Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.25812

Reconstructing Past Oxygen Minimum Zone Variability in the Eastern Arabian Sea Using Foraminiferal Porosity and Multi-Proxy Records

NIHARIKA PANIGRAHI[1,2] AND SUSHANT SURESH NAIK[2]

[1]Academy of Scientific and Innovative Research (AcSIR)
[2]CSIR-National Institute of Oceanography, Goa

Reconstructing past bottom-water oxygenation (BWO) is important for understanding the strength and variability of Oxygen Minimum Zones (OMZs) and the influence of intermediate water circulation on OMZ dynamics. The Arabian Sea hosts one of the most intense Oxygen Minimum Zones (OMZs), yet its long-term variability and driving mechanisms remain poorly understood. To address this gap, we present changes in the strength of the OMZ of the Eastern Arabian Sea (EAS) over the past ~15.5 kyrs using a novel approach - epifaunal benthic foraminiferal porosity (*Planulina dayi and Elphidium excavatum*), content, alongside other oxygenation proxies (molybdenum (Mo), uranium (U) from sediment Core SK-376/(GC)-02 (core length: 4.12m, water depth: 614 m). This study attempts to understand how past shifts in intermediate-water circulation and monsoonal variability influenced OMZ intensity since the last deglaciation.

Epifaunal benthic foraminiferal porosity, a proxy for bottom-water oxygenation, increases in low-oxygen conditions and decreases in well-ventilated waters. Porosity in the penultimate chamber of *Planulina dayi* and *Elphidium excavatum* on the dorsal side was measured using SEM imaging and ImageJ analysis, to reconstruct past oxygenation conditions. Geochemical analysis was carried out using Q-ICPMS. The reduced U and porosity data reveal a weaker OMZ during Heinrich Stadial 1, likely due to enhanced ventilation from increased Antarctic Intermediate Water (AAIW) incursion into the EAS [1] and reduced monsoon-driven productivity as evidenced by Singh et al. (2007). Whereas, the Bølling-Ållerød hosted a moderately strengthened OMZ coinciding with strengthened summer monsoon-driven productivity [2]. During the Younger Dryas, reduced U and Mo data suggest a weakened OMZ owing to a strengthened winter monsoon resulting in vertical mixing [2]. The U and porosity data showed an increasing trend throughout the Holocene suggesting a transition towards an intensifying OMZ associated with intensified summer monsoon-driven productivity [2]. Our results suggest that OMZ fluctuations possibly follow the incursion of oxygenated AAIW during deglaciation and monsoonal strength fluctuations highlighting the role of monsoonal dynamics and intermediate-water circulation in OMZ fluctuations and offering insights into future deoxygenation trends.

[1] Jung, Kroon, Ganssen, Peeters & Ganeshram (2009), Earth Planet. Sci. Lett. 280, 220-228.

[2] Singh (2007), Indian J. Mar. Sci. 36, 378-383.