Seattle Fault Earthquake Scenario

Conference

February 28, 2005

Earthquake Engineering Research Institute




Seattle Fault Earthquake Scenario

Seattle Fault and the Scenario Earthquake

Craig Weaver, PhD
U.S. Geological Survey

USGS science for a changing world




Seattle Fault Earthquake Scenario

Ground Motion Contributors

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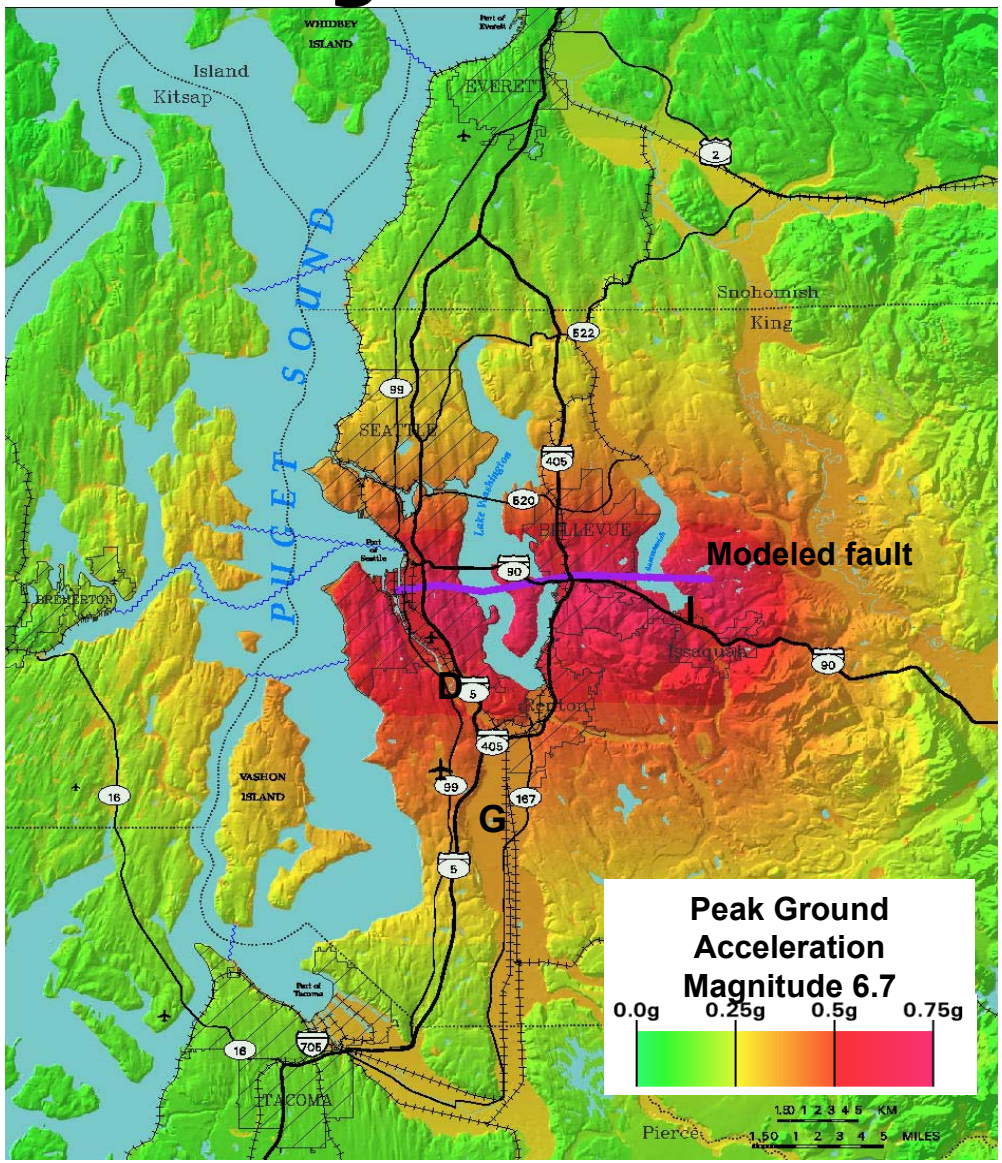
- Dr. Stephen Palmer, L.E.G., Ph.D.
  - Washington State Department of Natural Resources

** - Team Leader




Seattle Fault Earthquake Scenario

How Big?



The scenario earthquake produces very strong ground motions. The highest ground shaking in the Nisqually earthquake was about 0.3 g—in a few small areas.




Seattle Fault Earthquake Scenario

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) ???

