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1 Formation of reactive Fe(III)-minerals by anaerobic oxidation of Fe(II) by phototrophs and nitrate-reducing bacteria

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Anaerobic microbial oxidation of Fe(II) was recognized only a decade ago and presumably plays an important role in Fe-redox cycling in anoxic environments. Phototrophic bacteria from different phylogenetic groups were isolated that grow with Fe(II) as the sole electron donor in the light; the rates of iron oxidation and Fe(III)-mineral precipitation depend on Fe(II) concentration and light intensity. In addition to phototrophs, bacteria were isolated which gain energy through oxidation of Fe(II)-minerals with nitrate as electron acceptor.

We show that the formation of different Fe(III)-minerals by phototrophic and nitrate-dependent Fe(II)-oxidation, in particular the formation of reactive iron phases such as green rusts, depends on the Fe(II)-substrate identity as well as on growth conditions, e.g. medium composition and pH. Since substrates and products of iron metabolism are barely soluble at neutral pH, oxidation of Fe(II) at neutral pH represents a challenge for microorganisms. We investigate the mechanism(s) of electron transfer from Fe(II)-minerals to the cells and how cells avoid encrustation by insoluble Fe(III)-mineral products which would lead to a decrease or even cessation of metabolic activity and growth.