GEOLOGIC MAPPING RESULTS OF THE AUSTRALE SCOPULI REGION WITHIN PLANUM AUSTRALE, MARS.

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Introduction: Australe Scopuli forms a broad section of the Martian south polar ice plateau, Planum Australe, within an area southwest of Cavi Angusti. The region consists of deep canyons associated with the curvilinear canyon system that cuts Australe Mensa, the ice cap's dome-shaped plateau centered at 87ºS, 356ºE. The canyons expose the south polar layered deposits (SPLD) that make up Planum Australe.

Our preliminary MGS and ODY-based regional geologic mapping [1] divides the SPLD into the Planum Australe 1 and 2 units. The Planum Australe 1 unit comprises most of the volume of the SPLD and is characterized as evenly bedded sequences of meters-thick layers exposed in canyon walls. The Planum Australe 2 unit is also comprised of multiple layers that are evenly-bedded although the unit's total thickness is <300 m. Individual layers generally appear slightly thicker than their Planum Australe 1 counterpart and often exhibit moderately to heavily pitted and knobby surfaces. The unit unconformably buries the eroded topography of the Planum Australe 1 unit and is largely preserved on polar surfaces other than the canyon scarps. Our mapping of the Promethei and Ultimum Chasmata complex [2] identifies a regional unconformity within the Planum Australe 1 unit allowing further subdivision of the unit into the 1a and 1b members. The orientation and outcrop expression of the unconformity demonstrates that the chasmata formed early in the SPLD accumulation history, likely by aeolian downcutting of surface depressions in the SPLD during erosional episodes. The mapping also demonstrates that the curvilinear canyons are stable features that have not migrated "conveyor-belt-style" along the plateau surface either by glacio-dynamic or ablation-driven processes [see ref. in 2].

Mapping bases used in this study include the MOLA 1/512° (115 m/pixel) topographic grid, southern spring and summer THEMIS visible-image mosaics (72 and 36 m/pixel, respectively; [3]) and southern summer MOC narrow-angle images (2-14 m/pixel; through orbit S04). Also, we generated a southern summer THEMIS VIS mosaic at full resolution (18 m/pixel) of the region using images from orbits 7955 through 9752. These data sets permit us to map, characterize, and evaluate the region's geologic materials, features, mechanisms, and history.

Results and Discussion: The study area (Fig. 1) contains six curvilinear canyons and a high-standing plateau (informally labeled α) of SPLD cut both by several small canyons and elongated semi-closed depressions. The canyons and depressions trend northeast, extending for tens of to >250 km. SPLD that comprise the canyon scarps are well exposed. Within individual canyons, wall slope does not vary greatly over lateral distances, thus the outcrop expression of SPLD sequences remains consistent along an exposure. As a result, individual layers can be traced along the entire outcrop. The SPLD outcrops do not contain marker beds (e.g., exceptionally thick layers, distinct layer weathering patterns, layers with notably darker or brighter albedo) suitable for intra-canyon stratigraphic comparisons, which thus far has precluded inter-canyon correlation of layer stratigraphy. Subdivision of SPLD sequences is based on bedding unconformities and on their bench or terrace outcrop expression, analogous to the approach we used in mapping of SPLD within Australe Sulci [2]. We delineate Planum Australe 1 unit into members a and b (relationship to similar members in [2] is unknown), and also map the bases of sequences (labeled a_1 to a_5) defined by prominent layers within member a. Sequential numbering of the sequences corresponds to the highest elevation each sequence is found at within the map extent, Fig. 2).

The ω canyon cuts to the base of Planum Australe, and its scarps expose laterally continuous SPLD sequences devoid of obvious unconformities. Therefore, we assume that the SPLD exposed in ω canyon is representative of the basal kilometer of SPLD that comprise Planum Australe. At the head of ω canyon, the terrace-forming a_1 and a_5 sequences each crop out at the same elevation on each side of the canyon. Within the northeast extent of the δ canyon, the canyon floor exposes substrate, and the a_2 sequence is at the same elevation as the a_1 sequence within ω (Fig 2). Therefore, we assume that the a_1 and a_2 sequences are equivalent.

