**DETAILED MINERALOGICAL ANALYSES OF MARTIAN METEORITE-LIKE TERRAINS USING MGS TES AND ODYSSEY THEMIS DATA.** Victoria E. Hamilton[1] and Philip R. Christensen[2], [1]Hawai'i Institute of Geophysics and Planetology, University of Hawai'i, 2525 Correa Road, Honolulu, HI 96822 (hamilton@higp.hawaii.edu), [2]Department of Geological Sciences, Arizona State University, Box 876305, Tempe, AZ 85287-6305 (phil.christensen@asu.edu).

**Overview:** Global deconvolutions of MGS TES spectra using martian meteorite spectra as end members show that in several small regions, martian meteorite-like mineralogies are identified, including Chassigny, ALH A77005, and ALH 84001 [1, 2]. Orbital multispectral thermal infrared and visible wavelength imaging data from Odyssey THEMIS provide us the opportunity to map the distribution and geologic environment of these materials at unprecedented (100-m and 20-m) spatial scales and assess their viability as potential source regions for some martian meteorites. We present new analyses of the distributions of these intriguing materials by integrating MGS TES and Odyssey THEMIS imaging and spectral data.

**Data and Methods:** The Mars Global Surveyor Thermal Emission Spectrometer (TES) and the Mars Odyssey Thermal Emission Imaging System (THEMIS) provide complementary thermal infrared spectral measurements of Mars. The TES provides high spectral resolution data (10 or 5 $cm^{-1}$ sampling over ~1600 to 200 $cm^{-1}$) at spatial scales of ~3 x 6 km, the THEMIS infrared (IR) subsystem provides 100-m spatial resolution across multispectral (9 bands for mineralogy ~1 µm wide over ~1500 – 750 $cm^{-1}$) images ~32 km wide. The THEMIS visible imaging subsystem provides ~20-m resolution across images ~11 km wide in up to five bands from 0.425 to 0.86 µm. Because of the complementary nature of the TES and THEMIS instruments, the two data sets are even more powerful together than either one used alone. This strength is particularly useful for the investigation of surface mineralogical differences at scales of hundreds of meters to tens of kilometers.

In this study, selection of sites of mineralogical interest in THEMIS data were guided by prior results from TES spectral deconvolutions [1, 2]. Three-band infrared color images from THEMIS were created using decorrelation stretches of the calibrated radiance data and provide detail regarding the spatial distribution of lithologies of interest. Using these THEMIS images, emission spectra were extracted from the THEMIS data set and are used to examine the mineralogies of the sites. The THEMIS images are also used to more precisely identify locations where individual (or a few) TES pixels should be selected for detailed compositional analysis. Techniques and algorithms for removal of spectral features due to atmospheric components in TES data are well established [3, 4, 5] but do not yet exist for THEMIS data. However, mineralogical information can be extracted from THEMIS spectral data by differencing/ratio techniques, if applied carefully under the appropriate conditions [6]. Mineralogical variations observed in this manner may be further studied in one or more TES pixels.

**Results:** We produced decorrelation stretch images of several geographic regions that are identified as having martian meteorite-like mineralogies as components of the surface materials. These images show new details of the spatial distributions of the meteorite-like materials as well as the relationship of composition to geomorphology.

*Aurorae Planum.* Infrared spectra acquired by TES within two unnamed craters (10°S, 306°E and 9.5°S, 308°E), were identified by [1, 2] as having mineral components consistent with those of ALH A77005 and Chassigny. Chassigny is dominated by olivine (~94 vol.%), with minor plagioclase/maskelynite (~4 vol.%). ALH A77005 is also dominated by olivine (52 vol.%), but includes substantial amounts of pyroxene (~37 vol.%), and minor plagioclase (10 vol%). Relatively high olivine abundance is presumed to be the driving factor in the modeling of these craters' interior deposit compositions with these meteorites. TES coverage of these two craters is incomplete due to the nature of the MGS spacecraft "walk". New THEMIS IR data greatly enhance the coverage and resolution of these high olivine content deposits (Figure 1). Small impact craters ~100 – 200 m in diameter are visible within the olivine-bearing material in RGB images of the western crater and appear to excavate down to a layer with relatively low olivine abundance. Assuming a depth to diameter ratio of ~1:5, we can infer that the olivine-rich layer is on the order of 20 – 40 m in thickness. Nighttime temperatures on this unit are quite high, in excess of 205 K, and thermal models for the appropriate season, albedo, dust opacity, elevation, and local time predict thermal inertia ~850 J $m^{-2}$ $s^{-1/2}$ $K^{-1}$ for materials at these temperatures. This high thermal inertia is consistent with bedrock materials.

*Eos Chasma.* A small (~900 $km^2$) deposit of material containing significant abundances of orthopyroxene was identified by [1, 2]. These materials were recognized (i.e., modeled) because of their spectral similarity to the IR signature of the ALH 84001 meteorite, which is ~97 vol.% orthopyroxene. THEMIS IR and visible images reveal that this material is associated with an apparent landslide/debris flow deposit emanating from the wall of Eos Chasma. THEMIS nighttime temperatures on the deposit are ~190 K, corresponding to an approximate thermal inertia of 700 J $m^{-2}$ $s^{-1/2}$ $K^{-1}$, compatible with extremely rocky materials. TES-derived thermal inertias are comparable.

