NASA TECHNICAL MEMORANDUM

NASA TM X-58070
October 1971

# DESCRIPTION, DISSECTION, AND SUBSAMPLING OF APOLLO 14 CORE SAMPLE 14230



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NASA TM X-58070

# DESCRIPTION, DISSECTION, AND SUBSAMPLING OF APOLLO 14 CORE SAMPLE 14230

Roald Fryxell and Grant Heiken
Manned Spacecraft Center
Houston, Texas 77058

ABSTRACT

Core sample 14230, collected at Triplet Crater near the Fra Mauro landing site of the Apollo 14 mission, has been dissected in greater detail than any previous core. Sediment from the actual lunar surface was missing, and 6.7 grams of sediment were removed from the base of the core for a portion of the biotest prime sample. Upper and lower portions of the original 70.7-gram core (12.5 centimeters long) were fractured excessively but not mixed stratigraphically. Three major morphologic units and 11 subdivisions were recognized. Dissection provided 55 subsamples in addition to three others made by removing longitudinal sections of the core impregnated with n-butyl methacrylate for use as a permanent documentary record and for studies requiring particles of known orientation.

# DESCRIPTION, DISSECTION, AND SUBSAMPLING OF APOLLO 14 CORE SAMPLE 14230

By Roald Fryxell* and Grant Heiken
Manned Spacecraft Center

## INTRODUCTION

Core-tube samples of relatively undisturbed lunar regolith (CT 1, CT 2, CT 3, and CT 1T) were collected in four drive tubes by the commander and the lunar module pilot at the Apollo 14 landing site near Fra Mauro (ref. 1). The first core opened was drive tube 1, containing sample 14230. Drive tube 1 was used initially at station C' near Cone Crater on the second extravehicular activity but failed to retain a sample. The tube was reused at Triplet Crater, station G (fig. 1), in an attempt to obtain a core that was three drive-tube sections in length. At that time, the base of drive tube 1 was driven to a depth of 45 centimeters greater than the actual length of the core tube (ref. 2, table 4-III). At the time of withdrawal, the sample appeared to have been lost both from the base of the tube and from the upper end (from which the Teflon follower also was lost when the core-tube segments were disassembled and the ends were capped in situ). As a result, the sample was not supported at either end during transport from the moon, and sliding within the tube may have caused much of the severe cracking observed in the sample when the split-tube liner was opened. The sampling locality (fig. 2) was documented by the commander's reference to the drive tube by number (ref. 3, table 3-II) and by photographs (fig. 3).

Despite the problems that occurred during sample collection, a core 12.5 centimeters long, weighing 70.7 grams, was retained in the drive tube. Because some of the sample was lost from the top of the tube, the uppermost portion of the core did not contain lunar-surface material. Neither does the base of the sample represent material from the maximum depth of 45 centimeters to which the tube was driven, because (1) an unknown amount of sediment was lost from the tube when it was extracted and (2) 6.47 grams of sediment were taken from the base of the tube on February 14, 1971, in the Lunar Receiving Laboratory (LRL) for the biotest prime sample. Plugs of Teflon and of aluminum foil were inserted at the ends of the sample at that time.

Although sample 14230 is the least satisfactory core that has been obtained during any lunar-landing mission, it is the first to be dissected and subsampled without the constraints of quarantine conditions. As a result, the greater time and care made possible for this work have yielded subsamples providing certain opportunities for detailed study not possible with subsamples dissected previously.

*Laboratory of Anthropology, Washington State University, Pullman, Washington 99163.

The observations and procedures recorded in this report document the morphology, dissection, and subsampling of sample 14230. This report of the preliminary examination of sample 14230 will be useful during later studies by principal investigators as a reference catalog and a means of coordinating data concerning detailed physical and chemical properties, including mineralogy and particle-size distribution.

The authors thank Gustaf Arrhenius for collaboration in the selection of procedures for stabilizing the core; Henry Cantu for X-radiography; David Carrier for critical review of the manuscript; Richard Fuhrman for assistance in the curator's laboratory; and Allan Locke for the photography. Work was made possible, in part, through NASA contract NGL 05-009-154.

## SAMPLING EQUIPMENT

The drive-tube core-sampling equipment used on the Apollo 14 mission was essentially identical to that used on the Apollo 12 mission and differed from the Apollo 11 equipment in having a tapered bit on the outside rather than on the inside. After the tube is driven, cores usually are supported at the top by a Teflon follower; the bit and the handle are discarded immediately, and the bit is replaced by a metal cap. The drive tube is designed (ref. 4, fig. 4-9; ref. 5, fig. 10-80) so the core can be removed by extracting a liner that is split lengthwise and held together by a Teflon sheath. The interior dimensions of the liner are 31.75 centimeters in length and 1.95 centimeters in diameter.

Distortion of the sample resulted primarily from compression, fracturing, and smearing of a thin zone along the liner wall. Core-sample distortion that has occurred during the dissection of six lunar-soil cores has been less than that observed by Carrier et al. (ref. 6) during the dissection of cores composed of kaolinite and sand to simulate lunar soil. Substantial mixing of stratigraphic units has not been observed.

## PRELIMINARY EXAMINATION BY X-RADIOGRAPHY

The four Apollo 14 core samples were examined by X-radiography (ref. 1) before the dissection of sample 14230. Each core was X-rayed four times to obtain stereopairs; the plane of view of the second stereopair was at a 90° angle from that of the first stereopair. Medical X-ray equipment in the Crew Reception Area of the LRL was used to obtain the X-rays. The exposure settings were 72 kilovolts, 300 milliamperes, and 1/30 second with the X-ray head 0.9 meter above the sample. The procedures followed were essentially those described in reference 7.

Study of the images as stereopairs provided an indication of grain size; shape and location of coarse particles; changes in density or, possibly, in composition of matrix; fracturing; and layering in each sample. Specifically, examination of sample 14230 showed slumping of the unsupported ends of the core, severe fracturing and void spaces in the upper one-third of the sample, and two or three probable layers. Particles 2 millimeters or greater in diameter were estimated to comprise approximately 15 percent of the matrix (fig. 4). Most fragments appeared to be equant to elongated and subangular to subrounded. By examination of several groupings or alinements of coarse particles, it was possible to infer that the sample had not necessarily been homogenized by sliding in the tube and that additional layers might be found during dissection. One large fragment, 1.2 centimeters long, was visible near the base of the core and was situated such that the long axis was horizontal to that of the core sample.

