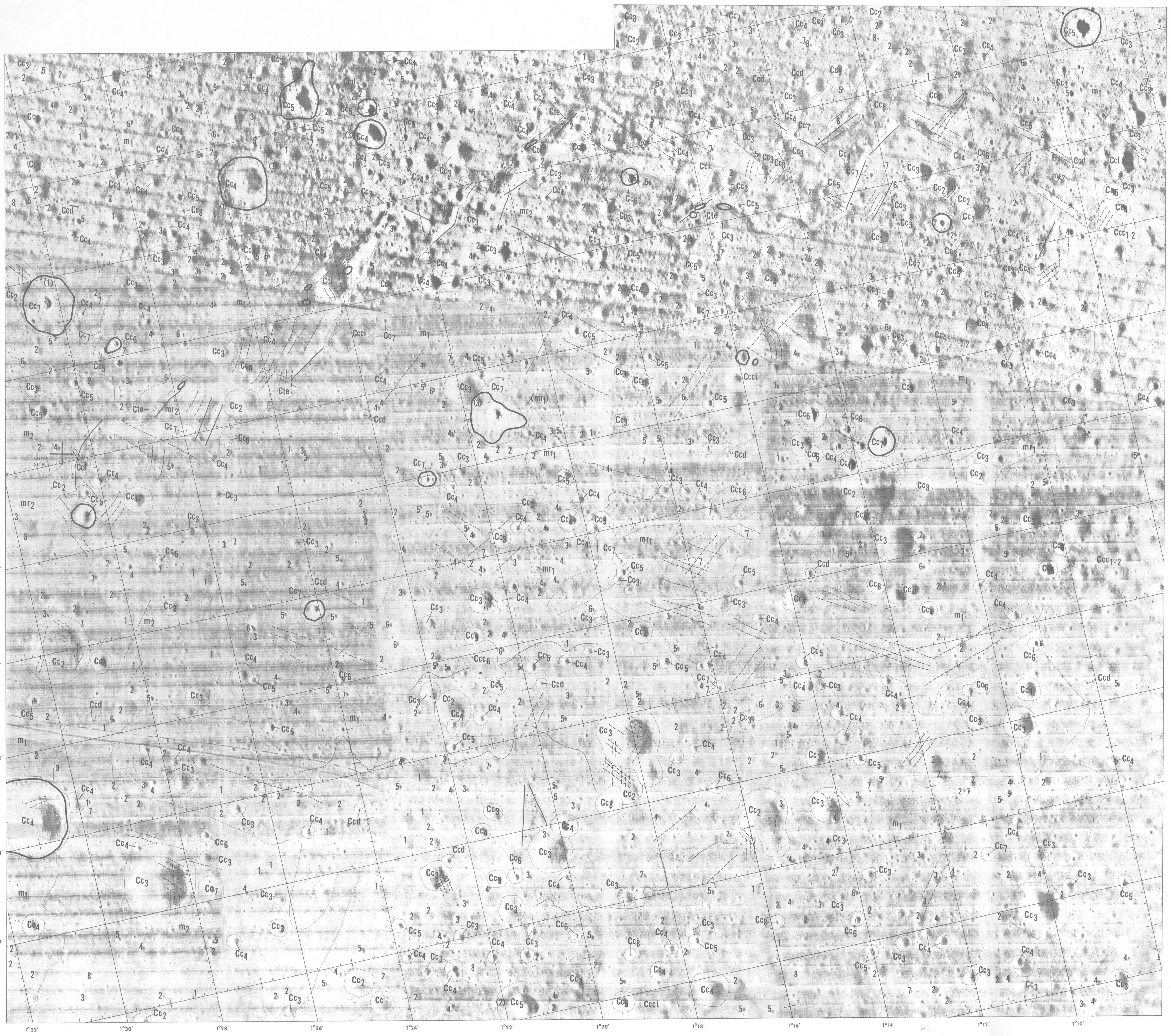
This report is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
OPEN FILE REPORT



Base is composite of portions of Lunar Mosaics ORB II-8e (25) and ORB II-8c (25), USAF Aeronautical Chart and Information Center, St. Louis, Mo. 63118

Sources of geologic information: photographs returned by Orbiters II through V, mainly frames M-121-123, Orbiter II, frames M-94-100, Orbiter III, frames M-109, 110, 113, 114, Orbiter V.

