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The triple oxygen isotope record of phytoliths in peat sediments to reconstruct paleoclimate changes following the African Humid Period

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Understanding the relation between vegetation and the water cycle and how they interact with other climatic variables is key to assess their influence on environments and ecosystems. Most notably, air relative humidity (RH) plays a pivotal role on plant transpiration, dryness stress, ecosystem productivity, soil and open water evaporation. However, RH is poorly accounted for in Earth System Models (ESM) and is currently hardly constrained quantitatively in past times. The triple oxygen isotope record of biogenic silica particles formed by plants – *phytoliths* – has emerged as a novel and promising indirect RH proxy (Alexandre et al., 2025). While the morphological analysis of these biominerals helps constraining past vegetation type assemblages, their $d^{18}O$ and $^{17}O_{excess}$ (or $D'^{17}O$) signatures reflect that of the plant water and the evaporative fractionation induced during transpiration, primarily controlled by atmospheric RH. This isotopic proxy has been calibrated using laboratory plant cultures, modern soil and sediment samples. The present study is one of the first to explore it in a paleoclimatic context.

We analyzed the phytolith oxygen isotope record in a peat core from the lower Ouémé Valley, a swamp zone south of Benin, recording the last ~7000 years and the end of the African Humid Period (AHP). The peat is located in the Dahomey Gap, an area of locally lower precipitation that creates an ecological discontinuity between western and central African rainforests, formed towards the end of the AHP. The transition from the AHP to modern days, marked by important changes in ecosystems and hydroclimates, provides an ideal frame to apply phytolith oxygen isotope signatures for deciphering the environmental processes that led to these paleoclimate changes. Preliminary $d^{18}O$ and $^{17}O_{excess}$ results show important fluctuations (over about 10 ‰ and 50 pmeg, respectively) reflecting changes in hydroclimate conditions. Combined with charcoal and phytolith morphotype analyses, these isotopic results will enable us to reconstruct environmental dynamics at this key location, during and after the AHP.

Alexandre A. et al. (2025). What does the triple isotopic composition of oxygen in precipitation, groundwater, soil water, plant water, and phytoliths reveal about current and past hydrological cycles? *JGR:Biogeosciences*, 130, e2024JG008615.