DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

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MANNED SPACECRAFT CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GEOLOGIC ATLAS OF THE MOON
LANSBERG P REGION
I-627 [ORB III-9 (100)]

GEOLOGIC SUMMARY

The Lansberg P region lies within a lowland area between Mare Cognitum and the main part of Oceanus Procellarum, about 135 km due south of the crater Reinhold. The Apollo 12 landing site is in the west-central part of the region and has been mapped in detail by Cannon (1969). Although the entire region is covered by cratered and rayed mare materials, the mare is almost entirely surrounded by terrae and is probably relatively thin. Superposed on the mare are two rays from the crater Copernicus, many individual craters, and crater clusters.

One of the earliest events to affect the region was the formation of the Imbrium basin, which probably reactivated much of a preexisting northeast- and northwest-trending lunar grid structure. The area was blanketed by ejecta from the tremendous impact that formed the basin. However, the surrounding uplands are cut by well-developed Imbrian sculpture suggesting that this blanket was probably only several tens of meters thick here. In late Imbrian time, the crater Lansberg was formed north of the region, and this event may have also contributed materials to the region.

The extensive mare materials were deposited at the end of the Imbrian Period or at the beginning of the Eratosthenian Period. The area lies in a shallow depression and the mare material gradually shoals against the surrounding terra. If one assumes a one percent slope eastward from the terra to the west, the mare material may be only 170 meters thick. Throughout the map area the mare is probably considerably less than half a kilometer thick.

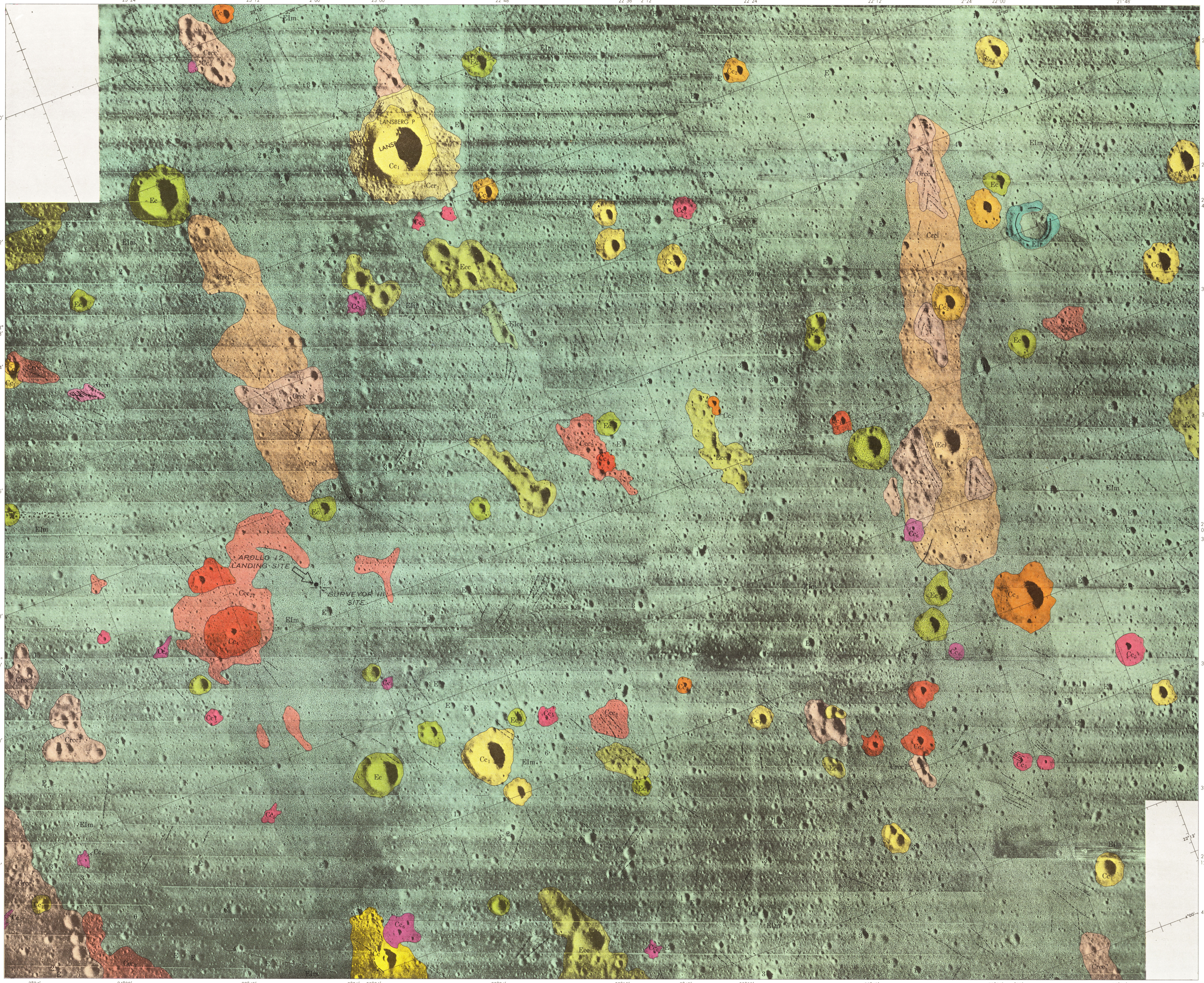
A 1:1,000,000-scale map based on telescopic photographs shows the mare material here as Imbrian (Eggleton, 1965), but Orbiter photographs suggest that much of it may be as young as Eratosthenian. The age of the mare material relative to that in other landing sites can be estimated from the size and morphology of superposed craters. The largest pan-shaped craters and barely detectable gentle depressions superposed on the mare material in this region are smaller than those in the Sabine D region in Mare Tranquillitatis where Apollo 11 landed and larger than those in the Flamsteed K, Wichmann CA and Maestlin G regions to the west in Oceanus Procellarum. Thus if most of these craters originally were morphologically fresh and if the time required to degrade them is roughly proportional to their diameters, the mare material in this region is younger than that in the Apollo 11 landing site and older than that in the mare landing sites farther to the west (see enclosed pamphlet) The mare materials were probably deposited as a series of thin flows although some volcanic ash fall deposits may also be included.

