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| CURATORIAL NEWSLETTER | Date: January 5, 1978 | No. 18 |
| | <i>Patrick Butler Jr</i> | |
| | Patrick Butler, Jr., Lunar Sample Curator | |

ATTACHMENTS

- I. Members of the Lunar Sample Analysis Planning Team
- II. List of Lunar Sample Catalogs
- III. Dissection Report - 15010
- IV. Report on Drill Stem 70005

CURATOR

In November Dr. Patrick Butler, Jr., became Chief of the Curatorial Branch and will be known henceforth as the Lunar Sample Curator.

SAMPLE REQUESTS

The next LSAPT meeting will be February 2-5, 1978. Please try to get your sample requests to us before January 26. The following meeting is tentatively scheduled for March 17-18.

MAILING LIST

On request we will gladly add co-investigators, collaborators and other participants in lunar sample studies to our mailing list for the Newsletters, catalogs and sample information publications. Please survey those involved in your program and let us know who would like to get their own copies of these communications.

LUNAR SAMPLE CATALOGS

Attachment II is a list of catalogs so that any that may be of use can be ordered. We will reprint those that have run out, or are about to, if requests for them are received. It may take two months, though, if the stock does run out. (We plan revisions of some of the catalogs and consequently do not want to stock up on them.)

LUNAR SAMPLE ANALYSIS PLANNING TEAM (LSAPT)

LSAPT met November 17 through November 21, 1977. Two new members, Carlton Moore, Professor of Chemistry at Arizona State University and Curator of the Ninger Meteorite Collection and David McKay of the Geology Branch at JSC overlapped with retiring members Dieter Heymann, Chuck Simonds, and Everett Gibson. (A list of the current LSAPT members is Attachment I.) The team considered the requests of 16 Principal Investigators and recommended allocation of 263 samples. The most numerous allocations are small aliquots distributed over the lengths of cores just dissected: Core 15010 samples to W. Gose for magnetic measurements; deep drill cores 70001 through 70007 to D. Lal for track studies to apply to regolith dynamics and ancient meteorite flux.

LSAPT was given a briefing on the plans to process Antarctic meteorites using techniques and equipment developed for lunar samples. (See the October 1977 Curatorial Newsletter.) Don Bogard of the Geochemistry Branch at JSC is heading up the effort. He described the freeze-drying methods that might be used and how the processing would be done in nitrogen atmosphere cabinets. Of considerable interest was the report on a meeting at the National Science Foundation in Washington which included representatives of the U.S. National Museum as well as Bogard and LSAPT member Ursula Marvin, and was chaired by Mort Turner, Program Director, Geological Studies, NSF Antarctica. LSAPT commented extensively on the protocols for the initial processing and the preliminary examination. LSAPT will continue as needed to advise on the handling of meteorites found in Antarctica but recommended constitution of a Meteorite Analysis Planning Team, with the participation of National Museums and the National Science Foundation.

HONORS

In a ceremony at JSC on December 7, 1977, NASA Administrator, Dr. Robert A. Frosch presented Dr. George W. Reed the NASA Exceptional Scientific Achievement Medal for his outstanding contributions to the lunar science program. Dr. Reed has been a Principal Investigator for eight years, served on LSAPT for four years, and for the past three years has been serving on the Facilities Subcommittee of LSAPT, which has been advising on the design of the remote storage facility for lunar samples in San Antonio and on the new storage and processing building adjoining the present curatorial laboratory building at JSC.

NEW OPPORTUNITIES: ANCIENT CLASTS IN BRECCIAS

LSAPT has recommended that this subject be brought to the attention of the lunar sample PI's. A policy has been followed for the past three years in which most sample allocations have been made in response to problem-oriented requests from investigators. The progress made in determining the petrological, chemical and isotopic evolution of the ancient lunar crust, gives testament to the vigor of scientific work in this problem-oriented mode.

Samples from the early lunar crust have now been identified. An understanding of these ancient rocks is considered essential to the determination of the formation processes of the lunar crust. Such rocks have been rare among the larger fragments studied to date. It appears that this key material is present in the form of clasts in many of the highland breccias.

To identify these clasts requires a combination of curatorial and Principal Investigator participation, since the searches require systematic examination of large amounts of material. We believe that this search should be carried out in the Curatorial Facility. Such studies can be undertaken more easily than in the past due to the greater availability of processing cabinet time and personnel.

LSAPT has recommended that high priority be given to finding and analyzing such ancient clasts. In their February meeting ways of encouraging and implementing searches for such ancient clasts, and for their analysis when found, will be considered by LSAPT. Any comments on the subject in advance of the meeting, to the Curator or a LSAPT member, would be most welcome.

CORE CATALOGS

All the available information on lunar cores is contained in two documents: Lunar Core Catalog, revised, March 1976; Lunar Core Catalog, Supplement, March 1977 with data on 60009, 60010, 70004, 70007, and 74001 (preliminary.) We have about 30 of each in stock for distribution on request. The final report on 74001 and 74002 is expected to be distributed to all PI's before February 1, 1978.

The first of four dissection passes from drive tube sample 15010 has been completed and a report is attached. A preliminary report on drill stem 70005 also is attached. The final report will include the entire drill core, 70001-70009, and will be prepared after dissection (this month) of the last stem, 70003.

Preparations are underway to saw the epoxy-impregnated portion of 74001 in half longitudinally to be followed by cross-cutting one half into 13 or so segments. Then thin sections will be made from these segments to give continuous coverage down the core length. Since there is a possibility that there may be lenses in the core not reached by the epoxy, owing to the usually dense character of the sample, the sawing will be done slowly and without cooling liquid so that further impregnation can be done if any lenses of loose soil are encountered.

Dissection of the two Apollo 11 drive tube cores has been completed. Because the stratigraphy was somewhat disturbed during collection and suffered further disturbance from handling between the time of the early (1969) dissection of half of each core for allocation and the final dissection of the remaining halves in 1977, no part of the cores was preserved by impregnation with epoxy. Despite the disturbances, however, the strata do not seem to be greatly mixed. A final report will be distributed before mid-February.

ANNUAL REVIEW OF CONSORTIUMS

The annual reports requested from consortium leaders were reviewed by LSAPT at the November meeting. The review identified four categories of consortium work:

- Category I - Active consortiums - sample study continuing - report submitted.
- Category II - Active consortiums - studies to be continued - no report submitted but their present proposals indicate that work will continue on samples designated as consortium samples.
- Category III - Consortium efforts which have been or are presently being terminated - report submitted.
- Category IV - No report submitted. Status unknown.

