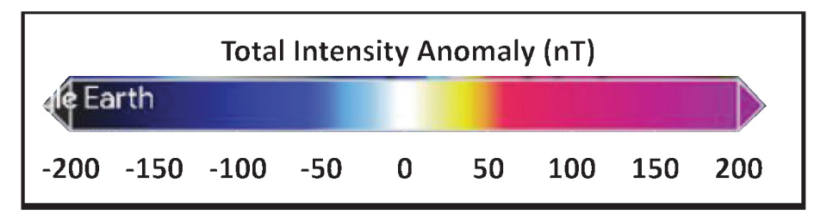
Earthquake Report: 2018.03.22
M 4.6 Gorda (& USGS Seismicity 1918-2018 M ≥ 4.5)



USGS Quaternary Fault and Fold Database
- Historic
- Holocene / Latest Pleistocene
- Late Quaternary
- Mid-Late Quaternary
- Quaternary

Magnitude
8
7
6
5
4
3
2
1
Depth (km)
0 - 33
33 - 70
70 - 150
150 - 300
300 - 500
500 - 800

Jason R. Patton
earthjay.com © 2018

USGS Google Earth

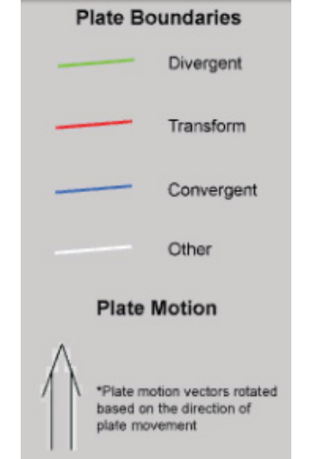
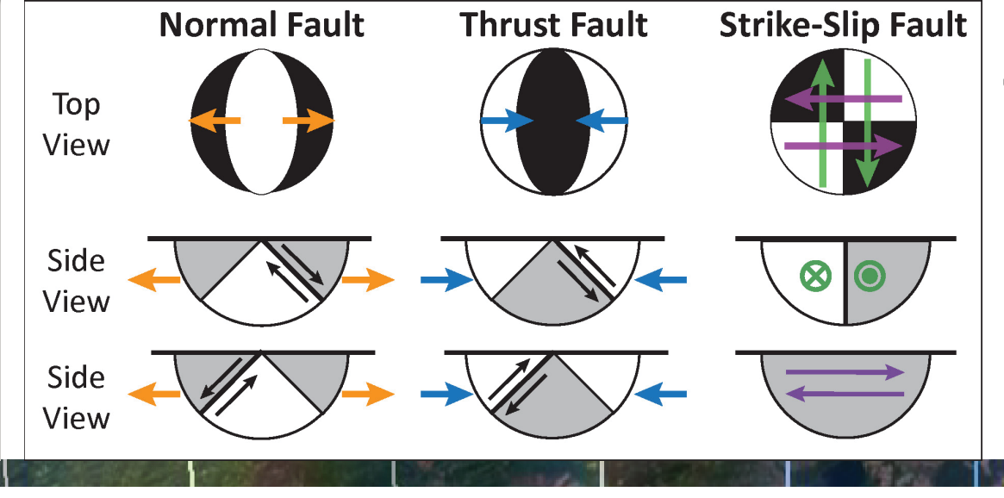
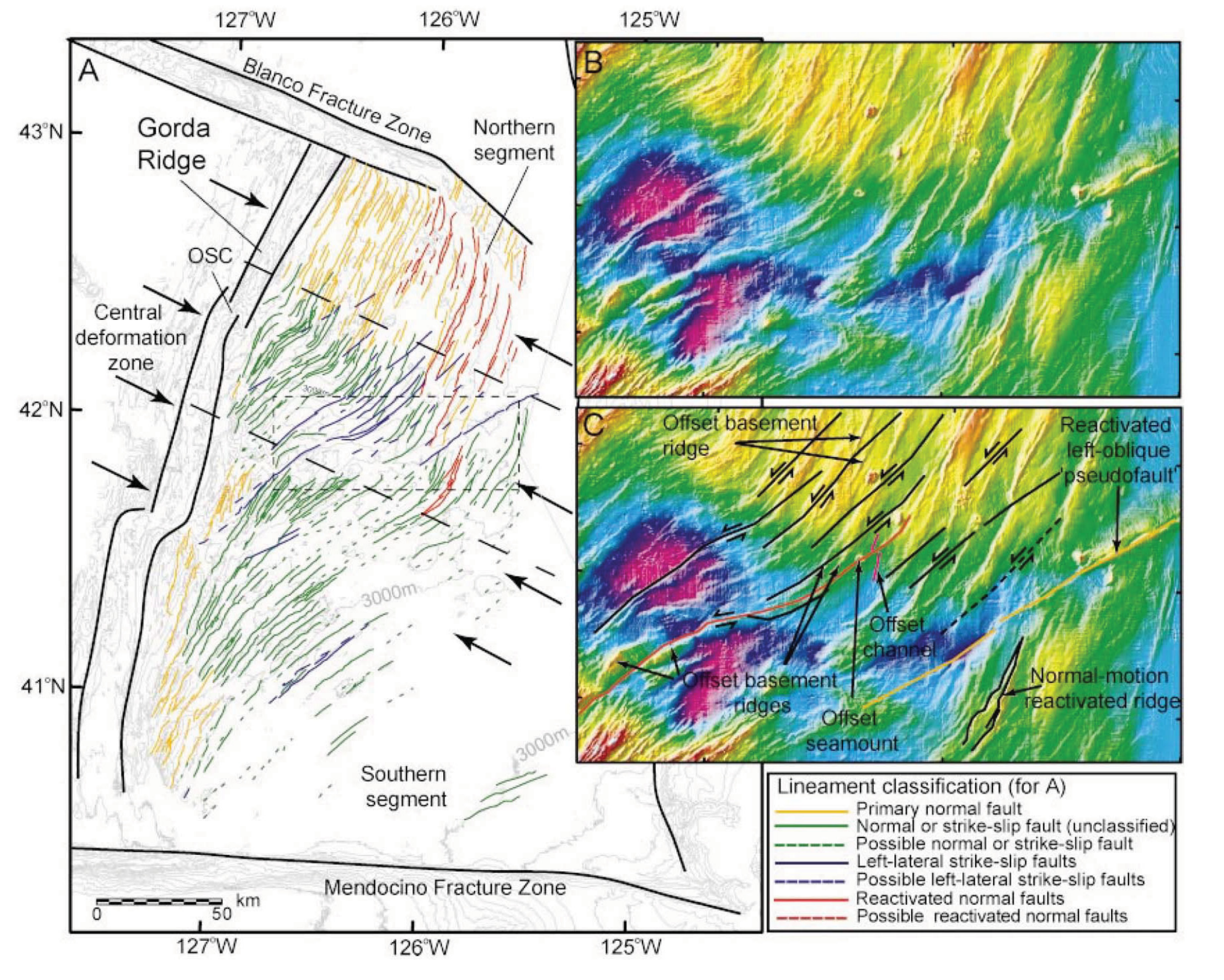


