MARTIAN BURIED BASINS AND IMPLICATIONS FOR CHARACTERISTICS OF THE BURIAL LAYER AND UNDERLYING SURFACE. A. R. Sarid[1,2], H. V. Frey[2], J. H. Roark[2]. [1]*Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721,* [2]*NASA Goddard Space Flight Center, Geodynamics Branch.*

Introduction: Deciphering the cratering record on Mars has been challenging because it may reflect the changes in both the population of impactors and in the resurfacing processes on Mars. However, it is possible to determine the breadth of impactors captured in the cratering record. Extensive areas of resurfacing are of particular interest because they likely contain material from various ages in Martian history. By deducing the impact populations in both surface and underlying layers of terrain, it is possible to determine the age of the layers and constrain theories on the development of the Martian surface. However, to do so requires a method of "seeing" impact features which are no longer visible.

Topographic data of Mars, taken by the Mars Orbiter Laser Altimeter (MOLA), has revealed impact features buried by resurfacing processes. These features are often indistinguishable on Viking images of the Martian surface. In this study, gridded MOLA data was analyzed in order to locate buried impact features, also called buried basins, in Syria, Solis, and Sinai Planum just south of Valles Marineris. The population statistics of buried features can be compared to those of visible features in order to determine the age of the underlying material and characteristics of the surface cover. Specifically, if the buried population in the Hesperian terrain is similar to the population of visible features in the Noachian, it would suggest that the underlying terrain is Noachian in age. The buried craters can then be compared to visible Noachian craters to reveal the amount of deterioration of the buried features. These comparisons allow us to explore the morphology of the terrain in the Hesperian region to determine if topographic variations are due to differences in the thickness of the overlying material or are a characteristic of the underlying terrain.

Procedure: Data collected by MOLA was analyzed using Gridview, a program developed at Goddard specifically for use with topographic data sets. The program enables the user to apply color stretches in order to accentuate subtle differences in topography. It can also convert data from a color image to a profile plot allowing the user to see quantitatively the variations in surface structure. Using such tools, 495 impact features greater than 15 km in diameter, both visible and buried, were found and recorded in nearly 8 million square kilometers of the Martian surface. The features were then marked as either visible or buried based on their visibility in the Viking images. Of the features marked, 132 were not visible on images and were assumed to be buried basins. The features were also divided into groups based on their mapped geologic unit: Noachian or Hesperian. The areas of the Noachian and Hesperian portions were calculated using Gridview so that the populations of features could be displayed as a number density. The results were plotted (Fig. 1) as four separate populations (Noachian buried, Noachian visible, Hesperian buried, Hesperian visible) as well as combined populations for all Noachian features and all Hesperian features. Characteristics of crater densities for periods of Martian history, based on work by Tanaka [1], have been extrapolated to include large diameter craters. These values give ranges of geologic periods that have been added to our population plots for comparison.

Results: The population plots clearly show that the buried population in the Hesperian is distinct from the visible in the Noachian. However, the buried population in the Hesperian terrain does fall within the Noachian age range. This suggests that the underlying material is Noachian, but the cratering record in this area is more complex than originally thought. The results also display some other interesting characteristics: Early Noachian craters are not visible in either buried population; they only reflect middle to late Noachian impactors. The buried populations in both the Noachian and Hesperian aged terrain roll off at small diameters, which can be explained through burial or the fact that the populations are missing the early Noachian craters. However, there is also a roll off in the visible populations in both areas, though it is less pronounced. This suggests that resurfacing processes are even destroying the cratering record of newer terrain, an unexpected result.

We also investigated spatial variations in depth and rim height differences between buried and visible features (Fig 2). Several profiles were taken across buried features in Hesperian plains, and the values for those of similar sizes were averaged. These measurements were compared to those of fresh, visible, Noachian features within the same area and size ranges. In general, features of similar size had similar values for rim height and depth differences regardless of their location even though the terrain in this area slopes downward northwest to southeast. Therefore, we can conclude that the layer of material covering the buried basins in Syria and Solis Planum is relatively constant in thickness. It must be the underlying terrain, in which the buried impact features reside, that slopes downward from northwest to southeast.

Although this study cannot confirm the hypothesis that terrain beneath Hesperian material is, in fact, Noachian cratered terrain, it does provide insight into the development of the Martian surface in this region. The lack of craters from the early Noachian in all populations suggests a more complex resurfacing record than either hypothesis accounts for. The removal of small craters in all populations also suggests an element of the surface history that has not been explained. By researching buried basins, we are, in essence, peeling back layers of surface material to reveal the past and gain a better understanding of the development of Mars.

References:

[1] Tanaka, K. L., Proc. Lunar Planet. Sci. Conf. 17, J. Geophys. Res. Suppl. 91: E139-E158, 1986.

