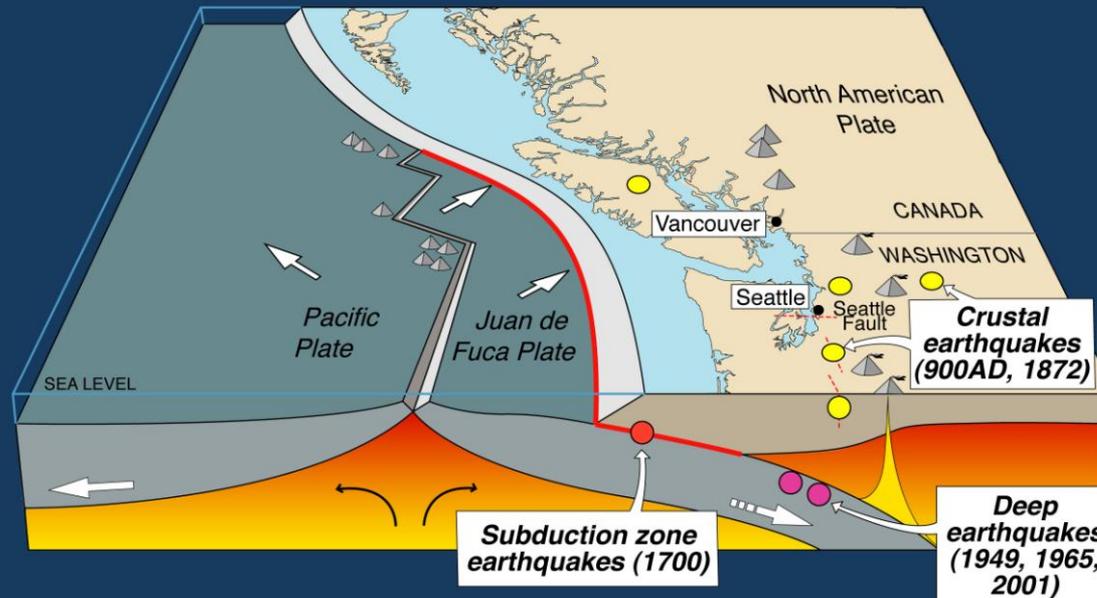


Earthquakes in the Pacific Northwest— Understanding the Hazard

Craig S. Weaver
United States Geological Survey
Seattle, Washington

The Big Picture

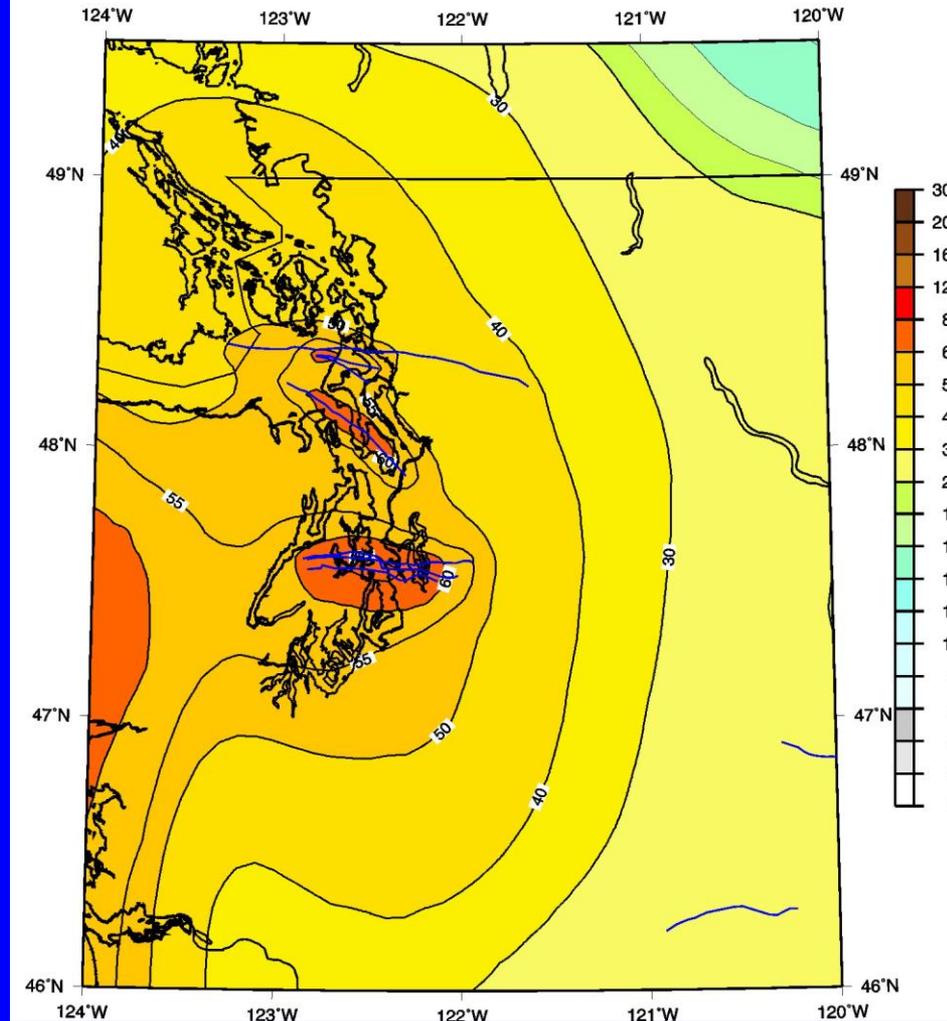
Cascadia earthquake sources



Source	Affected area	Max.Size	Recurrence
● Subduction Zone	W. WA, OR, CA	M 9	500-600 yr
● Deep JdF plate	W. WA, OR	M 7	30-50 yr
● Crustal faults	WA, OR, CA	M 7?	?

Current National Hazard Map (being updated)

From 2002 USGS National Seismic Hazard Map
PGA (%g) with 2% Prob. Of Exceedance in 50 Years



