

# **Independent Peer Review Panel**

## **Evaluation of Proposed Seismic Hazard Studies at Diablo Canyon and San Onofre**

California Energy Commission

**DOCKETED**

**13-IEP-1J**

TN 71299

JUN 19 2013

- Assembly Bill (AB) 1632 (Blakeslee, 2006) directed the California Energy Commission (CEC) to assess the potential vulnerability of California's largest baseload power plants to a major disruption due to a major seismic event and other issues.

- The CEC AB1632 report (2008) recommended that PG&E/SCE should use three-dimensional geophysical seismic reflection mapping and other techniques to reduce uncertainty in seismic hazards at the plants

- This action will supplement PG&E's Long Term Seismic Program and help resolve uncertainties surrounding the seismic hazard at Diablo Canyon.

- The research program should prioritize and include further investigations into the seismic setting at SONGS and should assess whether recent or current seismic, geologic, or ground motion research in the vicinity of SONGS has implications for the long-term seismic vulnerability of the plant.

- The California Public Utilities Commission has convened its own Independent Peer Review Panel (IPRP). The IPRP is conducting an independent review of PG&E's on-shore and off-shore seismic studies including independently reviewing and commenting on PG&E's study plans and findings. The IPRP's goal is to provide recommendations for studies to further refine our understanding of the potential seismic hazard at Diablo Canyon.

Other efforts that affect this review:

- PG&E Long-Term Seismic Program
- PG&E Diablo Canyon re-licensing through NRC
- NRC request for re-evaluation of all nuclear power plants following Tohoku earthquake: SSHAC level 3 process.
- Development of UCERF-3 by WGCEP.

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**IPRP Report No. 5 *March 25, 2013***

**Slip Rate of the Hosgri Fault: summary of available data  
and comments on ongoing investigations by PG&E for  
Diablo Canyon Power Plant seismic hazard studies**

**IPRP Report No. 4 *September 25, 2012***

**Comments on PG&E's Enhanced Seismic Study Progress  
Presentation for Diablo Canyon Power Plant**

**IPRP Report No. 3 *April 6, 2012***

**Comments on PG&E's Enhanced Seismic Study Plans  
for Diablo Canyon Power Plant**

**IPRP Report No. 2 *September 7, 2011***

**Comments on PG&E's Enhanced Seismic Study Plans  
for Diablo Canyon Power Plant**

**<http://www.cpuc.ca.gov/PUC/energy/nuclear.htm>**

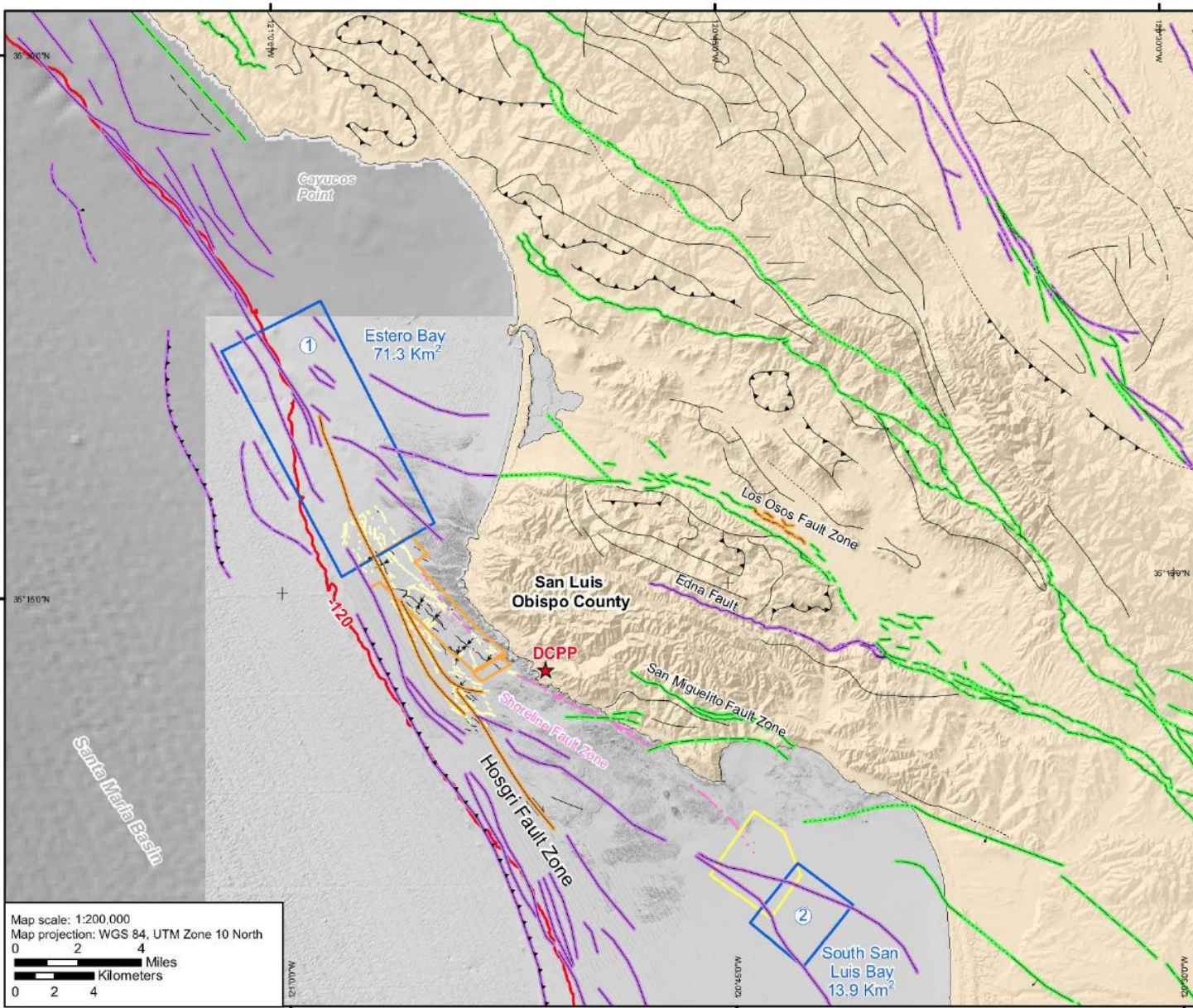
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**At the July 26, 2011 Independent Peer Review Panel (IPRP) review meeting, there was a request from the IPRP for PG&E to provide a summary of the main targets of the planned and ongoing geophysical surveys along with hazard sensitivity to help the IPRP understand the objectives of the studies and the potential impacts on the hazard estimates.**

