Geophysical Observations of Deformation Near The Grounding Line of Beardmore Glacier
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Major Pathway for Ice Exiting EAIS via RIS

Two Field Seasons
2012: Mid-Glacier
2013: Grounding Zone

Rignot et al 2011
MOA, nsidc
Major Pathway for Ice Exiting EAIS via RIS

Two Field Seasons
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Paul Winberry
Grounding Zones
Regulate Retreat

Complex Ice-Ocean Interaction

Ross Ice Shelf

WorldView from Polar Geospatial Center
2012 Airborne Radar Survey to Map Ice Thickness

Airborne Radar

10 km
2013 Ground Based Radar Survey to Map Ice Thickness
Combined Tracks

10 km
Phase Sensitive Radar
Survey to Map Ice Basal Melt (more ice deformation) see Twit at AGU
Active Source Seismic to map Water Column Thickness and Subglacial Geology
Passive Source Seismic to Monitor Ice Deformation and Motion
Continuous GPS to study Tidal Deformation and Motion

Paul Winberry
"Large" Channels carved into the bottom of the ice

Important for understanding basal melting of ice shelves

Formation? inherited, subglacial discharge, oceanographic

Le Brocq et al 2013
Melt Channels

May Weaken Ice Shelves

Vaughn et al. 2012
Imperfections created near grounding zones are advocated downstream.

Appear to influence calving.

Hulbe and Fahnestock 2007
Ridges appear in imagery that appear to be channels.
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Surface Elevation Across Ridge Trough
Seismic Reflection Image

Channels on Beardmore

Distance Along Profile (m)

Two Way Travel Time (s)

0
500
1000
1500
2000

0.3
0.4
0.5
0.6
0.7
0.8
0.9

10 km

650 m of ice

850 m of ice

Ice Bottom

Ocean Bottom

650 m of ice

850 m of ice
Radar profiles show the channel growing down flow.
Flow is Modulated by the Tide (see Marsh et al, 2013)

Fast On the Falling Tide (~5km from GL)

Minimal ~15 km down flow
Passive Source
Seismic
Record
Thousands of Ice Fracturing Events

Can we use to understand the Deformation of the ice shelf? Ala Fricker, Bassis amongst others
First thing we do is count.

Second, we plot versus time.

*Clear Tidal Pacing*

*Falling Tide Peak*

*Rising Tide Peak*
Next Thing we Do is Locate Events
Seismic Activity and Tidal Pacing

"Two" Clusters

Paul Winberry
Seismic Activity and Tidal Pacing

Grounding Line Events on Falling Tide
“speed up of ice shelf”

Ice Shelf Events on Rising and Falling Tide
“Far” from the Grounding Ice Shelf is still not Hydrostatic

Limit of Flexure from Marsh et al, 2014
“Far” from the Grounding Ice Shelf is still not Hydrostatic

Limit of Flexure from Marsh et al, 2014
Tidal Flexure is important see next talk