Within ω, δ, and β, unconformable bedding structures are not observed within the $a_{1\text{-}3}$ sequence exposures, indicating that deposition was not interrupted by erosion through a_3 sequence emplacement. Local unconformities are observed in the lowest sections of the κ and λ canyons intersecting the apices of substrate prominences. This geometry indicates the unconformities formed by planation of high-standing polar deposits that buried the prominences during apparent short periods of non-deposition.

Within the κ and λ canyons, the a_4 basal contact is unconformable along much of its exposure, cutting across a >200-m-thick stack of underlying SPLD and suggesting at least a comparable amount was removed from this region prior to a_4 emplacement. The spatial extent indicates erosion was not uniform, but preferentially removed SPLD from the eastern parts of Australe Scopuli and also equatorward.

Within ω canyon at the nexus of the λ and α features, deposition of sequence a_4 over an uneven paleosurface resulted in variably dipping beds within the $a_{4\text{-}5}$ sequences. Within the same canyon, member b beds unconformably bury the $a_{4\text{-}5}$ sequences. Similarly, member b unconformably buries sequence a_3 in the β canyon. These relationships indicate that canyon development began prior to member b deposition. At α, the stacked occurrence of unconformities within stratigraphically higher sequences indicates that the canyon has undergone down-cutting during each of at least three depositional hiatuses. This suggests a formational history similar to that of Promethei and Ultimum Chasmata, where substrate-controlled depressions (seedling chasmata) were progressively enlarged by funneling of katabatic winds during SPLD depositional hiatuses [2].

The uneven extent of member b indicates that intense erosion within eastern Australe Scopuli followed member b emplacement, removing most sequences of the Planum Australe 1 unit that are younger than a_4 from areas that comprise the κ and λ canyons and the northeast section of the ω canyon. For each erosional episode, wind action is the likely erosional agent. Finally, the Planum Australe 2 unit was emplaced and then was partly eroded to its current extent.

We identify 28 candidate small impact craters and nine buttes. Their mean diameter is 300 m, and all have diameters

<~1 km. The buttes are morphologically similar to buttes within Promethei Lingula interpreted as degraded, perhaps exhumed, pedestal craters [2]. Their density indicates a relatively long exposure age for the member a and b surfaces.

Summary: The geologic history of the Australe Scopuli region is as follows: (1) continuous deposition of sequences a_1 through a_3, (2) preferential removal of a_{1-3} form eastern Australe Scopuli, (3) emplacement of a_4 for which the eroded paleosurface controls the location of dipping beds and canyons within the α plateau, (4) regional deflation and likely initiation of canyons, (5) deposition of member b followed by regional deflation that was most intense within eastern Australe Scopuli, (6) long hiatus between deflation and Planum Australe unit 2 emplacement, and (7) subsequent erosion of all SPLD material until now.

Future work: We are extending this mapping west into canyon systems that connect with the Promethei and Ultimum Chasmata. When completed, we will determine the stratigraphic relationships and placement of SPLD units, members, and sequences within the chasmata.

References: [1] Tanaka, K. L. and E. J. Kolb (2005) In U.S. Geological Survey Open-file Report 2005-1271, 47-48. [2] Kolb, E.J. and Tanaka, K.L. (2006) *Mars* 2, 1-9. [3] Christensen P.R. et al. (2005) personal commun.