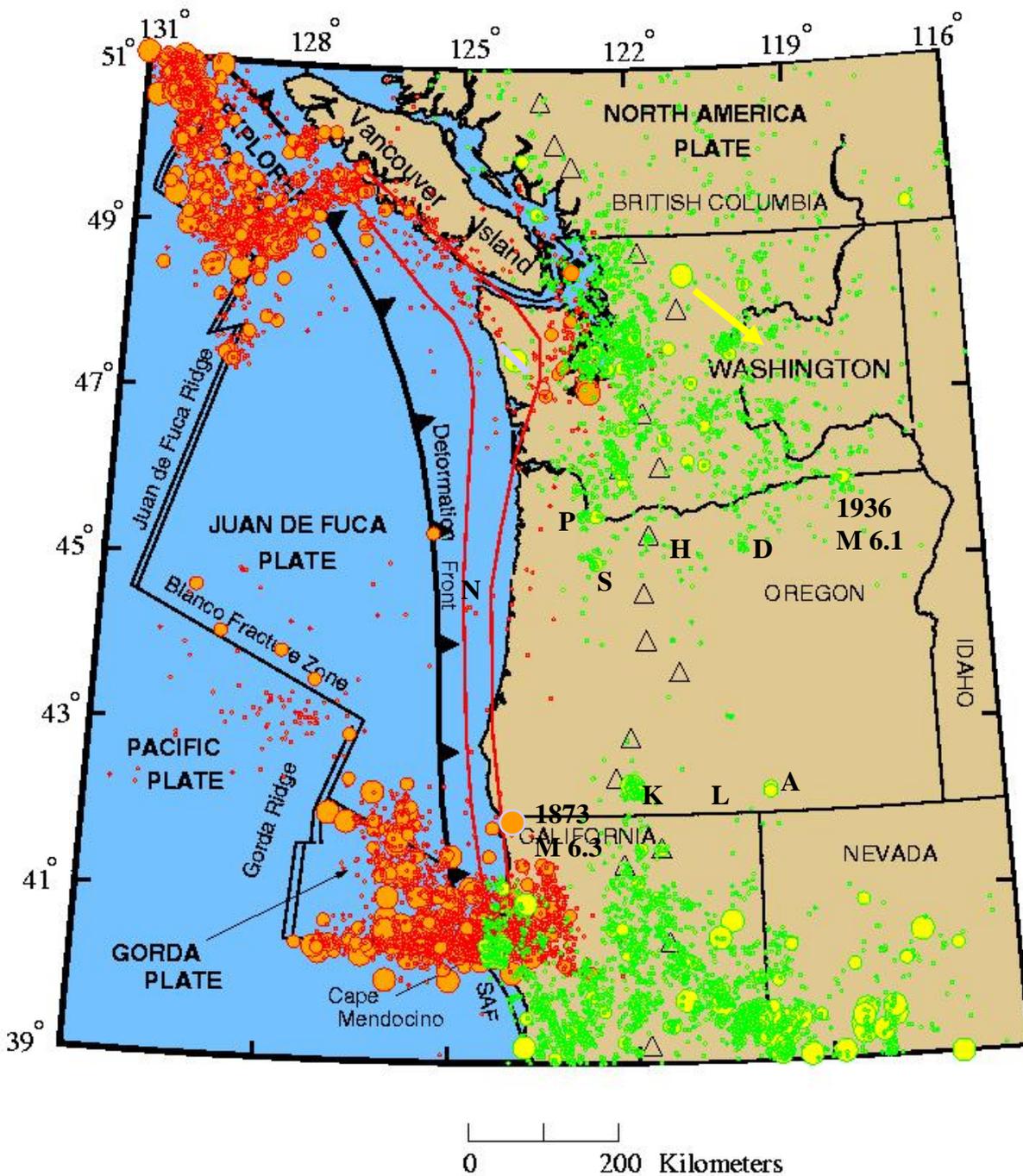
Earthquake Hazards Reduction
Program



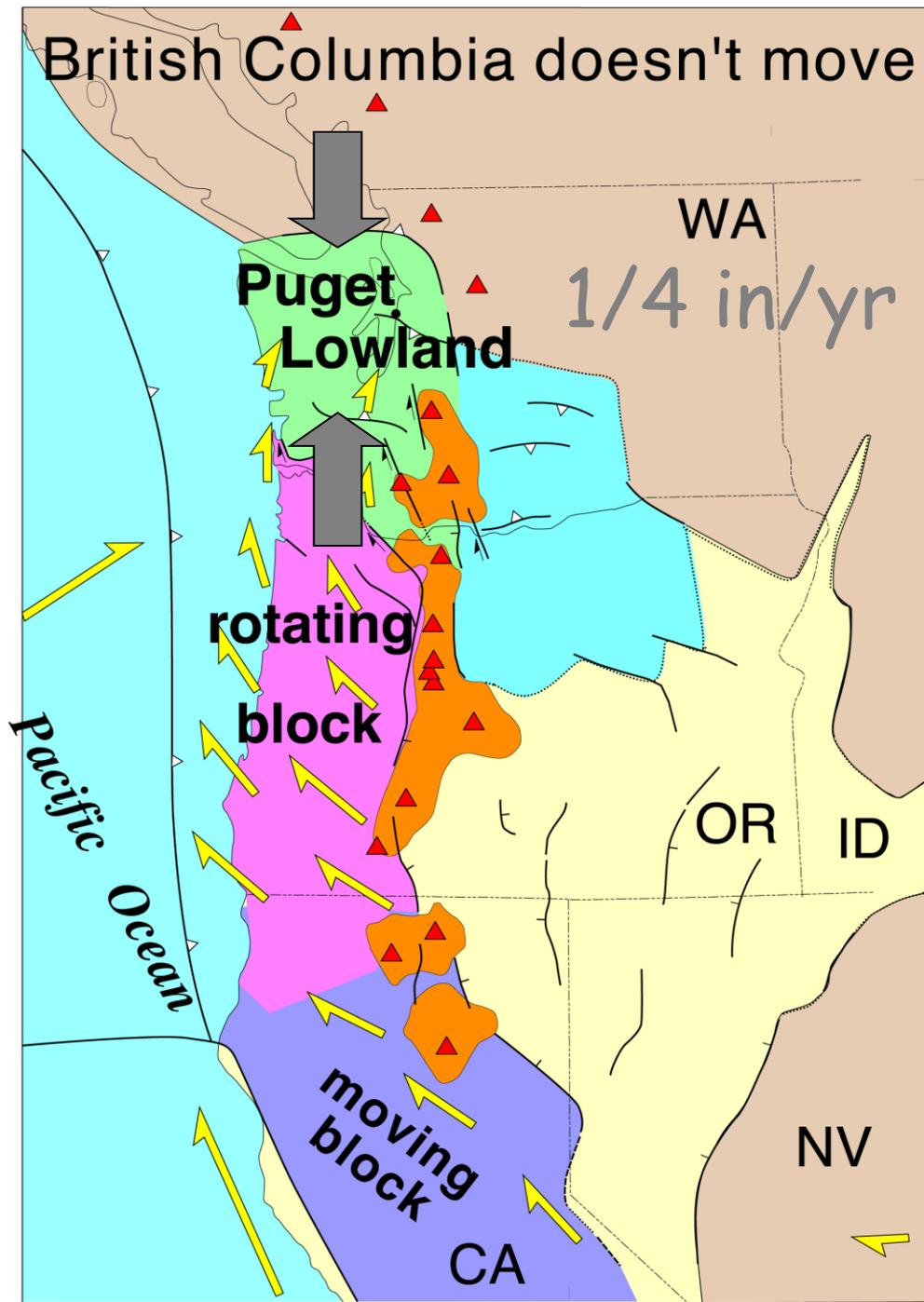
How Often?

Approximate 50 year probabilities

- **Cascadia M9: 10-14%**
- **Seattle Fault $M \geq 6.5$: 5% (from slip rate, GR model; 1000 yr return time) ???**
- **Deep $M \geq 6.5$: 84% (from 1949, 1965, 2001)**
- **Random shallow $M \geq 6.5$ in entire Puget Sound area: 15% (mostly from rate of $M \geq 4$ since 1963, $b=0.8$) ???**



Cascadia Earthquake Distribution. Orange events are in the Juan de Fuca plate system, Green events within North America. Yellow events are greater than magnitude 5 in NA.



Use Tectonics and Geology

Puget Lowland is being squeezed from south to north at a rate of about 1/4 inch/year (6 mm/yr). As much as a 1/3 of the squeezing is on the Seattle fault.

