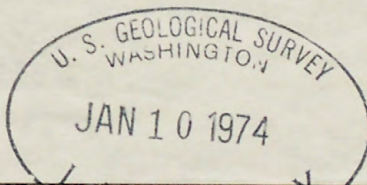
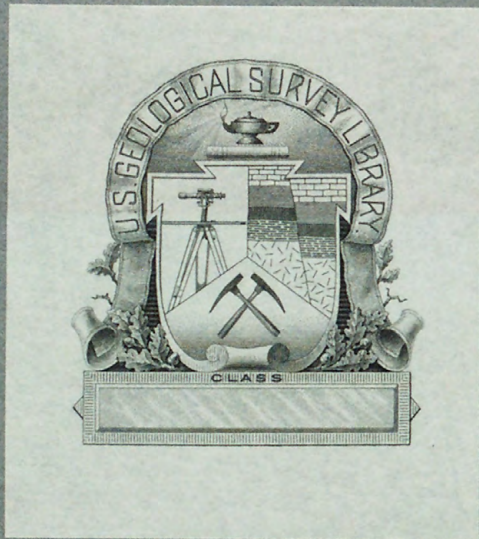


U. S. Geological Survey.

REPORTS-OPEN FILE SERIES, no. 1591: 1971.



(200)  
R29o  
No. 1591



(200)  
R290  
no. 1591

U. S. Geological Survey.

Reports - Open file series,  
no. 1591: 1971



OPEN-FILE REPORT

Documentation of the Apollo 14 samples

by

R. L. Sutton, R. M. Batson,  
K. B. Larson, J. P. Schafer,  
R. E. Eggleton, and G. A. Swann

July 1971

229812

## Illustrations

- Figure 1. Regional geologic map of the area surrounding the Apollo 14 landing site.
- Figure 2. Map of major geologic features in Apollo 14 traverse area.
- Figure 3. Rock distribution map.
- Figure 4. Traverse map showing sample locations.
- Figure 5. Sample 14047 before collection.
- Figure 6. Orthogonal views of sample 14047 shown in approximate lunar orientation.
- Figure 7. Sample 14051, shown in approximate lunar orientation reconstructed in the LRL using oblique lighting.
- Figure 8. Orthogonal views of sample 14051, shown in approximate lunar orientation.
- Figure 9. Boulder from which sample 14053 was collected.
- Figure 10. Orthogonal views of sample 14053.
- Figure 11. Samples 14068-14072 and 14144 before collection.
- Figure 12. Sample 14082, chipped from the white rock.
- Figure 13. Sample 14304 before collection.
- Figure 14. Orthogonal views of sample 14304, shown in approximate lunar orientation.
- Figure 15. Sample 14305, shown in approximate lunar orientation reconstructed in the LRL using oblique lighting.
- Figure 16. Orthogonal views of samples 14305 and 14302 wired together, shown in approximate lunar orientation.
- Figure 17. Sample 14306, shown in approximate lunar orientation reconstructed in the LRL using oblique lighting.
- Figure 18. Orthogonal views of sample 14306, shown in approximate lunar orientation.
- Figure 19. Samples 14301 and 14313. Sample 14313 is shown in approximate lunar orientation reconstructed in the LRL using oblique lighting.

- Figure 20. Orthogonal views of sample 14313, shown in approximate lunar orientation.
- Figure 21. View of portion of North Boulder Field, Station H, showing sample locations.
- Figure 22. Turtle rock, samples from top of rock and from fillet.
- Figure 23. Approximate lunar orientations of samples 14315 and 14318, shown by NASA models.
- Figure 24. Orthogonal views of sample 14315, shown in approximate lunar orientation.
- Figure 25. Sample 14318, shown in approximate lunar orientation reconstructed in the LRL using oblique lighting.
- Figure 26. Orthogonal views of sample 14318, shown in approximate lunar orientation.
- Figure 27. Approximate lunar orientations of samples 14312 and 14319, shown by NASA models, and by a reconstructed orientation of sample 14312 in the LRL using oblique lighting.
- Figure 28. Orthogonal views of sample 14312, shown in approximate lunar orientation.
- Figure 29. Orthogonal views of sample 14319, shown in approximate lunar orientation.
- Figure 30. Sample 14321, shown in approximate lunar orientation reconstructed in the LRL using oblique lighting.
- Figure 31. Orthogonal views of sample 14321, shown in approximate lunar orientation.

## Documentation of the Apollo 14 Samples

This report was prepared to illustrate the locations and lunar orientations of the documented samples returned by Apollo 14. It supersedes U.S. Geological Survey Interagency Report No. 27 (Swann et al., 1971a). Some of the illustrations are taken from the Preliminary Science Report ("Ninety-day report") submitted to the National Aeronautics and Space Administration by the Apollo Lunar Geology Investigation (S-059) team (Swann et al., 1971b).

Sample locations were determined from lunar surface photographs, from descriptions by the astronauts at the time of sampling, and from a correlation between sample bags in which the samples were returned and the traverse locations where those bags were used.

The lunar orientations of samples were determined from correlations between the samples, as seen in the LRL, with photographs taken on the lunar surface before the samples were collected. In several cases, NASA models of samples were used for the purpose of identification and orientation. Oblique lighting was used to reconstruct the approximate lunar orientations of identified samples (Sutton and Schaber, 1971).

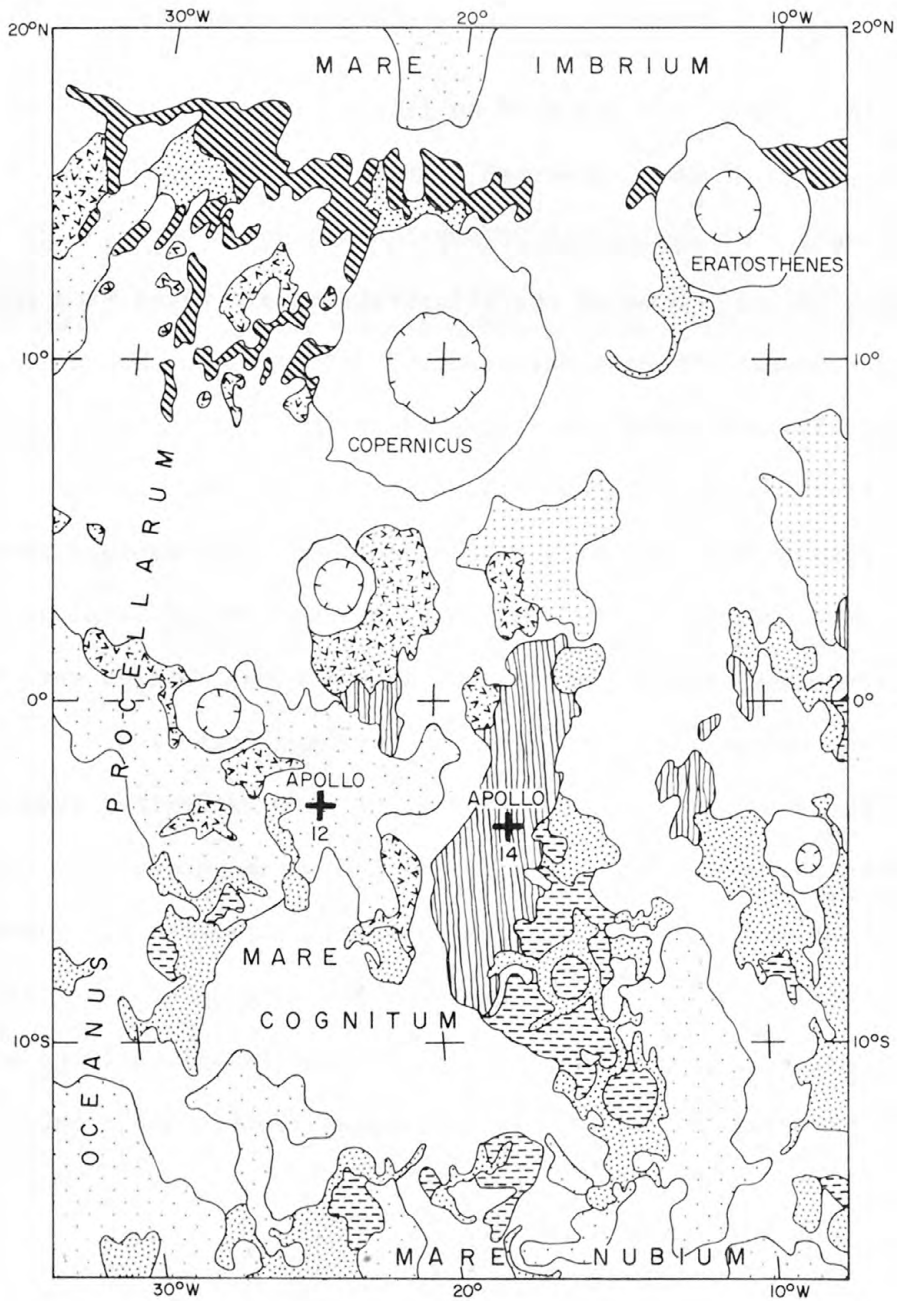
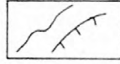
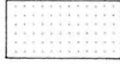


Figure 1. Regional geologic map of the area surrounding the Apollo 14 landing site (simplified from Wilhelms and McCauley, 1971).

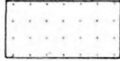
EXPLANATION



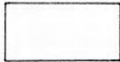
Materials of major post-Fra Mauro craters



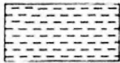
Dark mantling material



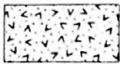
Young mare basalt



Old mare basalt



Pre-mare plains-forming material



Alpes Formation



Fra Mauro Formation



Materials of mountains rimming  
the Imbrium Basin



Undivided terra materials

Mostly pre-Fra Mauro materials,  
but includes some later crater de-  
posits and probable volcanic rocks

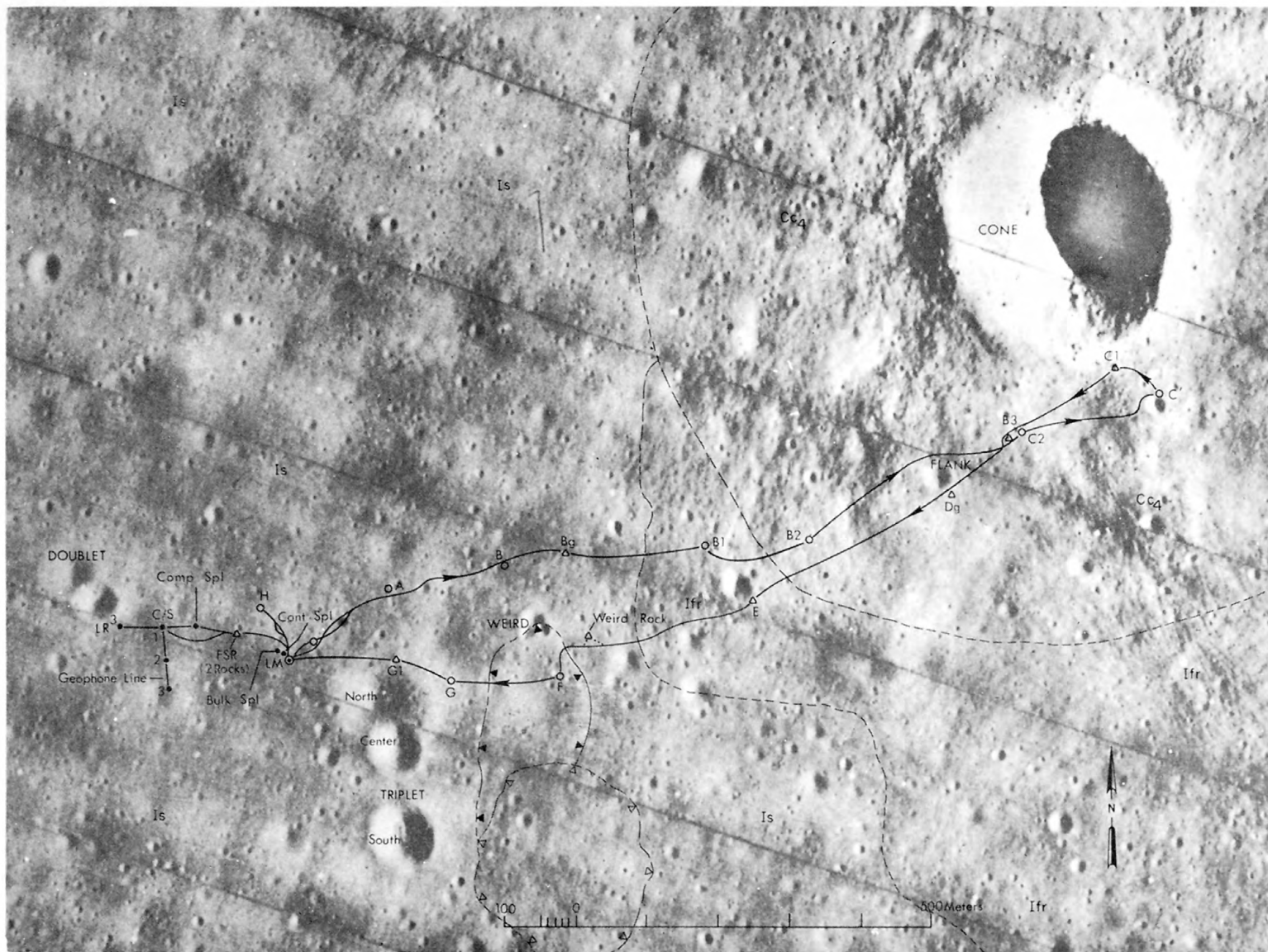


Figure 2. Map of major geologic features in Apollo 14 traverse area. Origin of geologic units is described in the Apollo 14 pre-mission maps by Eggleton and Offield (1970). (Base map prepared by Topographic Command, U.S. Army.)

EXPLANATION

Cc<sub>4</sub>

Materials of Cone Crater

I<sub>s</sub>

Smooth terrain material  
of the Fra Mauro Formation

I<sub>fr</sub>

Ridge material of the Fra Mauro  
Formation

-----

Contact

Long dashed where approximately  
located. Short dashed where lo-  
cation is inferred without local  
evidence

-----▲-----▲-----

Foot of scarp

Bounds small mesa. Triangles  
point down slope. Short dashed  
where location inferred

-----▲-----▲-----▲-----

Edge of hill

Long dashed where approximately  
located. Short dashed where lo-  
cation inferred. Triangles point  
down slope

----- Traverse route for EVA's 1 and 2

Stations

OB Panorama station  
ΔG1 Station without panorama  
C/S ALSEP Central Station  
LR<sup>3</sup> Laser Ranging Retroreflector

Samples

FSR Football-sized rock  
• Cont Spl Contingency sample  
• Comp Spl Comprehensive sample  
Dg Grab sample at Station D



Figure 3. Rock distribution map. (Base map prepared by Topographic Command, U.S. Army.)

