CARBONATES ON MARS: SEARCHING THE MARINER 6 AND 7 IRS MEASUREMENTS; Roush, T.L., Blaney, D., McCord, T.B., and Singer, R.B., Planetary Geosciences Division, Hawaii Institute of Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822.

Carbonate minerals have been suggested as a constitutent of Mars surface material (1,2,3,4). Calculations of the amount of CO_2 which should have been outgassed from Mars and the amount of CO_2 which is tied up in the atmosphere, polar caps, and regolith (absorbed) show that a major amount of the original CO_2 must be elsewhere (1,3). Carbonate minerals represent a possible reservoir for the remaining CO_2.

Reflectance spectra of Mars provide a fairly sensitive way of detecting carbonates on the Martian surface. These minerals have a series of absorption bands in the near and mid-infrared spectral region due to the CO_3 molecule (5,6,7). To date, telescopic measurements in the 1.0 to 2.5μm region have not revealed such absorptions in the Martian spectrum (8). The relatively weak absorptions in the near-infrared (to 2.5μm) might be masked by mixing with spectrally opaque materials.

As suggested previously (e.g. 9), the stronger absorptions which occur in the 2.5 to 5.0 μm region provide greater potential for identification of carbonate minerals on Mars. Figure 1 shows a laboratory spectrum of a reagent grade calcite, where are the bands at ~3.5 and ~4.0μm are particularly prominent. Figure 2 shows a laboratory spectrum of a smectite clay which contains ~17 wt% calcite as a contaminant. The ~4.0μm and is still readily discernable in the measured data but the ~3.5μm band is masked by the strong water absorption in the 3μm region. To investigate the effect of thermal emission on a ~4μm carbonate band, a model Mars spectrum (Figure 2) was calculated using the laboratory data of the smectite to model the resultant spectrum of the sample for mars at perihelion with a surface temperature of 275K. The ~4.0μm CO_3 band is still obvious, and from the strength of this band in the modeled spectrum it appears that even a few percent carbonate should be evident in the spectrum of Mars surface if it is present.

The Mariner 6 and 7 spacecraft each carried an IR spectrometer (IRS) (10) which obtained a total of 238 spectra in the 1.9-6.0μm spectral region. The Mars coverage was severely limited and mostly the southern hemisphere was sampled. These spectra have recently become available for digital analysis (11). A few examples of the IRS spectra are given in Figure 3 for the spectral region containing the 3.5 and 4.0μm carbonate bands. As a preliminary analysis all the available spectra were studied and none show obvious evidence of the ~4.0μm carbonate absorption. A more detailed analysis is now underway.

The absence of the ~4.0μm carbonate absorption does not entirely eliminate the possibility of extensive carbonates on the Martian surface. The areal coverage of the IRS was limited and the spatial resolution low (130km), resulting in considerable averaging of surface materials. The spectra studied have not been calibrated to reflectance nor the effects of the Martian atmosphere removed. If carbonate is present and not mixed with the global dust, exposures might be spatially localized and easy for IRS (and telescopic) measurements to miss. Because of the higher spatial resolution and full mapping coverage, these would be prime targets for a reflectance spectrometer on Mars Observer.

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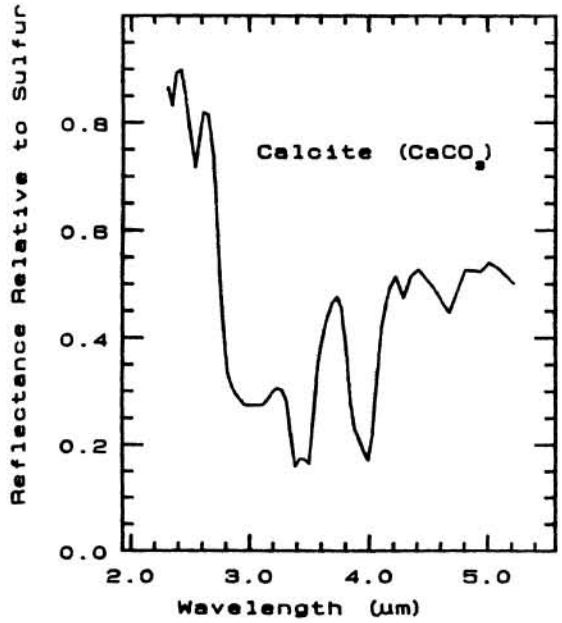

Figure 1. Laboratory reflectance spectrum of reagent grade calcite.

