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EVOLUTION OF THE EAST RIM OF THE HELLAS BASIN, MARS

David A. Crown, Katherine H. Price, and Ronald Greeley, Department of Geology, Arizona State University, Tempe, Arizona 85287; *Department of Geology & Geography, DePauw University, Greencastle, Indiana 46135*

The Hellas basin, an ~2000 km impact structure with possible rings extending 4260 km in diameter [1], is a dominant feature in the ancient, southern cratered highlands of Mars. Impact basin control of volcanism and tectonism is evident on the Moon [2], and relationships between martian basins and surface processes have been identified [3-4]. The east rim of Hellas is a complex geologic region affected by volcanism, tectonism, and channeling. Remnants of an extensive mantling deposit and smooth deposits filling craters may be indicative of widespread aeolian activity, presumably related to the dust storms originating in the Hellas region [5]. A detailed study of the area between 27.5 - 42.4°S and 260 - 275°W has been initiated to analyze the processes forming surface materials and to decipher the evolution of this geologically important highland area (Figure 1). Major units include Hesperian volcanics associated with Hadriaca and Tyrrhena Paterae in the N and Hesperian and Amazonian channeled plains and outflow channels in the S. Remnants of Noachian mountains and plateaus are found throughout the region [6].

Hadriaca and Tyrrhena Paterae are low relief volcanoes thought to lie on inferred rings of Hellas [1]. The asymmetry exhibited by both volcanoes reflects the regional slope [7] caused by the topography of the basin. Materials associated with Hadriaca (Hvf) are interpreted to be ash deposits on the basis of their erosional characteristics, the low relief of the volcano, and the absence of primary lava flow features [8]. The distribution of units at both Hadriaca Patera and Tyrrhena Patera (located NE of the study area) are consistent with an origin by the emplacement of gravity-driven pyroclastic flows [8-11]. A large flank flow (Hff) containing lava flow lobes and leveed channels extends from Tyrrhena to the SW adjacent to Hadriaca Patera.

Dao and Harmakhis Valles have lengths >500 km and trend ~S45W. Outflow channel deposits have been subdivided into 3 facies: $AHch_1$, irregular materials forming channel floors, associated with channel walls, or forming dissected, low-lying regions connecting channel deposits; $AHch_2$, smooth, featureless deposits forming channel floors; and $AHch_3$, materials with linear to curvilinear features parallel to channel margins. $AHch_1$ materials are interpreted to be remnants of the plains in which the outflow channels formed and occur as sections of incompletely collapsed, dissected plains or as hummocky mounds and blocks on channel floors or slumped from channel walls. $AHch_2$ materials are smooth channel floors resulting from uniform removal of materials or uniform collapse. $AHch_3$ deposits indicate fluvial modification. These facies suggest that water flowed in part of the channels following dissection and collapse. Surrounding the channels in the S part of the mapped area is the channeled plains rim unit (AHh_5). Cross-cutting relationships N of Dao Vallis indicate that the channeling pre- and post-dates collapse.

Based upon photogeologic mapping the geologic history of the east rim of Hellas has been derived. Uplift of Noachian mountainous (Nm) and plateau (Npld, Nh_1) materials occurred in association with the Hellas impact event. The locations of mountains identify possible basin rings, which may have produced zones of weakness providing access to the surface for the magmas forming Hadriaca and Tyrrhena Paterae in Hesperian time. Erosion by runoff and/or sapping modified the plains and flanks of the volcanoes, followed by the formation of Dao and Harmakhis Valles. The presence of volatile-rich surface materials and possible fluvial or periglacial activity is suggested by the deflation and collapse of the channel deposits [12], the style of erosion of the channeled plains, and the debris aprons (AHda) and pitted materials (AHpp) observed in association with the older units. The origin and extent of the mantling deposit in the S and the role of aeolian processes are current topics of investigation. Crater counts will further constrain the temporal relationships observed.

