DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
MANNED SPACECRAFT CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GEOLOGIC ATLAS OF THE MOON
WICHMANN CA REGION
I-624 [ORB III-11 (100)]

GEOLOGIC SUMMARY

This map shows the geology in and around two potential early Apollo landing sites in the lunar equatorial belt. The Wichmann CA region is in Oceanus Procellarum, south of the equator, approximately 320 km south of the crater Kepler. It is covered by mare material with numerous ridges, low domes, craters, and crater clusters. Relatively few of the craters are larger than 200 m across. Terra material is absent.

The relative freshness of the low domes and prominent mare ridges suggests that the mare material here is relatively young. On an earlier, small-scale reconnaissance geologic map of the Letronne region (Marshall, 1963), mare material in the Wichmann CA region was mapped as Imbrian; but Orbiter photographs show that the oldest craters on the surface are relatively young Eratosthenian craters and the mare material is now believed to be Eratosthenian. A detailed map of the landing sites has been prepared by West and Cannon (1971).

The most striking structures of the region are three sets of mare ridges. Although they all appear to be Eratosthenian, degradation and (or) burial of certain features suggest that the three sets did not form contemporaneously. These features are best preserved in the set of northwest-trending ridges interpreted as youngest in the northeastern part of the region. A plateau (Erp_3) occupies the central part of the ridge. On either side of it, and projecting above its surface, are spines (Ers_3). In two places, lobate protrusions (Erl_3) extend beyond the spine. Even though these features differ in topographic expression, they probably consist of the same material. Their interrelationships resemble those in recent terrestrial lava flows, such as the one that issued from SP Crater in the San Francisco volcanic field, north of Flagstaff, Ariz. If the analogy is valid, the mare ridges in this site are probably lava flows. (However, this interpretation by no means implies that all mare ridges on the Moon are lava flows. There are several types of mare ridges, and each may have a different origin.) The mare ridge set interpreted as second oldest occurs at the southern edge of the map area and trends almost east-west. The plateau (Erp_2) and spine (Ers_2) are preserved but moderately subdued. The ridge set (Emr_1) interpreted as oldest occurs throughout the region and trends generally north-south. This set may be represented only by remnants of the spines; the plateaus may have been buried or completely eroded.

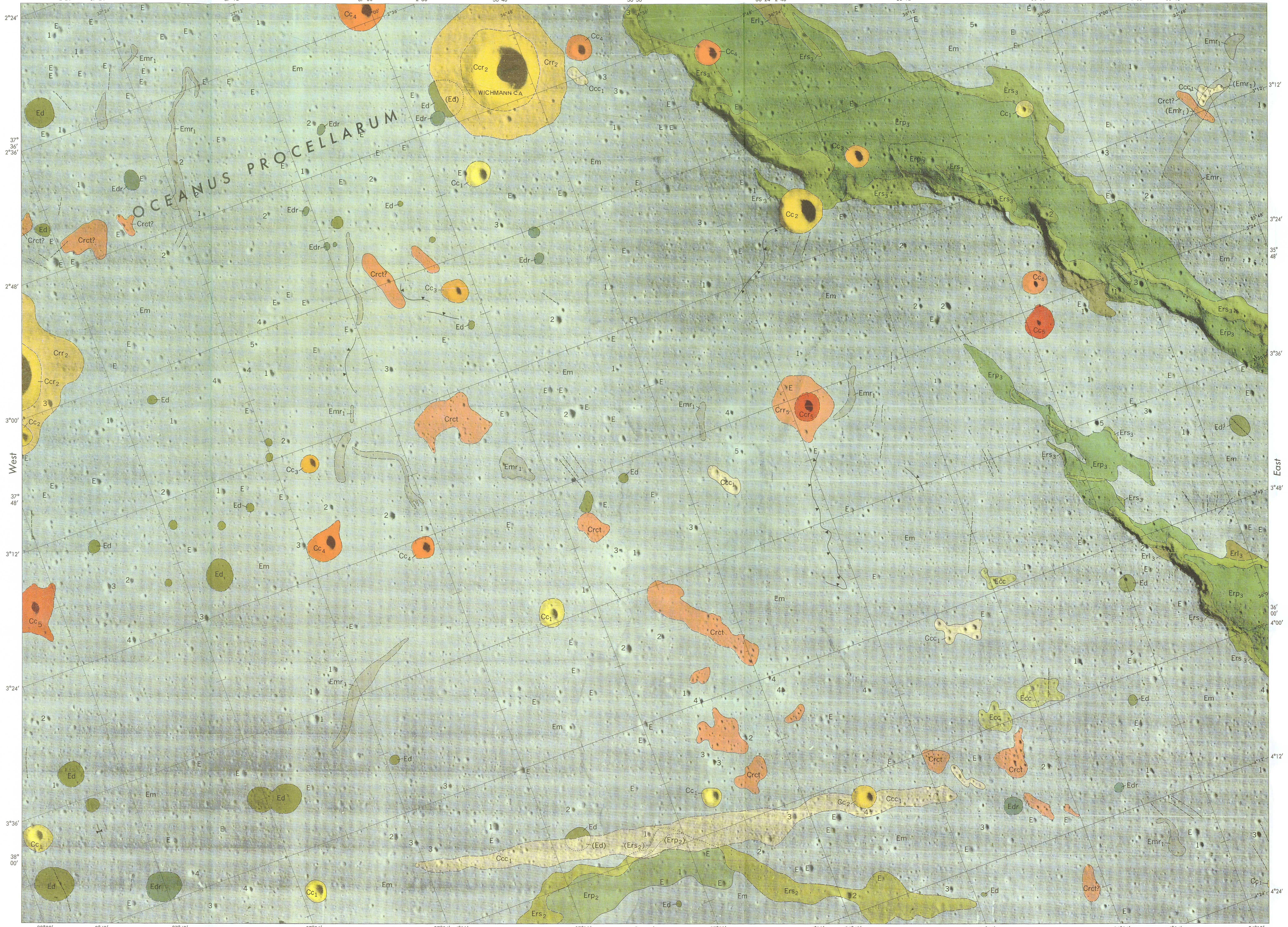
Two types of domes are present: (1) normal domes (Ed), and (2) ringed domes (Edr), which are characterized by a circular depression surrounding a raised center. Both types range from approximately 100 to 1,600 m in diameter and are only a few meters high. They appear to be more numerous in the western part of the map area, but the individual types are randomly distributed. They may represent surface expressions of small plug-like intrusions or laccoliths, and the circular depression of the ringed domes may result from differential magmatic subsidence.

