Co-existence of phototrophic, microaerophilic and nitrate-reducing Fe(II)-oxidizers in marine sediments

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Iron is an important redox-active element in the environment which is cycled between its divalent and its trivalent form by an interplay of biotic and abiotic processes. Three different metabolic types of microorganisms are able to oxidize iron(II) either by using the electron acceptor oxygen (microaerophilic iron(II)-oxidizers) or nitrate (nitrate-reducing iron(II)-oxidizers), or with light by anoxygenic phototsynthesis (anoxygenic phototrophic Fe(II)-oxidizers). So far, it has never been shown whether these different types of microorganisms coexist in one environmental habitat and which environmental factors control their abundance and activity.

In our study we enumerated and identified the three physiological types of iron(II)-oxidizing microorganisms in two geochemically distinct coastal marine sediments from Aarhus Bay (Denmark) by different culture-dependent (most probable number counts and enrichments) and culture-independent (qPCR) methods. We found that all three types of iron(II)-oxidizing microorganisms co-exist in both types of sediment. Surprisingly, the abundances of all three tpyes of Fe(II)-oxidizers did not correlate with geochemical and physical gradients (O_2, NO_3^-,light) in the sediment but were evenly distributed throughout the investigated sediment depth (0-3 cm). Highest cell numbers were found for microaerophilic Fe(II)-oxidizers which reached up to 1.0 x 10^6 cells per g sediment in most porobable number (MPN) counts and 3.2 x 10^6 cells per g sediment in qPCR. Nitrate-reducing Fe(II)-oxidizers reached up to 3.5 x 10^4 cells per g sediment in MPN counts. Lowest cell numbers were found for anoxygenic phototrophic Fe(II)-oxidizers, which only reached cell numbers of up to 3.1 x 10^2 cells per g sediment. For all three types of Fe(II)-oxidizers enrichment cultures were established which were phylogenetically classified. The next steps will will be a physiologically characterization of the isolated strains. Furthermore, qPCR and ITS assays will be used to determine the abundances and activities of the isolated Fe(II)-oxidizers in the natural sediment.