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Millennial-scale variations in Mozambique Channel nitrogen fixation recorded by foraminiferal bound nitrogen isotopes.

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The Mozambique Channel has recently been identified as a hotspot for nitrogen fixation in the modern ocean; this process imparts a clear signature of low nitrogen isotopic values ($\delta^{15}N$) to the available surface ocean nitrate pool provided by the subsurface ocean nitrate supply. In turn, the nitrogen preserved within the $CaCO_3$ lattice of foraminifera can be analyzed to understand the variability over geological time. Here we present a high resolution sedimentary record of planktonic foraminiferal-bound $\delta^{15}N$ to document the timing of changes in regional nitrogen fixation over the last 45 kyr. The sediment sequence, IODP Site U1477, is ideally situated to test the relationship between the nitrogen fixation and the hydroclimate variability of the adjacent Zambezi watershed. Prior radiocarbon work demonstrates that sedimentation rates average ~1 m/kyr throughout the last ice age interval, affording bi-decadal resolution. The $\delta^{15}N$ results from three species of planktonic foraminifera show a small (1 ‰) glacial-interglacial shift to lower values during the Last Glacial Maximum and an equally subtle maximum during the early Holocene. However, the multi-species results are dominated by prominent excursions to low $\delta^{15}N$ during the Heinrich Stadial (HS) events of the past 40 ka. The temporal connection between $\delta^{15}N$ decreases and the abrupt ocean and hydroclimate changes associated with HS events offers strong clues for the controls on nitrogen fixation in the Mozambique Channel and other analogous environments. Furthermore, we can use the full $\delta^{15}N$ record to quantify the Mozambique Channel water endmember, as the foraminiferal bound $\delta^{15}N$ offers one potential tracer for monitoring the leakage of Agulhas Current fauna into the Atlantic over abrupt and orbital scale climatic events.