

Interactive comment on “What Fraction of the Pacific and Indian Oceans’ Deep Water is formed in the North Atlantic?” by James W. B. Rae and Wally Broecker

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This paper is contributed by James Rae and Wally Broecker as part of a tribute to Ernst Meier-Reimer. Broecker and Meier-Reimer had a fruitful collaboration which led to insight on the basic workings of the oceanic carbon cycle. I enjoyed watching the two interact back in the early 1990’s as a student, and we all learned from their unique approaches to the problem.

The authors of this paper revisit an analysis of deep water masses that Broecker first proposed during that era, using a conservative tracer that combined PO₄ and oxygen to examine the relative contributions of NADW and AABW to deep waters in the Pacific.

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The updated and more complete data sets largely conform to the view put forward in 1998. But in the new analysis they are able to show explicitly the high PO₄* of the shelf water and follow its descent into the deep sea. This was defined as a hypothetical end member in the older, more limited data sets.

Despite the consistency of this work with the 1998 paper, other analyses using different approaches have come up with different fractional contributions of NADW and AABW. But as, the authors note, “At the heart of this discussion lies the issue of what ‘counts’ as ventilated Southern water”, and also what specific depths and regions are being considered. What “counts”, of course, depends on what specific question one would like to use these numbers to answer. Is it about carbon equilibration and controls on atmospheric CO₂? Oxygen saturation? Resetting the radiocarbon clock? Transformation of water from one density class to the next? The authors of this short piece acknowledge this ambiguity in the discussion and conclusion, suggesting that the different end members may be appropriate for different problems. Reviewer Jake Gebbie provides good insight into additional reasons for the different outcomes of the different approaches.

I find value in the new plots using the more complete data sets, and feel the work is a fitting tribute to the lasting impact of the approaches pioneered by Meier-Reimer, Broecker, and others who made foundational contributions to our understanding of the oceanic carbon cycle.

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