DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AND THE
USAF AERONAUTICAL CHART AND INFORMATION CENTER

GEOLOGIC ATLAS OF THE MOON
BYRGIUS QUADRANGLE
I-755 (LAC-92)

NOTES ON BASE

The base chart was prepared by ACIC with advisory assistance from Dr. Gerard P. Kuiper and his collaborators, D. W. G. Arthur and E. A. Whitaker.

DATUM

The horizontal and vertical positions of features on this chart are based on selenocentric measurements made by ACIC and published in ACIC Technical Paper No. 15, "Coordinates of Lunar Features", March 1965. The assumed lunar figure is that of a sphere corresponding to the mean lunar radius of 1738 kilometers. Supplementary positions are developed in the chart area as an extension of the primary control.

Primary Control Positions . . . . ⊕
Supplementary Control Positions . . . . △

ELEVATIONS

Radius vector lengths are the distances from the geometrical center of the moon to the plane of the crater rim or the designated position of the feature measured. The lengths of the radius vectors are expressed in kilometers.

The relative elevations of crater rims and other prominences above the surrounding terrain and depths of craters are in meters. They were determined by the shadow measuring techniques as refined by the Department of Astronomy, Manchester University, under the direction of professor Zdeněk Kopal. The probable error of the localized relative elevations is 100 meters in the vicinity of the center of the moon with the magnitude increasing to 300 meters at 70° from the center due to foreshortening.

Lengths of Radius Vectors to control points . . . . . ⊕ or △ 1738.2
Depths of craters (rim to floor) . . . . (400)
Relative elevations (referenced to surrounding terrain) with direction and extent of measured slope indicated 300R

NAMES

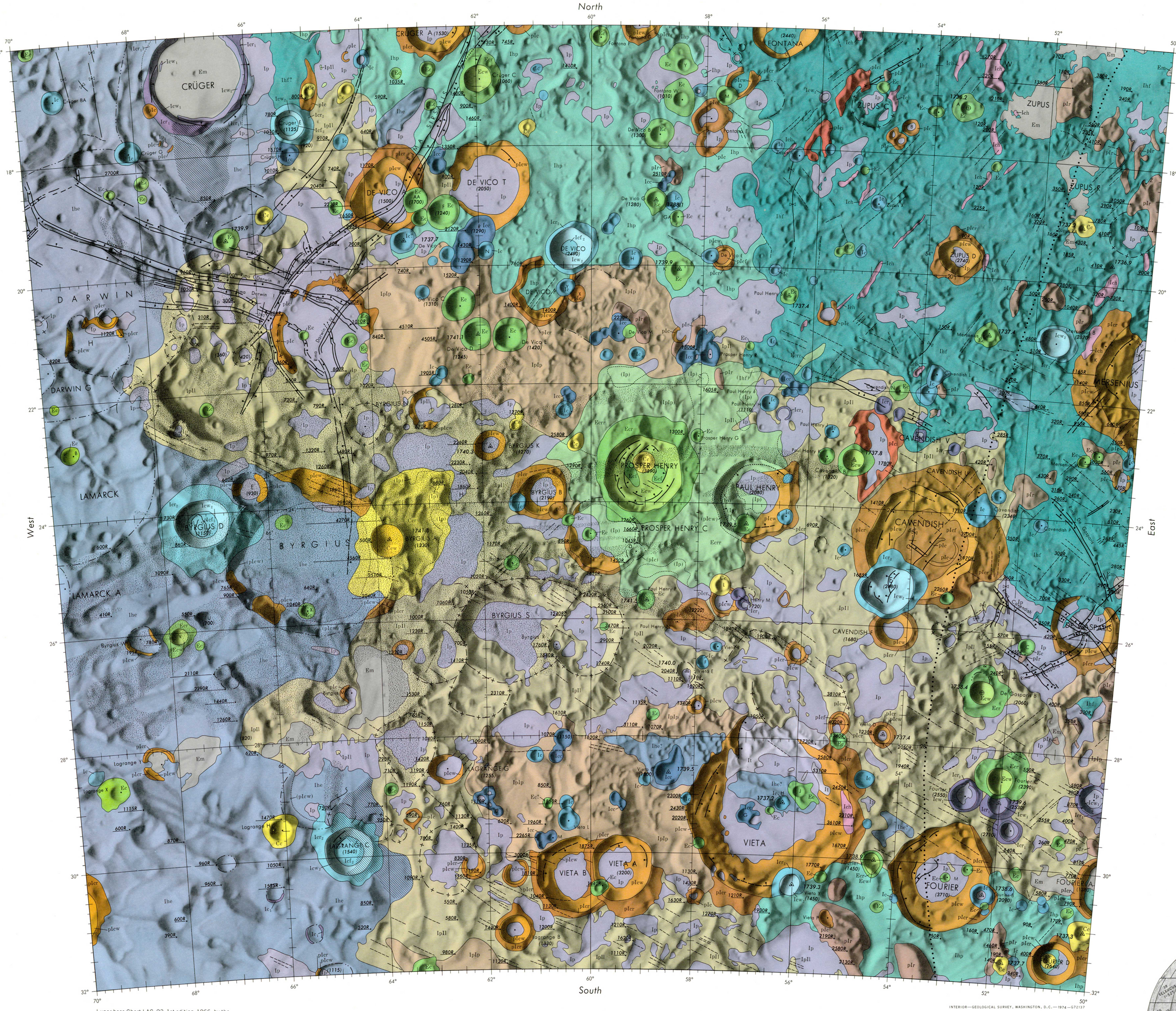
Feature names were adopted from the 1935 International Astronomical Union nomenclature system as amended by Commission 16 of the I.A.U., 1961 and 1964.

