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Geochemical characteristics of Holocene aeolian deposits and their paleoclimatic implications: a case study in East of Qinghai Lake, China

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Abstract: The paleoclimate evolution in the northeast of Qinghai-Tibet Plateau (QTP) has always been concerned by scholars, due to the particularity of geographical location, especially the Qinghai Lake Basin (QLB). However, because of the ambiguity of proxies and the lack of enough precise chronological data, the evolution of paleoclimate since Holocene in this region has been controversial. Hudong Dunefield is located in the east of Qinghai Lake, which is the largest sand accumulation area in QLB. Aeolian sand-paleosol sequences of Hudong Dunefield are precious terrestrial archives that contain information on paleoclimate change and aeolian activity. In this study, deposits of the Holocene aeolian sand-paleosol sequences CGE and QHH in Hudong Dunefield are systematically analyzed to determine their elemental geochemical characteristics and paleoclimatic implications. Combination with the grain size, total organic carbon (TOC) and redness, emphasis is placed on the paleoclimate change since Holocene in this region and its response to the East Asian Summer Monsoon (EASM). The relatively consistent immobile elements content and ratio indicated that the aeolian sediments have similar sources during the Holocene, which mainly from the insitu weathering products of the rocks. The higher Na2O/Al2O_3 and lower chemical index of alteration (CIA) showed most of them in the stage from unweathered to weakly weathered degree, except some samples reach the moderate weathered during mid-Holocene, implying that several transition from warm-wet to relatively cold-dry during the Holocene epoch in the QLB. The multi-proxy indicated that the regional climate was broadly coincident with the northeast of QTP and most regions of northern China, implying that the paleoclimate of QLB was closely correlated with the evolution of EASM during the Holocene. Additionally, after the 9.2 ka BP cold event, the chemical weathering increased gradually; in 8.7-4.0 ka BP, the higher CIA and TOC, lower redness and mean grain size are possibly associated with the mid-Holocene climate optimum period, indicated an intensified chemical weathering, denser vegetation cover and weakened aeolian activity in QLB in response to warmer and more humid climate. After 4.0 ka BP, the obviously weakened chemical weathering indicates that the study area is dominated by a relatively cold and dry climate, and there have been several alternating warm-wet and cold-dry intervals in 3.2-0.6 ka BP. Collectively, our new multi-proxy data add supporting evidence for the mid-Holocene climate optimum period, in addition, we also conclusion that the EASM dominated the chemical weathering in the HSL region.