Auxiliary Material for Paper 2009PA001879

Contrasting multiproxy reconstructions of surface ocean hydrography in the Agulhas Corridor and implications for the Agulhas Leakage during the last 345,000 years

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Martínez-Méndez, G., R. Zahn, I. R. Hall, F. J.C. Peeters, L. D. Pena, I. Cacho, and C. Negre (2010),
Contrasting multiproxy reconstructions of surface ocean hydrography in the Agulhas Corridor and implications
for the Agulhas Leakage during the last 345,000 years, Paleoceanography, 25, PA4227, doi:10.1029/2009PA001879.

This auxiliary material contains two word files.

1. Text S1 (2009pa001879-txts01.doc): Age model for MD02-2594 and Splicing of MD96-2080 and MD02-2594 into singular records, Agulhas Bank Splice (ABS)

This supplement provides information about the age model of core MD02-2594 and about the splicing procedure
between MD02-2594 and MD96-2080 to obtain a single record named Agulhas Bank Splice (ABS).
It contains two figures and two tables:

Figure S1. Age-depth function from MD02-2594 14C AMS dates. Conventional ages are shown in grey, calibrated ages in black.

Table S1. Globorotalia inflata 14C AMS ages and calibrated calendar year ages for core MD02-2594.

Table S2. Tie points for establishing the age model of MD02-2594.

Fig. S2. Data profiles for MD96-2080 and MD02-2594. MD02-2594 records are shown in pink. a) Benthic d18O (F. wuellerstorfi) (‰ VPDB), MD96-2080 in brown, CBR in blue; b) Benthic d13C (F. wuellerstorfi), MD96-2080 (cyan) (‰ VPDB); c) Planktonic d18O (G. bulloides), MD96-2080 in red (‰ VPDB); d) Planktonic d13C (G. bulloides), MD96-2080 in green (‰ VPDB); e) MD96-2080 (violet) and MD02-2594 G. bulloides Mg/Ca-derived SST (°C); f) MD96-2080 (navy) and MD02-2594 (micras). Top bar displays Marine Isotope Stages. Vertical shading highlights interglacials.

2. Text S2 (2009pa001879-txts02.doc): d18O records of sediment cores used in the SST comparisons between different core sites in the Indian Ocean (Fig. 5 of main text)

This supplement shows a figure with d18O records of the sediment cores used for comparison of SST in Figure 5 of the main text for inspection of age modelling.

Figure S3. d18O records of sediment cores whose SST records are shown in Figure 5 of main text. a) MIS 1-3, b) MIS 5e-6. Foraminiferal species used for isotope analysis are indicated with the core names. Core sites are ABS, this study; CBR, Atlantic sector of Agulhas Corridor [Peeters et al., 2004]; MD96-2077, Indian sector of Agulhas corridor [Bard and Rickaby, 2009]; WIND28K, western tropical Indian Ocean [Kiefer et al., 2006]; MD98-2165, south Indonesian archipelago, MD79-257, Mozambique Channel [Levi et al., 2007]; MD98-2162, Indonesian Through Flow [Visser et al., 2003]. d18O profiles are shown on their published age scales.

Text S1: Age model for MD02-2594 and Splicing of MD96-2080 and MD02-2594 into singular records, Agulhas Bank Splice (ABS)

This section provides the radiocarbon data (Table S1), age-depth function (Figure S1) and correlation tie points between MD02-2594 and MD97-2120 (Table S2) that were used to construct the age model for MD02-2594.

For details about the radiocarbon dates and age-depth function of MD96-2080 we refer the reader to *Martínez-Méndez et al.* [2008].

