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Drivers of Dense Shelf water formation in East Antarctic polynyas

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Coastal polynyas are key regions of Dense Shelf Water (DSW) formation that ultimately contributes to the ventilation of the ocean abyss. However, not all polynyas form DSW. In this study, we analyse the main drivers of DSW formation in four East Antarctic polynyas: Mackenzie, Barrier, Shackleton and Vincennes Bay from west to east. Mackenzie and Barrier (in lesser extent) were the only two polynyas where DSW formation was observed while it is absent in Shackleton and Vincennes Bay in the particular years when they were best sampled. We analysed the role of Bathymetry, water-mass distribution and transformation, stratification of the water column, sea-ice production rate and associated salt advection. We found that sea ice production was highest in Mackenzie, particularly in early winter, which likely contributed to reach higher salinity than the other polynyas at the beginning of the sea ice formation season. From April to September, the total salinity change in Mackenzie polynya was lower than in the other polynyas, and the strong contribution of the brine rejection was partly offset by freshwater advection. Overall, the preconditioning in early winter in Mackenzie polynya, likely due to strong SIP in February and March was the main driver determining DSW formation in Mackenzie in contrast with the other East Antarctic polynyas.