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Aeolian sediments as a palaeoclimate proxy in the transition zone between the Asian summer monsoon and the mid-latitude westerlies

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For this study we analysed OSL (optical stimulated luminescence) ages from aeolian sands or sandy deposits in Mongolia and the north-eastern Tibetan Plateau for the last 21 ka. While the north-eastern Tibetan Plateau is at the northern boundary of the Asian summer monsoon extent, the mid-latitude Westerlies control the climate in Mongolia. Aeolian sediments are widespread in both areas, ranging from thin sand covers with a high silt content in the mountains to large sand sheets with well-developed dune systems in the basins. We collected all available OSL ages, which were published until 2019 and analysed them for their spatial and temporal distribution. The dataset comprises nearly 350 OSL ages. However, while there is a large number of OSL ages available from the north-eastern Tibetan Plateau, only 68 ages from aeolian sediments from central and western Mongolia meet our quality criteria.

There are some remarkable differences in the timing of aeolian sediment deposition between these two areas. While in both areas only few ages from the last glacial maximum are available, aeolian deposition in Mongolia incepts at the beginning of the late glacial at 17 ka. In contrast, permanent aeolian deposition on the north-eastern Tibetan Plateau did not start before 13 ka. We interpret this signal as a time lag between the strengthening of the mid-latitude westerlies and the Asian summer monsoon after the last glacial. An increase in moisture caused by the two atmospheric systems resulted in an enhanced vegetation cover and consequently in the trapping and permanent fixation of aeolian sediments.

Furthermore, during the early Holocene at around 10.5 to 8.5 ka no OSL ages are available from Mongolia while on the monsoon influenced north-eastern Tibetan Plateau a comparably high number of OSL ages point to an enhanced trapping of aeolian sediments. At this stage, a straightforward explanation for the gap in the age distribution in Mongolia is not obvious. It might be caused by the generally wet climate conditions due to enhanced moisture transport to the area due to strong westerlies and thus the diminishing of source areas for aeolian entrainment by denser vegetation covers. The enhanced westerlies would be caused by higher insolation values and are reflected in several archives, especially from northern Mongolia. However, the gap might also just be related to the generally low number of OSL ages from Mongolia.

Both areas show an increase in aeolian activity in the late Holocene, indicating a return to drier

conditions after wetter climate conditions in the mid-Holocene. Drier conditions started on the north-eastern Tibetan Plateau at around 3.5 ka and in Mongolia at 2 to 3 ka. This trend is documented in a large number of archives in central Asia and is related to a weakening of the Asian summer monsoon as well as the mid-latitude Westerlies.

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