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Climate-driven changes to dune activity since the Last Glacial Maximum in the Mu Us dune field, north-central China

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Dune field dynamics are influenced by the interplay between two variables that are highly sensitive to climate change: surface erodibility (affected by vegetation, moisture, and other factors) and wind transport capacity. This basic connection with climate is clearly important in assessing possible responses of dryland landscapes to climate change in the 21st century, and has also led to many studies utilizing dune sand stratigraphy to reconstruct paleoclimatic change. The relations between the dynamics of the aeolian landscape and its drivers are not yet completely understood, however.

In recent ten years, we have been working in the Mu Us dune field, a typical semi-arid dune field in north-central China. Dozens of dune chronstratigraphies have been investigated to reconstruct paleoenvironmental changes in the Mu Us dune field since about 20,000 years, by optical simulated luminescence dating and analysis of proxy indexes. Mechanisms about climatic forcing of dune field variations could then be discussed.

In particular, our recent study finds that the evidence of aeolian sand deposition during the Last Glacial Maximum (LGM) is scarce in not only the Mu Us but also many mid-latitude dune fields around the world, whereas abundant evidence exists for aeolian sand accumulation during the deglaciation, i.e. after about 15 ka. We find in the Mu Us dune field, aeolian sands deposited during the LGM are preserved as fills in periglacial sand wedges and beneath loess deposits near the downwind dune field margin. The scarcity of LGM dune sand elsewhere in the dune field is interpreted as the result of intensive aeolian activity without substantial net sand accumulation. Increasing sand accumulation after 15 ka, reflected by much more extensive preservation, signals a change in sand supply relative to sand transportation through the dune field. Reduced wind strength and other environmental changes including regional permafrost degradation after 15 ka transformed the dune field state from net erosion to net accumulation; the dunes, however, remained largely mobile as they were in the LGM. Similar diverging patterns of dune sand accumulation and preservation before and after 15 ka in many mid-latitude dune fields imply broad climatic controls linked to the changes in high-northern-latitude forcing. Our study on Holocene climate change and dune field activity is also in progress.