

Microbial production and transformation of dissolved organic matter in the hydrothermal system

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This study was inspired by the lack of information on the microbial production of dissolved organic matter in course of chemosynthesis and methane oxidation at hydrothermal fields: most of studies didn't take into account the production of dissolved organic matter (DOM), considering only formed and consumed microbial biomass in the processes of microbial transformation of endogenous gases coming from hydrothermal solutions.

It is well known that the formation of organic compounds in the zones of hydrothermal activity proceeds under the influence of a number of physicochemical and biogeochemical (extremophile consortiums of bacteria and archaea) factors. We present i) radioisotope measurements of the activity of microbial communities in the hydrothermal fields of the Mid-Atlantic Ridge (MAR) and the East Pacific Rise (EPR), ii) investigation of the rates of microbial CO₂ assimilation, sulfate reduction, methane oxidation, lithotrophic and acetoclastic methanogenesis, and assimilation and oxidation of organic carbon, iii) analysis of samples of sulfide, sulfate, and carbonate hydrothermal deposits of various morphological types. Special attention was paid to the measurement of microbial DOM. We show for deep-sea hydrothermal systems, that in the process of microbial methane oxidation and dark assimilation of carbon dioxide at various temperature gradients of microbial production of DOM in most cases significantly higher than biomass production. Intensities of sulfate reduction and methanogenesis have been measured for the first time at different temperatures and dilution of the hydrothermal solution, not only in anaerobic sediments and solutions, but also in water samples of the contact zone and the plume.

The different content of organic compounds in microbiological samples and ore deposits from hydrothermal systems related to basalt volcanism and serpentinization of ultrabasic rocks testifies the different genesis of DOM.

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Production and diffusion of cosmogenic noble gases: Using open-system behavior to study surface processes

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We present a new geochemical approach to obtaining information about the temperature and surface exposure history of rocks and sediments. The approach is based on the simultaneous production and diffusion of cosmogenic noble gases in minerals at and near Earth's surface, and aims to take advantage of "open-system" behavior that has previously been viewed only as an undesirable obstacle to surface exposure dating. Given knowledge of diffusion kinetics, the relative abundances of cosmogenic ³He, ²¹Ne and other cosmogenic nuclides in natural samples constrain their temperature histories during surface exposure. When interpreted with a simple theoretical framework, and using laboratory-determined kinetics of He and Ne diffusion [1-3], our preliminary results indicate several pairs of common minerals and easily measurable cosmogenic noble gases that display partial retention at Earth surface temperatures. We focus initially on the minerals quartz and feldspars; these provide sets of nuclide-mineral systems that can be selected and optimized to constrain mean surface temperatures (and changes therein) across a range of climate settings and lithologies over the last few Ma. As an example, we present preliminary results from quartz-bearing Antarctic sandstones that constrain a mean, effective temperature of approximately -15 °C over 5-10 ka of surface exposure. We present the basic theory and fundamental assumptions of this approach, and discuss potential complexity and limitations to the interpretation of these data.

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