ArcticNet

Vertical sinking export of organic material in Hudson Bay during the fall

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Abstract

This study was conducted in the Hudson Bay system during the second oceanographic expedition of ArcticNet, on board the CCGS *Amundsen*. During the fall 2005, we measured the vertical sinking export of particulate material from the euphotic zone, using short-term free-drifting sediment traps. Traps were deployed from the ship at two or three depths (from 25 to 150 m) for 8 to 20 h at eight stations in the Hudson Bay system. Various hydrographic regions were sampled, including offshore and coastal waters. Analyses carried out on the sinking material included chlorophyll *a* and pheopigments (fluorometric determination), particulate organic carbon and nitrogen (POC and PON), particulate inorganic carbon (PIC), dissolved organic carbon (DOC), particulate organic phosphorus (POP), biogenic and lithogenic silica, isotopes (^{15}N and ^{13}C), phytoplankton abundance and identification, fecal pellet abundance and biovolume, and bacterial abundance. In addition, water samples were collected from the subsurface chlorophyll maximum to measure phytoplankton sinking velocities using settling columns. This poster presents preliminary results from our study.

Introduction

According to global circulation models, global warming will continue over the next decades. This warming, which parallels a rapid increase in CO_2 concentrations in the atmosphere, will be manifested first and amplified in the polar regions, particularly in the Arctic (IPPC 2001, Gagnon & Gough 2005). The biological pump, which basically consists in the conversion of carbon dioxide into phytoplankton carbon and its export to deep water, is an efficient process in removing CO_2 from surface waters and the sea-atmosphere interface. Information on the biological CO_2 pump, and especially on the vertical sinking export of particulate organic material in the Hudson Bay system is lacking.

Contrasting pathways for organic carbon sinking export:

- Sedimentation of intact cells
- Sedimentation of fecal pellets

This study aims to determine:

- The vertical fluxes of the organic and inorganic material from the euphotic zone in different biogeographic regions.
- The contribution of matter from terrigenous origin (riverine input and erosion) to the total sinking flux.

Materials and Methods

Sinking fluxes and composition of sedimenting matter

- Sampling was conducted on board the CCGS *Amundsen* during the second oceanographic expedition of ArcticNet, from 15 September to 26 October 2005 (Figure 1).
- Short-term (8-20 h) free-drifting sediment traps (JGOFS 1996) were deployed at two or three depths (from 25 to 150 m) at eight stations in the Hudson Bay / Hudson Strait (Figure 2).
- Analyses of the sinking material included:
  - Chlorophyll *a* and pheopigments (fluorometric determination: Parsons et al. 1984)
  - POC, PON and PIC (Perkin-Elmer Model 2400 CHN analyzer)
  - DOC (Tekmar-Dohrmann Apollo 9000 HS)
  - Biogenic and lithogenic silica (spectrophotometric method)
  - Isotopes (^{15}N and ^{13}C)
  - Cells and fecal pellet enumeration (inverted microscope Leica DH LS)
  - Bacterial abundance (epifluorescence microscope Leica DH LS)
  - POP, fatty acids and dry weight

Phytoplankton sinking velocities

- Phytoplankton sinking velocities were determined on water samples collected from the subsurface chlorophyll maximum, using settling columns (Bienfang 1981).

Estimates of fecal pellets in the water column

- Water samples were collected at six different depths (25, 50, 75, 100, 150 m and the subsurface chlorophyll maximum) and filtered through a 50 µm Nitex-screen, for identification and counts of fecal pellets.

In the current state of the analysis, only results from chlorophyll *a* and pheopigments sinking fluxes are presented in this poster.

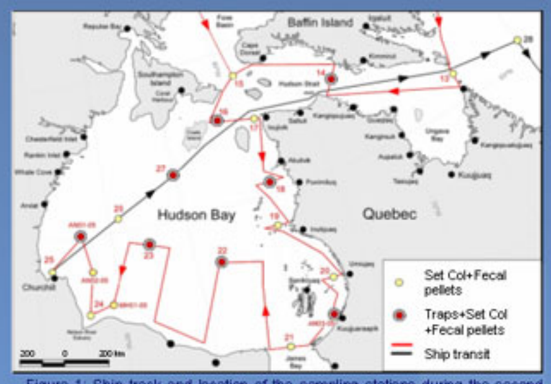


Figure 1: Ship track and location of the sampling stations during the second ArcticNet expedition in the Hudson Bay system, during the fall 2005 (Set Col = settling columns and traps = sediment traps).