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**LEGEND**

- ★ Diablo Canyon Power Plant (DCPP)
- 120 Meter Isobath (Pre-Holocene 15-20 Ka Low Sea Level Stand)

**Survey Areas**

- 2010/2011 High-Resolution 3D Survey Areas (Point Buchon)
- December 2011 High-Resolution 3D Survey Area (San Luis Bay)
- Possible 2012-2013 Survey Areas

**Shoreline Fault Zone**

Fault, dashed where approximate, dotted where concealed (January 2011 Shoreline Fault Report)

**Interpreted Faults**

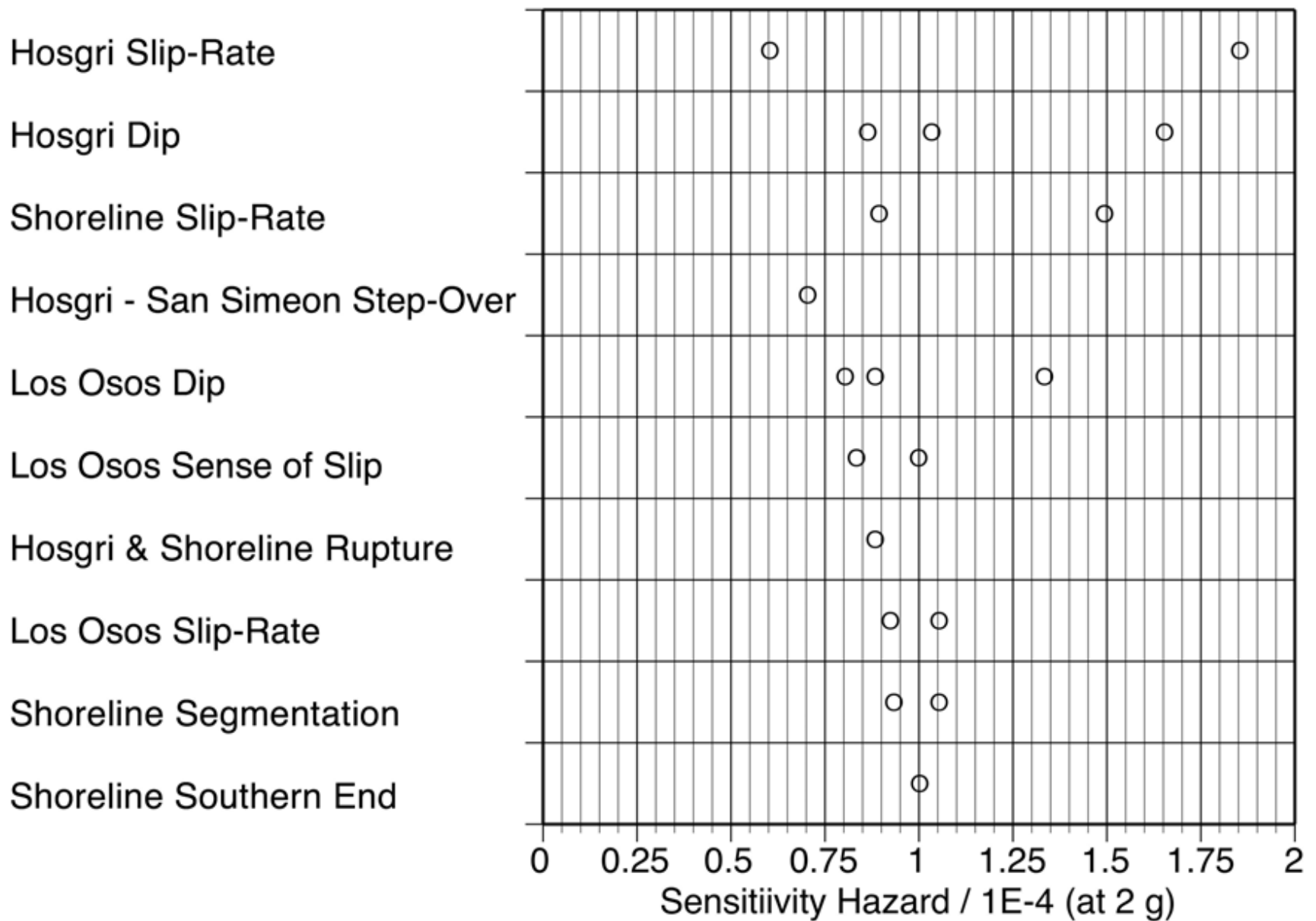
Faults interpreted on high-res 2D and 3D 2010-2011 PG&E data offshore Pt. Buchon by PG&E's interpretation team (Gary, Hans, Michael)

