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Ocean circulation in the southern Benguela region from the Pliocene to the Pleistocene: tracking Agulhas leakage into the SE Atlantic

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The transition from the warmth of the middle Pliocene to the large amplitude, 100 kyr glacial-interglacial cycles of the late Pleistocene provides a way to understand the forcings and impacts of regional and global climate change. Here, we investigate changes in ocean circulation over the period from 3.5 Ma to present using a marine sediment core, ODP Site 1087 (31^o28'S, 15^o19'E, 1374m water depth). ODP 1087 is located in the South-east Atlantic Ocean, outside the Benguela upwelling region. Its location allows investigation of the history of the heat and salt transfer to the Atlantic Ocean from the Indian Ocean ("Agulhas leakage"), which plays an important part in the global thermohaline circulation. It is not known how this transfer reacted to generally warmer global temperatures during the mid-Pliocene, nor to the transition to a globally cooler climate in the early Pleistocene.

Our approach is to apply several organic geochemistry proxies and foraminiferal analyses to reconstruct the history of ODP 1087. These include the U^K_{37}' index to reconstruct sea surface temperatures, pigment analysis for understanding productivity changes, and foraminifera assemblage analysis to detect the presence of different water masses at the site. We have identified changes in SSTs and biological productivity that we argue to reflect shifts in the position of the Benguela upwelling cells, and a changing influence of Agulhas leakage. Our new data reveal a different organization in the Southeast Atlantic. It shows that during the Pliocene ODP 1087 was dominated by Benguela upwelling which had shifted south. We find no evidence for Agulhas leakage during the mid Pliocene, which could mean that Agulhas Leakage was severely reduced during the mid Pliocene. The implications of these results for understanding Plio-Pleistocene climate changes will be explored here.