

Implications for paleo-oceanographic oxygen conditions during the Cretaceous OAEs: Results from laboratory culture experiments

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The oceanic redox state is a critical determinant of the evolutionary history of life on Earth, and “anoxic events” have been proposed as one of the causal mechanisms for mass extinctions. During the mid-Cretaceous, oceanic anoxic events (OAEs) occurred several times with substantial turnover of planktonic foraminiferal species. However, the direct effects of the anoxic condition on planktonic foraminifera remain obscure. In this study, we cultured 6 species ($n = 31$) in all at three treatments: ~ 2 mg hydrogen sulfide (H_2S) L^{-1} (H1 treatments), ~ 9 mg H_2S L^{-1} (H2 treatments), and control (without H_2S). All planktonic foraminifera could not survive more than 48 hours. Furthermore, gametogenesis ratio of each H_2S treatments showed considerable low value (8% and 17%), and time to gametogenesis was also very short (less than one day) under H_2S occurrence. It revealed that foraminiferal biological response of anoxic with the presence of H_2S should be fundamentally different from that of the dysoxic (i.e., low dissolved oxygen; ~ 0.7 mg O_2 L^{-1} or ~ 22 μmol O_2 L^{-1}). Our results also proposed the species-specific tolerance for H_2S and that if harmful influence of H_2S restricted in relatively short time (i.e., less than 24 hours) such as tidal cycle, some foraminifera (e.g., *Neogloboquadrina dutertrei*) might have the potential to survive even under the episodic/temporary occurrence of H_2S . Complete disappearance of planktonic foraminifera at Cretaceous OAE2 could result from the photic-zone euxinia (free H_2S), and presence/absence record of planktonic foraminifera could contribute to examine the detailed oceanic redox state in the photic zone around anoxic events.

Keywords: oceanic anoxic events, hydrogen sulfide, Planktonic foraminifera