

Organic sulfur compounds in extremophile metabolisms

M. SCHULTE¹ AND K.L. ROGERS²

¹NASA Ames Research Center, MS 239-4, Moffett Field, CA
94035 USA, (Mitchell.Schulte@nasa.gov)

²Dept. of Earth & Planetary Sciences, Washington University,
St. Louis, MO 63130 USA, (rogers@levee.wustl.edu)

Sulfur is a key component of metabolic and biochemical processes in many organisms that inhabit extreme environments. Inorganic sulfur redox reactions are nearly ubiquitous in the metabolisms of known thermophiles and use of reduced organic sulfur compounds may also be common. In low temperature environments, both methanogens and sulfate-reducers have been shown to metabolize dimethylsulfide (DMS) and methanethiol (MSH) (Tanimoto & Bak, 1994). Given that methanogens and sulfate reducers are also found in high temperature environments, it is likely that DMS, MSH and other reduced organic sulfur compounds are energy sources in hydrothermal systems. However, the energy yields of metabolic reactions among organic sulfur compounds under hydrothermal conditions have not been investigated.

Building on our earlier work on thiols (Schulte & Rogers, 2004), we have compiled and estimated thermodynamic properties for alkyl sulfides. We are investigating reactions among various sulfur compounds in a variety of extreme environments, ranging from sea floor hydrothermal systems to organic-rich sludge. Using thermodynamic data and the revised HKF equations of state, along with geochemical constraints imposed by extreme environments, we are able to estimate the abiotic production of organic sulfur compounds. In hydrothermal systems in which H₂ and H₂S concentrations are buffered by the PPM mineral assemblage, equilibrium activities of DMS are as high as 10⁻³ through formation with millimolar concentrations of CO₂. Higher activities are obtained when DMS formation from CO is considered. We also calculate the amount of energy that would be available to putative DMS- and MSH-metabolizing organisms in hydrothermal environments.

References

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