Impact Crater Morphologies as Indicators of Volatiles in Northeastern Arabia Terra, Mars. C. M. Atkins and N. G. Barlow, Dept. Physics & Astronomy, Northern Arizona University, Flagstaff, AZ 86011-6010. ca545@nau.edu; Nadine.Barlow@nau.edu.

Introduction: Arabia Terra presents us with a unique opportunity to evaluate the extent to which volatiles have shaped this region of Mars. We are investigating the influence of surficial and subsurface volatiles on impact craters in the northeastern quadrant of Arabia Terra, Mars. Analysis is ongoing, however preliminary results show statistically high concentrations of morphologies indicative of subsurface volatiles at high latitudes. These results along with further research will help us determine the volatile processes that have affected this region of Mars.

Project Outline: This study is using the large number of impact craters to investigate the role of subsurface and surficial volatiles (presumed to be mainly H_20 in liquid and solid states) on the evolution of Arabia Terra. This project will extend the current coverage of the *Catalog of Large Martian Impact Craters*, version 2.0 [1] in the Arabia Terra region to craters in the 1-5 km diameter range. Morphology classifications will be performed for all craters using the following classes: central pit/peak, lineated floor deposits, terrain softening, nested craters, inverted craters, and layered ejecta blankets. (See [2] for more information)

Current Progress: To date, craters between 1 and 5 km in diameter in the entire NE quadrant (27.5°- 85° E, 20°- 40° N) of Arabia Terra have been mapped. The database consists of 6,818 craters with their position and major/minor diameters while 6,193 of these craters are also classified by their preservational state and morphology characteristics. The remaining 625 craters yet to be classified lie in the most Eastern portion of the quadrant (∼78°-85° E and 20°-40° N).

Preliminary Results: Although the analysis is just beginning we are already seeing some interesting trends in morphology distribution with respect to latitude and elevation. The distribution of 1-5 km diameter craters throughout the NE quadrant of Arabia Terra is relatively uniform (Fig. 1). However, the specific morphology distribution maps show the spread of craters is very non-uniform in every case. This tells us the composition of the impact material and/or geologic processes vary throughout the region. Figures 2, 3, 4, and 5 show distribution maps for several specific morphologies. Terrain softening [3] and layered ejecta blankets [4] are believed to form due to ice in the target material while lineated floors deposits are suggested to be ice rich glacial deposits [5]. The distribution maps of these three morphologies are consistent with the theories of their formation. The northern latitudes are subject to ice deposition during periods of high obliquity and therefore the soil may have a high composition of volatiles. Nested craters have been proposed to support the theory of oceans on Mars because they have been observed in terrestrial marine impact craters [6]. If this were the case then the nested crater distribution would strongly correlate with low elevations. Although this database has not yet been compared quantitatively with elevation maps a qualitative comparison shows the nested crater distribution is more correlated to the higher elevations than to the lower elevations. Figure 6 is a histogram of the number of craters within a specific preservation state, following the system of [7]. This shows most craters are moderately preserved with few craters being pristine or severely eroded.

Future Analysis: Once the remaining 625 craters are classified, we will import this information into ArcGIS and investigate the distributions with respect to location, elevation, and soil composition. Size frequency distribution analysis will be conducted to further constrain the age and timing of the specific geologic processes. Crater modification/infilling will be determined using MOLA and shadow estimates.

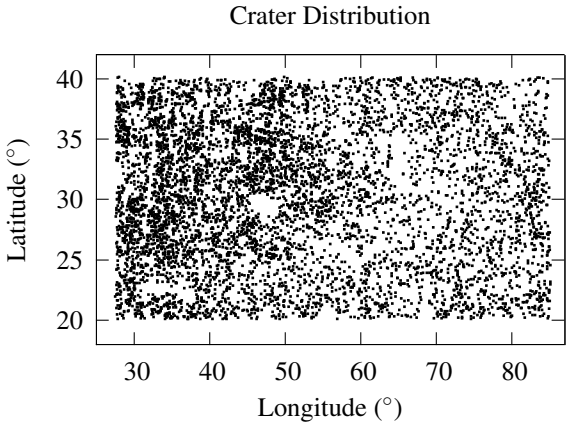

Figure 1: Plot of the 1-5 km-size crater distribution in the NE quadrant of Arabia Terra, Mars.

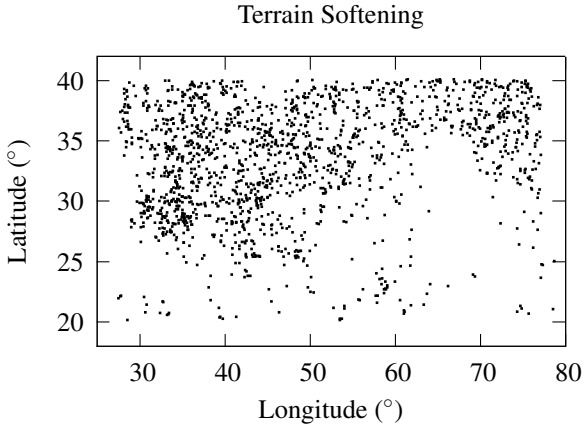

Figure 2: Distribution of all craters that display terrain softening.