Probabilities from Art Frankel

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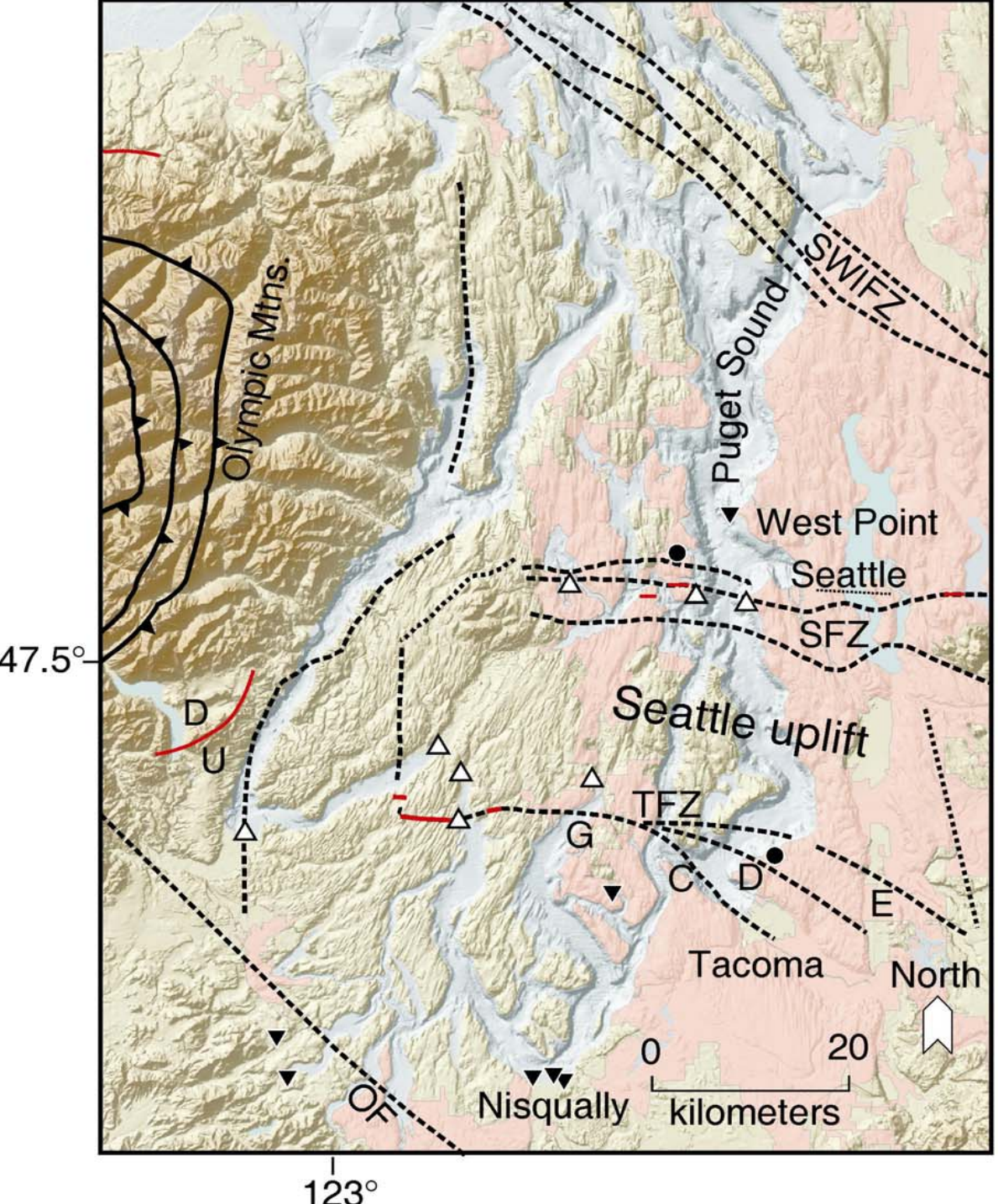

How Often??

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

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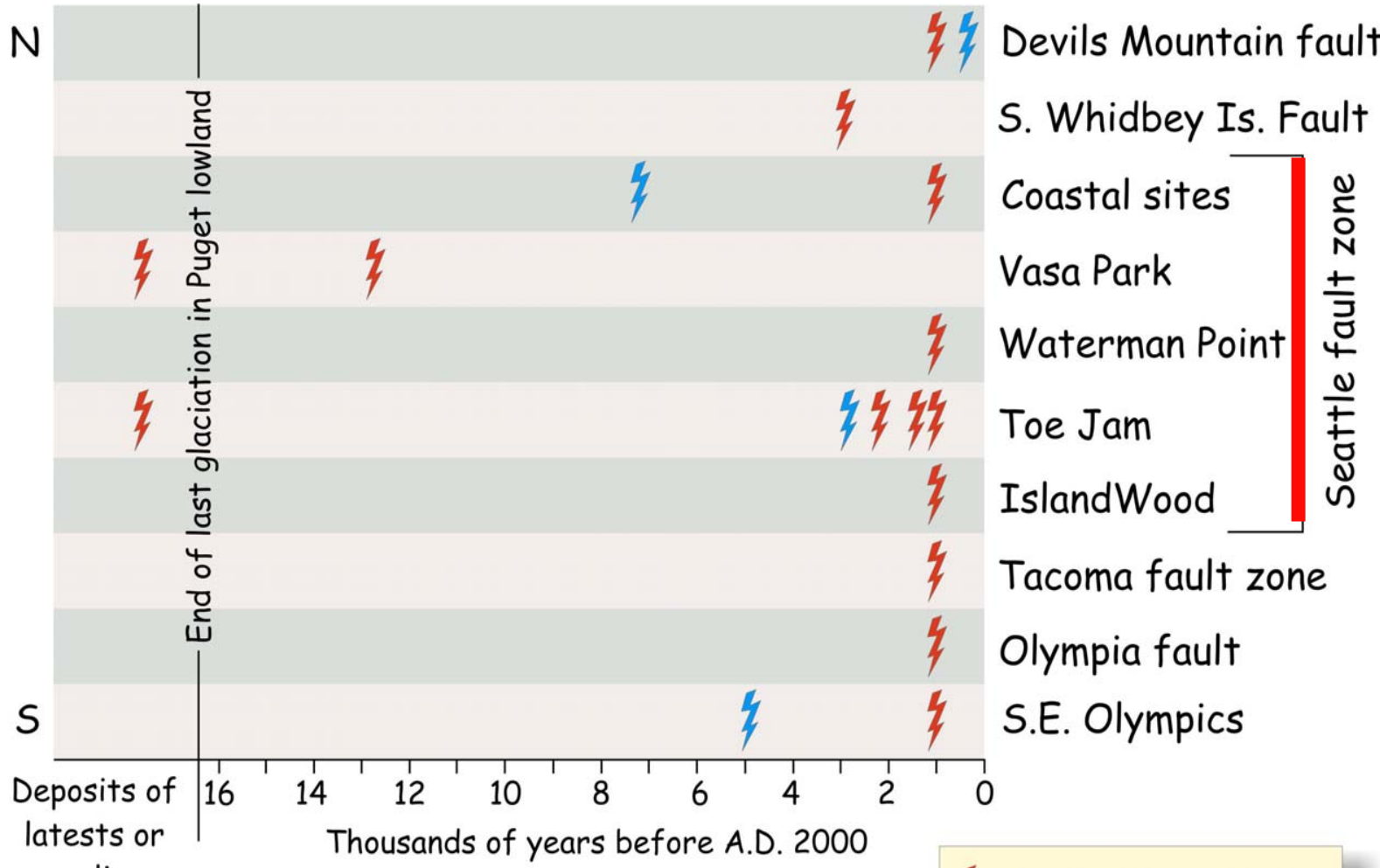
USGS

