GREEN MARS: GEOLOGIC CHARACTERISTICS OF OLIVINE-BEARING TERRAINS AS OBSERVED BY THEMIS, MOC, AND MOLA. V. E. Hamilton[1] and P. R. Christensen[2], [1]Hawai'i Institute of Geophysics and Planetology, University of Hawai'i, 2525 Correa Rd., Honolulu, HI 96822 (hamilton@higp.hawaii.edu) [2]Department of Geological Sciences, Arizona State University, Box 876305, Tempe, AZ 85287-6305.

Introduction: The presence of localized concentrations of olivine on Mars [1, 2] is important to understanding the igneous history of Mars, the possible origins of the Martian meteorites, and local weathering regimes. Globally distributed sites identified by [2] now have nearly complete diurnal coverage by the THEMIS IR subsystem, and greater than 50% coverage in the visible. We are examining these data and integrating them with MOC images and MOLA topography to understand the regional and global trends between olivine-bearing terrains and their geologic environs. We find that there are some common, as well as variable, correlations between thermophysical, visible, topographic, and infrared characteristics of these materials on Mars.

Previous work: [2] used MGS TES infrared spectra to identify regions on Mars with spectral signatures matching those of several Martian meteorites, including the olivine-dominated ALH A77005 and Chassigny meteorites. THEMIS infrared spectral data have revealed the distribution of these materials in greater detail [3] at all sites where they occur, and confirm identifications that were considered to be small in spatial extent in TES data [4]. Preliminary analysis of the thermophysical properties of the olivine-bearing materials revealed a range of likely physical forms, from coarse sands to bedrock [3]. [4] presented preliminary spectra from one THEMIS visible image over Nili Fossae that showed spectral features in areas corresponding to the locations of the strongest olivine signatures in the infrared. A broad similarity in the elevations of two widely separated occurrences of olivine, one in the Valles Marineris and another in an associated outflow channel, hints at the possibility of a genetic relationship [4], although not all meteorite-like olivine occurrences are at a common elevation.

New results: *Thermophysical properties.* Although nighttime brightness temperature (a proxy for thermal inertia, not shown) and olivine spectral feature strength (exemplified by the IR decorrelation stretch in Fig. 1) are commonly correlated, they are not always correlated, indicating that secondary processes (e.g., aeolian redistribution and sorting) contribute to locally strong IR olivine signatures.

Visible spectroscopy. We searched THEMIS visible spectra for two features that might be expected in olivine-bearing regions. First, we considered the difference between the reflectances in bands 3 (B3, 0.65 µm) and 4 (B4, 0.75 µm). Typical Martian spectra [e.g., 5] exhibit negative values of this difference. In our study, cases where B3-B4 is positive indicate the presence of an absorption at or beyond 0.75 µm, consistent with an Fe absorption in olivine. (Band 5, at 0.89 µm, is not suitably calibrated for spectral analysis.) We observe positive values of this parameter in Nili Fossae (Figures 1 & 2) and in some areas in and around Ganges Chasma [2]. Second, we searched for a "green kink" in the visible spectrum at 0.55 µm. This feature was parameterized as the reflectance in band 2 divided by the average reflectance in bands 1 (0.425 µm) and 3 (0.65 µm). In typical Martian spectra, this index produces values less than unity as a result of the strong ferric absorption edge. Values greater than unity would indicate a green color. Spectra from Nili Fossae show few values of this index >1, although an increased value of the index is associated with olivine-bearing materials (Figures 1 & 2), suggesting that a green material may be present, but that its color is being suppressed by a ferric iron absorption. Olivine-bearing materials in Eos Chasma, Ganges Chasma, and craters on the plains above Ganges Chasma can show values of this index >1, but some of these are artifacts of the calibration, and require that all values >1 be examined carefully for correlation with spectral features in the infrared data.

Topography. MOLA shot locations and elevations are plotted over simultaneously acquired MOC visible imagery in olivine-bearing sites using the method of [6]. The MOC images and MOLA data can be overlaid on THEMIS visible or infrared images to provide a high-resolution view of the topography and geomorphology of sites of interest. Analysis of these data is ongoing, but initial results suggest correlations between elevation and olivine-bearing units are present. Figure 3 shows the local topography and high-resolution geomorphology associated with olivine-bearing materials in Nili Fossae. The strongest olivine signatures coincide with local lows and (probably aeolian) bedforms.

Summary: Although integration of results is ongoing, we are developing a better understanding of the distribution of olivine-bearing materials. Features in the visible spectra apparently related to olivine are particularly exciting and are being studied in detail.

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References: [1] Hoefen, T. M. et al. (2003), *Science, 302,* 627-630. [2] Hamilton, V. E. et al. (2003) *Meteoritics & Planet. Sci., 38,* 871-885. [3] Hamilton, V. E. and Christensen, P. R. (2003), LPS XXXIV, Abstract #1982. [4] Hamilton, V. E. and Christensen, P. R. (2003) *Eos Trans. AGU,* Abstract #P21A-03. [5] Mustard, J. F. and Bell III, J. F., (1994) *GRL, 21,* 353-356. [6] Anderson, F. S. et al. (2003) JGR, 108, doi:10.1029/2003JE002125.

