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Aeolian deposits at the southeastern margin of Tengger Desert (China): Implication of surface wind strength in the Asian dust source area over the past 20 000 years

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Independent dust provenance data play an important role in understanding changes in the atmospheric dust loading over geologic time. Major elemental compositions and grain size characteristics of aeolian deposits (Xiangshan section) at the southeastern margins of Tengger Desert in northwestern China demonstrate that the deposits were an intermediate product from the dust source area (deserts) to the dust depositional regions (e.g., Chinese loess plateau), and were likely formed by dust storm processes. The fractions of >40 μm and 63– to 178–μm and the ratio of SiO2/TiO2 of the Xiangshan section were used as proxies to reconstruct the surface wind regime over the last 20 kyr. The results show that the surface winds were much stronger during 19.1 to 11.4 kyr with acute fluctuations on centennial to millennial scales. The winds became gradually attenuated after entering into Holocene and reached the minimum during 4.0–3.5 kyr BP. A sharp increase in surface winds appeared after 2.5 kyr. The surface winds in the Asian dust source area are largely consistent with the changes in dust concentration documented by the Greenland ice core during the period of 19–10 kyr BP, except for the period of Bölling–Allerød (B/A) when the washout of strengthened hydrological cycles decreased the dust loading at the remote dust depositional sites. This suggests that the stronger surface winds in source areas will effectively enhance the atmospheric dust loadings, which supports that variable wind strengths can result in the changes in dust flux and grain size inferred from the remote records (e.g., the Greenland ice core). The paleo-environmental changes in the study area since the late last glacial are broadly in agreement with the other adjacent records. A warm and wet event during 42.5–19.1 kyr BP, possibly accompanying with more intensive runoff process, needs more other evidence to testify although it seems to be in agreement with the Megalake event in Tengger desert. During 19.1–11.4 kyr BP a cold and dry climate with a strong wind regime prevailed in the study area. The relatively humid periods occurred during the early Holocene and during 4.5–2.5 kyr BP; while the dry spells appeared during mid–Holocene and since 2.5 kyr BP.