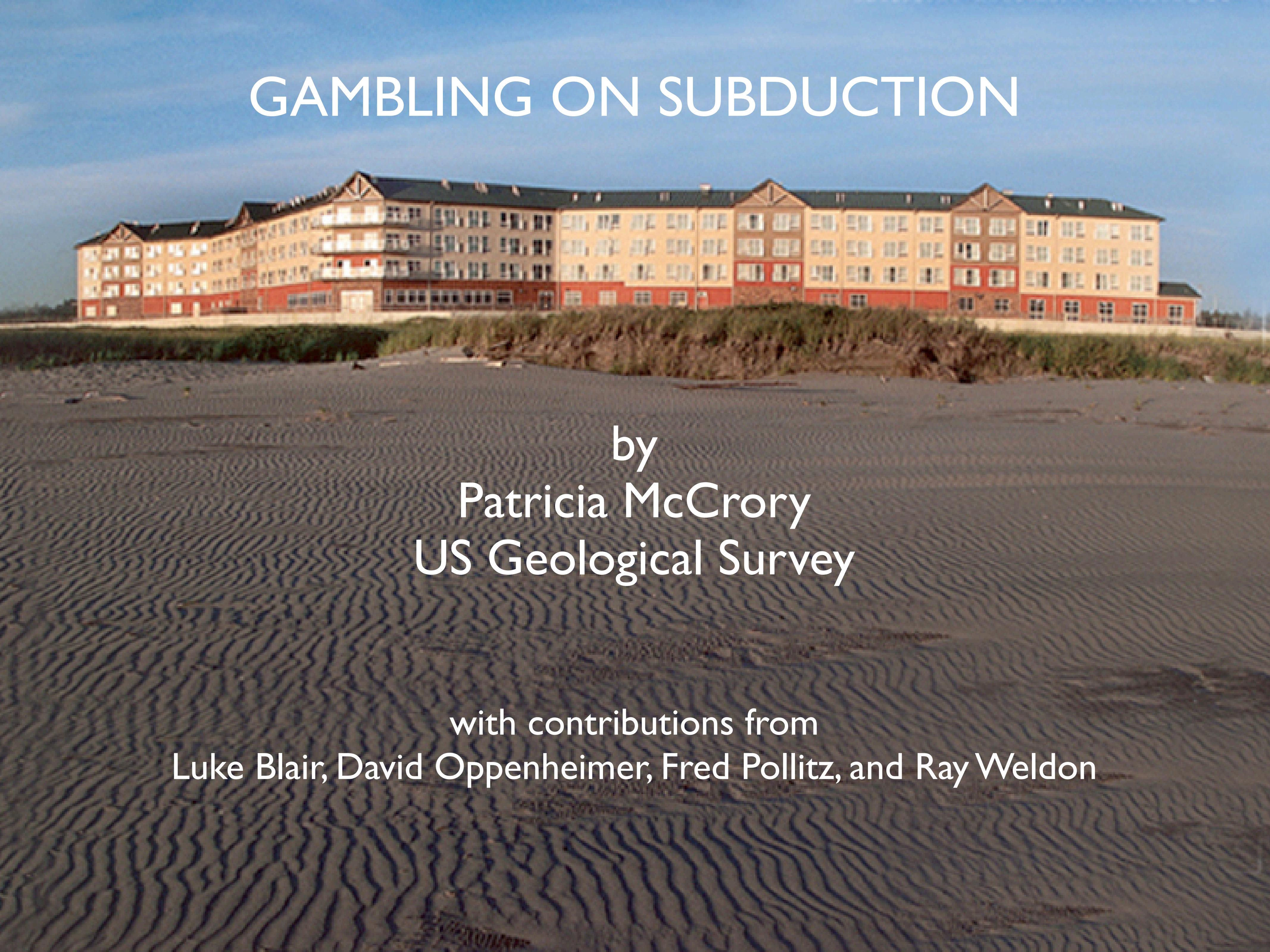
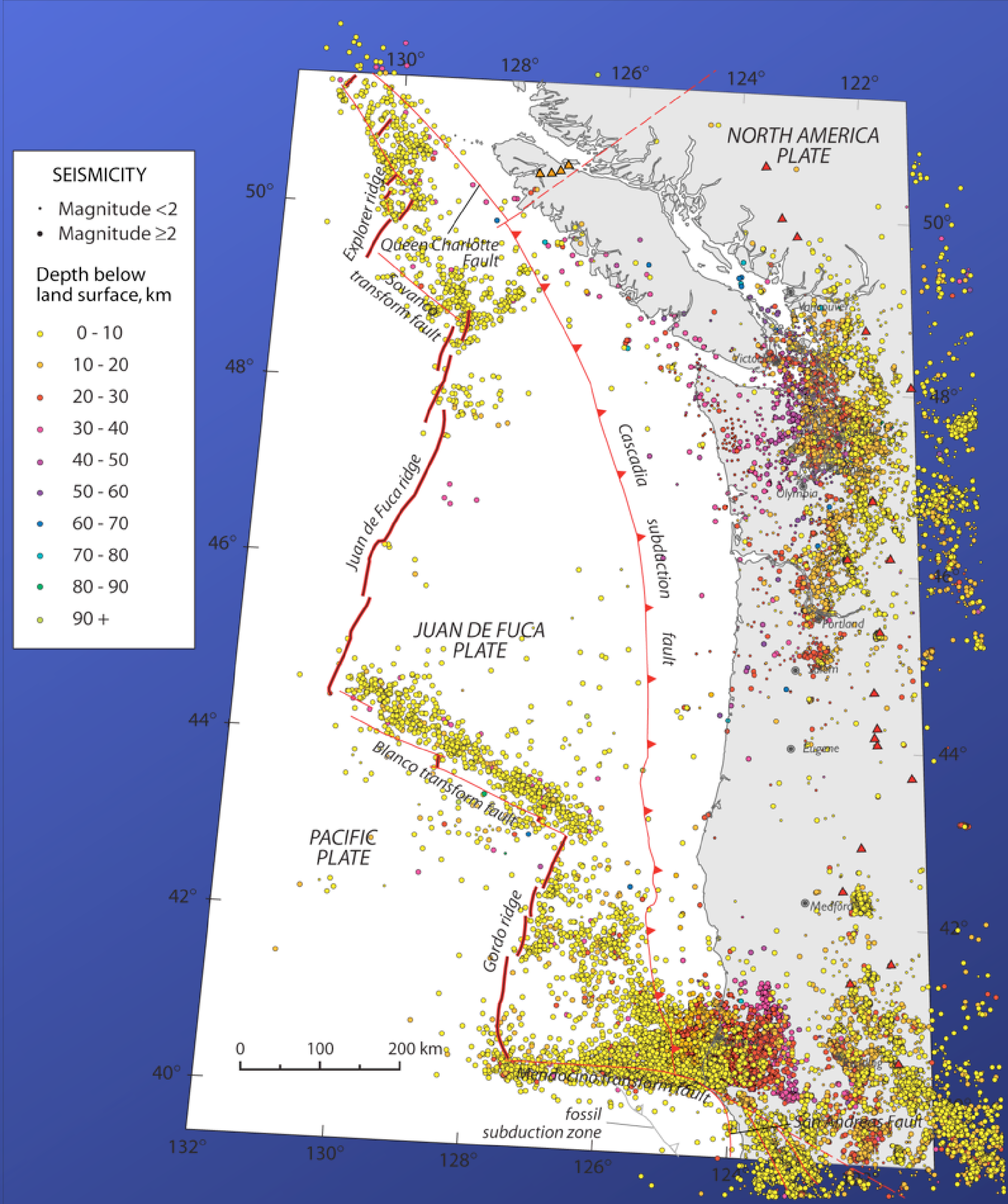
GAMBLING ON SUBDUCTION



