

Sediment features at the grounding zone and beneath Ekström Ice Shelf, East Antarctica, imaged using on-ice vibroseis

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Introduction

The grounding zone - where an ice sheet becomes a floating ice shelf - is a key threshold region for ice flow and stability. A better understanding of ice dynamics and sediment transport across such zones will improve knowledge of contemporary and palaeo ice flow, as well as past ice extent.

It is common to map geomorphological sediment features in front of ice shelves, using geophysical methods, but much less is known about the landforms beneath modern day ice shelves. Here we present a "first look" at an extensive grid of seismic reflection data collected on Ekström ice shelf in the 2016/17 season. A wide variety of sediment features are clearly imaged, which will allow us to map and determine the properties of flow features, determine sub-ice shelf bathymetry and reconstruct past ice flow.

Data

During the 2016/17 field season ~280 km of seismic reflection vibroseis data was collected in a pseudo-3D grid, over a 25-day period (Fig. 1). The method of collection using a snowstreamer and vibroseis source is much quicker than conventional explosion seismics, allowing for a high volume of data collection.

- **Seismic source:** 9 tonne EnviroVibe vibroseis truck, mounted on a polysled. Sweep 10-220 Hz. Shot point interval for all data shown here is 125 m, some data was collect with shot point intervals of 75 m and 50 m

- **Receivers:** All data was acquired using a 1500 m long AWI snow-streamer (Eisen et al., 2015) containing 60 channels at 25 m spacings. Source-receiver offset was 52.5 m

- **Recording parameters:** 15 s record with 1 ms sample interval

All data shown here is unmigrated stacked data - hot off the snow!

Summary of "First Look" Observations

- Basin with dipping bedding in shallower eastern part of survey area. Bedding dips towards the shelf edge (Line 101) and East (Line 104).

- Sea floor bathymetry deepens to the West of survey area, bed also becomes rougher, containing multiple MSGL-type features. The deepening coincides with surface ice ridges - combined with MSGL-features this is indicative of faster ice flow in this area

- Bed becomes rougher inland in to the West of survey area (Lines 109, 106, 105)

- Sediment wedge at ice front seen on Lines 101 and 109.

What next.....

- Determine seismic properties of sediment features to inform future sub-shelf drilling program