The region also contains several prominent crater clusters (Crct) which trend northwest. They were probably produced by the impact of secondary ejecta from Tycho. Some of the material in these secondary fields may have been derived from the southern highlands, several thousand kilometers away. An elongate older crater cluster (Ccc_1) occurs in the southern part of the area. It trends east-west and its origin is not clear.

A thin blanket of fragmental material (the lunar regolith) probably covers most of the region. It may consist of ejecta from meteorite impacts, or it may be volcanic debris such as ash-fall or unwelded ash-flow tuff. The mare material in this region is relatively young and may differ in composition from older mare material in sites to the east. Surficial fragmental material may be relatively thin, and blocks should be plentiful around small fresh craters.

REFERENCES

Marshall, C. H., 1963, Geologic map and sections of the Letronne region of the Moon: U.S. Geol. Survey Misc. Geol. Inv. Map I-385.
Pohn, H. A., and Wildey, R. L., 1970, A photographic-photoelectric study of the normal albedo of the Moon: U.S. Geological Survey Prof. Paper 599-E (in press).
West, Mareta, and Cannon, P. J., 1971, Geologic map of Apollo landing sites 4 and 4R (scale 1:25,000): U.S. Geol. Survey Misc. Geol. Inv. Map I-625.



Controlled base is photomap Orb III-11 (100) prepared by Army Map Service, Corps of Engineers, U.S. Army, Washington, D.C. 20315

SCALE 1:100 000

NAUTICAL MILES
STATUTE MILES
KILOMETERS

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1971—G70218

Principal sources of geologic information: Lunar Orbiter moderate resolution photographs: III—M173–180; V—M169–176. Lunar Orbiter high resolution photographs V—H169–176. Albedo data from Pohn and Wildey (1970) and from full-Moon plates 5818 and 5819 taken at U.S. Naval Observatory, Flagstaff, Ariz.