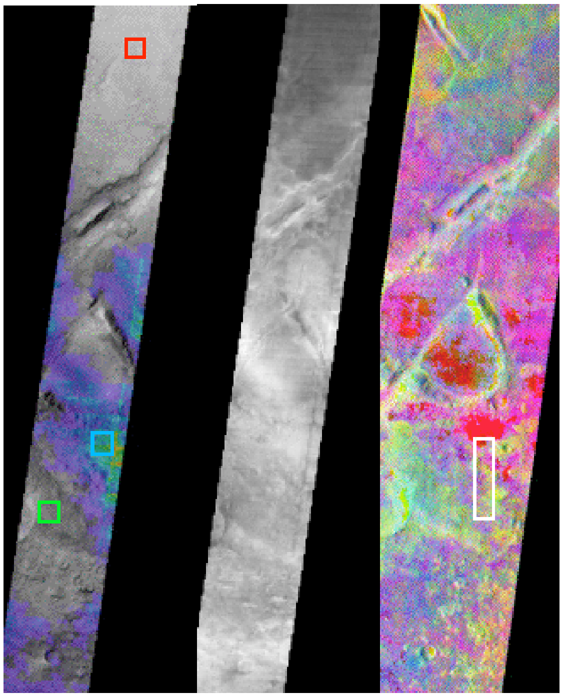

Figure 1. Left) THEMIS VIS band 3 (0.65 µm) with colorized overlay of B3-B4 index. Blues are low values, warmer colors are higher values. Visible images are ~19 m wide. Center) Grayscale image of "green kink" index. Brighter pixels have increasingly positive values. Right) THEMIS IR decorrelation stretch of bands 9, 7. and 5 showing the distribution of olivine-bearing materials in magenta-red. White box denotes approximate location of Figure 3. Image is ~32 km wide swath.

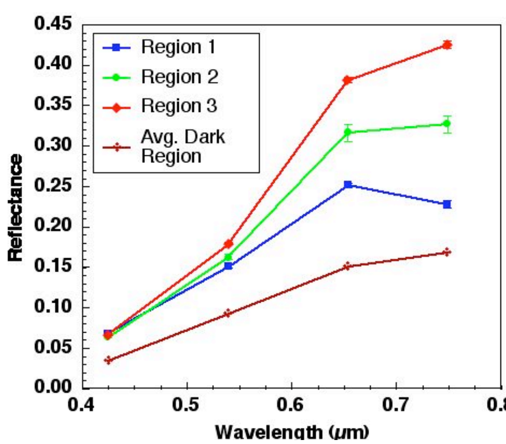

Figure 2. Average THEMIS reflectance spectra compared to typical Martian dark region spectrum of [5]. Spectra are color-coded to boxes in Figure 1 (left). Error bars on spectra represent standard deviation of averages.

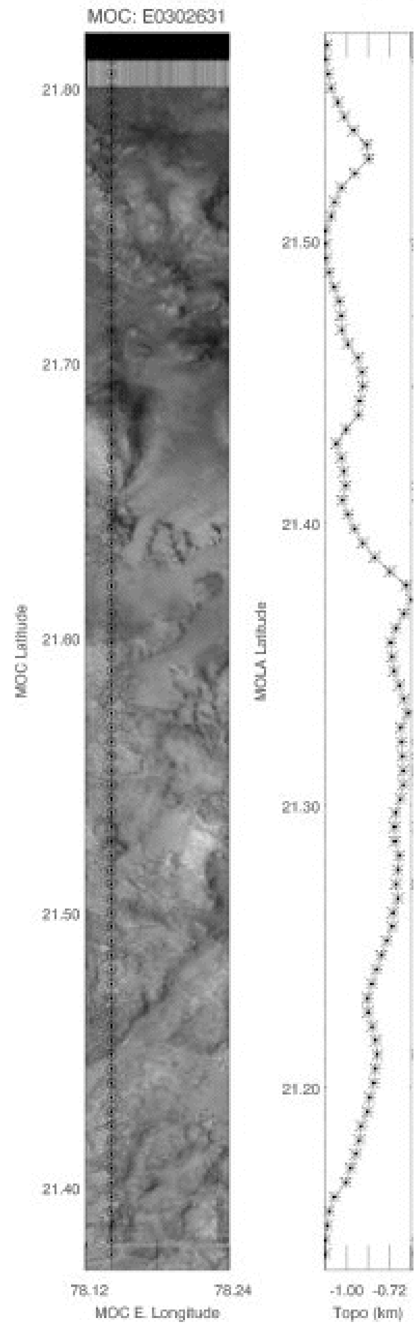

Figure 3. MOC image and corresponding MOLA profile in Nili Fossae at location shown in Figure 1 (right). Uppermost portion of image views area with relatively strong olivine spectral signature. Note: MOLA profile is offset slightly to the north relative to image as a result of the unknown length of missing data in MOC image.