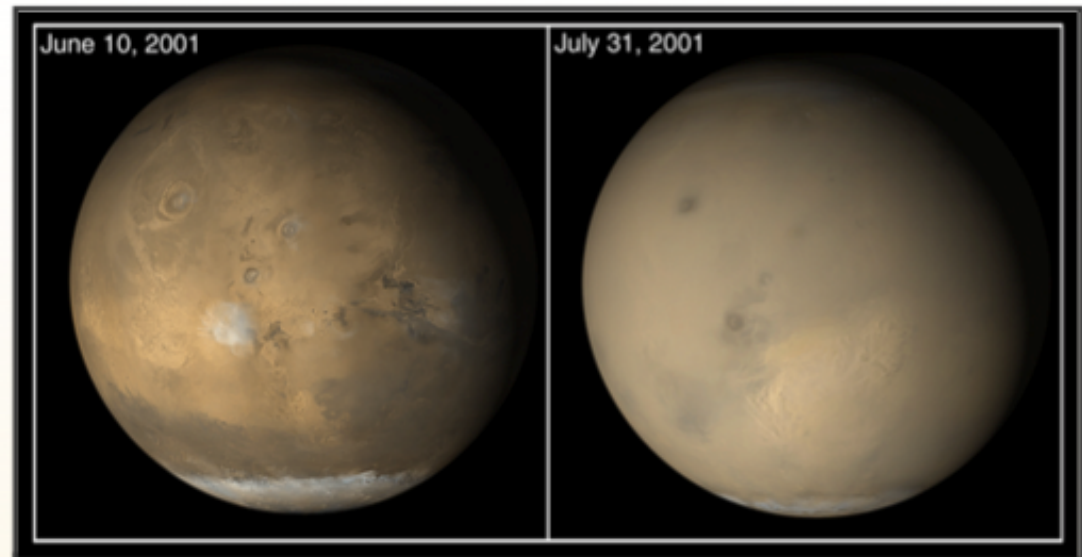
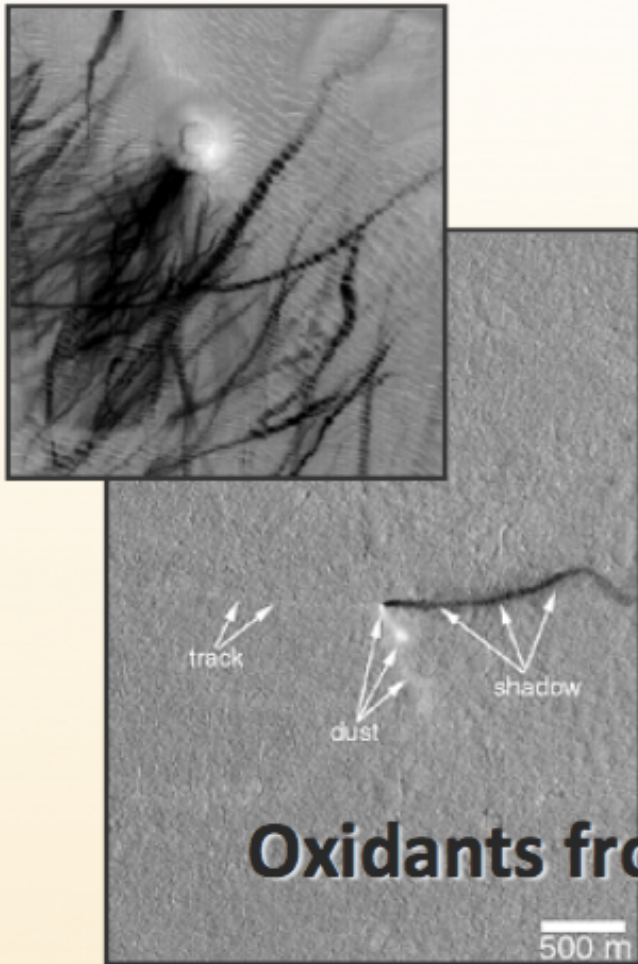


