Thin Section	B/W
	S-69-59236		
	S-69-59245		
	S-69-59246		
	S-69-59278		
	S-69-59281		
	S-69-59304		
	S-69-59310		
	S-69-59323		
	S-69-59334		
10021	S-70-19239	Thin Section	C
	S-70-19240		
	S-70-19241		
	S-70-19242		
	S-70-19243		
	S-70-19244		
10021,31	S-70-49226	Thin Section	B/W
	S-70-49227		
10021,28	S-70-49449	Thin Section	B/W
	S-70-49450		
	S-70-49451		
	S-70-49452		
10021,40	S-70-49469	Thin Section	B/W
	S-70-49470		
10021,28	S-70-49481	Thin Section	B/W
	S-70-49482		
10021,30	S-70-49483	Thin Section	B/W
	S-70-49484		
10021,36	S-75-31369	Rock Processing	C
	S-75-31370		
	S-75-31371		
	S-75-31372		
	S-75-31373		
	S-75-31374		
10021,10	S-75-31376	Rock Processing	C
10021,29	S-76-26858	Thin Section	B/W
	S-76-26859		
	S-76-26861		
10022	S-69-45209	Contingency Samp.	B/W
	S-69-45210		
	S-69-45211		
	S-69-45212		
	S-69-45213		
10022	S-69-45361	Stereo	B/W
	S-69-45362		
	S-69-45363		
	S-69-45364		
	S-69-45365		
	S-69-45366		
	S-69-45367		
	S-69-45380		
	S-69-45381		
	S-69-45382		
	S-69-45383		
10022	S-69-45384	Stereo	B/W
	S-69-45385		
	S-69-45386		
10022	S-69-45522	Mug Shot	B/W
	S-69-45523		
	S-69-45524		
	S-69-45525		
	S-69-45526		
	S-69-45527		
	S-69-45560		
	S-69-46328		
	S-69-47618		
	S-69-47619		
10022	S-69-47623	Micrograph	B/W
	S-69-47624		
10022,22	S-69-47895	Rock	C
10022	S-69-47908	Close-Up	B/W
10022,22	S-69-53981	Thin Section	B/W
	S-69-53992		
	S-69-54022		
	S-69-54026		
	S-69-54027		
	S-69-54029		
	S-69-54030		
	S-69-54031		
	S-69-54034		
	S-69-59312		
	S-69-59313		
10022,22	S-70-48942	Thin Section	C
	S-70-48943		
	S-70-48944		
	S-70-48945		
10022,40	S-70-49196	Thin Section	B/W
	S-70-49197		
10022,108	S-74-27029	Rock Display	B/W
10022,108	S-76-25426	Ortho	C
	S-76-25427		
	S-76-25428		
	S-76-25429		
	S-76-25430		
10022,57	S-76-26297	Thin Section	B/W
	S-76-26311		
10023	S-69-45387	Stereo	B/W
	S-69-45388		
	S-69-45389		
	S-69-45390		
	S-69-45391		
	S-69-45392		
	S-69-45393		
	S-69-45394		
	S-69-45395		
	S-69-45413		
	S-69 45414		
	S-69-45415		
	S-69-45416		
	S-69-45417		
	S-69-45418		
	S-69-45419		
	S-69-45420		
	S-69-45421		
	S-69-45422		
	S-69-45423		
	S-69-45424		
	S-69-45425		
10023	S-69-59250	Thin Section	B/W
	S-69-59251		
	S-69-59254		
	S-69-59255		
	S-69-59256		
	S-69-59257		
	S-69-59856		
10023,11	S-70-19245	Thin Section	C
	S-70-19246		

10023,11	S-70-19247	Thin Section	C
10023,1	S-75-31694	Rock Processing	C
10023,42	S-76-26300 S-76-26301	Thin Section	B/W
10024	S-69-45397	PCTL	B/W
10024	S-69-46026 S-69-46027 S-69-46028 S-69-46029 S-69-46030 S-69-46031 S-69-46032 S-69-46033 S-69-46034 S-69-46035	Stereo	B/W
10024	S-69-46329 S-69-47620 S-69-47621 S-69-47622 S-69-47906	Mug Shot	B/W
10024,14	S-69-53920	Thin Section	B/W
10024	S-69-59387	Thin Section	B/W
10024	S-70-48951	Thin Section	C
10024,23	S-70-49192 S-70-49193	Thin Section	B/W
10024,25	S-70-49880 S-70-49881	Thin Section	B/W
10024	S-70-49977 S-70-49978 S-70-49979 S-70-49980	Thin Section	B/W
10024,27	S-73-28295 S-73-28296 S-73-28297 S-73-28298	Rock Mount	B/W
10024,27	S-74-27030	Display	B/W
10024	S-75-31693	Rock Processing	C
10024,29	S-76-26260 S-76-26262	Thin Section	B/W
10025	S-69-45396 S-69-45398	PCTL	B/W
10025	S-69-46061 S-69-46062 S-69-46063 S-69-46064 S-69-46065 S-69-46066 S-69-46067 S-69-46068 S-69-46069 S-69-46070	Stereo	B/W
10025,3	S-75-32637 S-75-32638 S-75-32639	Ortho	C
10026	S-69-46071 S-69-46072 S-69-46073 S-69-46074 S-69-46075 S-69-46076 S-69-46077 S-69-46078 S-69-46079 S-69-46080 S-69-46081	Stereo	B/W
