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230Th-normalized fluxes of biogenic components from the central-southernmost Chilean margin over the past 22,000 years.

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During the last glacial maximum, the atmospheric partial pressure of CO2 ($_pCO_{2atm}$) was quite low, 180-190 ppm and rapidly increased to 280 ppm during the last deglacation (Monnin et al., 2001). The combination of the biogeochemical (e.g. export flux, nutrient utilization) and physical processes (e.g. upwelling, stratification) has been considered to control $_pCO_{2atm}$. Considering the response of $_pCO_{2atm}$ on global climate changes, the polar ocean such as Southern Ocean is one of the most important area linking between atmosphere and ocean, because the deepest water mass can directly connects to the atmosphere and the largest carbon reservoir in the world oceans. During glacial periods, strengthened productivity and an efficient biological pump in the North Pacific, equatorial Pacific, and Southern Oceans may have contributed to low $_pCO_{2atm}$. However, there is still some controversy as to whether marine productivity was high everywhere during glacial periods. Resolving this controversy requires more data from many regions regarding temporal changes in past export fluxes of biogenic materials, especially in the eastern South Pacific Ocean including the Chilean marginal region, where active biological production is observed at present.

The aim of this study was to identify changes in the ^{230}Th-normalized export flux of biogenic components commonly used as proxies for paleoproductivity-namely total organic carbon (TOC), total nitrogen (TN) and biogenic opal (Si_{opal})-from two sediment cores collected at 36 ^{o} S off central-south Chilean covering the past 22 kilo years (kyr) (PC-1) and at 52 ^{o} S near the mouth of Strait of Magellan, Pacific side over the past 13 kyr (PC-3). In 13-8 Calendar kyr before present (cal kyr BP), the ^{230}Th-normalized TOC flux at the PC-1 site were relatively high pointing to increased productivity, and a marked decrease characterized the time around 13 cal kyr BP and 8-5 cal kyr BP. At the PC-3 site, the ^{230}Th-normalized TOC flux was low during the last deglaciation until 6 cal kyr BP. Our ^{230}Th-normalized fluxes suggested that biological pump would not have fully worked throughout 22-14 kyr BP and the early Holocene in the central-south Chilean and 13-6 kyr BP at southern most Patagonia. The entire trend of ^{230}Th-normalized biological components looks a latitudinal symmetrical change at PC-1 and PC-3 during the deglaciation-6 cal kyr BP. This trend in biological pump changes at both sites corresponded to changes on wind direction associated with latitudinal shift of Southern Westerly Winds (SWW) core, which might be affected by insolation, supporting the notion of orbital influence. The indirect connection between biological productivity and insolation might be explained by as a following hypothesis: during 22-15 cal kyr BP (or 13-10 cal kyr BP) at PC-1 site, when austral summer insolation became strong (or weak), it would make zonal wind inhibit (or strengthen) and would enhance the northerly (or southerly) wind associated with equatorward (or poleward) shift of SWW in the central-south Chile, and then the upwelling would have been suppressed (or active) resulting low (or high) productivity there. After 5 cal kyr BP, the ^{230}Th-normalized TOC fluxes at both sites were relatively high and an apparent zonal symmetry disappeared suggesting that the breakdown of zonal symmetry might reflect the onset of permanent El Nino-Southern Oscillation variability.

Monnin, E. et al. (2001) Science, 291, doi: 10.1126/science.291.5501.112.

Keywords: off Chile, Thorium 230, biogenic components, biological pump, Southern Westerly Wind