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Source and spatial distributions of particulate organic carbon and its isotope in surface waters of Prydz Bay, Antarctica, during summer

YIN Xijie[1], LI Yunhai[1]*, QIAO Lei[2], WANG Aijun[1], XU Yonghang[1] & CHEN Jian[1]

[1] Third Institute of Oceanography, SOA, Xiamen 361005, China;

[2] Department of Natural Resource Ecology & Management, University of Oklahoma, Norman, OK 74078, USA

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Abstract In this study, we investigated the distributions of sea-surface suspended particulate organic carbon (POC) and its stable isotope ($\delta^{13}C_{POC}$) in Prydz Bay, Antarctica, and examined the factors influencing their distribution, sources, and transport. We used measurements collected from 61 stations in Prydz Bay during the 29th Chinese National Antarctic Research Expedition, in combination with remote sensing data on sea surface temperature (SST), chlorophyll *a* concentration, and sea ice coverage. The POC concentration in the surface waters of Prydz Bay was 0.28–0.84 $mg \cdot L^{-1}$, with an average concentration of 0.48 $mg \cdot L^{-1}$. The $\delta^{13}C_{POC}$ value ranged from −29.68‰ to −26.30‰, with an average of −28.01‰. The concentration of suspended POC was highest in near-shore areas and in western Prydz Bay. The POC concentration was correlated with chlorophyll *a* concentration and sea ice coverage, suggesting that POC was associated with phytoplankton production in local water columns, while the growth of phytoplankton was obviously affected by sea ice coverage. The $\delta^{13}C_{POC}$ value in suspended particles decreased gradually towards the outer waters of Prydz Bay, while in eastern Prydz Bay the $\delta^{13}C_{POC}$ value become gradually more negative from nearshore to deep-water areas, suggesting that $\delta^{13}C_{POC}$ was mainly influenced by CO_2 fixation by phytoplankton. The $\delta^{13}C_{POC}$ value in suspended particles near Zhongshan Station was significantly negative, possibly as a result of the input of terrigenous organic matter and changes in the phytoplankton species composition in the nearshore area.

Keywords **particulate organic carbon, $\delta^{13}C_{POC}$, Prydz Bay, Antarctica**

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1 Introduction

Organic carbon in the ocean, consisting of dissolved organic carbon (DOC) and particulate organic carbon (POC), is the largest carbon reservoir on the earth. Although POC, the main product from carbon fixation by marine phytoplankton, accounts for only 10% of total organic carbon, it plays a pivotal role in the marine carbon cycle and marine ecosystem[1]. The dissolution of carbon dioxide (CO_2) from the atmosphere to water initiates a series of physical, chemical, and biological interactions between water and particles, generating the main source of POC (including suspended particles and settling particles) in the ocean. However, in surface waters, POC mainly originates from bioclasts (including dead organisms), phytoplankton, and zooplankton. Part of the POC in the ocean is contained in deposits on the seabed, while some is consumed by microorganisms and reconverted into CO_2[2]. The concentration of POC in the ocean is closely related to the life process of organisms and primary productivity, and is therefore an important index for evaluating marine productivity[3]. In addition, POC is the main form of carbon involved in the processes of carbon fixation, migration, and output[4]. Identification of the various characteristics and distribution of POC in the ocean is a key topic in studies concerning the marine carbon cycle and is highly significant

* Corresponding author (email: liyunhai@tio.org.cn)

to marine biogeochemistry research[5].

