Hydrogen Peroxide on Mars

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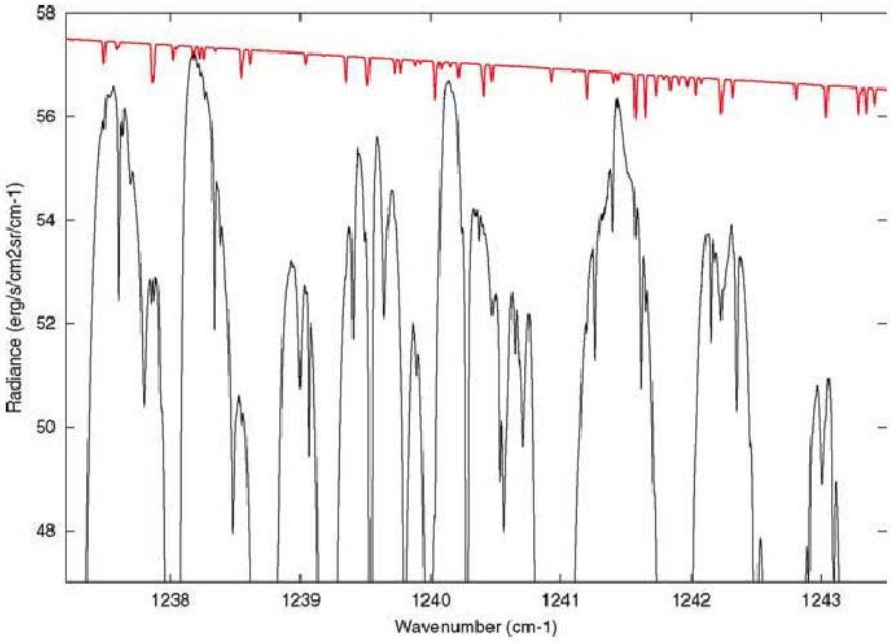
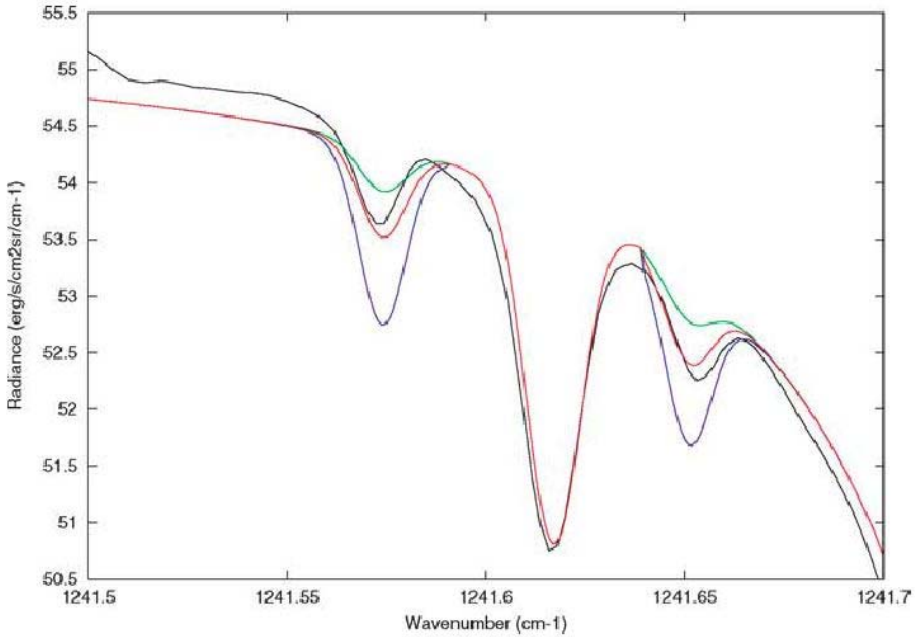
evidence for spatial and seasonal variations”

Hydrogen peroxide H_2O_2 has been suggested as a possible oxidizer of the Martian surface. Photochemical models suggest that its mean abundance should be in the range 10^{15} - 10^{16} cm^{-2}, and that H_2O_2 and H_2O abundances should be correlated.

We report the detection of H_2O_2 on Mars and its mapping over the Martian disk, using TEXES at the IRTF for Ls = 206°. Data were obtained in June 2003. Two spectral ranges were recorded near 8.1 microns with a spectral resolving power of 70000 and a spatial resolution (after binning) of about 1.5 arcsec. About ten H_2O_2 lines were distinctly detected over the whole spectral range.