**Faults (Jennings & Bryant, 2010)**

- fault, certain
- fault, approx. located
- fault, concealed
- thrust fault, certain
- thrust fault, approx. located (2)
- dextral fault, certain
- fault, solid, barball
- Historical
- Holocene
- Late Quaternary
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**2010-2011 3D High-Resolution Survey Areas**

Map scale: 1:200,000  
 Map projection: WGS 84, UTM Zone 10 North  
 0 2 4 Miles  
 0 2 4 Kilometers

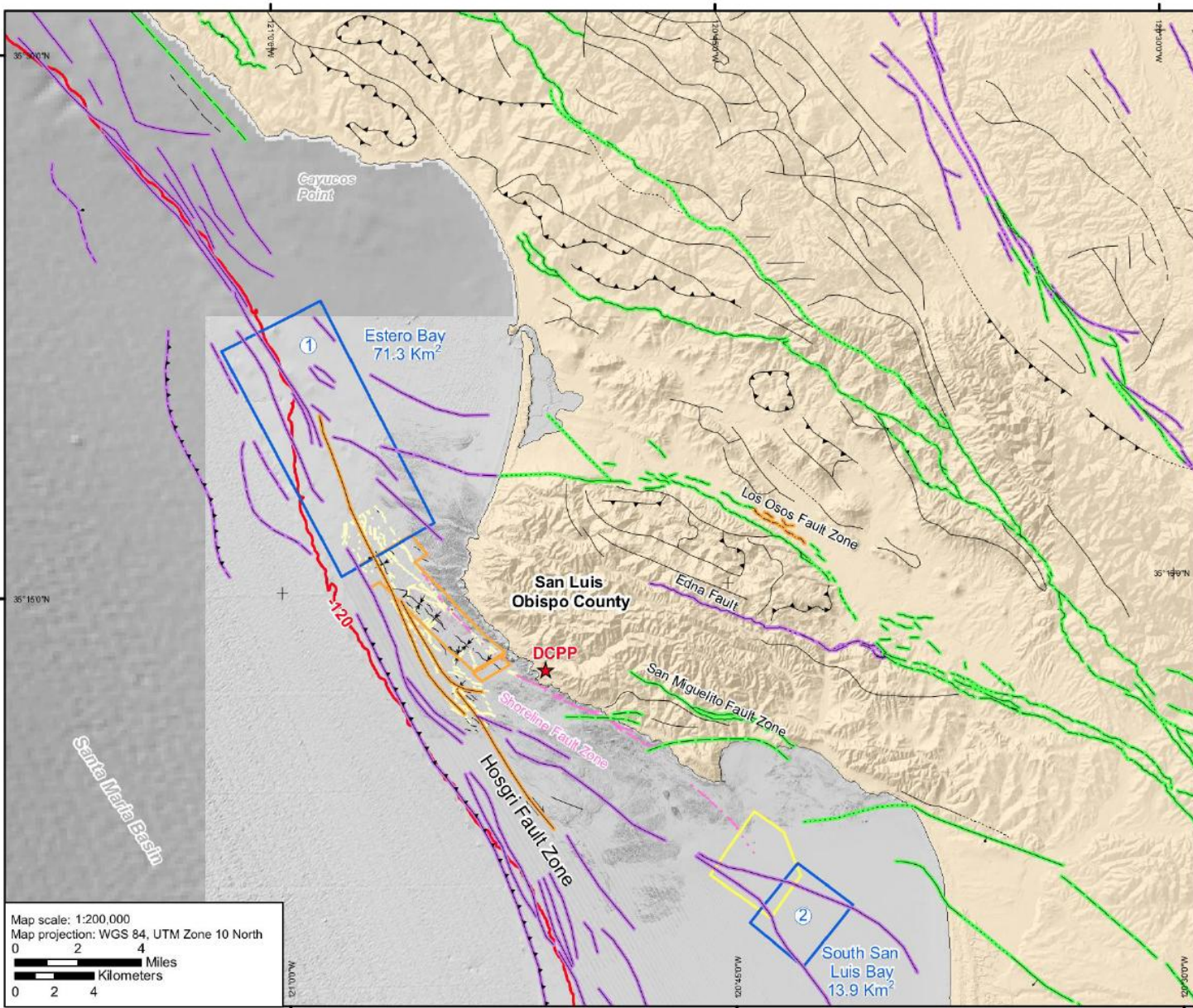


<b>Object of study</b>	<b>PG&amp;E Study Plans</b>	<b>IPRP Evaluation of PG&amp;E Study Plans</b>	<b>Priority/Status</b>
<b>Hosgri Fault Slip Rate</b>	Low Energy 3-D Seismic Survey	The IPRP recommends further studies to decrease the uncertainty in the seismic hazard at Diablo Canyon by better constraining the slip rate on the Hosgri Fault.	High/ Recommended
<b>Shoreline Fault Slip Rate</b>	Low Energy 3-D Seismic Survey	The IPRP recommends further studies to decrease the uncertainty in the seismic hazard at Diablo Canyon by better constraining the slip rate on the Shoreline Fault.	High/ More Recommended
<b>Southeast End of Shoreline Fault</b>	Low Energy 3-D Seismic Survey	This type of study has as good a chance as currently feasible of providing data on the orientation and continuity of the southeast end of the Shoreline Fault. The IPRP recommends that a secondary focus of these studies should be to constrain any potential connections to faults on-shore.	Moderate/ More Recommended

