Cutting the wire: Bioturbation impedes electrogenic sulphur oxidation

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Recently, a novel type of sulphur oxidation has been discovered in coastal sediments, whereby oxygen is reduced near the sediment-water interface, and sulfide is oxidized 10 to 20 mm deeper into the sediment. To make such a spatial separation of redox half-reactions physically possible, there must be a path via which electrons are transferred across the wide suboxic zone. Perturbation experiments suggest that the electron transport is mediated by filamentous bacteria. By establishing such electrical circuitry, these so-called cable bacteria have a clear competitive advantage. Given that coastal sediments support high rates sulphate reduction, an enigmatic question is why the electrogenic sulphur oxidation is not more prominent in the coastal ocean? To examine this, we performed both field observations and laboratory experiments. In strongly bioturbated sediment, the geochemical signature of electrogenic sulphur oxidation was not detected under field conditions. However, the process could be induced in these sediments in laboratory incubation experiments, as long as faunal reworking was excluded. Reintroduction of bioturbating fauna immediately halted electrogenic sulphur oxidation, most likely by a direct physical breakage of the bacterial filaments, in a manner similar to cutting an electrical wire. Our results show that bioturbation exerts a major control on the natural distribution of electrogenic sulphur oxidation in the coastal environment.