

# 'EarthsCAN' Initiative (CCArray)

(Boggs, K. (MRU), Eaton, D. (UofC), Hyndman, R. (PGC/UVic), Audet, P. (UofO), Schmidt, M. (UofC), Aster, R. (CSU), Schutt, D. (CSU), Rowe, C. (McGill), Morell, K. (UVic), Leonard, L. (UVic), and many others)



## The Blue Marble

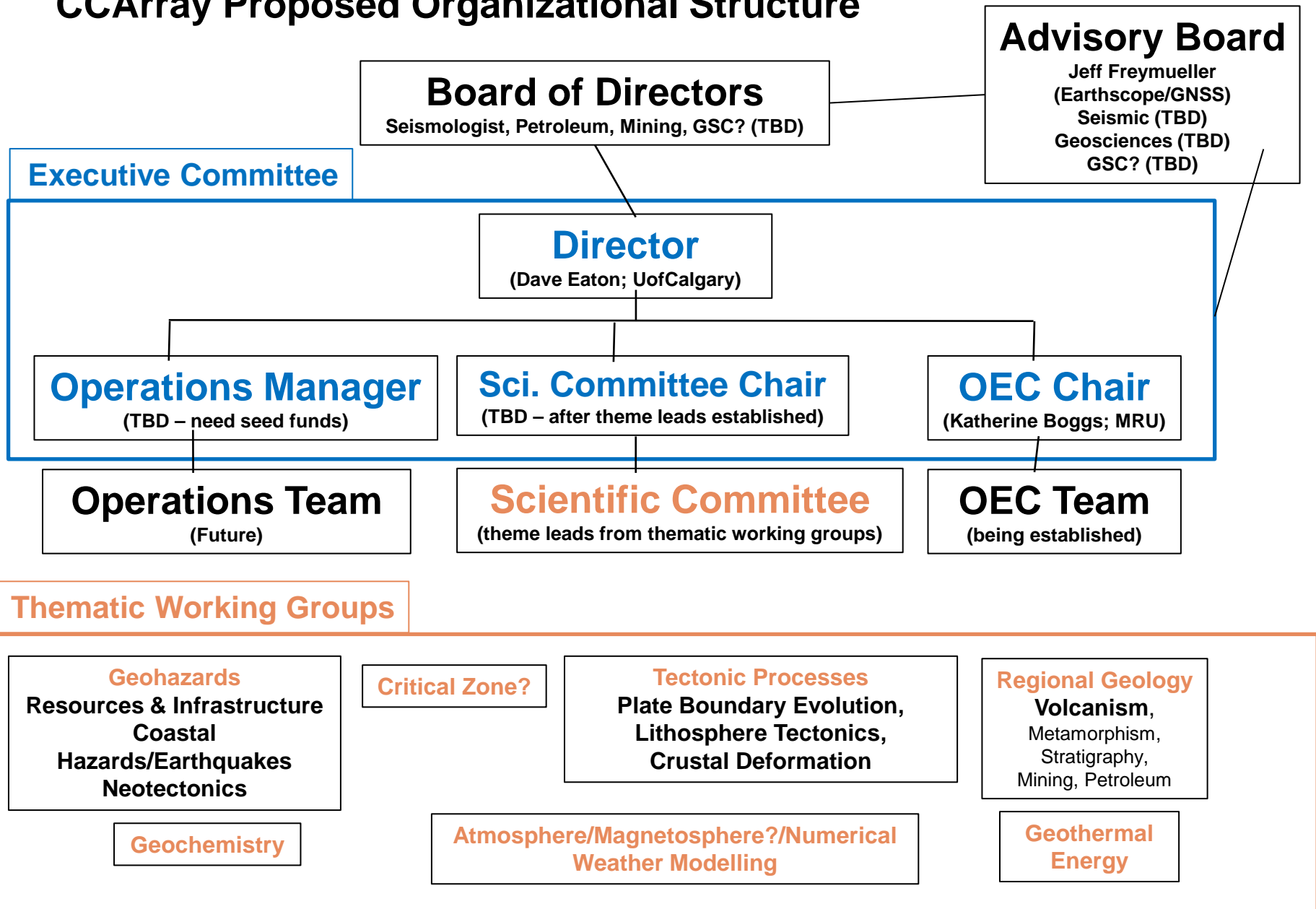
(Apollo 17 – Dec 7, 1972; ~45,000km)

### Goals:

1. Unify the Canadian Earth Sciences community
2. Create new research networks to improve holistic understanding of entire Earth Systems
3. Put geosciences on a national standing equivalent to the other natural sciences
4. Public benefits – hazard mitigation, strategic significance for transportation corridors; outreach/education

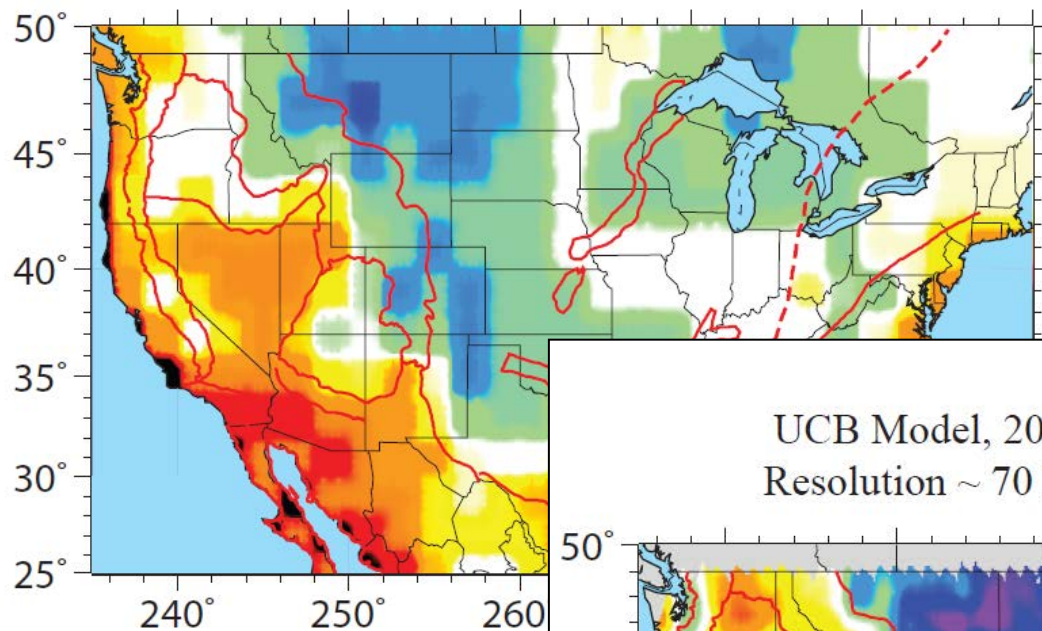
Godfrey Nowlan: “We have only one planet and it is important to us”

