History of Major Degradational Events in the Highlands of Mars: Preliminary Results From Crater Depth and Diameter Measurements: Joseph M. Boyce, Peter Mouginis-Mark, Harold Garbeil, Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, Hawaii; and Laurence A. Soderblom, 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 ther depth (d) and diameter (D) for 1665 craters in the diameter range 6 km to over 100 km using the technique developed by Mouginis-Mark et al, [1] applied to the 128th degree MOLA digital elevation model. We selected 14 test locations (Figure 1) (10 test areas in Noachian-age regions: Meridiani, Margaritifer, Memnonia, Ma'adin, Promethei, Thyles, S. Argyre, Sirenum, Tempe, and Dueteronilus regions and 4 test areas are in Hesperian-age regions: Sinai, Hesperia, Lunae Planum, Amphitrites regions)

Results and Discussion: A preliminary assessment of the data suggests that latitude and terrain age have been important factors in development of the d/D relationships of craters in the highlands of Mars. The depth and diameter data have been plotted on scatter plots for Noachian-age terrains located in mid-latitude (i.e., ~30ºS to 30ºN) (Figure 2) and high-latitude regions of Mars (i.e., 30ºS to 70ºS and 30ºN to 55ºN) (Figure 3), and for Hesperian-age terrains located in mid- and high-latitude highland terrain regions, corresponding to ~30ºS to 30ºN, and ~60ºS, respectively) (Figure 4). Our results indicate the following trends:

1. All regions show highly subdued Early Noachian-age craters that most likely represent an ancient population of craters buried by early Noachian-age volcanic plains [2].
2. The Noachian-age mid-latitude regions include an intermediate mode that mostly likely was produced by an early period of fluvial erosion [3, 4].
3. Noachian-age high-latitude regions do not appear to include this intermediate mode in their d/D distributions.
4. The d/D distributions curves of both Hesperian and Noachian-age mid-latitude terrains include a mode of relatively deep craters, some of which lie nearly on the fresh crater distribution curve [5]. The characteristics of this distribution suggests that the craters have been degraded by eolian infilling and erosion [4].
5. Neither the Hesperian-age nor the Noachian-age high-latitude d/D distributions include this "deep crater" mode.

Conclusions: These observations are in general consistent with those of other workers based on many different types of data [6, 7, 8]. Our preliminary analysis of the data we suggest that planet-wide volcanic resurfacing occurred early in Mars history (early to middle Noachian). Following this event, during the late Noachian, the mid-latitudes of Mars were degraded by a period of fluvial activity. Our preliminary data only show evidence that this episode affected only the mid-latitude terrain of Mars and not the high-latitudes. Following this event, from Early Hesperian onward, the surface appears to have been degraded principally by eolian infilling and erosion. In addition, the remarkable absents of fresh craters in the high-latitude regions of both ages suggests either the operation of a process only in the high-latitudes of Mars that recently significantly degraded or buried all craters there [e.g., 9] or that the crust of the region is composed of materials that cause craters to initially form relatively shallow and that the recognized fresh crater curve does not apply in these regions [10].

Future Work: This abstract presents our first results of highlands crater d/D distributions measured as part of our on going study to use crater d/D distributions to investigate the degradational history of Mars. We plan to continue data collection, in particular in test sites in the high-latitudes regions and at a variety of elevations, in an effort to search for and characterize additional degradational events.