Stable organic carbon isotopes have been widely used as natural tracers for determining sources of organic matter in the marine environment[6]. Suspended POC in the ocean can be derived from various sources, including terrigenous organic matter and marine plankton, etc. The isotope ratio, $^{13}C/^{12}C$, and the value of the POC isotope, $\delta^{13}C_{POC}$, differ between POC from different sources[7]. In mid to low latitude oceans, the average value of terrigenous $\delta^{13}C_{POC}$ is between −26‰ and −27‰, while the average value of marine $\delta^{13}C_{POC}$ is between −18‰ and −19‰[7]. This difference between the values is the basis upon which carbon isotopes can be used to determine the source. In addition, the settling velocity of suspended organic carbon particles is sufficiently slow to allow them to be carried by ocean currents over long distances and over long durations. Therefore, data on the carbon isotopes of suspended organic carbon can also provide useful information for studies on particle dynamics and mass transmission[8]. In recent years, there have been many studies on the source, distribution, cycling, and sedimentation of POC using stable carbon isotopes. These studies have promoted the development of biogeochemistry. The areas that have been investigated include estuaries and bays in the Pacific Ocean, the Atlantic Ocean, the Arctic Ocean, and Antarctica[9-17]. In China, there have been studies on the distribution of POC and its isotopes in the Yellow River Estuary, the Yangtze River, the Pearl River Estuary, and the Yellow Sea Shelf[18-20].

Prydz Bay is the third largest bay in Antarctica. The world's largest glacier, the Lambert Glacier, enters this bay, forming the vast Amery Ice Shelf[21], which is a key area for scientific investigation in the Southern Ocean. Prydz Bay is an important source of bottom water in Antarctica, and is a focus of research on physical oceanography, marine geology, marine geophysics, and the marine ecological environment. Several countries operate research stations near Prydz Bay, and in 1989 the Chinese Zhongshan Station was built in the Larsemann Hills in the southeast of Prydz Bay. A number of studies have provided valuable information on the factors influencing the distribution and the source of POC in Prydz Bay[22-24]. In the present study, we conducted a preliminary analysis of factors influencing the distribution and source of POC in the surface waters of Prydz Bay. The study was based on the measurement of POC and its stable isotope $\delta^{13}C_{POC}$ in suspended particles collected from 61 stations in Prydz Bay during the 29th Chinese National Antarctic Research Expedition (CHINARE), combined with remote sensing data on sea surface temperature (SST), chlorophyll *a* concentration, and sea ice coverage. Furthermore, based on $\delta^{13}C_{POC}$ values in suspended particles, we determined the summer migration process of the source of the organic matter in the suspended particles in the surface waters of Prydz Bay.

2 Materials and methods

The suspended particle samples were collected from 31 January to 3 March 2013, from the R/V *XUE LONG* icebreaker during the 29th CHINARE. A Niskin sampler was used to collect surface water samples from 61 stations (Figure 1). The water samples were filtered on the vessel using glass fiber filters (Whatman GF/F filter) with a filtration membrane with a pore size of 0.7 μm (preheated at 450℃ for 6 h). The filtration volume was 3 000–5 000 mL. After filtration, the filtration membrane was stored at −20℃ and was later used to determine the content and $\delta^{13}C_{POC}$ value of POC in the laboratories at the Third Institute of Oceanography, SOA.

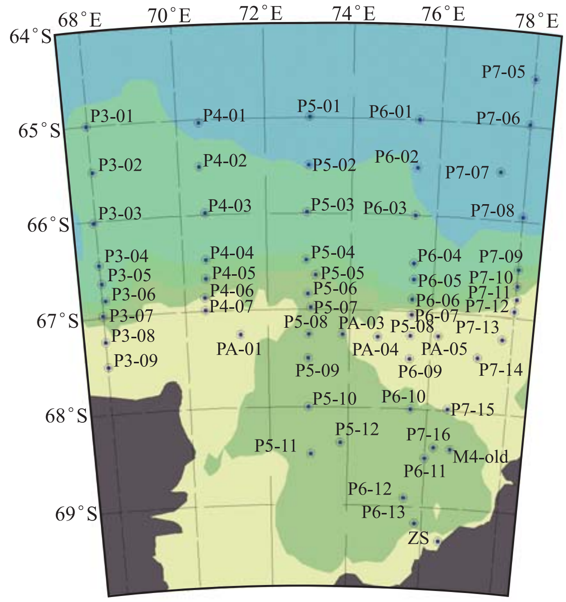

Figure 1 Sampling stations in Prydz Bay.

