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Bacterial incorporation of relict carbon in the hydrothermal environment of Guaymas Basin

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Radiocarbon analyses of bulk carbon and individual organic compounds are presented for the hydrothermal environment of the Rebecca's Roost vent in the southern trough of the Guaymas Basin hydrothermal field. The ^{14}C concentration of CO_2 and CH_4 in the hottest hydrothermal fluids (317°C) is "radiocarbon dead". These results indicate that rapid-flow fluids entrain minimal young carbon into the dissolved phase, either during downwelling along the flanks of the system, or during upwelling and venting through hydrothermal channels. In contrast, the ^{14}C concentration of off-axis sediments and of the individual fatty acids obtained from a bacterial mat are similar to values reported for hydrothermal petroleum (HP) in this environment [1]. Lower temperature hydrothermal fluids moving by diffuse flow through the sediments appear to supply ^{14}C of intermediate age to the bacteria. This carbon may take the form of, or be supplied by processes similar to, the generation of HP. Although the bacterial mat was visibly dominated by *Beggiatoa*, such mats are known to include numerous other species [2]. Individual compound data show that this HP flux is being consumed by the entire bacterial assemblage. Consumption of HP converts pre-aged carbon into fresh bacterial biomass. Subsequently, some of this newly-synthesized material is incorporated into the biomass of heterotrophic consumers, as ^{14}C concentrations of eukaryotic sterols from the mat also yield old ^{14}C ages. Therefore, the entire system may be viewed as a syntrophic consortium that is transforming relict carbon back into labile substrates, fueled by the sulfur cycle as an energy source. Some of this new production may be recycled back into the deep water column, providing a source of pre-aged dissolved organic carbon (DOC) that is more bioavailable than the recalcitrant, polymeric fraction of ancient DOC in the deep water column.

References

[1] Simoneit, B. R. T., and Kvenvolden, K. A. (1994) Comparison of ^{14}C ages of hydrothermal petroleums. *Org. Geochem.* **21**, 525-529.

[2] Dhillon, A., Teske, A., Dillon, J., Stahl, D. A., and Sogin, M. L. (2003) Molecular characterization of sulfate-reducing bacteria in the Guaymas Basin. *Appl. Env. Microbiol.* **69,** 2765-2772.

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Low-temperature hydrothermal mounds and chimneys formed by microbial mediated precipitation of Fe and Si

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Samples of Fe/Si-oxyhydroxide, collected from low-temperature hydrothermal mounds in the rift valley of the Mohns Ridge (71°18'N, 05°47'W), have been studied by scanning electron microscopy (SEM), transmissions electron microscopy (TEM), mass spectrometry and biomolecular analyses. The reddish orange deposits have a microtexture of branching, twisted filaments, similar to stalks of the iron oxidising bacteria *Gallionella ferruginea*. The Fe/Si-oxyhydroxide deposits are situated on hyaloclastites, cemented by silica and minor amounts of Fe-sulfide (about 1 vol%). This indicates that hydrothermal fluids, rich in Si and reduced Fe, Mn and S have been discharged along the fissures. Growth of *Gallionella* at the interface between reduced venting fluid and the surrounding oxidised seawater, has thus resulted chimneys of stalks encrusted and partly embedded in oxidised iron at the seafloor. The diameter of the filaments is in the range of 0.5 - 4 µm. Thin filaments are usually hollow, while thicker filaments are filled. Energy dispersive spectrometry (EDS) analyses show that the filamentous material and material between filaments mainly consists of FeO^t (45 - 60 wt%) and SiO_2 (10 - 24 wt%). TEM diffraction patterns reveal 2-line ferrihydrite and opal-CT. Fine grained particles and thin filamentous structures (< 0.5 µm) between the filaments may however contain up to 12 wt% Mn. 16S rDNA analyses of the material failed to show the presence of *Gallionella*, but sequences of *Actinobacteria*, *Proteobacteria*, *Chloroflexi*, *Bacteroidetes*, and *Planctomycetes* were retrieved. Iron isotope ratios are lighter in the stalks than in the pyrite precipitated in the underlying hyaloclastites. Inorganic ferrihydrite precipitation is reported to result in heavier iron isotope ratios. Carbon isotope ratio for delta^{13}C is –21 ‰. This suggests biomediated stalk formation and microbial fractionation of iron and carbon isotope ratios.