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Biomarker analysis of a snow core from Patriot Hills, Antarctica provides evidence for twentieth-century deep convection activity and ocean-climate interactions in the Weddell Sea Embayment

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The Weddell Sea Embayment (WSE) drains some 20% of the ice-mass of continental Antarctica, including sectors of the East and West Antarctic ice sheets and the Antarctic Peninsula, and plays a major role in the global ocean-climate system. Unfortunately, the WSE suffers from a relative dearth of records, limiting our understanding of multi-decadal to centennial changes in the region. Here we explore the potential of biomarkers for understanding ocean-climate dynamics over the past century using a snow/ice core from Patriot Hills, located in the Ellsworth Mountains in the southern part of the WSE (Turney et al., 2013; Winter et al., 2016; Fogwill et al., 2017). The analysis consisted of a novel approach to reconstructing past variability, using a combination of fluorescence spectroscopy and liquid chromatography to resolve organic signals contained within the ice. The parallel components analysis (PARAFAC) using fluorescence spectroscopy identifies both tryptophan-like and tyrosine-like signals. Both tryptophan and tyrosine are crucial for photosynthesis in marine bacteria and algae (Parlanti et al., 2009), demonstrating the potential for reconstructing off-shore changes in coastal ice sequences. Contemporary levels are highly variable. Parallel analysis of dissolved organic matter within contemporary samples helps identify past deep convection events within the WSE. In combination with climate reanalysis, we interpret past changes in ocean-climate interactions across the WSE. This finely resolved contemporary analysis provides the first record of 20th century polynya events within the Weddell Sea that predate the current observational record, and contributes important baseline data for the interpretation of longer (multi-millennial) blue-ice area (BIA) records in the region.