SURFACE COMPOSITIONAL HETEROGENEITIES RELATED TO THE MARTIAN GEOMORPHIC DICHOTOMY.

P. Martin (1), P. Pinet (1), R. Bacon (2), A. Rousset (2), F. Bellagh (1).
1 UPR 234/CNRS, Observatoire Midi-Pyrénées, 31400 Toulouse, France.
2 Observatoire de Lyon, 69561 Saint-Genis Laval Cedex, France.

Although the martian surface mineralogy is still debated, the most recent earth-based or orbital spectroscopic measurements of Mars pointed out the 0.8-1.1 µm spectral range to be essential to discriminate the major properties of bright and dark materials of the planet (e.g.,[1,2,3,4,5]). TIGER spectro-imagery observations were conducted on the western hemisphere of Mars (~80° W to ~200° W, longitude) in this wavelength interval at higher spectral resolution (R~600) than previous studies. Analyses performed on the resulting spectroscopic information reveal a systematic spectral shape evolution across the global geomorphic crustal dichotomy as indicated by the absorption band shift (0.96-0.99 µm to 0.85-0.94 µm) observed from dark to bright regions, suggesting the possibility of a progressive compositional change from Fe^{2+} to Fe^{3+} bearing minerals.

During the 1990 Mars opposition, the TIGER integral field spectrograph, mounted on the 3.60-m CFH telescope, acquired imaging spectroscopy data of Mars throughout the 0.84-1.05 µm domain, at 100-250 km spatial resolution. Approximately 1500 spectra (SNR: 100 to 200) were collected from a systematic imaging spectroscopy survey mapping the Tharsis region [7]. Measurements are mostly located across the albedo marking boundary southward the Tharsis dome region, a few covering Amazonis Planitia, Tharsis Montes, and Syria Planum regions. Absolute reflectances have been obtained by calibrating our TIGER data with a mean ISM bright spectrum of Tharsis [6]. Four transsects of dark to bright spectra from regions crossing the martian crustal dichotomy are presented hereafter (see Fig. 1). Each spectrum is referenced by a number and an associated location overlain on the map of Figure 2. The analysis of overall bandshapes as a function of albedo values shows that the large 0.96-0.99 µm absorption feature observed in dark region spectra (e.g., spectra 1 or 11 in Fig.1) rapidly decreases throughout the dichotomy toward bright terrains. All transsects support the general trend of a progressive evolution of the spectra morphology appearing from dark to bright regions, i.e. an absorption band shift from 0.96-0.99 µm to 0.85-0.94 µm, consistent with a possible progressive compositional change from Fe^{2+} to Fe^{3+} bearing minerals. Otherwise, our spectral resolution allows for the discrimination of clearly distinguishable absorption bands longward the spectral range, with variable band minima according to the surveyed units. Bright terrains of Mars appear to be more heterogeneous than previously noted, suggesting different crystalline ferric oxide compositions and alteration histories, in agreement with the interpretations of [4,5]. Our conclusions are reinforced by linear mixing modelings and other spectral analysis methods performed on the TIGER dataset [7]. Relationships are established between the observed spatial variations of the spectral properties and morphological surface units of the region under study. Martian bright and dark materials present heterogeneous compositions, probably caused by intermixtures of both crystalline ferric and/or augitic minerals in varied abundances, with a strong dependence on particle size distribution, alteration histories and soil maturity.

References:
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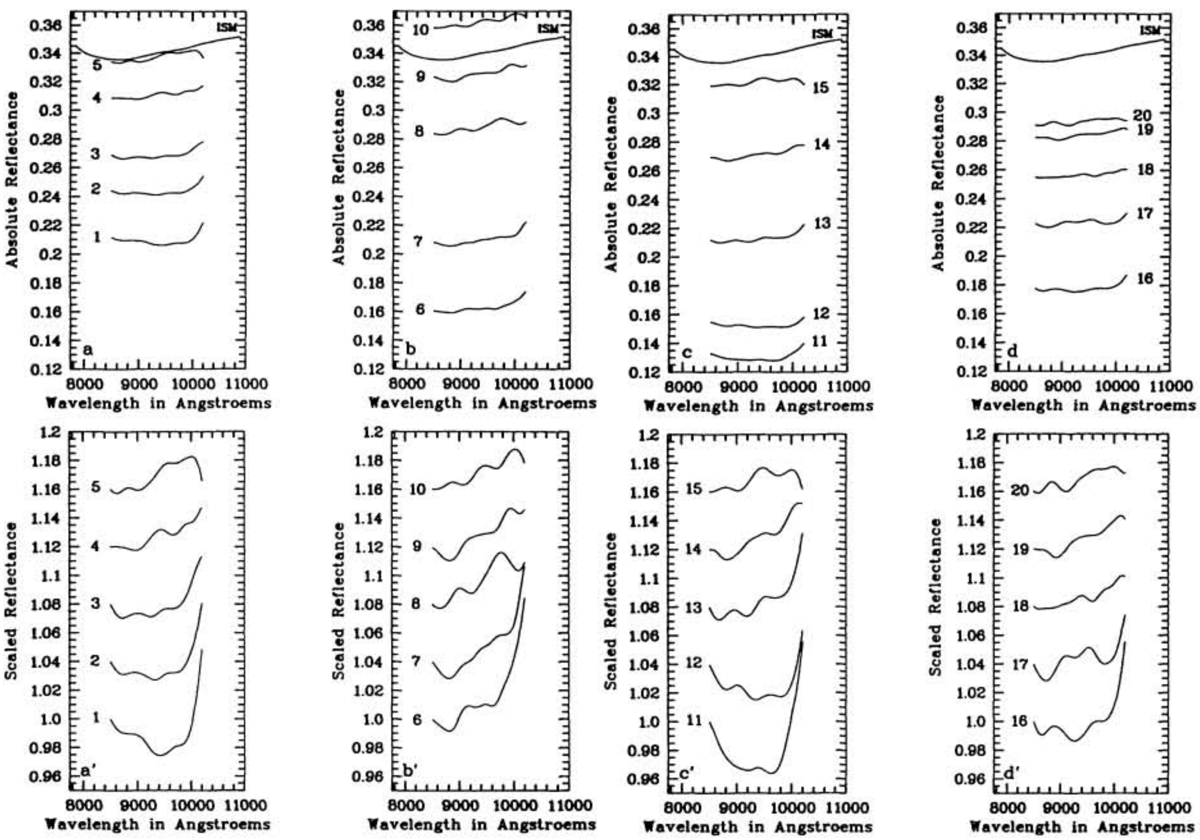

Figure 1.

Figure 1. (a) to (d) Transsects of reflectance spectra from dark to bright terrains crossing the martian geomorphic dichotomy (see Fig. 2), plotted with the ISM bright spectrum used for TIGER data calibration. Noisy channels longer than 1.02 μm have been removed from the dataset. (a') to (d') Same spectra as (a) to (d), scaled to unity at 0.86 μm and offset 4% for display. **Figure 2.** U.S. Geological Survey digital airbrush map (90° W to 180° W, longitude; 47.5° S to ~30° N, latitude).

Figure 2.