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Assessing the Role of Oceanic Forcing in West Antarctic Ice Sheet Retreat since the Last Glacial Maximum

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The West Antarctic Ice Sheet (WAIS) is one of the largest potential sources of future sea-level rise. For the last 40 years glaciers flowing into the Amundsen Sea have thinned at an accelerating rate resulting in greater destabilisation of the WAIS. These changes may be driven by warming in the Amundsen Sea, however, data extending beyond the last few decades is lacking largely due to difficulties in recovering and calibrating temperature proxies in polar waters. Using a suite of marine sediment cores from the continental shelf of the Amundsen Sea, we examine the links between ice sheet retreat and ocean properties through the last deglaciation and Holocene. We combine analysis of the long cores ($\sim$6m) recovered from Sites VC424 (1073 m water depth) and PS69/274 (1452 m water depth) with a series of shorter box cores (<1m from BC409 at 787 m water depth, BC423 at 1073 m water depth, BC431 at 512 m water depth).

Down-core biomarker characterisations, element geochemistry, and physical properties are used to identify changes in sea ice, phytoplankton productivity and terrestrial (ice sheet) inputs. We also reconstruct upper ocean (0-200 m) temperatures using the distributions of the Glycerol Dialkyl Glycerol Tetraethers (GDGTs), described by the TEX86L index. Our new data record high variability on centennial-millennial timescales in ocean temperatures and primary productivity during and immediately following deglaciation, from c. 13 kyr. The Holocene is characterised by warmer and less variable ocean temperatures, and evidence for broadly lower and less variable productivity. We evaluate whether the long-term trends in ocean temperature and productivity through the Holocene can be attributed to the presence of warm Circumpolar Deep Water (CDW) on the continental shelf, and assess the potential of CDW to impact ice sheet advance/retreat. In turn, the climate teleconnections that might drive CDW influence in the Amundsen Sea are considered, which include both the westerly winds over the Southern Ocean, and more remote connections to tropical Pacific forcing.