

LIPIDS FROM THE DIATOM GENUS *PROBOSCIA* AS A PROXY FOR SEASONAL UPWELLING

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Species from the diatom genus *Proboscia* are weakly silicified. They can adjust their buoyancy and migrate to deeper levels below the euphotic zone to obtain nutrients that are not available to other algae. In seasonal upwelling regions, this migration often enables them to reach nutrient-rich water layers before mixing in the photic zone takes place, resulting in a high contribution to the primary production by these diatoms. Therefore, remnants of *Proboscia* species may serve as biomarkers for upwelling conditions. Diatom silica tests are commonly used for palaeoenvironmental reconstruction but are prone to dissolution. Recently, we have identified a unique suite of lipid biomarkers in *Proboscia* diatoms: saturated and unsaturated C₂₈ and C₃₀ 1,14-diols and C₂₇ and C₂₉ 12-hydroxy methyl alkanates (Sinninghe Damsté et al., 2003). Eustigmatophyceae algae are the only other marine organisms known to produce similar compounds, but they mainly produce 1,13- and 1,15-diols with C₂₈ to C₃₄ carbon chain lengths and long-chain mid-chain hydroxy methyl alkanates with different homologues than those found in *Proboscia* diatoms. Thus, long-chain 1,14-diols and 12-hydroxy methyl alkanates (*Proboscia* lipids) can be used as indicators for seasonal upwelling. Indeed, sediment trap samples from the Arabian Sea showed high fluxes of *Proboscia* lipids during the upwelling season (Rampen et al., in press).

In this study, we analyzed long-chain diols and mid-chain hydroxy methyl alkanates in time series of 2 sediment traps in an upwelling area in the north-western Indian Ocean off Somalia. Our results show that high fluxes of *Proboscia* lipids coincided with high fluxes of *Proboscia* frustules during the second half of June, just at the onset of the upwelling season. Diatom frustules in the sediment traps show that other diatoms proliferated when the mixing took place. C₃₀ 1,15-diol fluxes followed neither *Proboscia* frustule fluxes nor organic carbon fluxes. We suggest that a ratio of *Proboscia* diols relative to C₃₀ 1,15 diols can be used as a proxy for upwelling and applied this new proxy on a piston core covering 34 ky, taken below the position of one of the sediment traps. Low diol ratio values were found during the last glacial, and values increased in the period after the Younger Dryas (Fig. 1a) when rapid warming took place. This is in agreement with the idea that, in this area, upwelling was subdued during the glacial period. Organic carbon content and the barium/aluminium ratio,

which are well known indicators for marine palaeo-productivity, show an increase after the Younger Dryas, but, unlike the diol ratio, also show relatively high values during the glacial period (Fig. 1b, from Ivanochko et al., 2005). Our new results indicate that this glacial productivity is not caused by upwelling.

Sediment cores from other upwelling areas, like the northern part of the Arabian Sea, the north-western Indian Ocean off Somalia, the South-East Atlantic region and the Santa Barbara Basin, are currently analyzed for this new proxy.

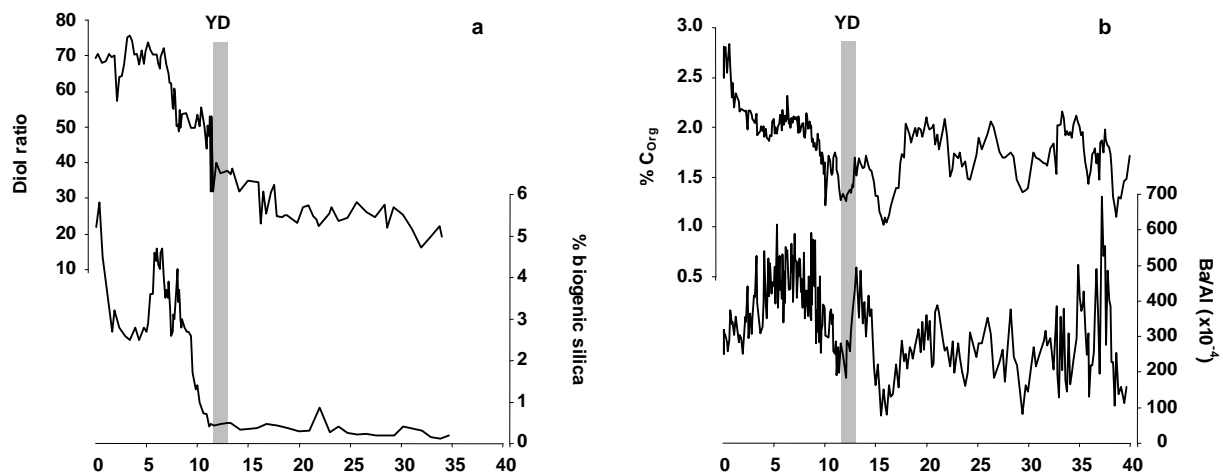


Figure 1. Data from a piston core from the Somali Basin, north-western Indian Ocean off Somalia. (a) Diol ratio [*Proboscia* diols / (*Proboscia* diols + C₃₀ 1,15 diols)] and biogenic silica content (the latter from Koning, 2002). (b) Organic carbon content and barium/aluminium ratio, both well known indicators for marine palaeo-productivity (both from Ivanochko et al., 2005).

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