# Rock Distribution Map

## Explanation

### Large Rocks

■ 8-16 meter diameter

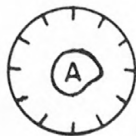
○ 4-8 meter diameter

▲ 2-4 meter diameter

● 1-2 meter diameter

— — — — — Boundary of area where rocks are obscured by poor lighting-- mostly inside Cone crater

### Small Rocks



Distribution of rocks larger than 10 cm in diameter within 10 meter radius of panorama station. Rocks shown by solid pattern.

Traverse and station symbols same as on Geologic Map

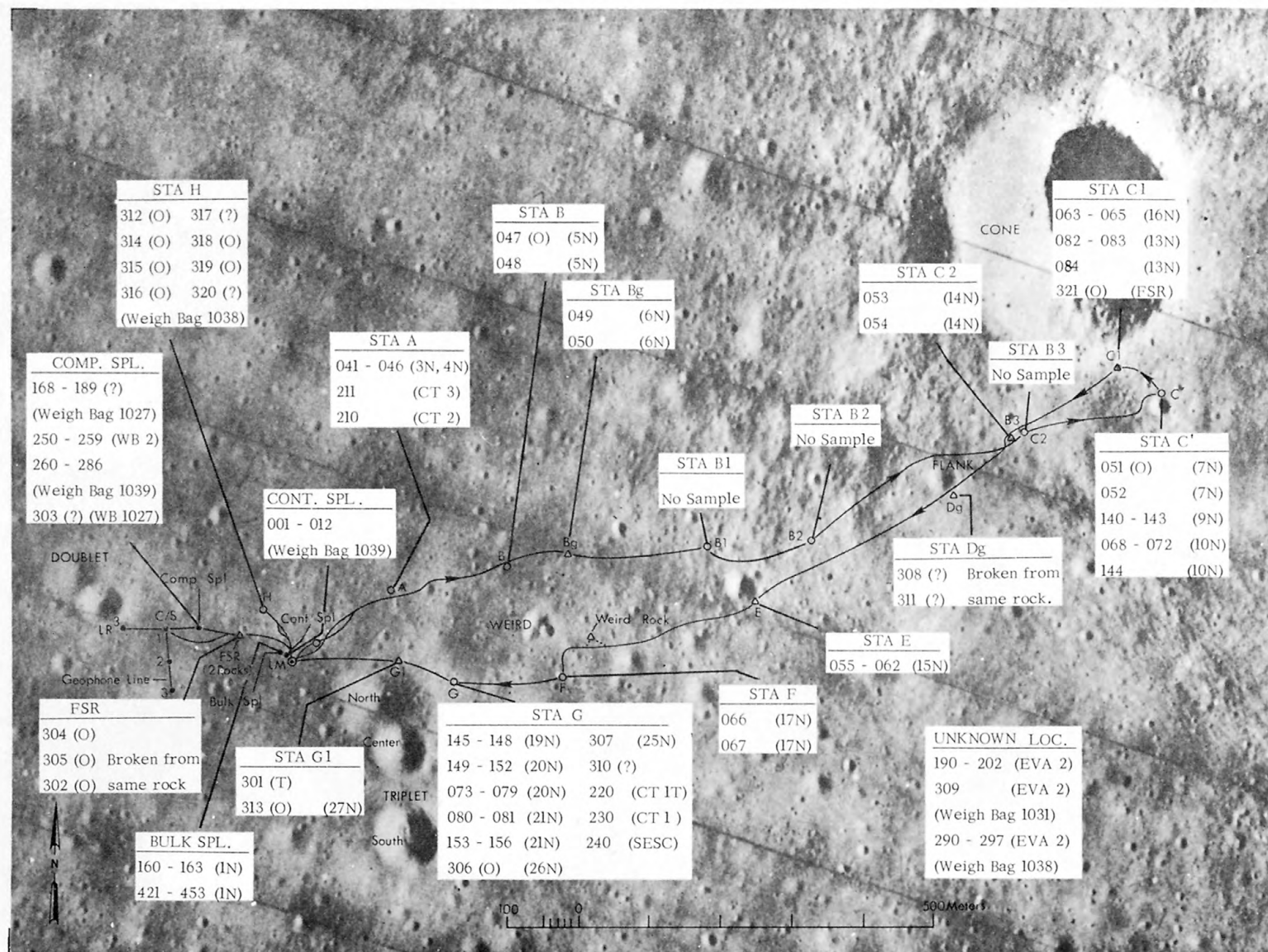


Figure 4. Traverse map showing sample locations. (Base map prepared by Topographic Command, U.S. Army.)

Sample Map

Explanation

Bag 6N        Pre-numbered sample bag

All sample numbers start with 14. Only the last three digits are shown on map.

14307        Sample for which location is "known" by reference to sample bags used at the time of collection

14306 (0)    Sample for which location and lunar orientation known

14318 (T)    Sample for which location is tentative, based on identification of sample in lunar surface photographs

14310 (?)    Sample for which location is tentative based on description by the astronauts, or by the process of elimination of known samples.

FSR         Football size rock

CT 1T       Core tube number 1 with a tab (not "tentative")

SESC        Special environmental sample

Weight bag 1038    Pre-numbered bag which is large enough to hold several samples

Traverse and station symbols same as on Geologic Map



Figure 5. Sample number 14047 before collection (enlargement of NASA photograph AS14-64-9073).

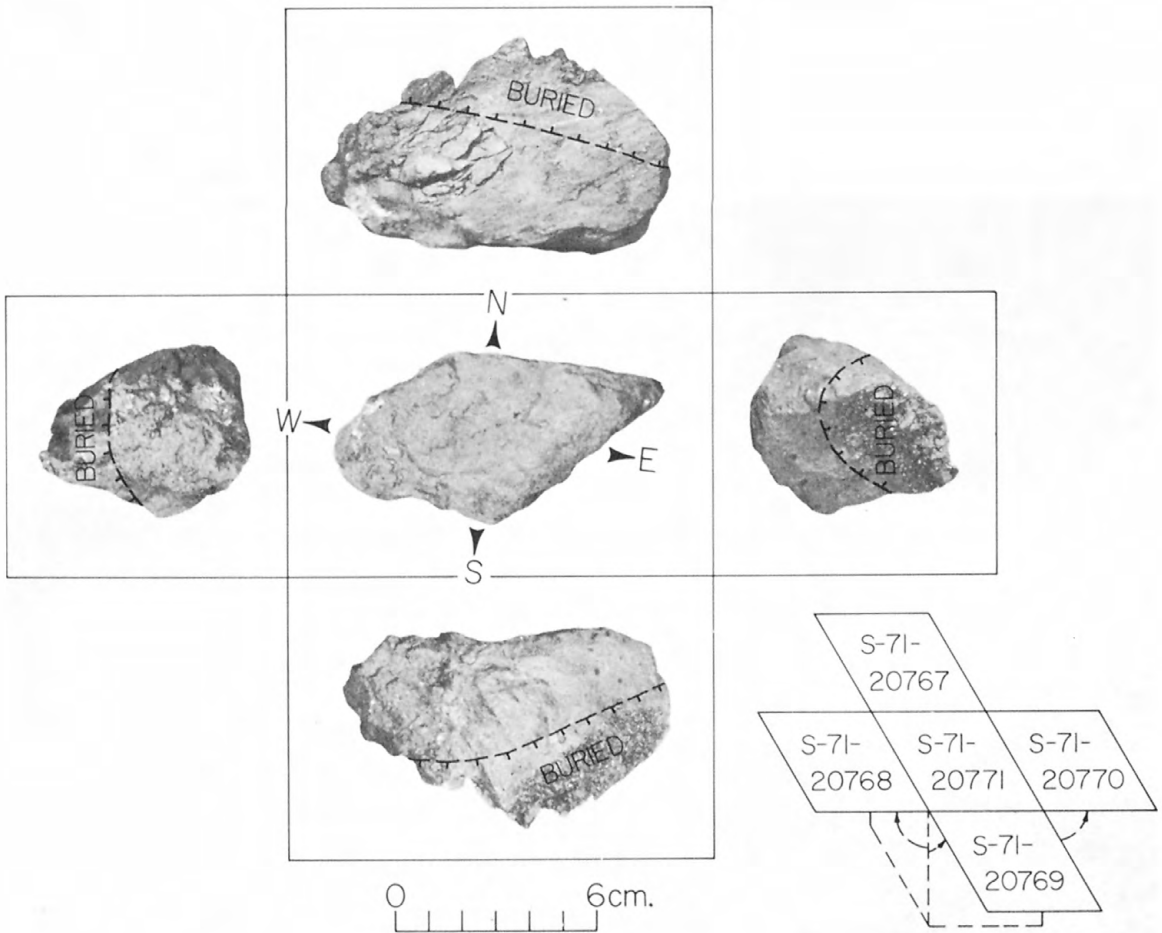


Figure 6. Orthogonal views of sample number 14047, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram. Note that the glass covered surface of the rock was buried at the time of sample collection.

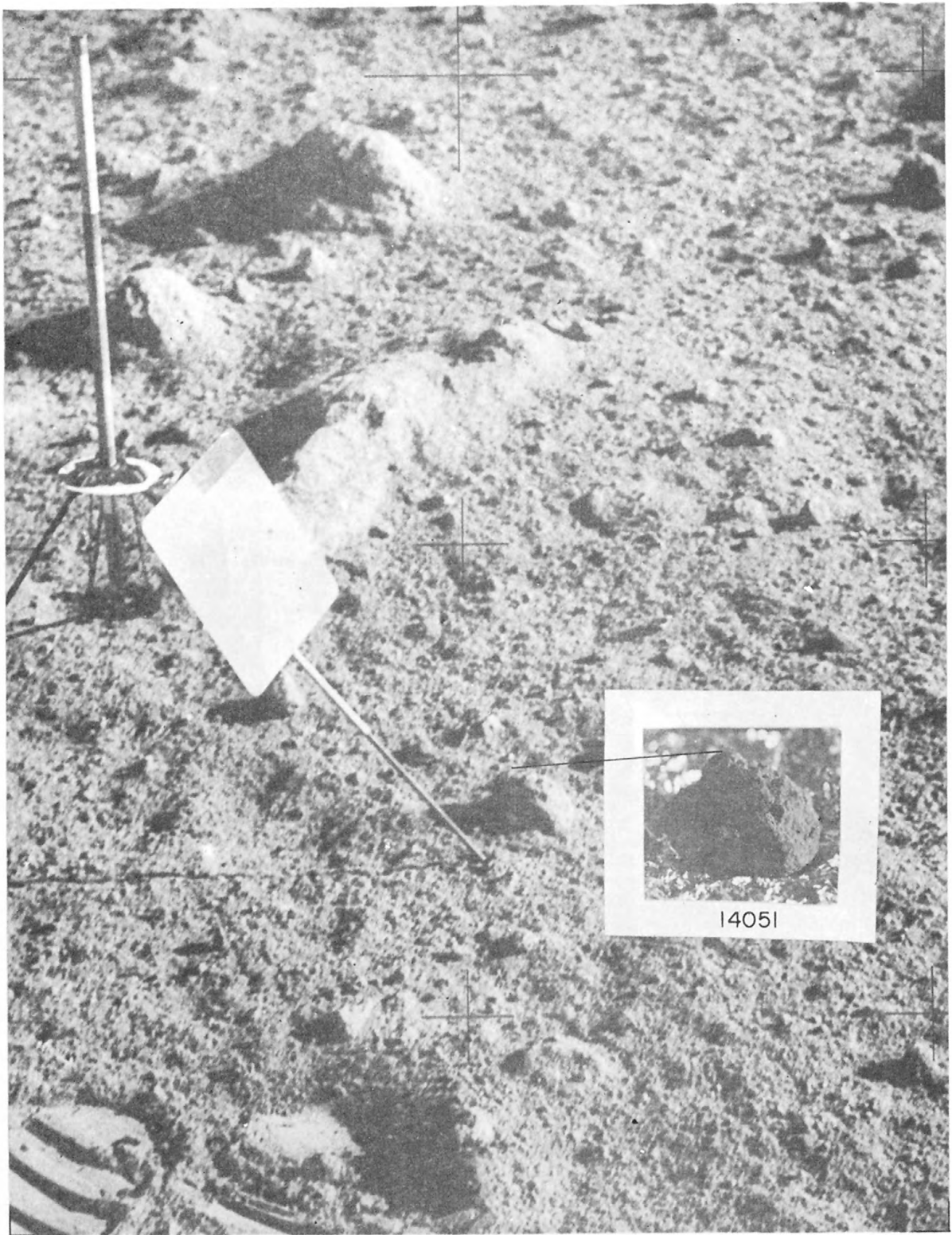


Figure 7. Sample number 14051, showing approximate lunar orientation reconstructed in the LRL using oblique lighting. The reconstruction is superimposed on NASA photograph AS14-68-9443 taken before sample collection.

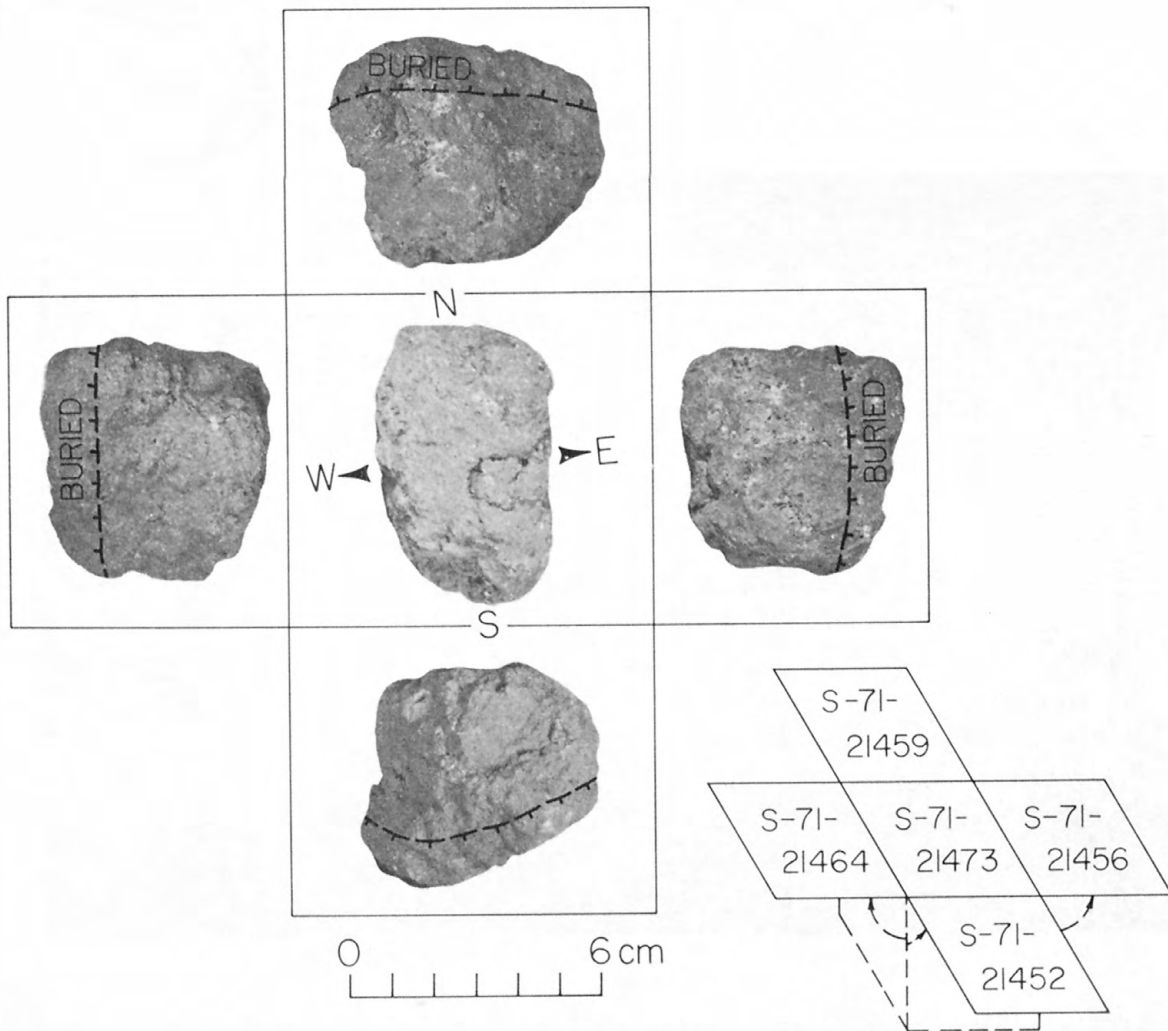


Figure 8. Orthogonal views of sample number 14051, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram.

