# The effect of basal melting of the Totten Ice Shelf on marine biogeochemical components in Sabrina Coast, East Antarctica

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To clarify the effect of basal melting of Antarctic ice sheet on the marine biogeochemical components in the coast of the Southern Ocean, dissolved inorganic carbon (DIC), total alkalinity (TA), nutrients ($NO_3^-$, $PO_4^{3-}$, $Si(OH)_4$), oxygen stable isotope ratio ($\delta^{18}O$), chlorophyll *a* were measured off from offshore slope (ice margin area) to Totten Ice Shelf ice front (sea ice area) in Sabrina Coast, East Antarctica during summer 2018 and 2019 conducted by *Kaiyo-maru* and *Shirase* (Figure 1). The distribution of DIC concentration, TA and nutrients concentration was corresponded to the ocean current that mCDW existing on the offshore slope flows under the Totten Ice Shelf along the trough and mixes with Totten Ice Shelf basal melt water to become low density and rise to the surface. DIC concentration and TA on the surface of the ice front were strongly influenced by the dilution effect of the ice shelf basal melt water and the inflow of mCDW. The ratio of ice shelf basal melt water with respect to the other water masses (sea ice water and mCDW) calculated using $\delta^{18}O$ was about 1.2% and the ratio of sea ice melt water was 3.1% and the rest ratio was inflow of mCDW. Because of the dilution effect, DIC concentration decreased about 84 µmol $kg^{-1}$, and this decrease was corresponded to a decrease of about 86 µatm for the partial pressure of carbon dioxide ($pCO_2$) (Figure 2). In other words, mCDW (about 437 µatm), which was supersaturated (source for atmosphere) of $CO_2$ with respect to the atmosphere (about 390 µatm), was changed to the undersaturation (about 350 µatm) (sink for atmosphere) due to the dilution effect of melt water. However, the surface of the ice front was strongly influenced by biological processes. The nDIC and nTA that normalized to salinity (34.3 pus) to remove the dilution effect of melt water were changed along nDIC : nTA = 106 : 16 by the photosynthesis of phytoplankton. Furthermore, the net community production (NCP) from 20 to 100 dbar was higher than that for the previous study [Arroyo et al., 2019] because the open water area was higher and availability of light for phytoplankton during this study observation was greater in our study period than those in previous study. Therefore, the decrease of more than 100 µatm for $pCO_2$ would be resulted by the biological productivity in this study (Figure 2). On the west side of the ice shelf, both the ratio of ice shelf basal melt water and NCP were higher and $pCO_2$ was lower than those of east side of the ice shelf. Therefore, the mCDW mixed with the ice shelf basal melt water floats on the west side of the ice shelf. This study highlighted that ice shelf basal melt water has a significant impact on marine biogeochemical components.

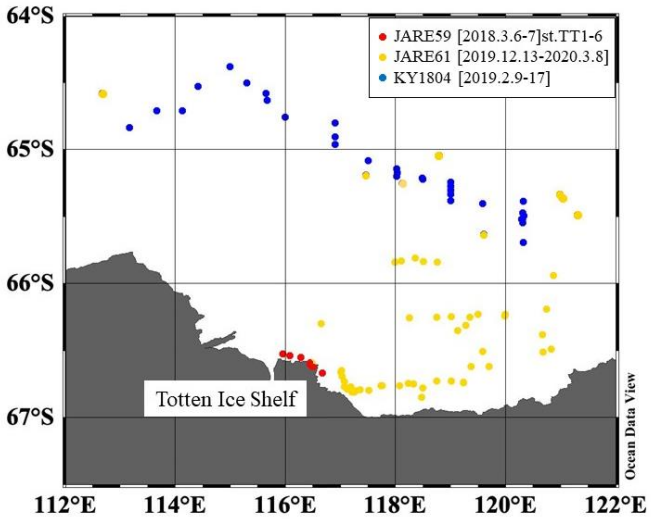


**Fig. 1** Map of the Sabrina Coast. Plots indicate stations where CTD observation and surface water sampling were performed.

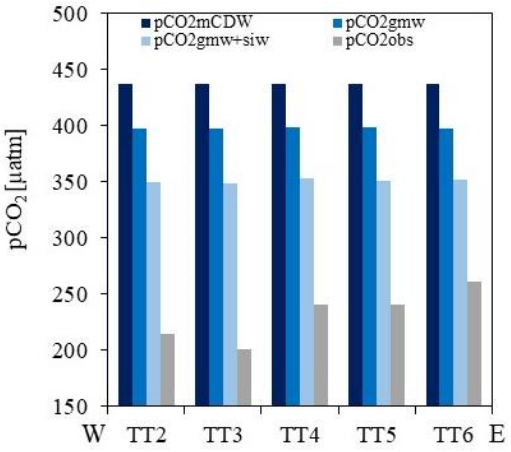


**Fig. 2** Bar chart representing $pCO_2$ calculated using CO2SYS. $pCO_2$mCDW means $pCO_2$ of mCDW. $pCO_2$gmw means $pCO_2$ as a result of mCDW mixing with glacial melt water (ice shelf basal melt water)**.** $pCO_2$gmw+siw means $pCO_2$ as a result of mCDW mixing with glacial melt water and sea ice melt water. $pCO_2$obs means actually observed $pCO_2$.

**References**

Arroyo, M. C., Shadwick E. H., & Tilbrook, B. (2019). Summer Carbonate Chemistry in the Dalton Polynya, East Antarctica, Journal of Geophysical Research: Oceans, 124, 1–20. https://doi.org/ 10.1029/2018JC014882