Plate Boundaries
Divergent
Transform
Convergent
Other
Plate Motion
*Plate motion vectors rotated based on the direction of plate movement


Normal Fault
Thrust Fault
Strike-Slip Fault
Top View
Side View
Side View

INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
Shaking	Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
Damage	None	None	None	Very slight	Light	Moderate	Moderate/ heavy	Heavy	Very heavy
Peak Acc	<0.17	0.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
Peak Vel	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16 -31	31-60	60-116	>116

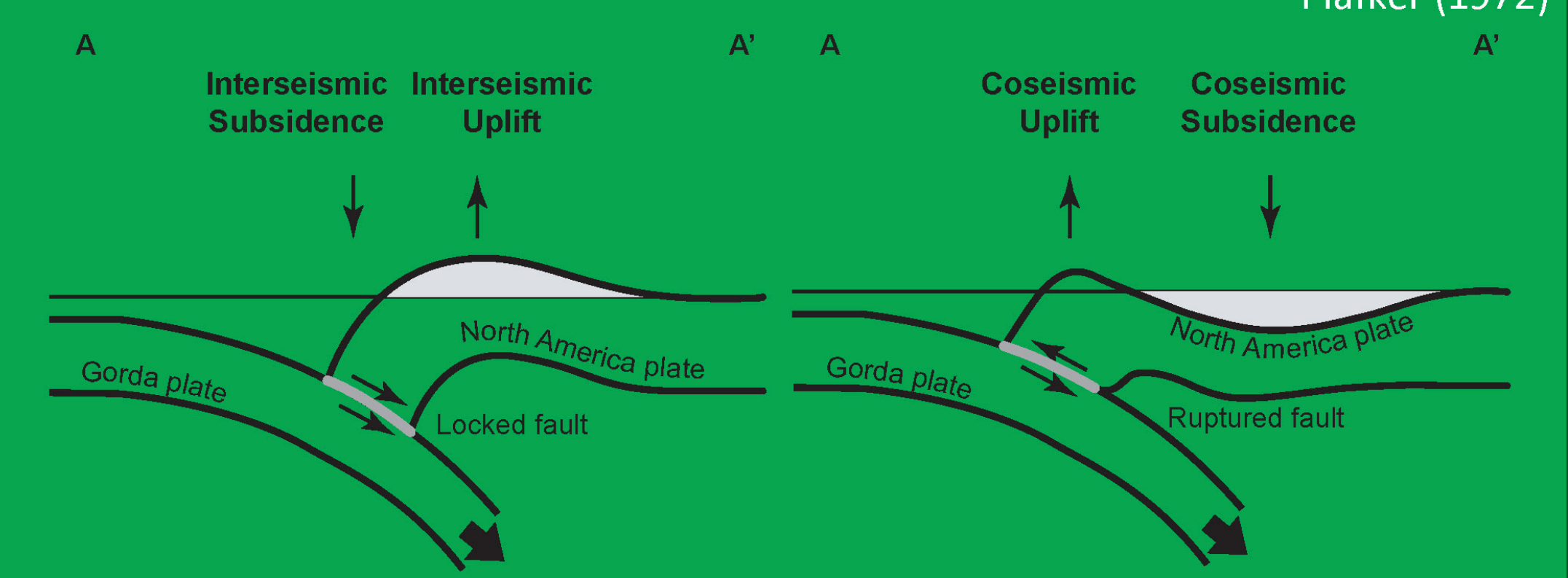
Peak Acc = Peak ground acceleration (g), Peak Vel = Peak ground velocity (cm/s)


