

**AFRICAN HYDROLOGY, SEA SURFACE TEMPERATURE AND ORGANIC CARBON BURIAL OFF EQUATORIAL WEST-AFRICA ACROSS THE LATE MIOCENE TO EARLY PLIOCENE CLIMATE TRANSITION. FIRST RESULTS FROM ODP SITE 959**

Olubunmi ENIOLA<sup>1</sup>, Martin JONES<sup>1</sup>, Erin MCCLYMONT<sup>2</sup>, Nikolai PEDENTCHOUK<sup>3</sup> and Thomas WAGNER<sup>1</sup>

*1. Newcastle University, Civil Engineering and Geosciences, Newcastle upon Tyne, NE1 7RU, UK.*

*2. Newcastle University, Geography, Politics and Sociology, Newcastle upon Tyne, NE1 7RU, UK.*

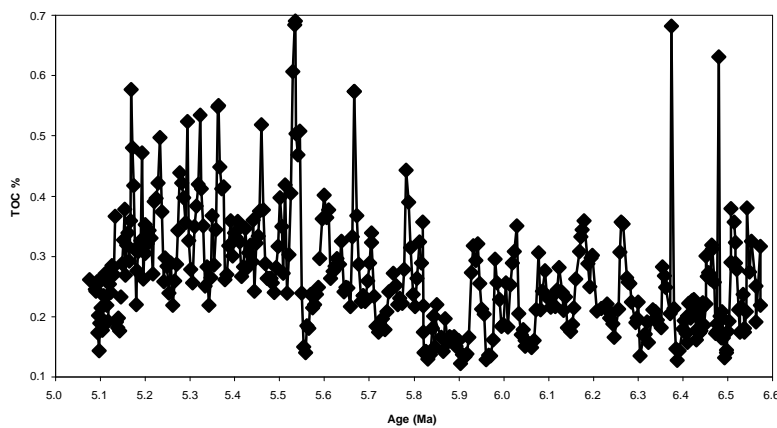
*3. University of Calgary, Department of Geology and Geophysics, 2500 University Drive, Calgary, AB T2N 1N4, Canada*

Assessing the processes and feedbacks of the water cycle and its relationship to continental vegetation, weathering, runoff, and the surface and deep ocean has become one of the key objectives of current climate research. In this new project we plan to explore short term swings in organic carbon at OPD Site 959 from the Deep Ivorian Basin (DIB) off Equatorial West-Africa with respect to the initial onset of upwelling processes off equatorial West-Africa at about 5.5 Ma and associated feedbacks. To further explore a millennial-scale TOC record we combine alkenone-based  $U_{37}^K$ -SST data and coupled hydrogen and carbon isotope signatures of plant leaf waxes (long-chain, odd-numbered C<sub>25</sub> to C<sub>35</sub> n-alkanes and alkanolic acids) aiming to provide an integrated view on the processes, feedbacks, and time relationships of the tropical climate-ocean system and thus tropical African hydrology and vegetation change at about 6-4 Ma. The late Miocene–early Pliocene interval (~11-3.5 Ma) was a period of major transition in global climate, vegetation, and ocean circulation. In particular, modern thermohaline and atmospheric circulation patterns were established with a source of warm, nutrient depleted deep waters originating in the North Atlantic (Berger and Wefer, 1996), short term but low amplitude fluctuations in atmospheric pCO<sub>2</sub> and hydrology (Pagani et al. 1999; Pagani pers. communication August 06), and the establishment of modern-type atmospheric and ocean circulation in the tropics at about 4.5-4.3 Ma (Billups et al., 1998, Norris et al., 1999, Wagner 2002)

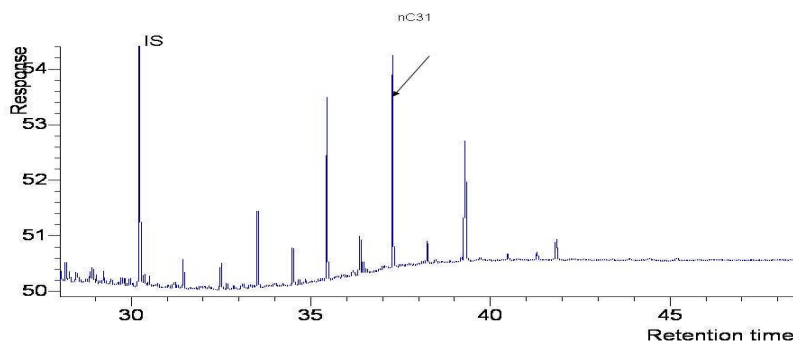
At 5 cm depth-resolution (equivalent to about 2.5-5 kyr) concentrations in organic carbon are generally low across the study section but highly variable (Figure 1). Frequency analyses suggest a strong precessional control on carbon burial and shallow ocean properties and thus a clear link to short term climate variability. Data resolution will be doubled with progress of the project to achieve a continuous high resolution record. Our molecular work is still at an early stage, but initial data show that plant wax n-alkanes and alkenones are present at ~130-180 ng/g sediment for individual samples enriched in organic carbon up to 0.7%

(Figure 2), which can make the generation of accurate SST and compound-specific isotopic data challenging. However, using the enhanced sensitivity of latest generation GC-IRMS instrumentation, preliminary  $^{13}\text{C}$  data from leaf wax n-alkanes in ODP Site 959 sediments covering a time period of about 5.5 Myrs shows values around  $-28.0\text{‰}$ , which is consistent with preliminary data from time equivalent sections at DSDP Site 94 from the Gulf of Mexico (Tipple and Pagani, pers comm.), while SST values were the region of  $26\text{--}28\text{ °C}$ . Detailed molecular isotopic and SST records from the sediments at this key site during a period of rapid climate change will provide information enabling a better understanding of the drivers

and effects of this process.



**Figure 1:** Millennial-scale TOC record of the Miocene-Pliocene Transition at ODP Site 959 off equatorial Atlantic (5 cm resolution) expanding on previously published lower resolution data (Wagner, 2002). Note distinct cycle pattern suggesting orbital forced fluctuations in upwelling and associated SST and continental climate.



**Figure 2:** GC trace of long chain leaf wax n-alkanes, sample 959C/10/5/62.5-65 at about 5.55 Ma.

## REFERENCES

- Berger & Wefer (1996). Central themes of South Atlantic circulation. in *The South Atlantic: Present and Past Circulation* (eds. Wefer et al.) 363-410 (Springer).
- Billups, K., A.C. Ravello, J.C. Zachos and R.D. Norris (1999). Link between oceanic heat transport, thermohaline circulation, and the Intertropical Convergence Zone in the early Pliocene Atlantic, *Geology* 27(4), 319-322.
- Norris, R.D. (1998). Miocene-Pliocene surface water hydrography of the eastern Equatorial Atlantic (1998) in: Ocean Drilling Program Scientific Results Volume, Leg 159, J. Mascle, G.P. Lohman and M. Moullard, eds., pp. 539-555, College Station, TX (Ocean Drilling Program), USA.
- Pagani, M., K.H. Freeman and M.A. Arthur (1999). Late Miocene atmospheric  $\text{CO}_2$  levels and the expansion of  $\text{C}_4$  grasses, *Science* 285, 876-879.
- Wagner, T. (2002). Late Cretaceous to early Quaternary organic sedimentation in the eastern equatorial Atlantic, *Palaeogeography, Palaeoclimatology, Palaeoecology* 179, 113-147.