MARTIAN POLAR IMPACT CRATERS: A PRELIMINARY ASSESSMENT USING MARS ORBITER LASER ALTIMETER (MOLA).

S. E. H. Sakimoto[1], J. B. Garvin[2], [1](USRA at NASA's GSFC, Code 921, Greenbelt, MD 20771 USA; sakimoto@denali.gsfc.nasa.gov) [2](NASA's GSFC, Code 921, Greenbelt, MD 20771).

Introduction: Our knowledge of the age of the layered polar deposits and their activity in the volatile cycling and climate history of Mars is based to a large extent on their apparent ages as determined from crater counts. Interpretation of the polar stratigraphy (in terms of climate change) is complicated by reported differences in the ages of the northern and southern layered deposits. The north polar residual ice deposits are thought to be relatively young, based on the reported lack of any fresh [1, 2] impact craters in Viking Orbiter Images. *Herkenhoff et al.,* [3] report no craters at all on the North polar layered deposits or ice cap, and placed an upper bound on the surface age (or, alternatively, the vertical resurfacing rate) of 100 thousand years to 10 million years, suggesting that the north polar region is an active resurfacing site. In contrast, the southern polar region was found to have at least 15 impact craters in the layered deposits and cap [4]. *Plaut et al*, [4] concluded that the surface was ≤ 120 million years old. This reported age difference factor of 100 to 1000 increases complexity in climate and volatile modeling. Recent MOLA results for the topography of the northern polar cap document a handful or more of possible craters [5], which could result in revised age or resurfacing estimates for the northern cap. This study is a preliminary look at putative craters in both polar caps.

MOLA Measurements and Results: Using MOLA profile and gridded topographic data, we have identified and located on the Viking MDIM and high resolution images approximately 10-20 possible craters for each of the martian polar caps, including those identified in earlier work [4,5]. For a preliminary look at the polar cap craters in both the images and topography, we have made an assessment of the likely modification processes for each crater, compared geometric properties to those of the mid-latitude and polar regions in general [6, 7], and used the total number of craters to reassess the polar cap surface ages.

For a few fresh-looking craters near the cap margins, we found that the general geometric properties were very similar to those recently reported for the polar regions [7], with a large, often asymmetric central peak or deposit, sometimes a visible ejecta blanket with rampart, and distinct rim. For the majority of the craters, which are farther into the cap interior or have a more degraded appearance, trough growth and/or filling ablation cycles have apparently much altered the crater geometry (compared to a fresh, non-cap polar region crater). The apparent depth and degradation often is seems different in the images and topography. The albedo changes in the cap images often seems to be a complex combination of surface brightness and topography, making it difficult to recognize and assess crater states from images alone.

Several interesting circular features stand out in the data. These include a possible crater collapse or debris flow at the northern cap margin; a possible volcanic shield in the Northern Chasma Boreale that was earlier classified as a crater [8]; several craters on both caps which have nearly normal near-polar crater morphologies, and may have "punched through" the cap to excavate the material below; and the lack of bright frost cover in some of the southern craters, despite their geometric similarity to the northern craters [9], and their presence on the topographic southern cap.

Some circular features at the smaller end of the age range are yet difficult to determine definitively as impact craters, this will have to await further MOLA data, and possibly MOC images for further analysis. Additionally, this study has checked only the first dozen or two of the promising circular features for each cap in the MOLA topography against the high resolution images for analysis as possible impact craters. Further work may very well find a much larger number of craters after comparing both MOLA and MOC high resolution databases.

CONCLUSIONS: From the early assessment of MOLA topography and Viking images of possible craters on both martian polar caps, we find at least a dozen and possibly more plausible impact features on each of the caps. Combined high resolution topography and images has yielded more craters than previous studies, but a complete assessment of respective cap ages awaits further data and analysis.

ACKNOWLEDGEMENTS: We are grateful for the support of the MGS project, and for the efforts of Greg Neumann in data file and grid generation.

References: [1] Cutts, J.A., (1973) JGR 78 4211-4221, [2] Cutts, J.A et al., (1976) Science 194 1329-1337 [3] Herkenhoff, K.E., et al., (1997) LPSC XVIII, Abstract #1575. [4] J.J. Plaut, et al., (1988) Icarus 75 357-377. [5] Sakimoto, S.E.H., and J.B. Garvin (1999) LPSC XXX Abstract #1993. [6] Garvin J. and J. Frawley, GRL 25, 4405-4408. 645-646. [7] Garvin J. B. et al. (1999) submitted to Icarus, 57 pp. [8] Benito, G., et al. (1997) Icarus 129 528-538. Garvin et al. (1999) This volume, abstract # 6163.