127°W
126°W
125°W
43°N
42°N
41°N
A
Blanco Fracture Zone
Gorda Ridge
Northern segment
OSC
Central deformation zone
3000m
Southern segment
Mendocino Fracture Zone
0 50 km
B
C
Offset basement ridge
Reactivated left-oblique 'pseudofault'
Offset channel
Offset basement ridges
Offset seamount
Normal-motion reactivated ridge
Lineament classification (for A)
Primary normal fault
Normal or strike-slip fault (unclassified)
Possible normal or strike-slip fault
Left-lateral strike-slip faults
Possible left-lateral strike-slip faults
Reactivated normal faults
Possible reactivated normal faults

Chaytor et al., 2004

Vertical Motion: Coseismic vs. Interseismic

Plafker (1972)


A
A'
Interseismic Subsidence
Interseismic Uplift
North America plate
Gorda plate
Locked fault
A
A'
Coseismic Uplift
Coseismic Subsidence
North America plate
Gorda plate
Ruptured fault

Schematic diagrams showing the pattern of (A) inter-seismic and (B) co-seismic deformation associated witha subduction zone earthquake during an earthquake deformation cycle. Adapted from Plafker (1972) to reflect the spatial pattern of tectonic deformation during the earthquake cycle in Cascadia.

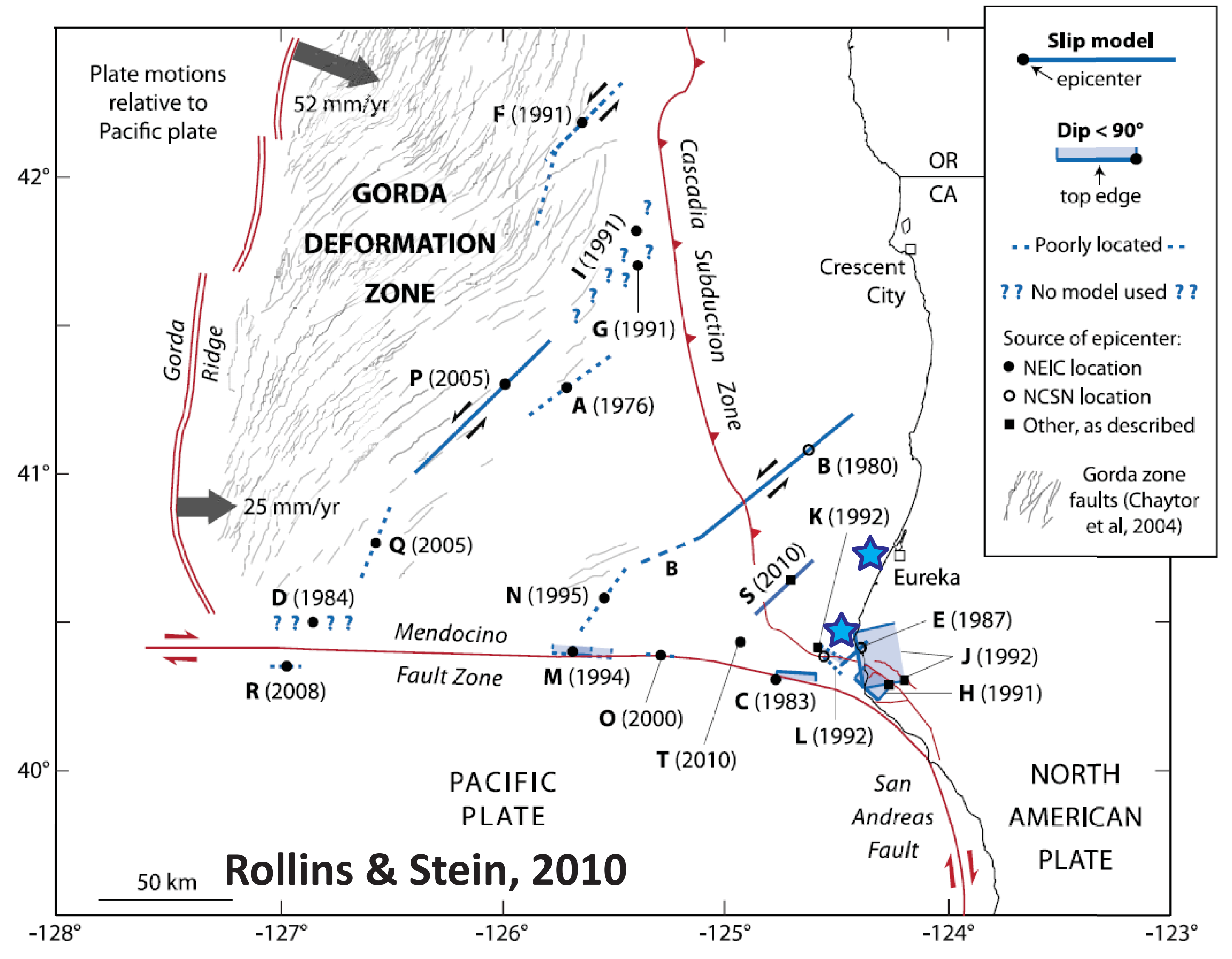
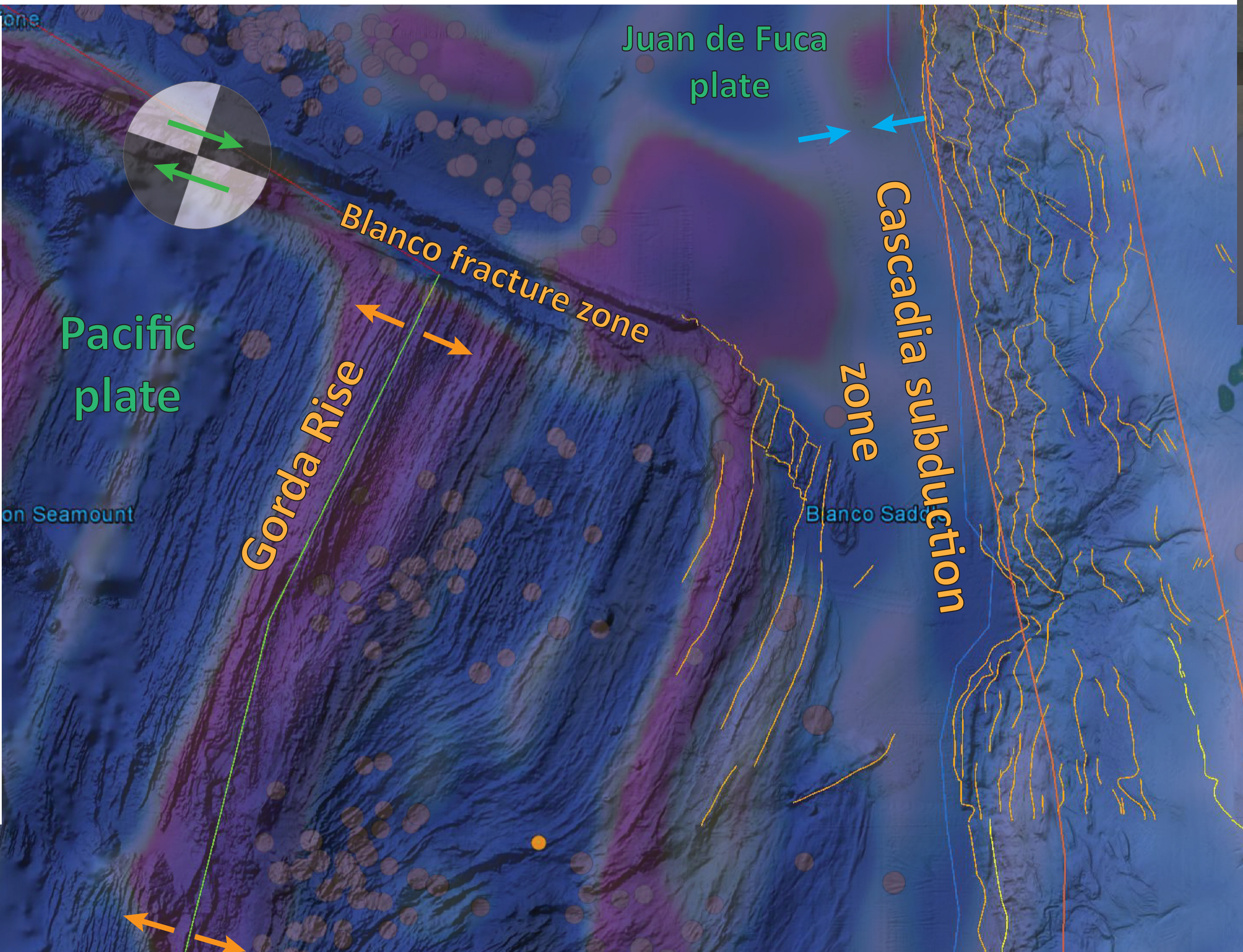
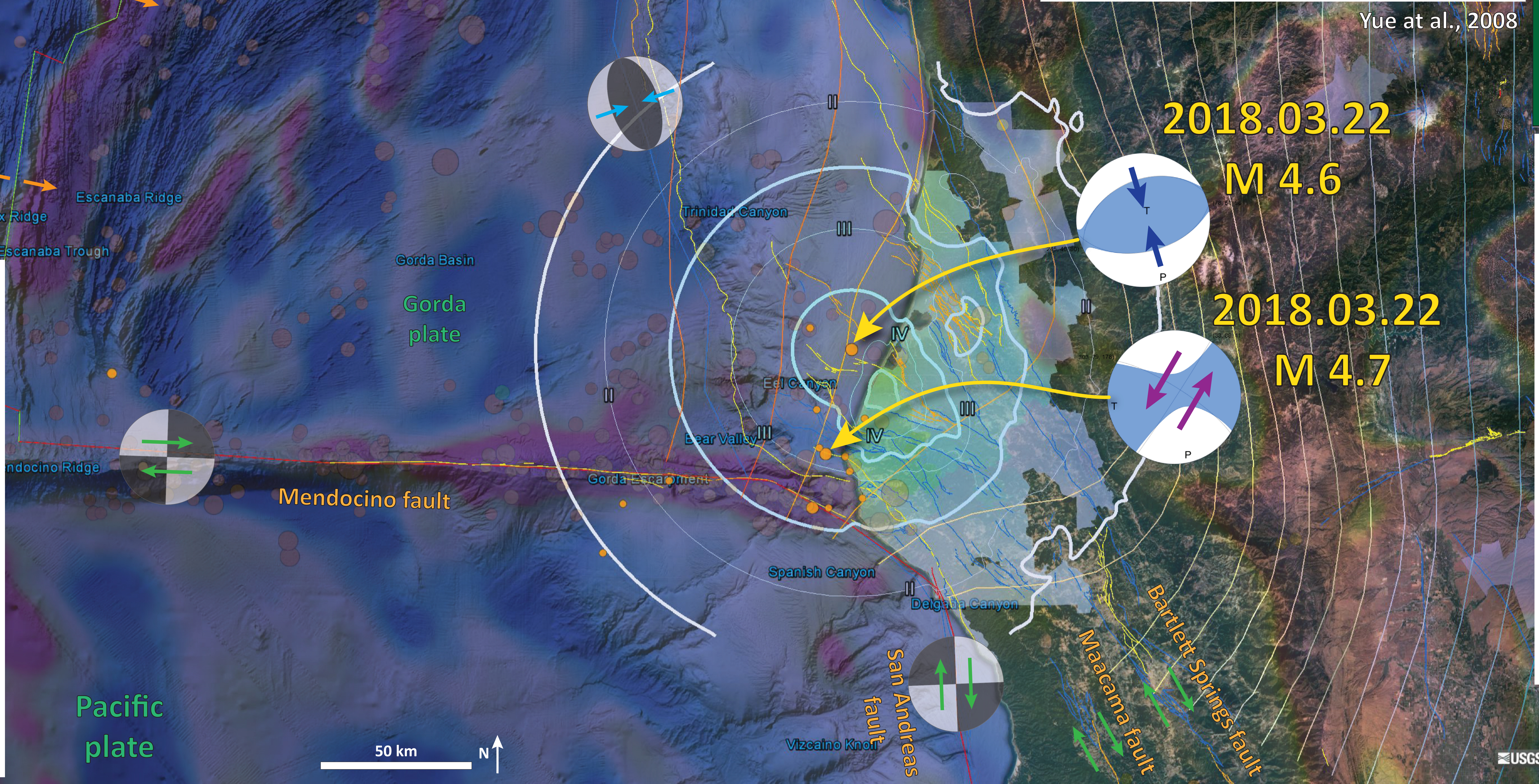
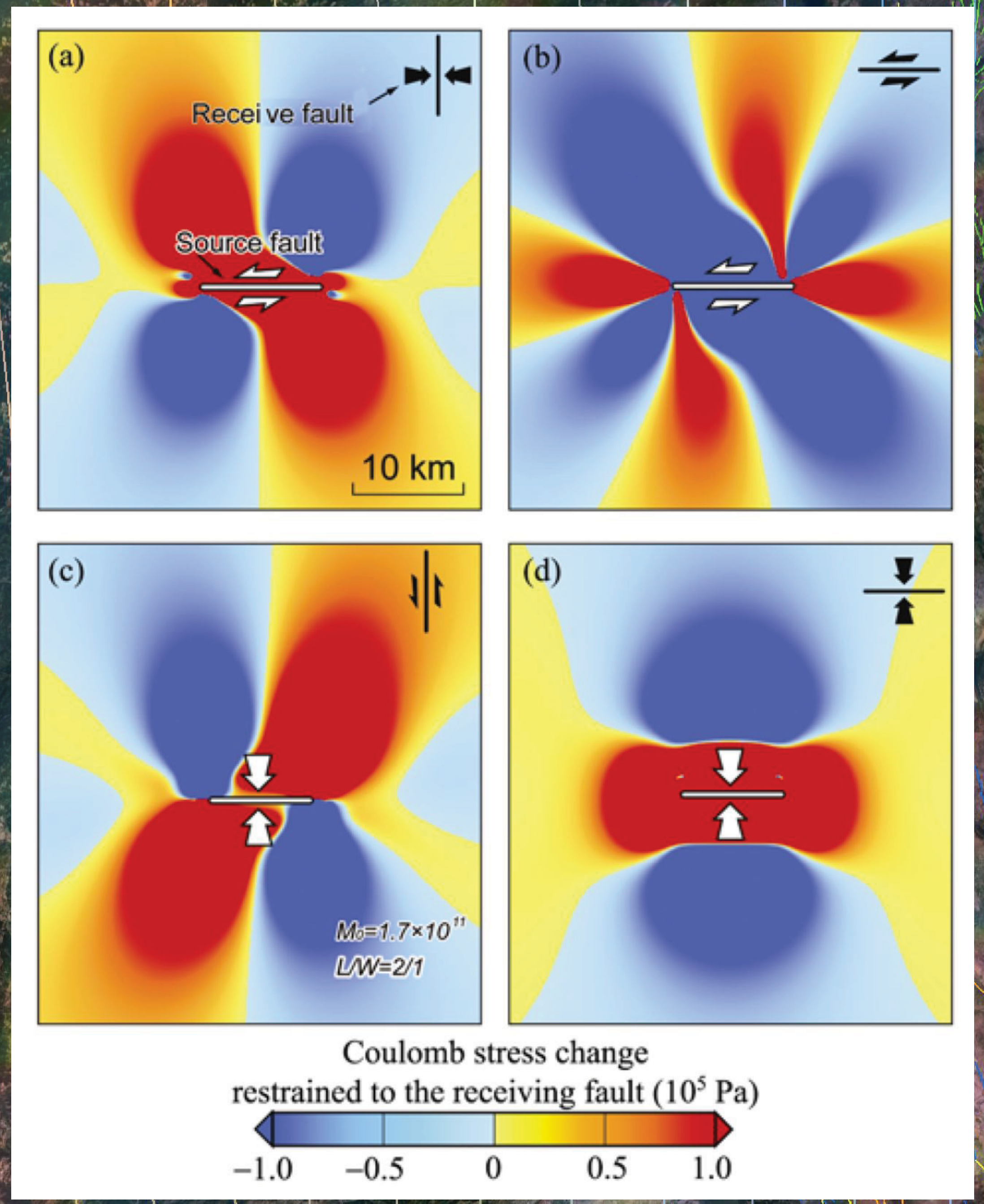


