Deeply-sourced formate fuels sulfate reducers but not methanogens at Lost City hydrothermal field

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Calcium carbonate chimneys host a unique ecosystem at the Lost City hydrothermal field. Active chimney venting is driven by reactions with ultramafic rock and seawater rather than magmatic activity. Hydrogen produced during these serpentinization reactions can drive the synthesis of organic compounds both biotically and abiotically.

We investigated abiotic carbon production and microbial metabolic pathways at the Lost City hydrothermal field. Compound-specific 14C data demonstrates that formate is mantle-derived and abiotic in some locations and has an additional, seawater-derived component in others [1]. Our results suggest bacteria living in the interior of the chimney metabolize a 14C-free carbon source that is consistent with their utilization of formate.

Metagenomic data is also consistent with the ability of some chimney microorganisms to metabolize formate. The enzyme formate dehydrogenase catalyzes the reversible oxidation of formate to CO_2. Several sequences of the alpha subunit of formate dehydrogenase (*fdhA*) were detected in the chimney metagenomes; the closest bacterial database matches were with sequences related to methylotrophic and sulfate-reducing bacteria [1]. This suggests the dominant member of the archaeal community, the Lost City Methanosarcinales, cannot use formate for methanogenesis. Instead, sulfate-reducing bacteria may be the primary consumers of formate in Lost City chimneys.

Our results suggest a system in which abiotic formate is consistently supplied with pure hydrothermal fluids and utilized by sulfate reducing bacteria who, in part, convert it to CO_2. This CO_2 would briefly be available to other members of the anaerobic microbial community, including the Methanosarcinales. Considering the lack of dissolved inorganic carbon in such systems, the ability to utilize formate may be a key trait for survival in pristine serpentinite-hosted environments.

[1] Lang, S *et al.* (2018) Deeply-sourced formate fuels sulfate reducers but not methanogens at Lost City hydrothermal field. Scientific Reports 8:755