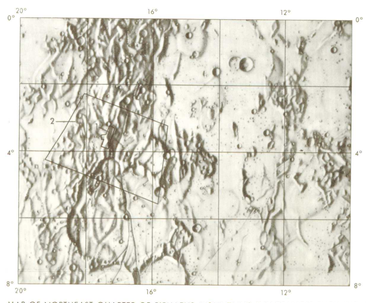
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

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

GEOLOGIC ATLAS OF THE MOON
PART OF FRA MAURO REGION–APOLLO 14
I–708 (SHEET 1 OF 2)



MAP OF NORTHEAST QUARTER OF RIPHAEUS MOUNTAINS QUADRANGLE SHOWING LOCATION OF DETAILED GEOLOGIC MAPS OF THE APOLLO 14 LANDING AREA

1. Area of 1:25,000 scale map (Offield, 1970)
2. Area of 1:250,000 scale map (Eggleton, 1970)

EXPLANATION

NOTE: Crater materials are outlined for craters larger than about 100 m in diameter and identified only by informal geologic series number (usually to the west) and a dot at center of crater for smaller craters.

COPERNICAN SYSTEM

Cc_5 5· — Crater material

Characteristics
Cc_5, *material of craters having weak to well-developed rays. Rim crests slightly subdued. Blocks visible to extent of mapped deposit and on floors of the larger craters. Crater interiors very rough and terraced*
5, *material of craters having short rays and slightly subdued rim crests*

Ray material

Characteristics
Diffuse bright material surrounding two Cc_4 craters near center of mapped area
Interpretation
Probably fresh fine-grained fragmental ejecta; forms thin surface layer

Cc_4 4· — Crater material

Characteristics
Cc_4, *material of craters having moderately subdued rim crests and generally bright rim deposits. A few blocks generally visible. Crater interiors moderately rough in larger craters. The two largest examples in the map area have short rays and slightly subdued rim crests; the larger (Cone crater) is surrounded by abundant blocks*
4, *material of craters having bright, moderately subdued rim deposits and moderately rough interiors*

Cc_3 3· — Crater material

Characteristics
Cc_3, *material of craters having completely rounded and moderately to strongly subdued rim crests and rim deposits only slightly brighter than surroundings. Crater interiors fairly smooth; slopes covered by strongly developed patterned ground*
3, *material of strongly subdued craters having rim deposits barely brighter than surroundings*

Cc_2 2· — Crater material

Characteristics
Cc_2, *material of craters having moderately to strongly subdued rim crests. Crater interiors fairly smooth; larger craters have flat floors. Blocks visible in only two craters but subresolution blocks probably common on rim crests of most craters*
2, *material of shallow bowl shaped craters with low rims and smooth interiors*

Cc_1 1· — Crater material

Characteristics
Cc_1, *material of craters ranging from a moderately subdued one-km crater near north edge of map to small shallow depressions. Larger craters have fairly flat floors and sparse to common blocks on rims and walls*
1, *material of gentle depressions having extremely subdued rim topography and smooth interiors*

ERATOSTHENIAN SYSTEM

Ccc — Crater cluster material

Characteristics
Material of three fifteen m craters clustered in elongate pattern, with slightly to moderately subdued rim crests. Northern of two clusters is the more subdued and is elongate northeast-southwest; other cluster is elongate east-west
Interpretation
Material of impact craters satellitic to large, young primary craters. Northern cluster of unknown source (but possibly Copernicus); other cluster probably satellitic to Lalande. Could possibly be of endogenetic origin

Ech — Chain crater material

Characteristics
Material of linear depressions consisting of coalescent craters. Craters in these chains have moderately subdued to barely visible rims. Interior slopes generally smooth, ranging from gentle to fairly steep
Interpretation
Material of possibly volcanic craters or may be secondary or clustered primary impact craters. If of volcanic origin, ejecta surrounding the craters may contain complex breccias mixed with pyroclastic debris. Querried examples at lat 3° 43′S long 17° 22′W, lat 3° 21′S long 17° 13′W may be of Copernican and Imbrian ages, respectively. Age determination of chain craters is generally indefinite because volcanic craters may have different initial forms from impact craters for which age criteria are defined

Ecc — Crater cluster material

Characteristics
Material of two areas occupied by contiguous craters of similar morphology within a cluster. The smaller of the two clusters consists of strongly subdued 300–400 m craters having barely visible rims and smooth, gentle interior slopes. The larger cluster consists of moderately subdued 300–1300 m craters having some fairly steep walls; blocks visible on the 800 m crater at the northeast margin of the cluster. Crater interiors only moderately smooth; hummocky, coarsely patterned ground occurs on all slopes
Interpretation
In each cluster, material of penecontemporaneously formed craters, probably clusters of primary craters or possibly secondary craters of unknown source. Possibly of volcanic origin (for example, a maar field)