Plate motions relative to Pacific plate
52 mm/yr
25 mm/yr
Gorda Ridge
GORDA DEFORMATION ZONE
Cascadia Subduction Zone
F (1991)
I (1991)
G (1991)
P (2005)
A (1976)
Q (2005)
D (1984)
R (2008)
N (1995)
B
B (1980)
K (1992)
S (2010)
M (1994)
O (2000)
T (2010)
C (1983)
L (1992)
E (1987)
J (1992)
H (1991)
Mendocino Fault Zone
Crescent City
Eureka
OR
CA
PACIFIC PLATE
NORTH AMERICAN PLATE
San Andreas Fault
50 km
42°
41°
40°
-128° -127° -126° -125° -124° -123°
Slip model
epicenter
Dip < 90°
top edge
Poorly located
?? No model used ??
Source of epicenter:
NEIC location
NCSN location
Other, as described
Gorda zone faults (Chaytor et al, 2004)

Rollins & Stein, 2010


Juan de Fuca plate
Pacific plate
Blanco fracture zone
Gorda Rise
Cascadia subduction zone
North America plate
Blanco Saddle
on Seamount


Gorda Ridges
Escanaba Ridge
Phoenix Ridge
Phoenix Trough
Escanaba Trough
Gorda Basin
Gorda plate
Trinidad Canyon
Eel Canyon
Bear Valley
Gorda Escarpment
Mendocino Ridge
Mendocino fault
Spanish Canyon
Delgada Canyon
Vizcaino Knoll
San Andreas fault
Maacama fault
Bartlett Springs fault
Pacific plate
II
III
IV
2018.03.22
M 4.6
T
P
2018.03.22
M 4.7
T
P
50 km
N


(a)
Receive fault
Source fault
10 km
(b)
(c)
M_0=1.7×10^{11}
L/W=2/1
(d)
Coulomb stress change
restrained to the receiving fault (10^5 Pa)
−1.0 −0.5 0 0.5 1.0

Yue at al., 2008

Cascadia subduction zone

Chaytor et al. (2004)
Nelson et al. (2004)

