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Aridification of Asian interior during Late Cretaceous

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The Cretaceous period is generally considered as a time of warm and humid climate, so called “greenhouse world”. Although evidence for cooler episodes during the Late Cretaceous is reported in some studies, the timing and significance of such cool episodes are not well constrained. The Asian Continent was the largest continent of that time, thus the terrestrial deposits in Asia should record typical intra-continental paleoclimatic changes during Cretaceous. However, reconstructions of those terrestrial paleoclimatic changes have been retarded due to the limited exposures, lack of continuous sections, and difficulty in age determinations of terrestrial strata.

Terrestrial Cretaceous strata, which yield abundant vertebrate remains, are widely distributed in the Gobi basin of southern Mongolia. During Cretaceous time, this region was located in a complete intra-continental setting, thus Cretaceous strata in the Gobi region are thought to represent a rare glimpse of the climate and biota in the interior of a large Asian Continent. Although stratigraphic and geochronological studies have been limited, Mongolian Upper Cretaceous strata are considered to represent a nearly continuous sequence. We examined spatial and temporal variations of lithofacies of Mongolian Upper Cretaceous sequence, and reconstructed paleoenvironmetal and paleoclimatic changes of the Gobi region throughout the Late Cretaceous. We also conducted a detailed magneto-stratigraphic study for determination of the ages.

On the basis of temporal changes in lithofacies, the Upper Cretaceous sequence of the Gobi region is considered to record following remarkable paleoclimatic changes during the Late Cretaceous. (1) Through the Cenomanian to the Santonian (Bayanshiree Fm.), humid climate characterized by fluvio-lacustrine environments were dominant.

(2) The fluvio-lacustrine environments were then gradually transformed into the sand dune desert environments (extending at least 160'000km^2) under the arid climate during the Campanian time (Djadokhta and Barungoyot Fms.), which are represented by the predominance of eolian large-scale cross-stratified sandstones and mature calcretes. (3) At the early Maastrichtian time (Nemegt Fm.), the sand dune desert environment was replaced by a fluvial environment characterized by predominance of meandering fluvial systems, indicating the increase in humidity.

Such desertification and climatic aridification during late Campanian time (76–71Ma) is also reported in northern China. Therefore, this climatic aridification is thought to have occurred broadly in the Asian interior. The reconstructed eastward paleo-wind direction in the Gobi region is similar to the present Subtropical Anticyclone zone of the Northern Hemisphere. However, the paleo-latitude of this region was much higher (44–46 degrees) compared to the latitude of typical Subtropical Anticyclone zone in the Northern Hemisphere at present (20–30 degrees). Development of such a broad intra-continental arid area in such high latitude implies the northern shift of Subtropical Anticyclone zone, which could have been related with the global cooling, the development of ice sheets in Antarctica, and consequent sea-level regression during Late Cretaceous (Campanian?–Maastrichtian).