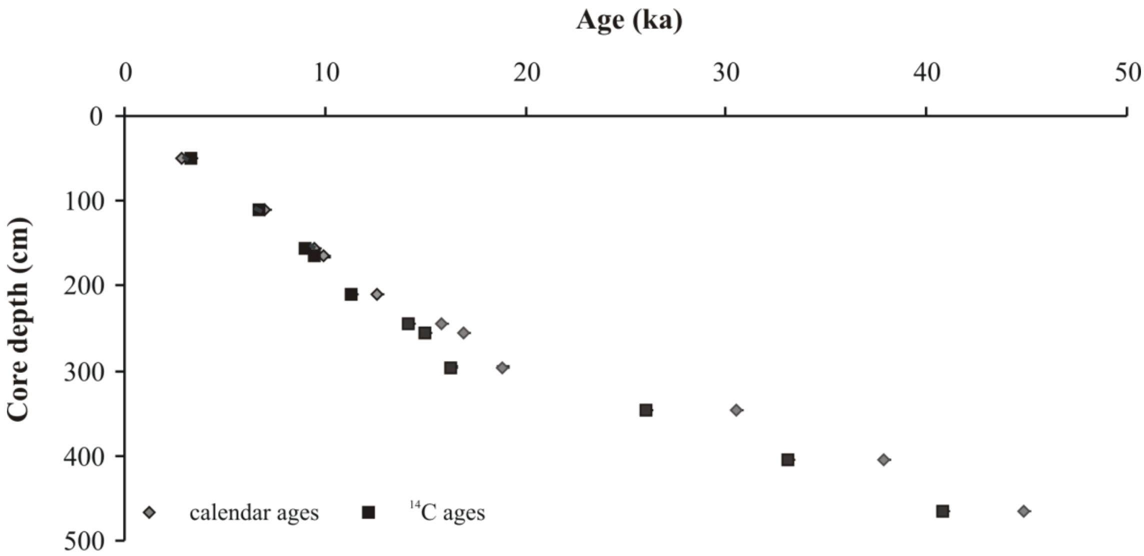

Fig. S1. Age-depth function from MD02-2594 ^{14}C AMS dates. Conventional ages are shown in grey, calibrated ages in black.

Table S1. *Globorotalia inflata* ^{14}C AMS ages and calibrated calendar year ages for core MD02-2594.

Publication Code NOSAMS	Sample Identifier MD02-2594 (cm) *G. inflata*	Fraction Modern ($Fm \pm 1\sigma$)	Conventional Radiocarbon Age (years BP $\pm 1\sigma$)	Sample weight (mg)	$\delta^{13}C_{PDB}$ (‰ ± 0.1)	Calibrated ^{14}C (calendar years $\pm \sigma$)	Calibration Tool
OS-65271	MD02-2594 50-51	0.6598 ± 0.0026	3,340 ± 30	5.54	0.82	2,815 ± 57	[*Fairbanks et al.*, 2007]
OS-65110	MD02-2594 110-111	0.4316 ± 0.0022	6,750 ± 40	3.81	0.75	7,014 ± 97	[*Fairbanks et al.*, 2007]
OS-64823	MD02-2594 155-156	0.3243 ± 0.0015	9,050 ± 35	3.97	0.69	9,460 ± 49	[*Fairbanks et al.*, 2007]
OS-64964	MD02-2594 165-166	0.3073 ± 0.0029	9,480 ± 75	3.32	0.64	9,966 ± 185	[*Fairbanks et al.*, 2007]
OS-65269	MD02-2594 210-211	0.2442 ± 0.0019	11, 300 ± 65	4.80	0.62	12,626 ± 75	[*Fairbanks et al.*, 2007]
OS-65111	MD02-2594 245-246	0.1711 ± 0.0018	14,200 ± 85	4.09	0.39	15,813 ± 157	[*Fairbanks et al.*, 2007]
OS-64824	MD02-2594 255-256	0.1541 ± 0.001	15,000 ± 50	4.11	0.62	16935 ± 154	[*Fairbanks et al.*, 2007]
OS-65113	MD02-2594 295-296	0.1324 ± 0.0001	16,250 ± 60	4.22	0.64	18,833 ± 93	[*Fairbanks et al.*, 2007]
OS-65274	MD02-2594 345-346	0.0393 ± 0.0007	26,000 ± 140	5.40	0.68	30,559 ± 203	[*Fairbanks et al.*, 2007]
OS-64965	MD02-2594 405-406	0.0162 ± 0.0004	33,100 ± 190	3.65	0.70	37,881 ± 249	[*Fairbanks et al.*, 2007]
OS-65112	MD02-2594 465-466	0.0062 ± 0.0003	40,800± 370	4.16	0.71	44,887 ± 382	[*Fairbanks et al.*, 2007]

Notes: 1) Fraction Modern (Fm) is a measurement of the deviation of the $^{14}C/C$ ratio of a sample from "modern." Modern is defined as 95% of the radiocarbon concentration (in AD 1950) of NBS Oxalic Acid I normalized to $\delta^{13}C_{VPDB}$ = -19 ‰ [*Olsson*, 1970]. AMS results are calculated using the internationally accepted modern value of 1.176 ±0.010 x 10-12 [*Karlen et al.*, 1968] and a final $^{13}C_{correction}$ is made to normalize the sample Fm to a δ13CVPDB value of -25 ‰. 2) Reporting of ages and/or activities follows the convention outlined by Stuiver and Polach [1977] and Stuiver [1980]. Radiocarbon ages are calculated using 5,568 (yrs) as the half-life of radiocarbon and are reported without reservoir corrections or calibration to calendar years. A $\Delta^{14}C$ activity normalized to 1950 is also reported according to these conventions. The activity, or $\Delta^{14}C$ of the sample is further corrected to account for the decay between collection (or death) and the time of 10/6/2005 measurement if a collection date is specified on the submittal form, otherwise $\Delta^{14}C$ is reported assuming that collection and measurement date are the same.

