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Holocene dynamics of Thwaites Glacier (West Antarctica): New insights from offshore provenance records

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Thwaites Glacier in the Amundsen Sea sector of the marine-based West Antarctic Ice Sheet is losing mass at an accelerating rate, with its landward dipping bed making the glacier prone to rapid and irreversible ice loss in the near future. Analysis of the provenance of marine sediment records recovered offshore from the modern ice margin can provide insights how glaciers draining into the Amundsen Sea behaved in the past and how they will behave in a warming world.

Measurements of radiogenic isotopes on the fine-grained fraction of seafloor surface sediments from the Amundsen Sea continental shelf have previously revealed that detritus eroded under and supplied by Thwaites Glacier has distinct Nd and Sr signatures that differ from those of glaciogenic debris delivered by neighbouring Pine Island Glacier. This allows us to trace the relative supply of detritus from each glacier to the offshore sites through time and relate its variability to changes in glacier extent. Here we present new geochemical and paleomagnetic data from three Holocene sediment records collected on behalf of the Thwaites Glacier Offshore Research (THOR) project in 2019 and 2020. We investigate (i) whether there have been provenance changes in the sediments over the past 10,000 years, and (ii) how we can utilize these changes for reconstructing past glacier dynamics.

The new paleomagnetic secular variation measurements on U-channels are providing independent stratigraphic constraints enabling more effective use of prior radiocarbon dates to improve both chronological accuracy and uncertainty. In addition, analysis of major and trace elements on the cores and CT scanning of the sedimentary sequences enabled core-to-core correlations. Applying these new age models, we have identified periods of major isotopic shifts in the sediment records during the Holocene, which are likely to indicate past phases of glacier retreat and readvance.