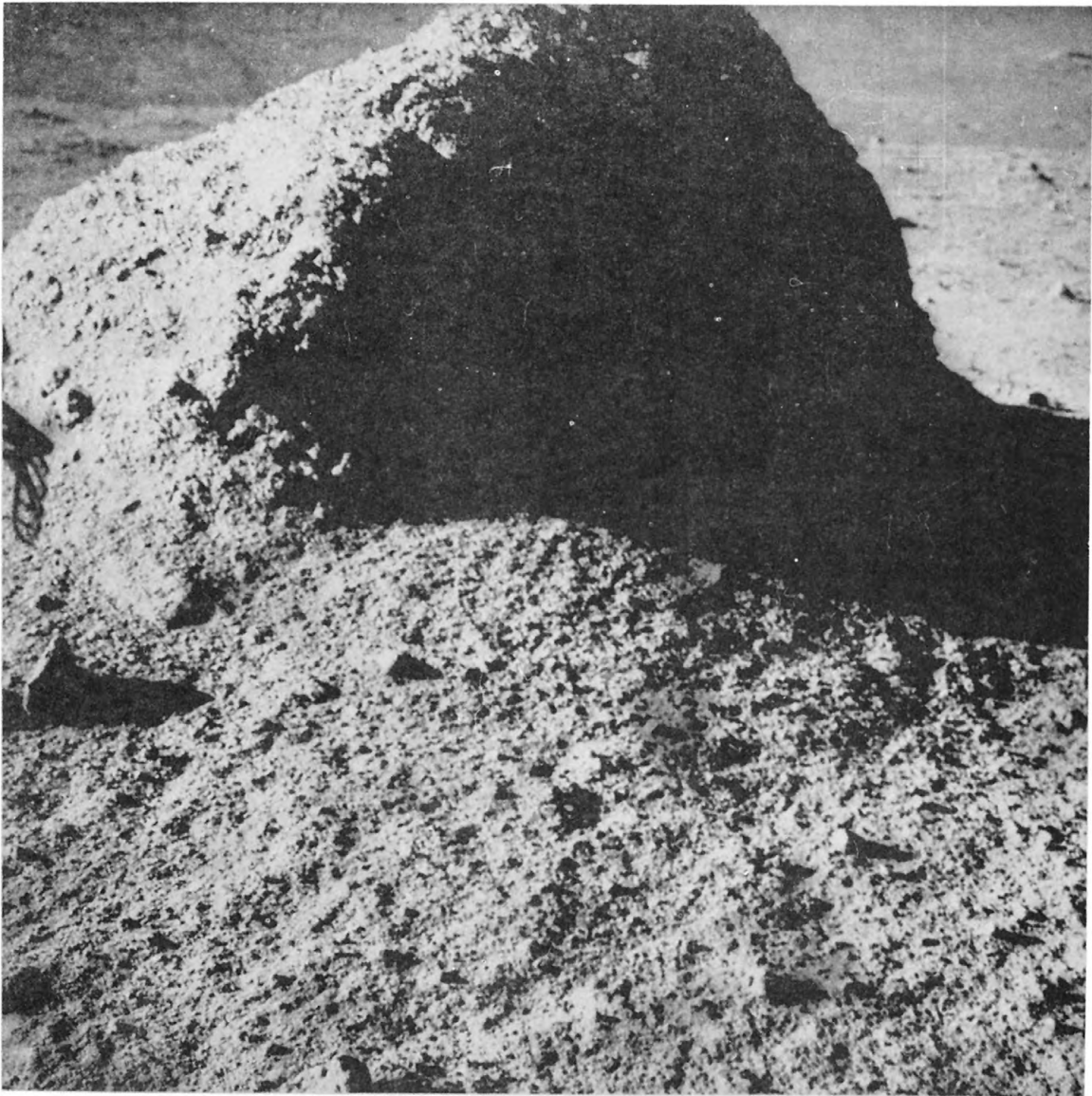


Figure 9. Sample 14053 was collected from the sunlit part of this boulder at traverse station C2. The sample has not been recognized in this pre-sampling photograph (NASA AS14-64-9133). The sample was collected from the sunlit portion of the boulder, approximately halfway up from the base. Note the light colored clasts in the shadowed part of the boulder. Sample 14053 may be a clast from this fragmental rock.

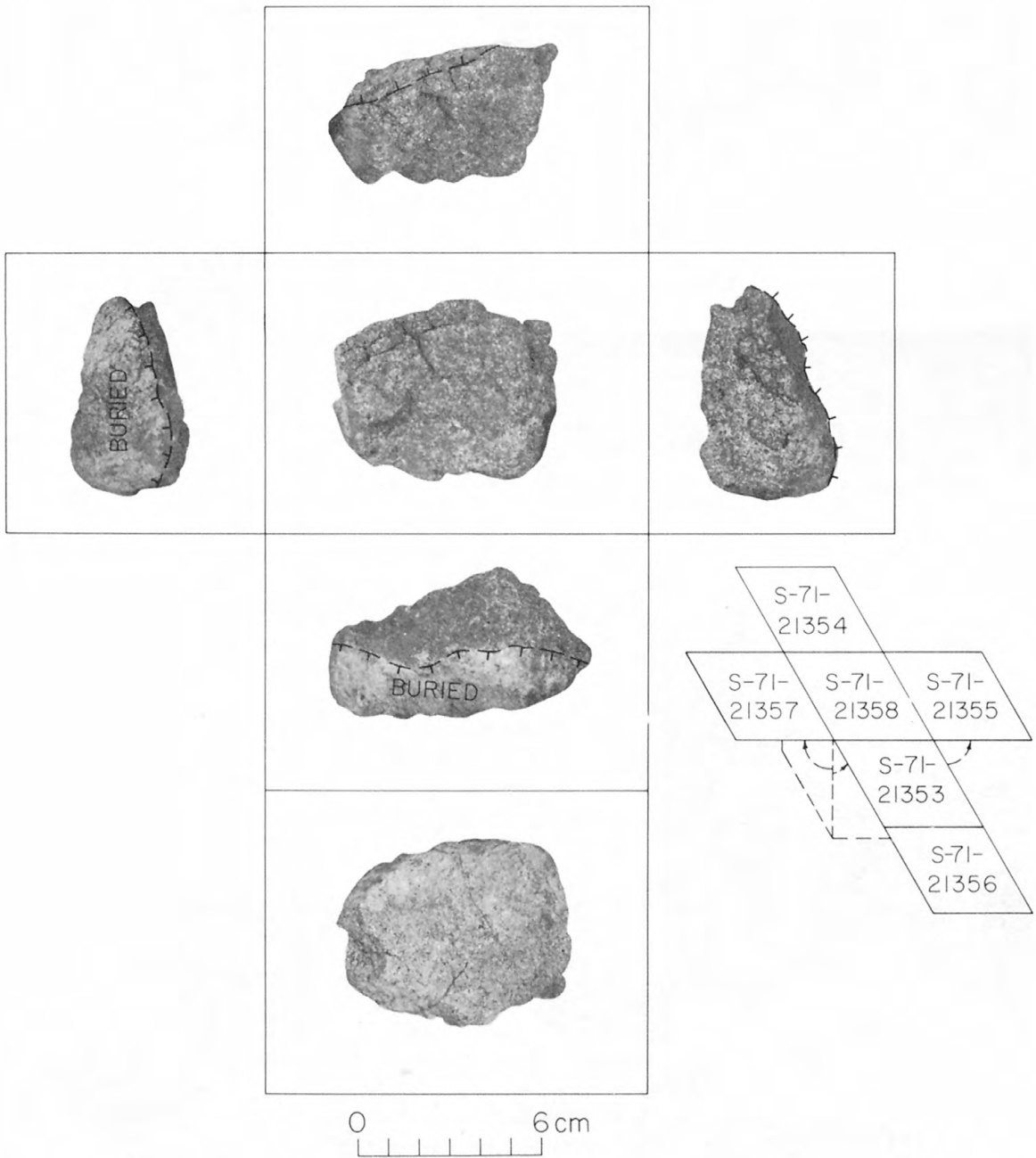


Figure 10. Orthogonal views of sample number 14053. NASA photograph numbers are shown in the schematic diagram. The lunar orientation of the rock is not known, but weathered and unweathered portions of the rock suggest a burial line.

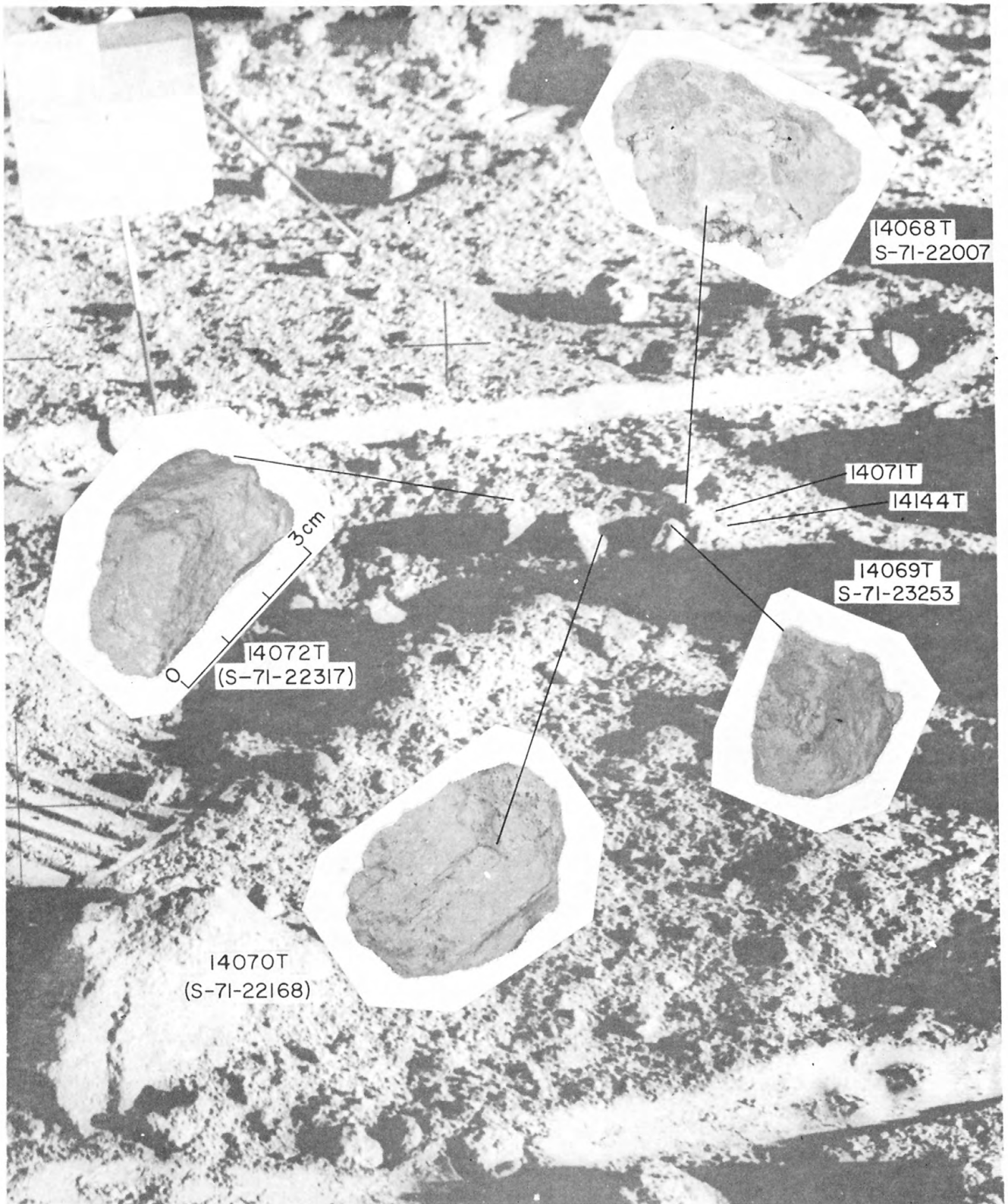


Figure 11. Samples 14068-14072 (rocks) and 14144 (fines) photographed before collection (NASA photograph AS14-64-9126). Tentative correlations have been made between the four largest fragments and LRL photographs of the samples.

