



Two modes of Weddell Sea Bottom Water Production: continental margin gravity currents and open ocean convection, which wins and when?

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There are 2 processes by which Southern Ocean surface waters may reach into the deep ocean: gravity currents over the continental slope and convection within the open ocean. In February 1977 the *Islas Orcadas* found clear evidence of the latter process, when it observed the remnants of a convective 'chimney' near Maud Rise, in the Weddell Sea. This observation was key in linking deep ocean convective processes to the "Great Weddell Polynya", a 250,000-km² area virtually free of sea ice during the winters of 1974–1976. Further research from AWI research vessel *Polarstern* revealed the vulnerability of central Weddell gyre, particularly in the Maud Rise region, to breakdown of water column stability. Climate forcing related to prolonged period of negative or neutral Southern Annular Mode, as was the situation before the "Great Weddell Polynya", acts to reduce freshwater input to the Weddell Sea and thus serves as a trigger for open ocean convection and Polynya development. Similar condition may be occurred during the 1912 *Deutschland* expedition into the Weddell Sea. We speculate that during glacial times, with sea level 130 m lower and the glacial ice extended to shelf break, with the Southern Annular Mode very much in a prolonged negative mode, open ocean production of Weddell Sea Bottom Water [and perhaps that of the Ross Sea too] was prevalent. The bottom water product during the open ocean convection mode may be expected to be saltier than that produced along the continental margin, which would incorporate glacial melt.