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Further paleobiological evidence for enhanced productivity and less ventilated bottom water in the glacial Southern Ocean

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The Southern Ocean has the potential to regulate climate via changes in its productivity and circulation regimes. We therefore investigated the glacial/interglacial variability of bioproductivity in the upper water column and bottom water ventilation in the Subantarctic and Antarctic zones at two sediment core locations, covering the last 150,000 years, in the eastern Atlantic sector of the Southern Ocean. We used a combined approach, and integrated information derived from two major plankton groups, diatoms and organic-walled cysts of dinoflagellates (dinocysts):

- The diatom group *Chaetoceros* reflects high-carbon/low silica export regimes, the abundance of *Fragilariopsis kerguelensis* frustules indicates low-carbon/high-silica regimes (Abelmann et al., 2006). Changes in relative abundance of these two types of diatoms in the sedimentary record reflect past changes/shifts in productivity regimes.

- The cyst-forming dinoflagellate genus *Protoperidinium*, the only heterotrophic dinoflagellate to be found as fossil cysts in the study area, feeds predominantly on diatoms such as *Chaetoceros* (Jacobson and Anderson, 1986), and thus high accumulation rates of *Protoperidinium* cysts in the sediment might reflect high *Chaetoceros* production.

- Protoperidinioid cysts are highly sensitive to pore water oxygen concentrations in the sediments in which they become embedded, and are used as proxies for a low oxygen sedimentation environment (Zonneveld et al, in press).

The direct comparison between *Chaetoceros* and sensitive dinocyst abundance in the

sediment record thus provides information on past primary production and pore water oxygenation, which can be integrated to results derived by other proxies for export productivity (the deep-dwelling radiolarian *Cycladophora davisiana*), pore water oxygen (authigenic Uranium) and bottom current velocity (percentage of sortable silt).

Our study provides an excellent opportunity to assess the causal relationship between upper-ocean regimes (temperature, nutrient gradients, sea-ice extent) and changes in bottom water formation, and suggests higher glacial productivity in both the Subantarctic and Antarctic zones synchronously to the production of less ventilated bottom water.

References: Abelmann, A., Gersonde, R., Cortese, G., Kuhn, G. and Smetacek, V., 2006. Paleoceanography 21, PA1013, doi: 10.1029/2005PA001199; Jacobson D. and Anderson, D.M., 1986. Journal of Phycology 22, 249-258; Zonneveld, K.A.F., Bockelmann, F. and Holzwarth, U., in press. Marine Geology.