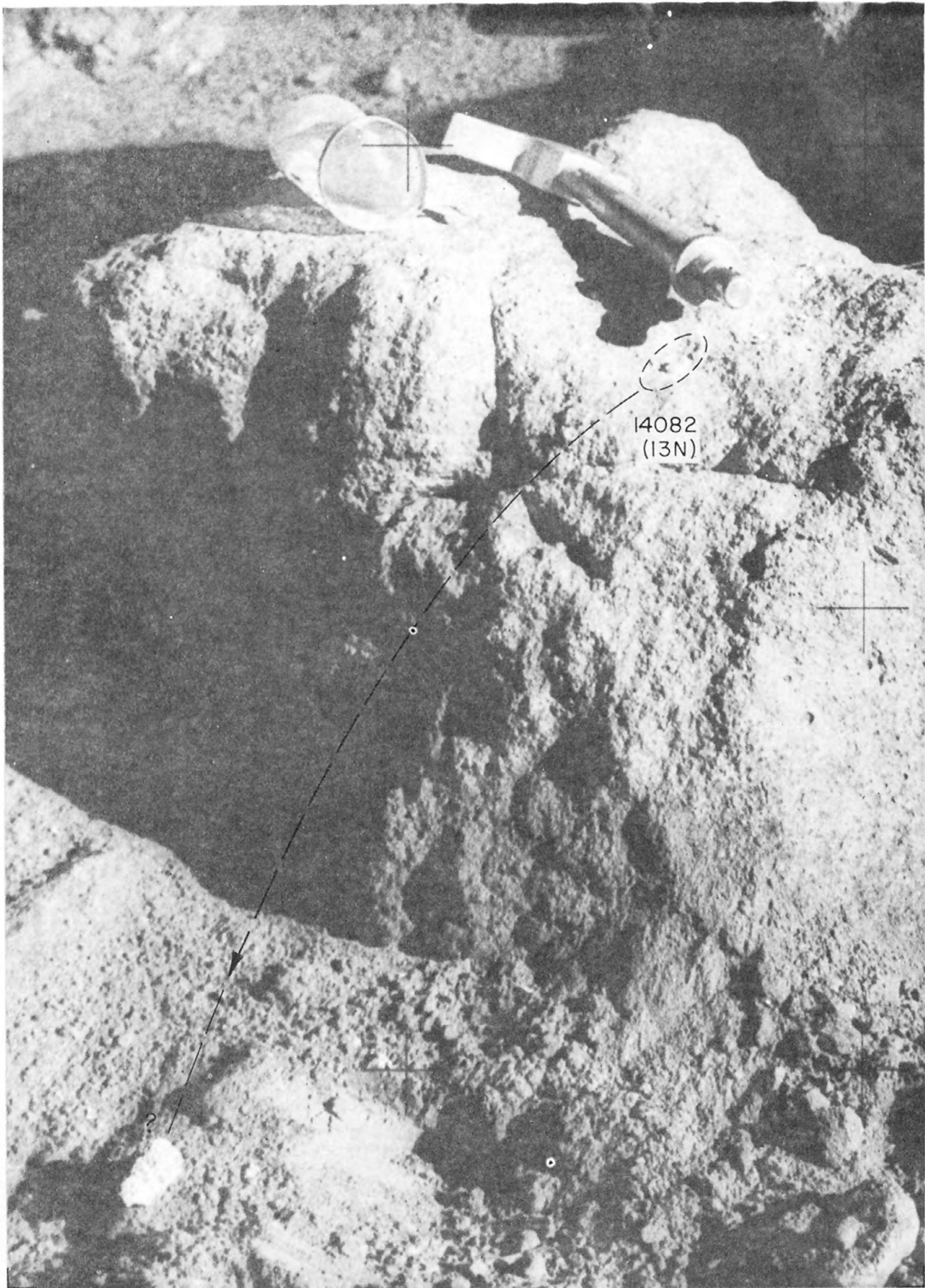


Figure 12. Sample number 14082, chipped from the white rocks. Geologic hammer is 40 cm long. (NASA photograph AS14-68-9452).



Figure 13. Sample number 14304 before collection (NASA photograph AS14-67-9391).

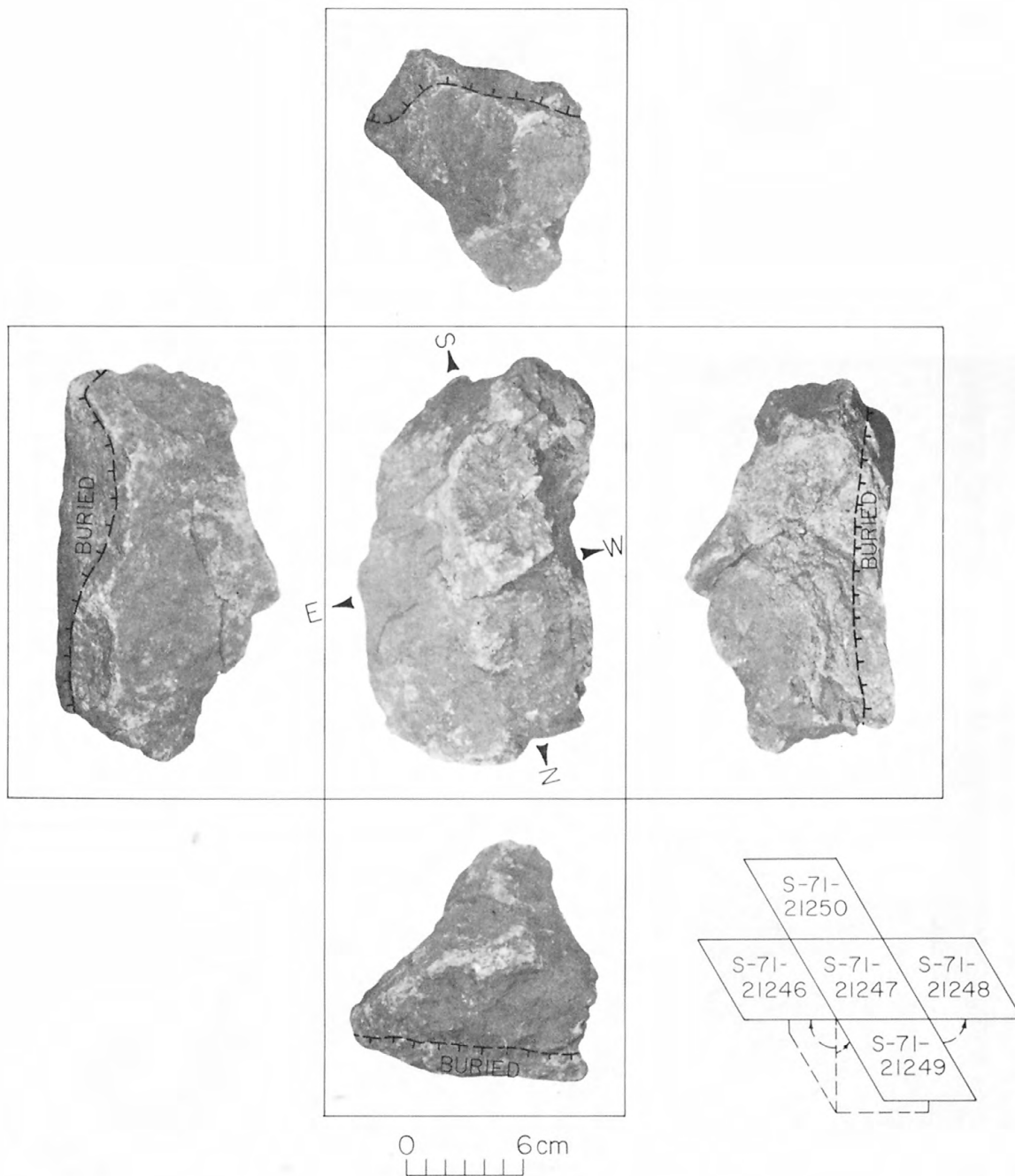


Figure 14. Orthogonal views of sample 14304, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram.

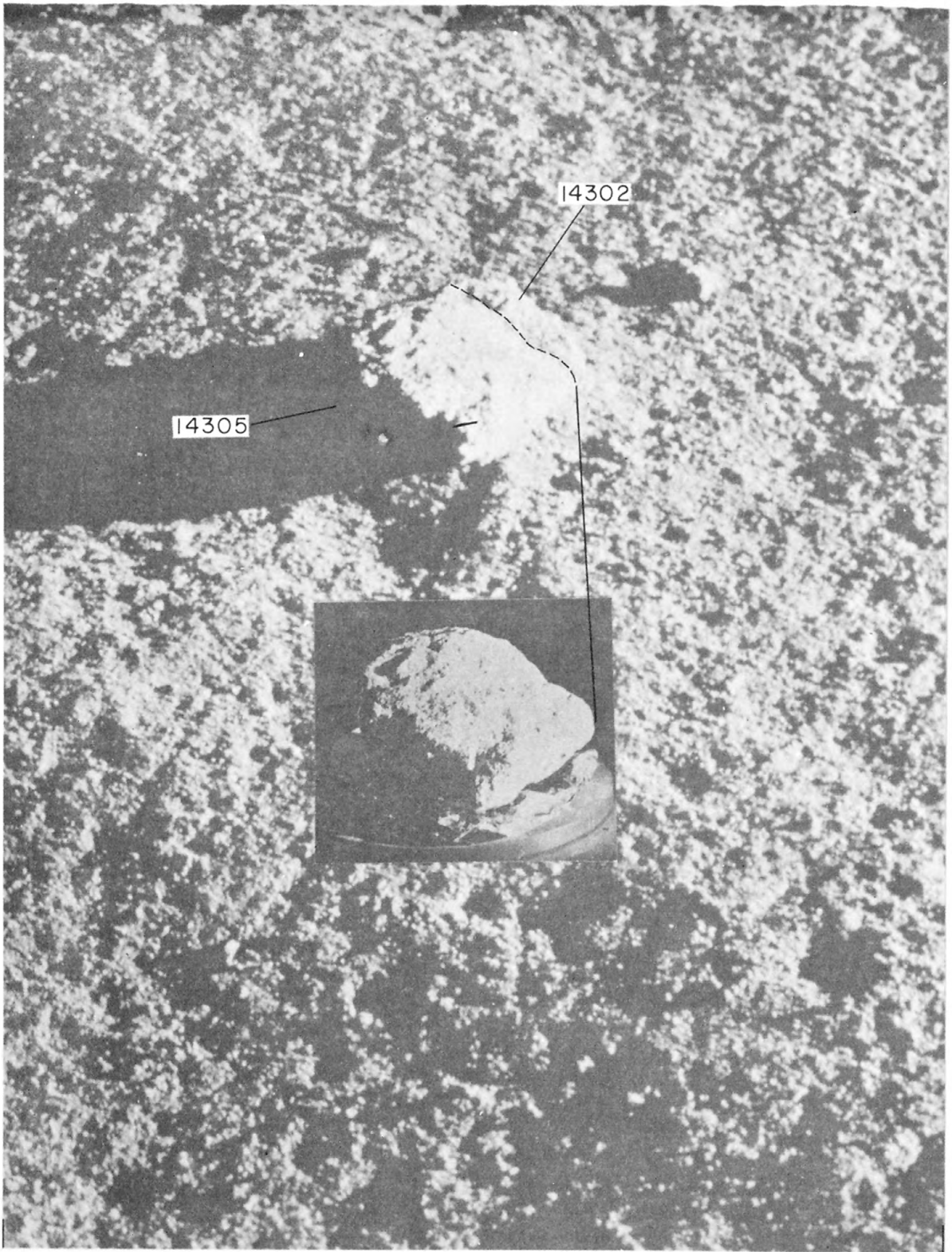


Figure 15. Sample number 14305 showing approximate lunar orientation reconstructed in the LRL using oblique lighting. The reconstruction is superimposed on NASA photograph AS14-67-9393 taken before sample collection and before 14302 broke from 14305.

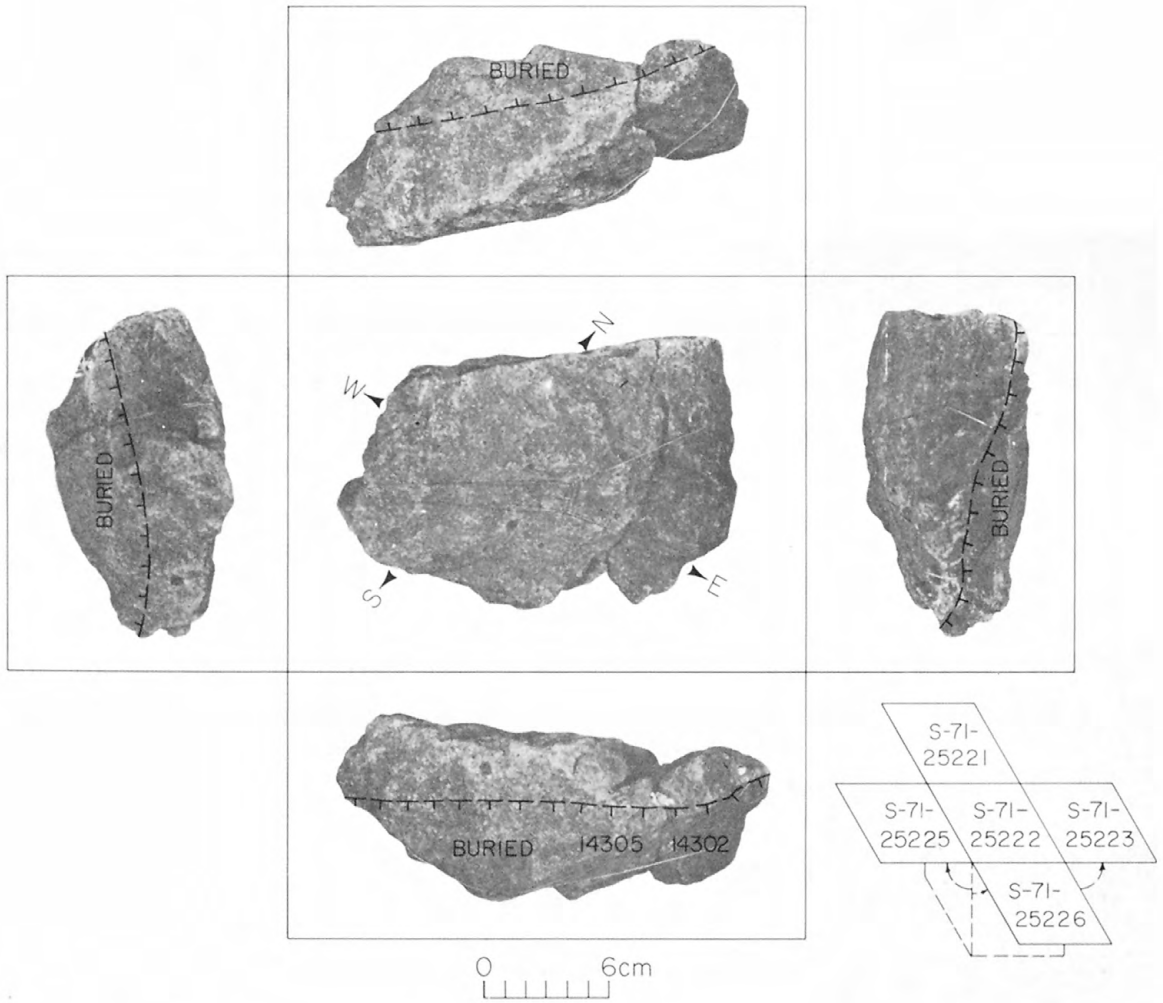


Figure 16. Orthogonal views of samples 14305 and 14302 wired together, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram.

