EVIDENCE FOR WIDESPREAD RESURFACING IN THE MARTIAN HIGHLANDS;
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The southern cratered highlands of Mars contain a large population of flat-floored, rimless craters which occur on a variety of Noachian geologic materials. Previously these craters have been interpreted to have formed by aeolian mantling [1] or flood volcanism [2]; however, neither of these geologic processes accurately explains the observed morphology or the crater statistics. Determining the distribution of the flat-floored, rimless craters, the timing of the process responsible for their formation, and the actual process involved in their formation is important for understanding the geomorphic evolution of most of the southern cratered hemisphere of Mars. Our initial investigation concentrated on the analysis of the Amenthes and Tyrrhena regions near the dichotomy boundary [3,4,5]. Currently we have begun investigations into other areas including Mare Australe, Eridania, Arabia, Noachis, and Memnonia.

The geologic analysis of these regions was based on the published 1:15M geologic maps of Mars and was limited to two materials: the Noachian cratered unit (Npl_1; 6) and the Noachian dissected unit (Npld; 6). Although flat-floored, rimless craters occur on other Noachian geologic materials as well, the interpretations of these units [7,8,9] includes resurfacing by processes we feel are separable from a larger, more extensive process. The Noachian cratered unit (Npl_1) and the Noachian dissected unit (Npld) are distinguished by the absence or presence of ancient valley networks (i.e., runoff channels), respectively [6]. Together these units make up a bulk (~70%) of the surface area of the southern cratered hemisphere.

The termination of the resurfacing event represented by the cumulative size-frequency curves of superposed, fresh craters was not a catastrophic, global event (Fig. 1). Resurfacing ceased during the late Noachian to early Hesperian in the regions analyzed. In general, resurfacing ceased in the Npld materials later than in the Npl_1 materials, suggesting that the ancient valley networks represent the late stages or a change in the resurfacing process. These observations correlate well with other work suggesting that the ancient valley networks ceased to form by the early Hesperian [6].

A proposed mechanism responsible for martian highland resurfacing must be able to explain not only the morphology of the flat-floored, rimless, craters, but also the timing of the process between regions and the bendover in crater size-frequency distribution curves of highland materials [e.g., 5] as well. Although a bulk of the cratered highlands may be composed of volcanics [e.g., 10], volcanism does not produce flat-floored, rimless craters except in very rare circumstances. Aeolian erosion/deposition is also a very active process on Mars as evidenced by the seasonal dust storms and a variety of landforms [e.g., 11]; however, unlike what has been suggested by Wilhelms and Baldwin (1) aeolian fallout would not only be deposited up to the rim crest of craters but <u>on</u> the rims of craters as well. The result is not to produce a flat-floored, rimless crater, but to subdue the morphology of the crater. Volcanic and aeolian resurfacing do not produce a bendover in the cumulative size-frequency curves either. In both processes a crater is either buried, or it is not, in which case it is still counted. We propose a fluvial process capable of eroding the rims of the craters primarily from the outside, thus reducing the apparent diameter of the craters. The eroded material is

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redistributed, inundating the smaller craters before they are eroded completely. Such a complicated process not only explains the morphology of the flat-floored, rimless craters, but also the bendover in the cumulative size-frequency curves and potentially the timing of the process between regions.

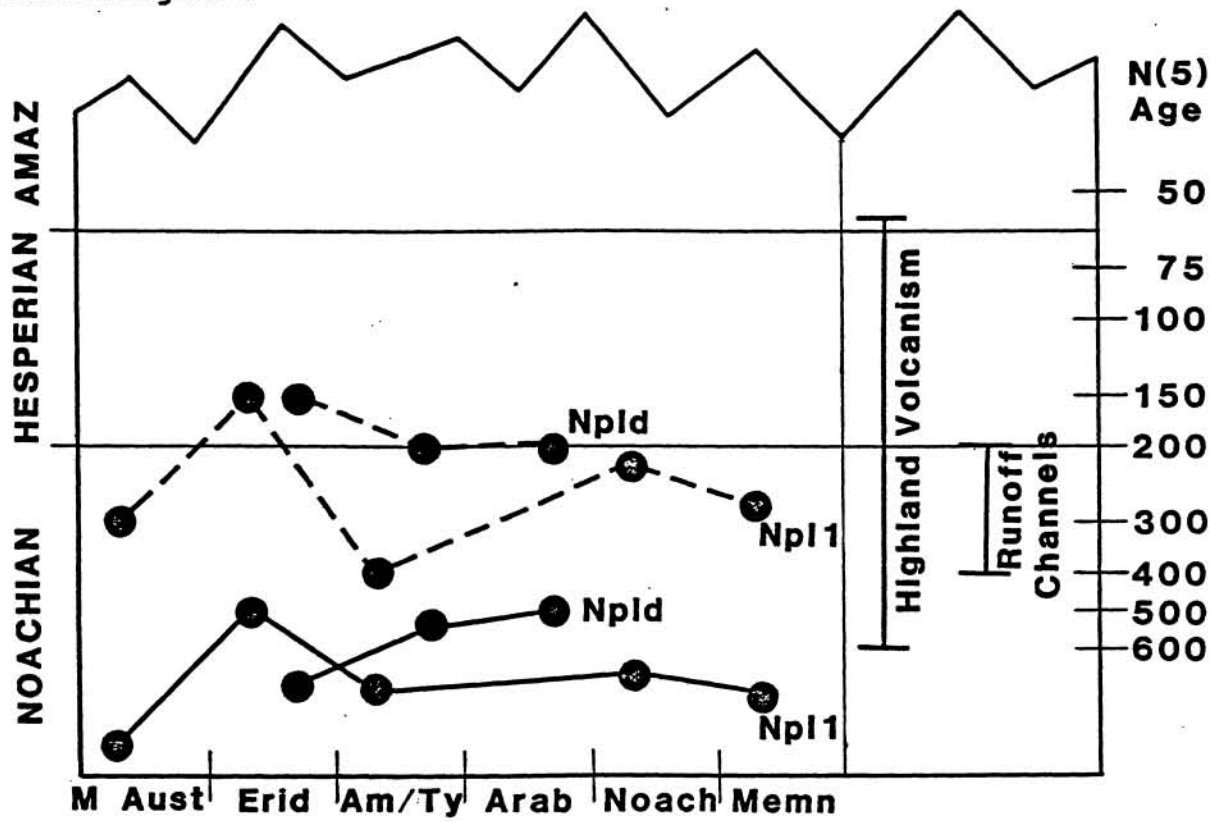

Figure 1. Timing of resurfacing in the areas mentioned in text. N(5) ages represent the number of craters >5-km-diameter per million square kilometers. Solid lines represent age of material based on all craters. Dashed lines represent termination of resurfacing event based on fresh, superposed craters.

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