Formation and metabolism of organic sulfur compounds in serpentinizing fluids

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Recently published chemical data for the Lost City fluids [1, 2] allow us to evaluate the potential for formation of organic sulfur compounds in a serpentinizing environment. Methanethiol (MeSH) has been detected in fluids of basalt-hosted hydrothermal vents (6), but no measurements are currently available of the organic sulfur composition of Lost City fluids. Combining reported hydrogen, carbon dioxide and hydrogen sulfide concentrations from chimney structures at Lost City with thermodynamic properties at *in situ* temperatures and pressures (40-90°C and 75-90 bars; [1, 3]) we calculate equilibrium organic sulfur compound abundances. At Lost City, MeSH activities range from 10^{-7} to $10^{-14.6}$ and dimethylsulfide (DMS) activities range from $10^{-7.6}$ to $10^{-11.5}$.

These data also allow us to evaluate the potential of these organic sulfur compounds to serve as metabolic energy sources for microorganisms that inhabit these environments [7, 8]. For example, methanogens have been demonstrated to use methanethiol and dimethylsulfide as substrates [8], and sulfate reducers can oxizide MeSH and DMS at temperatures up to 55°C in anaerobic environments [9]; however, little is known about organisms that might use organic sulfur compounds under the conditions found at Lost City.

In Lost City hydrothermal environments, reduction of both MeSH and DMS with hydrogen to produce methane can supply energy to microbial communities. Furthermore, while high hydrogen concentrations at Lost City make anaerobic methane oxidation unfavorable, if coupled to sulfate reduction, the overall syntrophic metabolism is energy-yielding. This is consistent with studies showing that these phylotypes are present at Lost City [7].

[1] Proskurowski *et al.* (2006) *Chem. Geol.* **229**, 331-343. [2] Proskurowski *et al.* (2008) *Science* **319**, 604-607. [3] Kelley *et al.* (2005) *Science* **307**, 1428-1434. [4] Schulte & Rogers (2004) *Geochim. Cosmochim. Acta* **68**, 1087-1097. [5] Schulte & Rogers (2008) in prep. [6] Schulte, unpublished data [7] Brazelton *et al.* (2006) *Appl. Envir. Microbiol.* **72**, 6257-6270. [8] Kiene *et al.* (1986) *Appl. Envir. Microbiol.* 52, 1037-1045. [9] Tanimoto & Bak (1994) *Appl. Envir. Microbiol.* **60**, 2450-2455.

A HRTEM- and XRD-based characterization of individual packets and layers of 2:1 clay minerals after treatment with *n*-alkylammonium

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The inability to determine the nature and precise chemical composition of individual layers in interstratified illite-smectite (I-S) with conventional XRD and TEM techniques prevents determination of all phases present during the burial diagenetic evolution of smectite to illite. Past microanalytical investigations were restricted by instrumental limitations and not able to analyse the chemical composition of single clay mineral layers. The application of the *n*-alkylammonium method and improved resolution in latest-generation TEM, however, has enhanced the analysis of nanoscale 2:1 clay mineral structures. In this study, we investigated individual packets and layers of smectite, illite, rectorite, and mica standards and compared them to clay mineral phases observed in diagenetic separates from the Jeanne d'Arc Basin, offshore eastern Canada.

In the course of this investigation (1) expandable and nonexpendable components were differentiated; (2) variations in the density of interlayer charge of the expandable components were determined; (3) fundamental particles were distinguished from short-range ordered structures; (5) the ordering of the T-O-T layers was related to their chemical composition, as measured directly by TEM based nano-scale energy dispersive X-ray spectroscopy (EDS) and (6) all types of particles present (not only the coherent sequences, as detected by XRD) were characterized.