CURATORIAL NEWSLETTER

Date: June 21, 1977 | No. 16

Everett K. Gibson, Jr.
Acting Chief, Curatorial Branch

Curator

Since the last newsletter Dr. Everett Gibson has been serving as Acting Curator of Lunar Samples. Dr. Gibson's tour will end on August 1 at which time another Acting Curator will be named. It is hoped that a permanent Curator will be selected and named within the next 2-3 months.

Consortia

All consortia leaders are reminded that the yearly progress reports will be due in October. If you need to check on progress of the team or hurry them along there is still time. Consortia that are not active or who do not submit plans for activity will be asked to return their samples.

Core 74002

Core 74002 is presently under dissection and will be ready for distribution in September. A preliminary description is attached to this newsletter to assist you in selecting sample for your request.

Sample Requests

The next LSAPT review session is scheduled for September 7-11, 1977. The deadline for sample requests is September 1. LSAPT will then tentatively meet on November 18-21. All PI's are encouraged to get sample requests in by September if you want material before the end of the year.

New Facility

The construction of the new curatorial facility continues to progress at a regular rate. The concrete vault floor has been poured and most of first floor walls are done. Construction is approximately on schedule.

Enclosure
Core Processing History

PROCESSING HISTORY

Drive Tube 74002 is the upper half of the "orange soil" core, collected at Shorty Crater on the Apollo 17 mission. Initial processing history is similar to that of 74001 (Lunar Core Catalog, 1977 supplement, p. 17-58), but 74002 was not opened in the laboratory for preliminary examination. Instead, 74002 was stored under dry N_2 in the Lunar Curatorial Laboratory from 12 February, 1973 (after initial X-radiography) until 18 May, 1977, when the core was re-radiographed in the Thin Section Laboratory. On 7/7/77, the core was transferred to the Lunar Core Laboratory Processing Cabinet (275-5) and extrusion was initiated. By 8 July, the surface 5 mm. was dissected in 1 mm. increments, and by 7/11/77 extrusion was completed. 74002 was the easiest core to extrude, to date, probably because there were no large particles to obstruct free passage of the extruding ram, and because special care was taken to maintain a straight alignment of the extruding device. By 12 July, the smeared surface was removed and the exposed core photographed. Soil in the core was then described, and compared to the X-radiograph.

COMPACTION DUE TO EXTRUSION

74002 showed 0.4 to 0.5 cm. of compaction during extrusion; this is much less compaction than any other core. Original length of the core was either 32.5 cm. measured on X-radiographs, or 32.4 cm, determined from hardware measurements prior to extrusion. Following extrusion, core length was 32.0 cm., indicating a compaction of 0.4 or 0.5 cm., depending on which original length is used. Compaction is probably confined to the lower end of the core, because the section between 30 and 32 cm. appears tightly compacted after extrusion, but is partially void and de-densified before extrusion. Other parts of the core are uncompacted, as evidenced by non-disruption of voids at 1-5 cml, 16 cm., 18 cm., and 20-22 cm. These voids appear in stereopair 2 of the pre-extrusion radiographs, and in the same position in post-extrusion photographs.

DESCRIPTION OF X-RADIOGRAPHS

The radiograph of 74002 shows alternating opaque and semi-opaque layers. In 1973, after 74002 was first radiographed, it was believed that the less opaque strata were orange soil, and the opaque were black. However, by comparing radiographs to the exposed core, it was found that compositional variations cannot be recognized in the X-radiographs. Instead, all changes in the radiograph appear to be related to internal changes in structural compactness.

