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Phytoplankton assemblages and (bio)geochemical proxies indicate enhanced productivity and sea-ice decline in the Ross Sea during Marine Isotope sub-Stage 5e

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Sea ice is an important component of the Antarctic cryosphere. It plays an important role in climate (e.g. albedo, gas exchange with the atmosphere), ocean circulation and primary productivity. Although sea ice has been increasing on average around Antarctica as a result of current global climate change, long-term model predictions expect sea ice to decline. To better understand the changes in sea-ice cover and its consequences on the oceanography, biology and geochemistry of the Southern Ocean during on-going and near-future warming it is important to study past periods of global warming, such as the Last Interglacial (LIG, ∼125-119 ka), also known as Marine Isotope sub-Stage 5e (MIS5e). During MIS5e global temperatures were on average 2°C warmer than present-day, the same temperature set as maximum global warming limit during the recent Paris Agreement (COP21).
We investigated changes in sea-ice cover and environmental conditions by means of diatom, palynological, foraminifer and (bio)geochemical data in a sediment core (AS05-10) from the continental slope of the Drygalski Basin, Ross Sea (2377 mbsl) encompassing the MIS5e. The core was collected within the frame of the PNRA 2009/A2.01 project, an Italian project with a multidisciplinary approach, and covers approximately the last 350 kyr according to an age model based on diatom bioevents and cyclostratigraphy. The productivity proxies, e.g., excess barium, magnetic susceptibility and diatom abundances show a strong relation to the glacial-interglacial cycles. The rapid deglaciations preceding MIS5e and MIS7e are characterized by Ice Rafted Debris and the presence of reworked material. Subsequently, each interglacial is characterized by enhanced productivity related to a decrease in annual sea-ice cover. The beginning of each interglacial is also marked by changes in the fossil assemblages and organic geochemical proxies indicative of high nutrient conditions and water column stratification due to fresh water discharge. Annual sea-ice cover was most reduced during MIS5e. Diatoms indicate that surface water conditions were much more open during MIS5e than during the other marine isotope stages. Furthermore, there was a brief period of reduced bottom water oxygenation during MIS5e, which has led to enhanced preservation of fossil organic material in the sediments. Possibly, this is caused by a reduced influence of oxygen-rich High Salinity Shelf Water due to freshening of the shelf waters.