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Changes in the Antarctic Circumpolar Current strength at the Pacific entrance of the northern Drake Passage over the past ∼1.5 million years

Maria H Toyos (1), Frank Lamy (2), and Carina B Lange (3)

(1) Graduate Studies in Oceanography, Department of Oceanography, Faculty of Natural and Oceanographic Sciences, University of Concepción, FONDAP-IDEAL Center, Concepción, Chile (maria.toyos@gmail.com), (2) Marine Geology Section, Alfred-Wegener Institut, Helmholtz-Zentrum für Polar und Meeresforschung, 27570 Bremerhaven, Germany, (3) Department of Oceanography, COPAS Sur-Austral and FONDAP-IDEAL Centers, University of Concepción, Barrio Universitario S/N, Casilla 160-C, Concepción, Chile

The Antarctic Circumpolar Current (ACC) is the world's largest current system connecting the Atlantic, Pacific and Indian oceans basins. The major geographical constriction for the transport of the ACC is the Drake Passage. Through the Drake Passage, fresh and cold waters return to the Atlantic ("cold water route") affecting the strength of the Atlantic meridional overturning circulation.

Three major oceanographic fronts are seen within the ACC. Their position is not stationary but changes through time at various time scales. In the Drake Passage area, the location of the fronts is crucial. Sediment cores along the northern margin of the Drake Passage have shown that a northward position of the fronts and the southern westerly winds during glacial times resulted in a reduction in the flow of the ACC thus weakening the cold water route through the Drake Passage. However, available proxy data and model simulations provide only little information on the potential role of the Drake Passage region in driving changes in the global ocean circulation beyond the last glacial, i.e. over multiple glacial/interglacial cycles across the Mid Pleistocene Transition (MPT).

The general objective of this work is to reconstruct the intensity of the ACC over the past ∼1.5 myr based on a multi-proxy approach of core PS97/093-2. The core is 16.45 m long and was collected at the Pacific entrance of the Drake Passage area near the Subantarctic Front and within the main flow of the ACC (57° 29.95'S, 70° 16.48'W, 3780 m water depth). As a first step, a preliminary age of 1.5 million years for core PS97/093-2 was estimated based on biostratigraphic markers and the graphical correlation of magnetic susceptibility and density records, and tuning XRF results to nearby cores, ice core records, and the global Lisieki & Raymo benthic foraminifera oxygen isotope stack. The age model will be further improved by oxygen isotope measurements on foraminifera. The mean sortable silt grain size (10–63 μm) of the terrigenous sediment fraction was used as a proxy for estimating changes in ACC current strength through time. These data were combined with records of grain-size sensitive elements (i.e. Zr/Rb), in order to obtain high-resolution records of bottom water circulation changes. Preliminary results on mean sortable silt grain size of the terrigenous sediment fraction and Zr/Rb of XRF scanner point to warm stages being characterized by high current strength and glacials by reduced currents consistent with the available results from the last glacial cycle. The Zr/Rb record shows a significant change in amplitudes at the marine isotope stage (MIS) 12/11 boundary (Mid-Brunhes). Interestingly, the glacial Zr/Rb levels were similar through time whereas current strength during interglacials was substantially reduced before MIS 11, suggesting an important change in current dynamics.