Deep-Sea Research Part 1: Oceanographic Research Papers

February 2013/Vol. 72, pp 1-8

Observations of an early Agulhas current retroflection event in 2001: A temporary cessation of inter-ocean exchange south of Africa?

H.M. van Aken[a,*,] J.R.E. Lutjeharms [b], M. Rouault [b,c,] C. Whittle [d,b], W.P.M. de Ruijter [e]

aNIOZ Royal Netherlands Institute for Sea Research, PO Box 59, Den Burg, Texel, The Netherlands

bDepartment of Oceanography, Mare Institute, University of Cape Town, Rondebosch, South Africa

cNansen-Tutu Center for Marine Environmental Research, James Building, University of Cape Town, South Africa.

d Marine Earth Observation, Natural Resources and the Environment, Council for Scientific and Industrial Research, Rondebosch, Cape Town, South Africa

e Institute for Marine and Atmospheric Research Utrecht, Utrecht University, The Netherlands

Abstract

The exchange of heat and salt between the South Indian Ocean and South Atlantic Ocean, at the southern terminus of the Agulhas current, forms a crucial link in the global ocean circulation. It has been surmised that upstream retroflections in this current could produce temporary interruptions to the exchange, but that their impact would depend on the vertical extent of such retroflections and on their duration. The fortuitous presence at sea of a research vessel has now enabled us to investigate such an episode at subsurface levels in combination with remote sensing of the sea surface. We present here the first in situ evidence that an upstream or early retroflection can extend to a depth of well over 750 m and last for 5 months. This event was likely triggered upstream by the happenstance of two Natal Pulses, large cyclonic eddies inshore of the Agulhas current. These eddies short-circuited the Agulhas with its Return current, leading to the shedding of three large Agulhas rings in quick

succession. The arrival of a third cyclonic eddy when the Retroflection was still quite retracted did not lead to another ring shedding event. The resulting early retroflection may have had the effect of stalling the shedding of Agulhas rings and their motion towards the Cape Basin. However, these early retroflections are too scarce to allow generic statements on their generation or consequences, and the relation with large-scale environmental factors. It is likely that the observed withdrawal of the retroflection into the Transkei Basin is a fortuitous result of a series of contingent interactions.