Geophysical Research Abstracts,
Vol. 11, EGU2009-5793, 2009
EGU General Assembly 2009

Coupled marine productivity and salinity and West African monsoon variability over the last 30,000 years in the eastern equatorial Atlantic Ocean

F. Marret (1), S-Y. Kim (), J Scourse (), and H Kennedy ()

(1) University of Liverpool, Department of Geography, Liverpool, United Kingdom (f.marret@liv.ac.uk, 0044 151 7942866), (2) South Sea Research Center, Koren Ocean Research and Development Institute, 391 Jangmok-ri Jangmok-myun Geoje, 656-830 Gyeongsangnam-do, South Korea, (3) School of Ocean Sciences, Bangor University, Menai Bridge, LL59 5AB, UK

Marine cores collected off west equatorial Africa have highlighted transfer of terrigenous material in the close ocean that have had a deep influence on the marine productivity for the last 30,000 years. The strength of the West African Monsoon has varied though time, from weak during glacial periods to strong during interglacials. In consequence, the amount of precipitation on the continent had drastic effect on the vegetation cover and soil erosion. Studies of marine cores have enabled the observation of changes in vegetation cover, from extended equatorial rainforest to expansion of savannahs. In association with open grassland association, soil is open to erosion, although precipitation is less; conversely, during periods of extended rainforest in a context of strong monsoon, soil erosion is minimised to the presence of trees. In both cases, terrigenous material is flushed out to the adjacent marine domain and has a profound influence on the marine biota.

Three marine cores were studied from a north south transect, from Cameroon to Angola (off Sanaga, off Ogouée, and off Congo rivers), for their palynomorph contents. All cores contain a robust chronology based on radiocarbon dates and two have stable isotope data, allowing comparison. Dinoflagellate cysts were studied for retracing sea-surface conditions such as temperature, salinity and productivity whereas pollen were used to assess changes in the vegetation on the close continent for the last 30,000 years (1).

A number of pollen records from terrestrial sequences from equatorial central Africa document the dynamics of the lowland rainforest and savannah in relation to climatic changes during the Holocene. Prior to the Holocene, continental records are scarce in this vast region and/or only allow reconstruction of the local vegetation. In our records, terrestrial proxies (pollen, spores, and charred grass cuticles) signal changes in the expansion/regression of the lowland rainforest which we relate to the migration of the Intertropical Convergence Zone. Arid periods, characterised by dominant open-vegetation indicators, also record increased savannah fires represented by higher fluxes of charred grass cuticle. Open vegetation or grasslands (Cyperaceae and Poaceae) were abundant from 23 to 12 cal ka BP, optimal around 21–20 cal ka BP, when the summer insolation (July) was at its lowest. A weak monsoonal circulation may have prevailed during the boreal summer, permitting the survival of rainforest vegetation, possibly as refugia, as documented from our records and nearby cores. The increase of rainforest, dry forest and woodland taxa after 15.2 cal ka BP coincides with the increase of summer insolation at 15°N, implying strengthening of the monsoon system and precipitation on the continent. Changes in the pollen record probably indicate the return of the bimodal precipitation regime over the Congo basin around 13 cal ka BP; the record of marine and terrestrial palynomorph fluxes shows strong river discharge pulses around 13 cal ka BP. The re-establishment of full monsoonal conditions had a large impact on marginal oceanic environments subject to freshwater influence, with enhanced river discharge increasing nutrient supply and the displacement of surface water generating upwelling of intermediate waters of lower temperature. In addition, sea-level rise promoted the erosion of shelves, further enriching coastal waters with nutrients.

In parallel, the marine proxy (dinocysts) document significant changes in the oceanographic environment, typically from seasonal coastal upwelling to river-induced upwelling due to increased river discharge linked to the return of monsoonal conditions. Results from transfer functions (modern analogue method) applied to the dinoflagellate cyst record of the Congo core for estimating the annual primary productivity (PP) show significant variations; the record documents two phases of relatively higher than present-day annual PP, with a maximum at around 20

cal ka BP, and the second from 15.2 to 13.2 cal ka BP, during the deglaciation period, when strengthening of the monsoon occurred in a context of open vegetation, allowing an increased erosion of soil. Evidence of decrease salinity due to strengthening of the monsoon dynamics is also observed from the Sanaga core, with the increased abundance of a marine taxon linked to low saline context from 12.5 cal ka BP onwards (2).
The study of these integrated records of marine and terrestrial proxies illustrates the complexity of interactions between land-ocean and atmospheric systems and emphasizes the need for high-resolution records to fully understand the coupled equatorial climate system.

References

1- Marret, F., Scourse, J., Kennedy, H. Ufkes, E., and Jansen, J.H.F., 2008. Marine production in the Congo-influenced SE Atlantic over the past 30,000 years: A novel dinoflagellate-cyst based transfer function approach. Marine Micropaleontology 68, 198-222.
2- Kim, S.Y., 2007, Dinoflagellate cyst and pollen stratigraphy of Niger and Ogouée fan sediments covering the last glacial cycle. PhD thesis, Bangor University.