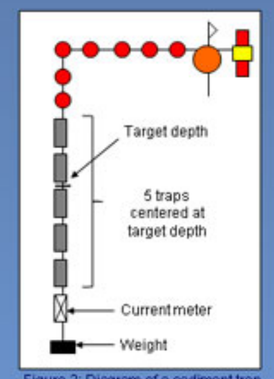


Figure 2: Diagram of a sediment trap mooring line.

Preliminary results

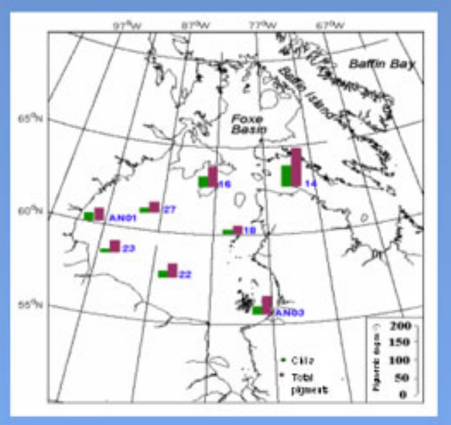


Figure 3: Spatial variations of chlorophyll *a* and total pigments (chlorophyll *a* and pheopigments) areal concentrations in the upper 75 m in the Hudson Bay system, during the fall 2005.

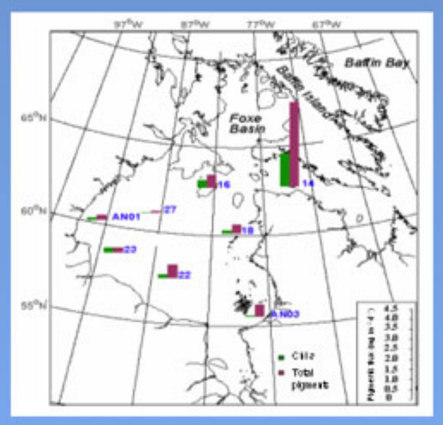
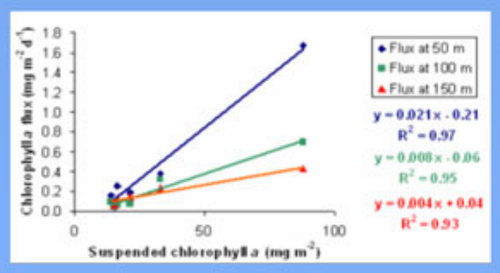


Figure 4: Spatial variations of chlorophyll *a* and total pigments sinking fluxes at 50 m in the Hudson Bay system, during the fall 2005.

- Highest sinking flux was in Hudson Strait (St14), where pheopigments dominated (60% of the flux).
- Lowest sinking flux of organic material was observed in the center of the Hudson Bay (St27). At this location, chlorophyll *a* and pheopigments were nearly in equivalent proportion.



- At each depth, we observed a significant relationship between chlorophyll *a* sinking fluxes and concentrations in the euphotic zone.
- At 50 m, the estimated sinking velocity was about 1 m d^{-1} and the residence time was 47 d.

Figure 5: Relation between sinking fluxes of chlorophyll *a* at 3 depths and suspended chlorophyll *a* concentrations in the euphotic zone.

Conclusion

- The highest concentration and sinking flux of pigments were observed in Hudson Strait.
- Sinking fluxes are significantly correlated with the phytoplankton biomass suspended in the upper water column.
- The high percentage of pheopigments sinking out of the euphotic zone suggests that a large part of the carbon is exported to depth under fecal pellet.

References

Billett, Lampitt, Rice & Mantoura. 1983. Nature 302:520-522; **Bienfang**. 1981. Can J Fish Aquat Sci 38:1289-1294; **Gagnon & Gough**. 2005. Clim Change 69:269-297; **IPCC**. 2001. Climate change 2001, synthesis report: contribution of working group I, II and III to the third assessment report of the IPCC. Cambridge University Press, Cambridge; **JGOFS**. 1996. Protocols for the JGOFS core measurements, report 19. Scientific Committee on Oceanic Research, International Council of Scientific Union, Bergen; **Parsons, Maita & Lalli**. 1984. A manual of chemical and biological methods for seawater analysis. Pergamon Press, Toronto.

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