EARTHQUAKE LOCATIONS

1. modern, high precision locations using double difference methods

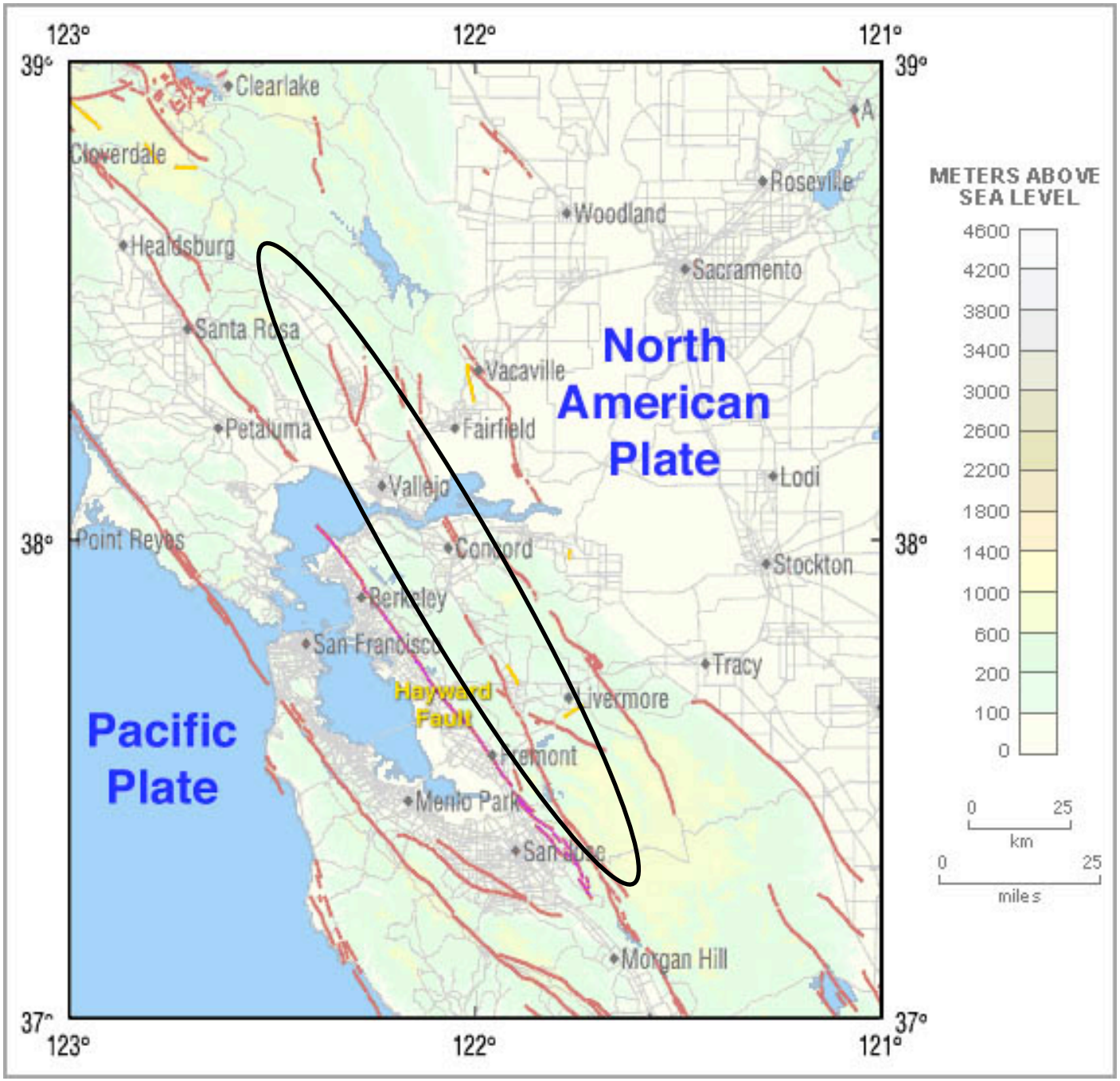
2. hypocenters in Cascadia

3. Wadati-Benioff Seismicity

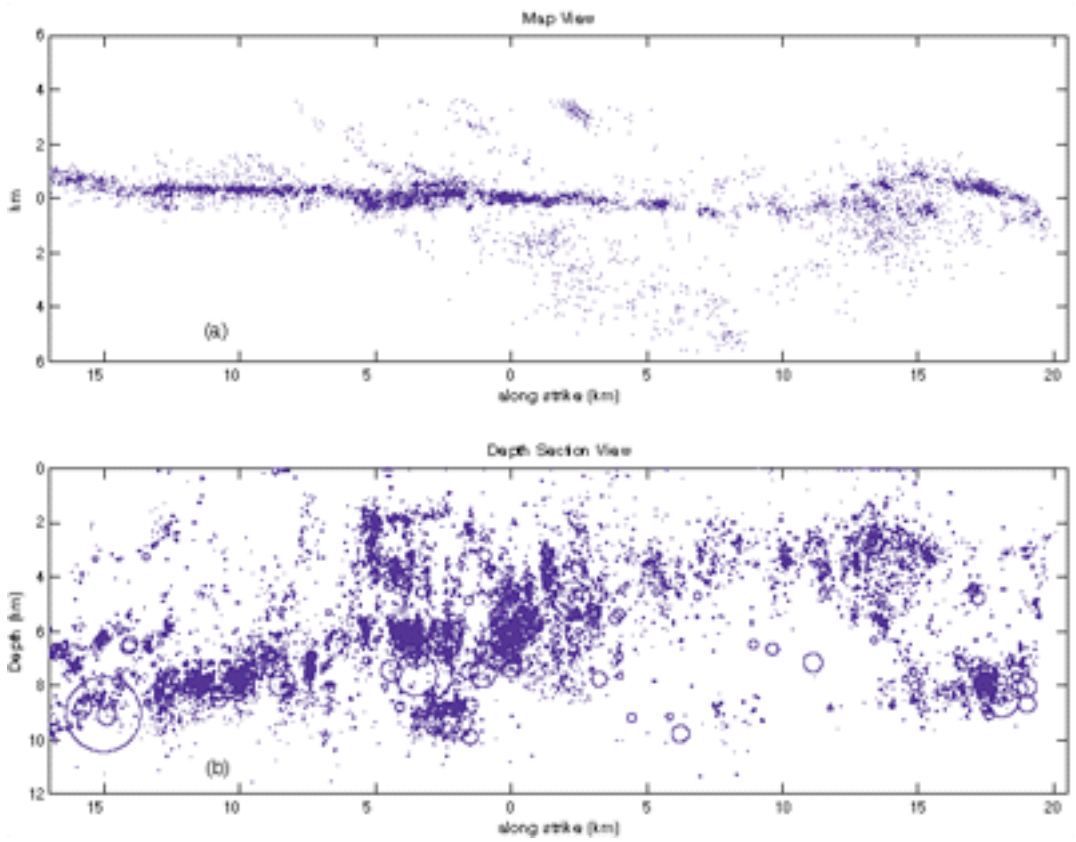
4. hypocenters in other parts of western Canada

