ABSTRACT

Karlson K, 2005, Impact of benthic macrofauna on sediment biogeochemistry – the importance of bottom water oxygen concentrations, Department of Marine Ecology, Göteborg University, Sweden. ISBN 91-89677-14-5

This thesis focuses on the overall importance of macrofaunal bioturbating activities for general sediment properties, and rates and pathways of organic material mineralization during early diagenesis in marine sediments. Performed laboratory experiments have included some of the most important benthic macrofauna species in Baltic Sea and Swedish west coast sediments. For example, the impact of macrofaunal density (*Monoporeia affinis* and *Amphiura filiformis*) and diurnal activities (*M. affinis*) on organic material mineralization have been examined. Studies have also included the importance of macrofauna functionality (*M. affinis*, *Macoma balthica* and *Marenzelleria viridis*) for biogeochemical processes during recolonisation of laminated anoxic Baltic Sea sediments. Different methodological approaches have been utilized, including e.g. benthic fluxes of oxygen and nutrients (nitrite + nitrate, ammonium, phosphate and silicate), sediment denitrification rates (the isotope pairing technique), solute production from the solid sediment (sediment reactivity), as well as pore water distributions.

Organic material mineralization rates were progressively stimulated with increasing density of the investigated species. A pronounced response in benthic solute fluxes was found between one and two days following the deposition of phytodetritus to the sediment surface, probably related to mineralization of the most labile organic material, release of macrofauna excretion products, and a food stimulated irrigation by the benthic macrofauna. Intra-specific competition at the highest macrofaunal densities investigated was exemplified e.g. by oxygen consumption rates and ammonium production from the solid sediment, normalized to density of macrofauna (i.e. rates per individual). The diurnal activity of *M. affinis* was found to affect solute fluxes across the sediment-water interface. Significantly higher fluxes of oxygen, ammonium and phosphate were found during laboratory simulated day conditions, compared to measurements made during the night. During macrofaunal recolonisation of the surface sediment, observations demonstrated a gradual recovery from the initially sulphidic Baltic Sea surface sediments. Survival of macrofauna (*M. affinis*) increased with time of incubation and reworking of the sediment, probably due to efficient irrigation and the subsequent oxidation of the surrounding sediment. The same pattern was, however, not found for the other investigated species (*M. balthica* and *M. viridis*). Generally, the investigated macofauna stimulated benthic solute fluxes and overall organic material mineralization. Mass balance calculations revealed that the main source of benthic ammonium fluxes to the overlying water was overlying water nitrate, rather than ammonium produced in surface sediments during mineralization of organic N. The effect of macrofauna on total denitrification rate was in general low. However, there were indications that irrigation activities of *M. affinis* stimulated denitrification using nitrate supplied from the overlying water (Dw).