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Central Asian aridification at ∼40 Ma revealed by an Eocene dust record, Xining Basin, NE Tibet

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Loess is formed by dust storms of the Asian winter monsoon and provides a unique record to study the history of Asian aridification. However, the mechanisms driving the origin and early evolution of the loess remain poorly constrained because deposits predating the Neogene are sparse. Late Eocene dust records have been identified based on quartz surface morphologies and grainsize distributions in the terrestrial sediments of the Xining Basin, NE Tibet. As a part of the ERC "MAGIC" project, we extend this grainsize record to ∼50 Ma using a recently established age model based on magnetostratigraphy and dating of a volcanic ash.

End-member analysis of the grainsize distributions reveals three end-members of fluvio-lacustrine origin with modes at <10 μm. A fourth end-member with a mode at 59 μm has a grainsize distribution similar to Quaternary loess. The abundance of this loess-like end-member is insignificant (<10%) in the early Eocene record, but increases abruptly to ∼20% at ∼40 Ma, coeval with an increase in steppe-desert pollen and the onset of orbitally forced cycles of playa lakes. The eolian origin of this end-member is further corroborated by the absence of fluvial sedimentary structures and the occurrence of dm-scale beds with foresets formed by eolian dunes. These dunes are composed entirely of gypsum grains deflated from nearby playas. We propose that the sudden increase in eolian dust at ∼40 Ma is linked to aridification due to the retreating proto-Paratethys Sea from western China and Siberia. However, other factors such as global cooling and the northward progression of the Tibetan Plateau may have further influenced the aridification of Central Asia.