IV ROSS SEA CONFERENCE 2023

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Topic: Biogeochemistry

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ABSTRACT Subject :

Physical and biological controls on anthropogenic CO2 sink of the Ross Sea

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The Antarctic continental shelf is a significant sink for anthropogenic CO2 (Cant) due to its cold waters, high primary productivity, and unique circulation that allows it to store large amounts of organic and inorganic carbon into the deep ocean. However, climate change is currently altering the Antarctic marine carbon cycle, making predictions of future ocean acidification in polar regions highly uncertain. In this study, we examined the marine carbonate system in the Ross Sea to assess the current anthropogenic carbon content and how physical-biological processes control Cant sequestration along the shelf-slope continuum. We found that winter water masses generated by convective events had high Cant levels (28 µmol kg-1) as a result of mixed layer break-up during the cold season. Old and less ventilated Circumpolar Deep Water entering the Ross Sea revealed little anthropogenic carbon (7 µmol kg-1). Cant concentrations also varied between polynya areas and the shelf break, due to their specific hydrographic characteristics and biological processes. Surface waters of polynyas in the Ross Sea and Terra Nova Bay acted as strong CO2 sinks (up to –185 mmol m-2) due to the remarkable net community production, but much of the particulate organic carbon produced was quickly consumed by intense microbial activity, returning back carbon dioxide into intermediate and deep layers of the continental shelf zone. In addition, High Salinity Shelf Water produced during winter sea ice formation (25 µmol kg-1) added Cant to the dense shelf waters, which was ultimately stored in the abyssal sink through continental slope outflow (19 µmol kg-1). Our results suggest that summer biological activity over the Ross Sea shelf plays a critical role in the transfer of anthropogenic CO2 between organic and inorganic carbon pools, leading significant acidification of the upper mesopelagic zone and contributing to the long-term sequestration of Cant into the deep ocean.