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Topic: Ocean-ice-atmosphere interactions

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ABSTRACT Subject :

Organic proxies reveal the Ross ice shelf retreat and sea ice dynamics in the Joides Basin, Ross Sea, Antarctica

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Quaternary glacial terminations are periods of rapid warming during which climate and carbon cycles experience large-scale reorganization. The last glacial termination (ca. 18-11.5 Ka), in particular, is the temporally closest timeframe from which we can gather information regarding processes and feedbacks that lead to such climatic reorganization. Here we present results from the Southern Ocean, a region which during the Last Deglaciation was affected by strong CO2 outgassing in relation to the resumption of the thermohaline circulation and ice shelf retreat. Our study focuses on a series of sedimentary cores collected in the JOIDES trough, Ross Sea. The studied area is characterized by complex ice shelf-ocean dynamics and represents one of the sites of Antarctic Bottom Water (AABW) formation which originates from a mixture of cold Ice Shelf Waters (ISW) and impinging modified Circumpolar Deep water (mCDW) from the outer shelf. Sea ice and open water dynamics, including information on trophic levels and paleo-seawater temperatures, were reconstructed using a suite of organic biomarkers that includes Highly Branched Isoprenoids (e.g. IPSO25 and HBI III), sterols (Brassicasterol and Cholesterol) and Glycerol Dialkyl Glycerol Tetraethers (GDGTs). Biomarker profiles were also compared to bulk organic carbon and stable carbon isotope data (δ13C), as well as sedimentary facies reconstructed from grain-size information, XRF analyses and IRD presence. Our results depict a coherent and rapid transition from a sub-ice shelf environment (during the Last Glacial Maximum, LGM) to a distal ice shelf system, evolving then into an open marine system. At the LGM the central JOIDES through was covered by the paleo-Ross Ice Shelf. Impinging warmer waters at the onset of the deglaciation likely caused the paleo - Ice Shelf to retreat southward, freeing the JOIDES trough from the thick ice cover and allowing pelagic primary productivity. Enhanced upwelling of warm and nutrient-rich waters (presumably paleo mCDW) caused persistent blooming of the open water organisms during the whole deglaciation, stabilizing during the Holocene. Collectively, our datasets illustrate the value of combining environmental organic proxies with sedimentary facies for the reconstruction of rapid changes in glacio-marine environments.