Drivers and impacts of Saharan dust variability over the last 240 kyr

DAVID MCGEE[1,*], CHARLOTTE SKONIECZNY[2,], CHRISTOPHER KINSLEY[1], GISELA WINCKLER[3], LOUISA BRADTMILLER[4], ALOYS BORY[5], PRATIGYA POLISSAR[3,] PETER DEMENOCAL[3]

[1]Massachusetts Institute of Technology, Cambridge MA 02139 USA, correspondence: davidmcg@mit.edu
[2]Géosciences Paris Sud (GEOPS), 91405 Orsay Cedex, France
[3]Lamont-Doherty Earth Observatory, Palisades, NY 10964
[4]Macalester College, St. Paul, MN, 55105
[5]Université de Lille, 59655 Villeneuve d'Ascq Cedex, France

The Sahara Desert is the world's greatest source of mineral dust to the atmosphere, and records of Saharan dust deposition in marine sediments are a basic part of our understanding of North African climate evolution over the Plio-Pleistocene. Despite the importance of Saharan dust reconstructions for understanding local and global climate, it has been unclear how well we can actually reconstruct Saharan dust deposition, how dust emissions relate to the strength of the West African monsoon, and what the relative importance of local insolation, glacial-interglacial changes, and millennial-scale variations is for the dust record.

We use Th-230 normalization to map Saharan dust inputs across the North Atlantic over the last 20,000 years, demonstrating strong coherence of records from both sides of the Atlantic and reflecting both summer and winter dust emissions. We then present new records of Saharan dust deposition extending as far back as 240 kyr. After establishing the tight relationship between dust emissions and West African monsoon strength, we use these records as tracers of past monsoon changes. Our results indicate that previous long-term dust records have underestimated precessional variability and overstated the importance of glacial-interglacial changes over the past two glacial-interglacial cycles, and potentially over the whole of the Pleistocene.

Beyond being a passive tracer of past climate changes, Saharan dust also has important – but poorly understood – radiative impacts. We examine the potential impacts of the dramatic changes in Saharan dust emissions observed on precessional and millennial timescales. We find that dust emissions may well have played a role in amplifying past monsoon changes, but that at present uncertainties in modeling these impacts are likely greater than uncertainties in dust reconstructions.