Bioenergetics in archaea/sulfate-reducing bacteria aggregates

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Recent studies of sediments from methane seep and vent sites using fluorescence *in situ* hybridization with group-specific ribosomal RNA probes provide detailed, microscopic portraits of microbial aggregates composed of archaea and sulfate-reducing bacteria (SRB). These aggregates are widely assumed to engage in syntrophic methane oxidation, but the actual metabolic processes mediated by the archaea and SRB remain poorly understood. We used a spherical diffusion-reaction model that incorporates thermodynamic controls, realistic aggregate morphology, and essential elements of cell structure to determine how cellular energy yields are affected by aggregate size and morphology, and to investigate the impact of organic matter remineralization on archaea and SRB in the aggregate.

The model provides the following insights: (a) archaea and SRB engaged in syntrophic methane oxidation face a substantial energetic cost for aggregating (a doubling of aggregate size reduces the average energy yield of archaea and SRB by factors of about 5 and 2, respectively); (b) direct contact between archaea and SRB engaged in syntrophic methane oxidation provides only a modest energetic advantage compared to a loose association; (c) remineralization of sedimentary organic matter can have a profound impact on reaction rates and energy yields in archaea/SRB aggregates; and (d) sulfidogenic-methanogenic aggregates that take advantage of fermentation products released during organic matter decay have a substantial energetic advantage over aggregates that rely exclusively on syntrophic methane oxidation.

Moreover, the model calls attention to a discrepancy between the observed sulfate reduction rate at a well-characterized methane-seep site and the theoretical upper-limit rate of syntrophic methane oxidation involving interspecies transfer of H_2, formate, acetate, or other chemical intermediates. An analysis of possible errors, ambiguities, and artifacts in modeling and experimental techniques leads us to a surprising conclusion: that archaea/SRB aggregates in methane-seep sediments may be methanogenic rather than methanotrophic.

Heavy metal contents in growth bands of *Porites* corals: Record of anthropogenic and human developments from the Jordanian Gulf of Aqaba

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To assess pollutants and impact of environmental changes in the coastal region of the Jordanian Gulf of Aqaba, concentrations of six metals were traced through variations in five years growth bands sections of recent *Porties* coral skeleton. X-radiography showed annual growth band patterns extending back to the year 1925. All metal profiles (except Fe and Zn) recorded the same metal signature from recent coral (1925-2005) in which low steady baseline levels were displayed in growth bands older than 1965, similar to those obtained from fossil and unpolluted corals. Most metals showed dramatic increase (ranging from 17 to 300 %) in growth band sections younger than 1965 suggesting an extensive contamination of the coastal area since the mid sixties (Fig.1). This date represents the beginning of a period that witnessed increasing coastal activities, constructions and urbanization. This has produced a significant reduction in coral skeletal extension rates. Results from this study strongly suggest that *Porites* corals have a high tendency to accumulate heavy metals in their skeletons and therefore can serve as proxy tools to monitor and record environmental pollution (bioindicators) in the Gulf of Aqaba.

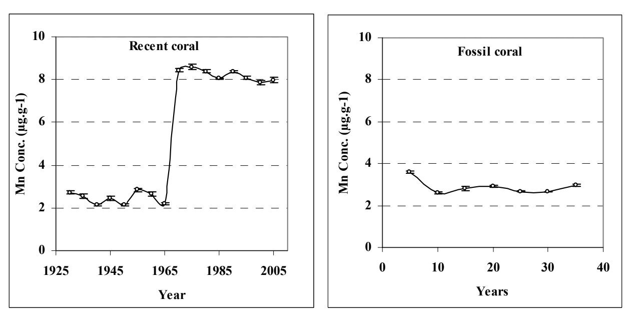

Figure 1: Time series record of Mn concentrations ($\mu g.g^{-1}$) measured in recent (1925-2005) and fossil (35 years long) *Porites* coral sp. collected from the northern Gulf of Aqaba.