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Astronomical forcing of Pleistocene terrestrial record in the western Tarim Basin, NW China

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Astronomically forced climate variations was documented in the climate-sensitive sedimentation and formed cyclic stratigraphic records. However, very few published papers have demonstrated the astronomical forced cycles within Quaternary fluvial-fan sequences. Here we carried out high-resolution logging of gamma-ray (GR), magnetic susceptibility (MS), Rb/Sr and total organic carbon (TOC) analysis of a continuous core from an 800-m borehole (KT11) from the Kashgar region in the western of Tarim Basin. Spectral analyses of the GR, MS and Rb/Sr data reveal cycles with ∼70 m, ∼30 m and ∼14 m wavelengths. These pertain to relative variations in clay to sand content. Electron spin resonance (ESR) dating and magnetostratigraphy imply that the cored interval spans the past 1.1 Myr. This age-span constraint, coupled with the comparison of the ratios of these cycle wavelengths to expected ratios of Milankovitch frequencies, suggests that these cycles represent ∼100-kyr short-eccentricity, ∼40-kyr obliquity and ∼20-kyr precession frequencies, respectively. We constructed an astronomical time scale (ATS) spanning the past 1.13 Myr using the ∼100-kyr short-eccentricity period. The average accumulation rate is about 70 cm/kyr for this 800-m core succession, and the evolutive spectrum emphasizes that long-term sedimentation rates were stable. Thus, we conclude that orbitally forced climate change was the main driver for fan deposition into Kashgar region. During 100 kyr eccentricity maxima (interglacials), more chemical weathering and increased seasonal runoff that delivered relatively coarser-grained sediments to the fluvial fan in the Kashgar region. The Mid-Pleistocene Transition (MPT) at ca. 0.9 to 0.65 Ma is also well recorded in our GR and Rb/Sr data, and is characterized by a shift of dominant period from 41 kyr cyclicity to 100 kyr. That MPT also corresponds to a decrease in TOC content and in the degree of chemical weathering of the hinterland, as reflected by the Rb/Sr values., which suggests that there was an increase in regional aridity of the Kashgar region in the western Tarim Basin. This regional change is synchronous with the trend toward aridification observed throughout central Asia.