Known Crustal Fault Events—How Often??



3 or 4 events in 3,000 yrs

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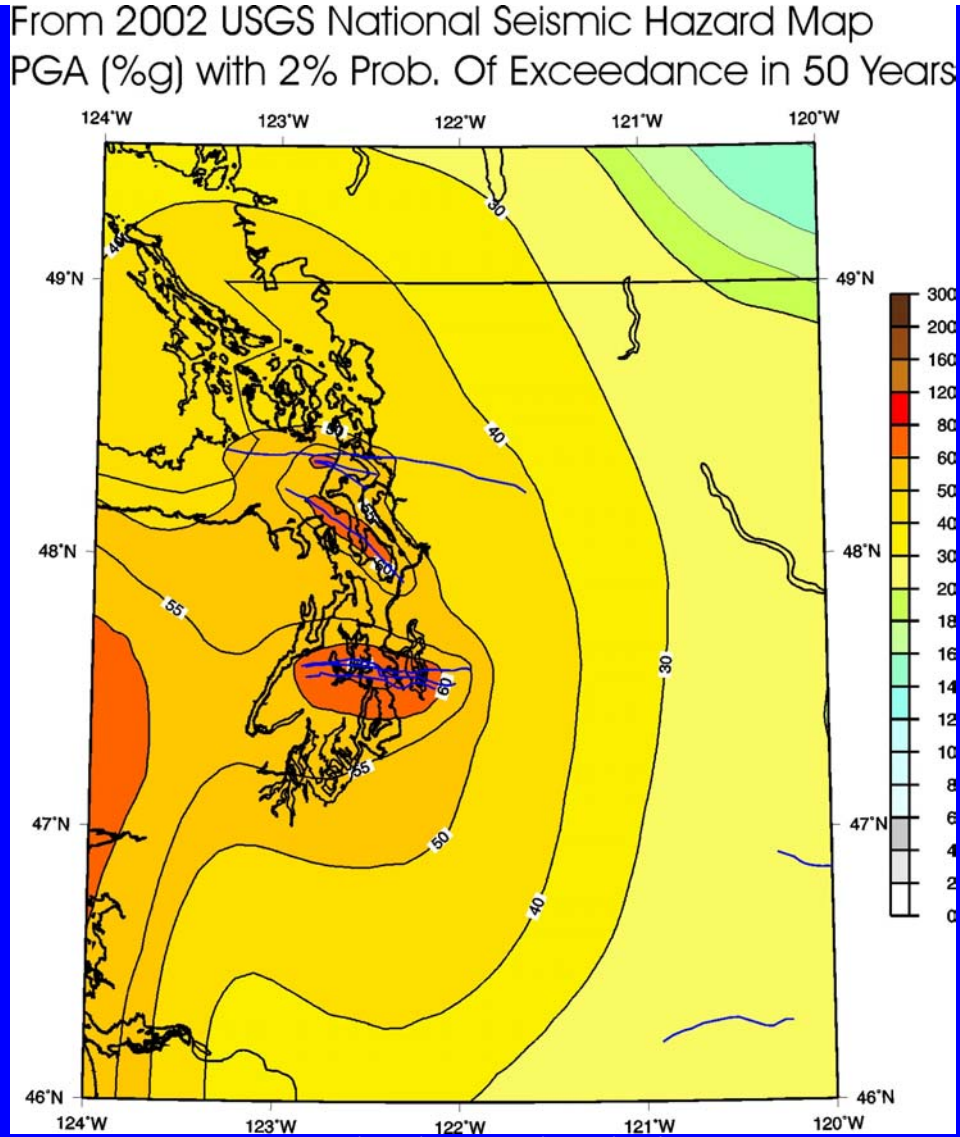
The Seattle Fault