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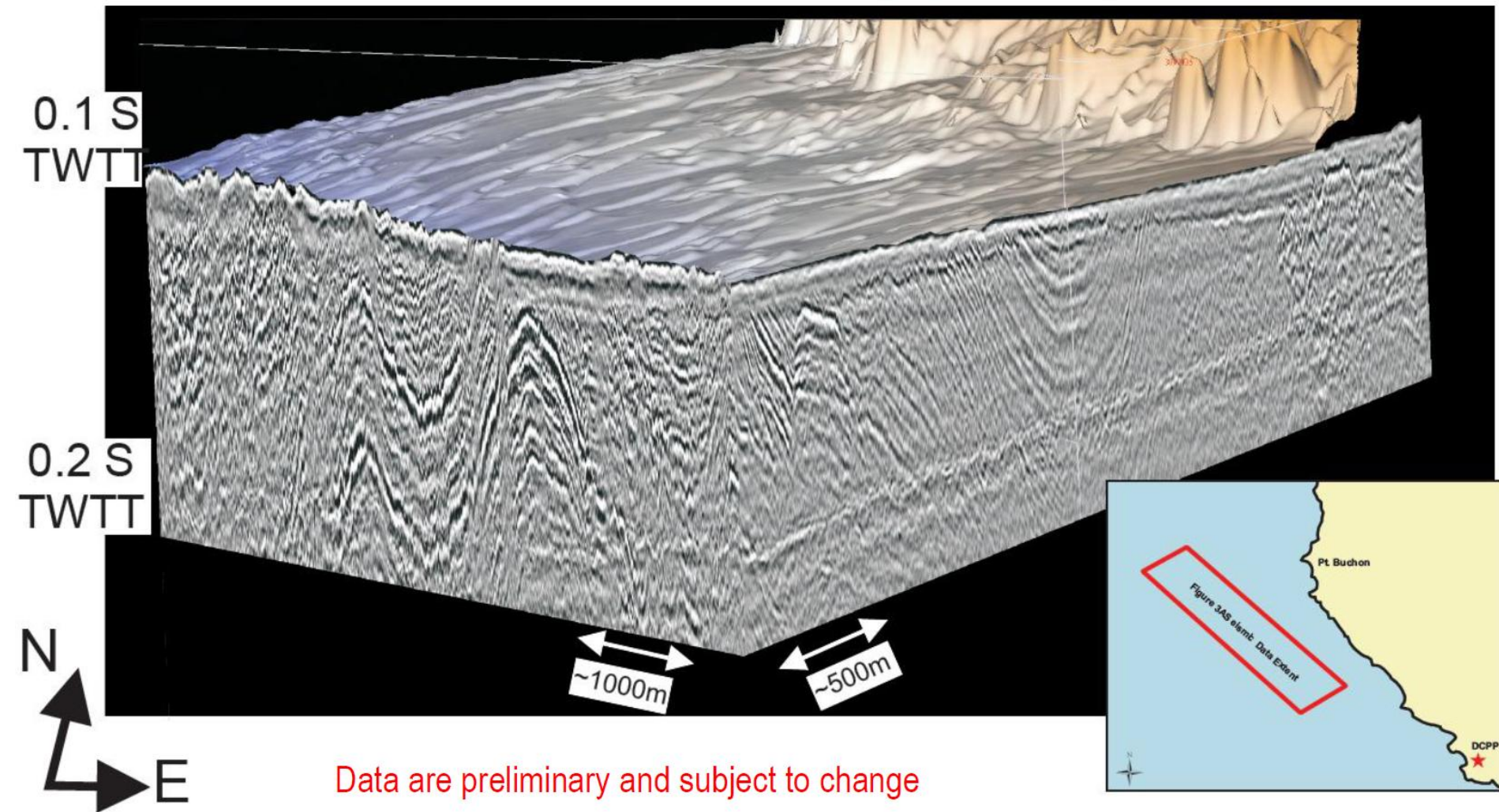
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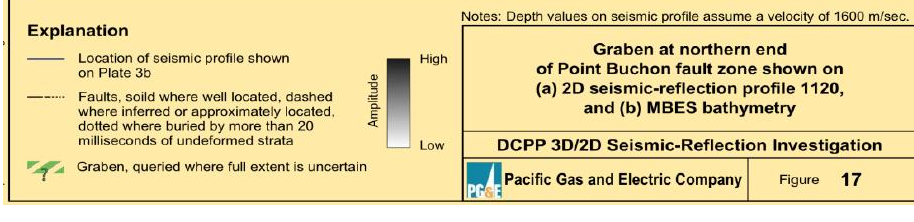
# 3D Block Diagram SW Point Buchon



Data are preliminary and subject to change

Source: Nishenko et al., Sea Technology, June 2012





Object of study	PG&E Study Plans	IPRP Evaluation of PG&E Study Plans	Priority/Status
<b>Los Osos Fault Dip</b>	High Energy on-land 2-D Seismic Survey	The current plans for on-land seismic surveys appear to be adequate to image reverse faults beneath the hills. The IPRP will be interested in reviewing the results that show the Los Osos Fault, but also any other geologic structure or structures beneath the hills.	High/ Awaiting results of surveys in 2011
<b>Los Osos Sense of Slip</b>  <b>Los Osos Slip Rate</b>	High Energy on-land 2-D Seismic Survey	The IPRP believes that a broader goal of the on-land seismic surveys should be for PG&E to develop a tectonic model of the Irish Hills that includes defining the locations and slip rates on all faults beneath the hills that can be checked against rates of uplift and surface deformation.	High/ Awaiting results of surveys in 2011

