



USGS tsunami-related studies in California

LANDSLIDES (Lee, Geist)

OFFSHORE FAULTS:

Catastrophic Hazards project

Multihazard Demonstration Project

State Waters mapping project

(Ryan, Conrad, Ross, Johnson)

PALEO-TSUNAMI STUDIES

(Jaffe)

The background of the slide is a reproduction of the famous Japanese woodblock print 'The Great Wave off Kanagawa' by Katsushika Hokusai. It depicts a massive, curling blue wave with white foam, threatening three small boats on the sea. The sky is a pale, hazy blue.

Talk overview

LANDSLIDE SOURCES

Probabilistic study (Geist and Parsons)

EARTHQUAKE SOURCES

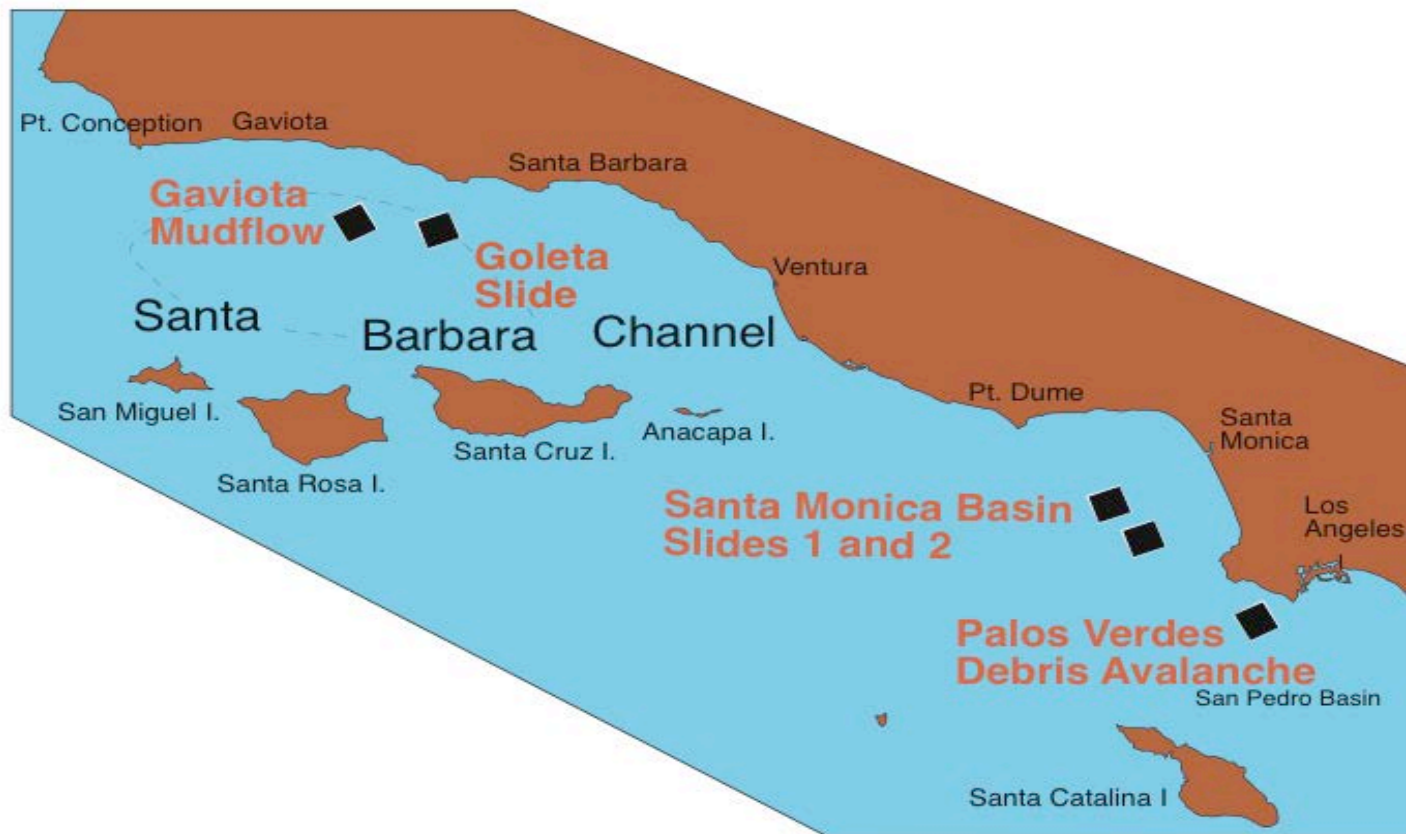
Southern California Borderland:
Recent field studies (hi res reflection, coring)
Carpenteria paleotsunami study

Central/Northern California

REGENCY OF FAULTING

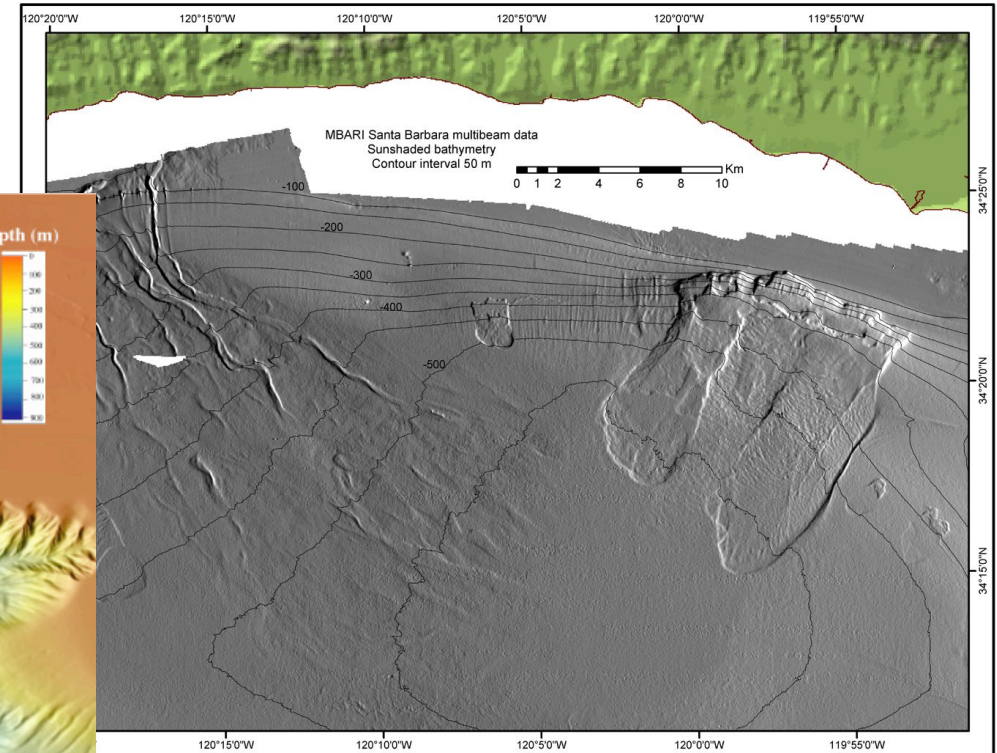
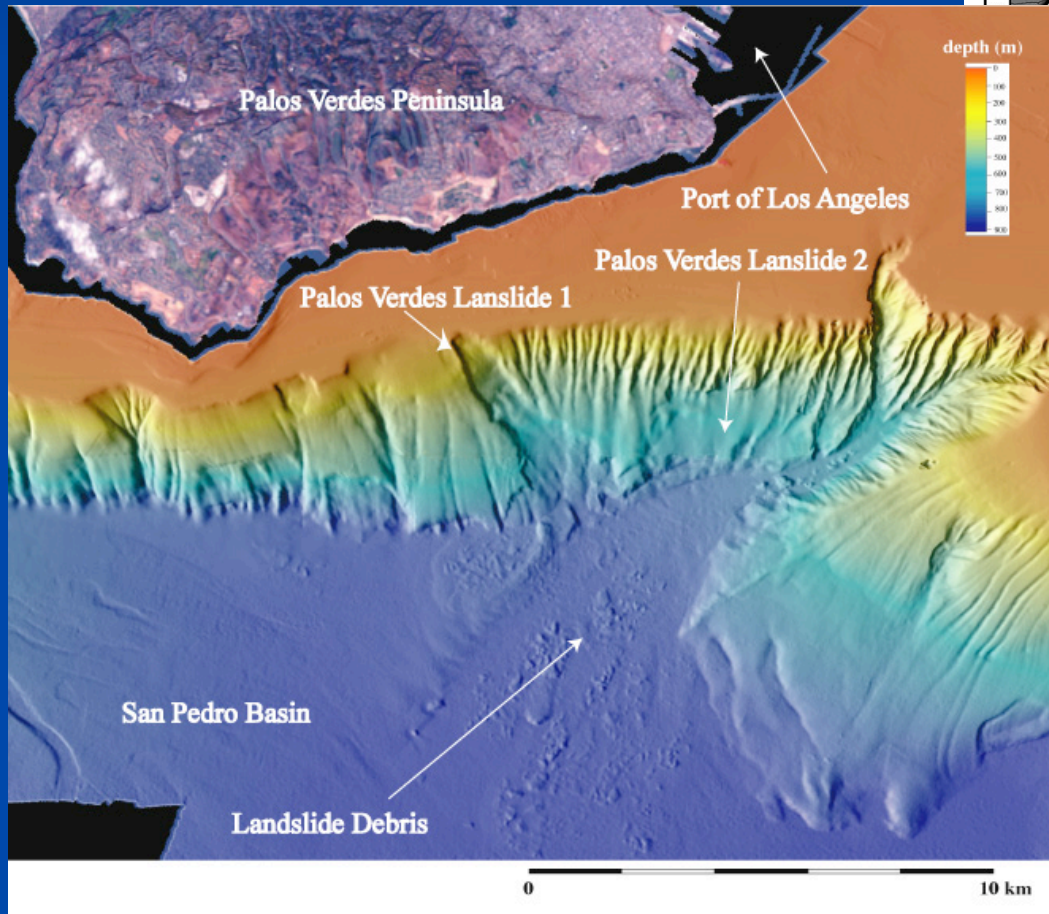
SLIP RATES/RECURRENCE INTERVALS/

Locations of Landslide Studies



LANDSLIDES in Southern California

Palos Verdes debris avalanche



Goleta landslide

Empirical Probability Landslide study, Geist and Parsons, 2010

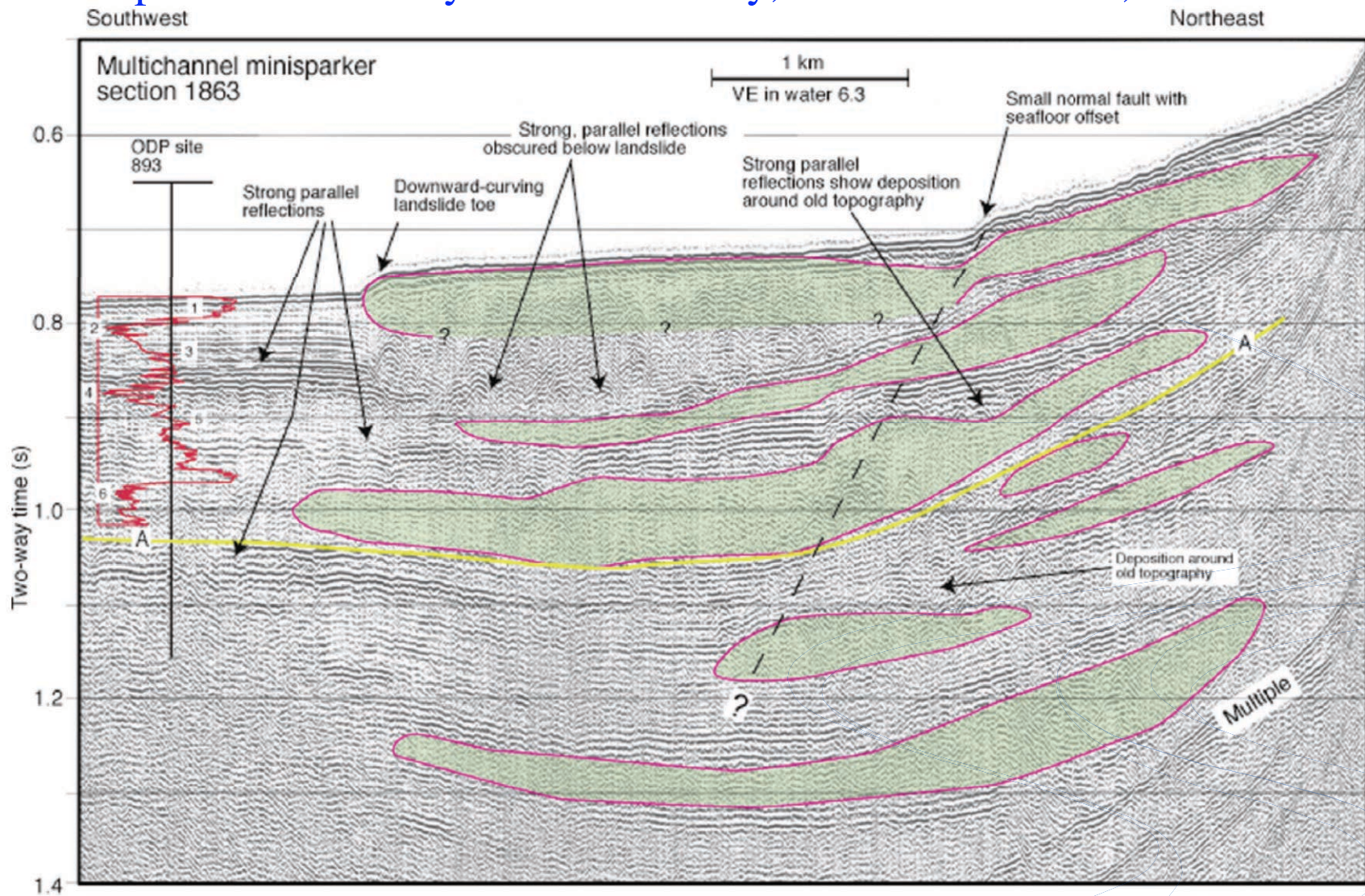


Fig. 1 High-resolution minisparker seismic reflection data oriented parallel to the axis of the Goleta landslide complex. Red outline and green shading indicates interpreted landslide deposits. Red curve is the oxygen isotope variation from ODP site 893. Numbers represent marine isotope stages. Figure from Fisher et al. (2005)

