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Production of Asian dust: tectonics vs climate

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Asian dust plays a major role in contributing to the world dust system, and in turn modulating global climate. Asian dust presumably originates from the deserts in Asian interior, yet the formation and evolutionary history of the deserts remain debated. In this paper we present sedimentological evidence from the southern margin of Tarim Basin (Taklimakan Desert) to determine the age of the formation of the desert, and to envisage the mechanism in which dust is produced through a series of tectonic, fluvial, sedimentological and eolian processes.
Cenozoic sedimentary successions along the southern margin of the Tarim Basin, western China, reach up to 10 km in thickness. The two studied sections, the Yecheng and Aertashi, comprise ca. 4.5 km and ca. 7.0 km of clastic sediments respectively. The base of the Yecheng section is palaeomagnetically dated to be at about 8 Ma. Age control of the Aertashi section is based on 87Sr/86Sr measurements (for the basal marine bed), together with magnetostratigraphy and regional stratigraphic correlation. The lower part of the sections is mainly composed of fine-grained mudstone and fine sandstone, which makes up the Wuqian Group (Miocene). The palaeoenvironment is low-energy, meandering and braided streams. The middle part is composed of red mudstone, sandstone with thin conglomerate beds, which makes up the Artux Formation (Pliocene). The palaeoenvironment is a distal- to mid-fan environment. The uppermost part of the section, known as the Xiyu Formation (Plio-Pleistocene), consists of cobble and boulder conglomerate intercalated with massive siltstone lenses, which formed as proximal alluvial fan and eolian deposits. Neogene red beds passing upward into upward-coarsening conglomerate and debris-flow deposits record the change in palaeoslope related to uplift of the northern margin of Tibetan Plateau.
The formation of eolian dunes at ca. 8 Ma, and underlying playa lake deposits (as at Aertashi), may indicate an arid, enclosed basin in the southern Tarim after this time. Sedimentological characteristics, together with grain size distribution and geochemistry of siltstone bands in the Xiyu and Artux Formations, point to an eolian origin. This indicates that the Taklimakan Desert and the regional climate regime may have been fully developed by the Early Pliocene, if not earlier. The onset of eolian sedimentation in the southern Tarim Basin coincided with uplift of the northern Tibetan Plateau, as inferred from the lithofacies change. Tibetan Plateau uplift resulted in the shift of sedimentary environments northwards into the southern Tarim Basin, and could well have triggered the onset of full aridity in the Taklimakan region as a whole.