Sea ice and diatom productivity in the Ross Sea, Antarctica: the response to post-glacial warming

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Abstract

The Holocene is characterised by millennial-scale climate fluctuations superimposed on an orbitally-paced warming trend. Spatial heterogeneity in these fluctuations appears to result from local variations in climate and oceanography associated with deglaciation. While timing of ice-retreat within the Ross Sea has been regionally constrained (Jones et al., 2015; McKay et al., 2016), there are fewer constraints on oceanographic and climatic conditions during Holocene warming, and the subsequent impacts on sea-ice extent and primary productivity.

We present a new multi-site reconstruction of deglacial ice-retreat timing and Holocene sea-ice extent and primary production from four Holocene marine sedimentary records. These cores were collected from the southwestern Ross Sea during the 2015 *Araon* Cruise ANA05B, and are located offshore of Mawson Glacier (GC78), Granite Harbour (GC80), north and northeast of Ross Island (GC72 and GC71 respectively). Cores are up to 4.5 m long and contain basal ice-associated facies overlain by diatom ooze. Core-to-core correlation is achieved through ramped pyrolysis ^{14}C chronology, reservoir-corrected using ^{210}Pb dating (Rosenheim, 2013). It is a unique chronological approach to this region, whereby local reservoir ages have been generated. Comparison to published records from onshore and offshore indicates a complex pattern of ice-shelf retreat in this region, and helps refine the history of Holocene variability in the SW Ross Sea.

To reconstruct the post-glacial environment, we utilize geochemical proxies for gross diatom abundance, nutrient utilization and water stratification (wt.% BSi, $\delta^{13}C$, $\delta^{15}N$), and diatom assemblages for sea-ice extent. Of particular interest is a $\delta^{13}C$ excursion (~-30‰) seen in GC72, GC78 and GC80 at 65, 95 and 104 cmbsf respectively. This excursion corresponds to a high abundance of *Corethron* spp. and/or *Chaetoceros* spp. that reflects a transient change in oceanography and sea ice dynamics. Similar monospecific *Corethron* spp. layers have been observed in several regions around the Antarctic continent that reflect a transient environment controlled by unusually warm conditions (Leventer et al., 1993; Taylor and McMinn, 2001; Maddison et al., 2011).

Keywords: paleoclimate, diatom micropaleontology, isotope geochemistry, radiocarbon

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