10026,10	S-75-32593 S-75-32594 S-75-32595 S-75-32596	Ortho	C
10026,10	S-75-32597 S-75-32598	Ortho	C
10026,17	S-76-26860 S-76-26865	Thin Section	B/W
10027	S-69-45556 S-69-45557 S-69-46016 S-69-46017 S-69-46018 S-69-46019 S-69-46020 S-69-46021 S-69-46022 S-69-46023 S-69-46024 S-69-46025	Stereo	B/W
10027	S-69-46327	Mug Shot	B/W
10027,10	S-75-32186 S-75-32187 S-75-32188 S-75-32189 S-75-32190 S-75-32191	Ortho	C
10027,36	S-76-26306 S-76-26307	Thin Section	B/W
10028	S-69-46036 S-69-46037 S-69-46038 S-69-46039 S-69-46040 S-69-46041 S-69-46042 S-69-46043 S-69-46044 S-69-46045 S-69-46046 S-69-46047	Stereo	B/W
10028	S-76-21143 S-76-21148	Rock Processing	C
10029	S-69-45748 S-69-45749	Stereo	B/W
10029,13	S-75-33058 S-75-33059 S-75-33060	Ortho	C
10030	S-69-46048 S-69-46049 S-69-46050 S-69-46051 S-69-46052 S-69-46053 S-69-46054 S-69-46055 S-69-46056 S-69-46057 S-69-46058 S-69-46059 S-69-46060	Stereo	B/W
10030,5	S-76-21142	Rock Processing	C
10031	S-69-45401	Stereo	B/W
10031	S-76-21144 S-76-21147	Rock Processing	C
10032	S-69-46006 S-69-46007 S-69-46008 S-69-46009 S-69-46010 S-69-46011 S-69-46012 S-69-46013 S-69-46014 S-69-46015	Stereo	B/W

10032,20	S-75-31696 S-75-31697 S-75-31698 S-75-31699 S-75-31700 S-75-31701	Ortho	C
10032,26	S-76-25824 S-76-25825	Thin Section	B/W
10044	S-69-45538 S-69-45539 S-69-45540 S-69-45541 S-69-45542 S-69-45543 S-69-45544 S-69-45545 S-69-45546 S-69-45547 S-69-45548 S-69-45549 S-69-45550 S-69-45551 S-69-45552 S-69-45553 S-69-45554 S-69-45555 S-69-45564 S-69-45565 S-69-45566 S-69-45567 S-69-45568 S-69-45569 S-69-45570 S-69-45571 S-69-45572 S-69-45573 S-69-45574 S-69-45575 S-69-45576 S-69-45577 S-69-45578 S-69-45579 S-69-45580 S-69-45581 S-69-45582 S-69-45583	Stereo	B/W
10044,1	S-69-46484 S-69-46485	Stereo	B/W
10044	S-69-47328 S-69-47329 S-69-47330 S-69-47331	Stereo	B/W
10044	S-69-57249	Thin Section	B/W
10044,50	S-69-59242	Thin Section	B/W
1004?	S-69-59319 S-69-59320 S-69-59321 S-69-59324	Thin Section	B/W
10044,49	S-69-59332	Thin Section	B/W
10044	S-69-59339 S-69-59344 S-69-59363 S-69-59364	Thin Section	B/W
10044,50	S-69-59367	Thin Section	B/W
10044	S-69-59385	Thin Section	B/W
10044,49	S-69-59398 S-69-59399	Thin Section	B/W
10044	S-69-59828 S-69-59833 S-69-59834	Thin Section	B/W
10044,51	S-70-48950	Thin Section	C
10044,57	S-70-48952 S-70-48953 S-70-48954 S-70-48955	Thin Section	C
10044,57	S-70-49981 S-70-49982 S-70-49983 S-70-49984	Thin Section	B/W
10044,54	S-74-27031	Rock Display	B/W
10044,59	S-75-31691 S-75-31692	Ortho	C
10044,15	S-75-31695	Ortho	C
10044,189	S-76-25541 S-76-25543	Rock	C
10044,55	S-76-25827 S-76-26295	Thin Section	B/W
10045	S-69-45584 S-69-45585 S-69-45586 S-69-45587 S-69-45588 S-69-45589 S-69-45590 S-69-45591 S-69-45592 S-69-45593 S-69-45594 S-69-45595 S-69-45596 S-69-45597 S-69-45598 S-69-45599 S-69-45600 S-69-45601 S-69-45602 S-69-45603 S-69-45604 S-69-45605 S-69-45606 S-69-45607	Stereo	B/W
10045	S-69-45658	Mug Shot	B/W
10045,1	S-69-46486	Stereo	B/W
10045	S-69-47324 S-69-47325 S-69-45326 S-69-45327	Stereo	B/W
10045	S-69-57237 S-69-59305 S-69-59317 S-69-59322 S-69-59327 S-69-59830 S-69-59832	Thin Section	B/W
10045	S-70-48956 S-70-48957 S-70-48958 S-70-48961 S-70-48963	Thin Section	C
10045	S-70-49001 S-70-49002 S-70-49985 S-70-49986 S-70-49987 S-70-49988	Thin Section	B/W
10045	S-75-31795 S-75-31796 S-75-31797 S-75-31799 S-75-31800 S-75-31803 S-75-31805	Rock Processing	C

10045,47	S-76-20458 S-76-20459	Rock	C
10045,12	S-76-25837 S-76-26263	Thin Section	B/W