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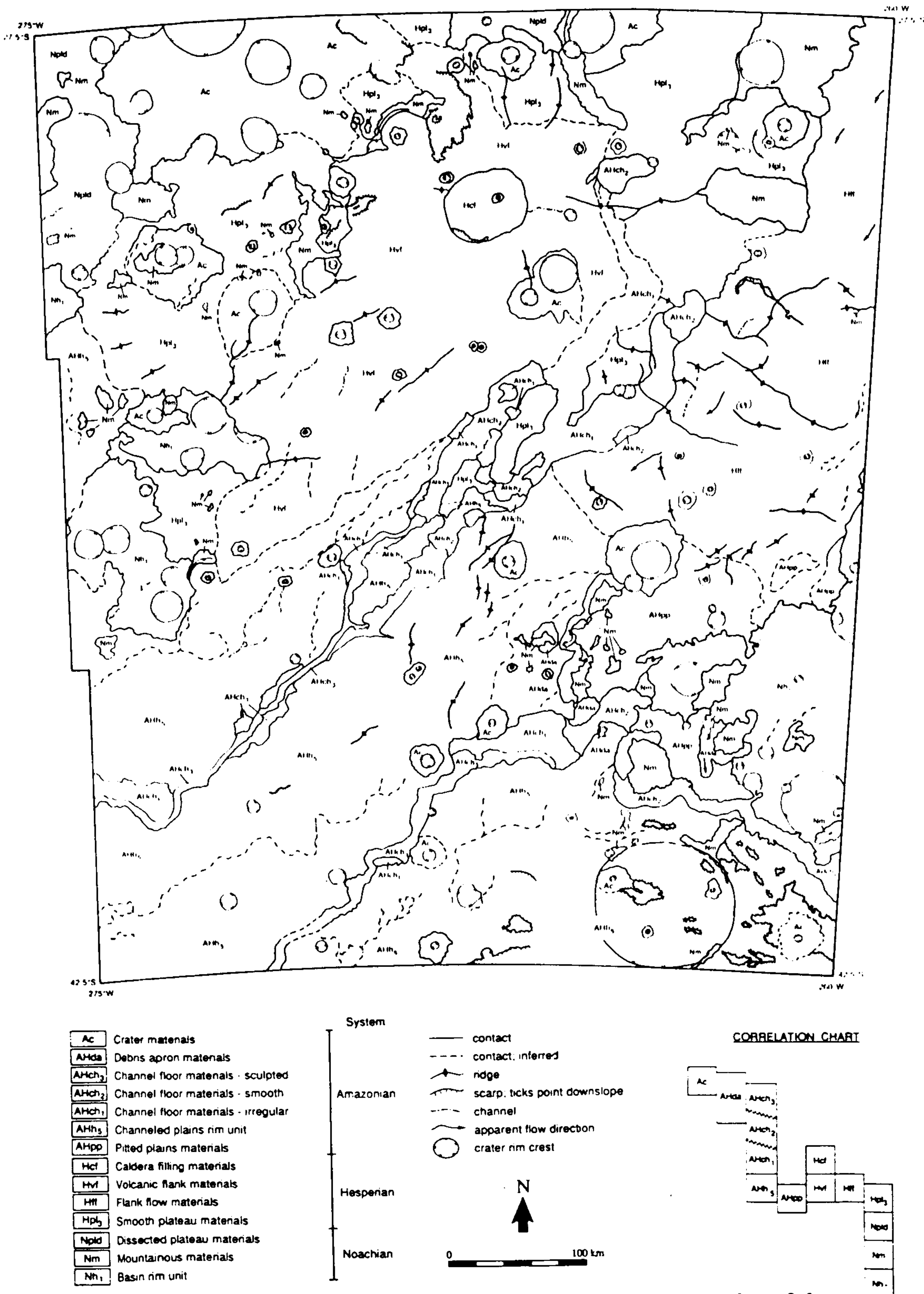

Figure 1. Geologic sketch map of the Hadriaca Patera region on the east rim of the Hellas basin.