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Circulation in the modern and glacial Pacific: oxygen isotope and model constraints

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Changes in the circulation of the Pacific are thought to be central to the regulation of atmospheric CO_2 on glacial/inter-glacial timescales. However, two contrasting views exist for the Pacific modern circulation; the classical view with Pacific Deep Water upwelling to the mid-depths (Talley, 2013), and the bathymetrically constrained view which sees the mid-depths largely isolated from the global overturning circulation (de Lavergne, 2017). Furthermore, despite the potential importance for climate and carbon cycling, past changes in the circulation of the Pacific under differing climate states remain poorly understood. We bring new constraints on the circulation of the modern and Glacial Pacific using oxygen isotopes in seawater and the calcite of benthic foraminifera, both of which act as conservative tracers. The distribution of seawater oxygen isotopes (and other conservative tracers), along with results from dye tracer experiments performed with a realistic ocean general circulation model support lateral diffusion as the key ventilation pathway for the mid depth of the modern Pacific. Our results indicate a reduction in the influence of vertical mixing relative to lateral diffusion in the mid-depths during the LGM, which we interpret as a reduction in vertical mixing in the deep Glacial Pacific which would have contributed to increased oceanic carbon storage. Our results also indicate enhanced Glacial overturning in the intermediate depths from an expansion of North Pacific Intermediate Water (NPIW), providing a further mechanism to lower atmospheric CO_2 (Rae, 2020).

References:

Lynne D. Talley. Closure of the global overturning circulation through the Indian, Pacific and Southern Oceans: schematics and transports. *Oceanography* **26,** 80-97 (2013). DOI: 10.5670/oceanog.2013.07

de Lavergne, C., Madec, G., Roquet, F. *et al.* Abyssal ocean overturning shaped by seafloor distribution. *Nature* **551,** 181–186 (2017). https://doi.org/10.1038/nature24472

W. B. Rae, W. R. Gray *et al.* Overturning circulation, nutrient limitation, and warming in the Glacial North Pacific. *Science Advances* **6** (2020). DOI : 10.1126/sciadv.abd1654