The filtration membrane was covered by a ø5 × 9 mm tin cup (SÄNTIS®). An elemental analyzer coupled with a stable isotope mass spectrometer (Flash EA 1112 HT–Delta V Advantage, Thermo Fisher Scientific) was used to determine the $\delta^{13}C_{POC}$ value of the POC carried on the membrane. The carrier gas was high-purity helium (He) at a flow speed was 90 mL·min^{-1}. The temperature was 960℃ in the oxidation tube and 50℃ in the chromatographic column. Pee Dee Belemnite (PDB) international standards were used as the reference for the total isotopic ($\delta^{13}C_{TOC}$) value. The $\delta^{13}C_{TOC}$ value was calculated using the following equation:

$$\delta^{13}\text{C value (\%)} = \left[\frac{R(^{13}\text{C}/^{12}\text{C}_{\text{sample}})}{R(^{13}\text{C}/^{12}\text{C}_{\text{VPDB}})} - 1\right] \times 1\,000 \qquad (1)$$

where $R(^{13}C/^{12}C_{VPDB})$ represents the abundance ratio of the carbon isotope of the international standard Vienna Pee Dee Belemnite (VPDB). The analysis precision of the $\delta^{13}C_{TOC}$ value was ±0.2‰ and the analysis precision of the POC value was ±0.8‰.

The remote sensing data for chlorophyll *a* concentration in the surface waters were derived from level 2 (L2) data observed with the Aqua Moderate Resolution Imaging Spectroradiometer (Aqua MODIS; February–March 2013; http://oceancolor.gsfc.nasa.gov). The spatial resolution of the data was 4 km × 4 km. The SeaDAS 4.9 Mercator projection (http://seadas.gsfc.nasa.gov/doc/tutorial/sds_tut2.html) was used to convert the L2 MODIS data to level 3 (L3) data for Prydz Bay. Because of extensive cloud coverage in the study area during the investigation, average points from downloaded remote sensing data were used to determine chlorophyll *a* concentration and SST. Data on sea ice coverage were obtained from the Earth System Research Laboratory of the National Oceanic and Atmospheric Administration (NOAA) (http://www.esrl.noaa.gov/psd/). The spatial resolution of the data was 0.5° × 0.5° (longitude × latitude), and the data used were the average values for the period from February to March 2013.

3 Results

3.1 Horizontal distribution of POC in surface waters

The concentration of suspended POC in the surface waters of Prydz Bay and its surrounding areas during the summer ranged from 0.28 mg·L^{-1} to 0.84 mg·L^{-1}, with an average of 0.48 mg·L^{-1}. Overall, the concentration was higher in nearshore areas compared with deep-water areas. The maximum concentration of POC was observed at station P5-09 near Zhongshan Station, while the minimum concentration was observed at station P3-03 located in the west of the study area (Figure 2). If 67.5°S (latitude) is set as a boundary, the average suspended POC concentration in the surface waters was <0.5 mg·L^{-1} in outer Prydz Bay north of the boundary, and >0.5 mg·L^{-1} in the area south of the boundary. Between 66.8°S and 67.5°S, there was only a slight variation in the suspended POC concentration in the surface waters (range = 0.4–0.5 mg·L^{-1}). However, north of 66.8°S, there was a large variation in the suspended POC concentration, showing an overall trend to higher concentrations in the east compared with the west of Prydz Bay. The two areas surrounding stations P3-03 and P5-01 exhibited low concentrations of suspended POC of 0.28 mg·L^{-1} and 0.29 mg·L^{-1}, respectively.