How does the earth's crust
respond to squeezing?

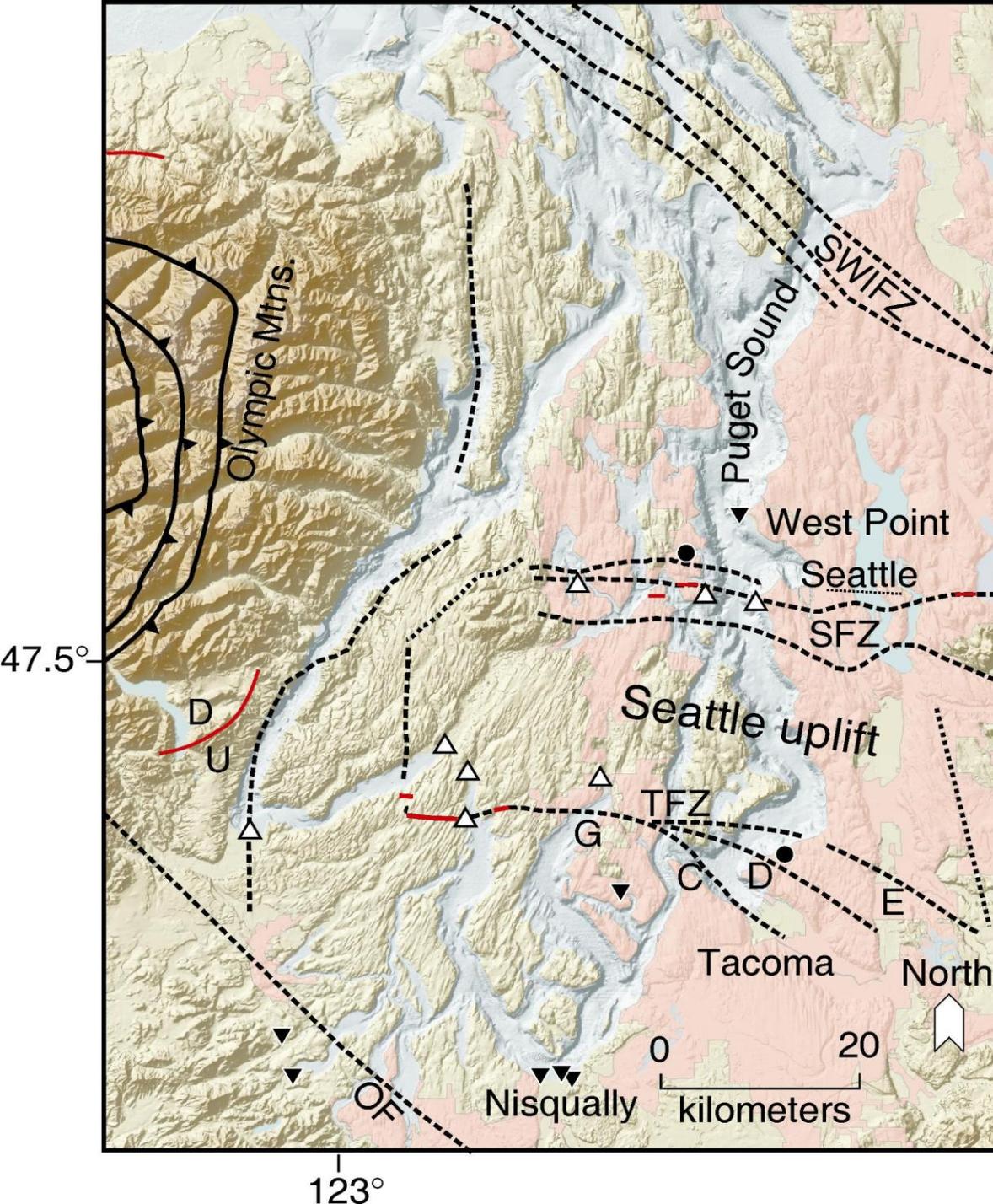


By folding and faulting!!



How Often??

The Seattle fault zone is one of a series of major faults that cut across the Puget Sound basin



