Organic matter distribution and preservation in the latest Permian Dalong Formation in the Northeast Sichuan Province, South China

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Sedimentary organic matter (OM), which associates "active" surface pools of organic carbon with carbon pools that cycle on geological time scales, is the major reservoir of organic carbon in the global carbon cycle (Burdige 2007, Zonneveld, Versteegh et al. 2010). It influences the content of atmospheric CO_2 and O_2 on long times scales in a highly simplified fashion OM burial in sediments (Burdige 2007), and it comprises the primary source of oil and gas that is stored in organic deposits. Only less than 0.5% of the original OM that is produced within the upper water column can be transported to the sediments-water interface and buried, after degraded by aerobic and anaerobic re-mineralization processes (Hedges and Keil 1995). The chemical, physical and biological effects on OM preservation are key topic of many scientific research disciplines. However, until now synergetic discussion has been scarce. On this basis, ascertaining the controls on OM preservation in sediments is a valuable and significant topic in geological and chemical oceanography exploration.

Organic matter is always preserved well in finely laminated, pyrite-rich sediments (Pedersen and Calvert 1990, Kennedy, Pevear et al. 2002), and the same circumstance appeared in the latest Permian Dalong Formation in Shangsi, Northeast Sichuan, South China. Our work aims to seek out controlling factors on preserved organic matter in Dalong Formation. 126 samples were collected in the fields and analysis of trace elements, major elements and TOC were proceeded. High TOC values appear in black argillaceous rocks formed in transgression period, the lower-middle part of the Dalong Formation, which indicates high primary productivity within this interval. On the basis of Ti content, the bio-relate elements, such as Cu, Zn, Ni, donated as Cu_{xs}, Zn_{xs}, Ni_{xs} show significant correlation with TOC content in this interval, as Fe and S do.

Scanning electron microscope (SEM) and Energy Dispersive Spectrometer (EDS) studies has been used to identify organic matter and observe micro-structure of samples in this study. According to morphology and elements content, we divided organic matter into 3 categories: biopolymers, adsorbed organic matter and bitumen. Biopolymers from the samples are extracellular polymers substances (EPS). As EPS is major composed of proteins which are high-molecular-weight and stable, this organic matter is selectively preserved in sediments.

Adsorbed organic matter co-exists with the mineral matrix and emerges in two forms: discrete and diffuse. Bitumen preserved in large crack of carbonate or carbonate interlayer of mudstone. Both adsorbed organic matter and bitumen suggest that clay minerals are conductive to preservation of organic matter. We found that only discrete organic matter is preserved in low TOC samples (c.a. TOC<1), both discrete and diffuse organic matter occur in moderate TOC samples (c.a. TOC~2-5) and more diffuse organic matter can be seen in higher TOC samples (c.a. TOC>10). In addition, diffuse organic matter is accompanied with Fe in the mineral matrix, which was consistent with the correlation between TOC and Fe. Conclusively, elevated primary productivity and mineral matrix with distinct metal elements co-operation promote the preservation of organic matter.

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