

Temporal changes of Asian interior arid-zone during the Cretaceous Period: implications for the Cretaceous atmospheric circulation

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Cretaceous Period is generally considered as a time of warm and equable climate, so called 'greenhouse' world, which is characterized by different paleogeography, high atmospheric CO₂, and low meridional thermal gradients. Thus, Cretaceous world has long been a focus of paleoclimatic studies, both for its unique nature and the need for understanding the fundamental climate processes and feedbacks during times of CO₂ induced 'greenhouse' conditions. The pattern of the general atmospheric circulation during Cretaceous has been discussed based on the distribution of paleoclimatic indicators, while direct evidences lacked. The present study examined Cretaceous sand dune desert deposits in Mongolia and China recording wind directions across the northern hemisphere mid-low latitude desert belt, and reconstructed the temporal changes of Asian interior arid-zone and pattern of the general atmospheric circulation during the Cretaceous.

The result shows expansion of arid-zone in Asian interior during early Cretaceous (Berriasian-Barremian) and late Cretaceous (Coniasian-Maastrichtian) 'cold greenhouse' time, and shrinkage of such zone during mid-Cretaceous (Aptian-Turonian) 'hot greenhouse' time. Paleo-wind directions, reconstructed from the orientation of sand dune fore-sets, show westerlies in Mongolia and northern China and northeast trades in the central and southern China, suggesting development of subtropical high in such latitudes during early and late Cretaceous. Hence, it is confirmed that the Asian interior was really controlled by the planetary circulation before the uplift of the Tibetan Plateau. The result also implies that the low meridional thermal gradients of the mid-Cretaceous 'hot greenhouse' time would have weakened the baroclinic component of atmospheric circulation, which in turn resulted in a 'sluggish' atmosphere during the mid-Cretaceous.