Table S2. Tie points for establishing the age model of MD02-2594.

Core depth (cm)	Age (a BP)	Age control point	^{14}C calibration and references
50.5	2,815	^{14}C AMS	[*Fairbanks et al.*, 2007]
110.5	7,014	^{14}C AMS	[*Fairbanks et al.*, 2007]
155.5	9,460	^{14}C AMS	[*Fairbanks et al.*, 2007]
165.5	9,966	^{14}C AMS	[*Fairbanks et al.*, 2007]
210.5	12,626	^{14}C AMS	[*Fairbanks et al.*, 2007]
245.5	15,813	^{14}C AMS	[*Fairbanks et al.*, 2007]
255.5	16,935	^{14}C AMS	[*Fairbanks et al.*, 2007]
295.5	18,833	^{14}C AMS	[*Fairbanks et al.*, 2007]
345.5	30,559	^{14}C AMS	[*Fairbanks et al.*, 2007]
405.5	37,881	^{14}C AMS	[*Fairbanks et al.*, 2007]
465.5	44,887	^{14}C AMS	[*Fairbanks et al.*, 2007]
545.5	55,074	$\delta^{18}O_{benthicc}$ tuned to MD97-2120	[*Pahnke et al.*, 2003; *Pahnke and Zahn*, 2005]
669.5	74,479	$\delta^{18}O_{benthic}$ tuned to MD97-2120	[*Pahnke et al.*, 2003; *Pahnke and Zahn*, 2005]

For the youngest part of MD02-2594, i.e. sediment samples above 50.5 cm (our first radiocarbon age), we have assigned ages by extrapolation. To do so, we have assumed an age of 0 for the sample at 1 cm core depth (sample interval 0-2 cm) and computed the equation of the straight line between that present age and our first ^{14}C calendar age at 2,815 yr (50.5 cm sample depth, Fig. S1). We have used this equation to compute all ages younger than 2,815 yr. Age for samples between control points are calculated by linear interpolation.

In order to fill the gap in MD96-2080 and to construct the continuous ABS records we determined the best fit with MD02-2594 by comparing the benthic [*Martínez-Méndez et al.*, 2008; *Martínez-Méndez et al.*, 2009] $\delta^{18}O$ and $\delta^{13}C$ and planktonic records, the planktonic Mg/Ca records and the $\overline{SS}$ [*Martínez-Méndez et al.*, 2008, *Negre et al.*, in press] of both cores with each other (see Fig. S2). Data records from the nearby Cape Basin Record (CBR) [*Peeters et al.*, 2004] were used as further reference (Fig. S2). The MD96-2080 and MD02-2594 $\delta^{18}O$ and Mg/Ca records match well at 80 ka while planktonic and benthic $\delta^{13}C$ of both cores are offset in this section. This potentially indicates that some of the MD96-2080 sediment section that we initially ascribed to MIS 5a may actually be from MIS 3, in which case multiple hiatuses would exist in this core. Hence to construct the spliced ABS record we use the MD02-2594 records back to MIS 5a and then splice in MD96-2080 at 87 ka.

