GEOLOGIC MAP OF THE SOUTH LAYERED DEPOSITS, MARS. J. García-Cajiao[1], S. F.A. Cartwright[2], J.L. Whitten[1], M.E. Landis[2]. [1]Tulane University, New Orleans, LA, jgarcia15@tulane.edu [2]Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder.

Introduction: The south polar layered deposits (SPLD) are comprised of layers of water ice mixed with dust and other sediments [1]. Together, the north and south polar layered deposits contain approximately one million cubic kilometers of layered water ice [2]. These visible layers are likely the result of deposition and orbital obliquity [3] and eccentricity [4] changes, preserving a record of the Martian climate cycle [1], and references therein]. Previous data demonstrate that the bulk density of the SPLD is higher than the NPLD (1200 kg/m^3 versus 1000 kg/m^3, respectively) [5] and has more craters across its surface [6], indicating that it is older than the NPLD and may preserve a longer climate record. Seasonal frost CO_2, in particular, has shaped the surface of the SPLD through the formation and evolution of araneiforms [7] and may contribute to local-scale resurfacing more prominently on the older SPLD surface.

Despite the diversity of landforms and surface morphologies, most published geologic maps of the south polar region of Mars classify the SPLD as a single unit distinct from the south polar residual cap [8-10], regardless of map scale (1:5M to 1:20M). One previous map did break the SPLD into multiple units but is not widely available [11]. Here, we map an initial region of interest (ROI) on the SPLD to identify preliminary geologic units. In addition to these units, we identify surface and structural features, including craters, dunes, ridges, and steep slopes. The final purpose of this research is to complete a USGS Science Investigation Map (SIM) accessible to researchers in the Mars community focused on its polar and climate history.

Methods: We will produce a 1:2M scale geologic map of the south polar region of Mars (70° S to 90° S) [e.g.,12]. However, to complete the geologic map of the SPLD, we first map sub-regions of the SPLD to come to a consensus on geologic units and their definitions. Once the geologic units are defined, another sub-region of the SPLD will be mapped. Lastly, both maps will be integrated into one for a final publication.

In this abstract, we present the results from mapping our first sub-region (Fig. 1). Our mapping process includes two mappers' independent observations of the same area. The independent maps are compared and will be reconciled to produce a single geologic map of the SPLD. The process will be conducted in accordance with the USGS Astrogeology 2022 Mapping Protocol [13].

The primary base map used is the Thermal Emission Imaging System (THEMIS) daytime infrared mosaic (100m/pixel) [14]. Both mappers relied on elevation data from Mars Orbiter Laser Altimeter (MOLA) hillshade map (115m/pixel) [15] as a reference for surface morphology and topography. The mapping was done at a scale of 1:500,000.

One mapping approach employed in this study was to use the gridded MOLA MEGDR, while the second relied more on the THEMIS Daytime mosaic. For the first mapping technique, a MOLA hillshade was also used but with a 3x vertical exaggeration to identify geologic units. Another supplemental basemap used was the CTX-HRSC mosaic [16]. Further discussion of how these basemaps can be used together to interpret SPLD units can be found in [17]

Results: The two mappers produced maps with approximately the same geologic units (Fig. 1). One of the mappers identified five geologic units, and the other one mapped four units.

Map 1 (Fig. 1 top): Geologic units identified by one mapper are labeled as A, B, C, D, and E. Unit A divided into two subunits, based on differences in surface texture: A1 (smoother), and A2 (rougher, with varied topographic ridges and through features. The B unit is an intricately ridged area that possesses a defined overprinting of parallel grooves. This area is widely known as the "wire brush terrain" [18]. The C unit is defined by areas with curvilinear scarps surrounding flat-floored stair-stepped surfaces. Unit D also displays curvilinear scarps that reveal SPLD layering but compared to unit C, the valleys cut deeper and are approximately U-shaped. Lastly, unit E is a flat-lying area with sinuous ridges that are heavily cratered in comparison with the rest of the surface within the ROI.

Map 2 (Fig. 1 bottom): Units B, D, and E are similar subunits identified in both maps, while unit A is subdivided differently on each map. Unit C is not included in Map 2. Map 1 divides unit A into two units while Map 2 subdivides it into three. In Map 2, unit A1 covers a smoother surface, A2 a rough surface, and A3 is rough, similar to unit A1, but it appears darker in THEMIS. In both maps, the surface features identified include craters, troughs, dunes, steep slopes, and ridges.

