DISTRIBUTION OF THE MAJOR INORGANIC NUTRIENTS IN THE ROSS SEA, ANTARCTICA

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Abstract

Despite high concentration of nutrients in ambient water, the Antarctic has low chlorophyll a where primary production is low compared to other regions on an annual basis. Our research region is the Ross Sea, known as one of the most productive polynya. We investigated spatial and temporal variations of major inorganic nutrients to understand the environmental changes in the Ross Sea. Seawater sampling was carried out at 13 stations in 2018 (ANA08C, February 25 – March 1) and 17 stations in 2019 (ANA09B, January 16 – 21). In 2018, the average concentrations of phosphate, nitrate + nitrite and silicate were 2.11 ±0.14, 20.94 ±1.22, and 74.34 ±13.45 µM, respectively. Overall, no significant difference was shown between 2018 and 2019, average concentrations of phosphate, nitrate + nitrite and silicate in 2019 were 1.97 ±0.22, 28.25 ±3.51, and 72.90 ±12.50 µM, respectively. Dissolved inorganic ammonium concentration remained low ranging from 0 to 1.56 µM (2018) and from 0 to 1.09 µM (2019) throughout the study region and it was just above the level of detection at some stations. We found high concentration of nutrients at the Ross Sea continental shelf. Consistent with our result, warm circumpolar deep water (CDW) intruded on the Ross Sea continental shelf and flowed toward the Ross sea ice shelf. This flow pattern suggests that the major nutrients seemed to be provided with intrusion of CDW.

Introduction

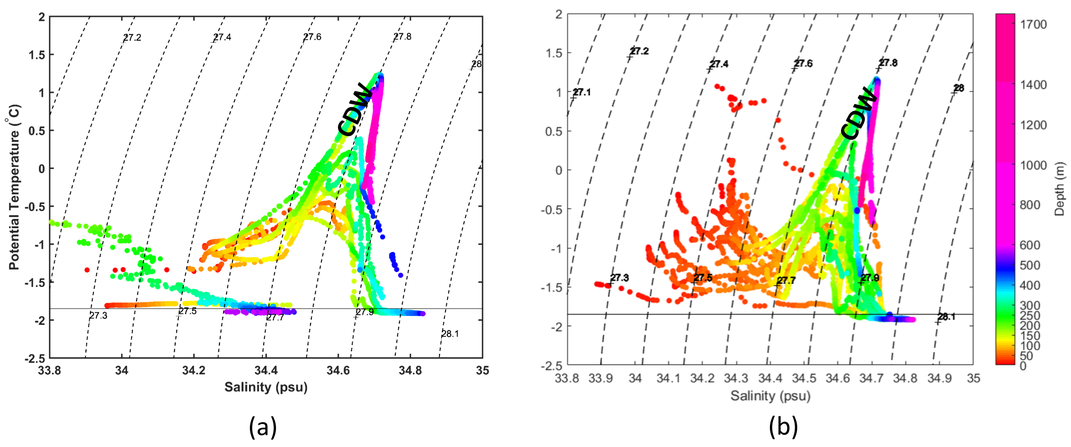

Fig. 1. T-S diagram of (a) ANA08C and (b) ANA09B.

Circumpolar Deep Water (CDW, relatively warm; T>0°C and saline; S>34.6), which is derived from a mixture of the deep waters from all the world's oceans (Dinniman et al., 2011). In this study, CDW was observed at Station 2, 3, and 5 in 2018 (Fig. 1(a)) and Station 21, 22, and 23 in 2019 (Fig. 1(b)).

Study area

Seawater sampling for nutrients was carried out at 13 stations from February 25th to March 1st in 2018 (Fig. 2(a)) and 17 stations from January 17th to 21st in 2019, respectively (Fig. 2(b)).