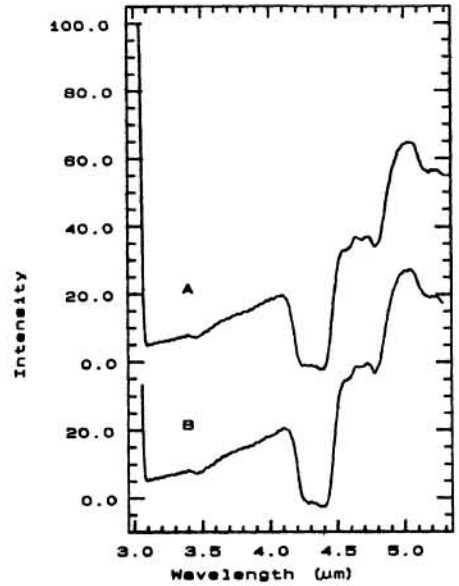

Figure 3. Mariner 6 spectra of the Martian surface. A) centered -8.9S,309.7W and B) centered -11S,314.9W. Both spectra exhibit the strong atmospheric CO_2absorption in the ~4.2-4.4μm region.

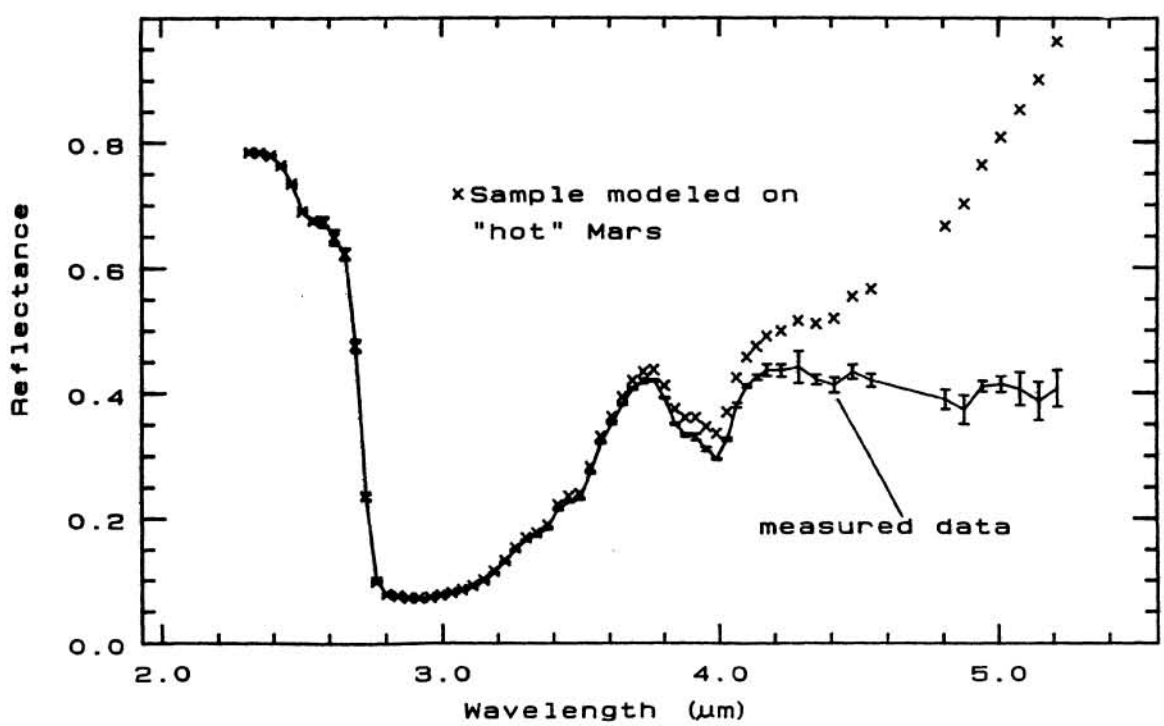

Figure 2. Laboratory reflectance spectrum of a smectite with ~17 wt.% calcite as a contaminant (measured data), relative to sulfur and the same sample modeled to include martian surface thermal effects (x).