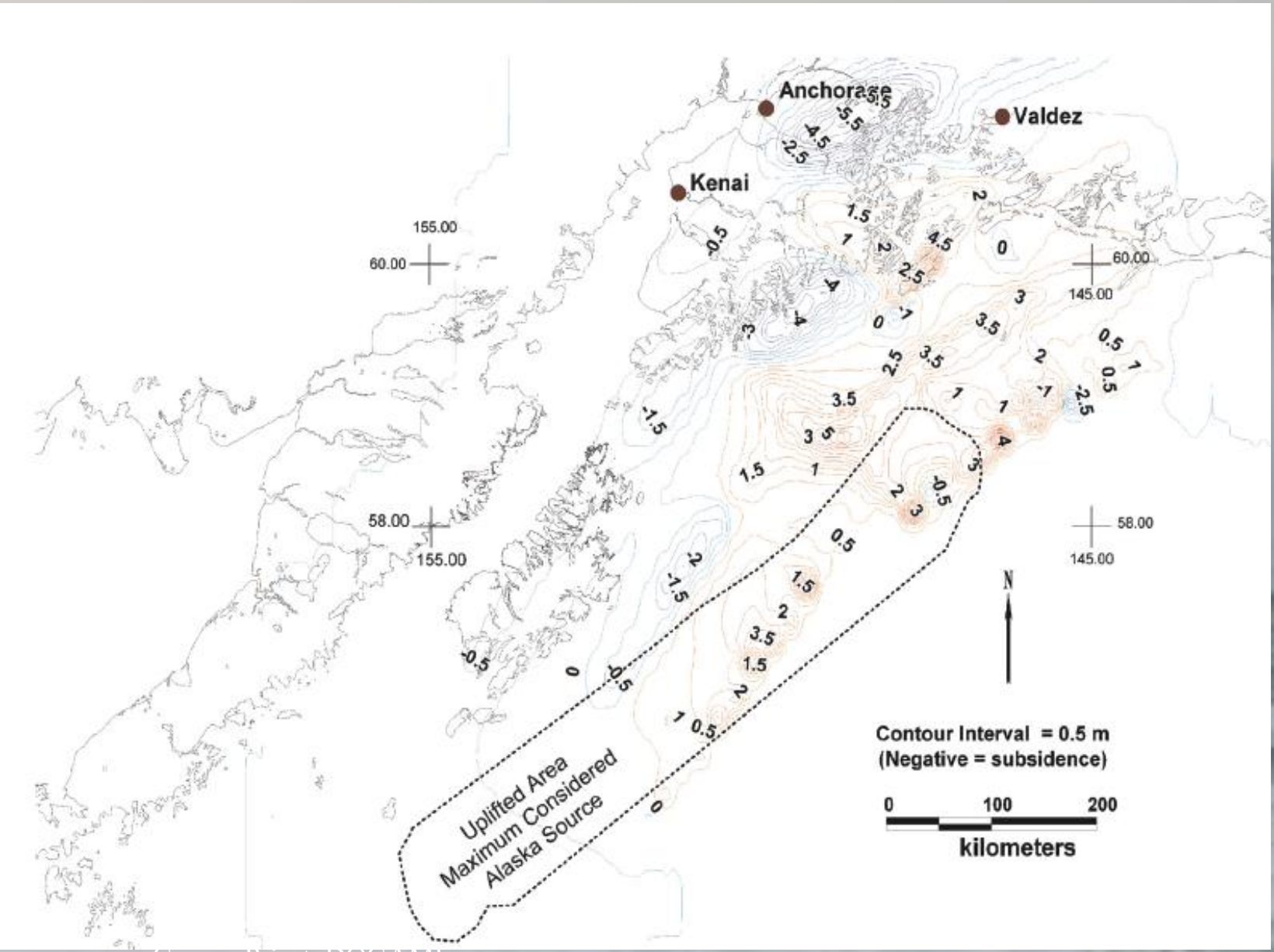
Oregon Tsunami Sources
July 2012

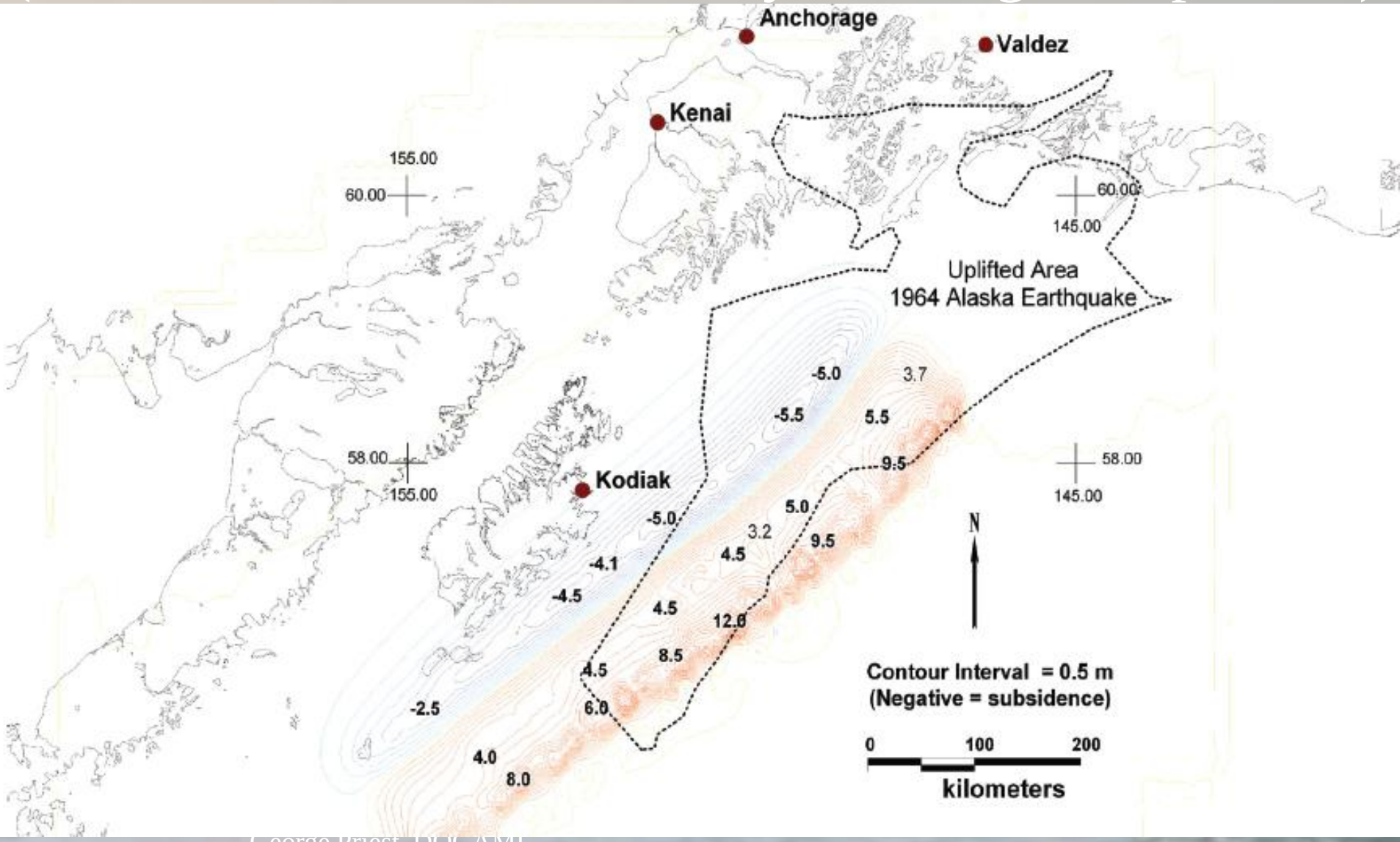
George R. Priest

Oregon Department of Geology and Mineral Industries

