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Did the Ronne Ice Shelf and West Antarctic Ice Sheet retreat in the last interglacial?

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The largest uncertainty in long-term sea level projections (as shown by the recent IPCC reports) is the fate and stability of the West Antarctic Ice Sheet (WAIS). Models include different physics, and range widely in their predictions. The timescales for ice sheets are long, so observational data from the recent past provide little constraint, and we need to look at the past behaviour of WAIS. The last interglacial (LIG) is particularly relevant because Antarctic temperature was higher than present and some models predict the complete loss of WAIS and of the large adjacent ice shelves adjacent.

Within the WACSWAIN (WArm Climate Stability of the West Antarctic ice sheet in the last INterglacial) project, we drilled (in 2019) a 651 metre ice core to the bed of Skytrain Ice Rise. This ice rise is adjacent to the Ronne Ice Shelf and the WAIS, but is expected to have maintained an independent ice flow because of the protection afforded by the Ellsworth Mountains. The ice core has been processed and analysed continuously for a range of analytes, including water isotopes, methane and major chemistry.

Our analyses show that the core is continuous through the last glacial period, and most of the last interglacial. There are flow disturbances at the base of the core, with the very warmest part of the LIG missing, although older ice lies below it. There is also a small flow disturbance at the top of the LIG. However our analyses, including discrete measurements of CH4 and δ18Oatm, show that the ice is continuous between 106 and 126 ka, allowing us to interpret what happened during the bulk of the LIG.

In the LIG, the record of marine ions in the ice suggest that the Ronne Ice Shelf was present at least from 126 ka onwards. This rules out occurrence of some of the more extreme retreats of WAIS that would have led to seaways between the Weddell, Amundsen and Ross Seas. The ice shelf may have partly retreated later in the LIG but was never absent. We see somewhat higher water isotope ratios in the LIG than the Holocene, possibly consistent with drawdown of WAIS in sectors other than the Weddell region.

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