ACTIVE AND UPCOMING SEISMIC INVESTIGATIONS OF THE WESTERN CANADIAN ARCTIC







Geological Survey of Canada







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L. Murray-Burquist, plus many others...





Ressources naturelles Canada

THE CANADIAN ARCTIC AND ARCTIC GATEWAY



- Wide variety of tectonic environments
- Critical economic importance: Shield regions host numerous diamond deposits, offshore basins potential oil and gas reservoirs
- Northwest Passage: with loss of sea ice, rapid increase in ship traffic already occurring
- Elevated seismicity and hazard





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SEISMIC HAZARD ACROSS CANADA







CANADA/AMERASIA BASIN





Pease et al, Tectonophysics 2014

Northern Canadian Cordillera



Hyndman et al., CJES 2005





THE SOUTHWEST CANADIAN ARCTIC



Banks Island Seismograph Network 2015 -







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What is the tectonic affinity of Banks Island?

- Extended continental margin or Arctic Platform?
 - Of interest for offshore oil & gas or onshore diamond exploration

Beaufort Sea seismic hazard

 Insipient subduction zone, for which maximum magnitude and frequency of earthquakes is poorly constrained



Currently 4 Stations + 1 Additional Station to be installed Summer 2019.

Adhoc/piecemeal network:

- Utilized existing undeployed seismometers and digitizers
- Scavenged site equipment from retired POLARIS sites
- Only new equipment was batteries + solar controllers

Budget:

- ~\$8000/yr personnel mobilization costs
- ~\$1000/yr shipping costs
- ~\$2000/yr battery costs
- ~\$30,000/yr Fixed wing costs (wet)
- Reduced via mobilization sharing and back-hauling trades

Logistics:

- Staging out of NTGS in Yellowknife and ARI in Inuvik
- Aklak/Ken Borek Air out of Inuvik





Differences with extensive deployments across Alaska...

Western Arctic Advantages:

- Little topography
- Little Bedrock
- Large sedimentary stretches
- Can access and service much of the reason via fixed wing on Tundra Tires
 - Twin Otter saves lots of money over helicopter
 - Extremely stable and capable airframe
 - STOL capable with heavy loads

Logistic Challenges:

- Endurance of Twin Otter: 5 hrs at 150 knots
- Populated regions few and far between
- Off-strip landing requires VFR and minimum ceilings
- Fuel caching rapidly becomes necessary





Instrumentation

Seismometers:

- Guralp CMG-3ESP
- Guralp 40T
- Nanometrics Trillium 120 PA

Digitizers:

- Nanometrics Taurus (now decommissioned)
- Nanometrics Centaur

Solar Controllers (many lessons learned):

- Recycled controllers from decommissioned POLARIS sites
- Outback FM60
 - High self-consumption
 - Battery-oriented (fails to engage in spring)
- Morningstar Sunsaver 10, Prostar 30M

Solar Panels:

- 75 W Seimen's panels
- ~120 W Kyocera Panels























































BISN: PRELIMINARY RESULTS



Shear-wave splitting measurements from the south-western Canadian Arctic

- Almost N-S alignment of fabrics, roughly parallel to margin
 - Rotated ~90° CCW from continental fabrics

Moho depth variations across the southwestern Canadian Arctic

- Crustal thickness (Moho depth) tends to increase southwards into mainland
 - ~35 km +/- 5 km
- Thinning from Northern Banks to Prince Patrick
 - < 30 km</p>
- Match with Crust 1.0 relatively poor







BISN: PRELIMINARY RESULTS



Results from Audet et di, CGO 2018

1 Yr Ambient Noise Group Velocity Measurements: January 2015 to December 2015

- Lowest Group velocities lie within Beaufort Sea and Mackenzie Delta
- Relatively higher Group velocities in the onshore region

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BISN: PRELIMINARY RESULTS





Audet & Ma, SRL 2018

WHAT'S NEXT?

2018 -> MBC

2019 -> New sites Melville Northern Victoria Island

2020 -> WARNS

We've already discussed: TA Station Adoption Beaufort OBS





BISN: 2018 & 2019 FIELDWORK PLANS



2020 - ?: WARNS; TA ADOPTION



NATIONAL FACILITY FOR SEISMIC IMAGING CFI INNOVATION FUND

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OR INNOVATION

FONDATION CANADIENN



Research Development



ACTIVE TECTONICS IN THE CANADIAN ARCTIC

Beaufort Sea Program:

- Proposed two 1-year deployments of 80 OBS
- Two dense lines
- Complements USArray TA in Yukon, and CCArray in NWT, BISN (WARNS)

Purpose:

- Understand margin structure around BS
- Characterize seismicity within BS
- Constrain thrust seismicity







