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A New Conceptual Model for Microbial Processes in Sediments

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Microbial degradation of organic matter in sediments has conventionally been viewed as a series of successive processes, each occurring within a specific zone (e.g. Froelich et al., 1979). Recent work suggests that this classical scheme of biogeochemical zones is an oversimplification of the microbial processes which occur in organic rich marine sediments (e.g. Hulth et al., 1999). Preliminary findings from a coupled deployment of state-of-the-art geochemical and biochemical probes (Davison et al., 1991; Mortimer et al., 1998; Stephen et al., 1998) in Loch Duich, Scotland, provide evidence for rapid recycling reactions within the iron and sulphate reduction zones (Mortimer et al., submitted). High resolution pore-water geochemistry indicates that coupled suboxic nitrification and de-nitrification is occurring throughout the iron reduction zone, leading to rapid recycling of N and Fe/Mn. Molecular genetic analysis (^{16}S rDNA) confirms the presence of nitrifiers throughout this zone, and the absence of nitrate is a strong indication of the presence of denitrifiers. Fe-DGT and conventional iron pore-water profiles indicate that iron is dissolved and precipitated in a series of rapid Fe/S recycling reactions throughout the sulphate reduction zone. The presence of such complex recycling reactions requires modification of the current conceptual framework. This has far reaching implications because it will not only modify our understanding of natural systems, but also of those artificial systems such as sewage treatment and intensive aquaculture systems where we use the same microbial processes to solve water quality problems.

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