

1. Introduction

- This study uses high-resolution 2-D seismic reflection data collected by ION Geophysical Corporation as part of the BeaufortSPAN East survey to examine the seismic stratigraphy and architecture of a 1000 km-long section of the Beaufort Sea margin, Arctic Ocean (Fig. 1A).
- Three cross-shelf troughs, representing locations of former ice streams draining the Laurentide Ice Sheet (LIS), are examined: the Mackenzie, Amundsen Gulf, and M'Clure Strait systems (Fig. 1A).
- The troughs were occupied by ice streams during the Late Wisconsinan glaciation (MIS 2) (Blasco et al., 1990; Stokes et al., 2005, 2006) and a hitherto unknown number of earlier glaciations.
- Dynamics of these palaeo-ice streams influenced ice-sheet configuration and may have forced abrupt climatic change through delivery of ice and freshwater to the Arctic Ocean (Stokes et al., 2005).

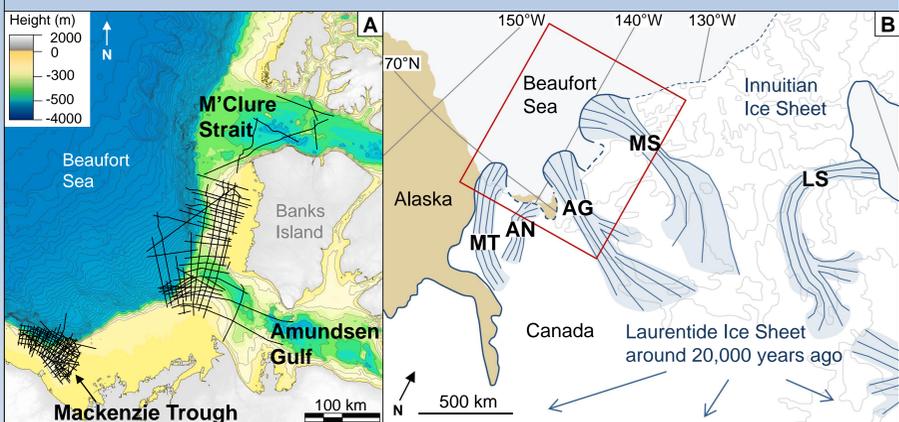


Figure 1. A: Distribution of seismic lines over IBCAO bathymetry (Jakobsson et al., 2012). Late Wisconsinan LIS (Dyke et al., 2002) with Mackenzie Trough (MT), Anderson (AN), Amundsen Gulf (AG), M'Clure Strait (MS) and Lancaster Sound (LS) ice streams (Winsborrow et al., 2004).

2. Aims

- Determine the number of Quaternary ice-stream advances through each trough.
- Examine the impact of ice advances on the shelf and slope architecture.
- Describe and interpret glacialic landforms and sediments.
- Draw comparisons between three neighbouring former ice-stream locations.

3. Results: Seismic Facies and Features

Facies	Example	Description and Interpretation	Feature	Example	Description and Interpretation
Ci		Chaotic, high amplitude reflections. Interpreted as till.	V-shaped indentations		Widths <300 m, depths <10 m. Raised berms. Interpreted as iceberg keel ploughmarks.
Cii		Chaotic, low amplitude reflections. Interpreted as till.			Widths <700 m, depths <60 m. On trough base reflector (red). Interpreted as gullies on palaeo-shelf break.
T		Semi-transparent. Interpreted as till.	U-shaped indentations		Semi-transparent asymmetric wedges. Low amplitude dipping reflections. Interpreted as grounding-zone wedges.
Si		Stratified, high amplitude reflections. Interpreted as deglacial sediment.			Trough-parallel mounds with high amplitude chaotic reflections. Interpreted as lateral moraines.
Sii		Stratified, low amplitude reflections. Interpreted as deglacial to open-marine sediment.	Asymmetric wedges		Transparent with lobate geometry. Interpreted as glacialic-debris flows.
L		Impenetrable with incoherent reflections. Interpreted as bedrock.			Impenetrable with incoherent reflections. Interpreted as bedrock.
N		Impenetrable with incoherent reflections. Interpreted as bedrock.	Trough-parallel mounds		Impenetrable with incoherent reflections. Interpreted as bedrock.
		Impenetrable with incoherent reflections. Interpreted as bedrock.			Impenetrable with incoherent reflections. Interpreted as bedrock.

Table 1. Seismic facies and features identified from seismic profiling (Fig. 1A).

