Pacific/Circumpolar and North Atlantic Deep Waters in the Argentine Basin: lateral stirring within the AMOC

2000 character limit:

The South Atlantic meridional overturning circulation (SAMOC) is typically described as the southward transport of North Atlantic Deep Water (NADW) balanced by northwards transport of Antarctic Bottom Water (AABW) and Antarctic Intermediate Water (AAIW)/Upper Circumpolar Deep Water (UCDW). However, these water masses can interleave horizontally and mix throughout the Deep Water density range, which is often overlooked in the zonally-averaged description. In the Argentine Basin warm, salty, high oxygen NADW is modified by colder, fresher, low oxygen Upper Circumpolar Deep Water (UCDW), which is dominated by Pacific Deep Water (PDW); this water enters from Drake Passage and travels northwards, which can be observed using Southern Ocean Carbon and Climate Observation and Modeling (SOCCOM) biogeochemical Argo floats.

Between 2018 and 2020, 3 SOCCOM BGC floats in the Northern Argentine Basin have recorded anomalously low oxygen levels in the deep water density range (σ_2=36.65 to 36.9). These anomalies were on average 13.59 micromol/kg of dissolved oxygen lower, 1.87 degrees celsius colder, and 0.34 psu fresher than the previous and subsequent profiles. The uniqueness of these profiles and the strength of the eddy field on the 36.8 isopycnal (found through examination of temperature anomalies from the 1 degree mean on that isopycnal) indicates that a deep eddy field is responsible for injecting relatively unaltered UCDW north of the Argentine Basin. Argo trajectory analysis (at 1000 m) and isopycnal analysis suggests that the source of these waters is mostly Drake Passage, hence the most likely source region is the southeast Pacific. Mean circulation analyses (e.g. Reid, Progress in Oceanography 1994; Stramma and England, JGRO 1999) suggest a circuitous anticyclonic route for UCDW to the northern Argentine Basin. The trajectories of an additional BGC Argo dataset from Drucker and Riser, 2017, suggests that there is a small cyclonic circulation pattern created by the topography around the Zapiola Rise. Therefore, the complete path of this relatively unmixed UCDW is a northern anticyclonic route into the Argentine Basin, feeding into the cyclonic pattern of the Zapiola Rise, and sometimes resulting in an eddy-driven northern injection.

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