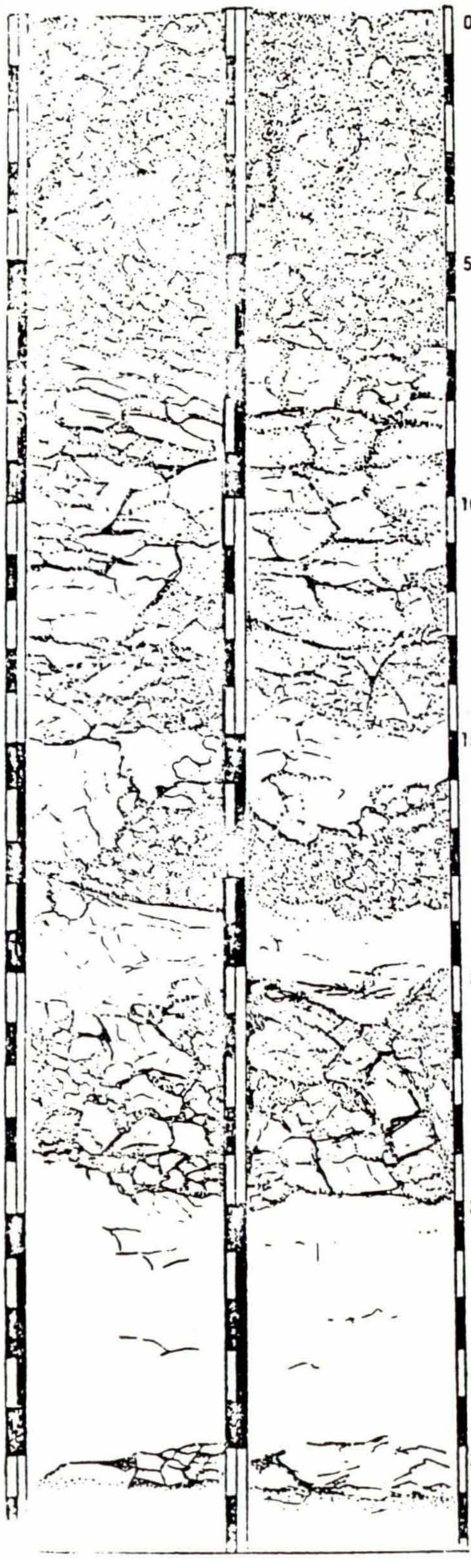
As shown in Fig. 1, ten structural units were defined on the basis of massiveness of strata, and size and type of internal polygons. Internal structure is defined as massive, marbled, or shattered. Massive strata show no internal structures, marbled strata show distinct polygons that are rounded, and which have boundaries discordant from those of neighboring polygons, and shattered structure shows angular edges, and boundaries of adjacent polygons show matching fractures. The matrix in some units appears to be not as dense or opaque as that in other units, probably because of degree of compaction rather than because of changes in composition.

In general, the core is most densely compacted near the base, and shows extremely low compaction above 4.5 cm. Rock fragments and coarse particles, other than soil clods or polygons, are not evident in any part of the core. Unit I is described separately because it is different in appearance from the rest of the core, but is probably a fractured and shattered continuation of unit II, distorted during processing. Unit III may have been partially fractured from surrounding units, because indentations in polygons of unit III match similar fractures at the boundaries of units II and IV. Unit V is different from shattered units in that it shows finer, more rounded, more even-sized particles than the shattered units; the particles are interpreted here to be sorted clasts rather than fractured spalls. Unit VIII is unusual because it exhibits features characteristic of both shattered and marbled units (see Fig. 1). Furthermore, X-ray propoerties of this unit do not correspond to physical properties, seen on the opened core.

3

RE-RADIOGRAPH OF DRIVE TUBE 74002

STEREOPAIR 1 (radiographed head-on with respect to number on outside of core) — STEREOPAIR 2 (radiographed at 90° with respect to number on core)