△ Uplifted site

▼ Subsided site

● Site with no change

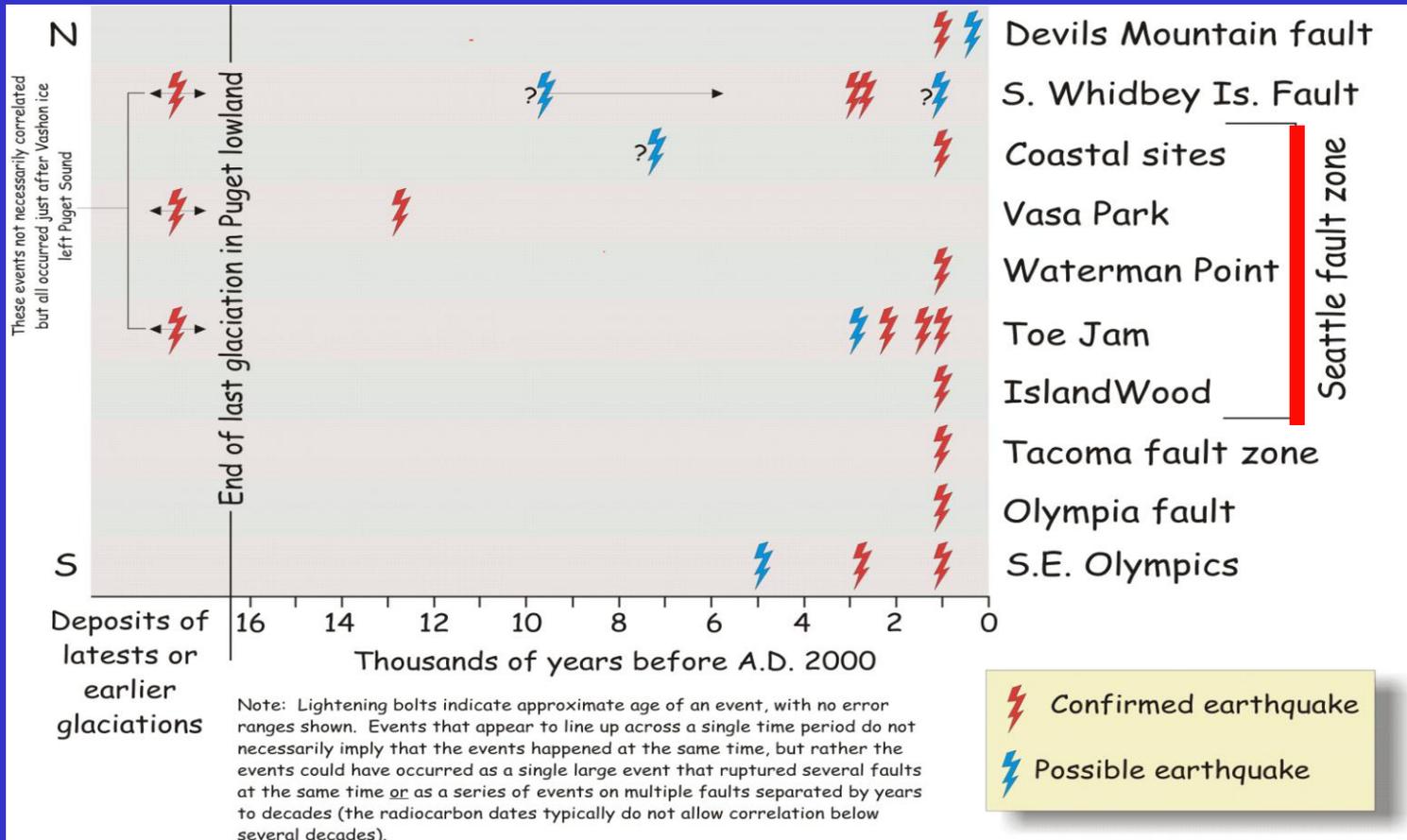
↖ Thrust fault, barb on upthrown block

- - - Geophysical anomaly

— Holocene scarp

■ Urban areas

Known Crustal Fault Events—How Often??



Seattle fault: 3 or 4 events in 3000 years, one event of magnitude 7+.