Preparation of schematic drawings of the stereopair substantially assisted in the dissection of the core and in the identification of individual coarse fragments during subsampling.

## DISSECTION AND SUBSAMPLING OF THE CORE

Sample 14230 was opened in a nitrogen-gas atmosphere under positive pressure on July 13, 1971. During the next 9 days, the sample was drawn, photographed, and dissected. First, the liner was removed from the drive-tube barrel by use of a mechanical extruder and then locked horizontally in a vise block so that the Teflon sheath could be slit, and the upper half of the split-tube liner could be lifted off.

Before dissection, the core was photographed on black-and-white and on color film at a scale of 1:1 with approximately 50 percent overlap between frames and on single frames from directly above and from the left side (fig. 5). A listing of photographic documentation is provided in table I. A diagram (fig. 6) also was prepared at a scale of 1:1, and the surface morphology was compared with X-ray stereopairs to delineate the stratigraphy as dissection progressed.

The dissection was conducted in the following manner. The fine matrix was removed a few milligrams at a time, by using small, stainless-steel spatulas, and transferred to bolt-top McKinney containers of stainless steel and aluminum. Coarse fragments were transferred by stainless-steel forceps or wire tongs to individual containers whenever desirable. Subsampling boundaries were determined during dissection on the basis of morphology, wherever possible, or by arbitrary subdivision if morphologic units exceeded 5 millimeters in thickness. Thus, all subsamples are representative of material not more than 5 ± 1 millimeter along the length of the core; each interval, in turn, was further subdivided into two or more containers by collecting the upper portion of the sample interval in fluorescent light for examination and morphologic description and by collecting a matching sample in red light only.

To protect samples intended for thermoluminescence study, only the upper one-third diameter of the core was dissected while illuminated by the fluorescent cabinet lights. After the core morphology had been described, the sediment, illuminated by red light, was dissected to the midline. After all material exposed to white light had been removed, a duplicate sample exposed only to red light was removed from the bottom half of the liner to a depth of approximately 2 millimeters. Samples collected under red light were exposed approximately 1 to 3 minutes; individual scoops removed by spatula were exposed 30 to 60 seconds. Stratigraphic mixing of individual samples was avoided by working transverse to the long axis of the core.

Dissection by this procedure resulted in 54 closely documented subsamples, comprised mostly of matrix and of individual fragments removed from known stratigraphic provenance. The relationship of these samples to the morphology of the core and relative depth is indicated schematically in figures 4 and 7.

## MORPHOLOGY OF THE CORE

Three distinct morphologic units and 11 morphologic subdivisions of those units were recognized in sample 14230. The boundaries of these morphologic units were defined on the basis of coincident changes in characteristics such as color, texture, structure, consistency, distribution of coarse particles and alinement of the long axes, and the nature of both coherent and incoherent materials within the units. On these bases, it is evident that the core, though crushed at both ends and fractured more than any other core yet collected, has not been mixed stratigraphically except at the ends.

Except for the lower half of the double core tube collected at Halo Crater on Apollo 12 (refs. 8 and 9), the core is browner (overall), coarser in texture, less cohesive, and more complexly stratified than any other previously opened (ref. 10) cores. The original length and weight of sample 14230, before removal of the biotest prime sample, were 12.5 centimeters and 70.7 grams, respectively. In the upper one-third of the core, fractures that were open the entire diameter of the core defined fragile, blocky structures up to 5 centimeters or more across. The middle layer is slightly lighter in color, finer in texture, and more cohesive than the adjacent layers (fig. 6).

No crustlike or strongly contrasting layers comparable with those of the Apollo 12 double core tube from Halo Crater (layers VI and IX, for example) were observed. Three incoherent ellipsoidal bodies of light gray material, occurring in alinement in morphologic unit IIIA, resemble those first observed in Apollo 11 cores (ref. 11) and may be remnants of a thin but distinctive layer. Because of the incoherence and small size ($<1$ millimeter), the layers were impossible to separate with the tools available. Other types of material included in the matrix — such as glass spheres; rock fragments (many of which are lighter gray than the matrix); weakly coherent aggregates resembling the matrix; and small, weakly coherent ($\approx 1$ millimeter) whitish pellets (most common in morphologic unit III) — were separable from the matrix and superficially resemble features previously observed in other cores. Particles coarser than 0.5 millimeter frequently were found in alinement, often with the long axes oriented in subhorizontal positions, and were especially useful in providing evidence of depositional surfaces separating morphologic subdivisions (fig. 7).

Calculation of bulk density was impossible because of the fracturing of the core and the presence of void space, especially at the top. Mechanical analysis was not attempted, because it was desirable to preserve the samples for other purposes. Qualitative impressions that the core is slightly coarser than others dissected (excluding the coarse layer of Apollo 12 core 12028) are only partially supported by the analysis of other core samples collected during the Apollo 14 mission (ref. 1; ref. 2, fig. 4-21). Other impressions that the material is less cohesive than cores from Apollo 11 and 12 agree with soil mechanics data from surface studies and from preliminary examination (ref. 2).

Bedding planes intersect the core obliquely at several points. Because the tube was driven at an angle, some of these planes actually may have been horizontal at the sampling site. Reorientation of the core to the proper position may be possible through further study of X-ray stereopairs and surface photography. However, not all boundary planes are parallel; therefore, not all depositional surfaces were flat or sedimentary units of even thickness. A systematic morphologic description of the core, with a listing of subsamples removed from each recognized unit, is contained in table II.

## PRESERVATION OF CORE STRATIGRAPHY

Sediment remaining in the lower half of the split-tube liner was impregnated with n-butyl methacrylate to form three additional subsamples for preserving intact the stratigraphy of sample 14230 (fig. 8). The first two of these subsamples consist of so-called peels produced by coating the exposed surface of the remaining core sediment with a viscous solution of the methacrylate and allowing the surface to polymerize over a curing period of 24 hours or longer during which the methacrylate penetrated the sediment to depths of 1 to 3 millimeters. After removal of the first two sections of impregnated sediment, the remainder of the core also was impregnated and will remain in storage indefinitely. In all three cases, the methacrylate impregnation serves to stabilize individual grains of the regolith in the relative stratigraphic position and at the orientation in which the grains were returned in the drive tube.

