Seismic exploration of the sub-ice continental shelf using a vibroseis source, Dronning Maud Land, Antarctica

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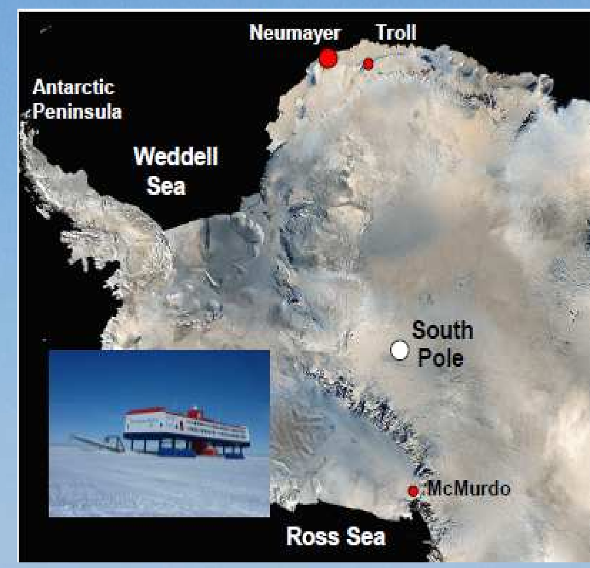
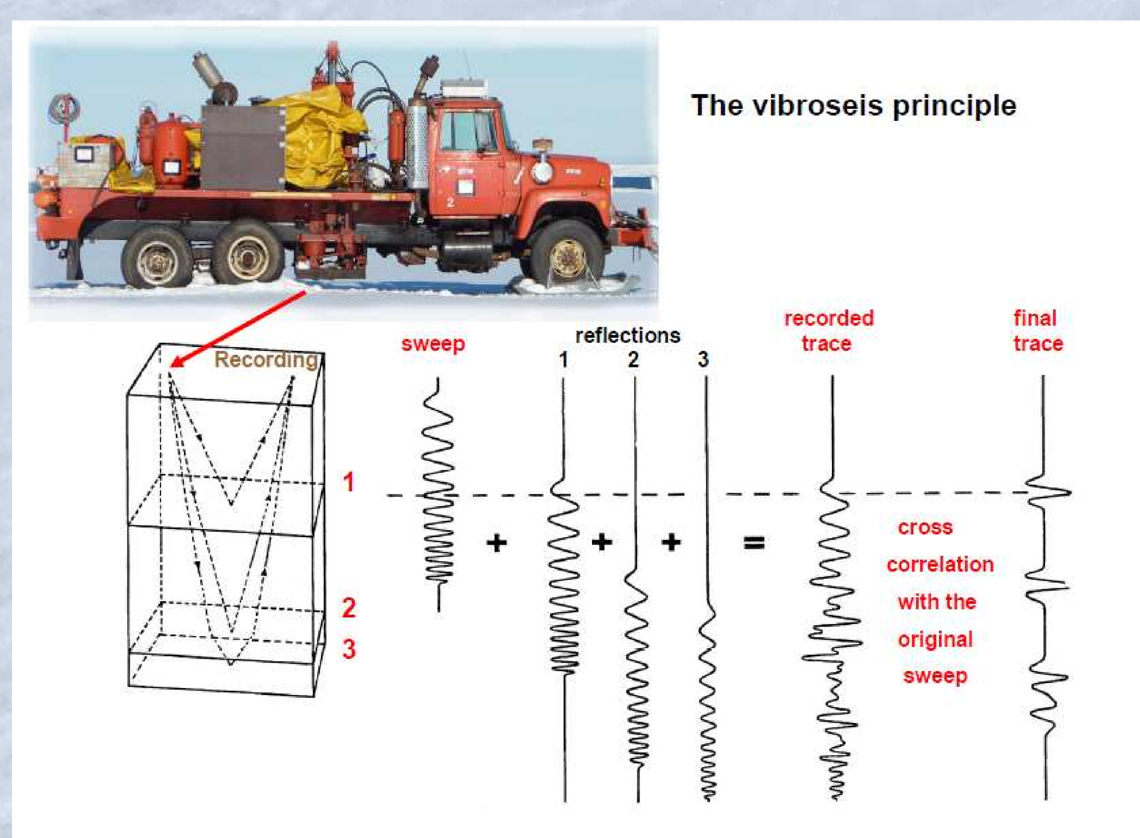


