Climatic changes in the upwelling region off Northwestern Africa over the late Quaternary: a multi-biomarker approach

Y. Ternois — Institute of Low Temperature Science, Nishi 8, Kita 19, Hokkaido University, 060 Sapporo, Japan

M.-A. Sicre
M. Paterne — Laboratoire des Sciences du Climat, et de l'Environnement, Domaine du CNRS, Ave. de la Terrasse, 91191 Gif-sur-Yvette Cedex, France

In order to determine the climatic variability of the North West Africa upwelling system on a regional scale, two sediment cores 20bK (25°01N, 16°39W, 1445 m depth) and 11K (21°29N, 17°57W, 1441 m depth) located on the continental slope off Mauritania (Fig. 1) were analysed using a multi-biomarker approach.

Marine-derived alkenones, sterols and terrigenous high molecular-weight *n*-alkanols were quantified to assess sources of sedimentary organic matter, and their deposition over the late Quaternary. Downcore profiles of the C_{37} alkenone unsaturation ratio ($U^{K'}_{37}$) were used to estimate past changes in Sea Surface Temperature (SST) using the calibration of Prahl *et al.* (1988). Chronology derives from oxygen isotope measurements.

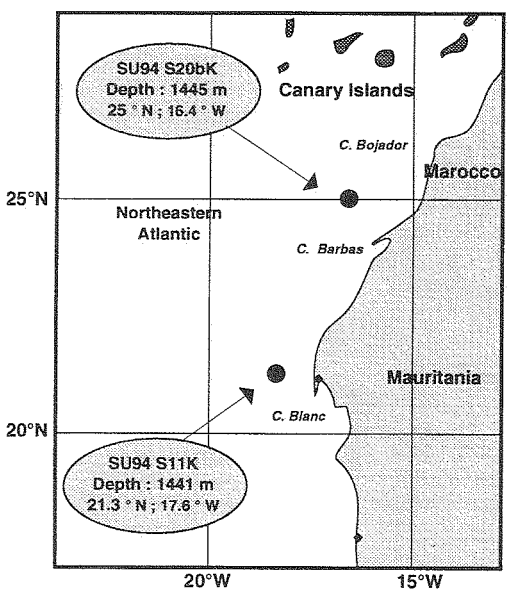

FIG. 1. Map of the Northwest African continental margin showing the location of cores 20bK and 11K collected during the SEDORQUA cruise, 1994.

Results and discussion

At site 20bK, *n*-alkanol, sterol, and alkenone accumulation rates (AR) followed similar trends, showing a net increase of marine and terrigenous inputs during isotopic Stage 2 (Fig. 2*b,c,d*). These results are consistent with the hypothesis of a strenghtening of Trade Wind circulation at the Last Glacial Maximum (LGM), inducing an intensification of the upwelling circulation and higher aeolian supply off Cape Bojador. Organic carbon data from the nearby M-12392 core suggest that upwelling cells during glacial times were probably stronger further offshore than over the shelf. Sterol AR indicate low levels of marine production during the Holocene and Stages 4-5, as a result of the weakening of Trade Wind regime, as also shown by the low *n*-alkanol AR. Higher alkenone AR from Stages 4 to 6 suggest that coccolithophorid production was higher at the time of low OC production. SST indicated a 4°C warming during the last deglaciation.

As opposed to core 20bK, sterol and alkenone AR were higher at Holocene in core 11K, reflecting intense upwelling-induced marine productivity at 21°N (Fig. 2b,c,d). *n*-alkanol AR decreased over the last 8 ka B.P.. This result possibly reveals a regional anthropogenic disturbance and soil degradation from nomadic herdsmen as previously hypothesized by Pokras and Mix (1985). Another conspicuous feature of the 11K record is the 1.5°C warming occurring between 24 to 15 ka B.P. (Fig. 2*a*). The concomitant drop of the marine and terrigenous biomarker AR suggests a reduction of upwelling intensity likely due to a change in the atmospheric circulation pattern of the Trade Wind system. The SST warming for the last deglaciation calculated form $U^{K'}_{37}$ values is 2.5°C.

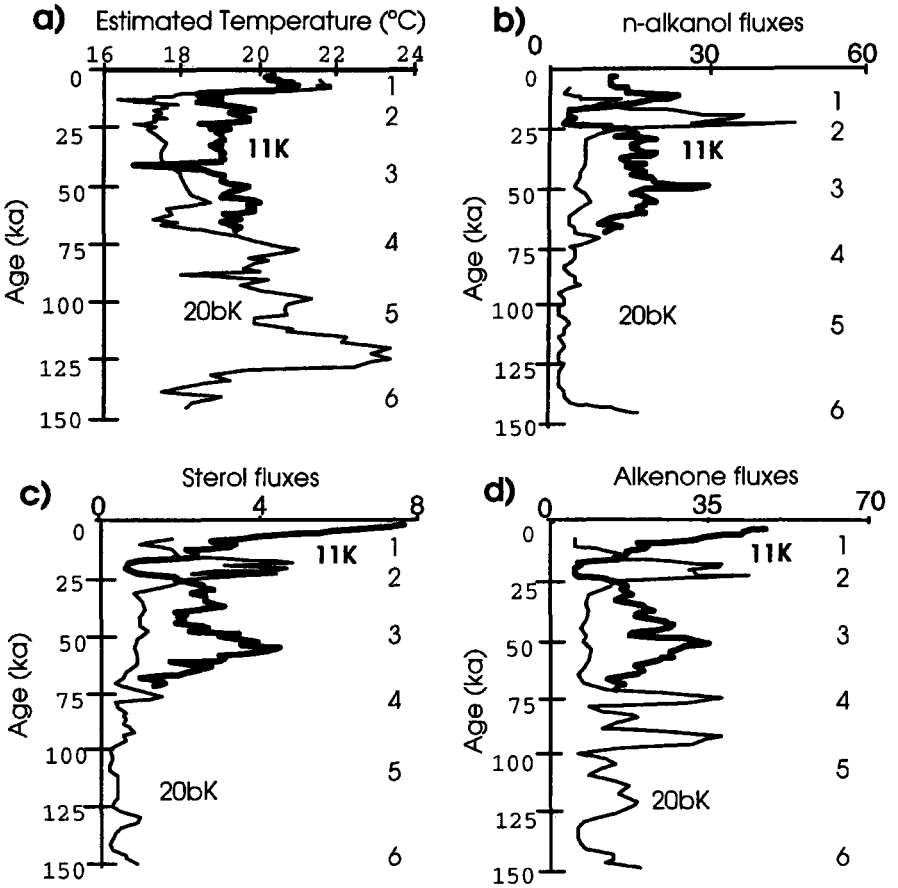

FIG. 2. Downcore profiles of (a) alkenone-related SSTs, (b) *n*-alkanol accumulation rates (AR), (c) sterol AR, and (d) alkenones AR (expressed in $\mu g/cm^2/ka$) at 20bK and 11K sites.

Conclusions

Our data show distinct temporal evolution of biomarker AR at 25°N and 21°N in the Northwest african upwelling zone. They indicate different regional features of atmospheric and oceanic palaeo-circulations in this region over the late Quaternary.

References

Prahl, F.G., Muelhausen, L.A. and Zahnle, D.L. (1988) *Geochim. Cosmochim. Acta*, **52**, 2303–10.

Pokras, E.M. and Mix, A.C. (1985) *Quater. Res.*, **24**, 137–49.