Early diagenesis of arsenic in electro-active sediments

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Electro-active sediments are characterised by a microbially induced electrical current in the upper few centimetres of the sediment. This current is induced by cable bacteria during electrogenic sulfur oxidation (e-SOx), in which the reduction of oxygen near the sediment-water interface is electrically coupled to the oxidation of sulfide in deeper sediment. This spatial decoupling of redox reactions generates extreme pH excursions in the pore water, which strongly promotes the cycling of iron, sulphur and manganese. The biogeochemical cycle of arsenic in marine sediments is strongly associated with the iron cycle, which suggests that e-SOx could also have a strong influence on the early diagenesis of arsenic.

Here we present *in situ* data from station BCZ130 in the Belgian Coastal Zone (North Sea), as well as complementary results from a long-term whole-core incubation experiment (Lake Grevelingen, The Netherlands). These data show that e-SOx strongly mobilises arsenic in the upper few centimeter of the sediment via the acidic dissolution of iron sulfides. Arsenic is subsequently enriched in the oxic part of the sediment near the sediment-water interface, where it adsorbs onto freshly formed iron oxides. This particular enrichment mechanism may have important consequences for the arsenic cycling in seasonal hypoxic systems, where oxic periods in winter are followed by periods of low bottom water oxygen in summer. During the oxic period, cable bacteria growth is promoted and arsenic is concentrated near the sediment-water interface. When the bottom water turns anoxic, massive amounts of arsenic are released via the reductive dissolution of the iron oxide layer. This release of arsenic potentially contributes to other adverse effects of hypoxia.