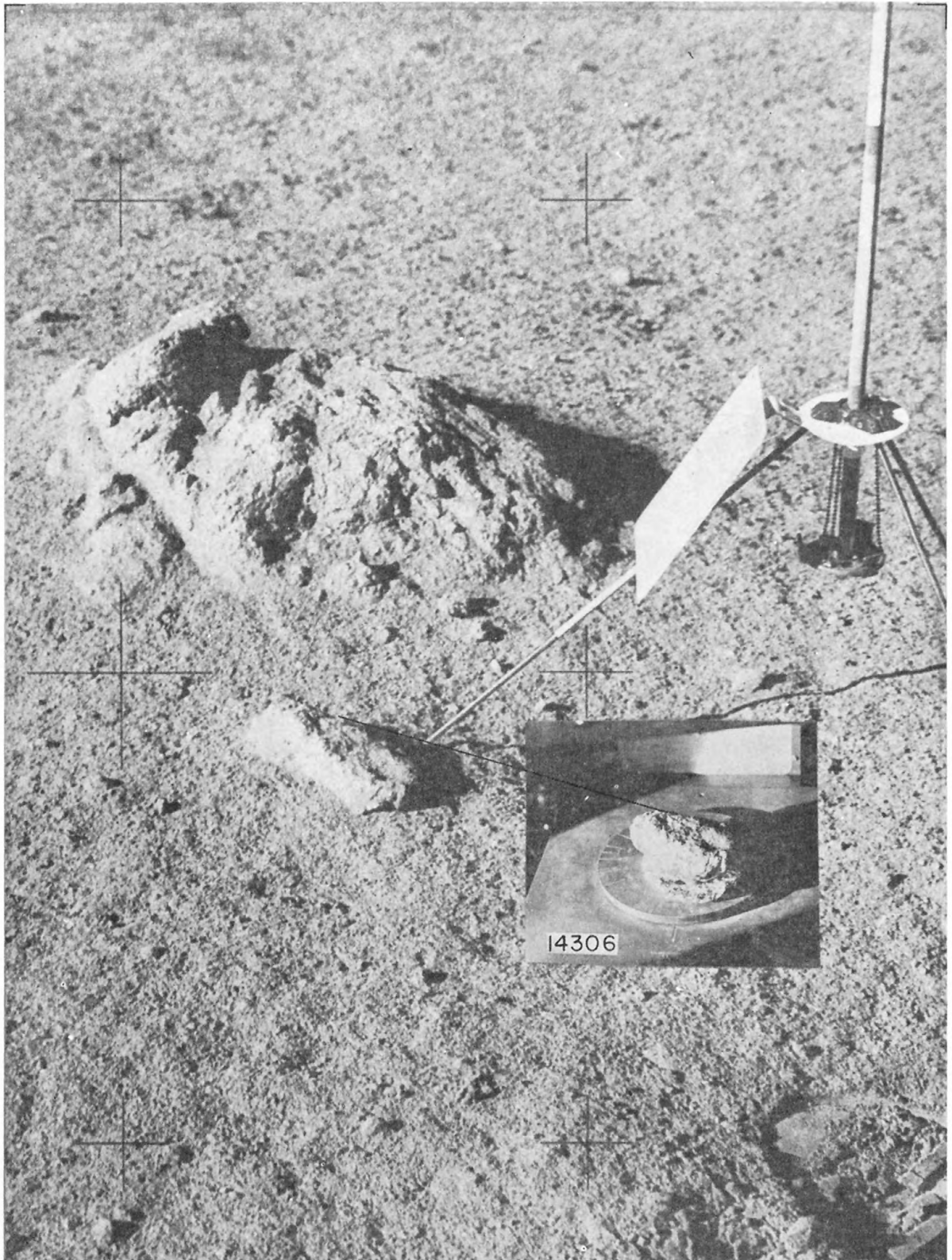


Figure 17. Sample 14306, showing approximate lunar orientation reconstructed in the LRL using oblique lighting. The reconstruction is superimposed on NASA photograph AS14-68-9461 taken before sample collection.

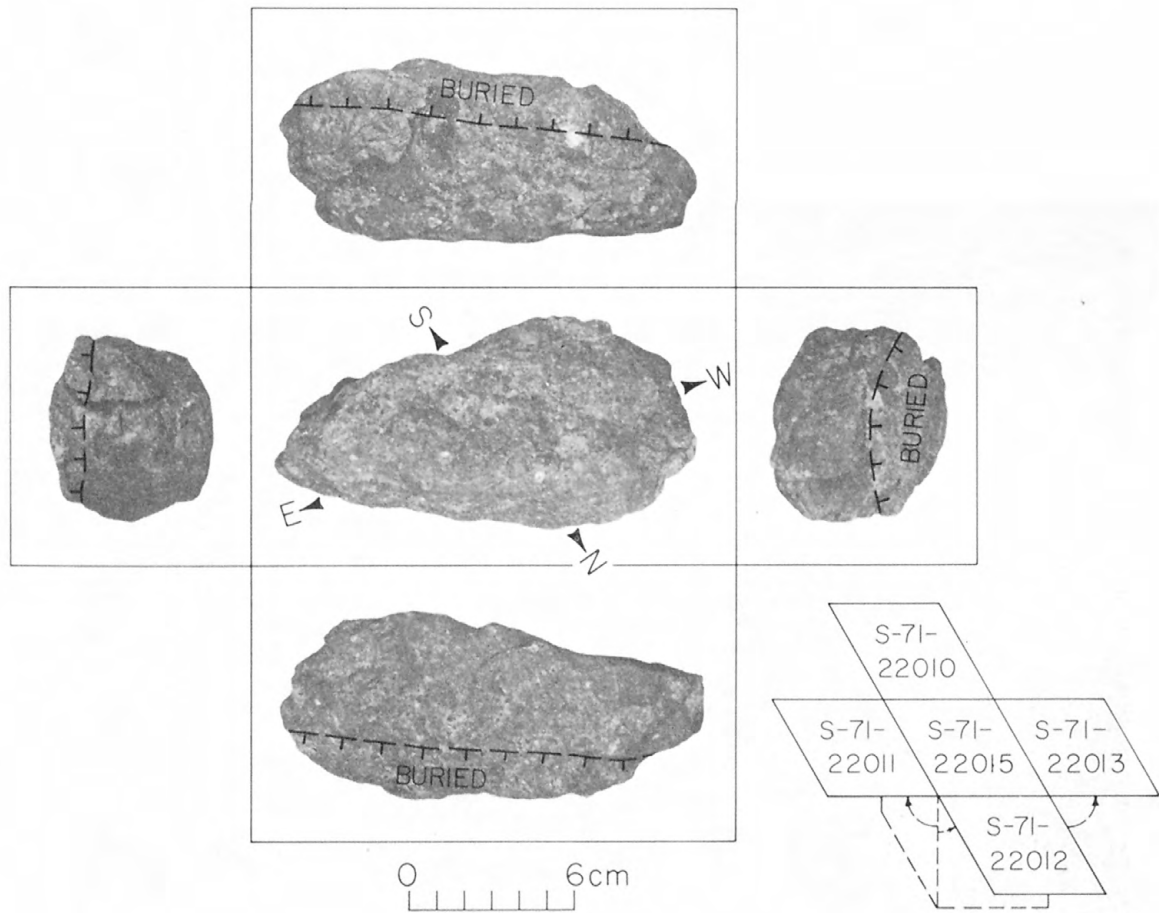


Figure 18. Orthogonal views of sample 14306, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram.

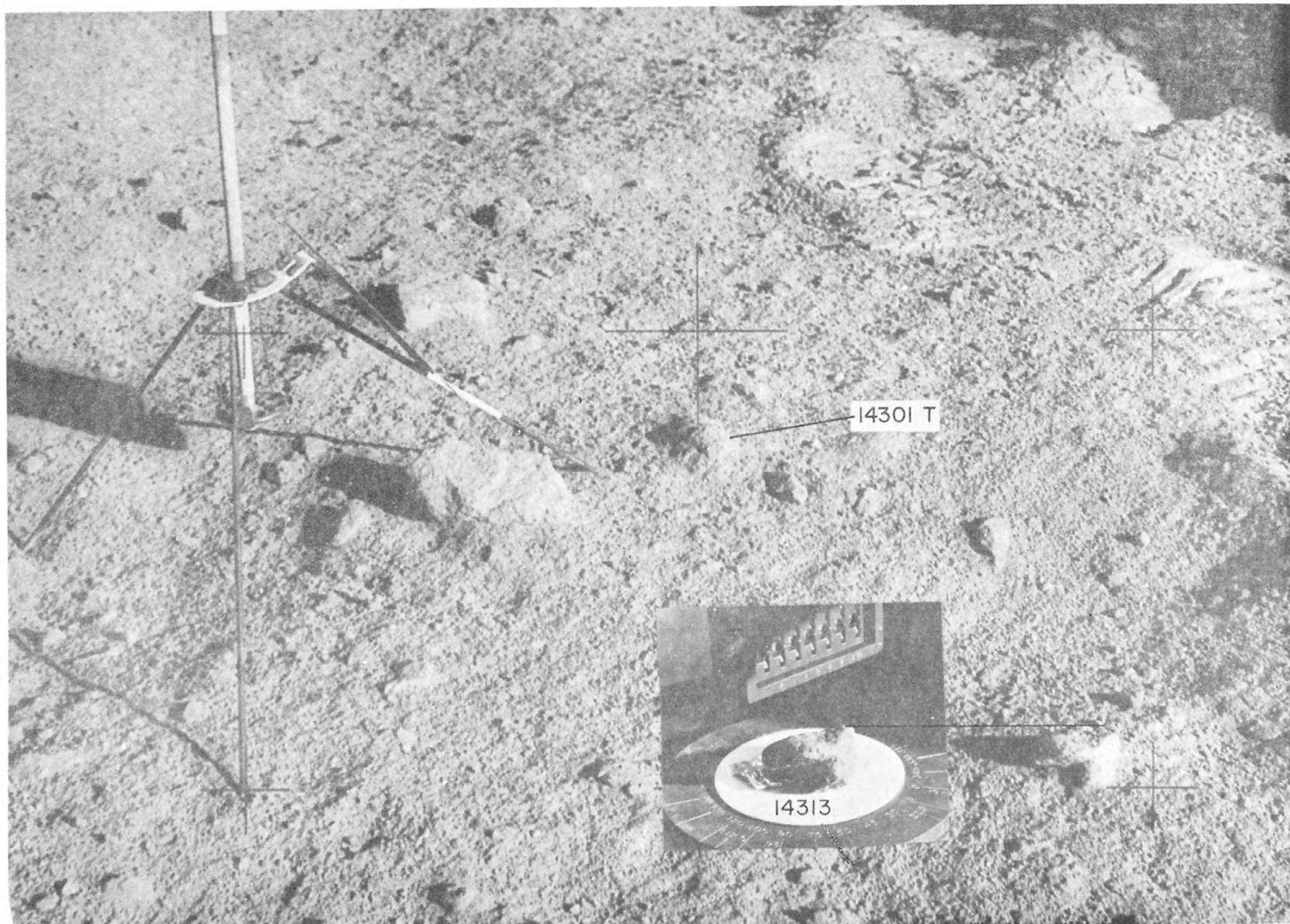


Figure 19. Samples 14301 (tentatively identified) and 14313. Sample 14313 is shown in approximate lunar orientation reconstructed in the LRL using oblique lighting. The reconstruction is superimposed on NASA photograph AS14-68-9466 taken prior to collecting the sample.

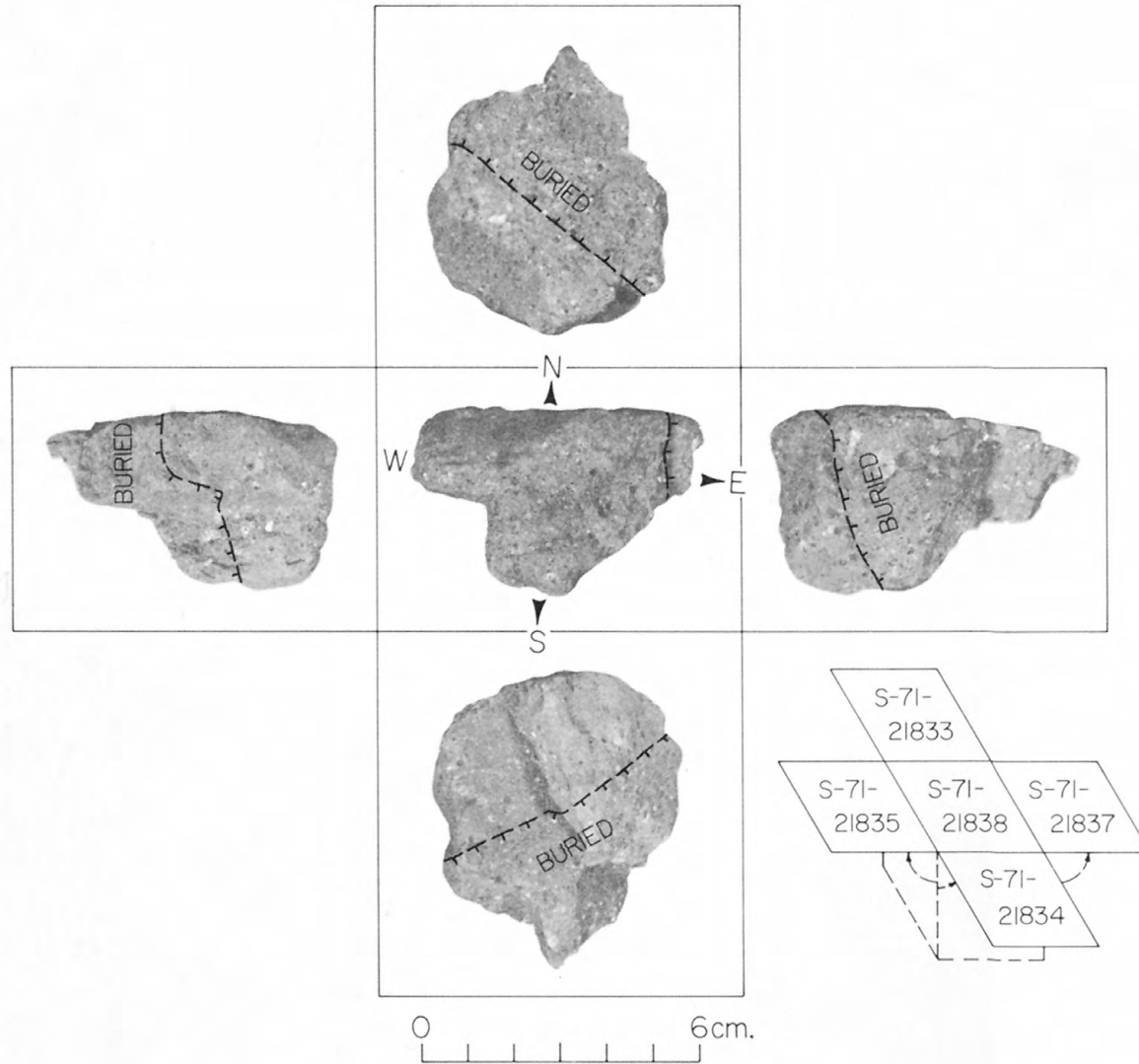


Figure 20. Orthogonal views of sample 14313, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram.