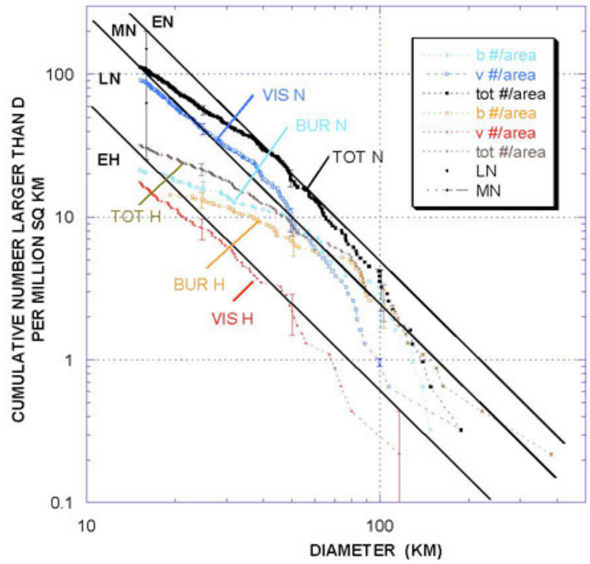

Figure 1: Crater population plots per area versus diameter shown on a log-by-log scale. The six populations shown include Noachian buried, Noachian visible, combined Noachian, Hesperian buried, Hesperian, combined Hesperian. The age ranges for early Hesperian through early Noachian, based on [1], are also shown. Comparison with our populations shows a lack of early Noachian craters. Also, all populations roll off at small diameters. While this is expected for buried populations, it was a surprising result for the visible populations.

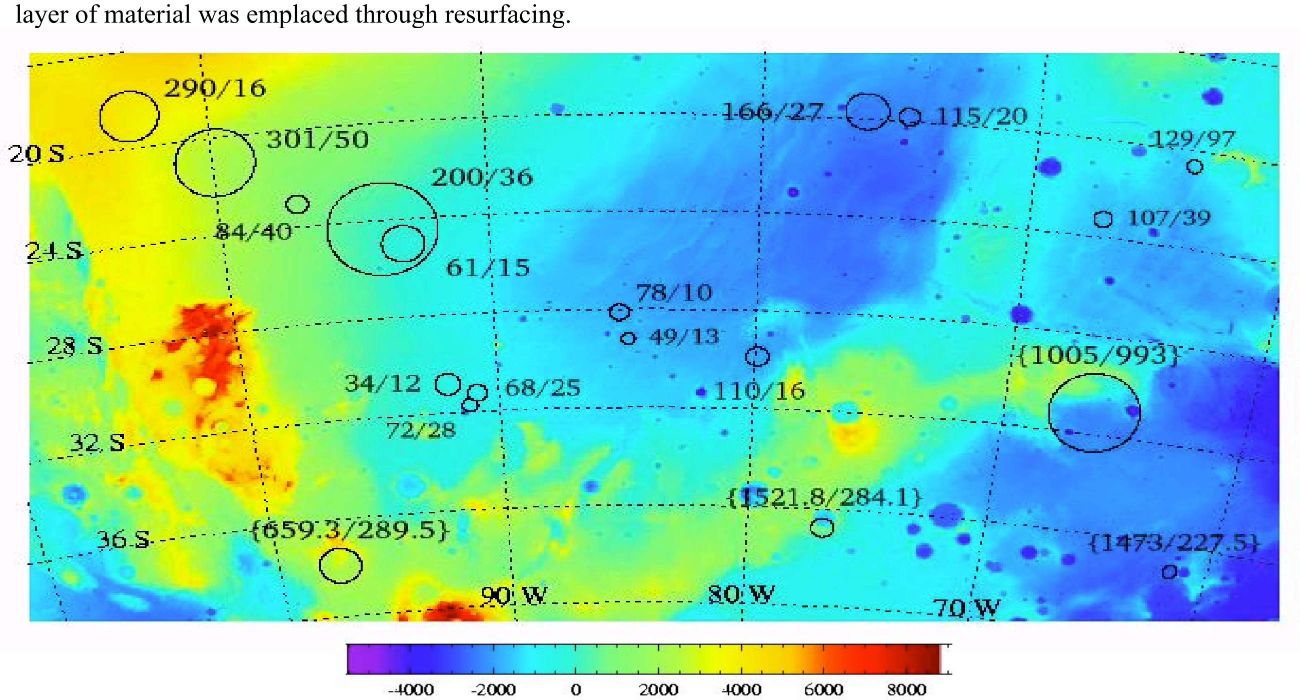

Figure 2: Differences in average depths and rim heights between buried features of varying size ranges and fresh, visible craters at the same sizes (rim height/depth differences) are superimposed on a MOLA image of the area. Bracketed values are averaged rim heights and depths for visible Noachian craters in similar size ranges. Spatial variations suggest that the underlying terrain was sloped before an even layer of material was emplaced through resurfacing.