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Editorial: Paleoecological records from Atlantic deep-sea sediments

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Editorial on the Research Topic
Paleoecological records from Atlantic deep-sea sediments

The Atlantic Ocean is a unique “bridge” that connects the two frigid poles – the Arctic and Antarctic. It is a salty ocean covering approximately one-fifth of earth’s surface, separating the continents of Europe and Africa to the east from those of North and South America to the west. It is second in size to the Pacific Ocean, with an average depth of 5000 m. The surface waters of the North Atlantic have a higher salinity than those of any other ocean. The average salinity of the Atlantic Ocean is highest in the North at 35.5 psu and lowest in the South Atlantic at 34.5 psu. Being surrounded by vast continents on both east and west sides, the Atlantic Ocean plays a crucial role in controlling the climate, including ecology and vegetation, of the adjacent regions of Americas and Europe. Covering both polar and tropical spheres, the Atlantic Ocean hosts some of the most diverse aquatic micro and macro fauna and flora, mainly phytoplankton.

Sudden changes in the surface ocean, such as unexpected surges of coastal currents and icebergs along the North Atlantic coast, are likely to affect coastal communities. Such events could become more frequent and severe in the near future owing to global warming. The Atlantic Meridional Overturning Circulation (AMOC) is a critical component of the global circulation of the ocean, which redistributes heat, salt, and nutrients around the globe, consequently influencing regional weather, sea level, and the ecological communities we depend on, such as fisheries. The AMOC connects the two hemispheres and is a principal cause of interhemispheric asymmetries in climate (Buckley and Marshall, 2016). Part of the “pump” that drives AMOC is deep water formation occurring near the Arctic and Antarctic regions of the Atlantic Ocean. It is therefore crucial to improve the understanding of linkages between the South Atlantic

Ocean and Southern Ocean, the North Atlantic and Arctic, and the Atlantic Ocean and climate system. If global warming shuts down the AMOC, which is crucial for carrying heat from the tropics to the northern latitudes, what would be the magnitude of climate change and its impact on marine and land fauna and flora? By providing a more detailed characterization of AMOC flow pathways and their impacts on climate variability, the climate research community can advance toward the overall goal of improving seasonal, inter-annual, decadal, and multi-decadal climate prediction. A better understanding of AMOC will enable the scientific community to improve information for decision makers and policy planners concerned with coastal inundation, and weather and climate extremes, and thus coastal economy.

The Atlantic Ocean stores vast proxy archives for paleoclimatologists to study and reconstruct millennial-scale changes in the earth's climate during the Neogene. On tectonic time scales, the major intensification of the northern hemisphere glaciation in the Late Pliocene, Early Pliocene warmth and Pleistocene glaciations have been documented in Atlantic sediments (e.g., Raymo, 1994; McClymont et al., 2023). Some of the more recent extreme events that have been reported from the Atlantic include the Last Glacial Maximum, Bølling-Allerød interstadial, the Younger Dryas, as well as Bond events of the Holocene (e.g., Bond et al., 1993; Grootes et al., 1993).

Ocean currents are driven by winds, tides, and differences in water density – the so-called Ocean's Conveyor Belt (Figure 1; Broecker, 1991). The Ocean's Conveyor Belt appears to be driven by the salt left behind as the result of water-vapor transport through the atmosphere from the Atlantic to the Pacific basin. A byproduct of its operation is the heat that maintains the anomalously warm winter air temperatures enjoyed by northern Europe, and turning on and off the conveyor causes pronounced changes in the air temperatures over Greenland and Europe. The conveyor is only one of many components that together constitute the earth's climatic system – the atmospheric transport of water vapour must have also played a prominent role in climatic shifts.

The other important forcing factors for ocean and climate variability include western and eastern boundary currents, which are crucial not only in ocean circulation, transporting surface waters from tropics to poles and poles to tropics, respectively, but also in influencing continental climates. The intensity of these surface coastal currents impact the strength of the upwelling cells, and consequently wetting and aridification of the adjacent landmasses. For instance, changes in the Southern Benguela Current upwelling system had driven the expansion and contraction of the Namibian desert since the late Miocene (Mohanty et al., 2024). To understand land-sea complexities, it is pertinent to analyse deep-sea cores from below the coastal upwelling systems of the Atlantic, including the Benguela, Guinea, Canary, and Norway Currents in the eastern Atlantic and Brazil and the Guiana, Caribbean, and Labrador Currents in the western Atlantic Ocean.

