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Fertilizing the Amazon and Equatorial Atlantic with dust from the Bodélé Depression in Chad

Charlie Bristow and Karen Hudson-Edwards

Department of Earth and Planetary Sciences, Birbeck College, University of London, London, United Kingdom (c.bristow@ucl.ac.uk)

Atmospheric mineral dust plays a vital role in Earth's climate and biogeochemical cycles. The Bodélé Depression in Chad has been identified from remote sensing as the single biggest source of atmospheric mineral dust on Earth. This is due to a combination of strong near surface winds and a large reservoir of readily eroded and easily entrained, low density sediment. During the Holocene and Late Pleistocene, the Bodélé Depression was host to a great lake, Palaeolake Megachad, that is now completely desiccated leaving the lake bed sediments exposed to deflation. Deflation is revealed by erosional remnants of lake bed deposits exposed as yardangs on the palaeolake floor. These erosional remnants indicate that locally up to 4 m of sediment have been removed by deflation. Optical dating and radiocarbon dating indicate that the lake bed dried out around 1000 years ago giving a rate of deflation of at least 4 mmyr^{-1}. A range of other geomorphological features indicate that in some areas rates of deflation may be greater than or equal to 10 mmyr^{-1}. Satellite image analysis shows that outcropping diatomite covers 24,049 km2 of the Bodélé Depression. Furthermore, the area from which diatomite has been removed by deflation is around 14,000 km2. Combining this information with the ages and rates of deflation mentioned above indicates that some 61,000 km3 of diatomite has been eroded from the Bodélé Depression during the past 1000 years (Bristow et al 2009). The northeasterly Harmatan wind that erodes the Bodélé caries dust southwest across Nigeria to the Gulf of Guinea and then out over the equatorial Atlantic Ocean towards South America. The mineral dust contains micronutrients such as Fe and P that have the potential to act as a fertilizer, increasing primary productivity in the Amazon rain forest as well as the equatorial Atlantic Ocean, and thus leading to N2 fixation and CO2 drawdown. We present the results of chemical analysis of 28 dust samples collected from the source area, which indicate that up to 6.5 Tg of Fe and 0.12 Tg of P are exported from the Bodélé Depression every year. This suggests that the Bodélé may be a more significant micronutrient supplier than previously proposed (Bristow et al. 2010).

Bristow, C.S., Drake, N., and Armitage, S., 2009, Deflation in the dustiest place on Earth: the Bodélé Depression, Chad. Geomorphology 105, p.50-58. doi:10.1016/j.geomorph.2007.12.014

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