Interval	UNIT	Boundary	Description of Unit
0.0 - 4.5 cm.	X		Loosely compacted, marbled interval with clasts 65% of tot clasts are equant, subrounded, irregular to lumpy-marginec 2 cm. to 1 mm. in size, with clasts being 2 cm. at the bas of the unit, but averaging 3 mm. at the top.
4.5 - 7.0 cm.	IX	partially void, irregular	Interval with medium-scale marbling, with 75% clasts, 25% matrix, with elongate to irregular clasts ranging from 2 m to 1.5 cm., progressively increasing in size toward the to of the unit.
7.0 - 13.0 cm.	VIII	transitional over 1/2 cm.	Coarsely marbled to shattered interval, 90% coarse, 10% matrix or interstital material; internal polygons are 1 - 3 cm. in diameter, are evenly-sized with subrounded edges, and in this way resemble clasts, but polygons are stacked as blocks, not randomly aligned as in a marbled stratum, and many polygons show similar configuration on opposite sides of fractures.
13.0 - 14.5 cm.	VII	transitional	Shattered to marbled interval, 80% coarse particles, 20% matrix or interstital material; coarse particles are mostl rhombohedral fragments with semi-planar sides, 2 cm. to 5 in diameter; some conchoidal, cross-cutting fractures pres
14.5 - 17.5 cm.	VI	indistinct, irregular	Massive interval, moderately opaque, with common, irregula rectangular fractures and intersecting sets of fractures.
17.5 - 18.5 cm.	V	distinct, irregular	Finely marbled interval, consisting of 65% clasts, 35% mat clasts are fairly evenly-sized 5 mm. equant to elongate, irregular lumpy, randomly-aligned particles.
18.5 - 20.5 cm.	IV	distinct, semi-planar surface	Massive interval, moderately opaque, with numerous 1 - 2 c thin, horizontally-aligned, planar to conchoidal fractures
20.5 - 25.0 cm.	III	distinct, irregular	Marbled interval, with 75% clasts, 25% matrix; clasts are poorly sorted, ranging from 2.5 cm. to 2 mm., larger clast planar-faced polyhedrons, but smaller clasts are irregular subrounded lumpy objects.
25.0 - 30.5 cm.	II	distinct, but in stereopair 1 seems to show some plucking from top of underlying unit	Massive interval, moderately opaque, with scattered cm.-length, horizontal, planar to conchoidal fractures.
30.5 - 32.5 cm.	I	transitional	Shattered interval, moderately opaque, as overlying unit, with numerous 1 - 4 cm. straight to conchoidal fractures. Unit is interpreted to be a continuation of Unit II, fract and disrupted during handling.

Fig 1

DESCRIPTION OF UPPERMOST 5 MM

The uppermost 5mm was dissected in 1 mm. increments, from the top (lunar surface) down to a depth of 5 mm. At least three microstrata were identified in this interval; quantitative characteristics are presented in table 1. The uppermost stratum occupies the interval between the lunar surface and 1 mm, and consists of very fine-grained drab-grey soil with 99.4 %<1mm. The one coarse particle is an agglutinate. The next 2 mm are mixed grey and orange soil, and are somewhat coarser, containing 2% coarse material, mostly agglutinates, with a few clasts of orange soil. Although the bulk of the sample is drab-grey, small orange clasts are scattered irregularly in linear and irregular clumps around the core. The clasts appear to be 1-5 mm in diameter, and occupy 5 - ;0% of the surface of the second through fifth intervals of the 5mm dissection. From 3 to 5 mm. is a noticeable change in texture and composition. Coarse material makes up more than 10% of the sample, and there is an abundance of clasts over 5mm in diameter. Compositionally, there is a decrease in drab-grey fines, in favor of orange soil; and fragments of mare basalt make their appearance, comprising approximately 10% of the coarse fraction. Selected coarse fractions are depicted in Fig. 2, and distribution of clasts on dissection surfaces is depicted on Fig. 3.

Table 1. Textural properties of 0-5 mm of 74002.