Seattle Fault Earthquake Scenario

Seattle Hazard Maps



Earthquake Hazards Reduction Program

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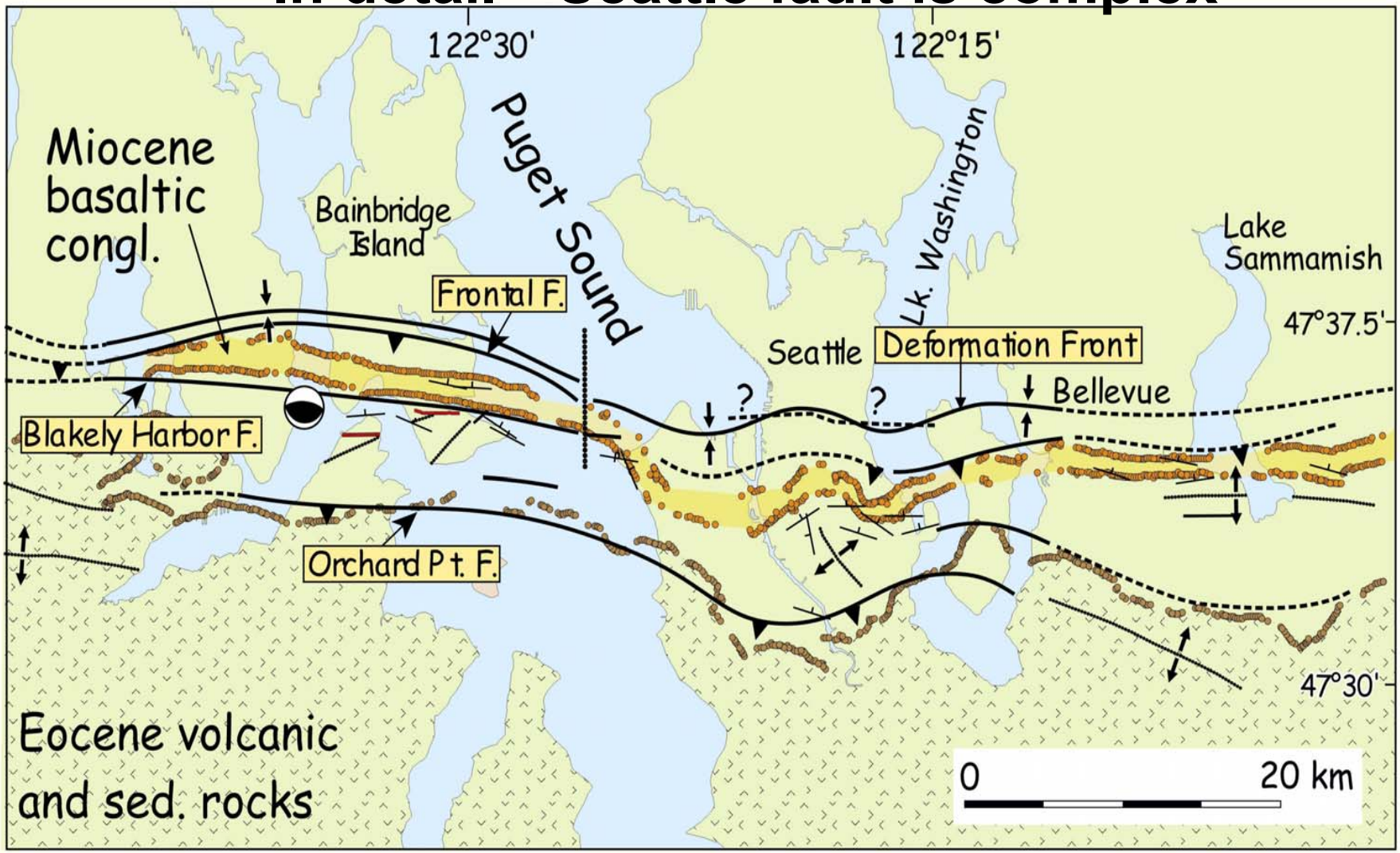
In detail—Seattle fault is complex