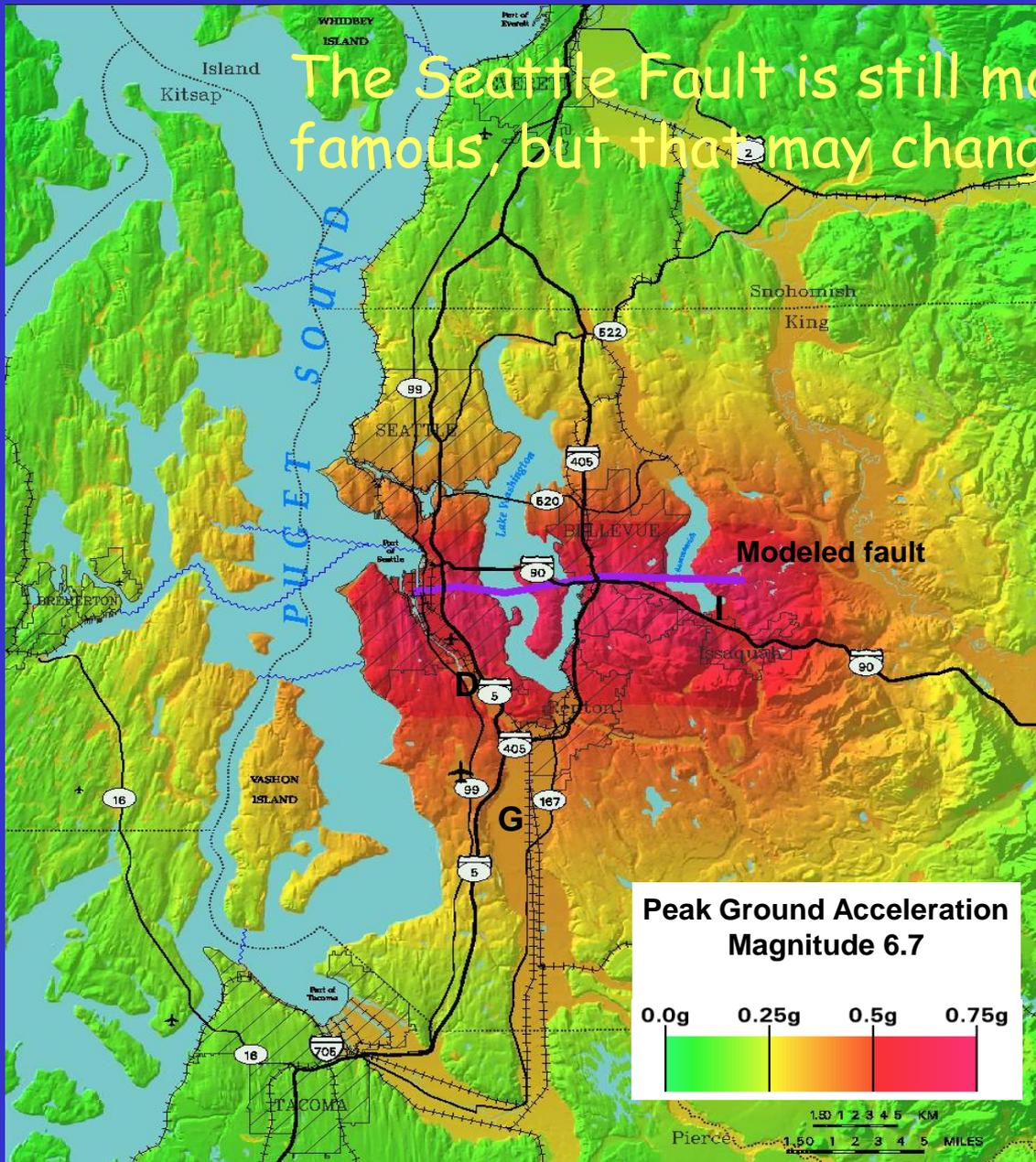
SWIF fault: 2 or 3 events in 3000 years.

Seattle Fault

An aerial photograph of the Seattle Fault line. A dark, horizontal line representing the fault runs across the water. In the foreground, a sandy beach is visible, labeled as an 'uplifted prehistoric beach'. The background shows the Seattle city skyline across the water.