Depth (mm.)	Sample No.	1 mm Wt.	%	1-2 mm. Wt.	%	over 2 mm Wt.	%	total (wt.)
0								
	2 - 3	1.934 gm.	99.4%	0.011 gm.	0.6%	-----	-----	1.945 gm,
1								
	4 - 5	2.188 gm.	98.0%	0.045 gm.	2.0%	-----	-----	2.233 gm.
2								
	6 - 7	2.445 gm.	97.9%	0.053 gm.	2.1%	-----	-----	2.498 gm.
3								
	8 - 9	2.426 gm.	89.9%	0.060 gm.	2.2%	0.213 gm.	7.9%	2.699 gm.
4								
	10 - 11	2.150 gm.	87.6%	0.075 gm.	3.0%	0.229 gm.	9.3%	2.454 gm.
5								

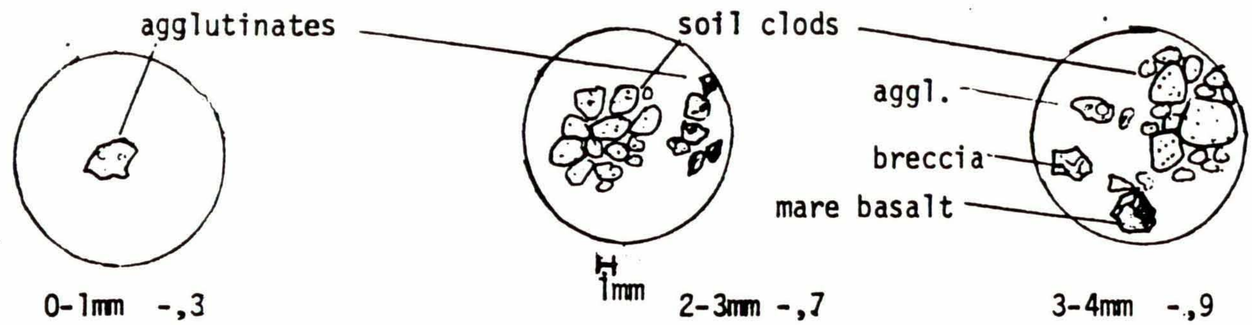


Fig. 2. Sketches of representative coarse fractions, uppermost 5mm, 74002.

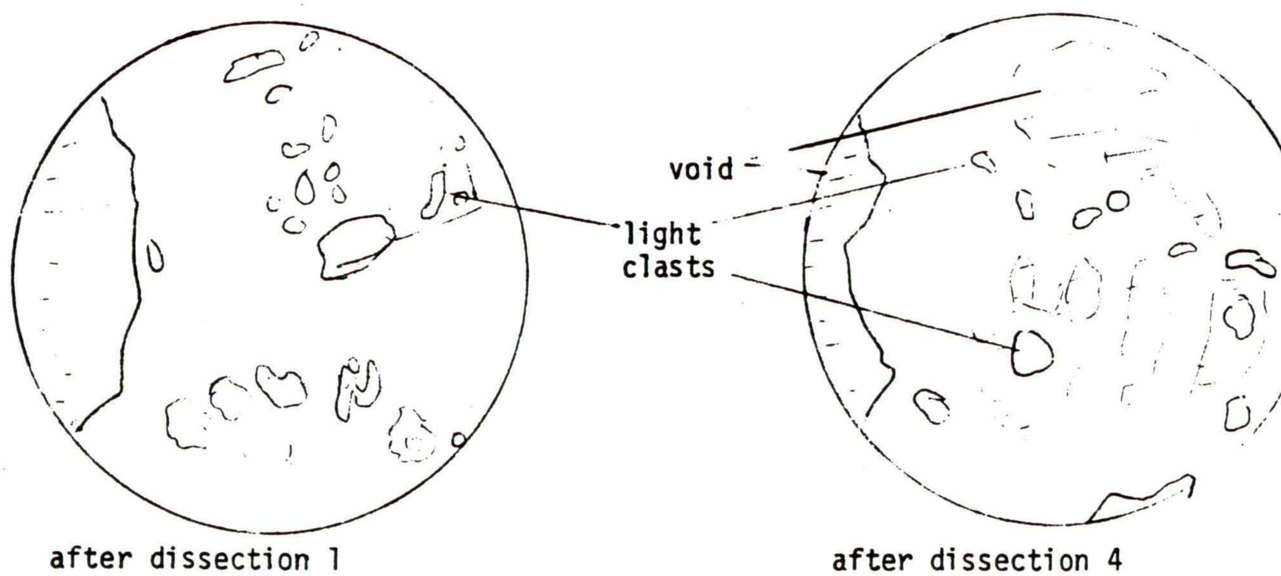


Fig. 3, Sketch of light clasts on surface of core during 5mm dissection. (Diameter in both cases is 4 cm.)