Supplementary features are associated with the named features through the addition of identifying letters. Craters are identified by capital letters. Eminences are identified by Greek letters.

Names of the supplementary lettered features are deleted when the association with the named feature is apparent. A black dot is included, where necessary, to identify the exact feature or features named.

PORTRAYAL

The configuration of the lunar surface features shown on this chart is interpreted from photographs taken at Lick, McDonald, Mt. Wilson, Yerkes, Stony Ridge, Kwasan, and Pic du Midi Observatories. Supplementary visual observations with the 20 and 24 inch refracting telescopes at Lowell Observatory provide identification and clarification of indistinct photographic imagery and the addition of minute details not recorded photographically. The pictorial portrayal of relief forms is developed using an assumed light source from the west with the angle of illumination maintained equal to the angle of slope of the features portrayed.



Lunar base Chart LAC-92, 1st edition, 1966, by the U.S. Air Force Aeronautical Chart and Information Center, St. Louis, Missouri 63118

SCALE 1:1 000 000
LAMBERT CONFORMAL PROJECTION
STANDARD PARALLELS 21°20′ AND 42°40′

Mapped 1968–1971. Principal sources of geologic information: Lunar Orbiter IV high-resolution photographs shown on index map (approx. 100 m identification resolution), courtesy of Lunar Orbiter Project Office, Langley Research Center, NASA; albedo data from Pohn and Wildey (1970); thermal infrared data from Shorthill and Saari (1969).

Prepared on behalf of the National Aeronautics and Space Administration under contract Nos. R-66 and W-13,130.

