NORTH-SOUTH ASYMMETRY IN MARTIAN CRATER SLOPES. R. A. Parsons[1], F. Nimmo[1] and M. D. Ellehoj, [1]University of California, 1156 High St., Santa Cruz, CA 95064 (rparsons@pmc.ucsc.edu)

Introduction: A significant amount of data suggests that water ice is present in variable concentration within the Martian shallow subsurface [1], [2]. Equatorial regions appear to be depleted in ice, while an ice mantle extends poleward of 30^o [3]. Global roughness measurements suggest topographic relaxation at short wavelengths in mid-latitudes, possibly due to creep of ice-rich regolith [4]; this creep may also be responsible for the observed north-south asymmetry in slopes [5]. Relaxation of a deformable, presumably ice-rich, regolith layer of approximately 1 km in thickness may explain softened craters at mid to high latitudes [6]. Softened craters are characterized by rounding of the crater rims and by crater slopes that are more convex. Crater softening due to ice-driven creep may vary spatially within a single crater due to temperature variations induced by the angle of insolation. Since creep processes are more rapid at higher temperature, one would expect equator-facing crater slopes to be shallower than pole-facing slopes for low obliquities. To test this hypothesis, we measured crater slopes in the equatorial and north and south mid-latitude regions of Mars.

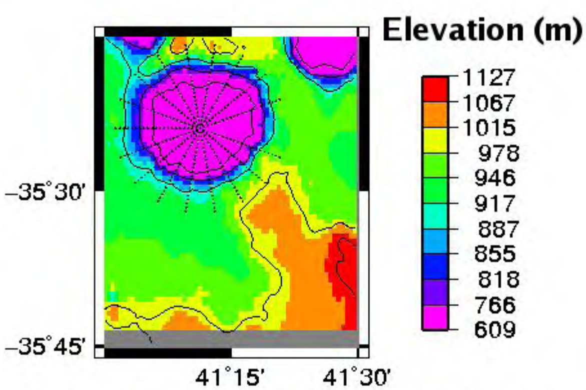

Figure 1. MOLA topography of a 8 km radius crater in the southern mid-latitude of Mars at 41.2 degrees east longitude. Dotted lines indicate locations of topographic profiles used to calculate slope.

Method: We analyzed relatively fresh craters ranging from 5 to 20 km in radius located in the mid-latitude northern (~30^{o}N), equatorial (~0^o), and mid-latitude southern(~30^{o}S) regions of Mars. Radial topographic profiles were taken every 20 degrees, each extending from the center of the crater to just beyond the rim (dotted lines in Figure 1). A total of 18 profiles were made: 4 profiles transect the north and south crater faces and 5 profiles transect the east and west faces. The topography was sampled at a resolution of 375 m for all profiles. Next, we find the maximum slope for each profile and average the maximum slopes of the appropriate profiles together to get a value for the slope of a particular crater face. Finally, the crater slope asymmetry is quantified by the parameter A, where $A = (S_n - S_s)/S_{ew}$. In this expression, S_n and S_s are the slopes of the north and south crater faces, respectively, and $S_{ew.}$ is averaged slope of the east and west faces. The parameter A measures the difference in slope between the north and south faces. A negative value for A indicates that the south face of the crater is steeper in slope than the north face.

Preliminary Results: As shown in Table 1 and Figure 2, slope asymmetry appears to be weakly dependent on latitude. Surprisingly, the data suggests that pole-facing slopes tend to be shallower than equator facing slopes for craters at mid-latitudes. If this result is correct, the crater asymmetry we observe today may actually reflect a period of high obliquity in the recent Martian past. During high (~30^o) obliquity periods the pole-facing crater slopes would receive more

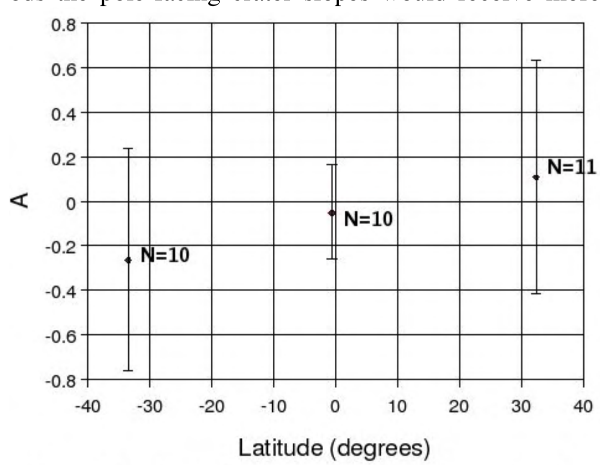

Figure 2. North-south asymmetry in crater slopes plotted versus latitude for each of our three study regions. N is the number of craters analyzed within a particular region. Exact locations of craters are given in Table 1. These preliminary results suggest pole-facing slopes are shallower.

sunlight than equator-facing slopes. Crater modification studies by Kreslavsky and Head, 2006 [7] suggest moderately high obliquity periods were probable during the last 40-160 Myr. The accentuated softening on poleward facing slopes during these periods of high obliquity would result in the crater asymmetry suggested by these, preliminary, data.

Future Work: Although the preliminary results are intriguing, a larger set of craters needs to be analyzed to reduce the uncertainty (Figure 1). Some of the scatter may be due to the inclusion of craters of different ages or geological settings in our data, which will require image interpretation to disentangle. Nonetheless, if the initial results are confirmed, analyzing craters of different diameter will help to determine how crater modification via ice-rich soil creep modifies features of different wavelength [6], [8] and potentially constrain the thickness of the ice-rich layer.

References: [1] Boynton W. V. et al., (2002) *Science, 297,* 81–85. [2] Feldman W. C. et al. (2002) *Science, 297,* 75-78. [3] Mustard J. F. et al. (2001) *Nature, 412,* 411-414. [4] Kreslavsky M. A. and J. W. Head, (2000) *JGR, 105,* 26695-26711. [5] Kreslavsky M. A. and J. W. Head, (2003) *GRL, 30,* 1815. [6] Jankowski D. G. and Squyres S. W., (1992) *Icarus, 100*, 26-39. [7] Kreslavsky M. A. and J.W. Head, (2006) *Meteoritics & Planet. Sci., 41,* 1633-1646. [8] Pathare A. V. et al., (2005) *Icarus, 174,* 396-418.

Table 1

Latitude (°)	Longitude(°)	A	Radius (km)
34.39	48.33	0.56	9
33.67	44.26	-0.83	17
33.66	44.27	-0.66	16
33.15	46.3	0.18	7
32.97	47.22	0.4	11
31.85	44.15	-0.15	9
31.58	44.64	0.78	15
31.32	43.82	0.21	14
30.6	44.18	0.13	17
29.84	40.43	0.45	13
2.14	1.32	0.4	7
2.03	2.97	0.06	7
1.58	9.34	-0.05	5
0.99	11.8	-0.17	5
-1.12	3.22	-0.1	13
-2.05	7.69	-0.18	6
-2.2	3.48	-0.01	8
-2.51	2.37	-0.09	18
-2.58	1.8	-0.41	8
-2.72	16.19	0.01	7
-30.85	43.64	-2.05	9
-31.14	42.03	-0.42	9
-31.98	43.15	0.57	13
-32.55	43.61	0.23	10
-33.55	49.28	-0.18	5
-33.87	40.47	-0.55	8
-33.9	46.17	-0.02	5
-33.97	48.56	0.05	6
-35.26	41.45	0	5
-35.4	41.19	-0.23	8
-36.76	44.04	-0.3	5