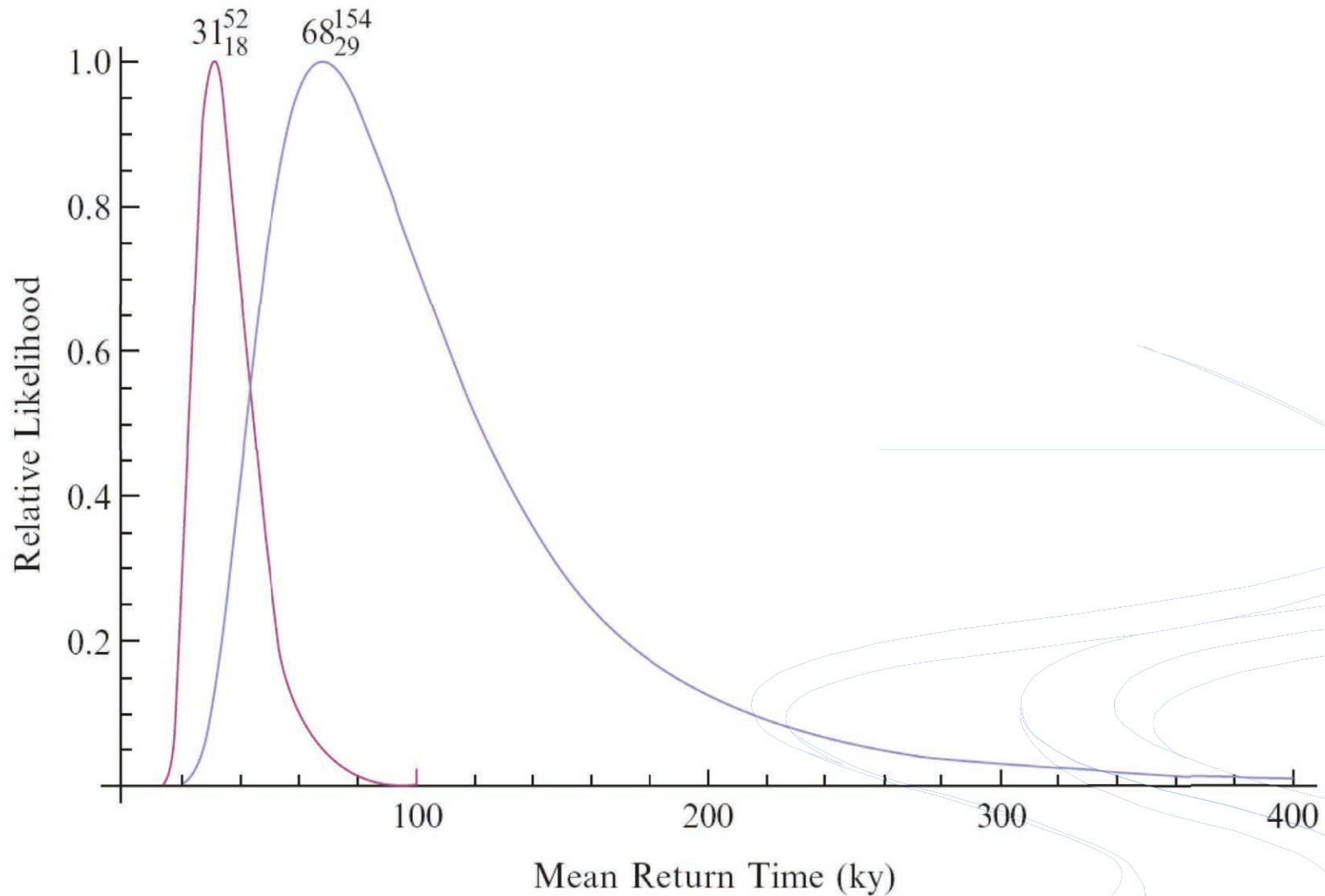


Fig. 2 Distribution of mean return times ($1/\lambda$) for two estimates of the occurrence of landslides in Santa Barbara Channel. Blue curve: three landslide occurrences younger than Horizon A (170 ka) shown in Fig. 1. Red curve: seven landslide occurrences younger than approximately 200 ka. Most likely mean return time (ka) and 95% confidence range (indicated by sub- and superscripts) in the mean return time indicated for each curve

SOUTHERN CALIFORNIA OFFSHORE FAULT STUDIES

CHANNEL ISL THRUST
OAK RIDGE THRUST ETC.

SAN
PEDRO
BASIN

PALOS
VERDES

OCEANSIDE
THRUST

NIRC

SAN
DIEGO
TROUGH

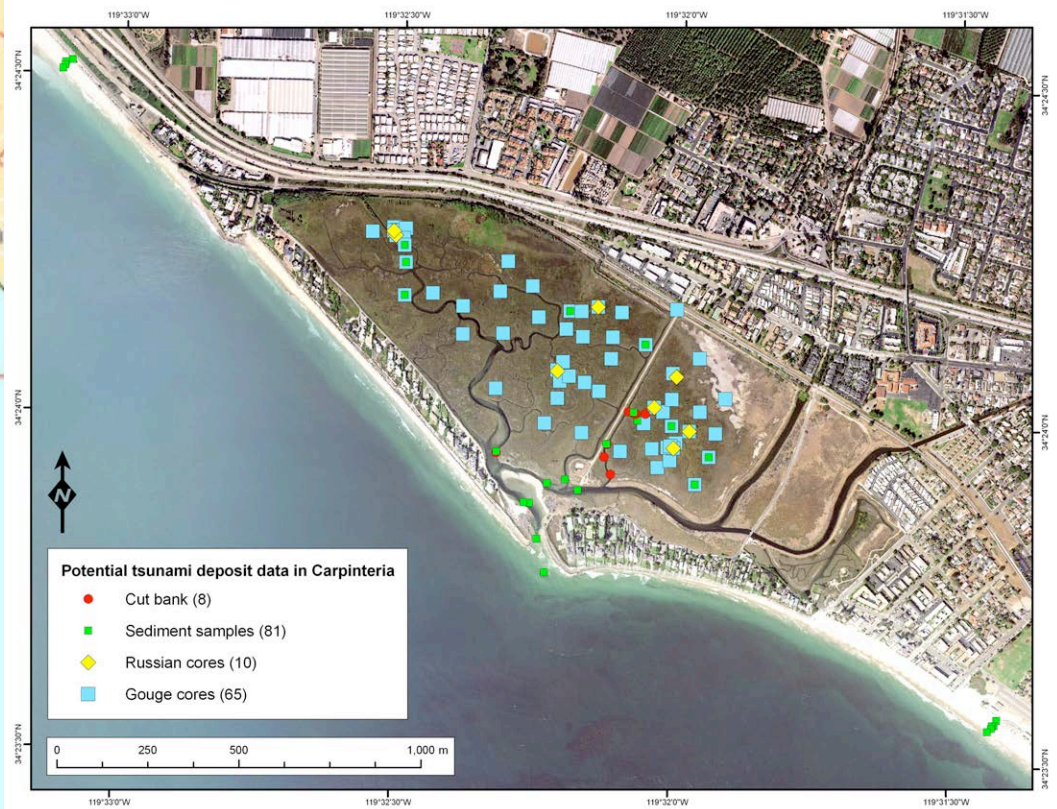
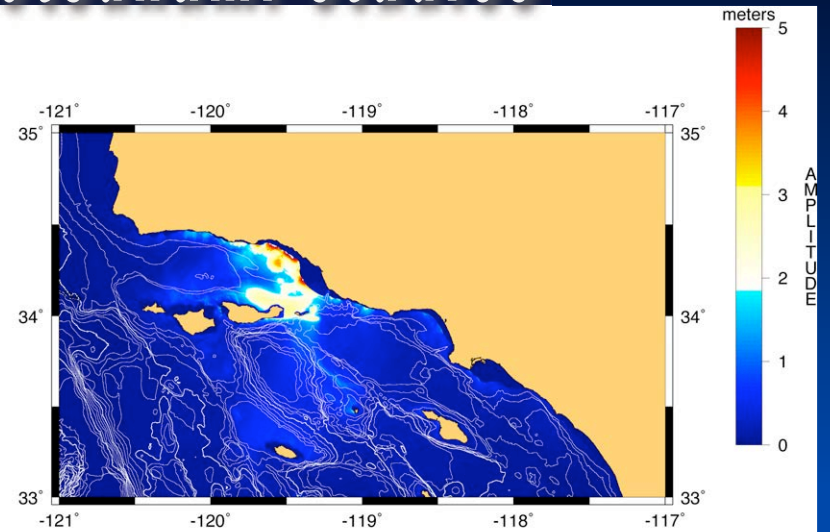
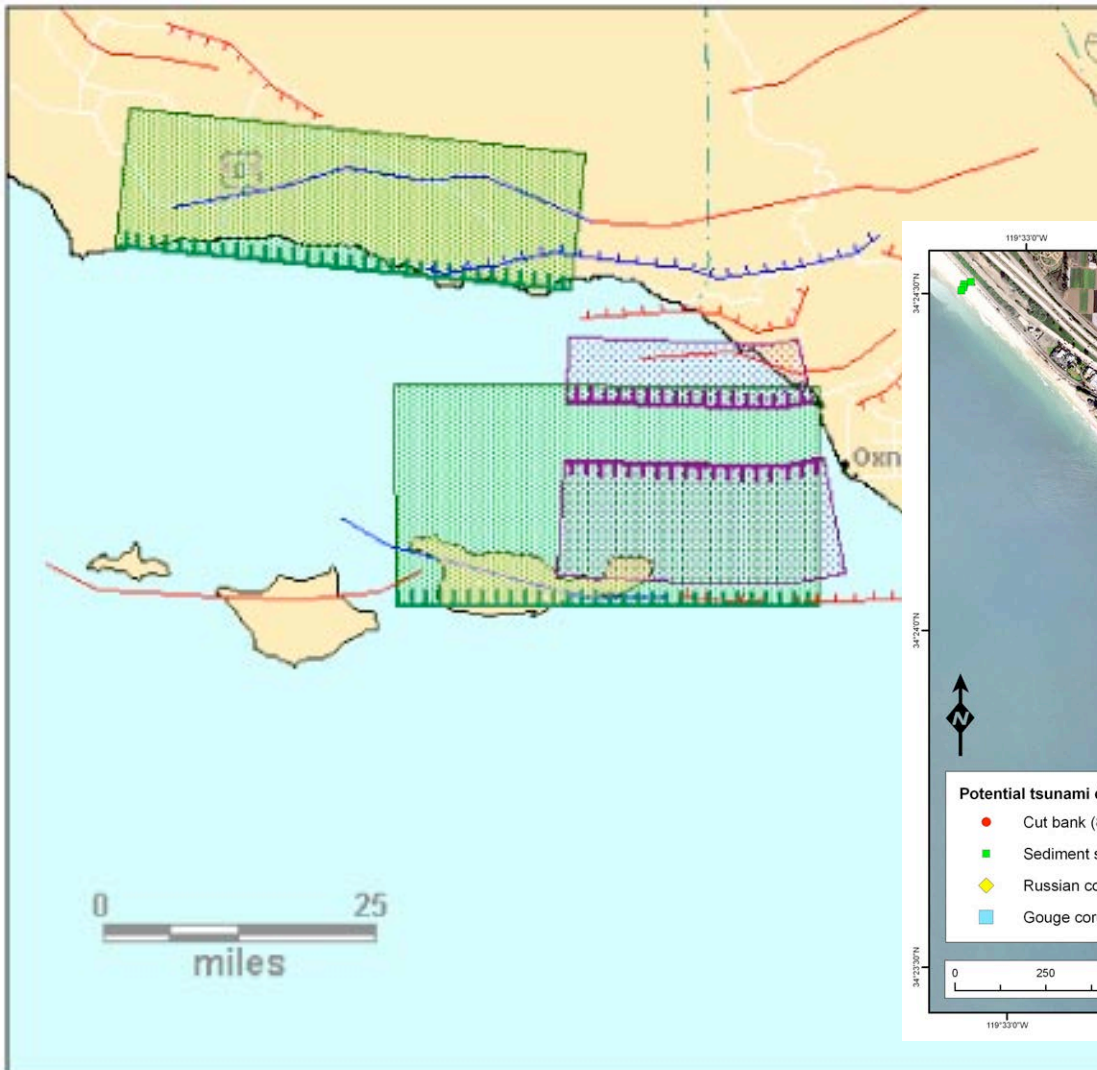
2010 FAULT ACTIVITY MAP
STATE OF CALIFORNIA

