

Seasonal variations of the biogenic particulate carbon flux on the Mackenzie Shelf slope during 2003-2004



Alexandre Forest¹ (alexandre.forest@giroq.ulaval.ca), Makoto Sampei¹, Hiroshi Hattori², Hiroshi Sasaki³, Paul Wassmann⁴, Louis Fortier¹

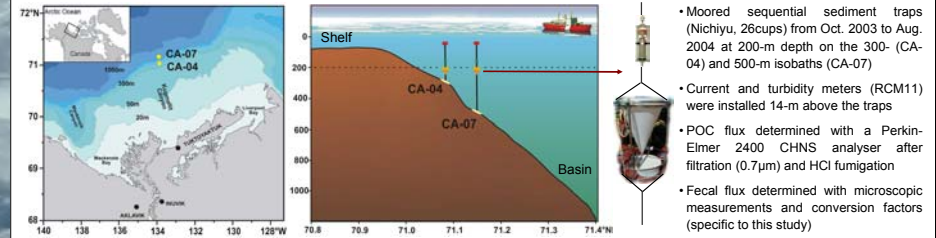
¹Québec-Océan, Université Laval, Québec, Canada; ²Hokkaido Tokai University, Minamisawa, Hokkaido, Japan; ³University of Ishinomaki, Miyagi, Japan; ⁴Norwegian College of Fishery Science, University of Tromsø, Norway

1. Abstract

Vertical fluxes of particulate organic carbon (POC) were recorded on the Mackenzie Shelf slope to describe the seasonal pattern of biogenic carbon sedimentation at the shelf-basin boundary. Total and fecal POC fluxes were determined for two sediment traps deployed from October 2003 to August 2004 at 200-m depth on the 300- and 500-m isobaths of the shelf slope respectively. Total POC flux at 200-m was larger (1433 versus 756 mg C m⁻² d⁻¹ for the 11-mo period) on the upper part of the slope (300-m isobath) than at mid-slope (500-m isobath), but the seasonal pattern of sedimentation characterized by discrete peaks was generally similar at the two locations. At the upper slope (300-m isobath), a first increase in POC flux (8 mg C m⁻² d⁻¹) centered on November corresponded to the production of small fecal pellets by omnivorous zooplankton. A second strong sedimentation peak in February (12 mg C m⁻² d⁻¹, upper slope only) resulted from an abrupt and isolated amplification of the circulation at the shelf break, when current speeds >65 cm s⁻¹ resuspended old, highly-degraded zooplankton fecal pellets from the bottom. A third, unexplained increase in POC flux (up to 4 mg C m⁻² d⁻¹) centered on the month of April was characterized by a low fecal fraction (<1 mg C m⁻² d⁻¹). In late May-early June, a fourth, short-duration peak (2 weeks) in POC flux (15 mg C m⁻² d⁻¹) was characterized by a high C:N ratio (>20 relative to an annual baseline of 10) and coincided with the spring maximum discharge of the Mackenzie River and the expansion offshore of the river plume. In July, a last peak (7 mg C m⁻² d⁻¹) in POC flux linked to the sinking of large, intact fecal pellets reflected intense feeding activities by large calanoid copepods and pelagic tunicates. Our results illustrate the multiplicity of hydrological and biological factors that modulates vertical POC fluxes at the edge of the Mackenzie Shelf.

2. Study area, sampling and analysis

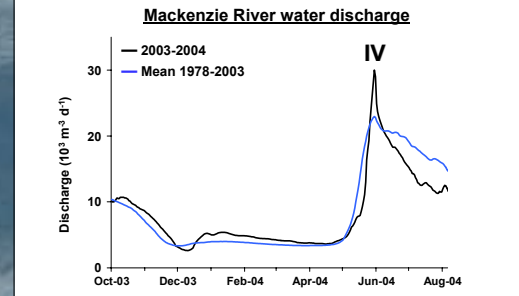
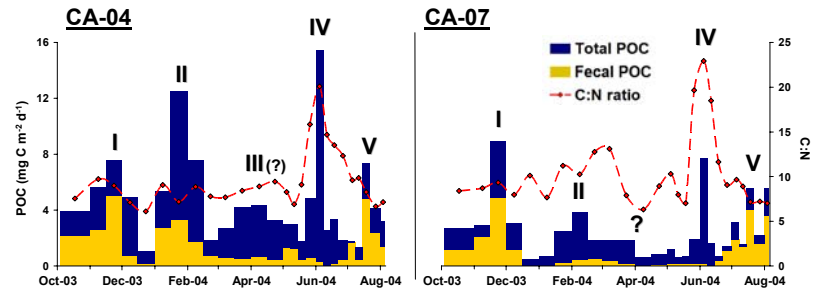
Objective : To characterize the annual cycle of total and fecal particulate organic carbon flux at two locations along the Mackenzie Shelf slope