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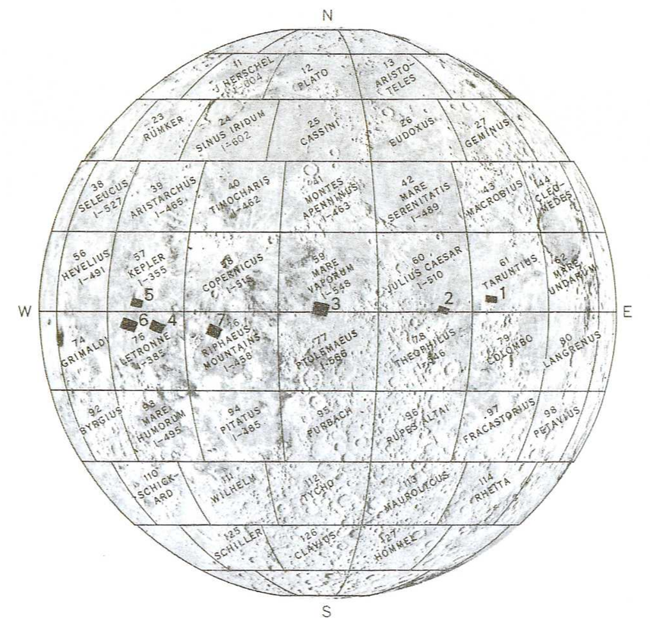
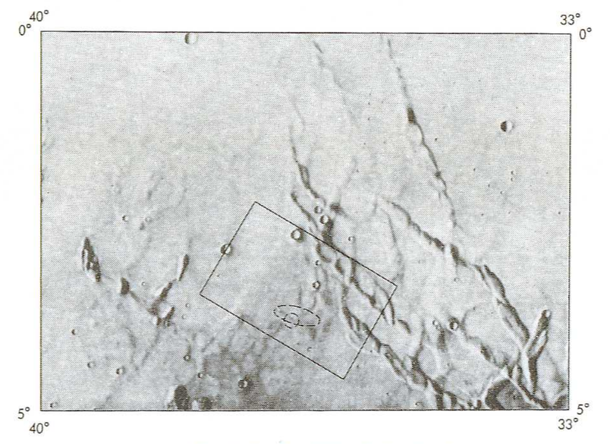
Large numbers 1-7 refer to regions that include early Apollo landing sites:
1. Maskelyne DA region – I-616
2. Sabine D region – I-618
3. Oppolzer A region – I-620
4. Wichmann CA region - this report
5. Maestlin G region – I-622
6. Flamsteed K region
7. Lansberg P region

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
WICHMANN QUADRANGLE OF THE MOON
(AIC SERIES)

Area of this report shown by solid line; dashed ellipse indicates original LM landing dispersion area, site 4 (99% landing probability); dashed circle indicates relocated landing site (4R) for possible use on a mission after the first. Approximate scale 1:3,000,000.

GEOLOGIC MAP OF THE WICHMANN CA REGION OF THE MOON
LUNAR ORBITER SITE III P-11, OCEANUS PROCELLARUM INCLUDING APOLLO LANDING SITES 4 AND 4R

By
David Cummings

1971

EXPLANATION

NOTE: A crater's materials are mapped and given symbols according to the size (rim-crest 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 mapped in color (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 unit, 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 in each age group are not outlined; such craters are indicated by 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. 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_5 | Ccr_5 | Crr_5 | 5

Crater material

Characteristics

Cc_5, material of bright rayed craters having block-strewn, hummocky rims. Abundant blocks on wall. Crater rim crest sharp

Ccr_5, inner rim and wall material, undivided. Rim material has concentric dune-like structures and appears brighter than surroundings

Crr_5, outer radial rim material. Both concentric and elongate dune-like hummocks that appear brighter than surroundings

5, material of craters with rays. Abundant blocks on rims and within craters. Crater rim crest sharp to slightly subdued

Crct

Tycho ray cluster material

Characteristics

Material in and around clusters of mostly elongate craters approximately 50-100 m in diameter; many have the same characteristics as Cc_3, Cc_4-type craters; others are more strongly subdued; albedo higher than that of surroundings. Clusters have consistent northwest trend radial to Tycho

Interpretation

Material of secondary impact craters formed by fragments ejected during formation of the crater Tycho

Cc_4 | 4

Crater material, undivided

Characteristics

Cc_4, material of craters having bright-appearing rim material. Abundant blocks. Crater rim crest sharp to slightly subdued

4, material of craters having rim material that appears slightly brighter than surroundings. Abundant blocks on rims and within craters. Rim crest slightly subdued

Cc_3 | 3

Crater material, undivided

Characteristics

Cc_3, material of craters with block-strewn smooth rims that appear slightly brighter than surroundings. Abundant blocks on wall. Crater rim crest slightly subdued

3, material of rayless craters having smooth rims that appear only as bright as surroundings. Scattered blocks on rim and within crater. Rim crest moderately subdued

Cc_2 | Ccr_2 | Crr_2 | 2

Crater material

Characteristics

Cc_2, material of rayless craters. Rim crest moderately to slightly subdued. Some blocks on rim and wall

Ccr_2, rim and wall material undivided. Abundant blocks. Rim crest slightly subdued