# CCArray Proposed Organizational Structure



# Tomography Resolution Before

CRUST 2.0, 2000

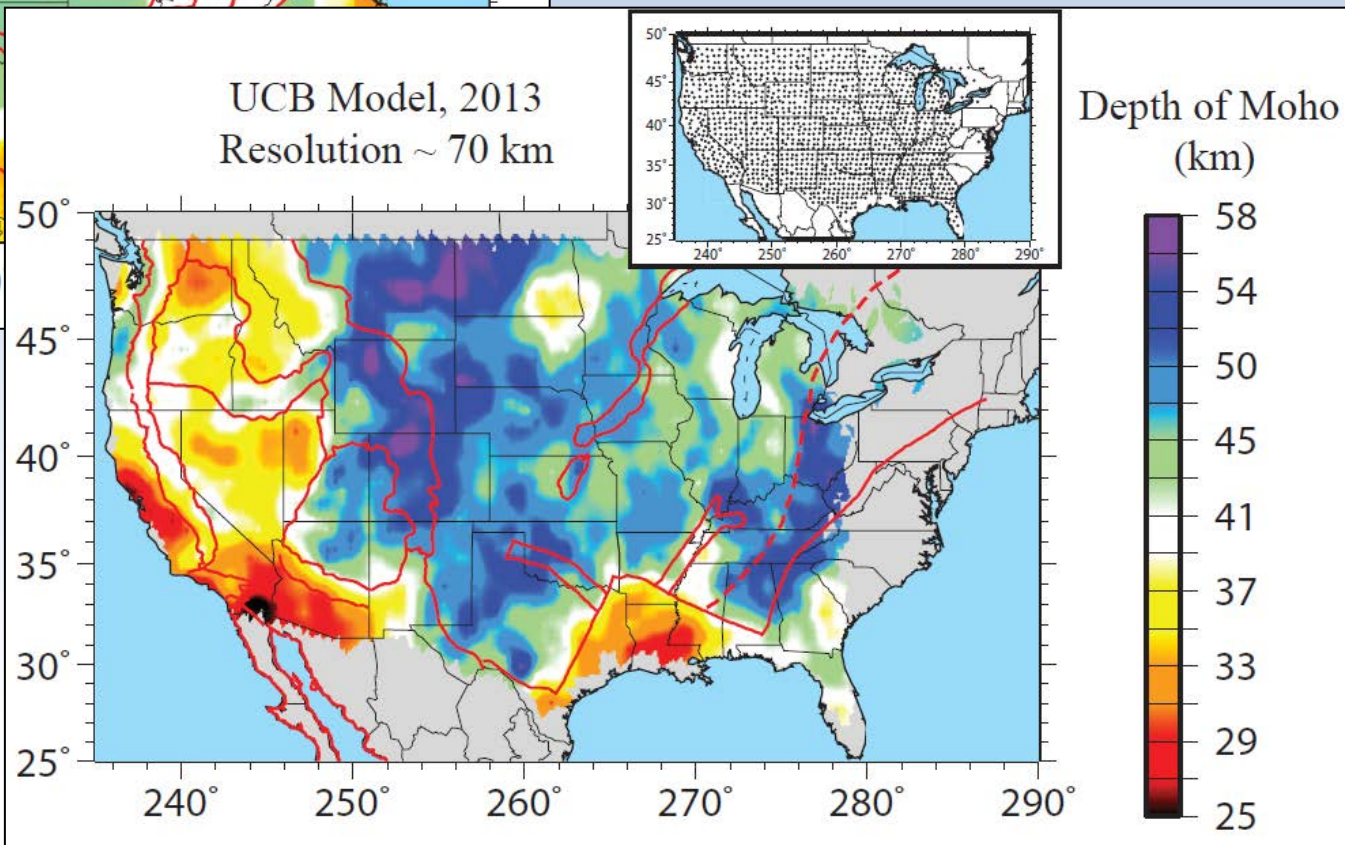


Bassin et al., 2000  
AGU Fall Meeting

# Resolution After

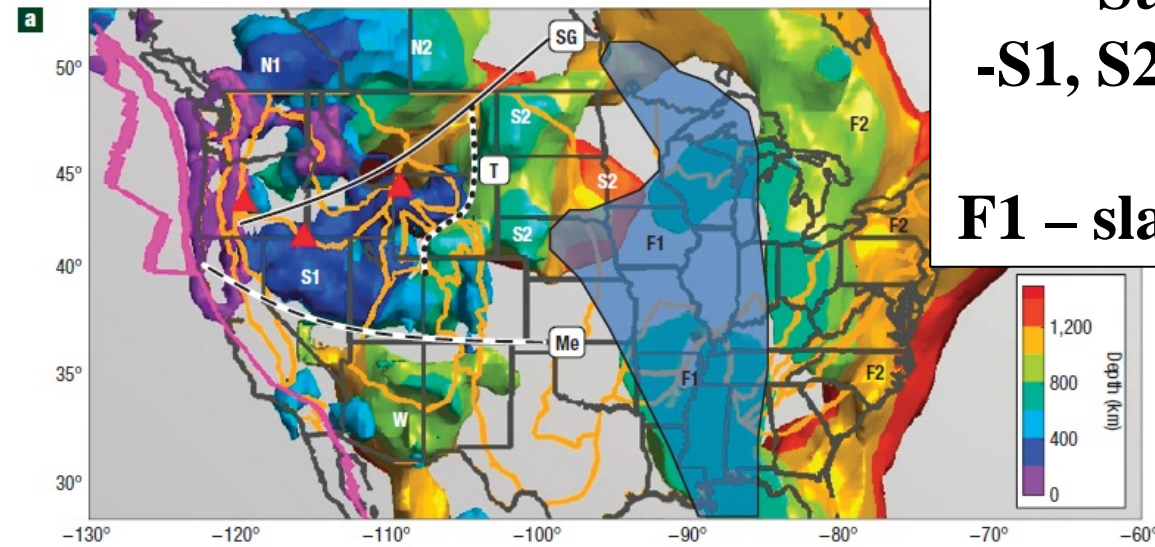
Shen and Ritzwoller,  
CU-Boulder, 2013  
AGU Fall Meeting

UCB Model, 2013  
Resolution ~ 70 km

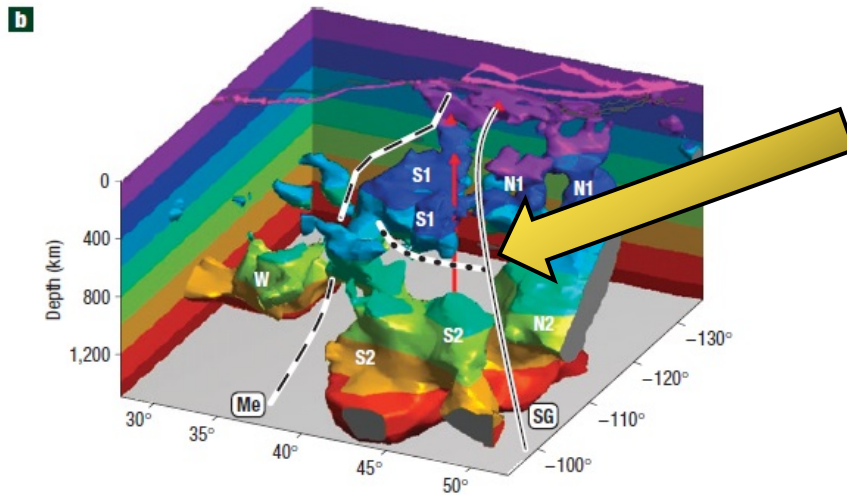


# 3-D - subducted Farallon plate under North America

(Sigloch et al 2008)



**Subducted Farallon plate**  
**-S1, S2, N1, N2, W – Cascadia**  
**F1, F2 – predecessor**  
**F1 – slab material shaded blue**