Olivine-bearing materials resembling Chassigny and ALH A77005 have also been identified in Eos Chasma [1, 2]. These localities were not considered in detail by [1, 2] because of the small number of pixels in which they were identified. THEMIS permits an improved view of these sites (Figure 2) and provides an additional level of confidence that the TES detections are accurate and merit detailed investigation.

*Nili Fossae.* This region was first identified as olivine-bearing by [7]. This is by far the largest spatially coherent detection of martian meteorite-like material [1, 2]. Figure 3 shows an example THEMIS IR image of the region and Figure 4 shows average (121 pixels) THEMIS IR apparent emissivity spectra from the outlined areas (not atmospherically corrected). The difference spectrum shows a signature clearly dominated by olivine, similar to that of ALH A77005.

**References:** [1] Hamilton, V. E. et al. (2002) *LPS XXXIII*, Abs. #1937. [2] Hamilton, V. E. et al. (submitted) *Meteoritics & Planet. Sci.* [3] Smith, M. D. et al. (2000) *JGR*, *105*, 9589-9607. [4] Bandfield, J. L. et al. (2000) *JGR*, *105*, 9573-9587. [5] Bandfield, J. L. and Smith, M. D. (in press) *Icarus*. [6] Ruff, S. W. and Christensen, P. R. (2002), JGR, *107*, doi:10.1029/2001JE001580. [7] Clark, R. N. et al. (2000) *DPS, 32*, 1118.

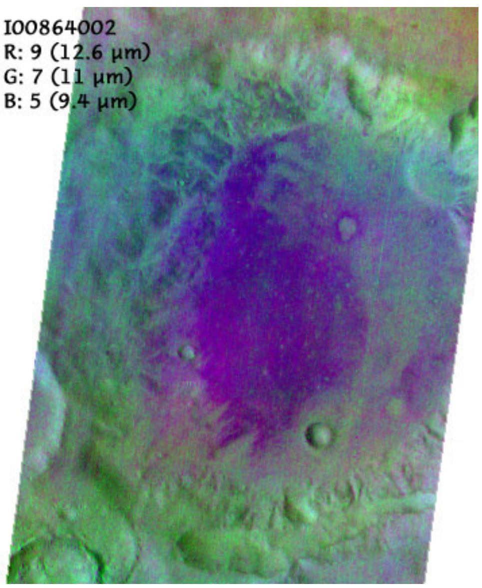


**Figure 1.** THEMIS decorrelation stretch showing terrain with martian-meteorite-like composition (in purple/magenta) in Aurorae Planum (10°S, 306°E). All image widths = 32 km.

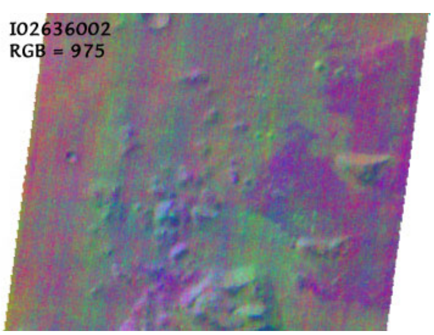


**Figure 2.** Olivine-bearing materials in Eos Chasma (magenta, at right). Image center ~11°S, 320.5°E.

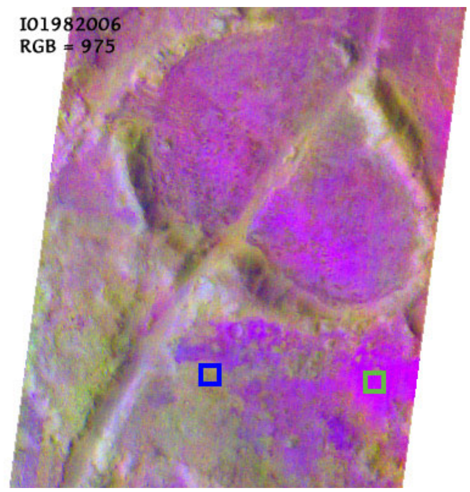


**Figure 3.** Region of highest meteorite-like (olivine) abundance (magenta) in Nili Fossae. 21.7°N, 78.2°E.

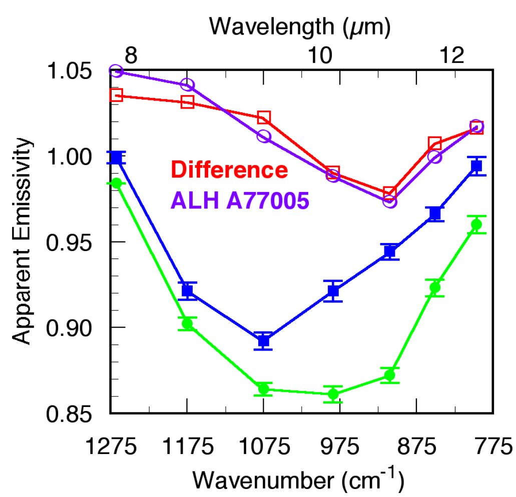


**Figure 4.** THEMIS apparent emissivity spectra of Nili Fossae. Blue and green spectra color-coded to Fig. 3. Difference and ALH A77005 offset 0.05 for clarity. Error bars represent standard deviation of the average.