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Controls on Weddell Sea water mass Nd isotope signatures and their export to the subantarctic Southern Ocean

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The Weddell Sea in the Antarctic zone of the Southern Ocean is an excellent region to evaluate the importance of neodymium (Nd) boundary fluxes in a high-latitude setting, the capability of Nd isotopes to resolve water mass mixing relationships, and to trace the generation and export of the Weddell Sea-sourced Antarctic Bottom Water Nd isotope signature. Three major water mass domains can be distinguished in the Weddell Sea: the Antarctic Slope Current interacts with the Weddell Gyre further north, which in turn occupies large portions of the Weddell Sea. The precursors of Weddell Sea Bottom Water dominantly form on the Antarctic continental shelf in front of the Filchner, Ronne and Larsen ice shelfs before their descent into the abyssal Weddell Sea. Weddell Sea Deep Water is finally exported into the subantarctic Southern Ocean further north at an approximate rate of 7 Sv.

The Nd isotopic composition of individual water masses is largely controlled by the average continental input signature. Hence from a Nd isotopic perspective the Weddell Sea is an attractive location for water mass tracing since the East Antarctic craton is substantially older than West Antarctic crustal sequences bordering the Weddell Sea. Besides this geological diversity, sediments supplied into the Weddell Sea were largely only sub-glacially weathered prior to its transfer to Weddell Sea shelf sites. These predominantly fine-grained glacially eroded sediments commonly have high surface-to-volume ratios and reactive mineral surfaces that usually lead to elevated REE release at the seafloor, thereby potentially altering the ambient bottom water Nd concentration and isotope signal.

We present Nd isotope compositions from most major water masses in the southern and northern Weddell Sea that were sampled during two seawater sampling campaigns on board RV Polarstern (PS111 and PS118). These also include several mud water samples taken directly at the seafloor at various shelf and deep ocean sites. Together with Nd, Sm and Zr concentration data we are able to identify the presence (or lack) of Nd boundary fluxes across the sediment-bottom water interface, (non-)conservative mixing relationships, estimates on regional trace metal scavenging and a refined Weddell Sea Deep Water