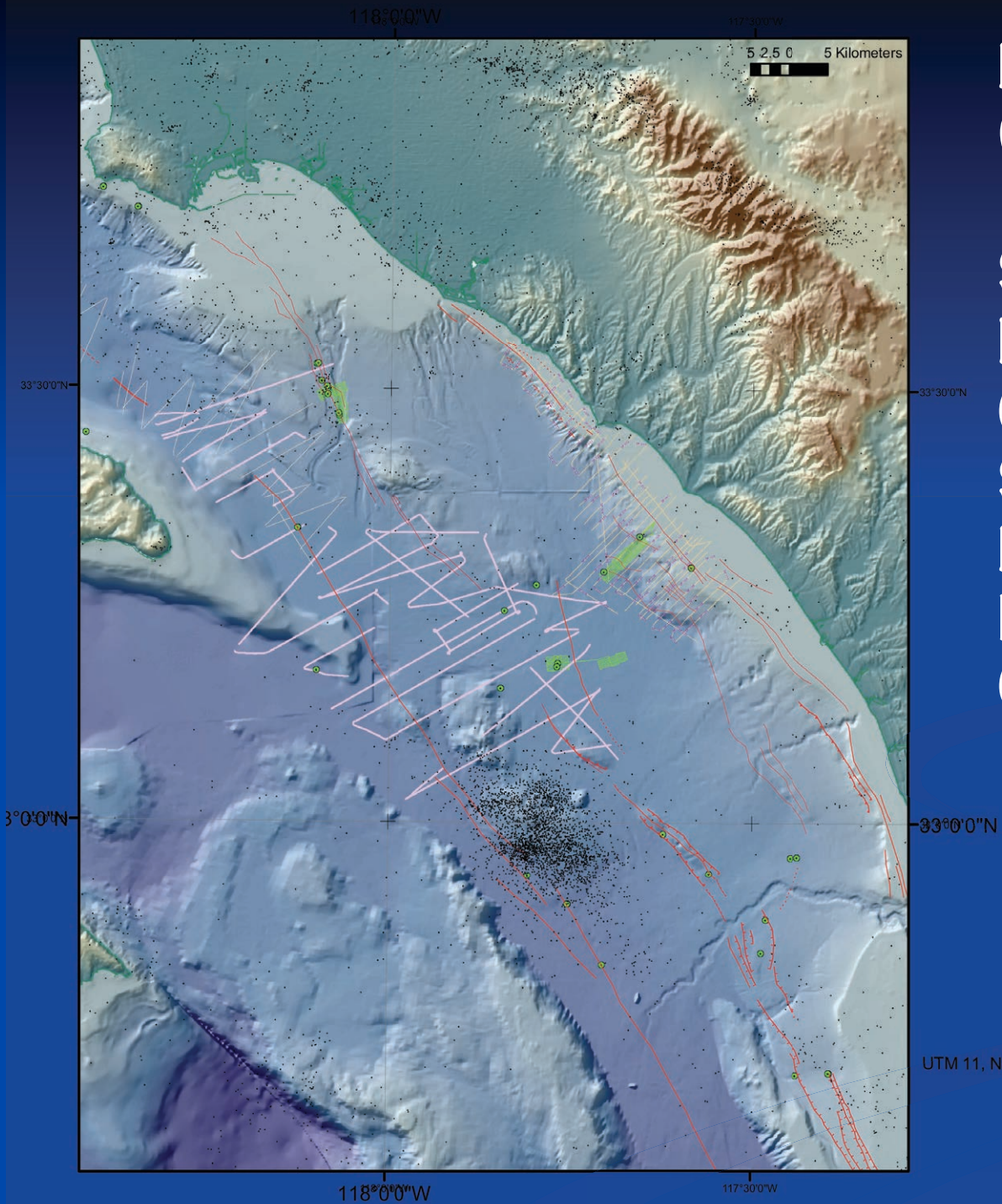
California Geological Survey

CHANNEL ISLAND THRUSTS: paleotsunami studies

2002 CALIFORNIA FAULT PAR
Transverse Ranges and Los A

Click on fault for informat





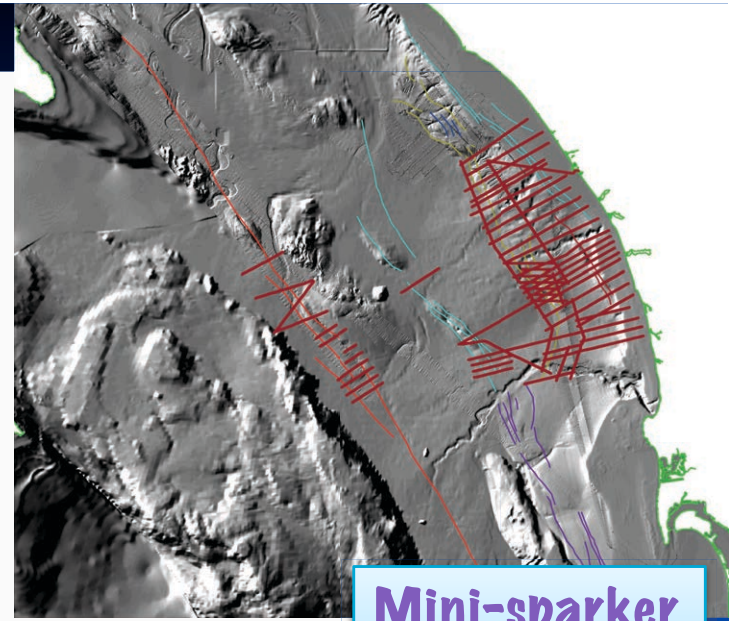
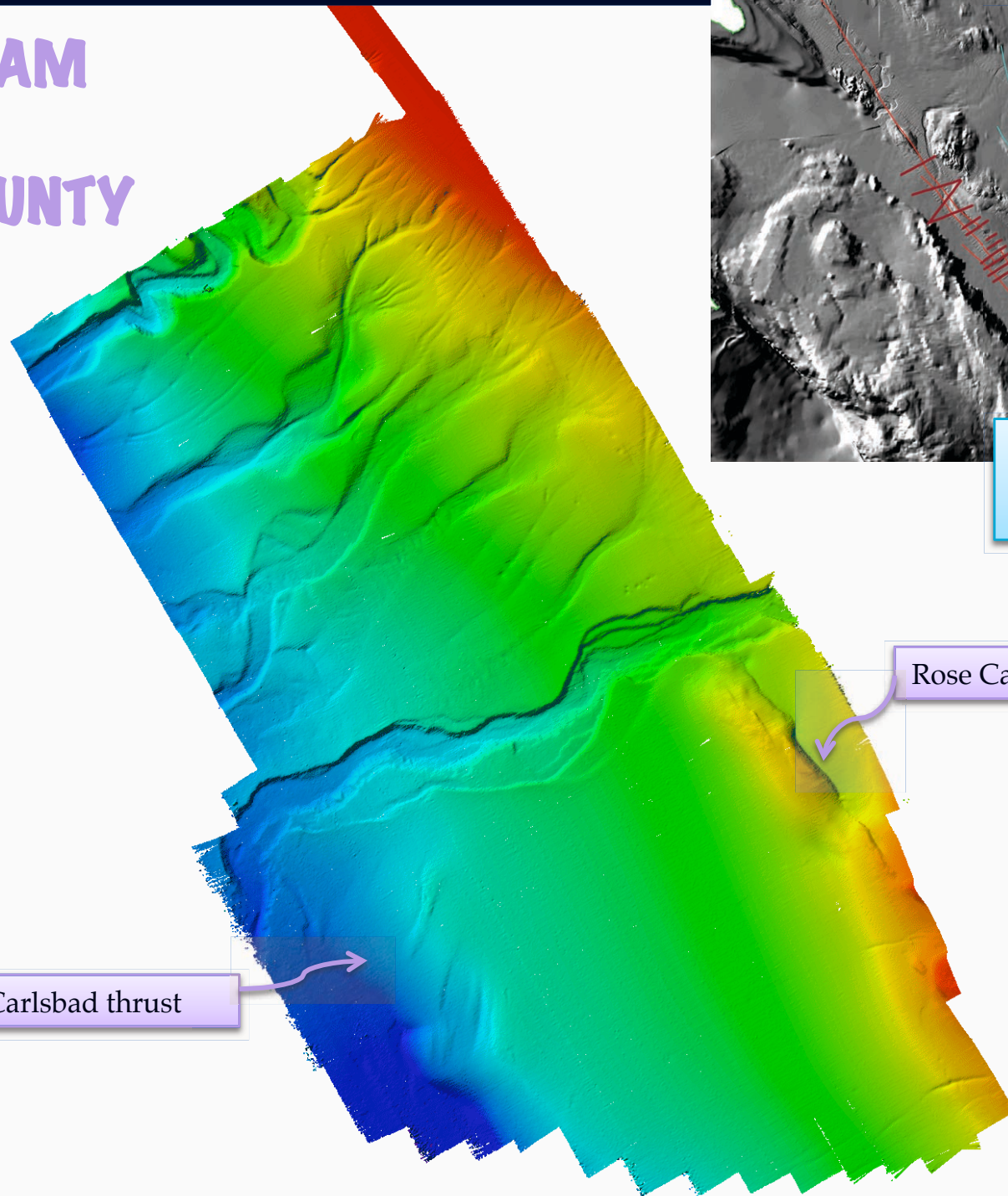
NEW FAULT STUDIES (Cat Haz Proj, MHDP):

**San Mateo/Oceanside
Palos Verdes
Coronado Bank
San Diego Trough
Newport-Inglewood
Rose Canyon
Carlsbad**

Very high-resolution chirp and mini-sparker reflection profiles plus gravity cores (< 2m) collected by USGS and MBARI from 2006-2010.

