Evolved Gas Measurements Planned for the Lower Layers of the Gale Crater Mound with the Sample Analysis at Mars Instrument Suite

The lower mound strata of Gale Crater provide a diverse set of chemical environments for exploration by the varied tools of the Curiosity Rover of the Mars Science Laboratory (MSL) Mission. Orbital imaging and spectroscopy clearly reveal distinct layers of hydrated minerals, sulfates, and clays with abundant evidence of a variety of fluvial processes. The three instruments of the MSL Sample Analysis at Mars (SAM) investigation, the Quadrupole Mass Spectrometer (QMS), the Tunable Laser Spectrometer (TLS), and the Gas Chromatograph (GC) are designed to analyze either atmospheric gases or volatiles thermally evolved or chemically extracted from powdered rock or soil. The presence or absence of organic compounds in these layers is of great interest since such an in situ search for this type of record has not been successfully implemented since the mid-70s Viking GCMS experiments. However, regardless of the outcome of the analysis for organics, the abundance and isotopic composition of thermally evolved inorganic compounds should also provide a rich data set to complement the mineralogical and elemental information provided by other MSL instruments. In addition, these evolved gas analysis (EGA) experiments will help test sedimentary models proposed by Malin and Edgett (2000) and then further developed by Milliken et al (2010) for Gale Crater.
In the SAM EGA experiments the evolution temperatures of H_2O, CO_2, SO_2, O_2, or other simple compounds as the samples are heated in a helium stream to 1000°C provides information on mineral types and their associations. The isotopic composition of O, H, C, and S can be precisely determined in several evolved compounds and compared with the present day atmosphere. Such SAM results might be able to test mineralogical evidence of changing sedimentary and alteration processes over an extended period of time. For example, Bibring et al (2006) have suggested such a major shift from early nonacidic to later acidic alteration.
We will illustrate through a variety of evolved gas experiments implemented under SAM-like gas flow and temperature ramp conditions on terrestrial analog minerals on high fidelity SAM breadboards the type of chemical information we expect SAM to provide.

Bibring, J.-P., et al. (2006), Global mineralogical and aqueous Mars history derived from OMEGA/Mars Express data, Science, 312, 400–404, doi:10.1126/science.1122659.

Malin, M. C., and K. S. Edgett (2000), Sedimentary rocks of early Mars, Science, 290, 1927–1937, doi:10.1126/science.290.5498.1927.

Milliken, R. E., J. P. Grotzinger, and B. J. Thomson (2010), Paleoclimate of Mars as captured by the strati- graphic record in Gale Crater, Geophys. Res. Lett., 37, L04201, doi:10.1029/2009GL041870.

Authors
Paul Mahaffy