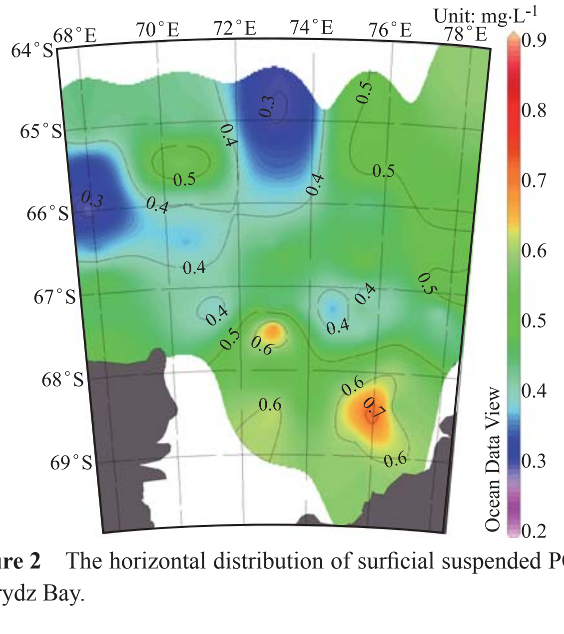

Figure 2 The horizontal distribution of surficial suspended POC in Prydz Bay.

3.2 Horizontal distribution of $\delta^{13}C_{POC}$ in surface waters

The variation in suspended $\delta^{13}C_{POC}$ in the surface waters reflects the source of the POC and the growth of phytoplankton. The $\delta^{13}C_{POC}$ in the surface waters of Prydz Bay ranged from −29.68‰ to −26.30‰, with an average of −28.01‰. The horizontal distribution of the $\delta^{13}C_{POC}$ value was relatively complex. In the outer bay region (64°S–67°S), the suspended $\delta^{13}C_{POC}$ value tended to become more negative from east to west, as indicated by the minimum value (−29.41 ‰) at station P4-02 and the maximum value (−27.00‰) at station P7-07 (Figure 3). Within Prydz Bay and its offshore area, the maximum $\delta^{13}C_{POC}$ value (−26.40‰) was observed at station P3-09 near the Fram Bank, while the minimum $\delta^{13}C_{POC}$ value (−29.68‰) was observed at station P6-11 (Figure 3). In the eastern area within the bay and south of 68°S, the $\delta^{13}C_{POC}$ value was significantly more negative compared with the surrounding continental shelf area. In the outer waters west of 72°E, the $\delta^{13}C_{POC}$ value gradually decreased from nearshore to deep-water areas. Conversely, in the outer waters east of 74°E, the $\delta^{13}C_{POC}$ value gradually increased from nearshore to deep-water areas.

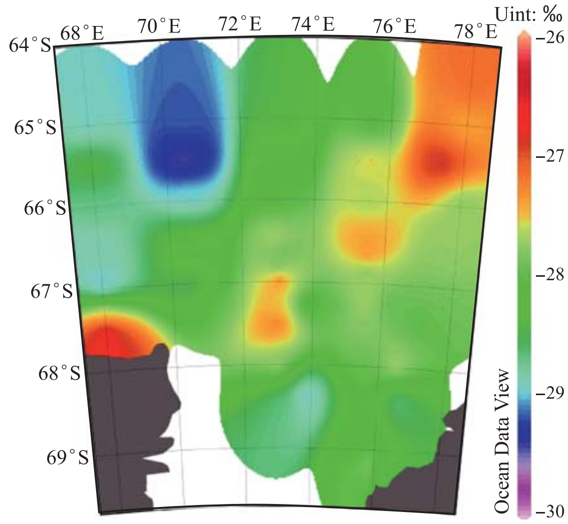

Figure 3 Horizontal distribution of surficial suspended $\delta^{13}C_{POC}$ in Prydz Bay.

3.3 Horizontal distribution of chlorophyll *a*, sea ice, and SST

Using a remote sensing inversion method, we calculated the SST, the floating ice coverage and the chlorophyll *a* concentration in the surface waters of Prydz Bay during the summer. This calculation method overcame the shortcomings in limited observation time and region of field observations, and was used to macroscopically reveal the summer marine ecological conditions in Prydz Bay and the surrounding areas. The data provided useful information for research on the distribution and variation of suspended POC. Figure

4 shows the horizontal distribution of the chlorophyll *a* concentration, SST, and floating ice coverage in the surface waters of Prydz Bay and its surrounding areas from February to March 2013 interpreted from remote sensing.