Acknowledgements

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4. Results: Mackenzie Trough

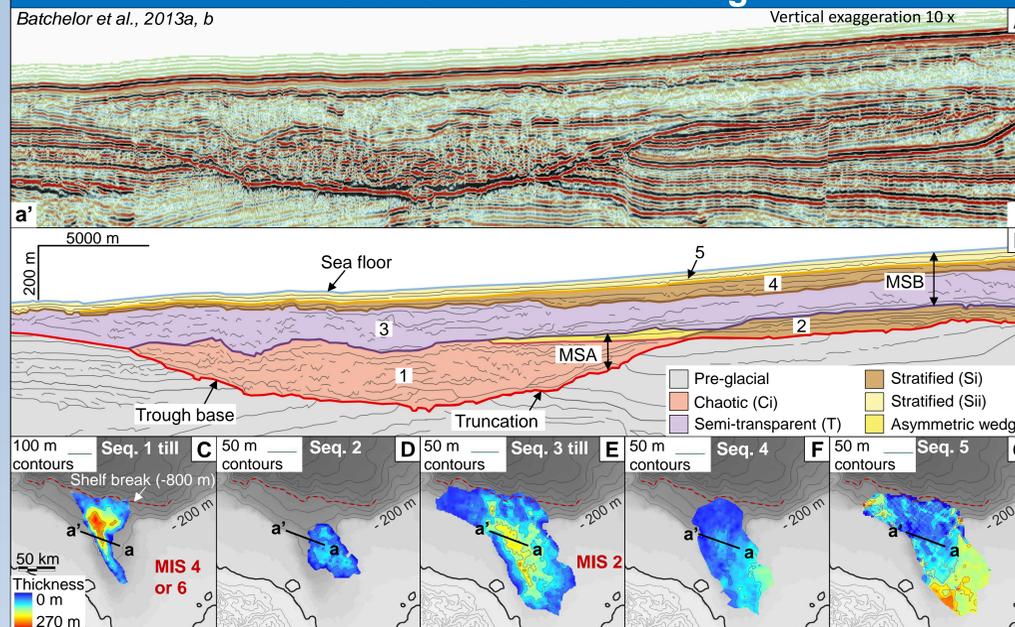


Figure 2. A: Strike line through Mackenzie Trough. B: Interpretation of seismic facies, sequences (1-5) and megasequences (A and B). C-G: Thickness of Sequences 1 to 5, respectively. Scale is same as in C.

- The trough base is identified as a high-amplitude unconformity that truncates underlying reflections (Fig. 2A and B).
- Mackenzie Trough is infilled by 500 m of sediment, divided into 5 seismic sequences and 2 megasequences (Fig. 2).
- Seq. 1:** chaotic facies, interpreted as subglacial till. Correlation with the onshore record suggests that the till was probably deposited by an ice stream during either the Early Wisconsinan (MIS 4) or Illinoian glaciation (MIS 6).
- Seq. 2:** stratified facies, interpreted as deglacial sediment.
- Seq. 3:** semi-transparent facies, interpreted as subglacial till deposited by a Late Wisconsinan ice stream (MIS 2).
- Seqs. 4 and 5:** stratified facies, interpreted as open-marine sediment.
- Canyons and thin glacialic-debris flows exist on the slope. There is no major glacial-sedimentary depocentre.