by

Patricia McCrory
US Geological Survey

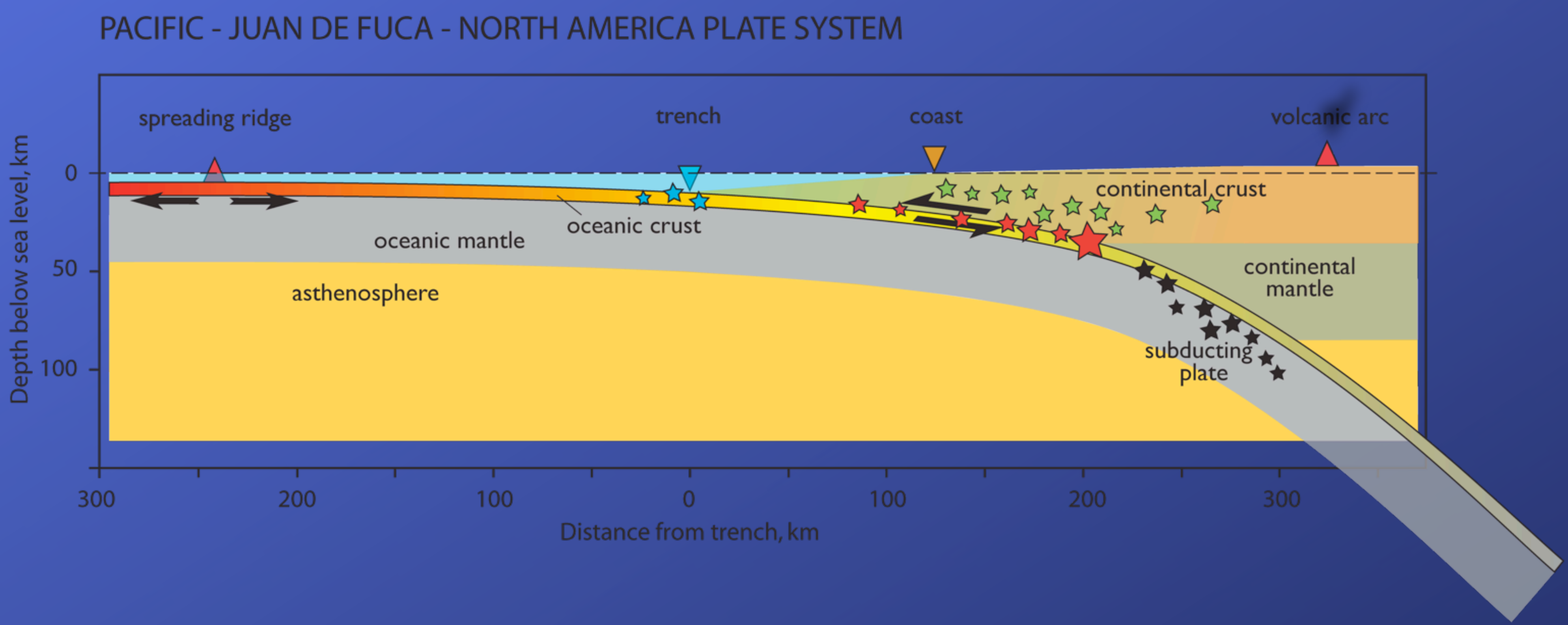
with contributions from
Luke Blair, David Oppenheimer, Fred Pollitz, and Ray Weldon



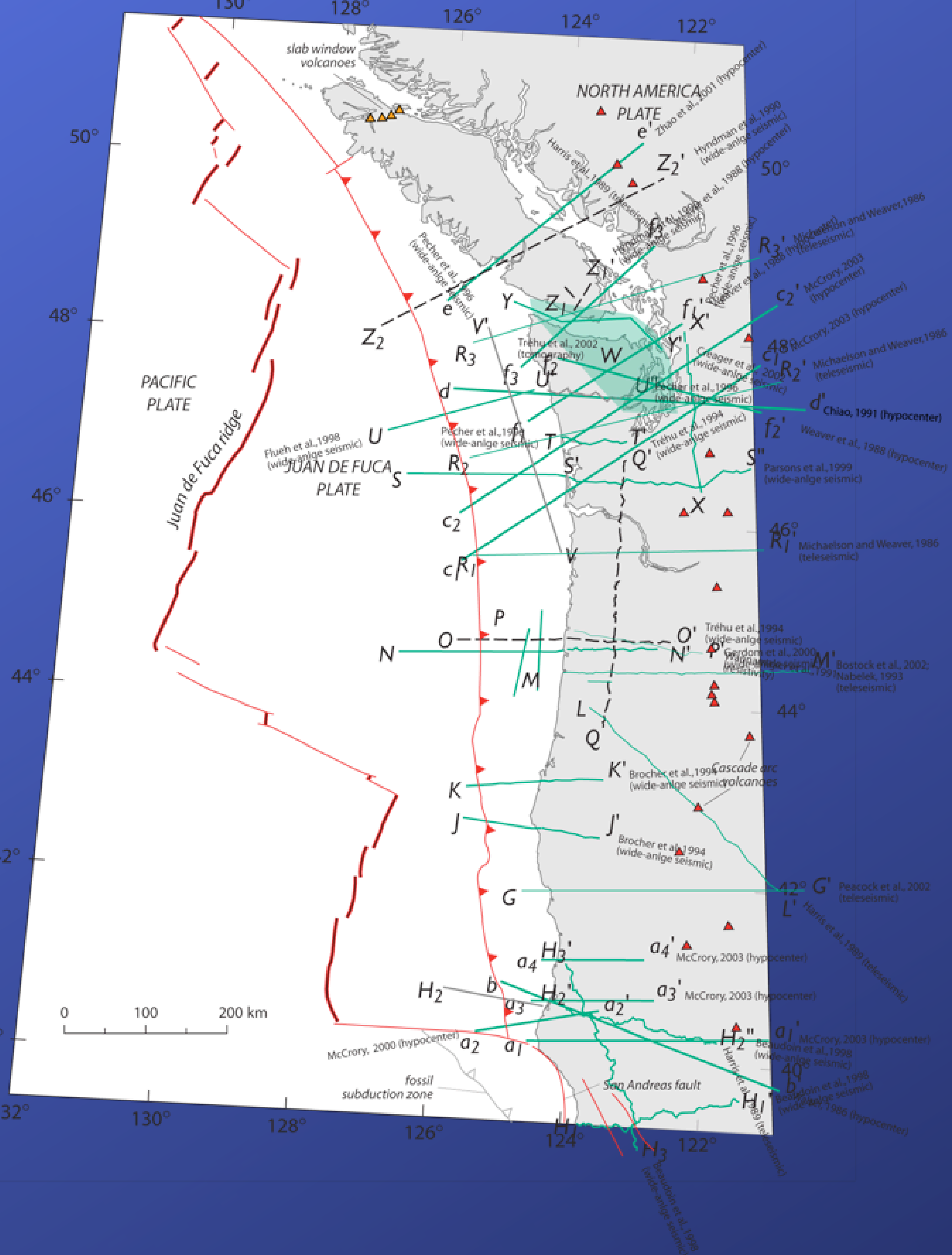
Modified from McCrory *et al.*, 2004, *USGS DS-91*

ANSS CATALOG SEISMICITY, 1975-2002

magnitude ≥1
depth ≥2 km
stations ≥8
regional rms ≤0.3 s
teleseismic rms ≥0.3 & ≤1 s

