**Thermal Infrared Spectral Characterization of the Gorgonum-Atlantis Subregion of Mars' Eridania Basin.**

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**Introduction:** Previous geomorphic studies on the Eridania Basin [1 , 2] have shed insight into the possible mechanisms which created and modified units in the region. These geomorphic characterizations and previous global mapping [3] show that this region hosts some of the most diverse suites of Martian southern highlands geologic units. The early history (up to the late Noachian) of the region was likely dominated by drainage basin development. By the late Noachian, a continuous topographic low formed, which allowed for the collection of either surface waters or upwelling groundwater into this basin. During the Late Noachian water had collected to a level (~1150 m) that breached the containing crater walls and formed Ma'adim Vallis, a large outflow channel [2].

A previous spectral study (both visible-near infrared and thermal infrared) of Columbus crater, which lies directly northeast of our study region, found evidence for a complex history of aqueous alteration [4]. We studied a portion (175-195° E, 30-40° S) of the Eridania Basin using data from the Mars Odyssey Thermal Emission Imaging System (THEMIS) to preliminarily classify the spectral character and mineralogy of the region (Figure 3). Corresponding Thermal Emission Spectrometer (TES) and near-infrared analyses will be incorporated in the future.

**Approach:**

*Unit Identification* Using THEMIS decorrelation stretched (DCS) [5] images we first identified spectrally distinct areas in the study region. Three combinations of bands were used to map the spatial extents of different spectral units (8-7-5, 9-6-4, and 6-4-2 in the RGB channels respectively) (Figure 2). These spectral combinations provide a broad spectral sampling which has previously been shown to correspond to mineralogical differences in surficial materials [6]. After preliminary DCS classification, we examined the morphology of spectrally similar units using THEMIS VIS and Mars Reconnaissance Orbiter Context Camera (CTX) images. These datasets provide high resolution, continuous coverage over the entirety of the study area and prove useful in identifying geomorphic diversity among spectrally similar units. In addition to geomorphic observations, we collected thermal inertia values for units in the region using THEMIS nighttime infrared (IR) data [7]. Thermal inertia measurements allow us to constrain the level of consolidation of surface materials [7]. Areas with unique DCS signatures in multiple images, continuous morphologies and the highest thermal inertia values were used to define 'Type Areas' which best represent the characteristics of a unit.

*THEMIS Emissivity* We examined the highest quality daytime THEMIS IR images covering these previously defined 'Type Areas'. These images were atmospherically corrected and converted from radiance to emissivity. 'Type Spectra' were collected over these 'Type Areas' for comparison between and among images across the study region.

**Results:** Unit identification using THEMIS DCS images identified four broad spectrally distinct unit classes.

*1. Intercrater Highlands Units.* The intercrater regions of study area are dominated by a suite of Noachian highlands materials. Spectrally, these units closely resemble the globally extensive TES Surface Type 2 (Figure 1) [8]. These highlands units are further divided into three sub-units based on morphology and thermophysical properties:

A. "Undifferentiated highlands plains" units are the most areally extensive in the study region. Morphologically this unit appears smooth at THEMIS resolution with little pronounced topography. Thermal inertia values for this unit are the lowest in the region, rarely exceeding 250 $Jm^{-2}K^{-1}s^{-0.5}$. B. "Layered highlands" units show layering in THEMIS VIS and CTX images that is continuous for up to ~100 km. These units crop out mostly along the edges of the basin and have near constant elevation. Thermal inertia values of this unit fall within the same range as the undifferentiated highlands. C. "Electris Deposits" are spectrally indistinguishable from undifferentiated highlands plains within the THEMIS spectral range. They have previously been distinguished primarily based on morphology [9]. "Electris Deposits" have steep margins and overlie the layered highlands unit (Figure 2). Their thermal inertia values are also relatively low but consistently range slightly higher than other highlands material in the 250-300 $Jm^{-2}K^{-1}s^{-0.5}$ range.

*Intercrater Ridged Plains Units.* The highlands units in the southwestern region of the study area are embayed by Hesperian Ridged Plains (HRP) [3]. Spectrally, these units resemble TES Surface Type 1 (Figure 1) [8]. Morphologically the areas appear smoother with the exception of the characteristic ridges that are associated with HRPs. Areas covered by HRPs have elevated TI values ranging from 250-450 $Jm^{-2}K^{-1}s^{-0.5}$.

*Putative Chlorides and associated 'scalloped terrain'.* Putative chloride units [10] appear scattered throughout the study area. Their spectral character is dominated by a downward slope with increasing wavelength that is unique to these units (Figure 1). Chlorides units appear in two forms: discontinuous linear topographic highs and larger more continuous beds. Associated with chloride materials are 'scalloped terrains' which appear in conjunction with chloride units. Similar scalloped terrains also appear outside of the presence of chloride (Figure 2). These units have elevated TI values in the 240-444 $Jm^{-2}K^{-1}s^{-0.5}$ range.