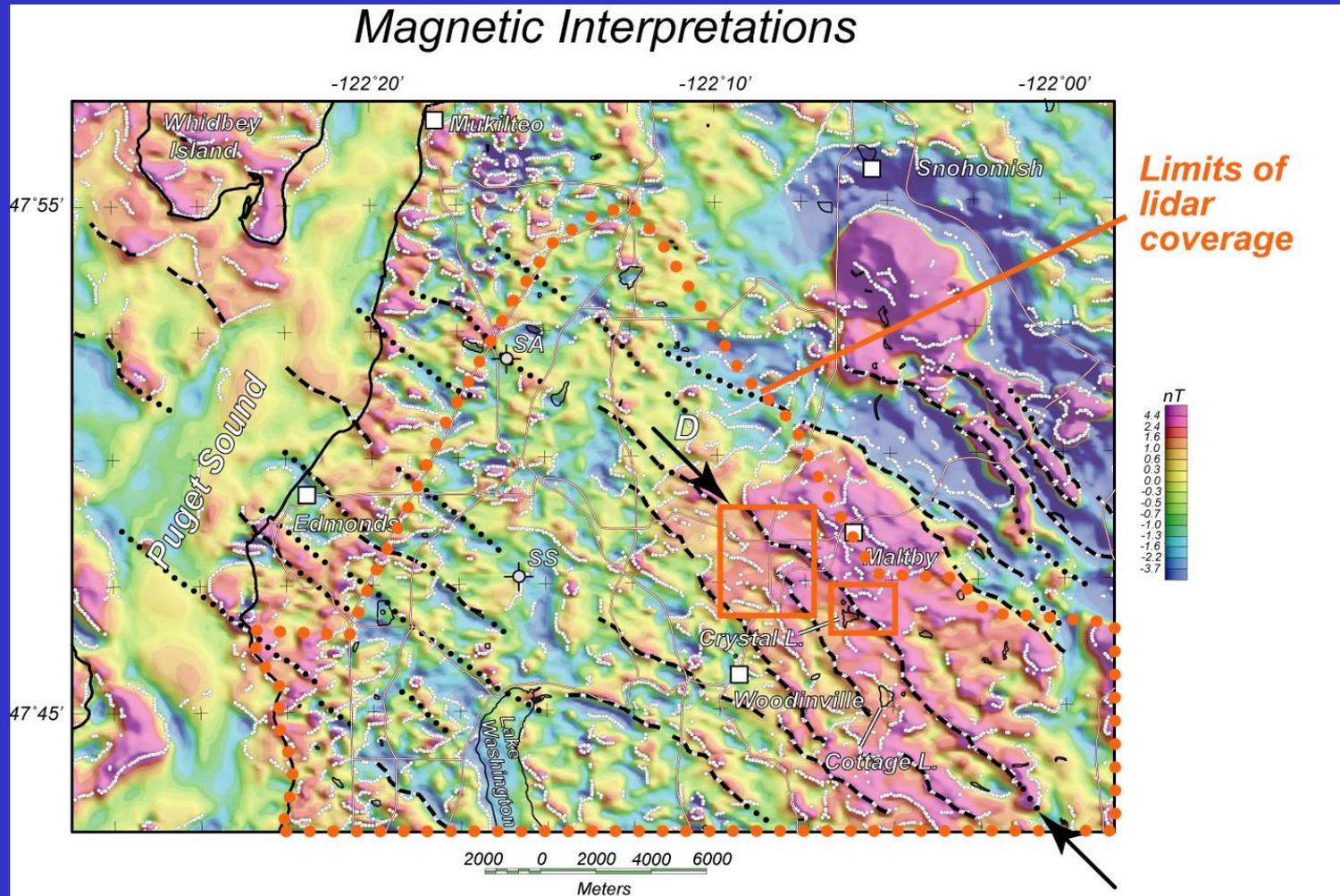
uplifted
prehistoric
beach

The Seattle Fault is still more famous, but that may change ...

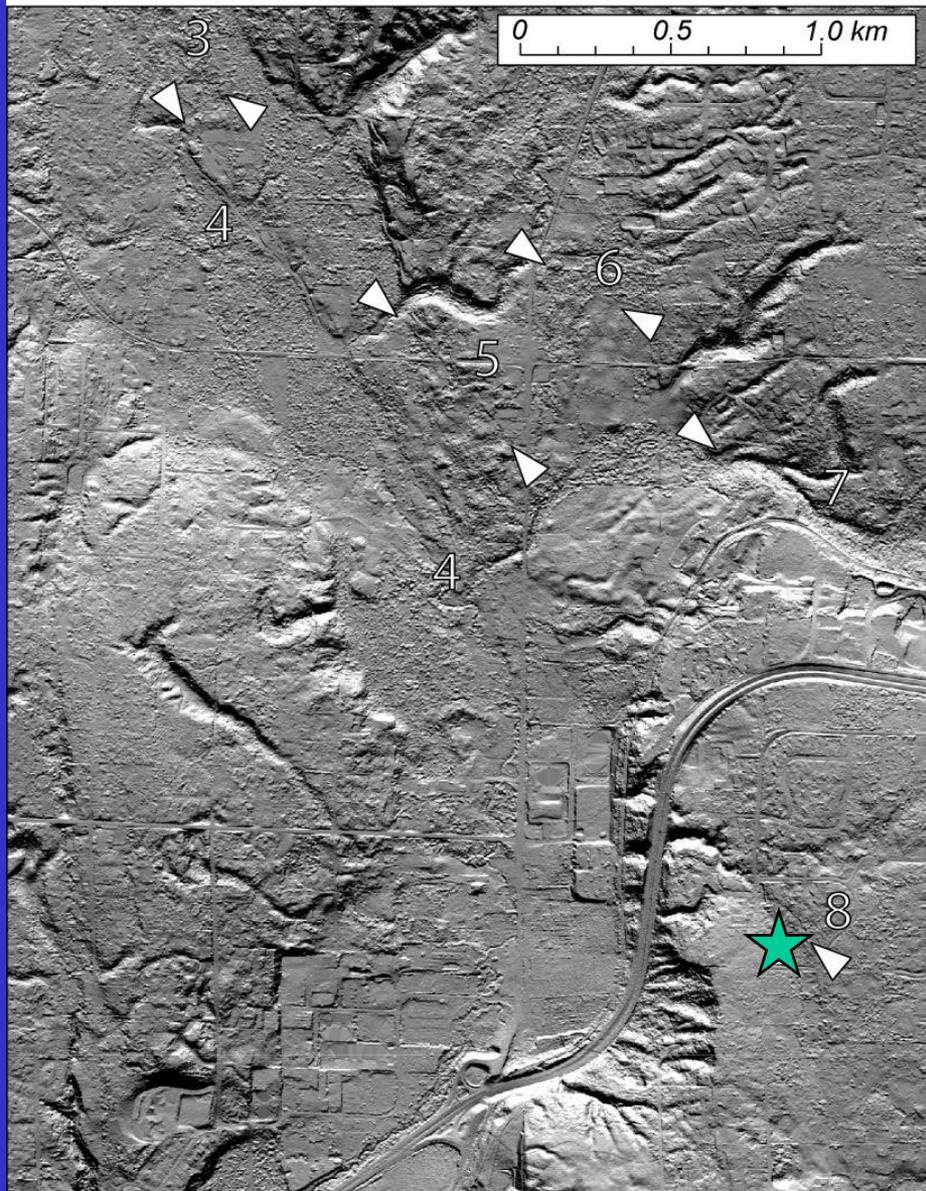


The scenario earthquake produces very strong ground motions. The highest ground shaking in the Nisqually earthquake was about 0.3 g.