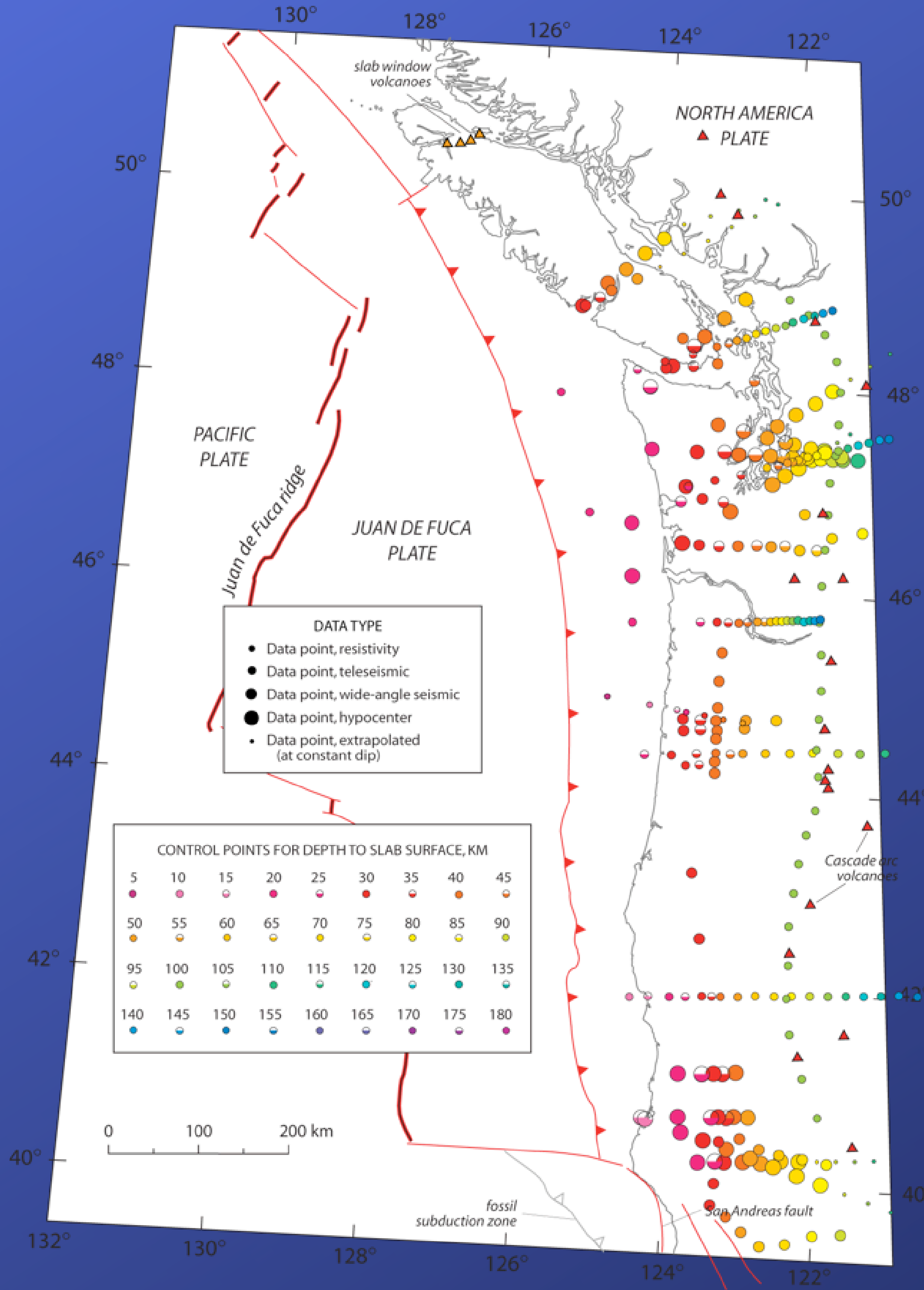


EARTHQUAKE SOURCES IN A SUBDUCTION SYSTEM

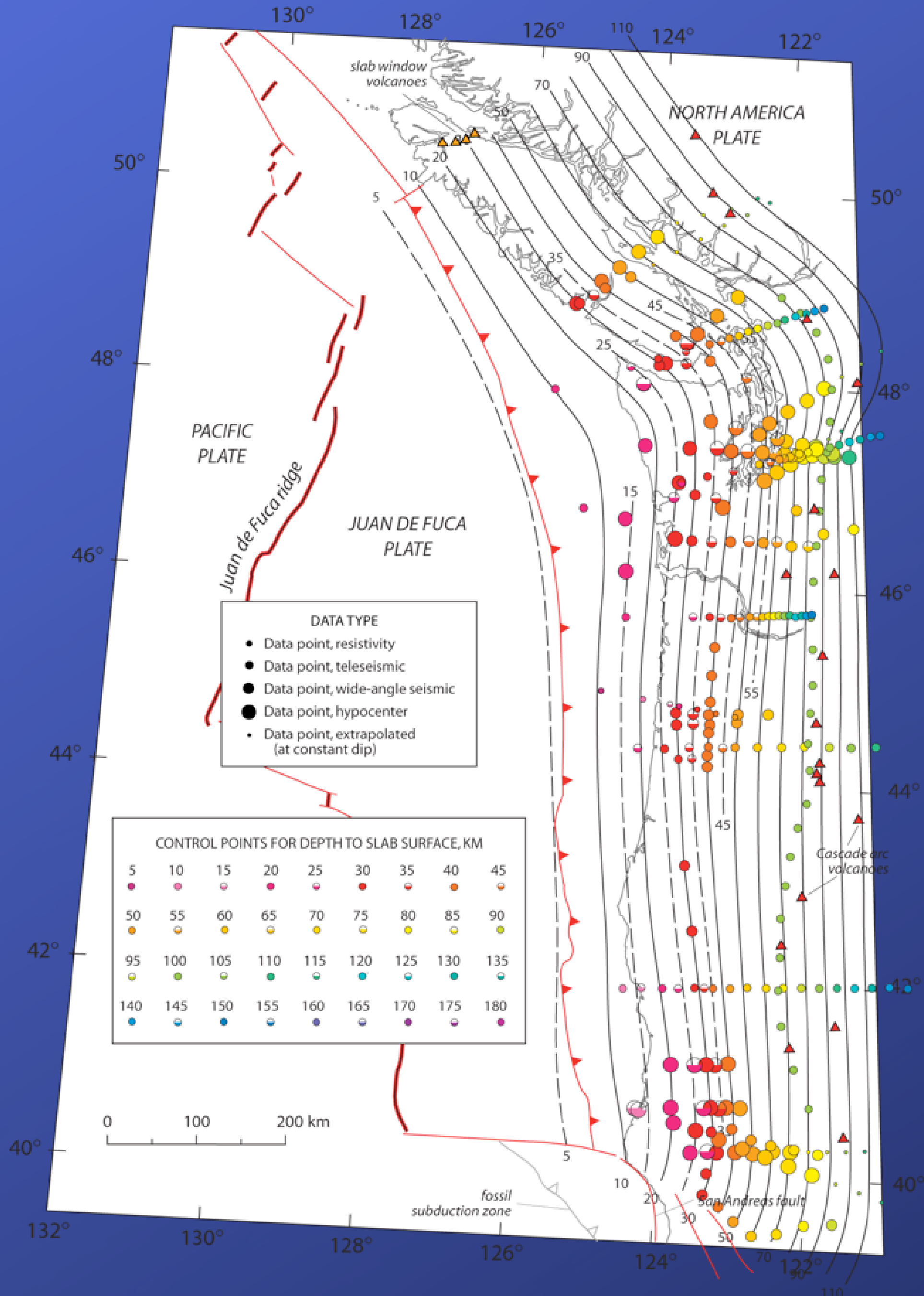


LOCATION OF GEOPHYSICAL DATA USED TO CONSTRAIN GEOMETRY OF SLAB SURFACE

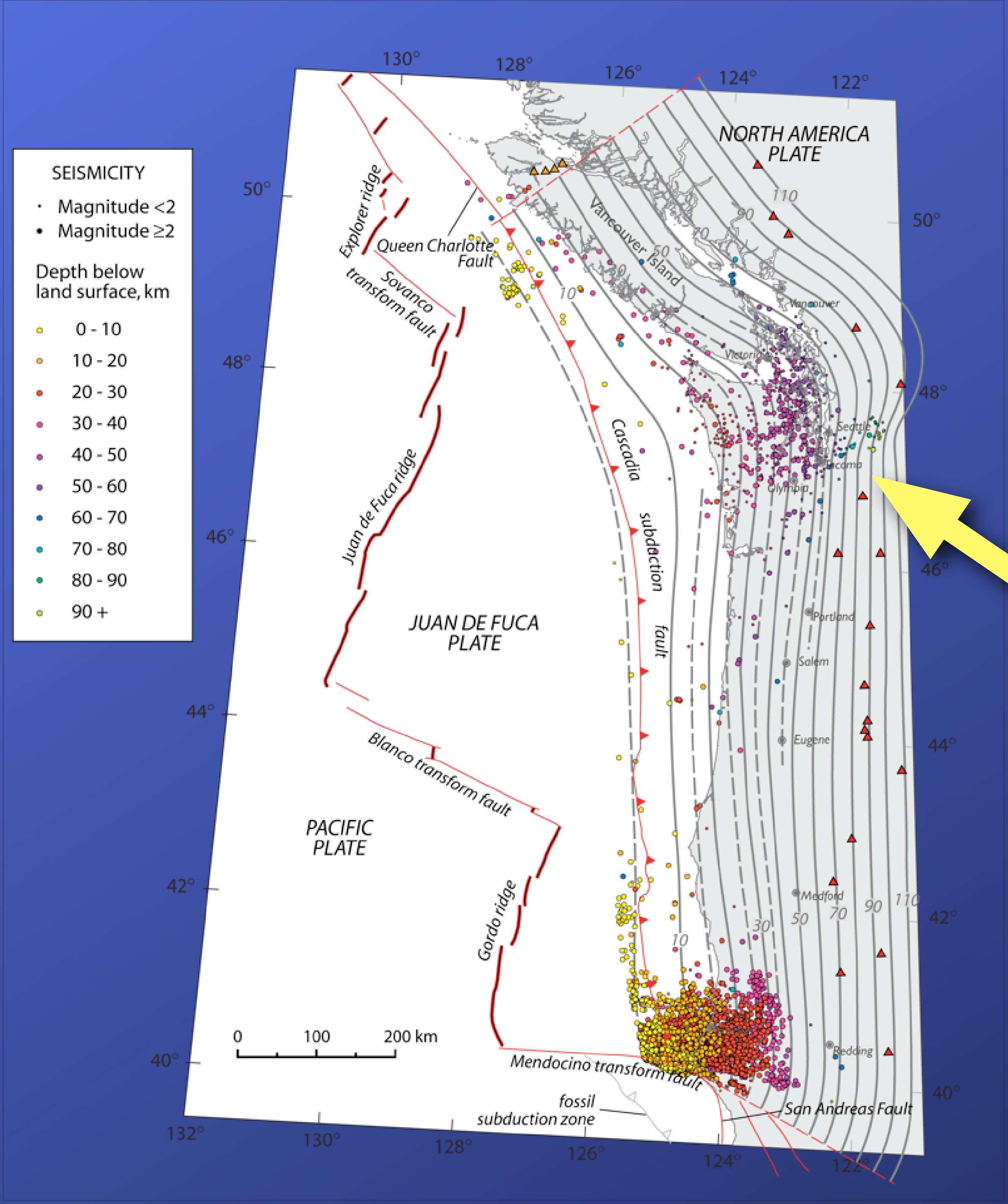
Modified from McCrory *et al.*, 2004, *USGS DS-91*