CALVERAS FAULT SYSTEM

> major branch of San Andreas



EARTHQUAKE LOCATIONS ON THE CALVERAS FAULT - CALIFORNIA

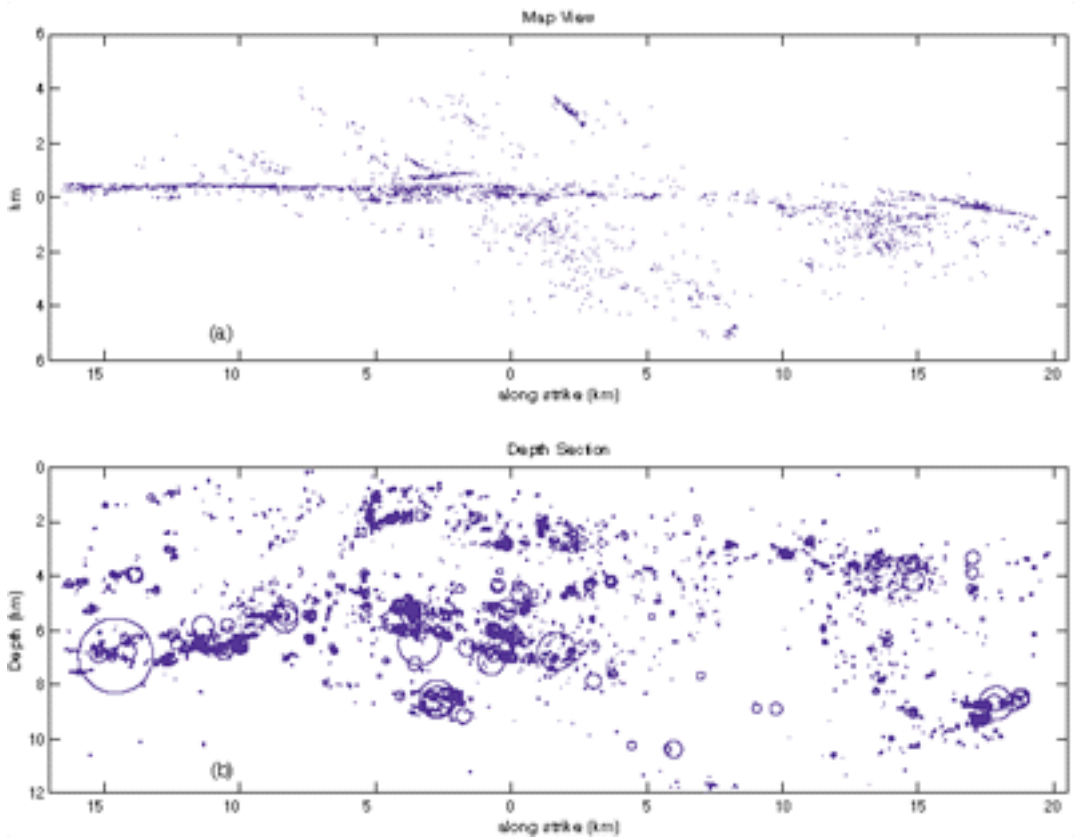


> earthquake locations using conventional methods

> note epicenters in map view define linear fault trace (7757 quakes from 1984 to present)

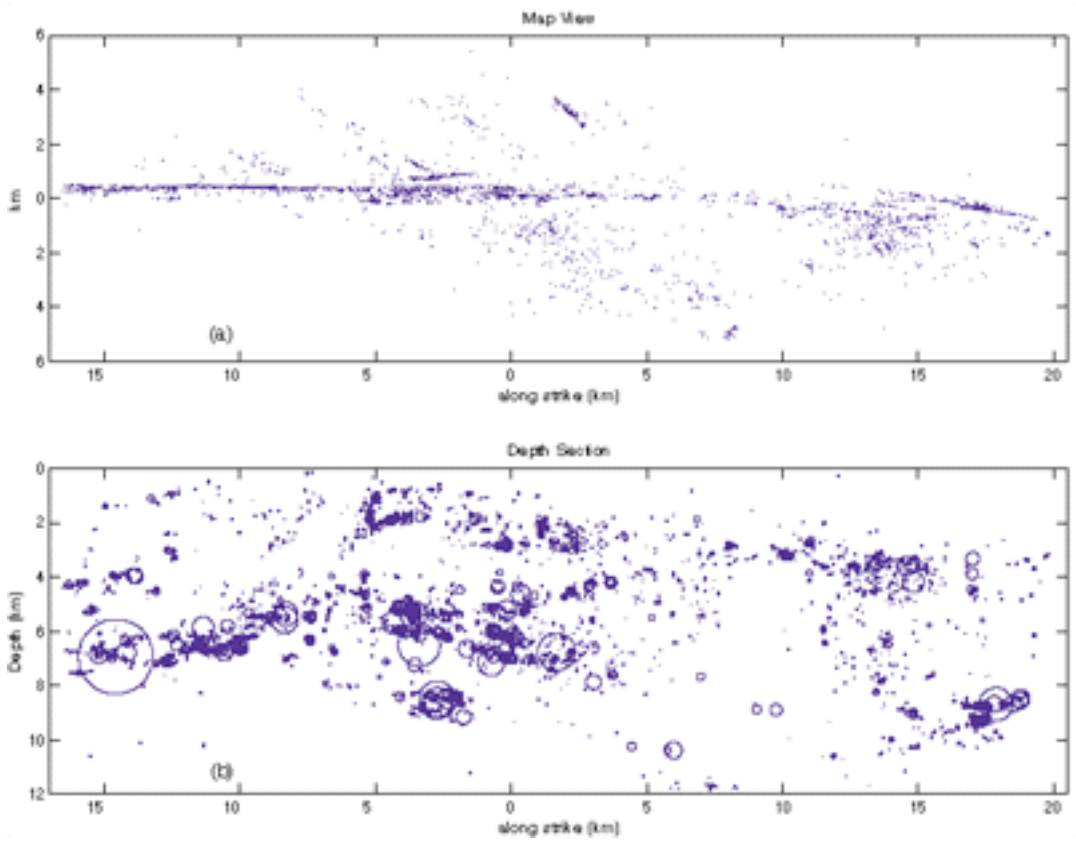
> size of circle scales with magnitude of earthquake

IMPROVED LOCATIONS USING DOUBLE-DIFFERENCE APPROACH



> double difference method employs relative timing variations between different earthquakes (only possible where dense station/eq coverage)
> note improved resolution especially in vertical direction
> new definition of several off-fault structures, and restriction of seismicity to well-defined bands

