Euler, C. and Ninnemann, U. S.: Climate and Antarctic intermediate water coupling during the late Holocene

Supplementary Material

Methods

We measured oxygen and carbon isotope ratios ($\delta^{18}O$ and $\delta^{13}C$) of the planktic foraminifer species *Neogloboquadrina pachyderma dextral.* About 10 shells (150-250µm fraction) were used per sample. Multiple replicates (1-5) were analyzed at each depth (whenever possible). Benthic foraminifera species *Uvigerina peregrina* were picked in the size above 250µm (1-3 per sample). Due to the low abundance of *Uvigerina peregrina* it was not possible to produce a continuous record. Additional benthic species *Cibicides wuellerstorfi* and *Cibicides lobatulus* were analyzed to supplement the *Uvigerina peregrina* record in intervals were they were abundant. The offset between the $\delta^{18}O$ values of the benthic species has been calculated using 71 points were we have measurements of both *U. peregrina* and *Cibicides wuellerstorfi/ Cibicides lobatulus* from the same depth in the core. The average difference between the $\delta^{18}O$ values of *U. peregrina* and of *C. wuellerstorfi/C. lobatulus* is 0.706% and the two benthic scales in Figure 2 have been adjusted accordingly.

All isotopic measurements were done at the GMS laboratory in Bergen using a Finnigan MAT 253 mass spectrometer coupled to an automated Kiel-device. Long-term analytical precision (1σ) of the standards over a time interval of several months is better than 0.1‰ and 0.04‰ for $\delta^{18}O$ and $\delta^{13}C$ respectively for samples between 6-60µg.

Age model

The section of ODP1233D presented here has low amounts of foraminifera and there was insufficient material to produce radiocarbon dates on the core. We correlated the core to a radiocarbon dated core from the same site, GeoB3313-1 (Lamy et al., 2001) using magnetic susceptibility core logging data from both cores, connecting them with 4 tie points with the help of AnalySeries 2.0 X software (Figure DR 1). In this way two ^{14}C AMS dates (KIA 6793 and KIA 7231; mixed planktic foraminifera; Lamy et al. (2001)) were transferred to the ODP12333D mcd scale, the age model for ODP1233 was then established through linear interpolation. Lamy et al. (2001) have converted the ^{14}C ages to calendar years with the Calib 4.0 software (Stuiver and Reimer, 1993). The mean reservoir age for the Pacific at 41°S is ~400 years (Bard, 1988) and since the site is not prone to upwelling (Strub et al., 1998) or close to the polar front, a correction of the reservoir age was not indicated ($\Delta R=0$) (Lamy et al., 2001). The estimated error for the age control points comprises the error associated with the ^{14}C measurement and the Calib06 calibration error (2σ, 95.4%), and the estimated error associated with correlation between GeoB3313 and ODP 1233 (see table 1). Our linear correlation of the age control points during the Medieval Climate Anomaly is confirmed by the correlation to GeoB3313 (continuous age model until 260 yr B.P.), our age at 1201 AD (1.05mcd, first pointer; Figure DR1) is confirmed by the GeoB3313-1 age (Δ20yr).

Table DR1
Age control points of ODP1233 (late Holocene)

Sample ID	Conventional 14C age B.P.	Standard deviation (± yr)	CALIB error (2σ) (± yr)	Estimated correlation error (± yr)	Calibrated age (cal yr B.P.)
KIA 6793	1620	30	84	50	1180
KIA 7231	2370	50	130	35	1980

Figure caption for Supplementary Material figure

Figure DR 1. Correlation of core ODP1233 with GeoB3313. A: Magnetic susceptibility of the cores GeoB3313-1 (red)(Kaiser et al., 2005; Mix, 2003) and ODP1233D (green) versus depth. The cores are correlated using the computer software AnalySeries with 4 tie points shown in blue. B: Magnetic susceptibility of GeoB3313-1 (red) and ODP1233 (green) after correlation versus depth.

References:

Bard, E., 1988, Correction of accelerator mass spectrometry 14C ages measured in planktonic foraminifera: paleoceanographic implications: Paleoceanography, v. 3, p. 635-645.