10046	S-69-45608 S-69-45609 S-69-45610 S-69-45611 S-69-45612 S-69-45613 S-69-45614 S-69-45615 S-69-45616 S-69-45617 S-69-45618 S-69-45619 S-69-45620 S-69-45621 S-69-45622 S-69-45623 S-69-45624 S-69-45625 S-69-45626 S-69-45627 S-69-45628 S-69-45629 S-69-45630 S-69-45631	Stereo	B/W
10046	S-69-45657	Mug Shot	B/W
10046,1	S-69-46489	Stereo	B/W
10046	S-69-47603	Pit Detail	B/W
10046	S-69-49212 S-69-49213 S-69-49214	Mug Shot	B/W
10046	S-69-53959 S-69-53960 S-69-53973 S-69-53974 S-69-53986 S-69-53987 S-69-53988 S-69-53989 S-69-53990 S-69-59243 S-69-59248 S-69-59270 S-69-59279 S-69-59356 S-69-59376 S-69-59377 S-69-59378 S-69-59379 S-69-59843 S-69-59844 S-69-59847 S-69-59849 S-69-59850 S-70-19248	Thin Section	B/W
10046,65	S-70-19511 S-70-19512	Thin Section	B/W
10046	S-70-49224 S-70-49225	Thin Section	B/W
10046,69	S-74-[illegible]038	Rock Display	B/W
10046,46	S-75-32771 S-75-32772 S-75-32773 S-75-32774 S-75-32775 S-75-32776	Reconstruction	C
10046,193,194	S-75-33422 S-75-33423	Ortho	C
10046,193,194	S-75-33424 S-75-33425 S-75-33426	Ortho	C
10046,195,198	S-75-33599 S-75-33600 S-75-33601	Ortho	C
10046,94,193	S-75-33826	Rock Processing	C
10046,152	S-75-33974 S-75-33975	Ortho	C
10046,129,[illegible],124	S-76-20719 S-76-20720	Rock	C
10046,55	S-76-25828 S-76-25829	Thin Section	B/W
10047	S-69-45561 S-69-45562 S-69-45632 S-69-45633 S-69-45634 S-69-45635 S-69-45636 S-69-45637 S-69-45638 S-69-45639 S-69-45640 S-69-45641 S-69-45642 S-69-45643 S-69-45644 S-69-45645 S-69-45646 S-69-45647 S-69-45648 S-69-45649 S-69-45650 S-69-45651 S-69-45652 S-69-45653 S-69-45654 S-69-45655 S-69-45656	Stereo	B/W
10047,1	S-69-46482 S-69-46483	Stereo	B/W
10047	S-69-47907	Stereo	B/W
10047	S-69-53977 S-69-53980 S-69-54011 S-69-54012 S-69-54044 S-69-54048 S-69-54064 S-69-59261 S-69-5927[illegible] S-69-59282	Thin Section	B/W
10047	S-70-48962	Thin Section	C
10047,42	S-70-49212 S-70-49213	Thin Section	B/W
10047,25	S-70-50539 S-70-50540 S-70-50541 S-70-50542	Thin Section	B/W
10047,1,151	S-75-25083 S-75-25084 S-75-25085 S-75-25086 S-75-25087	Ortho	C
10047,58,93	S-75-26511 S-75-26512 S-75-26513 S-75-26514	Ortho	C
10047,27,54,56	S-76-25537 S-76-25542	Rock	C

10047,47	S-76-26298	Thin Section	B/W
	S-76-26299		
10048	S-69-45659	Stereo	B/W
	S-69-45660		
	S-69-45661		
	S-69-45662		
	S-69-45663		
	S-69-45664		
	S-69-45665		
	S-69-45666		
	S-69-45667		
	S-69-45668		
	S-69-45669		
	S-69-45670		
	S-69-45671		
	S-69-45672		
	S-69-45673		
	S-69-45674		
	S-69-45675		
	S-69-45676		
	S-69-45677		
	S-69-45678		
	S-69-45679		
	S-69-45680		
	S-69-45681		
	S-69-45682		
	S-69-45683		
10048	S-69-46165	Mug Shot	B/W
	S-69-46166		
	S-69-46167		
	S-69-46168		
	S-69-46169		
	S-69-46170		
	S-69-46171		
	S-69-46172		
	S-69-46173		
10048,1	S-69-46490	Stereo	B/W
10048	S-69-47601	Pit Detail	B/W
	S-69-47602		
	S-69-47603		
	S-69-47604		
	S-69-47605		
	S-69-47606		
	S-69-47607		
	S-69-47608		
	S-69-47609		
	S-69-47610		
	S-69-47611		
10048	S-69-53956	Thin Section	B/W
	S-69-53975		
	S-69-59237		
	S-69-59238		
	S-69-59286		
	S-69-59841		
	S-69-59851		
	S-69-59852		
	S-69-59858		
10048	S-70-19251	Thin Section	C
	S-70-19252		
10048,49	S-70-47601	Mug Shot	B/W
	S-70-47602		
	S-70-47603		
	S-70-47604		
	S-70-47605		
10048,53	S-70-48964	Thin Section	C
	S-70-48965		
	S-70-48966		
	S-70-48967		
	S-70-48968		
	S-70-48969		
10048,33	S-70-49471	Thin Section	B/W
	S-70-49472		
10048,48	S-70-49884	Thin Section	B/W
	S-70-49885		
10048,67	S-70-50555	Thin Section	B/W
	S-70-50556		