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# 2011 Vibroseis and Node Coverage

Blue: Vibroseis and Receiver coverage  
Red: Receiver only

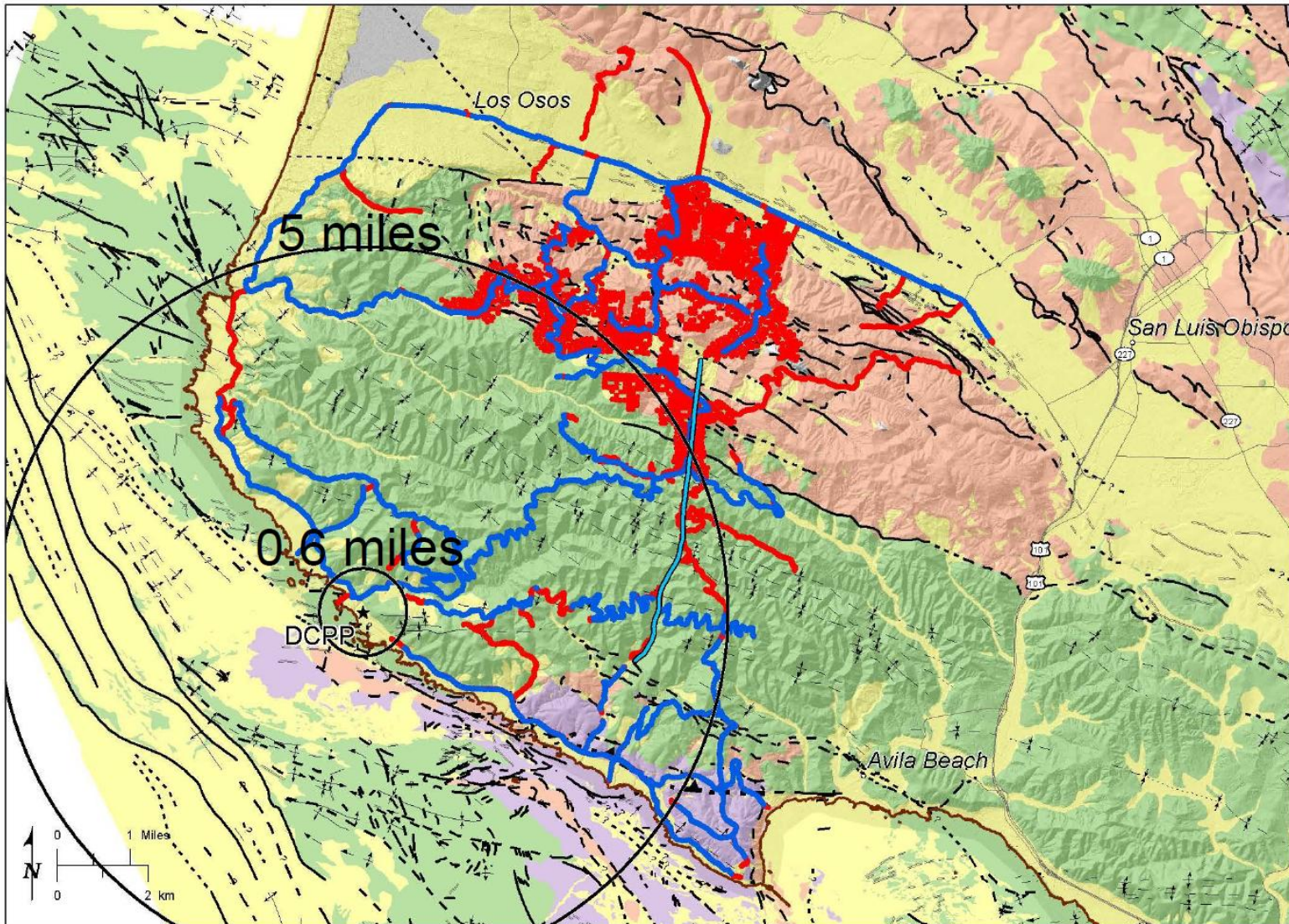


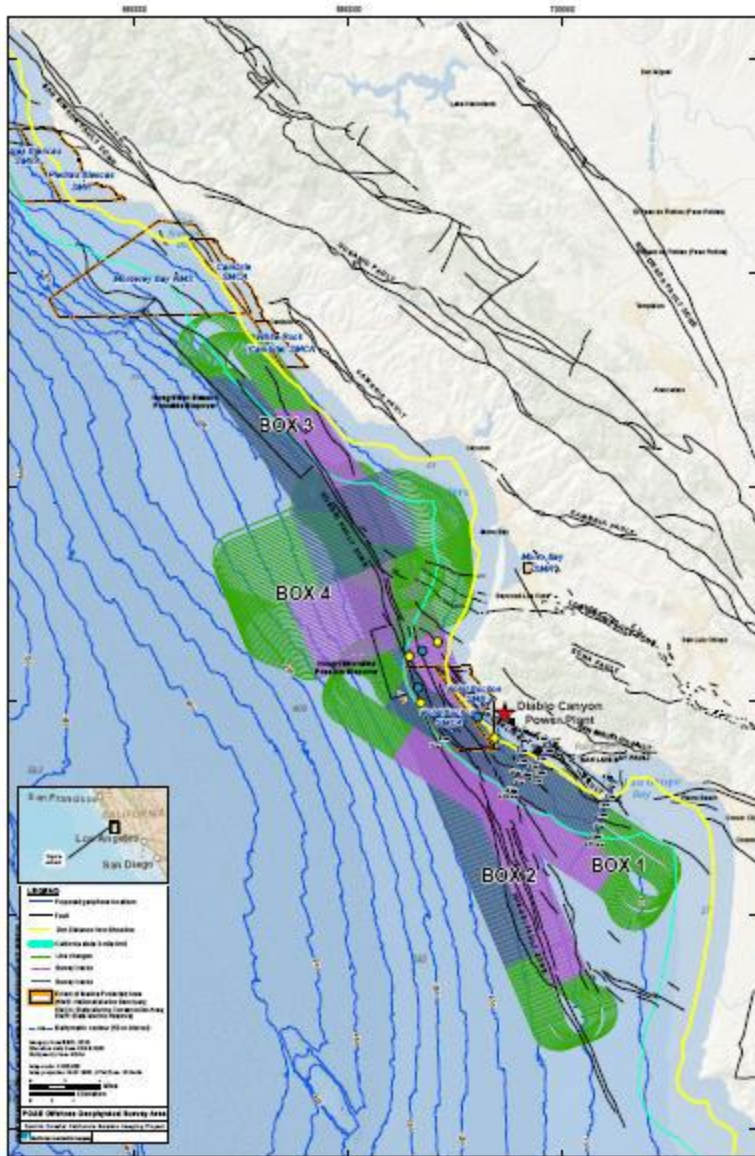
FIGURE 3



<b>Object of study</b>	<b>PG&amp;E Study Plans</b>	<b>IPRP Evaluation of PG&amp;E Study Plans</b>	<b>Priority/Status</b>
<b>Hosgri-Shoreline Intersection</b>	High Energy 3-D Seismic Survey	This type of study has as good a chance as currently feasible of providing data on the intersection of the Hosgri and Shoreline Faults.	Moderate/ CCC permit denied
<b>Hosgri Dip</b>	High Energy 3-D Seismic Survey	This type of study has as good a chance as currently feasible of providing data on the dip the Hosgri Fault near the intersection of the Shoreline and the Hosgri Faults.	Moderate/ CCC permit denied
<b>Shoreline Fault Segments</b>	High Energy 3-D Seismic Survey	This type of study has as good a chance as currently feasible of providing data on the orientation and continuity of the Shoreline Fault at depth	Moderate/ CCC permit denied
<b>Hosgri-San Simeon Step-Over</b>	High Energy 3-D Seismic Survey	Ongoing investigation and more closely spaced seismic survey lines by USGS have shown that the direct connection between the San Simeon and Hosgri Faults is by far the most likely explanation from the available data. It appears very unlikely that additional data from high energy survey of this area would significantly change the seismic hazard analysis results based on these faults.	Low/ No Longer being considered

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High-energy marine geophysical surveys were designed to investigate faults in several distinct areas.

None of these are currently planned.

# SONGS Seismic Research Projects

## Offshore Projects

- Historical Marine Geophysical Data Reprocessing and Reanalysis
- 2-D Deep Marine Seismic Reflection Survey
- 3-D Deep Marine Seismic Reflection Survey
- 2-D Shallow Marine Seismic Reflection Survey
- 3-D Shallow Marine Seismic Reflection Survey
- Seafloor Surveys
- Seafloor Sediment Sampling and Age Dating