CONTROL POINTS CONTOURED TO CONSTRAIN GEOMETRY OF SLAB SURFACE

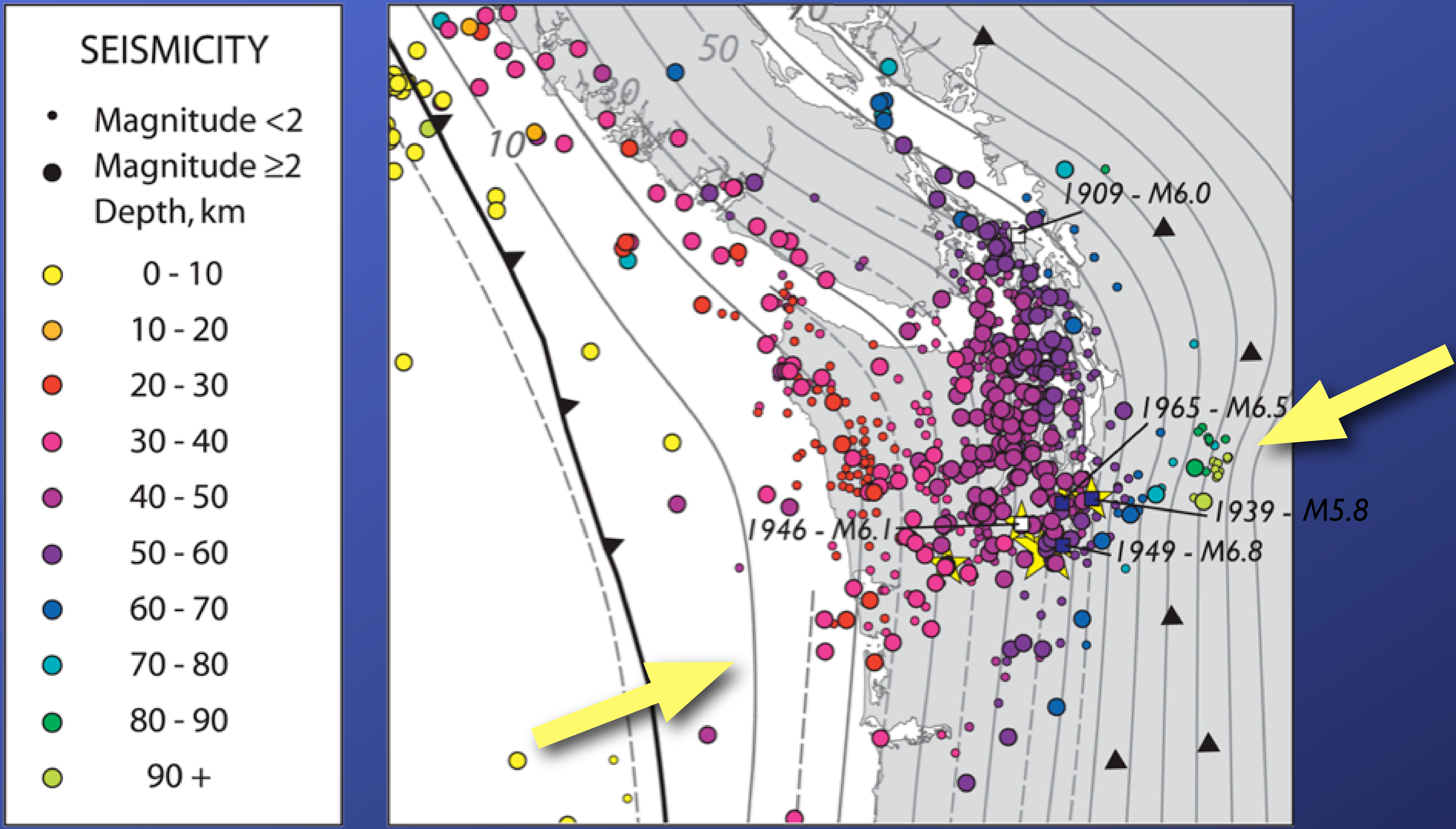


CONTOURED JUAN DE FUCA SLAB SURFACE WITH KINK ALONG 'NISQUALLY' TREND

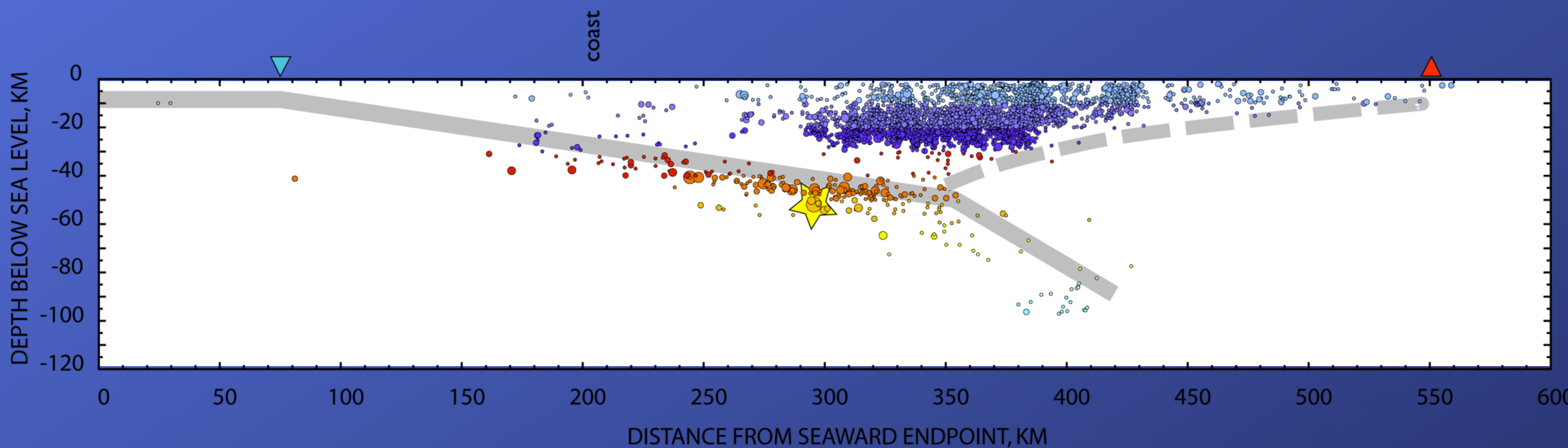


Modified from McCrory *et al.*, 2004, *USGS DS-91*

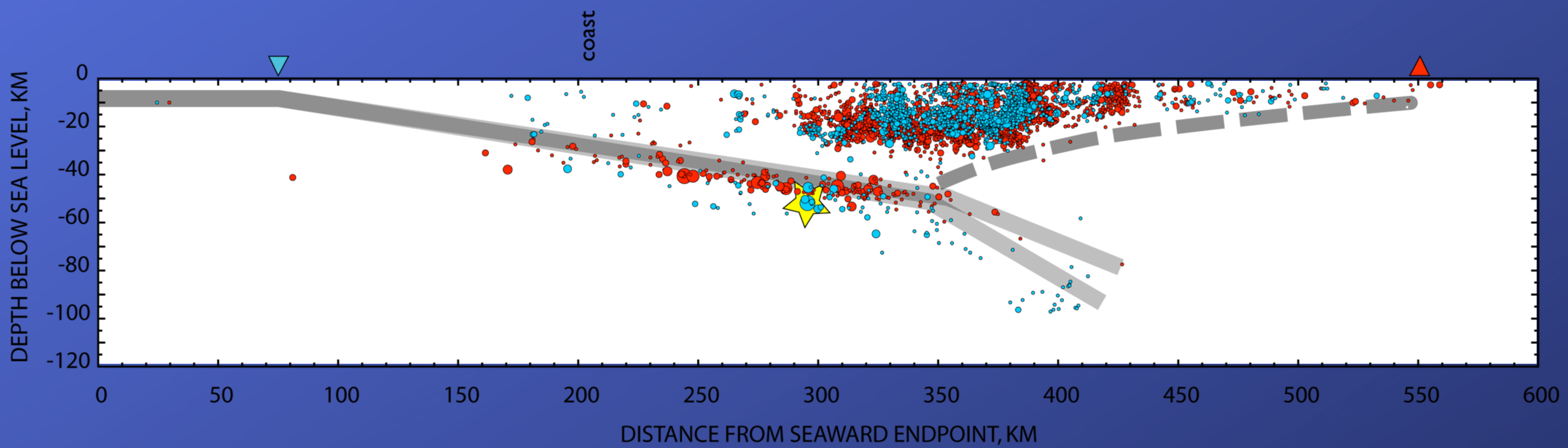
ANSS CATALOG EARTHQUAKES WITHIN JUAN DE FUCA SLAB (below slab surface)