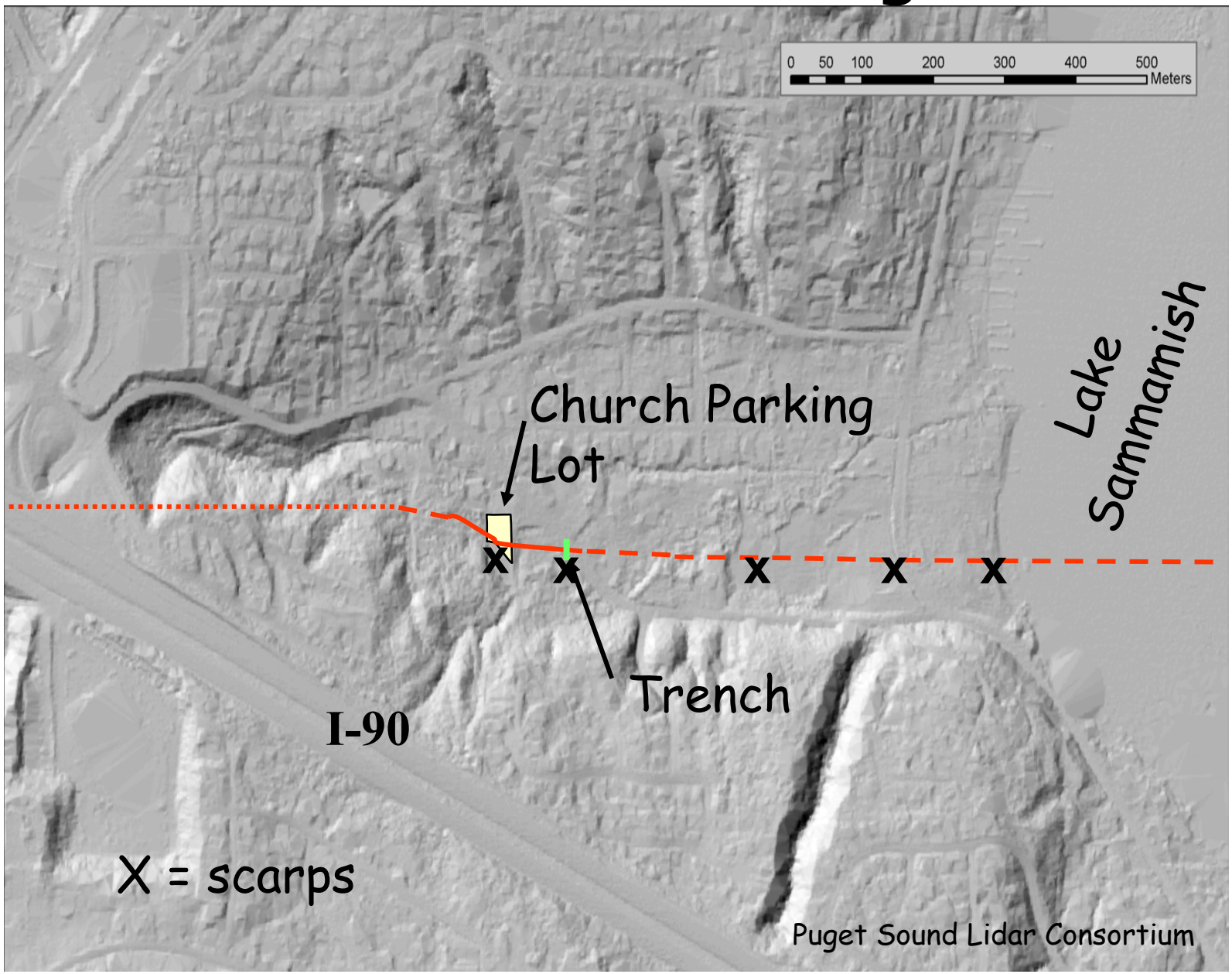


Epicenter, M 4.9
Bainbridge Island earthquake

Interpreted Aeromagnetic Map of the Seattle Fault Zone

Seattle Fault Earthquake Scenario

Bellevue Surface Faulting Sites

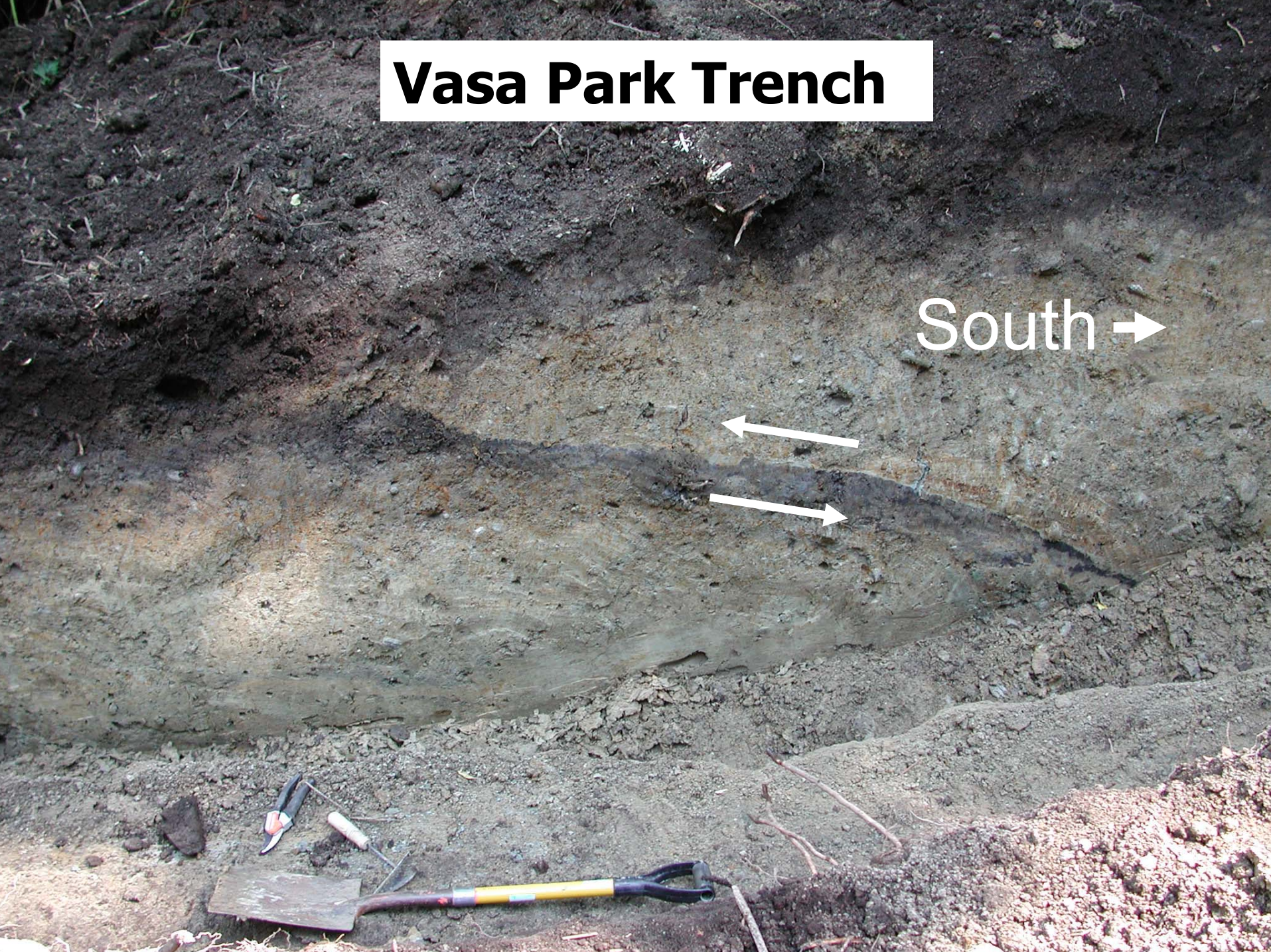



Church Parking Lot
Bedrock
Sediments
2000. 8. 26 18:31

Seattle Fault Earthquake Scenario

Before the Vasa Park Trench

Why we need lidar!!