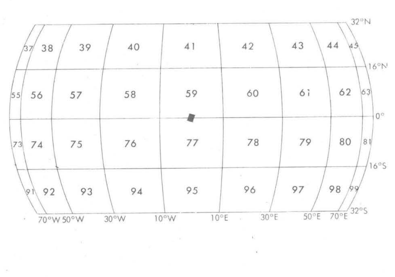
SCALE 1:25,000

PRELIMINARY GEOLOGIC MAP OF ELLIPSE II-8-3 AND VICINITY

By
N.J. Trask
1967

Mercator Projection

SITE LOCATION DIAGRAM KEYED TO LAC



EXPLANATION

Contact

(mr1)

Buried contact

Buried unit shown in parentheses.

(3)

Buried crater

Lineament

Shallow groove or subdued scarp. In areas of patterned ground the general trend and extent of the troughs and scarps are indicated by several lineament symbols.

Scarp

Line marks base; barb points downslope. Visible on only one set of photographs. Interpretation: May be a flow front.

Scarp

Line marks base; barb points downslope. Visible on more than one set of photographs. Interpretation: Front of small debris flow.

Fault

Bar and ball on downthrown side. Mapped along relatively sharp scarps.

Block field

Line outlines continuous or semicontinuous field of resolvable blocks around craters or along mare ridge. Subresolution blocks probably abundant within line and probably extend beyond it.

Linear depression

Very shallow linear depression with very low rim. Crater-like enlargements occur along its length. Interpretation: Very old string of secondary impact craters.

Tentative location of Surveyor VI.

Crater materials

Crater cluster material

Terrace material

Simple crater material

Material of irregular craters / Material of clusters of irregular craters

Crater cluster material

Mare ridge material

Mare material

COPERNICAN SYSTEM

This map is one of a series showing the geology of potential early Apollo landing sites. It was prepared largely from high-resolution photographs taken by Lunar Orbiters II and V.

Ellipse II-8-3, in the central part of Sinus Medii, is an area of relatively heavily cratered mare near the subterrestrial point of the lunar disk. A map of Orbiter site II-P-8 at a scale of 1:100,000 (Rowan, 1967) includes the ellipse and its regional setting. It shows a large number of crater clusters superposed on very heavily cratered mare material (unit m_1). Many of the clusters lie along well-defined rays from Copernicus and Tycho and probably belong to the widespread fields of secondary impact craters around these large craters. Ellipse II-8-3 lies between the large crater clusters and includes a small patch of mare material with below-average crater density (unit m_2).

Crater materials

Craters are the most obvious and readily mappable topographic features in the map area. Surveyor I and III photographs show that many craters larger than a certain size are surrounded by distinctive blocky deposits. These deposits may not be visible on Orbiter photographs. Study of crater rim deposits is of high priority for early missions.

A morphologic range exists from sharply sculptured, ...

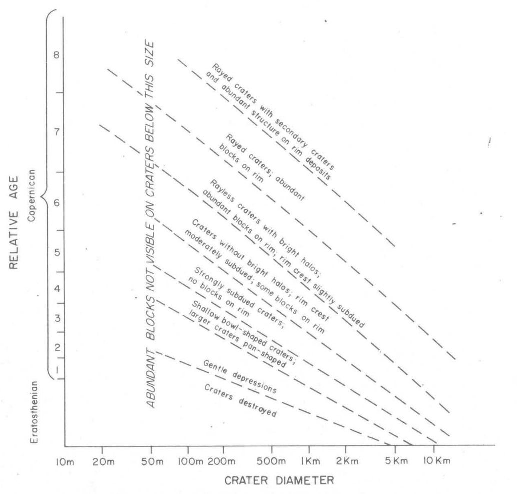


Figure 1.--Graph showing assumed relations among crater diameter (measured from rim crest to rim crest), crater properties, and crater age. Width of intervals on abscissa carries no implication as to length of intervals of lunar geologic time.

Engineering properties.--All large craters (>500 m in diameter) constitute hazards to landing because of their large surrounding blocks and steep slopes. Hazards diminish as crater size decreases and crater age increases. Cc_1 and Cc_2 craters that are 200 meters and less in diameter probably present only minor hazards. Fields of resolvable blocks are shown on the map with a heavy line; additional blocks that are below the limit of resolution probably occur around most craters.

