Research using the North Pole Fibre infrastructure

by Martin Landrø
The two fibre optic cables offshore Svalbard

These fibres are being used by:

- CGF (Centre for Geophysical Forecasting, NTNU)
- SUBMERSE (EU Tech01 project)
- Sea Sounds (EU ITN project)

JAMSTEC in Japan is a partner in CGF
Sensing whales, storms, ships and earthquakes - Arctic fibre-optic cable
Blue whale interferometry: Subsurface reflections

(a) Time (s)

(b) Waterborne direct wave

(c) Subsurface-reflected wave

(d) Waterborne multiples

Waterborne multiples with a subsurface reflection

Subsurface-reflected wave

Waterborne multiples with a subsurface reflection

Destructive interferences introduced by the sea surface

Destructive interferences likely introduced by a thin subsurface layer
The 2022 CGF Svalbard field campaign: Using 4 interrogators
The 6th February Turkey Earthquake recorded offshore Ny Ålesund. Filter 0.1 to 3 Hz
24 fin whale calls recorded simultaneously on both cables
Tracking several fin whales for 5 hours
Low frequency DAS – Distant storms

Munk, 1963:

1: Edouard 4100 km
2: Offshore Brazil, 13000 km
3: Storm between Iceland and Greenland 2400 km
4: Offshore Brazil, 11 000 km

31 scientists in the group
Basalt is more conductive due to seawater.

Shallow resistivity variations controlled mainly by fluid content (seawater) in basaltic crust.

Deep resistivity variations controlled by melt (basalt) content in peridotite mantle.

Deep electrical imaging of the ultraslow-spreading Mohns Ridge

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We are interested in data close to the polar spreading ridges.
Mid-Atlantic ridge sensing infrastructure
Oceanic lithosphere and upwelling asthenosphere imaged to 120 km depth

Shallow resistivity variations controlled mainly by fluid content (seawater) in basaltic crust

Deep resistivity variations controlled by melt (basalt) content in peridotite mantle
Summary

• Ocean floor DAS:
  • Efficient tool for tracking of whales:
    • Need to develop efficient and fast algorithms (huge amount of data)
    • Potential tool to avoid/reduce amount of ship strikes
  • Oceanography (distant storms, ocean currents, ...)
  • Seismological studies (earthquakes, gas flares, explosions,..)

• Present range of DAS is 100-150 km – need amplifiers every 100 km => under development
• Possible to combine DAS and telecommunication in near future

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References


• Landrø, M. et al., 2022, Sensing whales, storms, ships and earthquakes using an Arctic fibre optic cable, Sci Rep 12, 19226.


• Rørstadbotnen, R. et al., 2023, Simultaneous tracking of multiple whales using two fibre-optic cables in the Arctic, Front. Mar. Sci. 10, 3389