NEW MULTIBEAM OFFSHORE SAN DIEGO COUNTY

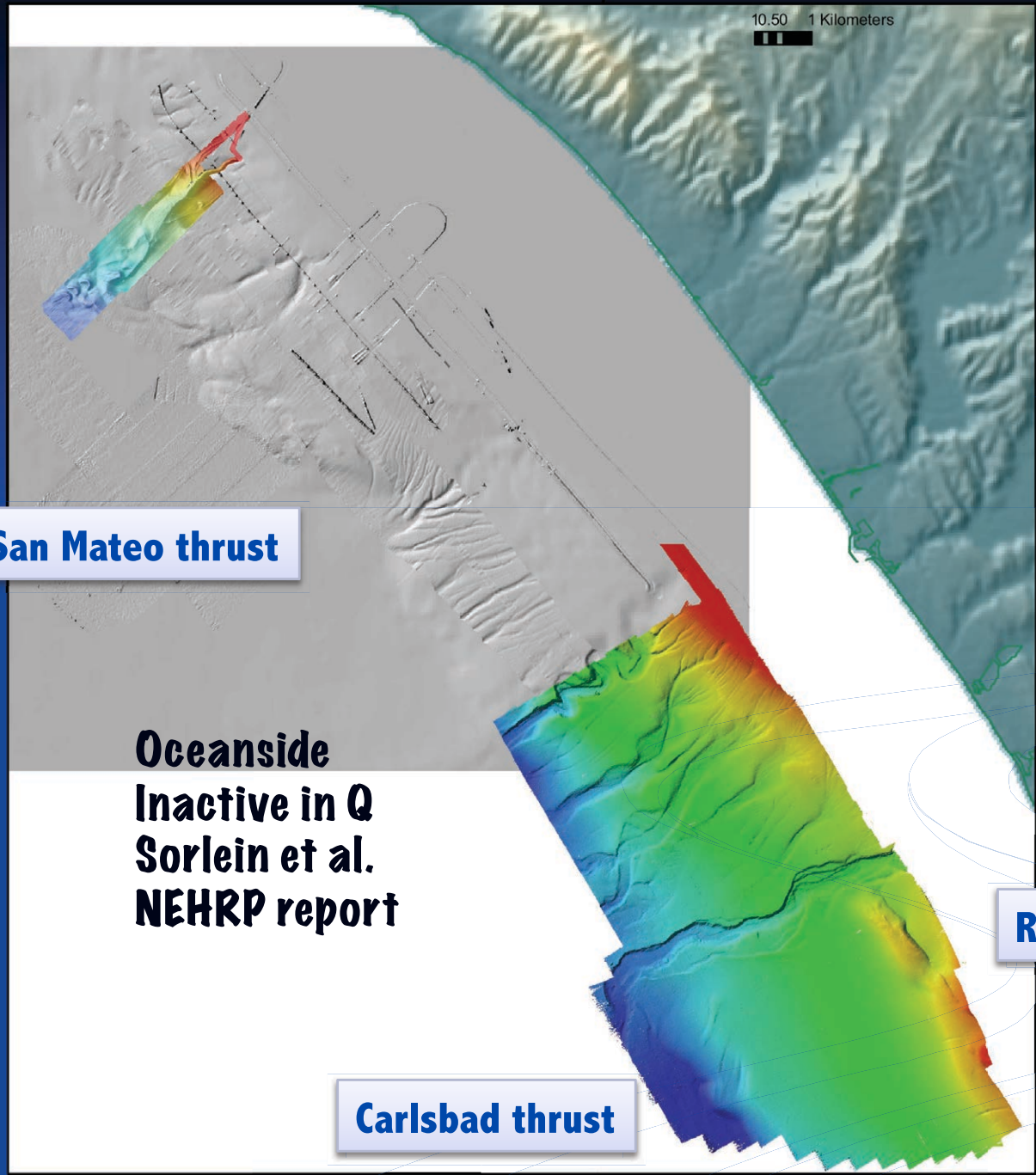
MAY 2010



Mini-sparker
June, 2010

Carlsbad thrust

Rose Canyon FZ

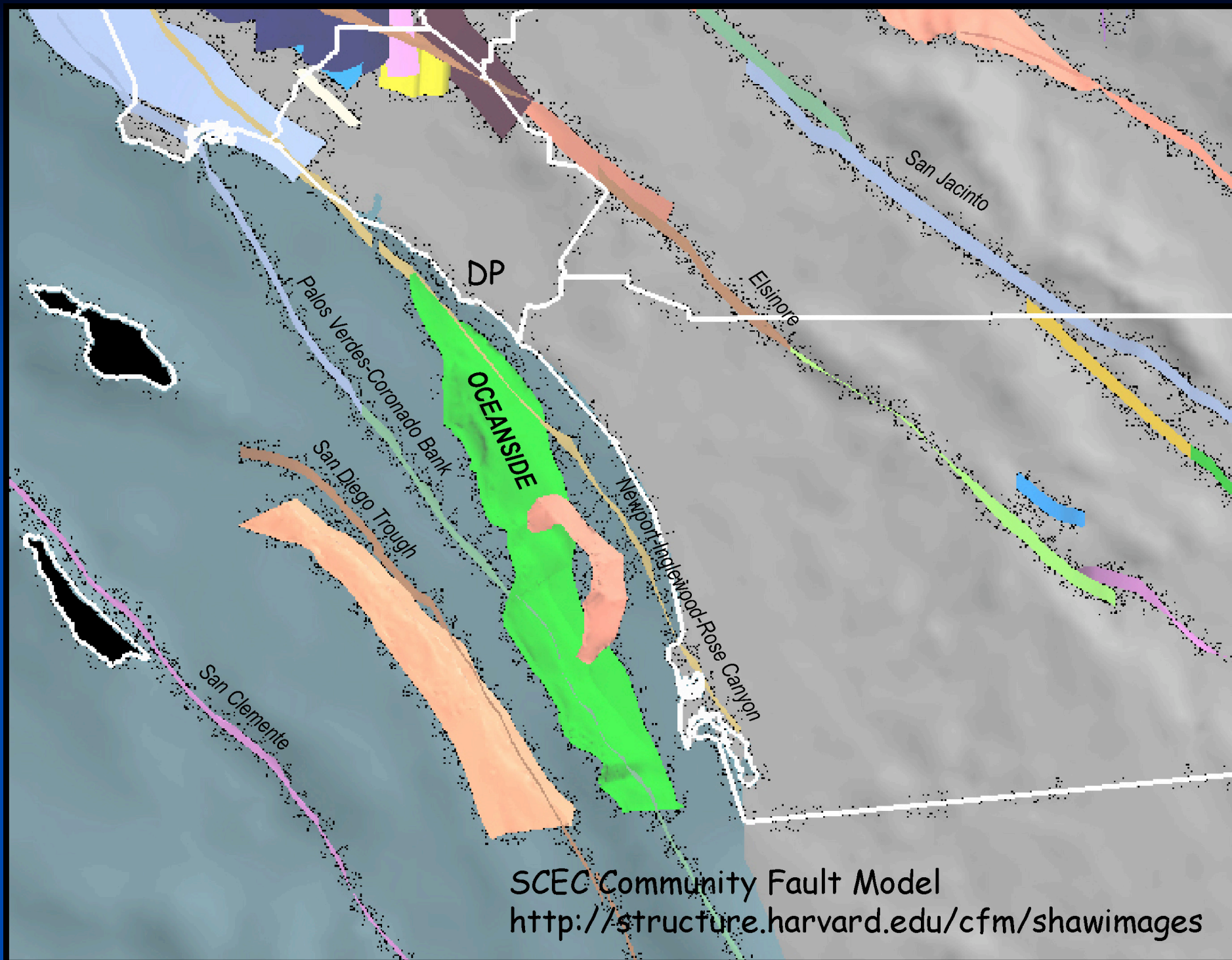


San Mateo thrust

**Oceanside
Inactive in Q
Sorlein et al.
NEHRP report**

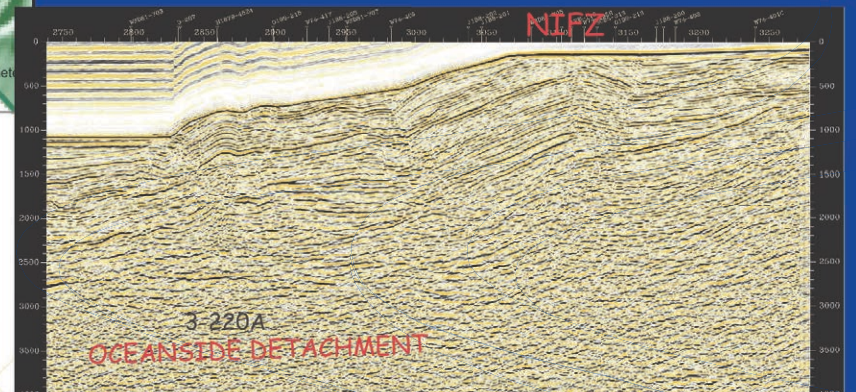
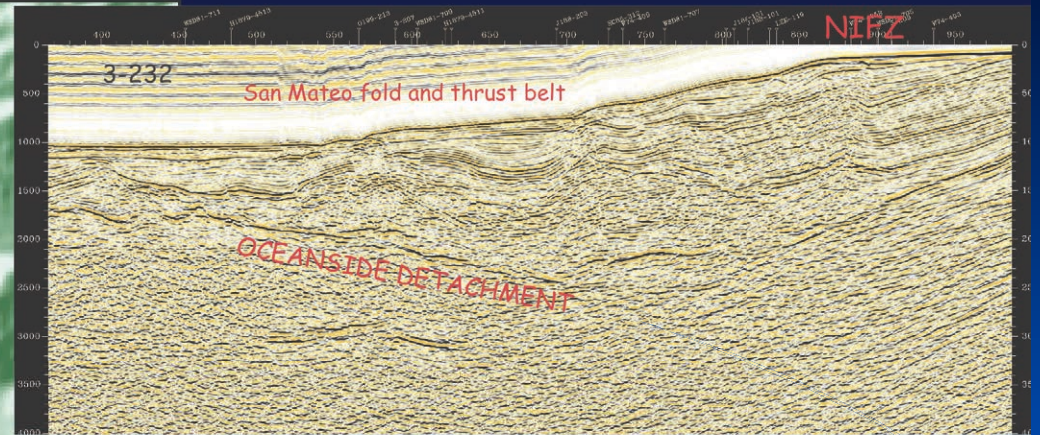
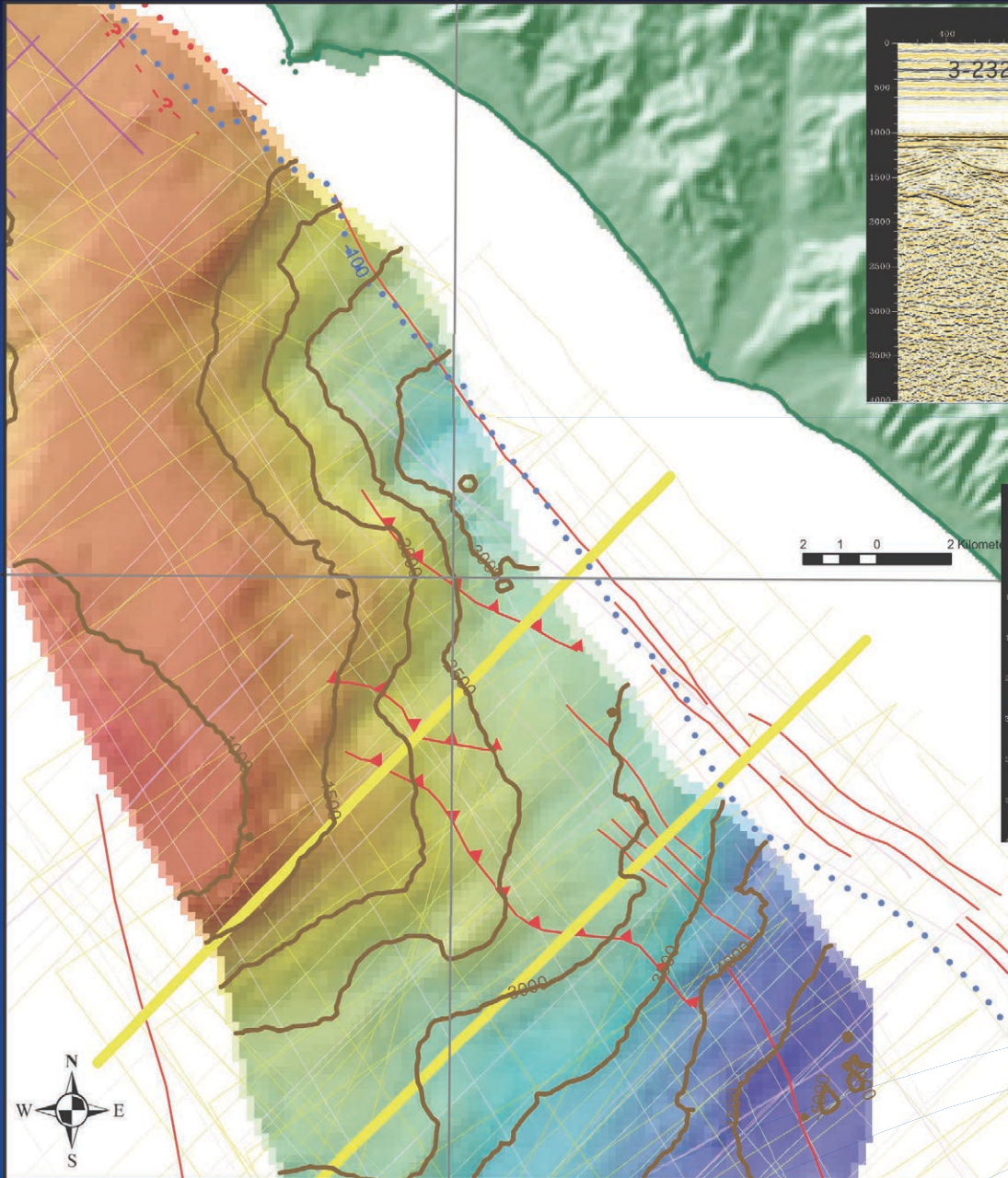
Carlsbad thrust

Rose Canyon

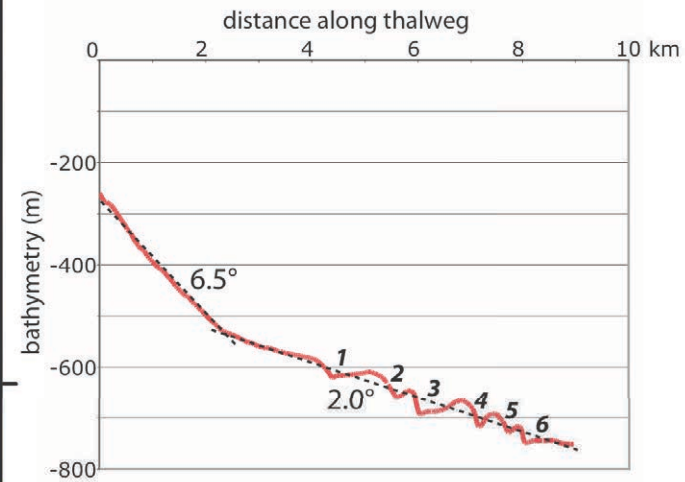


SCEC Community Fault Model
<http://structure.harvard.edu/cfm/shawimages>

OCEANSIDE DETACHMENT, SAN MATEO FOLD AND THRUST BELT

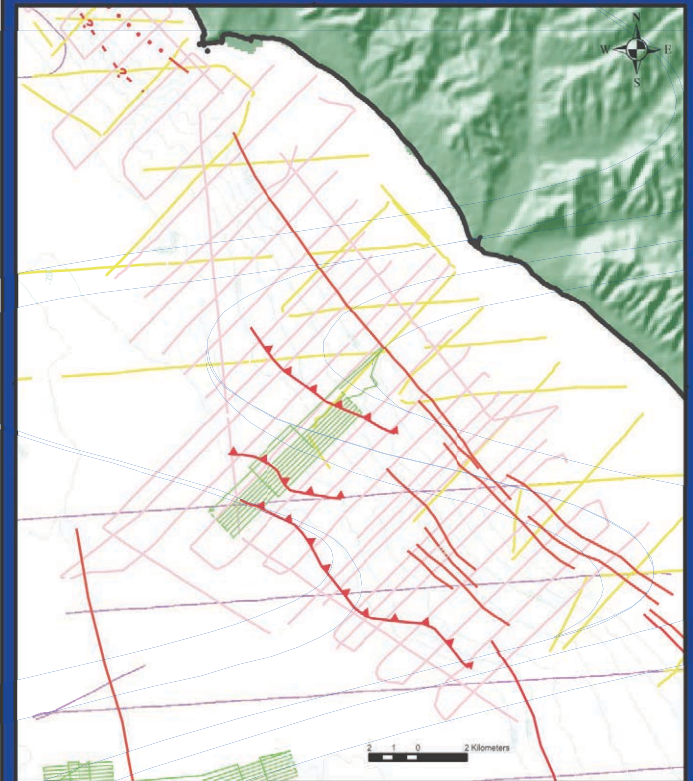
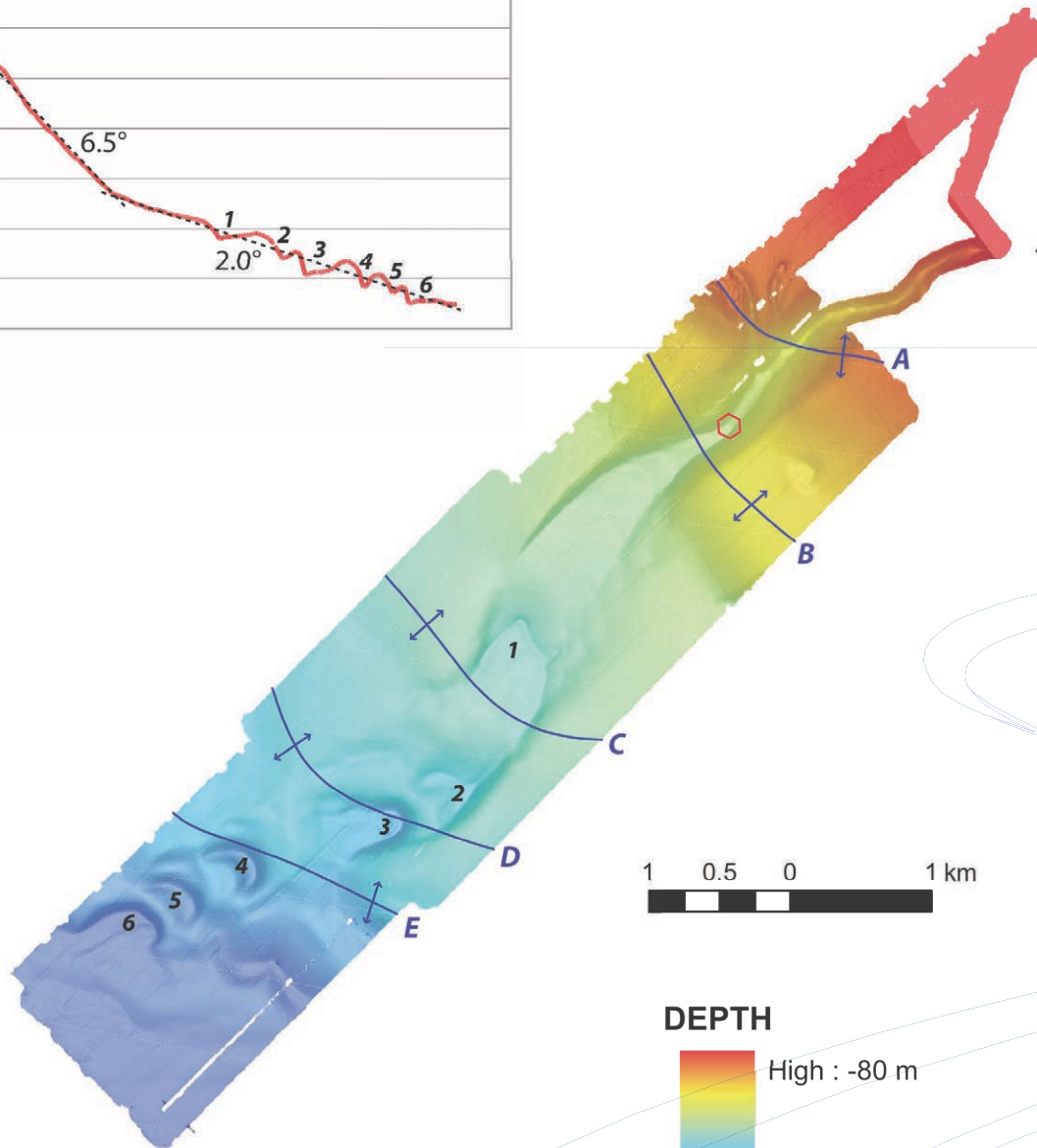