Subsample 14230,56 (peel 1) best displays the characteristics of the core observed during dissection and is intended as a permanent reference document of stratigraphy and morphology of the lunar core, to which analytical data derived in the future may be related directly or which may be studied by nondestructive techniques. The layer (approximately 1 millimeter thick) that was disturbed by dissection comprises the back of the peel that averages 2 to 3 millimeters in thickness; the exposed face of the peel is essentially undisturbed (fig. 5).

Subsamples 14230,57 (peel 2) and 14230,58 (the portion impregnated in the tube liner) are intended for eventual subsampling. Material to be studied for analyses requiring knowledge of grain orientation may be removed by dissection or may be liberated from the impregnated matrix by dissolving and washing away the methacrylate with acetone. Until such studies are considered desirable, the impregnated sections are protected by the methacrylate bond.

## CONCLUSIONS

Core sample 14230 consists of lunar sediment taken from a depth not exceeding 45 centimeters below the surface of the regolith and lacks the original surface material that was lost from the top at the time of collection. Otherwise, the sediment has not been mixed during transport despite serious fracturing.

This core is the first one that has been dissected with the benefit of stereographic X-radiography before opening and without the time and technique limitations imposed by quarantine procedures. Thus, the subsamples of core 14230 offer opportunity for the study of physical and chemical properties on a more detailed depth and frequency basis than subsamples obtained from Apollo 11 or 12 cores.

Layering recognized in sample 14230 is more subtle and less complex than that of the sample collected in a double core tube at Halo Crater on Apollo 12. Layers in sample 14230 are evident, however, from macroscopic differences in the nature of the matrix and the abundance and lithology of particles coarser than 2.0 millimeters in each of the three major morphologic units.

Stabilization of these morphologic characteristics by impregnation with n-butyl methacrylate provides the first permanent record of stratigraphy in the lunar regolith and offers the first opportunity for studies of single oriented grains or fine particles comprising the core matrix.

Manned Spacecraft Center
National Aeronautics and Space Administration
Houston, Texas, November 9, 1971
914-40-52-01-72

## REFERENCES


1. Lunar Sample Preliminary Examination Team (LSPET): Preliminary Examination of Lunar Samples. Apollo 14 Preliminary Science Report, sec. 5, NASA SP-272, 1971.

2. Mitchell, J. K.; Bromwell, L. G.; Carrier, W. D., III; Costes, N. C.; and Scott, R. F.: Soil Mechanics Experiment. Apollo 14 Preliminary Science Report, sec. 4, NASA SP-272, 1971.

3. Swann, G. A.; Bailey, N. G.; Batson, R. M.; Eggleton, R. E.; Hait, M. H.; Holt, H. E.; Larson, K. B.; McEwen, M. C.; Mitchell, E. D.; Schaber, G. G.; Schafer, J. B.; Shepard, A. B.; Sutton, R. L.; Trask, N. J.; Ulrich, G. E.; Wilshire, H. G.; and Wolfe, E. W.: Preliminary Geologic Investigations of the Apollo 14 Landing Site. Apollo 14 Preliminary Science Report, sec. 3, NASA SP-272, 1971.

4. Costes, N. C.; Carrier, W. D., III; Mitchell, J. K.; and Scott, R. F.: Apollo 11 Soil Mechanics Investigation. Apollo 11 Preliminary Science Report, sec. 4, NASA SP-214, 1969.

5. Scott, R. F.; Carrier, W. D.; Costes, N. C.; and Mitchell, J. K.: Mechanical Properties of the Lunar Regolith. Apollo 12 Preliminary Science Report, sec. 10, part C, NASA SP-235, 1970.

6. Carrier, W. David, III; Johnson, Stewart W.; Werner, Richard A.; and Schmidt, Ralf: Disturbance in Samples Recovered with the Apollo Core Tubes. Vol. 3 of Proceedings of the Second Lunar Science Conference, A. A. Levinson, ed., MIT Press (Cambridge, Mass.), 1971, pp. 1959-1972.

7. Bouma, Arnold H.: Methods for the Study of Sedimentary Structures. Wiley-Interscience, 1969.

8. Lunar Science Preliminary Examination Team (LSPET): Preliminary Examination of Lunar Samples. Apollo 14 Preliminary Science Report, sec. 12, NASA SP-272, 1971.

9. Lindsay, John F.; Heiken, Grant H.; and Fryxell, Roald: Description of Core Samples Returned by Apollo 12. NASA TM X-58066, 1971.

10. Anon.: Munsell Book of Color. Munsell Color Company, Inc., Baltimore, Md., 1963.

11. Fryxell, Roald; Anderson, Daniel; Carrier, David; Greenwood, William; and Heiken, Grant: Apollo 11 Drive-Tube Core Samples: An Initial Physical Analysis of Lunar Surface Sediment. Science, vol. 167, no. 3918, Jan. 30, 1970, pp. 734-736.

TABLE I. - SAMPLE 14230 PHOTOGRAPHY[a]

| Type of view | NASA photograph nos. |
|---|---|
| **Black and white** | |
| Predissection: | |
| Side | S-71-40142 to 40150<br>S-71-40169 to 40177 |
| Top | S-71-40156 to 40162<br>S-71-40163 to 40165 |
| Postdissection: | |
| Peels | S-71-40178 to 40187 |
| Top | S-71-40984 to 40955<br>S-71-40962 to 40963<br>S-71-40971 to 40980<br>S-71-40991 to 40993 |
| Techniques: | |
| Dissection | S-71-40151 to 40153<br>S-71-40166 to 40167<br>S-71-40956 to 40962 |
| Peels | S-71-40964 to 40970<br>S-71-40981 to 40990 |
| **Color** | |
| Peels: | |
| Top | S-71-41172 to 41186<br>S-71-41189<br>S-71-41195 |
| Predissection and postdissection: | |
| Top | S-71-40210 to 40222<br>S-71-40223 to 40231 |
| Predissection: | |
| Side | S-71-40226 to 40231 |
| Technique: | S-71-41187 to 41188<br>S-71-41190 to 41194<br>S-71-41196 to 41199<br>S-71-40796 and 40798 |

[a]Lunar-surface photographs are AS14-68-9455 to 9458.

