

## **The Permian double extinction: Stratigraphy at Chaotian, Sichuan, South China**

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The Permian mass extinction was one of the largest biodiversity crises in the Phanerozoic. This catastrophic event was characterized by its double-phased nature: the smaller and gradual extinction at the end-Guadalupian (Middle Permian) (ca. 260 Ma) and the larger and abrupt extinction at the end-Permian (ca. 252 Ma). The Guadalupian to lowermost Triassic shelf carbonates of characteristic deep-water facies are continuously exposed in the Chaotian section in northern Sichuan, South China. Litho-, bio-, and carbon, nitrogen, and multiple sulfur isotope chemo-stratigraphy of the Guadalupian-Lopingian (Upper Permian) boundary interval and Permian-Triassic boundary interval at Chaotian are described. The analytical results at Chaotian suggest sulfate reduction in the anoxic water column at the end-Guadalupian and at the end-Permian. In these two interval, the enhanced water-mass sulfate reduction likely resulted in the emergence of a sulfidic deep-water mass on the slope/basin prior to the extinction associated with the anomalous authigenic carbonate precipitation<sup>1</sup>. Moreover, based on the multiple sulfur isotope records of the two extinction intervals, we argue the changes in the sedimentary sulfur cycle associated with bioturbation in the late Permian oceans and the validity of the previously suggested scenario in which the shoaling of toxic (anoxic/sulfidic) deep-water contributed to the Permian double extinction<sup>2</sup>.

### [Refs.]

1. Saitoh, M. et al. (2014) Isotopic evidence for water-column denitrification and sulfate reduction at the end-Guadalupian (Middle Permian). *Global and Planetary Change* **123**, 110–120.
2. Saitoh, M. et al. (2017) Multiple sulfur isotope records at the end-Guadalupian (Permian) at Chaotian, China: Implications for a role of bioturbation in the Phanerozoic sulfur cycle. *Journal of Asian Earth Sciences* **135**, 70–79.