Based on the Apollo 15 photographs (Figs. 2 and 3), a geologic sketch map shown as Fig. 4 was made of the area. From this data the geologic history of the region may be summarized as follows:

1. The Serenitatis Basin was formed by a giant impact, which formed a 700 km-wide depression and at least two major systems of fractures, one concentric with the basin and the other radial to it. Massif units of the Taurus Mountains appear to have been uplifts along the concentric fault system, and they display fractures parallel to both.

2. A major episode of basin filling by Imbrian basaltic flows occurred. This episode probably ended about 0.5 billion years later (estimated by extrapolation of data acquired at previous Apollo landing sites). Another episode of filling followed, ending perhaps another 0.5 billion years later (Eratosthenian in age), during which the darker annulus surrounding the older mare material was formed (estimated on the basis of age dates of Apollo 12 and 15 basalts as opposed to Apollo 11 basalts, as well as relative ages in Wilhelms and McCauley, 1971). One of the latest manifestations of mare material extrusion was the formation of the wrinkle ridges now visible on the mare surface.

3. After the completion of basin filling by mare materials, volcanic eruptions began in the southwestern corner of the Taurus Mountains. Cinder cones, located mainly in the lowlands between the massif units, deposited the dark blanket that mantles the highland materials, the mare materials, and the grabens and wrinkle ridges in the southeastern corner of Mare Serenitatis.

4. From the time of formation, scarps of massif units of the Taurus Mountains were subjected to mass wasting. (Blocks on the foothills and their tracks on the slopes are shown in Fig. 3). One of the manifestations of this process is a unit, with north-south lineaments, which is interpreted as a landslide that originated from the southern massif unit and which has a distinct trough at its base (Fig. 4).

5. A fault scarp was formed by the relative upward movement of the materials west of the fault line and/or by the downward movement of the materials east of it. The fault is among the youngest tectonic features in the area; it bisects the oldest material (Taurus Mountains massif units) as well as the younger formation (the dark, ashlike mantling material). However, within the latter the scarp looks like a wrinkle ridge and the fault may have been draped by a thin ash deposit.

NEW VOLCANIC FEATURES AND LANDFORMS

In addition to the cinder cones in the Taurus-Littrow region, Apollo 15 orbital photography exhibits numerous volcanic features that were observed on the moon for the first time. Detailed study of these structures will further our understanding of lunar endogenetic processes. Following is a brief description of four of these features.

D-shaped structure southwest of the Haemus Mountains

The hilly upland units between the circum-Serenitatis Haemus Mountains and the circum-Imbrium Apennine Mountains is characterized by isolated mare-like

EXPLANATION

Ct, TALUS MATERIAL
Cr, RIDGE MATERIAL

PLAINS MATERIAL

Epd, DARK PLAINS MATERIAL, PROBABLY A PYROCLASTIC MANTLE
Ep(ls), LIGHT PLAINS MATERIAL, PROBABLY A LANDSLIDE

pltd, HILLY TERRA, WITH SOME DARK MANTLE
plth, HILLY TERRA, SMOOTH
plrm, TERRA MASSIF, WITH BRIGHT AND FRESH SLOPE MATERIALS

BRIGHT HALO CRATERS WITH RAYS, PROBABLY IMPACT CRATERS

DARK HALO CRATERS, PROBABLY "CINDER CONES"

CRATER METERIALS

Elc, CRATERS
Elcc, CRATER CLUSTERS
Elch, CRATER CHAINS

COPERNICAN SYSTEM
ERATOSTHENIAN SYSTEM
IMBRIAN SYSTEM
PRE-IMBRIAN

CONTACT FAULT LINEAMENT SCARP TROUGH BLOCK FIELD BLOCK

Fig. 4. Geologic sketch map of the area shown in Fig. 3.

patches. These dark patches are relatively younger mare flows that are superposed on the highland materials (Fig. 5). Within one of these patches the Apollo 15 panoramic camera photographs reveal a D-shaped structure with unusual characteristics (Whitaker, 1972a).

The structure is located at 18° 40′N, 5° 20′E and is about 3 km along the straight part of the rim. It is a depression with a raised rim and an outer topographic rise that extends to a maximum of about 4 km. The rim deposit is somewhat darker than the surrounding mare material, but exhibits similar textural characteristics. As shown in Fig. 6, the floor of the depression displays three different units: (1) a slightly undulating, hilly and domical, light-gray unit that occupies the central and northeastern portions of the floor, (2) a very bright, almost white unit that makes an annulus occupying the outer part of the depression, and (3) a unit made of about 50 disconnected, slightly sloping positive structures, which produce a blister-like appearance. They are reminiscent of volcanic domes and a few display distinct summit craters in the middle.

These characteristics indicate that the structure is of volcanic origin. It is my opinion that we are dealing here with a caldera with several stages of extrusion and intrusion in the central part. The blister-like domes appear to constitute the latest events. The unusual low density of craters within the structure suggests that it may be among the youngest lunar formations of volcanic origin.