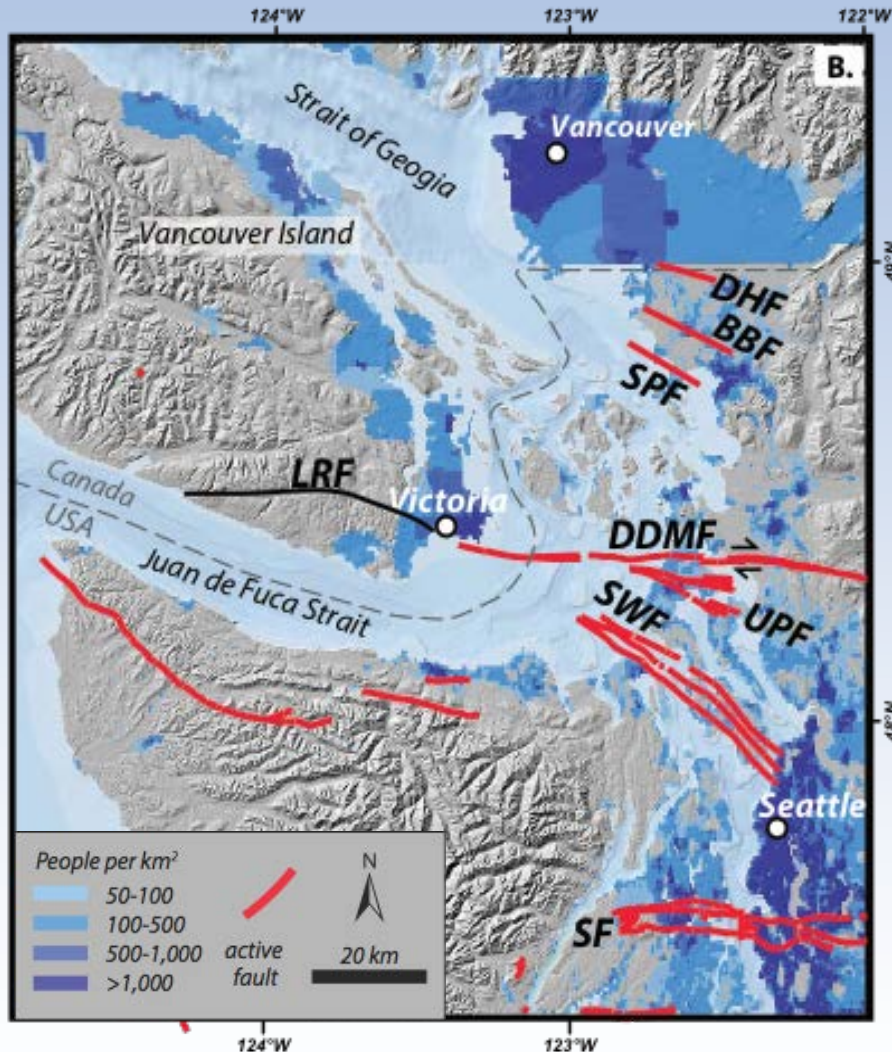


**A lateral tear between  
upper and lower mantle**

# First White Paper – Cascadia Forearc active faults

(Amos (WWU), Harrington (McGill), Kirkpatrick (McGill), Leonard (UVic), Levson (UVic), Liu (McGill), Morrell (UVic), Regalla (Boston U) , Rowe (McGill); Morrell et al GSA Today 2016)

-overview presentation by Kristin Morell (just this slide)



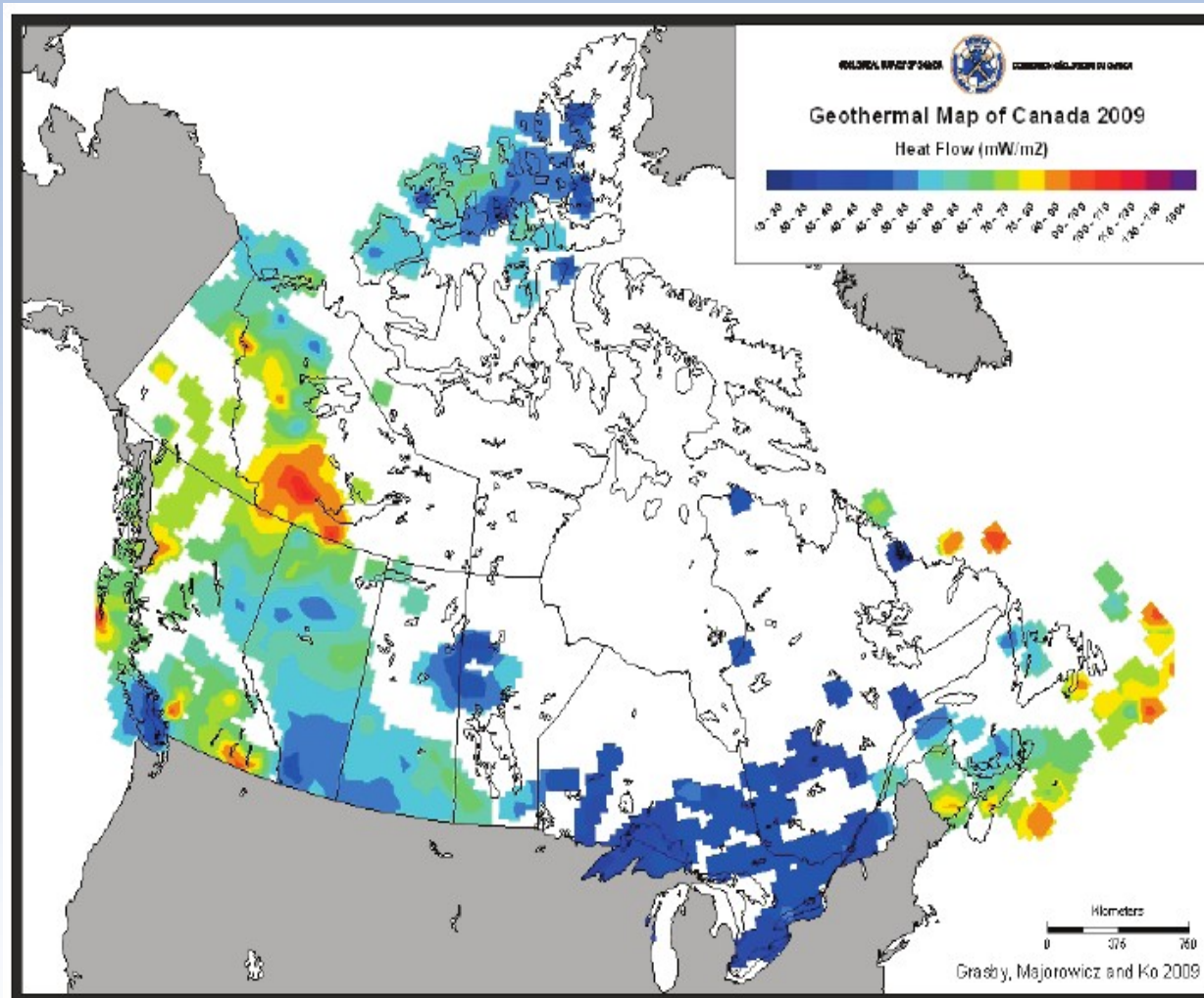
**Red** – active crustal faults

Recent lidar, field work, &  
paleoseismic trenching  
→ large (M6-7) late Quaternary  
Eq on Leech River Fault

Proposed:  
Expand lidar, seismic, GPS  
→ fieldwork, trenching  
→ ID other active crustal faults in  
western (and NW) Canada

