DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY MAP I-708
(SHEET 2 OF 2)

GEOLOGIC MAP OF THE FRA MAURO REGION OF THE MOON

APOLLO 14 PRE-MISSION MAP

[scale 1:250,000]

By R.E. Eggleton

The accompanying map shows the regional geologic setting of the landing area for the Apollo 14 mission to the Moon. It is in the western part of the lunar equatorial belt approximately 1,240 km south of the center of the Imbrium basin--a large, nearly circular, multi-ringed, partly mare-filled structure generally believed to have been formed by the impact of an extra-lunar body. The map area includes part of the crater Fra Mauro (94 km in diameter) and the Fra Mauro Formation (Eggleton, 1964; Wilhelms, 1970), a distinctive stratigraphic unit that underlies extensive areas around the Imbrium basin (Eggleton and Marshall, 1962; Wilhelms and McCauley, 1970). The formation is characterized by braided, ridgy, hummocky, and smooth surface textures and is believed to represent an ejecta blanket transported radially outward by the Imbrium basin impact. The thickness of the Fra Mauro Formation generally decreases with increasing distance from the mountainous rim of the Imbrium basin (Eggleton, 1963). After it was deposited, much of the blanket became buried by younger volcanic materials and ejecta from primary and secondary impact craters.

On the basis of differences in topographic texture, three morphologic facies of the Fra Mauro Formation are recognized and mapped as separate informal members. In the map area, ridge material of the Fra Mauro (unit Ifr) is largely concentrated in the northwest, hummocky material (unit Ifh) occurs in the southern and central parts, and smooth material (unit Ifs) occupies small slightly depressed areas in the surfaces of both the ridge and hummocky materials.

The differences between the members of the Fra Mauro Formation may be interpreted in terms of different modes of transportation and deposition of the Imbrium ejecta. The ridge material has the appearance of being deposited during radial flowage along the surface, whereas the more distal hummocky material may have been deposited in part during radial flowage but has been highly perturbed by a rain of fragments ejected ballistically from the Imbrium basin. The radial flowage may result fairly directly from the radial momentum of ballistically transported ejecta or from a base surge representing part of a complex array of ejecta-transport regimes associated with the Imbrium event. The smooth material of the Fra Mauro appears to have flowed into, and been entrapped by, topographic depressions and tended to attain a level surface. This material may be finer grained, and hence, more mobile in flow than the rest of the Fra Mauro.

Three mappable plains-forming units of probable or possible volcanic origin are locally superposed on the Fra Mauro Formation--the Cayley Formation (Ica, Icas), smooth-terrain material (Is), and mare material (Im). The Cayley Formation (Morris and Wilhelms, 1967), an upland plains-forming unit, covers much of the eastern quarter of the map area. It resembles mare material but has a more cratered surface and higher albedo. Two facies are distinguished by differences in topographic expression: unit Ica forms level plains and unit Icas occurs on substantial slopes. Smooth-terrain material resembles the Cayley Formation and may have a similar origin, but it is probably older than the Cayley. Mare material of low albedo only occurs at the west edge of the map. Two small areas of somewhat brighter probable mare material are present in the southeastern part of the area. The mare material is probably composed of lava flows and possibly some pyroclastic layers.

Features interpreted to be of constructional volcanic origin are concentrated along the west side of the map. They consist of cones and domes (dc) and sharply bounded ridge material (Crs). Many individual occurrences and clustered groups are elongated in a north-south direction. Their preferential orientation may be controlled by fractures radiating from the Imbrium basin.

Crater materials ranging in age from pre-Imbrian to late Copernican are scattered throughout the area. Only deposits larger than about 2 km across are mapped. The craters are dated according to a method reported by Trask (1969) and modified by Offield (1970a, b). (See figure 1.) Most of the craters are inferred to be of primary impact origin. In the northeast part of the area, burial by later deposits and structural deformation have so thoroughly obscured the original form of the old features, partly mapped as unit plc, that their origin, whether by impact or volcanism, is uncertain. Materials more certainly identifiable as the deposits of secondary impact craters (units Ecc and Crcc)