TABLE II. - MORPHOLOGIC DESCRIPTION OF SAMPLE 14230

| Color | Texture | Structure | Consistency | Special features | Morphologic subunits | Nature of boundary |
|---|---|---|---|---|---|---|
| | | | | Unit III[a] | | |
| Dark grayish-brown (10YR 4/2) | Matrix of fine to very fine sand and silt | Distinct, fragile prismatic to subangular, blocky aggregates, 2 to 5 mm across, breaking to blocks approximately 2 mm in diameter to single grains | Loose to very weakly coherent; reforms fragile clumps less than 1 mm in diameter | Unit is fractured throughout with open cracks penetrating entire diameter of core; includes coarse fragments to 5 mm in diameter, grouping of alined incoherent ellipsoidal light gray inclusions less than 1 mm in diameter, scattered and weakly coherent round to subrounded white inclusions (aggregates?), and weakly coherent subangular aggregates same color as matrix. | IIID: 11.6 to 13.0 cm; severely disturbed; estimated 1/4 to 1/3 void space; "fluffy" behavior; contains weakly coherent white inclusions and piece of ropy glass (gray, curved, 5 by 1.2 mm); see subsamples 14230,51 to to 14230,54.<br><br>IIIC: 13.0 to 14.2-14.3 cm; very fractured; loose; coarser texture with more visible sand grains than IIIB; some void space at edge of tube; contains subrounded whitish inclusions to 0.5 mm in diameter; see subsamples 14230,46 to 14230,50.<br><br>IIIB: 14.2-14.3 to 15.3 cm; fractured throughout; cross-fracture at top coincides with alined coarse grains, hence, probably is a bedding plane; slightly more cohesive than IIIA; see subsamples 14230,42 to 14230,45.<br><br>IIIA: 15.3 to 16.7-17.1 cm; more fractured and coarser than IIC; less cohesive; contains visible, fine sand grains, light gray incoherent inclusions, and aggregates same color as matrix; see subsamples 14230,36 to 14230,41. | Contact recognized on basis of color (slightly lower value than II), texture (finer below), structure (less fractured below), consistency (more coherent below), and coincidence of coarse particles with long axes alined with contact; plane of contact crosses core obliquely as an open fracture |
| | | | | Unit II[b] | | |
| Dark grayish-brown (10YR 4/2 to 5/2) | Matrix of silt and smaller particles with few visible individual grains | Distinct, fragile, prismatic to subangular, blocky aggregates, 5 to 8 mm across, breaking to angular or subangular blocks 1.5 to 2 mm in diameter | Weakly coherent; reforms fragile crumb-like clumps to 1.5 mm in diameter | Unit is most coherent portion of core; contains angular to subangular coarse fragments to 5 mm in maximum diameter, some lighter in color than matrix, and weakly coherent aggregate same color as matrix, 2.0 by 2.5 mm | IIC: 16.7-17.1 to 18.0 cm; abrupt decrease in fracture size, frequency, and texture, and increase in coherence compared with IIIA; contains subangular fragments to a maximum dimension of 4 mm; see subsamples 14230,32 to 14230,35.<br><br>IIB: 18.0 to 19.0-19.8 cm; slightly lower color value than adjacent subunits; few more visible sand grains; separates by cross-fracture from IIA; see subsamples 14230,25 to 14230,31.<br><br>IIA: 19.0-19.8 to 20.0-20.8 cm; more coherent and less separation along fractures than adjacent subunits; finer texture than IIB or ID; boundaries cross core obliquely but are approximately parallel to each other; see subsamples 14230,20 to 14230,24. | Contact recognized on basis of color (slightly higher value than I), texture (coarser below), consistency (more coherent than below), structure (prismatic in contrast to subangular blocky with some open fractures below), cross-fracture coinciding with other changes; plane of contact crosses core obliquely but not parallel to top of II |
| | | | | Unit I[c] | | |
| Dark grayish-brown (10YR 4/2) | Matrix of very fine sand and silt | Distinct, fragile, subangular, blocky aggregates, 3 to 5-mm maximum dimension; breaking to smaller blocks or single grains; highly fractured at base | Loose to very weakly coherent; reforms clumps 1 mm or smaller in diameter | Base was disturbed by sample removal and aluminum foil plug inserted at the LRL; contains subangular to subrounded coarse fragments to a minimum diameter of 5 mm (most fragments smaller than 3 mm, most lighter gray than matrix); also contains occasional weakly coherent whitish inclusions smaller than 0.2 mm in diameter. | ID: 20.0-20.8 to 21.5 cm; texture of matrix intermediate compared with adjacent units; contains subangular fragments to 5 mm in diameter, lighter gray than matrix, occasional whitish inclusions, one black sphere observed; see subsamples 14230,15 to 14230,19.<br><br>IC: 21.5 to 22.6 cm; boundaries marked by alinements of coarse fragments and transverse bedding-plane fracture at base; see subsamples 14230,10 and 14230,12 to 14230,14.<br><br>IB: 22.6 to 23.6 cm; partially disturbed; contains large fragment 1.4 by 0.9-0.6 cm; see subsamples 14230,4 to 14230,9 and 14230,11 (rock fragment).<br><br>IA: 23.6 to 24.0+ cm; disturbed and loose at base of core but otherwise disaggregated and mixed; see subsamples 14230,2 to 14230,3 and 14230,1 (fines swept from interior of upper half of split-tube liner). | Not applicable |

[a]Depth of 11.6 to 16.7-17.1 cm below top of drive-tube liner.

[b]Depth of 16.7-17.1 to 20.0-20.8 cm below top of drive-tube liner.

[c]Depth of 20.0-20.8 to 24.0+ cm below top of drive-tube liner (6.47 grams removed in LRL for biotest prime sample on Feb. 14, 1971).