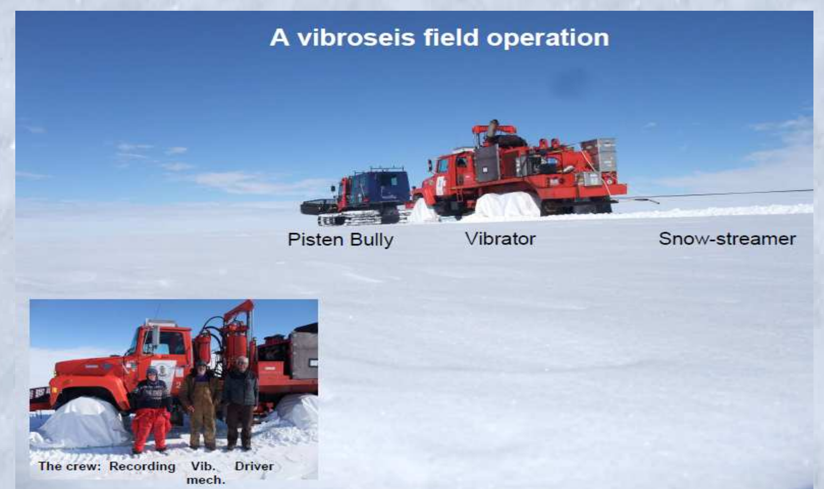
Abstract

A vibroseis source and a 1.5 km snow streamer pulled by a track vehicle have been used to acquire a 90 km long transect of multichannel seismic reflection data across the continental shelf at the location of Neumayer Station, Dronning Maud Land. The 2.5 sq.m. pad of the 12 ton peak force truck mounted vibrator on skies rarely sank more than 15 cm into the snow for 10-100 Hz sweeps of 10 second duration. and yielded useful signal/noise ratios down to 2 seconds two-way travel time. We maintained a production rate of ca. 20 km/day for 8-fold data. The sea bed below the Ekstrøm Ice Shelf is an erosional surface with no resolvable cover of younger sediments except irregular < 100 meter thick accumulations within 5 km of the grounding line. A strong reflection event at about 2 sec. depth (TWT) below the outer continental shelf can be associated with the top of the volcanic Explora Wedge and followed to outcrop about 13 km south of Neumayer Station.