Oceanside detachment mapped from industry MCS data

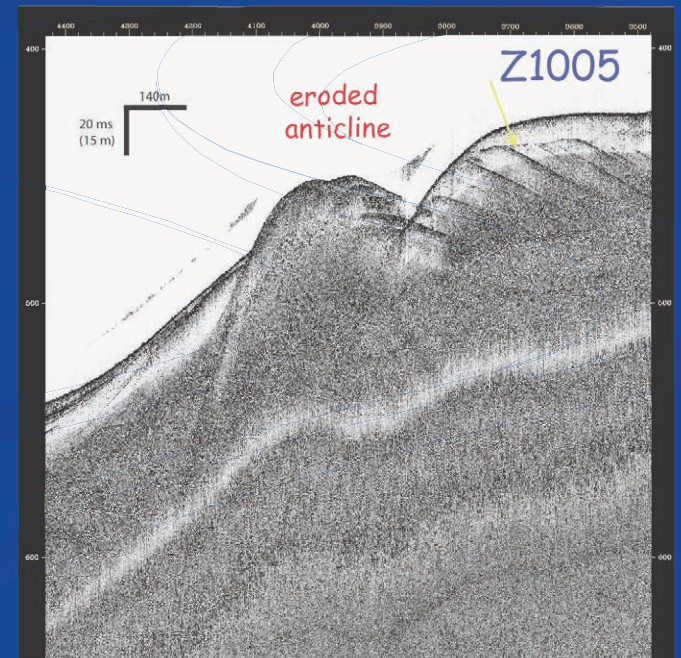
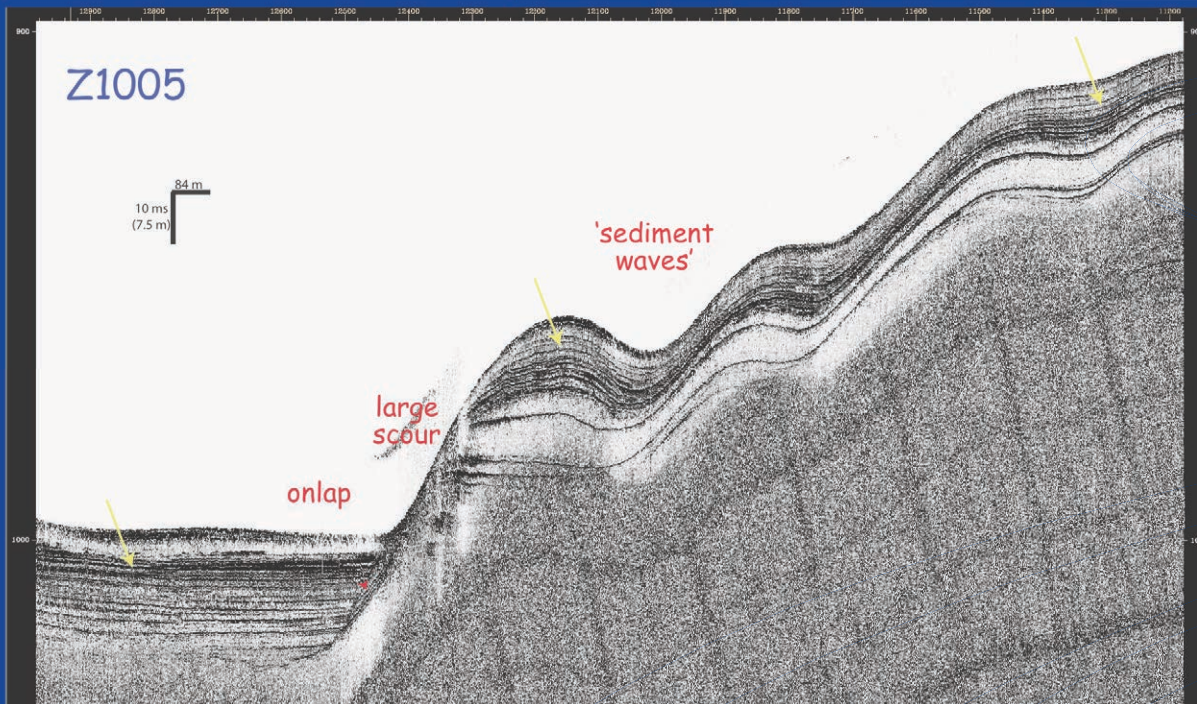
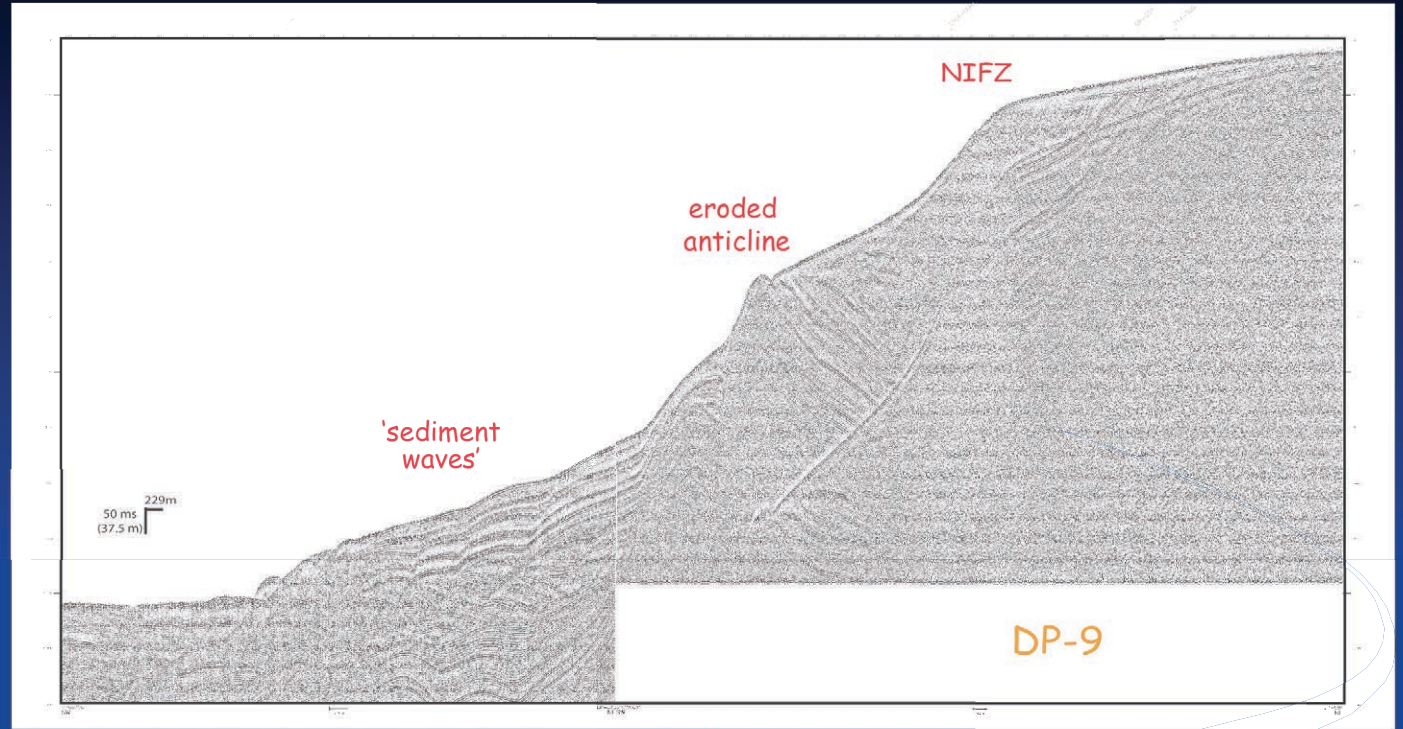


MBARI VERY HIGH RESOLUTION AUV MULTIBEAM AND CHIRP COLLECTED ACROSS SAN MATEO FOLD AND THRUST BELT

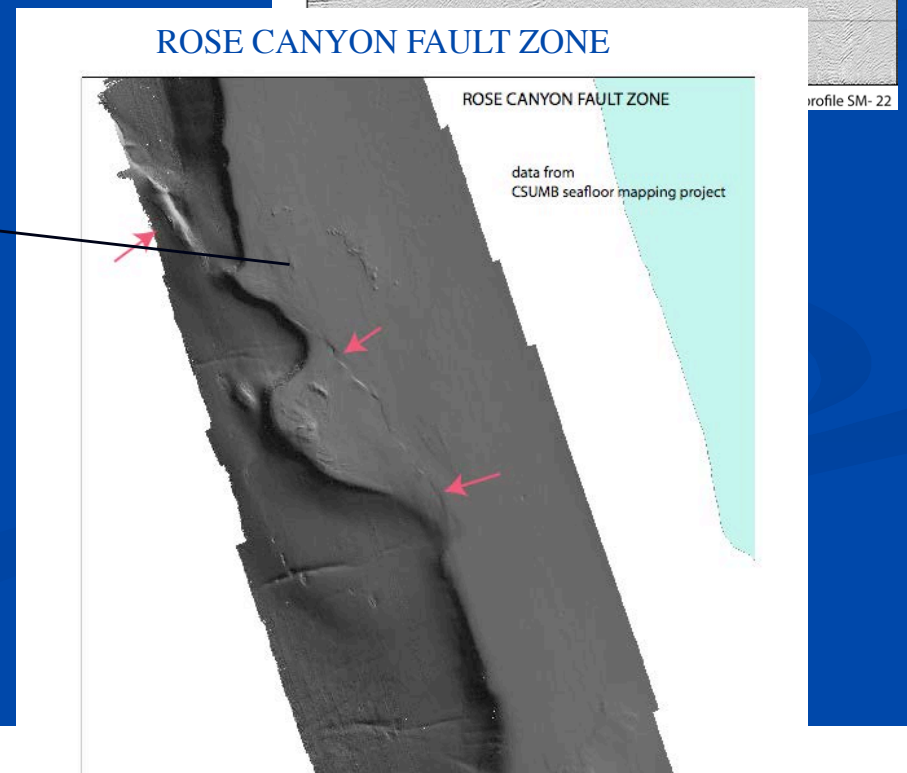
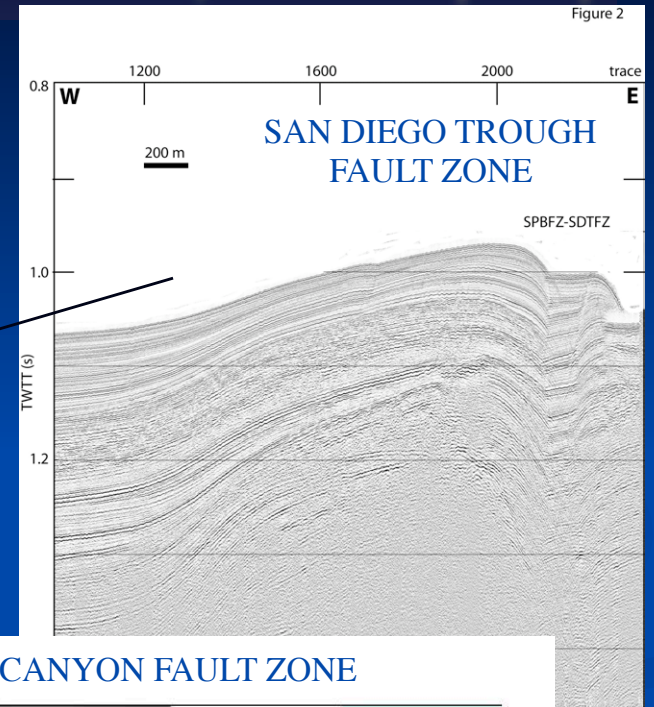
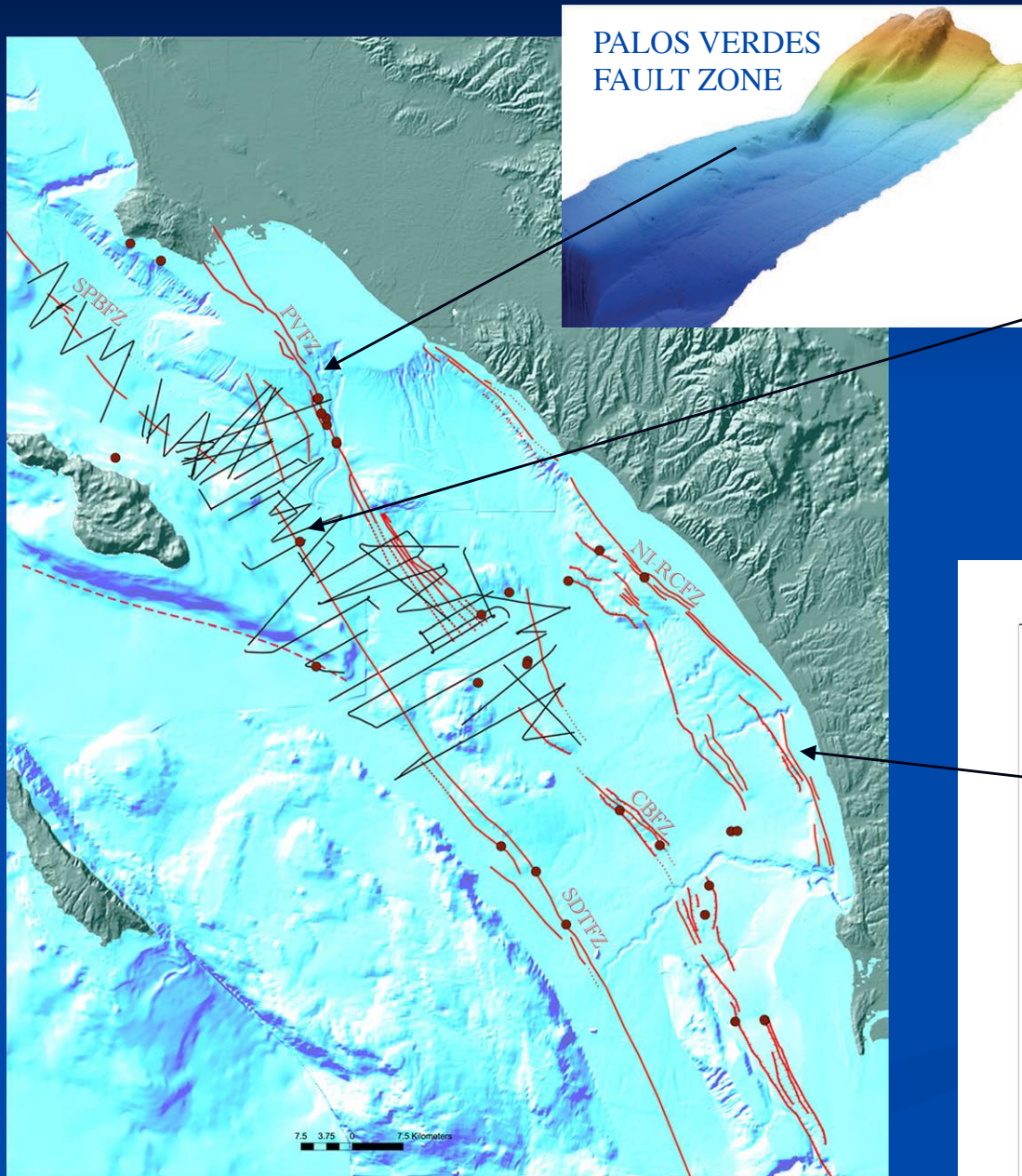
33.33°



