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Geomorphological context of Quaternary desert loess - from dust sink to dust source

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Quaternary loess covers desert margins and vast areas of the Negev, southern Israel. The Negev loess is among the best-studied desert loess, with research going back to the early 20th century. The contrast between carbonate rocks of the Negev and its silicate-rich coarse-silt loess allows determining the loess sources, learning the synoptic-scale paleoclimatology, and exploring processes of coarse silt formation. Here, we present an overview of new perspectives on the origins and climatic significance of the Negev loess, expand on how (a) coarse silts affected soils farther downwind, and (b) how the loess has now turned into an active dust source.

The sources of the Negev loess are the (a) distal Sahara and Arabia delivering fine silts and clays, transported over thousands of kilometers, and (b) proximal sand dunes in Sinai and Negev, advancing and concurrently supplying the coarse silts to the loess accretion through eolian abrasion of sand grains. It was found that the coarse silts which compose the majority of the loess, commenced during the late middle Pleistocene – early late Pleistocene, coeval with the appearance of the advancing Sinai/Negev sand dunes and the first coarse silt accretion in regional soils; The main loess formation episode is ~95-10 ka, when the dunes appeared in the Negev. Within the loess, the dust mass accumulations rates (MAR), and consequently, soil formation rates, spatiotemporally vary according to specific site location and distance relative to the proximal sources. With increasing distance beyond the loess zone, both dust MARs and grain size gradually decrease; thus, whereas Mediterranean mountains located in central Israel, tens of kilometers downwind the loess, exhibit thick soils on top of the carbonate bedrock, the even wetter regions in northern Israel, located hundreds kilometers away from the loess, exhibit only thin soils. Thus, in Mediterranean regions located at the desert fringe, coarse silt influx is one of the main factors in determining the environmental sustainability, rather than only the precipitation amount.

During the Holocene, dust MARs in the Negev were much lower than late Pleistocene ones, and loess was not formed. Recently, the Negev loess became a prime source of dust mainly due to anthropogenic interferences, contributing to the regional dust cycle, and thus, at present the loess zone is a dust source rather than a dust sink. Today, the Negev loess is a non-replenishable natural resource that is slowly eroding and disappearing from the landscape.