An unusual early Holocene diatom event north of the Getz Ice Shelf (Amundsen Sea): Implications for West Antarctic Ice Sheet development

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Abstract

Modern global change affects not only the polar north but also, and to increasing extent, the southern high latitudes, especially the Antarctic regions covered by the West Antarctic Ice Sheet (WAIS). Consequently, knowledge of the mechanisms controlling past WAIS dynamics and WAIS behaviour at the last deglaciation is critical to predict its development in a future warming world. Geological and paleobiological information from major drainage areas of the WAIS, like the Amundsen Sea Embayment, shed light on the history of the WAIS glaciers. Sediment records obtained from a deep inner shelf basin north of the Getz Ice Shelf document a deglacial warming in three phases. Above a glacial diamicton and a sediment package barren of microfossils that document sediment deposition by grounded ice and below an ice shelf or perennial sea ice cover (possibly fast ice), respectively, a sediment section with diatom assemblages dominated by sea ice taxa indicates ice shelf retreat and seasonal ice-free conditions. This conclusion is supported by diatom-based summer temperature reconstructions. The early retreat was followed by a phase, when exceptional diatom ooze was deposited between 12,000 and 13,000 cal. years B.P. Microscopical inspection of this ooze revealed excellent preservation of diatom frustules of the species *Corethron pennatum* together with vegetative *Chaetoceros*, thus an assemblage usually not preserved in the sedimentary record. Sediments succeeding this section contain diatom assemblages indicating rather constant Holocene cold water conditions with seasonal sea ice. The deposition of the diatom ooze can be related to changes in hydrographic conditions including strong advection of nutrients. However, sediment focussing in the partly steep inner shelf basins cannot be excluded as a factor enhancing the thickness of the ooze deposits. It is not only the presence of the diatom ooze but also the exceptional preservation and the species composition of the diatom assemblage, which point to specific scenarios involving e.g. changes in the food web that can be related to warmer surface water temperatures. Such warming of shelf waters may be related with an overshooting Atlantic Meridional Overturning Circulation (AMOC) and strong injection of warmer North Atlantic Deep Water into the Southern Ocean water masses at Termination I. Such finding may highlight the effects of AMOC changes on Antarctic ice shelf extent and coastal ecosystems.

Keywords: WAIS, Amundsen Sea Embayment, diatoms, deglacial warming