The mappers identified geologic units in which four generally coincided. In Map 2, unit A2 is identified in only two areas while in Map 1, unit A2 is mapped in three locations. Unit D in Map 1 is located in three different areas, whereas in Map 2 it is only in one.

Preliminary Conclusions. More sub-regions will be observed and mapped in order to identify more geologic units and refine those already defined. These preliminary units suggest that different stratigraphic sections of the SPLD vary in their resistance to erosion. Unit C in Map 1 appears more susceptible to erosion compared to unit D, potentially hinting at changes in the composition/dust fraction of the SPLD with depth. Overall, we find that with the finer map scale, we are able to identify morphologically distinct regions that appear to indicate unique geologic histories in more abundance than previous work, with Unit B as an extreme example of this.

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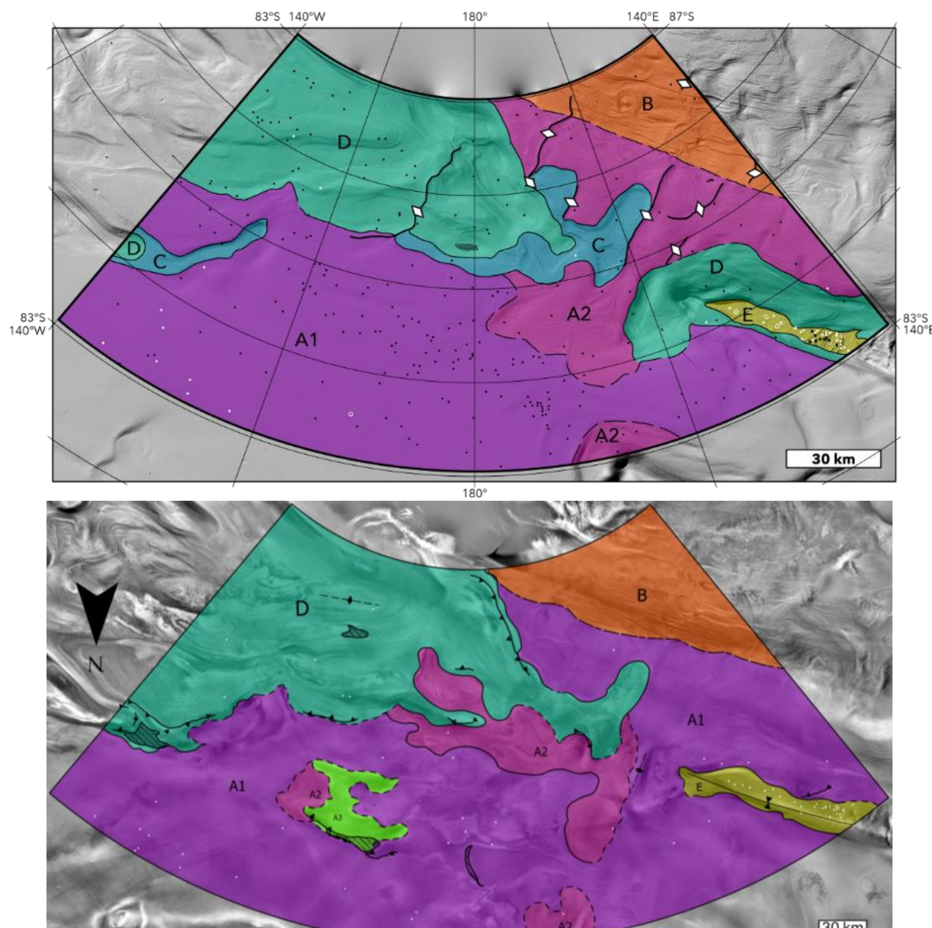

Figure 1: Geologic maps of subregion of the SPLD with our preliminary units identified. Solid lines refers to certain contacts and dashed lines are for approximate contacts. White dots are for impact crates, black dots are for small knobs, and small crater rims are represented as a transparent white line. Hatched area are dune fields. Steep slopes are lined with various triangles pointing to the direction of the slope/low, ridges are identified as a line with a triangle in the middle pointing outwards/opposite direction (triangle colors depend on their type; type 1 is black and type 2 are white). (top) Hillshade of gridded MOLA data as the basemap. Unit A1 is violet, Unit A2 is purple, Unit B is orange, Unit C is blue, Unit D is aqua and Unit E is yellow. Grid lines refers to the ROI map coordinates. (bottom) THEMIS Daytime IR daylight image as basemap. Unit A1 is violet, Unit A2 is purple, Unit A3 is green, Unit B is orange, Unit C is yellow and Unit D is aqua.