

Stable isotope insights into seawater mixing and fractionation beneath Antarctic ice shelves

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Understanding the interactions between ice and seawater is essential for assessing the stability of Antarctic ice shelves. This study explores the isotopic composition of seawater in Terra Nova Bay, Antarctica, with a focus on isotopic fractionation processes occurring beneath the ice shelf. Seawater samples collected during multiple Antarctic summer research expeditions were analyzed for their thermohaline and isotopic characteristics. Based on the Temperature-Salinity diagram, distinct water masses were identified including High Salinity Shelf Water (HSSW), Ice Shelf Water (ISW), and Antarctic Surface Water (AASW). The $\delta^{18}\text{O}$ -salinity relationship was used to trace water mass transformations, revealing that ISW formation is primarily influenced by mixing with glacial meltwater. Isotopic fractionation modeling further indicated that equilibrium interactions with ice shelves play a key role in modifying the water mass composition. These findings demonstrate the utility of stable isotopes as tracers for water mass evolution and sub-ice shelf processes in polar regions.