

Reconstruction of the Last glacial to Holocene climate changes in Shaamar loess-paleosol succession, northern Mongolia

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Two atmospheric circulation systems, the mid-latitude Westerlies and the Asian monsoon, play key roles in northern-hemisphere climatic changes. However, the variability of the Westerlies in mid-latitude Asia and their relationship to the Asian summer and winter monsoon remain unclear. We examined the variations in the grain size and elemental composition from the 30 m long loess-paleosol succession in Shaamar area, northern Mongolia, which could be recorded the interplay of the Westerlies and Asian winter monsoon for the last 30 k.y. We then compared our results with the multi-proxy paleoclimate records (e.g., eolian grain sizes, lake levels, pollen assemblages) of the Asian summer and winter monsoon regions and the Westerlies affected region.

According to the compiled data of the Wang and Feng (2013), the Holocene climatic variation patterns (mainly from lake levels and pollen records) in Asia are categorized into 4 characteristic regions, such as the Summer monsoon region (southern and northeastern China), Westerlies affected region (northwestern China), Winter monsoon region (southern Siberia), and Mixture of westerlies and winter monsoon affected region (Mongolia). Specifically, summer monsoon region is characterized by dry earliest Holocene (12-11 ka), humid early to middle Holocene (11-6 ka), and the moderate-humid late Holocene (last 6 ka), corresponding to the Northern hemisphere summer insolation changes. Westerlies affected region is characterized by dry early Holocene (12-8 ka) and humid middle to late Holocene (last 8 ka). Winter monsoon region is characterized by the humid early Holocene (12-8 ka) and dry middle to late Holocene (last 8 ka). On the other hand, Mongolian records (e.g., Lake Khuvsgul, Lake Gun Nuur) demonstrate humid early Holocene (12-9 ka), dry middle Holocene (9-5 ka), and humid late Holocene (last 5 ka), which seems mixture of westerlies and winter monsoon affected region.

Shaamar loess-paleosol succession record is characterized by the humid early Holocene (12-8 ka) and dry middle to late Holocene (last 8 ka), similar to the winter monsoon region in southern Siberia. Thus, it is suggested that the eolian sediment record in Shaamar could be affected more strongly by winter monsoon influence, although Shaamar section is located closely to the mixture of westerlies and winter monsoon affected region (e.g., Lake Khuvsgul and Lake Gun Nuur). Except for the Chinese Loess Plateau, Shaamar loess-paleosol succession is only the continuous eolian sediment record in mid-latitude Asia. Thus, Shaamar loess-paleosol succession should provide us rare glimpse for understanding the interplay of westerlies and winter monsoon in Asian mid-latitude. We will further examine the Last glacial records of the Shaamar loess-paleosol succession and compare with other records of the Asian summer and winter monsoon regions and the Westerlies affected region.

Keywords: Mongolia, Loess-paleosol succession, Westerlies, Winter monsoon, Holocene, LGM