Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36237

Long-Term Seawater Biogeochemical Trends at the Atlantic–Mediterranean Gateway: Insights from the GIFT Observatory Since 2005

I. EMMA HUERTAS[1], SUSANA FLECHA[1], SILVIA AMAYA-VÍAS[1], RICARDO SANCHEZ-LEAL[2], AHMED MAKAOUI[3], FATIMA ZOHRA BOUTHIR[3] AND SIMONE SAMMARTINO[4]

[1]Instituto de Ciencias Marinas de Andalucia (CSIC)
[2]Instituto Español de Oceanografía (CSIC)
[3]Institut National de Recherche Halieutique
[4]Universidad de Malaga

Gradual changes in ocean biogeochemistry occur as a result of human-induced climate forcing over long timescales. Detecting and attributing these changes in biogeochemical properties and their long-term trends requires sustained, high-quality ocean observations capable of resolving variability across seasonal to multi-decadal scales. In particular, the ongoing incorporation of anthropogenic CO_2 into the ocean drives ocean acidification (OA) by altering the marine carbonate system and lowering seawater pH. This progressive shift in acid-base chemistry modifies carbonate ion availability and saturation states, making sustained monitoring of carbonate system variables essential to quantify the pace, magnitude, and spatial heterogeneity of OA. The Gibraltar Fixed Time Series (GIFT) was established in 2005 in the Strait of Gibraltar to address this need within one of the most dynamically active ocean gateways on the planet. The Strait connects the North Atlantic and the Mediterranean Sea through a two-layer exchange system in which North Atlantic Central Water flows eastward at the surface, while denser Mediterranean waters exit at depth. By continuously observing this gateway, GIFT provides a unique opportunity to assess how anthropogenic carbon accumulation and regional circulation interact to shape long-term trends in pH and carbonate saturation states across contrasting basins. To achieve this, GIFT integrates high-precision discrete measurements of the carbonate system obtained through repeated hydrographic surveys with high-frequency observations from moored oceanographic sensors deployed within the Strait. Here we present two decades of observations (2005–2025) that document accurate rates of OA within the Atlantic inflow and Mediterranean outflow waters. The sustained decline in pH is accompanied by a progressive reduction in carbonate ion concentration and aragonite saturation state, evidencing a systematic weakening of the buffering capacity of these waters. These changes directly affect the thermodynamic conditions governing biogenic calcification, with implications for calcifying organisms inhabiting both basins. Using the latest IPCC high-emission pathways, we further assess the expected evolution of carbonate saturation states over the coming decades. Our results indicate that, if current emission trajectories persist, critical thresholds for calcification may be approached within this century in surface Atlantic waters entering the Mediterranean, with longer-term progression toward undersaturation conditions in intermediate and deep waters.