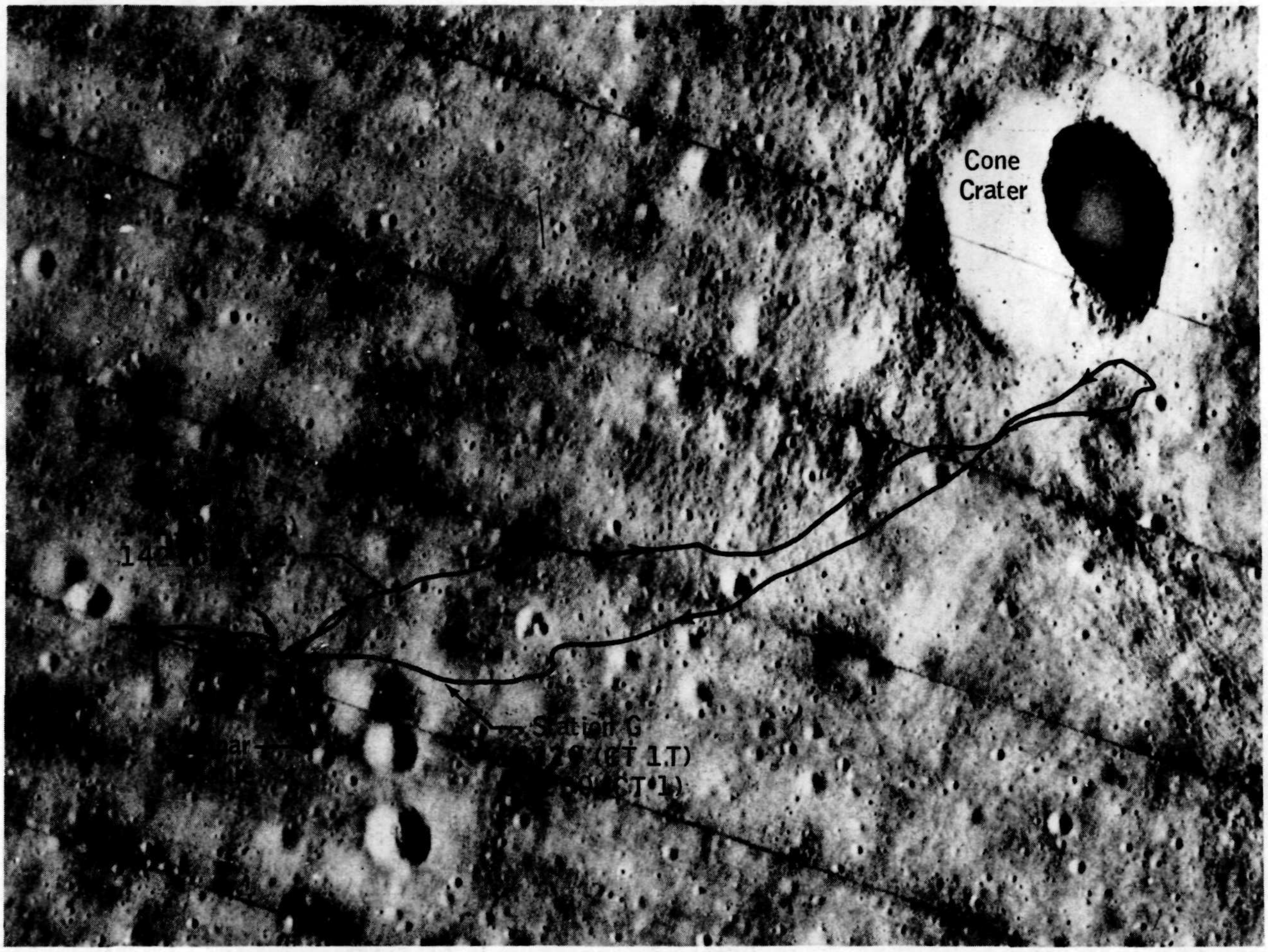



Figure 1. - Locations of core samples at the Apollo 14 landing site.

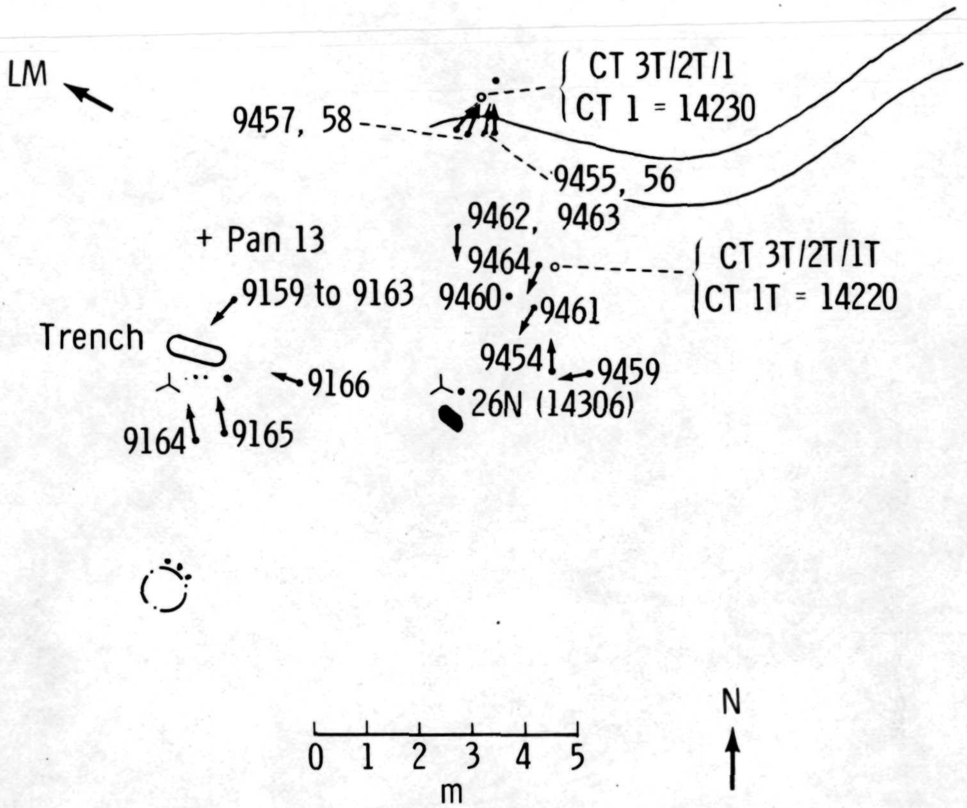



Figure 2. - Planimetric map of station G at the Apollo 14 lunar module (LM) landing site, showing location of core sample 14230 relative to locations of core sample 14220 and other documented samples (including trench).