The last major event that affected the region was the Copernicus impact. It formed the two bright northeast-trending rays, which may consist of deposits of Copernicus ejecta, and which appear to have subdued much of the cratered mare surface. Both rays include shallow elongate craters and numerous faint lineaments. In several places, including the Apollo 12 landing site, however, the rays have little topographic expression. Along the western ray, there is a paucity of 100-200 meter craters, and along the eastern ray, craters 0.1 to 1 km in diameter appear to be slightly subdued by the formation of the ray. A clear example of a Copernicus secondary impact crater occurs at the northern end of the eastern ray in the northeast corner of the region. The northern wall of the crater (toward Copernicus) is continuous, whereas the southern wall is breached. A herringbone pattern extends southward from the breach and grades into a lineated depositional pattern (unit Crcl) which has subdued the preexisting topography.

Clusters of small post-Copernicus craters (unit Ccc_2) are common in the region. These may be either clusters of secondary impact craters (although the primary crater is unknown) or endogenetic craters formed along preexisting lunar grid directions.

REFERENCES

Cannon, P.J., 1969, Geologic map of Apollo landing site 7 [scale 1:25,000]: U.S. Geol. Survey open-file report.
Eggleton, R.E., 1965, Geologic map of the Riphaeus Mountains region of the Moon: U.S. Geol. Survey Misc. Geol. Inv. Map I-458.
Pohn, H.A., and Wildey, R.L., 1970, A photoelectric-photographic study of the normal albedo of the Moon: U.S. Geol. Survey Prof. Paper 599-E, 20 pages.



