Influence of transition metal cations on the formation and reactivity of biogenic Mn oxides

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Microbial manganese oxidation is the dominant pathway for Mn oxide precipitation in many environments. Several strains of *Pseudomonas putida*, a common soil and freshwater bacterium, oxidize soluble Mn(II) *via* a multicopper oxidase enzyme, producing a poorly-crystalline layer-type Mn(IV) oxide, which is deposited in matrix of extracellular polysaccharides. These reactive nanoparticles have a remarkably high sorption capacity for metals due to their large surface areas (100 - 220 m^2 g^{-1}), permanent structural charge (~16% Mn(IV) vacancies), and redox activity.

Our research is directed towards understanding the formation of biogenic Mn oxide minerals in metal-contaminated environments and their capacity to immobilize metals during active microbial precipitation. We have determined the effects of varying concentrations of cobalt, nickel, copper, and zinc on rates of bacterial growth and kinetics of enzymatic Mn(II) oxidation by *P. putida* GB-1. In addition, we have applied X-ray absorption spectroscopy and X-ray diffraction to probe the mechanism of metal sorption to the biooxide-biofilm assemblages. The results from these experiments are interpreted in light of sorption experiments performed with freshly precipitated biogenic Mn oxides.

This work elucidates the dynamic and complex interactions between aqueous species, oxide minerals, and microorganisms encountered in natural systems. The results from this research have important implications for determining the role of biogenic manganese oxides in regulating the concentrations and distribution of trace and contaminant metals in aquatic and soil systems.

Petrology and *P-T* path of the Guyang mafic granulites: Implications for tectonic evolution of the Western Block of the North China Craton

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In the last few years, two Paleoproterozoic continent-continent collisional belts, named the Trans-North China Orogen and Khondalite Belt have been recognized in the North Chia Craton. The Khondalite Belt formed by the collision between the Yinshan Block and the Ordos Block to form the Western Block at ~1.92 Ga, which then collided with the Eastern Block to form the North China Craton along the Trans-North China Orogen at ~1.85 Ga. In the last few years extensive investigations have been carried on the granulite-facies rocks in the Eastern Block, Trans-North China Orogen and Khondalite Belt, but few studies have been done on the late Archean granulites in the Yinshan Block. In this study, we present detailed textural and compositional data for various symplectites or coronas observed in the mafic granulites from the Guyang Complex in the Yinshan Block.

Petrological evidence from the Guyang mafic granulites indicates four stages of metamorphic evolution (M1 to M4). The M1 assemblage is preserved as mineral inclusions within minerals of the peak assemblages, represented by hornblende + plagioclase + quartz ± biotite in the mafic granulites, with P-T conditions of ~0.6 GPa and ~750 ºC. The M2 assemblage is represented by orthopyroxene + clinopyroxene + garnet + plagioclase + quartz at 8.0-10.0 kbar and 800-900 ºC. The M3 assemblage is characterized by garnet+quartz or garnet+clinopyroxene symplectic coronas surrounding orthopyroxene, clinopyroxene and plagioclase grains, with P-T of 9.0-10.0 kbar and 700-750ºC. The M4 assemblage consists of cummingtonite + plagioclase replacing clinopyroxene and orthopyroxene. These assemblages and the estimated P-T conditions indicate that the Guyang mafic granulites underwent medium-pressure granulite-facies metamorphism with an anticlockwise P-T path involving near isobaric cooling following peak metamorphism, which reflects a metamorphic event related to the intrusion and underplating of large amounts of mantle-derived magmas rather than a continent-continent collisional environment.

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