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Rapid microbial respiratory reduction of biologically produced ferric iron minerals

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Iron is the fourth most abundant element in the Earth's crust, and in soils and sediments it is the dominant redox-active metal. Depending on the environmental conditions, a variety of different ferrous and ferric iron minerals form. Anaerobic dissimilatory ferric iron-reducing and ferrous iron-oxidizing bacteria that gain energy through reduction or oxidation of iron minerals presumably play an important role in catalyzing iron transformations in anoxic environments. In anoxic freshwater habitats, ferric iron minerals represent the dominant electron acceptors for the mineralization of carbon compounds. However, the different ferric iron minerals are not equally well suited as electron acceptor for microbial respiration. Microorganisms preferentially reduce poorly crystalline iron oxides such as ferrihydrite. Poorly crystalline iron oxides were also the primary products of anaerobic ferrous iron oxidation by phototrophic or nitrate-reducing bacteria. We will discuss laboratory co-culture experiments with ferrous iron-oxidizing and ferric iron-reducing bacteria that showed an anaerobic cycling of iron. The electron diffraction patterns of biologically produced ferric iron resembled poorly crystalline 2-line ferrihydrite. However, in growth experiments with different *Geobacter* species biologically produced ferric iron was reduced much more rapidly than synthetically produced 2-line ferrihydrite: The reduction of 7 mM biologically produced ferric iron was completed within two days while the complete reduction of 6 mM synthetically produced ferrihydrite took approximately two weeks. Similar results were obtained in cell suspension experiments. In addition, we observed that biologically produced ferric iron minerals, which were kept in suspension, maintained

their low crystallinity for more than three years. What is the reason for the differences we observed with the two types of poorly crystalline ferric iron minerals? Did ferrous iron-oxidizing bacteria leave some organic coatings/imprints on the ferric iron minerals they produced which in turn ease their utilization as electron acceptor? Additionally, we will discuss experiments with biologically produced ferric iron minerals that were treated with bleach to remove potential organic coatings/imprints.