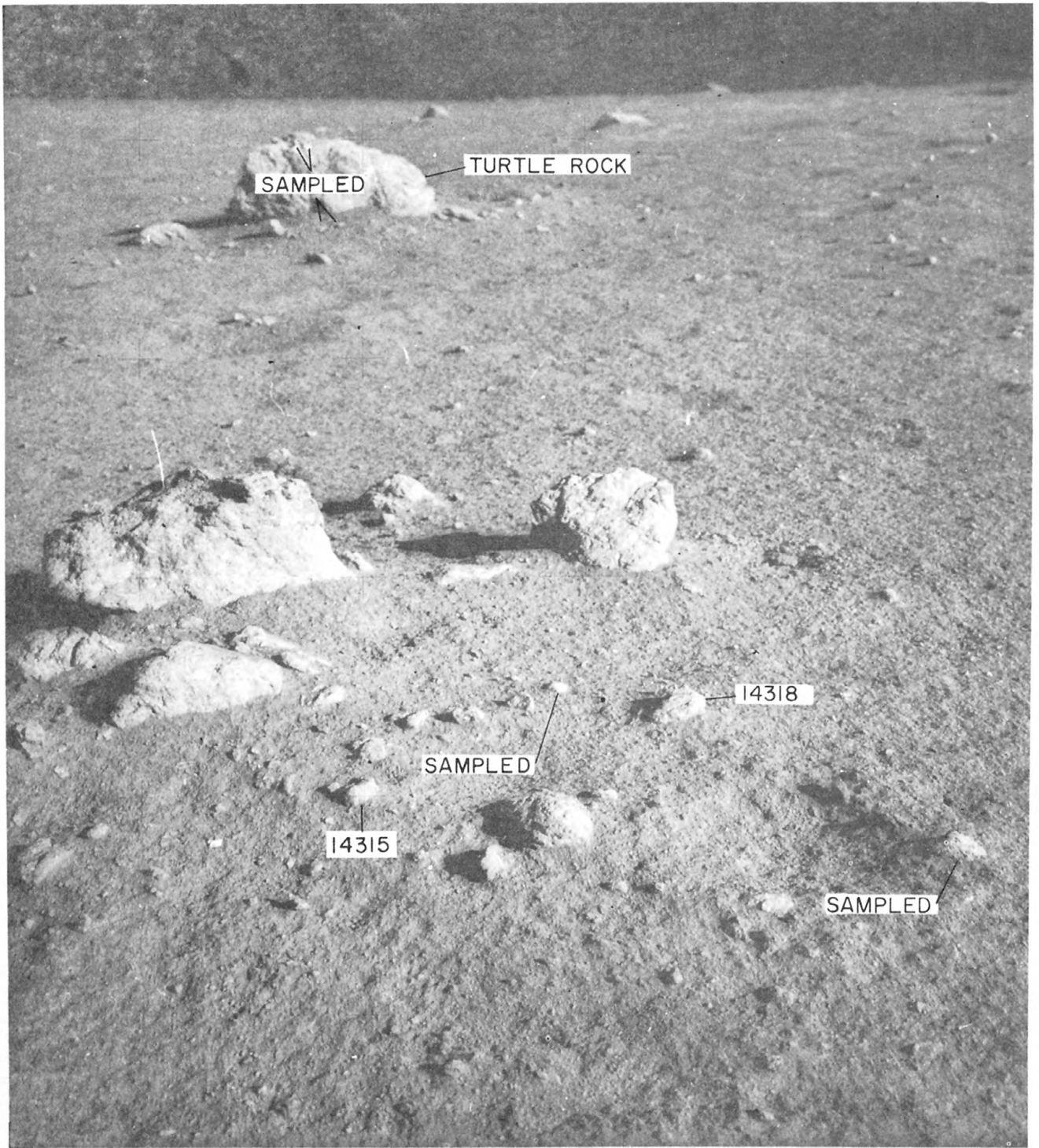


Figure 21. View of portion of North Boulder Field, Station H showing locations of samples 14315, 14318, and two other unidentified samples. "Turtle rock" in background. (NASA photograph AS14-68-9469.)

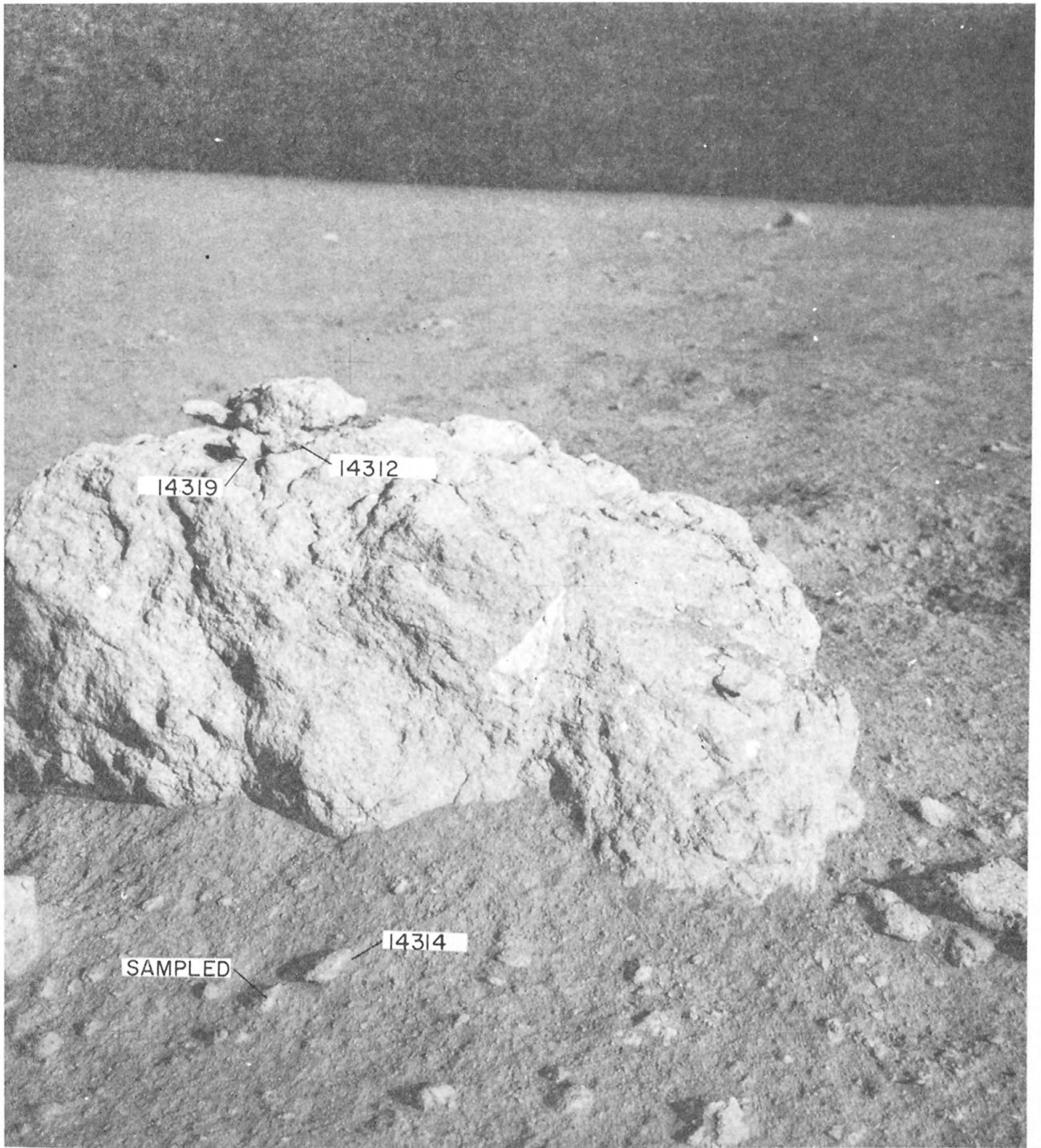


Figure 22. Turtle rock near Station H, showing samples from rock surface and fillet. (NASA photograph AS14-68-9474).

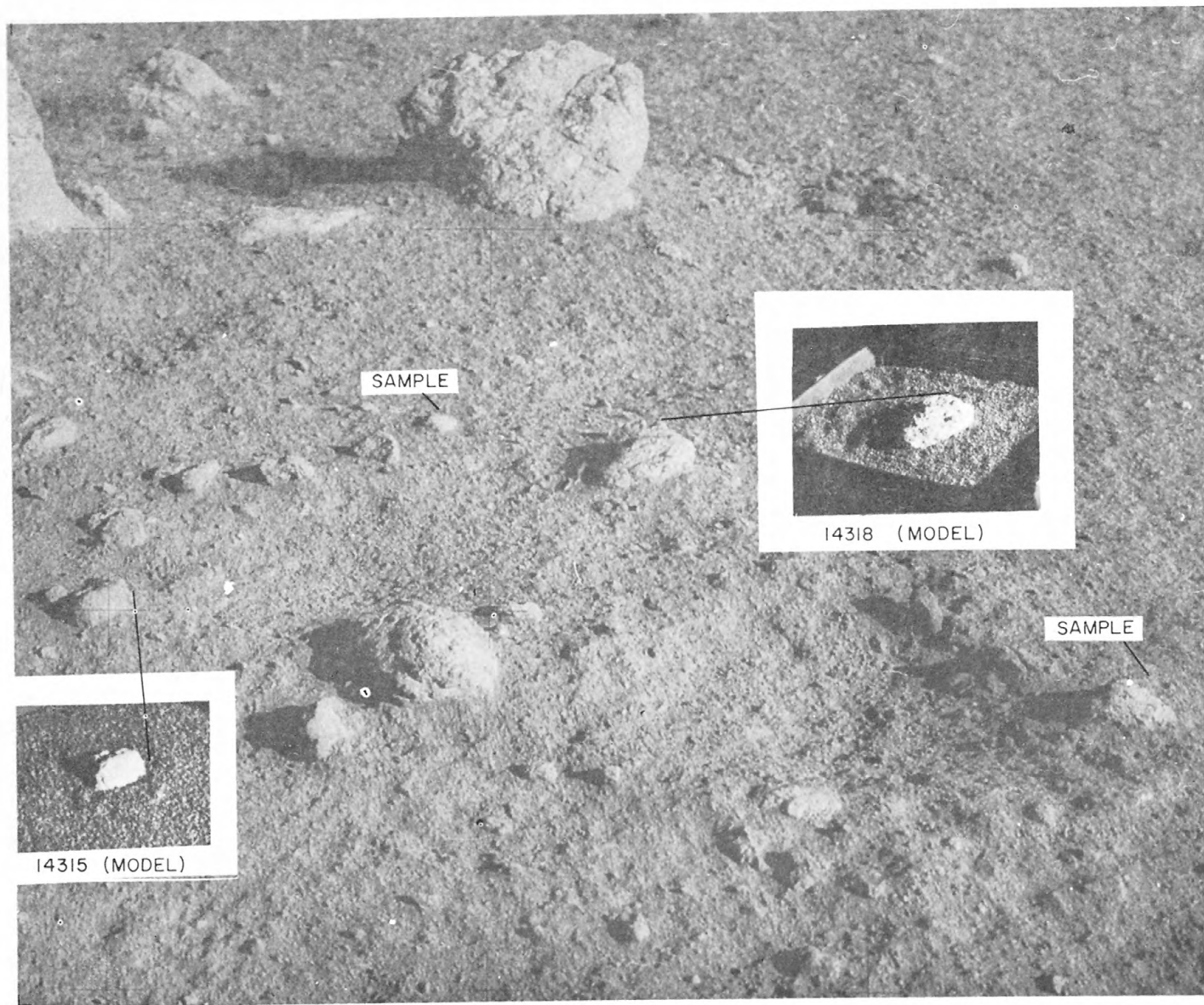


Figure 23. Approximate lunar orientations of samples 14315 and 14318 are shown by the use of NASA models under oblique lighting. Insets are superimposed on an enlargement of NASA photograph AS14-68-9469.

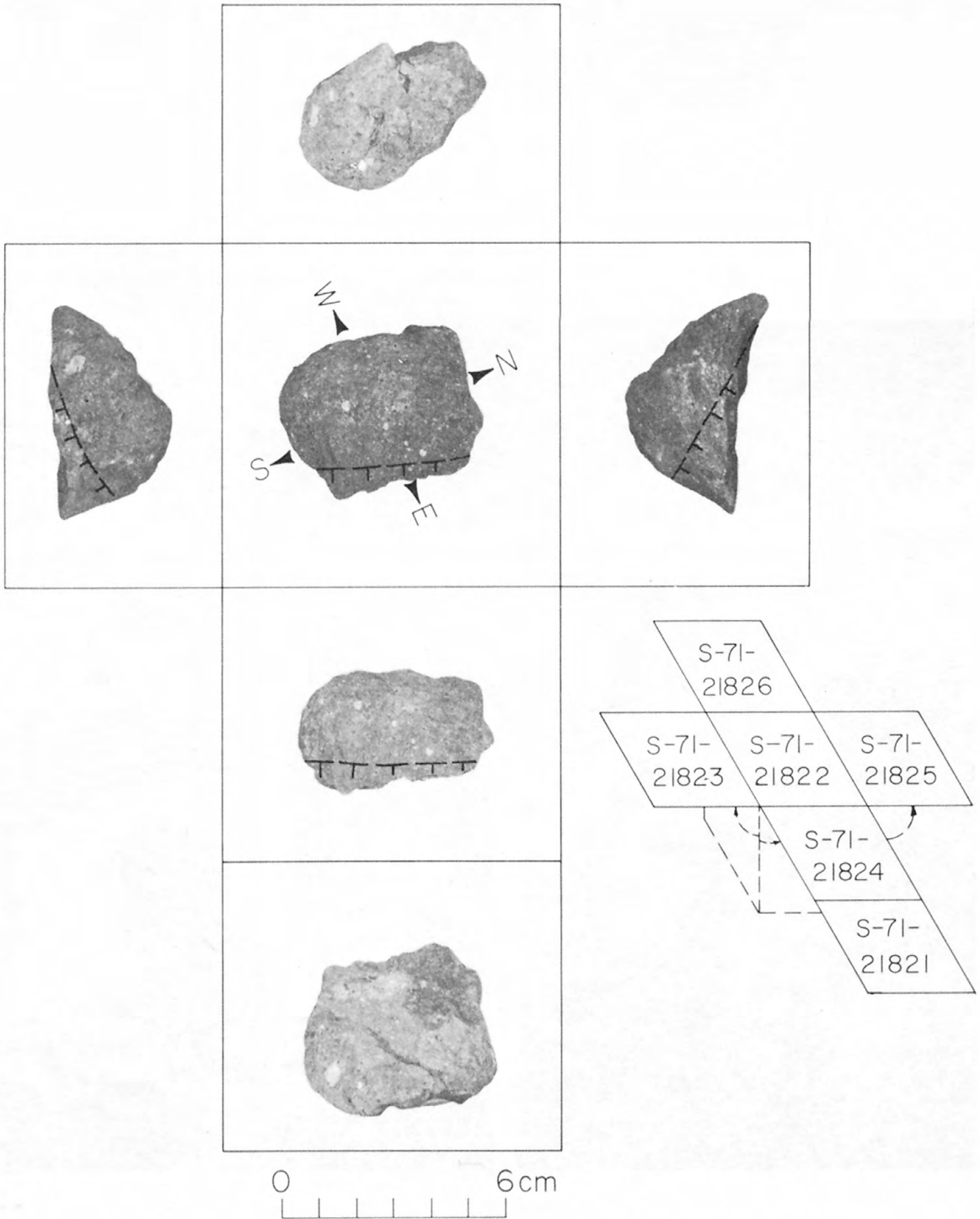


Figure 24. Orthogonal views of sample 14315, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram.

