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MAPPING COMPOSITIONAL AND PARTICLE SIZE VARIATIONS ACROSS SILVER LAKE PLAYA - RELEVANCE TO ANALYSES OF MARS TIR DATA

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The high spectral and spatial resolution thermal infrared (TIR) data to be acquired from the upcoming Mars Observer-*TES* mission will map the composition and texture of the martian sediments [1]. To prepare for these data, portions of two remote sensing field experiments (MFE-1988 and GRSFE-1989) [2,3] were conducted to test procedures for extracting surface property information from TIR data. What follows is a report of the continuing analyses of Thermal Infrared Multispectral Scanner (TIMS) data, field emission spectra, laboratory FTIR reflectance spectra, and field observations with respect to the physical characteristics (composition, emissivity, etc.) of Silver Lake playa in southern California.

In February, 1989, emission data were collected over two sites at Silver Lake with the JPL Portable Field Emission Spectrometer (PFES) [4]. The analyses of these data were reported in Petroy and Arvidson (1990) [5]. The PFES was unavailable the following field season; thus, in May, 1990, samples were collected from five sites at the north end of Silver Lake. Reflectance spectra (between 6.0 and 14.0 μm) of these samples were collected in the laboratory using the JPL FTIR spectrometer. An integrating hemisphere has been attached the spectrometer, providing a means for collecting total hemispheric reflectance measurements. The reflectance data were then converted to emissivity using Kirchoff's law (1-reflectance = emissivity) [6].

Emission spectra from samples collected at three of the sites are shown in Fig. 1. These spectra represent the range of data collected from all the samples. All three spectra are dominated by the strong absorption feature centered at 9.6 μm due to the stretching vibrations of the Si-O bonds in the layered clays. XRD data have confirmed that the dominant constituent in the samples is smectite clay. The quartz absorption feature is represented by the diagnostic quartz doublet, consisting of two lobes centered at approximately 8.4 and 8.8 μm . The intensity of the absorption feature decreases from site B to site D indicating either a change in the particle size of the quartz sands from each site [7], or a variation in the amount of quartz exposed at each site.

The distribution of quartz particles sizes was measured for each sample and is approximately the same from site to site on the playa, ranging from silt size to fine-medium grained sands (0.54 μm to 250 μm). Therefore, the change in the quartz absorption feature from site B to site D probably represents a variation in the amount of quartz exposed at each site. To test this hypothesis, point counts were made over each playa tiles to determine the amount of quartz sand versus the amount of clay material exposed at the surface (referred to as the QC ratio). The FTIR spectra were then normalized by setting the emissivity values between the wavelength region 7.4 and 7.7 μm (i.e. the Christiansen frequency) to 1.0. The area beneath the curves was then

integrated between 7.4 μm and 12.0 μm (12.0 μm was selected because the emission spectra from all of the sites approached constant values of 0.96 at this wavelength).

The QC ratio calculated for each sample was then plotted against the normalized area under the curve derived from the emission spectra collected over the samples. The results of this analysis are displayed in Fig. 2. There is a linear relationship between the amount of quartz exposed at the surface of the playa tiles versus the depth of the quartz absorption feature suggesting that similar approaches can be used to extract compositional information from TES data.

References

- [1] Christensen et al., preprint, [2] Wall, S., et al., (1988) *Bull. Am. Ast. Soc.*, 20, p.809. [3] Arvidson, R.E. and D.L. Evans (1989) *GSA Abst. with Prog.*, p. A121. [4] Hoover, G. and A.B. Kahle (1987) *Phot. Eng. and Rem. Sens.*, vol. 53, p. 627-632. [5] Petroy, S.B. and R.E. Arvidson (1990) *Abst. with Prog. - 21st Lunar Plant. Sci. Conf.*, p. 952-953. [6] Nicodemus, F. (1965) *App. Opts.*, p. 767-773, [7] Conel, J.E. (1969) *J. Geophys. Res.*, 74, p. 1614-1634.

