

Review of Romahn et al, **Deglacial intermediate water reorganization: new evidence from the Indian Ocean.**

Climate of the Past. (CPD, 9, 4035–4063, 2013)

GENERAL COMMENTS

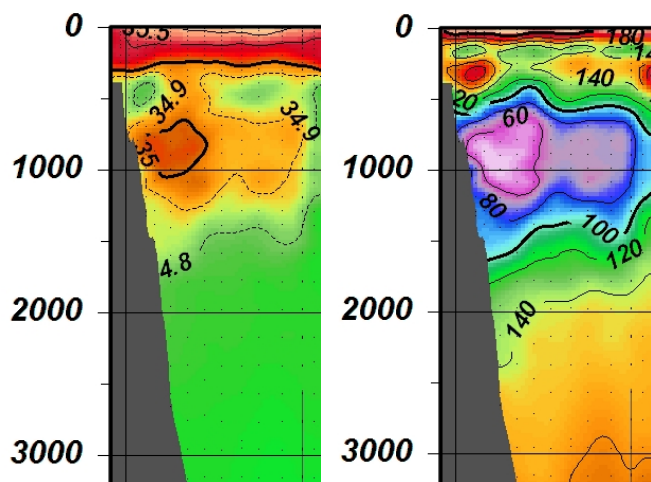
This is a useful dataset and (mainly) illuminating discussion relating to relatively shallow water masses that are infrequently monitored in sediment cores (the present core is from 446 m). It provides another well documented case of a tropical surface water signal derived from the circum-Antarctic region via the “Oceanic Tunnel” – transport in SAMW/AAIW (Subantarctic Mode Water/ Antarctic Intermediate Water). The difference between the history of SST (looking like Antarctica) and surface $\delta^{18}\text{O}$ (looking like Greenland) across the deglacial transition is striking. The benthic carbon isotope signal also displays features in common with sediment records under AAIW in other oceans, notably an isotope minimum excursion spanning the onset of H-1 to ~8ka in the early Holocene. Clearly this should be published in CP, but there are a few issues to clear up.

SPECIFIC COMMENTS

Science

There is a remarkable shift in sedimentation rate between 18 and 12 ka, from 3.5 to 40 cm/ka (Fig 2). In only 600 m of water I doubt it, but are the authors sure this is not a core-stretching artifact? It is not mentioned. The slow glacial/fast Holocene sedimentation rate, differing by a factor of 10, is noteworthy. (It makes no difference to the conclusions).

The percentages of You (1998) (p 4038/9-10) may be far off relative to Fine’s better



constrained data, but they do draw attention to the fact that Red Sea (RSW) and Persian Gulf waters make their way down this margin from the north. The high salinity /low oxygen core of RSW with high nutrients is very obvious in the WOCE section at about 5°S, very close to this site. A low $\delta^{13}\text{C}$ would be expected in these waters. In this regard It

Salinity and dissolved oxygen on WOCE line IO2 at ~ 5° S. Note high S/low O₂ of RSW on the margin. Figures from the eWOCE gallery (Schlitzer, 2000)

would be useful to have a figure showing hydrographic

profiles (S, O₂, a nutrient, maybe DIC) that would cast light on the setting of this core site. This information will assume significance when discussing possible shifts of water mass boundaries as the authors appear to have an open ocean hydrographic structure in mind with UCDW below AAIW and have ignored the possibility of RSW hugging the margin where their core is located. A cursory examination of the diagrams shown above suggest that at the depth of the sediment core there is a patch of lower salinity (<34.8)/high oxygen (>180 μmol/kg) water consistent with SAMW as they claim. However examination of the N-S salinity profile of WOCE line IO7 suggests that AAIW does not get much further than 10° S near this margin. It may be a mistake to refer to AAIW/SAMW as a single entity at this location; open ocean maybe, but not here. The authors need to consider the hydrographic setting, taking into account Red Sea isolation at the lowest sea-level, and expand this section.

In section 5.2.4 of the discussion the authors rather over-extend themselves. This discussion goes well beyond the capacity of the author's data to resolve the problem of water mass production rates. Their data have nothing to say directly about AAIW production rates and indirectly the carbon isotope ratios have several possible controls as enumerated in section 5.2.2 : Gas exchange fractionation, productivity, water mass mixing and so on. No causal connection between benthic δ¹³C and water mass production rate is set out here, just reference to others, often with larger databases, who have made a tenuous set of assumptions leading to a conclusion regarding dynamics. The authors appeal to shoaling of 'CDW' (that would be Upper CDW, (UCDW)), a water mass marked by oxygen depletion, high nutrients and low δ¹³C. But on this margin, if the Red Sea Outflow was active by 17 ka then the water mass here at some depth would likely have been RSW with similar properties but high salinity. This is a can of worms and the authors should stay well clear of it by removing this speculative section.

Reference.