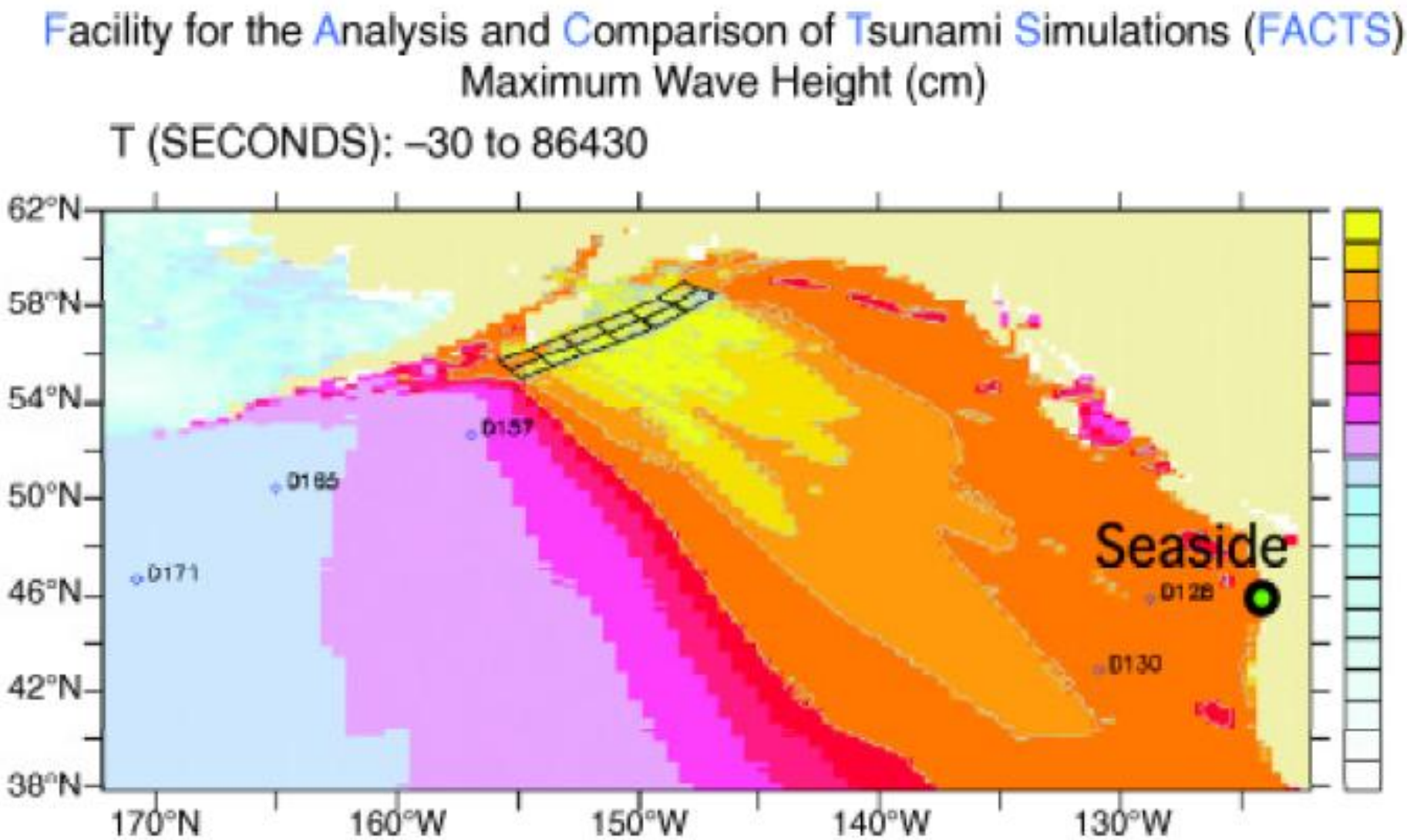
Largest Historical Distant Tsunami Event: 1964 Prince William Sound Earthquake



Hypothetical Maximum Alaska Tsunami Source – (Source 3, Tsunami Pilot Study Working Group, 2006)



Source 3 illustration from Tsunami Pilot Study Working Group (2006)



Maximum Uplift
Alaska vs Maximum Cascadia Source
(all ~M_W 9.2)

