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Electric shortcuts of biogeochemical processes

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Recent observations in marine sediment have revealed conductive networks transmitting electrons from oxidation processes in the anoxic zone to oxygen reduction in the oxic zone. The involved electrochemical processes seem to be biologically catalyzed and may account for more than half of the oxygen uptake in laboratory incubations of initially homogenized and stabilized sediment. Using microsensors and process rate measurements we further investigated the effect of the electric currents on sediment biogeochemistry. Dissolved sulfide readily donated electrons to the networks and could be depleted below detection limit in a several cm thick layer below the oxic zone. Subsequent dissolution of iron sulphide was indicated by mobilization of ferrous iron being precipitated again as ferric iron at the oxic-anoxic interface. Lowered sulphate reduction rates in the upper centimeters of the sediment confirmed the depth range of the electric communication and indicated donation of electrons directly from organotrophic bacteria. The separation of oxidation and reduction processes created steep pH gradients eventually causing carbonate precipitation at the surface and probably also carbonate dissolution at depth. We suggest that the electric currents allowing reactions between compounds far from one another have significant effects in natural marine sediments as well as other environments with redox gradients.