ANSS SLAB SEISMICITY PLUS HISTORIC EARTHQUAKES

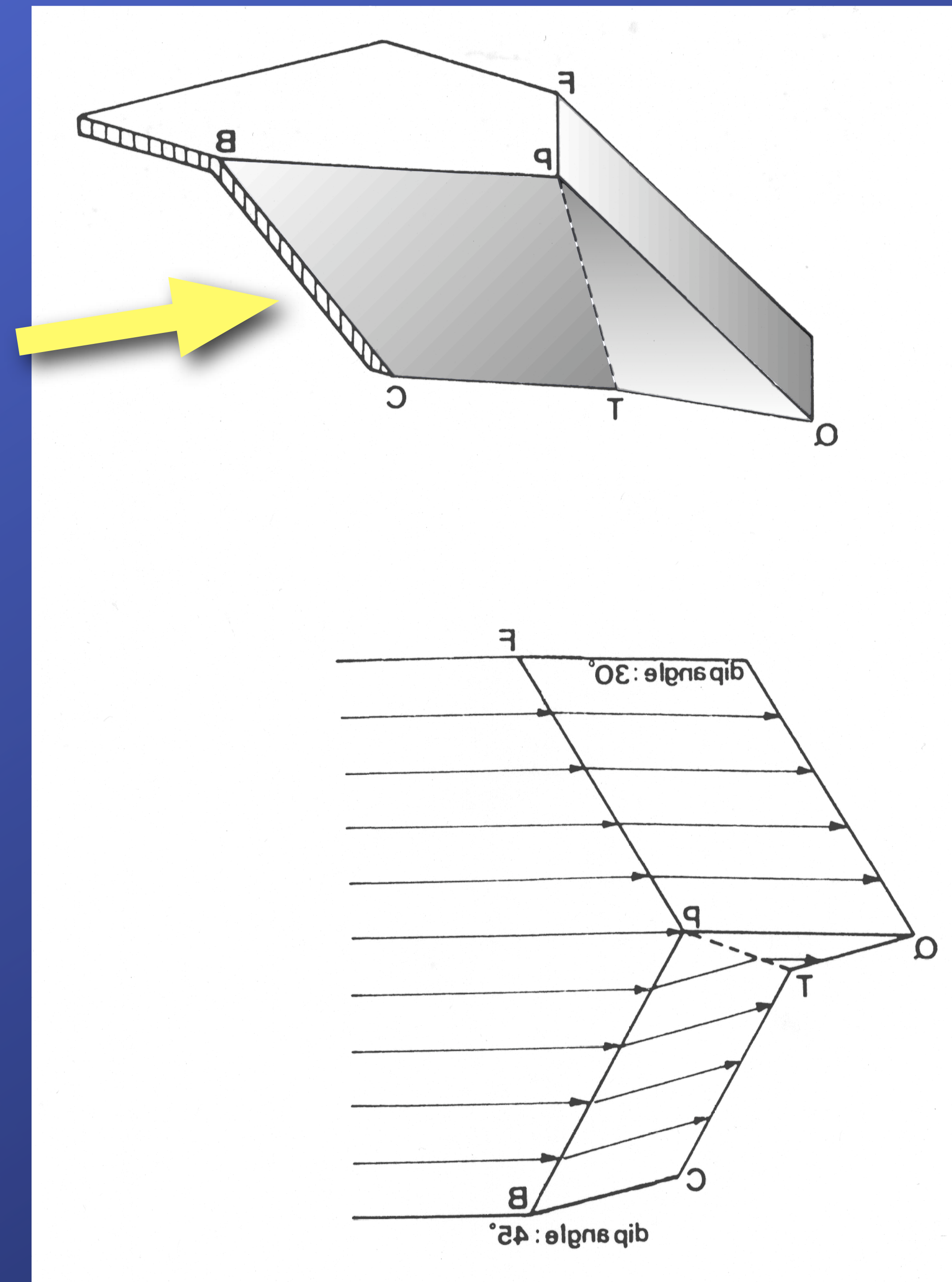


SEISMICITY PROFILE ALONG NISQUALLY TREND
(includes events within 50 km of profile)



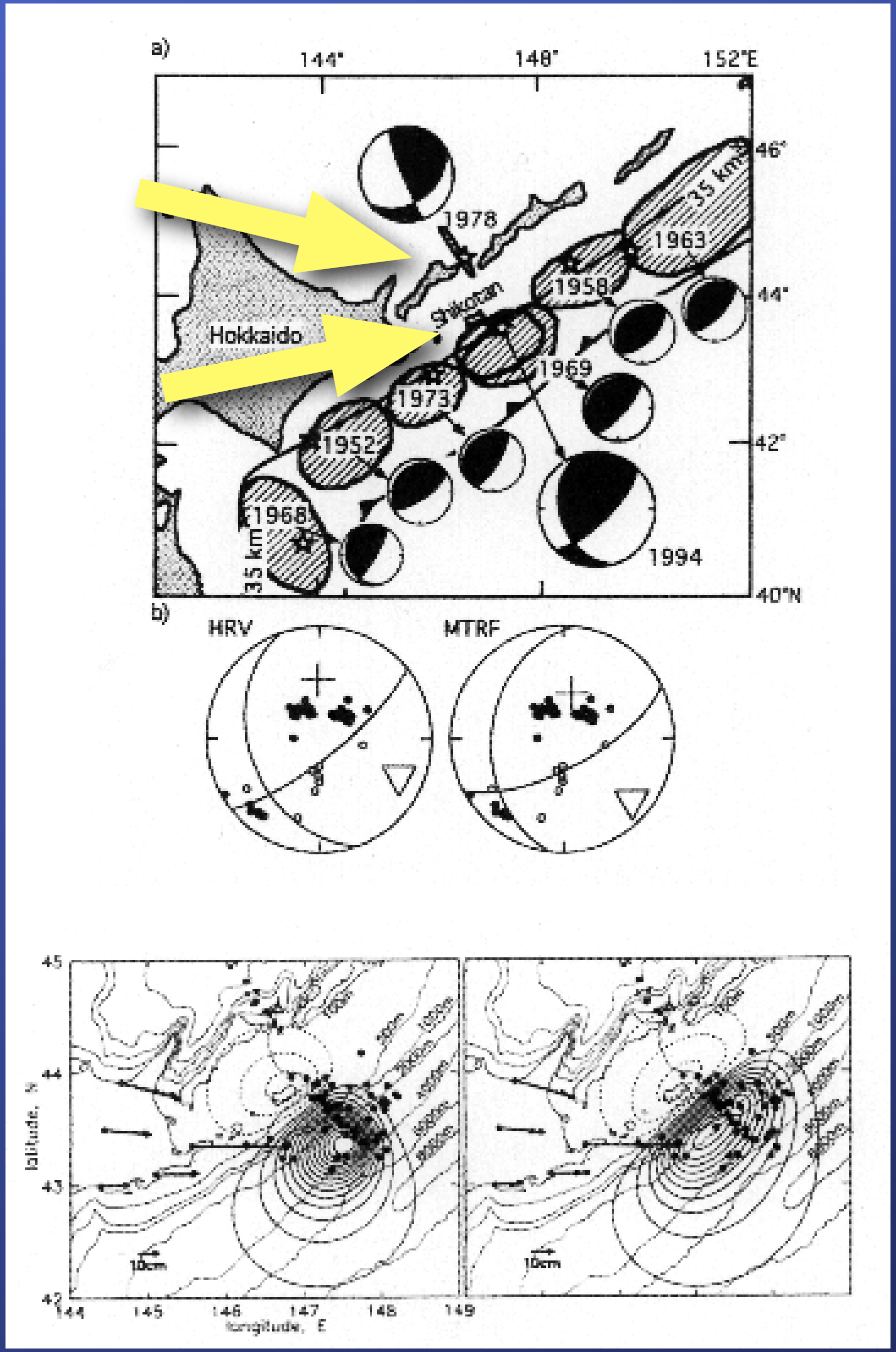
PROFILE ALONG SLAB KINK SHOWING DIFFERING SLAB DIPS NORTH (RED) AND SOUTH (BLUE) OF NISQUALLY TREND

Both the Kurile tear and the Nisqually kink are located along the steep side of asymmetric slab arches

