Siliceous phytoplankton flux reflecting oceanographic variation in the southern Northwind Abyssal Plain

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Summer sea-ice decrease in the Arctic Ocean (Stroeve et al., 2012) and change of hydrographic condition (i.e., Beaufort Gyre intensification) (McPhee, 2013)

The impacts to lower-trophic marine ecosystems, material transportation such as lateral advection, and biological pump

Fig. 2 Vertical sections of phytoplankton chlorophyll $a$ (μg/L) in large-sized cells of $>$10 μm (colors) and salinity (contours) in a 2002/2003 and b 2008/2009, vertical sections of phytoplankton chlorophyll $a$ (μg/L) in small size cells of $<$10 μm (colors) and salinity (contours) in c 2002/2003 and d 2008/2009, and dynamic height (dyn m) at 50 m relative to 250 db (dashed contours) and nitrate (μmol/kg) at 50 m (colors) in e 2002/2003 and f 2008/2009. The sections in a–d are illustrated along red lines in e and f. The blue lines in e and f show the sections of nitrate distributions in Figs. 4 and 5. Red and yellow circles in f indicate stations where nitrate uptake rates were measured in 2009 (Fig. 3). Data were obtained from cruises by the R/V Mirai in 2002, 2008, and 2009, USCGC Polar Star in 2002 (Woodgate et al. 2002), and CCGS Louis S. St-Laurent in 2003 (McLaughlin et al. 2010)
Objectives: Understanding the relationship between hydrographic condition and sinking particle flux (sinking diatom flux and the assemblage)
Methods - Diatom Analysis

1/10 sample  <1mm particle size fraction

Splitting  1/100-1/1000

Filtering  membrane filter, 0.45μm pore size

SEM Observation

Mounting on slide glass  Canada Balsam

Valve Size Measurement

Diatom Valve Count  >400 valves, Light Microscope (x600)

Diatom Valve Flux  (Unit: number of valves m⁻² d⁻¹)

Diatom Carbon Flux  (Unit: mg C m⁻² d⁻¹)

carbon : cell volume  (Menden-Deuer & Lessard, 2000)

Sea-ice Concentration, and shortwave radiation data from NCEP-CFSR (Saha et al. 2010)
Methods – physical oceanographic model

Pan-Arctic Ice-Ocean Model

Physical Part: COCO 4.9 [Hasumi, 2006] (sea ice-ocean general circulation model)

Ecosystem Part: NEMURO [Kishi et al., 2007] (lower-trophic marine ecosystem model)

- No sea ice ecosystem (e.g., ice algae) yet

Experimental Design
- NCEP/CFSR atmospheric daily forcing
- AOMIP river water discharge
- Pacific water inflow at Bering Strait
- Integrated from PHC T/S, WOA09 NO3/SIL
- Nutrient input from sea bottom (NH4/DON/SIL)
- Sinking PON velocity increasing with depth

[2010M case]
Total Mass Flux & Bulk Particle Components

Shallow Trap

Deep Trap

*: NCEP-CFSR (Saha et al. 2010)
Diatom Valve Flux in Nov.-Dec.

Chaetoceros sp. (late November 2010)
Ebridian Skeleton Flux in Nov.-Dec.

Material transport process on high particle flux in early winter
Active eddy formation around the shelf break, taking shelf materials in the eddy, and the eddy propagation to basin

Figure 1. Hydrographic stations of CTD/water sampling and XCTD (red dots) of the R/V Mirai Arctic Ocean cruise in 2010 and temperature distribution at 50 m depth (color).
Diatom Valve Flux in July-Sept.

Shortwave Radiation
Sea Ice Conc.*

Shallow Trap

Deep Trap

*Chaetoceros Resting Spore
*Vegetative Valves
*Ice-related Species
*No Data
**Fossula arctica** - Common in the shelf of Laptev and Chukchi Seas
-(Cremer 1998, Quifeldt et al. 2003)

Sample NAP10t-180m #22 (July-Aug.2011)
Particle Flux at Shallow Trap Depth

Influence of shelf waters
- High particle flux
- Abundant lithogenic matters
- Coastal planktic diatoms and ice-algae

Oligotrophic waters
- Low particle flux
- Absence of summer flux maximum
Intensified Beaufort Gyre and oligotrophic water input to Station NAP in summer 2012

Sea surface height in the western Arctic (JJA mean, 25km exp.)

(Nutrient-poor) Canada Basin water was transported toward NAP in 2012
Oligotrophic
High Productivity
+ Resuspension

Eddy

Intensified Beaufort Gyre
Western center shift of the gyre

Oligotrophic
**Preliminary Data – Sedimentation Rate based on the sediment thickness in trap bottle**

**Future works**
- Data accumulation of sinking particle fluxes to find the interannual trend
- Quantitative estimation on the significance of each transportation process (effect of eddy formation and propagation,
  (biological pump by major planktons such as diatoms, copepod)

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