

## Abstract

As the fourth most abundant element in the crust, iron (Fe) plays a key role in the earth redox cycling. The interplay of Fe(II) oxidation and Fe(III) bio-reduction occurs widely in both natural and engineered redox dynamic systems. However, properties of Fe minerals are poorly understood in natural sediments with variable redox conditions. In this study, the aerobic and anaerobic cycle of sediments was simulated artificially. A variety of characterization techniques, including SEM-EDS, XRD, XRF, XPS, and  $^{57}\text{Fe}$  Mössbauer, were combined with chemical analysis to investigate the valence distribution of solid-phase Fe speciation, and transformation of Fe minerals in biogeochemical transformation process.

Two aeration cycles were carried out. The iron-bearing components in the original sediments were mainly composed of adsorbed Fe, goethite and iron-bearing phyllosilicate. After first aeration, the adsorbed Fe on the surface of the sediments disappeared. During the subsequent anaerobic phase, the Fe(III) minerals reduced and dissolved. The ferric oxides represented by goethite were reduced and the amorphous Fe(II) and low-priced siderite were generated as products. When re-aerated the anaerobic sediment, the amorphous Fe(II) disappeared and iron-bearing phyllosilicate decreased along with more goethite generated.

In conclusion, the morphology of iron in the the natural sediments changed with the variation of redox conditions. The amorphous Fe(II) changed easily in aerobic environment. Siderite and goethite were main secondary minerals accompanying with microbial reduction. Although the detailed constituent of iron-bearing phyllosilicate has not been fully revealed, its amount fluctuated after the aerobic and anaerobic cycle. This study indicates that redox process exert an influence on the transformation of iron morphology in sediments, which may affect the biogeochemical cycles of carbon, nitrogen, and sulfur and the fate of contaminants in environment.