Isotopic biosignatures associated with freshwater microbialites and carbonate precipitating microbial mats

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Microbialites present at Pavilion Lake, British Columbia, Canada and nearby microbial mats on the Cariboo Plateau present a unique opportunity to assess the diversity and metabolic variability of predominantly cyanobacterial, carbonate precipitating microbial communities. These modern microbialites and microbial mats represent an opportunity to constrain isotopic variability and the potential for preservation of associated microbial biosignatures.

Isotopic analyses ($\delta^{13}C$) were used to investigate the potential for organic and inorganic microbial biosignatures. Bulk cell analysis of microbialite and microbial mat communities showed inorganic to organic isotopic depletions of 23-25 ‰, consistent with photosynthetic fractionations. Observations of ^{13}C-enrichments of microbialite surface carbonate of up to 2-3 ‰ are indicative of biologically induced ^{13}C-enrichment of DIC. Such enrichment has the potential to be preserved in ancient microbialite systems. In contrast, the microbial mats demonstrated significant variations in carbonate $\delta^{13}C$ values ranging from isotopic enrichments to ^{13}C-depleted carbonate.

Variations in phospholipid fatty acid (PLFA) distribution demonstrate that Pavilion Lake microbialite community structure varies seasonally and spatially. The Cariboo Plateau mats likewise exhibit significant inter-lake and intra-mat variations in PLFA distribution. $\delta^{13}C$ of microbialite individual PLFA were depleted with respect to bulk cells and demonstrated a range in $\delta^{13}C$ values of up to 8 ‰ from a single sample, in contrast to the commonly reported value of 9 ‰ for cyanobacteria. Seasonal variations in Pavilion Lake microbialite PLFA $\delta^{13}C$ values ranging from 0 to 4 ‰, indicate system-wide variations in isotopic signatures.

Observation of significant variations in biomarkers and isotopic biosignatures on both seasonal and spatial scales highlights the need to constrain such variability in order to accurately interpret signatures preserved in the geologic record or exobiological systems.

Isotopic characterisation of magmatic volatiles as new tool for tracing of hidden active magmatic processes

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Our investigation area is part of the European Cenozoic rift system and located at Czech-German border close to the earthquake swarm region Nový Kostel. Comprehensive isotopic studies of free fluids (CO_2, He) have been started 15 years ago and have in particular included three extended chemical and isotope monitoring studies lasting for several years each [2].

CO_2 is the major component of the escaping magmatic volatiles. The degassing centers Cheb basin and Mariánské Lázně are characterized by high CO_2 fluxes having the same level of $\delta^{13}C$ values as well as high portions of upper mantle derived helium. Between 1993 and 2000 an increase of mantle-derived helium has been observed at degassing locations of the Cheb basin whereas at locations of Mariánské Lázně degassing center the mantle helium portions were nearly the same [1]. The repeated annual samplings (from 2003 to 2007) have yielded further increasing $^3He/^4He$ ratios at locations of the Cheb basin and nearly unchanged values at locations of the surroundings of Mariánské Lázně. These findings have been interpreted as indication for a hidden active magmatic process beneath the Cheb basin - a nonvolcanic area in Central Europe. Superimposed to this long-time trend the results of our latest detailed fluid monitoring close to the active fault zone have shown local, three month-lasting $^3He/^4He$ anomalies indicating the occurrence of dike-like mantle-derived magma intrusions. The finding of mantle-derived free fluids marked by $^3He/^4He$ ratios within the subcontinental mantle range (> 6Ra), as well as the fault-related increase of upper mantle-derived helium contributions associated with high gas fluxes as a whole confirm the assumption of channel-like degassing on very deep reaching faults. For the first time, a hidden magmatic process in a non-volcanic region has been traced and may improve our knowledge about the connection between intraplate seismicity and repeated magma injections.

[1] Bräuer *et al.* (2005) *GRL* **32**, L08303, doi,10.1029/2004GL022205. [2] Bräuer *et al.* (2008) *G³* **9,** Q04018. doi, 10.1029/2007GC001921.