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Ice shelf history inferred from sub-ice shelf sediment cores

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Sediment cores recovered after the break-up of the Larsen-B Ice Shelf show that it had been stable throughout the Holocene (past 11,500 years). This result led to the suggestion that recent ice shelf retreat on the Antarctic Peninsula (AP) was unprecedented, on Holocene timescales, and that we have entered a period of unparalleled climatic change. However, this is not a feature common to other AP ice shelves so far studied. There is evidence that ice shelves on the west (George VI Ice Shelf (GVI-IS)) and northeast of the AP (e.g., Larsen-A/Prince Gustav Ice Shelves) have behaved differently. For example, retreat of the Prince Gustav Channel Ice Shelf during the mid-Holocene (c. 5000-2000 years BP) has been attributed to a well-documented period of atmospheric warming whilst work on GVI-IS demonstrated that ice shelf retreat immediately followed a period of early Holocene warmth detected in ice cores as well as a rapid influx of warmer surface waters over the AP continental shelf.

These studies indicate that both atmospheric and oceanic warming are key features of previous retreats of different AP ice shelves during the Holocene, they also highlight an emerging geographical pattern in the history of ice shelf collapse. On the east side of the AP the Larsen B Ice Shelf has been stable throughout the Holocene, whilst ice shelves studied further north (Larsen A Ice Shelf and Prince Gustav Channel Ice Shelf) and on the west of the AP (GVI-IS) have broken up before in the Holocene. It has been suggested that ice shelves on the west coast are pre-disposed to melting (thinning) by warm Circumpolar Deep Water, which is largely absent from such shallow depths in the Weddell gyre. Alternatively, ice shelf thickness has been proposed as a key factor in ice shelf collapse (simply, thicker ice shelves are more stable) and may explain the long-term stability of the Larsen B Ice Shelf which is thought to have remained relatively thick following deglaciation of the ice sheet after the LGM.

Here we present a new dataset of sub-ice shelf sediment samples collected during the 2011/12 field season from two sites on the Larsen C Ice Shelf, one in the south and one in the north and one site on southern GVI-IS. Sediments were recovered using a simple hammer assisted gravity corer, which proved to be enormously effective and simple to deploy. In total, 11.60m of sediment was recovered with a maximum penetration of 2.90m. Our new sedimentological datasets will offer a long-term perspective on the Larsen-C Shelf (thinning/evidence for past retreat) and provide new insight into the controls and spatial pattern of past ice shelf retreats on the AP.