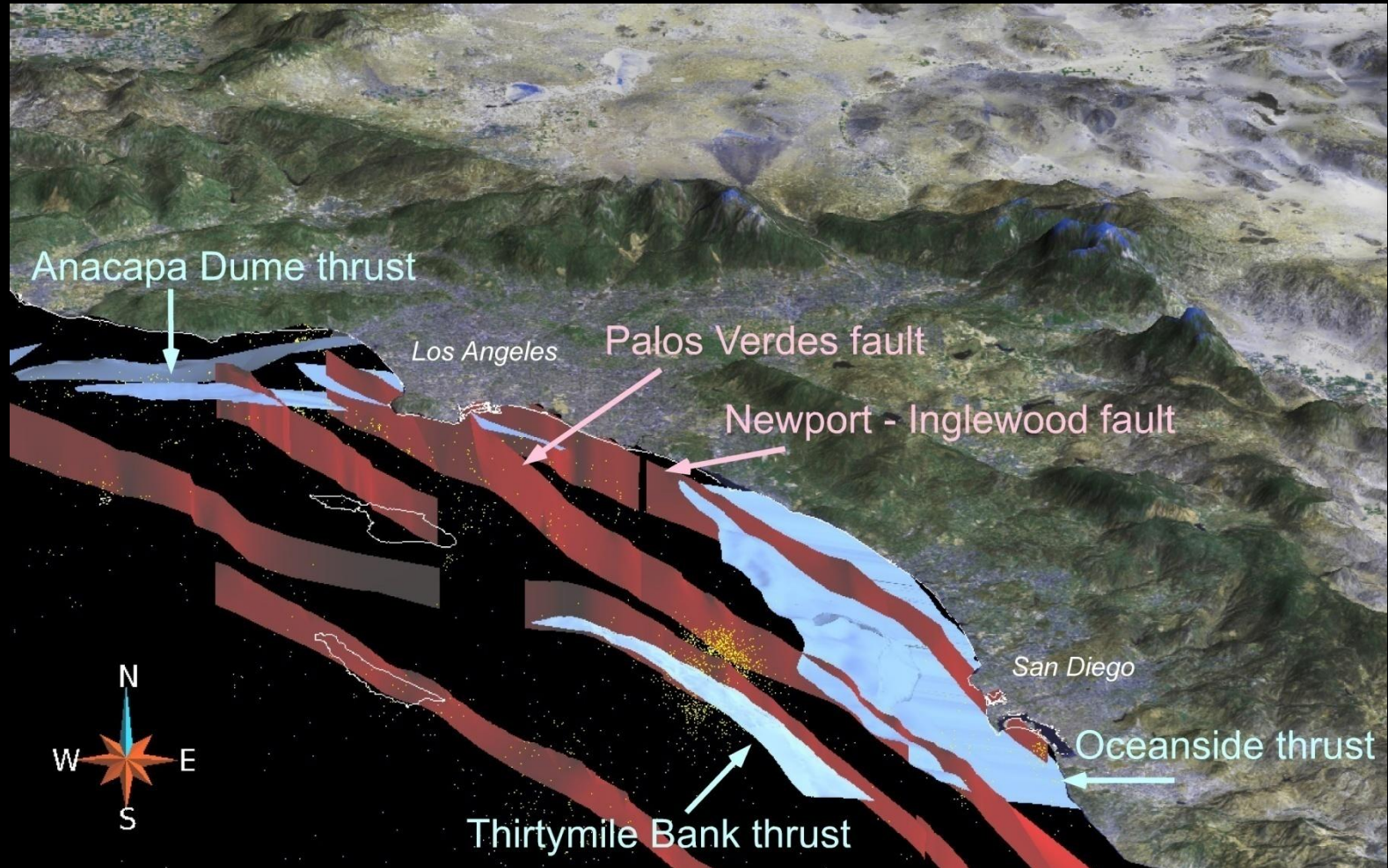
## Onshore Projects

- GPS Monitoring
- Marine Terrace and Coastal Deformation Investigations
- Paleoseismic Trenching
- Seismic Monitoring

**Independent Peer Review Group**

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# Thrust faulting in the Inner California Borderlands: *the Oceanside and Thirtymile Bank blind thrusts*



- Our view is that both strike-slip and thrust faults accommodate crustal deformation in the Inner California Borderlands.
- Challenges are to define the recent activity, slip rates, and seismogenic potential of these faults, including the blind thrust systems.



