



## **Benthic responses to Permian icehouse-greenhouse climatic turnover from Gondwana and Tethys: Evidence from brachiopod faunas in South China and Western Australia**

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The Permian witnessed the most dramatic climatic change in our Earth during its Phanerozoic history. The Late Carboniferous to earliest Permian glaciation resulted in huge ice sheets covering the entire Gondwana continent in the south and vast Boreal regions in the north. The integration of palaeogeographic, biogeographic and geochemical data show that the glaciation has terminated in late Sakmarian (Early Permian) and our planet was governed by greenhouse climate during the Middle Permian. The global warming has been obviously accelerated during the Late Permian and such a deleterious climate has also prevailed throughout much of the Permian-Triassic transition. Thus, the extreme climates have also tested benthos' adaptation tolerance during the Permian times. The effects of climatic changes, particularly the Late Permian global warming, to marine benthos are tested by analyzing the Permian fossil records from both South China and Western Australia. During the Permian South China was located at the Tethys region and the latter was positioned at the Gondwana region, representing the low-latitude tropic zone and the relatively high-latitude temperate-cold climate zone, respectively. The assessment of the Permian benthic assemblages from both regions shows the climatic switch from icehouse to greenhouse has triggered a significant increase in biodiversity in low-latitude region, whereas the global warming resulted in decrease in biodiversity in the high-latitude region. Brachiopod faunas are mostly sessile organisms and thus sensitive to climate changes. The Gondwana faunas

were characterized by the cold-water brachiopods during the Early Permian, invaded some temperate-subtropical elements in the Middle-Late Permian and dominated by the subtropical-tropical elements in the Late Permian. In contrast, the Tehtyan faunas were mixed with numerous Gondwanan elements during the Early Permian, dominated by the tropic elements in the Middle-early Late Permian, and curiously were invaded by several distinct cold-water brachiopod species in latest Permian. The late Permian global warming destroyed most of the cold-water brachiopod habitats. As a result, on one hand, some relatively adaptable cold-water elements migrated involuntarily to the hospitable deep-water niches of the low-latitude region due to collapse of their original habitats. On the other hand, some Tethyan elements inhabiting tropical zone expanded their niches to the relatively high-latitude regions due to increase in water temperature. In addition, as the consequence of the late Permian global warming, some shallow-water brachiopods were forced to settle in the relatively hospitable deep-water settings in the low-latitude region.