

**THE THERMOPHYSICAL PROPERTIES OF ARES VALLIS FROM THERMAL EMISSION SPECTROMETER DATA.** S. A. Nowicki and P. R. Christensen, Arizona State University, Department of Geological Sciences, Box 1404, Tempe, AZ, 85287. (snowicki@asu.edu)

**Introduction:** This investigation of the Area Vallis region of Mars is a detailed analysis of TES data to constrain the thermophysical properties of the material exposed in the region, and interpret those as geologic surfaces. This focus on the thermophysical properties is similar to interpreting the surface as it would look in lander observations. To future lander imagers and spectrometers, the underlying geology and topography are not as important as what materials are exposed at the surface in a relatively small area.

The region described here covers from 8 S to 30 N latitude, and 12 to 40 longitude, including the entire channel of Ares Vallis, Tiu Vallis, and part of Simud, as well as a portion of Chryse Planitia. This area was selected for investigation due to a large high thermal inertia region at the mouth of the channel that stands out in the global inertia map, and the region displays a wide range in elevation, albedo, thermal inertia, and rock abundance. It has been extensively described and mapped using Viking imagery, and contains the Pathfinder landing site.

**Observations:** The TES data used here include: thermal inertia, a modeled property derived from the observed surface temperature [1,2]; albedo, from daytime visible bolometer observations; rock abundance, a modeled surface property derived from nighttime spectral radiance observations[3]; and surface composition, derived from the analysis of daytime spectral observations[4]. The thermal inertia values and rock abundance used here are nighttime data from Ls 100 to 205, the albedo was taken from all daytime observations made from Ls 100 to 360 with a total dust opacity of  $< .2$ .

These data are observations of the material exposed at the surface, and the depth of penetration for these observations ranges from microns to only a few centimeters, thus only the upper surface is observed. Other data useful for relating the thermophysical properties to formational processes include Mars Orbiter Camera (MOC) images, which provides a link between surface properties to small-scale landforms, and Mars Orbiter Laser Altimeter (MOLA) data, which were used to constrain elevations and slopes.

**Results:** In the Ares Vallis region, as is the case on most of Mars, there are two prominent surfaces which can easily be identified and interpreted: crater dunes (low albedo and a high inertia); and dust-mantled surfaces (high albedo, low thermal inertia). Both of these surfaces are relatively homogeneous over a distinguish-

able area, and each represents an endmember in terms of albedo and thermal inertia. Each of the other surfaces observed in the region fits somewhere between those two. Assuming that the only materials at work on the surface of Mars are dark sand and bright dust, every other surface should follow a simple trend between the sand and dust. The plot of thermal inertia vs. albedo shows that this is not the case (Figure 1).

A few anomalous regions with high thermal inertia were identified, the most prominent being the fan-shaped region in Chryse Planitia, near the mouth of Ares Vallis, which includes the Pathfinder landing site. This unit can be broken into three distinct regions both spatially and characteristically. Two other anomalously high thermal inertia regions were noted: along the upper channel of Ares Vallis in Arabia Terra, and in Tiu Vallis near Hydraspis Chaos.

Figure 1 shows that three of the anomalous regions cluster with an albedo between .13 and .16, and an inertia of 480 to 680. Though these surfaces have characteristics that fit within the range of other identifiable surface, they are some of the rockiest places in the Ares Vallis region. The Tiu Vallis unit has a low rock abundance, despite its high inertia and high albedo with respect to the crater dunes.

The channels of Ares Vallis and Tiu Vallis show very different characteristics, as Ares has a relatively high thermal inertia surface along its entire course, while Tiu (and Simud) do not exhibit a continuous channel distinguishable in the thermal inertia data. Though these two features show different morphologies, the most likely explanation for their surface differences is topography. Ares Vallis has a deep channel that could serve as a barrier for surface processes, while Tiu has a wide channel with a less continuous topographic boundary.

**Conclusions:** Many of the surfaces identified from the TES data do not correlate with much of the geologic mapping made using Viking images. The thermophysical properties derived with TES data are measurements of only the surface materials on Mars, while much of the previous mapping was made from observations dominated by mantled landforms. The surfaces investigated here have most likely been formed from recent surface processes. The most likely processes to be controlling the surface properties are the removal/deposition of dust, and the eolian activity of sand. Anomalous regions were observed that have properties that can not be explained by the interactions

of sand and dust alone, but it is likely that those regions formed due to eolian surface processes (eg erosion or exposure) of a preexisting material or another recent or active surface process. It is unlikely in the Ares Vallis region that any of the observable surfaces are the primary result of an ancient fluvial or glacial processes. The analysis and selection of future landing sites may benefit from being made on the basis of what material the lander is going to observe, rather than the large-scale features or underlying geology, which in the Ares Vallis region is obscured by the effects of recent surface processes.

**References:** [1] Jakosky B. M., et al. (2000) JGR 105, E4, 9643-9652. [2] Mellon M. T., et al. (2000) *Icarus*. [3] Nowicki S. A. and P.R. Christensen, (2000) AGU Abstract. [4] Christensen, P.R., et al. (2000) JGR 105, E4, 9609-9621

three values with low inertia and an albedo of  $\sim 0.15$  were taken from low inertia surfaces adjacent to the Wahoo, Acidalia, and Arabia high inertia units.

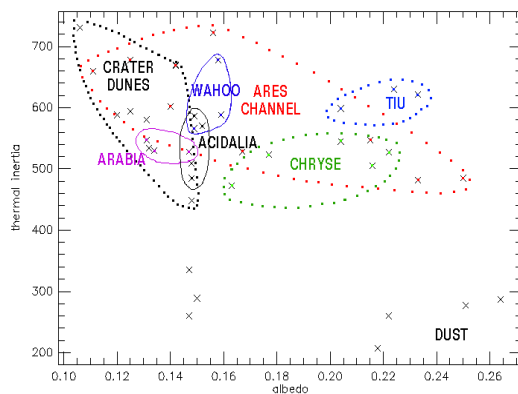


Figure 1. Plot of thermal inertia and albedo of selected surfaces in the Ares Vallis region of Mars. Thermal inertia is in units of  $J/m^2Ks^{1/2}$ , derived from TES nighttime data. Most of the values were taken from some of the highest thermal inertia locations within each selected unit. Only in the crater dunes units were less than the highest values selected, to show the range of values for known dune surfaces. "Crater Dunes" values were selected from craters across the entire observed region. "Ares Channel" values were selected from the linear high inertia channel from Iani Chaos to just above the mouth. "Arabia" values are from  $\sim 6N, 7W$ . "Acidalia" is the northernmost high inertia unit near  $26N, 27W$ . "Wahoo" is a circumcrater deposit around Wahoo crater. "Chryse" includes the Pathfinder landing site, at the mouth of Ares Vallis. "Tiu" values were taken from the channel at  $\sim 5N, 30W$ . "Dust" values were gathered from locations across the region that showed the highest albedo. The