10048,51	S-74-25904	Rock Display	B/W
	S-74-25905		
	S-74-25906		
	S-74-25907		
10048,0	S-76-25411	Ortho	C
	S-76-25412		
	S-76-25413		
	S-76-25414		
	S-76-25[illegible]		
	S-76-25416		
	S-76-25417		
	S-76-25418		
	S-76-25419		
10048,9	S-76-24823	Rock	C
10048,49	S-76-26846	Rock	C
	S-76-26847		
10048,66	S-76-26862	Thin Section	B/W
10049	S-69-45684	Stereo	B/W
	S-69-45685		
	S-69-45686		
	S-69-45687		
	S-69-45688		
	S-69-45689		
	S-69-45690		
	S-69-45691		
	S-69-45692		
	S-69-45693		
	S-69-45694		
	S-69-45695		
	S-69-45696		
	S-69-45697		
	S-69-45698		
	S-69-45699		
	S-69-45700		
	S-69-45701		
	S-69-45702		
	S-69-45703		
	S-69-45704		
	S-69-45705		
	S-69-45706		
	S-69-45707		
	S-69-45708		
	S-69-45709		
	S-69-45710		
	S-69-45711		
	S-69-45712		
	S-69-45713		
	S-69-45714		
	S-69-45715		
	S-69-45716		
	S-69-45717		
10049,1	S-69-46487	Stereo	B/W
10049	S-69-4733[illegible]	Stereo	B/W
	S-69-473[illegible]		
	S-69-47338		
	S-69-47339		
10049	S-69-57241	Thin Section	B/W
	S-69-59273		
	S-69-59283		
	S-69-59347		
	S-69-59352		
	S-69-59382		
	S-69-59413		
	S-[illegible]-59854		
	S-70-17980		
	S-70-17981		
	S-70-48995		
	S-70-48996		
	S-70-48997		
	S-70-48998		
	S-70-48999		
	S-70-49000		

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10049,21	S-70-49447 S-70-49448	Thin Section	B/W
10049,22	S-70-49475 S-70-49476	Thin Section	B/W
10049,0	S-76-25446 S-76-25448 S-76-25449 S-76-25452 S-76-25455 S-76-25456	Ortho	C
10049,39	S-76-25838 S-76-26330 S-76-26331	Thin Section	B/W
10050	S-69-45718 S-69-45719 S-69-45720 S-69-45721 S-69-45722 S-69-45723 S-69-45724 S-69-45725 S-69-45726 S-69-45727 S-69-45728 S-69-45729 S-69-45730 S-69-45731 S-69-45732 S-69-45733 S-69-45734 S-69-45735 S-69-45736 S-69-45737 S-69-45738 S-69-45739 S-69-45740 S-69-45741 S-69-45742 S-69-45743 S-69-45744 S-69-45745 S-69-45746 S-69-45747	Stereo	B/W
10050,1	S-69-46478	Stereo	B/W
10050	S-69-57234 S-70-49003 S-70-49004 S-70-49005 S-70-49006 S-70-50017 S-70-50018	Thin Section	B/W
10050	S-76-21349 S-76-21350 S-76-21351	Rock Processing	C
10050,11	S-76-21738 S-76-21739	Weathered Areas	C
10050,36	S-76-26261 S-76-26272	Thin Section	B/W
10054,64	S-70-49882 S-70-49883	Thin Section	B/W
10056	S-69-46174 S-69-46175 S-69-46176 S-69-46177 S-69-46178 S-69-46179 S-69-46180 S-69-46181 S-69-46182 S-69-46183 S-69-46184 S-69-46185 S-69-46186 S-69-46187	Mug Shot	B/W
10056	S-69-46188 S-69-46189 S-69-46190 S-69-46191 S-69-46192 S-69-46193 S-69-46194 S-69-46195 S-69-46196 S-69-46197 S-69-46198	Mug Shot	B/W
10056	S-69-47105 S-69-47106 S-69-47107	Post Split	B/W
10056	S-69-47604 S-69-47605 S-69-47606 S-69-47607 S-69-47608	Rock	B/W
10056	S-69-59308 S-69-59311 S-69-59316 S-69-59348	Thin Section	B/W
10056	S-70-19253 S-70-19254 S-70-19255 S-70-19256	Thin Section	C
10056	S-70-19526 S-70-19527 S-70-19528 S-70-19529	Thin Section	B/W
10056,14	S-75-32571 S-75-32572 S-75-32573 S-75-32574 S-75-32575 S-75-32576	Ortho	C
10056,42	S-75-32657	Processing	C
10056,26	S-76-25832 S-76-26264 S-76-26265	Thin Section	B/W
10057	S-69-46271 S-69-46272 S-69-46273 S-69-46274 S-69-46275 S-69-46276 S-69-46277 S-69-46278 S-69-46279 S-69-46280 S-69-46281 S-69-46282 S-69-46283 S-69-46284 S-69-46285 S-69-46286 S-69-46287 S-69-46288 S-69-46289 S-69-46290 S-69-46291 S-69-46292 S-69-46293 S-69-46294 S-69-46295 S-69-46296	Stereo	B/W
10057	S-69-47472	PCTL Chip	B/W
10057	S-69-47477 S-69-47478 S-69-47479	Post Chip	B/W
10057,33	S-69-54018 S-69-59335 S-69-59366	Thin Section	B/W