**USGS - Barrie and Greene, 2015**

# Heat Flow Map: Geothermal Energy Potential

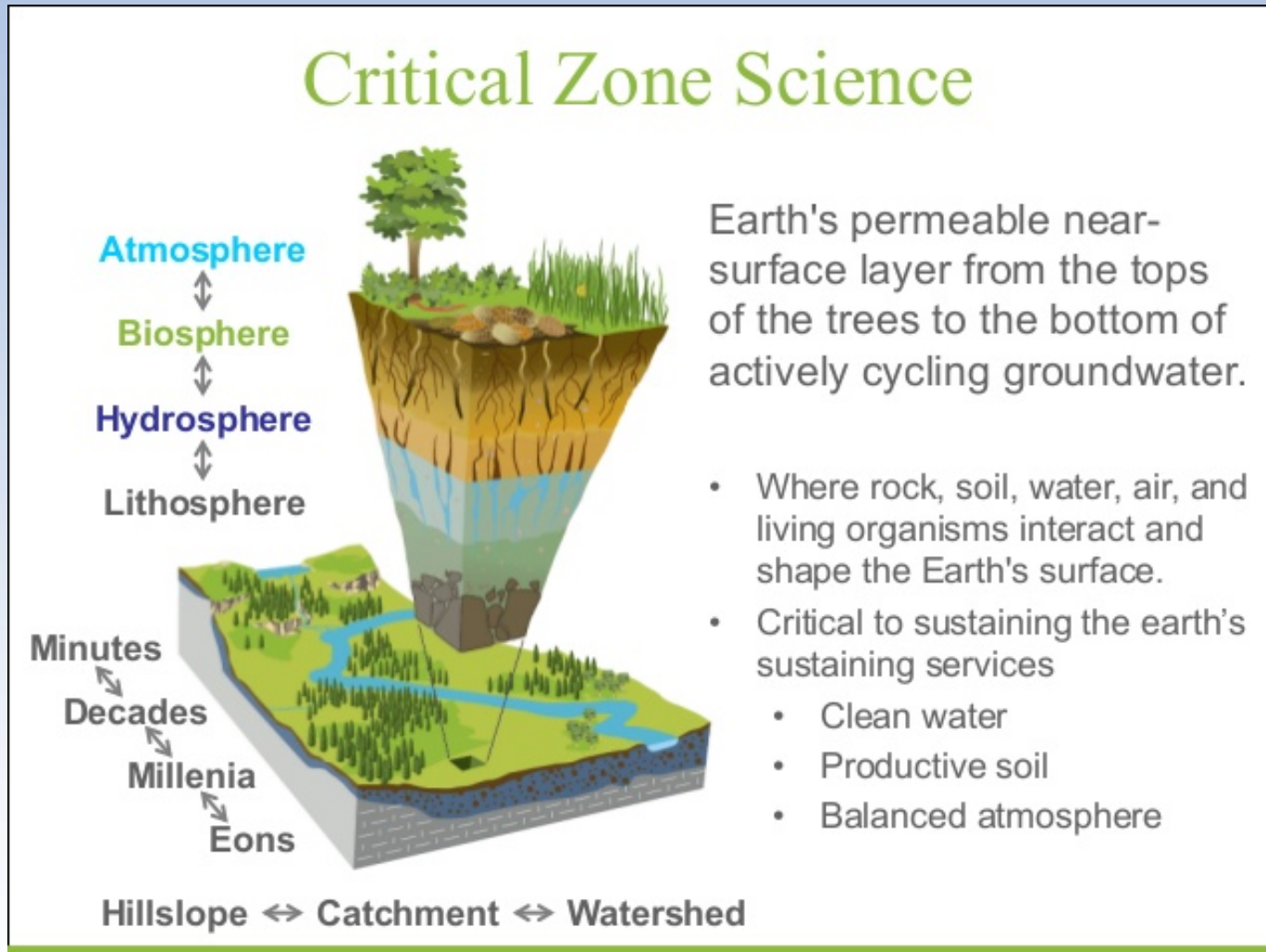


**NOTE:**  
**Gaps &**  
**Bright spots:**  
**S Cordillera**  
**W Coast BC**

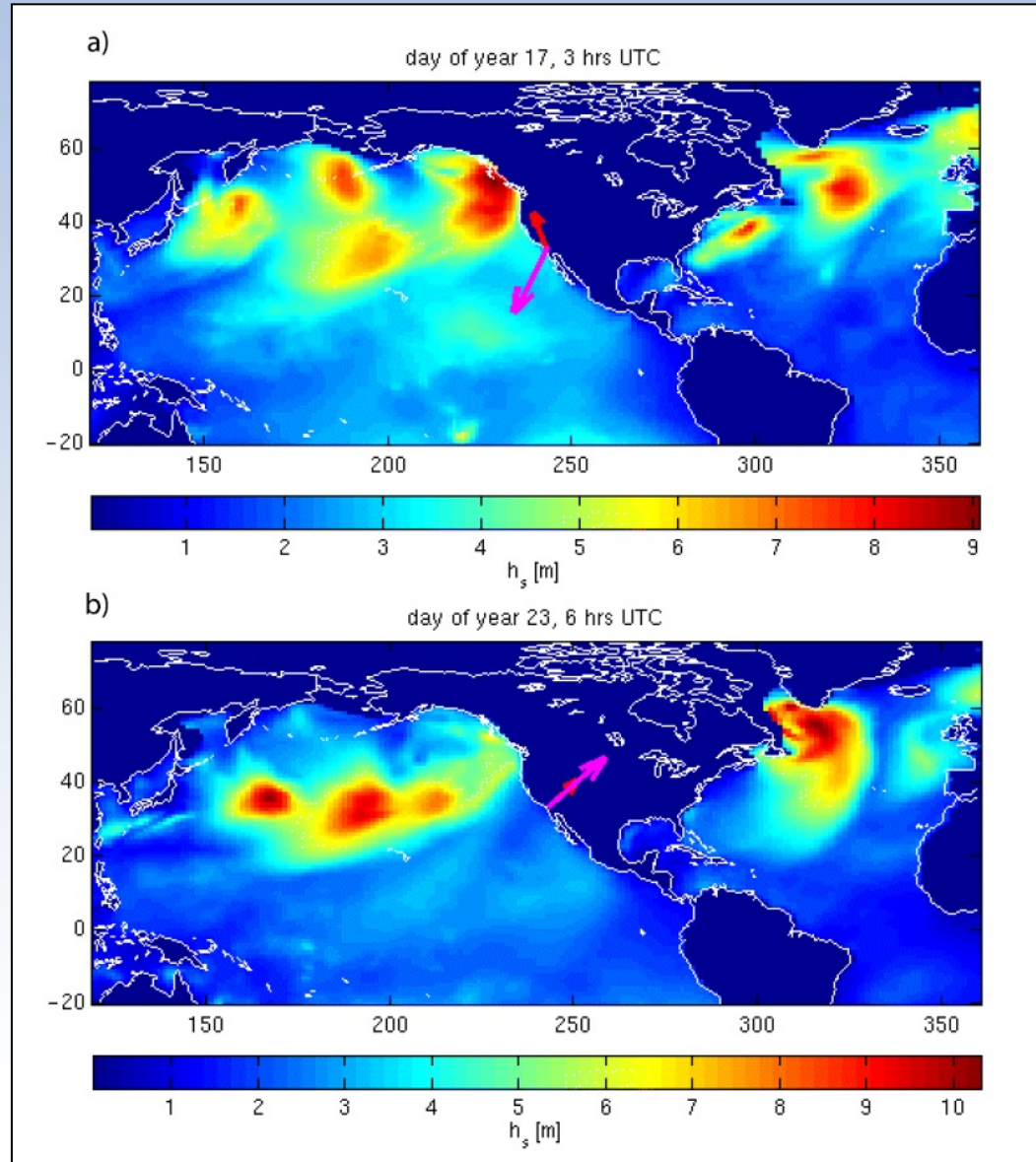
(Grasby et al 2009)

# Expand Critical Zone Science North??

-presentation by Nicole West on Critical Zone



**Wavewatch-III swell field and microseism beams.** When a large long-period swell hits the Cdn coast, the lower attenuation frequency microseism beam (red arrow) switches to that azimuth, while the double frequency microseisms (magenta arrow) stays on the SSW azimuth (these swells trigger microseisms across entire continent (Schulte-Pelkum et al 2004).





# Magnetosphere - Auroras



**Collaborate with European Space Agency??  
SWARM mission to study Earth's magnetic field  
(SWARM logo)**



# Next Steps? Discussion Points

**1. Other ideas?** - applications of Earth Observation Network Stations (with power & telemetry)

**2. Funding** – start planning/permitting spring 2017  
How to split funding US-Canada??

**3. How to spread the word?**

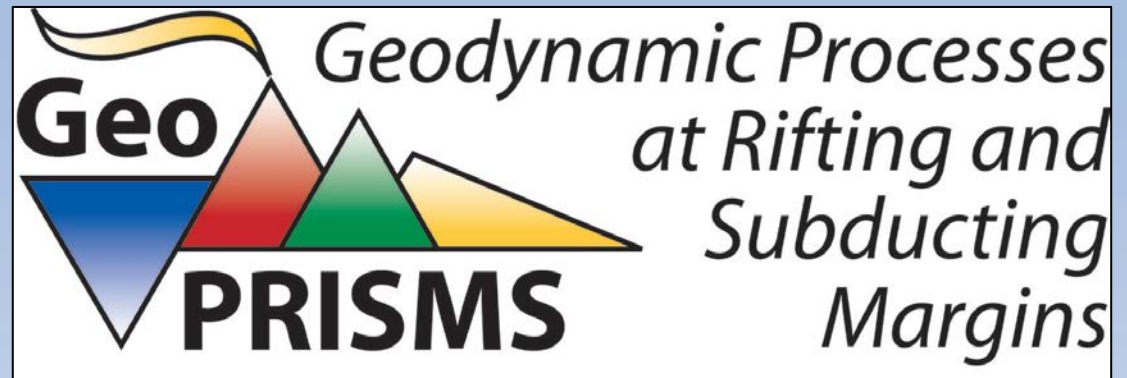
**May 2017** – sessions/workshops at CGU & GAC-MAC