Scientific interest.--Ejected blocks around craters will be prime objects of scientific interest in early missions. The chemistry, mineralogy, and physical aspects of these blocks can be compared with blocks from the general lunar regolith; and blocks from craters of widely differing ages can be compared to give information on the effects of exposure over various periods of time. Evidence bearing on the origin of craters is most likely to be found in the youngest craters.

Mare material

On a regional scale, the map area is part of a large tract of dark level mare material crossed by several low ridges. The mare material is probably a series of volcanic flows that have been intensely cratered; vast numbers of craters smaller than those shown at the map scale cover the surfaces shown in Surveyor photographs. The cratering process has apparently comminuted and stirred the original surface of the mare material so that it is now covered with a layer of fragmental debris; any original volcanic textures and most boundaries between individual flows are no longer discernible. A small tract of the mare material in the western part of the area (unit m_2) is distinctly deficient in craters of all types. It probably consists of flows that are slightly younger than the rest of the mare material (unit m_1), although the crater deficiency may be partly due to a random lack of secondary impact craters (Rowan, 1967). Several low sinuous scarps within unit m_1 may be vestiges of individual flow fronts that were once more extensive.

A well-defined mare ridge with a zigzag pattern crosses the northern part of the map area but is wholly outside landing ellipse II-8-3. A second, lower and less well-defined ridge with the same trend occurs in the western part of the ellipse. It was recognized for the first time on high-resolution Orbiter V photographs which provided convergent stereopsis. The ridges appear to be uplifted segments of mare material; patches of patterned ground on the ridges are probably the result of downslope movement of fragmental material. New mare material may have been extruded along the peripheral parts of some ridges where they merge with adjacent mare material along a broad area of slightly elevated ground (Rowan, 1967). Unit m_2, on which Surveyor VI landed, may be such a flow unit, although distinct flow fronts are not visible.

Engineering properties.--The properties of level mare material and gently rolling mare ridge material are apparently similar throughout the map area; more rugged parts of the mare ridges may have different properties. Fragmental material in which shallow gouges form under the impact of very low velocity fragments, extends to a depth of at least 1 meter on the level and gently rolling surfaces. The material is broadly similar to that at the Surveyor III and V sites. Surveyor VI landed successfully on unit m_2 in an area surrounded on three sides by mare ridge material. Results from Surveyor VI should be extrapolated with caution, since the landing spot may contain a substantial amount of loose debris eroded from the surrounding ridges. Material stronger than that at the surface lies at depths ranging from 1.5 to 6 meters, and a substrate of solid rock apparently lies at depths of from 5 to 10 meters. These depth estimates are based on a study of the morphology of small, relatively fresh craters (fig. 2), using the method described by Oberbeck and Quaide (1967). Part of unit m_1 in the eastern part of the map area has an unusually high density of strong lineaments and a relative lack of subdued craters. Loose material on this surface may have undergone extensive compaction because of jiggling along subsurface fractures. On mare ridge crests, fragmental material is probably thinner than that on level mare; on ridge flanks it is probably thicker. Downslope movement of material on the steeper ridges may have occurred relatively recently.

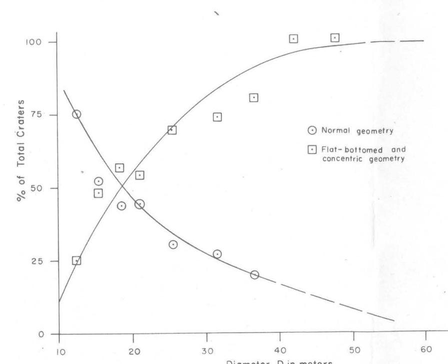


Figure 2.--Apparent geometry of small fresh craters as a function of crater diameter. Depth to cohesive substrate >D/6.5 for normal craters, <D/6.5 for flat-bottomed and concentric craters. Sun angle 28°.

Scientific interest.--Samples of any of the mare material will be of great interest in early missions. Age, chemical composition, and physical properties may differ from place to place within the ellipse, especially across the contact between units m_1 and m_2 and across the sinuous scarps that may be flow fronts. Unit m_2 may be younger than unit m_1, and material along the mare ridges may be younger still.

References

Oberbeck, V. R., and Quaide, W. L., 1967, Estimated thickness of a fragmental surface layer of Oceanus Procellarum: Jour. Geophys. Research, v. 72, p. 4697-4704.

Rowan, L. C., 1968, Preliminary geologic map of Lunar Orbiter site ORB II P-8: U.S. Geol. Survey ~~map (in prep.)~~ open-file report.