5. Results: Amundsen Gulf Trough

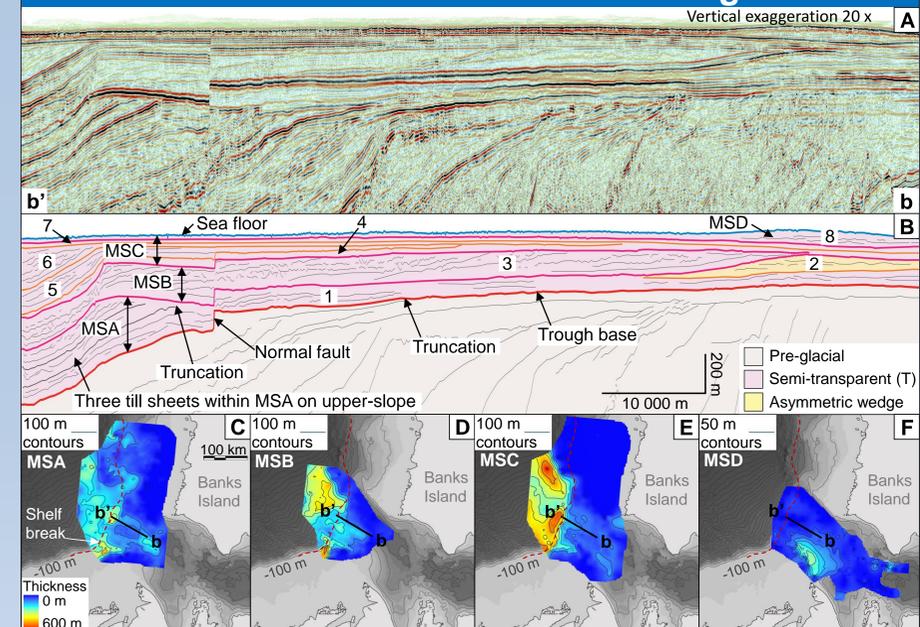


Figure 3. A: Dip line through Amundsen Gulf. B: Interpretation of seismic facies, sequences (1-8) and megasequences (A-D). C-F: Thickness of Megasequences A to D, respectively.

- Outer-shelf sediment is divided into 8 seismic sequences, categorised into 4 megasequences (Fig. 3).
- Nine till sheets are identified, suggesting at least nine ice-stream advances to the shelf break.
- A major trough-mouth fan (TMF) with a minimum volume of 10,000 km³ is present on the slope (Fig. 4).
- Megasequence D progrades in a northeast direction into the southern side of Amundsen Gulf Trough (Fig. 3F). Megasequence D may have been deposited by the Anderson ice stream (Fig. 1B) subsequent to deglaciation of the last, Late Wisconsinan Amundsen Gulf ice stream.

6. Conclusions

Mackenzie Trough

- Two till sheets provide evidence for two Quaternary ice-stream advances to the shelf break (Fig. 2).
- The ice advances probably occurred during the last, Late Wisconsinan glaciation (MIS 2), and either the Early Wisconsinan (MIS 4) or Illinoian glaciation (MIS 6).
- Buried lateral moraines and a grounding-zone wedge (Table 1 and Fig. 4) record the position of former still-stands in the ice margin.
- The slope is dominated by canyon incision and there is no TMF.

Amundsen Gulf Trough

- Nine till sheets provide evidence for at least nine Quaternary ice-stream advances to the shelf break (Fig. 3).
- Cross-shelf glaciation was probably initiated earlier in the Quaternary compared with the Mackenzie Trough to the west.
- Glacialic landforms, including a buried grounding-zone wedge, a lateral grounding-zone wedge and palaeo-shelf break gullies, are identified within the trough (Table 1 and Fig. 4).
- A major TMF is present on the slope (Fig. 4).
- The youngest till sheet, MSD (Fig. 3F), may have been deposited by the Anderson ice stream (Fig. 1B), suggesting that reorganisation of the northwest sector of the LIS may have occurred during the last deglaciation.

M'Clure Strait Trough

- A lateral grounding-zone wedge is present at the southern trough margin (Fig. 4).
- Swath bathymetry data suggest that a TMF with a minimum volume of 60,000 km³ is present on the slope (Fig. 4).

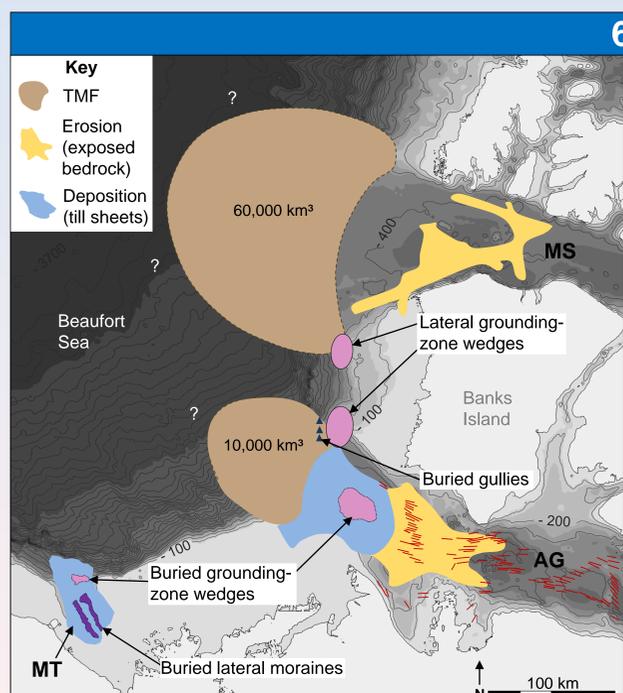


Figure 4. Glacialic landforms and zones of erosion and deposition derived from seismic data in Fig. 1A. Red lines are streamlined sea-floor landforms from MacLean et al. (2012).

7. References

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