10057,33	S-69-59386 S-69-59407 S-69-59408 S-70-49007 S-70-49008	Thin Section	B/W
10057,77	S-70-49870 S-70-49871	Thin Section	B/W
10057	S-70-49969 S-70-49970	Thin Section	B/W
10057,58	S-74-22871 S-74-22872 S-74-22873 S-74-22874 S-74-22875 S-74-22876 S-74-22877 S-74-22878 S-74-22879 S-74-22880 S-74-22881	Cathedral Sec.	C
10057,30	S-74-25354 S-74-25355 S-74-25356 S-74-25357 S-74-25358	Rock Display	C
10057,19,98,105	S-75-20520 S-75-20521 S-75-20522 S-75-20523	Rock	C
10057,28	S-75-34139 S-75-34140	Ortho	C
10057,14	S-75-34415 S-75-34416 S-75-34417 S-75-34424	Ortho	C
10057,13	S-76-21408	Rock Processing	C
10057,9	S-76-20323 S-76-20326 S-76-20327 S-76-20328 S-76-20717 S-76-20718	Rock	C
10057,204	S-76-20325	Rock	C
10057,13	S-76-21408	Rock	C
10057,81	S-76-26315 S-76-26316	Thin Section	B/W
10058	S-69-46297 S-69-46298 S-69-46299 S-69-46300 S-69-46301 S-69-46302 S-69-46303 S-69-46304 S-69-46305 S-69-46306 S-69-46307 S-69-46308 S-69-46309 S-69-46310 S-69-46311 S-69-46312 S-69-46313 S-69-46314 S-69-46315 S-69-46316 S-69-46317 S-69-46318 S-69-46319 S-69-46320 S-[illegible]-47318 S-69-47319 S-69-47320	Stereo	B/W
10058	S-69-47321 S-69-47322 S-69-47323	Stereo	B/W
10058	S-69-47474 S-69-47475 S-69-47476	Post Chip	B/W
10058	S-69-47485 S-69-47486	Chipping	B/W
10058	S-69-59247 S-69-59249 S-69-59258 S-69-59261 S-69-59268 S-69-59341 S-69-59354 S-69-59358 S-69-59395 S-69-59825 S-69-59835 S-69-59836 S-70-49009 S-70-49010 S-70-49011 S-70-49012	Thin Section	B/W
10058,33	S-70-49874 S-70-49875	Thin Section	B/W
10058	S-70-49967 S-70-49968	Thin Section	B/W
1005[illegible],[illegible]4	S-74-27032	Rock Display	B/W
10058,3	S-76-21347	Rock Processing	C
10058,2,34	S-76-21354 S-76-21355	Rock Processing	C
10058,109	S-76-23295 S-76-23296	Rock	C
10058,51	S-76-26326 S-76-26327	Thin Section	B/W
10059	S-69-47081 S-69-47082 S-69-47083 S-69-47084 S-69-47085 S-69-47086 S-69-47087 S-69-47088 S-69-47089 S-69-47090 S-69-47091 S-69-47092 S-69-47093 S-69-47094 S-69-47095 S-69-47096 S-69-47097 S-69-47098 S-69-47099 S-69-47100 S-69-47101 S-69-47102 S-69-47103 S-69-47104 S-69-47316 S-69-47317 S-69-47346 S-69-47347 S-69-47348 S-69-47349 S-69-47350 S-69-47351 S-69-47352	Stereo	B/W
10059	S-69-49205 S-69-49206 S-69-49207 S-69-49208	Mug Shot	B/W

10059	S-69-49209 S-69-49210 S-69-49211 S-69-49287 S-69-49288 S-69-49289 S-69-49290	Mug Shot	B/W
10059	S-69-59853 S-70-19530 S-70-19531 S-70-19532 S-70-19533 S-70-19534 S-70-19535 S-70-19536 S-70-19537	Thin Section	B/W
10059,7	S-70-50021 S-70-50022	Thin Section	B/W
10059,82,83	S-76-21410 S-76-21411	Rock Processing	C
10059,63	S-76-22650 S-76-22651 S-76-22652 S-76-22653 S-76-22654 S-76-22655	Ortho	C
10059,41	S-76-25835 S-76-26266 S-76-26267	Thin Section	B/W
10060	S-69-46491 S-69-46492 S-69-46493 S-69-46494 S-69-46495 S-69-46496 S-69-46497 S-69-46498 S-69-46499 S-69-46500	Stereo	B/W
10060	S-69-48450 S-69-48451 S-69-48452 S-69-48458 S-69-48459	Mug Shot	B/W
10060	S-69-49223 S-69-49224 S-69-49225 S-69-49231 S-69-49232 S-69-49233 S-69-49240 S-69-49241 S-69-49242	Rock	B/W
10060	S-69-53976 S-69-59239 S-69-59240 S-69-59241 S-69-59259 S-69-59260 S-69-59271 S-69-59280 S-69-59294 S-69-59295 S-69-59299 S-69-59302 S-69-59303 S-69-59328 S-69-59349 S-69-59350 S-69-59353 S-69-59381 S-69-59404 S-69-59405 S-69-59406	Thin Section	B/W
10060	S-69-59826 S-69-59837 S-69-59839 S-69-59845 S-69-59848 S-70-19538 S-70-19539 S-70-19540 S-70-19541 S-70-19543 S-70-49013 S-70-49014 S-70-49015 S-70-49016 S-70-49017 S-70-49018	Thin Section	B/W