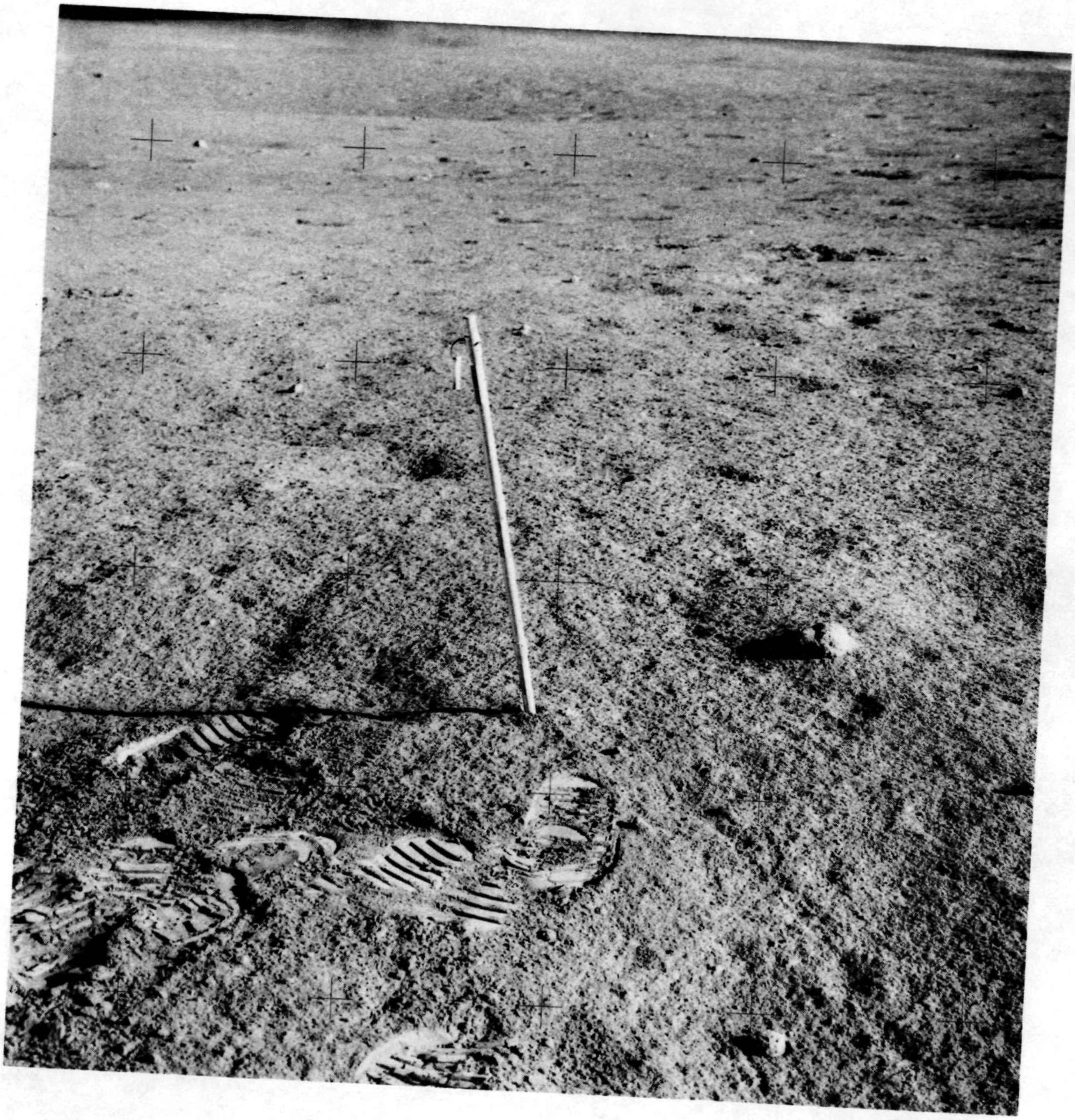


Figure 3. - Drive tube 1 in lunar surface at location of core sample 14230.