Table of consortium samples:

CONSORTIUM SAMPLES

| <u>SAMPLE NO.</u> | <u>LEADER(S)</u> | <u>SAMPLE LOCATION</u> | <u>CATEGORY</u> |
|-------------------|---------------------------------|------------------------|-----------------|
| 12013 | Albee/Wasserburg | C.I.T. | II |
| 12023 | Pillinger (European Consortium) | Pillinger | I |
| 12054 | Hartung | Hartung & JSC | I |
| 14006 | Nyquist | Nyquist | II |
| 14064 | Wood | Imbrium Consortium-JSC | II |
| 14068 | Nyquist | Nyquist | II |
| 14073 | Wasserburg | C.I.T. | IV |
| 14082 | Wood | Imbrium Consortium-JSC | II |
| 14083 | Wasserburg | C.I.T. | IV |
| 14171 | Nava | Nava | IV |
| 14276 | Wasserburg | C.I.T. | IV |
| 14305 | Nava | Nava | IV |
| 14311 | Albee | C.I.T. | II |
| 14312 | Wood | Imbrium Consortium-JSC | II |
| 14318 | Wood | Imbrium Consortium-JSC | II |
| 14319 | Nava | Nava | IV |
| 15205 | Albee | C.I.T. | II |
| 15206 | Wasserburg | C.I.T. | IV |
| 15255 | Nava | Nava | III |
| 15405 | Wood | Imbrium Consortium-JSC | II |
| 15435 | Pillinger | Pillinger | IV |
| 15445 | Nyquist | Nyquist-JSC | II |
| 15445 | Wood | Imbrium Consortium-JSC | II |
| 15455 | Wood | Imbrium Consortium-JSC | II |
| 15465 | Haskin | Haskin | IV |
| 15565 | Haskin | Haskin | IV |
| 15601 | Pillinger | Pillinger | I |
| 60002 | Heymann | Heymann | II |
| 60003 | Heymann | Heymann | II |
| 60018 | Haskin | Haskin | IV |
| 61175 | Nava | Nava | III |
| 61195 | Nyquist | Nyquist | II |
| 66075 | Albee | Albee | II |
| 67435 | Keil | Keil | I |
| 67455 | Chao | Chao | III |
| 67475 | Chao | Chao | III |
| 72417 | Wasserburg | C.I.T. | II |
| 72435 | Wasserburg | C.I.T. | II |
| 73215 | James | James-JSC | I |
| 73255 | James | James-JSC | I |
| 75081 | Meinschein "Big Pot" | JSC-Berne-Chicago | III |
| 76015 | Phinney | JSC | III |
| 76215 | Phinney | JSC | III |
| 76235 | Phimney | JSC | III |
| 76255 | Phimney | JSC | III |

CONSORTIUM SAMPLES (Contd)

| <u>SAMPLE NO.</u> | <u>LEADER(S)</u> | <u>SAMPLE LOCATION</u> | <u>CATEGORY</u> |
|-------------------|------------------|------------------------|-----------------|
| 76275 | Phinney | JSC | III |
| 76295 | Phinney | JSC | III |
| 76315 | Phinney | JSC | III |
| 77075 | Chao | Chao-JSC | III |
| 77115 | Chao | Chao-JSC | III |
| 77135 | Chao | Chao-JSC | III |

Material from samples with active consortiums may be requested by non-consortium PI's, but the proposed study will be checked to see that it does not infringe on a similar study within the consortium. In addition, the selection of sample has to be cleared with the consortium leader to assure that material essential to the consortium study (because of location or lithology, for example) would not be involved in the allocation. Communication with the consortium leader prior to submitting the request speeds and simplifies the checking and usually results in a recommendation of appropriate samples by the leader.

CONTAMINATION WARNING

We have recently had reports of contamination of lunar samples by containers of two types:

1. Teflon shavings in FTH containers (3/4 inch diameter stainless steel tubes with white Teflon snap-off caps). A rough or sharp lip on the stainless steel tubes cuts into and shaves off slivers from the caps on some of these containers. We are now rounding off and smoothing the lips of all of these containers before cleaning them for use.
2. Stainless steel particles in WAP containers (1/2 inch long screws with hexagonal socket (Allen) heads. The sample goes into the recessed socket and is held there by a Teflon cap.) The bottoms of the sockets on the first batch of these containers were roughly finished. The present type is smoothly finished. We are discarding the few remaining of the older type.

We apologize for difficulties caused by problems of this sort. Let me know promptly when they occur so we can act to correct them.

November 21, 1977

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LSAPT SUBGROUPS

Group A

Marvin (Chr)
Keil
McKay
Taylor

Group B

Lipschutz (Chr)
Van Schmus
Moore
Marti

Group C

Housley (Chr)
Spetzler

LSAPT SUBCOMMITTEES

Cleaning

Lipschutz (Chr)
Marti
Van Schmus

Consortia

Van Schmus (Chr)
Marvin
Moore

Cores*

McKay (Chr)
Lipschutz
Housley
Taylor

Cutting

Taylor (Chr)
McKay
Spetzler

Data

Marti (Chr)
Spetzler

Facilities

Bell (Chr)
Nyquist
Papanastassiou
Pepin
Reed
Wasserburg
Bence

Public Displays

Spetzler (Chr)
Housley
Taylor
Marvin
Moore

SSPL & RSPL

Marvin (Chr)
Lipschutz
Van Schmus
Marti

Procedures Annex

Taylor (Chr)
Lipschutz
Marti
Housley
McKay

LUNAR SAMPLE CATALOGS

January 4, 1978

| | Date of Publication | Number of copies |
|---|------------------------|---------------------|
| <u>Apollo 11</u> | | |
| A Summary of Apollo 11 Chemical, Age and Modal Data | 1971 | 103 |
| Lunar Sample Information Catalogue (Revised) JSC 12522 | 2-1977 | 32 |
| <u>Apollo 12</u> | | |
| NASA Technical Report S-243 Apollo 12 Lunar-Sample Information | 6-1970 | 1 |
| <u>Apollo 14</u> | | |
| Description, Classification, and Inventory of the Comprehensive Sample from Apollo 14 | 1975 | 69 |
| NASA TM X-58062 NASA TECHNICAL MEMORANDUM Apollo 14 Lunar Sample Information Catalog | 9-1971 | 47 |
| Apollo 14 Coarse Fines (4-10mm) Sample Location and Classification | 6-1977 | 7 |
| <u>Apollo 15</u> | | |
| Apollo 15 Coarse Fines (4-10mm): Sample Classi- fication, Description, and Inventory | 1972 | 48 |
| Lunar Sample Information Catalog Apollo 15 Lunar Receiving Laboratory | 11-1971 | 20 |
| <u>Apollo 16</u> | | |
| Description, Classification, and Inventory of Apollo 16 Rake Samples from Stations 1, 4, 13 | 1973 | 120 |
| Description, Classification, and Inventory of 151 Apollo 16 Rake Samples from the LM Area and Station 5 | 1972 | 90 |
| Lunar Sample Information Catalog Apollo 16 Lunar Receiving Laboratory | 7-1972 | 23 |
| Apollo 16 Coarse Fines (4-10mm): Sample Classi- fication, Description and Inventory | 10-1972 | 70 |

| | Date of Publication | Number of copies |
|--|---------------------|------------------|
| <u>Apollo 17</u> | | |
| Description, Classification and Inventory of 113 Apollo 17 Rake Samples from Station 1A, 2, 7, and 8 | 1974 | 20 |
| Apollo 17 Coarse-Fines (4-10mm): Sample Location Classification and Photo Index | 1973 | 110 |
| Lunar Sample Information Catalog Apollo 17 Lunar Receiving Laboratory | 4-1973 | 9 |
| Description, Classification, and Inventory of Apollo 17 Rake Samples from Station 6 | 9-1974 | 241 |
| <u>Luna 24</u> | | |
| Luna 24 Samples Presented to the USA, 1977 Catalog and Preliminary Description | 5-1-1977 | 30 |

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|--|----------------------------|
| Apollo 16 Special Samples | COPIES NO LONGER AVAILABLE |
| The Apollo 16 Lunar Samples: A Petrographic and Chemical Description of Samples from the Lunar Highlands | COPIES NO LONGER AVAILABLE |
| Apollo 16 Rake Samples 67515 to 68537 Sample Classification, Description, and Inventory | COPIES NO LONGER AVAILABLE |

DISSECTION REPORT, - 15010

By Judith Allton
Northrop Services, Inc.

