African Freshwater Bivalve Shells as Hydroclimate Proxies

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Freshwater bivalve shell geochemistry may record hydroclimate at a high temporal resolution (subannual). Here we test oxygen and carbon isotopes, as well as trace element ratios (e.g., Sr/Ca, Mg/Ca Ba/Ca, Mn/Ca) in African freshwater bivalve shells as potential recorders of hydroclimate. Bivalves from three regions of sub-Saharan Africa were analyzed: the Oubangui River in Central African Republic, the Niger River in Niger, and the Chobe/Linyanti River system in northern Botswana. Oxygen isotopes ($\delta^{18}O$) in all shells matched expected values, but showed signs of sample time-averaging due to slower growth in longer lived specimens. Pooling several shells into one master shell circumvented this problem. While we had problems reconstructing river discharge from shell $\delta^{18}O$ values, shells did record water $\delta^{18}O$ values remarkably well. River water $\delta^{18}O$ values vary due to changes in precipitation, amount of precipitation vs. groundwater, and evaporation and transpiration. Thus shell $\delta^{18}O$ values may be used as a proxy of hydroclimate. Carbon isotopes ($\delta^{13}C$) of riverine dissolved inorganic carbon (DIC) also tracked discharge, but shell $\delta^{13}C$ values did not track seasonal $\delta^{13}C$-DIC values. However, large differences in $\delta^{13}C$-DIC values between sites were recorded in the shells, suggesting shell $\delta^{13}C$ values may be used as a rough proxy of watershed carbon biogeochemistry. Trace elements in water also varied with the seasonal variation of discharge, but trace elements in shells did not track those in the water. Shell elements also did not track water elements across the strong evaporative gradient in Botswana despite large differences in water chemistry. Thus, shell oxygen (and carbon isotopes to some extent) can be used as hydroclimate proxies across Africa. Indeed, shells collected from the Oubangui over the past 100 years show clear shifts in the range of $\delta^{18}O$ values, which are associated with changes in regional precipitation.