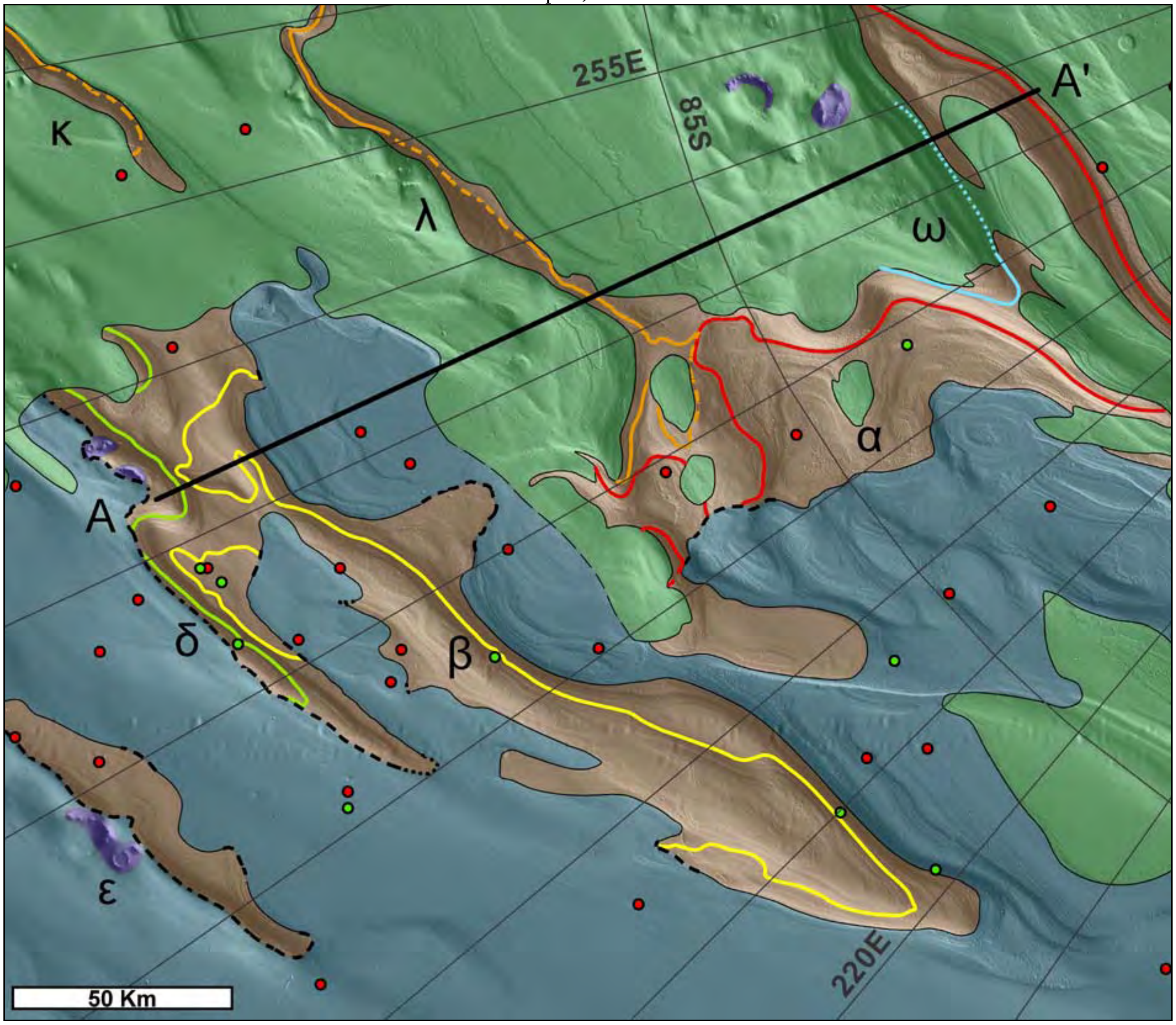

Fig. 1. Geologic map of Australe Scopuli region of Planum Australe, Mars. Units include: Salmon and blue areas = members a and b, respectively, of the Planum Australe 1 unit; green = Planum Australe 2 unit; purple = substrate. Colored lines are traces of member a sequences discussed in text; blue = a_1 (dotted where buried), green = a_2, yellow = a_3, orange = a_4, red = a_5; heavy dashed lines mark unconformable bedding structures as seen in THEMIS visible images. Red dots mark impact craters; green dots mark circular buttes that may be degraded pedestal craters. MOLA shaded relief base (115 m/pixel); 5º lat/long grid, south pole at upper right.

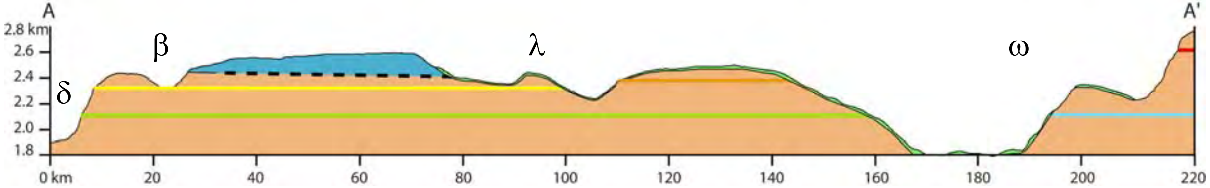

Fig. 2. Cross-section A-A'. 25X vertical exaggeration. See Fig. 1 for explanation of unit and line colors.