

The BONUS-GOODHOPE cruises

A. Cruises description

1. Cruise track

The BONUS-GOODHOPE cruise track is divided into two cruise-legs:

- **LEG-1 in 2008:** large monitoring from South Africa towards the Southern Ocean along *one section* at the zero meridian to and beyond the Polar Front (from 34°S, 18°E to ~51°S, 00°W; and from 51°S to 57°S along the Greenwich meridian) [Figure 1],

- **LEG-2 in 2009:** mesoscale study of the Agulhas Current, its Retroflexion and the African continental margin system south of South Africa along *three across-slope* high-resolution *sections* (across the shelf, slope of the Agulhas Bank and crossing the Agulhas Current) near 19, 22, and 24°E – and a shorter section at 28°E for currentmeter mooring - and along *three alongshore sections* on the Agulhas Bank (joining the inner ends of the cross-shore sections at 19, 22 and 24°E) along the Agulhas Bank shelf-break and an offshore section (joining the other end of the cross-slope sections). [Figure 2]

Rafos floats and acoustic sources for dr L. Beal experiment ([Figure 3], Annexe 2) will also be deployed.

2. Cruise period

To achieve our scientific objectives, the two LEGs should take place during the austral summer when biological activity is maximal and ice cover is minimal. Ideally the LEG-1 will take place between February and March 2008 to keep with the IPY-GEOTRACES-CASO synoptic cruise ANT-XXIV/3 on board the german vessel *RV POLARSTERN* (06/02/08-17/04/08, Chief scientist: E. Fahrbach) in the context of the IPY GEOTRACES ZERO&DRAKE project (PI H.J.W. de Baar, NL). The LEG-2 should take place one year later the first LEG, thus between January and February 2009. The LEG-1 has received the mention “prioritaire-1” by the OPCB Committee in 2006 (see the attached letter here below) and the LEG-2 has been re-submitted to the OPCB Committee in 2007.

3. Justification of the two LEGs

The BONUS-GOODHOPE LEG-1 from Cape Town to the Southern Boundary of the ACC along the Greenwich Meridian has been chosen because it crosses the geographical region where water masses of the ACC and the Agulhas Current converge and mixes before entering the South Atlantic as thermocline waters. The specific shape of the transect has been chosen because it follows the TOPEX/POSEIDON-JASON1 altimeters flight path (nb 133). This will efficiently increase the spatio-temporal sampling of observations. The southern fraction of this section (south of 50°S) has already been sampled for several years by moorings of the German WECCON project and will be sampled hopefully at the same time of our cruise by the ZERO&DRAKE SOFI group. Its northern part overlaps with the USA ASTTEX programme, thus linking the Southern Ocean dataset with that collected in the Benguela region.

It encompasses stations of GEOSECS across the ACC in the South Atlantic, and of individual expeditions across the ACC for which trace metals (DeBaar et al., 1995; 1999, Löscher et al., 1997; 1998), Be (Kusakabe et al., 1982; Frank et al., 2002), REE (Jeandel, 1993); Th, Pa (Rutgers van der Loeff and Berger, 1993), Ra (Hanfland, 2002); ²²⁷Ac (Geibert, 2001) were measured, but no systematic coordinated tracer study has been made. It is part of a series of synoptic studies proposed in the framework of IPY-Southern Ocean in coordination with CLIVAR/CASO and GEOTRACES programs. Especially the IPY-GEOTRACES “ZERO&DRAKE” (EoI#880, H. de Baar, The Netherlands) & IPY-CASO (EoI#132, S. Rintoul, Australia) project that extends the section of BONUS-GOODHOPE on the zero-meridian from Polar Frontal Region towards the Antarctic continent. Strong collaboration between the two projects will provide a full section of TEIs between South Africa and Antarctica.

Furthermore coupling the Indo-Atlantic connection south of Africa in BONUS-GOODHOPE with the Pacific-Atlantic connection at the Drake Passage in ZERO&DRAKE will give significant advances in understanding the respective role and impact of the “warm route” and “cold route” of water masses transport (salts and heat) on the thermohaline circulation that regulates earth climate to a large extent.

The advantages of the BONUS-GOODHOPE LEG-2 in the Agulhas Current system and the African continental margin system lie in the high-resolution sections of physical parameters will provide strong insights into the origin, transformation and dynamical role of the Agulhas cyclones in the water-masses exchanges between the continental margin and the southwest oceanic region of Cape Cauldron. Moreover, comparing inshore and offshore stations before and after the Agulhas Current interfere with the shelf and slope of the Agulhas Bank will provide significant advances in unravelling physical, biological, geological processes within interfaces between continental margin and oceanic region. Finally, it allows a detailed study of the margin/open ocean exchange processes that could drive sources, sinks or both for the trace elements and isotopes. Mixing and cross-slope exchanges along the Agulhas Bank are also essential for water mass evolution. Solving this issue is crucial for balancing the oceanic budgets of heat, salt and for these tracers, and for quantifying realistic continent/ocean fluxes.

Connection between both legs of BONUS-GOODHOPE will provide fundamental information on the modification of the water masses chemistry once contacting an energetic boundary (the South African margin). An important part of the fluxes in the Cape Cauldron is achieved by eddies which are formed from instabilities of the Agulhas Current and adjacent water masses, developed along the Agulhas Bank. In that respect, quantifying these turbulent fluxes requires the knowledge of dynamical processes along the continental slope.

Coordination with a US proposal (by Dr L. Beal, RSMAS, Miami) aiming at measuring the NADW eddies

(formation and paths) south of Africa and their contribution to the deep flow, by means of RAFOS floats, has been prepared (Annexe 2) and is proposed. This would significantly enrich the information on both routes and possibly on the impact these deep eddies may have on mesoscale fluctuations of the Agulhas Current near the Agulhas Bank.