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1974—G72137

GEOLOGIC MAP OF THE BYRGIUS QUADRANGLE OF THE MOON

By
H. G. Wilshire
1973

EXPLANATION

COPERNICAN SYSTEM

Ray material

Characteristics
Bright material on and outside Byrgius A; occurs as streaks nearly radial to crater. No visible relief. Superposed on most other units
Interpretation
Ejecta from Byrgius A, and slope material of unresolved secondary impact craters

Cc Ccr Ccw — Crater materials

Characteristics
Material of sharp-rimmed, rayed craters. Steep inside walls, with slopes continuous to center of floor. Rim deposits extensive. High albedo. Byrgius A and Lagrange H have anomalously low cooling rates during eclipse (Shorthill and Saari, 1969)
Cc, *crater material, undivided. Byrgius A divided into:*
Ccr, *rim material. Relatively smooth-surfaced blanket around crater. Faint radial grooves in places*
Ccw, *wall material. Steep, smooth, high albedo (.16 to .22)*
Interpretation
Impact origin. Sharpness and preservation of rays indicate relative youth. High albedo indicates exposure of fresh rock. Rim material, ejecta blanket thinning outward; wall material, bedrock mantled by colluvium

ERATOSTHENIAN SYSTEM

Em — Mare material

Characteristics
Smooth, level plains with low albedo (.08–.09); fewer superposed craters than mare material assigned to Imbrian System in adjacent quadrangles. Very irregular borders against older rock; contains numerous small "islands" of older rock
Interpretation
Basaltic lava flows formed by eruption of fluid magma from fissures

Ec Ecr Ecrr Ecw Ecf — Crater materials

Characteristics
Material of sharp, fresh craters without rays. Less sharp and lower albedo than Copernican craters of comparable size
Ec, *undivided. Craters >10 km divided into:*
Ecr, *rim material. Relatively smooth rimcrest; hummocky around Prosper Henry*
Ecrr, *rim material, radial. Low ridges of moderate relief subradial to Prosper Henry*
Ecw, *wall material. Steep, smooth slopes; terraced in Prosper Henry*
Ecf, *floor material. Relatively flat, smooth part of Prosper Henry floor*
Interpretation
Impact craters. Units interpreted as for Copernican craters; terraced walls of Prosper Henry due to slump of crater wall

IMBRIAN SYSTEM

Dark terra mantling material

Characteristics
Slightly hummocky, faintly furrowed material with distinctly lower albedo than surrounding material; mantles south flank of Crüger and eastern half of La Grange C
Interpretation
Volcanic materials, probably pyroclastic

Upper Imbrian

Ip — Plains-forming material

Characteristics
Forms level plains; low to medium crater density compared to surroundings; intermediate albedo. Partly fills many isolated topographical low areas of older units.
Interpretation
Fluid lava flows erupted from multiple fissure vents

It — Terra-mantling material

Characteristics
Hummocky material grading into unit Ip *both inside and outside crater Vieta*
Interpretation
Equivalent of unit Ip *that has not flowed to depressions*

Ihe — Hevelius Formation

Characteristics
Material with prominent linear to braided texture that partly to completely mantles older terrain. Albedo intermediate. Most texture results from close-spaced, narrow ridges and trough typically 3 to 5 km long alined approximately radially to Orientale basin. Underlying topography progressively more subdued from edge of deposit westward. Orientation of ridge-trough texture influenced by subjacent topography; oriented nearly concentric to Orientale basin where deposit only partly fills old craters (as in Darwin); ridge and groove texture follows contours of lobate extensions near edge of deposit (near Byrgius). Queried where could be hilly and furrowed material
Interpretation
Impact debris deposited mainly from dense suspension of material ejected at low angles from Orientale basin

Icr_2 Icw_2 Icf_2 — Crater materials

Characteristics
Materials of moderately sharp craters >10 km diameter. Some partly filled with unit Ip. *Younger than Hevelius Formation*
Icr_2, *rim material. Smooth to moderately hummocky, faint radial grooves*
Icw_2, *wall material. Mostly smooth, locally terraced (Cavendish E) or irregularly mantled (Lagrange C; Byrgius D)*
Icf_2, *floor material. Slope convex, cut by irregular to crudely concentric grooves*
Interpretation
Probably of impact origin. Rim and wall interpreted as for Copernican craters. Floor material mostly material slumped from walls (Lagrange C and Cavendish E); ropy structure suggests shock melted material in Byrgius D

