Bioirrigation as a source of nutrients for benthic algae: A study of burrow ventilation by ghost shrimp (Thalassinidea) from the Northern Gulf of Mexico.

CHRISTOPHER M. FINELLI

Louisiana Universities Marine Consortium, Chauvin, LA USA, cfinelli@lumcon.edu

The importance of infaunal organisms to a variety of ecological and geochemical processes is well documented. The burrow itself increases the surface area available for microbial growth and exchange of porewater. Moreover, during ventilation these organisms rapidly flush subsurface sediments with oxygenated water and transport inorganic nutrients to the sediment-water interface, potentially stimulating primary production in the surface sediments.

The research in my lab examines burrow ventilation by three species of ghost shrimp. Locally, these shrimp inhabit intertidal sand-flats at densities up to 100 m^{-2}. Our work encompasses measurements of nutrient content in burrow effluent and porewater, measurements of ventilation patterns as a function of temperature and salinity, boundary layer transport of effluent plumes, and measurements of algal pigment concentrations as a function of burrow density and distance from burrow openings.

Burrow effluent is highly enriched in ammonium, nitrate/nitrite, phosphate, and silicate compared to the adjacent water column and, oftentimes, porewater. Shrimp contribute 1-2 µmol NH_3^- h^{-1} g^{-1} AFDW directly to the burrow effluent.

Laboratory measurements of ventilation reveal episodic pumping with maximum volumetric pumping rates of 10 ml min^{-1}. Pumping rates increased with temperature while exhibiting no clear pattern with variation in salinity. These results reflect the strong positive effect of temperature and negligible effect of salinity on the metabolic rates (as measured by oxygen consumption) of these estuarine species.

Once released from the burrow, effluent is transported in the benthic boundary layer. Burrow effluent in these intertidal areas is often saltier and cooler than the water column. The difference in density between these two pools causes nutrient rich effluent to travel along the sediment surface where it may be more readily available to benthic algae. However, the relationship between algal pigment concentration and proximity to burrows is complex and depends on location within the intertidal zone.

Two dimensional optical O_2 measurements in marine bioturbated sediments

H. STAHL AND R.N. GLUD

Marine Biological Laboratory, University of Copenhagen, Strandpromenaden 5, DK-3000 Helsingor, Denmark (hjstaahl@bi.ku.dk)

Oxygen dynamics of marine sediments is strongly influenced by bioirrigating and bioturbating macrofuna. Traditional methods for quantifying the benthic O_2 distribution and the benthic O_2 exchange rate include measurements of concentration changes in sediment enclosures and vertical O_2 microsensor profiles. Chamber incubations integrate the activity of the entire benthic community but give no insight of the interstitial O_2 distribution or dynamics. Microprofiles on the other hand, allow detailed studies of oxygen dynamics but only on a few selected points and areal extrapolation is often compromised by small scale variability. The introduction of planar optodes into aquatic biogeochemistry bridges the gap between the "black box" approach of the benthic chamber and the single point measurements performed by microsensors. The approach allow vertical 2D-quatification of spatial and temporal O_2 dynamics at heterogeneous benthic interfaces with a high spatial (<0.2 mm) and temporal (<1-5 sec) resolution covering many cm^2. Laboratory and in situ application of this new technique have proven the approach to be an excellent tool for quantitative studies on O_2 dynamics associated to; macrofaunal activity, burrow structures to complex biofilm communities, microbial mats, oxic and anoxic microniches and plantroots. Based on a number of case studies the present talk discusses the new insight that can be obtained by planar O_2 optodes.