The chlorophyll *a* concentration in the surface waters of Prydz Bay in summer ranged from 0.1 mg·m^{-3} to 1.2 mg·m^{-3}. Overall, the concentration was relatively low, with higher concentrations in offshore areas and lower concentrations in deep-water areas. Chlorophyll *a* was concentrated within Prydz Bay and the nearshore areas of the Antarctic continent, mainly south of 67.5°S, where the concentration was usually >0.6 mg·m^{-3}. Within Prydz Bay, the chlorophyll *a* concentration was higher in the east than in the west, while the highest concentration was observed in the area near Zhongshan Station. In the vast area between 67.5°S and 62.5°S, the chlorophyll *a* concentration was extremely low, generally <0.3 mg·m^{-3}, where is part of a low productivity area in the Southern Ocean. In eastern waters north of 62.5°S, the chlorophyll *a* concentration was higher and ranged from 0.4 mg·m^{-3} to 0.8 mg·m^{-3} (Figure 4a). The horizontal distribution of chlorophyll *a* in the surface waters of the study area, identified through remote sensing inversion, is in agreement with the distribution of chlorophyll *a* tested *in-situ* by Han et al.[22] in 2011 and by Sun et al.[23] from 2007 to 2009. Previous studies have shown that the low chlorophyll *a* concentration in deep-water areas is mainly an effect of active iron[23-24], while the high chlorophyll *a* concentration within the bay is mainly an effect of ice melting in the summer[25]. The distribution characteristics of the chlorophyll *a* concentration obtained through remote sensing can provide useful information for analyzing the distribution of suspended POC and its isotopes in the surface waters.

The year-round presence of sea ice contributes to the unique environmental characteristics of Antarctica. The sea ice prevents the atmosphere from interacting with the underlying water. Consequently, a relatively isolated environment is formed. Seasonal changes in the sea ice can affect hydrological process, water temperature, and photosynthesis in the underlying water, thus determining the living environment of plankton[26]. The sea ice coverage in Prydz Bay decreased from the inner bay to the bay mouth during the summer and reached zero in the open sea outside the bay (Figure 4c). The floating sea ice coverage was highest in the area where the ice shelf enters the sea, where it was generally >0.8. There was floating sea ice scattered in the open sea, where the coverage was generally <0.5. Outside the bay, the sea ice coverage was significantly higher in the east compared with the west of the bay, which was in agreement with the distribution characteristics of the chlorophyll *a* concentration.

The SST in the Southern Ocean is mainly determined by solar radiation, ice melting, and temporal and spatial variations in marine meteorology and ocean currents. The SST in the area around Prydz Bay ranged from −1.4℃ to 1.8℃ during the period between February and March 2013, with an average of −0.98℃ . Overall, the water temperature gradually increased from south to north. As a result of the effects of continental glaciers and offshore floating ice, the water temperature was lowest within Prydz Bay and near the continental coast of Antarctica, generally <0℃ (the 0℃ isotherm was close to 66°S). North of 66°S, the water temperature gradually increased and was generally above >0℃ (Figure 4b). The SST in Prydz Bay during the summer matches the distribution of the sea ice coverage.

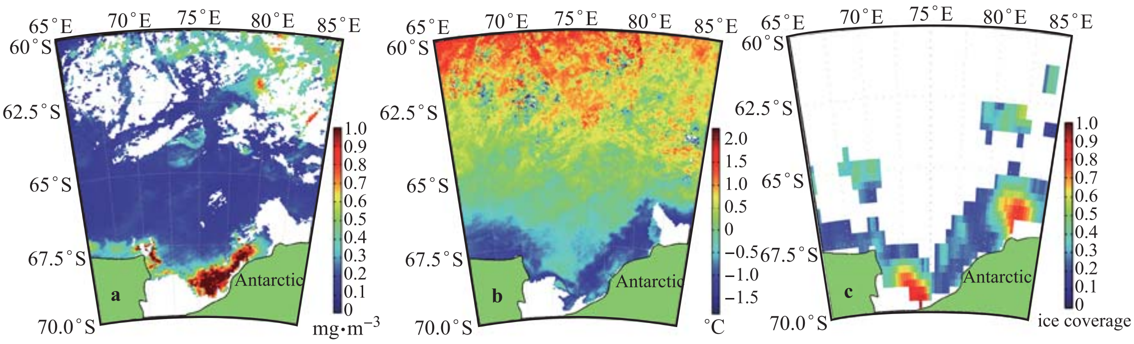

Figure 4 Horizontal distribution of sea surface chlorophyll *a* (**a**), SST (**b**) and sea ice coverage (**c**) in Prydz Bay.

