Multi-dating the Mu Us Desert: Integrating cosmogenic nuclide, paleomagnetic, and luminescence chronologies

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Abstract

The Mu Us Desert is strategically located at the margin of the East Asian summer monsoon, between the upper and middle reaches of the Yellow River. Its formation and evolution are therefore critical to understanding Quaternary desertification dynamics across northern China, as well as the desert's provenance link to the drainage evolution of the upper Yellow River. To address these issues, we drilled a 160-m core in the southwestern Mu Us Desert; however, establishing a reliable age model for this core poses a major challenge. Here, we synthesize cosmogenic nuclide (26Al and 10Be), paleomagnetic, and luminescence dating to establish a robust chronology for this core. 74 OSL ages from the upper 25m reveal a 100-kyr cycle in sand-dune preservation over the past 320ka. Below this depth, paleomagnetic analyses at ~25cm intervals yield two alternative models, placing the basal age at either 2.2Ma or 1.8Ma. To test these two alternatives, we input the cosmogenic 26Al/10Be data into a CosmoChron model. The modeling shows that the 1.8Ma scenario requires an initial 26Al/10Be ratio of less than 2, which contradicts the measured ratios (all > 2). By combining these cross-dating techniques, we constrain the onset of sand-dune deposition to ~2.2Ma and the establishment of a persistent desert landscape to ~1.1Ma, thus providing a robust chronological foundation for paleoclimatic interpretations of the Mu Us Desert.

Keywords: Mu Us Desert, Cosmogenic nuclide dating, Paleomagnetic dating, OSL dating, CosmoChron modeling

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