Storms and dust: Investigating terrestrial inputs and their impacts on the Equatorial Atlantic over glacial-interglacial cycles

Supervisors

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Project description

Wind-blown dust is thought to supply key nutrients to the surface ocean of the Equatorial Atlantic that help to fertilise the ocean and promote biological productivity. Understanding how wind-driven deposition of terrestrial material shifts during periods of climatic change is key to understanding how marine ecosystems will respond to future changes.

There is evidence from marine sediment cores off NW Africa for changes in speed, location and gustiness of the trade winds since the last glaciation, in particular during the abrupt climate events of the deglaciation. However, these records rely on several assumptions about the sediment records, and are limited in extent to shelf sediments. The aim of this project is to develop novel archives of past dust input to the oceans, and to apply proxies developed through an innovative interdisciplinary approach to a suite of well-dated sediment cores across a wide longitudinal gradient in the Equatorial Atlantic, focusing on the last glacial maximum and deglaciation.

1) Siliceous microfossils are well preserved in the Equatorial Atlantic sediment cores and can provide a wealth of information about oceanic conditions. Preliminary work shows clear downcore trends in the number of phytoliths (microscopic silica structures produced by land plants, Figure 1) and the abundance of siliceous diatoms (marine algae). The student will analyse these phytoliths and diatoms in order to reconstruct past changes in terrestrial dust input and marine ecosystem response. The isotopic composition of the diatom microfossils will be used to reconstruct changes in nutrient utilisation that occurred in response to changes in terrestrial inputs.

2) Organic biomarkers of land plants, in particular, plant waxes and their isotopic composition can be used to trace terrestrial organic matter inputs and to identify its sources (1). Initial data from the Equatorial Atlantic suggests that terrestrial plant lipids in the surface sediments mainly derive from savannah vegetation. As African vegetation cover changed significantly since the last glacial maximum the eolian export of terrestrial biomarkers towards the Equatorial Atlantic varied considerably. The student will compile downcore biomarker records, to reconstruct terrestrial organic matter input to the oceans over these timescales and to relate these to the supply of phytoliths.

3) Thorium-232 (^{232}Th) is a trace isotope enriched in continental material, and is used in marine sediment cores that are in remote regions of the oceans to reconstruct input from dust (2). Preliminary work from these cores indicate substantial downcore variations in dust supply, and the student will produce detailed records of dust input using uranium series measurements.

Field work: The student will be encouraged to participate in an ocean research expedition during the course of the project. The student will combine the new archives, together with additional geochemical and sedimentary data from these cores, into a multi-proxy study in order to gain an integrated view into terrestrial inputs and dust fertilisation since the last glaciation.

Eglinton, TI, Eglinton, G, Dupont L et al. (2002) Composition, age, and provenance of organic matter in NW African dust over the Atlantic Ocean. *Geochemistry, Geophysics, Geosystems* 3.

D. McGee, P.B. deMenocal, G. Winckler, J.B.W. Stuut, L.I. Bradtmiller (2013) The magnitude, timing and abruptness of changes in North African dust deposition over the last 20,000 yr, *Earth and Planetary Science Letters*, Volumes 371–372, 163-176

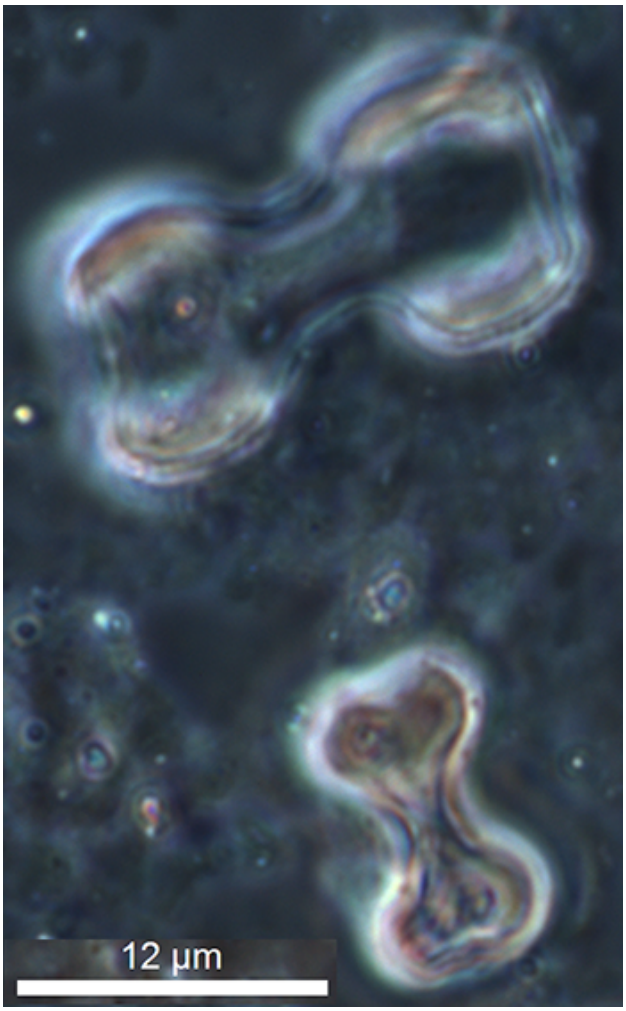

Figure 1: Microscope image of phytoliths from the deglaciation