

Stratigraphy of the upper Middle-Permian rocks at Chaotian, Sichuan, South China

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Nearly 70% of shallow-marine organisms became extinct at the Middle-Late Permian boundary (G-LB), probably being related to global environmental changes in the Capitanian (Late Guadalupian). The G-LB timing apparently coincides with the onset of Superanoxia, although the causal relationship between them has not been revealed. We are analyzing detailed stratigraphy of Middle-Upper Permian shallow marine carbonates at Chaotian in northern Sichuan that faced the Tethyan ocean to the west, in order to clarify the pre-extinction environmental change during the Late Guadalupian.

The Permian system at Chaotian consists of the Maokou Formation (Guadalupian; over 200 m thick), the Wujiaping Formation (Wuchiapingian; 68 m thick), and the Dalong Formation (Changhsingian; 26 m thick) in ascending order. The Permian rocks are mainly composed of dark-gray bioclastic limestone. The Wangpo tuff bed (2 m thick) occurs between the Maokou Fm and the Wuchiaping Fm. The Wordian (Middle Guadalupian) fusulines occur at 148 m below the top of Maokou Fm, and the Capitanian ones at 58 m below the top. From the interval 3-5 m below the Wangpo bed, early to middle Capitanian conodonts occur, while no index fossils occur from the topmost 3 m thick part. As the Wuchiapingian fusulines occur from the lowermost Wujiaping Fm immediately above the Wangpo bed, the latest Capitanian strata is probably missing. On the basis of the observations of rock slabs and thin sections from the Capitanian part of the Maokou Fm, we tried to reconstruct sedimentary environments of the Maokou Fm at Chaotian.

The Maokou Fm is mainly dark gray massive limestone, whereas the topmost part (13 m thick) is composed of interbedded black shale and chert. The massive limestone part consists chiefly of bioclastic packstone with various Tethyan fossils, including fusuline, rugose coral, calcareous algae, bryozoa, crinoid, brachiopod, bivalve, gastropod, ostracod, smaller foraminifer, and trilobite. The topmost Maokou Fm contains Capitanian conodonts and ammonoids, together with fragments of bryozoa, radiolarian, smaller foraminifer, and ostracod.

The massive limestone part of the Maokou Fm has lime-mud matrix, and no cross-beddings or evaporitic textures have been found. We interpreted that this massive limestone was deposited below the fair-weather wave-base. The lithofacies changes abruptly at the top of the massive limestone from calcareous to argillaceous rocks. In harmony with this lithofacies change, shallow-marine fauna (corals and algae) disappear, in turn, more pelagic elements (radiolarians, conodonts and ammonoids) appear abundantly. These indicate that the depositional setting has changed into a relatively deeper environment. Similar facies change is observed in the Maokou Fm at Shangxi section, about 80 km southwest of Chaotian section. This indicates that a relative sea-level rise occurred in northern Sichuan in the mid-Capitanian.

In South China, an extensive unconformity characterizes the G-LB except some sections in Guangxi, suggesting a great regression in the late Capitanian. Also at Chaotian section, an unconformity exists just below the Wangpo bed. On the other hand, this study first shows a mid-Capitanian transgression in Sichuan immediately before the G-LB regression. The relative sea-level rise detected in northern Sichuan may have been caused by local tectonics or by eustatic fluctuations. The continuous lower Capitanian rocks of deep-water facies at Chaotian likely provide good records of environmental changes preceding the end-Guadalupian extinction event.