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Intensification and migration of the Benguela upwelling system associated with the Pliocene-Pleistocene transition

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The transition between the Pliocene and Pleistocene epochs is marked by a shift toward a globally cooler state, the development of extensive biopolar glaciations, and the strengthening of ocean-atmosphere circulation systems. A comparison of a global suite of records has highlighted the possibility that the Pliocene-Pleistocene transition was not a simple, globally synchronous series of events. To gain perspective on the southern hemisphere response to the Pliocene-Pleistocene transition, we examine the Benguela upwelling system (BUS) over the last 5 million years. The BUS forms part of one of the world's major eastern boundary current systems. As the only eastern boundary current to carry waters equatorward and ultimately to the northern hemisphere, the BUS may play an important role in shaping global climate. By reducing evaporation rates offshore, the extensive region of relatively cool surface waters along the eastern margin of the south Atlantic has also been linked to aridity onshore.

Here, we assess the long-term evolution of the BUS at a regional scale over the last 5 million years by comparing three sites drilled during ODP Leg 175. These form a north-south transect across the BUS, and record the major upwelling cell at Lüderitz (Site 1084), and the northern and southern upwelling regions, where upwelling intensity differs at the present day (sites 1081 and 1084 respectively). We combine records

of sea-surface temperatures and organic carbon export to track changes in upwelling intensity. The new data presented here are compared to previously published Pliocene-Pleistocene datas.

The results reveal that considerable cooling occurred within the BUS, and changes associated with both the intensification of northern hemisphere glaciation and the mid-Pleistocene transition are identified. These occurred in parallel to reported changes in SST upwelling sites in the eastern Pacific. The BUS did not respond to the Pliocene-Pleistocene transition uniformly, resulting in the evolution of the northern and southern upwelling regimes which have remained to the present day.