Controlled base photomap ORB III-9 (100) prepared by Army Map Service, Corps of Engineers U.S. Army, Washington, D. C. 20315

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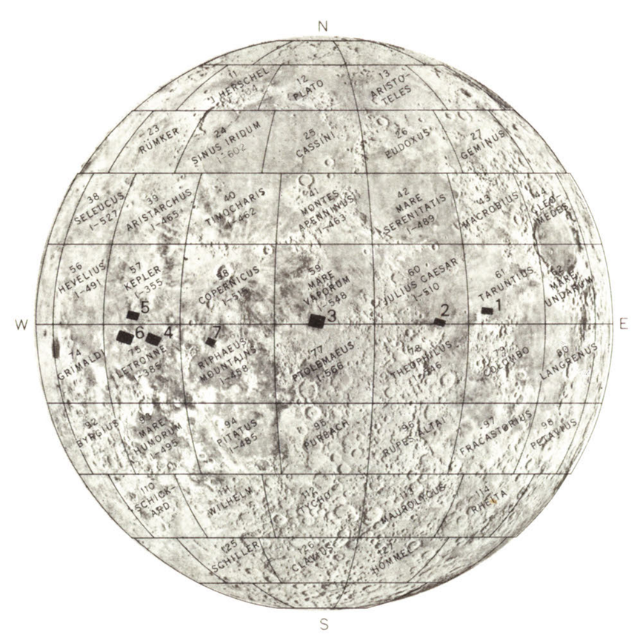
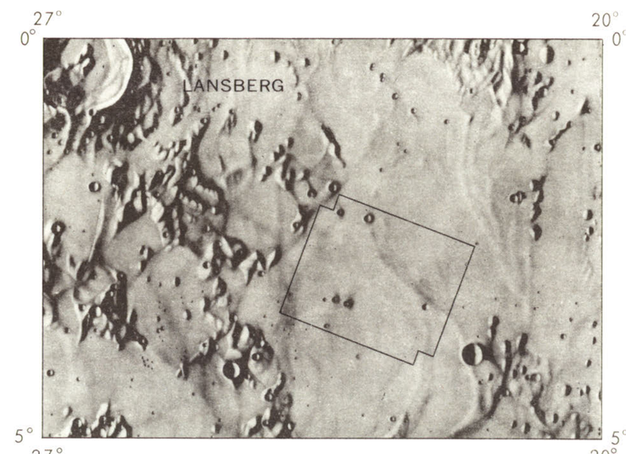
SCALE 1:100 000
MERCATOR PROJECTION

Large numbers 1–7 refer to regions that include early Apollo landing sites:
1. Maskelyne DA region–I–616
2. Sabine D region–I–618
3. Oppolzer A region–I–620
4. Wichmann CA region–I–624
5. Maestlin G region–I–622
6. Flamsteed K region–I–626
7. Lansberg P region–I–627 this report

Small number above quadrangle name refers to lunar base chart (LAC series)
Small number below refers to published geologic map (scale 1:1,000,000)



INDEX MAP OF THE EARTHSIDE HEMISPHERE OF THE MOON



MAP OF PART OF THE EUCLIDES P QUADRANGLE OF THE MOON (AIC SERIES)
Area of this report shown by solid line; dot indicates Apollo 12 landing spot. Approximate scale 1:4,200,000

Principal sources of geologic information: Lunar Orbiter moderate-resolution photographs: I—M157–173; III—M136–160; and IV—H125–126; rays from full-Moon plate 5818 taken at U.S. Naval Observatory, Flagstaff, Arizona, and from Lunar Orbiter IV photographs
Geology compiled in 1969
Work performed on behalf of the National Aeronautics and Space Administration under contract No. T-66353G

EXPLANATION

NOTE: A crater's materials are mapped and given symbols according to the size (rimcrest diameter) and interpreted relative age of the crater. The apparent freshness of the crater on Orbiter photographs is used to determine its age, and allowance is made for an inverse relation between the sizes and rates of degradation of craters (see enclosed pamphlet). The larger craters in each age group are outlined by geologic contacts (mappable materials extend relatively farther from the rim crests of young craters than from the rim crests of old craters of comparable size). The map symbols that identify these materials consist of a capital letter to designate lunar time-stratigraphic division (system), lowercase letters to designate rock units, and, in the Copernican System, a subscript number to designate relative age within that system. To keep the map from becoming crowded, materials of the smaller craters are not outlined; such craters are indicated by a number or letter symbol only. For example, materials designated Cc_1, outlined and colored, are associated with a relatively old Copernican crater more than 600 m (meters) in diameter; materials designated simply 1 are the same age but are associated with craters from 400 to 600 m in diameter. Materials designated Cs, not outlined, are associated with small craters (<700 m) which may be either secondaries of the field around Copernicus or older craters unrelated to Copernicus. The mapping is extended to smaller size craters for younger craters than for older craters; the smallest craters in all age groups are unmapped.