4 Discussion

4.1 The distribution of POC and its relationship with primary productivity

The distribution of the marine POC concentration is affected by various physical, chemical, and biological factors, such as overland runoff, coastal upwelling, light, nutrient, and biological activity[8].

Yu et al.[27] investigated the POC in the surface waters of Prydz Bay and the surrounding area during the 22nd CHINARE. They found that the average POC concentration within Prydz Bay was as high as 0.72 mg·L^{-1}, while the POC concentration outside the bay was relatively low (0.13 mg·L^{-1})[27]. During the 15th CHINARE, Hu et al.[2] also found that the average POC concentration was as high as 0.53 mg·L^{-1} in the bay and 0.17 mg·L^{-1} outside the bay. These results were essentially consistent with the results obtained in the present study.

During the 15th and 16th CHINAREs, Qiu et al.[28]

investigated the primary productivity of Prydz Bay and found that the primary productivity was higher within the bay than outside the bay. Liu et al.[29] investigated primary productivity and POC concentration in Prydz Bay during the summers of 1991 and 1992, and found that the primary productivity and POC concentration were both higher in the northern continental shelf area near Prydz Bay and in the outer east of the bay compared with the west. These findings were also consistent with the results of the present study.

The trends in the distribution of chlorophyll *a* and suspended POC in the surface waters near Prydz Bay, obtained through remote sensing interpretation, were similar (Figure 2 and Figure 4a). Investigations during the 15th and 22nd CHINAREs showed that POC and chlorophyll *a* were closely correlated, with correlation coefficients of r=0.889 (n=91) and r=0.7 (n=114), respectively[2,27]. These results demonstrated that the distribution and variation of POC in the Prydz Bay area were largely related to the activity of phytoplankton. The results obtained from the present and previous investigations support the conclusion that the suspended POC in the surface waters near Prydz Bay is primarily produced by phytoplankton during the summer.

The distribution of sea ice also affects the suspended POC concentration in the surface waters. Liu et al.[30] investigated the distribution of primary productivity in Prydz Bay and the surrounding area and found that when floating sea ice near the research vessel melted, the ice algae within the sea ice entered the waters. As a result, the marine primary production increased exponentially and reached its maximum[30]. In the present study, the remote sensing inversion method was used to identify the distribution of sea ice coverage in the study area. We found that the distribution of sea ice was also similar to the distribution of POC and chlorophyll *a* concentration (Figures 2 and 4c). Based on these results, it is likely that the melting of sea ice in Prydz Bay might significantly affect the marine primary productivity. The ice coverage was highest in the sea area near Zhongshan Station within Prydz Bay. The barrier formed by the dense floating ice on the sea surface may prevent the spread of wind waves and weaken water exchange, thus stabilizing the water in this area and providing an environment suitable for the growth and reproduction of phytoplankton. Consequently, the chlorophyll *a* concentration in the surface waters was the highest in this area.