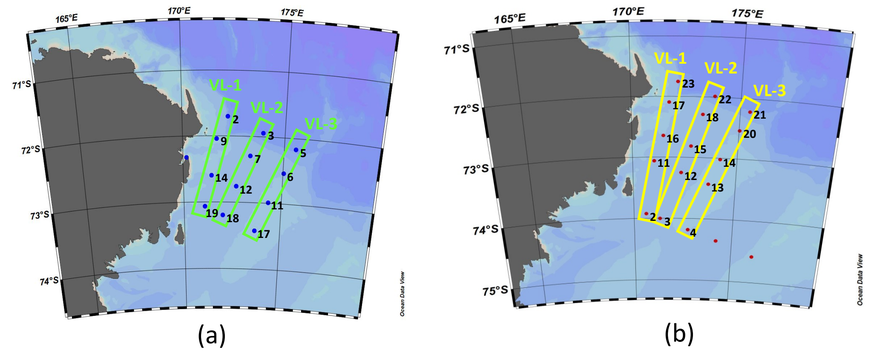

Fig. 2. Study site of (a) ANA08C and (b) ANA09B

Preliminary Results

ANA08C

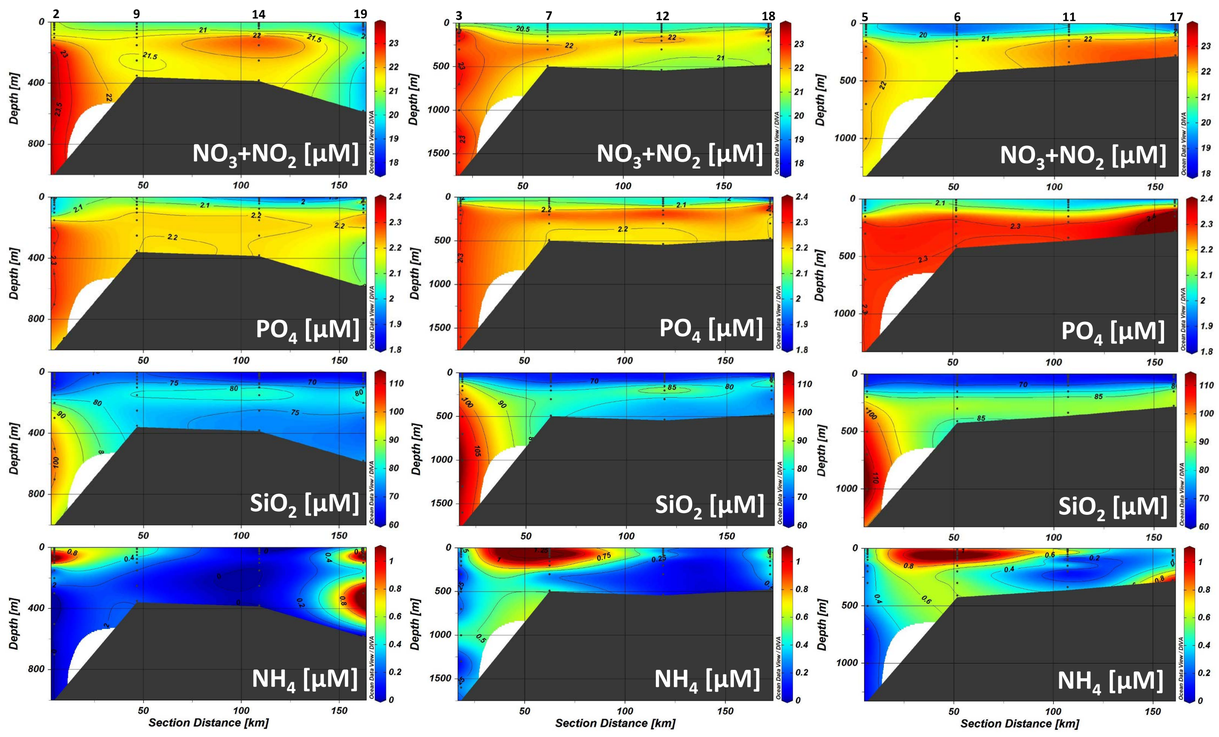

Fig. 3. Vertical profiles for (a) VL-1, (b) VL-2 and (c) VL-3 in the Ross Sea, 2018.

- ✓ The nitrate + nitrite and phosphate concentrations were 18.83 – 23.82 µM and 1.87 – 2.48 µM from the surface to bottom, respectively. The silicate ranged from 60.74 to 115.90 µM. The average concentrations of nitrate + nitrite, phosphate and silicate were 20.94 ±1.22, 2.11 ±0.14, and 74.34 ±13.45 µM, respectively.
- ✓ Most of the concentrations of nitrate + nitrite, phosphate, and silicate were gradually increased with depth.
- ✓ However, ammonium did not show a specific trend and ranged from 0 to 1.56 µM with a mean of 0.50 µM (SD = ±0.39 µM).