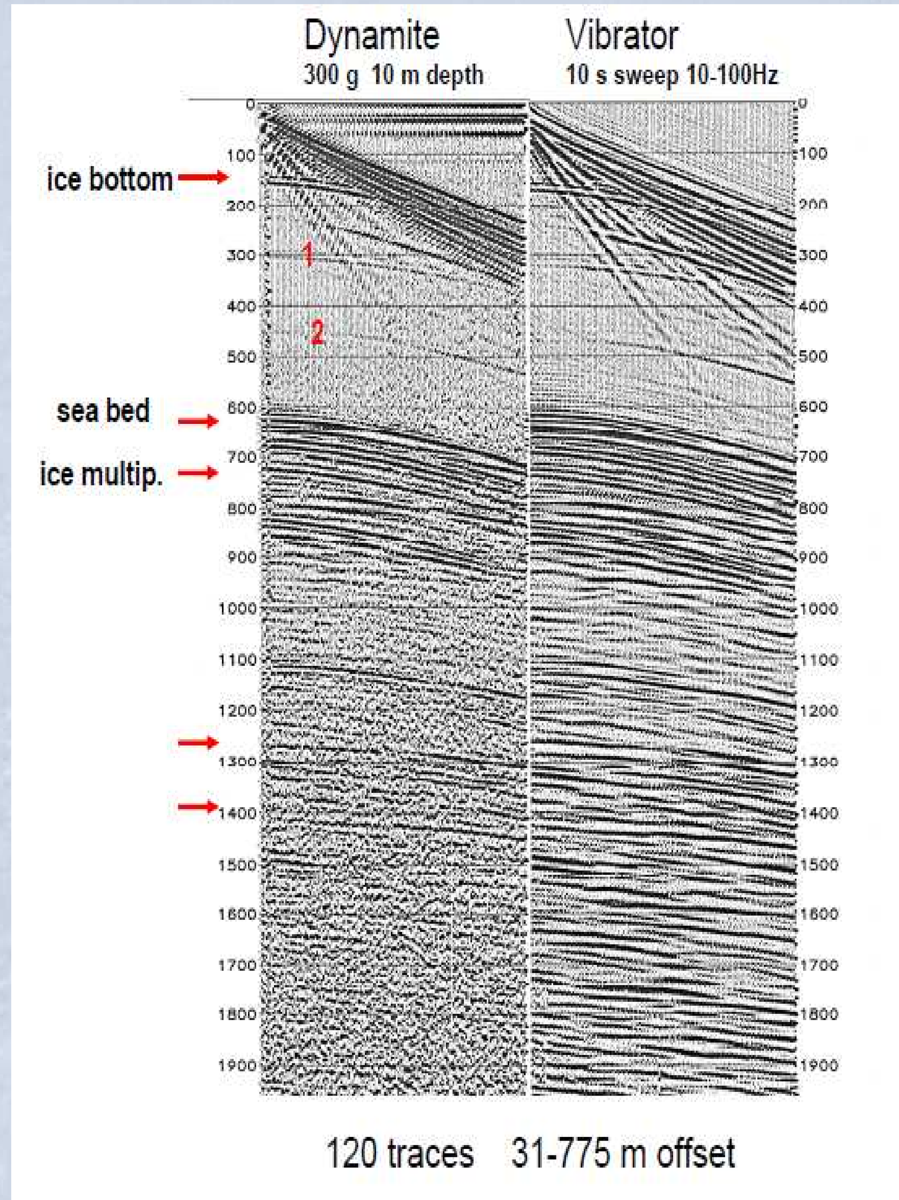
The vibroseis method



The vibrator generates a known signal which is cross correlated with the recorded trace to obtain a zero phase image of reflecting interfaces

