Microbial Activities and Formation of Secondary Minerals in Modern Sediments of the Taihu Lake, Eastern China

XIANCAI LU[1,2*], HUAN LIU[1], RUIYONG WANG[3], JIAJIA FAN[4], WEIJIE LI[1], JUAN LI[1], YUMEI LI[3]

1 Key Lab of Surficial Geochem. MiOE, Nanjing Univ., Nanjing, China
2 State Key Lab for Mineral Deposits Research, School of Earth Sciences and Engineering, Nanjing Univ., Nanjing, China
3 School of Life Sciences, Nanjing Univ., Nanjing, China
4 Ocean College, Zhejiang Univ., Hangzhou, China

*correspondence: xcljun@nju.edu.cn

The ecology and environment of the Taihu lake, the largest freshwater lakes in China, is directly affected by the dynamics and diverse geo-microbial processes occurring in the water and shallow sediments. The shallow sediments were drilled out and sampled together with the lake water. By using multiple technologies in microbiology, mineralogy and geochemistry, a systematic analysis of the microbial diversity, the mineralogical composition and existing forms of Fe, Mn, C and P in the sediments have been carried out.

In the sediments, there are various Fe-bearing minerals, such as goethite, hematite, mica, clay minerals and carbonate, whereas few manganese oxides or hydroxides was detected. EXFS analysis indicate that the ratio of Fe^{II}/Fe^{III} of the sediments increases with depth. The manganese in the surface sediments are mixed by Mn^{II} and Mn^{IV} states, while in the deep samples all the manganese presents as Mn^{II} species. The changing in valances of Mn and Fe suggests that the oxidation degree of sediment declines closely with buried depth, and the reduction of Mn occurred before Fe although their host minerals are quite different. The diagenetic minerals can be found at the depth of 3-4 cm, where pyrite particles with different size and crystallinity and clay mineral cementation began to appear. It is deduced that the oxygen dissolved in pore water of the surface sediment has been consumed out. At the depth of about 210 cm, siderite can be observed in sediment matrix and irregular nodules. In these diagenetic siderite, Mn content can be as high as >5 wt%. Actually, the formation sequence of secondary minerals is closely related to the organic carbon and sulphur species, which were mainly controlled by microbial activities. The microbiological analysis revealed the remarkable variation in the community structure, species diversity as well as function groups. The Fe-Mn geochemical evolution in sediments is driven by the electron transfer between minerals and organic matters mediated by microbial activities.

Acknowledgments: We are grateful for the support from NSFC projects (No. 41425009 and 41730316).