

Evolved Gas Analysis of the Rocknest aeolian bedform, Gale Crater, Mars

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The Sample Analysis at Mars (SAM) Investigation on the Mars Science Laboratory (MSL) is designed to address the past and present habitability of Mars by exploring molecular and elemental chemistry relevant to life. The SAM instrument suite includes a Quadrupole Mass Spectrometer (QMS) equipped with an electron ionization source, and a pyrolysis oven capable of smart ramping from ambient temperatures up to 1000°C. This compilation of hardware enables the chemical characterization of martian rock/regolith by Evolved Gas Analysis (EGA), a technique used to identify and quantify the abundances and isotopic compositions of volatile organic and inorganic molecules released during pyrolysis.

Regolith collected at the Rocknest aeolian bedform, which may be representative of local and possibly global unconsolidated surface materials on Mars, was characterized via EGA techniques and found to contain wt.%-levels of H₂O, SO₂, CO₂, and O₂, and trace amounts of HCl, H₂S, NH₃, NO, and HCN. The evolution of these gases suggests a sample mineralogy formed under alkaline (carbonates) and possibly acidic (sulfates) conditions. The presence of both oxidized (perchlorates) and reduced phases (sulfides) indicates a physical mixture in chemical disequilibrium, thus providing a chemical potential capable of supporting life.