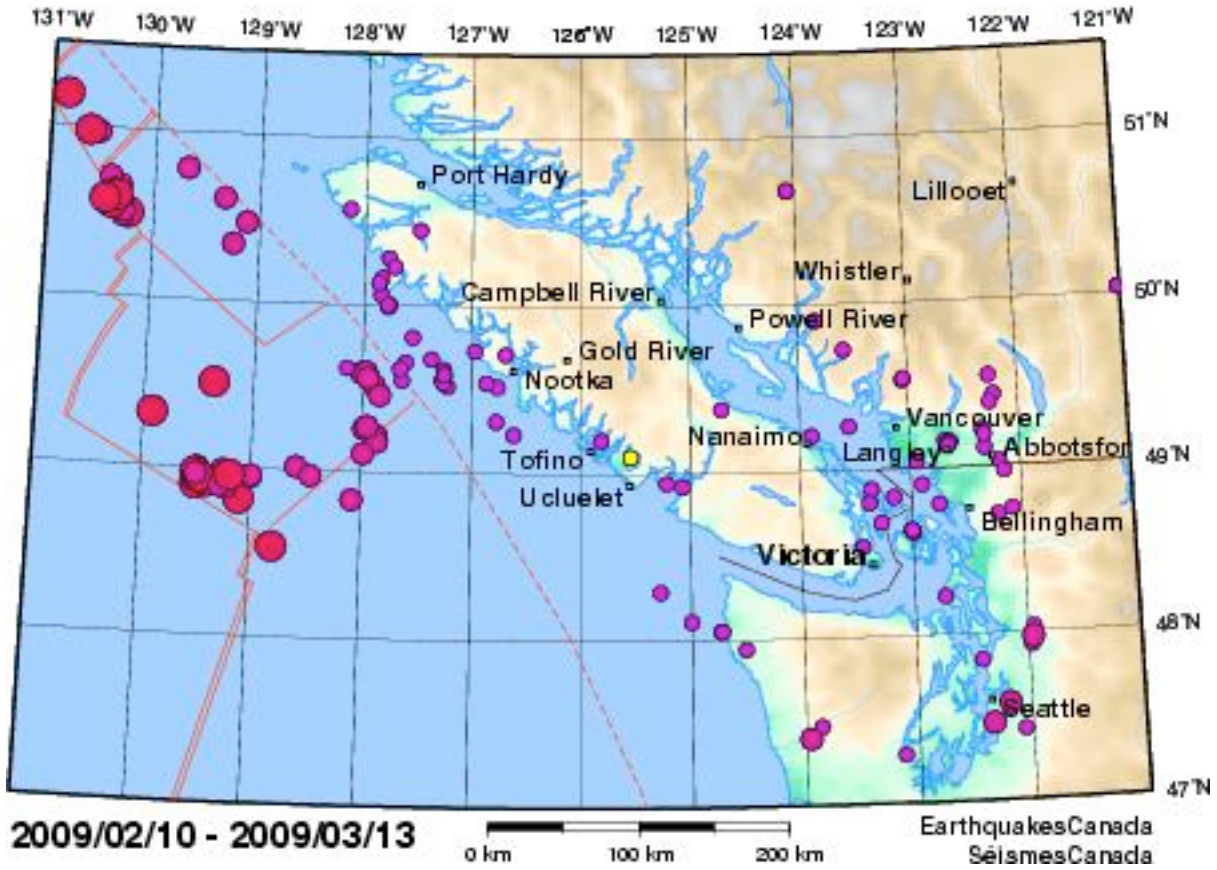
EARTHQUAKE LOCATIONS ON TRANSFORM FAULTS AND RIDGES



> note earthquake hypocenters on transform faults generally above 15 km which is depth to brittle ductile transition

> at mid-ocean ridges hypocenters are still shallower ~< 5 km

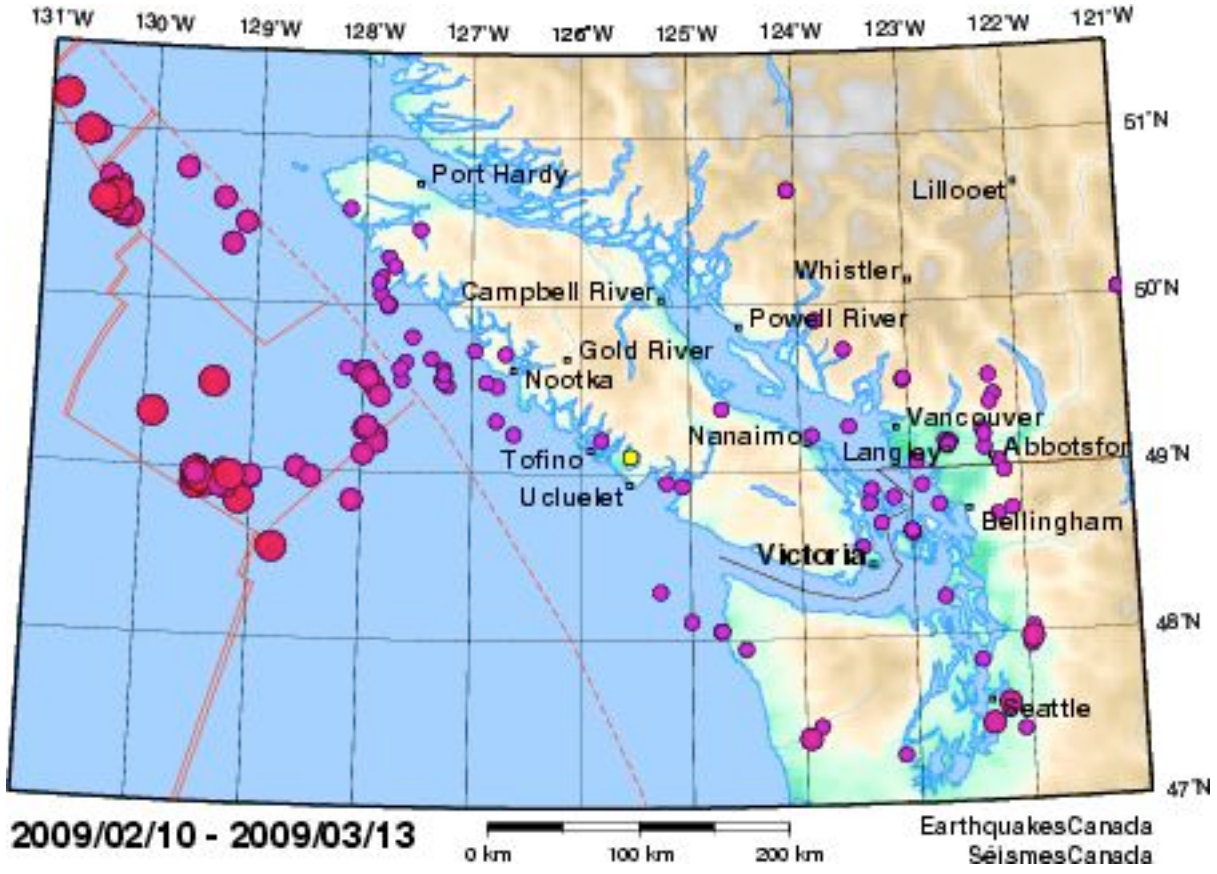
EARTHQUAKE LOCATIONS IN BC



> offshore earthquakes poorly located - why?

