

Co-occurrence of Methanogenesis, Sulfate Reduction, and Iron Reduction in Deep-Sea Sediments

Guizhi Wang

*Graduate School of Oceanography
University of Rhode Island
Kingston, RI 02881
USA
gzhwang@gso.uri.edu*

Arthur J. Spivack

*Graduate School of Oceanography
University of Rhode Island
USA*

Steven D'Hondt

*Graduate School of Oceanography
University of Rhode Island
USA*

Concentration profiles of dissolved chemicals demonstrate that iron reduction, sulfate reduction, and methanogenesis (methane formation) co-occur in subseafloor sediments at Ocean Drilling Program (ODP) Site 1226 of the eastern equatorial Pacific (D'Hondt et al., 2004). This co-occurrence is counter to the generally accepted idea that these processes take place at successively greater depths below the seafloor. This idea is typically explained by a hypothesis that the free energy yields of these processes differ from each other and the process that yields the greatest free energy out-competes the others. In an effort to understand the co-occurrence of these processes at Site 1226, we calculated *in situ* free energy yields of acetate-oxidizing iron reduction, acetate-oxidizing sulfate reduction, and acetoclastic methane formation. Our results indicate that all three reactions are energetically favorable throughout most of the sediment column. *In situ* free energy yields for iron reduction and sulfate reduction are approximately equal to each other and relatively constant at depths where total dissolved sulfide is detectable. For example, sulfate reduction consistently yields 43.9 ± 2.7 (1 σ , n=28) kJ/mol-acetate. Methanogenesis yields about half as much energy as sulfate reduction per mole of acetate [23.9 ± 1.2 kJ (1 σ , n=27)] throughout the sediment column. These results indicate that this subseafloor ecosystem is in some sense a homeostat where multiple pathways co-exist.