

**The Impact of Biogenic Organic Matrices
on Early Diagenetic Processes
in Marine Sediments**

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Abstract of the Thesis

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Biogenic organic matrices are common components of various marine regimes, especially sediments, and may significantly alter transport and reaction processes. This Thesis explores the impact of two types of biogenic organic matrices: mucous secretions and organic tube linings.

Mucous secretions of the naticid gastropod *Polinices duplicatus* are mostly water, have a high inorganic component, and owe their special character to a carbohydrate-protein complex. The pedal mucus' viscous and lubricatory nature is explained by the presence of a sulfur-rich, highly charged macromolecular complex, whereas the additional need for consolidation and

compaction of debris in the case of hypobranchial mucus is apparently satisfied by a slightly higher protein content relative to pedal mucus. When exposed to natural microbial assemblages, it decomposes steadily, with the protein moiety being selectively decomposed first.

The gel-like, viscous mucus of *P. duplicatus* inhibits the diffusion of inorganic and organic solutes. The inhibitory effect is on average more pronounced with the fibrous burrow lining of the ampharetid polychaete *Melinna cristata*. This difference suggests a structural semi-permeability effect on DOC diffusivity. A charge effect on diffusion has not been observed here, thus contradicting previous reports. However, size-dependent inhibition of diffusion is demonstrated. Inhibition increases with increasing size, but no threshold "filtering" effect was found up to the investigated size of MW 70,000. Organic solute diffusion is enhanced in seawater relative to patterns predicted by relationships derived from distilled water diffusion experiments, due to changes in the conformation of organic macromolecules in electrolyte solutions.

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Introduction

Early diagenetic processes in marine sediments are defined as those which cause physical and chemical alterations of matter in surface sediments (Berner, 1981). A brief look at the surface of sediments very quickly reveals that there are assemblages of animals inhabiting them, diverse in form and mode of life (Figure 1). These animals greatly impact these early alterations of matter which may originate from water column activity or from terrestrial production or erosion. Diagenetic processes, especially in medium to fine-grained sediments, are typically strongly controlled by diffusion of various solutes, especially the electron acceptors which control organic matter diagenesis (Froelich *et al.*, 1978).

This study investigates the impact of mucous secretions by infaunal animals on early diagenesis. For the most part, mucus of the naticid gastropod *Polinices duplicatus* is the primary focus of study. Its biochemical composition is determined, its likely decomposition pattern is investigated, and finally, the impact of its presence on diffusion of inorganic and organic solutes in sediments is documented. Organic burrow wall linings of the ampharetid polychaete *Melinna cristata* are also investigated to compare the effects of these two very common types of organic matrices on solute transport in marine sediments.

The thesis consists of three parts: (i) biochemical composition; (ii) anoxic decomposition properties; and (iii) impact on diffusion of solutes in marine sediments.

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Figure 1. Schematic of a typical macrofaunal assemblage in Long Island Sound, U.S.A. (Aller, 1977).