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The role of active sand seas in the formation of desert loess

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Loess is a widespread eolian deposit dominated by coarse silt-sized quartz particles, which serves as an important archive of information on Quaternary climate change. Despite the intensive research during the past century on desert loess formation, its origin remains poorly understood and is still a fundamental problem in sedimentology and in Quaternary paleoclimatology. The ongoing debate is focused on the first stage of loess formation - the production of coarse silt quartz grains. Although laboratory experiments indicate the potential of dunes with their abundant quartz sand grains as a primary source for generating coarse silt grains, this concept has been generally rejected as field-based evidence for abrading from sand grains (eolian abrasion) is rare. Here we adopted a global view of the sand sea - loess association and examine in detail several well-known late Pleistocene loess regions in different subtropical deserts (North Africa, The Sahel, Middle East and Arabia). This analysis demonstrates that all these loess regions are located downwind of adjacent sand seas. Together with evidence of mineralogical similarity between the loess and the sand dunes and their contemporaneous activities, these observations suggest that sand seas are an important source for desert loess. Since there is only limited silt storage in sand dunes, we postulate that the silt grains comprising most of the loess are not reworked from the dunes but are generated probably through active eolian abrasion of the medium sand grains under past climates characterized by intensified winds. As a result, the role of sand dunes and eolian abrasion in the formation of desert loess can be more important than previously thought.