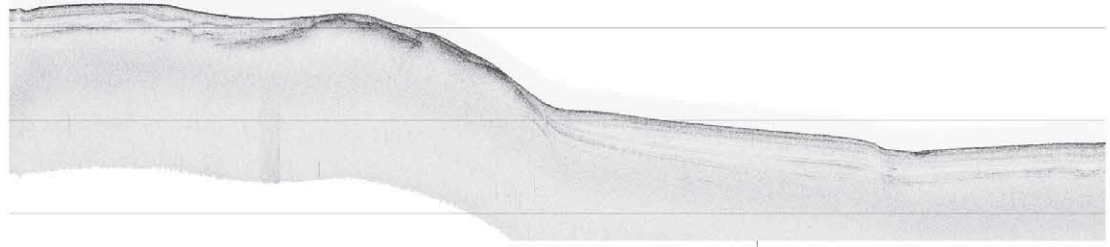
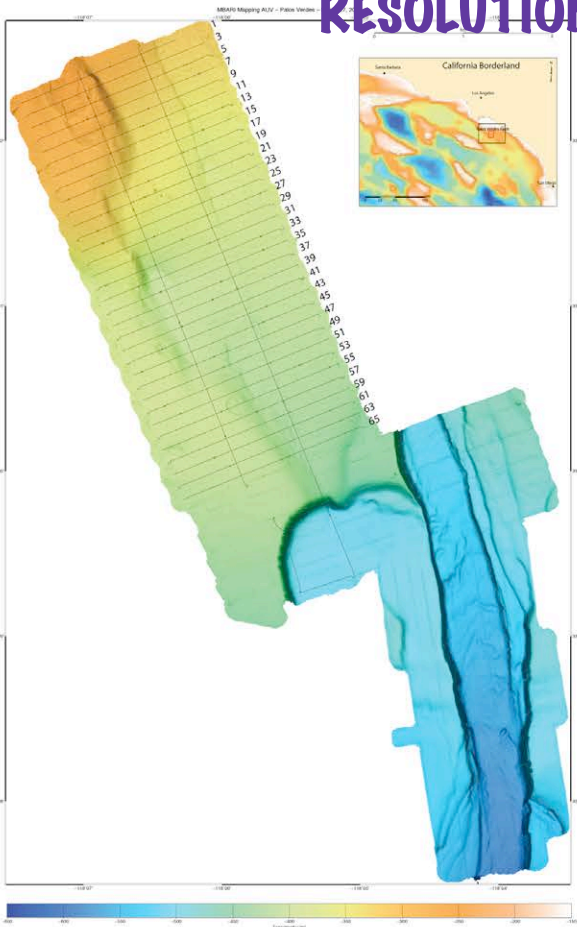
Is the San Mateo
fold and thrust
belt active?



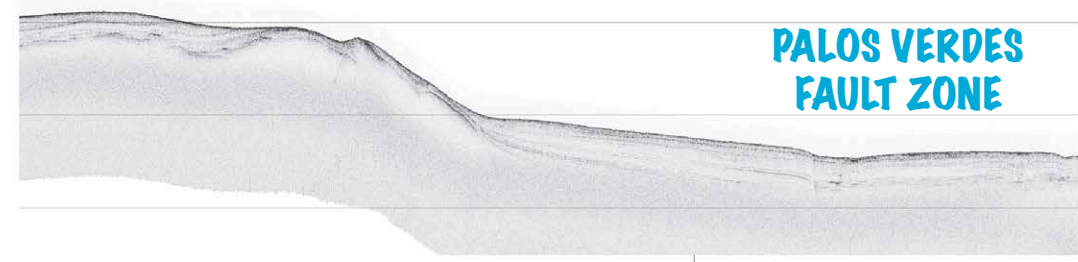
STRIKE-SLIP FAULTS: low slip rates, discontinuous, small dip slip



MARINE PALEOSEISMOLOGY: DETERMINING SLIP RATES FROM VERY HIGH RESOLUTION SEISMICS AND CORES



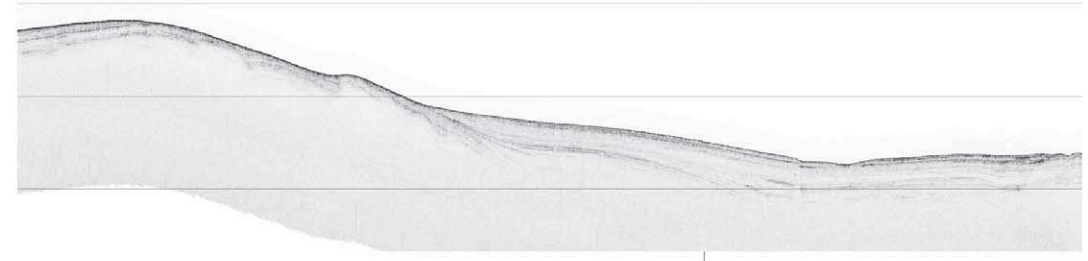
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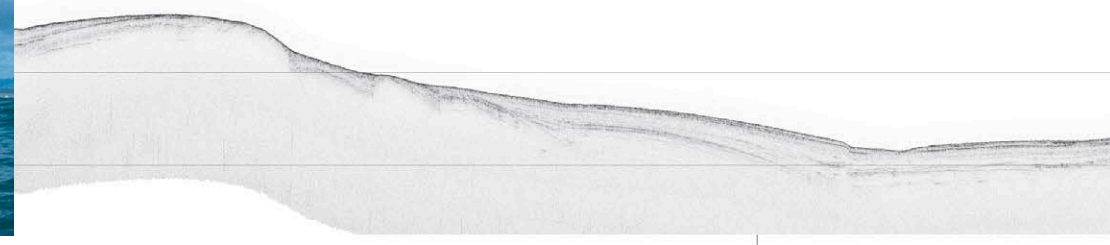
13



15



17



19



Todd Walsh (c) 2004 MBARI

The Palos Verdes fault does not continue to the south to connect up with the Coronado Bank fault zone

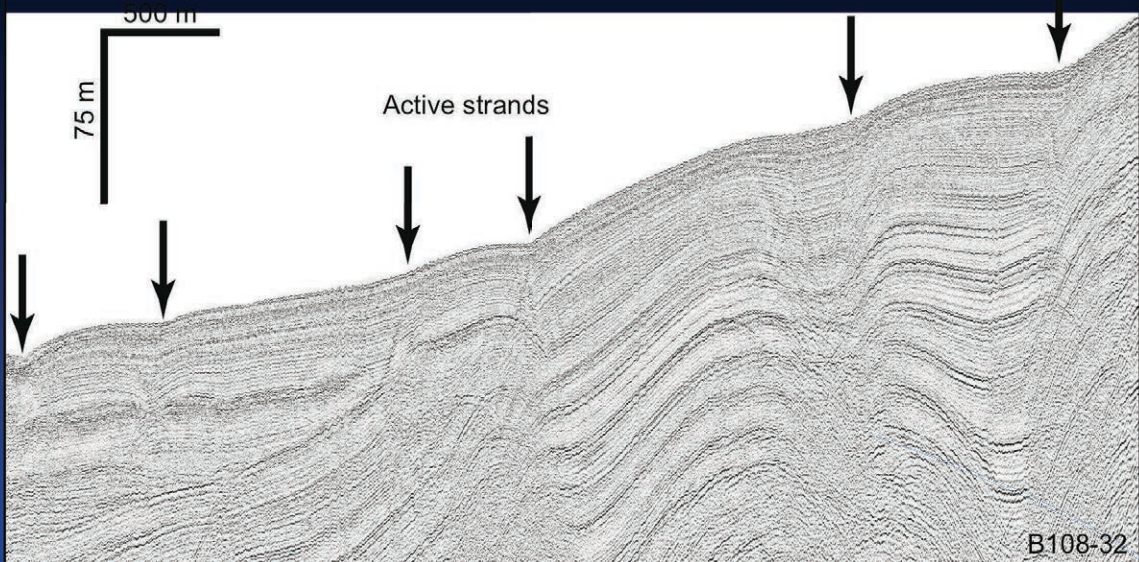


Figure 2. About 10 km south of Lasuen Knoll (Fig. 1), the Palos Verdes Fault consists of several strands in a zone about 5 km wide. Some of these strands appear active, with clear evidence of sea floor offset.

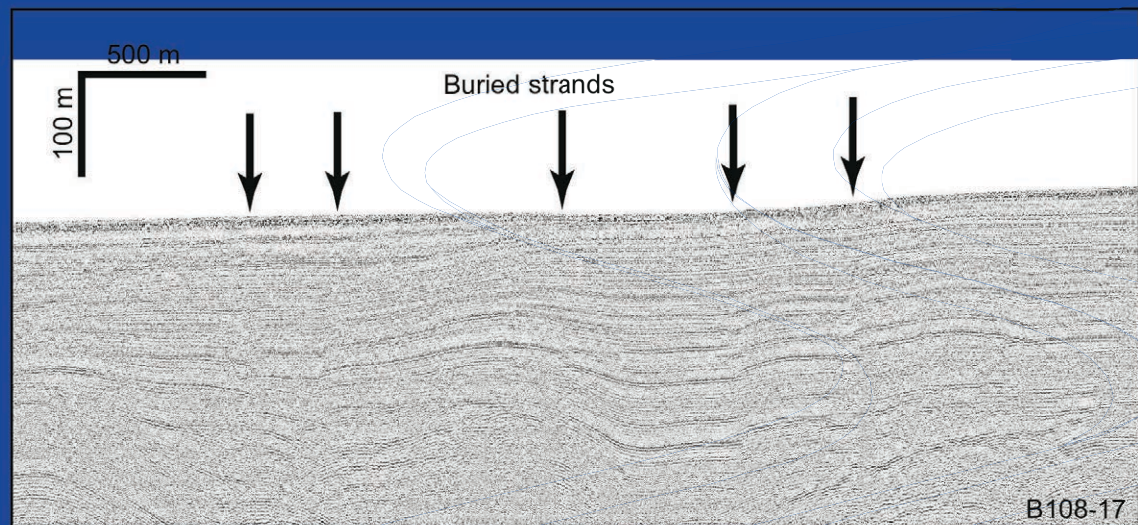
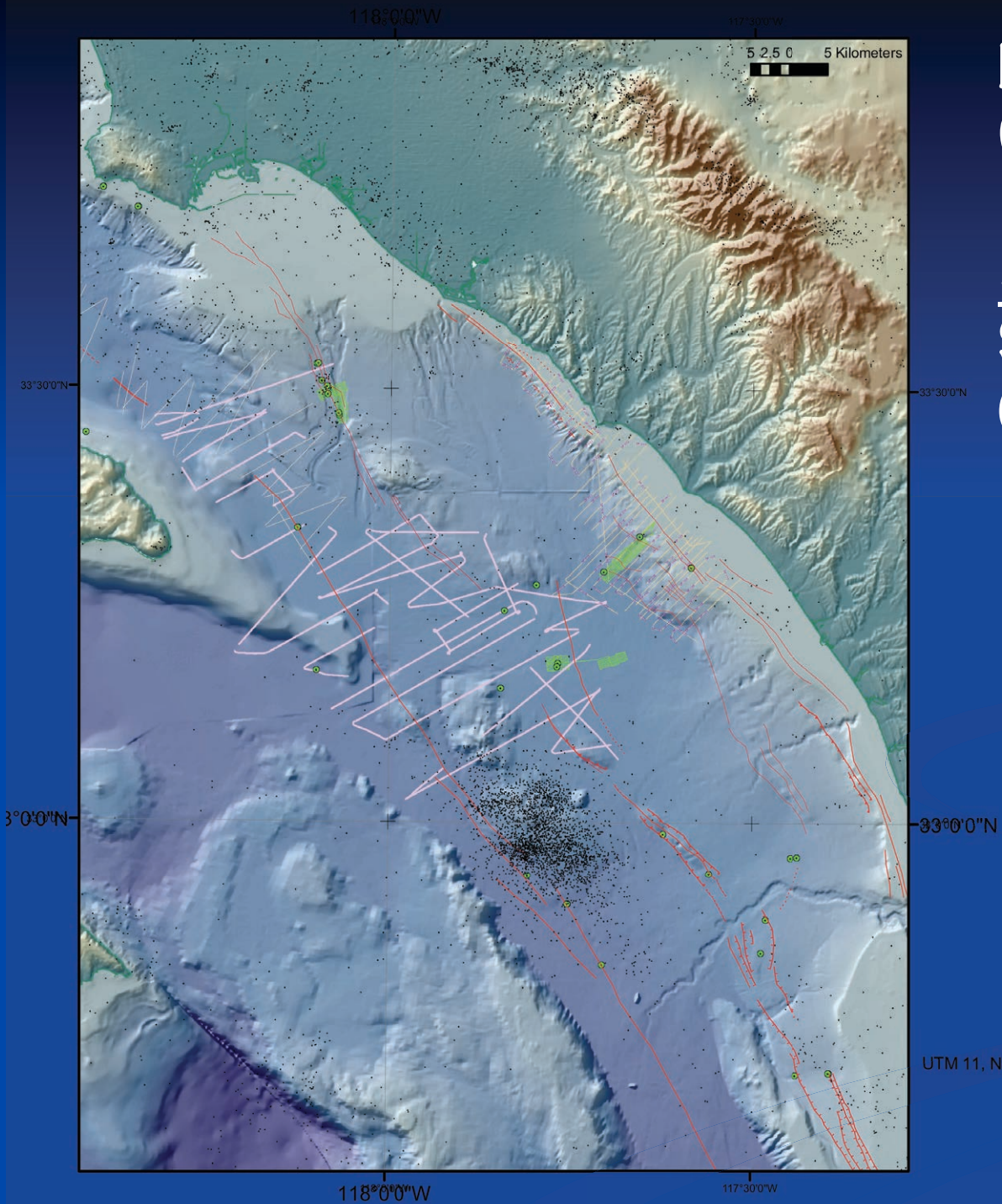