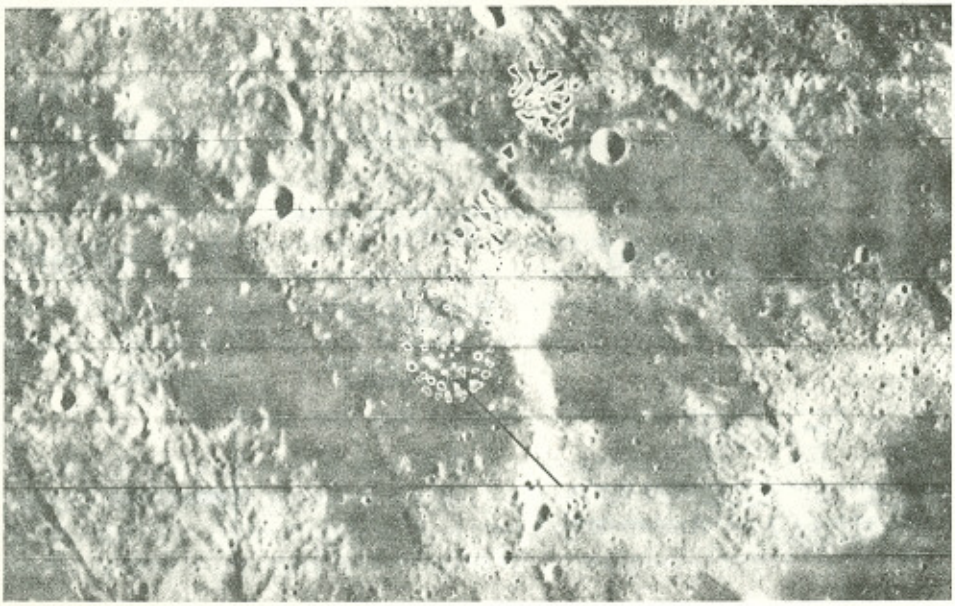

Fig. 5. Portion of Lunar Orbiter IV photograph H-102 showing the area north of Mare Vaporum on the foothills of the Haemus and Apennine Mountains. Several pools of mare units overlie the low highland hills. The "bimat" defects in the center of the photograph partly mask the structure shown in Fig. 6 (arrow).

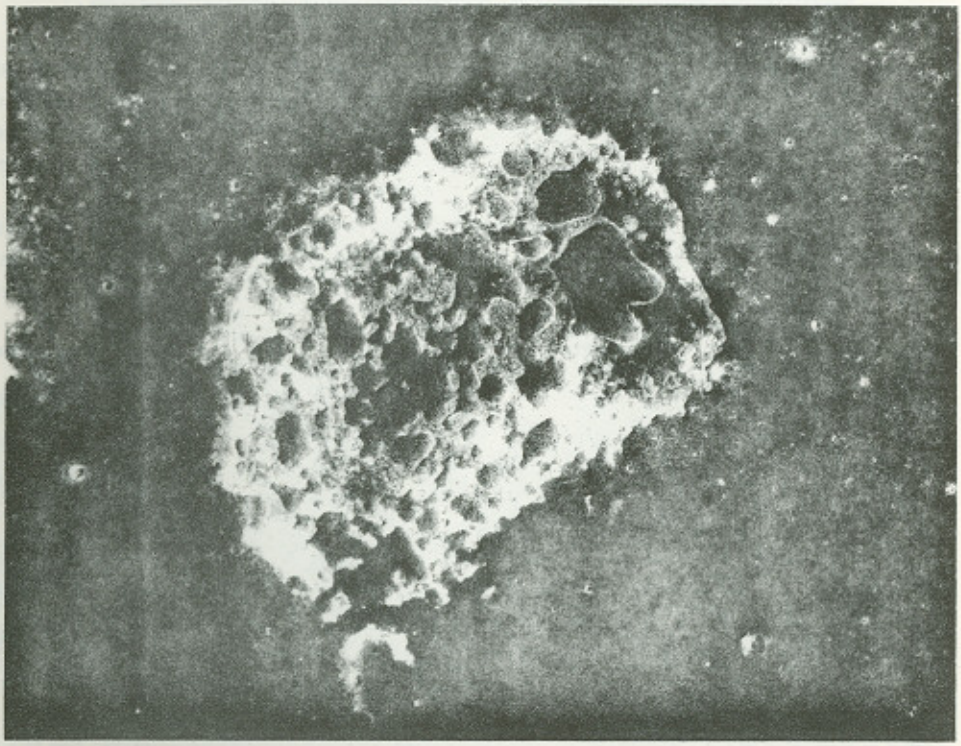

Fig. 6. D-shaped structure that is interpreted as a caldera. The straight segment of the rim is approximately 3 km long. Note the light-colored annulus in the floor, which is also exposed in the wall of the crater on the lower left corner. The blister-like domical hills have summit vents and appear to be completely void of impact craters, suggesting a very young age. Apollo 15 panoramic camera frames 0176 and 0181 make a stereo pair of the structure.

The most ambiguous feature in the structure is the light-colored unit. It is suggested by Whitaker (1972a) that this highly reflective material probably is sublimates. It is evident from Fig. 5 that the exposure on the bright crater wall near the southwest corner of the structure represents a difference of materials within a unit that was dug up by that crater.

It must be stated that the general area between the Haemus and Apennine Mountains exhibits an anomalous Al/Si ratio. As reported by Adler *et al.* (1972), the average ratio over mare areas is 0.67 and over highland areas 1.13. The region in question shows a median ratio of about 0.85. This apparently is due to the mare patches within the highland units. The area also is the seat of the A-7 zone of moonquake activity as reported by Latham *et al.* (1972). Movements along fractures within this area of intersection between the Imbrium and Serenitatis fracture systems is not unexpected. The apparent young age of the D-shaped caldera within the region also indicates a possibility of volcanic eruptions and/or readjustments to relatively recent volcanic deposits.