STRATIGRAPHY OF THE NORTH POLAR LAYERED DEPOSITS ON MARS. K. E. Herkenhoff, C. Fortezzo, G. Cushing, R. L. Kirk, L. A. Soderblom, and L. Weller, U. S. Geological Survey Astrogeology Science Center, 2255 N. Gemini Dr., Flagstaff, AZ 86001 (kherkenhoff@usgs.gov).

Introduction: The Martian polar layered deposits (PLD) have long been thought to be the best source of information about the recent climate history of Mars [1-3], but the detailed mechanisms of accumulation are still a mystery [4]. The polar layers are sedimentary deposits composed of water ice and varying amounts of dust or other impurities [5]. Because climate changes are likely recorded as variations in composition or deposition/erosion rates between layers, the detailed stratigraphy of the PLD is of great interest. Layer thicknesses of ~10 to 50 m were observed in Viking Orbiter images of the north PLD [6], and MGS MOC images resolve layers with similar or lesser thicknesses in both polar regions [7]. In order to accurately determine the thickness of layers and interpret PLD stratigraphy and structure, the topography of exposures must be known. Previous studies have modeled brightness variations in the PLD in an attempt to link them to orbital/axial variations [8-10], but lack of detailed topography has hindered stratigraphic interpretations. More recently, MRO HiRISE images have shown that brightness variations between layers can be caused by mantling deposits of frost and other (dusty) material and are therefore probably not related to the internal composition of the layers [11]. Therefore, brightness variations alone cannot be used to infer PLD stratigraphy; high-precision topographic information is needed. Here we describe results of our continuing study to evaluate the topography and stratigraphy of the north PLD using photoclinometry on MOC images taken in the spring, when the surface was covered by seasonal frost and albedo variations are minimized.

Approach: We used a 2-dimensional photoclinometric technique [12] constrained using simultaneously-acquired MOLA data. This technique is well suited to images taken at high latitudes when the surface was covered by seasonal frost and the solar elevation angle was low so that albedo variations and their effects are minimized and topographic modulation is emphasized. The high density of MOLA data in the polar regions allows gridded topographic products to be generated at higher spatial sampling (~115 m/pixel) than is possible at lower latitudes (Fig. 1). The MOLA gridded data are used to initialize the photoclinometric solution and constrain surface and atmospheric scattering parameters. The ability to discern the layers facing the sun in the photoclinometrically-derived digital elevation model (DEM) is at essentially the same spatial resolution as the original image.

Results: Individual layers visible in the MOC images are typically 20-40 m thick, as noted in previous studies and consistent with digital elevation models derived from HiRISE stereo pairs [13]. Many layers are characterized by a raised "rim" or "lip." While it is possible to correlate stratigraphy in the data shown here, correlation is difficult in other areas due to unconformities and other structural complexity. Further analysis of MOC photoclinometric models of PLD exposures will be presented at the conference.

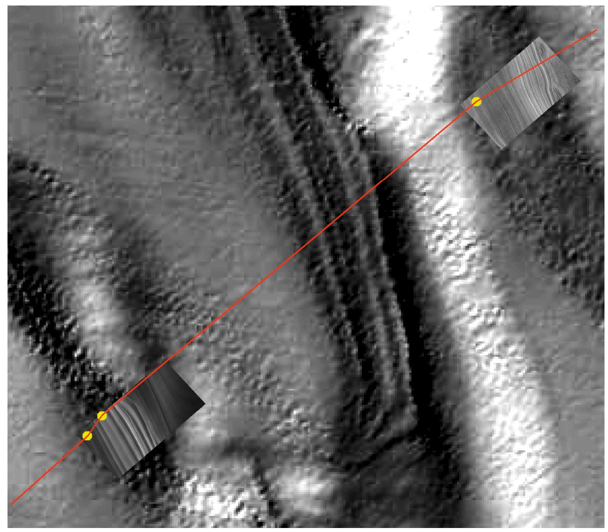

Figure 1. MOC images on MOLA shaded relief, with illumination from left.

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