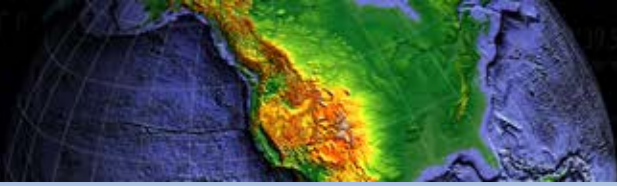
**June 8-10; 2017** GSA Rocky Mtn Section Mtg (MRU) – Earthscope to EarthsCAN/CCArray session & meeting

**FUTURE?** Next stage of EarthsCAN - Arctic? Roll east?  
St Lawrence Seaway & Charlevoix Structure??

**Thank you:**

**Sponsors:**



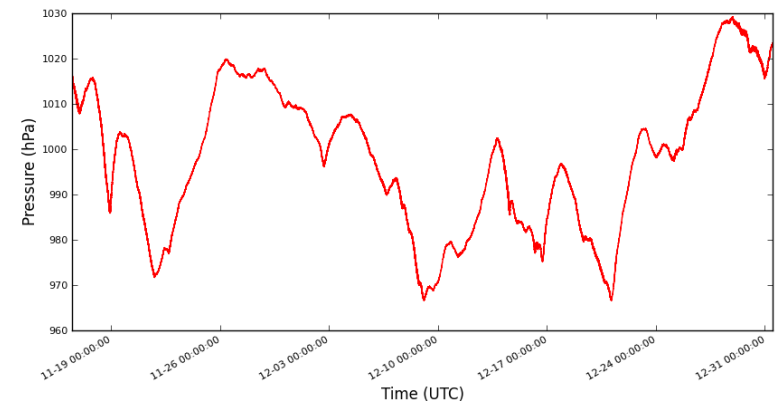


# Atmospheric studies

## ion, Pressure and Hurricanes

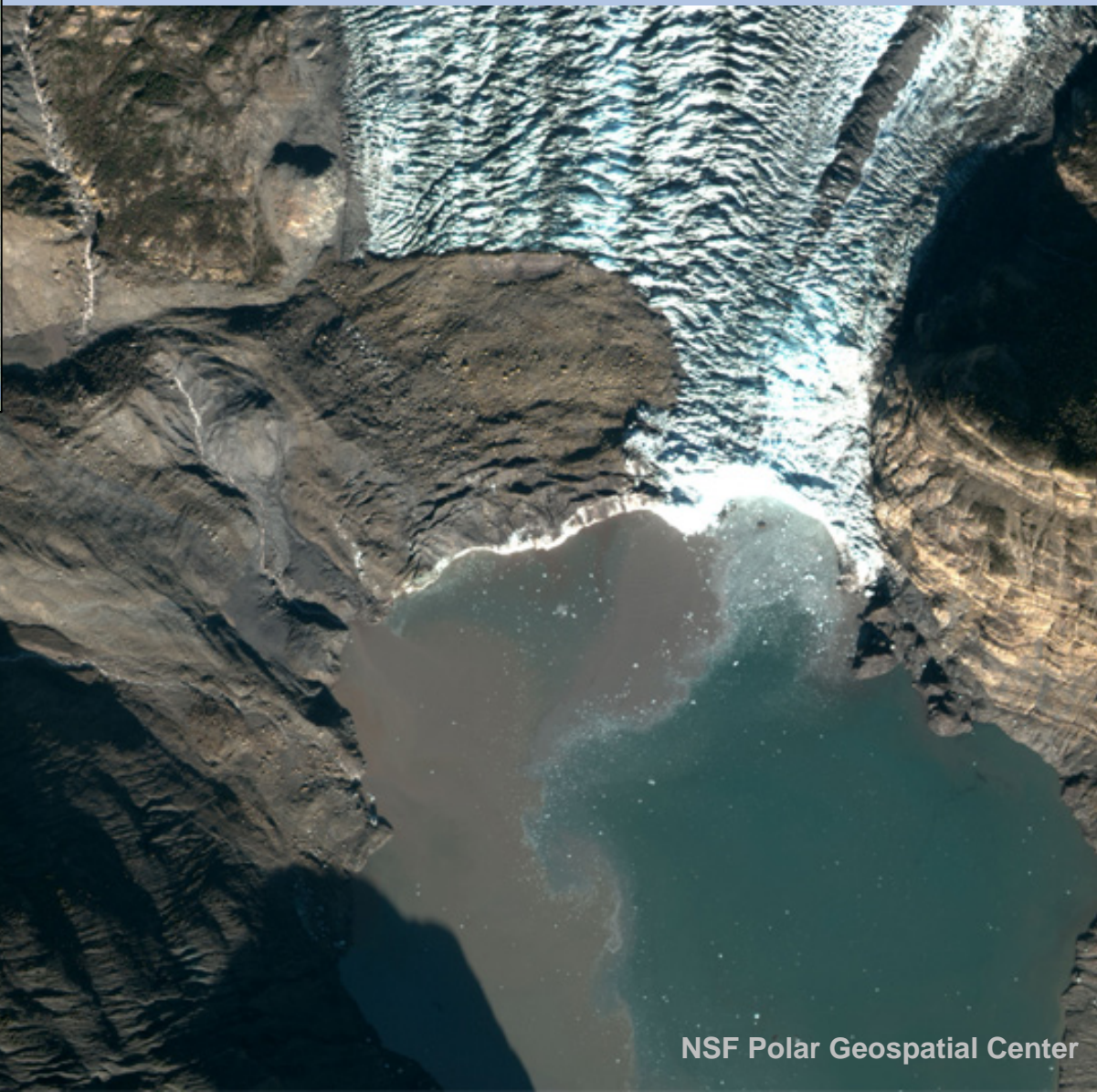
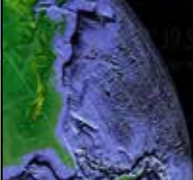
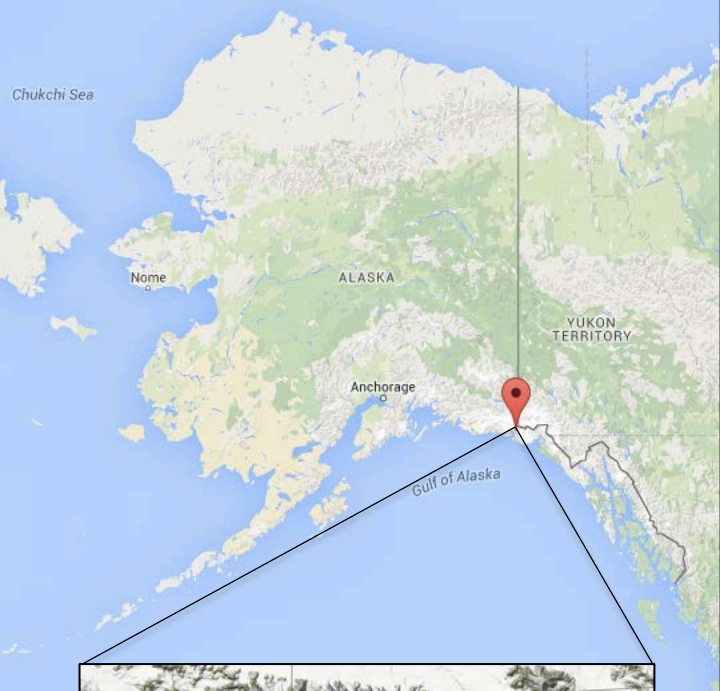
Dots show station  
barometric pressure as it  
varies over a period of  
ten days in April 2011. A  
severe outbreak of  
Tornados (red squares)  
occurred and spawned a  
pressure wave rolling  
north thousands of miles  
into Canada.