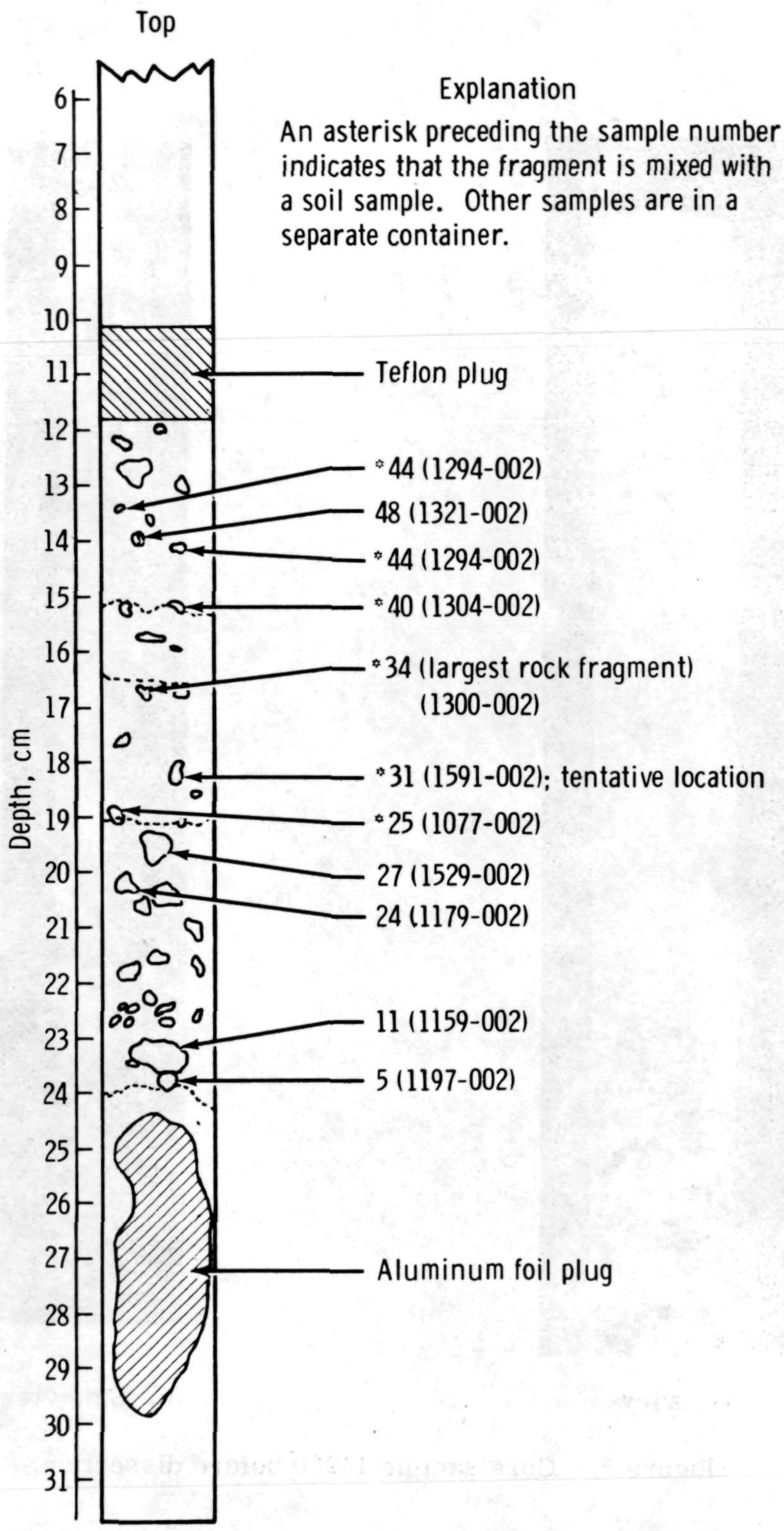
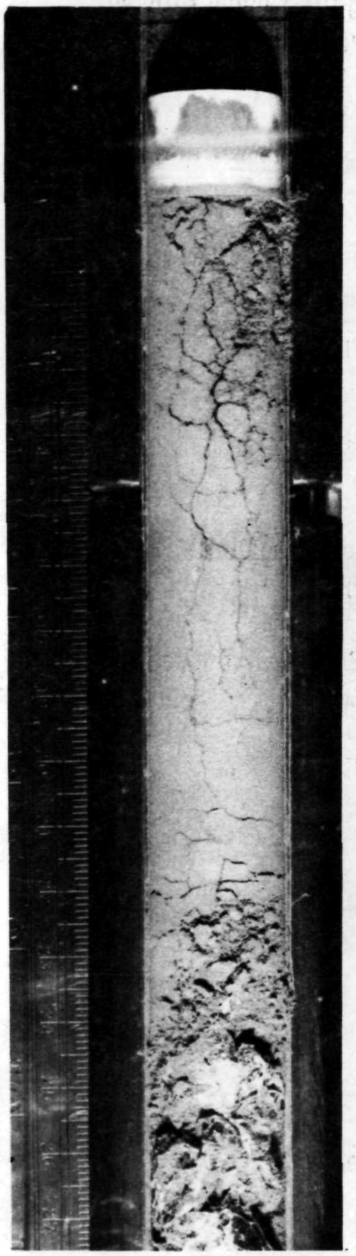
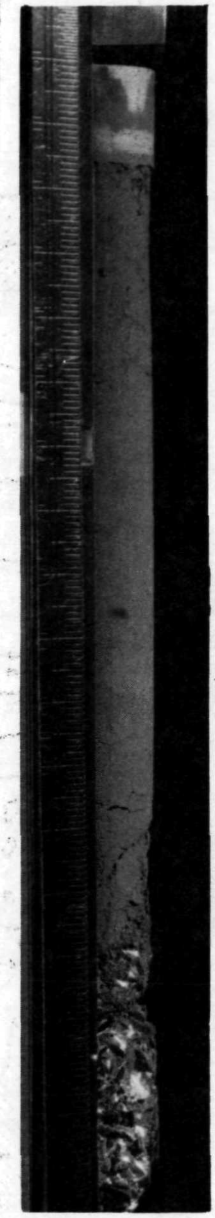



**Figure 4. - Schematic diagram based on stereopair 1, showing relationship of subsamples from matrix of core sample 14230.**



(a) Top view.



(b) Side view.

Figure 5. - Core sample 14230 before dissection.