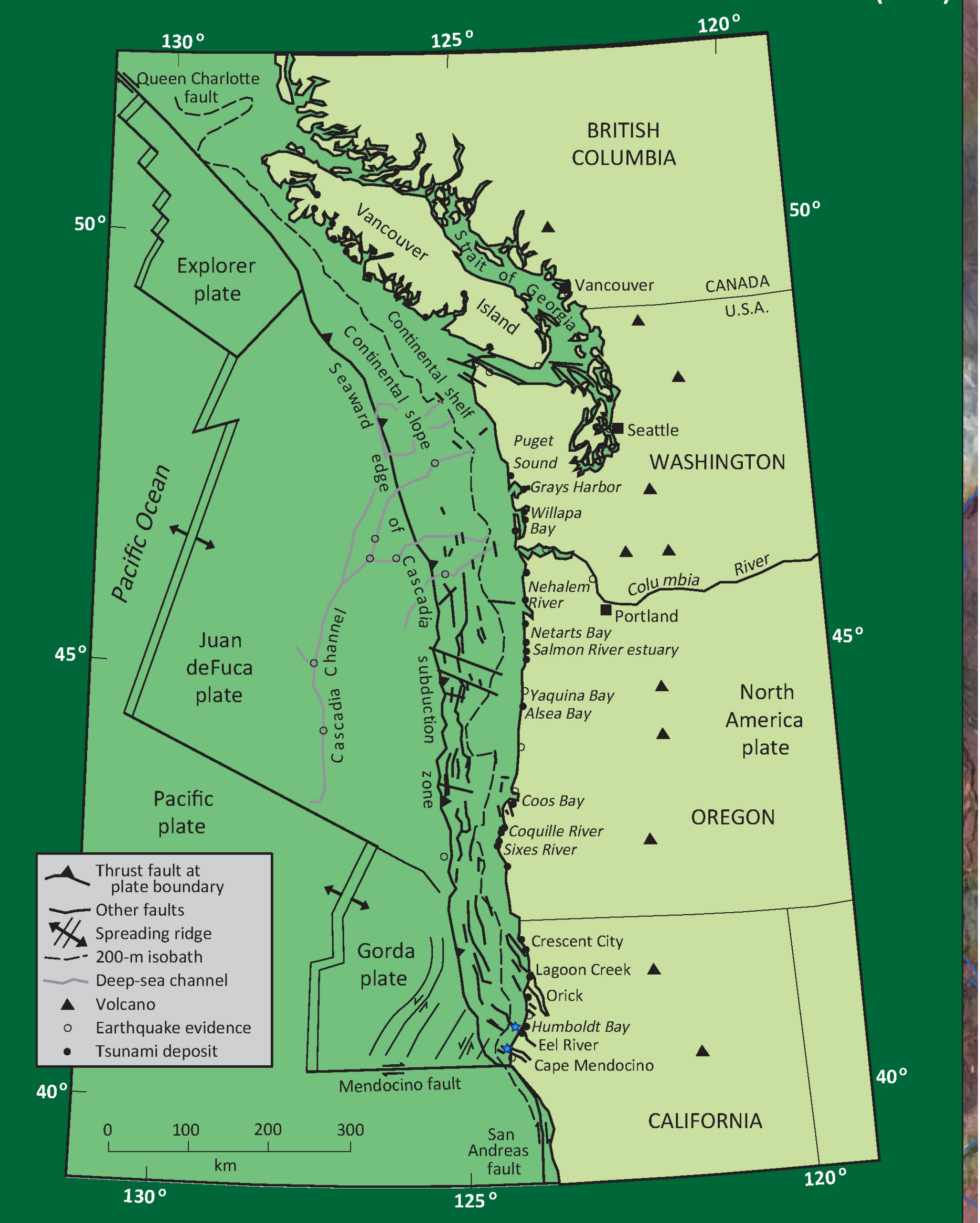
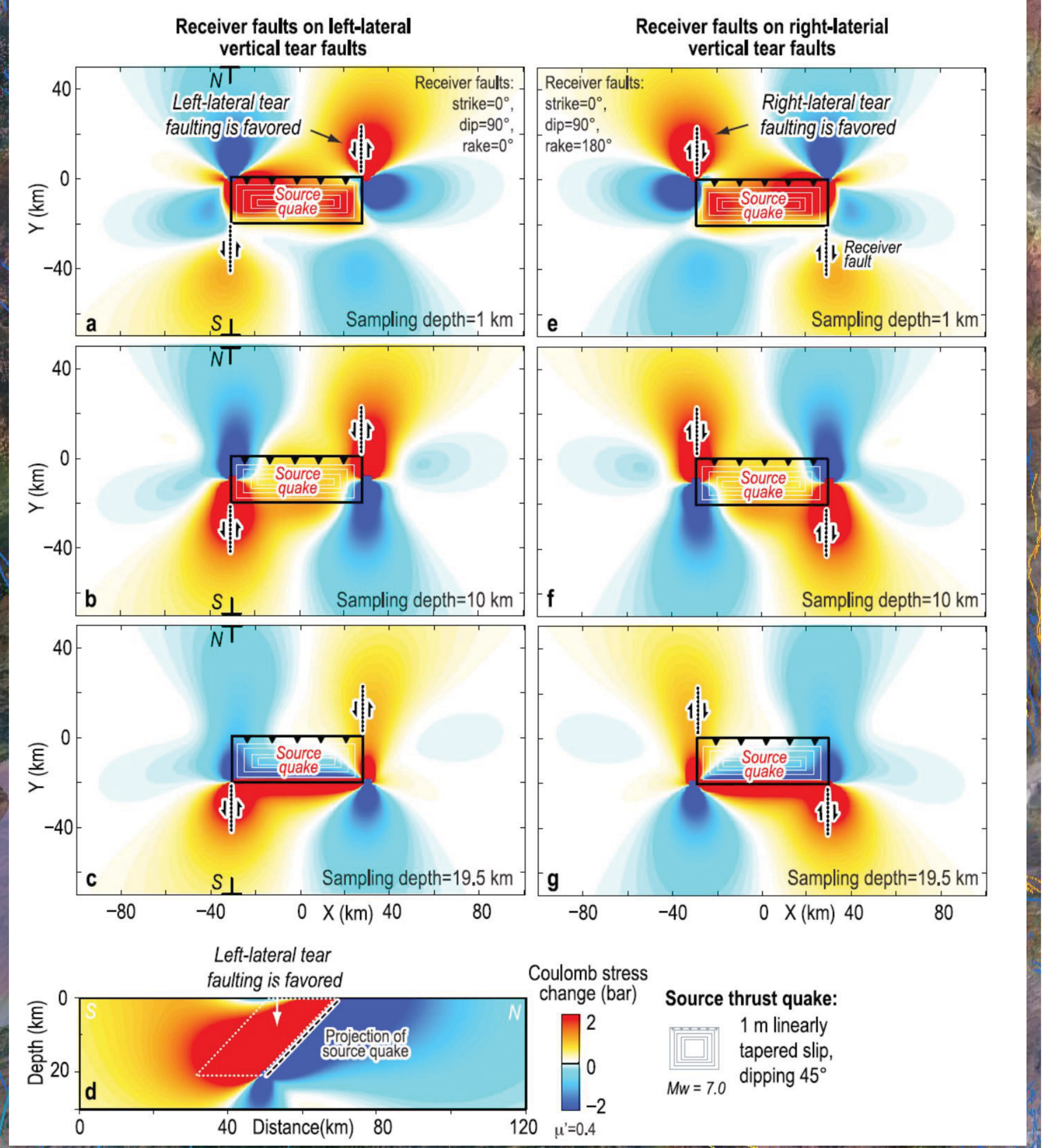