First Dissection of 15010 - An Interim Report on Soil Unit Identification

The first dissection of core 15010 was completed 10-28-77. This core was the lower half of a double drive tube sample taken on the rim of Hadley Rille.

Figure 1 compares 1), units observed in 1977 x-rays, 2), units defined by soil color as seen on flat surface after 1st dissection, and 3), units defined by distribution of coarse fragments (>1 mm) in the dissected intervals (.5 cm increments). The units defined by composition will be the numbered units by which the core will be known.

Units Defined by X-ray:

Six units were identified from the 1977 x-radiograph. Larger fragments and fines and varying density were distinguishable; therefore, units were characterized by coarseness and density. These six units are shown in Fig. 1. In correlating x-ray units to observed surface units it is necessary to know how much compaction occurred. When the core was x-rayed in 1977, the follower was 32.9 cm. from the bottom of the tube. The core had lain horizontally in storage. Settling of material during this time left void spaces at the ends of the core on the side facing up. In preparation for extrusion, the core was placed vertically with the bottom end up. Approximately 1 cm. of material was removed from the bottom of the core, and the resulting core length was 30.9 cm. Therefore, about 1 cm of compaction must have occurred at this time. During extrusion the core was shortened by 2 cm. resulting in the present 28.9 cm. length.

Units Defined by Soil Color:

Six units were identified by the soil color observed on the flat surface after layer "A" was removed. (In the dissection procedure, the quartz top was removed, 1-2 mm of rind were removed, then layer "A" was removed leaving a flat surface flush with the aluminum surface.) Soil color was observed to range from 5Y 2/1 to 5Y 4/1 on the Munsell Color Scale in fluorescent room light. Distinctions between color units were vague. Value observations were made in white, yellow, red, green and light blue. Yellow light most enhanced the contrast.

Units Defined by Distribution of Fragments >1 mm:

The core was dissected in .5 cm increments. Each increment was sieved thru a 1 mm screen. The particles greater than 1 mm were categorized in the following seven lithologies: basalts, soil breccia, glass, agglutinates, anorthositic breccia, devitrified glass or recrystallized breccia. Particle weights were taken in each category. Unit definition was based on the lithology distribution by weight and on the distribution of percent of coarse material. The changes in coarseness or amount of basalt, for example, were determined from graphs made of (1) percent material >1 mm vs. depth in core

and (2) abundance of rock type by weight vs. depth in core.

The units defined by this data should be viewed with caution since no corrections were made for particles included in layer "A" which extended down into layer "B" which was not dissected. Nor were corrections made for particles left in layer "B" but which protruded up into layer "A". This type of distortion was especially great in the bottom of the core where a 4 cm.-long piece of basalt was partially excavated when layer "A" was removed.

Unit I 27.0 - 28.9 cm

17% material >1 mm

Basalt/Soil Breccia/Glass = 1/.8/.5

Glass was more abundant in this coarse unit. Amounts of basalt and soil breccia were more nearly equal than in other units. Trends in lithology distribution within the unit were not observed.

Unit II 20.5 - 27.0 cm

17% material >1 mm - This does not include large rock.

Basalt/Soil Breccia/Glass = 1/.3/.05

Basalt dominates this very coarse unit. A large piece of basalt was located at 22.5 - 26.8 cm. Since this basalt fragment was not entirely included in the dissected portion of core, it remained with the undissected part. Therefore, fractional shares of this rock were not included in the calculations for coarseness or lithologic content, and these numbers do not correctly represent this unit. A very small amount of glass was noted, and soil breccia distribution was sporadic in range and location.

Unit III 17.0 - 20.5 cm

12% material >1 mm

Basalt/Soil Breccia/Glass = 1/.3/.3

Basalt was most abundant in this coarse unit. The amounts of soil breccia and glass were nearly equal and were evenly distributed.

Unit IV 12.5 - 17.0 cm

12% material > 1 mm

Basalt/Soil Breccia/Glass = 1/.1/.1

This coarse unit was dominated by basalt. The very small amounts of soil breccia and glass were nearly equal and were evenly distributed.

Unit V 11.0 - 12.5 cm

29% material >1 mm

Basalt/Soil Breccia/Glass = 1/.1/.04

Basalt dominated this very coarse unit. Soil breccia and glass were found in equal portions and in small quantity. The lithologic distribution within the unit showed no trends, except for a large increase in basalt in the bottom one-half centimeter.

Unit VI 9.0 - 11.0 cm

22% material >1 mm

Basalt/Soil Breccia/Glass = 1/1.1/.4

In this very coarse unit soil breccia was most abundant. Substantial amounts of basalt were evenly distributed throughout the unit. There was an increase in glass and soil breccia content toward the top of the unit. Most unusual was the occurrence of a large (1 centimeter diameter) "agglutinate" at the very top of the unit. This "agglutinate" consisted of soil clods glued together in angular fashion with black splash glass. (For purposes of lithology distribution this particular piece was apportioned 50% to soil breccia and 50% to glass.)

Unit VII 3.0 - 9.0

7% material >1 mm

Basalt/Soil Breccia/Glass = 1/.2/.1

Basalt was dominant and evenly distributed in this relatively fine unit. Soil breccia appeared to increase with depth. Glass was of low abundance and of even distribution.

Unit VIII 0.0 - 3.0

10% material >1 mm

Basalt/Soil Breccia/Glass = 1/1.6/.7

In this coarse unit, soil breccia content, which was most abundant, decreased with depth. The second abundant most component, basalt, increased with depth. Glass content was concentrated in the top centimeter which also appeared slightly darker in color.