Figure 1. Location of Data Points

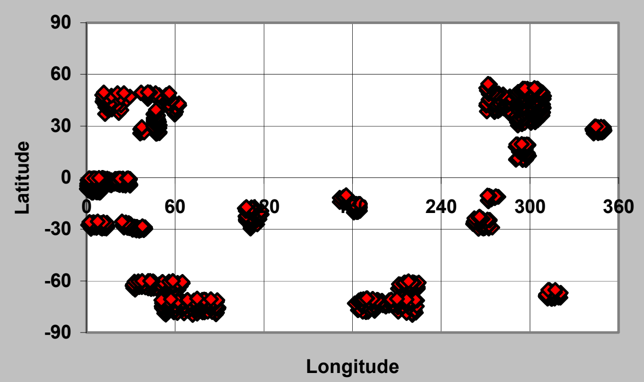


Figure 2. Mid-Latitude (+/- 30 Degrees) Noachean Terrain

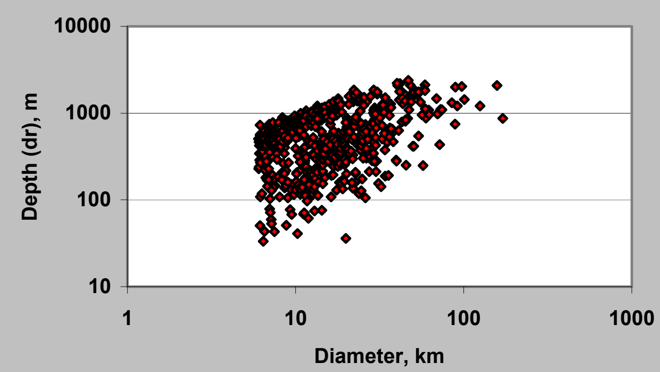


Figure 3. Noachian-Age Terrain in the High Latitudes of Mars

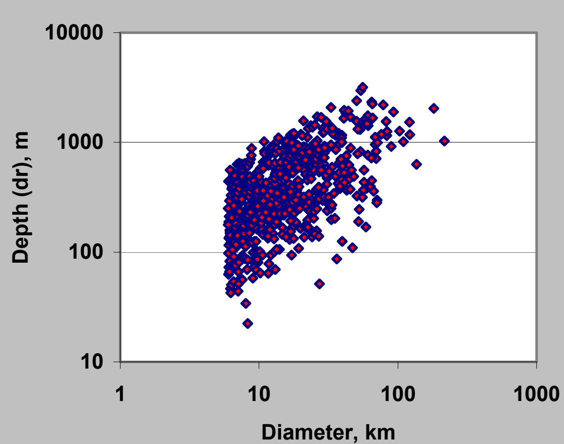
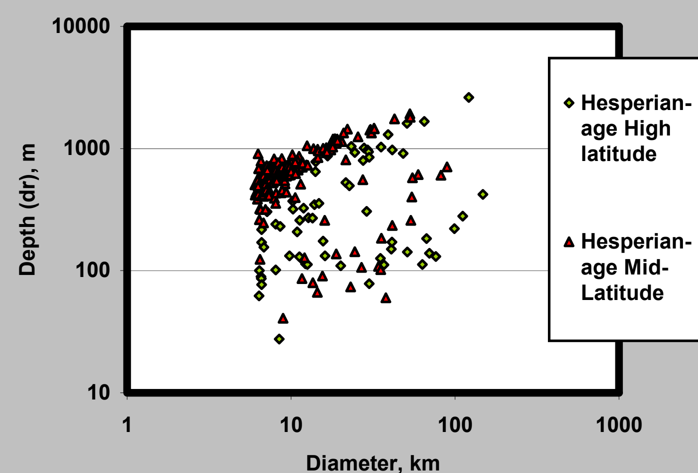


Figure 4. Hesperian-Age Terrain in the High Latitudes of Mars



Reference: [1]Mouginis-Mark, P.J., H. Garbeil, J. M. Boyce, C. S. E. Ui, and S. M. Baloga (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., A. D. Howard, and R. A. Craddock (2004), *J. Geophy. Res., 109(E0)*, 5002, doi:10 1029/2004JE002242; [5] Garvin, J. B., S. E. H., Sakamoto, and J. J. Frawley, *6th Mars conf.,* abstract # 3277, 2003; [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*, 1987; [8] Tanaka, K. L., D. H. Scott, and R. Greeley, (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., S. E. H. Sakamoto, J. J. Frawley, and Schnetzler (2000a), , *Icarus, 144*, 329-352.