

Paleohydrology of tropical South America since the Last Glacial Maximum. Insights from the δD of algal and terrestrial molecular markers in lake sediments.

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There is renewing evidence that the Tropics might strongly influence climate dynamics on millennial time-scales. Part of this "tropical forcing" is related to changes in the water cycle that impacts atmospheric and oceanic processes on a broad scale. Past variations of the continental hydrology are poorly documented due to the few available records and the lack of quantitative data on climate parameters. The deuterium/hydrogen ratio (δD) of algal derived biomarkers captures the isotopic composition of meteoric waters (Huang et al., 2002; Sachse et al., 2004). In turn, terrestrially-derived biomarkers captures the isotopic composition of meteoric waters through their δD but with a strong influence of the evapotranspiration. A combination of these two factors should thus allow the quantification of the variations in relative humidity (i.e. precipitation–evaporation; P-E). We applied such an approach to estimate hydrological changes in Northern Brazil during the last 20,000 yr. The δD of algal (*n*-C₁₈) and land plant (*n*-C₃₀) fatty acids (FA) have been measured on 30 samples selected on a 6 m long lacustrine sediment core.

In a first approximation, we considered a mean hydrogen isotope fractionation of -157 ‰ between the *n*-C₁₈ FA and water and between the *n*-C₃₀ FA and water of -128 ‰ (e.g. Sachse et al., 2004). Because the amount of precipitation is the major control on the isotopic composition of meteoric waters in tropical systems, we used the $\delta D_{\text{wat-alg}}$ (δD of the water used by algae for lipid synthesis, estimated from the δD of the *n*-C₁₈ FA) as a proxy of precipitation amount. The $\delta D_{\text{wat-hp}}$ (δD of the water used for land plant lipids synthesis) is measured from the δD of the *n*-C₃₀ FA and used to estimate relative moisture (P-E). The difference in isotope fractionation between land plants and phytoplankton ($\delta D_{\text{wat-hp}} - \delta D_{\text{wat-alg}}$) is used to quantify evapotranspiration (evaporation from soils and transpiration from plants).

These results allowed to distinguish five contrasted periods in our 20,000 yr record (see below). The 20-19 kyr period is characterized by high precipitation associated with high evapotranspiration, i.e. a semi-arid climate. By comparison, from 19 to 17 kyrs, both precipitation and evapotranspiration are both reduced. The resulting climate is nevertheless dryer than during the previous stage. During the Lateglacial interval, i.e. from 17 up to 13.5 kyrs, evapotranspiration is reduced but the precipitation which remains at the same level than before entails a more humid climate. The Younger Dryas interval (YD) shows higher precipitation levels but stronger evapotranspiration, thus a dryer climate than during the Lateglacial but nevertheless more humid than at the end of the Last Glacial Maximum (LGM). Finally, the Holocene shows a decreasing trend in the amount precipitation and with few variations of the evapotranspiration that finally delineate a drying trend. These results are coherent with independent data produced by palynology and biomarker analysis (Ledru et al., 2001; Jacob et al., 2004) and give clue information on the variations in water cycling in the Tropics since the LGM.

References:

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