15010: First Dissection Units

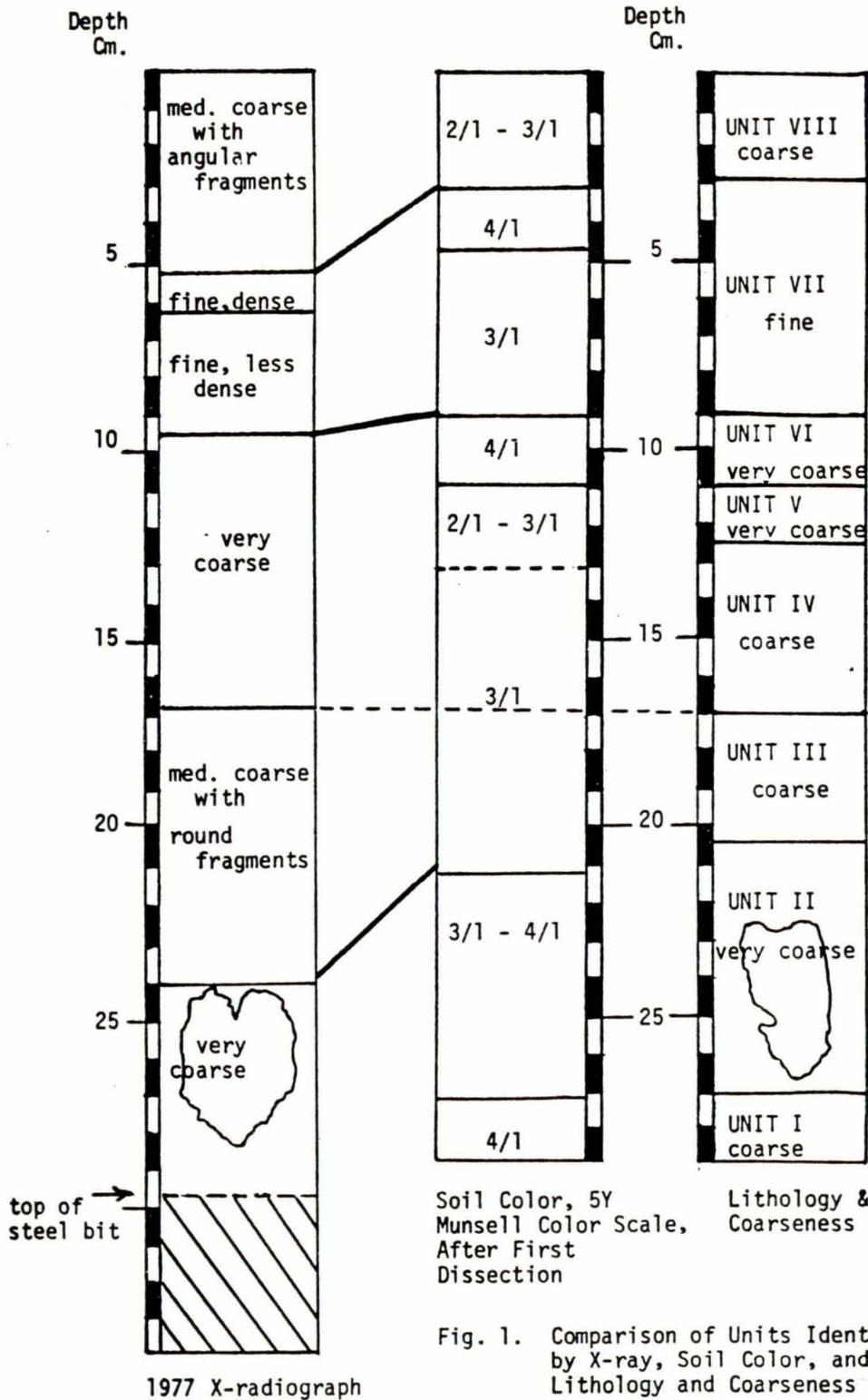


TABLE 1 - DRIVE TUBE 15010: LOCATION OF SAMPLES FROM FIRST DISSECTION

| | INTERVAL SAMPLES | | | | SPECIAL SAMPLES | | | | |
|-----------|------------------|------------------|-----------------|------------------|-----------------|-----------------|------------------|-----------------|----------------------|
| | Interval Cm. | Fine Fraction | | Coarse Fraction | | Interval Cm. | Sample Number | Weight Grams | Description |
| | | Sample Number | Weight Grams | Sample Number | Weight Grams | | | | |
| Unit VIII | .5 - 0 | 12 | .130 | 13 | .010 | | | | |
| | 1.0 - .5 | 14 | .477 | 15 | .086 | | | | |
| | 1.5 - 1.0 | 16 | .677 | 17 | .073 | | | | |
| | 2.0 - 1.5 | 18 | .681 | 19 | .061 | | | | |
| | 2.5 - 2.0 | 20 | .723 | 21 | .070 | | | | |
| | 3.0 - 2.5 | 22 | .813 | 23 | .026 | 3.1 - 2.8 | 24 | .105 | Soil breccia |
| Unit VII | 3.5 - 3.0 | 25 | .682 | 26 | .040 | | | | |
| | 4.0 - 3.5 | 27 | .974 | 28 | .043 | | | | |
| | 4.5 - 4.0 | 29 | .920 | 30 | .071 | | | | |
| | 5.0 - 4.5 | 31 | .804 | 32 | .022 | 5.3 - 4.8 | 33 | .148 | Basalt |
| | 5.5 - 5.0 | 34 | .864 | 35 | .052 | | | | |
| | 6.0 - 5.5 | 36 | .935 | 37 | .064 | | | | |
| | 6.5 - 6.0 | 38 | 1.129 | 39 | .086 | | | | |
| | 7.0 - 6.5 | 40 | 1.017 | 41 | .050 | | | | |
| | 7.5 - 7.0 | 42 | 1.025 | 43 | .123 | | | | |
| | 8.0 - 7.5 | 44 | 1.146 | 45 | .070 | | | | |
| Unit VI | 8.5 - 8.0 | 46 | 1.080 | 47 | .090 | | | | |
| | 9.0 - 8.5 | 48 | 1.154 | 49 | .047 | | | | |
| | 9.5 - 9.0 | 50 | .848 | 51 | .173 | 10.0 - 9.0 | 54 | .250 | Soil breccia + glass |
| | 10.0 - 9.5 | 52 | 1.012 | 53 | .078 | | | | |
| Unit V | 10.5 - 10.0 | 56 | .889 | 57 | .496 | 11.1 - 10.0 | 55 | .047 | Light gray soil |
| | 11.0 - 10.5 | 58 | .696 | 59 | .075 | | | | |
| | 11.5 - 11.0 | 60 | .995 | 61 | .309 | | | | |
| Unit IV | 12.0 - 11.5 | 62 | .949 | 63 | .174 | | | | |
| | 12.5 - 12.0 | 64 | .801 | 65 | .721 | | | | |
| | 13.0 - 12.5 | 66 | 1.010 | 67 | .054 | | | | |
| | 13.5 - 13.0 | 68 | 1.102 | 69 | .094 | | | | |
| | 14.0 - 13.5 | 70 | .933 | 71 | 1.100 | | | | |
| | 14.5 - 14.0 | 72 | 1.054 | 73 | .053 | 15.0 - 14.0 | 74 | .258 | Basalt |
| | 15.0 - 14.5 | 75 | .976 | 76 | .098 | | | | |
| | 15.5 - 15.0 | 77 | 1.117 | 78 | .060 | | | | |
| | 16.0 - 15.5 | 79 | 1.085 | 80 | .358 | | | | |
| | 16.5 - 16.0 | 81 | .968 | 82 | .137 | | | | |
| Unit III | 17.0 - 16.5 | 83 | 1.082 | 84 | .082 | | | | |
| | 17.5 - 17.0 | 85 | 1.163 | 86 | .062 | | | | |
| | 18.0 - 17.5 | 87 | 1.188 | 88 | .120 | | | | |
| | 18.5 - 18.0 | 89 | 1.079 | 90 | .195 | | | | |
| | 19.0 - 18.5 | 91 | 1.099 | 92 | .226 | | | | |
| | 19.5 - 19.0 | 93 | 1.045 | 94 | .156 | | | | |
| | 20.0 - 19.5 | 95 | 1.176 | 96 | .199 | | | | |
| Unit II | 20.5 - 20.0 | 97 | 1.089 | 98 | .116 | | | | |
| | 21.0 - 20.5 | 99 | 1.057 | 100 | .314 | | | | |
| | 21.5 - 21.0 | 101 | 1.001 | 102 | .106 | 21.6 - 20.8 | 103 | .232 | Basalt |
| | 22.0 - 21.5 | 104 | 1.094 | 105 | .181 | | | | |
| | 22.5 - 22.0 | 106 | 1.064 | 107 | .156 | | | | |
| | 23.0 - 22.5 | 108 | .935 | 109 | .061 | | | | |
| | 23.5 - 23.0 | 110 | .805 | 111 | .088 | | | | |
| | 24.0 - 23.5 | 112 | .694 | 113 | .278 | | | | |
| | 24.5 - 24.0 | 114 | .767 | 115 | .117 | | | | |
| | 25.0 - 24.5 | 116 | .727 | 117 | .158 | | | | |
| | 25.5 - 25.0 | 118 | .850 | 119 | .208 | | | | |
| Unit I | 26.0 - 25.5 | 120 | .723 | 121 | .095 | | | | |
| | 26.5 - 26.0 | 122 | 1.088 | 123 | .251 | | | | |
| Unit I | 27.0 - 26.5 | 124 | .951 | 125 | .266 | 27.0 - 26.8 | 126 | .015 | Green anorthosite |
| | 27.5 - 27.0 | 127 | .894 | 128 | .188 | | | | |
| | 28.0 - 27.5 | 129 | 1.146 | 130 | .271 | | | | |
| | 28.5 - 28.0 | 131 | .963 | 132 | .215 | | | | |
| | 28.9 - 28.5 | 133 | .745 | 134 | .103 | | | | |

