

AN INVENTORY OF IMPACT CRATERS ON THE MARTIAN SOUTH POLAR LAYERED DEPOSITS.

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Introduction: The polar layered deposits (PLD) of Mars continue to be a focus of study due to the possibility that these finely layered, volatile-rich deposits hold a record of recent eras in Martian climate history. Recently, the visible sensor on 2001 Mars Odyssey's Thermal Emission Imaging System (THEMIS) has acquired 36 meter/pixel contiguous single-band visible image data sets of both the north and the south polar layered deposits, during the local spring and summer seasons. In addition, significant coverage has been obtained at the THEMIS visible sensor's full resolution of 18 meters/pixel. This paper reports on the use of these data sets to further characterize the population of impact craters on the south polar layered deposits (SPLD), and the implications of the observed population for the age and evolution of the SPLD.

Data: Image data of the SPLD acquired during the early spring display nearly uniform albedo at the highest latitudes due to cover by seasonal CO₂ frost. Many of these images are ideal for detecting subtle topographic features such as impact craters. At slightly lower latitudes, springtime images contain highly variable albedo patterns, due to defrosting and other effects related to the seasonal CO₂ [e.g., 1, 2]. For these areas, the summer images are better suited to the search for impacts. Images obtained after Odyssey orbit number 7800 (Ls = 262°) are free from almost all seasonal albedo effects, though occasional local dust storms affect the quality of some images.

Impact Craters: A key objective of the SPLD imaging campaign was to obtain a new inventory of the population of impact craters on the SPLD. Studies using Viking orbiter images [3] and Mars Global Surveyor laser altimeter data [4] determined that the SPLD contained ~10 to 100 impact craters with diameters >800 m. These crater abundances are consistent with a surface age ~10s of My [5]. The THEMIS visible data set at 36 m/pixel allows identification of impact craters as small as about 200 m (~6 pixels). 150 features deemed likely to be of primary impact origin have been found in a search of about 60% of the SPLD (Figure 1). An additional 131 features of possible impact origin are also catalogued and plotted in Figure 1. Standard criteria for determining impact origin were used to place a feature in the "likely" category, including one or more of the following characteristics: circularity, raised rim, or ejecta. The cumulative size frequency distributions of both the likely and combined likely and possible populations show a slope close to -2 down to diameters of about 300 m. This indicates preservation of small craters,

suggesting the possibility that the crater population may be close to a production population, with less size-dependent resurfacing than has been postulated by some [4]. This conclusion remains to be verified, and depends in part on the assumed production slope of martian craters of $D < 1$ km. The absolute abundance of craters in the size range 300 m to 2 km is consistent with that reported in [3], and thus the estimated age of the upper surface should be considered in the 10s of My range [4]. This result implies that the volatile materials of the SPLD (unlike the north polar deposits which appear much younger in crater age) have not participated in recent cycles of orbit-oscillation-driven climate change, which are thought to occur on timescales of 10^4 to 10^6 years.

References: [1] Kieffer, H. et al. (2000) *JGR*, 105, 9653. [2] Titus. et al. (2004) 35th LPSC. [3] Plaut, J. J. et al. (1988) *Icarus* 75, 357-377. [4] Koutnik, M. et al. (2002) *JGR* 107, doi:10.1029/2001JE001805, [5] Herkenhoff and Plaut (2000) *Icarus* 144, 243-253.

(See next page for Figure 1)

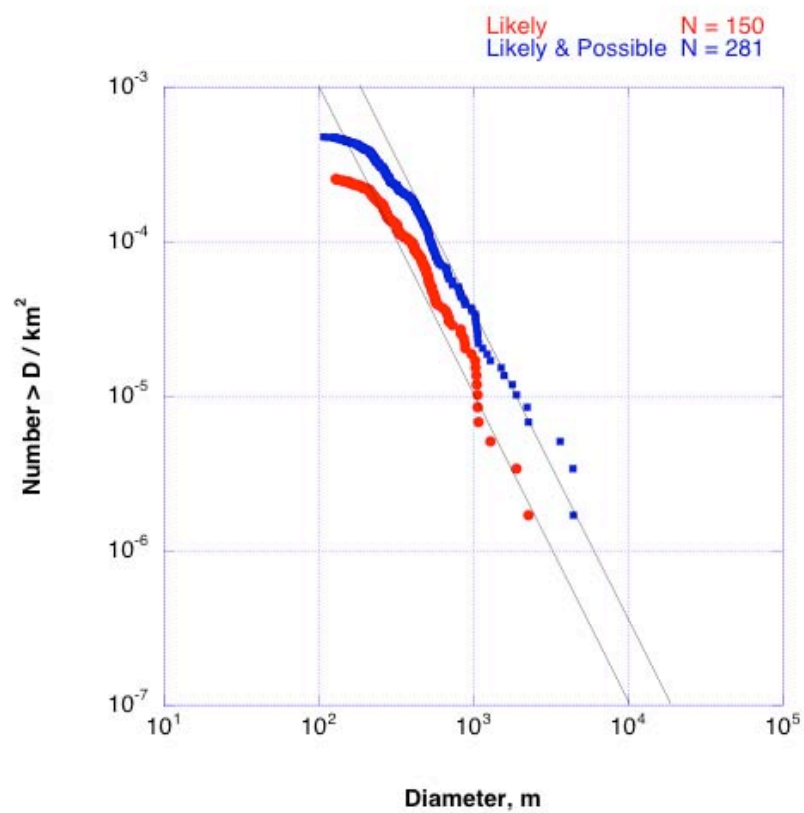


Figure 1. Impact crater size frequency distribution for the martian south polar layered deposits. Craters in the “likely” category display one or more of the following characteristics: circularity, raised rim, ejecta. Count represents 0.6 M km², or about 60% of the SPLD. For reference, line segments with slope of -2 are shown.