History of Major Degradational Events in the Highlands of Mars: Preliminary Results From Crater Depth/Diameter Measurements. Joseph M. Boyce[1], Peter J. Mouginis-Mark[1], Harold Garbeil[1], and Laurence A. Soderblom[2], [1] Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, Hawaii ; [2] U.S. Geological Survey, Flagstaff, Arizona.

Introduction: In an effort to gain insight into the degradational history of the highlands of Mars, we have measured the depth (d) and diameter (D) of 1,692 craters (D ranging from 6 km to > 100 km) using the technique developed by Mouginis-Mark et al. [1] applied to the 1/128th degree MOLA digital elevation model. We have selected 19 test areas (12 areas in Noachian-age regions: Terra Meridiani, Margaritifer Terra, Memnonia Fosse, Ma'adim Valles, N.W. Arabia Terra, N.E Arabia Terra, N. Promethei Terra, S. Central Promethei, S.E. Cimmeria Terra, S. Argyre, Sirenum Terra, and Dueteronilus Regions; and 5 test areas in Hesperian-age regions: Sinai, Hesperia, Lunae Planum, Amphitrites regions and Tempe Terra). Figure 1 shows the location of craters in each of these areas.

Results and Discussion: A preliminary assessment of the data suggests that latitude and terrain age have been important factors in the development of the d/D relationships of craters in the highlands of Mars. Figs. 2 and 3 are scatter plots for d/D distributions in Noachian-age terrains located in mid-latitude (i.e., ~40ºS to 40ºN) and high-latitude regions of Mars (i.e., ~40ºS to 70ºS and 40ºN to 55ºN), respectively. Figs. 4 and 5 are similar scatter plots for Hesperian-age terrains located in mid- and high-latitude highland terrain regions, respectively. Our preliminary results indicate the following trends:

1. Most regions show highly subdued Early Noachian-age craters that most likely represent an ancient population of craters buried by the emplacement of later volcanic plains [2].
2. The d/D distributions in Noachian-age mid-latitude regions (Fig. 2) include a Late Noachian-age mode that may have had a period of fluvial erosion that produced channel networks [3, 4].
3. In Noachian-age high-latitude regions, d/D distributions (Fig. 3) show only one broad continuous mode.
4. The d/D distributions curves of both Hesperian and Noachian-age mid-latitude terrains (Figures 2 and 4) include a mode of relatively deep craters (i.e., fresh craters [5]). The characteristics of this distribution suggest that the craters have been degraded by eolian infilling and erosion [4].

Neither the Hesperian- nor the Noachian-age high-latitude terrains (Figs. 3 and 5) include deep "fresh" craters.

Conclusions: These observations are in general consistent with those of other workers based on many different types of data [6, 7, 8] and suggest that a planet-wide period of volcanic resurfacing occurred early in the Noachian, followed by a period of fluvial activity in the Late Noachian that rapidly degraded topography. Following this event, from the Early Hesperian onward, the surface appears to have been degraded principally by eolian infilling and erosion. Remarkably, the major episodes of crater degradation in the mid-latitudes of Mars are not generally recognized in crater d/D distributions in high-latitude terrains. The absence of these episodes suggests either the operation of processes in the high latitude that have erased evidence of these major events and/or these events were restricted to the mid-latitudes. In the case of fluvial processes, it is conceivable that they may be latitude dependent, but it is unlikely that volcanism is latitude dependent. Also, the absence of fresh craters in the high-latitude regions suggests either the operation of a recent degradational or burial process exclusive to the high-latitudes of Mars [e.g., 9] or that the material properties of the crust produced relatively shallow craters that the general fresh crater curve does not apply in these regions [10].

References: [1] Mouginis-Mark, P.J., et al. (2004), *J. Geophys. Res.,* 109(E8), doi:10 1029/2003JE002147. [2] Frey, H. V. (2003), *6th Mars Conf.*, abstract # 3104. [3] Craddock, R., and T. Maxwell (1993) , J. Geophys. Res., 98(E2), 3453 – 3468. [4] Forsberg-Taylor, N. K., et al. (2004), *J. Geophy. Res., 109(E0)*, 5002, doi:10 1029/2004JE002242. [5] Garvin, J. B., et al., 2003, *6th Mars Conf.,* abstract # 3277. [6] Scott, D. H., and K. L. Tanaka, (1986), *U.S. Geol. Sur. Misc. Invest. Map, I-1802-A*. [7] Greeley, R., and J. E. Guest, (1987) *U.S. Geol. Sur. Misc. Invest. Map, I-1802-B*: [8] Tanaka, K. L., et al., (1992), in: *Mars*, edited by H. H. Kieffer et al., 345-382, Univ. of Ariz. Press, Tucson, 1992. [9] Mustard J.F., et al. (2001), 412, 412-414; [10] Garvin, J. B., et al. (2000), *Icarus, 144*, 329-352.

