CCArray: Consequences in Cordillera of Present and Past Plate Interactions

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Fill the Northern Cordillera gap in seismic stations (USArray) and in GPS (PBO) between Washington State and Alaska

200-400 Seismic Stations and OBSs, numerous GPS stations, and supporting geoscience

World class scientific objectives to be addressed:
CCArray schematic with current seismic stations

Area to be covered
In several phases
Margin Tectonics Targets

1. Current Plate Interactions

2. Past Plate Interactions, assembly of Cordillera
Consequences of Yakutat terrane collision

Landward extension of Steep project etc. studies on margin
Active thrusting on the Beaufort Sea margin

Potential for great thrust earthquakes and tsunamis
Cordillera-wide deformation and seismicity from Yakutat Terrane collision on margin (Hyndman and Mazzotti, 2002)

Area with high seismicity and poor seismic station coverage, and poorly defined active faults
Queen Charlotte margin

Subduction initiation
*Haida Gwaii margin*
2012 megathrust and tsunami

Margin parallel sliver

Yakutat terrane collision

Active thrusting seismicity

Seismicity, earthquake hazard; mostly Cordillera

Ocean-Continent transform fault

Induced seismicity

Margin-parallel sliver motion

Ridge-subduction slab window effects

Cordillera terrane boundaries; old subducted slabs

Craton-Cordillera lithosphere boundary

Cascadia Subduction
Subduction initiation at \(~6\) Ma

Uplift created Islands of Haida Gwaii

No arc volcanics or slab seismicity yet
Margin parallel coast zone
Margin parallel sliver

Elliott et al. (2010)

Hippchen (2005)
Ridge subduction
Slab windows
Consequences of ridge subduction and slab window formation

Thorkelson et al., 2011
Cordillera terrane
dea boundaries

Old subducted slabs

Terrane assembly
Traces of old subducted slabs; Terrane accretion boundaries

Tomography velocities
Western N. America
Depth 100 km
(Schaeffer and Lebedev, 2014)
Cordillera-craton boundary

Thermal and lithosphere thickness boundary

Thinning of craton lithosphere? Widening of Cordillera backarc mobile belt?
Cordillera-craton velocity and thermal boundary

Bao et al., 2014
Seismicity, active fault, hazard
Seismicity in Cordillera

Mapping active faults

Earthquake hazard
Induced seismicity

Mainly western Canada sedimentary basin
Address some world class scientific targets

*Fill gap in coverage (USArray) and in GPS (PBO) between Alaska and western US*

1. **Delineation of crustal structure of W. Canada**: Underpinnings of Cordillera geology and geological history; terrane assembly; map sutures, old subducted slabs in mantle

2. **Seismicity in W. Canada**: much improved locations, statistics and other hazard characterization; delineation of active faults

3. **Induced seismicity**, especially regional seismicity baselines

4. **Ridge subduction**: effects on continent, from plate edges, slab windows, origin of Cordillera volcanism

5. **Constraints on continental tectonics** from current plate margin interactions, incl. Yakutat terrane collision landward deformation

6. **Subduction initiation** (Haida Gwaii at 6Ma); A key process in past plate re-organizations

7. **Arctic Array continuation**? And then eastern Canada?

Also, meteorology, GPS ionosphere, etc. use of grid with communications and “supporting geoscience”?
Some new technologies for seismic arrays

- Array processing
- Ambient noise and earthquake tomography
- Receiver functions

Crustal and lithosphere thickness
Crust and upper mantle temperatures
For discussion:

(a) input from a number of authors with broad expertise,
(b) further definition of scientific targets and how the new data will address them,
(c) a draft seismic and GPS operational plan; supporting geoscience,
    other uses of station array
(d) budget estimates
(e) Funding and in-kind sources; NSERC, CFI, NSF, GSC and others

Wide involvement from Canadian and US universities, Geol. Survey Canada, and provincial geological surveys is essential at an early stage.
Some CCArray
Scientific targets

Active thrusting seismicity
Seismicity, earthquake hazard; mostly Cordillera

Yakutat terrane collision
Induced seismicity
Ocean-Continent transform fault
Margin-parallel sliver motion

Subduction initiation
Ridge-subduction slab window effects

Cordillera terrane boundaries; old subducted slabs
Craton-Cordillera lithosphere boundary

Cascadia Subduction