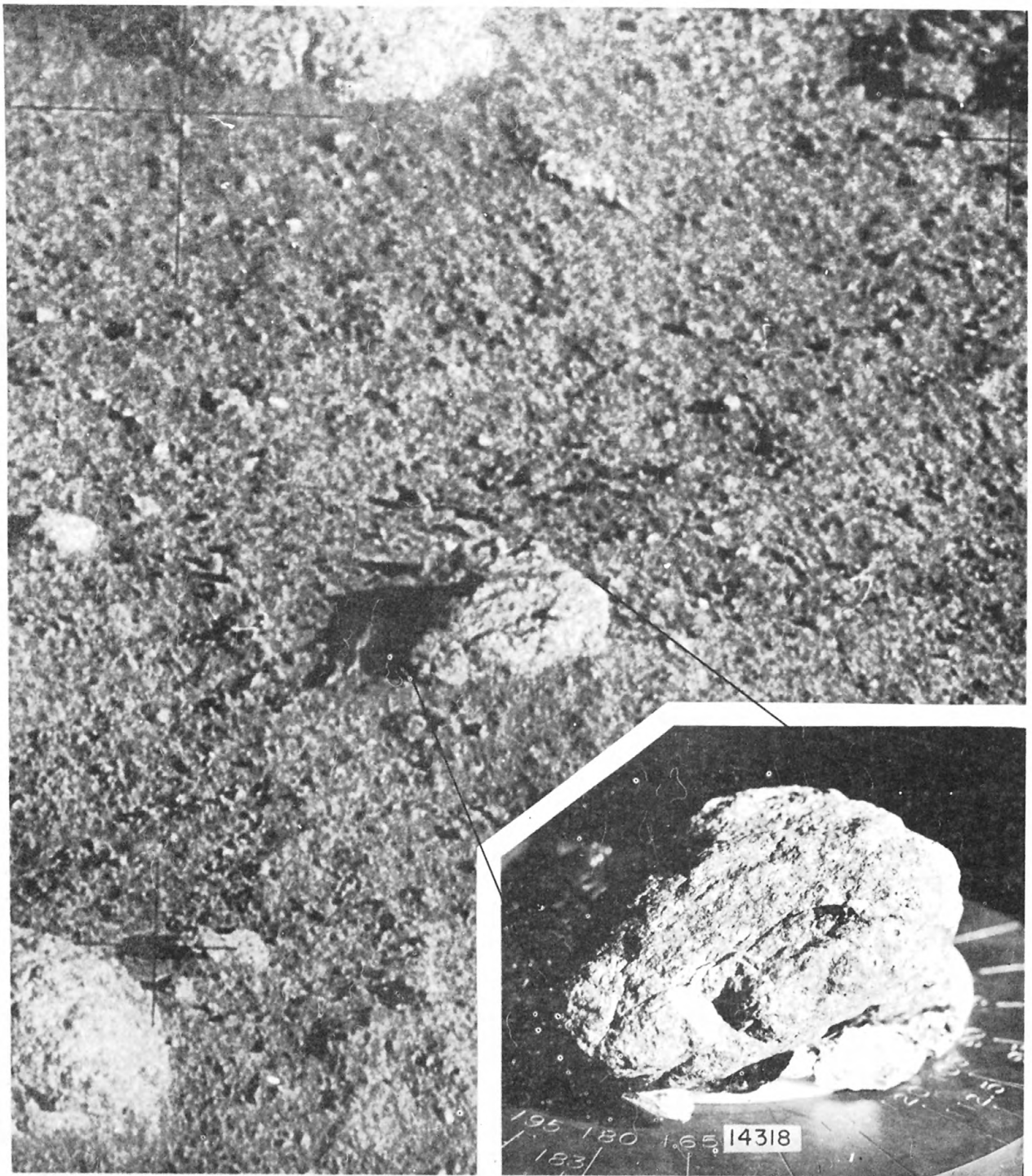


Figure 25. Sample 14318, shown in approximate lunar orientation reconstructed in the LRL using oblique lighting. The reconstruction is superimposed on an enlargement of NASA photograph AS14-68-9469.

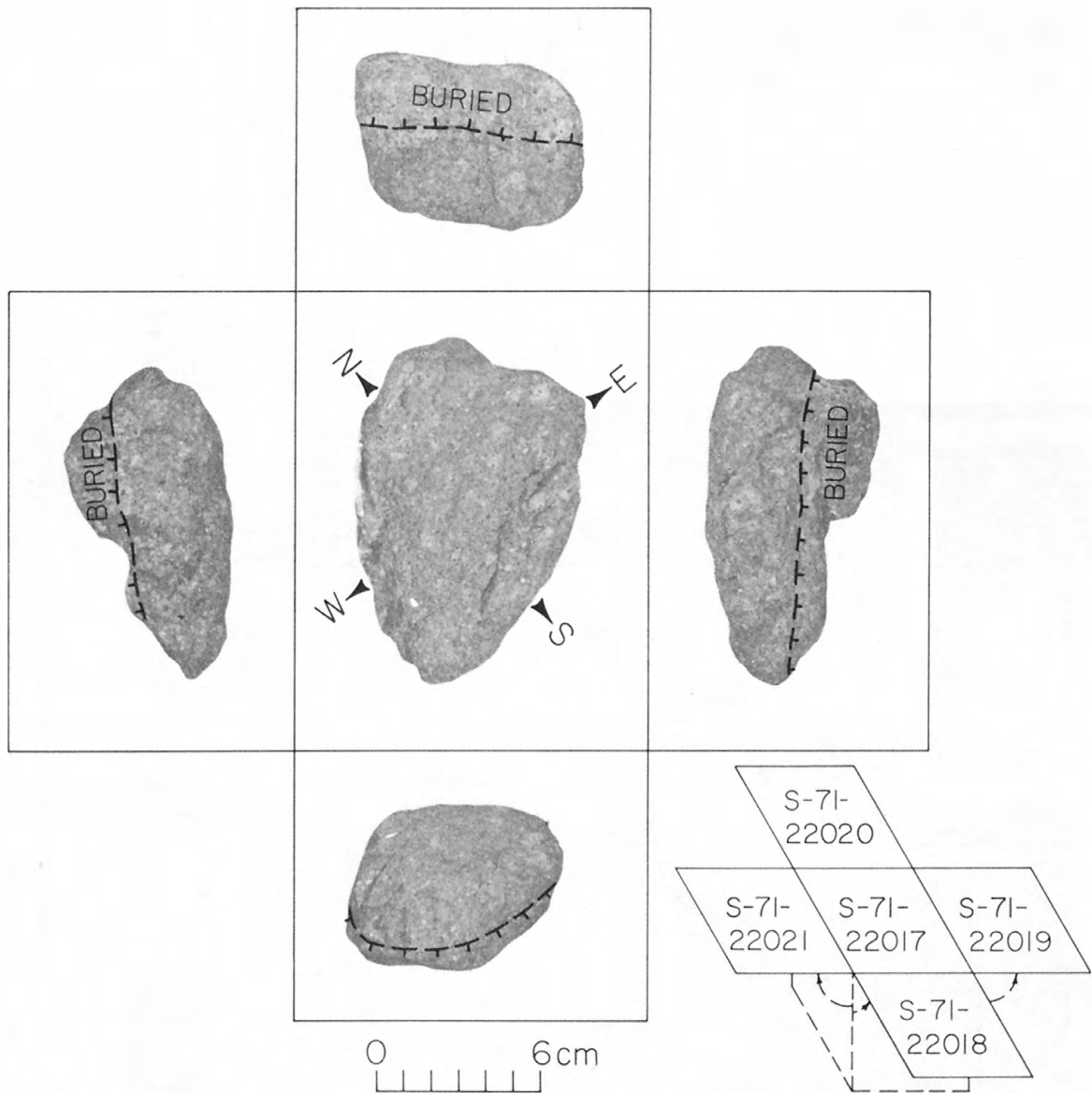


Figure 26. Orthogonal views of sample 14318, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram.

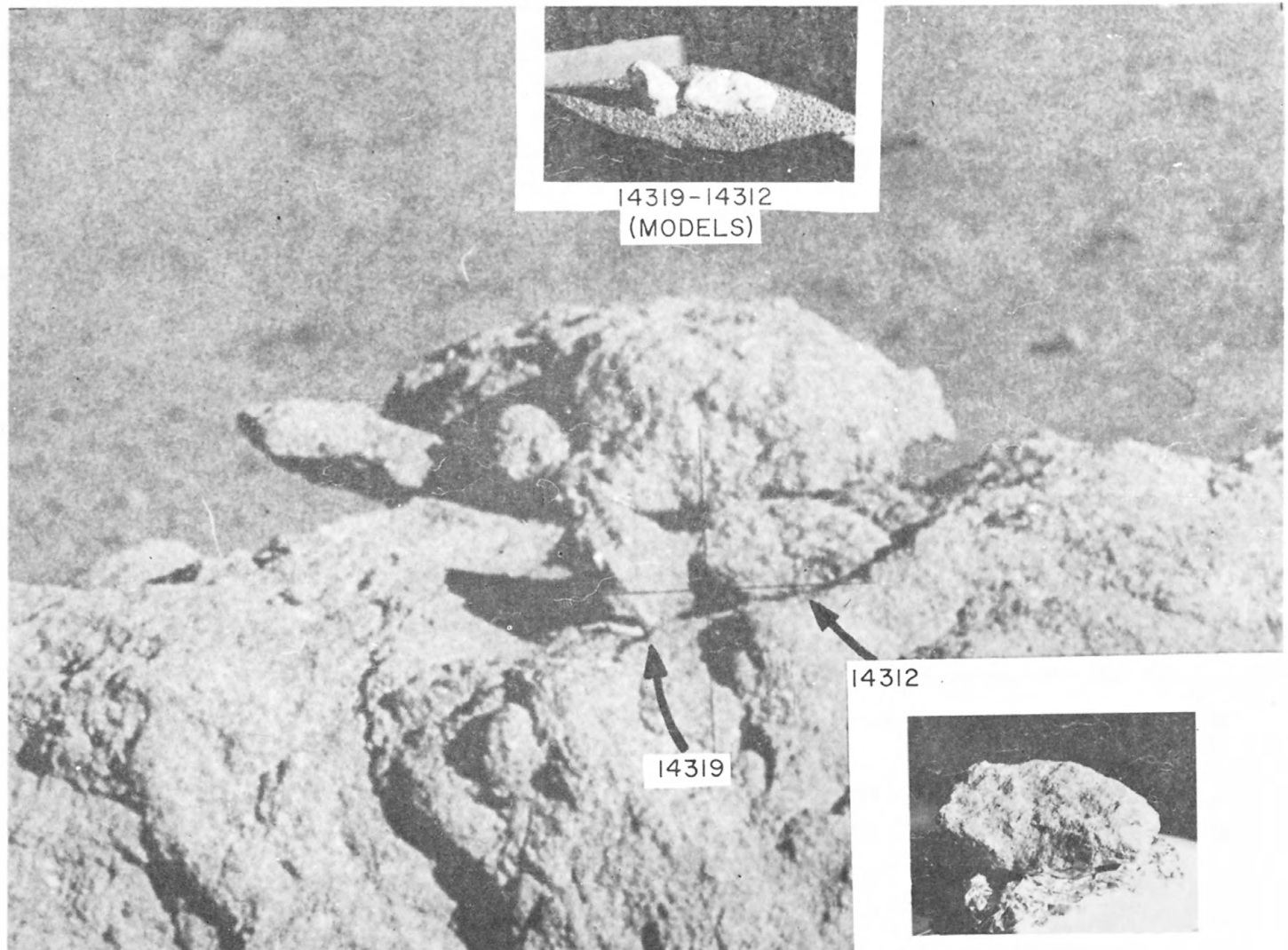


Figure 27. Approximate lunar orientations of samples 14312 and 14319 are shown by the use of NASA models under oblique lighting, and by a reconstructed orientation of sample 14312 in the LRL using oblique lighting. Insets are superimposed on an enlargement of NASA photograph AS14-68-9475.

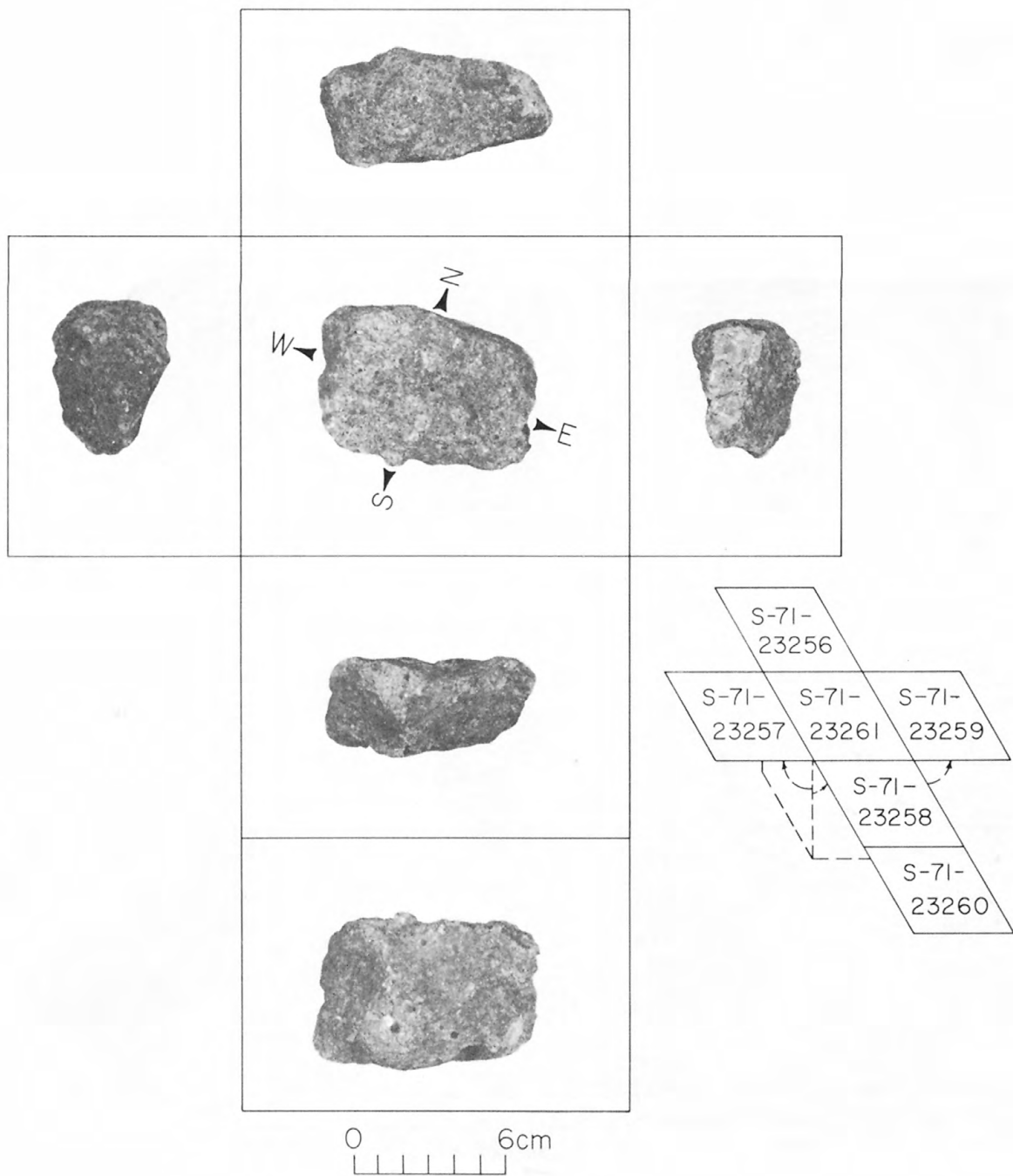


Figure 28. Orthogonal views of sample 14312, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram.