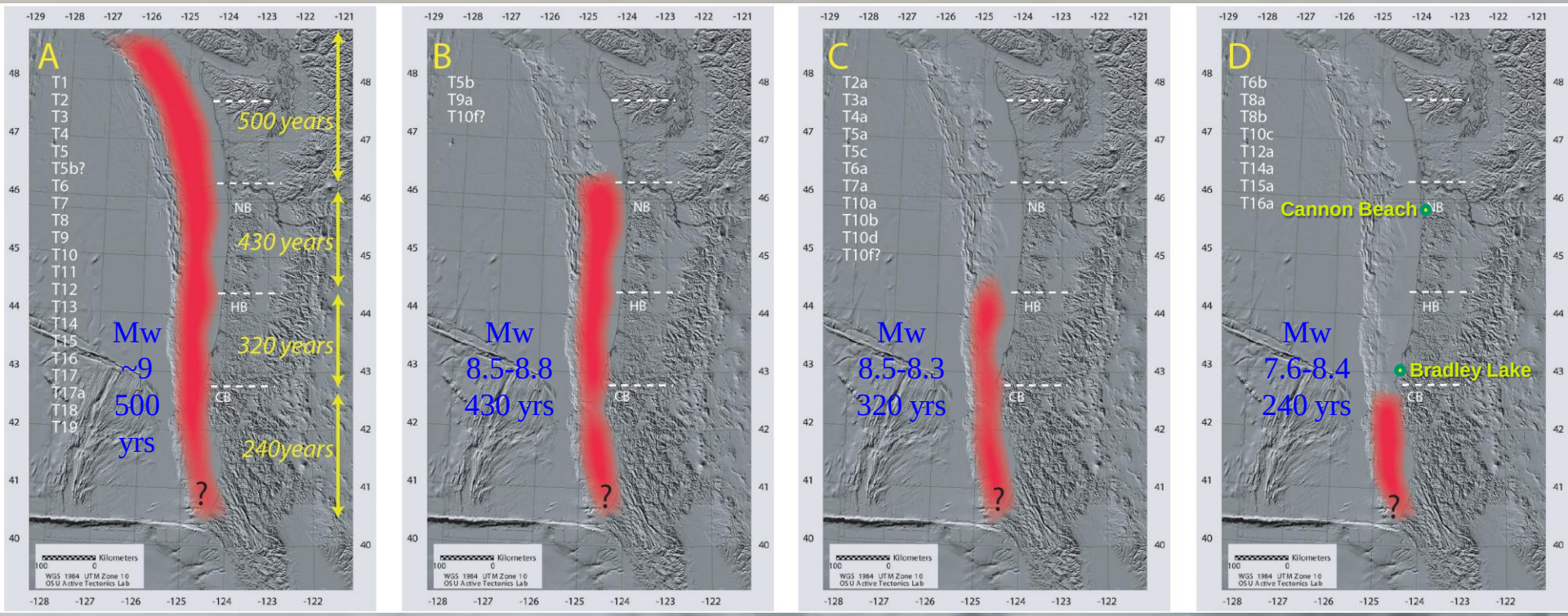
Source	Peak Slip (m)	Peak Uplift (m)
Cascadia XXL (Witter et al., 2011)	40	10
Alaska Max (Source 3, Gonzalez et al., 2008))	30	9-12
1964 Alaska (Johnson et al. (1996)	20-22	4-6

Probabilistic Implications: Oregon Cascadia Scenarios

- "**Small**":
  - Approx. inundation for 5 of 19 full-margin events over the last ~10,000 years.
  - Approx. min. slip to produce the 13 of 32 (~41%) tsunamis that made it into Bradley Lake (southern Cascadia) over the last 7,300 years.
- "**Medium**"
  - Approx. inundation for 10 of 19 full-margin events
  - Approx. min. slip for tsunamis to cover AD1700 tsunami sands (AD1700 = "average" turbidite)
- "**Large**" Approx. mean inundation for 3 of of the top 4 full-margin events over the last ~10,000 years.
- **XL and XXL** are similar and approx. inundation for the largest event over the last 10,000 years.