Q23K 1 Hz Setra-278 Pressure: 16 Nov 2014 12:00 UTC - 31 Dec 2014 12:00 UTC

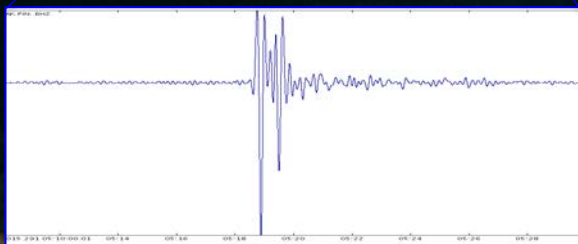


Seismometers can detect landslides in remote areas

200 million ton landslide on Tyndall Glacier  
Seismic data discerns time, location, size, direction, velocity



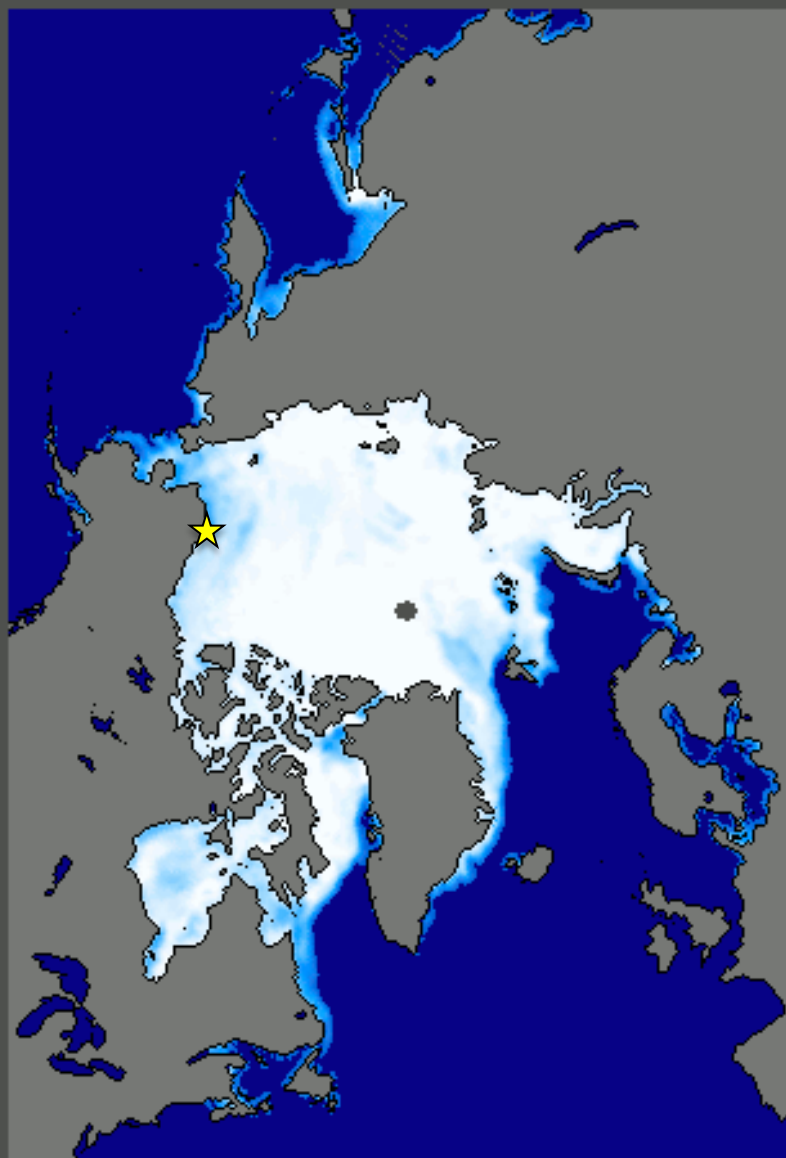
AK.PIN ~70km away



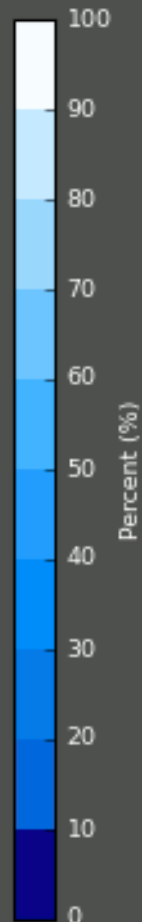
# Seismometers can track the status of sea ice extent in northern Alaska

High noise (red) corresponds to open water after the peak of summer

01/01/2015

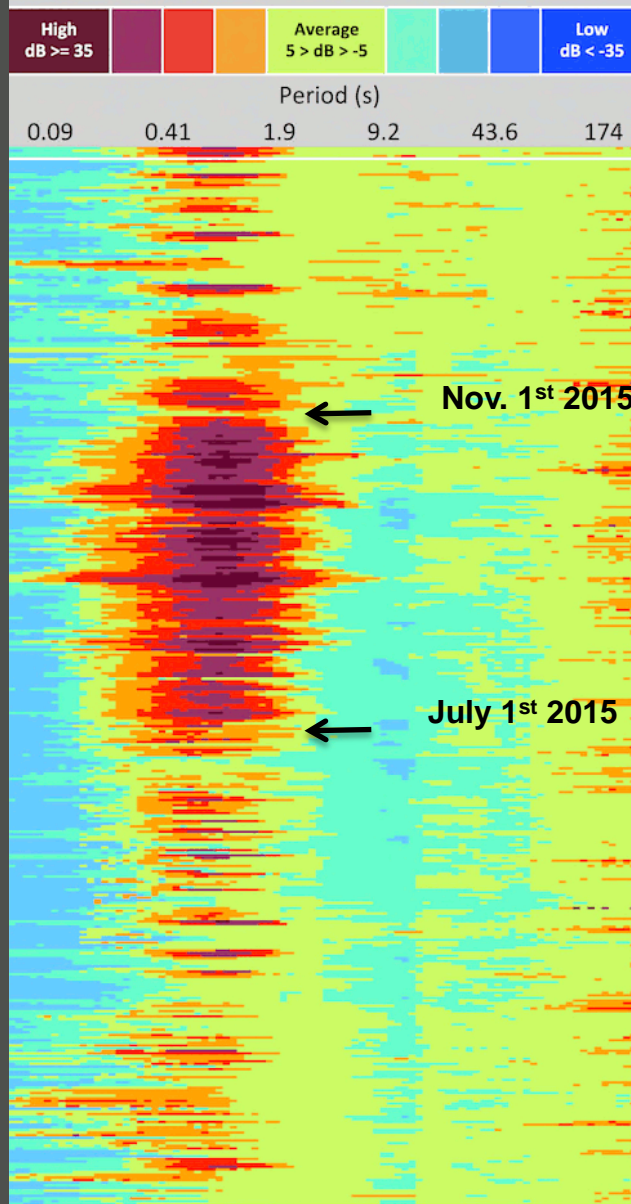


National Snow and Ice Data Center, Boulder, CO



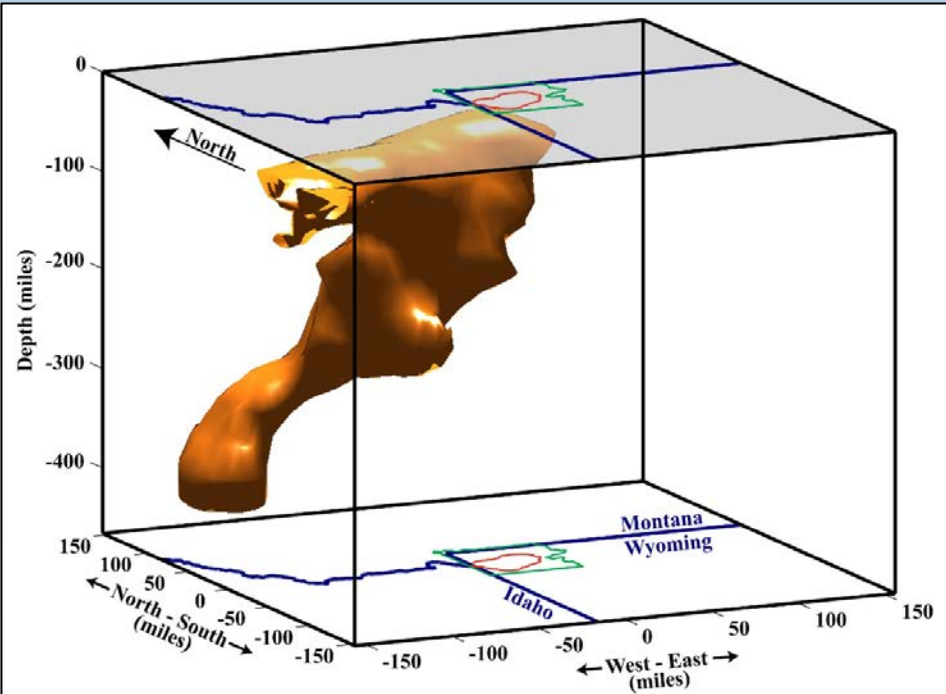
Near-Real-Time DMSP SSM/I-SSMIS Daily Polar Gridded Sea Ice Concentrations

