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A Holocene lacustrine record of Lake Sonkul: hydro-climatic changes in central Asia and possible interactions between westerlies and Asian monsoon

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As evidenced by a number of lake sediment records, the climate in central Asia has experienced a significant change from wet to dry during the Holocene. However, it is still highly debated on which component of atmospheric circulation, either mid-latitude westerlies or Asian monsoon, should be responsible for the climate change in central Asia. By a detailed investigation on a 133-cm length of paleolimnological record of Lake Sonkul in Kyrgyzstan and comparison with previously published records, we attempt to understand hydro-climatic changes in central Asia and discuss the possible interactions between westerlies and Asian monsoon.

The age-depth model of this record was established based on six AMS ^{14}C dates. We examined the geochemical and isotopic signatures of the record at a depth interval of 1 cm (equivalent to ∼40 year), including total nitrogen (TN), total carbon (TC), total organic carbon (TOC), organic carbon isotopes as well as oxygen and carbon isotopes of bulk carbonates. To thoroughly understand and explain the above indicators, microfacies and X-ray diffraction analyses of selected samples and three thin sections were also conducted. As shown by the results, there were two significant changes of the lake environment centered at ∼5, 300 cal yr BP and at ∼3,400 cal yr BP. Accordingly, the lake hydrological history could be defined into three units. Unit III (133-88cm; 7, 600- 5, 300 cal yr BP) is characterized by rapid fluctuations in the lake level as indicated by pronounced changes in TN, TOC, $CaCO_3$, carbon and oxygen isotopes of carbonates. In contrast, variations of these proxies in Unit II (88 - 44.5 cm; 5, 300 - 3, 400 cal yr BP) and Unit I (44.5 - 0 cm; 3, 400 -1, 900 cal yr BP) are less significant, suggesting relatively stable hydrological environment. We conclude that the hydrological changes of Lake Sonkul are generally consistent with the climate trend from wet to dry in central Asia during the early and mid Holocene. The changes are possibly related to the evolution of atmospheric circulation in central Asia influenced by the westerlies and Asian monsoon during the early and mid Holocene to one dominated only by westerly wind systems during the late Holocene and today.

Key words: Lake Sonkul, central Asia, hydrological change, Holocene, Asian monsoon, westerlies.