- Migration and depth conversion to improve sub-surface image

- "3-D" bathymetry mapping of sea floor

- "3-D" mapping of sea floor and sub-surface sediment features

Flow Lines

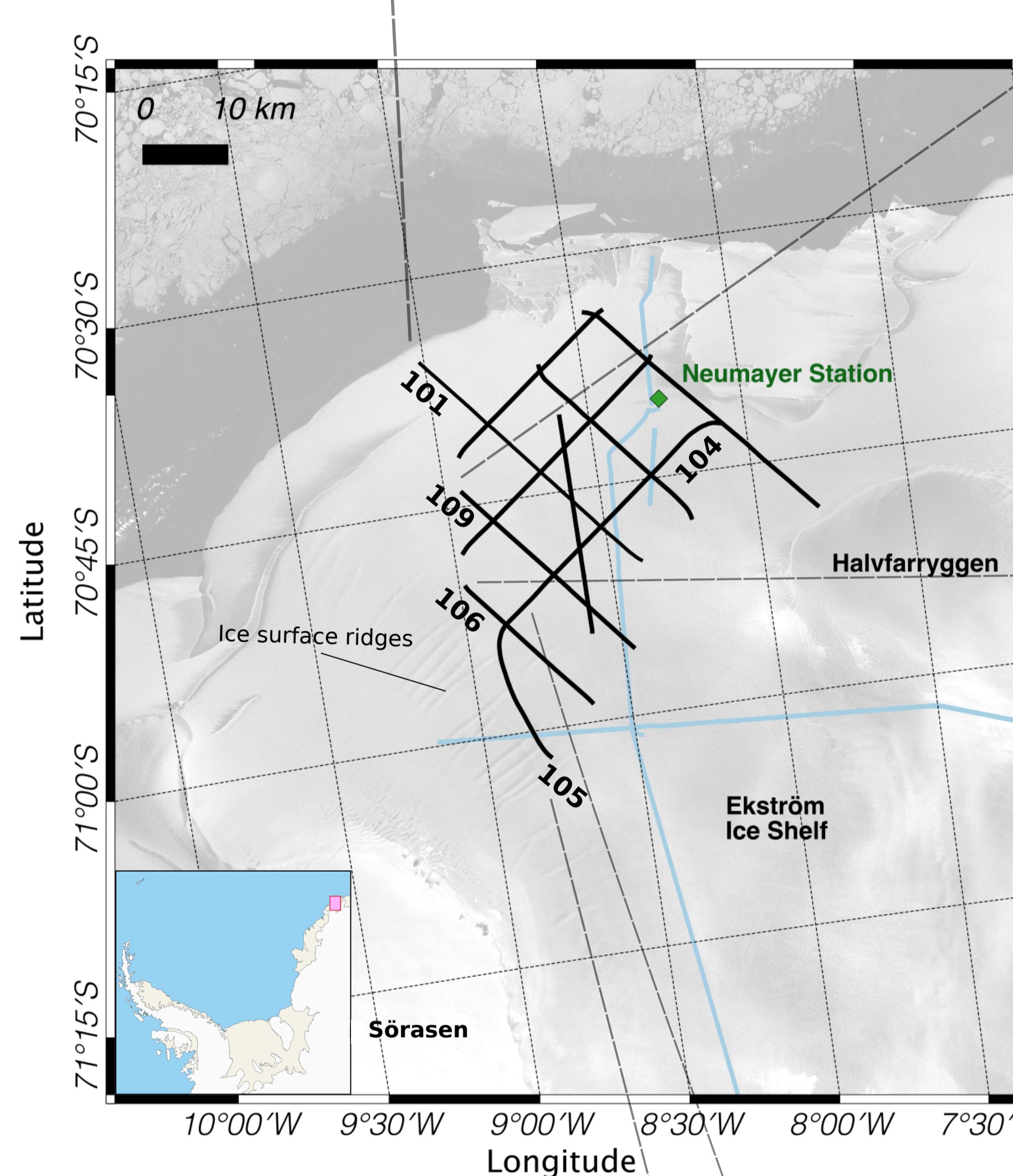
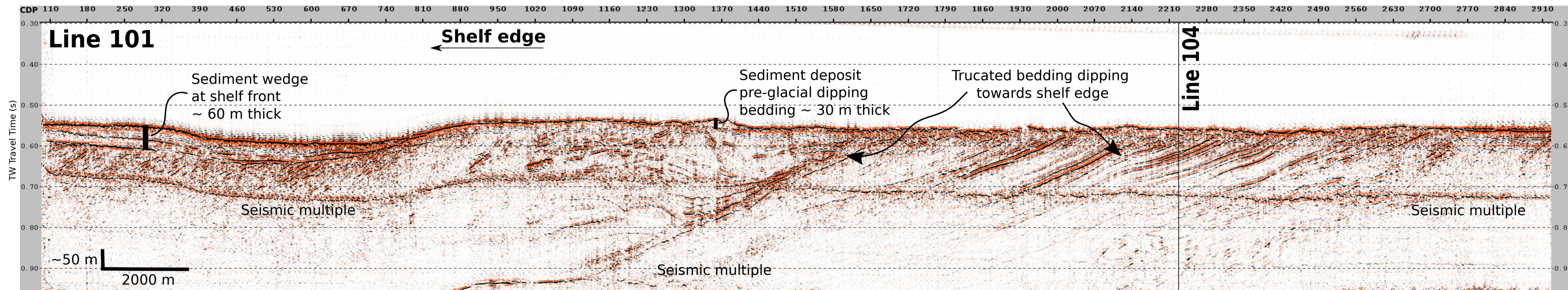
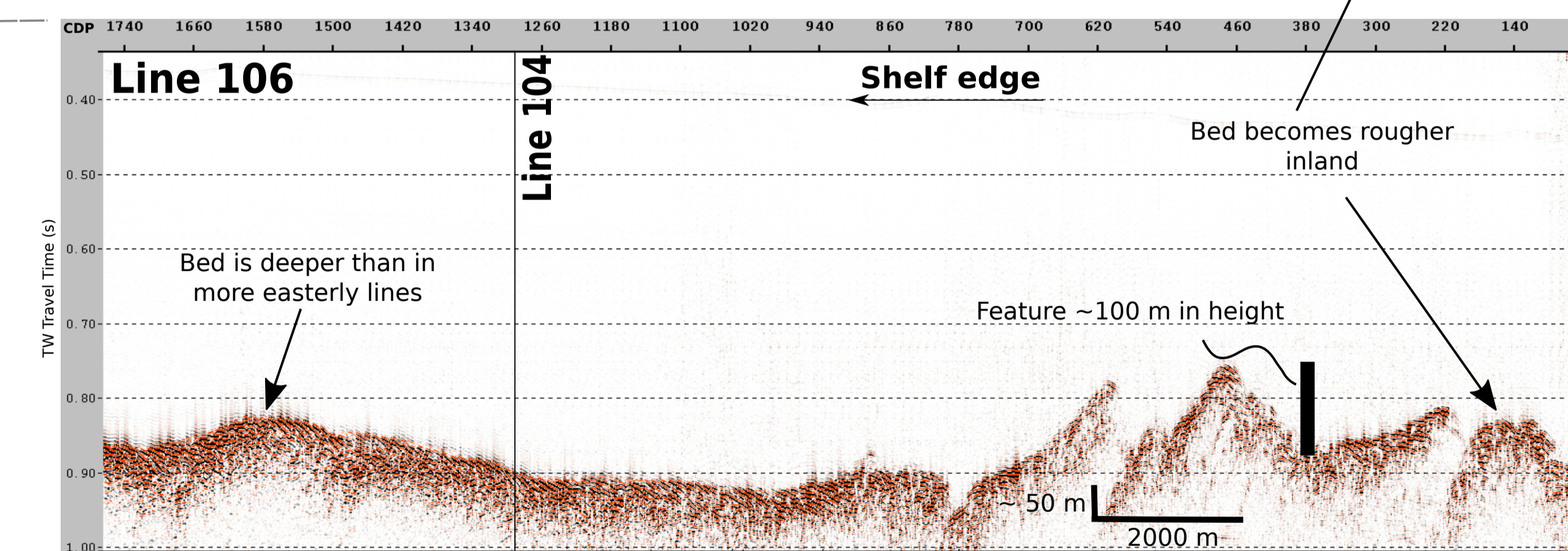
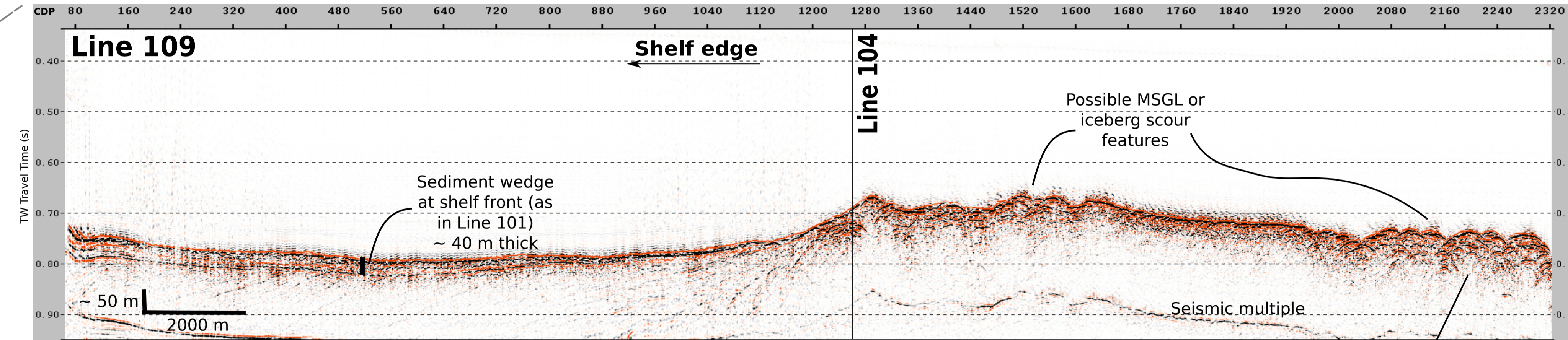
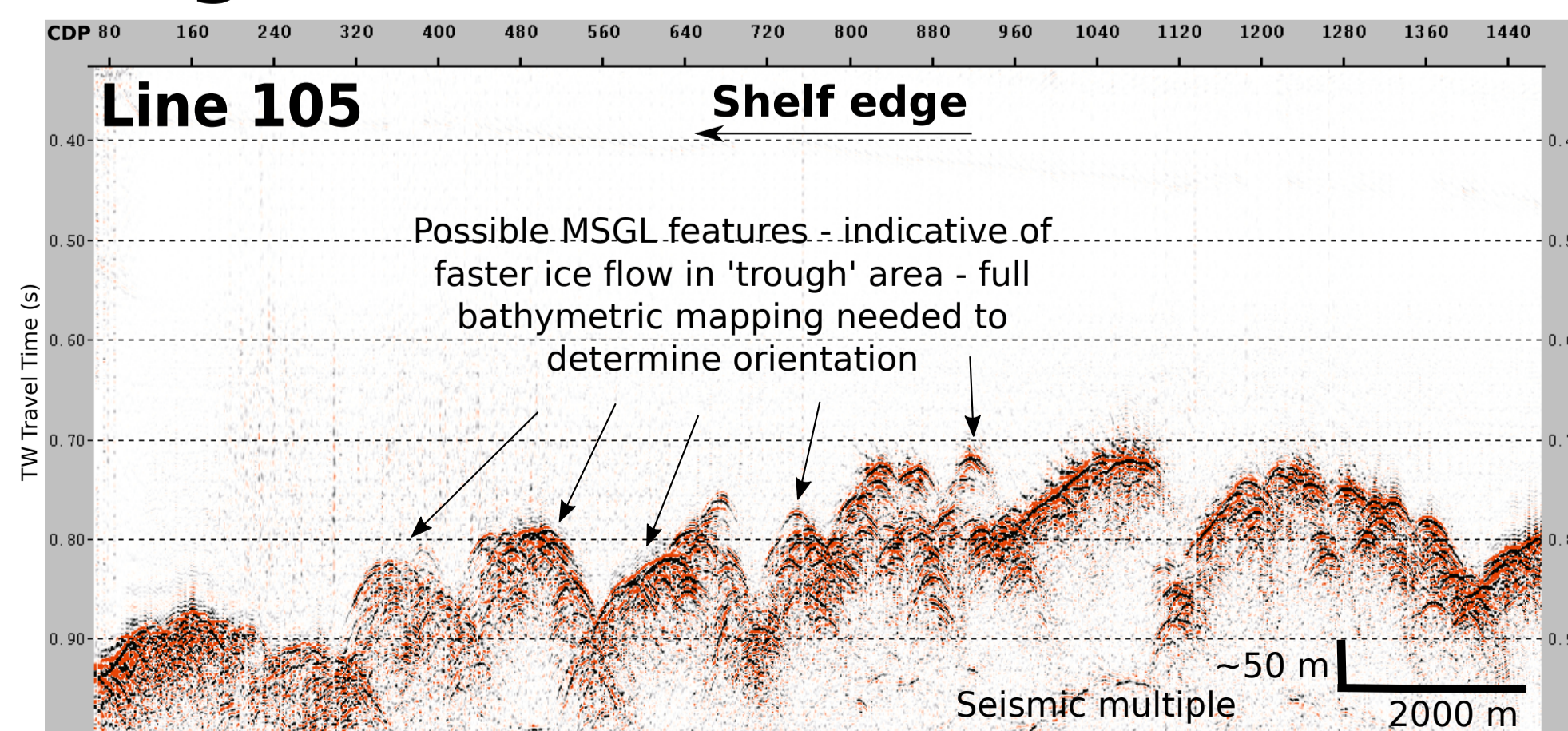