REPORT ON DRILL STEM 70005

Drill stem 70005 is the fifth stem below the top of the Apollo 17 Drill String. Calculations based on x-radiographs and previous dissections of other drill stems in the string place the top of 70005 at 132 cm below the lunar surface. Due to various factors such as mechanical compaction, this figure is only a close approximation. The drill string, with a total length of about 294.5 cm, has three major stratigraphic units: an upper, coarse-grained, basaltic unit, 107 cm thick; a middle, fine-grained zone 56 cm thick, high in anorthosite; and a lower zone of alternating coarse and fine basaltic and breccia material, 131.5 cm thick. Part of each of the lower major units is contained in drill stem 70005. The Apollo 17 Deep Drill String was taken about 40 meters north of the ALSEP central station.

Sample History

Upon extraction of the drill string from the drill hole, the string was separated into three segments for packing. Drill stem 70005 was the bottom stem of the middle, two-stem segment -- 70006 being the top stem. An internal-fitting, hollow cap was installed at the lower end of 70005 at this time. The hollow nature of the cap allowed soil to shift from 70006 into 70005, thus filling the cap with soil indirectly. Drill stem 70006 was short by 1.2 cm of soil column and 70005 was long by about 1.8 cm. The 0.6 cm difference is probably due to low density zones such as seen in the attached x-radiograph diagram.

Burrowed end samples were taken at the upper end totaling nearly 6 grams or the equivalent of 11 mm of soil column. Prior to milling, another 6.6 grams or the equivalent of 12 mm of soil column was removed from the lower end in order to properly contain the soil during the milling operation.

The remaining soil was compressed by 1.5 cm as a pre-milling stabilization measure. The resultant soil column was 38 cm in length. The upper soil/plug interface became established at 2.0 cm and the lower interface at the 40.0 cm mark.

Pre-Dissection Description

The exposed surface of the core closely correlates with the x-ray interpretation. The boundary between the lower and middle major units of the drill string is evidenced by a broken rind below about 29 cm and by the coarseness below 30 cm as seen in the x-radiographs and exposed surface. In addition, the soil tone below 30 cm is noticeably lighter. Further subdivisions into units cannot be inferred from the exposed surface. The overall color is closest to 10Y 3/1 on Munsell's Color Chart. The matrix soil grain size is in the silt range.

Processing Procedures

Dissection began at the lower end of the core in order to more quickly process the intervals with disrupted rind. Standard 5mm intervals were taken throughout, with the exception of lead-free sample intervals at 23.0-24.5 cm and 6.5-8.0 cm. Red light samples were taken in conjunction with the lead-free samples and additionally at 15.0-15.5 cm and 30.0-30.5 cm. Also, the interval 31.0-32.0 was taken double due to a large particle which filled most of the interval. Unusual or large particles transcending interval boundaries were individually containerized as special samples. Wherever possible, large particles were located on a diagram of the interval in order to record orientations. All particles not passing through a 1mm sieve were classified, photographed, and containerized for each dissection interval. Voids created by the extraction of large particles extending below standard dissection depth were maintained if possible. It was necessary to remove these particles in order to obtain a peel sample. At 30 cm, a void created by the removal of a large particle caused a gap in the peel record of 5mm. After peeling, the remaining core was impregnated with epoxy, then encapsulated in a mold of epoxy. This mold provides a block of epoxy containing sample which is longitudinally split and transversely cut into blocks for thin-sectioning.

ANALYSIS OF DATA

The collected quantitative data consists of the weights of the fine fraction and coarse fraction of each interval, plus the weights of special samples. In addition, frequency counts of particles in the coarse fraction were taken in three size ranges — 1-2 mm, 2-4 mm, and greater than 4 mm. Each size range is also divided into seven compositional types. Frequencies are computer-normalized to the standard interval width and average weight. Graphs of normalized frequencies versus depth are plotted in eight groupings: by compositional type for each of the three size ranges; by compositional type for the combined sizes; by combined compositions for each of the three sizes; and by combined compositions for the combined size ranges. When combining sizes, scale factors are used. In addition to the frequency graphs, a weight percent coarseness indicator is plotted. The percentages are computed by dividing the weight of material greater than 1 mm in size by the weight of all the material per unit.