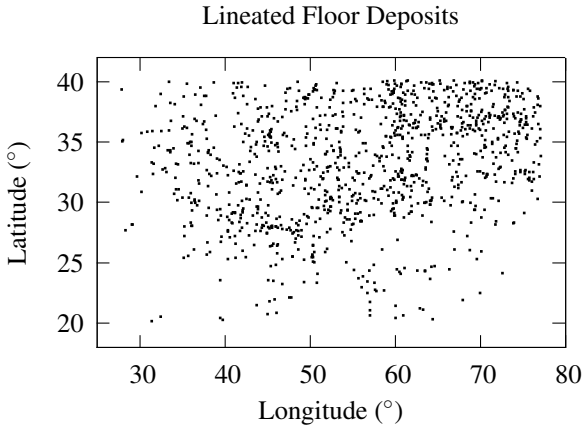

Figure 3: Distribution of all craters that display lineated floor deposits.

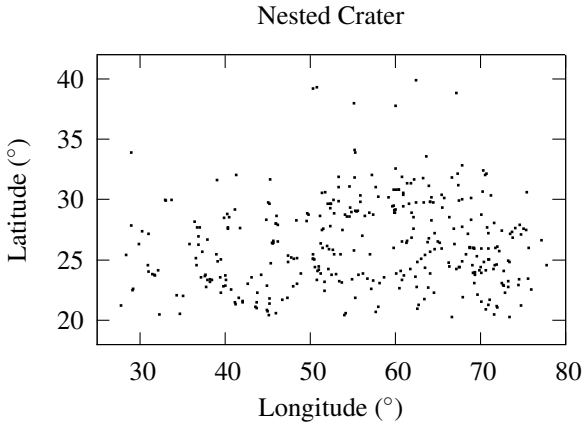

Figure 4: Distribution of all craters that classified as nested craters.

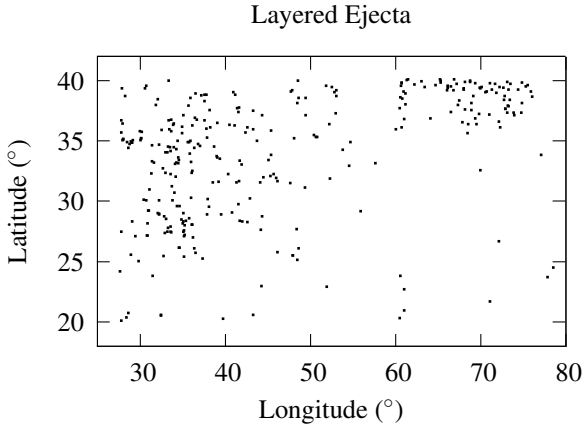

Figure 5: Distribution of all craters that have layered ejecta blankets.

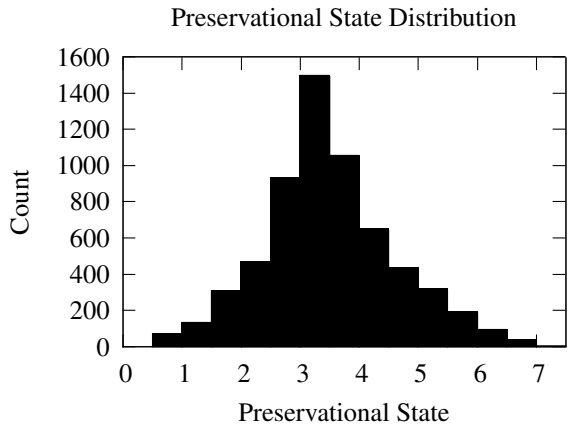

Figure 6: Histogram showing the distribution of preservational states of all classified craters. On a scale of 0-7, 0 being "ghost crater" and 7 being a pristine crater.

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References: [1] Barlow, N. G. (2006), *LPS XXXVII*, Abs. #1337. [2] Atkins C.M. and Barlow N.G. (2011) *LPSC XLII*, Abs. #1972. [3] Barlow, N.G. (2005), GSA SP 384, 433-442. [4] Jankowski, D.G. and Squyres, S.W. (1992), *Icarus 100*, pp. 26-39. [5] Levy, J.S., Head, J.W., and Marchant, D.R. (2007), *JGR 112*, E08004. [6] Ormö, J., et al. (2004), *MAPS 39*, pp. 333-346. [7] Barlow N.G. (2004), *GRL 31*, L05703.