Elemental sulfur mineralogy, surface chemistry, and aqueous chemistry affecting microbial metabolisms

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Elemental sulfur is a component in sulfur systems that has a complexity that is often oversimplified but is central to many different intracellular and extracellular metabolisms. The mineral form can exist as over 180 different allotropes and polymorphs, occurs in nanocrystalline and disordered forms, and is strongly affetced by organic complexation in different ways. Each of these forms can additionally be part of a number of important reactions involving other sulfur intermediates, including polysulfides and thiosulfate. Fortunately a number of analytical techniques can be utilized to investigate the form of elemental sulfur and its role in sulfur cycling reactions. Of particular importance are *in situ* and real time techniques that can characterize elemental sulfur and other sulfur intermediates; Au-amalgam voltammetry, Raman spectroscopy, and UV-Visible spectroscopy can be utiliized in flow-through systems and for field measurements. These measurements can be combined with other lab-based techniques to begin sorting out how changes in elemental sulfur 'character' (mineralogy, surface chemistry, dissolved aquoeus forms) can be controling factors in overall sulfur cycling and in the forms of sulfur that are either available metabolites for microorganisms or indicators of particular microbial metabolic products. Data from a selection of Yellowstone National Park thermal springs, meromictic lakes (Green Lake in NY and Mahony Lake in BC), and sulfidic springs (Frassasi system, Italy) will be presented and discussed with special emphasis on elemental sulfur.

Equations of State online calculation for the study of fluid inclusions

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Equation of state (EOS) is very important in the interpretation of fluid-inclusion data because it can be used to derive homogenization conditions, isochores, and internal pressures of fluid inclusions. There are many equations or thermodynamic models used in the study of fluids, but most of them lack consistent accuracy over a meaningful temperature-pressure space, yielding unreliable predictions. Therefore, caution must be taken in choosing or developing accurate EOS or models to study fluid inclusions. The objective of this study is to apply the updated EOS or models developed by previous researchers or us to give the most accurate calculation of homogenization pressure and isochores. The online calculation is made available on the website (www.geochem-model.org).

For pure fluids like H_2O, CO_2, CH_4, O_2, N_2, C_2H_6 or H_2S, and the binary like CO_2-H_2O, CH_4-H_2O and NaCl-H_2O systems, the best EOS in terms of precision and applicable range will be presented. Programs for the CO_2-H_2O-NaCl and H_2O-NaCl-CH_4 systems can be calculated from the website: http://geotherm.ucsd.edu/geofluids/run.html, but a better version is still under development. Once the homogenization temperature and the composition are determined, the internal pressure of the fluid inclusion and the isochores can be calculated.