Relative Daily Noise – Barrow, AK – TA.A21K.BHZ

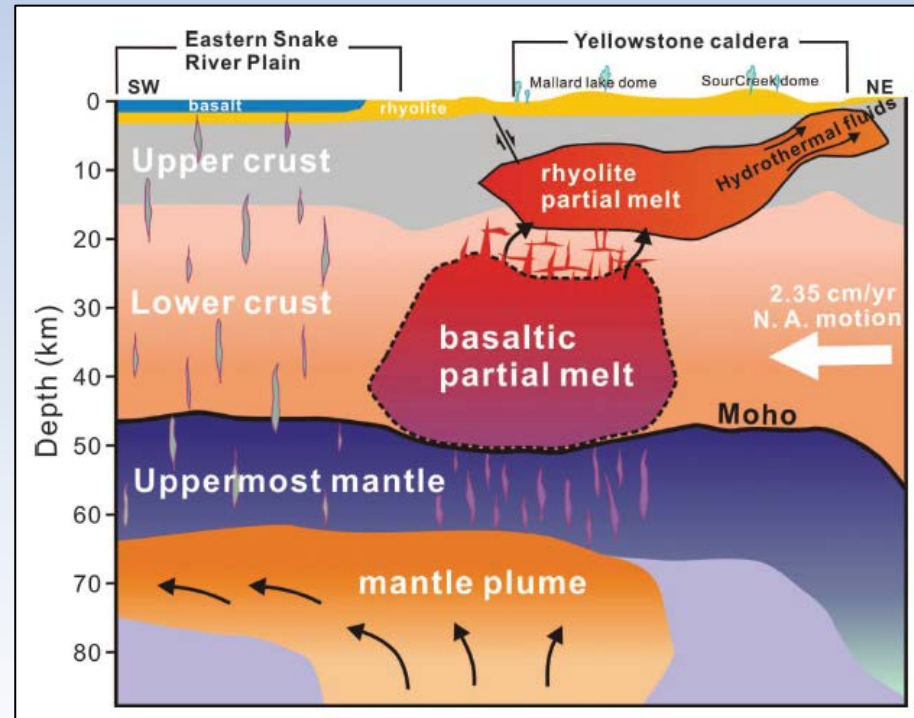


Data Available at IRIS DMC

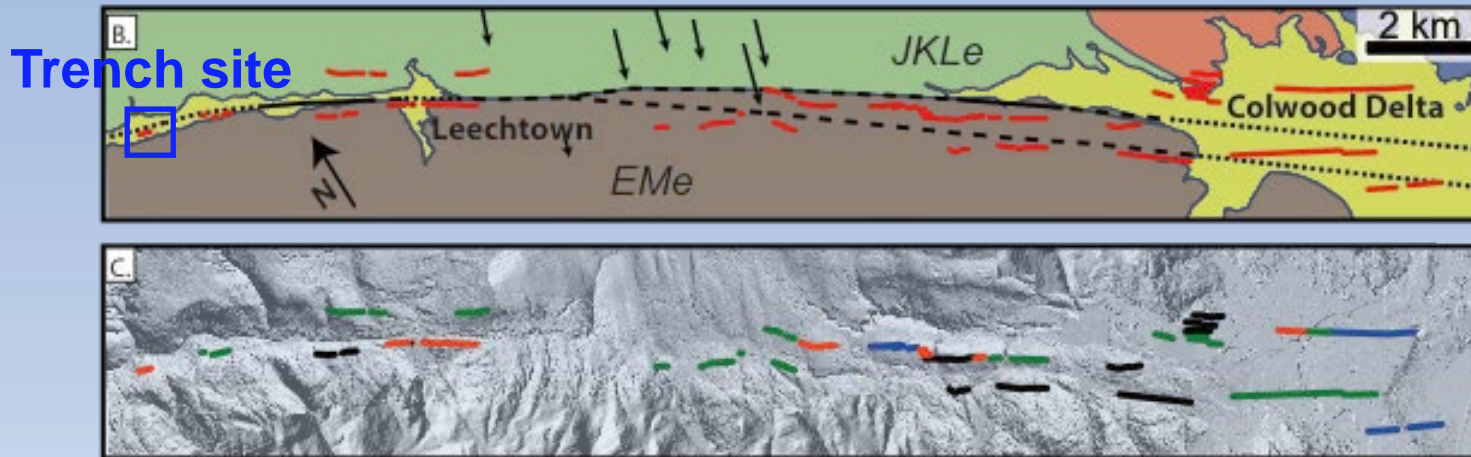
# Yellowstone – Magma Plumbing System (other possibilities)



(Smith et al 2009; J Volc Geo Res)



(Huang et al 2015; Science)



## ***Evidence recent tectonic features:***

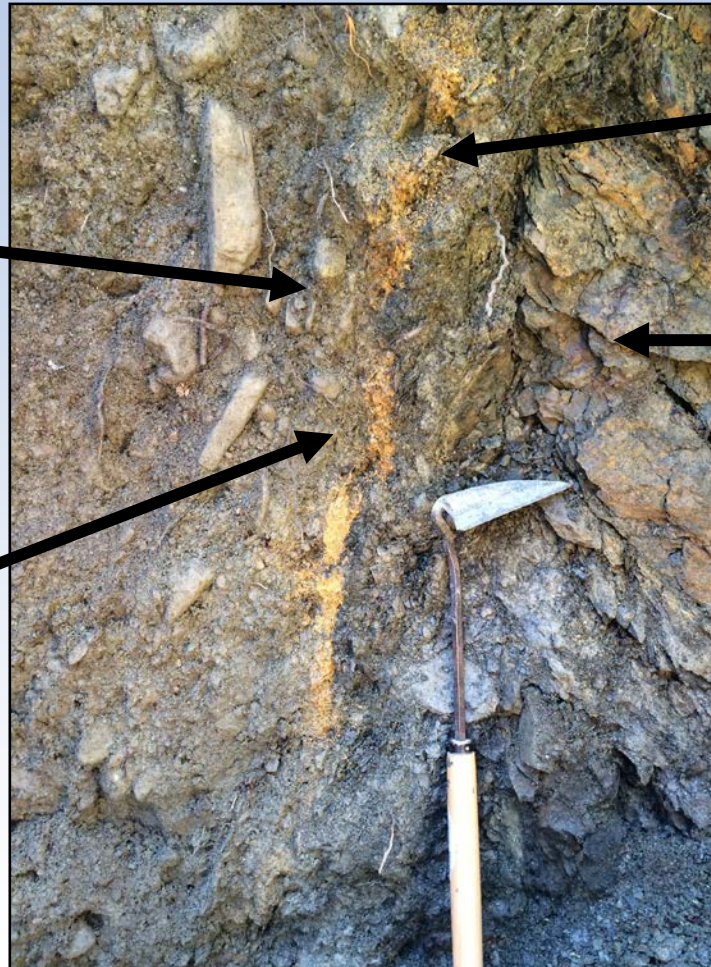
- Not parallel to ice flow direction
- Many scarps are uphill facing, in bedrock
- Fault gouge observed in field
- Features align along strike
- Channels & interfluves cutting <15 ka sediment are offset
- Recent paleoseismic trenching confirms faulting of young (<15 ka) sediment



# May 2016: Paleoseismic trenching

Trench site scarp: only identifiable from lidar data (James et al. 2010).