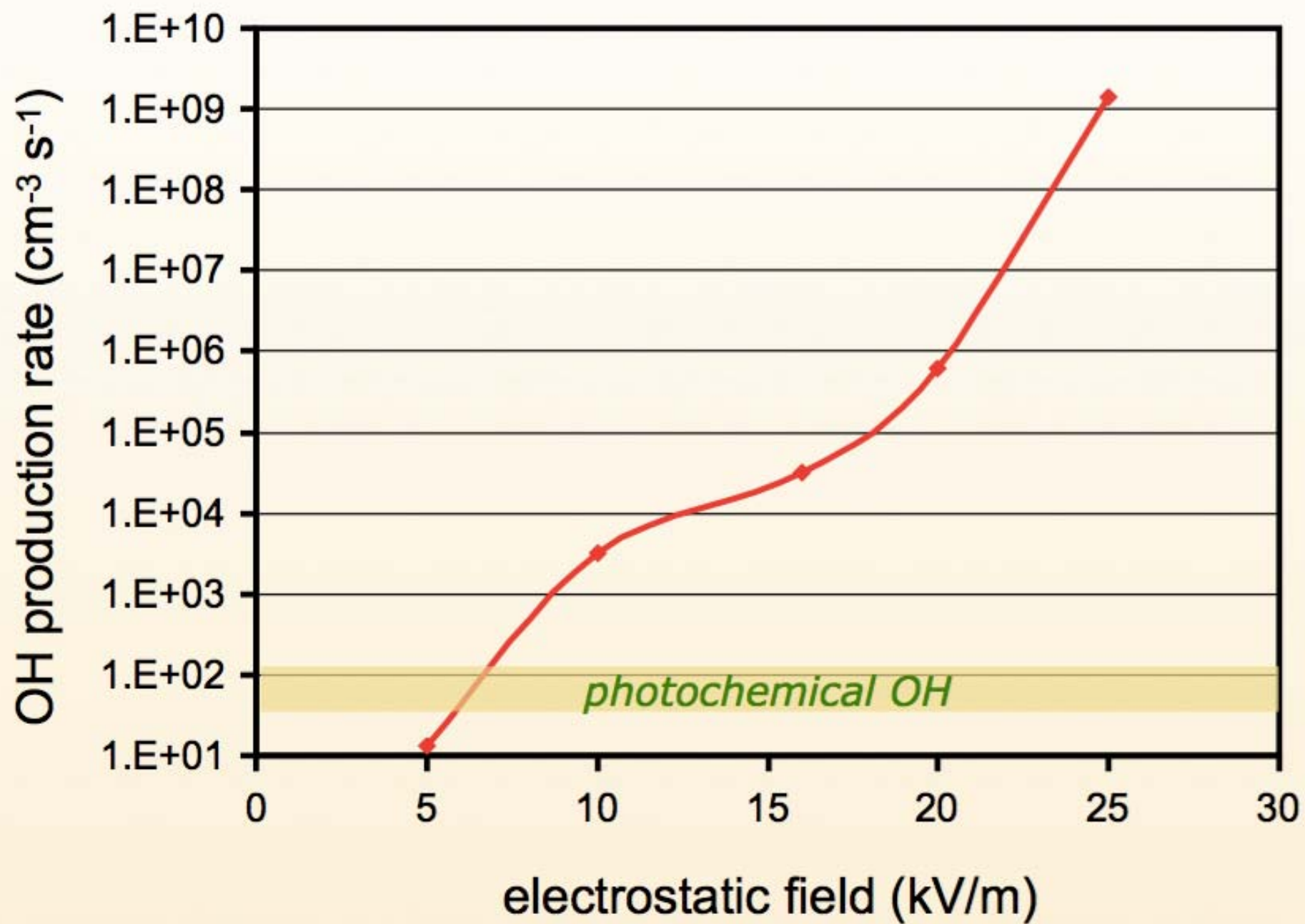
# Dust and Heterogeneous Chemistry

**S. Atreya, M. Mischna, P. Gao, M.  
Wong, M. Mumma, M. Okumura, A.  
Kleinboehl, P. Wennberg, Y. Yung, P.  
Chen, F. Lefevre, C. Webster**

