The Search for Organic Compounds of Martian Origin in Gale Crater by the Sample Analysis at Mars (SAM) Instrument on Curiosity

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One of the key objectives of the Mars Science Laboratory rover and the Sample Analysis at Mars (SAM) instrument suite is to determine the inventory of organic and inorganic volatiles in the atmosphere and surface regolith and rocks to help assess the habitability potential of Gale Crater. The SAM instrument on the Curiosity rover can detect volatile organic compounds thermally evolved from solid samples using a combination of evolved gas analysis (EGA) and gas chromatography mass spectrometry (GCMS) (Mahaffy *et al.* 2012). The first solid samples analyzed by SAM, a scoop of windblown dust and sand at Rocknest, revealed several chloromethanes and a C4-chlorinated hydrocarbon derived primarily from reactions between a martian oxychlorine phase (e.g. perchlorate) and terrestrial carbon from *N*-methyl-*N*-(*tert*-butyldimethylsilyl)-trifluoroacetamide (MTBSTFA) vapor present in the SAM instrument background (Glavin *et al.* 2013). After the analyses at Rocknest, Curiosity traveled to Yellowknife Bay and drilled two separate holes in a fluvio-lacustrine sediment (the Sheepbed unit) designated John Klein and Cumberland. Analyses of the drilled materials by both SAM and the CheMin X-Ray Diffraction instrument revealed a mudstone consisting of ~20 wt% smectite clays (Ming *et al.* 2013; Vaniman *et al.* 2013), which on Earth are known to aid the concentration and preservation of organic matter. Oxychlorine compounds were also detected in the Sheepbed mudstone during pyrolysis; however, in contrast to Rocknest, much higher levels of chloromethanes were released from the Sheepbed materials, suggesting an additional, possibly martian source of organic carbon (Ming *et al.* 2013). In addition, elevated abundances of chlorobenzene and a more diverse suite of chlorinated alkanes including dichloropropane and dichlorobutane detected in Cumberland compared to Rocknest suggest that martian or meteoritic organic carbon sources may be preserved in the mudstone (Freissinet *et al.* 2013). Chloromethane and dichloromethane were also identified after thermal volatilization of the surface soils by the GCMS instruments at the Viking landing sites, although no other chlorinated hydrocarbons were reported (Biemann *et al.* 1977). Here we focus on the origin of the chlorinated hydrocarbons detected in the Sheepbed mudstone by SAM and the implications for the preservation of organic matter in near-surface materials on Mars.

References

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