## *Field photo from trench*



**Fault gouge**

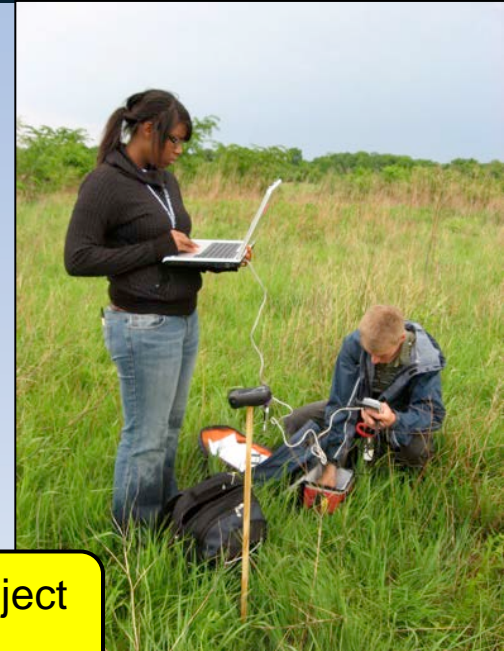
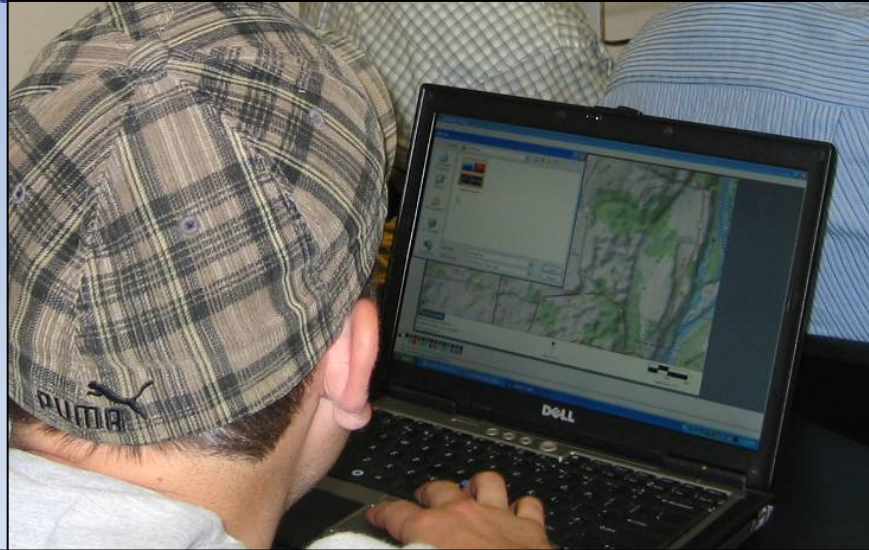
**Leech  
River  
Schist  
bedrock**

**Confirmed: up to 3 large  
earthquakes since the last  
glaciation (~15 ka)**

**Young (<15 ka)  
colluvium  
deformed  
adjacent to the  
Leech River  
fault**

**Clasts  
coseismically  
rotated parallel  
to the fault  
zone**

# Students Key to TA Site Reconnaissance



- Direct student participation in national science project
- Altered students' studies and careers



“I especially enjoyed the traveling aspect of reconnaissance in an endeavor to become a ‘salesman for science.’ We brought ...EarthScope’s mission to ...**people who otherwise would never have even considered earthquakes in their state** or the impressive earth sciences beneath their own feet...I would consider my summer task an absolute success and would do it again in a heartbeat.”

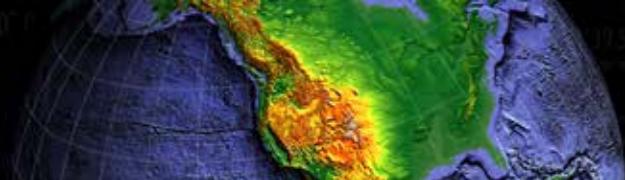


“**Seeing my state in this way was a life altering experience** and to know that I helped a scientific community in learning more about earth structure gives a sense of pride.”

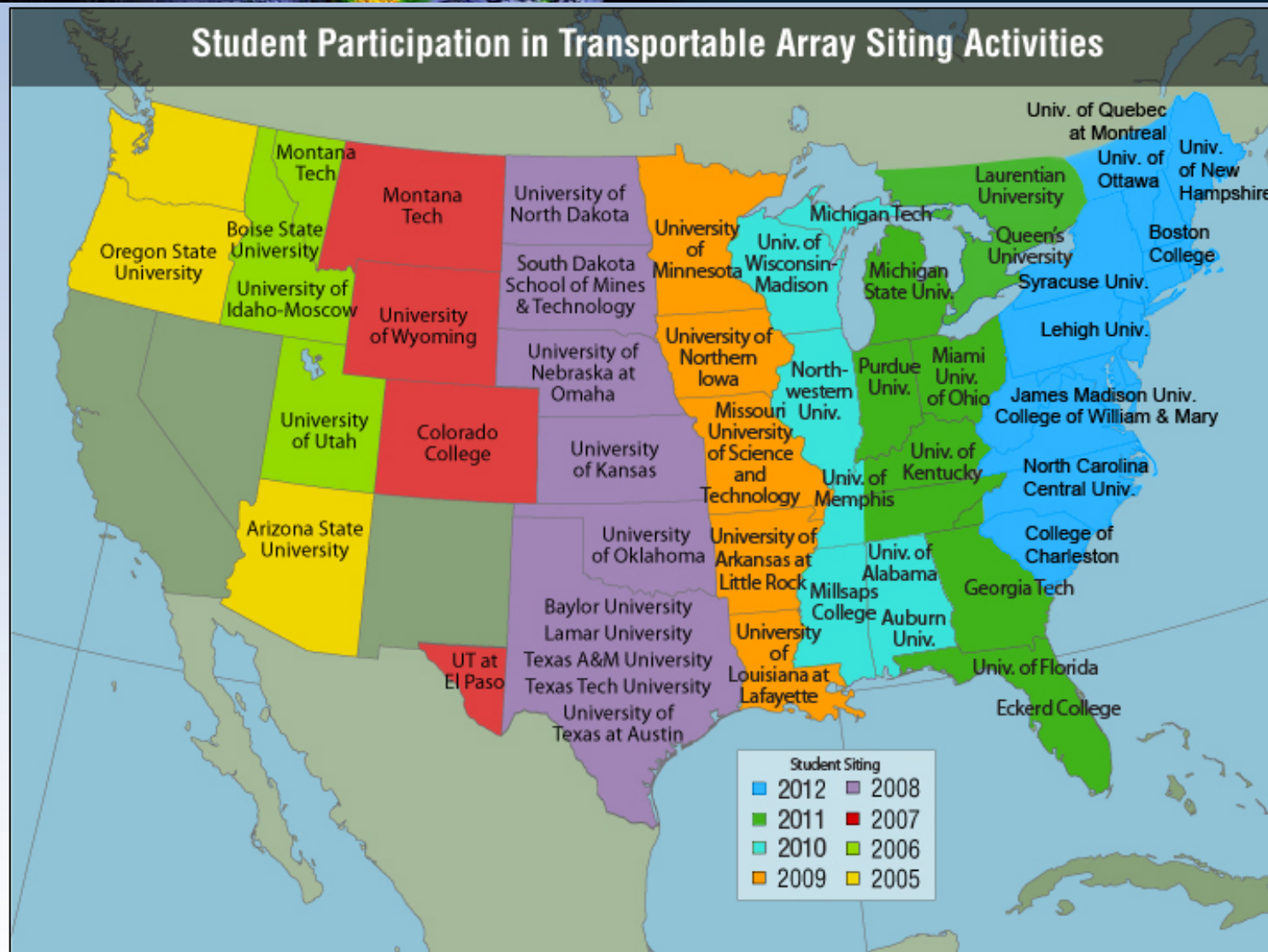


“My experience this summer was absolutely a positive one. It gave me the opportunity to travel, improve my communication skills...and start to focus on the upcoming school year. **I could not recommend this program enough to other future students in the Earth Sciences.**”





# Student Siting



- 31 schools (51 total) and 67 students (131 total) participated in the summer siting program during the award