# aeolian triboelectricity



**Oxidants from martian dust activity**



# Atreya email

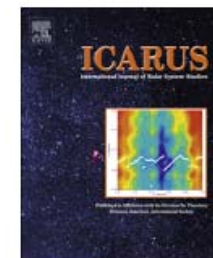
Besides not having anything new on heterogeneous chemistry, I have yet to convince myself heterogeneous chemistry plays a significant role in methane production or loss.



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## A sink for methane on Mars? The answer is blowing in the wind



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### ARTICLE INFO

#### Article history:

Received 11 September 2013

Revised 5 March 2014

Accepted 15 March 2014

Available online 31 March 2014

#### Keywords:

Mars, atmosphere

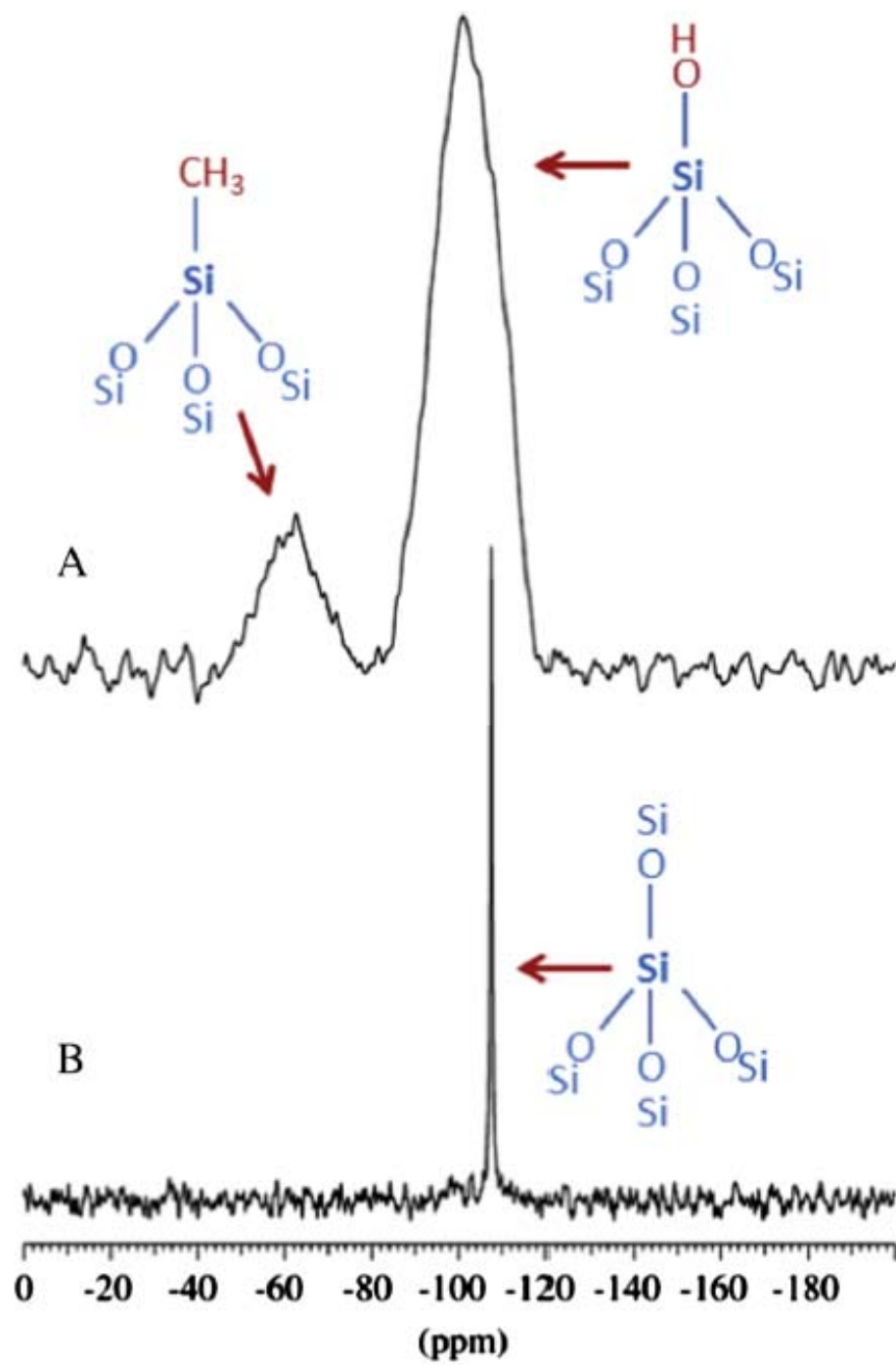
Aeolian processes

Atmospheres, chemistry