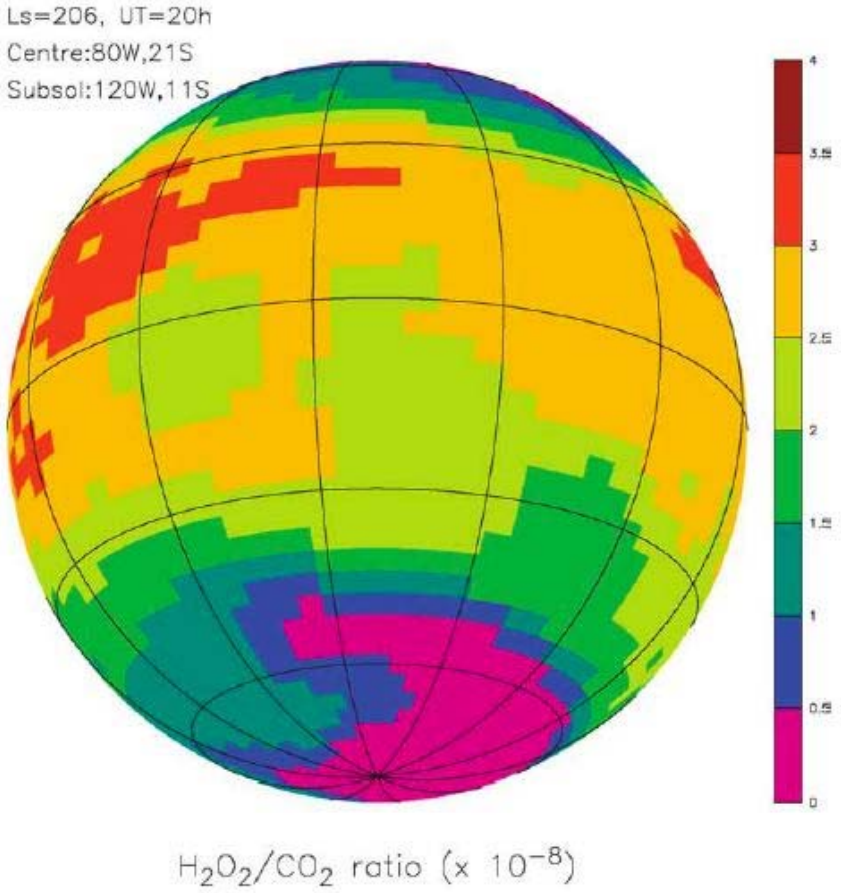




Left: Spectra of Mars (black line) at 1237.2-1243.5 cm^{-1} (8.1 microns) integrated over a selected area around the sub-solar point and uncorrected for telluric absorptions. The synthetic absorption spectrum of H_2O_2, corresponding to a mixing ratio of $4x10^{-8}$, is shown for comparison (red line). Absorption lines are due to both telluric and lines of CO_2 and H_2O_2 in the Martian atmosphere.

Right: Expanded view showing models corresponding to H_2O_2 mean vertical mixing ratios of $2x10^{-8}$ (green), $4x10^{-8}$ (red, best fit), and $8x10^{-8}$ (blue) in the atmosphere of Mars.

The mean mixing ratio of H_2O_2 integrated over the disk is $3x10^{-8}$, corresponding to a column density of $6x10^{15}$ cm^{-2}. This is significantly higher than our previous upper limit. Our new result is consistent with the predictions of photochemical models and also with the global measurement obtained by Clancy et al. (2003, Icarus, 168, 116) from submillimeter heterodyne spectroscopy in September 2003 (Ls = 254°) .



Left: The spatial distribution of H_2O_2 inferred from our data shows an enrichment of H_2O_2 in the morning and around the equator, also in overall agreement with photochemical models.

Summary

- Our results are in good agreement with predictions of both 1D and 3D photochemical models. Our measured H_2O_2 mixing ratio ranges from 2 $x10^{-8}$ to 5 $x10^{-8}$ in the area where this parameter can be inferred, with a maximum around the sub-solar point.

- The enhancement of H_2O_2 in the morning sector could possibly be explained by the lack of H_2O_2 photolysis loss throughout the night (Atreya and Gu, 1995), which could result in its build up towards morning. It can also be noted that the region of maximum H_2O_2 mixing ratio is an area of low altitude (south of Amazonis Planitia), and topographic effects may also be involved. To distinguish between the two possibilities, observations at a different sub- Earth longitude are needed.

- Our results of Feb. 2001 and June 2003 show evidence for seasonal variations of the H_2O_2 content.