Vasa Park Trench
South

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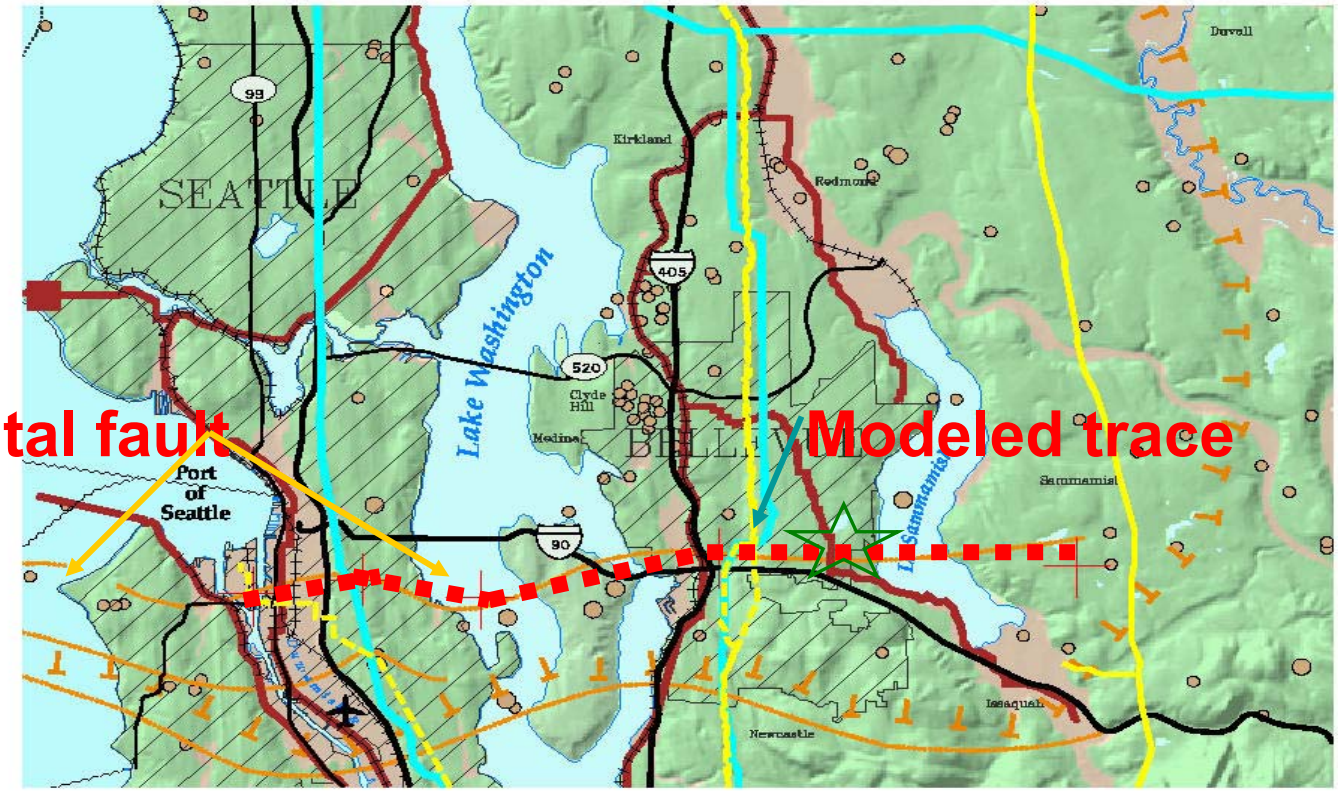
Modeled fault trace: 4 segments, about 22 km length



