A SEARCH FOR SO_2 ON MARS FROM INFRARED SPECTROSCOPY

T. Encrenaz, *LESIA, Observatoire de Paris, France (therese.encrenaz@obspm.fr))*, **T. K. Greathouse,** *SWRI, San Antonio, TX, USA*, **M. J. Richter,** *Physics Department, University of California, Davis, CA, USA*, **B. Bézard, T. Fouchet,** *LESIA, Observatoire de Paris,France*.

Introduction:

Sulfur-bearing molecules have been found at the surface of Mars by the Viking landers (Toulmin et al., 1977) and more recently by the Opportunity rover (Squyres et al., 2004). Still, no gaseous sulfur-bearing molecule has been ever detected in the Martian atmosphere. Upper limits have been reported by Krasnopolsky (2005) from thermal infrared spectroscopy (1 ppb over the Tharsis region) and by Nakagawa et al. (2009) in the submillimeter range (2 ppb, integrated over the disk). In this abstract, we present a preliminary analysis of ground-based data obtained by high-resolution imaging spectroscopy in the thermal infrared.

TEXES Observations:

Observations were performed on October 10-15, 2009, using the Texas Echelon Cross Echelle Spectrograph (TEXES) instrument at the InfraRed Telescope Facility (IRTF) at Mauna Kea Observatory. TEXES is a high-resolution imaging spectrometer operating in the 5 - 25 μm range, with a spectral resolving power higher than 70,000, and a spatial resolution of about 1 arcsec after convolution.

TEXES observing campaigns have been performed since 2002 for simultaneously monitoring the spatial and seasonal variations of hydrogen peroxide H_2O_2 and water vapor, using the 1227-1245 cm^{-1} range (Encrenaz et al., 2004, 2005, 2008, 2010). Maps of the Martian disk have been achieved by using a 11.5 x 8 arcsec slit, aligned with the celestial N-S axis, and by stepping the telescope by 0.5 arcsec from west to east. Individual maps, recorded in 10 minutes, were co-added over a total of 3 to 4 hours.

SO_2 data:

During our October 2009 run (Ls = 352°), we recorded the 1350-1365 cm-1 range in order to search for SO_2 on Mars. Because our method allows us to map the minor species over the Martian disk, we intend to derive at least an upper limit of the SO_2 mixing ratio as a function of latitude and longitude near equinox. A special attention will be devoted to the high northern latitudes where gypsum has been detected by the OMEGA instrument aboard Mars Express (Langevin et al., 2005). The same method was used to determine an upper limit of CH_4 on Mars (Encrenaz et al., 2005).

Figure 1 shows an example of a spectrum of Mars near 1354 cm^{-1} where strong transitions of SO_2 are present. This spectrum corresponds to a single pixel in an area of high continuum. Preliminary estimates indicate that, from the single SO_2 transition at 1353.98 cm^{-1}, an upper limit of a few ppb can be expected from this spectrum. As many SO_2 transitions can be used in the 1350-1365 cm^{-1} range, it should be possible to infer, for the SO_2 mixing ratio, an upper limit of 1 to a few ppb over most of the Martian disk (except possibly at the limb).

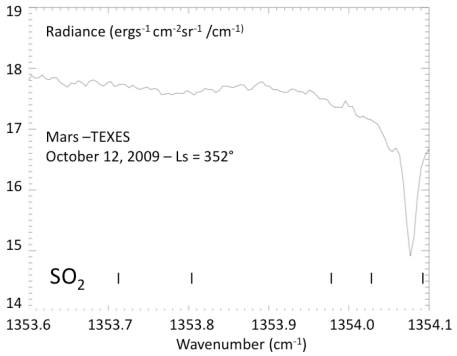

Figure 1. An example of the spectrum of Mars between 1353.6 and 1354.1 cm^{-1}. SO_2 transitions appear at 1353.66, 1353.75, 1353.92, 1353.98 and 1354.03 cm^{-1} (Doppler-shifted positions are shown in the Figure).

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