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Reconstructing Weddell Sea current variability since the LGM: insights from authigenic and detrital radioisotope analyses of marine sediments.

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Water-mass transformation in the Weddell Sea is responsible for the generation of 50-70% of Antarctic Bottom Water exported to the global deep ocean, with effects for the deep marine sequestration of atmospheric CO_2. Uncertainties in the dynamics of this system urgently need to be addressed to assist with modelling the carbon cycle in the southern high latitudes, and identifying whether the Weddell Sea and the Southern Ocean may act as either a carbon source or sink as the global climate shifts.

In this study, we used sequential acid-reductive leaching and total digestion to obtain neodymium (Nd), lead (Pb), and uranium (U) concentrations and isotopic compositions from both the authigenic and the detrital fractions of sediments from a suite of long-cores and surface sediments around the Weddell Sea. Paired isotope analyses were carried out to reconstruct bottom water conditions during deposition, and determine the sedimentary provenance of lithogenic detritus. The combination allows us to observe the relationship between lithogenic and authigenic phases. Authigenic Nd and Pb isotope signatures were interpreted to reflect pore-water compositions, affected by a combination of bottom-water composition, lithology, and element release from sediments into the pore-water and overlying water column. We further assess whether authigenic U may serve as a proxy for bottom-water oxygenation and ocean productivity at our Southern Scotia Sea sites, giving insight to deep-ocean ventilation and bottom-water export rates from the Weddell Sea.

Our results suggest that detrital isotopic records indicate an increase in sediment delivery from the East Antarctic to the northwestern Weddell Sea during the deglacial. We hypothesize that this was the result of a strengthening in the Weddell Gyre or Antarctic Circumpolar Current at this time. Here, we present an updated dataset of new authigenic and detrital measurements from the Weddell Sea investigating this hypothesis, and we unveil new details of the dynamic nature of Weddell Sea circulation and ice-ocean interactions over the last 30 kyr.