> epicenters on NA plate are either in continental crust or in down-going plate - NOT on boundary!

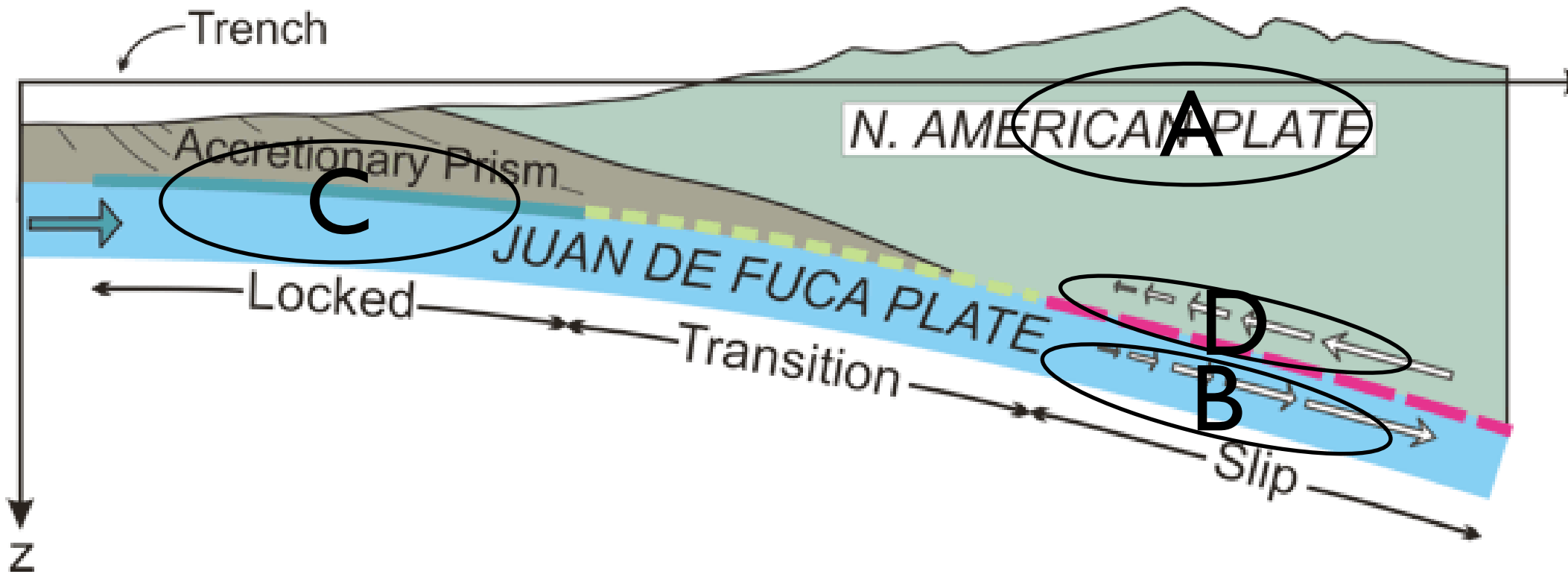
EARTHQUAKE LOCATIONS IN BC



> earthquake locations are most accurately determined if epicenter lies within network

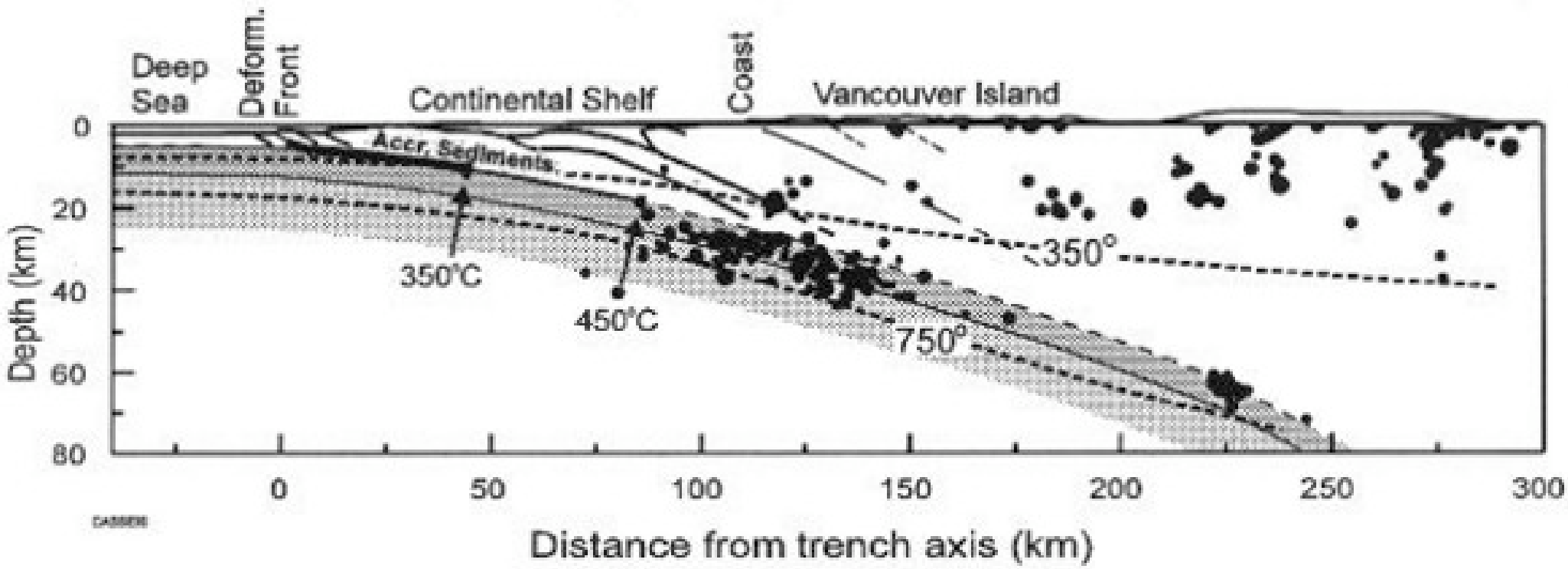
> for this reason, depths are usually less well determined than epicenters