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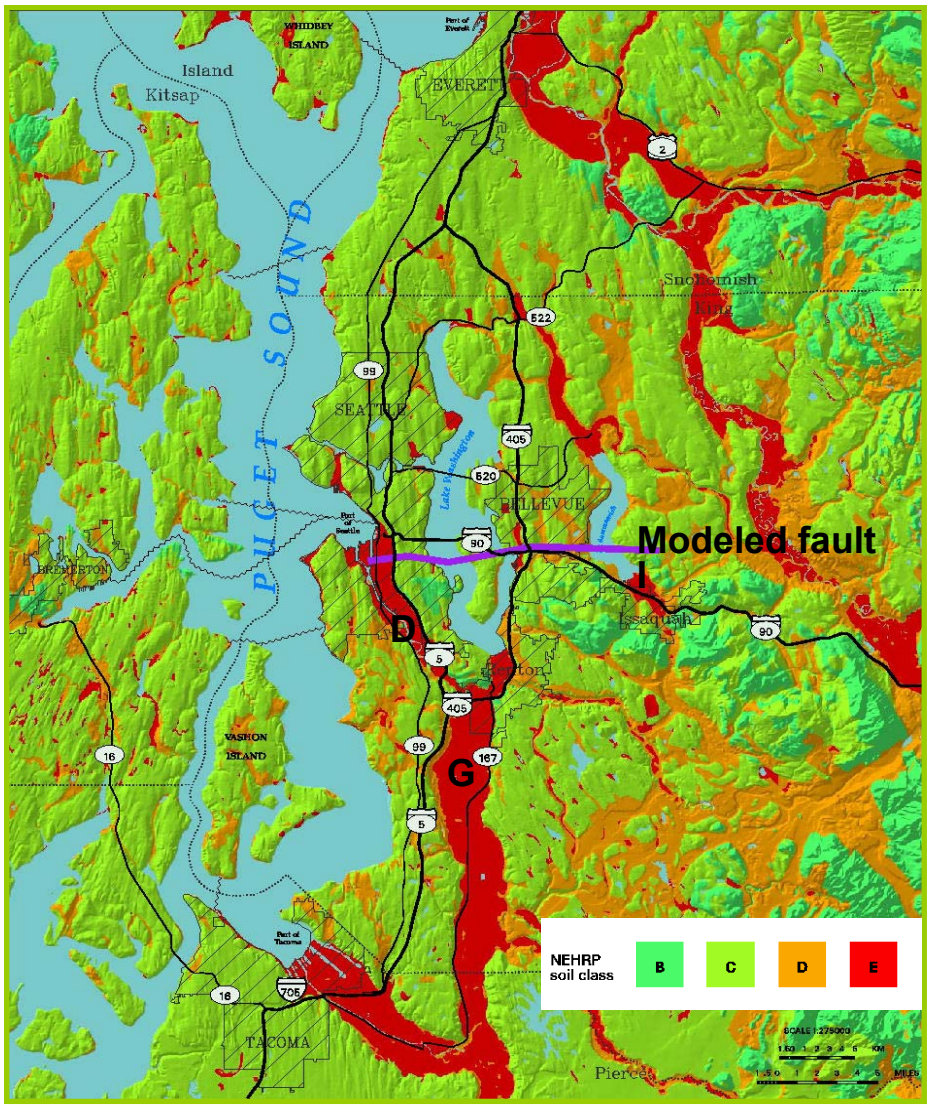
Scenario Earthquake Faulting Parameters

- Magnitude 6.7
- Surface rupture = 6 feet (matches trench)
- Located at frontal fault
- Four segments, about 16 miles length
- 9 miles deep fault
- 45º from surface
- Breaks from depth up

Seattle Fault Earthquake Scenario

Local Site Conditions



E soils are expected to cause problems

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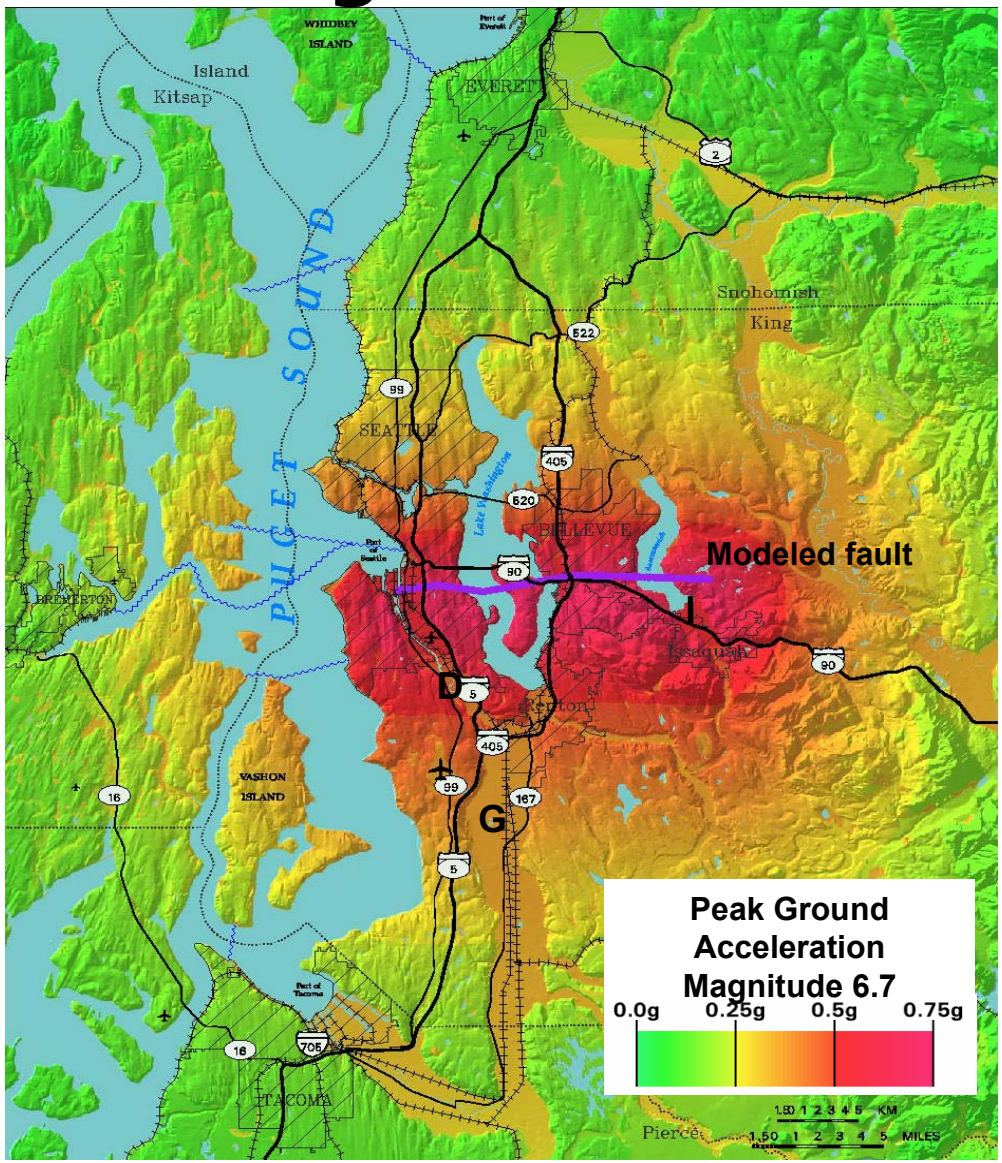
How Big?