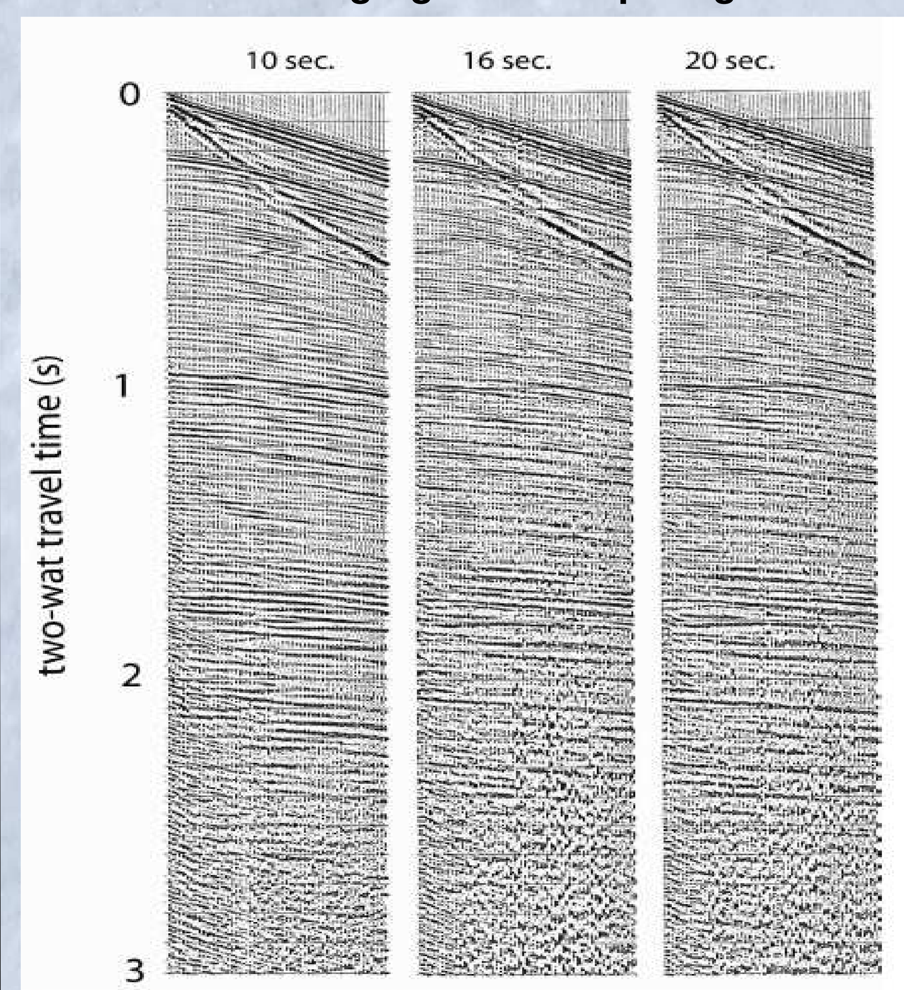


Signal characteristics



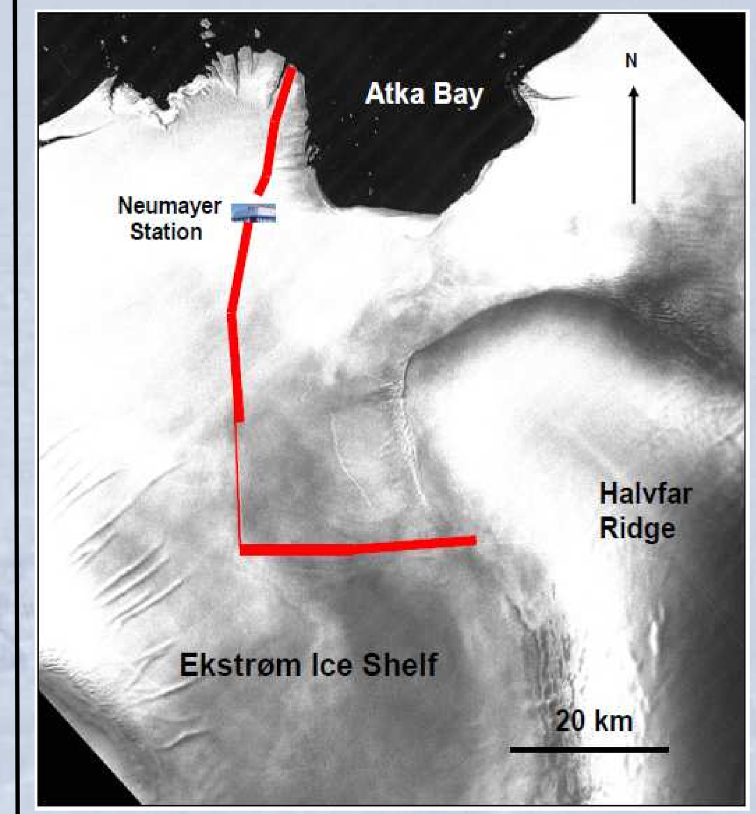
The dynamite signal is richer in higher frequencies compared to the band limited vibroseis signal

