Ccc 2

material Characteristics Material of craters without rims or with very low rims; smooth walls, convex upward, steepening into a central pit or funnel. The same brightness as the surrounding material. Craters appear intermediate in age between Cc2 and Cc3 craters of the main crater sequence.

Ccd

Interpretation May be material of collapsed volcanic structures or drainage craters. However, the random distribution and similarity to type 2 and 3 craters suggest they are a representative stage in the cycle of degradation affecting a particular size range of craters. The thickness of the local fragmental layer and mass wasting subsequent to crater formation combine to form dimple shape.

Crater-cluster material

Characteristics Material of cluster of Cc2 craters having raised but strongly subdued rim crests. Abundant blocks on walls and floors. Scattered blocks occur on rims. Patterned ground (irregular anastomosing ridges and troughs approximately 10 m high and several meters apart) on floors. Sparse lineaments trend northnortheast.

Interpretation Material of secondary impact craters formed by projectiles from an unknown source. Most of the unit is probably disturbed mare material but some exotic material transported from great distances may be pres-

Ray material

Characteristics Appears brighter than surroundings on full-Moon and Orbiter IV photographs. No apparent topographic expression. Lies on a ray of the system surrounding Copernicus. Ray includes shallow gouges and satellitic craters uprange toward Copernicus. Spectral reflectivity is the same as that of surrounding un-

rayed areas (Johnson and Soderblom, 1969). Interpretation Mare material compacted and disturbed by tertiary ejecta from Copernicus secondary impact craters to the north on a scale smaller than the limit of resolution of Orbiter III photographs. Similarity of spectral curve to that for unrayed areas indicates little, if any, exotic material from Copernicus is present.

Crater materials

Characteristic**s** Cc4, material of craters whose rim deposits appear as bright or slightly brighter than surroundings. Moderately abundant blocks. Relatively subdued fractures on floor; wall has arcuate terraces. Crater rim crest moderately subdued. 4, material of moderately subdued craters whose rim deposits appear no brighter than surroundings. Scattered blocks in rim material. Terraces in wall.

> Cc3 Crater materials

Characteristics Cc3, material of craters whose rim deposits appear only as bright as surroundings. Scattered blocks in rim deposits; abundant blocks inside crater. Slightly subdued structure on floor; subdued remains of terraces line lower parts of walls. Crater rim crest raised but strongly sub-3, material of craters whose rim deposits appear only as bright as surroundings. Scattered blocks in rim deposits; abundant blocks inside crater. Subdued hummocks or terrace on floor. Crater rim

crest strongly subdued.

Cc₂ 2 Crater materials

Characteristics Cc₂, material of craters whose rim deposits appear only as bright as surroundings. Sparse blocks in rim material; scattered blocks on wall and floor. Very subdued fractures on floor; concentric ridges and troughs in rim. Crater rim crest strongly subdued. 2, material of craters whose rim deposits appear only as bright as surroundings. Scattered blocks on walls. Associated crater has shape of shallow bowl. Crater rim crest slightly raised but strong-

> Cc1 Crater materials

Characteristics Cc1, material of shallow, bowl-shaped craters. Scattered patches of blocks on walls. Weak concentric lineaments on rims and walls. Crater rim crest missing or very low. 1, material of gentle depressions. Scattered patches of blocks on walls.

ated fragmental debris. Similar to Em₁ and Em₂ but probably has a thicker layer of surficial debris because of its probable greater

Contact

Long dashed where approximately located.

Buried contact

Buried unit indicated by symbol in paren-

Interpretation of Crater Materials Cc6-Ic; 6-1 Poorly sorted mixtures of shock-metamorphosed breccia and unshocked debris, associated with both primary and secondary impact craters. Craters continuously modified by micrometeorite bombardment and downslope slumping of rim and wall materials. The craters interpreted as youngest are shown by Cc6 and 6, oldest by Ic. Craters with lower numbers have evolved from those with higher numbers by subsequent erosion and mass movement. Thickness of regolith above mare bedrock is greater on floors of large subdued craters than on rims. Crater deposits provide a range of shocked and unshocked surface and subsurface materials. Samples from craters of all ages may shed light on radiation history; the freshest samples being found around the youngest craters. Projectile fragments, although scarce, may provide samples of extralunar materials a-

round primary craters and samples of distant

lunar regions around secondary craters.

____ Scarp Line drawn at base of scarp. Barbs point downslope. Interpretation: Fault scarp or degraded flow front.

Lineament Gentle narrow trough or scarp. Interpretation: Fault or joint.