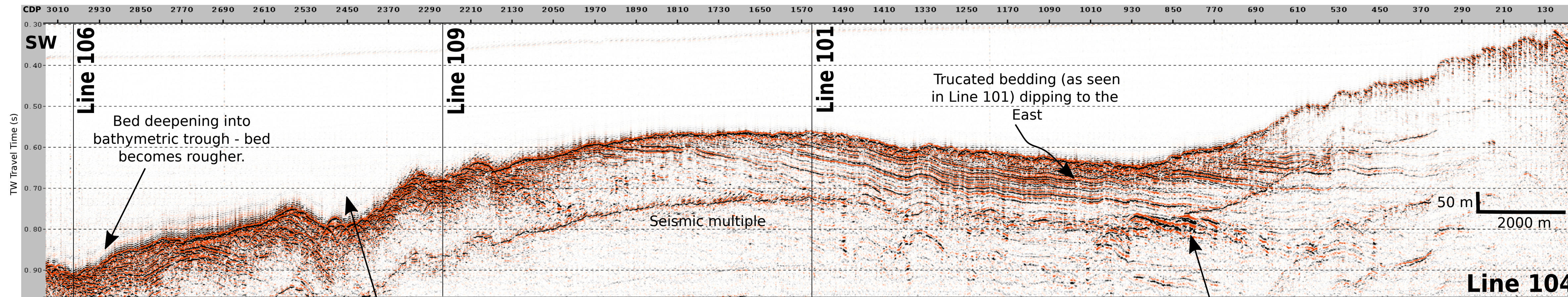
Figure 1: Map of the survey area on Ekström ice shelf, East Antarctica. The black lines indicate data acquired during the 2016/17 season. Blue lines indicated older data from 2010, 2011 (Kristoffersen et al., 2014) and 2014 (Eisen et al., 2015) field campaigns. Neumayer Station is marked in green for reference. Seismic lines with data examples are labelled with their line numbers and thin dashed lines connect approximate points on the map to data examples. Inset: Location of study area in red box.



Diagonal Line



Cross Flow Line



Volcanic Explora wedge (see Kristoffersen et al., 2014)

References

Eisen, O., C. Hofstede, A. Diez, Y. Kristoffersen, A. Lambrecht, C. Mayer, R. Blenker, S. Hilmarsson (2015), On-ice vibroseis and snowstreamer system for geoscientific research, *Polar Science*, 9, 51-65, 10.1016/j.polar.2014.10.003
 Kristoffersen, Y., C. Hofstede, A. Diez, R. Blenker, A. Lambrecht, C. Mayer, O. Eisen (2014), Reassembling Gondwana: A new high quality constraint from vibroseis exploration of the sub-ice shelf geology of the East Antarctic continental margin, *J. Geophys. Res. Solid Earth*, 119, 9171-9182, doi:10.1002/2014JB011479