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Glacial-Interglacial variability in Ocean Productivity: The Need for a Multiproxy Approach

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A comparison of paleo-productivity proxies like Cd/Ca in planktic foraminifera, the ratio of *Globigerina bulloides* to *Globigerinoides ruber*, and planktic foraminiferal abundance, through analysis of sediment samples collected in the Bay of Bengal, reveals that a single proxy derived determination of productivity might lead to overestimation/underestimation. As a key climate modulator, primary productivity regulates CO_2 exchange between the ocean and atmosphere [1]. Multiple factors, including availability of nutrients and light (turbidity), wind intensity, and sea surface temperature influence oceanic primary productivity. Consequently, proxy based productivity signatures are commonly used to determine hydroclimate variability in a given region, making paleoproductivity records essential for understanding climate change under different boundary conditions.

Past changes in productivity are reconstructed using various proxies like abundance ratio of planktic and benthic foraminifera, biogenic opal, select organic proxies (e.g. C_{org} %, C/N and $\delta^{13}C$), and the carbonate content of sediment. However, regional biases associated with different proxies can lead to misinterpretations when using a single proxy for productivity reconstruction. To address this, we present a marine biogenic carbonate-based multiproxy record of glacial-interglacial productivity changes from the northern Indian Ocean. This study aims to untangle the complexities of using different proxies to assess glacial-interglacial productivity changes at a regional scale. We employ foraminifera-based proxies including the absolute abundance of planktic foraminifera, the ratio of *Globigerina bulloides* to *Globigerinoides ruber*, eutrophic assemblages based on planktic foraminiferal populations, and Cd/Ca in surface-dwelling *G. ruber*. Additionally, Li/Ca values in *G. ruber* help distinguish carbonate preservation from productivity signals. The present productivity record is compared to published results of seawater $\delta^{18}O$, $\delta^{13}C$ of leaf wax, Rb/Ca, and pCO_2 reconstruction from the same site. Data from the last ~1.45 million years indicate increased productivity during interglacials and enhanced carbonate preservation during glacials. Our proxy comparison highlights the differential influence of hydrodynamic conditions on various productivity proxies. Therefore, we emphasize the need for caution when interpreting paleoproductivity changes based on a single proxy.

[1] Broecker, W.S. (1982). Progress in Oceanography 11, 151-197.