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Polar Exploration with ARAON (아라온)



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CARBON AND NITROGEN UPTAKE RATES OF PHYTOPLANKTON IN THE CHUKCHI SEA AND CENTRAL ARCTIC OCEAN

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ABSTRACT

As a Chinese IPY event, the 3rd Chinese National Arctic Research Expedition (CHINARE) was conducted from the Chukchi Sea to the central Arctic Ocean from late July to early September in 2008. Using a ¹³C-¹⁵N dual isotope tracer, the primary productivity experiments were measured at 24 stations for total, but 12 stations in the Chukchi Sea and 12 stations in the central Arctic Ocean during the period. In general, the temperature and salinity at surface were 4 to 6 °C and 30 in the Chukchi Sea and -1 to 3 °C and 25-27 in the central Arctic Ocean, respectively. The lower temperature and salinity in the central Arctic Ocean is believed to mainly due to the melting water from sea ice. The primary productivity of phytoplankton was higher in the Chukchi Sea than in Canada Basin during the cruise period. Especially in the station R03, the productivity was 199.6 mg C m⁻² h⁻¹ which was twice higher than the previous result in 2007. However, the average nitrogen uptake rate in the Chukchi Sea was lower in 2008 than in 2007. Based on high f-ratios in the study areas, nitrate uptake rates compared to ammonium uptake rates were relatively higher than those from other studies.

INTRODUCTION

Recently, higher temperatures have decreased the sea ice extent and thickness in the Arctic Ocean, especially in the western part of the Arctic Ocean, over the past 40 years and have produced more open water. Although the production and biomass of phytoplankton are mainly controlled by available light and nutrients (Smith and Sakshaug 1990), the recent studies show the carbon production of phytoplankton in the surface water under the sea ice are limited by light in the Canada Basin and Barrow regions (Lee and Whitledge 2005). Therefore, the ongoing decrease in sea ice thickness might be favorable to an increase in primary production in the Arctic Ocean. However, we still do not know if the predicted climate change will provide less or more food

because little is known about primary production responding to the changes in these remote regions.

Chukchi Sea is the important connection of the water masses and hence organic matters between the Arctic and North Pacific Oceans. The inflows through Bering Strait convey three different water masses, which are Anadyr Current water (AW), Bering Shelf water (BSW), and Alaskan Coastal water (ACW), into the Chukchi Sea (Lee et al. 2007). These three different water masses through Bering Strait largely affect the primary production in the Chukchi Sea and consequently Canada Basin.

MATERIALS AND METHODS

As a Chinese IPY event, the 3rd Chinese National Arctic Research Expedition (CHINARE) was conducted from the Chukchi Sea to the central Arctic Ocean from late July to early September in 2008. In-situ carbon and nitrogen uptake rates of phytoplankton were measured at 12 stations in the Chukchi Sea and 12 stations in the Canada Basin, using both ^{13}C - ^{15}N dual tracer techniques (Fig. 1). Particulate organic carbon and nitrogen and abundance of ^{13}C and ^{15}N were determined in the Finnigan Delta+XL mass spectrometer at University of Alaska Fairbanks after HCl fuming overnight to remove carbonate.

RESULTS AND DISCUSSION

In general, the temperature and salinity at surface were 4 to 6 °C and 30 in the Chukchi Sea and -1 to 3 °C and 25-27 in the central Arctic Ocean, respectively (Fig. 1). The lower temperature and salinity in the central Arctic Ocean is believed to mainly due to the melting water from sea ice.

