MULTI-METAL MINERALIZATION AND MICROFOSSILS IN A BLACK SHALE-HOSTED SULFIDE ORE LAYER, SOUTH CHINA: IMPLICATIONS FOR EARLY CAMBRIAN BIOMINERALIZATION

X. Jun1, H. Hong-Ping2, L. Yi-Liang3

1 Key Laboratory of Mineralogy and Metallogeny, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China, junxu@gig.ac.cn
2 Key Laboratory of Mineralogy and Metallogeny, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China, hehp@gig.ac.cn
3 Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong SAR, China, yiliang@hku.hk

A remarkable polymetallic sulfide extremely enriched ore layer is embedded at the bottom of the Lower Cambrian Niutitang Formation along the passive margin of the Yangtze Platform in South China, with its genesis still highly disputable. Previous studies suggested that marine organisms probably played an important role in the formation of this ore layer. A combination of techniques, including optical and electron microscopy, Raman spectroscopy, electron microprobe analysis, X-ray absorption fine structure analysis, etc., were used to examine the mineralogy and petrology of the polymetallic sulfide ore. Laminated and frambiodal pyrite was proved to be the predominant form of iron sulfides, and the uranium minerals were recognized as mainly coffinite. Uranium radioactive decay-caused carbonization effects were scrutinized in the micro-environment, suggesting the authigenecity of coffinite. Thus the redox conditions at the depositional and early diagenetic stages were implied by the association of minerals. Submicron-scale organic vesicles resembling green algae as well as some relatively larger biogenic structures with possible red algal affinities were identified from the ores, suggesting the wide participation of both planktonic and benthic lives during the mineralization process. It is demonstrated that different minerals have varied abilities to preserve biological structures. Finely grained Mo sulfide and apatite are more suitable material for fossil preservation than Ni and Fe sulfides. We suggest that the biosorption and post-mortem enrichment of metals by biomass in stratified waters, especially by algal materials, might be responsible for the ultrahigh accumulation of various metals, such as Ni, Fe, Cu and Zn. These metals were subsequently fixed through microbially mediated reduction in an anoxic and euxinic environment. Marine lives jointly played a critical role in the geochemical cycling of such elements. This unique ore formation reflects the complicated relationships between Cambrian biota and its paleoenvironment. Our results may provide a better understanding of the role of biological activities in the problematic metallogenesis of the polymetal sulfide enriched ores and open a new window to the cognition of the hypothetic Cambrian Explosion.