Schlitzer, R., 2000. Electronic atlas of WOCE hydrographic and tracer data now available, EOS, Transactions AGU 81(5), 45. <http://www.ewoce.org/>

Minor concerns

4039/21: It would be helpful to be told the depth habitat at which *G. ruber* calcifies in these tropical waters.

4040/11: In what were the samples dissolved?

4041/24: At 446 m this is not 'deep-water', say 'benthic records' instead.

TECHNICAL CORRECTIONS

Figures

Fig 1. Black numbers on dark blue is not best for legibility.

Fig 3. When printed the colour bars are too dense and obscure key sections of the data.

Fig 4. Caption says GeoB is green line but figure (correctly) says green is RC27-14.

Figs 5,6,7. Line for $\delta^{13}\text{C}$ is not green.

Fig 7. Poor colour choice; purple line and purple bars for YD and H-1.

Typos, grammer, phrasing etc (new words, substitutions etc underlined)

p 4036, line 19; I doubt formation of AAIW has been recorded: hypothesised or suggested or proposed may be better.

4036/22; Unnecessary to cite an abstract here, Liu & Yang are sufficient; many authors use the word 'tunnel', suggest you remove it (also from 4042/12). Kiefer et al. could have been cited here, but not needed.

4037/3; Elemental is wrong word; perhaps essential.

4037/6; depths

4037/10-12; AAIW is not 'preformed' (see 4038/16-21). The rest of the sentence is awkward: Suggestion; '.... pulses of AAIW thereby demonstrating the presence of an aged deep water reservoir in the Southern Ocean. Spero and Lea (2002) presented a higher level hypothesis' [Although English has 'subordinate', 'superordinate' is unknown]

4038/13; substitute '....supposed to be upwelled in the open ocean at 9-10°S ...'

4038/16; '....associated with [NEVER 'to']; '... associated with sinking at the Subantarctic ...'

4039/4; not 'spans' but '... is 644 cm long.'

4040/17; '... analysis in an external ...'

4041/17; 'Synchronous with the ...' [NEVER 'to'].

4042/23; '...record from NIOP905...'

4043/3; cap, Antarctic.

4043/5; rephrase '... influencing SST ..' (a bit repetitive of 'modulate')

4043/6-7; The construction is 'not only ... but also...'. Thus '.... 12615-4 not only exhibits a $\delta^{18}\text{O}$ variability, but also shows a ...'

4043/8; '... suggested this CIME was linked ...' (CIMEs are generic so you need to specify this one.)

4044/2-3; rephrase '... recent data that also focus on AAIW/SAMW variability.'

4044/6; rephrase; '...interpreted as reflecting deep ...'

4044/10; rephrase, '...results where no old water could be found at Intermediate Water depths (Cléroux' [not correct to speak of 'injections' for subducted water masses].

4044/13; rephrase, '... upwelling of a long-isolated carbon reservoir, should exactly coincide ...'

4044/22; '...and minima of intermediate ...'

4044/28; '...when the lowest ...'

4045/5; rephrase, '... of the Southern Ocean surface and provides evidence ...'

4045/24; sea not see.

4045/27; temperature

4046/1; rephrase, '... almost simultaneously ...'

4046/8; '... CIME at shallow depths can ...'

4046/19; rephrase, '...not want to completely exclude a role for temperature-dependent fractionation during air-sea gas exchange in production of the deglacial CIME in AAIW/SAMW.'

4046/26; insert, '...the concept of deep-water outgassing proposed by Spero ...'

4046/27-1; '... the timing of the CIME synchronous with early H-1 in many marine...'

4047/4; '.... signals need not necessarily be coupled ...'

4047/8; rephrase '....and via AAIW in the "oceanic tunnel" in the case of that in the subsurface (Chen ' [AAIW not 'preformed].

4047/14; synchronously

4047/16; confirms not corroborates.

4047/28-1; rephrase, '.... Spero and Lea (2002), carrying a pronounced $\delta^{13}\text{C}$ minimum as a large-scale ...' [it doesn't carry an event].

4048/3-4; rephrase, '...because the $\delta^{13}\text{C}$ datasets of NIOP905 and GeoB12615-4 anticorrelate during the specific time interval of H1 and YD.

4048/5; '....within the Intermediate Water layer was found ...' Stockwork is an English word but is not the same as German 'Stokwerk'

4048/7; make a sentence, '...of seawater. Two recent ...'

4048/18; delete 'respectively'

4048/19; '... associated with ...' [NEVER 'to']

4048/20; '... contains no evidence of anomalously high ...'

4048/29; '.. unaffected by the ...'

4049/3; '...the mid-depth ...'

4049/25; '...isotope ratios ...'

4050/8; spell out 'early Holocene'

4050/9; '.... precede it.'

References

Remove caps from 4051/9, Bryan.
Remove Ninneman et al abstract (4054/8);
otherwise these are very clean.