Ec — Crater material

Characteristics
Material of craters that range from large and moderately to strongly subdued to small gentle depressions. Larger craters typically have flat floors, strongly developed patterned ground on walls, and some blocks on rim and walls

IMBRIAN SYSTEM

Is — Smooth terrain material

Characteristics
Material of low areas displaying fairly smooth to gently hummocky surfaces. Southwestern part of unit more hummocky and possibly more structurally sculptured than elsewhere. Albedo noticeably lower than adjacent units, similar to albedo of plains-forming material outside the map area
Interpretation
Albedo and surface character are similar to nearby plains material of presumed volcanic origin. Spatial association with possibly volcanic chain craters strengthens the possibility that this unit is a volcanic deposit of uncertain thickness. Alternatively, Is could be a morphologic facies of the Fra Mauro Formation, smooth because it was ponded where the ejecta materials flowed into topographically low areas

Ifr Ifh — Fra Mauro Formation

Characteristics
Ifr, *material of linear ridges, having relief of at least as much as 100 m relative to adjacent terrain in mapped area*
Ifh, *material of hummocky terrain characterized by irregular hills and swales which typically measure ½ to 3 km across*
Interpretation
Ifr and Ifh, *material of ejecta blanket surrounding Imbrium basin. Probably composed of fragments in a very wide range of sizes and rock type within a fine-grained matrix. Internal flow structures may be present and be the product of radial flowage of ejecta from the basin. Linear ridges may be flow ridges of particularly thick Fra Mauro deposits or may be raised fault blocks of pre-Imbrian terrain mantled to varying thicknesses by the Fra Mauro. The westernmost of the two ridges mapped is arcuate and possibly is a partial rim of an old crater*

Ic — Crater material

Characteristics
Material of strongly subdued craters, some only vague depressions, having barely discernible rims even on examples 500–1000 m in diameter. Crater interiors smooth and have patterned ground. Some visible blocks

Contact
Approximately located

Lineament

Slump mass
Arrow indicates direction of movement of surficial granular material

Block field
Symbol outlines continuous to semicontinuous field of resolvable blocks (> 2m) in and around craters. Subresolution blocks probably abundant within line and well beyond it

C — Approximate computer target

NOTE: Landing site correctly located with respect to topographic features; but because of subsequent revision of lunar control network, mission coordinates for same location are lat 3°40′19″ S. and long 17°27′46″ W.

Interpretation of Crater Materials
Cc_5–Ic; 5–1
Materials of both primary and secondary impact craters; youngest Cc_5, oldest Ic. Older craters were once similar in appearance to younger craters but have been subdued morphologically with time by micrometeorite impact erosion and by slumping and downhill creep caused by seismic shaking. Poorly sorted debris consisting mainly of crushed rock and some shocked rock and impact-produced glass occur in the rim deposits of craters; materials were probably shock metamorphosed to varying degrees in most craters. Blocks are most angular around youngest craters, becoming progressively more rounded and more deeply buried in finer grained fragmental surface materials in older craters. Walls and floors of younger craters large enough to penetrate local regolith consist of highly fractured and variably shocked bedrock. Fragmental debris covers much of the bedrock even in relatively young craters and mantles the wall and floors entirely in most craters older than middle Copernican. Cc_2 and Cc_3 craters in the 100–250 m size range appear to be somewhat more abundant than would be expected from size-frequency distributions of craters of other ages; it is possible that many of these Cc_2 and Cc_3 craters are satellitic to Copernicus, within whose conspicuous ray field the site is located

Base map prepared by Aeronautical Chart and Information Center, U.S. Air Force, and western extension prepared by U.S. Army Topographic Command (TPC) both under the direction of Department of Defense for National Aeronautics and Space Administration, 1969.

Source of informal crater names: U.S. Geological Survey Apollo Lunar Geology Experiment Mission Planning staff.

SCALE 1:25 000
MERCATOR PROJECTION

1 ½ 0 1 NAUTICAL MILE
1 ½ 0 1 STATUTE MILE
1 .5 0 1 KILOMETER

Principal sources of geologic information: Lunar Orbiter high-resolution photographs III–H133, IV–H120; Lunar Orbiter moderate-resolution photographs III–M132–M134; Apollo 12 photographs; telescopic photograph 1129 by Catalina Station, Lunar and Planetary Laboratory, University of Arizona; and full-Moon plate 5818 taken at U.S. Naval Observatory, Flagstaff, Arizona.
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GEOLOGIC MAP OF PART OF THE FRA MAURO REGION OF THE MOON
APOLLO 14 PRE-MISSION MAP

By
T. W. Offield
1970

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For sale by U.S. Geological Survey, price $1.00 per set
Explanatory pamphlet accompanies map