### ABSTRACT

Tumbling experiments that mimic the wind erosion of quartz grains in an atmosphere of  $^{13}\text{C}$ -enriched methane are reported. The eroded grains are analyzed by  $^{13}\text{C}$  and  $^{29}\text{Si}$  solid-state NMR techniques after several months of tumbling. The analysis shows that methane has reacted with the eroded surface to form covalent  $\text{Si-CH}_3$  bonds, which stay intact for temperatures up to at least  $250^\circ\text{C}$ . The NMR findings offer an explanation for the fast disappearance of methane on Mars.

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ICARUS **111**, 124–150 (1994)

# A Photochemical Model of the Martian Atmosphere

HARI NAIR, MARK ALLEN,<sup>1</sup> ARIEL D. ANBAR, AND YUK L. YUNG

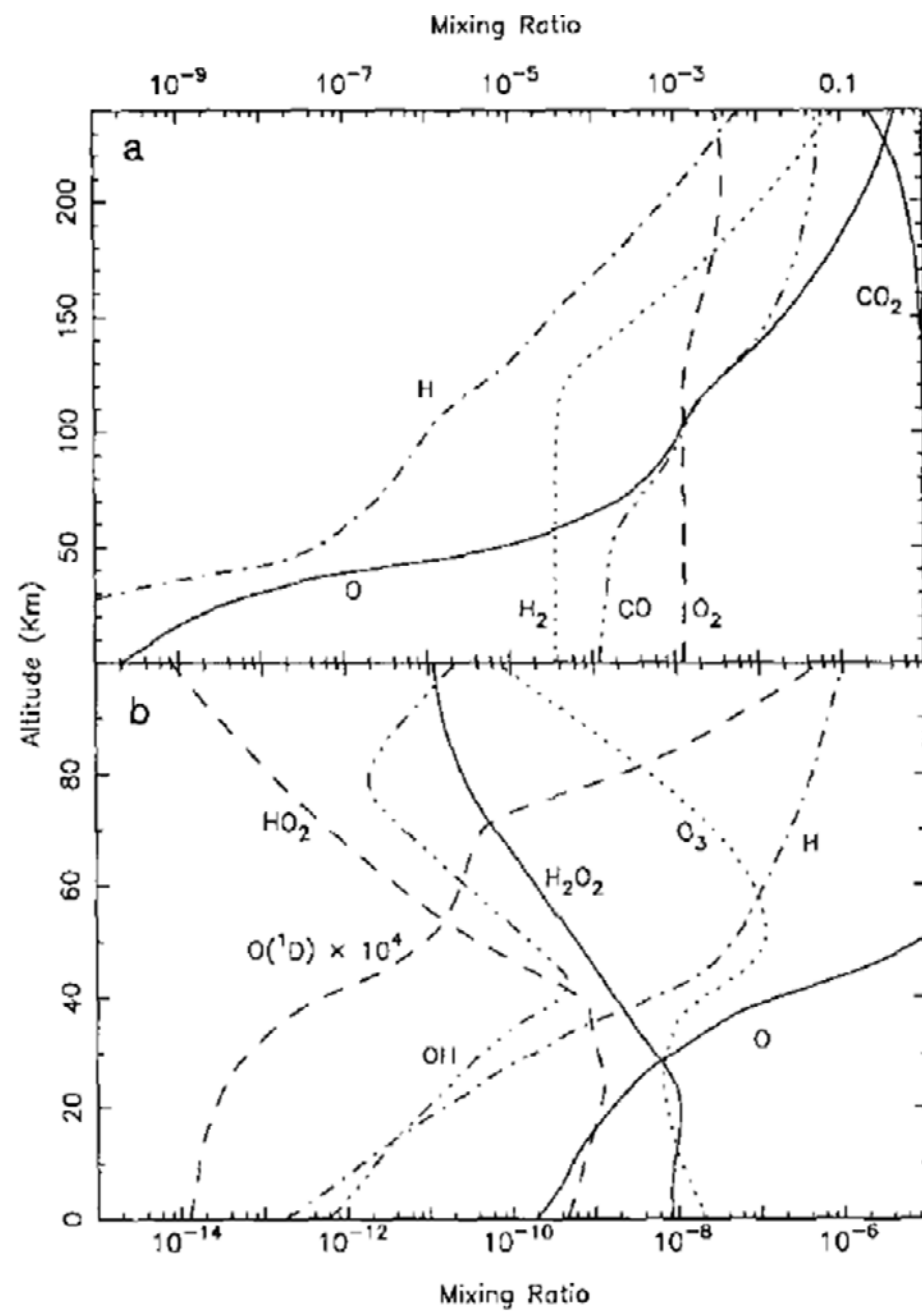
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AND