Ic — Crater material

Characteristics
Material of moderately to strongly subdued craters too small (<10 km) to subdivide
Interpretation
Probably of impact origin. Some may be secondary craters of Orientale basin

Icc — Crater cluster material

Characteristics
Elongate to irregular clusters of three or more close-spaced, similar, narrow-rimmed craters
Interpretation
May be secondary craters of Orientale basin

Lower Imbrian

Ihf Ich — Hilly and furrowed material

Characteristics
Coarsely hummocky terrain with numerous round and elongate hills and narrow-rimmed highly elongate craters or linear chains of coalescing craters elongate parallel to chain length. Surface texture resembles unit Ihp, *but coarser. Queried where could be Hevelius Formation*
Ich, *crater material. Largest elongate craters and crater chains in unit*
Interpretation
Volcanic deposits with aggregate thickness sufficient to bury most pre-Imbrian craters. Ich *and other elongate craters probably structurally controlled vents through which pyroclastic rocks and moderately viscous lavas extruded*

Ihp — Hilly and pitted material

Characteristics
Gently rolling terrain containing close-spaced round hills and shallow narrow-rimmed or rimless craters and narrow chains of hills and shallow craters
Interpretation
Volcanic deposits, probably mostly pyroclastic and of sufficient thickness to almost completely mask subjacent topography. Craters mostly of internal origin, either collapse craters or formed by explosive eruptions

Icr_1 Icw_1 — Crater materials

Characteristics
Features less sharp than upper Imbrian craters of comparable size; mostly shallower, some with fill of unit Ip. *Older than Hevelius Formation*
Icr_1, *rim material. Narrow, moderately smooth; locally cut by lineaments radial to Orientale basin*
Icw_1, *wall material. Moderately smooth*
Interpretation
Impact craters. Rim and wall material interpreted as for younger craters

PRE-IMBRIAN OR IMBRIAN

IpIl — Lineated terra material

Characteristics
Moderately rough terrain composed of materials of old, subdued craters to 125 km across; cut by lineaments mostly radial to Orientale basin, typically about 10 km long and 1–5 km apart. Superposed lower Imbrian and younger craters
Interpretation
Materials of old cratered surface cut by well-developed fracture system produced by event that formed Orientale basin. May consist in part of Orientale ejecta

IpIp — Plateau material

Characteristics
Isolated, steep-sided plateaus with gently rolling surfaces; subordinate pits and furrows. Intermediate albedo. Northern plateau appears superposed on old cratered terrain west of Prosper Henry. Age of southern plateau relative to Vieta not clear
Interpretation
Accumulations of volcanic material, possibly successive flows of very broad shields

PRE-IMBRIAN

pIc pIcr pIcw pIcf — Crater materials

Characteristics
Crater features moderately subdued in large craters, very subdued in small ones. Younger than Humorum basin
pIc, *undivided. Mainly remnants of highest parts of rim and wall*
pIcr, *rim material. Mapped on basis of positive relief, not texture*
pIcw, *wall material. Smooth to rough texture. Terraced in most large craters*
pIcf, *floor material. Gently rolling to hummocky*
Interpretation
Probably of impact origin. Units interpreted as for younger craters

pIci — Irregular-crater material

Characteristics
Very irregular, steep-walled depressions with narrow, steep rims
Interpretation
Possibly volcano-tectonic collapse depressions

pIr — Material of rugged terra

Characteristics
Small, steep-sided blocks typically about 15 km long; irregular to rectilinear outlines. Mostly smooth-surfaced and bright. Contacts gradational with adjacent materials
Interpretation
May be remnants of fault blocks which are part of Humorum basin ring system

Approximate or gradational contact

(Ip)
(IpIp)
Concealed contact
Buried materials indicated by symbols in parentheses