EARTHQUAKES IN CASCADIA



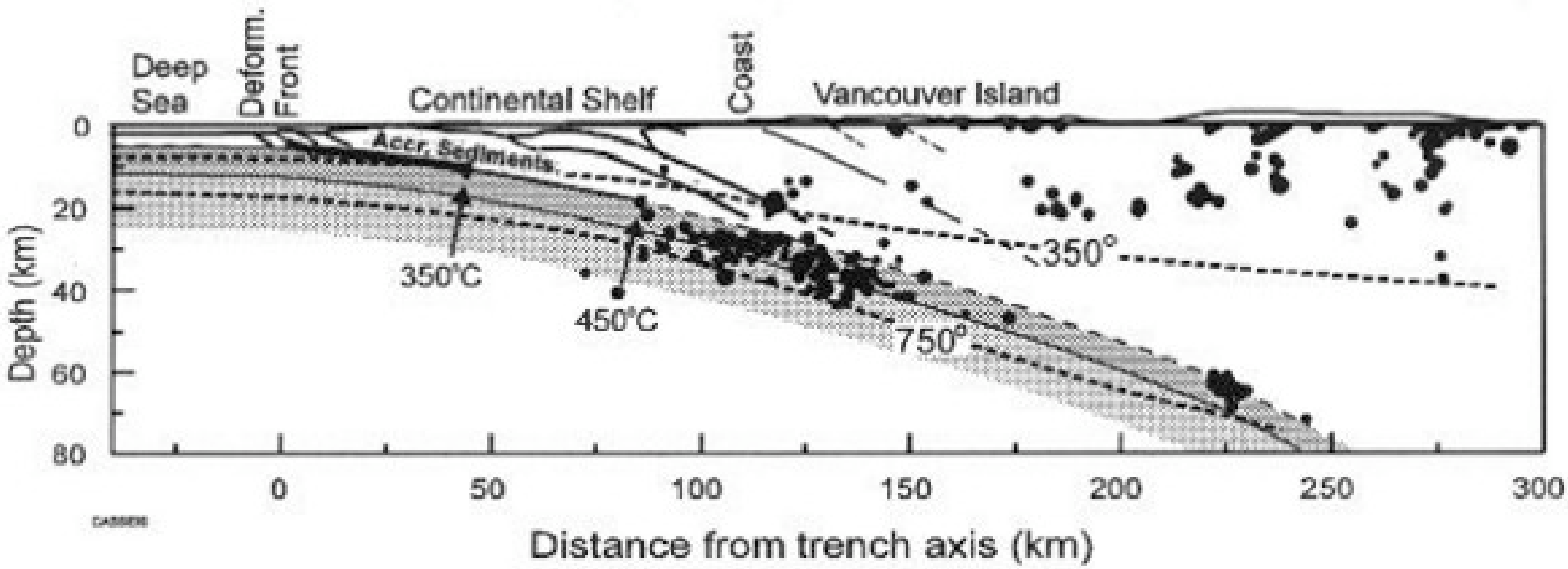
A: intracrustal (e.g. Vancouver I, June 23, 1946, M=7.3)
B: intraplate (or Wadati-Benioff, e.g. Seattle February 28, 2001, M=6.8)
C: megathrust (e.g. January 26, 1700, M=9.?)
D: episodic tremor and slip (every 14 months)

CASCADIA HYPOCENTERS



> deepest hypocenters represent intraplate earthquakes
> in Cascadia, no deeper than ~80 km - WHY?

CASCADIA HYPOCENTERS



> Juan de Fuca plate is young and hot, since it is created several 100's km off shore and is ~ 10Ma at trench

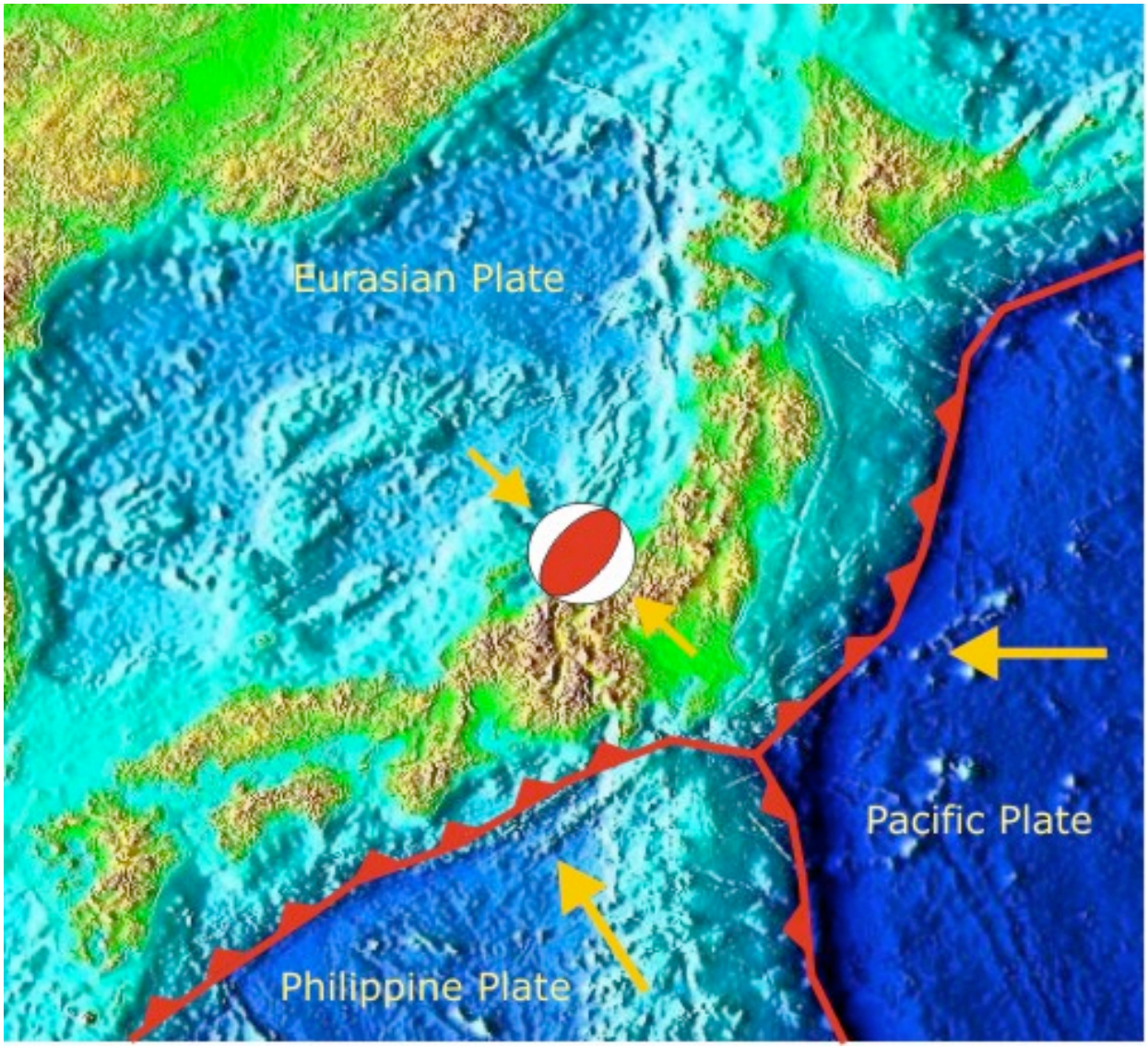
> below 100 km, plate too hot to sustain brittle rupture

