Improving our understanding of sediment biogeochemistry and heterogeneity by using in situ, two-dimensional, high resolution measurement techniques

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Sediments are complex systems that play an important role in the cycling of metals, nutrients, and carbon. They have typically high microbial productivity that is disturbed by the presence of burrowing macro- and micro-invertebrate populations and benthic plants, which induce heterogeneity. Obtaining representative measurements of pore water solute concentrations in heterogeneous sediments remains a major challenge, especially with conventional coring techniques that provide one-dimensional profiles at cm-resolution and often require a mixing step as part of the sample processing. However, the development and application of inexpensive, thin-film passive samplers that measure two-dimensional, high-resolution distributions of pore water solutes have facilitated investigation of this spatial heterogeneity within sediments and the role such heterogeneity plays in biogeochemical processes. The DET (diffusive equilibration in a thin film) and DGT (diffusive gradients in a thin film) measure iron(II) and sulphide, respectively, and can be combined in a way that has been particularly useful for obtaining co-distributions of the major biogeochemical zones (iron(III)-reduction in the sub-oxic, sulphate-reduction in the anoxic zone) in coastal sediments. Our study has attempted to observe the degree of heterogeneity present in various benthic habitats (seagrass, mangrove and mudbanks) and to establish whether these techniques can be used to describe a 'typical' biogeochemical distribution.