DAY-NIGHT DIFFERENCES IN NEAR-SURFACE MARS METHANE SEEN BY CURIOSITY AT GALE CRATER: UPDATED RESULTS INCLUDING INTERCOMPARISON WITH EXOMARS TRACE GAS ORBITER. C.R. Webster[1], P.R. Mahaffy[2], G.J. Flesch[1], C.A. Malespin[2], S.K. Atreya[3], J.E. Moores[4] and A.R. Vasavada[1]. [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, Chris.R.Webster@jpl.nasa.gov, [2]NASA Goddard Space Flight Center, Greenbelt, MD 20771, [3]University of Michigan, Ann Arbor MI 48109, [4]York University, Toronto, ON, M3J 1P3, Canada.

Introduction: Curiosity's Sample Analysis at Mars (SAM) [1] has operated successfully on the surface of Mars in Gale crater for over 7 years. During this time, SAM's Tunable Laser Spectrometer (SAM-TLS) instrument has reported occasional spikes in atmospheric methane detected directly [2, 3] above a low background level. By enhancing the SAM-TLS sensitivity by factor of ~25 using SAM's gas processing and atmospheric enrichment, SAM-TLS has discovered that over 3 martian years, the background levels show seasonal variation from 0.25 to 0.65 ppbv with a mean value of 0.41 ±0.16 (95% CI) ppbv for the near-surface methane abundance [3].

ESA's ExoMars Trace Gas Orbiter (TGO) [4] has used its NOMAD and ACS instruments to report non-detection (upper limit ~50 pptv) of methane in the martian atmosphere above a few kilometers from the surface [5]. If methane is long-lived, it is at first sight not possible to reconciled these two data sets. A critical issue is to understand to what extent the nighttime measurements at Gale crater are representative of the methane flux over the whole day and at other near-surface locations. Day-night differences in the SAM-TLS measurements have the potential to reduce the discrepancy between Curiosity and ExoMars TGO data sets [6], although fast destruction mechanisms are still required [6,7].

Results: We will report the results of daytime measurements by SAM-TLS of atmospheric methane and their comparison with the predominantly nighttime measurements made to date. These data will test the model [6] of inhibition of mixing near the surface overnight whereby methane emitted from the subsurface will accumulate within meters of the surface before being mixed below detection limits shortly after dawn. The model-calculated microseepage fluxes will be presented in context with the effects of proposed fast destruction mechanisms that would be amplified during the day and inhibited overnight.

In co-ordination with our European partners, we will also present the results of two intercomparisons with the ExoMars TGO NOMAD and ACS instruments during December 2019. The updated SAM-TLS results will be described in light of the recent detection of a large spike (~20 ppbv) seen by SAM-TLS during the night at Gale crater, and reports of other observations of methane spikes seen by Mars Express PFS and from ground-based observations.

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