Southern Whidbey Island fault (SWIF)



Lidar Image, Brightwater Area



Lidar is the
crucial link
between
aeromagnetic
data and field
sites for study

Geologist's tool of choice



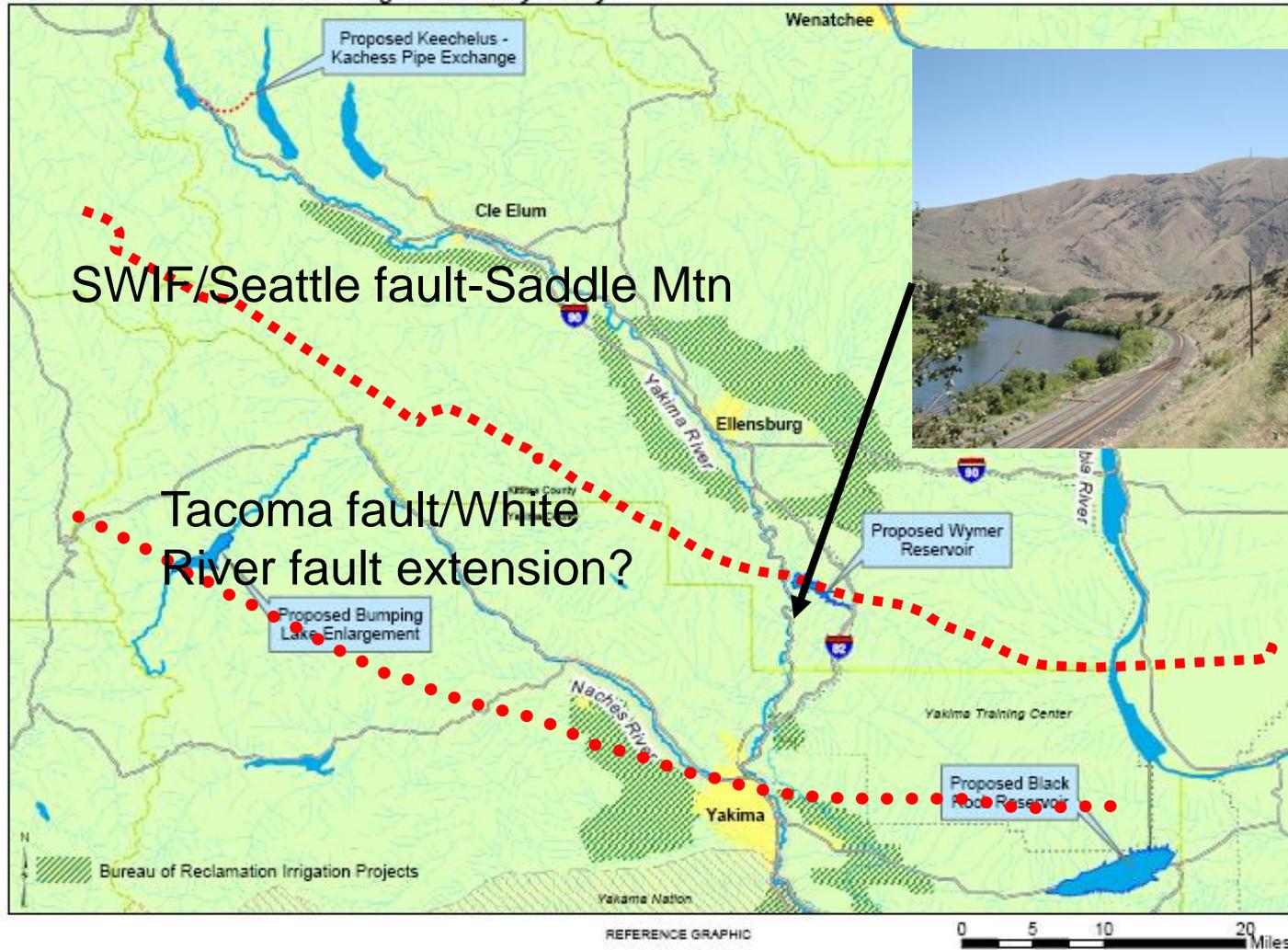
Vasa Park Trench

South →



Where does the SWIF go? EAST!

Yakima River Basin Water Storage Feasibility Study



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