ABSTRACT

Granberg ME, 2004, Role of sediment organic matter quality and benthic organisms for the fate of organic contaminants in marine systems, Department of Marine Ecology, Göteborg University, Sweden. ISBN 91-89677-10-2

Marine sediments constitute important contaminant sources within our environment. Organic matter input to marine sediments changes seasonally in terms of both quantity and quality, and has been profoundly altered in many coastal areas due to eutrophication. Current risk assessment models consider the quantity but not the quality of sedimentary organic matter when estimating bioaccumulation of sediment-associated organic contaminants. The aim of this thesis is to investigate some aspects of the role of sediment organic matter (SOM) quality in determining bioaccumulation and metabolism of organic contaminants in marine sedimentary macro-invertebrates, and in modulating contaminant distribution and biodegradation in different sediment compartments (surface, burrow, and bulk sediments). The organic contaminants studied are the polyaromatic hydrocarbons (PAHs) pyrene and fluoranthene and the polychlorobiphenyl (PCB) 3,3',4,4'-tetrachlorobiphenyl (TCB).

All contaminants except fluoranthene were accumulated to a greater extent with high SOM quality (high in nitrogen and amino acids) in the brittle star *Amphiura filiformis*, the ragworm *Nereis diversicolor* and the mud snail *Hydrobia ulvae*. Lack of coupling between SOM quality and flouranthene accumulation in *A. filiformis* was likely due to combined negative effects of sediment hypoxia and fluoranthene itself, hampering feeding and lowering general organism health. Enhanced bioaccumulation of pyrene in *H. ulvae* was caused by increased ingestion rate (IR) rather than by greater selectivity or absorption efficiency (AE) in relation to high quality SOM. Thus, IR is suggested to determine observed SOM quality related bioaccumulation. Further, absorption rate, the product of AE and IR, may better than AE predict digestive contaminant accumulation. Macrofaunal PAH metabolism was highest in *N. diversicolor* (*H. ulvae* was not tested), and remained unaffected by SOM quality. *A. filiformis* metabolized both PAHs, although pyrene to a greater extent. Our results suggest that bioaccumulation of sediment-associated contaminants, and subsequent trophic contaminant transfer should increase following labile organic matter input, such as after phytoplankton blooms.

Sedimentary contaminant distribution and microbial biodegradation depended on SOM quality and macrofauna combined. SOM quality acted on microbes through altered sedimentary oxygen conditions and macrofaunal behaviour. All contaminants were transferred from surface sediments and incorporated in burrow sediment by the organisms, while bulk sediment concentrations remained low. Microbial pyrene mineralization (MPM) depended greatly on previous contaminant exposure, and increased with sedimentary oxygen availability from bulk to burrow and surface sediments. Surface sediment MPM rates were stimulated by high quality SOM and inhibited by faunal presence, suggesting contaminant burial and competition for organic matter between macro- and micro-organisms. Remarkably, burrow sediment MPM rates greatly exceeded those measured in surface sediment with low quality SOM and *A. filiformis* specifically. Thus highlighting macrofaunal burrows, along with surface sediments, as important sites for sedimentary organic contaminant mineralization.

The results suggest that fate and effects of sediment-associated organic contaminants should not be assessed without considering sedimentary macrofaunal species composition and the trophic state of the system. Furthermore, integrated approaches, where effects of combined variables are investigated, are suggested to be applied in future ecotoxicological research.