

Fig. 12a. The contrasting style of modification of the (a) outer and (b) inner rings of Ladon basin (Figure 1). The outer scarps and massifs shown in Figure 12a are heavily modified by networks of narrow valleys. This concentration of valley networks may be related to the permeable nature of the ejecta facies believed to have been deposited in this region. Viking frame 650A14.

longer have preserved ejecta facies and are delineated by features and terrains similar to those found around Ladon, Aram, and the other three preceding illustrations. In this survey several significant patterns emerge. First, the oldest structures commonly exhibit extensive narrow valley networks on exposed massifs. Second, large outflow channels generally originate along a ring. Third, smaller multiring structures are found overlapped by larger structures in a cookie cutter style of superposition. Fourth, differential erosion along the fretted terrains of Deuteronilus, Protonilus, and Nilosyrtris Mensae has exposed overlapping basins that indicate near saturation cratering hidden by extensive erosion and deposition during early Martian geologic history.

The network of narrow valleys mapped around Ladon and Aram also occurs around much older basins such as Isidis and Argyre. Such valley networks commonly originate along certain scarp segments and massifs, i.e., they do not pervasively modify all positive relief. Figure 12a illustrates this process along the outer scarp of Ladon. In contrast, the inner massifs of Ladon do not exhibit the same style of mass wasting (Figure 12b). The selective occurrence of valley networks may reflect more easily eroded terrain or higher permeability, e.g., water-ice saturated ejecta deposits. The very old multiring structure north of Copernicus displays pervasive furrowing of the scarp and high relief often enhanced where partly superposed by an old crater (Figure 13). The resulting morphology may give the appearance of volcanic edifices [Scott and Tanaka, 1981] but in most instances represents extensive mass wasting of basin massifs by sapping or runoff during an early epoch of climate change [Carr,

1981] or global internal heating [Schultz, 1978; Pieri, 1980;]. The furrowed massifs near Copernicus and other old basins strengthen the interpretation by Schultz and Glicken [1979] that the large massifs south of Tharsis are remnants of an ancient impact basin rather than volcanic constructions as in Scott and Tanaka [1981]. Such extensive erosional and depositional processes early in martian history may partly account for the relatively subtle expression of old basins except where reexposed by endogenic modification or differential erosion.

Impact basin control of large outflow channels was illustrated by the source regions of Tiu and Ares Vallis and by the topographic/structural control of Ares Vallis (Figures 3 and 4). Smaller outflow channels were noted in Ladon. Similarly Ma'adim Vallis and Al-Qahira Vallis originate along the outer ring of a 1000 km-diameter basin south of Apollinaris Patera (Figure 11). The existence of this basin is strongly supported by the areoid heights shown in Christensen and Balmiro [1979]. Additional examples include an unnamed channel in E. Hellas [see Masursky et al., 1977] and the group of channels (Maja, Vedra, Bahram) that originate along an interpolated massif ring of the Chryse Basin. Shalbatana and Simud Vallis also can be associated with an outer Chryse ring extrapolated from isolated massifs. The discussion of the Chryse Basin and its relation to outflow channels, Valles Marineris, chaotic terrains of Margaritifer Sinus, and other basins is deferred to a subsequent section concerning basin evolution.

The overlap and near overlap of ring structures exposed along the fretted terrain underscores the point that ancient basins may be hidden topographically but their imprints remain in the crust. Although Figure 11 identifies relatively subtle remnants, we must suspect that it still is only a partial inventory

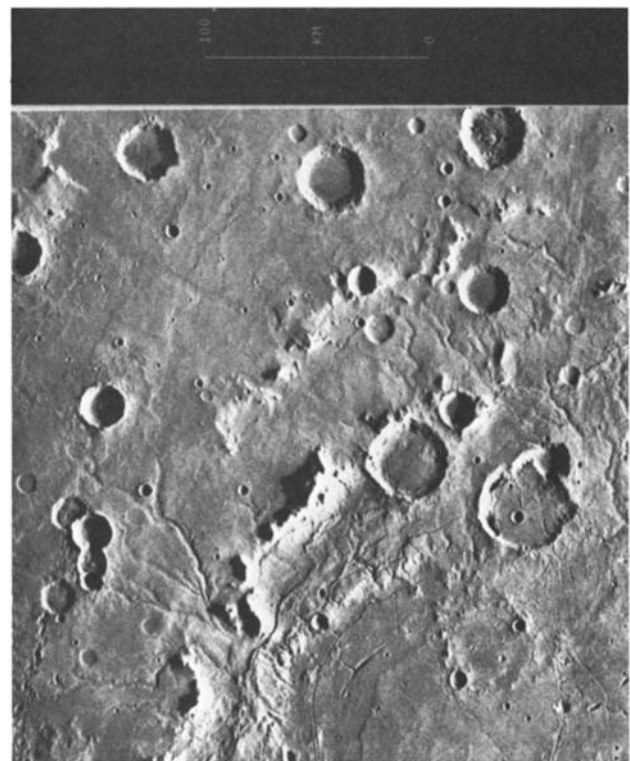


Fig. 12b. In contrast, the massifs of the inner rings of Ladon do not appear to be modified in the same manner, perhaps due to material differences. Viking frame 650A17.