COPERNICAN SYSTEM

Cc — Crater material

Characteristics

Material of a single crater at 3°35′S., 23°34′W., having bright-appearing rim material. Crater has appearance of a Cc_3 or Cc_4 crater but has a field of anomalously large satellitic craters to the north. Satellitic field intersects north rim of crater

Interpretation

Material of primary impact crater having subsequent volcanism and collapse at northern edge

Cc_6 | 6 — Crater materials

Characteristics

Cc_6, *material of craters having very bright ray material extending two or three crater diameters away from rim crest. Concentric fractures on walls and radial hummocks on rims. Abundant blocks in rim deposits. Floor hummocky. Crater rim crest raised, very sharp, and distinctly polygonal*

6, *similar to* Cc_6

Cc_5 | 5 — Crater materials

Characteristics

Cc_5, *material of craters having very bright appearing ray material. Abundant blocks. Arcuate fractures on walls and floors. Rim crest sharply raised*

5, *similar to* Cc_5

Cc_4 | 4 — Crater materials

Characteristics

Cc_4, *material of craters having bright-appearing rim material. Abundant blocks on walls and in rim material. Blocks as large as 30 m around one 500 m crater. Rim crest sharp to slightly subdued*

4, *material of craters having rim material that appears slightly brighter than surroundings. Abundant blocks. Rim crest slightly subdued*

Cc_3 | 3 — Crater materials

Characteristics

Cc_3, *material of craters having rim material that appears slightly brighter than surroundings. Abundant blocks. Weakly developed fractures on floors and walls. Rim crest slightly subdued*

3, *material of craters having rim material that appears only as bright as surroundings. Abundant blocks. Concentric ridges and troughs in rim material. Rim crest slightly to moderately subdued*

Ccch — Material of clustered crater chains

Characteristics

Cluster of crater chains at 2°30′ S., 23°42′ W. Several chains of small craters (mapped as rilles) and one single chain of about 100 m craters. Chain of large craters has a continuous septum along long axis of chain. Rims low or absent

Interpretation

Material of a field of maars

Ccc_2 — Crater cluster material

Characteristics

Material of clusters of Cc_2 *craters; individual craters 50-400 m in diameter. Long axis of most clusters trends north-northwest. Lines of craters trend northwest*

Interpretation

Material of secondary impact craters for which no primary crater has been located. Alternatively, may be endogenetic craters developed along lunar grid direction

Cc_2 | 2 — Crater materials

Characteristics

Cc_2, *material of craters that appear only as bright as surroundings. Moderately abundant blocks on rims and walls. Rim crest slightly to moderately subdued*

2, *material of craters having moderately subdued rim crests and moderately abundant blocks. Concentric ridges and troughs in a few places in rim material. Patterned ground (irregular anastomosing ridges and troughs several meters high and approximately 10 m wide) on walls*

(stippled) | Crcc | Crcl | Cs — Copernicus ray and ray cluster materials

Characteristics

Stippled, material that appears brighter than surroundings on full-Moon, Orbiter IV, and enhanced Orbiter III photographs; includes a few shallow craters and some lineations; otherwise, has no topographic relief

Crcc, *material of clusters of mostly shallow irregular rimless craters or craters having strongly subdued rim crests; abundant lineaments; herringbone pattern on sides of some craters away from Copernicus. Some clusters occur at the head of bright rays shown on full-Moon photographs; others are in interray areas*

Crcl, *material having numerous lineaments, herringbone pattern, and a few subdued craters; conspicuously subdues subjacent topography*

Cs, *material of small shallow craters which have general appearance of either isolated craters of a* Crcc *cluster or* Ec *craters*

