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Paleotemperature and paleosalinity evolution across Eocene-Oligocene Transition in North Atlantic Ocean: Insights from geochemical analysis of bivalve shells.

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The Cenozoic period encompasses the last transition from the “greenhouse” climate of the late Early Eocene (~50 Ma) to our modern “icehouse” climate with its much lower CO₂ levels, significant polar glaciation and major sea level drop. The Eocene-Oligocene transition (EOT), that marks the first major ice-sheet build-up on Antarctica, has been extensively studied as it represents the entrance into an icehouse mode. Identification of this major step of Antarctic ice-sheet build-up strongly relies on $\delta^{18}\text{O}$ and Mg/Ca benthic foraminifera records from ODP / DSDP sites. By contrast, few records currently exist from coastal environments despite the presence of abundant fossil archives, like bivalve shells. Yet palaeoenvironmental records from these peculiar coastal sites could bring information on how they react to global climate changes and help to further understand the behavior of our climate system. In this study, we applied a multi-proxy strategy coupling $\delta^{18}\text{O}$, $\delta^{13}\text{C}$, clumped isotopes (Δ_{47}), strontium isotopes ($^{87}\text{Sr}/^{86}\text{Sr}$) analyses on aragonitic and calcitic bivalves and sediments recovered from the Isle of Wight (London-Paris Basin, Northeastern Atlantic Ocean) to provide additional constrain on environmental changes in this region across the Eocene-Oligocene Transition (~37.8–33 Ma).

Our new coupled $\delta^{18}\text{O}$ and Δ_{47} dataset highlights a marked decrease in local seawater temperatures (~ 8°C) coupled to a drop in local seawater $\delta^{18}\text{O}$, likely linked to the sea level drop associated with ice-cap formation and an evolution toward more proximal, brackish environment in this region (that is apparent from sediment facies evolution). We estimate the salinity decrease recorded at the local scale from the Eocene to the Oligocene as reaching about 6 PSU, from 31 to 25 PSU. Strontium isotope analyses of the bivalves support this interpretation, showing values close to that of seawater up to the EOT but a marked deviation from contemporaneous global seawater $^{87}\text{Sr}/^{86}\text{Sr}$ values toward more radiogenic values afterward. This positive deviation is in agreement with an evolution toward more proximal environments, subjected to larger freshwater inputs.