Identification of active autotrophic, nitrate-reducing Fe(II)-oxidizing bacteria in coastal marine sediment

N. BLACKWELL[1], A. KAPPLER[1,2], S. KLEINDIENST[1]

[1]Geomicrobiology, University of Tuebingen, Germany, [2]Center for Geomicrobiology, Aarhus University, Denmark

Bacteria capable of coupling nitrate reduction to Fe(II) oxidation (NRFeOx) under autotrophic conditions were first discovered 20 years ago. However, most of the described pure cultures can oxidize Fe(II) only under mixotrophic conditions, i.e. in the presence of an organic co-substrate. Furthermore, many of those that were suggested to not require an organic co-substrate for Fe(II) oxidation cannot be cultivated autotrophically over several generations in the laboratory. The aim of this study was to use microcosms and stable-isotope probing (SIP) (i) to identify active autotrophic NRFeOx bacteria in marine sediments from Aarhus Bay, Denmark and (ii) to determine the effects of temperature and Fe(II) concentrations on active microbial populations. Sediment samples were pre-incubated (>70 days) with 2 mM nitrate to stimulate heterotrophic nitrate reduction and to deplete bioavailable organic carbon at either 20°C or 4°C. When nitrate reduction ceased and the nitrate concentration remained stable, the conditions were considered to be optimal for autotrophic growth. At this point either 2 mM or 500 µM of Fe(II) and labeled/unlabeled bicarbonate (HCO_3^-) were added. Nitrate reduction resumed in all biotic setups and was coupled to Fe(II) oxidation. Active bacteria in the microcosms were identified using DNA-based SIP. Our findings demonstrate the occurrence and activity of autotrophic NRFeOx bacteria in a marine sediment and show the implications of temperature and Fe(II) concentrations on active microbial populations.