



Clathrate hydrates as possible source of episodic methane releases on Mars

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Methane has been shown to vary with location and time in the Martian atmosphere, with abundances of up to tens of parts-per-billion by volume (ppbv). Since methane is short-lived on geological time scales, its presence implies the existence of an active, current source of methane that is yet to be understood.

In this study we investigate the destabilization of subsurface reservoirs of clathrate hydrates as a possible geological source of methane. Clathrate hydrates are crystalline compounds constituted by cages of hydrogen-bonded water molecules, inside of which guest gas molecules are trapped. We show the present-day maps of methane clathrate stability zones, in particular in the vicinity of Gale Crater where the Sample Analysis at Mars (SAM) suite on the Curiosity rover has made in situ measurements of atmospheric methane, during more than 3 years. Curiosity has observed spikes of elevated methane levels of ~ 7 ppbv on four sequential observations over a 2-month period. The possibility of episodic releases consistent with curiosity observations from a subsurface clathrate source, is investigated using a gas transport through porous Martian regolith considering different depths of reservoirs. Transport of the released methane spike into the atmosphere is simulated using the PlanetWRF model.