Surface and thermocline ocean circulation intensity changes in the western Arabian Sea during ∼172 kyr

Hidayatullah Khan a, b, Pawan Govil a, b, *, Rajani Panchang c, Shailesh Agrawal a, Pankaj Kumar d, Brijesh Kumar a, b, Divya Verma a, b

a Birbal Sahni Institute of Palaeosciences, Lucknow, U.P., 226007, India
b Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, U.P., 201002, India
c Department of Environmental Science, Savitribai Phule Pune University, Pune, Maharashtra, 411007, India
d Inter-University Accelerator Center, New Delhi, 110067, India

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1. Introduction

The dynamics of the tropical Indian Ocean response to the seasonally reversing surface wind, which governs the monsoonal circulation. The movement of the Intertropical Convergence Zone (ITCZ) and the atmospheric pressure cell formed over central Asia control the precipitation. This dynamic interaction between the atmosphere, ocean (surface mixed layer and thermocline), and land provides valuable information about ocean heat budgets. The driving mechanism of the mixed layer is different in both monsoon seasons, which are southwest monsoon (SWM) and northeast monsoon (NEM) (White et al., 1998; Ramesh and Krishnan, 2005). The intense wind speed accompanied by a stronger SWM causes the deepening of the mixed layer, driven by turbulent kinetic energy and mixing (Chen et al., 1994; Ramesh and Krishnan, 2005).

On the other hand, the winter monsoon is characterized by moderate and dry winds, enhanced evaporation over precipitation, and net heat loss from the ocean, which strikes the deep convective mixing and cooling of the mixed layer (Ramesh and Krishnan, 2005). Deeper mixed layers suggest stronger wind speeds associated with the stronger SWM, weaker surface stratification, and deepening of the thermocline. In addition, strong wind speeds and the formation of shear through turbulence and mixing cause the mixed layer to deepen into the open ocean. These factors accelerate toward weak stratification in the upper water column and a deepening thermocline linked to negative and positive wind stress curls (Murtugudde et al., 2007). Regarding heat budget, the peak