R. TODD CLANCY

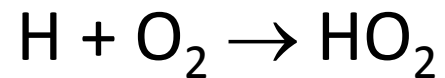
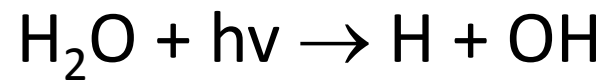
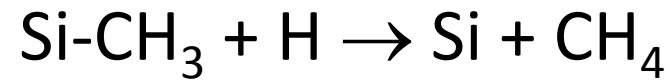
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Received March 14, 1994; revised May 31, 1994





# Release Mechanism



# Rates

$$[H] \sim 10^4 / \text{cc}$$

$T \sim$  month if fast

$$[HO_2] \sim 10^7 / \text{cc}$$

$T \sim$  days if reasonably fast





# Hypotheses for Near-Surface Exchange of Methane on Mars

Renyu Hu,<sup>1,2</sup> A. Anthony Bloom,<sup>1</sup> Peter Gao,<sup>2</sup> Charles E. Miller,<sup>1</sup> and Yuk L. Yung<sup>1,2</sup>

## Abstract

The Curiosity rover recently detected a background of 0.7 ppb and spikes of 7 ppb of methane on Mars. This *in situ* measurement reorients our understanding of the martian environment and its potential for life, as the current theories do not entail any geological source or sink of methane that varies sub-annually. In particular, the 10-fold elevation during the southern winter indicates episodic sources of methane that are yet to be discovered. Here we suggest a near-surface reservoir could explain this variability. Using the temperature and humidity measurements from the rover, we find that perchlorate salts in the regolith deliquesce to form liquid solutions, and deliquescence progresses to deeper subsurface in the season of the methane spikes. We therefore formulate the following three testable hypotheses. The first scenario is that the regolith in Gale Crater adsorbs methane when dry and releases this methane to the atmosphere upon deliquescence. The adsorption energy needs to be  $36 \text{ kJ mol}^{-1}$  to explain the magnitude of the methane spikes, higher than existing laboratory measurements. The second scenario is that microorganisms convert organic matter in the soil to methane when they are in liquid solutions. This scenario does not require regolith adsorption but entails extant life on Mars. The third scenario is that deep subsurface aquifers produce the bursts of methane. Continued *in situ* measurements of methane and water, as well as laboratory studies of adsorption and deliquescence, will test these hypotheses and inform the