**References:**

[1] Irwin R. P. et al. (2002) *Science*, *296*, 2209-2212. [2] Irwin R. P. et al. (2004) *JGR*, *109 (E12)*, E12009. [3] Scott D.H. and Tanaka K.L. (1986) USGS *Map I-1802-A*. [4] Wray J.J. et al. (2011) *JGR*, *116(E1)*, E01001. [5] Gillespie A.R. (1992) *Remote Sensing of Environment*, *42(2)*, 147-155. [6] Rogers A. D. and Fergason R. L. (2010) *JGR*, *116(E9)*, E08005. E09. [7] Fergason R. L. et al. (2006), *JGR*, *111 (E12)*, E12004. [8] Bandfield, J. L. et al. (2000) *Science*, *287*, 1626-1630. [9] Grant J. A. et al. (2010) *Icarus*, *205*, *I1*, 53-64. [10] Osterloo. M. M. et al. (2010) JGR, 115, E10012.

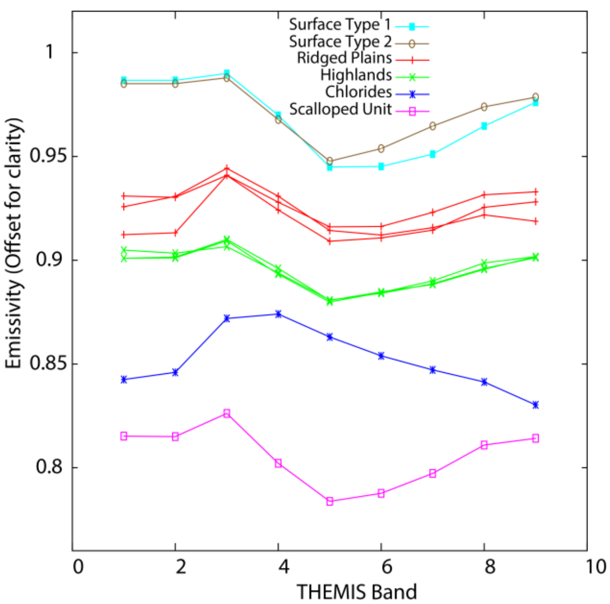


**Figure 1.** THEMIS surface emissivity spectra taken over representative surface units.

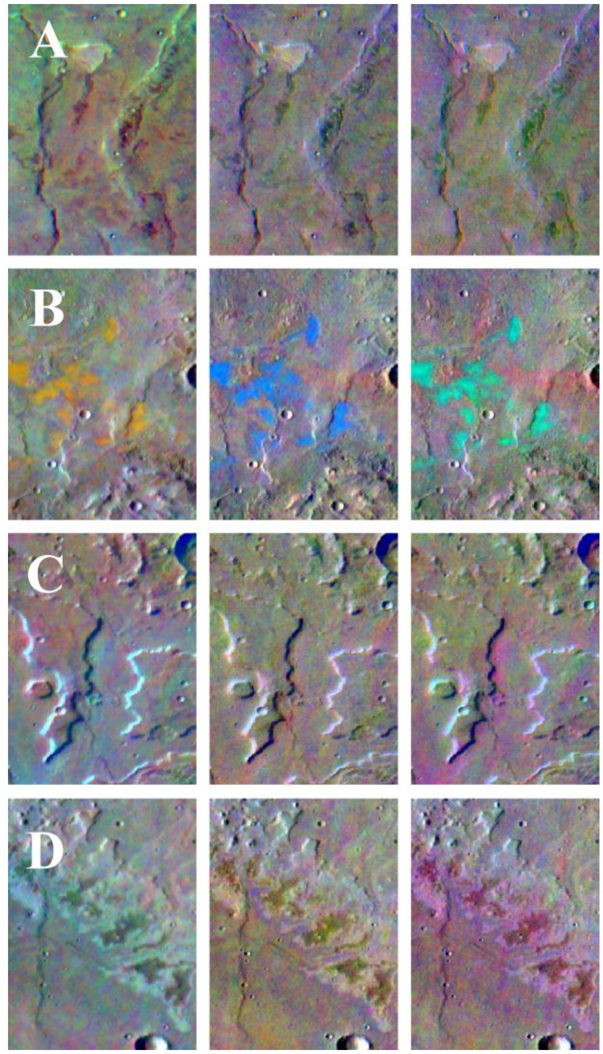


**Figure 2.** Spectral diversity in the Atlantis-Gorgonum Chaos region. All figures shown have band combinations 6-4-2 (left), 8-7-5 (middle), and 9-6-4 (right). A) *Intercrater Ridged Plains* B) *Putative Chlorides* C) *Electris Deposits* overlying *Undifferentiated Highlands Plains* D) Isolated *Scalloped terrain*

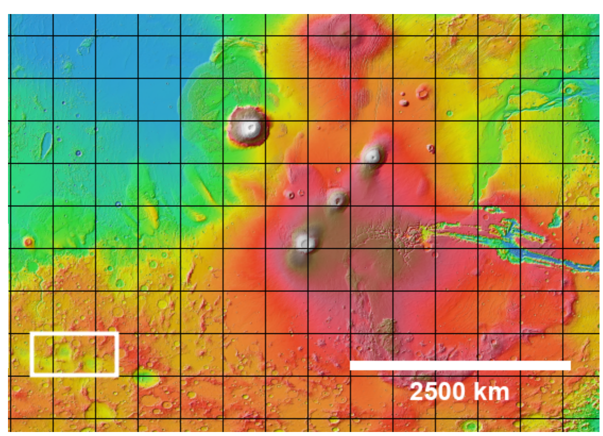


**Figure 3.** Regional context of the study area (white box) within context of other notable topographic features within the region (Tharsis Volcanic complex, Valles Marineris, Global topographic dichotomy).