Bias is introduced by the sampling size of the drill stem, in that the presence of a particle approaching tube diameter in size eliminates the possibility of occurrence of other particles. Other statistical error is brought about by the discrete size categorization, rather than a continuous size measurement of each particle. This error is demonstrated by comparing the weight percent coarseness graph with the combined composition/ combined sizes graph. The lack of congruence that can be seen is partially due to this "pidgeonhole" effect and partially due to generalizing assumptions that had to be made in order to combine the discrete size categories. Other biases or errors include -- sampling below standard dissection level, measurement error, assumptions of uniform density, and misclassification of lithology. Bearing these limitations in mind, interpretation of the constructed graphs was not attempted at the order of resolution provided.

COMPOSITIONAL DESCRIPTIONS

Seven compositional categories were used to classify particles greater than 1 mm in grain size: anorthositic breccia (ANBX); agglutinates (AGGL); devitrified or partially-crystallized glasses (PXGL); recrystallized or high-grade breccia (RXBX); vesicular, droplet, or fresh glasses (VSGL); soil or low-grade breccia (SOBX); and basaltic or crystalline rock fragments (BSRF). Of these seven, SOBX is by far the most abundant.

The category "BSRF" includes any particle which is apparently no recrystallized material, but is polycrystalline and contains plagioclase and pyroxene. In practice, some of the smaller particles classified as BSRF's may be monominerallic. Also, many particles are soil or glass coated to the point of being barely recognizable. Some soil coated BSRF's may have been misclassified as SOBX's for this reason. Most occur as fairly equant chunks with coarsely-textured surfaces. When the rough pockets in the surface are filled with soil, they are easily mistaken for the equant, smooth-surfaced SOBX's. Effort was taken to remove as much loose soil as possible SOBX's without significantly damaging the normally friable SOBX's in the process. Some BSRF's have shocked plagioclase or anorthositic material. ANBX's may be derived directly from this source, in which case they are more likely to display some evidence of crystal structure. When found as clasts in SOBX's, they tend to be sugary in texture. Some particles classified as "ANBX" may either be soil coated ANBX's or anorthositic clasts from broken SOBX's. SOBX's therefore, exclude white, sugary masses of supposed anorthositic material, even though the only difference may be the color of the soil matrix in which it is formed. "SOBX" refers to a particle of welded, non-white soil matrix. Welding may have been brought about by heat, pressure, small amounts of molten glass, or some combination of these. When glass welding creates a more spindly particle, it is considered to be an "AGGL" rather than a more massive and rounded SOBX. SOBX's are usually

friable and occasionally break open to reveal an interior of crystalline mesh. Others simply disintegrate when broken. Certain SOBX's are distinguished as medium grade in that they are tougher and seemingly transitional to the category of RXBX. "RXBX" is an angular, waxy-appearing particle that would seem to be the high grade equivalents of SOBX or ANBX. "PXGL" is somewhat similar in appearance to RXBX, but readily distinguishable by a duller surface luster and glass fracture shape characteristics, as it is a devitrified form of VSGL. "VSGL" refers to fresh, vitreous glass which occurs as beads, shards, or coatings. It is often found as coatings on SOBX and causes some difficulty in classification, as SOBX may be glass welded.

Descriptions of Physical Units

Drill stem 70005 contains parts of two major units of the drill string. The upper unit, together with the lower part of 70006, comprise the middle major unit of the drill string, which is characterized by moderate tone and cohesivity and a fine-grained texture. Compositionally, it is glass-rich. The basal sub-unit is coarse with large chunks of vesicular glass. The contact with the lower unit is marked by a lightening of tone and increases in cohesivity, coarseness, and BSRF content.

In drill stem 70005, nine minor units are marked off -- eight above the major unit contact. The minor units are further subdivided into seventeen sub-units, mostly based on variations seen in tone, cohesivity, and coarseness. See the chart below for a detailed account of these variations.

70005 Physical Unit Description Index

| 70005 Unit | X-Ray Unit | Depth below Lunar Surface | Unit Thickness | Internal Location Notation | Sample Numbers | Wt. % Matrix | Tonal Value | Rel. Cohesion | Major Comp. | Minor Comp. | Other features Minor Comp. |
|------------|------------|---------------------------|----------------|----------------------------|----------------|--------------|-------------|---------------|-------------|-------------|-------------------------------|
| IX | 43 | 132.6 | 3.1 | 040-09 | 171-178 | 94 | 6 | 7 | - | SOEX | |
| VIIIIB | 42 | 135.7 | 1.5 | 055-40 | 165-170 | 91 | 5 | 6 | SOEX | - | |
| VIII A | 41/2 | 137.2 | 1.0 | 065-55 | 161-164 | 91 | 5½ | 4 | SOEX | - | Sl. Mottling |
| VIIIB | 41 | 138.2 | 2.0 | 085-65 | 155-160 | 95 | 5 | 5 | - | SOEX | Mottled |
| VII A | 40/1 | 140.2 | 2.0 | 105-85 | 147-154 | 92 | 6 | 6 | SOEX | VSGL | |
| VIB | 39 | 142.2 | 1.5 | 120-05 | 141-146 | 97 | 6 | 2 | - | - | |
| VIA | 39 | 143.7 | 1.5 | 135-20 | 135-140 | 97 | 6 | 4 | - | - | |
| VC | 38 | 145.2 | 1.0 | 145-35 | 131-134 | 90 | 5½ | 5 | - | BSRF | |
| VB | 38 | 146.2 | 1.7 | 162-45 | 124-130 | 95 | 4½ | 6 | SOEX | - | |
| VA | 38 | 147.9 | 1.3 | 175-62 | 118-123 | 88 | 5 | 4 | SOEX | - | |
| IV | 37 | 149.2 | 4.0 | 215-75 | 102-117 | 96 | 5 | 5 | - | VSGL | |
| III | 36 | 153.2 | 5.3 | 268-15 | 84-101 | 92 | 5½ | 2 | - | SOEX | |
| IIB | 35/6 | 158.5 | 2.7 | 305-68 | 66-83 | 79 | 6 | 1 | SOEX | PXGL | Lt. Streaks |
| IIA | 35 | 161.2 | 2.5 | 330-05 | 57-65 | 58 | 6 | 3 | VSGL | SOEX | |
| IC | 34 | 163.7 | 2.5 | 355-30 | 46-56 | 76 | 8 | 6 | SOEX | VSGL | PXGL |
| IB | 34 | 166.2 | 2.5 | 380-55 | 36-45 | 72 | 7 | 7 | SOEX | VSGL | BSRF |
| IA | 34 | 169.7 | 3.2 | 412-80 | 25-35 | 83 | 7½ | 8 | SOEX | VSGL | BSRF |
| 70004 | | 172.9 | | | | | | | | | |

