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Introduction: Our study of methane on Mars now extends over three Mars years, sampling a wide range of seasons with significant spatial coverage [1,2]. Three spectrometer-telescope combinations were used. With the spectrometer slit oriented North-South on the planet, we obtain simultaneous spectra at latitudes along the central meridian. Successive longitudes are sampled as the planet rotates, and the combination then permits partial mapping of the planet. We earlier reported differential detections of methane and water on Mars. Here, we present absolute extractions of methane, based on improved analytical procedures developed since 2005.

We now identify and correct instrumental effects such as variations in resolving power along the slit, second-order optical fringe removal, and correction of (minor) internal scattered light. We synthesize the fully-resolved terrestrial transmittance spectrum, convolve it to the instrumental resolution, and subtract it from the measured Mars-Earth spectrum. Fraunhofer lines are removed from the residual Mars spectra along with spectral lines of water and of (newly identified by us) carbon dioxide isotopomers [3,4]. The residuals are then inspected for signatures of methane and other possible trace constituents such as HDO and H_2O (Villanueva et al., this Conference).

On certain dates, the residual spectra display spectral lines at the Doppler-shifted positions expected for methane on Mars. The positive indications favor certain seasons (e.g., L_s = 121° & 155°) and locations. Mixing ratios derived from those residuals (up to 60 ppb) greatly exceed upper limits obtained at other seasons (e.g., < 3ppb at L_s = 17°); these variations could be consistent with episodic release. The CH_4 spatial extent requires transport over large distances (eddy diffusion), and destruction lifetimes of order one year.

Source strengths rival the massive hydrocarbon seep at Coal Oil Point (Santa Barbara, CA). A comparison with methane emission from arctic tundra is also drawn. Local regions of release are identified and compared with geological features. Details will be presented and aspects of possible production mechanisms will be discussed.

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References:

[1] Mumma M. J. et al. (2008), *Science* (submitted). [2] Villanueva G. L., Mumma M. J., and Novak R. E. *(2008), Science* (submitted). [3] Villanueva G. L., Mumma M. J., Novak R. E., and Hewagama T., *Icarus* 195, 34-44. [4] Villanueva G. L., Mumma M. J., Novak R. E., and Hewagama T., *J. Quant. Spectrosc. Rad. Transf.* 109 (No. 6), 883-894.