10060,35	S-70-49876 S-70-49877	Thin Section	B/W
10060	S-70-50023 S-70-50024 S-70-50025	Thin Section	B/W
10060,5	S-76-25884 S-76-25885 S-76-25886 S-76-25887 S-76-25888 S-76-25889 S-76-25890 S-76-25891	Ortho	C
10060,46,38	S-76-25544 S-76-25549	Rock	C
10060,49	S-76-26323 S-76-26324 S-76-26325	Thin Section	B/W
10061	S-69-46501 S-69-46502 S-69-46503 S-69-46504 S-69-46505 S-69-46506 S-69-46507 S-69-46508 S-69-46509 S-69-46510	Stereo	B/W
10061	S-69-47617	Mug Shot	B/W
10061	S-69-54002 S-69-54056 S-69-54057	Thin Section	B/W
10061,20	S-69-54069 S-69-54070	Thin Section	B/W
10061	S-69-54085 S-69-59285 S-69-59309 S-70-19509 S-70-19510 S-70-19542	Thin Section	B/W
10061,40	S-70-49019 S-70-49020 S-70-49021 S-70-490[illegible]	Thin Section	B/W
10061,39	S-70-49216 S-70-49217	Thin Section	B/W
10061,42	S-72-46777	Thin Section	B/W
10061,13	S-74-27041	Rock Display	B/W
10061	S-75-34224 S-75-34225 S-75-34226 S-75-34227 S-75-34228 S-75-342[illegible] [illegible] S-75-34263	Rock Processing	C

10061	S-76-20470 S-76-20471 S-76-20472 S-76-20473	Rock	C
10061,28	S-76-25836 S-76-26313 S-76-26314	Thin Section	B/W
10062	S-69-46511 S-69-46512 S-69-46513 S-69-46514 S-69-46515 S-69-46516 S-69-46517 S-69-46518 S-69-46519 S-69-46520 S-69-46521	Stereo	B/W
10062	S-69-48447 S-69-48448 S-69-48449 S-69-48460 S-69-48461 S-69-48462 S-69-48463 S-69-48464 S-69-48465 S-69-48466 S-69-48467 S-69-48468 S-69-48469 S-69-48470 S-69-49142 S-69-49143 S-69-49144 S-69-49145 S-69-49146 S-69-49147 S-69-49148	Mug Shot	B/W
10062	S-69-49219 S-69-49226 S-69-49227 S-69-49228 S-69-49229 S-69-49230 S-69-49237 S-69-49238 S-69-49239	Rock	B/W
10062	S-69-59371 S-69-59375 S-69-59391 S-69-59394 S-69-59831 S-69-59838 S-69-59842 S-70-49023 S-70-49024 S-70-49025 S-70-49026 S-70-50019 S-70-50020	Thin Section	B/W
10062,33	S-76-22210 S-76-22211	Rock Processing	C
10062	S-76-21515 S-76-21516 S-76-21517 S-76-21518	Ortho	C
10062,35	S-76-26268 S-76-26271	Thin Section	B/W
10063	S-69-46522 S-69-46523 S-69-46524 S-69-46525 S-69-46526 S-69-46527	Stereo	B/W
10063	S-69-46528 S-69-46529 S-69-46530 S-69-46531	Stereo	B/W
10063,1	S-75-30486 S-75-30487 S-75-30488 S-75-30489 S-75-30490 S-75-30491	Ortho	C
10063,1,14,15	S-75-34399	Rock Processing	C
10063,17	S-76-26274 S-76-26275	Thin Section	B/W
10063,1	S-76-26837 S-76-26838 S-76-26839	Photomicrograph	C
10064	S-69-46614 S-69-46615 S-69-46616 S-69-46617 S-69-46618 S-69-46619 S-69-46620 S-69-46621 S-69-46622	Stereo	B/W
10064,6	S-76-20397 S-76-20398 S-76-20399 S-76-20400 S-76-20401	Ortho	C
10064,25	S-76-26319 S-76-26320	Thin Section	B/W
10065	S-69-46623 S-69-46624 S-69-46625 S-69-46626 S-69-46627 S-69-46628 S-69-46629 S-69-46630 S-69-46631	Stereo	B/W
10065	S-69-54910 S-69-59244 S-69-59264 S-69-59266 S-69-59267 S-69-59315 S-69-59318 S-69-59326 S-69-59359 S-69-59360 S-69-59365 S-69-59380 S-69-59411 S-69-59824 S-69-59827 S-69-59829 S-70-19505 S-70-19506 S-70-19545 S-70-49027 S-70-49028 S-70-49971 S-70-49972	Thin Section	B/W
10065,7	S-74-27044	Rock Display	B/W
10065,7	S-76-22541 S-76-22542	Ortho	C
10065,49	S-76-22543 S-76-22544	Ortho	C
10065,7	S-76-22546 S-76-22547 S-76-22548 S-76-22549	Ortho	C

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10065,30,43	S-76-23361 S-76-23362 S-76-23363 S-76-23364	Rock	C
10065,27	S-76-25833 S-76-25834 S-76-76863 S-76-76864	Thin Section	B/W
10066	S-69-46632 S-69-46633 S-69-46634 S-69-46635 S-69-46636 S-69-46637 S-69-46638 S-69-46639 S-69-46640	Stereo	B/W