JAPANESE SUBDUCTION ZONES

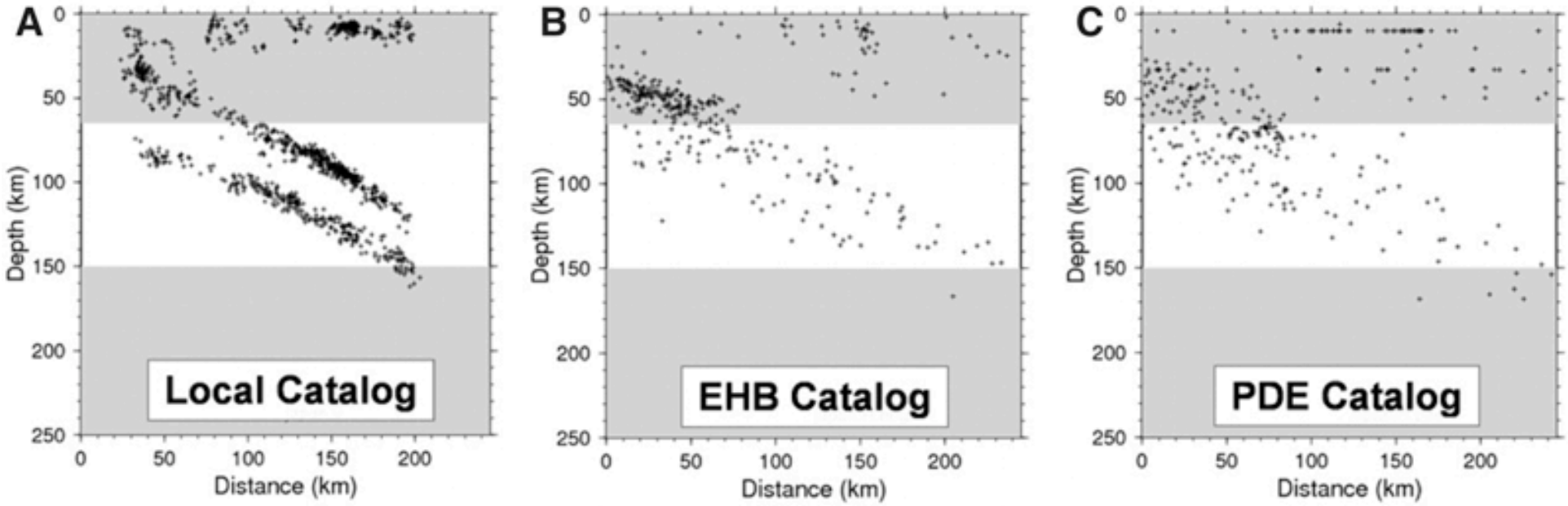
> Japan has 2 separate subduction zones

> Philippine plate is young, warm with shallow W-B seismicity like Cascadia

> Pacific plate is old, cold, W-B seismicity to greater depths



HYPOCENTERS IN NE JAPAN



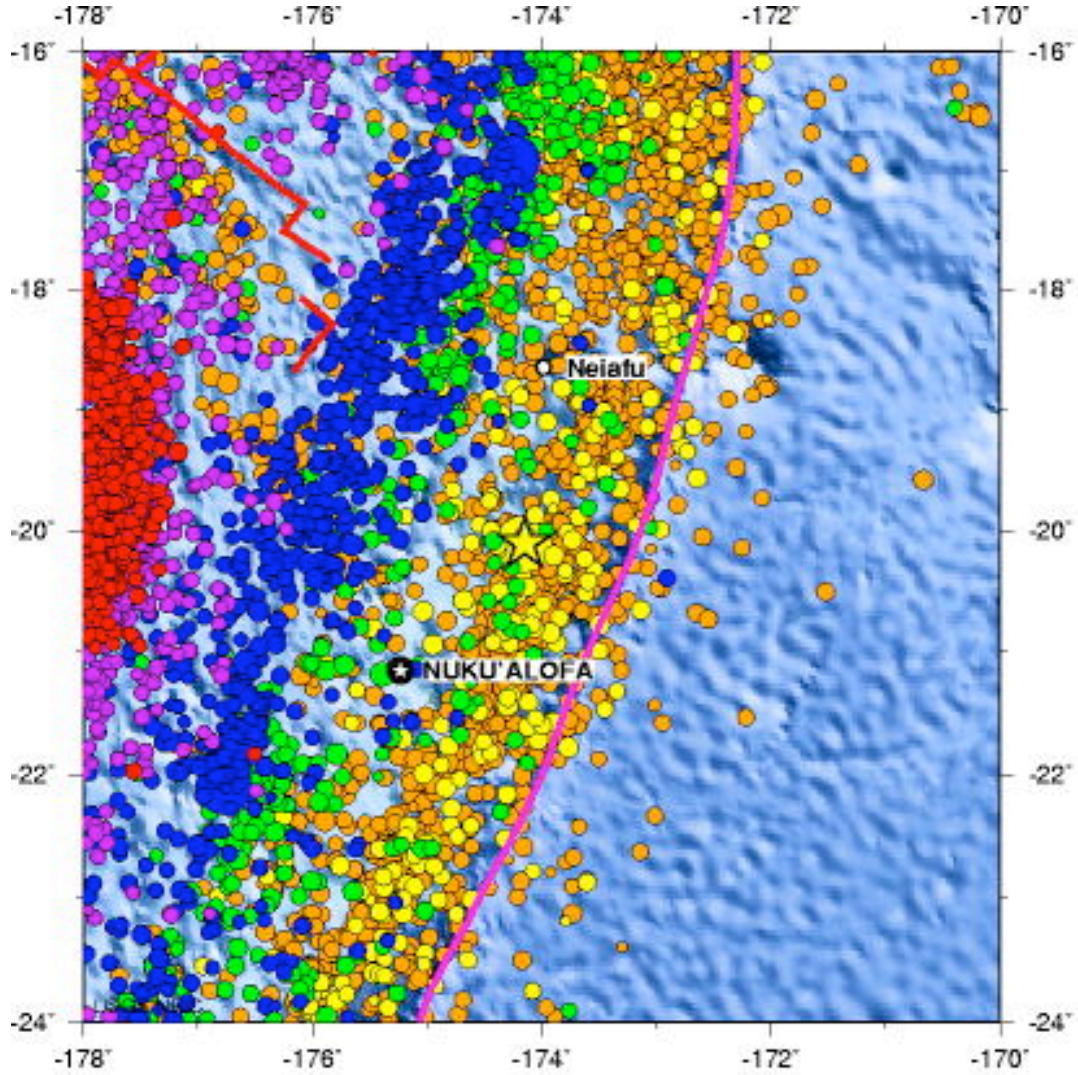
> note quality of locations with different networks
> seismicity to at least 150 km
> double seismic zone, both limbs due to H2O producing reactions

