The earth and biosphere in 1.4 billion years ago

S C ZHANG[1*], X M WANG[1], H J WANG[1], D E CANFIELD[2]

[1]Key Laboratory of Petroleum Geochemistry, RIPED, CNPC, 100083, Beijing, China

[2]Institute of Biology and Nordic Center for Earth Evolution, University of Southern Denmark, 5230 Odense M, Denmark

(sczhang@petrochina.com.cn)

The Mesoproterozoic Eon is emerging as a key interval in Earth history, while there is great controversy on the levels of atmospheric oxygen through the Mesoproterozoic Eon (1600 to 1000 million years ago, Ma), generating uncertainty in relationships between oxygen concentrations and biological evolution. Through the discovery of ancient oxygen-minimum zone (OMZ), and the aerobic respiration in 1400 Ma sediments of the Xiamaling Formation, we constrain atmospheric oxygen was high enough to fuel animal respiration long before the evolution of animals themselves.

The distribution and enrichments of redox-sensitive trace metals in Unit 3 of the Xiamaling Formation reveal oxygenated bottom waters during deposition of the sediments, and biomarker results demonstrate the presence of green sulfur bacteria in the water column. Thus, we document an ancient oxygen minimum zone in 1.4 billion years ago[1]. Through a simple, yet comprehensive, model of marine carbon–oxygen cycle dynamics, our geochemical results are consistent with atmospheric oxygen levels >4% of present-day levels[1].

Through the trace metal dynamics and Organic indicators of Hydrogen Index (HI) in Unit 1, we confirmed aerobic sedimentary organic matter decomposition takes place in the sediment, implying that oxygen diffused into the sediments during the deposition of the grey shales of the Xiamaling Formation, thus through a simple model, we deduced the oxygen levels are in line with previous minimum atmospheric oxygen estimates of > 4% PAL[1], reinforce the previous high oxygen level results.

[1] Zhang SC, et al. (2016) *Proc Natl Acad Sci USA*, doi: 10.1073/pnas.1523449113.