Submarine preservation of massive tabular ground ice by coastal retrogressive thaw slumps

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Around the Arctic Ocean there are many stretches of coastline composed of ice-rich sediments. With the dramatic climatic, oceanic and terrestrial changes that are currently occurring, there is considerable concern over the stability of these coasts and how they are being altered. With the complexity that permafrost conditions add to the coastal setting, modelling erosion involves a more detailed understanding of the physical and thermal conditions as well as the sedimentological and wave action processes. This research examines the role that the shallow water energy balance plays in preserving sub-bottom massive ice as the coastline retreats and the implications it has for secondary subsea disturbance once the water depth increases.

The study area was Peninsula Point which is approximately 10 km west of Tuktoyaktuk, NWT, Canada. The massive ice and retrogressive thaw slumps at this location are some of the more dramatic examples of the impact of ice-rich permafrost on coastal processes in the Arctic. By mapping the area with satellite and aerial imagery and conducting repeat ground penetrating radar surveys (GPR) over a 30 year period, the long-term character of coastal retreat above, and below, the water line is revealed. In winter, the GPR was pulled behind a snowmobile along transects on land, across the shoreline and out onto the near shore area of the Beaufort Sea. This provided the stratigraphic continuity between the terrestrial and subsea settings. The GPR revealed the massive ice and sedimentary architecture, from which vertical and lateral relationships to the coastline were determined. The roles of erosion, re-sedimentation and shallow-water thermodynamics in the degradation and preservation of massive ground ice were revealed. Using this new information, modeling of the coastal retreat and sediment contributions to the ocean demonstrated a much more complex system than previously assumed.