

# Potential lifestyles in ancient environments of Gusev crater, Mars

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Habitable environments must sustain liquid water at least intermittently and also provide both chemical building blocks and useful sources of energy for life. Observations by Spirit rover indicate that conditions have probably been too dry to sustain life, at least since the emplacement of the extensive basalts that underlie the plains around the Columbia Memorial Station landing site. Local evidence of relatively minor aqueous alteration probably occurred under conditions where the activity of water was too low to sustain biological processes as we know them.

In contrast, multiple bedrock units in West Spur and Husband Hill in the Columbia Hills have been extensively altered, probably by aqueous processes. The Fe in several of these units has been extensively oxidized, indicating that, in principle, any microbiota present during the aqueous alteration of these rocks could have obtained energy from Fe oxidation. Spirit discovered olivine-rich ultramafic rocks during her descent from Husband Hill southward into Inner Basin. Alteration of similar ultramafic rocks on Earth can yield H<sub>2</sub> that can provide both energy and reducing power for microorganisms. Spirit's discovery of "salty" soil horizons rich in Fe and/or Mg is consistent with the aqueous dissolution and/or alteration of olivine. Such processes can oxidize Fe and also yield H<sub>2</sub> under appropriate conditions. Very high S concentrations in these salty deposits indicate that soluble salts were mobilized by water and/or that S oxidation, a potential energy source for life, occurred. The Athena team has not yet established whether these salt components were deposited as large beds in ancient water bodies or, for example, were concentrated by more recent groundwater activity. Collectively these observations are consistent with the possibility that habitable environments existed at least intermittently in the distant geologic past.