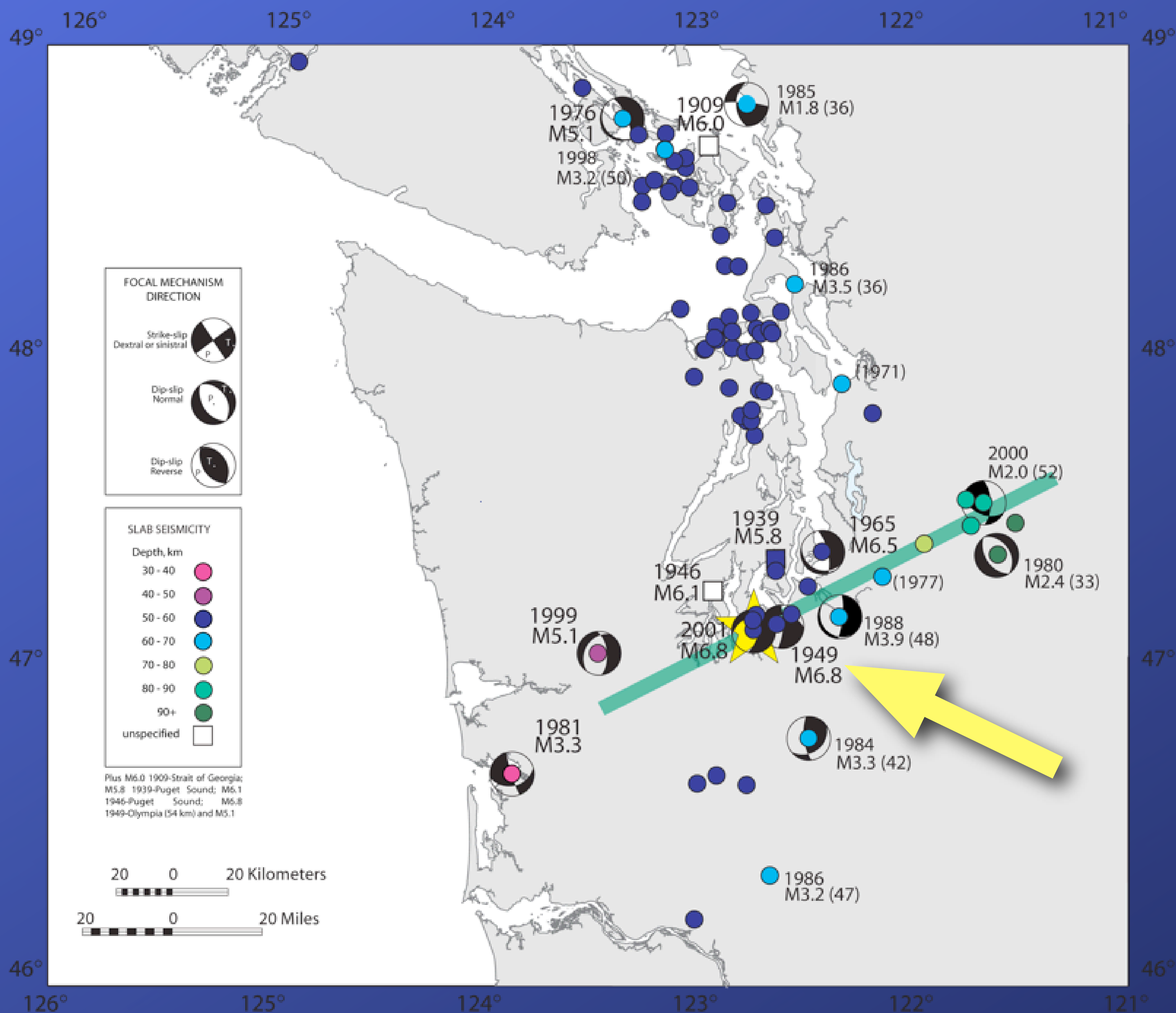


Modified from Minamino and Fujii, 1981

Both the 1978 M7.8 and the 1994 M8.3 Kurile earthquakes have oblique strike-slip motion and aftershock distribution oriented normal to the trench at depths just below the slab surface