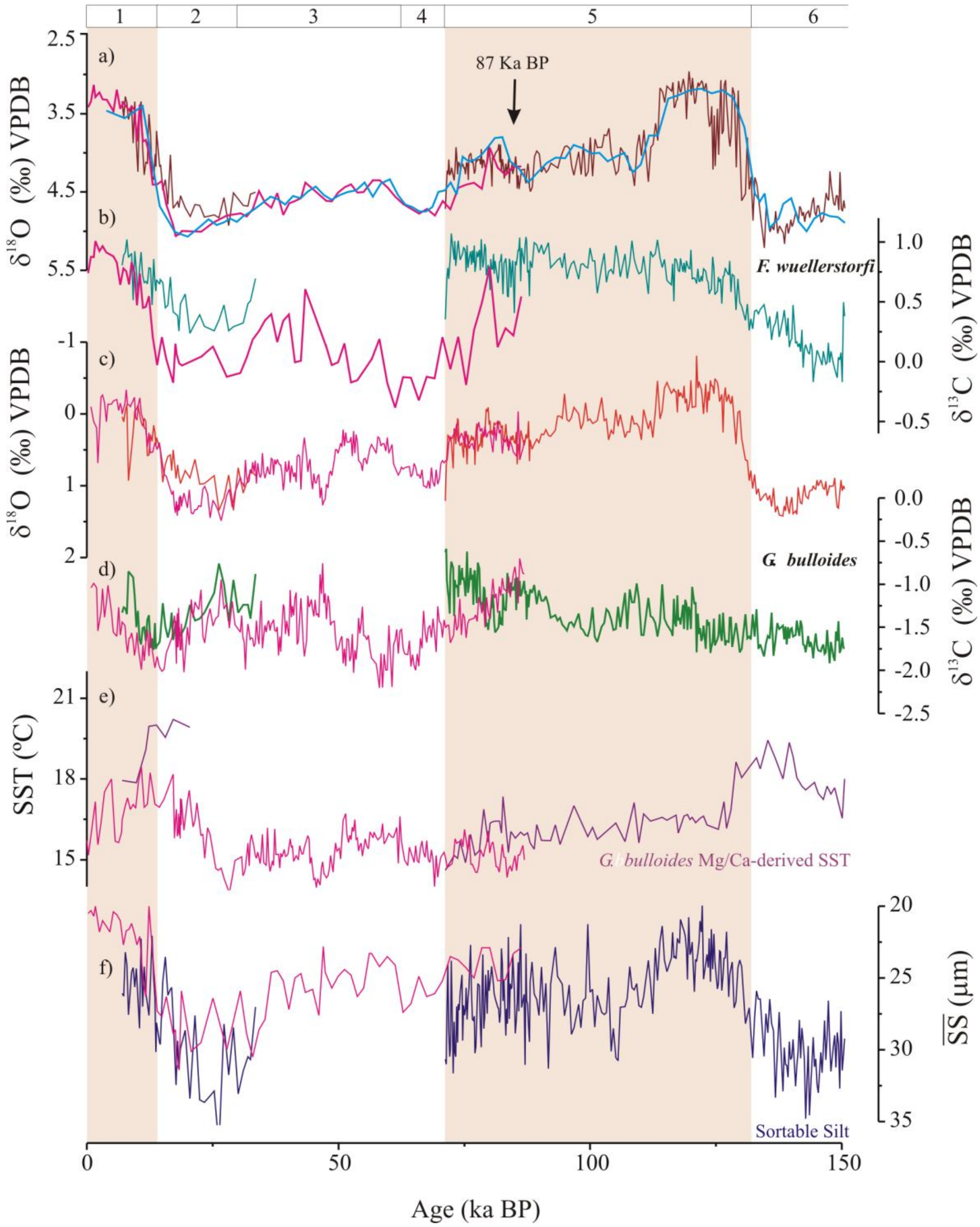

Fig. S2. Data profiles for MD96-2080 and MD02-2594. MD02-2594 records are shown in pink. a) Benthic $\delta^{18}O$ (*F. wuellerstorfi*) (‰ VPDB), MD96-2080 in brown, CBR in blue; b) Benthic $\delta^{13}C$ (*F. wuellerstorfi*), MD96-2080 (cyan) (‰ VPDB); c) Planktonic $\delta^{18}O$ (*G. bulloides*), MD96-2080 in red (‰ VPDB); d) Planktonic $\delta^{13}C$ (*G. bulloides*), MD96-2080 in green (‰ VPDB); e) MD96-2080 (violet) and MD02-2594 *G. bulloides* Mg/Ca-derived SST (ºC); f) MD96-2080 (navy) and MD02-2594 $\overline{SS}$ (μm). Top bar displays Marine Isotope Stages. Vertical shading highlights interglacials.

We observe that MIS 2 data of all MD96-2080 records is closer to Holocene values than that of MD02-2594. We suspect that disturbance in the upper meter of MD96-2080 produced mixing of sediments of Holocene and MIS 2 age erasing the full glacial signatures. Also note that most of the Holocene is lost in MD96-2080 due to flow out during core recovering. The Mg/Ca-derived SST of both cores in the upper part disagrees in which MD96-2080 Mg/Ca-derived SST reaches 20ºC while the estimations from MD02-2594 hardly reach 18ºC. Furthermore, we have suggested that mixing of sediments of Holocene and MIS 2 age erases the full glacial-interglacial amplitude in MD96-2080; hence, the Mg/Ca-derived SST on MD96-2080 may have been even higher. Although we do not have a satisfactory explanation for this discrepancy, we note that the region around South Africa displays high SST gradients due to the interaction of waters from the South Atlantic Subtropical Gyre, Sub-Antarctic domain and the inflow of the Agulhas Current (see Fig. 1). It may be possible that the slightly northward and westward position of MD02-2594 leaves this core with a slightly lower influence of the Agulhas Current than MD96-2080 undergoes. Indeed, the few Mg/Ca data available for the Holocene of MD96-2080 suggests an increasing trend in SST along the past 345 ka on MD96-2080.

