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Iron isotopes reveal redox influences on the Late Ordovician 'Katian Extinction' and 'Early Silurian Recovery'

CAN CHEN[1,2], JIASHENG WANG[1,2], THOMAS J. ALGEO[1,3,4], ZHOU WANG[1,2] AND QIANG SONG[1,2]

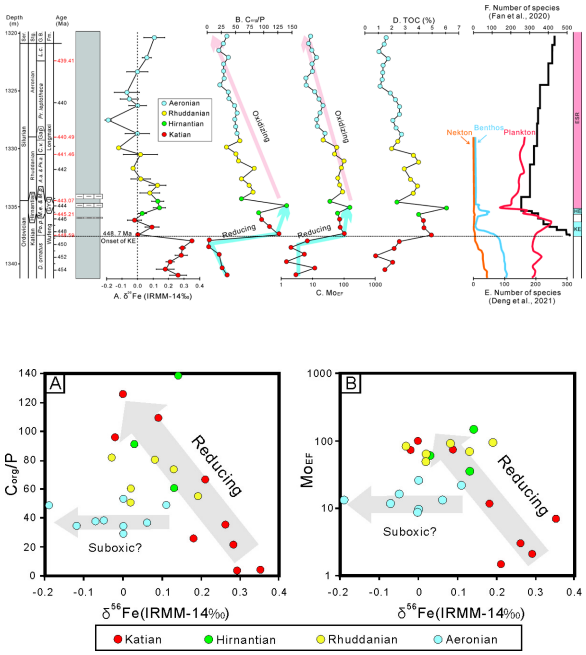
[1]State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences

[2]Hubei Key Laboratory of Marine Geological Resources & College of Marine Science and Technology, China University of Geosciences

[3]University of Cincinnati

[4]State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences

Presenting Author: hbcc1992@163.com



Redox variation in marine environments during the "Katian Extinction"(KE;448.7–446.7 Ma), a prelude to the Late Ordovician Mass Extinction (LOME), as well as during the "Early Silurian Recovery"(ESR;445-437 Ma), the interval of increasing biodiversification following the LOME, remains poorly known. Here, we report whole-rock iron isotopic compositions ($\delta^{56}Fe_{IRMM-14}$) for the YD-1 drillcore in Yichang, South China (31°07′29″N,111°35′14″E) and, combined with other geochemical proxies, use them to investigate environmental influences on the KE and ESR. Iron isotopes are more sensitive to fluctuations in the oxic-to-suboxic part of the redox spectrum than commonly used proxies (e.g., Fe-speciation and trace-metal data) because sediment $\delta^{56}Fe$ increases in the oxic zone as a result of ^{56}Fe uptake by Fe(III), whereas it decreases in the suboxic zone due to fractionation in favor of ^{55}Fe during dissimilatory iron reduction. The Katian Extinction coincided with decreasing $\delta^{56}Fe_{IRMM-14}$ (from +0.35‰ to 0.00‰) as well as increasing C_{org}/P and Mo_{EF}, supporting an anoxia-driven biocrisis (Fig. 1). The coupling between $\delta^{56}Fe_{IRMM-14}$ and other redox proxies (i.e., C_{org}/P and Mo_{EF}) in the late Katian to Rhuddanian demonstrates $\delta^{56}Fe_{IRMM-14}$ to be a robust proxy in the anoxic part of the redox spectrum (Fig. 2). In the Aeronian, C_{org}/P and Mo_{EF} exhibit nearly uniform values despite substantial variation in $\delta^{56}Fe_{IRMM-14}$, reflecting a suboxic environment and the greater utility of the iron isotopes for evaluating variation in the suboxic part of the redox spectrum. Our study provides insight into the causes of the KE, which was an integral part of the multi-phased LOME, and documents the detailed pattern of redox changes in the Yangtze Sea during the ESR.