MARTIAN POLAR IMPACT CRATERS: NORTH-SOUTH COMPARISONS AND IMPLICATIONS FOR TARGET PROPERTIES AND POLAR PROCESSES. A.L. Fagan and S.E.H. Sakimoto, Department of Civil Engineering and Geosciences, University of Notre Dame, 156 Fitzpatrick Hall, Notre Dame, IN 46556-5637, E-mail: abacasto@nd.edu.

Introduction: Impact crater morphologies have been used as indicators of variations in target properties and local geologic processes. Recently, a study of a limited subset of martian north polar impact craters suggested that they tend to have more cavity fill than the martian global crater population [1,2,3,4]. Other authors [5] suggest that there may be a latitude dependent, north-south wall slope asymmetry. Either a greater cavity fill or a N-S slope asymmetry could have widespread implications for the interpretation of martian polar processes. Therefore, in this study, we evaluate cavity wall slopes and interior deposits for several hundred north polar craters in order to better describe potential variations from the global population. In addition, 73 randomly selected south polar craters were evaluated for comparison purposes.

Approach: We use high-resolution (256 pixels/degree or about 230 meters/pixel) topographic data from the Mars Orbiter Laser Altimeter (MOLA) instrument on the Mars Global Surveyor Mission using the *Gridview* program [6] to examine impact crater topographic characteristics. These include the following: regional variations of crater characteristics due to either target properties or post-impact polar processes; crater geometry (depth, diameter, volume, crater cavity wall slope); and cavity deposit (location within cavity, relative size, relative shape). Three-hundred fifty north polar impact craters (figure 1) were evaluated as well as 73 south polar impact craters to be used for comparison.

Discussion: This limited data set suggests that north polar impact craters are generally shallower than the global fresh crater population data for both simple and complex craters (figure 2a). In addition, the limited, randomly selected group of south polar impact craters also seem to be shallower than the global fresh crater population (figure 2b). This suggests an increase in cavity fill in these craters.

Some craters in this study have significant amounts of cavity fill, for example 1/3 of the width or depth of the crater is covered(see subimage in figure 3). The majority of the 96 north polar impact craters with significant fill have fill lying adjacent to the crater wall in a W-E directional preference (figure 3). In addition, a smaller subset of craters have an interior topography that exceeds that of the central peak and sometimes that of the surrounding plains. For this small subset of craters, the interior deposits all lay adjacent to the western crater cavity wall.

Crater cavity wall slope symmetry for north polar craters tends to increase with increasing latitude; that is, the difference in pole-facing and equator-facing wall slopes tends to decrease with higher latitudes. In addition, the average cavity wall slope tends to decrease with latitude.

A small set of south polar impact craters were sampled to use as a comparison to the data collected from the north polar craters. While several craters show similar interior deposit shape, this data set does not appear to be as idiosyncratic as the north polar impact crater dataset. In addition, none of the sampled south polar craters exhibit fill that lies above the surrounding plains nor do they show any particular cavity wall slope latitude dependence.

Large (≥~25km diameter) south polar craters are systematically shallower (60-70% of depth) than north polar craters of similar diameter. This is not observed for smaller diameter south polar impact craters. In addition, we observe an apparent shift of the simple to complex crater transition diameter to larger diameters in latitudes poleward of –80S. Two possible explanations come readily to mind: (1) there is an actual change in simple-to-complex crater transition diameter, perhaps due to different a target property or (2) the simple-to-complex transition diameter is unchanged, but large south polar complex craters systematically have more fill than the global crater population.

Conclusions: We find that south polar craters have inherently different cavity fill characteristics than their northern polar counterparts. Those south polar craters with significant fill do not show the same preferential placement as do the northern polar craters. In addition, south polar craters appear to be shallower than both the global crater population and the north polar crater population (60-70% of the depth of the northern polar craters).

References: [1] Sakimoto, S.E.H., (2005), The Role of Volatiles and Atmospheres on Martian Impact Craters, p 3036. [2] Sakimoto, S.E.H., (2005), LPSC XXXVI, no. 2099. [3] Garvin, J.B., et al. (2003), Sixth International Conference, no. 3277. [4] Bacastow, A.L. and S.E.H. Sakimoto, (2006), LPSC XXXVII, no. 2239. [5] Parsons, R.A. et al., (2007), LPSC XXXVIII, np. 2108. [6] Roark, J.H., et al., (2004), LPSC XXXV, no. 1833. [7] Garvin,

J.B., et al., (2000), *Icarus* 144, 329-352.

