Abstract:

Temperature is an important factor regulating the rate of biological processes and, therefore, is likely to exert a selective pressure in the environment. The temperature response of carbon mineralization via bacterial sulfate reduction of polar, temperate and tropical marine sediments was studied in temperature-gradient incubations experiments by measuring sulfate reduction rates (SRR) using $^{35}$S-sulfate. Sediment slurries were incubated in a thermal gradient between -10°C and +50°C to cover the physiological temperature range of the active sulfate-reducing bacteria (SRB) and the resulting temperature response profiles were used to characterize the competitiveness of SRB, in terms of relative SRR at in situ temperatures, the temperature dependence for energy metabolism of SRB and the correlation of cardinal temperatures of sulfate reduction and sediment temperatures. In polar regions, only temperatures close to the freezing point of the sediment limit the rates of sulfate reduction. In these environments SRB exhibited high metabolic rates of ca 10-17% of maximal potential rates at the in-situ temperature of 0°C. Similar relative SRR in temperate and tropical sediments were only observed at temperatures around 15-20°C. These observations imply psychrophilic adaptation of polar SRB and the predominance of mesophilic SRB in warmer latitudes. Further examination of the temperature dependency for sulfate reduction using Arrhenius plots in temperate sediments revealed that tropical sediments exhibited a more limited metabolic regulation at temperatures below 8-18°C and optimal temperature conditions for sulfate reduction closer to their ambient temperatures. Together, the inspection of the temperature responses for metabolic activity of SRB in marine sediments showed that temperature adaptations of SRB form a continuum with respect to their environmental latitude, which implies the potential of environmental temperatures for the selection of adaptive physiologies and for evolutionary divergence of microbiota in different latitudes.