Crr_2, radial rim material. Weakly developed dune-like hummocks

2, material of rayless craters having smooth low rims. Scattered blocks on rim and within craters. Rim crest moderately subdued

Ccc_1

Crater cluster material

Characteristics

Material in and around clusters of nearly circular 50-300 m craters that have the same characteristics as Cc_1-type craters; albedo slightly higher than that of surroundings

Interpretation

Material of secondary impact craters and ejecta; origin unknown. Cluster oriented east-west at south edge of map area may be craters of endogenetic origin related to mare ridge (Erp_2, Ers_2)

Cc_1 | 1

Crater material, undivided

Characteristics

Cc_1, material of rayless craters having smooth rims. Scattered blocks on rim and wall. Rim crest moderately subdued. Patterned ground (irregular anastomosing ridges and troughs approximately 10 m wide and several meters high) conspicuous

1, material of rayless craters having smooth rims. Crater rim crest strongly subdued and rounded. Scattered blocks on rim and within craters. Patterned ground on walls

ERASTOSTHENIAN SYSTEM

Erp_3 | Ers_3 | Erl_3

Mare ridge material

Characteristics

Material of clearly visible broad, sinuous mare ridge. Crater density approximately the same as on surrounding mare areas. Albedo low. Divided into morphologic subunits as follows:

Erp_3, plateau. Broad generally undulatory surface that makes up major part of the ridge

Ers_3, spine. Narrow, sharp-crested ridge projecting above the plateau surface

Erl_3, lobe. Lobate protrusions of the mare ridge extending outward from the base of a spine

Interpretation

Probably volcanic flows. Several flows may be present in a single ridge as suggested by the apparent overlapping of plateaus and spines. Erp_3 probably represents the major part of the surface of the flow; Ers_3 may define natural flow levees; and Erl_3 may define subsidiary flows that broke through the levees analogous to levees of terrestrial lava flows, or aprons of erosional debris from the levees

Erp_2 | Ers_2

Mare ridge material

Characteristics

Material of sinuous mare ridge. Grossly similar in form to younger ridges but more subdued; spines less well developed, and lobes not visible. Crater density and albedo approximately the same as on surrounding mare

Erp_2, plateau

Ers_2, spine

Interpretation

Similar to corresponding units of younger mare ridge

Emr_1

Mare ridge material

Characteristics

Material of highly subdued mare ridges. Most are sinuous. Morphologic subunits (plateaus, spines, and lobes) cannot be distinguished. Crater density approximately the same as on surrounding mare material

Interpretation

Old volcanic flows, subdued and partly covered by erosional debris

Em

Mare material

Characteristics

Albedo low. Flat to gently undulating surface. Low domes (including some unmapped) and short, irregular, unmapped scarps more abundant than in Apollo sites 1,2,3,5 and 7

Interpretation

Volcanic flows or ash-flow tuffs. Probably basaltic. From the age and distribution of craters and abundance of low domes, the mare appears to be relatively young and approximately the same age throughout the area

Ed | Edr

Dome material and ringed dome material

Characteristics

Ed, dome material, circular features 100-1,600 m across that rise slightly above level of surrounding mare surface. In some, center is slightly lower than rim and occupied by a small pit. A few partly encircled by a raised outer ring

Edr, ringed dome material. Same as Ed but surrounded by a circular depression

Interpretation

Surface expression of small plug-like intrusions or laccoliths. Edr may be surface expression of plug or laccolith around which differential subsidence has occurred. Those partly enclosed by a raised outer ring may be a form of degraded crater

Ecc

Crater cluster material

Characteristics

Material in and around clusters of highly subdued 50-300 m craters (E type); albedo similar to that of surroundings

Interpretation

Materials of secondary impact craters subdued by cratering and mass wasting. Origin unknown

E

Crater material, undivided

Characteristics

E, material of gentle depressions and shallow craters having strongly subdued rims that barely stand above surroundings. Many craters pan shaped. Patterned ground on walls. A few blocks on wall

Interpretation of Crater Materials

Materials of craters that are probably mostly of impact origin. Cc_5 craters interpreted as youngest, E as oldest. Interior slope of youngest craters is probably fragmental and brecciated debris which may include blocks of highly shocked rock. Rim material is impact ejecta of finely pulverized and brecciated rock. Interior slope of many of the oldest craters may have a blanket of material deposited over the original crater surface

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Contact
Long dashed where approximately located. Short dashed where gradational

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

Lineament
Gentle scarp, or trough. Probable fracture or fault

Scarp
Barbs point downslope. May be flow front or flow lobe

Gentle linear depression
Barbs point downslope. May be fault, fracture, or volcanic vent