DESCRIPTION OF THE EXPOSED CORE

After the smeared surface of 74002 was scraped away, some stratigraphic changes within the core were evident. The base of the core was dark drab (5Y 2/1) and showed a smooth color gradationto dark orange (10YR 2/1) between 32 and 16 cm. Between 16 and 11 cm., orange soil is at a maximum and soil color is 7.5 YR 5/4. Soil is dark orange 10YR 2/1 between 11 and 4.5 cm., but darkens noticeably toward the top of the section, where the matrix is dark drab (5Y 5/1) and clasts drab (10Y 4/1).

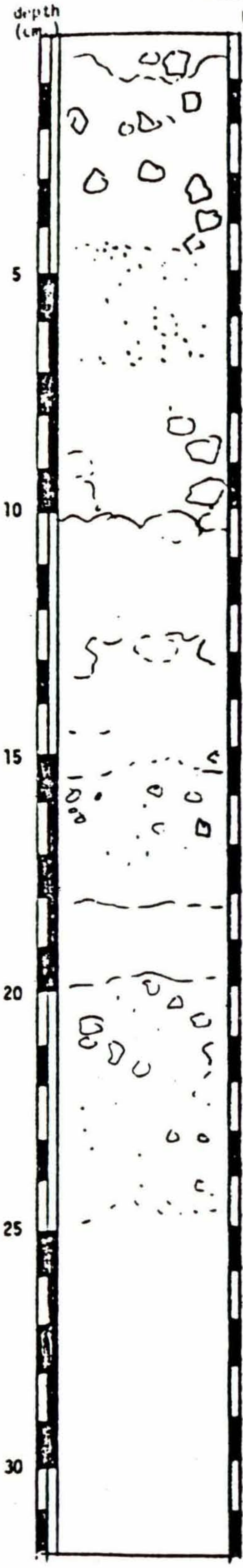
Many structures and features seen in the X-radiographs could be recognized after the core was opened. The marbled intervals, units III and V (16 - 18 cm. and 20 - 24 cm.) appear as zones that tend to show an inhomogeneous and cloddy scraped surface, whereas the massive zones between 18-20 cm. and 24-32 cm. scraped off smoothly and cleanly. Likewise, the marbled structure of the low density zone at 0 - 4.5 cm. shows clearly on pre-dissection photographs as well as X-radiographs. The reduced density material between 4.5 and 7 cm. can be differentiated from the massive strata between 7 and 16 cm. both on X-radiographs and pre-dissection photographs, although it is not as noticeable as the low density cloddy zone at the top of the core. On the other hand, structures between 7 and 16 cm. do not correspond to X-radiograph structures; instead the structures in the exposed core are related to composition. Flattened to slightly rounded, cm.-sized orange clasts make up the entire interval between 10.5 and 13 cm.; such clasts also make up 50% of the core between 10.5 and 8 cm. Slightly darker soil is interstitial to the clasts between 10.5 and 8 cm.

Size of grains is difficult to assess because most particles are very small. Estimates shown here and on Fig. 4, are for particles coarser than .1mm, which are visible under the dissecting microscope. Below 26 cm., grain size is very fine, with only 2% coarse material (over .1mm); and approximately half of the coarse particles are doubled or compound droplets. At 27 cm., there is an increase in maximum grain size, from .1 to .25mm, but abundance of coarse particles does not increase until 26 cm, where coarse particles make an abrupt increase to 4 - 5% of the total. Concurrently, double and compound grains decrease to approximately 1/3 of the total. From 22 to 17 cm., abundance of coarse particles drops from 4 to 2%, but compound droplets continue to make up 1/3 of the coarse fraction. From 17 to 2 cm., the coarse fraction makes up 3 - 5% of the sample, but less than 20% of the coarse fraction consists of double and compound grains. Principal changes between 14 and 7 cm. are in composition, and not size. In this part of the section, where there are orange clasts, the particles in the orange clasts are finer than those in the dark matrix. Above 2 cm, abundance of coarse particles decreases to 1-2%.

