Downstream nutrient changes and vertical structure of the Mackenzie Estuary, NT: The Arctic River-Delta Experiment (ARDEX)

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Background

The Arctic Ocean is the world’s most river-influenced marine region1 (Fig. 1). Annual spring flooding of these rivers provides heat, nutrients and organic matter to coastal areas and coupled with nearly continuous irradiation, these conditions initiate a short and intensive growing season2. Both physical and biological processes within estuaries control the nutrient fluxes to the productive near coast. With climate-related changes in sea ice3 and river hydrology4 occurring throughout much of the Arctic, it is essential to study the current nutrient structure in order to understand how Arctic estuaries will respond.

The Mackenzie Estuary (Fig. 2) is an important environment to investigate the nutrient structure of an Arctic estuary as the Mackenzie River is the largest source of nutrients, freshwater and sediment to the western Arctic Ocean.

Objectives

Within the context of the Arctic River-Delta Experiment (ARDEX), objectives of this study were:

1.) To test the hypothesis that nutrients will deviate from conservative behaviour across the transition from fresh to saltwater.

2.) To characterize the vertical structure of the Mackenzie Estuary from river to marine environments.

Study site and methods

The overarching goal of the ARDEX cruise was to evaluate processes controlling organic matter across the Mackenzie Estuary. The cruise was comprised of a 12 site transect (4 fresh; 4 estuarine; 4 marine; Fig. 3,4) sampled from 26-Jul. to 02-Aug. 2004.

Table 1. ARDEX cruise site, sampling and analyses information.

<table>
<thead>
<tr>
<th>Site</th>
<th>Type</th>
<th>Layer Sampled</th>
<th>GF/C-filtered nutrients sampled</th>
</tr>
</thead>
<tbody>
<tr>
<td>R4-R6</td>
<td>River</td>
<td>Surface, bottom, column</td>
<td>Inorganics (NO3-, NH4, Si(OH)4, PO4-3)</td>
</tr>
<tr>
<td>R5</td>
<td>Estuary</td>
<td>Surface, bottom, pycnocline</td>
<td>Organic (DOC, DON, DOP)</td>
</tr>
<tr>
<td>R6-R7</td>
<td>Marine</td>
<td>Surface, bottom, pycnocline, chlorophyll-a max.</td>
<td>Particulates (C, N, P, TSS) Others (chl-a, SO4-2, Cl, salinity)</td>
</tr>
</tbody>
</table>

Water samples were collected at various sites and depths for nutrient analyses using clean methods (Table 1).

Conclusions

Vertical nutrient structure was well defined throughout the fresh-salt water transition zone during low flow conditions. Downstream nutrient changes through the estuary suggested that most did not exhibit conservative behaviour.

References