Using opal and organic carbon as proxies for migration of the North African monsoon

L.I. BRADTMILLER[1]*, M.B. AWALT[1], D. MCGEE[2] AND P.E. DEMENOCAL[2]

[1]Macalester College, Saint Paul, MN, 55406, USA (*correspondence: lbradtmi@macalester.edu)
[2]Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY, 10964, USA

Marine and terrestrial records from northern Africa have greatly enhanced our understanding of both the causes and effects of climate change in the geologic past. Specifically, proxy records of changes in paleoproductivity yield information about upwelling strength, and therefore trade wind strength along the North African margin. Changes in wind strength, in turn, have been shown to correlate with changes in the relative aridity of the Sahel: periods of increased precipitation in the past were periods of weaker trade winds and decreased upwelling, and vice verse.

Records of opal flux over the past 18kyr illustrate the inverse relationship between precipitation and marine productivity, as periods of greater opal flux (increased wind-driven upwelling) correspond to periods of increased terrigenous flux (increased wind-borne dust flux). Paleoceanographic records have identified the African Humid Period (AHP; ~11 – 5.5 kyr) as a period of low dust flux and decreased opal flux consistent with a northerly shift in the ITCZ, increased precipitation and reduced upwelling. However, our current understanding of the causes and effects of the AHP is limited by the lack of upwelling/productivity data along a north-south transect of the African margin, as well as by a general lack of high-resolution data.

Here we present opal and organic carbon (C_{org}) records from a north-south transect of marine sediment cores on the northwest African margin. We observe decreased fluxes of opal and C_{org} in all cores at the onset of the AHP, although the magnitude of this response varies greatly from core to core. At the end of the AHP, opal and C_{org} fluxes increase, albeit not to pre-AHP levels. During both transitions the magnitude of flux change is greatest in the southernmost cores, which are closest to the region of maximum upwelling in the modern ocean. Current age models suggest that decreased fluxes of opal and C_{org} occur first in the southernmost core at the onset of the AHP, consistent with the hypothesis that these changes represent a northward shift in the ITCZ.

Chemical evolution of MORB: New insights from old crust

P.A. BRANDL*, M. REGELOUS AND K.M. HAASE

GeoZentrum Nordbayern, Universität Erlangen-Nürnberg, Schlossgarten 5, 91054 Erlangen, Germany (*correspondence: philipp.brandl@gzn.uni-erlangen.de)

The chemistry of mid-ocean ridge basalt (MORB) is studied almost exclusively using samples dredged from active spreading ridges. However, flows erupted at the ridge axis itself eventually make up the lowermost part of the extrusive section, and may not be representative of the entire oceanic crust. In contrast, samples drilled from old oceanic crust will include flows erupted both on- and off-axis, and also can be used to determine whether changes in MORB composition occur over the lifetime of an ocean basin. Despite this, few detailed studies of ancient MORB have been carried out.

We have analysed major element compositions of more than 400 fresh volcanic glasses from 35 DSDP-ODP drillsites in the Atlantic and Pacific, which range in age from 10 to 170 Ma. Trace element analyses of the same samples using LA-ICPMS are in progress.

In contrast to some previous studies, we find no significant difference in fractionation-corrected major element composition of Mesozoic and zero-age MORB in either the Pacific or the Atlantic. There is no indication that EMORB are concentrated in the upper parts of the oceanic crust, as would be expected if they were preferentially erupted off-axis. Instead, the youngest lavas (upper 100m) at a given drillsite tend to have relatively homogenous compositions, which could be explained if larger-volume flows flow further from the axis. If this is the case, then sampling MORB only from active spreading ridge axes may not give an entirely accurate picture of the average composition of the oceanic crust. It also means that direct comparison of lavas from slow- and fast-spreading ridges, which differ in axial topography and average flow volumes, will not be straightforward.