SEISMICITY IN TONGA

> hypocenters colour coded in depth

> maximum depth of earthquakes to ~670 km

> due again to mineral reactions



TONGA

2006 05 03 15:26:40 UTC 20.11S 174.15W Depth: 55 km, Magnitude: 7.9

Seismicity 1990 to Present

<=3 4 5 6 7 8 9

Magnitude (size)

-800 -500 -300 -150 -70 -35 0

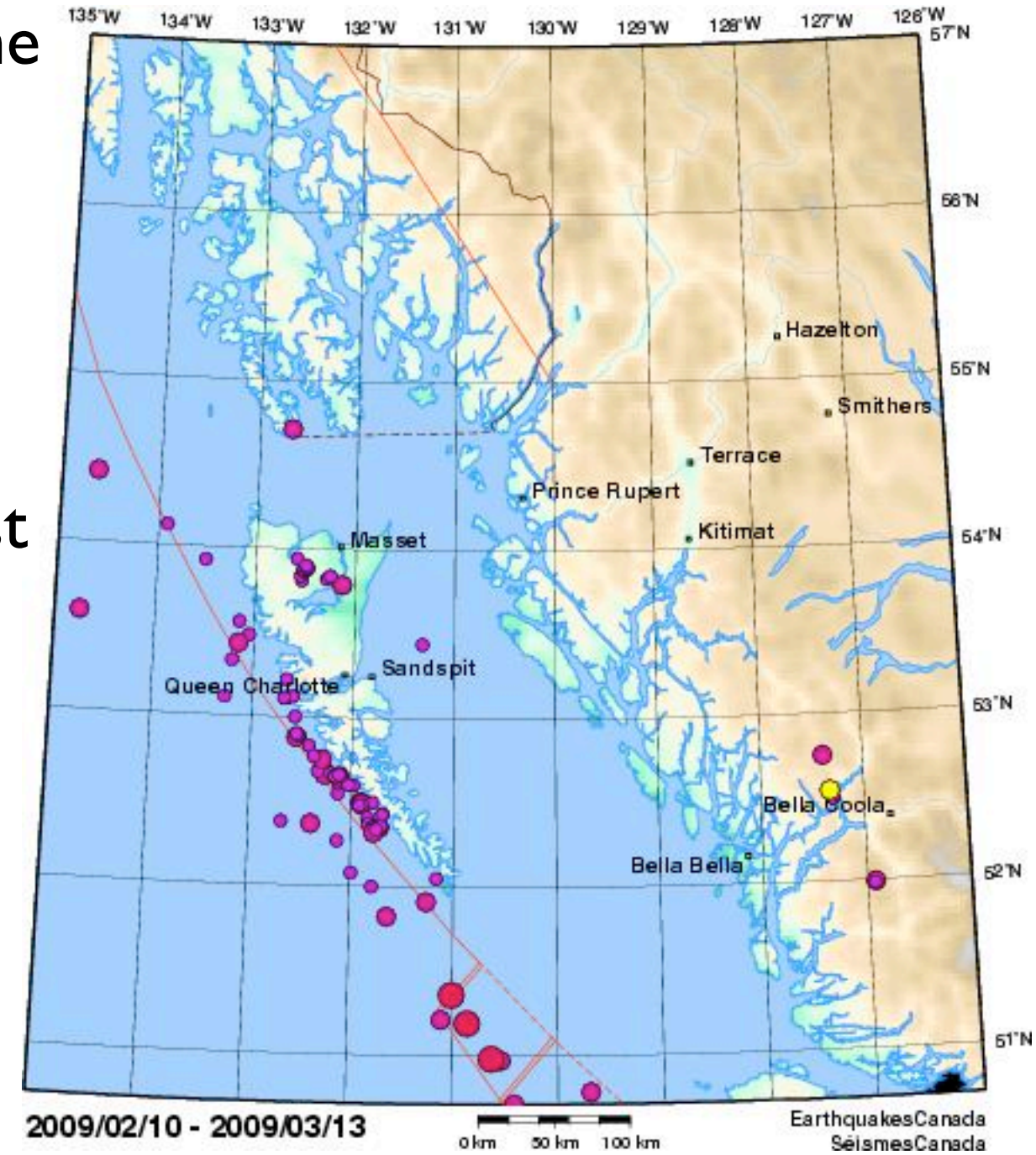
Depth in km (color)