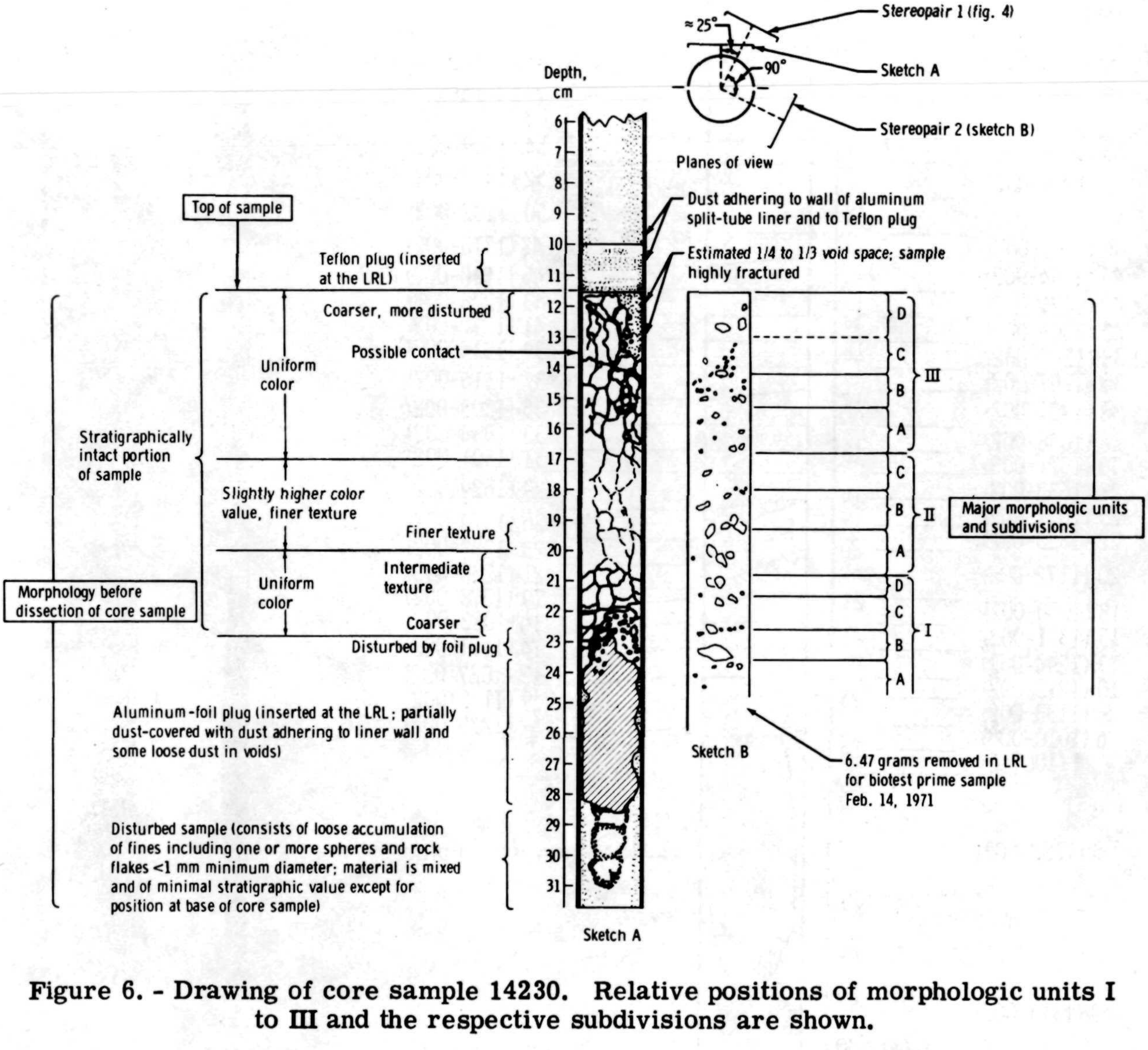



**Figure 6. - Drawing of core sample 14230. Relative positions of morphologic units I to III and the respective subdivisions are shown.**

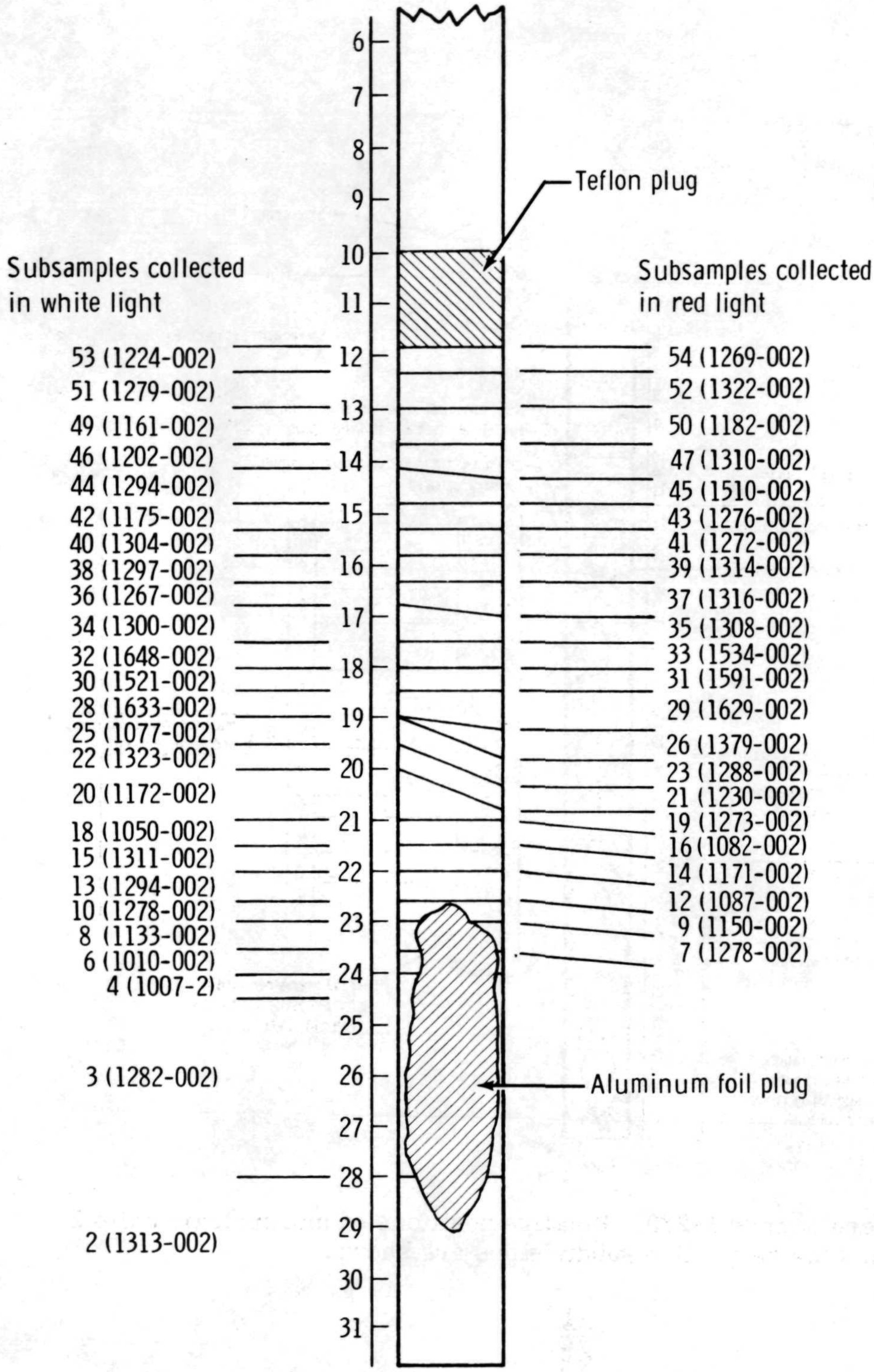



Figure 7. - Drawing based on X-radiography of core sample 14230. Locations of grains removed as individual subsamples are shown. Numbers in parentheses indicate container number.

TOP

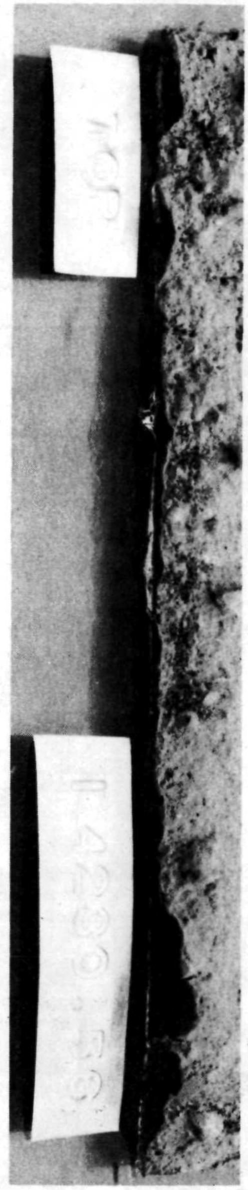


Figure 8. - Sections of sample 14230 after stabilization with n-butyl methacrylate.

NASA — MSC