10066,1	S-75-31111 S-75-31112 S-75-31113 S-75-31114 S-75-31115 S-75-31116	Rock Processing	C
10066,20	S-76-26287 S-76-26288 S-76-26289	Thin Section	B/W
10066,53	S-76-26281 S-76-26282	Thin Section	B/W
10067	S-69-46641 S-69-46642 S-69-46643 S-69-46644 S-69-46645 S-69-46646 S-69-46647 S-69-46648 S-69-46649	Stereo	B/W
10067	S-69-59265 S-69-59296 S-69-59325 S-69-59329 S-69-59388 S-69-59389 S-69-59390	Thin Section	B/W
10067,10	S-70-49220 S-70-49221	Thin Section	B/W
10067,6	S-70-50553 S-70-50554	Thin Section	B/W
10067,12	S-76-21920 S-76-21921	Rock Processing	C
10067,3	S-76-21923 S-76-21924	Rock Processing	C
10067,9001	S-76-22214 S-76-22215	Rock Processing	C
10067,10	S-76-26269 S-76-26270	Thin Section	B/W
10068	S-69-46650 S-69-46651 S-69-46652 S-69-46653 S-69-46654 S-69-46655 S-69-46656 S-69-46657 S-69-47064 S-69-47065 S-69-47066 S-69-47067 S-69-47068 S-69-47069 S-69-47070 S-69-47071 S-69-47072	Stereo	B/W
10068	S-69-59331 S-69-59356 S-69-59357 S-69-59400 S-69-59402	Thin Section	B/W
10068,36	S-70-19513 S-70-19514 S-70-19544	Thin Section	B/W
10068,12,33	S-76-22212 S-76-22213	Rock Processing	C
10068,5	S-76-22539 S-76-22545	Rock Processing	C
10068,35	S-76-26328 S-76-26329	Thin Section	B/W
10069	S-69-46658 S-69-46659 S-69-46660 S-69-46661 S-69-46662 S-69-46663 S-69-46664 S-69-46665	Stereo	B/W
10069	S-69-47615	Mug Shot	B/W
10069	S-69-59275 S-69-59292 S-69-59336 S-69-59342 S-69-59351 S-69-59372 S-69-59383 S-69-59393 S-69-59412 S-70-19507 S-70-19508 S-70-48975 S-70-48976 S-70-48977 S-70-48978 S-70-48979 S-70-48980 S-70-49029 S-[illegible]49030 S-70-[illegible] S-70-4903[illegible]	Thin Section	B/W
10069,31	S-76-23293 S-76-23294	Rock	C
10069,4	S-76-23281 S-76-23282 S-76-23283 S-76-23284 S-76-23285 S-76-23286 S-76-23287	Ortho	C
10069,37	S-76-26290 S-76-26291	Thin Section	B/W
10070,1	S-69-03081	Rock	B/W
10070	S-69-47300 S-69-47301 S-69-47302 S-69-47303 S-69-47310 S-69-47311 S-69-47312 S-69-47313 S-69-47314 S-69-47315	Stereo	B/W
10070	S-69-47616	Mug Shot	B/W
10070,18	S-75-34237	Rock Processing	C
10070,4,17	S-75-34239 S-75-34240 S-75-34241 S-75-34242	Ortho	C

10070,4,17	S-75-34246	Ortho	C
10070,2	S-76-20324 S-76-20329	Rock	C
10070,18	S-76-34237	Rock	C
10070,4,17	S-76-34239 S-76-34240 S-76-34241 S-76-34242	Ortho	C
10070,2	S-76-26308 S-76-26309	Thin Section	B/W
10071,73	S-69-47288 S-69-47289 S-69-47290 S-69-47291 S-69-47292 S-69-47293 S-69-47294 S-69-47295 S-69-47296 S-69-47297 S-69-47298 S-69-47299	Stereo	B/W
10071	S-69-47304 S-69-47305 S-69-47306 S-69-47307	Stereo	B/W
10071	S-69-47309	Mug Shot	B/W
10071	S-69-47353 S-69-47354 S-69-47355 S-69-47356 S-69-47357 S-69-47358 S-69-47359 S-69 47360 S-69-47361	Stereo	B/W
10071	S-69-47614	Mug Shot	B/W
10071	S-69-54025 S-69-54088	Thin Section	B/W
10071,2	S-69-57247	Thin Section	B/W
10071	S-69-59374 S-69-59384 S-69-59392 S-70-17978 S-70-17979 S-70-17980 S-70-17981 S-70-17982	Thin Section	B/W
10071,5	S-76-22602 S-76-22603	Ortho	C
10071,7	S-76-22605	Processing	C
10071,5	S-76-22606 S-76-22607 S-76-22608 S-76-22609	Ortho	C
10071,11	S-76-23372 S-76-23373	Ortho	C
10071,34	S-76-26321 S-76-26322	Thin Section	B/W
10071,13	S-76-26082 S-76-26083	Thin Section	B/W
10072	S-69-03102	Rock	B/W
10072	S-69-47364 S-69-47381 S-69-47382 S-69-47383 S-69-47384 S-69-47385 S-69-47386	Stereo	B/W
10072	S-69-47387 S-69-47388	Stereo	B/W
10072	S-69-47494 S-69-47495 S-69-47496 S-69-47497 S-69-4749[illegible] S-69-4749[illegible] S-69-47500 S-69-47501 S-69-47502 S-69-47503	Post Split	B/W
