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Reconstructing the surface water condition of southeast Atlantic ocean for last 1.8Ma using Planktic foraminifera census and stable carbon and oxygen isotope record

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Interoceanic exchange, surface ocean productivity and upwelling along the western coast of Africa (cape basin, Southeastern Atlantic ocean) are the three major phenomena which play a key role in modifying Atlantic meridional overturning circulation and atmospheric carbon dioxide budget. In the present study, planktic foraminiferal census and stable carbon and oxygen isotope record from ODP site 1085A (SE Atlantic ocean) were used to reconstruct the inter-oceanic exchange, surface water productivity and upwelling during the last 1.8Ma. Planktic foraminiferal record reveals enhanced interoceanic exchange during interglacials except during 1.6-1.5Ma and 0.85-0.62Ma named IOE-1 and IOE-2 respectively while highly reduced during the glacial intervals. Negative $\delta^{13}\text{C}$ values coincide with the enhanced interoceanic exchange and points towards the role of Agulhas leakage in lowering the productivity of the study area. $\delta^{18}\text{O}$ record of thermocline dweller planktic foraminiferal shows a gradual depletion of 1‰ after IOE-2 onwards which is indicative of gradual warming of the thermocline. While during IOE-1 and IOE-2 higher values of $\delta^{18}\text{O}$ have been observed indicative of cooling. $\Delta\delta^{18}\text{O}(\textit{Gr. inflata}-\textit{O.universa})$ were used as a proxy to reconstruct the vertical mixing of the thermocline and mixed layer water and associated productivity. A long-term vertical stratification of the thermocline and mixed layer water associated with low productivity were observed from 1.8-0.9Ma excluding HP-1(1.6-1.5Ma), HP-2(1.3-1.2Ma) and HP-3(1.1-0.90Ma). During HP-1 and HP-2 moderate productivity is attributed to the disturbed vertical stratification as reflected in $\Delta\delta^{18}\text{O}(\textit{Gr. inflata}-\textit{O.universa})$ while high productivity during HP-3 was due to reduced influx of warm oligotrophic water from Agulhas leakage and cooling as reflected in $\delta^{18}\text{O}$ of thermocline dweller species. The increase in vertical mixing along with an increase in associated productivity has been observed after IOE-2. Stable carbon isotope value also supports high productivity after IOE-2 by showing a gradual increase in $\delta^{13}\text{C}$ of mixed layer planktic foraminifera. Water mass sensitive planktic foraminifera *Gr. inflata* were plotted to reconstruct the prevailing oligotrophic condition in the study area. *Gr. inflata* relative abundance was highly variable during the studied time interval and shows a negative correlation with the *N. pachyderma (dex)* relative abundance. Our results suggest warm upwelling in the Southeastern Atlantic ocean 0.6Ma onwards due to warming of thermocline along with strong vertical mixing and enhanced productivity after IOE-2.

Keywords: Interoceanic exchange, warm upwelling, productivity, Southeast Atlantic ocean