Within Prydz Bay, the barrier formed by the Four Ladies Bank and the Fram Bank on the eastern and western sides, respectively, as well as the surrounding icebergs and floating ice, can prevent wind waves from spreading into the bay. This reduces deep-water exchange within and outside the bay. In addition, the melting of ice and snow on the Amery Ice Shelf during the summer not only releases algae that were previously stored in the ice but also reduces the surface water salinity. Moreover, the stable stratification formed by the low-density sea ice melt water floating above high-density sea water promotes the rapid growth of phytoplankton[31]. Sea ice melting can yield a large quantity of terrigenous matter (in particular, the active iron that is necessary for growth of organisms in the Southern Ocean) and can increase the primary productivity, which in turn forms an area with relatively highly concentrations of chlorophyll *a* and POC. Lin et al.[32] studied the active iron in sea water around floating ice in Antarctica. They found that the concentration of dissolved iron increased from 0.58 nmol·L^{-1} to 2.92 nmol·L^{-1} in the water near the sea ice and the concentration of dissolved iron increased by 60% in the water within a 1-km radius of the sea ice[32]. Shaw et al.[33] found that floating ice in the Weddell Sea was the primary source of the bioactive iron in the surface waters of the Southern Ocean. The continental slope outside Prydz Bay is at the confluence of the east wind and west wind drift. In this area the wind waves are large and the water undergoes extensive exchanges in the deep-sea area situated at the southern margin of the westerly zone. Consequently, this area has a low stability, which is detrimental to the growth of phytoplankton. There is a decrease in the abundance and standing crop of phytoplankton, and decreased primary productivity and new productivity[30], and decreased chlorophyll *a* and POC concentrations in the corresponding surface waters.

4.2 Factors influencing POC distribution

There are a variety of sources of marine POC. Within the same area, the source and composition of POC can exhibit temporal and spatial differences[8]. The value of $\delta^{13}C_{POC}$ can be used to accurately identify the main source and formation process of POC[8]. The main factors affecting the composition of the carbon isotopes of POC in sea water mainly include the input of terrigenous organic matter, the growth rate of phytoplankton, phytoplankton species composition, and the solubility of CO_2[17,34].

In the deep-water area outside Prydz Bay in the summer, the input of terrigenous organic matter is relatively low, and the POC in the water is mainly produced by summer phytoplankton. Therefore, the carbon isotopes of the POC in the water reflect the phytoplankton formation process. Kopczyńska et al.[35] and Zhang et al.[34] discovered that the variation in the $\delta^{13}C_{POC}$ value of organic particles in the Prydz Bay surface waters was directly correlated with the concentration of organic matter. Popp et al.[36] discovered a close correlation between the $\delta^{13}C_{POC}$ value and the solubility of CO_2. In addition, they found that the species composition and growth rate of phytoplankton exerted a relatively large impact on the $\delta^{13}C_{POC}$ value[36]. The above factors may be responsible for the finding that the $\delta^{13}C_{POC}$ value of suspended particles in the surface waters gradually becomes more negative from offshore areas to the deep-water areas in the east of Prydz Bay and more negative from east to west in the sea north of 67°S. When the growth rate of phytoplankton in the surface waters and the CO_2-dissolving conversion rate is low, a relatively strong biological fractionation might occur during the conversion from inorganic carbon to organic carbon by phytoplankton, leading to a more negative $\delta^{13}C_{POC}$

in low-productivity areas.

Zhang et al.[37] used an infrared analysis method to measure *in-situ* partial pressure in the water and atmosphere of Prydz Bay and its surrounding area from December 1991 to January 1992. They found that the P_{CO_2} of the surface waters was low in the nearshore areas and high in the deep-water areas[37]. Gao et al.[38] investigated the P_{CO_2} of the surface waters in Prydz Bay, and found that the P_{CO_2} was significantly lower within the bay south of 65.5°S (continental shelf and slope) than in the deep-water area outside the bay (north of 65.5°S)[38]. These results further confirm that the $\delta^{13}C_{POC}$ value of the surface waters in the sea outside Prydz Bay may be affected by the CO_2 adsorption and stabilization rates of phytoplankton.

