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Early Last Interglacial ocean warming drove substantial ice mass loss from Antarctica

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The future response of the Antarctic ice sheet to rising temperatures remains highly uncertain. A useful period for assessing the sensitivity of Antarctica to warming is the Last Interglacial (LIG; 129-116 kyr), which experienced warmer polar temperatures and higher global mean sea level (GMSL +6 to 9 m) relative to present day. LIG sea level cannot be fully explained by Greenland Ice Sheet melt (~2 m), ocean thermal expansion and melting mountain glaciers (~1 m), suggesting substantial Antarctic mass loss was initiated by warming of Southern Ocean waters, resulting from a weakening Atlantic Meridional Overturning Circulation in response to North Atlantic surface freshening. Here we report a blue-ice record of ice-sheet and environmental change from the Weddell Sea Embayment at the periphery of the marine-based West Antarctic Ice Sheet (WAIS) which is underlain by major methane hydrate reserves. Constrained by a widespread volcanic horizon and supported by ancient microbial DNA analyses, we provide the first evidence for substantial mass loss across the Weddell Sea Embayment during the Last Interglacial, most likely driven by ocean warming and associated with destabilization of sub-glacial hydrates. Ice-sheet modelling supports this interpretation and suggests that millennial-scale warming of the Southern Ocean could have triggered a multi-meter rise in global sea levels. Our data indicate that Antarctica is highly vulnerable to projected increases in ocean temperatures and may drive ice-climate feedbacks that further amplify warming.

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