Relative Tonal Value -- 10=White/0=Black
 Relative Cohesion Value -- 10=Tight/0=Loose

| PHY.-LITHOLOGICAL UNIT | LITHOLOGICAL DEPTH (CM) | THICKNESS (CM) | DRILL CORE SAMPLE LOCATION INFORMATION | | | | | | | | | | |
|------------------------|-------------------------|----------------|--|---------------|-----------------|---------------|-----------------|-------------------|---------------|-------------|----------------------------|-----------|--------------|
| | | | FINE FRACTION | | COARSE FRACTION | | SPECIAL SAMPLES | | | | | | |
| | | | Interval Location Notation | Sample Number | Weight (mg) | Sample Number | Weight (mg) | Location Notation | Sample Number | Weight (mg) | Compositional Description | | |
| 70005 132.6 3.1 IX | | | 020-09 | 3 | 2925 | 4 | 35 | 079-00 | 2 | 40 | Joint/Compact Cold Storage | | |
| | | | 025-20 | 177 | 2134 | 178 | 173 | 020-09 | 5 | 3026 | | | |
| | | | 030-25 | 175 | 2086 | | 176 | | | | | | |
| | | | 035-30 | 173 | 2267 | | 174 | | | | | | |
| | | | 040-35 | 171 | 2050 | | 172 | | | | | | |
| | | | 045-40 | 169 | 2118 | | 170 | | | | | | |
| 70005 135.7 2.5 VIII | | | 050-45 | 167 | 2100 | | 168 | | | | | | |
| | | | 055-50 | 165 | 1972 | | 166 | | | | | | |
| | | | 060-55 | 163 | 2252 | | 164 | | | | | | |
| | | | 065-60 | 161 | 1851 | | 162 | | | | | | |
| | | | 080-65 | 157 | 5255 | | 158 | | | 080-65 | 160 | 400 | Red Light |
| | | | 080-65 | 159 | | | | | | 080-65 | 159 | 1030 | Lead Free |
| 70005 138.2 4.0 VII | | | 085-80 | 155 | 2110 | | 156 | | | | | | |
| | | | 090-85 | 153 | 1995 | | 154 | | | | | | |
| | | | 095-90 | 151 | 2338 | | 152 | | | | | | |
| | | | 100-95 | 149 | 2120 | | 150 | | | | | | |
| | | | 105-00 | 147 | 1930 | | 148 | | | | | | |
| | | | 110-05 | 145 | 2319 | | 146 | | | | | | |
| | | | 115-10 | 143 | 2212 | | 144 | | | | | | |
| | | | 120-15 | 141 | 2235 | | 142 | | | | | | |
| | | | 125-20 | 139 | 2118 | | 140 | | | | | | |
| | | | 130-25 | 137 | 2277 | | 138 | | | | | | |
| 70005 142.2 3.0 VI | | | 135-30 | 135 | 2192 | | 136 | | | | | | |
| | | | 140-35 | 133 | 2257 | | 134 | | | | | | |
| | | | 145-40 | 131 | 2182 | | 132 | | | | | | |
| | | | 150-45 | 129 | 2040 | | 130 | | | | | | |
| | | | 155-50 | 126 | 1705 | | 128 | | | 155-50 | 127 | 440 | Red Light |
| | | | 160-55 | 124 | 2144 | | 125 | | | | | | |
| | | | 165-60 | 122 | 1981 | | 123 | | | | | | |
| | | | 170-65 | 120 | 2189 | | 121 | | | | | | |
| | | | 175-70 | 118 | 2013 | | 119 | | | | | | |
| | | | 180-75 | 116 | 2210 | | 117 | | | | | | |
| 70005 145.2 4.0 V | | | 185-80 | 114 | 2297 | | 115 | | | | | | |
| | | | 190-85 | 112 | 2146 | | 113 | | | | | | |
| | | | 195-90 | 110 | 2173 | | 111 | | | | | | |
| | | | 200-95 | 108 | 2093 | | 109 | | | | | | |
| | | | 205-00 | 106 | 2124 | | 107 | | | | | | |
| | | | 210-05 | 104 | 2212 | | 105 | | | | | | |
| | | | 215-10 | 102 | 2096 | | 103 | | | | | | |
| | | | 220-15 | 100 | 2135 | | 101 | | | | | | |
| | | | 225-20 | 98 | 2188 | | 99 | | | | | | |
| | | | 230-25 | 96 | 2175 | | 97 | | | | | | |
| 70005 149.2 4.0 IV | | | 245-30 | 92 | 4665 | | 93 | | 245-30 | 95 | 400 | Red Light | |
| | | | 245-30 | | | | | | | 245-30 | 94 | 1025 | Lead Free |
| | | | 250-45 | 90 | 2295 | | 91 | | | | | | |
| | | | 255-50 | 88 | 2188 | | 89 | | | | | | |
| | | | 260-55 | 86 | 2231 | | 87 | | | | | | |
| | | | 265-60 | 84 | 2163 | | 85 | | | | | | |
| | | | 270-65 | 82 | 1820 | | 83 | | | | | | |
| | | | 275-70 | 80 | 1693 | | 81 | | | | | | |
| | | | 280-75 | 78 | 2190 | | 79 | | | | | | |
| | | | 285-80 | 76 | 2165 | | 77 | | | | | | |
| 70005 153.2 5.3 III | | | 290-85 | 74 | 1710 | | 75 | | | | | | |
| | | | 295-90 | 71 | 1825 | | 72 | | | 294-85 | 73 | 848 | PXGL |
| | | | 300-95 | 69 | 1970 | | 70 | | | | | | |
| | | | 305-00 | 66 | 1706 | | 67 | | | 305-00 | 68 | 400 | Red Light |
| | | | 310-05 | 64 | 1650 | | 65 | | | | | | |
| | | | 320-10 | 61 | 2403 | | 62 | | | 319-07 | 63 | 2485 | VSGL |
| | | | 325-20 | 59 | 1732 | | 60 | | | | | | |
| | | | 330-25 | 57 | 1851 | | 58 | | | | | | |
| | | | 335-30 | 55 | 1973 | | 56 | | | | | | |
| | | | 340-35 | 53 | 1900 | | 54 | | | | | | |
| 70005 158.5 5.2 II | | | 345-40 | 51 | 1800 | | 52 | | | | | | |
| | | | 350-45 | 49 | 1750 | | 50 | | | | | | |
| | | | 355-50 | 46 | 2188 | | 47 | | | 360-51 | 48 | 580 | SOBX |
| | | | 360-55 | 44 | 1229 | | 45 | | | | | | |
| | | | 365-60 | 42 | 1465 | | 43 | | | | | | |
| | | | 370-65 | 40 | 2097 | | 41 | | | | | | |
| | | | 375-70 | 38 | 1776 | | 39 | | | | | | |
| | | | 380-75 | 36 | 1737 | | 37 | | | | | | |
| | | | 385-80 | 34 | 1956 | | 35 | | | | | | |
| | | | 390-85 | 32 | 1502 | | 33 | | | | | | |
| 70005 163.7 8.2 | | | 395-90 | 29 | 2040 | | 30 | | 396-86 | 31 | 346 | SOBX | |
| | | | 400-95 | 27 | 2169 | | 28 | | | | | | |
| | | | 412-00 | 25 | 6236 | | 26 | | | | | | |
| | | | 412-20 | 180 | 1006 | | 181 | | | 400-20 | 179 | 637 | Funnel Misc. |

(See text of this report for explanation of acronyms and other descriptions.)

