

## Serpentinization and the flux of reduced volatiles to the seafloor

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Serpentinization of ultramafic rocks has long been recognized to be a source of reduced volatile compounds, particularly hydrogen ( $H_2$ ) and methane ( $CH_4$ ). Over the last couple of decades, there has been increasing scientific interest in the capacity of these reduced compounds to support chemolithoautotrophic biological communities, both now and on the early Earth. In the deep sea, serpentinization of ultramafic rocks can serve as a source of  $H_2$  and  $CH_4$  to biological communities living within the ocean crust, at the seafloor where fluids are discharged from serpentinites, and in the overlying water column. The abundance and spatial distribution of serpentinite-supported autotrophic communities depends on when, where, and how much reduced volatiles are generated.

The production of reduced volatiles during serpentinization depends strongly on the fate of Fe as the reaction proceeds, since the generation of reduced compounds is directly linked to the oxidation of Fe(II) to Fe(III). Serpentinization is often portrayed as a fairly straightforward process whereby ultramafic rocks are converted to a limited set of minerals dominated by serpentine polymorphs, brucite, and magnetite. Within this rather simple framework, however, there is a lot of room for complexity. In particular, it is increasingly clear from petrologic studies, laboratory experiments, and numerical modeling that the distribution of Fe among reaction product minerals, and the oxidation state of Fe in those products, is highly variable, and is dependent on a complex mixture of factors including temperature, kinetics of dissolution, precipitation and diffusion, bulk rock and mineral compositions, extent of reaction, and thermodynamic constraints. A recent bevy of laboratory experiments by both ourselves and others [e.g., 1-3] focusing on the fate of Fe during serpentinization is providing new insights into pathways leading to generation of  $H_2$  and other reduced compounds, and will provide the basis for improved models of the flux of reduced volatiles from serpentinization environments within the ocean crust. We will present results from a series of experiments that examine production of  $H_2$  and concurrent mineral alteration during serpentinization of olivine and peridotite at temperatures from 230 to 320 °C.

[1] Seyfried et al. (2007) *Geochim. Cosmochim. Acta* **71**, 3872-3886. [2] Marcaillou et al. (2011) *Earth Planet. Sci. Lett.* **303**, 281-290. [3] Malvoisin et al. (2012) *J. Geophys. Res.* **117**, doi:10.1029/2011JB008612.

## Investigating biomineralized structures and morphology associated with laminated freshwater stream terraces: Stromatolites?

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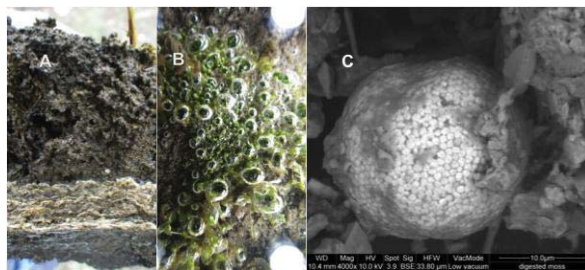
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### Introduction

Biogeochemical cycles are considered the driving force behind how elements are transported and buried in sediments. A principle mechanism in the addition and removal of elements in biogeochemical cycles involves biomineralization. In the strict context we can classify biomineralization as extracellular, intracellular or as catalytically induced depending on the organisms in question. Investigation of the Erickson Creek watershed BC Canada, has led to the discovery of interesting phenomena involving cementation of the streambeds possibly affecting aquatic habitats adjacent to coal mine impacted riparian zones.

These mineralized mats are calcareous in nature and have managed to form densely layered sequences associated with proliferation of freshwater mosses/biofilms. The streams support localized assemblages characterized by benthic, alkaliphilous diatoms with relatively low species richness. To investigate the process attributing to the biomineralized event, samples were collected to determine the casual relationships between the mosses, bacteria and the *in situ* mineralization that is taking place (Figure 1). SEM and Raman microscopy provide structural, morphological, and chemical information about the biomineralized structure within aged layers. In addition, DNA extraction, species richness and identification, was used to determine biological composition.



**Figure 1:** (A) laminated structure of biomineralized mat, (B) top down surface showing freshwater moss, (C) SEM micrograph suggesting the existence of localized chemically reduced microhabitats with S/Fe precipitation.

### Conclusion

This data will provide insight and address questions pertaining to the cementation process at this location and its affects on aquatic habitats influencing the biogeochemistry and microorganisms that live in this environmental system.