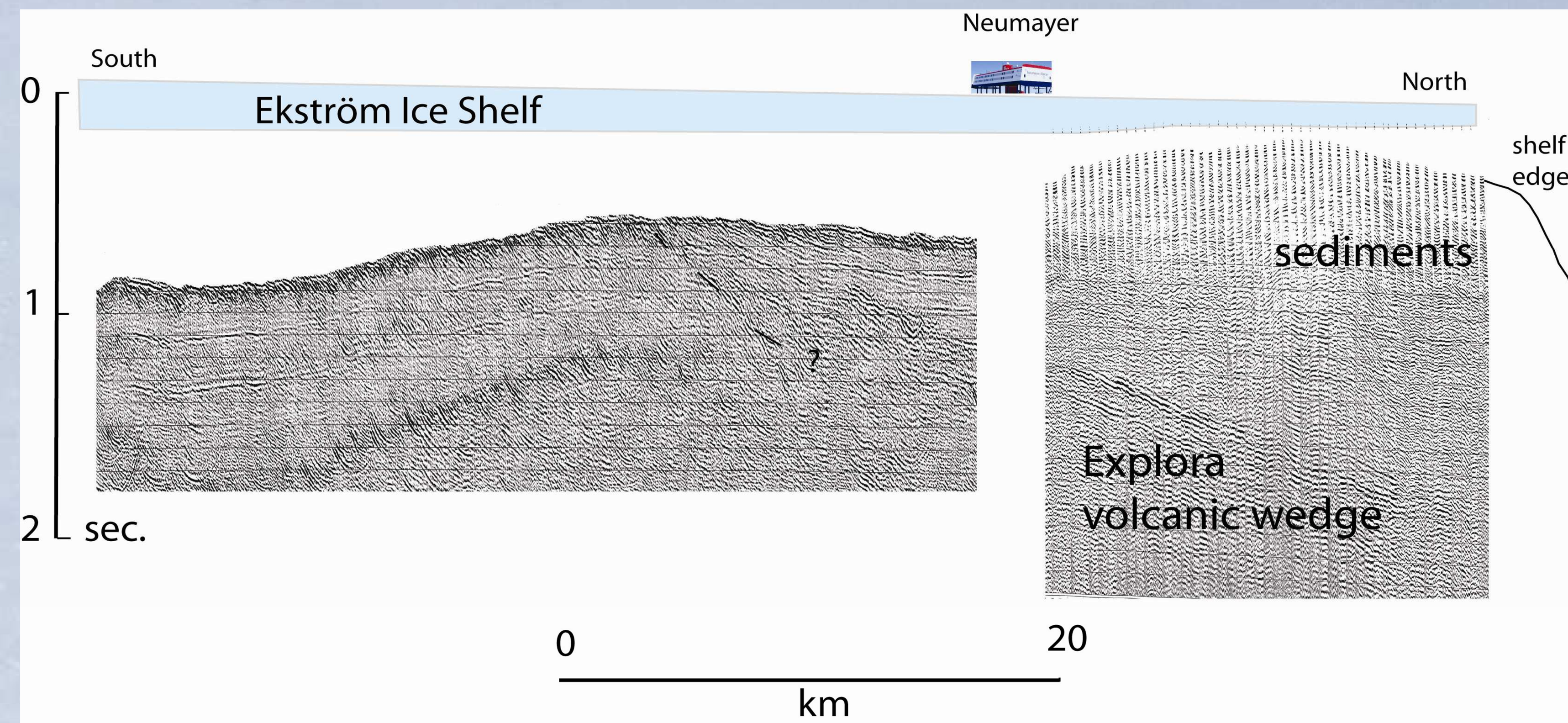
Changing the sweep length

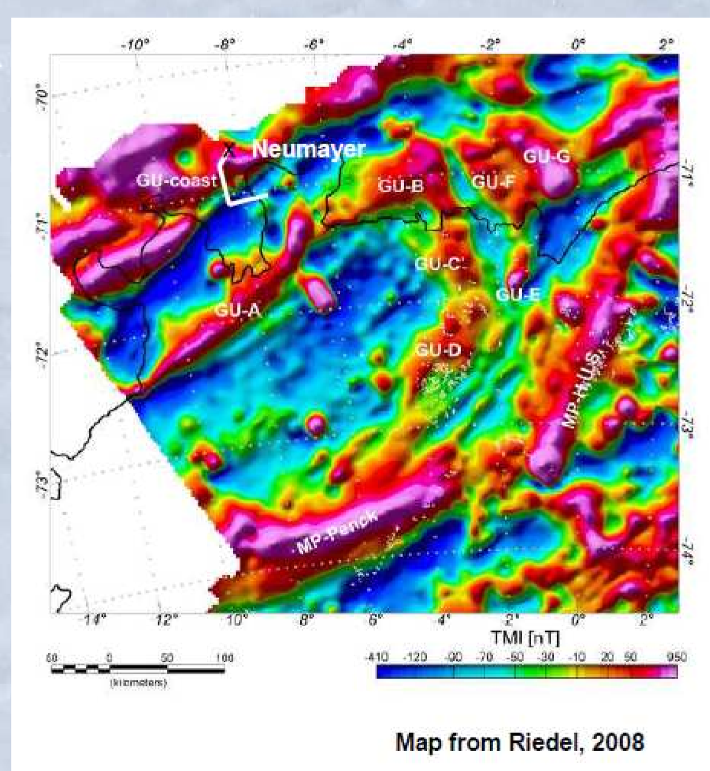


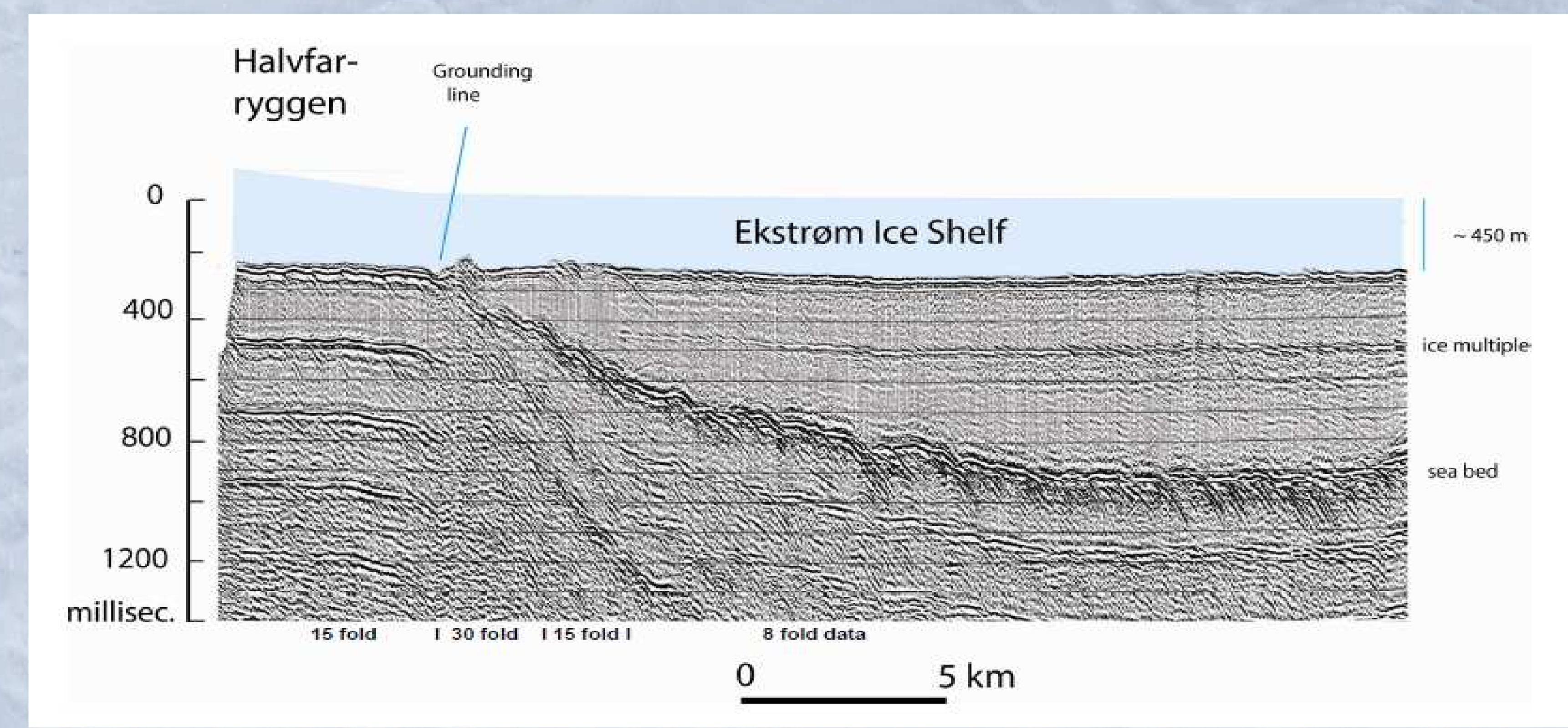
Changes in signal to noise vary little with Increasing sweep lengths

Results









Conclusions

Use of vibrators for exploration of the sub-ice geology on the Antarctic continent have the advantage of low environmental impact and reduced data acquisition costs. The operation of a vibrator and snowstreamer pulled by a snow cat require 3-4 persons and can achieve a production rate of > 20 km/day for 8 fold data.

Future vibroseis operations may have objectives such as:

i) exploring for sub-ice sediment accumulations suitable for sampling by scientific drilling,
ii) tying together offshore and onshore geology
iii) the physical properties of the ice-bedrock interface,
iv) grounding line processes, basal debris layers and marine ice,
v) surveys of sub-glacial lake settings,

Acknowledgements

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