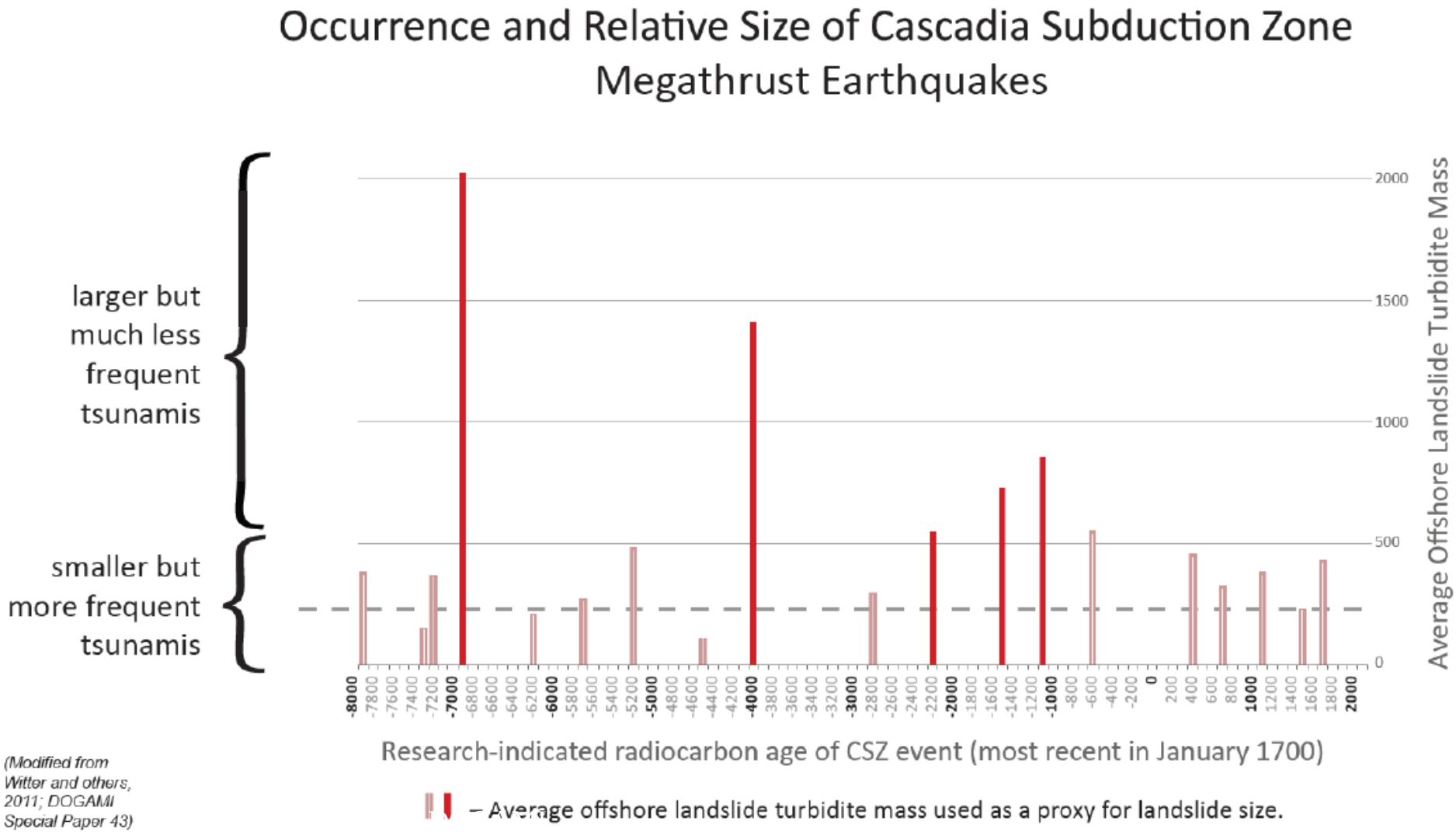
Cascadia Rupture Lengths from Turbidite Data

