Geophysical Research Abstracts
Vol. 15, EGU2013-6690, 2013
EGU General Assembly 2013

Hydrogen isotopes of leaf lipids indicate gradual hydrologic transition at the end of the African Humid Period

Britta Beckmann (1), Barbara Haese (2), Martin Werner (2), and Enno Schefuß (1)

(1) MARUM – Center for Marine Environmental Sciences, University of Bremen, Leobener Str., D-28359 Bremen, Germany, (2) Alfred Wegener Institute for Polar and Marine Research, Am Handelshafen 12, D-27570 Bremerhaven, Germany

The hydrologic evolution of the NW African monsoon system over the Holocene, in particular during abrupt climate changes like the end of the African Humid Period (AHP) is not yet fully understood. The dust record at ODP Site 658C (DeMenocal et al., 2000) for example suggests an abrupt end of the AHP with a sudden desertification in the mid-Holocene. Contrastingly, a gradual transition to drier conditions at the end of the AHP has been detected in pollen records from lake sedimentary archives from northern Chad (Kröpelin et al., 2008) and northeastern Nigeria (Salzmann et al., 2002). However, neither dust nor pollen data can serve as immediate proxy for aridity itself, but rather reflect responses to changes in the hydrological regime. To test the abruptness of the end of the AHP and unravel late Holocene hydrologic change, we combine compound-specific carbon and hydrogen isotope analyses (δ13C, δD) of plant lipids covering the past 14ka with simulations of water isotope composition in an Earth System Model.

We extracted terrestrial biomarkers (long-chain n-alkanes) from the high resolution marine sedimentary core GeoB7920-2 taken in immediate proximity to ODP Site 658C off the Sahara-Sahel transition in NW Africa. Because plants use environmental water (in the Sahel mainly from precipitation) as hydrogen source, changes in the δD signature of the plant-derived biomarkers can be attributed to isotopic changes in rainfall and ultimately to changes in the hydrological cycle on the continent.

The n-alkanes show typical terrestrial plant signatures; δ13C values indicate predominance (60-100%) of C4-type plants, i.e. warm-season grasses. δD values of the most abundant n-C31 alkane, vary between -140‰ and -165‰ VSMOW. Generally, the AHP is characterized by lower δD values, indicating more rainfall and humid conditions in NW Africa.

Compound-specific plant-wax isotope data from GeoB 7920-2 suggest a gradual transition in continental hydrology at the end of the AHP, contrasting the dust record at ODP Site 658C (DeMenocal et al., 2000). Results of Holocene transient model simulations support a gradual change in precipitation amount and vegetation cover at the end of the AHP. The discrepancies between the various environmental proxies likely reflect the different processes that drive rainfall change and vegetation variation versus dust mobilization.

References:

DeMenocal, P. et al., 2000. Abrupt onset and termination of the African Humid Period: rapid climate responses to gradual insolation forcing. Quaternary Science Reviews, v. 19, p. 347-361.

Kröpelin, S. et al., 2008. Climate-driven ecosystem succession in the Sahara: The past 6000 years. Science, v. 320, p. 765-768.

Salzmann, U. et al., 2002. Late Quaternary Climate and Vegetation of the Sudanian Zone of Northeast Nigeria. Quaternary Research, v. 58, p. 73-83.