Millennial-Scale Changes in Benthic Foraminifera Stable Carbon Isotope Gradients in the Western Equatorial Atlantic

Show affiliations

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The stable carbon isotope ratio of benthic foraminifera ($\delta^{13}C$) is a widely applied proxy for ocean circulation and productivity changes, as the $\delta^{13}C$ gradient between some species is linked to carbon export and bottom water oxygen concentration. Although there is some consensus about what could drive the variability of the oxygen concentration (such as the ocean circulation or the export of primary productivity), the mechanisms, especially in the Western Equatorial Atlantic (WEA), remain unexplained. To explore potential factors influencing bottom water [O_2] over the last glacial period (63 to 29 kyr) in more detail, we analyzed the $\delta^{13}C$ difference between three benthic foraminiferal species (Cibicides wuellerstorfi, Uvigerina peregrina, and Globobulimina affinis) from a site in the WEA. Our records demonstrate that the most prominent decreases in oxygen diffusion occurred during the Heinrich Stadials (HS) (especially HS3 and HS4) as a result of a reduced North Atlantic Deep Water (NADW) ventilation and increased fluvial terrigenous input. Our results show decreases in the strength of the bottom-water currents during these events, reflected by decreases in the "sortable silt" grain-size fraction (SS). Moreover, we show that the highest values of total organic carbon content (TOC) at our site during HS did not result from increased surface primary productivity but rather from continental input via the Parnaíba River. Furthermore, the highest TOC values are inconsistent with the gradient between two benthic foraminifera species (U. peregrina and C. wuellerstorfi), which reflects the low flux of labile organic carbon in the sediment. We suggest that the deposition and accumulation of terrigenous material reduced O_2 diffusion into the sediment and, coupled with millennial-scale ventilation, played an important role in influencing the oxygen availability in the WEA during several HS over the last glaciation.

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