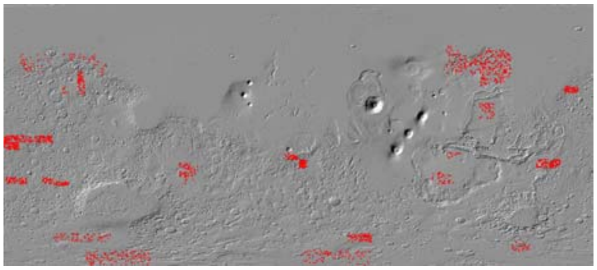

Fig. 1: Distribution of the 1,692 craters included in this analysis. All of these craters have a diameter greater than 6.0 km.

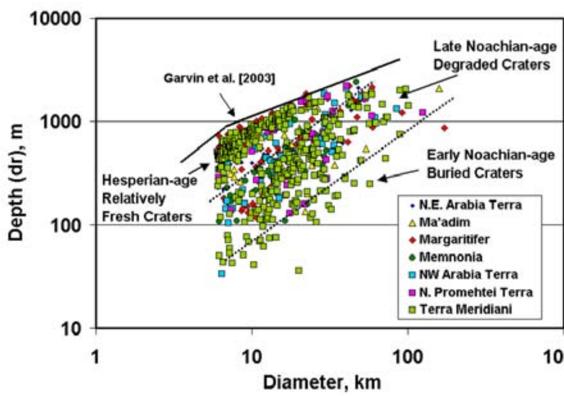

Fig. 2: d/D distributions in Noachian-age terrains located in mid-latitude (i.e., 40ºS to 40ºN). The Garvin et al. [2003] line comes from reference [5].

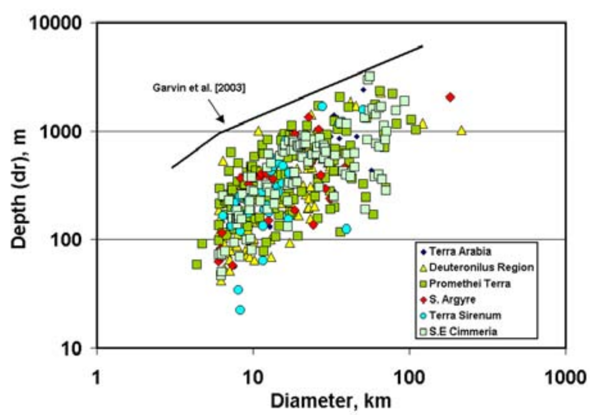

Fig. 3: d/D distributions in Noachian-age terrains located in high-latitude regions of Mars (i.e., 40ºS to 70ºS and 40ºN to 55ºN).

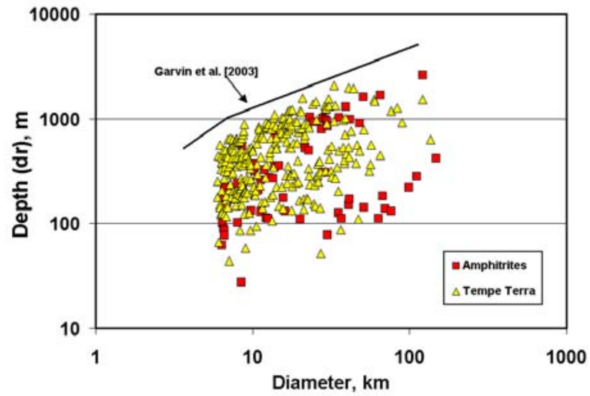

Fig. 4: d/D distributions in Hesperian-age terrains located in mid-latitude (i.e., 40ºS to 40ºN).

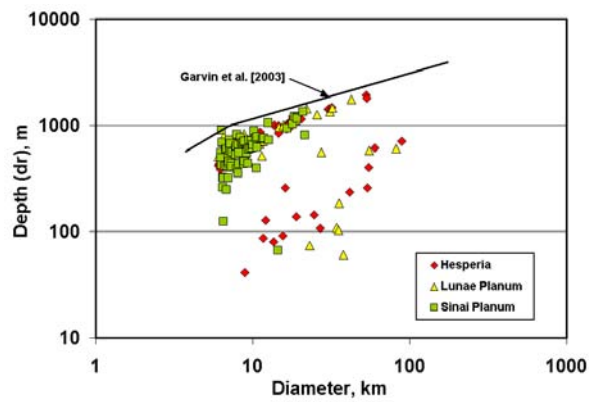

Fig. 5: d/D distributions in Hesperian-age terrains located in high-latitude regions of Mars (i.e., 40ºS to 70ºS and 40ºN to 55ºN).