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Palaeoclimate interpretations of Late Pleistocene vegetated linear dune mobilization episodes: evidence from the northwestern Negev dunefield, Israel

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The northern Sinai - northwestern (NW) Negev erg stretches east out of the Nile Delta that is believed to be the erg's sand source. The vegetated linear dune (VLD) field of the NW Negev Desert, situated at the downwind eastern end of the erg, constitutes an ideal setting for dating and interpreting its Late Quaternary dune encroachment episodes. This study builds upon the results of Roskin et al. (Age, origin and climatic controls on vegetated linear dunes in the northwestern Negev Desert (Israel), Quaternary Science Reviews 30 (2011), 1649-1674) that presented the stratigraphy of 35 sections and 97 optically stimulated luminescence (OSL) ages from the NW Negev dunefield. Here we analyze Late Pleistocene dune mobilizations and stabilizations and interpret their palaeoclimatic controls in light of regional and global dune ages, sediment records and proxies.

While initial dune encroachment into, and stabilization in, the NW Negev took place during the Last Glacial Maximum (LGM) at $\sim 23^{-1}8$ ka, spatial and statistical analyses of the OSL dataset suggest that since the LGM, Negev dune activity was concentrated in two significant mobilization-stabilization episodes: a main episode at $\sim 16^{-1}3.7$ ka and a minor one at $\sim 12.4^{-1}1.6$ ka when the dunes reached their maximum spatial extent and stabilized. These episodes include rapid dune encroachment and accretion events and coincide with the Heinrich 1 and Younger Dryas cold events, respectively. The Late Pleistocene sand-transporting winds were characterized by a westerly direction that resulted in west-east VLD elongation.

Dune mobilizations may have occurred in response to wintertime East Mediterranean cyclonic systems that brought storms of rainfall and strong winds. The rapid dune mobilization events and their concurrence with the Heinrich 1 and Younger Dryas cold events suggest a more global control. Despite the rainfall, the elongating VLDs were probably sparsely vegetated because of the high wind power; their stabilization resulted from a decrease in storminess, with the onset of a more arid Holocene climate.

Other global low-latitude dune mobilizations and stabilizations are concentrated at the end of the Late Pleistocene, leading us to suggest that these were also controlled mainly by global cold-events and subsequent changes in windiness.

The recurring discontinuous aeolian sedimentation pattern found in OSL-dated VLDs provides new and important chronological and sedimentological insight into prominent dune mobilization and stabilization processes. The suggested link between global drops in cold-event windiness and low-latitude dune stabilization episodes emphasizes the prevalence of winds over aridity regarding major dune mobilizations for low-latitude dunes, even if vegetated.