COMETARY ORIGIN OF METHANE ON MARS HIGHLY UNLIKELY. M. Roos-Serote[1], S.K. Atreya[1], G. Kim[1], C. R. Webster[2], P. R. Mahaffy[3], [1]University of Michigan, Space Research Bldg, 2455 Hayward Street, 48109-2143, Ann Arbor, USA, roos@umich.edu, [2]Jet Propulsion Laboratory [3]Goddard Space Flight Center.

Methane, the Mysterious One: Methane on Mars has been the subject of much debate. Remote sensing measurements from space and ground over the past four decades have been reported, with more recent data showing a methane mixing ratio that varies with time and place on the planet. Over the past three Earth years, the Tunable Laser Spectrometer (TLS) of the Sample Analysis at Mars (SAM) instrument suite of the Mars Science Laboratory has been measuring methane in situ at Curiosity Rover's Gale Crater landing site with unprecedented accuracy. Most measurements show a very low background value of methane, smaller than 1 ppbv. However, during one period lasting several months in the Northern Spring of Martian Year 32 methane values ranging from 5 to 9 ppbv were detected on four sequential observations, but they dropped back to background level again within two months New measurements of the same season in the current Martian Year 33 do not show any enhancement in methane mixing ratio [2].

Photochemical models predict that methane is stable on timescales of several hundred years [3], and reported variations between 0 and 70 ppbv on time scales of months up to a year are hard to explain by any known destruction mechanism.

Meteor Showers: Many ideas about the origin and destruction of methane have been proposed in the past. A plausible explanation for the high methane values seen by the TLS is a relatively small, localized release from a subsurface source [1]. Fries et al. [4] argue for an alternative mechanism, according to which methane spikes are caused by carbonaceous materials from comets brought in by meteor shower events. A high altitude source is proposed. Just like the Earth, Mars passes through the dust trails left behind by comets on their orbits around the Sun. This happens at specific times in the martian year, as these dust trail are fairly stable in space. When Mars passes through such a trail, cometary dust particles collide with the atmosphere and bring carbonaceous material. Lab work claims that methane could form rapidly by UV degradation of this material at the surface of Mars (Schuerger et al. [5]; Keppler et al. [6]). Christou [7] published a list of 30 potential candidate meteor showers at Mars from known comets, giving the times when they are predicted to occur during a given martian year. Fries et al. [4] add two more comets to that list. As on Earth meteor showers last from several hours up to many days, so that when Mars passes through a dust trail a large part or all of the planet is exposed. Note, however, methane created anywhere would be mixed vertically in less than a few days and distributed globally by atmospheric circulation on timescales of several weeks.

Methane and Meteors Live Separate Lives: In our analysis we compare the times and data of all 19 MSL/SAM methane observations to date with the occurrence of predicted meteor showers. Our measure of time is the Solar Longitude (L_s) of Mars on its orbit, where 0˚ is defined as the start of the Northern Spring Equinox [8]. Mars travels roughly 0.5˚ L_s per day. For each methane observation we go back in time by 15˚, 30˚ and 60˚ of L_s and evaluate the number of meteor showers predicted to occur in that time period [4,7]. A simple statistical analysis shows that most meteor events "correlate" with *low* values of methane and we find no correlation between the occurrence of meteor showers on Mars and high values of methane. In addition we have looked at each individual methane measurement of the TLS for MY31-MY33 to investigate any correlation, or lack of it, with known meteor events. We do that not just for the high methane data but the rest of the data also that show only a low background level, which has been determined very precisely to be as low as 0.25 ppbv [2]. Again, this analysis confirms that there is no systematic correlation between the martian methane detected by the TLS and the meteor events at Mars.

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