Microbial habitability in Gale Crater: Sample Analysis at Mars (SAM) instrument detection of microbial essential carbon and nitrogen.

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Chemical analyses of Mars soils and sediments from previous landed missions have demonstrated that Mars surface materials possessed major (e.g., P, K, Ca, Mg, S) and minor (e.g., Fe, Mn, Zn, Ni, Cl) elements essential to support microbial life. However, the detection of microbial essential organic-carbon (C) and nitrate have been more elusive until the Mars Science Laboratory (MSL) rover mission. Nitrate and organic-C in Gale Crater, Mars have been detected by the Sample Analysis at Mars (SAM) instrument onboard the MSL Curiosity rover. Eolian fines and drilled sedimentary rock samples were heated in the SAM oven from ~30 to 860°C where evolved gases (e.g., nitrous oxide (NO) and CO_2) were released and analyzed by SAM's quadrupole mass spectrometer (MS). The temperatures of evolved NO was assigned to nitrate while evolved CO_2 was assigned to organic-C and carbonate. The CO_2 releases in several samples occurred below 450°C suggesting organic-C dominated in those samples. As much as 7 µmole NO_3-N/g and 200 µmole CO_2-C/g have been detected in the Gale Crater materials. These N and C levels coupled with assumed microbial biomass (9×10^{-7} µg/cell) and C (0.5 µg C/µg cell) and N (0.14 µgN/µg cell) requirements, suggests that <1 % and <10% of Gale Crater C and N, respectively, would be required if available, to accommodate biomass requirements of 1×10^5 cells/g sediment. While nitrogen is the limiting nutrient, the potential exists that sufficient N and organic-C were present to support limited heterotrophic microbial populations that may have existed on ancient Mars.