CONTROLS ON THE OCEANIC CO_2 SINK NEAR THE CROZET PLATEAU IN THE SOUTHERN INDIAN OCEAN (1991-2005)

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ABSTRACT

The CROZEX cruises (November 2004 to January 2005) had the objective to test whether natural iron fertilisation from the Crozet plateau promotes algal blooms. Results from the cruises show that algal blooms created an oceanic CO_2 sink downstream of the Crozet plateau. Vertical advection of water into the mixed layer occurred close to two islands on the plateau. Data from 18 cruises between 1991 and 2002 are used to quantify the seasonal variability of surface pCO_2 and CO_2 air-sea exchange in the region.

AN OCEANIC CO_2 SINK DOWNSTREAM OF THE CROZET PLATEAU

A better understanding of the processes controlling the oceanic CO_2 sink in the Southern Ocean is a priority in international carbon research. Large phytoplankton blooms occur in austral spring and summer downstream of the Crozet Plateau, a volcanic plateau between the Subantarctic Front and the Polar Front in the southern Indian Ocean (~45-47°S 49-53°E). The CROZEX cruises (November 2004 to January 2005) had the objective to test whether natural iron fertilisation from shallow topography of the Crozet plateau promotes these algal blooms.

Results from the CROZEX cruises show that algal blooms reduced the partial pressure of CO_2 (pCO_2) in surface water by 20-80 µatm and created a major oceanic CO_2 sink downstream of the Crozet plateau. The blooms increased the oxygen saturation by 10%. Upstream of the plateau surface water pCO_2 decreased by 20 µatm over a 42 day period, despite warming of the surface water by 1°C, making the waters a small sink for atmospheric CO_2. Evidence of vertical advection of water into the mixed layer was found close to the two easternmost islands on the plateau. The upward transport of water increased surface pCO_2 by at least 15 µatm, decreased sea surface temperature by 0.7°C and reduced oxygen saturation by 5%. This vertical transport of water might introduce silicate and micronutrients into the surface waters, making them available for phytoplankton growth.

SEASONAL AND INTERANNUAL VARIATION

Data from 18 earlier cruises (Minerve, OISO, OP98/5, Antares 4) between 1991 and 2002 are used to quantify the seasonal and possible interannual variability of surface pCO_2 and CO_2 air-sea exchange in the region. The data notably demonstrate low summer-time surface pCO_2 downstream of the plateau, probably the result of algal blooms. About half of the cruises, including 4 autumn and winter cruises,

show elevated surface pCO_2 close to the easternmost islands on the plateau, possible evidence of upward transport of water into the mixed layer.

The unique CO_2 data set will allow a thorough study of the processes controlling the oceanic CO_2 sink in the highly dynamic Crozet region.

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