'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"

Do you feel?

Geoscience "Research funding ... (is) stagnant even though the discipline is critical to the economic and social well being of the country" (and our planet)?

(Clowes 2010; CJES - motivation for Lithoprobe in 1980s)

Geosciences are not represented on Canada's Fundamental Science Review panel!!

We are much stronger as a community, than as individuals

(Canadian physicists have had several large research initiatives receive funding from Cabinet level budget lines)

Takeaways

- 1. Community building intrigued? Want to be involved? Is there someone else who we should talk to? All are welcome!
- 2. Ideas for "grand" research questions? Or other approaches?
- **3.** Are there other applications (sensors) to these proposed stations that would benefit your research?
- 4. Comments, suggestions?
- 5. Please spread the word

Please contact one of the authors (or Katherine Boggs at kboggs@mtroyal.ca)

The significant problems we face cannot be solved at the same level of thinking we were at when we created them (Albert Einstein)

EarthsCAN concept: Improve holistic understanding of entire Earth Systems with:

Lithoprobe's "other supporting geosciences" model



http://serc.carleton.edu/eslabs/carbon/index.html

Earthscope's techonological / scientific advances (with outreach - communication - education approaches) + atmospheric - oceanographic – climatic / weather modeling

(expand upon the serendipitous outcomes from Earthscope)

"EarthsCAN" – Motivation:

Maintain North American Large Geoscience Research Program Momentum



NOTE: Timeline = Earthscope funding ends in 2018!! Strong support from US Collaborators, IRIS (& UNAVCO) (Did not cover GNSS (GPS) component here due to time constraints; There could have many presentations with other focii)

Resolution Before

CRUST 2.0, 2000

earth



earth Science Outlook for AK and NW Canada

Deployment = transformative results

- First order geophysical targets
- Extensive seismicity
- "Uncharted" terrain









Subduction Zone Observatory

First Step? Canadian Cordillera Array (CCArray)

Stations: All will have:

-telemetry & power -seismic, P, infrasonic & weather stations **Experiment with co-location of:** -GNSS (GPS) -gas monitors (air & soil flux) Others?

(From IRIS Workshop June 2016; EarthsCAN brainstorming workshops Calgary/Ottawa Aug. 2016; SZO Workshop Sept. 2016)



Why timing is critical:

Instruments in NW Canada & E Alaska

In remote areas the expensive component is the installation costs

Need 2-3 years of data acquisition

Earthscope ending in 2018

Instruments could be removed as early as 2019

LOI in progress to request use of Instruments from NSF/IRIS

IRIS (& UNAVCO) willing to waive charges for data acquisition/processing/archiving because they want CCArray to go ahead



CCArray separated from EarthsCAN

-take advantage of Earthscope instruments, expertise and technology

-permit EarthsCAN time to mature

-3 to 4 years

-200 to 400 seismic stations (with OBSs)



"Mini Himalayas" Yakutat Block



Orogenic Float Model



(Hyndman & Mazzotti 2002)

(Mazzotti et al 2008)

Subduction initiation

Haida Gwaii Margin -partition of oblique convergence into strike slip -2012 thrust Eq (Hyndman et al 2014)





Induced seismicity; eastern margin Canadian Cordillera



(Atkinson et al 2016)

First White Paper – Cascadia Forearc active fault

(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)



Red – active crustal faults

No previous active faults ID in Canada

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

Proposed:

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

Heat Flow Map: Geothermal Energy Potential



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

(Grasby et al 2009)

Next Steps?

- Planning meeting mid Nov (Calgary; dates TBD)
- GeoPRISMS sponsored workshop Sunday Dec 11 before AGU (<u>http://geoprisms.org/meetings/mini-</u> workshops/agu2016-earthscan/)



FUTURE? Next stage of EarthsCAN possibly the St Lawrence Seaway and the Charlevoix Structure??

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Thank you: People – "firsts" timeline

June 2015 – Earthscope workshop – only 2 other Cdns **October 2015** – 1st CCCESD presentation November 2015 – McGill/UQAM/UVic WP (Rowe et al) -R. Clowes, R. Hyndman, C. Barnes (more WPs) -M. Colpron – first letter of support; J. Hsieh (Repsol), Nanometrics Inc. & G. Brunet (ECCC) – (more WPs) March 2016 – NGSC presentation to Survey Directors May 2016 – Info sessions at CGU/CMOS & GACMAC Aug 2016 – brainstorming workshops MRU & UofO Now – would fill this page and many more... = start of research community

Yellowstone – Magma Plumbing System (other possibilities)



(Huang et al 2015; Science)

Earthquake focal mechanisms; inferred regional stresses





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).

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

Clasts coseismically rotated parallel to the fault zone

fault

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

Schist

bedrock

Field photo from trench

