Dear Cristoph,

Thank you for sourcing two helpful reviews by Jake Gebbie and Jean Lynch-Steiglitz. We have also received helpful comments offline by Greg Johnson and other colleagues.

Both reviewers appreciate the revisiting of this fundamental problem about the filling of the deep ocean, and seem supportive of publication.

Jean Lynch-Steiglitz in RC2 provides a nice summary of the contribution of our manuscript and has no requests for edits, though supports the value of the comments of RC1 by Jake Gebbie.

Jake Gebbie in RC2 has several suggestions for edits, which we plan to address as discussed below.

Definition of formation/contribution (RC1, C2)
We will make the distinction between tracer flux and seawater flux more explicit from the start. This is a point we elaborate on towards the end of the paper, but will also highlight near the beginning.

16 Sv of NADW vs 45 Sv of Southern Water
We motivated discussion near the start of the paper by suggesting that if 16 Sv of NADW form, and this only accounts for 25% of the water filling the deep Indo-Pacific, then the flux of Southern-sourced water is an unfeasibly large 45 Sv. However Jake points out that not all of the 16 Sv of NADW necessarily leaves the Atlantic basin to join the Indo-Pacific. The 16 Sv is typically thought of as the strength of the mid-depth overturning cell within the Atlantic, but some of this water flux may be lost to vertical mixing (and CDW and AABW formation) before making it into the Indo-Pacific.
Greg Johnson made a related point, stressing that volume and volume flux may not be equivalent: if the residence time of AABW is longer than that of NADW (as it occupies deeper volumes), then the production rates could be similar but the volume of AABW could be larger. Jake points out that if the residence time of AABW is 1.7 larger than NADW, then the formation rates could be equal and the volume ratio could be 75:25. Jake suggests using 14C to try and test this.
To address these comments we will remove figure 6 showing relative proportions directly translated to formation rates, and give a more nuanced discussion of these points in the paragraph where we mention formation rates.

The ventilated shelf water end-member in the Southern Ocean
Jake suggests we compare our results with ventilated shelf water (the 1.95 PO4* end member) to the equivalent exercise by Johnson (2008). In the case of Johnson, the Weddell Shelf Water exercise reduces the Antarctic contribution to the global ocean and also means that 2 end-member decomposition is less effective, because, Jake argues, the WSW is “too specific”, so captures less of a range of AABW contributors.
We will investigate this point and elaborate on it. It is possible that some of the discrepancy here is based on the choice of the T-S properties used for WSW by

Johnson, which vary widely in these regions, making end-member selection tricky (see cross plots in figure 9). Choice of a specific T-S pair may exclude other similar shelf water contributors due to the large range of possible values. The tighter range of PO4* end member values – even in the Southern Ocean – may make it a more helpful tracer in this regard.
We will discuss this important point in the revised manuscript, and also carry out the decomposition exercise suggested by Jake (R1, C5).

We will correct the specific comment about the size of the grid boxes used by Gebbie and Huybers (2010).

Finally, it was suggested by some colleagues that we elaborate on some of the features in the cross plots in the section on large scale features of the overturning circulation, and the link between PO4* (or preformed phosphate) and biological pump efficiency and CO_2 to add further interest to the conclusions.

Best wishes,

James Rae and Wally Broecker