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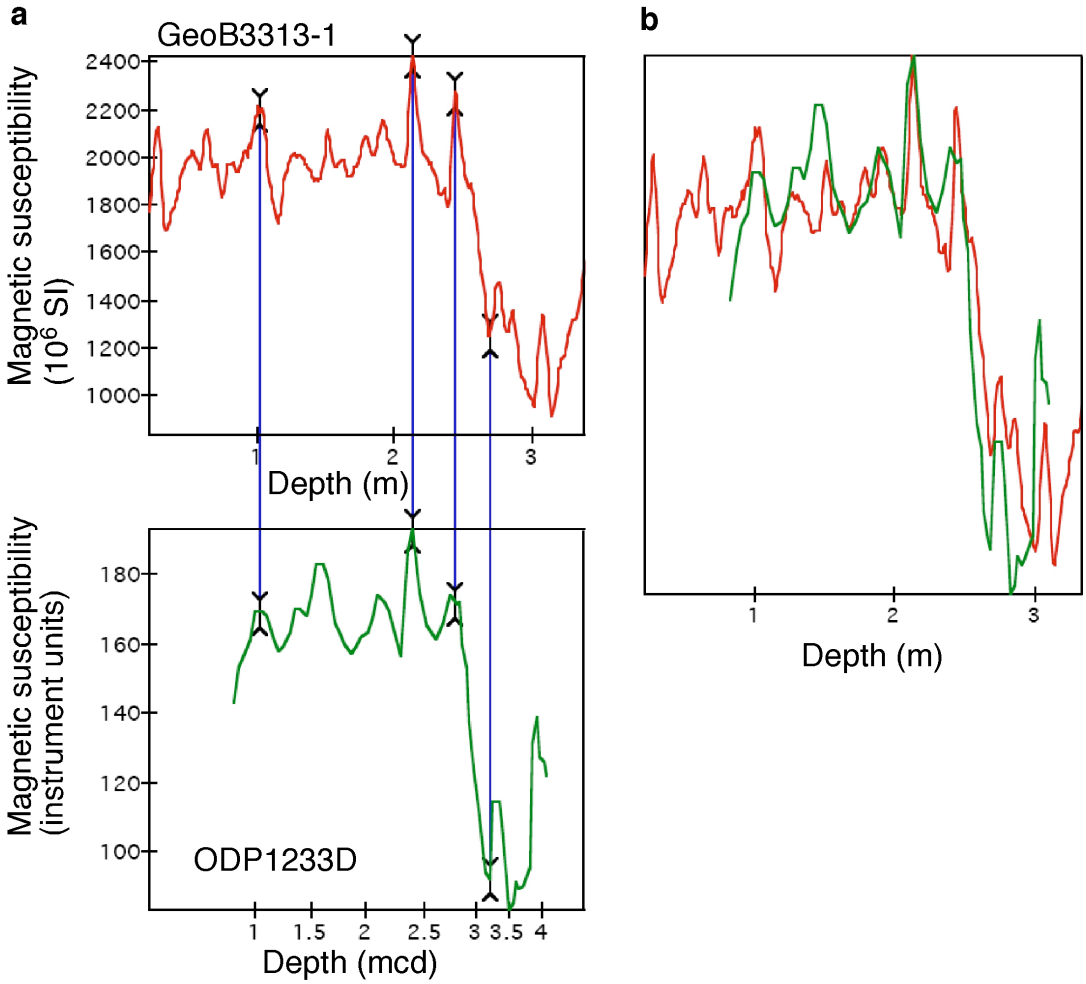
Lamy, F., Hebbeln, D., Röhl, U., and Wefer, G., 2001, Holocene rainfall variability in southern Chile: a marine record of latitudinal shifts of the Southern Westerlies: Earth and Planetary Science Letters, v. 185, p. 369-382.

Mix, A.C., Tiedemann, R., Blum, R., et al., 2003, Leg 202, Chapter 4 Site 1233: Proc. ODP, p. 1-76.

Strub, P.T., Mesías, J.M., Montecino, V., Rutllant, J., and Salinas, S., 1998, Coastal ocean circulation off western South America: The Sea, v. 11, p. 273-313.

Stuiver, M., and Reimer, P.J., 1993, Extended 14C data-base and revised Calib 3.0 14C age calibration program: Radiocarbon, v. 35, p. 215-230.

Figure DR 1


a
GeoB3313-1
Magnetic susceptibility
(10^6 SI)
2400
2200
2000
1800
1600
1400
1200
1000
1
2
3
Depth (m)
Magnetic susceptibility
(instrument units)
180
160
140
120
100
ODP1233D
1
1.5
2
2.5
3
3.5
4
Depth (mcd)
b
1
2
3
Depth (m)