Fault
Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side

Shallow linear groove

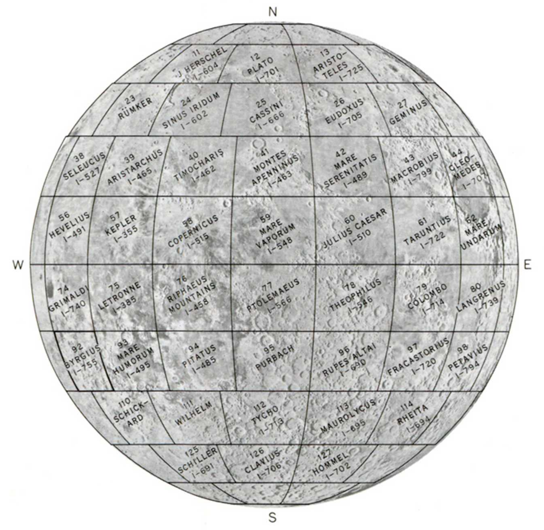
Narrow depression
Axis of steep-walled, narrow fissure

Scarp
Base of steep slope; barb points downslope

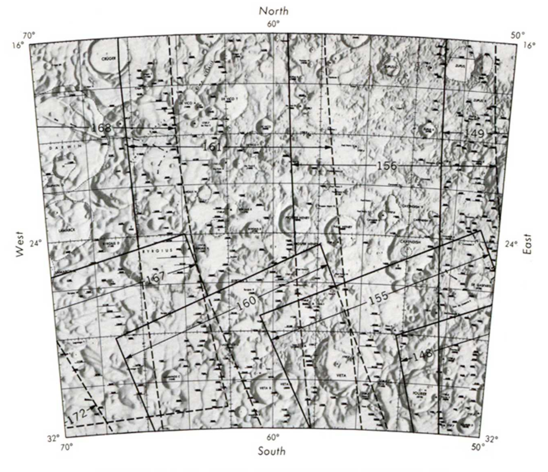
Covered crater rim crest

Very subdued possibly exposed crater rimcrest

Crest of Humorum basin ring (approximately located)



INDEX MAP OF THE EARTHSIDE HEMISPHERE OF THE MOON
Number above quadrangle name refers to lunar base chart (LAC series); number below refers to published geologic map



LUNAR OR IV HIGH-RESOLUTION COVERAGE OF BYRGIUS QUADRANGLE

INTRODUCTION

The geologic units in the Byrgius quadrangle are distinguished by differences in topographic expression and albedo as seen on Orbiter IV and telescopic photographs. The stratigraphic and structural principles discussed by Shoemaker (1962), Shoemaker and Hackman (1962), McCauley (1967a), and Wilhelms (1970) are used to assign relative ages to these units, and tentative correlation with the lunar time-stratigraphic system is based on crater morphology (Offield, 1971). All craters larger than 3 km are mapped, and those larger than 10 km are subdivided. A preliminary geologic map of the Byrgius quadrangle was prepared by Trask (1965a, b). Regional studies by McCauley (1967a, b; 1968) and Stuart-Alexander and Howard (1970) form the basis for interpreting the Hevelius Formation.

GEOLOGIC SUMMARY

The Byrgius quadrangle, at the western edge of the near side, lies in the terra southwest of Oceanus Procellarum between the Humorum and Orientale basins. Structures and deposits related to the Orientale basin, which is younger than the Humorum basin (Hartmann and Kuiper, 1962), dominate the southwestern half of the quadrangle. The northeastern half is dominated by mantling deposits that are older than Orientale (Imbrian) and younger than Humorum (pre-Imbrian), but which lie mostly outside the zone of recognizable Orientale-related deposits and structures. These main subdivisions are visible on the albedo map of the Moon (Pohn and Wildey, 1970), the northeastern one having generally the lower albedo. The older units throughout the quadrangle have complex topography, probably formed mostly from intersecting, degraded craters. North and east of the crater Byrgius the eroded walls of old craters as large as 125 km across are the dominant topographic features of these older rocks. These craters appear to have been modified principally by mass wasting, repeated impact, and infilling or mantling by younger deposits.