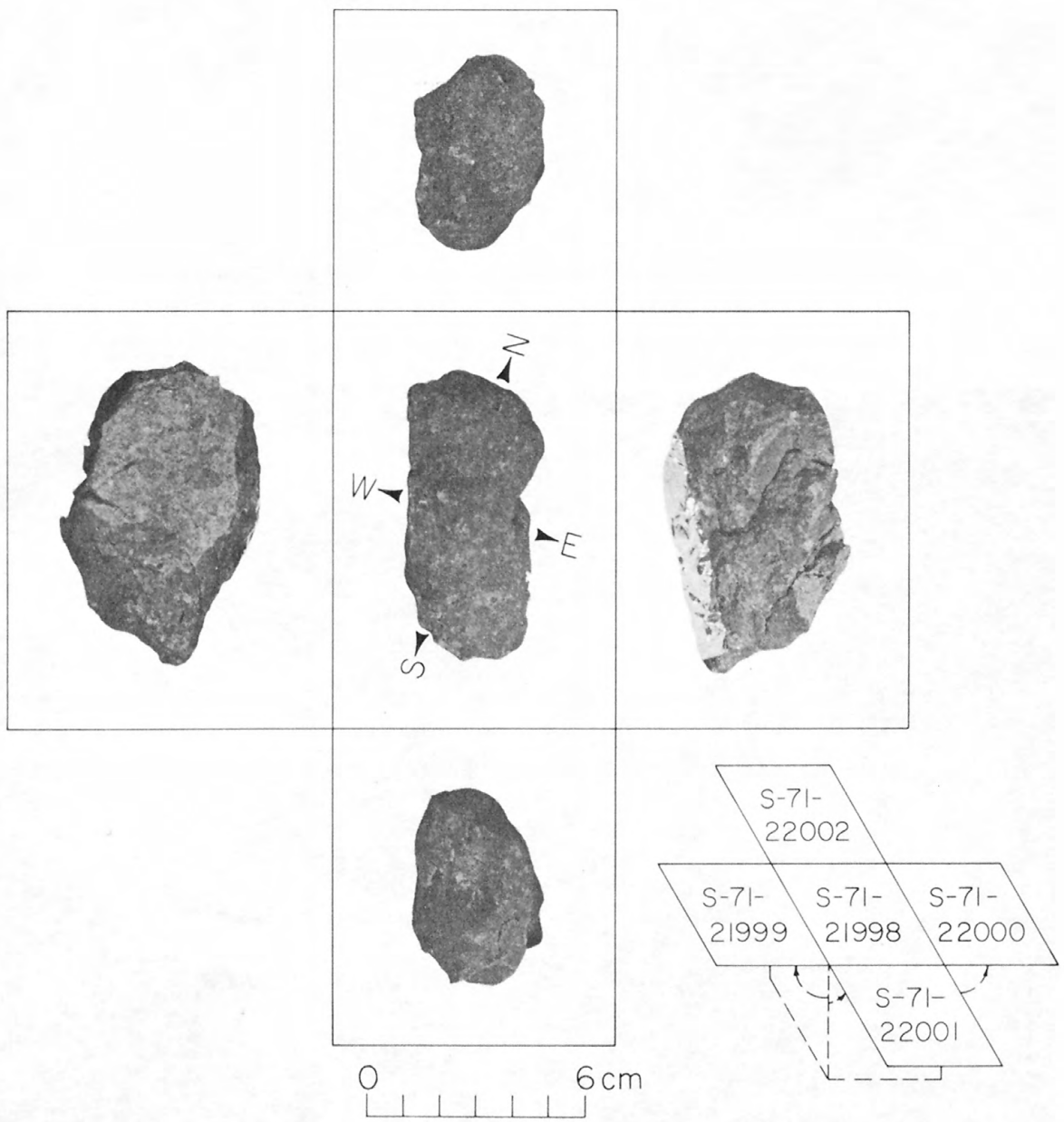


Figure 29. Orthogonal views of sample 14319, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram.

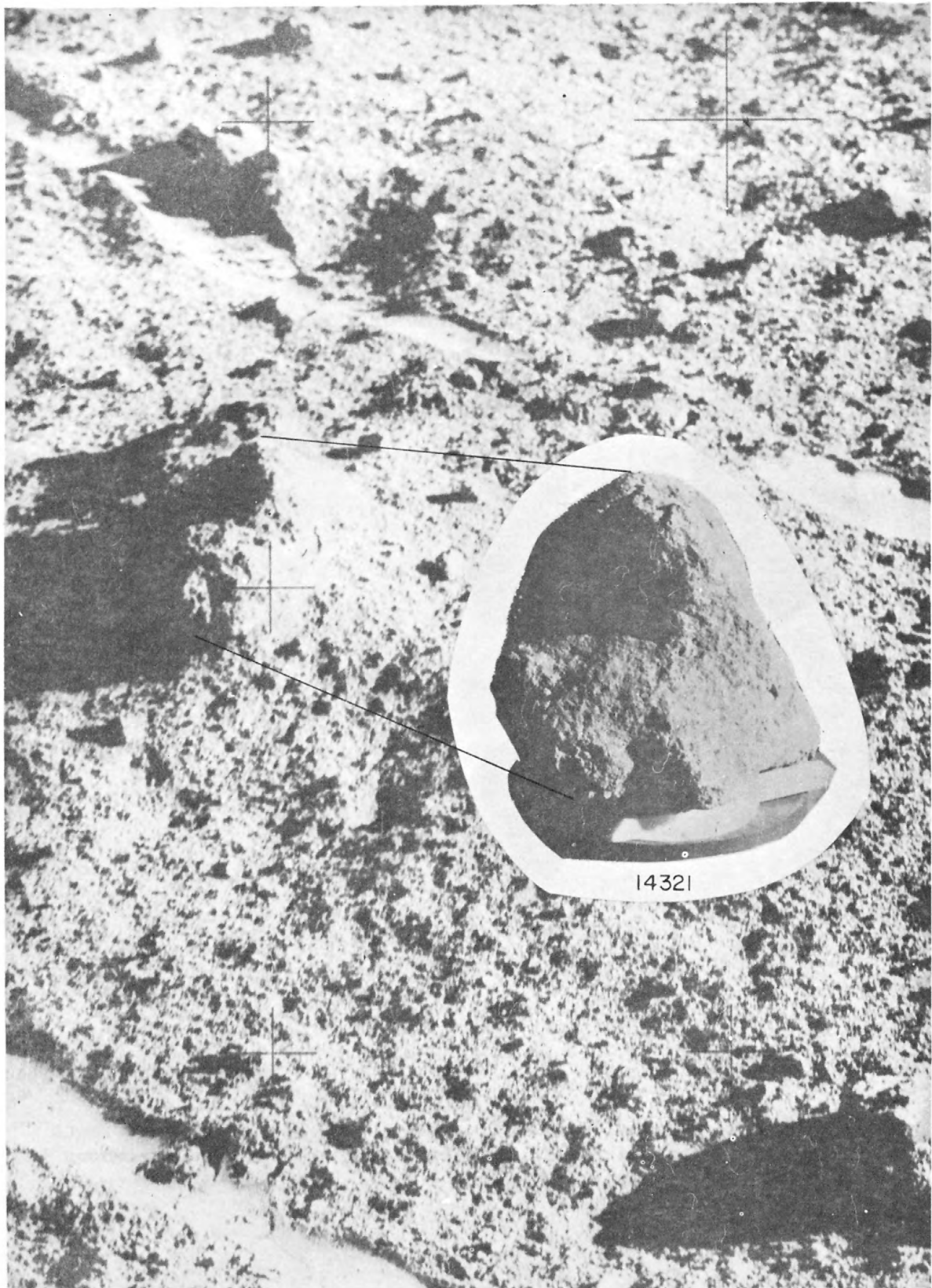


Figure 30. Sample 14321, showing approximate lunar orientation reconstructed in the LRL using oblique lighting. The reconstruction is superimposed on NASA photograph AS14-64-9128 taken before sample collection.

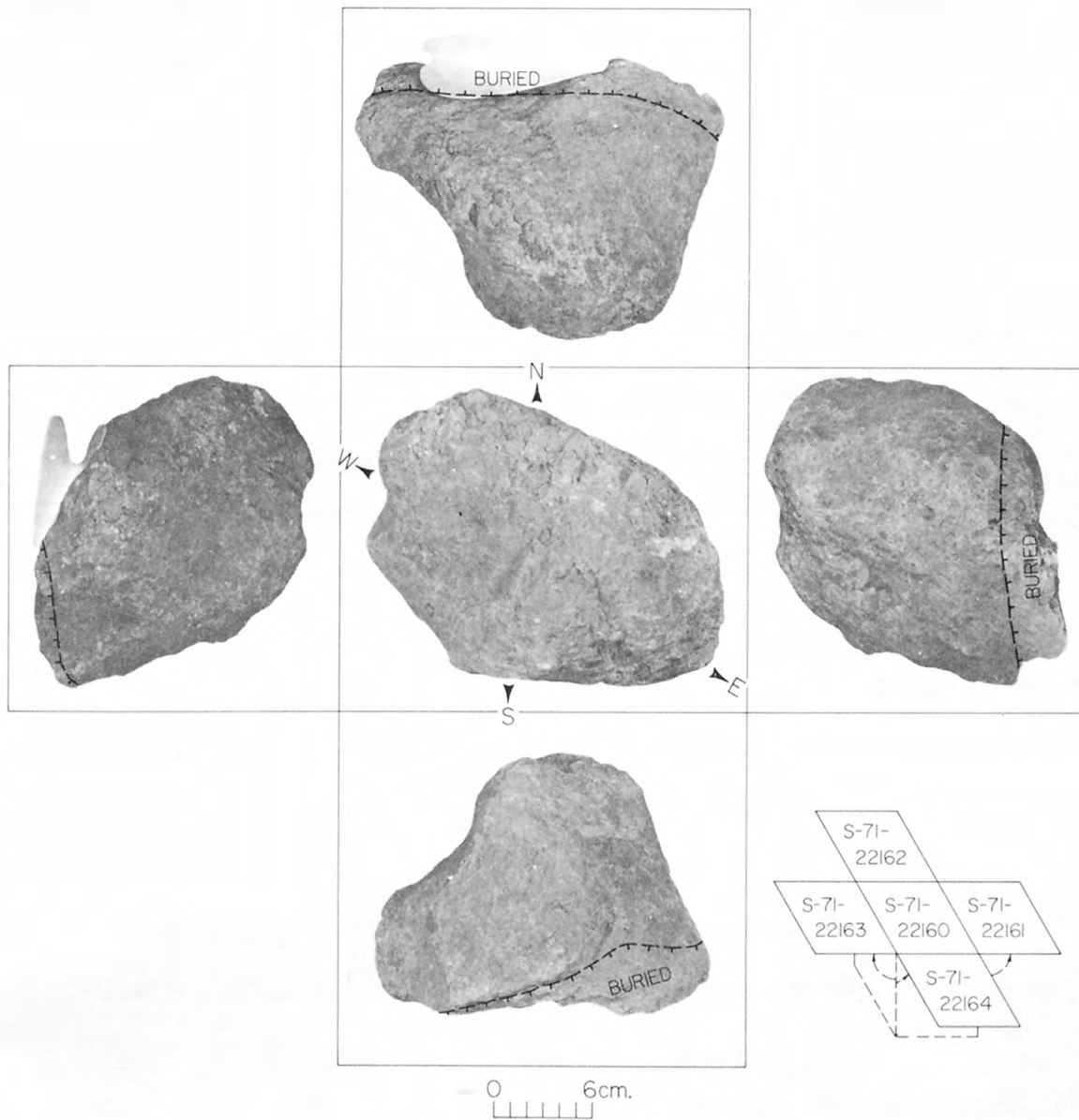


Figure 31. Orthogonal views of sample 14321, shown in approximate lunar orientation. NASA photograph numbers are shown in the schematic diagram.

## References

- Eggleton, R. E. and Offield, T. W., 1970, Geologic maps of the Fra Mauro region of the moon: U.S. Geol. Survey Misc. Geol. Inv. Map I-708.
- Sutton, R. L., and Schaber, G. G., 1971, Lunar locations and orientations of rock samples from Apollo missions 11 and 12: Proceedings of the Second Lunar Science Conference, Geochim. Cosmochim. Acta, The MIT Press (in press).
- Swann, G. A., Batson, R. M., Eggleton, R. E., Larson, K. B., Schafer, J. P., and Sutton, R. L., 1971a, Documentation of the Apollo 14 samples: U.S. Geol. Survey Interagency Report No. 27.
- 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. P., Shepard, A. B., Sutton, R. L., Trask, N. J., Ulrich, G. E., Wilshire, H. G., and Wolfe, E. W., 1971b, Preliminary geologic investigations of the Apollo 14 landing site, National Aeronautics and Space Administration Special Paper, (in press).
- Wilhelms, D. E., and McCauley, J. F., 1971, Geologic map of the near side of the moon: U.S. Geol. Survey Misc. Geol. Inv. Map I-703, (in press).



**BRO  
DART**

MADE IN U.S.A.



USCS LIBRARY-RESTON



3 1818 00077772 0