Extracting palaeoceanographic signals from a suite of isotopic and biomarker records

R.D.PANCOST[1], C.S.BOOT[1], M. MASLIN[2], AND V. ETTWEIN[2]

[1] Bristol Biogeochemistry Reseach Centre, School of Chemistry, University of Bristol; r.d.pancost@bristol.ac.uk
[2] Environmental Change Research Centre, Department of Geography, University College London

The organic geochemical characteristics of marine sediments are a potentially rich archive of information on past climate change. Here, we show how lipid biomarker distributions and isotopic compositions can be used to obtain new insights into past oceanographic changes in the Bengula Upwelling System and complement inorganic geochemical approaches. We focus on both the last glacial-interglacial cycle and the Intensification of Northern Hemisphere Glaciation (INHG).

During three glacial cycles spanning the INHG, alkenone-derived sea surface temperatures track benthic foraminferal $\delta^{18}O$ values, exhibiting coldest temperatures during glacial intervals. Such temperature variations reflect enhanced upwelling during glacial times. Consistent with this, total organic carbon (TOC) and porphyrin accumulation rates indicate the onset of strong productivity cycles. However, TOC and porphyrin cycles are not always in phase with changes in SST/$\delta^{18}O$ values and are inversely correlated to organic $\delta^{15}N$ values. Thus, productivity is not governed solely by upwelling intensity but also the source and nutrient content of upwelled water.

The change in the intensity of glacial-interglacial cycles was also associated with a change in biomarker assemblages and, thus, inferred phytoplankton community structure. For example, the biomarker distribution during the productivity maximum at 2.53 Ma is dominated by alkenones with little input from other marine biomarkers, whereas during the maxima at 2.49 and 2.45 Ma there is also a large contribution from alkyl diols, suggesting that other organisms, probably diatoms, are more important components of the algal community. Similarly, biomarkers for sulfate-reducing bacteria and methanogens are more abundant in the latter two cycles. Thus, the transition to a climatic state characterized by intense glaciations was complex and involved not only an increase in primary productivity, but also reorganization of photoautotroph assemblages and changes in sedimentary redox conditions.