Interpretation

Stippled, material that is either a very thin blanket of Copernicus ejecta or is an area where the mare surface material has been disturbed by the downrange movement of material

Crcc, *material of secondary impact craters and ejecta material from the crater Copernicus*

Crcl, *mainly tertiary ejecta downrange from Copernicus secondary craters*

Cs, *material of craters which are either Copernicus secondary impact craters or older craters of the main sequence*

Cc_1 | Ccr_1 | 1 — Crater materials

Characteristics

Cc_1, *material of craters having moderately subdued rim crests. Few blocks on rims; abundant blocks on walls; abundant blocks as large as 50 m on rim and wall of Lansberg P. Rim material appears only as bright as surroundings. Patterned ground on walls*

Ccr_1, *material of dune-like or elongate hummocks, subconcentric to Lansberg P*

1, *material of craters having moderately to strongly subdued rim crests. Few blocks on rims; moderately abundant blocks on walls. Patterned ground on walls*

ERATOSTHENIAN SYSTEM

Ecc — Crater cluster material

Characteristics

Material of clusters of 200 m to 1 km Ec *craters. Long axes of clusters trend north-northwest; some craters in clusters elongate north-northwest; some clusters breached on northwest end with apparent buildup of material on that end*

Interpretation

Material of secondary impact craters for which primary crater is not known

Ec | E — Crater materials

Characteristics

Ec, *material of craters having moderately to strongly subdued rim crests. Few blocks on rims; abundant blocks on walls. Some concentric structure in rim material of larger craters. Patterned ground on walls*

E, *material of craters that are nearly rimless, shallow depressions or have shape of shallow pans. Blocks sparse. Patterned ground on walls*

Interpretation of Crater Materials
Cc_6–Ec; 6–E

Poorly sorted breccia and rubble of secondary and primary impact craters; probably of basaltic composition; may have shock-induced structures. Craters are assigned numbers or letters according to relative age. Numbered craters are the youngest and the higher the number the younger the crater. Morphology of craters progressively modified with increasing age by mass wasting, tectonism, impact, and deposition of fragmental material. A few of the small subdued craters may be of internal origin

IMBRIAN OR ERATOSTHENIAN SYSTEM

EIm — Mare material

Characteristics

Forms extensive flat to gently undulating surfaces. Albedo 0.109-0.120 (Pohn and Wildey, 1970). Fewer shallow pan-shaped depressions (400 m to 1 km) than on Imbrian mare material of Apollo 11 landing site; more than on Eratosthenian mare material in potential landing sites to west

Interpretation

Volcanic materials: either lava or pyroclastic deposits or both, mantled by rubble layer. Number of shallow pan-shaped depressions suggests an age near the Imbrian-Eratosthenian boundary

EIcc — Crater-cluster material

Characteristics

Material of very gentle depressions trending north-south. One occurrence in region

Interpretation

Degraded secondary impact craters or collapse features

EIr — Ring material

Characteristics

Forms subdued circular ridge having patterned ground on slopes. Concentric trough just below crest. Appears to have same albedo as mare material

Interpretation

May be remnant of old crater thinly covered with mare material or may be volcanic ring structure

Contact
Solid where approximately located

(Ec)
Buried contact
Buried unit indicated by symbol in parentheses

Fault
Bar and ball on apparent downthrown side

Scarp
Barbs point downslope

Lineament
Narrow trough or low scarp

Very narrow trough or rille

The explanatory pamphlet accompanying this map was prepared prior to the designation of the Lansberg P region as an Apollo landing site. It describes the general principles followed in mapping at this scale but makes no reference to this map area. The principal features of the Lansberg P region distinguishing it from the other Apollo landing sites indicated on the index map are the rays from the crater Copernicus and the crater clusters interpreted as secondary impact craters formed by ejecta from Copernicus.

GEOLOGIC MAP OF THE LANSBERG P REGION OF THE MOON
LUNAR ORBITER SITE III P–9, OCEANUS PROCELLARUM INCLUDING APOLLO LANDING SITE 7 (APOLLO 12)

By
H. A. Pohn
1971

Geological Survey, price $1.00
Explanatory pamphlet accompanies map