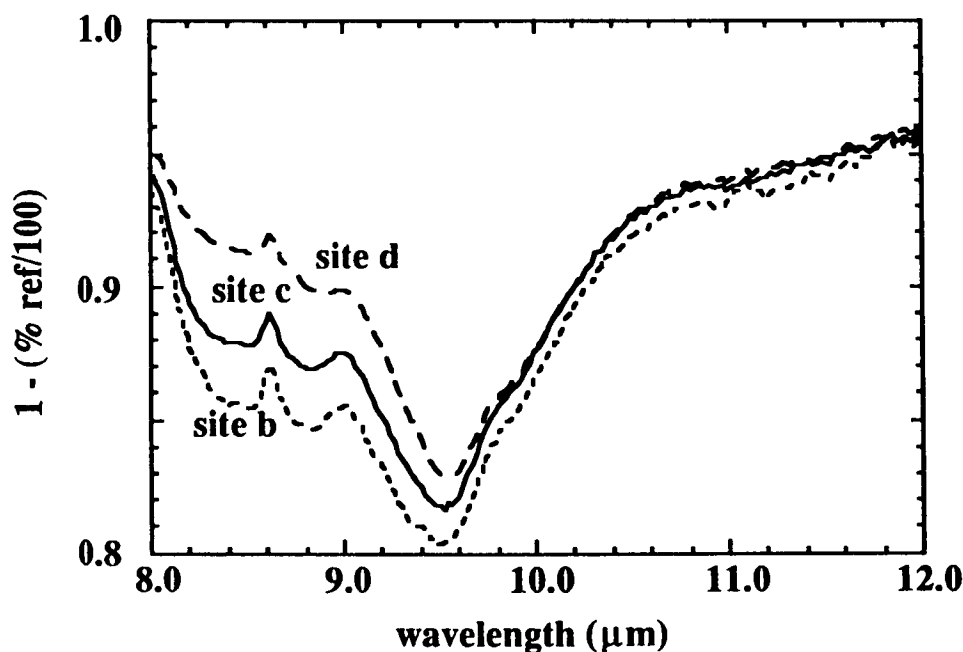


Fig. 1: FTIR reflectance spectra (converted to emission) for samples from three sites at Silver Lake playa.

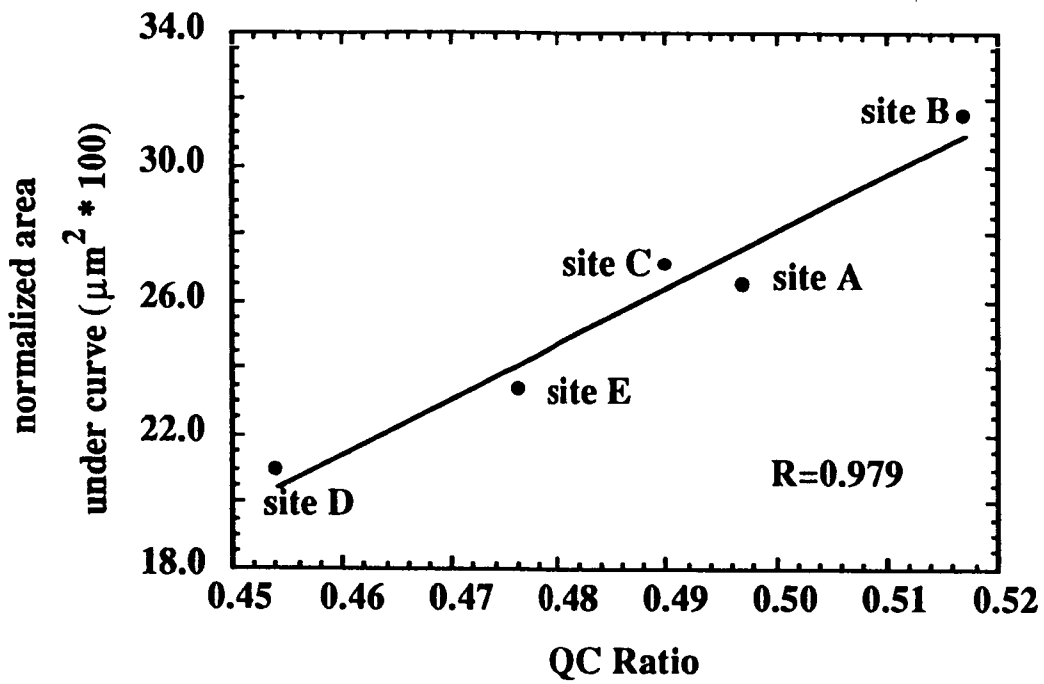


Fig. 2: Plot of QC ratio (surface distribution of quartz vs. clay) for each sample against the normalized area under the curve derived from the emission spectra collected from each sample.