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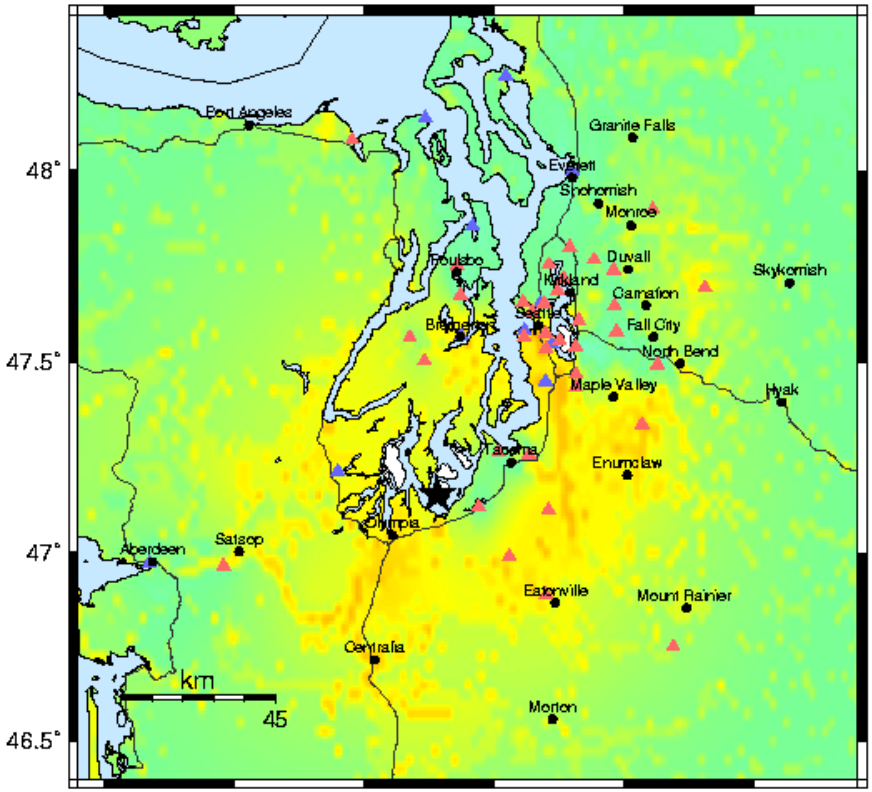
Ground Motions Comparison

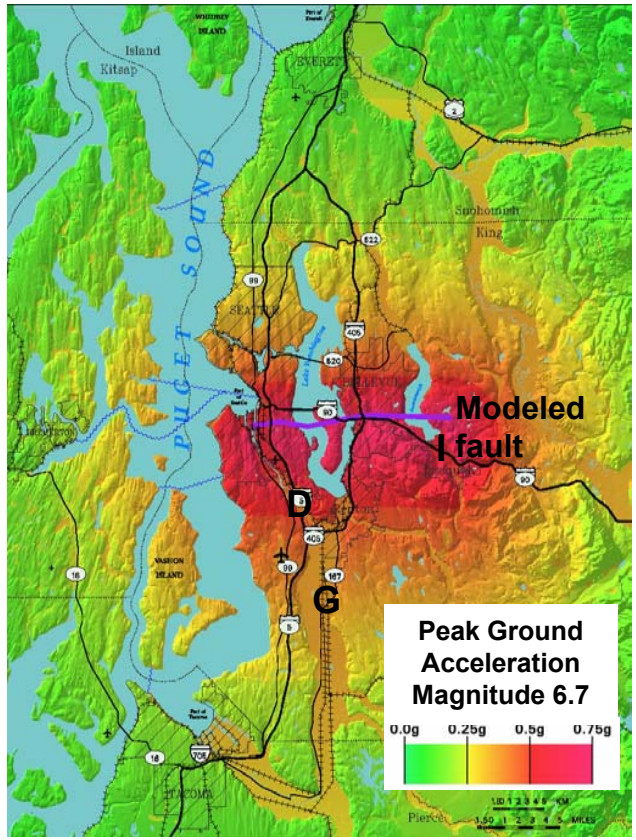
PNSN Rapid Instrumental Intensity Map Epicenter: 17.6 km NE of Olympia, WA

Wed Feb 28, 2001 10:54:00 AM PST M 6.8 N47.15 W122.72 ID:0102281854



PROCESSED: Mon Mar 12, 2001 03:19:15 PM PST,

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+



Nisqually Scenario

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Call to Action—Earth Sciences

- **Complete lowland lidar**
  - **North Puget Sound and Lewis County highest priority**
  - **Coastal Counties and SW Washington second priority**
- **Accelerate geological and geophysical studies**
  - **Paleoseismology of crustal faults**
  - **Geological mapping of urban areas**
  - **Geophysical studies of Tacoma basin, selected faults**
- **Enhance regional seismic network**
  - **Increase number of urban strong motion stations—do site characterizations of all sites**
  - **Instrument critical structures, lifelines, and buildings**
  - **Increase capabilities at the UW seismic lab to meet state, local and private informational needs**

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