A new way of life detected in coastal sediments: microbial sulphur oxidation via long-range electron transport

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Recently, an entirely novel type of microbial metabolism has been described from marine sediments, whereby filamentous bacteria are transporting electrons over centimeter-scale distances. By establishing such electrical circuitry, these micro-organisms are able to exploit spatially segregated pools of electron acceptors and donors, equipping them with a competitive advantage. First observed in laboratory experiments, we show that this electrogenic form of sulfide oxidation also occurs naturally in the seafloor. We observed the geochemical fingerprint of electrogenic sulphur oxidation at three coastal sites in the North Sea area: a subtidal mud deposit, a salt marsh site and seasonal hypoxic basin. A detailed study at the seasonal hypoxic site (Grevelingen, The Netherlands) reveals that electrogenic sulphur oxidation strongly dominates the sediment geochemistry during winter months. In particular, the process ensures a deep oxidation of sulphide, which prevents the ventilation of free sulphide to the overlying water column during the anoxic summer months. In addition, the rapid development of the electrical biofilm in late autumn engenders a rapid “detoxification” of the surface sediment, thus potentially promoting recolonization by infauna. Overall, our field observations suggest that electrogenic sulphur oxidation can strongly affect the water quality, biogeochemical cycling and ecosystem functioning in coastal systems.