~40 earthquakes over the last 10,000 years



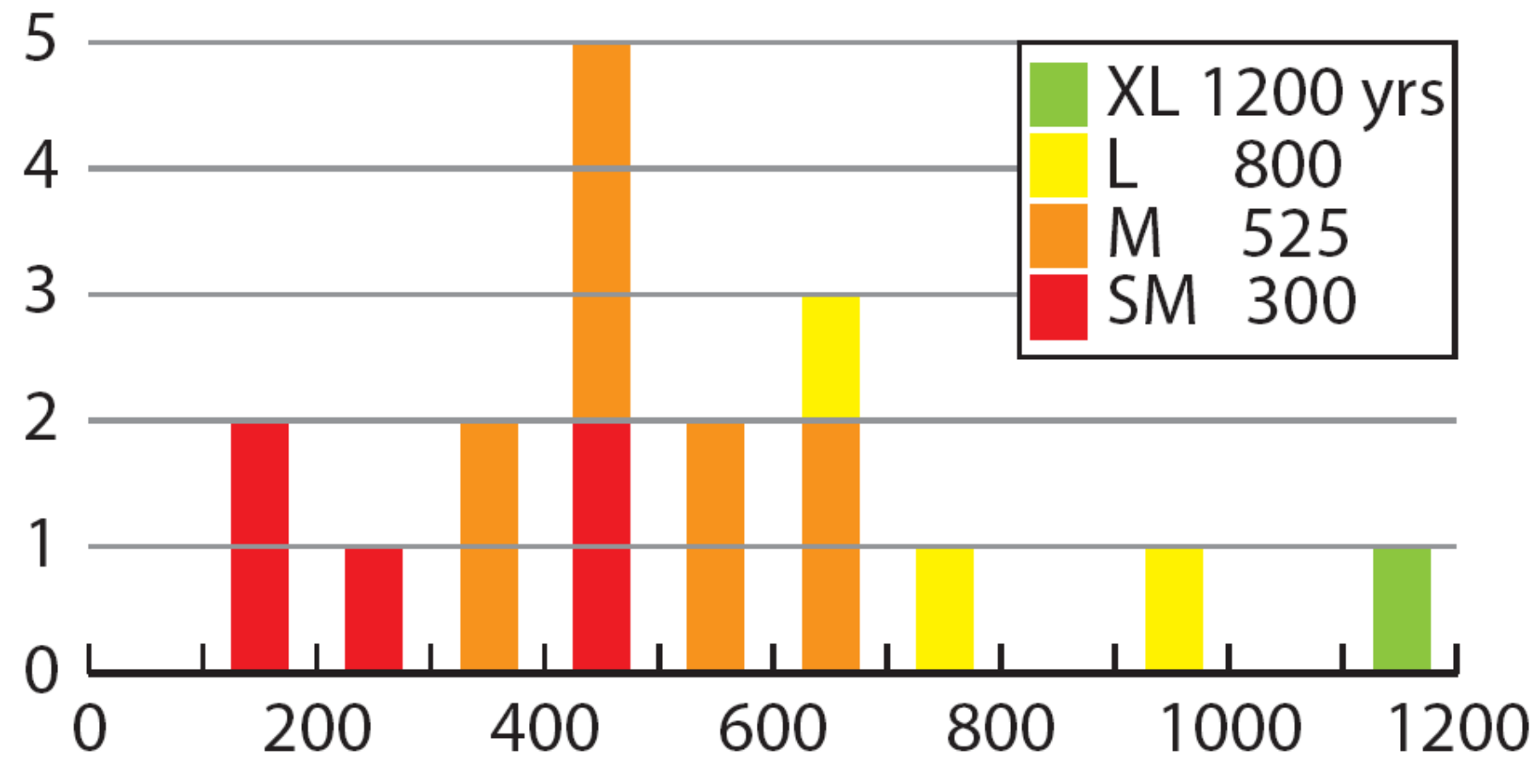
Modified from Goldfinger et al., (2012)

19 CSZ Earthquakes & Tsunami Over past 10,000 Years



(Modified from Witter and others, 2011; DOGAMI Special Paper 43)

Frequency and size (mass) of full-margin turbidites vs. inter-event follow times over the last 10,000 years