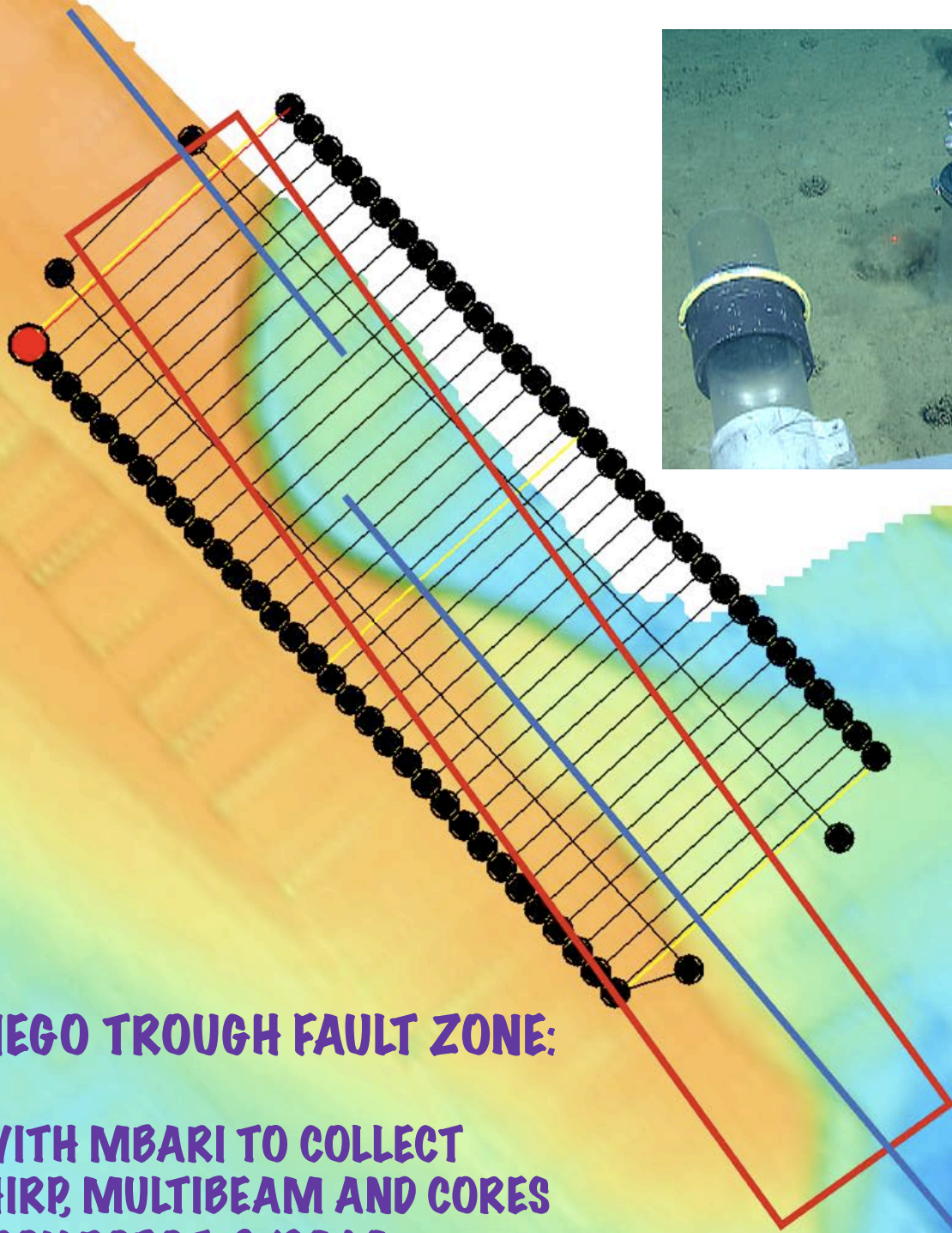
Figure 3. About 15 km to the south along strike, however, strands of the Palos Verdes Fault Zone are buried under 50-75 m of unfaulted sediment (Fig. 3). South of here, the Palos Verdes Fault is not imaged at all in the seismic data. If present, it is buried under at least 100-150 m of undeformed sediment.



NEW FAULT STUDIES (Cat Haz Proj, MHDP):

San Diego Trough
San Pedro Basin
Catalina
30mile bank

Very high-resolution chirp and mini-sparker reflection profiles plus gravity cores (< 2m) collected by USGS and MBARI from 2006-2010.



SAN DIEGO TROUGH FAULT ZONE:

**COOP WITH MBARI TO COLLECT
AUV CHIRP, MULTIBEAM AND CORES
USING ROV ROBOT, 8/2010**

San Diego Trough fault does not bend to left to connect to the Catalina fault on the south side of Catalina Island

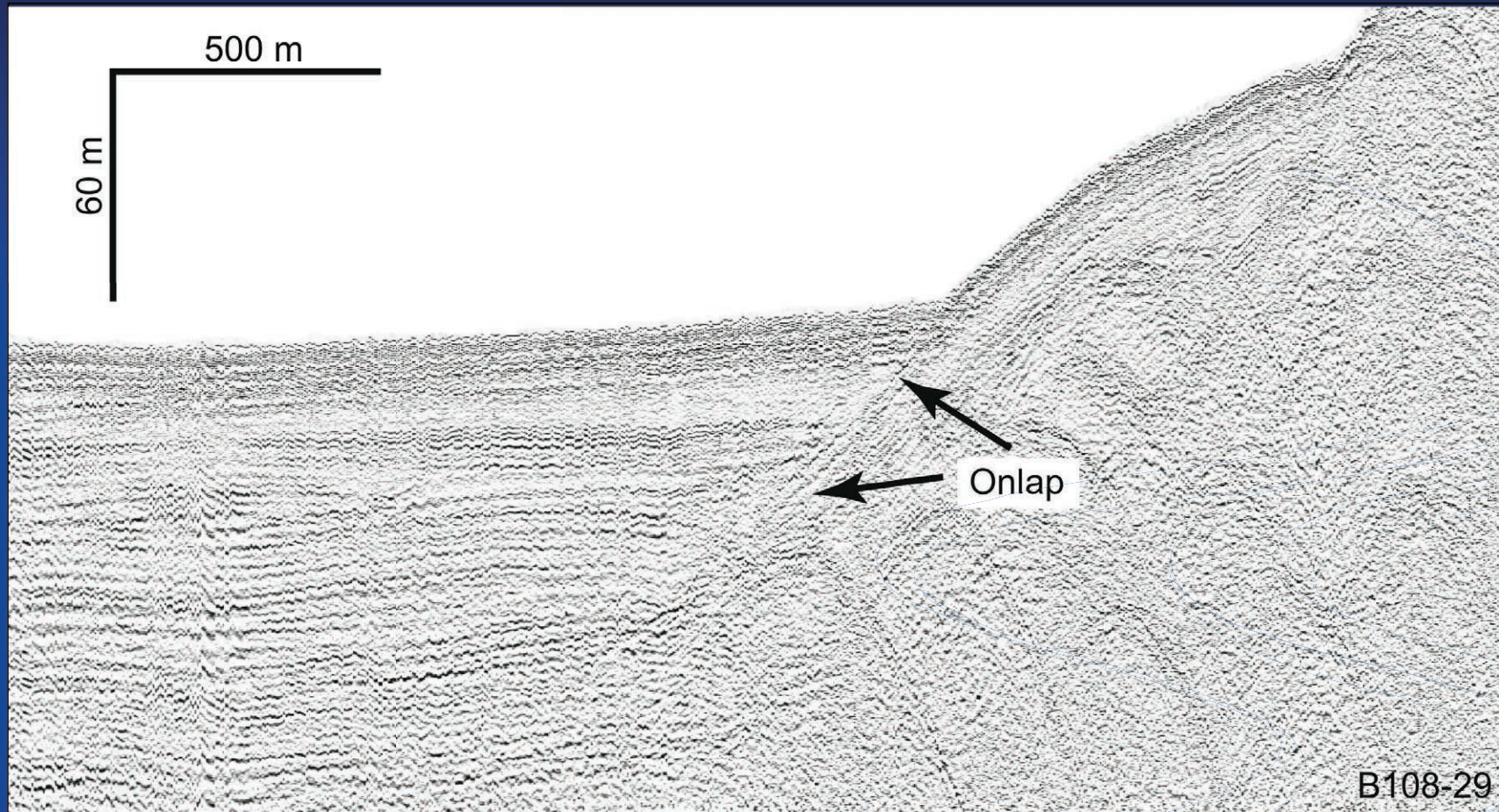


Figure 5. On the south side of Santa Catalina Island, unfaulted basin sediments (arrows) onlap the Catalina escarpment showing no evidence of recent fault offset on the Catalina fault.



