STATISTICAL ANALYSIS OF BED THICKNESS DISTRIBUTIONS IN LAYERED DEPOSITS ON MARS.
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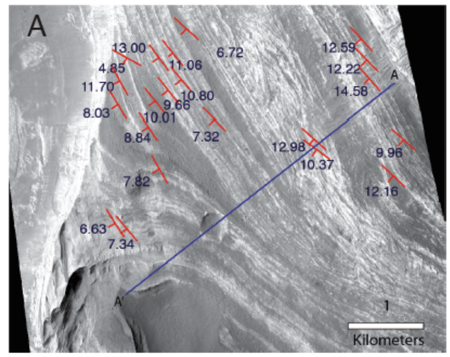
Introduction: This study examines the statistical characterization of bed thicknesses in a diversity of martian layered terrains with the broad goals of 1) providing an objective approach to their description and taxonomy, and 2) eventually helping to inform understanding of the depositional environments of proposed sedimentary rocks on Mars.

Methods: The three-dimensional orientation of bedding within each measured section is calculated from HiRISE Digital Terrain Models (DTMs, 1 m vertical resolution) using least squares regression. Topographic profiles are extracted from the DTMs parallel to dip direction along well-exposed, vertically continuous layered outcrops. Individual beds are identified by visual inspection of HiRISE images. The mean bed thickness and dip are calculated for each section, and we examine changes in bed thickness relative to the mean throughout the section. Deviations of the cumulative distribution of bed thicknesses from a typical power law distribution are compared at each location.

Initial Results- Terby Crater: We examine the layered sequence at the southern end of the western bench in Terby crater (Fig. 1A), located on the northern rim of Hellas basin. We find that beds in this section dip ~10º and have an average thickness of ~40 m, ranging from ~5 to over 150 m. These findings are in agreement with the estimations of Wilson et al. By comparison, layers measured in Holden crater have a mean bed thickness of ~1 m, and a dip of ~2º, yet the layered sequences in both Terby and Holden craters are interpreted as lacustrine in origin [1, 2]. Perhaps Terby crater contains other types of sedimentary deposits that would generate a higher degree of amalgamation, or simply a greater initial bed thickness. It is also possible that bed boundaries reflect diagenetic processes and do not record initial deposits. These effects will be considered during the course of the study. We also note that boundaries between individual beds that are not characterized by clear changes in albedo/tone may not be apparent in the visible images used for this study (HiRISE, CTX, MOC).

The cumulative distribution of bed thicknesses within this section shows significant deviation from a power-law distribution at the thin end of the distribution (Fig. 1B). The bending here is due to the underrepresentation of thin beds, likely because of an inability to resolve thin beds near or below the resolution of HiRISE images. However, it is also possible that the shape of the cumulative distribution is related to processes of erosion, bed amalgamation, and/or diagenesis that may be linked the depositional environment of this sequence. Continuing analysis within Terby crater, and at other layered deposits on Mars that have similar or diverse proposed depositional will provide additional context for these initial results.



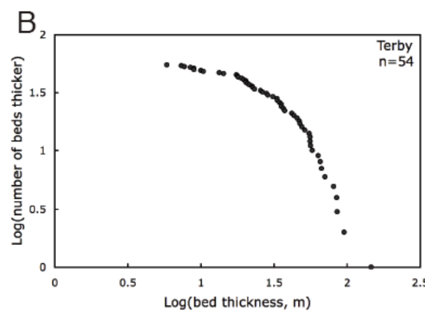


Figure 1. A) HiRISE image PSP_002572_1520. Strike and dip symbols represent the 3-D orientation of the beds. Bed thicknesses were measured along transect A-A'. B) Cumulative distribution of bed thicknesses along transect A-A'.

Implications: This study represents a first attempt at examining the statistics of stratigraphic layering on Mars, with the goal of determining whether these techniques can provide useful, semi-quantitative criteria for distinguishing sedimentary depositional environments on Mars. It complements the approach of Lewis et al., who assume a characteristic period for the strata and then calculate a power spectrum in the search for periodicity [3]. Statistical analysis of bed thickness distributions, coupled with morphologic and mineralogical interpretation has the potential be a powerful tool to characterize sedimentary rocks on Mars.

References: [1] Wilson, S. A. (2007) *JGR*, *112,* E08009-E08009. [2] Grant J. A., and Parker, T. J. (2002) *JGR*, *107*. doi: 10. 1029/2001JE001678. [3] Lewis, K. W. (2008) *Science*, *322*, 1532-1535.