130°
125°
120°
50°
45°
40°
Queen Charlotte fault
BRITISH COLUMBIA
Explorer plate
Vancouver Island
Strait of Georgia
Vancouver
CANADA
U.S.A.
Continental shelf
Continental slope
Seaward edge of Cascadia subduction zone
Cascadia Channel
Pacific Ocean
Juan deFuca plate
Puget Sound
Seattle
WASHINGTON
Grays Harbor
Willapa Bay
Columbia River
Nehalem River
Portland
Netarts Bay
Salmon River estuary
Yaquina Bay
Alsea Bay
North America plate
Pacific plate
Coos Bay
Coquille River
Sixes River
OREGON
Gorda plate
Crescent City
Lagoon Creek
Orick
Humboldt Bay
Eel River
Cape Mendocino
Mendocino fault
CALIFORNIA
San Andreas fault
0 100 200 300 km
Thrust fault at plate boundary
Other faults
Spreading ridge
200-m isobath
Deep-sea channel
Volcano
Earthquake evidence
Tsunami deposit

Plate configuration for the Cascadia subduction zone (CSZ). The Juan de Fuca and Gorda plates are subducting northeastwardly oblique beneath the North America plate at ~36 mm/yr in the Humboldt Bay region. Paleoseismic core sites (marine and terrestrial) are plotted as circles.


Receiver faults on left-lateral vertical tear faults
Receiver faults on right-lateral vertical tear faults
Left-lateral tear faulting is favored
Receiver faults: strike=0°, dip=90°, rake=0°
Receiver faults: strike=0°, dip=90°, rake=180°
Right-lateral tear faulting is favored
Source quake
Receiver fault
N
S
Y (km)
40
0
−40
a
b
c
e
f
g
Sampling depth=1 km
Sampling depth=10 km
Sampling depth=19.5 km
−80 −40 0 X (km) 40 80
Left-lateral tear faulting is favored
Projection of source quake
Depth (km)
0
20
d
0 40 Distance(km) 80 120
Coulomb stress change (bar)
2
0
−2
μ'=0.4
Source thrust quake:
1 m linearly tapered slip, dipping 45°
Mw = 7.0

Lin et al., 2011