10072	S-69-47610 S-69-47611 S-69-47612 S-69-47613 S-69-49311 S-69-49312 S-69-49313 S-69-49314 S-69-49315 S-69-49316 S-69-49317 S-69-49318 S-69-49319 S-69-49320 S-69-49321 S-69-49322 S-69-49323 S-69-49324 S-69-49325	Mug Shot	B/W
10072	S-69-54007 S-69-54008	Thin Section	B/W
10072,40	S-69-54013	Thin Section	B/W
10072,40	S-69-54020	Thin Section	B/W
10072	S-69-5407[illegible] S-69-54076	Thin Section	B/W
10072,42	S-69-57221 S-69-57235	Thin Section	B/W
10072	S-69-59337 S-69-59857 S-70-48983 S-70-48984 S-70-48985 S-70-48986 S-70-48987 S-70-48988	Thin Section	B/W
10072,33	S-70-49194 S-70-49195	Thin Section	B/W
10072,49	S-70-49228 S-70-49229	Thin Section	B/W
10072,41	S-76-21145 S-76-21146	Rock Processing	C
10072,12,139	S-76-22595	Processing	C
10072,80	S-76-22596 S-76-22597 S-76-22598 S-76-22599 S-76-22600 S-76-22601	Ortho	C
10072,15,109	S-76-23374 S-76-23371	Ortho	C
10072,43	S-76-26285 S-76-26286	Thin Section	B/W
10073	S-69-47308	Mug Shot	B/W
10073	S-69-59253 S-69-59298 S-69-59301 S-69-59368 S-69-59369 S-69-59370	Thin Section	B/W

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	S-70-48992		
	S-70-48993		
	S-70-48994		
10073,26	S-70-49453	Thin Section	B/W
	S-70-49454		
10073,24	S-70-49477	Thin Section	B/W
	S-70-49478		
	S-70-49479		
	S-70-49480		
10073,29	S-70-49485	Thin Section	B/W
	S-70-49486		
	S-70-49487		
10073,12,53	S-76-22590	Processing	C
10073,1	S-76-22591	Ortho	C
	S-76-22592		
10073,27	S-76-25831	Thin Section	B/W
	S-76-26294		
10074	S-69-47372	Stereo	B/W
	S-69-47373		
	S-69-47374		
	S-69-47375		
	S-69-47376		
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	S-69-47378		
	S-69-47379		
	S-69-47380		
10074,7	S-70-53757	Thin Section	B/W
10074,5	S-70-53768	Thin Section	B/W
10074,7	S-70-53769	Thin Section	B/W
10074,6	S-70-53770	Thin Section	B/W
10074,5	S-70-53772	Thin Section	B/W
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	S-76-20393		
	S-76-20394		
	S-76-20395		
	S-76-20396		
10074,7	S-76-26317	Thin Section	B/W
	S-76-26318		
10075	S-69-47362	Stereo	B/W
	S-69-47363		
	S-69-47365		
	S-69-47366		
	S-69-47367		
	S-69-47368		
	S-69-47369		
	S-69-47370		
	S-69-47371		
10075	S-69-47609	Mug Shot	B/W
10075,3	S-76-20467	Ortho	C
	S-76-20317		
	S-76-20318		
	S-76-20319		
	S-76-20320		
	S-76-20321		
10075,14	S-76-26279	Thin Section	B/W
	S-76-26280		
10082	S-69-57952	Thin Section	B/W
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	S-76-20462		
	S-76-20463		
	S-76-20464		
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	S-76-20466		
10082,0	S-76-26282	Thin Section	B/W
	S-76-26283		
	S-76-26284		
10085,78,75,76	S-70-18468	Thin Section	B/W
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,66,65,64	S-70-18470		
,63	S-70-18471		
	S-70-18472		
	S-70-18473		
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	S-70-18484		
	S-70-18485		
	S-70-18486		
10085,99,97,96	S-70-19515	Thin Section	B/W
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,758	S-76-26853		
,755	S-76-26852		
,756	S-76-26851		
,754	S-76-26850		
,753	S-76-26848		
,753	S-76-26849		
10091,26	S-76-25548	Rock	C
	S-76-25552		
10092,0	S-76-25871	Ortho	C
	S-76-25872		
	S-76-25873		
	S-76-25874		
	S-76-25875		
	S-76-25876		
10093,0	S-76-25989	Ortho	C
	S-76-25990		
	S-76-25991		
	S-76-25992		
	S-76-25995		
	S-76-25996		

10093.0	S-76-25997 S-76-2[illegible]998	Ortho	C
10094.0	S-76-25993 S-76-[illegible]994 S-76-25986 S-76-25999	Ortho	C
10094.0	S-76-26000 S-76-26001 S-76-26002	Photomicrograph	C

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