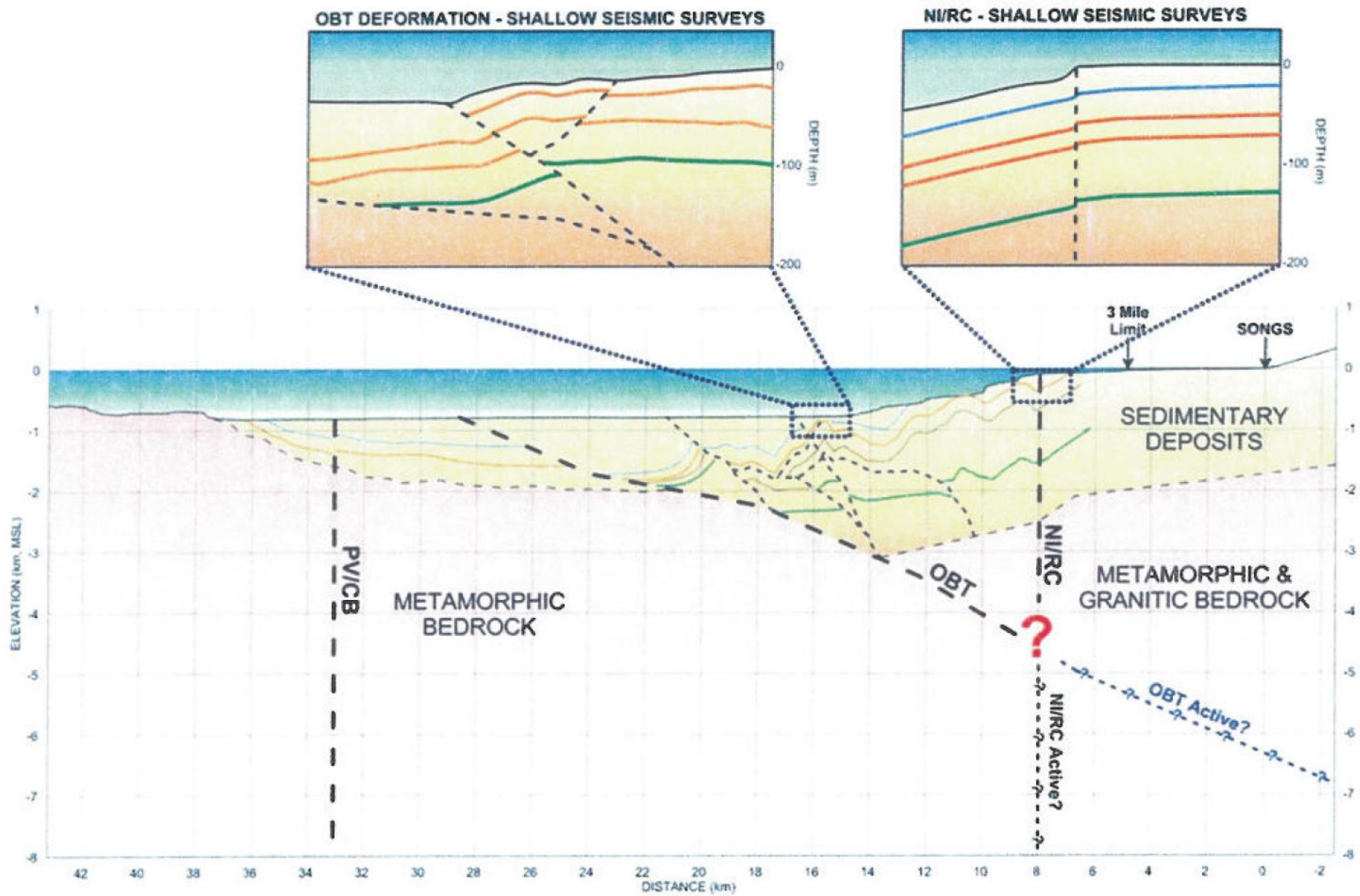
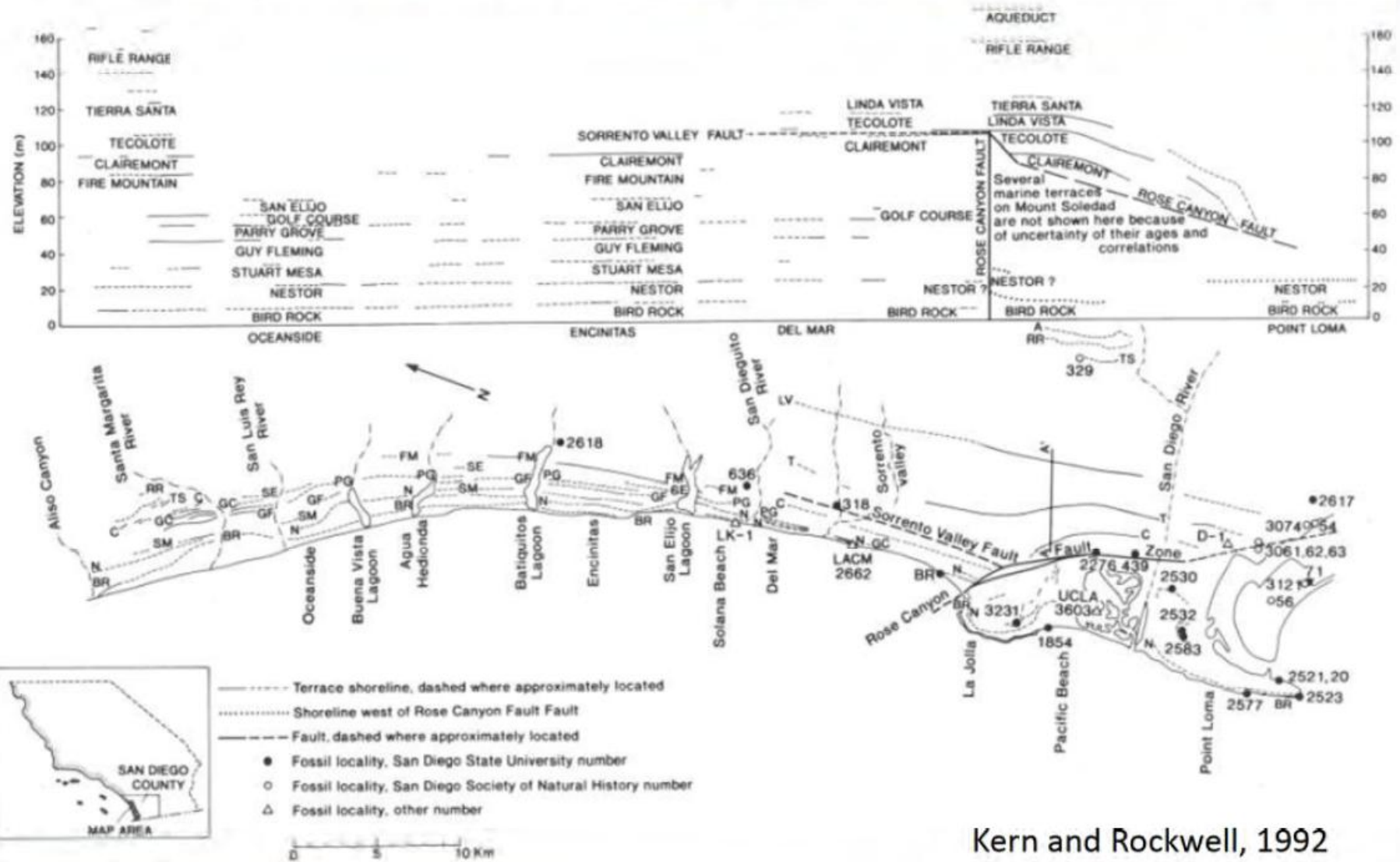


Figure 2. Schematic of shallow seismic imaging and generalized profile of offshore geologic structure.

San Diego County terraces are mapped, surveyed, and locally dated



Kern and Rockwell, 1992

**SAN ONOFRE NUCLEAR GENERATING STATION  
SEISMIC HAZARD ASSESSMENT PROGRAM**

**IPRP for Diablo Canyon has been reviewing proposed seismic study plans presented by PG&E to ensure that additional studies will result in increased understanding of / reduced uncertainties in seismic hazard at DCPD. Five IPRP reports have been completed to date and additional reviews are ongoing.**

**IPRG for San Onofre Nuclear Generating station has been briefed on SCE plans for seismic hazard investigations at SONGS and will review plans presented by SCE when an interagency agreement is completed between CPUC and agencies involved in the IPRG so that staff time can be devoted to the review.**

**<http://www.cpuc.ca.gov/PUC/energy/nuclear.htm>**

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