GEOLOGIC MAPPING AND STUDIES OF DIVERSE DEPOSITS AT NOCTIS LABYRINTHUS, MARS.

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Introduction: Noctis Labyrinthus consists of a network of intersecting linear troughs and pits along the eastern Tharsis rise that connect eastward to the continuous chasmata of Valles Marineris. The pits and troughs may have formed due to withdrawal of magmatic reservoirs at depth [1], or by collapse over conduits developed as a consequence of groundwater flow along pre-existing fault systems [2]. The age of the Noctis Labyrinthus depressions is thought to be Late Hesperian to Early Amazonian based upon disruption of the lava plains along the plateaus [3-5]. Consequently, sediments deposited within the depressions represent this age or younger materials.

Mapping Investigation: For this study, we are mapping the western portion of Noctis Labyrinthus (-6 to -14°N, -99.5 to -95.0°W; Fig. 1), which includes some of the most diverse mineralogies identified on Mars using CRISM data [6-9]. We are using THEMIS daytime IR as a basemap, with a 1:500,000 publication scale. Thus far across the Noctis Labyrinthus region, the following minerals have been identified in association with light-toned deposits (LTDs): several kinds of sulfates (monohydrated {kieserite, szomolnokite} and polyhydrated sulfates, jarosite, and Ca-sulfates {gypsum, basanite}, clays {Fe/Mg-phyllosilicates and Al-phyllosilicates}, a doublet absorption between 2.2-2.3 µm, and hydrated silica/opal. The role of water, both in the formation of the Noctis depressions and the hydrated deposits found within them, is a focus of this investigation. The diverse range of sulfates and phyllosilicates identified within the depressions of Noctis Labyrinthus either resulted from localized aqueous activity [8,9] and/or may have been part of a broader synoptically driven period of late activity during the Late Hesperian to Amazonian [e.g., 10-12].

Constraints from geologic mapping and morphologic and stratigraphic analyses will be key contributions toward deciphering the geologic diversity and history of this portion of Noctis Labyrinthus, with specific implications regarding the role and history of water. In particular, the timing, duration, nature, and spatial extent of the influence of water-related processes in the region is a focus on this study. An understanding of the history of deformation and collapse within this region will also be key to deciphering the timing of sedimentary deposition and aqueous alteration.

Mapping Progress: We have been working in the second year of our grant on mapping geologic units and linear features (Fig. 1). Numerous structural features, including grabens and scarps, are found throughout the mapping region. Mapping of normal faults and grabens indicate multiple episodes of collapse. Several volcanic shields have been identified along the plateau.

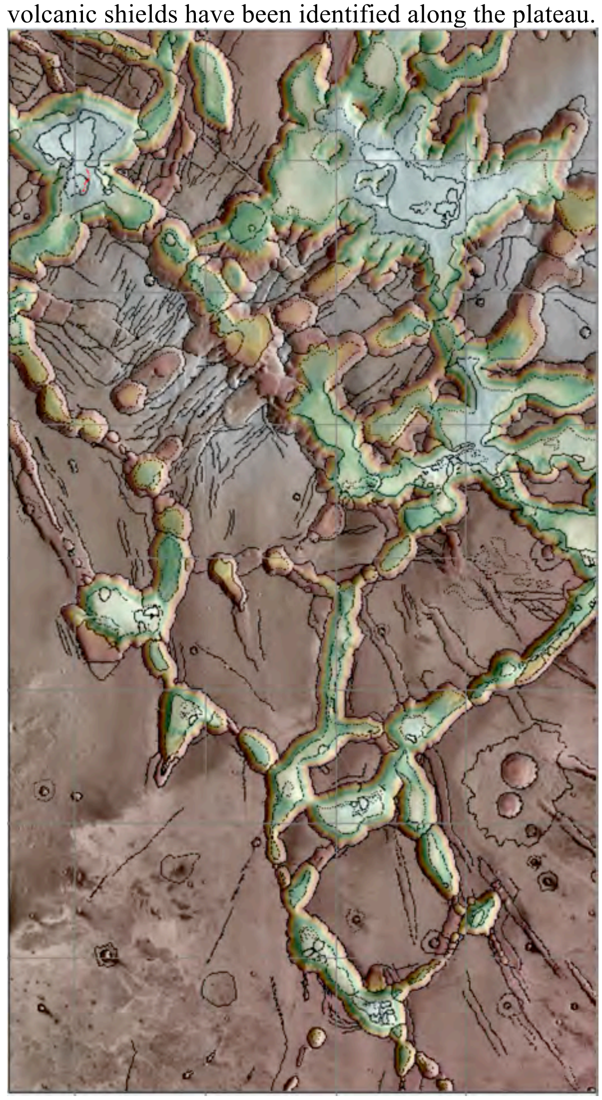

Figure 1. THEMIS daytime IR basemap with MOLA topography overlain in color for our geologic mapping region in Noctis Labyrinthus. Linework shows structural features across the mapping region and geologic units within the trough and pit depressions.

Detailed examination and mapping of the LTDs are providing key stratigraphic relationships (Fig. 2) that may allow us to decipher the origin of these deposits. In addition to the LTDs, other floor deposits include mass wasting and landslide materials, which have been identified in several of the Noctis depressions. Lava flows have also been identified and mapped on several trough floors. An example of platy-ridged flows with a pyroxene composition and a Late Amazonian age [13] are shown in Figure 3.

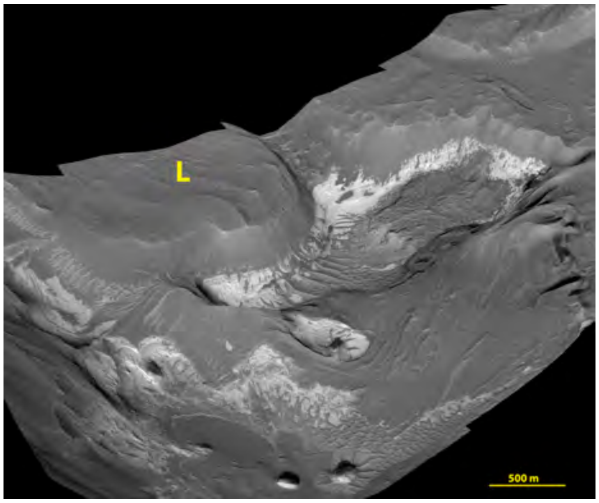

Figure 2. Digital Terrain Model perspective view (5X VE) of a depression in Noctis that contains LTDs. A younger landslide (L) buried a portion of the LTD.

Figure 3. Late Amazonian-aged platy-ridged lava flows [13] on a trough floor.

Loose eolian debris covers much of the plateau, trough floors, and wallrock, obscuring geologic contacts between different units at these locations. No fluvial channels have yet been identified, but a possible volcanic channel sourced by a collapsed rounded depression within one of the troughs (Fig. 4) indicates younger volcanism occurring after formation of the trough. Once all geologic units have been identified and mapped, crater size-frequency distributions combined with cross-cutting and stratigraphic relationships will be used to establish ages of each geologic unit.

Figure 4. Example of a possible lava pit and lava channel within a trough.

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