This Research Topic in *Frontiers in Ecology and Evolution* examines "Paleoecological Records from Atlantic Deep-Sea Sediments," attracting both original articles as well as one review article, focusing on diverse problems of ecology and climate variability in the Atlantic Ocean. The peer-reviewed articles include: morphological variations in planktic foraminifera during the Neogene (Brombacher et al.); sea surface temperature (SST) reconstructions from the subtropical North Atlantic (Repschläger et al.); surface fertilization-linked

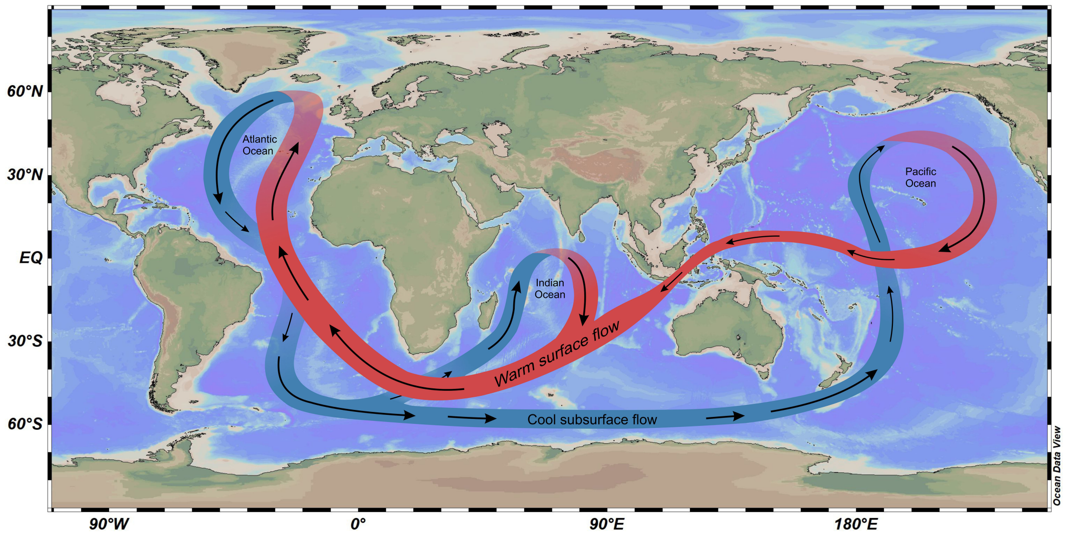

FIGURE 1
The Great Ocean Conveyor (modified from Broecker, 1991).

dissolution in the western South Atlantic (Suárez-Ibarra et al.); and a review article on Quaternary Dinoflagellate cysts from the Atlantic Ocean (Marret and de Vernal). These articles cover different time slices as well as locations within the Atlantic, highlighting the importance of ocean fertilization and ocean circulation in the understanding of ecology and climate. We suggest exploring future Research Topics on related aspects, such as "Changes in the Atlantic Ocean driving shifts in the continental climate and ocean ecology on different time scales."

Author contributions

AG: Conceptualization, Funding acquisition, Writing – original draft, Writing – review & editing. HD: Conceptualization, Writing – original draft, Writing – review & editing. TS: Writing – review & editing. AF: Investigation, Writing – review & editing.

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References

Bond, G., Broecker, W., Johnsen, S., McManus, J., Labeyrie, L., Jouzel, J., et al. (1993). Correlations between climate records from North Atlantic sediments and Greenland ice. *Nature* 365, 143–147. doi: 10.1038/365143a0

Broecker, W. S. (1991). The great ocean conveyor. *Oceanography* 4, 79–89. doi: 10.5670/oceanog

Buckley, M. W., and Marshall, J. (2016). Observations, inferences, and mechanisms of the Atlantic Meridional Overturning Circulation: A review. *Rev. Geophys.* 54, 5–63. doi: 10.1002/2015RG000493

Grootes, P., Stuiver, M., White, J., Johnsen, J., and Jouzel, J. (1993). Comparison of oxygen isotope records from the GISP2 and GRIP Greenland ice cores. *Nature* 366, 552–554. doi: 10.1038/366552a0

McClymont, E. L., Ho, S. L., Ford, H. L., Bailey, I., Berke, M. A., Bolton, C. T., et al. (2023). Climate evolution through the onset and intensification of northern hemisphere glaciation. *Rev. Geophys.* 61, e2022RG000793. doi: 10.1029/2022RG000793

Mohanty, R. N., Clemens, S. C., and Gupta, A. K. (2024). Dynamic shifts in the southern Benguela upwelling system since the latest Miocene. *Earth Planet. Sci. Lett.* 637, 118729. doi: 10.1016/j.epsl.2024.118729

Raymo, M. E. (1994). The initiation of northern hemisphere glaciation. *Annu. Rev. Earth Planet. Sci.* 22, 353–383. doi: 10.1146/annurev.ea.22.050194.002033