

TELESCOPIC DETECTION OF SULFUR COMPOUNDS ON MARS. Diana L. Blaney and Thomas B. McCord. Planetary Geosciences Division, Hawaii Institute of Geophysics, University of Hawaii at Manoa.

A summary of the results of measurements collected August 17, 1988 UT at the NASA Infrared Telescope Facility using a Cooled Grating Array Spectrometer described by Tokunaga, 1987 and their interpretation is presented below.

Description of Spectra

--The spectra shown in Figure 1 exhibit increasing reflectance between 3.2 μm and 4.2 μm due to absorption from hydrated minerals depressing the continuum level in the 3 μm region and an increase in thermal emission at longer wavelengths.

--Near 4.1 μm the reflectance decreases due to Mars CO₂ atmospheric absorptions.

--No evidence of carbonates was observed. An upper limit of carbonate abundance is <1-3 wt% based on laboratory measurements of calcite and palagonite mixtures (Blaney and McCord 1988, Walsh personal communication).

--Between 3.76 μm and 3.87 μm an absorption feature appears with a double minimum at 3.810 μm and 3.854 μm and a maximum strength of about 4%. This absorption is consistent with the feature observed in Syrtis region in 1986 (Blaney and McCord 1988).

--Further analysis was done by approximating a continuum with a straight line fitted to the spectrum at 3.75095 and 3.9133 μm and dividing the slope out.

--The continuum removed spectra, not shown, revealed no variation in the band minima location but showed some variation in the band strength. Depth of absorption feature does not appear to be correlated with geologic terrain, age of unit, albedo, or latitude.

--This implies that on the scale measured, the material causing the absorption is widespread and of uniform composition on this spatial scale. Additionally, the wide age range of the two regions with the highest concentration (deepest band depth) implies that the process which formed the material causing the absorption has been in operation throughout Martian history, or that the process is a recent one with global importance.

Interpretation of the 3.81 μm Absorption Feature: Bisulfates?

--Sulfur containing compounds are geochemically reasonable given Viking results indicate a high relatively uniform sulfur content at both Chryse and Utopia. Sulfur containing compounds therefore are expected to occur (e.g. Toulmin et al. 1987, Clark et al. 1982).

--Sulfates such as gypsum and anhydrite do not have absorption features in the 3.8 μm region due to the symmetry of the SO₄⁻² ion. However bisulfates are infrared active in this region due to the asymmetry of the HSO₄⁻¹.

Bisulfate Spectra

--Both NaHSO₄ and KHSO₄ were measured.

--Both spectra show broad absorptions in the 3.8 μm to 4.0 μm region. The feature has two distinctive relative minima at about 3.8 μm and 3.9 μm . The second feature is slightly shallower than the first.

--Location of minimum are dependent on the anion. For KHSO₄, the minimum are at 3.806 μm and 3.965 μm , while for NaHSO₄, the minimum occur at 3.755 μm and 3.890 μm .

--Figure 2 shows the KHSO₄ spectrum plotted above the Chryse spectra. The KHSO₄, is a better, though not exact, match to the absorption feature than the NaHSO₄. (Given the results the Viking XRF experiment is reassuring that potassium is not an exact match). The strong dependence on anion and absorption position indicates that laboratory measurements may be able to determine the specific anion involved.

Conclusions

--Absorption feature at 3.81 μm exists.

--Feature is widespread, shows variation in depth, and is not correlated with geologic, albedo, or terrain age.

--Bisulfates are a likely candidate. Absorptions from bisulfates do occur at around 3.8 μm however, exact band position is very sensitive to anion. An exact match has yet to be made.

--No evidence for carbonates at the 1-3 wt% level has been found.

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References: Blaney and McCord, *JGR*, submitted, 1988. Clark et al. *JGR* 87, 10,059-10,068, 1982. Tokunaga et. al. *Infrared Astronomy with Arrays*, ed. Wynn-Williams and Becklin, p 367-378, 1987. Toulmin et al., *JGR* 82, 4625-4634, 1977.

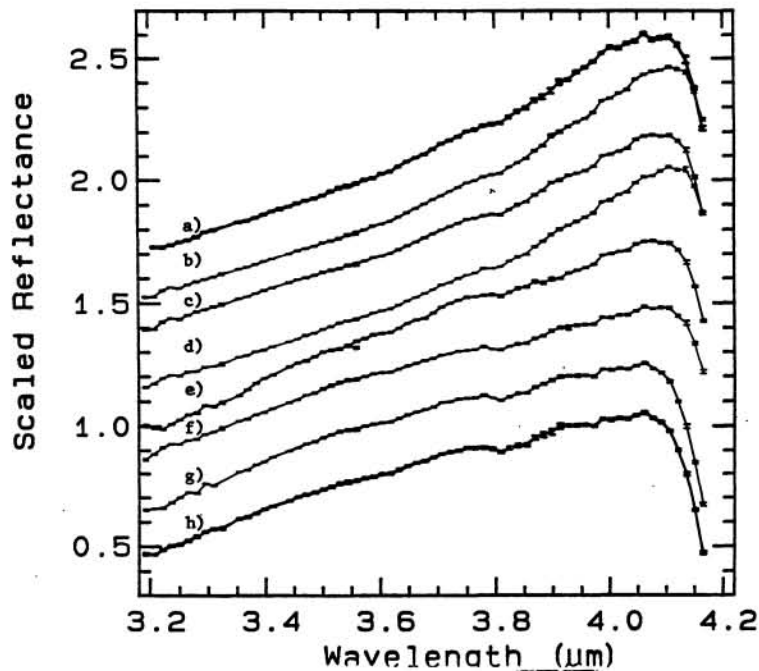


Figure 1. Spectra for eight ~900-km diameter regions on Mars reduced using the standard star BS437 and normalized to unity at 3.9133 μm . The rough geographic locations are a) Margaritifer Sinus, Nirgal Valles, and Eastern Valles Marineris, b) Central Valles Marineris and Surroundings, c) Argyre Basin, d) Eastern Solis Planum, Ridged Plains, Heavily Cratered Terrain, e) Mid to High Latitude Heavily Cratered Terrain, f) Eastern Tharsis, g) Western Tharsis Montes, h) Southern Chryse and Outflow Channels. A specific aperture location map will be presented. Subsequent spectra are offset from each other by 0.2 units.

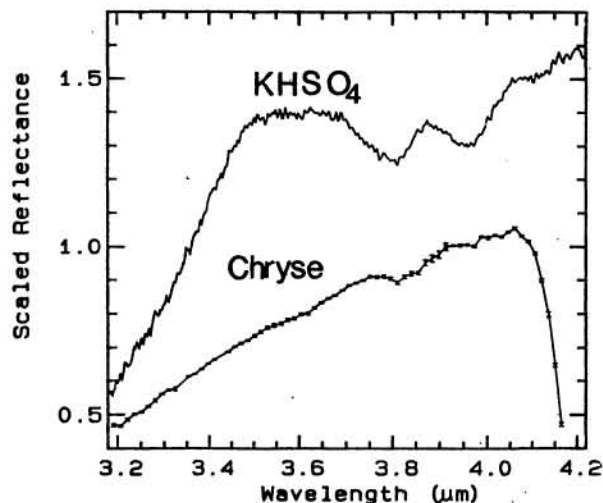


Figure 2. Scaled reflectance for KHSO_4 and the spectra for the Mars region Chryse. Both spectra are scaled to 1.0 at 3.913 μm . The KHSO_4 spectrum is offset from the origin by 0.4 units.