70006
180

70005

180

70004 200
70005

- Moderately opaque interval with small, scattered, sorted rock fragments.
- 44 Matrix: 85 percent; moderately opaque with \approx 20 percent indistinct equant mottles, near limit of resolution to 0.5 mm, 1 percent opaque spherules less than 0.5 mm in diameter.
Coarse fraction: 15 percent; semiopaque with partially distinct outline (probably partially concealed by density of matrix), 3 to 5 mm, well sorted, equant to ovoid, subrounded particles, long axes tend to be aligned horizontally.
- UNIT 43 Depth: TDS, 160 to 164 cm; lunar surface, 133 to 137 cm Thickness: 4 cm
Rock fragmental unit fractured at top of core.
- 43 Matrix: 70 percent; appears similar to that of unit 42, but is strongly permeated by cracks and fractures, contains \approx 20 percent finely granular mottles, traces of opaque spherules, near limit of resolution.
Coarse fraction: 30 percent; clumps or rock fragments with distinct outline, 2 to 11 mm in diameter, subovoid to polygonal with irregular angularly wavy edges most commonly defined by cracks in matrix.
- UNIT 42 Depth: TDS, 164 to 166 cm; lunar surface, 137 to 139 cm Thickness: 2 cm
Thin bed with moderately opaque matrix and small sorted rock fragments.
- 42 Matrix: 80 percent; intermediate opacity, finely mottled with 20 percent pinpoint mottles, less than 1 mm in diameter, but no opaques.
Coarse fraction: 20 percent; semiopaque rock fragments with moderately distinct outline, 1 to 4 mm in diameter, average 2.5 mm with few fragments being much smaller or larger, fragments with one or two relatively straight margins, but fading out along crenulate margins on other side of fragment.
- UNIT 41 Depth: TDS, 166 to 170 cm; lunar surface, 139 to 143 cm Thickness: 4 cm
Fine-grained interval with scattered fine mottles and sparse rock fragments.
- 41 Matrix: 95 percent of intermediate to low opacity, with 5 to 15 percent mottles under 1 mm in diameter and \approx 1 percent spherical opaques, limit of resolution to 0.8 mm.
Coarse fraction: 5 percent; semiopaque rock fragments with distinct outline, blocky slightly elongate with relatively straight edges and angular corners.
- UNIT 40 Depth: TDS, 170 to 170.5 cm; lunar surface, 143 to 143.5 cm Thickness: 0.5 cm
Thin rock layer.
- 40 Matrix: 60 percent; moderately transparent and uniformly fine grained.
Framework: 40 percent; semiopaque rock fragments with distinct outline, 1 to 4 mm in diameter, moderately well sorted, equant to slightly elongate, with smoothly faceted to blocky outline, subangular to angular corners.
- UNIT 39 Depth: TDS, 170.5 to 174.5 cm; lunar surface, 143.5 to 147.5 cm Thickness: 4 cm
Fine-grained interval with indistinct granules.
- 39 Matrix: 95 percent; moderately high transparency, but with 2 percent opaques, ranging from spheroids at limit of resolution to shards 1 mm long; elongate opaques tend to have long axes aligned horizontally.
Coarse fraction: 5 percent; semiopaque density concentrations with indistinct outline, 1 to 3 mm in diameter with regular and even fadeout as in unit 37.
- UNIT 38 Depth: TDS, 174.5 to 178.5 cm; lunar surface, 147.5 to 151.5 cm Thickness: 4 cm
Medium-thin interval with abundant, small, well-sorted rock fragments.
- 38 Matrix: 70 percent; moderate to high transparency, with less than 10 percent fine mottles and only a trace of pinpoint opaques, near limit of resolution.
Framework: 30 percent; 20 percent is semiopaque rock fragments with distinct outline, 2 to 4 mm in diameter, well sorted, blocky to wedge shaped with nearly straight sides and angular to subangular corners; 10 percent is semiopaque density concentrations with indistinct outline, 2 to 4 mm diameter, fading out over relatively straight and even edge, suggesting breccia fragments.
- UNIT 37 Depth: TDS, 178.5 to 183 cm; lunar surface, 151.5 to 156 cm Thickness: 4.5 cm
Densely granular interval with sparse rock fragments.
- 37 Matrix: 95 percent; more opaque than unit 36, densely and finely granular with traces of minute spherical opaques.
Coarse fraction: 5 percent; semiopaque with indistinct outline, appearing as equant density concentrations 1 to 3 mm in diameter, with regular and even fadeout, sorting and type of semitransparency suggest breccia fragments rather than clods.
- UNIT 36 Depth: TDS, 183 to 190 cm; lunar surface, 156 to 163 cm Thickness: 7 cm
Massive interval with sparse rock fragments and abundant opaque fragments.
- 36 Matrix: 90 percent; uniformly fine grained and noticeably transparent with \approx 1 percent spherical opaques, 0.5 mm to limit of resolution.
Coarse fraction: 10 percent (decreasing upward); 5 percent is semiopaque rock fragments having distinct outline, moderately well sorted, 2 to 3 mm in diameter, best sorting at top of bed, continuous gradation upward; 4 percent is semiopaque mottles, 1 to 4 mm in diameter with crenulate fadeout; 1 percent is opaque fragments, averaging 1 mm in diameter, blocky equant to comma shaped.
- UNIT 35 Depth: TDS, 190 to 194.5 cm; lunar surface, 163 to 167.5 cm Thickness: 4.5 cm
Rock fragmental zone with relatively transparent matrix.
- 35 Matrix: 60 percent; decidedly less dense in appearance than underlying unit with \approx 1 percent spherical opaques, 0.5 mm in diameter to limit of resolution; matrix becomes progressively more transparent upward.
Framework: 40 percent; rock fragments, similar in appearance to unit 34, \approx 30 percent is semiopaque rock fragments with distinct outline; 10 percent is crenulate mottles with indistinct outline.
- UNIT 34 Depth: TDS, 194.5 to 200 cm; lunar surface, 167.5 to 173 cm Thickness: 5.5 cm
Rock fragmental zone with relatively opaque matrix.
- 34 Matrix: 65 percent; relatively opaque to X-rays, compared to unit 35, but appears to be uniformly dense throughout with no distinct mottles or opaque fragments.
Framework: 35 percent; 25 percent is semiopaque rock fragments with distinct outline, 2 to 11 mm in diameter, poorly sorted, equant to slightly elongate, polygonal, relatively straight sided, subangular corners; 10 percent is semiopaque with indistinct outline, appears as indistinct mottles, 1 to 4 mm in diameter with finely crenulate fadeout.
- UNIT 33 Depth: TDS, 200 to 202.5 cm; lunar surface, 173 to 175.5 cm Thickness: 2.5 cm
Moderately thin bed with abundant rock fragments.
- 33 Matrix: 80 percent; intermediate transparency with some granules as unit 32.
Coarse fraction: 20 percent; 10 percent is semiopaque rock fragments with distinct outline, 2 to 5 mm in diameter, moderately well sorted, elongate-equant polygonal with straight edges, subangular corners; 10 percent is semiopaque