Assessing martian surface alteration from thermal infrared observations

J. R. MICHALSKI, T. G. SHARP, AND M. D. KRAFT

Dept. of Geological Sciences, Arizona State University, Tempe, AZ, 85287, USA; (michalski@asu.edu)

Recent NASA missions to Mars have carried thermal infrared emission spectrometers that have provided new mineralogical information about the martian surface. In this abstract, we review and discuss global-, regional-, and local-scale observations that provide insight into aqueous alteration of the martian surface.

Global-scale spectral observations by the Thermal Emission Spectrometer (TES) indicate that martian dark regions are dominantly composed of mafic volcanic materials, with large components of plagioclase feldspar and clinopyroxene, and minor, spatially variable components of aluminous silica and clay minerals (or poorly crystalline materials compositionally similar to clays). These data are consistent with observed trends for basaltic rocks with thin weathering rinds formed under oxidizing conditions and relatively low water/rock ratios. The spectra are also consistent with immature sediments with thin grain coatings or weak chemical cements. Spectra of bright regions are broadly similar to spectra of fine-grained, hydrated basaltic material; relative abundances of primary and secondary phases in martian dust remain unconstrained at present.

Regional-scale thermal infrared imaging of the surface with THEMIS data shows mineralogical diversity at 100 meter-scales and provides geologic context. Imaging of putative clay-bearing materials reported previously supports the previous interpretation [1] that these are ancient, clay-bearing stratigraphic units. In other localities, subtle differences in surface composition are decoupled from photogeologic units, suggesting that surface compositions are related to recent or ancient subaerial or subice weathering processes, rather than differences in bulk composition of the rock units.

Spectra of rocks and soils measured by the Mini-TES instrument onboard the Mars Exploration Rovers provide constrains on the local-scale alteration mineralogy of Mars. Materials at Gusev Crater with high Al/Si ratios, proposed to contain significant abundances of montmorillonite [2], lack obvious spectral features of crystalline clay minerals. It is possible these materials are highly altered, but poorly crystalline. Other rocks at Gusev Crater that have chemical signs of alteration, lack clear spectral evidence for clays or free silica, but instead have spectra dominated by basaltic glass-like features [3].

References:

[1] Poulet, F. et al., Nature, **438**, 623-627, 2005.
[2] Clark, B. et al., in prep.
[3] Ruff, S. et al.,in prep.