ANA09B

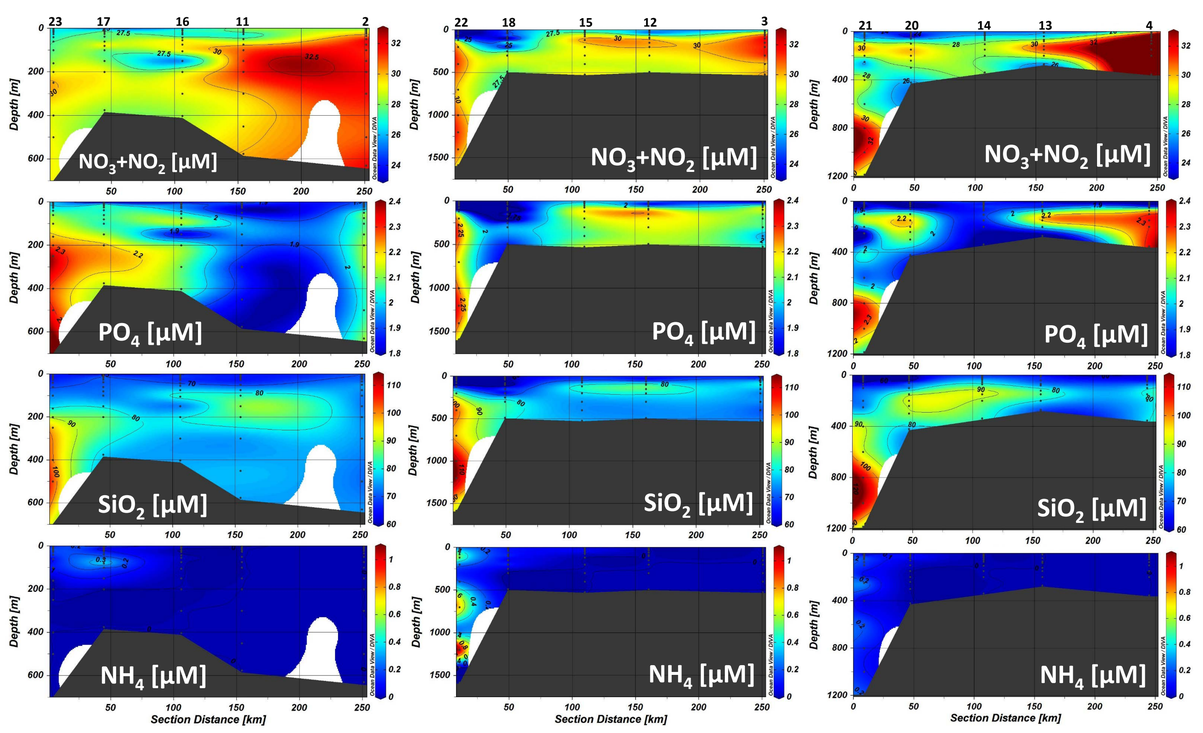

Fig. 4. Vertical profiles for (a) VL-1, (b) VL-2 and (c) VL-3 in the Ross Sea, 2019.

- ✓ The nitrate + nitrite and phosphate concentrations ranged from 17.55 to 42.67 µM with a mean of 28.25 (SD = ±3.51 µM) and 1.14 to 2.52 µM with a mean of 1.97 (SD = ±0.22 µM) from the surface to bottom, respectively. The silicate concentration, ranging from 39.95 to 114.12 µM with a mean of 72.90 (SD = ± 12.50 µM).
- ✓ Dissolved inorganic ammonium concentration remained low ranging from 0 to 1.09 µM throughout the study region and it was found to be just above the level of detection at some stations.

→ Stations were divided into 3 sections (VL-1, VL-2, and VL-3) to describe the spatial distributions of nutrients (Figs. 3 and 4). We found that warm CDW intruded on the Ross Sea continental shelf and flowed toward the Ross sea ice shelf through the Drygalski Trough in the mid-depth of water column. This flow pattern suggests that the major nutrients seemed to be provided with intrusion of CDW.

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