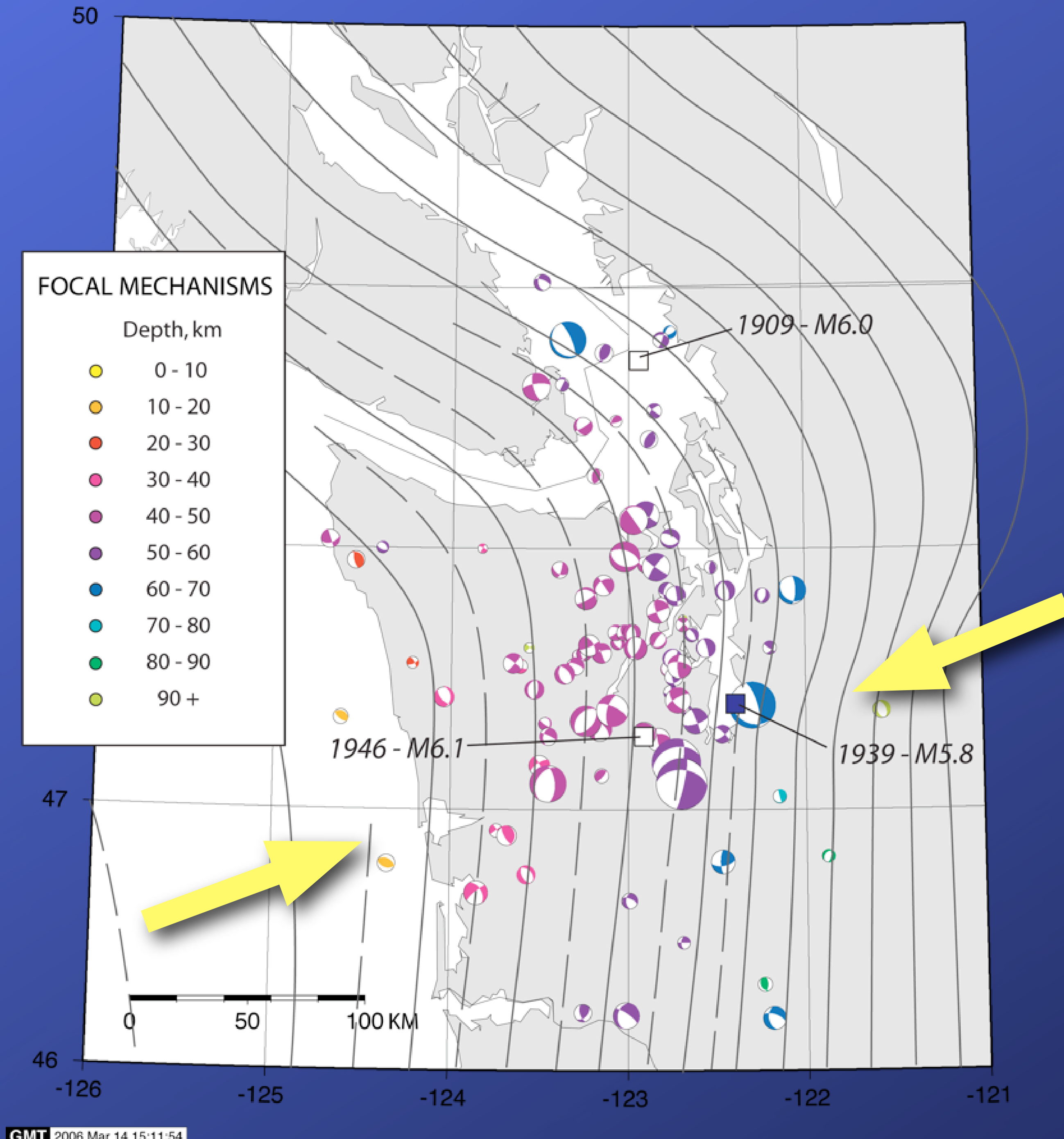


From Tanioka, Ruff and Satake, 1995



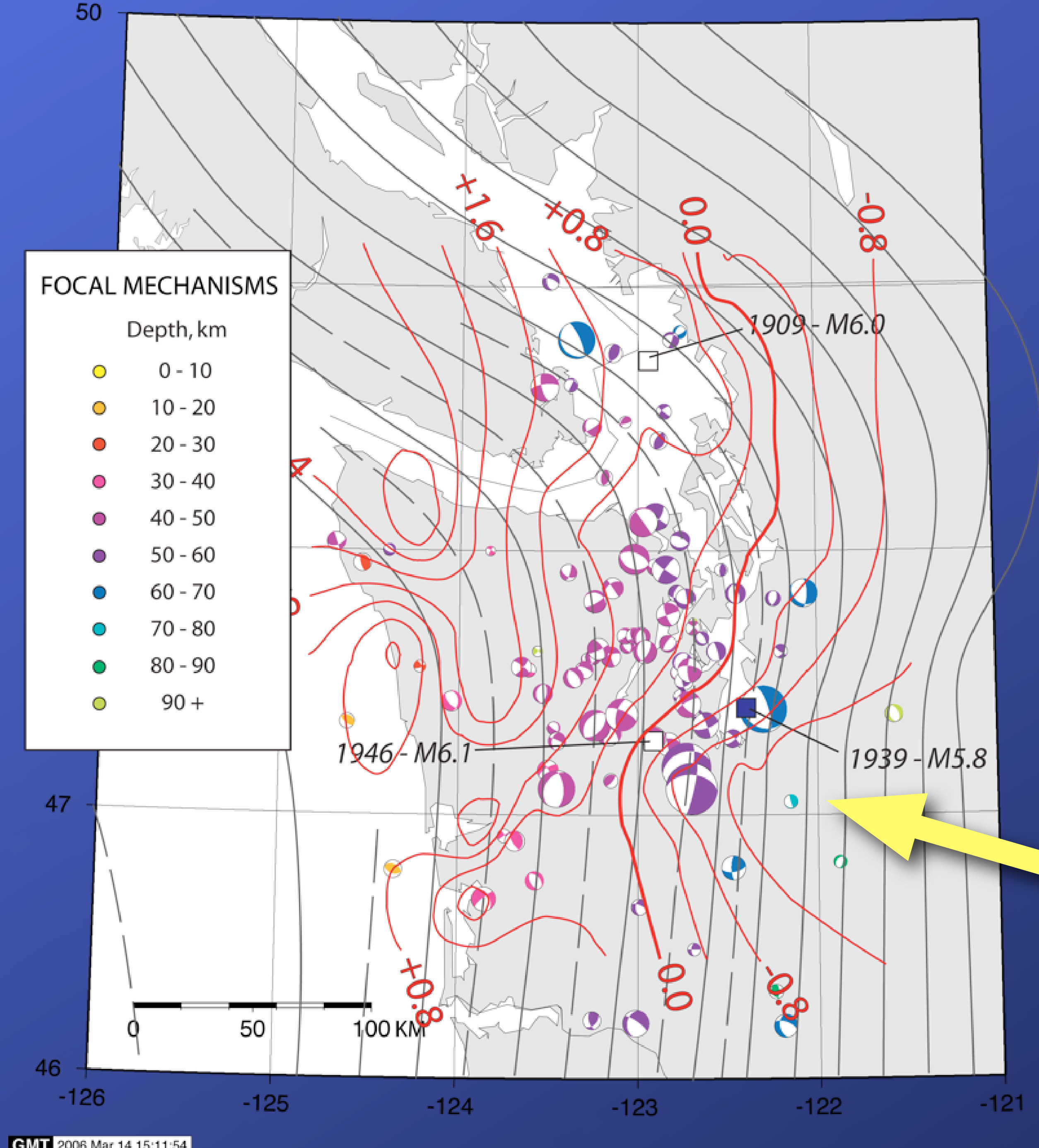
Selected focal mechanisms in vicinity of Nisqually trend

Note, the 1949 event as well as the 2001 event have a component of strike-slip motion



PNSN SLAB FOCAL MECHANISMS, 1975-2003

Note, focal mechanisms will be inverted to infer variations in stress field orientation



PNSN SLAB FOCAL MECHANISMS, 1970-2003

Note, distribution of slab events bounded by kink in contours (red) depicting rate of elevation change in mm/y

Geodetic contours modified from Savage, Lisowski, and Prescott, 1991, *JGR*

SLAB EARTHQUAKES IN WASHINGTON WITH MAGNITUDE >5

Note, Nisqually trend aligns with sharp gradient in rotational as well as vertical strain observations.

Earthquakes along this trend have a recurrence interval measured in decades.

Vertical geodetic observations from R. Weldon, 2005, *unpubl. data*; Horizontal rotations from F. Pollitz, 2006, *unpubl. data*

