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Ocean-Atmosphere CO_2 Exchange in Southern Ocean During the Last Deglaciation

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Southern Ocean is a location of extensive ocean-atmosphere CO_2 exchange. High-resolution records of sea-surface and deep sea pCO_2 from the last glacial-interglacial termination are needed to elucidate the timing, locations, and magnitude of the pCO_2 degassing from the Southern Ocean. However, the quantification of Southern Ocean CO_2 uptake and degassing in controlling glacial-interglacial atmospheric pCO_2 concentration remains enigmatic due to a lack of proxy data. In comparison, other oceanic basins like the Atlantic and Pacific have been thoroughly studied. We present new evidence of substantial CO_2 degassing during the last termination (T1) from the Indian sector of Southern Ocean. Our high-resolution surface-ocean pCO_2 record is constructed from a meter-long gravity core, collected from a depth of ~3000m on the continental slope of Kerguelen Island (45°00.15' S & 72°00.26' E), in the Indian sector of the Southern Ocean during the Southern Ocean Expedition 11.

We utilized boron isotope ratio of chemically cleaned foraminifera samples from the Southern Ocean (45ºS) to reconstruct surface ocean pH and pCO_2. This record will play a key role in re-budgeting the role of Southern Ocean in modulating the carbon flux to/from the ocean to the atmosphere during Termination-1. A combination of radiocarbon dates (n=10) and $d^{18}O$ (n=100) data were utilized for chrono stratigraphy. The abundance of upwelling species like *G.bulloides* and *G.inflata*, and the absence of any benthic foraminifera is indicative of strong upwelling. An inversion of radiocarbon age at ~40cm depth implies possible intensification of upwelling. This is supported by a shift in Mg/Ca based temperature of the deep thermocline dwelling species *G.inflata* to lower values at the same depth. Whereas the shallow thermocline species does not demonstrate any such shift in T. The pH data obtained from *G. bulloides* and *G. inflata* indicate very low values ranging from 7.2-8.0, corresponding to high pCO_2 levels of 500-1600 ppm. From these values, a CO_2 flux was computed to be 108.70 Gt CO_2 per degree per day, leading to a degassing rate of 39.67 pg of CO_2 per 1000 years was also estimated, which is similar to the current degassing rates seen in the eastern equatorial Pacific.