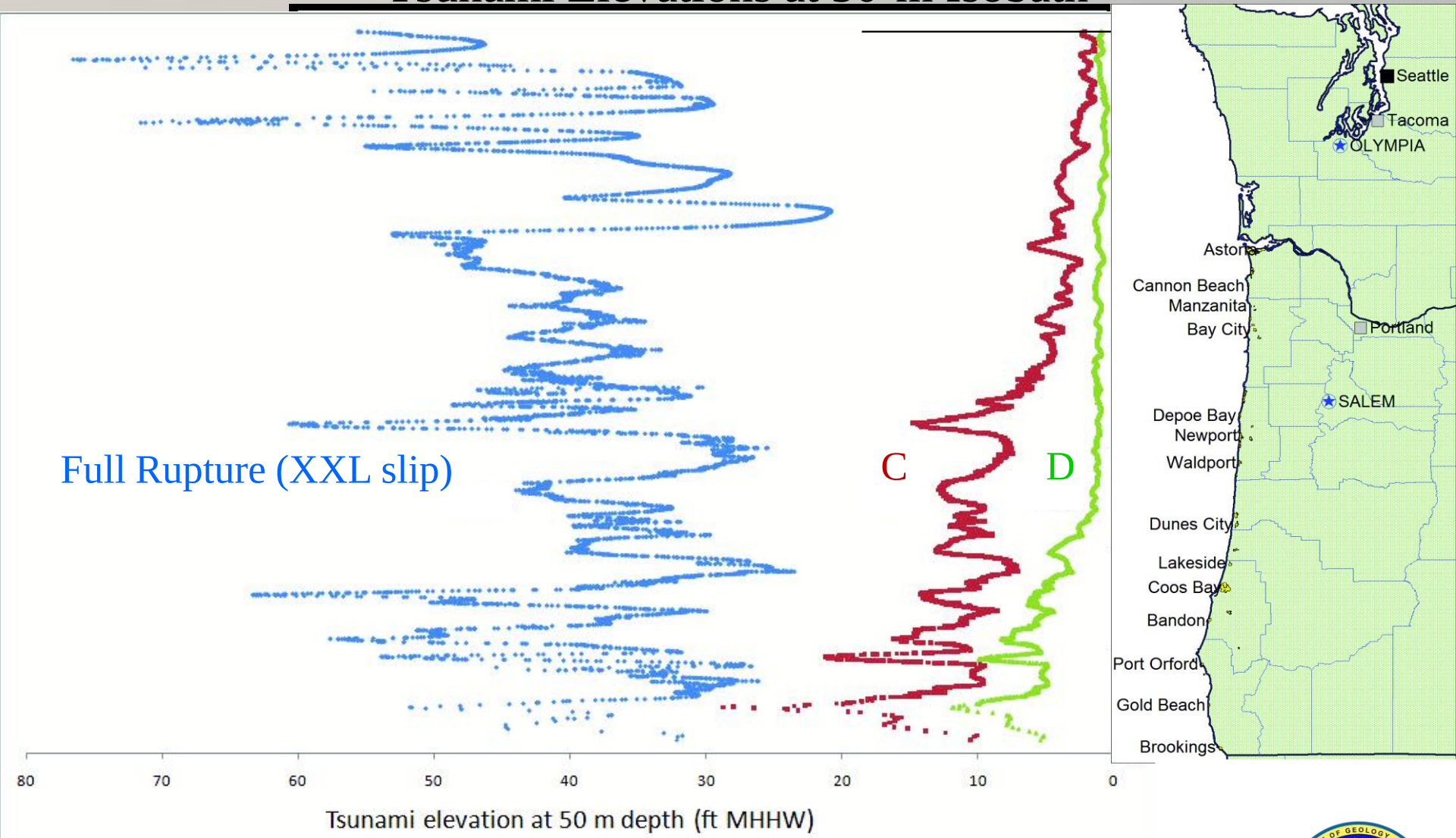


Scenario slip is calculated from the 1200-, 800-, 525-, and 300-yr follow times.
Note that follow time times do not correlate exactly with turbidite size (mass).
Graph is from Witter et al. (2011), DOGAMI Special Paper 43

Further Implications to consider:

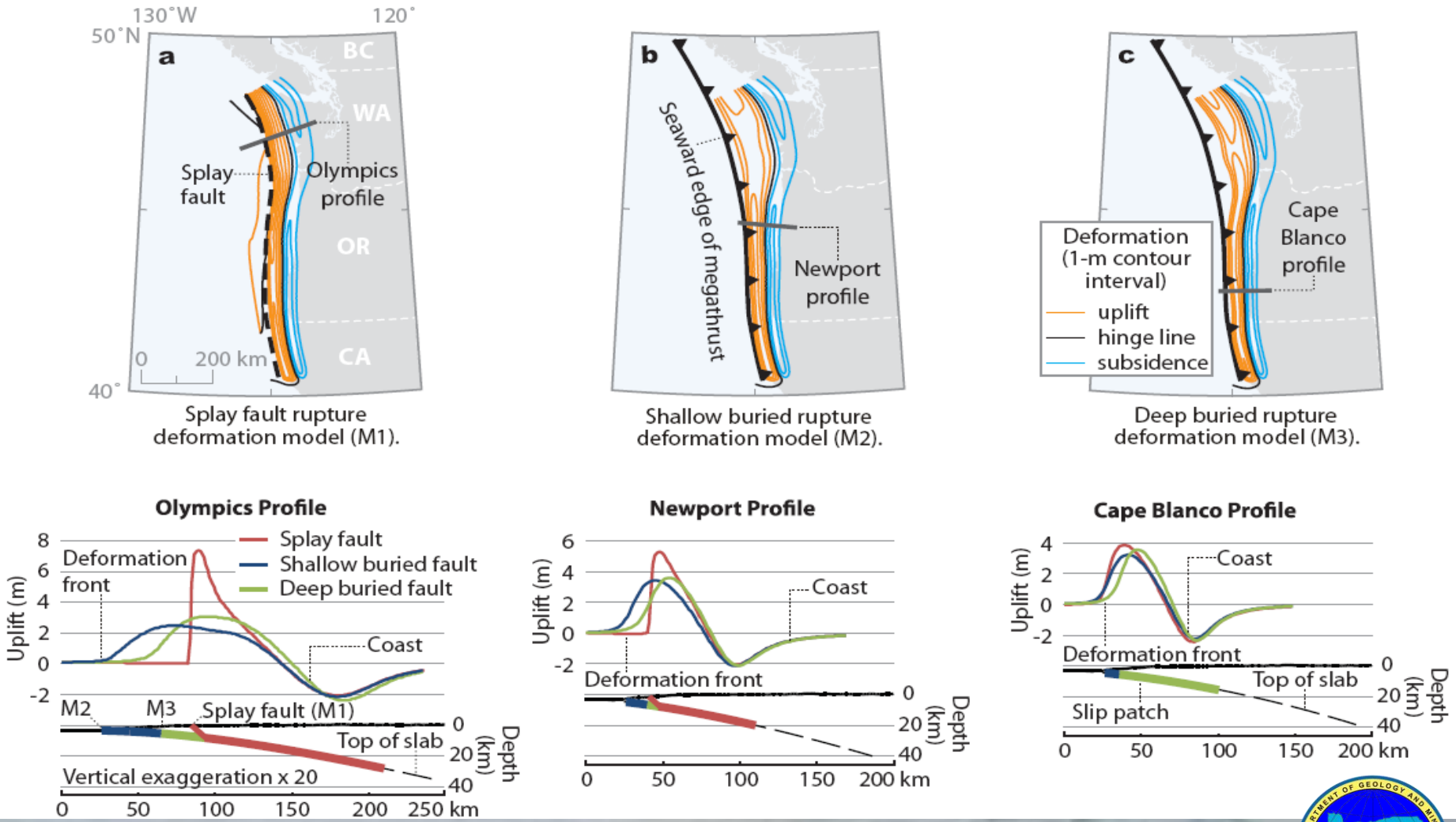
- Published inundation maps use only the splay fault model
  - Probably okay for M-XXL cases; maybe not for “Small” slip
  - Amplifies inundation by 6-20% and elev. at shore by 27-31%.
- Mw = 8.7 to 9.2
- Slip patches = regional north to south (no “null” zones)
  - “Null” zones create de facto segments
  - Segment tsunamis die out quickly north and south of patch
  - “Null” zone patches are thus effectively “no tsunami” cases
- Slip tapers E-W from a maximum near the slope break
  - Based on observations of many modern events (Sumatra, etc.)
  - May be problematic for southern Cascadia (e.g., Tohoku slip to trench)

Regional Experiment: Tsunami Elevations at 50-m Isobath



Unpublished data and graphics of Oregon Dept. of Geology and Mineral Industries.

Vertical Deformation:
Splay Fault vs Buried Rupture Sources



Source: Witter et al (2011), DOGAMI SP43