SAN ANDREAS FAULT

NORTHERN CALIFORNIA OFFSHORE FAULT STUDIES

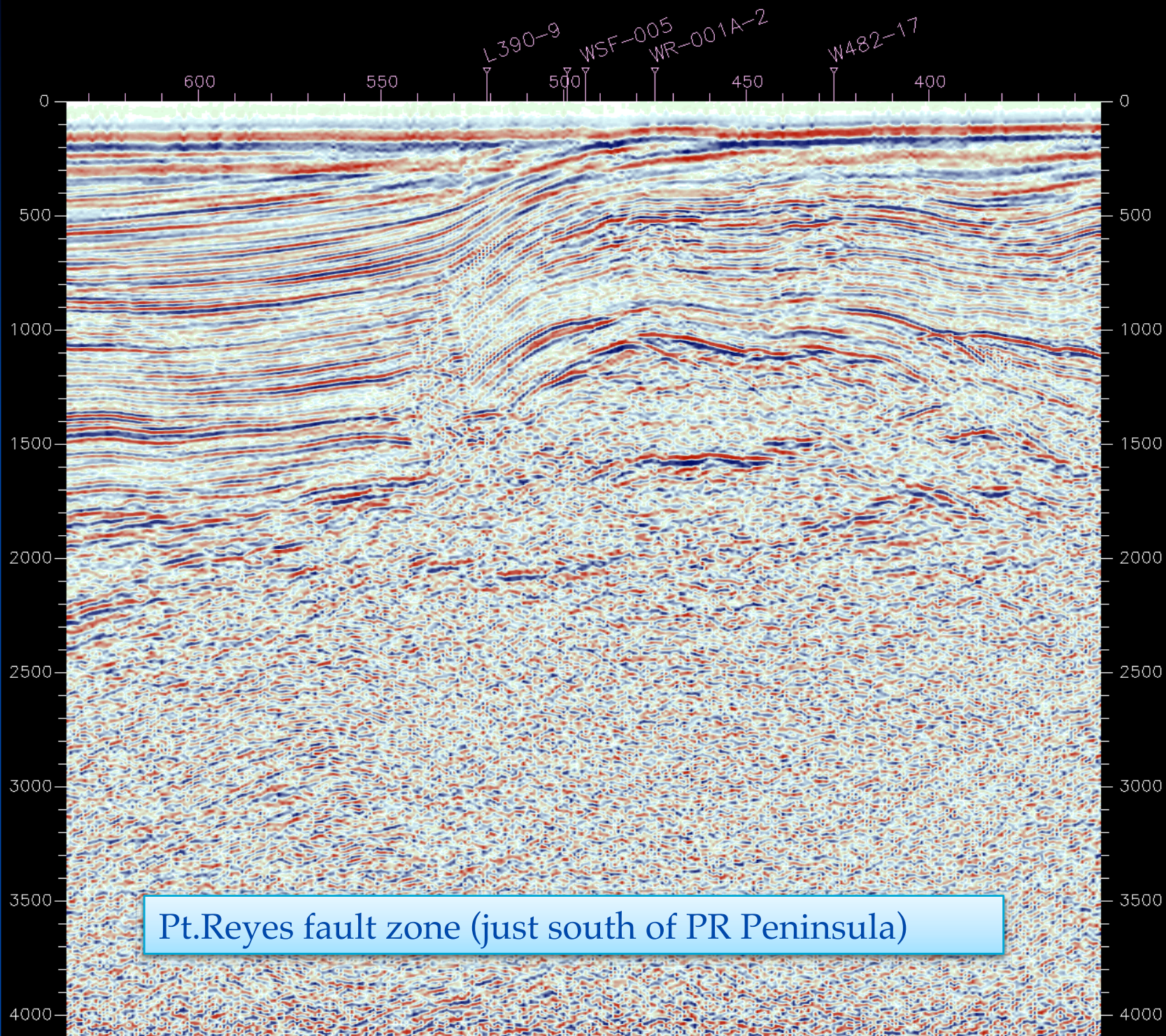
POINT REYES FAULT

SAN ANDREAS FAULT

2010 FAULT ACTIVITY MAP STATE OF CALIFORNIA

California Geological Survey

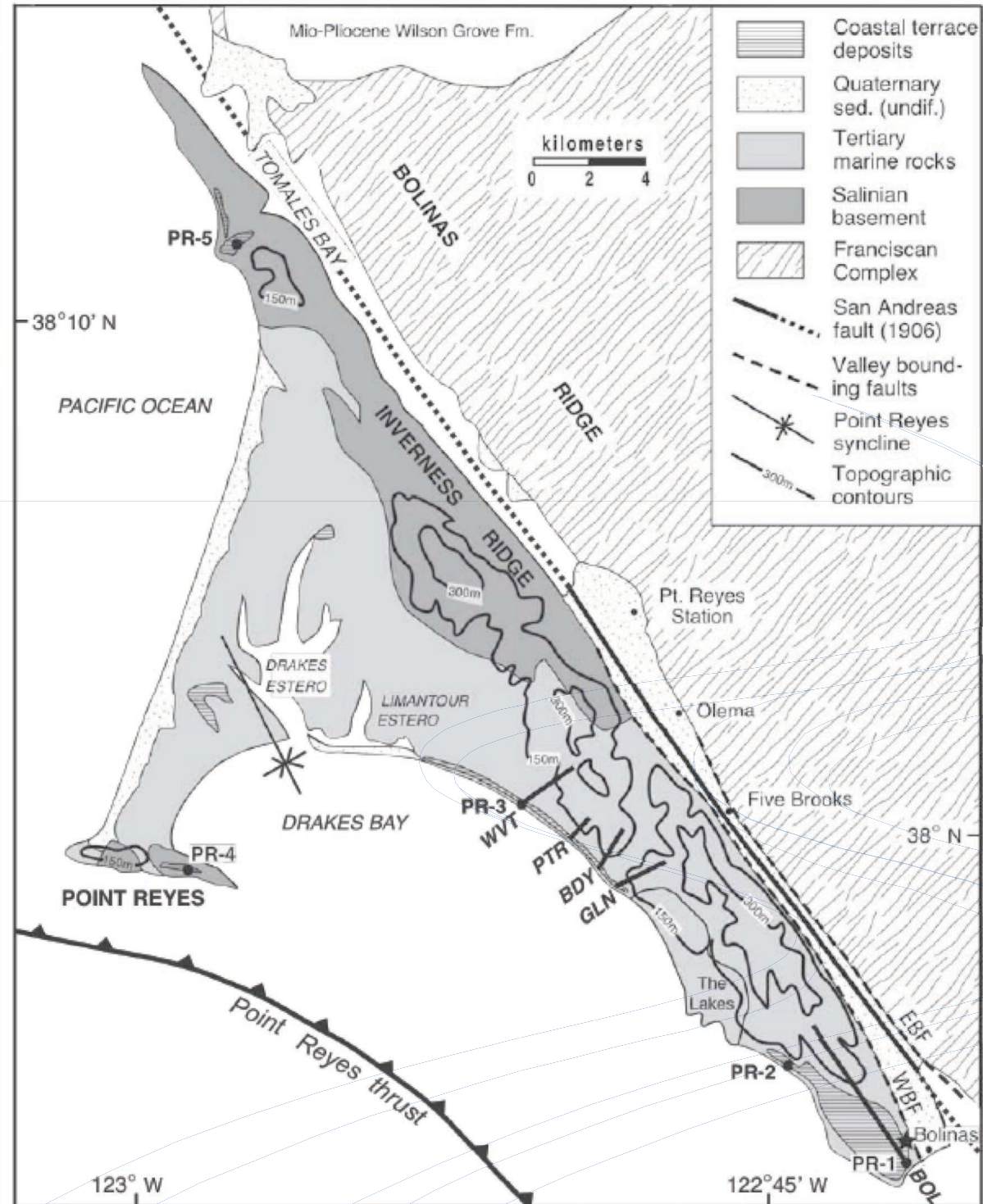
reverse faults



Pt. Reyes fault zone (just south of PR Peninsula)

Karen Grove and
students at SFSU

Quaternary history of Point Reyes Fault zone





High resolution mini-sparker reflection data acquired by the USGS in 9/2009 as part of the California state waters mapping project

The background of the slide is a reproduction of the famous Japanese woodblock print 'The Great Wave off Kanagawa' by Katsushika Hokusai. It depicts a massive, curling blue wave with white foam, about to crash over three small yellow boats. The sky is a pale, hazy blue.

CONCLUSIONS

USGS CMG OFFSHORE STUDIES:

- 1) More accurate mapping of fault traces using both industry and high res data
- 2) Dating most recent fault offset
- 3) ****Slip rates on offshore faults****
- 4) Recurrence intervals (may have a chance for dip-slip faults with progressive tilting)
- 5) What next?





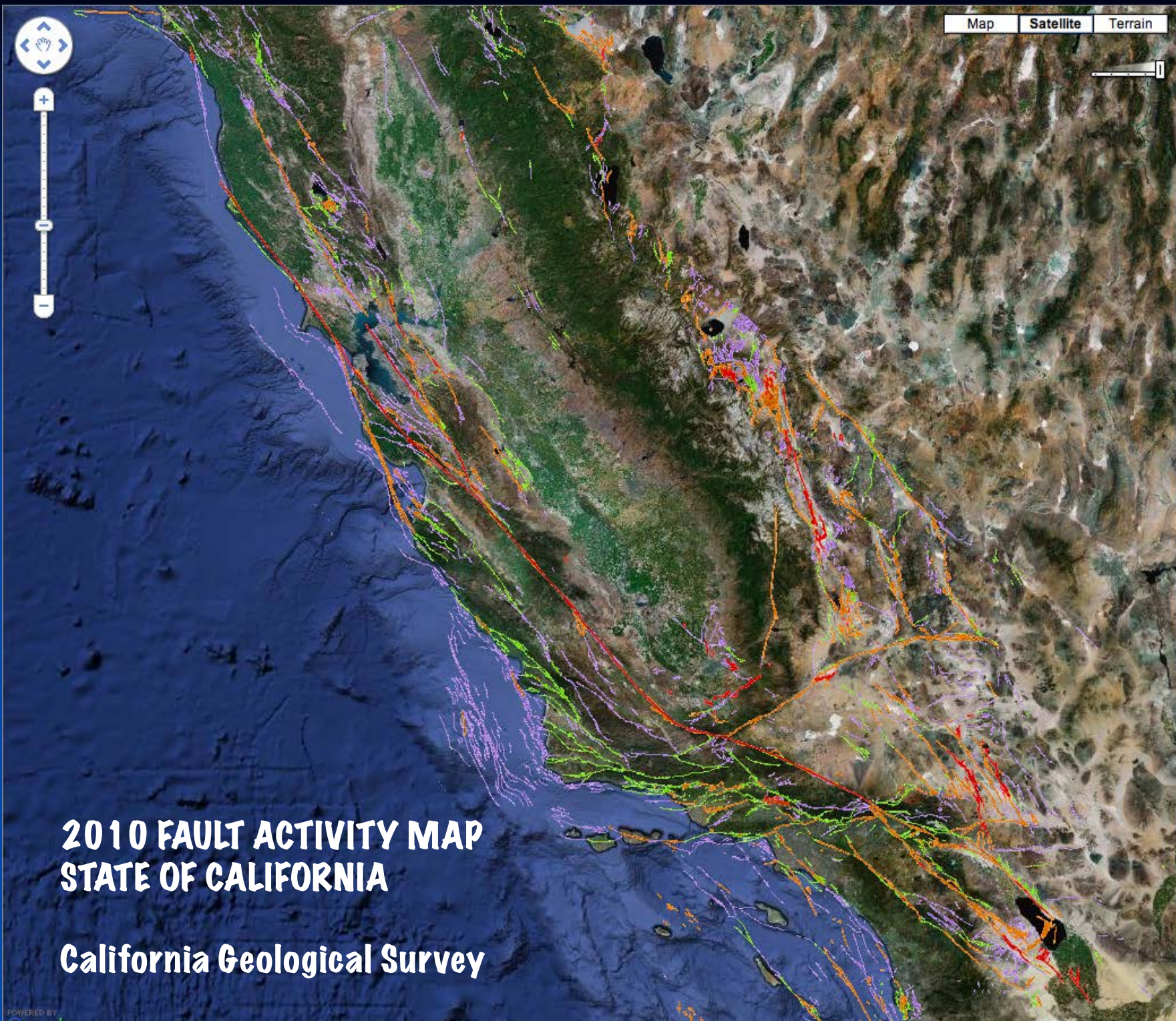
Tsunami Source Workshop: July 19 and 20, 2010

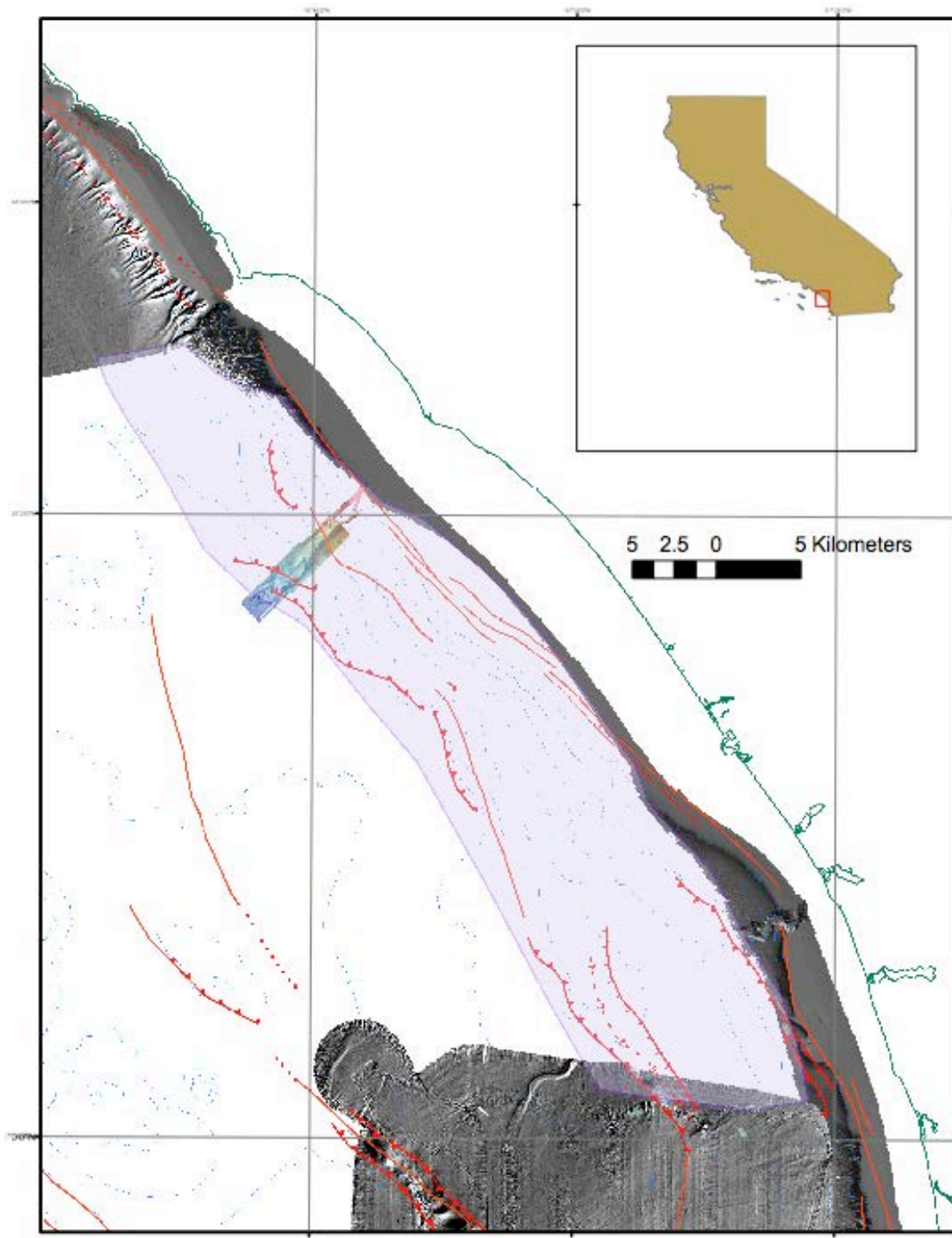
To celebrate the fifth anniversary of the USGS Tsunami Source Working Group, a tsunami source workshop will be held in the big Conference Room of Building 3, USGS, Menlo Park on July 19 and 20, 2010.



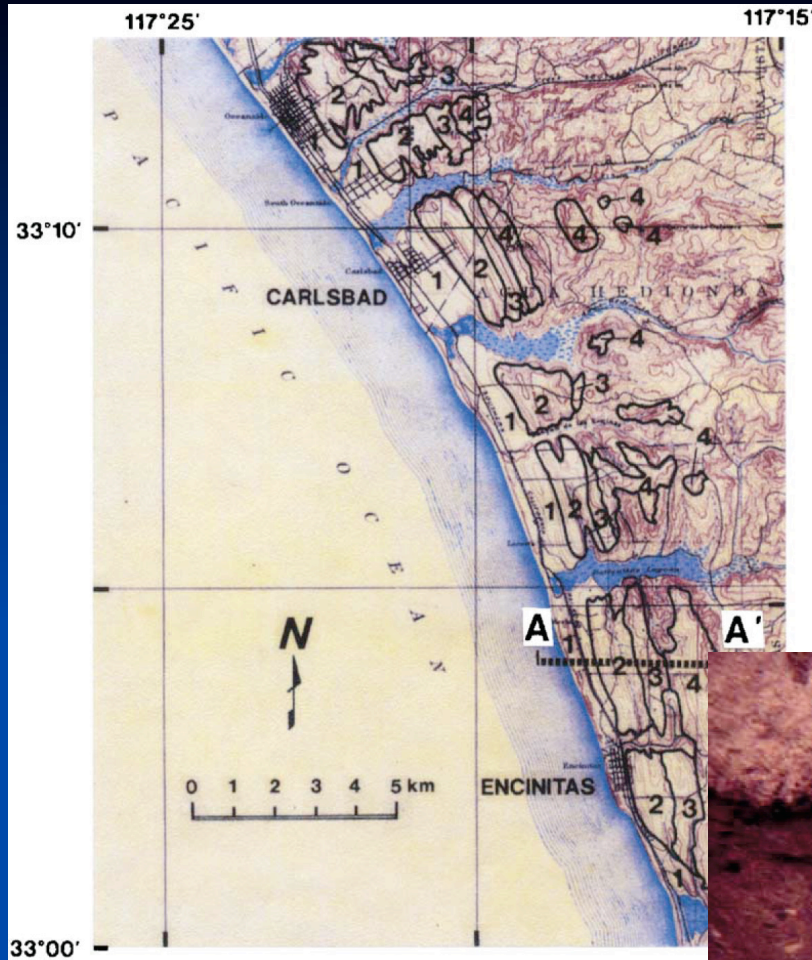
2010 FAULT ACTIVITY MAP STATE OF CALIFORNIA

California Geological Survey





Swath multibeam
bathymetry off of
north/central
San Diego County



KUHN, 2005 interpretation of paleo-tsunami deposits near Encinitas (onshore from Carlsbad mid-slope anticline).

