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An Atmospheric Column Model Coupled to Surface Adsorption for Martian Methane Production in Gale Crater Using JSC-1 Martian Simulant with Metallic Sulfates KEITH ANDREW, ERIC STEINFELDS, Physics and Astronomy, Western Kentucky University, KRISTOPHER ANDREW, Physics and Astronomy, University of Kentucky , MELINDA THOMAS, Physics and Astronomy, Western Kentucky University, ALICIA PESTERFIELD, Department of Chemistry, Western Kentucky University , QUENTIN LINEBERRY, Applied Physics Institute — We consider an atmospheric column model with solar UV forcing and competitive Langmuir, Freundlich, and BET adsorption based reactions at the atmosphere-surface interface to investigate methanogenesis on Mars. By combining Curiosity rover data, with the Mars Climate Database 5.2 and lab measurements of JSC-1 Martian Regolith Simulant we model the near surface adsorption reaction pathways linked to methane production. The effects of freezing point depression from metallic hydrated sulfates and a Clausius-Clapeyron mixed state phase give rise to subsurface liquid interactions that add to the Bloom model of deliquescence and biogenetic sources for methane. We numerically solve an integro-differential equation for methane production that can be cast as a Volterra Equation Column Model yielding subsurface production of methane that is moderated by the local daily and seasonal variations of solar radiation. We find that there are reasonable values for the geochemical reaction rates as functions of local temperature, solar radiation, humidity, partial pressure, and soil granularity to produce methane levels that compete with biogenic extremophile based sources.

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