The role of reactive iron in preservation of terrestrial organic carbon in marine environment

BIN ZHAO [1, 3, 4], PENG YAO [1, 2 *], THOMAS S. BIANCHI [4], MICHAEL R. SHIELDS [4], XINGQIAN CUI [4], XIAOWEN ZHANG [4], XINYING HUANG [1, 3], JINPENG WANG [1,3] ZHIGANG YU [1, 2]

[1]Key Laboratory of Marine Chemistry Theory and Technology (Ministry of Education), Ocean University of China, Qingdao, China, yaopeng@ouc.edu.cn
[2]Laboratory for Marine Ecology and Environmental Science, Qingdao National Laboratory for Marine Science and Technology, Qingdao, China
[3]College of Chemistry and Chemical Engineering, Ocean University of China, Qingdao, China
[4]Department of Geological Sciences, University of Florida, Gainesville, USA

Understanding the mechanisms of long-term storage of organic carbon (OC) in marine sediments is important for studying the carbon cycling in the ocean. In this study, we examined OC, sediment surface area (SSA), grain size, OC-Fe associations and Fe-bound lignin phenols composition in surface sediments of the Changajiang Estuary and adjacent shelf in order to better understand the role of reactive iron (Fe_R) in the preservation of sedimentary OC. About 8.0% of the OC was bound to Fe_R, and the dominant binding mechanism is adsorption in the Changjiang Estuary and adjacent shelf. Distinctively low TOC/SSA loadings and OC: Fe ratios in mobile-muds indicated that frequent physical reworking may inhibit the formation of OC-Fe associations through intense iron reduction. Fe_R was mainly combined with marine OC in shelf region, but they prefer to combine with terrestrial OC in deltaic regions. Our results supported the hypothesis that there is preferential retention of lignin-derived dissolved organic matter with Fe_R. Due to lower OC:Fe ratios and higher OC burial rates in deltaic regions than other marine environments (Non-deltaic shelf, anoxic basins and slope and deep sea), our findings suggest that about 15.7% OC is directly bound to Fe_R on a global scale, which is lower than previous estimation. Based on a simple two-end member model, we estimated that about 14.8% of total terrestrial OC burial in marine sediments is preserved by Fe_R, and this is similar with the preservation ratio (16.3%) of total marine OC burial. Thus, we concluded that Fe_R also play an important role in the preservation of terrestrial OC in marine sediments.