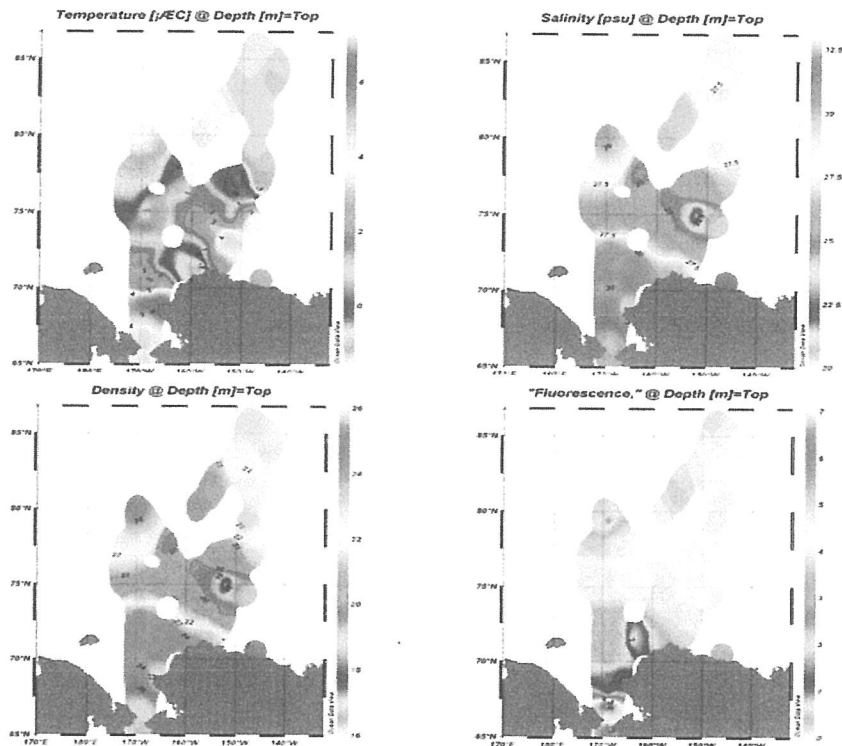


Fig. 1. Temperature, Salinity, Density and Fluorescence at surface in the Chukchi Sea and Central Arctic Ocean in 2008.

The hourly carbon production rate of phytoplankton during the cruise period ranged from 0.43 mg C m⁻² h⁻¹ to 196.6 mg C m⁻² h⁻¹, with a mean of 18.2 mg C m⁻² s⁻¹ (Fig. 2). The primary productivity of phytoplankton was higher in the Chukchi Sea than in Canada Basin during the cruise period. Especially in the station R03, the productivity was 199.6 mg C m⁻² h⁻¹ which was twice higher than the previous result in 2007.

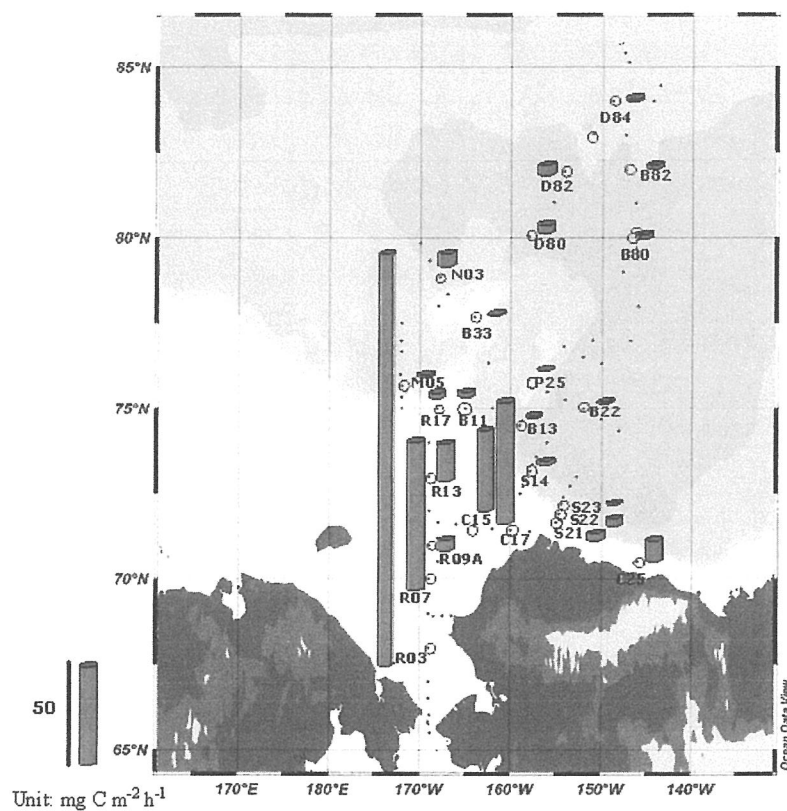


Fig. 2: Carbon uptake rates of phytoplankton in the Chukchi Sea and Canada Basin in 2008.

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