RECENT QUAKES ON THE QUEEN CHARLOTTE FAULT

> Canada's version of the San Andreas

> major transform (strike-slip) fault

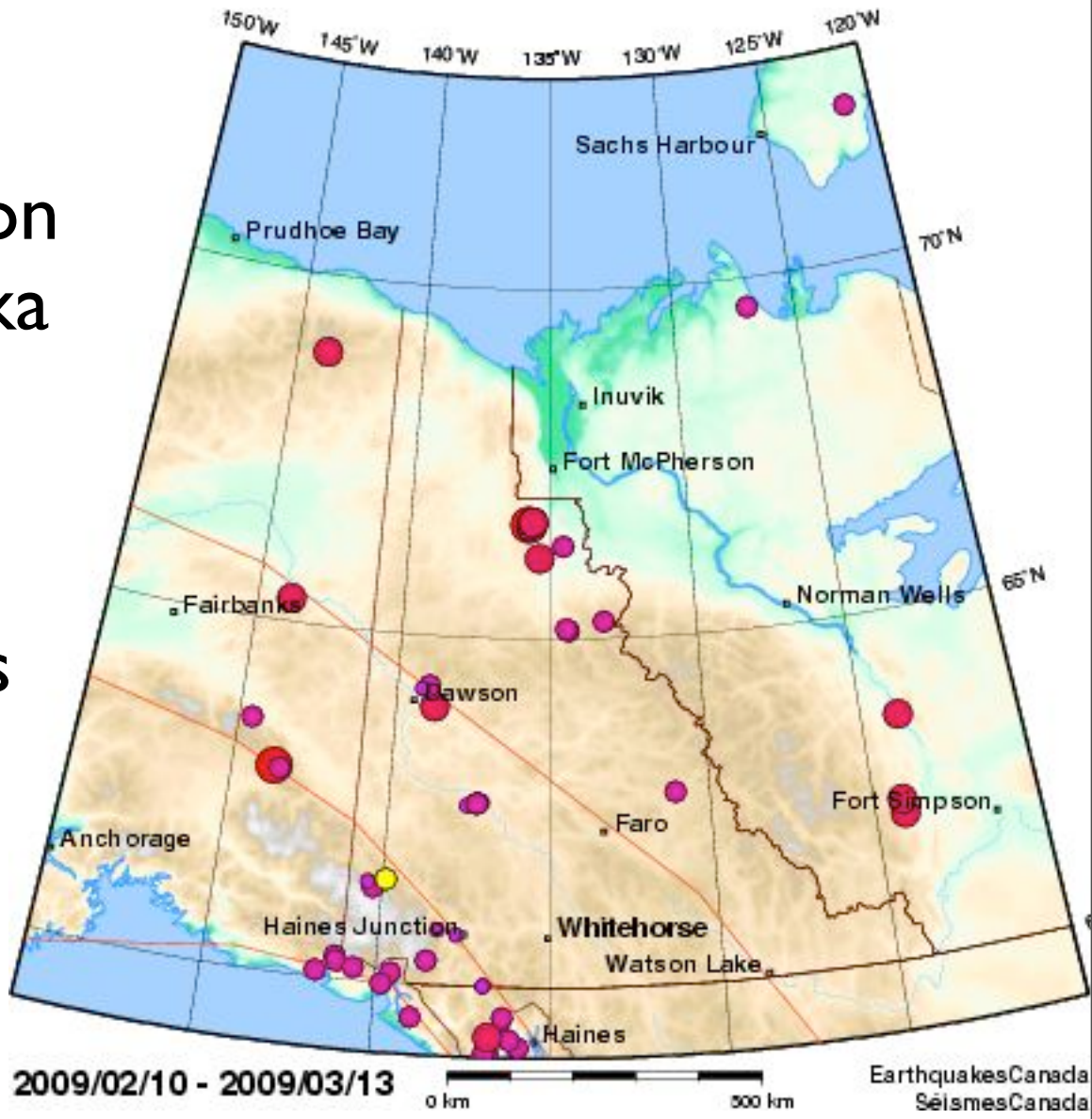
> site of Canada's largest historic quake (M=8.1, 1949)



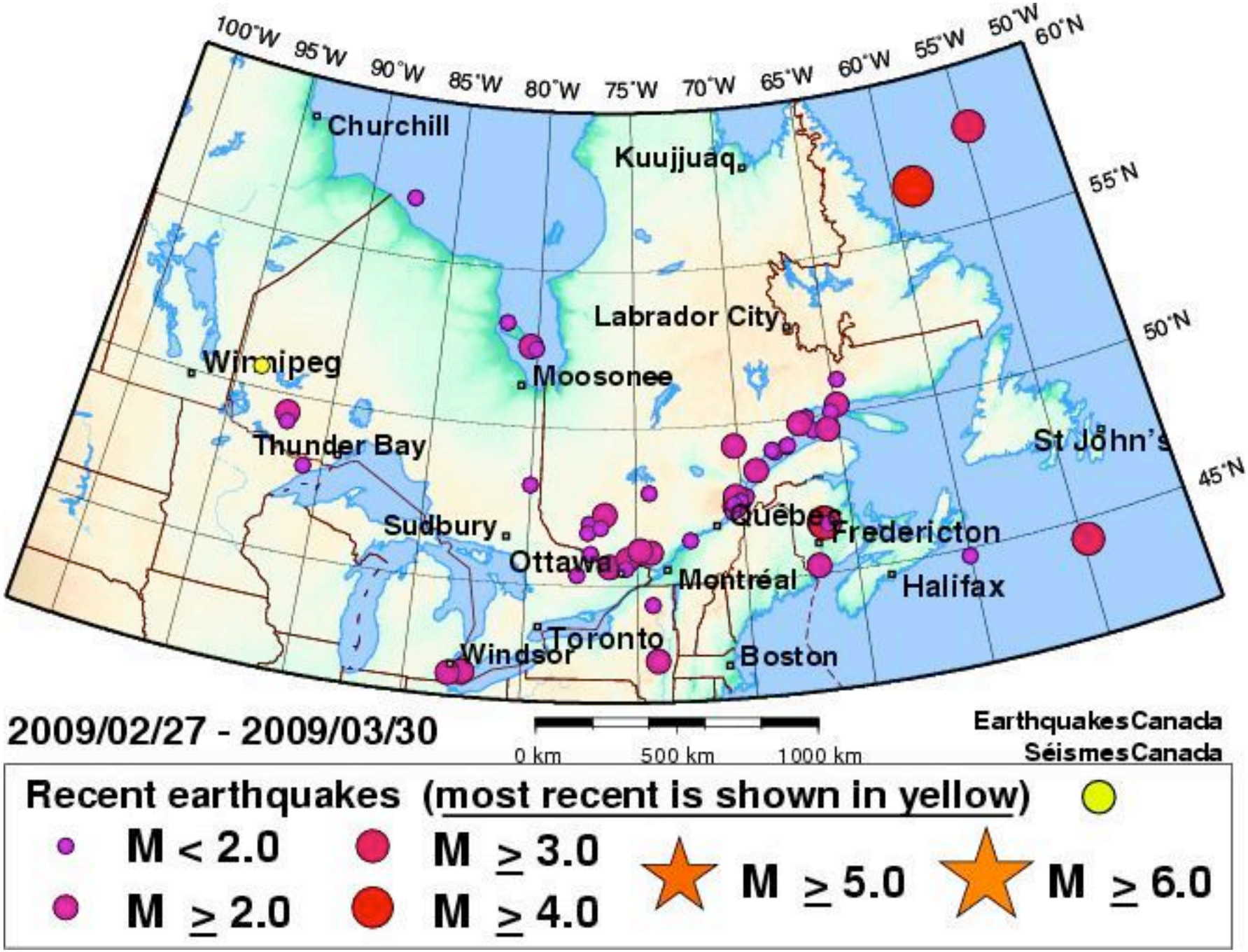
SEISMICITY IN NW CANADA

> Queen Charlotte Fault becomes Alaska subduction zone west of Yukon/Alaska border

> additional seismicity broadly distributed across Cordillera to Mackenzie Mtns



EASTERN CANADA EARTHQUAKES



EASTERN CANADA EARTHQUAKES

> Charlevoix region (near Quebec city) is most active zone in eastern Canada (5 eq's with M>=6)

> Ottawa-Bonnechere graben is another active region

> causes not well known, quakes appear to be located in zones of crustal weakness, perhaps related to ancient plate b oundaries