Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.22850

Spatiotemporal variation of dissolved oxygen in the Ediacaran surface ocean and its implication for oceanic carbon cycling

ZIHU ZHANG[1], CHUNXIA YANG[1], MENG CHENG[1], HAIYANG WANG[1], XINYANG CHEN[1], WEI GUO[2] AND CHAO LI[1,2]

[1]Chengdu University of Technology
[2]China University of Geosciences
Presenting Author: zhzhang@cdut.edu.cn

The Ediacaran Period witnessed the largest negative excursion in inorganic carbon isotope ($\delta^{13}C_{carb}$) over the Earth's geological history, also known as the Shuram Excursion (SE) event. The occurrence of the SE has been widely attributed to an increase in atmospheric-oceanic oxygen levels and the subsequent oxidation of organic matters in Earth's surface system. However, the oxygen levels in the Ediacaran ocean during the SE remain poorly constrained, limiting our ability to better understand the cause and mechanisms behind the SE. Recently, the ratio of I/(Ca+Mg) in carbonate has emerged as an effective proxy for quantifying dissolved oxygen ($[O_2]$) in the ocean. In this study, we analyzed I/(Ca+Mg) ratio in the Shuiquan Formation at the Mochia-Khutuk (MK) section, which records the SE event in the Tarim continent to reconstruct $[O_2]$ in the ocean during this time interval. The I/(Ca+Mg) ratio shows synchronous variation with $\delta^{13}C_{carb}$ in the MK section, with the average value decreasing from 2.2 μmol/mol at the bottom of the section to 0.8 μmol/mol in the middle and then increasing to 3.4 μmol/mol at the very top along with the decline and recovery of $\delta^{13}C_{carb}$. According to the relationship between I/(Ca+Mg) and oxygen content in minimum oxygen zones of the modern ocean, we infer that $[O_2]$ of surface water in the MK section decreased from >20–70 μM to <20–70 μM during the SE, which may reflect the upwelling of the deep seawater enriched dissolved organic carbon (DOC) and reduced iron together with its subsequent consumption of $[O_2]$ in the surface ocean. The I/(Ca+Mg) pattern in the MK section is significantly different from those of other contemporaneous SE records on other continents, indicating the surface $[O_2]$ in the Ediacaran ocean could have been temporally and spatially heterogeneous. Local factors, such as latitude, temperature, productivity, and input of anoxic water masses could play important roles in regulating the surface ocean redox conditions. Similar phenomenon has been reported for the terminal Ediacaran Dengying Formation. This observation further suggests that the atmospheric oxygen level during the Ediacaran was relatively low and insufficient to dominate the regulation of $[O_2]$ in the surface ocean.