Architecture of Eolian successions under icehouse and greenhouse conditions

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Anthropogenic climate change is one of the foremost scientific and societal challenges. In part, our response to this global challenge requires an enhanced understanding of how the Earth's surface responds to episodes of climatic heating and cooling. As historical records extend back only a few hundred years, we must look back into the ancient rock record to see how the surface of the Earth has responded to shifts between icehouse (presence of ice at the Earth's poles) and greenhouse (no substantial ice at Earth's poles) climates in the past.

In their study published last week in *GSA Bulletin*, Grace Cosgrove, Luca Colombera, and Nigel Mountney use a novel relational database (the Database of Aeolian Sedimentary Architecture) to quantify the response of ancient eolian systems (i.e., wind-dominated environments, such as sand dune fields) to global climatic shifts between icehouse and greenhouse climates, as registered in the rock record. They analyzed data on thousands of geological features that preserved a record of eolian processes and landforms, from 34 different eolian systems spanning over two billion years of Earth's history.

Their results demonstrate statistically that preserved sedimentary architectures developed under icehouse and greenhouse conditions are fundamentally different. These differences can be tied to contrasting environmental conditions existing on Earth's surface. During icehouse climates, alternations between glacial and interglacial episodes (caused by changes in the Earth's orbit—the so-called Milankovitch cyclicity) resulted in cycles of glacial-episode accumulation and interglacial

deflation.

Greenhouse conditions instead promoted the preservation of eolian elements in the geological record due to elevated water tables and the widespread action of biogenic and chemical stabilizing agents, which protected deposits from wind-driven deflation.

In the context of a rapidly changing climate, the results presented in this work can help predict the potential long-term impact of climate change on Earth surface processes.

More information: Grace I.E. Cosgrove et al. Quantitative analysis of the sedimentary architecture of eolian successions developed under icehouse and greenhouse climatic conditions, *GSA Bulletin* (2021). DOI: 10.1130/B35918.1

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