PRELIMINARY INTERPRETATIONS

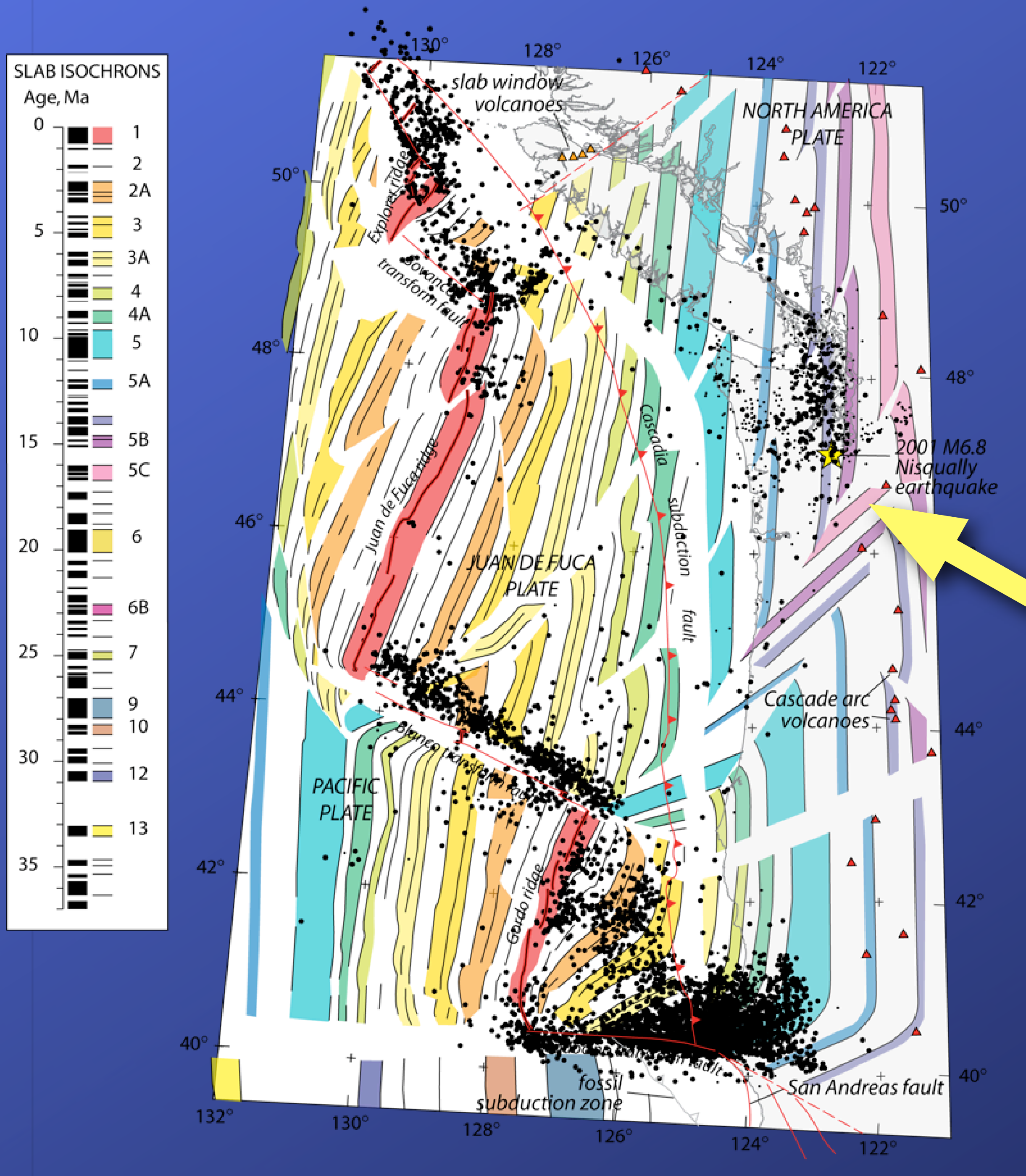
> The Nisqually "tear" or trend marks a boundary between contrasting strain segments in the Juan de Fuca slab

> The flatter dipping slab to the north is more strongly coupled to the overriding plate and resists subduction when compared with the slab to the south

> The more strongly coupled plate interface results in a higher rate of background seismicity, both above and below the interface

> The Nisqually "tear" may be an accommodation structure that concentrates strain locally at the segment boundary

> Future earthquakes are expected in the vicinity of this feature



Sea-floor and slab age from Wilson, 2000

JUAN DE FUCA PLATE AGE WITH SLAB SEISMICITY

Note, Nisqually trend does not align with any pseudo-faults in the Juan de Fuca slab (zones marked by discontinuities in magnetic isochrons)