3. Seasonal pattern of biogenic carbon sedimentation

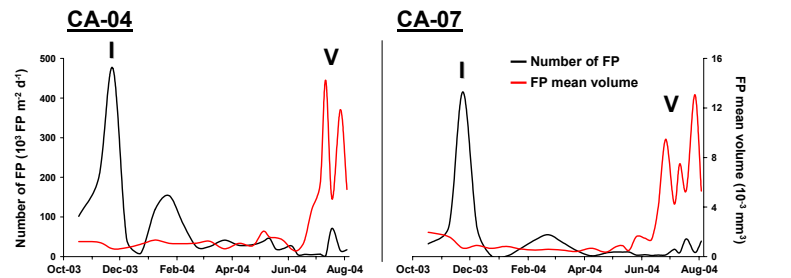
Mean fluxes	Fecal POC (mg C m ⁻² d ⁻¹)		Total POC (mg C m ⁻² d ⁻¹)		% Fecal POC / Total POC	
	CA-04	CA-07	CA-04	CA-07	CA-04	CA-07
4 Oct – 15 Dec	2.5	2.1	5.2	4.1	49%	52%
16 Dec – 21 Jun	1.0	0.2	4.8	1.7	22%	11%
22 Jun – 4 Aug	1.9	2.1	3.3	2.9	57%	71%

- Fluxes similar at the two locations in fall and summer
- Fluxes unexpectedly high in winter-spring, with distinct peaks in February and June, particularly strong at CA-04
- High C:N ratio in June indicative of terrigenous input

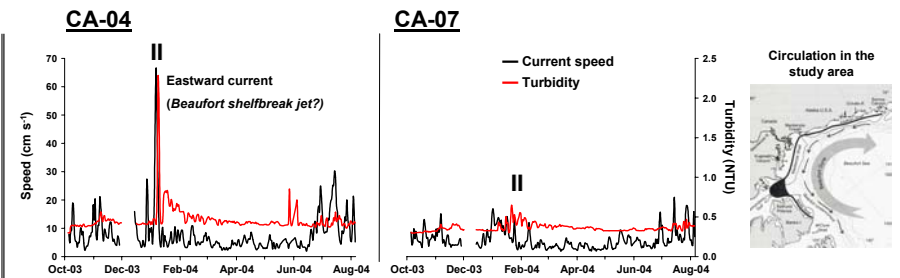


- Peak IV : terrigenous input due to the rapid expansion offshore of the Mackenzie River turbid plume in June

4. Interpretation of sedimentation peaks

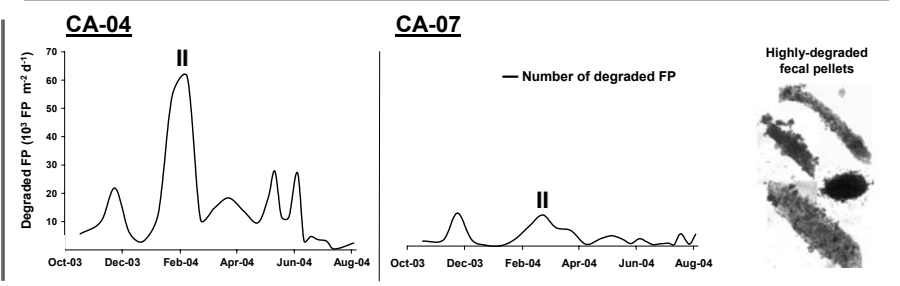
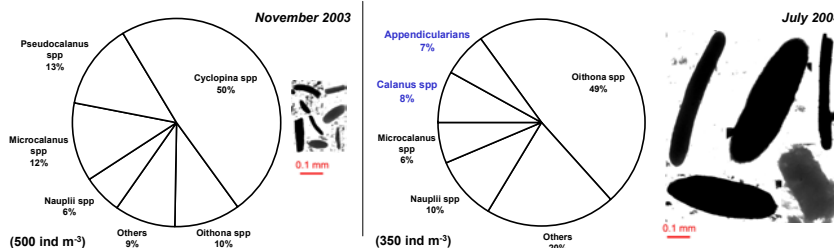


- Peaks I & V : excretion of numerous small FP in fall and few huge FP in summer explains similar fluxes (up to 70%)
- Zooplankton is dominated in fall by small omnivorous copepods whereas large grazers and tunicates are present in summer



- Peak II : resuspended material (which persisted several weeks in the water column) owing to a high-speed undercurrent
- The resuspension event is confirmed by the high amount of degraded fecal pellets in February

Fall and summer zooplankton at the shelf edge



Ingram et al., pers. com. Stein & Macdonald Eds., 2003