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A 90 ky upwelling record from the Northwestern Indian Ocean using a novel long-chain diol index

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The Arabian Sea is one of the most productive open marine areas in the world, driven by strong monsoonal winds. In summer, warm and humid southwestern winds cause coastal upwelling of nutrient-rich water off Oman and open-ocean upwelling northwest of the Findlater Jet. In winter, dry and cold northeasterly winds of the winter monsoon cool the surface water, causing convective mixing which brings nutrients back to the surface. At present, primary production is highest during the summer monsoon upwelling period; mixing during the winter monsoon leads to a second, but much weaker productivity pulse. Previous studies have shown that, in the past, upwelling mainly occurred during interglacials, while it was reduced during glacial times. However, accurate reconstruction of upwelling is hampered because only a few proxies specifically record upwelling. Recently we have shown that in the Arabian Sea, specific *Proboscia* diatom lipids (long-chain 1,14-diols and 12-hydroxy methyl alkanoates) may be used as proxies for primary productivity caused by upwelling, as high fluxes of these lipids in this area almost exclusively occurred during periods of upwelling in the summer monsoon.

In this study, variations in the seasonal flux of long-chain 1,14- and 1,15-diols were determined in the western Arabian Sea off the Somali coast using time-series sediment traps. The results were in agreement with previous studies, i.e. highest fluxes of 1,14 diols were found during summer monsoon upwelling while 1,15-diols were present both during the summer and the winter monsoon. We then applied an index of 1,14-diols vs. 1,14- + 1,15-diols on a 15 meter long piston core, covering the last 90 ka, taken from the same site. The results show that this index records changes in

upwelling intensity and confirms that upwelling in this region is strongly related to global climate events like glacial and interglacial periods. Because this index specifically registers upwelling intensity, it can be used to distinguish between productivity driven by upwelling during the summer monsoon and productivity driven by mixing during the winter monsoon. According to our study, productivity during Marine Isotopic Stage (MIS) 1, 5, and the beginning of MIS 3 was mainly driven by summer monsoonal upwelling, while during MIS 2 and 4 and the stage 3 event between $\sim$45 and 30 cal kyr BP, productivity was mainly related to deep water mixing during the winter monsoon.