appear older than they actually are. Other isolated strongly subdued and pan-shaped craters in the site may also be secondary impact craters of the field around Copernicus but unidentifiable as such. They might also appear to be older than their true age and would suggest an age for the mare material that is too high. Evidence that the mare material in site 7 may be as young as that in sites 4 and 5 is the fact that resolvable blocks (>2 m) are roughly as abundant in site 7 as in sites 4 and 5. However, this abundance may be due to one or two especially blocky craters that happen to lie in

site 7, rather than to an overall abundance of blocks in the lunar regolith. A number of techniques for remotely determining the nature of the lunar surface provide indirect evidence regarding the probable age of the mare material in the site. (1 The spectral reflectivity curve for unrayed mare material near the site is nearly identical with that for site 3 in Sinus Medii (Johnson and Soderblom, 1969), where the age of the mare material appears to be latest Imbrian, and intermediate between that in site 2 and that in sites 4 and 5 (Trask, 1969). (2) Analysis of the radar signal strength from the Surveyor radar altimeter and doppler velocity sensor indicates that the radar reflectivities at Surveyor sites III (Apollo 7), V (Apollo 2), and VI (Apollo 3) are similar and are lower than at Surveyor site I (Muhleman, 1969), where the mare material is the same age as that in Apollo sites 4 and 5. The radar reflectivity should reflect the blockiness of the surface material and thus indirectly its age. The highest radar reflectivity observed was at the Surveyor VII site on the rim of Tycho, an area of fresh, blocky materials. (3) Radar data from the Explorer 35 spacecraft showed an area of anomalously high reflectivity over Apollo site 4 (Tyler, 1968), where the mare material is relatively young. Explorer 35 passed only 50 km south of the Lansberg P region, and no such enhancement was observed

The mare material in site 7 has been divided on this map into two main units largely on the basis of crater population. Unit Im, interpreted as older, has a 600-meter Imbrian crater superposed on it and has more pan-shaped and gentle depressions 200 to 600 m in diameter than the units interpreted as younger (Em₁ and Em₂). Conversely, units Em₁ and Em₂ have more 100 to 200 meter strongly subdued craters than unit Im. The excess craters on units Em₁ and Em₂ are probably mostly secondary impact craters. The best estimate that can be made at present is that the age of the mare material in the site, including that at the nominal landing point at the Surveyor III spacecraft, probably falls near the Imbrian-Eratosthenian boundary on the lunar geologic time scale. The absolute age of the mare material cannot, of course, be estimated at this time, but the evidence suggests that it will be somewhat younger than the 3.0 \pm 0.7 x 10^9 years determined by the preliminary analysis of the rocks returned from Apollo site 2 (Lunar Sample Prelim. Exam. Team, 1969). The spectral reflectivity curve for site 7 is very simi-

lar to those for Mare Serenitatis and site 3 in Sinus Medii, and it differs significantly from those for landing sites 2, 4, and 5 and most of Mare Tranquillitatis. These observations suggested to Johnson and Soderblom (1969) that the materials at Apollo site 7 may contain less titanium than those at Apollo site 2. Turkevich and others (1969) found evidence in the data returned by the Surveyor V and VI alpha particle backscattering instruments that titanium is also less abundant in site 3 than in site 2.

site are assigned ages according to the criteria shown in figure 1. The age assignment of individual craters is based on the assumptions that the craters were originally sharp and fresh in appearance and that small craters are degraded faster than large craters so that a small subdued crater may be the same age as a larger sharper one (Trask, 1969). Blocks are more numerous and more angular around Cc4, Cc5, and Cc6 craters and appear to rest on the surface. Blocks associated with Ec to Cc3 craters are subrounded and less

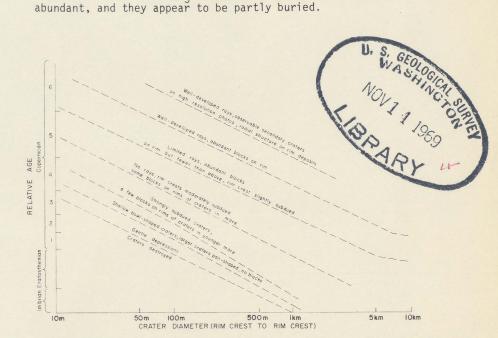


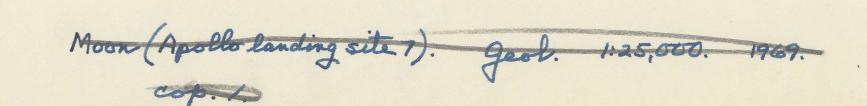
Figure 1.--Relation between diameters, properties, and ages of craters. Categories are intergradational.

Johnson, T. V., and Soderblom, L. A., 1969, The relative reflectivity (.4 μ to 1.1 μ) of the lunar landing site Apollo 7: Jour. Geophys. Research [in press]. Lunar Sample Preliminary Examination Team, 1969, Preliminary examination of lunar samples from Apollo 11: Science,

v. 165, no. 3899, p. 1211-1227. Muhleman, D. O., 1969, Interpretation of Surveyor radar data, chap. VII B, in Surveyor project final report, pt. II. Science results: California Inst. Technology, Jet Propulsion Lab. Tech. Rept. 32-1265, p. 262-264.
Pohn, H. A., 1969, Geologic map of the Lansberg P region of the Moon [scale 1:100,000]: U.S. Geol. Survey open-

file report. Trask, N. J., 1969, Geologic maps of early Apollo landing sites of set C: U.S. Geol. Survey open-file report (Interagency Report: Astrogeology 17 Turkevich, A. L., Franzgrote, E. J., and Patterson, J. H., 1969, Chemical composition of the lunar surface in Mare Tranquillitatis: Science, v. 165, no. 3890, p. 277. Tyler, G. L., 1968, Oblique-scattering radar reflectivity of the lunar surface: Preliminary results from Explorer

35: Jour. Geophys. Research, v. 73, p. 7609.





M(200)

R290

Cil

no. 69-3