During the 22nd CHINARE, Zhang et al.[34] studied the carbon isotopes of POC in the waters east of the present study area. They found that the $\delta^{13}C_{POC}$ value of the suspended particles in the surface waters from the continental shelf to the deep-water area ranged from −25.3‰ to −27.5‰, with a gradually decreasing trend from offshore areas to the open ocean[34], consistent with the distribution trend identified in the present investigation in the same area. However, we further observed that the $\delta^{13}C_{POC}$ value in the coastal area near Zhongshan Station appeared abnormally negative compared with the value in nearby areas, which was contradictory to the distribution pattern found in other investigated areas. In the study by Kopczyńska et al.[35] the composition of the phytoplankton and the isotopes of POC in the waters of Prydz Bay revealed a significant difference in the $\delta^{13}C$ value between different algal species. Significant differences were observed among the carbon isotopes produced by the three biological combinations in Prydz Bay. Specifically, Pennales, such as *Nitzschia curta* and *N. subcurvata*, had a relatively high carbon isotope value, ranging from −20.12‰ to −22.37‰, while *Phaeocystis*, naked flagellates, and autotrophic dinoflagellates had a relatively low carbon isotope value, ranging from −29.73‰ to −31.85‰[35]. Therefore, the low $\delta^{13}C_{POC}$ value of the suspended organic particles in the east of Prydz Bay might be caused by the change in the phytoplankton species composition. More research, including plankton identification and carbon isotope measurements in key locations, is needed to reveal the underlying processes.

Cozzi et al.[39] studied the concentration and isotopes of organic matter in Terra Nova Bay in Antarctica and found that the isotopes of the terrigenous POC above the ice layer were significantly negative, the $\delta^{13}C$ value was generally less than −29.3‰[39]. During the summer, the land inshore of the sea area near Zhongshan Station is exposed, and the terrigenous humus with partial low carbon isotopes may enter the coastal waters along with glacial melt, leading to a reduction in the $\delta^{13}C_{POC}$ value of the suspended organic particles in the area.

To date, there have been few studies on the effects of the Prydz Bay marine environment on the carbon isotopes of suspended POC, and the underlying mechanisms. In particular, there are no satisfactory explanations for the phenomenon that the $\delta^{13}C_{POC}$ value of the isotopes in the suspended organic particles appears abnormally negative in the waters near Zhongshan Station. The mechanism underlying changes in phytoplankton species composition should be further investigated. Studies of the POC concentration, dissolved inorganic carbon concentration, $\delta^{13}C_{POC}$, and $\delta^{13}C_{DIC}$ in water bodies and in melted ice are warranted. Moreover, the carbon isotopes of the terrigenous organic matter near Zhongshan Station should also be the focus of future studies on the distribution characteristics and mechanisms of variation in POC and its isotopes in the Prydz Bay area. These results may provide scientific support for better understanding the carbon cycle process in Prydz Bay as a whole.

5 Conclusions

The concentration of POC and $\delta^{13}C_{POC}$ values in suspended particles collected from 61 stations in Prydz Bay during the 29th CHINARE were determined. Based on data on SST, chlorophyll *a* concentration in the sea surface water, and sea ice coverage, which were obtained through remote sensing interpretation, we identified the distributions of suspended POC and its isotopes in the Prydz Bay area and investigated the relevant influencing factors. The results are summarized as follows:

(1) The POC concentration in the surface waters of Prydz Bay and its surrounding area was higher in nearshore areas than in deep-water areas, and higher in the west than in the east. POC was concentrated mainly around the ice shelf, and its distribution was in agreement with the distribution of the chlorophyll *a* concentration and sea ice coverage determined through interpretation of remote sensing data. This finding indicates that the POC in the surface waters of Prydz Bay was mainly produced by phytoplankton in the area and that the phytoplankton growth was affected by the sea ice.

(2) The value of $\delta^{13}C_{POC}$ in suspended organic particles in the waters outside Prydz Bay showed a horizontal distribution trend, becoming gradually more negative from east to west. In addition, the $\delta^{13}C_{POC}$ value in the east of the study area gradually decreased from nearshore to deep-water areas, indicating that the $\delta^{13}C_{POC}$ distribution was mainly controlled by the CO_2 adsorption and stabilization rate of phytoplankton. The $\delta^{13}C_{POC}$ value was very low in the sea near Zhongshan Station, which might be a result of the input of terrigenous organic matter and a change in the phytoplankton species composition. Further research, including the investigation of plankton species composition and more detailed carbon isotope measurements in Prydz Bay, is needed to better explain the complex biogeochemical processes in the area.

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