The most extensive of the older units, lineated terra material, is distinguished by the presence of linear structures that are radial to the Orientale basin. Smaller areas of rugged topography (unit pIr) may be remnants of concentric structural blocks around the Humorum basin (Wilhelms and McCauley, 1971).

A series of younger deposits of varied character is superimposed on the old cratered terrain. The oldest of these form steep-sided gently rolling plateaus (unit IpIp) that are generally pitted and locally furrowed. These resemble in overall form very broad terrestrial volcanic shields. Part of an extensive area (Wilhelms and McCauley, 1971) of distinctively hilly and furrowed terrain (unit Ihf) covers the northeast part of the quadrangle. This unit, like the materials of the Kant Plateau described by Milton (1968) and the hummocky materials described by Rowan (1971), contains many linear constructional forms and irregular depressions giving it a generally rough-textured surface. It partly inundates the craters Mersenius and DeGasparis, and may be of volcanic origin. The elongate furrows follow a moderately strong northeast lineation in contrast to their more northerly orientation in the adjacent Grimaldi quadrangle (McCauley, 1973). The furrows are presumed to be the vents from which pryoclastics and lavas more viscous than those of the plateau-forming unit were erupted.

Hilly and pitted material (Ihp), also of possible volcanic origin, is similar to hilly and furrowed material but is somewhat more finely textured. It is characterized by many rimless circular craters and irregular to elongate rimmed depressions that may be vents from which pyroclastic materials and moderately viscous lavas were erupted.

The western part of the quadrangle is covered by ejecta from the Orientale basin (Hevelius Formation; McCauley, 1967b). These deposits are characterized by prominent ridges and troughs that are generally radial to Orientale but which swirl about the local topography. Where this deposit only partly fills old craters (such as Darwin and Byrgius), the grooves are in approximately concentric orientation to Orientale, or follow the contours of lobate extensions of the formation. These features are interpreted by McCauley (1968) to be the result of deposition of material ejected at very low angles from the Orientale basin. The radial grooves represent regions of high-velocity surface flowage, whereas the marginal concentric grooves result from deceleration of the ejecta where it became ponded in pre-Orientale craters.

Following the Orientale event, plains-forming material (Ip) was widely deposited. Variations in crater density suggest that this deposition spanned a considerable time, possibly beginning before the Orientale basin formed. This remarkable material forms very smooth-surfaced infillings in local topographic lows and partly fills many craters. The fact that on only one slope (the north wall of the crater Vieta) terra-mantling material identifiable as continuous with plains-forming material is preserved, and the fact that plains occur side by side at markedly different elevations, suggest that the plains were formed by volcanic material erupted with very low viscosity so that it ordinarily did not accumulate on slopes. The general lack of cone-like features associated with the plains suggests multiple emplacement by fissure eruptions on a very broad scale.

A complex group of graben, especially well developed in the northwest part of the quadrangle, formed after deposition of the plains-forming material, possibly before Erathosthenian time as suggested by superposition of materials of the crater Crüger C on one of the graben.

Mare material, probably of Eratosthenian age, makes up only a small part of the Byrgius quadrangle. It differs from the plains-forming material only in that it has a lower albedo and is restricted to topographically low areas. Its similarity in mode of occurrence to the plains-forming material suggests that it too was formed from a very fluid magma.

The craters in the quadrangle vary in form and origin. The majority of those mapped are thought to be of impact origin, and to have been modified with time by erosional processes. Thus, craters of comparable size show progressive modification of form from fresh Copernican craters to the degraded pre-Imbrian craters. Some craters of highly irregular form (pIci) are thought to be volcano-tectonic collapse depressions. Most elongate craters of the hilly and furrowed material and rimless depressions of hilly and pitted material are probably volcanic vents. The crater Crüger resembles Damoiseau in the Grimaldi quadrangle (McCauley, 1972), a smooth-rimmed crater contrasting with the more common rough-rimmed craters that are believed to be of impact origin; these craters may be calderas.

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