TENTATIVE ASSIGNMENT OF STRATIGRAPHIC UNITS

On the basis of X-radiography and examination of the exposed core, a preliminary assignment of nine stratigraphic units can be made (Fig. 4). The first, or lowest unit of the exposed core includes units I and II of the radiographs, primarily because I of the radiograph is a shattered artifact at the base of II. The lowest exposed core unit is dark, fine-grained, dense and compact, and is rich in compound particles. The second exposed core unit, from 25 to 20 cm., corresponds to X-ray unit III, and is coarser than the lowest unit, is slightly lighter orange in color, and contains 1/3 compound particles instead of 1/2, in the coarse fraction. The change from unit 1 to 2 is fairly major and abrupt. The third unit is similar to the first in being relatively dark and massive, but compound particles are less abundant. The fourth unit is similar in color and abundance of droplets to the third, but it is less dense and coarser grained. Although the lowest four units of the exposed core closely match the X-ray units, the next three do not correspond to the X-ray units, even though there are the same number of units. Unit five, between 16 and 14 cm., is relatively massive, moderately orange in color, and shows a decrease in compound droplets, compared to four. Six, between 14 and 10.5 cm., is rich in orange clasts, and seven, between 10.5 and 7 cm., has numerous orange clasts in a darker matrix. Unit eight resembles the matrix of seven, but is slightly less dense and lacks orange clasts. Nine is much more clod-rich and much less dense and compact than all underlying units.

PRELIMINARY DESCRIPTION OF 74002 BEFORE FIRST DISSECTION



UNIT	MASSIVENESS	COLOR	PERCENT COARSE	COMPOU DROPL
			1 - 2 %	10 in 6
nine	crumbly, clod-rich	5Y 5/1	3 - 5 %	10 in 60
eight	slightly friable	10YR 2/1	3 - 5%%	10 in 60
seven	massive, clasts as friable as matrix	10YR 2/1 (matrix) 7.5YR 5/4 (orange clasts)	3 - 5%%	10 in 60
six	as above	as orange	3 - 5 %	10 in 60
five	as above	10YR 2/1	3 - 5 %	10 in 60
four	crumbly, clod-rich	as above	3 - 5 %	10 in 5
three	massive	gradational	2 - 3 %	20 in 60
two	crumbly	gradational	4 - 5 %	20 in 60
			2 - 4 %	20 of 35
one	massive	5Y 2/1	1 - 2 %	20 of 43
			1 - 2 %	20 of 41

Fig 2

c

DISSECTION

74002/01 is unusually homogeneous, for a lunar core, and probably represents relatively undiluted volcanic material. An important aid in understanding lunar volcanism is knowing whether the section in 74002/01 is continuous or fragmented. Three possibilities are present: (1) the section is an undisturbed clast representing a continuous section of volcanic material, (2) the section is a partially fragmented clast, and is partially continuous, (3) the section is an overturned flap of pulverized or disrupted volcanic material from near the floor of Shorty Crater. Especial care should be taken in dissection, to compare lateral and vertical changes in texture and composition, to test the possibility of small-scale inhomogenieties that could be characteristic of a disrupted section. Attempts shall be made to expose the semi-planar surface, seen at 18 cm. on stereopair 1, to determine the nature of the surface. Because agglutinates were found in the top 5 mm, the upper, less dense part of the core should be dissected with special care, to search for authigenic agglutinates and other oriented particles. Some clasts in the orangest part of the section should be extracted separately, to help determine if most orange clasts are more pure orange glass than the 74220 bulk soil. Otherwise, standard dissection procedures should apply.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1977 – 771-015/1451