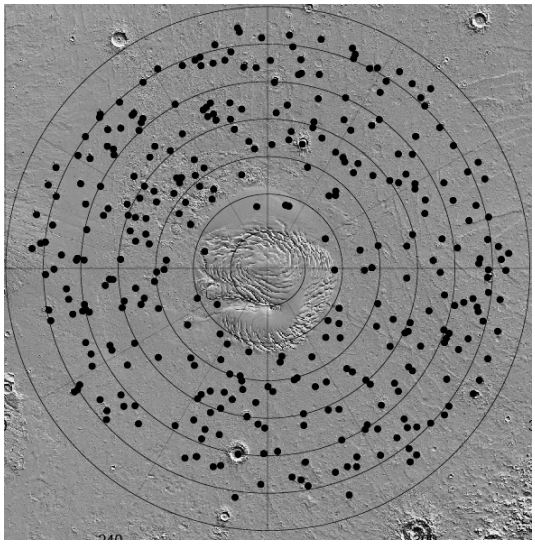

Figure 1. Location map for the 350 impact craters (shown as black points) measured in this study from 55°-90°N. The base map is shaded relief MOLA topography (from USGS Planetary GIS Web server-PIGWAD).

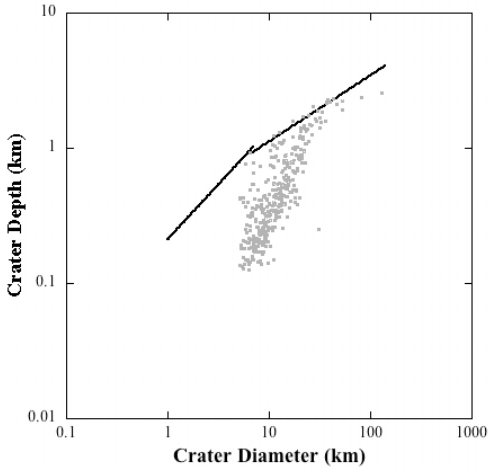

Figure 2a. Depth vs Diameter for north polar impact craters in this study represented by grey points. The solid lines are the global depth-diameter relationships reported by Garvin et al [7].

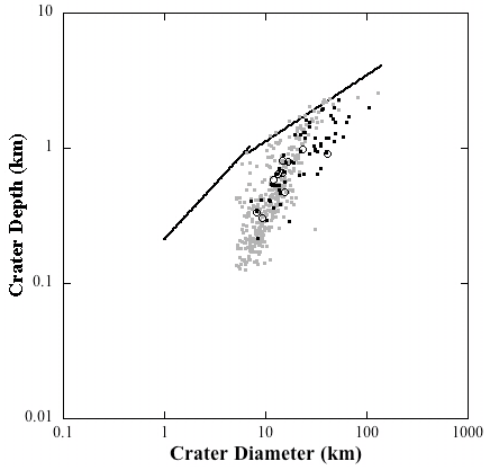

Figure 2b. Depth vs Diameter for all polar impact craters in this study. Grey points represent north polar impact craters, open circles represent south polar craters with a latitude poleward of -80°S, and black points represent all other south polar craters in this study. The solid lines are the global depth-diameter relationships reported by Garvin et al [7].

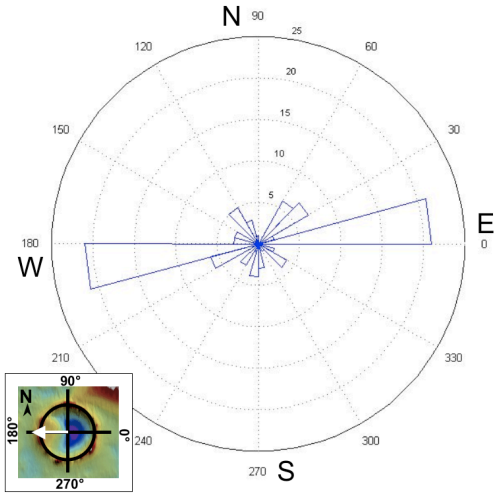

Figure 3. Locations of fill in north polar crater cavities. Petal length represents the number of craters with fill at a particular compass location. The inset image shows an example crater with fill at a compass location of 180°.