Geophysical Research Abstracts
Vol. 14, EGU2012-3058, 2012
EGU General Assembly 2012
© Author(s) 2012

An apparent contradiction in plant-wax-specific isotopes: How can more rain favor aridity-adapted plants?

R.R. Kuechler, B. Beckmann, L. Dupont, and E. Schefuß
University of Bremen, MARUM, Germany (rkuechler@marum.de)

Studies on NW African palaeoenvironments during the Pleistocene suggest periodical alternations of humid and arid conditions (Tjallingii et al., 2008). It has been proposed that these humid periods reflect favourable conditions for mammalian and hominin migrations out of Africa (Castañeda et al., 2009). Moreover, it has been shown that these humid events were coupled to maximum summer insolation in the northern low-latitudes causing strong monsoonal rainfall with additional influence of high-latitude climate variability (Tjallingii et al., 2008). In particular, the Atlantic meridional overturning circulation (AMOC) and the associated heat transport appear to be of main importance for controlling vegetation distributions (Castañeda et al., 2009).

The main purpose of this study is to decipher rainfall variability over NW Africa during the last glacial cycle. Previous studies (e.g., Castañeda et al., 2009) infer humidity changes from vegetation type changes and dust fluxes, but so far, continental palaeo-hydrologic conditions have not been assessed directly. Therefore, we applied a molecular isotopic approach by using hydrogen and carbon isotopes of terrestrial plant waxes (δDwax, δ13Cwax). These compounds were extracted from deep-sea sediments, cored off Mauritania at ODP Site 659. This site is located far offshore and solely influenced by aeolian contributions. It is situated right beneath the main trajectory of the African Easterly Jet, which carries terrestrial material from the Sahara-Sahel-transition westwards onto the Atlantic.

Sedimentary concentrations of long-chain C27-35 n-alkanes range between 0.08 to 1.84 (average 0.46) μg g-1 dry weight and display typical plant wax signatures with carbon preference-indices (CPI) between 2.7 and 7.1 (average 4.9). n-Alkane concentrations appear to be elevated at the beginning of dust pulses, which is in accordance with the model of dust generation during transitions from wet to arid climates, accompanied by a strong export of plant material during such aridification events (e.g., Trauth et al., 2009). Overall, δDwax values express a pronounced variability with an average amplitude of about 32‰ VSMOW between humid and arid periodes. δ13Cwax values of the same compounds vary between -25.6‰ and -23‰ VPDB and confirm a predominance (70-90 %) of C4 plants.

The most striking observation is the consistent anti-correlation of hydrogen and carbon isotopes in plant lipids reflecting a higher C4 plant contribution under humid conditions and vice versa. This is interpreted as a specific catchment sensitive to low precipitation intensities such as the Sahara-Sahel-transition. During increased aridity, even C4 plants get water-stressed, leading to a decline of such a C4-dominated vegetation cover. This in turn results in a relative contribution increase of C3 plant material derived from the more stable tree savannah in the southern parts of the Sahel. Compared to other studies, our isotopic records show only a rough correlation with variations in AMOC strength and summer insolation in the northern hemisphere, whereas the timing of humid phases is in good agreement with mammalian/hominin migrations.

References:

Castañeda, I.S., Mulitza, S., Schefuß, E., Lopes dos Santos, R.A., Sinninghe Damsté, J.S., Schouten, S., 2009. Wet phases in the Sahara/Sahel region and human migration patterns in North Africa. Proc. Natl. Acad. Sci. USA 106(48), 20159-20163.

Tjallingii, R., Claussen, M., Stuut, J.-B.W., Fohlmeister, J., Jahn, A., Bickert, T., Lamy, F., Röhl, U., 2008. Coherent high- and low-latitude control of the northwest African hydrological balance. Nat. Geosci. 1(10), 670-675.

Trauth, M.H., Larrasoaña, J.C., Mudelsee, M., 2009. Trends, rhythms and events in Plio-Pleistocene African climate. Quat. Sci. Rev. 28(5-6), 399-411.