On-ice Vibroseis: What lies beneath Ekström Ice Shelf, East Antarctica?

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Sub-EIS-Obs: Vibroseis on ice

What?
• ~700 km of seismic vibroseis surveys

Why?
• Evidence of paleo-ice flow and retreat
• Geological history of region
• Ice-ocean interaction
• Predictions of SLR contribution
Sub-EIS-Obs: Vibroseis on ice

What?
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Sub-EIS-Obs: Vibroseis on ice

Key Findings:

- Sea-floor trough
- Glacial debris deposits 10-60 m thick
- Volcanic Explora wedge outcrop imaged
- Other features of ice flow and retreat
Motivation

The sea-floor and sub-sea floor topography beneath Antarctic ice shelves holds a wealth of information:

- Sea floor topography -> past ice dynamics
- Sub-sea floor -> geological history
- The shape of the cavity -> implications of ocean circulation and ice melt

So how do we „see“ beneath the ice shelf?

Seismic reflection vibroseis data collected between (2010 -2018) on Ekström ice shelf used to map the sea-floor bathymetry and sub-sea floor structures.
Vibroseis on ice!

Eisen et al., *Polar Sci.*, 2015

**1. Motivation**

**2. Method – Vibroseis on Ice**

- **Sweep:** 10 – 220 Hz
- **Time:** 10 seconds

**3. Location and Data**

- **SPs:** 75 – 750 m
- **Distance:** 1500 m, 60 channels
Ekström Ice Shelf

1. Motivation
2. Method – Vibroseis on Ice
3. Location and Data

Please click to view seismic data
1. Motivation

2. Method – Vibroseis on Ice

3. Location and Data

2017 – SP 125 m (6 fold)

Interpretation ON

Interpretation OFF
1. Motivation

2. Method – Vibroseis on Ice

3. Location and Data

2017 – SP 125 m (6 fold)

Interpretation ON

Interpretation OFF

Two-way travel time (ms)

Sea floor
Base glacial debris
Explora wedge

Sediment wedge
Glacial debris
Truncated dipping sediment

Seismic multiple
Volcanic Explora wedge

Sea floor depth
on sea ice surface

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1. Motivation

2. Method – Vibroseis on Ice

3. Location and Data

2017 – SP 125 m (6 fold)

Interpretation ON

Interpretation OFF

Two-way travel time (ms)

<table>
<thead>
<tr>
<th>400</th>
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Seismic multiple

Truncated dipping sediment

Glacial debris

Base glacial debris

Sea floor

Explora wedge

Volcanic Explora wedge

50 m

2500 m
1. Motivation

2. Method – Vibroseis on Ice

3. Location and Data

2017 – SP 125 m (6 fold)

Interpretation ON

Interpretation OFF

Two-way travel time (ms)

400
600
800
1000

~50 m

2500 m

Seismic multiple

Glacial debris

Truncated dipping sediment

Base glacial debris

Explora wedge

Volcanic Explora wedge
2018 – SP 125 m (6 fold)

Interpretation ON

Interpretation OFF

Seismic multiple

Truncated dipping sediment

Glacial debris

Volcanic Explora wedge

Seafloor depth (in meters)
2018 – SP 125 m (6 fold)

Interpretation ON

Interpretation OFF

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2018 – SP 75 m (10 fold)

Interpretation ON
Interpretation OFF

Two-way travel time (ms)

- Sea floor
- Base glacial debris
- Explora wedge

- Sediment wedge
- Volcanic Explora wedge
- Seismic multiple

- ~50 m
- 3000 m
- Back to Map >
2018 – SP 75 m (10 fold)

Interpretation ON

Interpretation OFF

Two-way travel time (ms)

Sediment wedge

Volcanic Explora wedge

Seismic multiple

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2014 – SP 750 m (1 fold)

LOCATION & DATA

1. Motivation
2. Method – Vibroseis on Ice
3. Location and Data

Back to Map >

Interpretation ON
Interpretation OFF

Two-way travel time (ms)

Sea floor
Base glacial debris
Explora wedge

Seismic multiple

~50 m
3500 m
1. Motivation

2. Method – Vibroseis on Ice

3. Location and Data

2014 – SP 750 m (1 fold)

Interpretation ON

Interpretation OFF

Back to Map >
1. Motivation
2. Method – Vibroseis on Ice
3. Location and Data

2017 – SP 125 m (6 fold)

Interpretation ON
Interpretation OFF

Two-way travel time (ms)

- Sea floor
- Base glacial debris
- Explora wedge

Sediment wedge
Truncated dipping sediment
Volcanic Explora wedge

Seismic multiple

~50 m
2000 m

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2017 – SP 125 m (6 fold)
2017 – SP 125 m (6 fold)

1. Motivation
2. Method – Vibroseis on Ice
3. Location and Data

Interpretation ON
Interpretation OFF

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2017 – SP 50 m (15 fold)

**1. Motivation**

**2. Method – Vibroseis on Ice**

**3. Location and Data**

- **Two-way travel time (ms)**
  - 600
  - 800

**Interpretation ON**

**Interpretation OFF**

**Back to Map >**

- **Location & Data**
  - **Seismic multiple**
  - **Glacial debris**
  - **Truncated dipping sediment**
  - **Volcanic Explora wedge**
  - **Base glacial debris**
  - **Sea floor**

- **Explora wedge**

- **~50 m**

- **1500 m**

- **2017 SP 50 m (15 fold)**

- **Interpretation ON**

- **Interpretation OFF**

- **Location & Data**

- **Back to Map >**
2017 – SP 50 m (15 fold)

Interpretation ON

Interpretation OFF

1. Motivation

2. Method – Vibroseis on Ice

3. Location and Data

Two-way travel time (ms)

Glacial debris

Truncated dipping sediment

Seismic multiple

Volcanic Explora wedge

~50 m

1500 m
2017 – SP 125 m (6 fold)
2017 – SP 125 m (6 fold)

Interpretation ON

Interpretation OFF

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Whoops – you are at THE END!
Click to return to main menu