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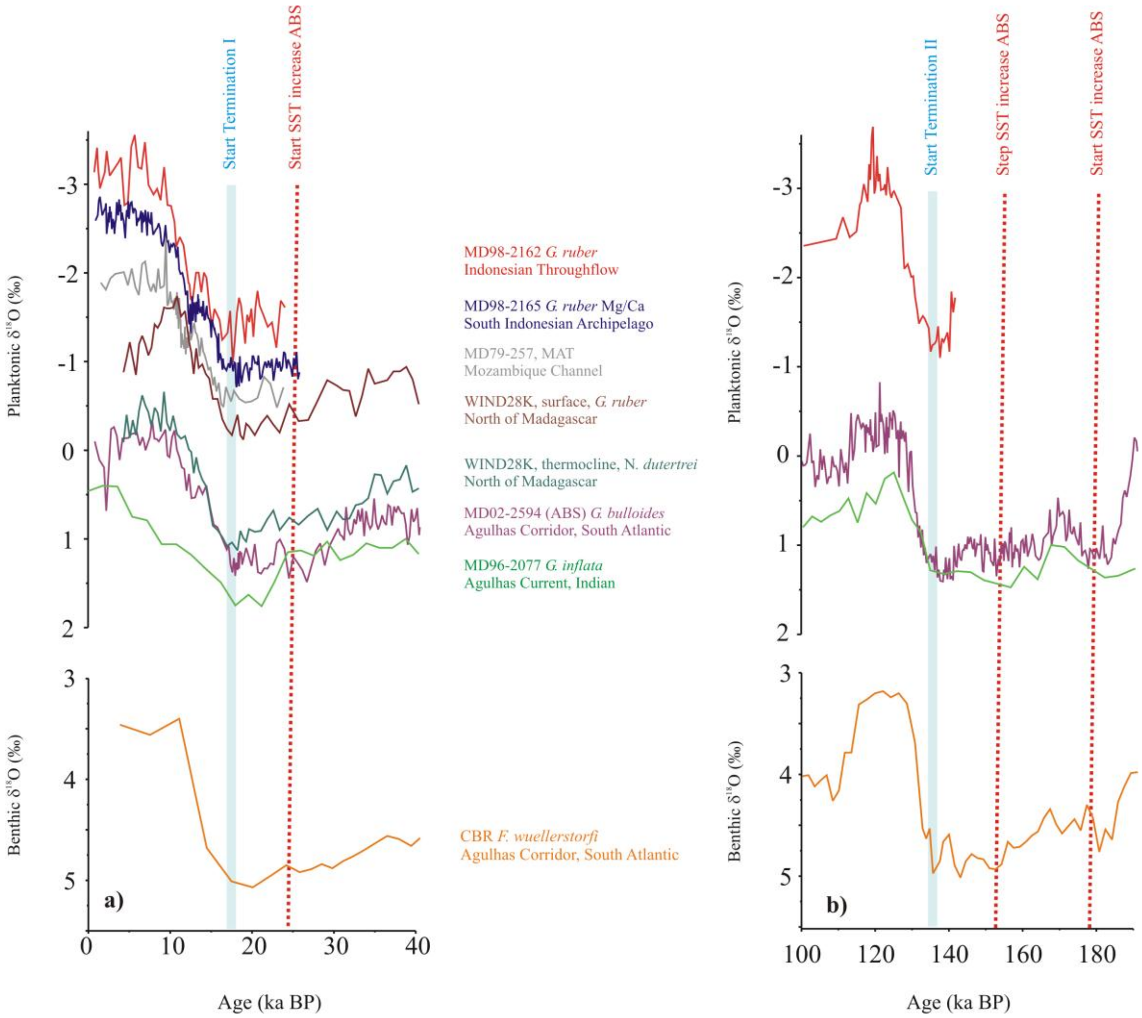
Text S1Text S2: δ^{18}O records of sediment cores used in the SST comparisons between different core sites in the Indian Ocean (Fig. 5 of main text)



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