Channel morphology and hydraulics of East Channel within Kittigazuit Bay, Mackenzie Delta, Northwest Territories

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Introduction

River channels within the Mackenzie Delta are used as ice roads during the winter months (Fig. 1). The ice on these channels can be unstable, compromising these roads and resulting in the loss of property and life. The need to understand the stability of these channels led to this study of the morphology and hydraulics of the East Channel in Kittigazuit Bay (Fig. 3). The focus was on the channels within Kittigazuit Bay which serve as part of the route between Inuvik and Tuktoyaktuk (Fig. 4). These channels are highly linear extending out several kilometers across the bay where they abruptly terminate. It has long been believed that these submarine channels are geomorphically inactive, remnants of channels formed during the Pleistocene when sea levels where much lower.

Figure 1.
Traffic on an ice road on the Mackenzie River in the Mackenzie Delta.

Method

In March of 1986, prior to spring freshet and ice breakup, the submarine channels were surveyed, including the elevation of the snow and ice cover and the land surface and bay floor. The water level and flow velocities within these channels were also surveyed (Fig. 2). Observations were made of the ice cover across the bay. Although further study of hydrology and sedimentology was planned, work was necessarily discontinued.

Figure 2. Survey of submarine channels using Wild N2 Engineer's Level and Price WSC Winter Flow Meter.

Results and Discussion

These submarine channels are hydrologically active throughout the winter, particularly once flow is confined to these channels by bottomfast ice. Flow velocity patterns suggest a strong parallel helicoidal flow, a condition normally only seen in straight closed channels. This flow pattern would explain the presence of central channel bar within the channel. The abrupt termination of the submarine channels appeared to be associated with the limit of bottomfast ice and resulting in a sediment fan at the point of termination. Overlying ice will be most unstable as flows increase during spring prior to breakup or as tides exert backpressure.

➤ **Fluvial geomorphic features such as submarine channels in estuaries of north-flowing Arctic rivers may serve as indicators of environmental change.**

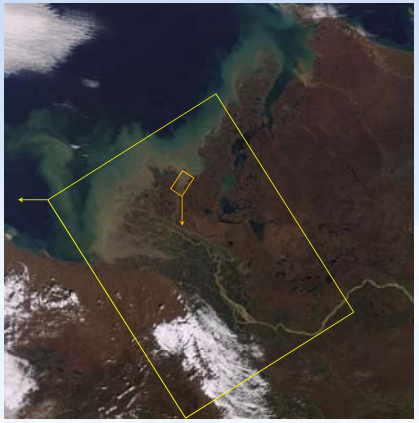


Figure 3.
(a) Map of the Mackenzie Delta showing Kittigazuit Bay. (b) Satellite image of Mackenzie Delta on August 19, 2010 with an inset of the map area.

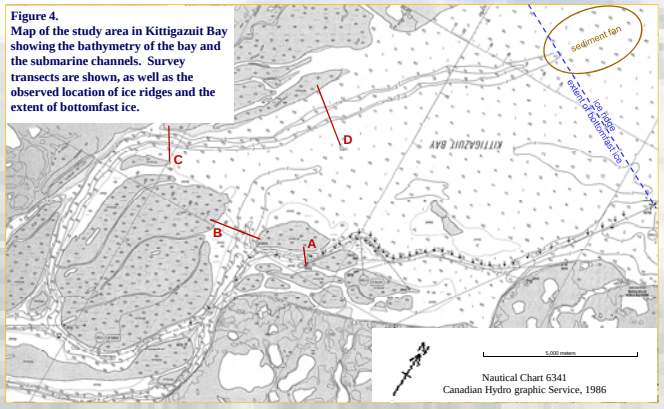


Figure 4.
Map of the study area in Kittigazuit Bay showing the bathymetry of the bay and the submarine channels. Survey transects are shown, as well as the observed location of ice ridges and the extent of bottomfast ice.

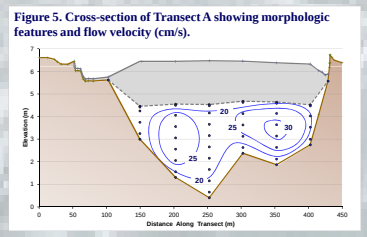
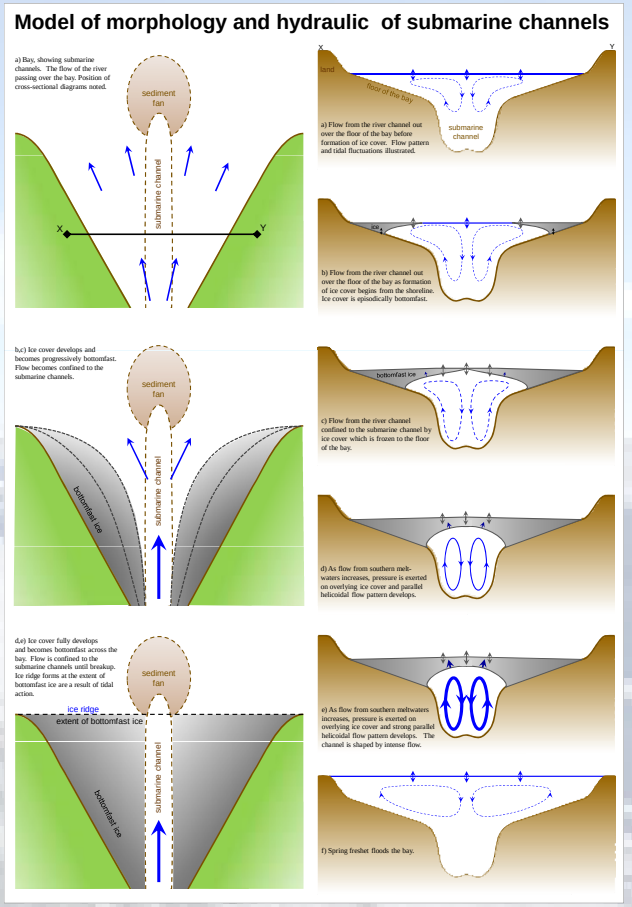


Figure 5. Cross-section of Transect A showing morphologic features and flow velocity (cm/s).

Figure 6.
View through the bottomfast ice showing the uppermost layer of sediment ripples in a sequence extending down 1.8 m to the floor of the bay, illustrating the episodic and progressive nature of the confinement of submarine channels under tidal influence.



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