DOCKETED

Docket Number:	15-IEPR-12
Project Title:	Nuclear Power Plants
TN #:	204335
Document Title:	PRELIMINARY FINDINGS OF THE INDEPENDDENT PEER REVIEW PANEL FOR SEISMIC HAZARD STUDIES AT DIABLO CANYON
Description:	N/A
Filer:	Raquel Kravitz
Organization:	Independent Peer Review Panel/ Chris Wills
Submitter Role:	Public
Submission Date:	4/23/2015 3:09:33 PM
Docketed Date:	4/23/2015

PRELIMINARY FINDINGS OF THE INDEPENDENT PEER REVIEW PANEL FOR SEISMIC HAZARD STUDIES AT DIABLO CANYON

Chris Wills
California Geological Survey,
Chair, IPRP

California Energy Commission Joint Commissioner Workshop
April 27, 2015

Background:
What is the Independent Peer Review Panel

•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 should use three-dimensional geophysical seismic reflection mapping and other advanced techniques to explore fault zones near Diablo Canyon"

- •This action will supplement PG&E's Long Term Seismic Program and "help resolve uncertainties surrounding the seismic hazard at Diablo Canyon".
- •"…ground motion can be highly variable in the region near a [earthquake] rupture, with significant amplification of ground motion in some areas"… "As ground motion models are refined to account for a greater understanding of the motion near an earthquake rupture, it will be important for PG&E to consider whether the models indicate larger–than-expected seismic hazards at Diablo Canyon and, if so, whether the plant was built with sufficient design margins…"

•CPUC decision D 10-08-003 approved funding for the proposed seismic hazard studies and established the IPRP. The IPRP members represent the California Geological Survey, Coastal Commission, Seismic Safety Commission, County of San Luis Obispo, as well as the Energy Commission and the Public Utilities Commission.

Note that AB1632 and the IPRP pre-date the Tohoku earthquake and subsequent studies required by NRC – The IPRP review has been separate from evaluations using the NRC SSHAC process, but has benefitted from the SSHAC workshops

IPRP Report No. 9, *March 6, 2015*
Comments on PG&E's Central Coastal California Seismic Imaging Project Report part 3: onshore seismic studies intended to reduce the uncertainty in seismic hazard at Diablo Canyon Power Plant

IPRP Report No. 8, *December 17, 2014*
Comments on PG&E's Central Coastal California Seismic Imaging Project Report part 2: onshore seismic studies intended to reduce the uncertainty in seismic hazard at Diablo Canyon Power Plant

IPRP Report No. 7, *November 21, 2014*
Comments on PG&E's Central Coastal California Seismic Imaging Project Report part 1: offshore seismic studies intended to reduce the uncertainty in seismic hazard at Diablo Canyon Power Plant

IPRP Report No. 6, *August 12, 2013*
Site shear wave velocity at Diablo Canyon: summary of available data and comments on analysis by PG&E for Diablo Canyon Power Plant seismic hazard studies

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

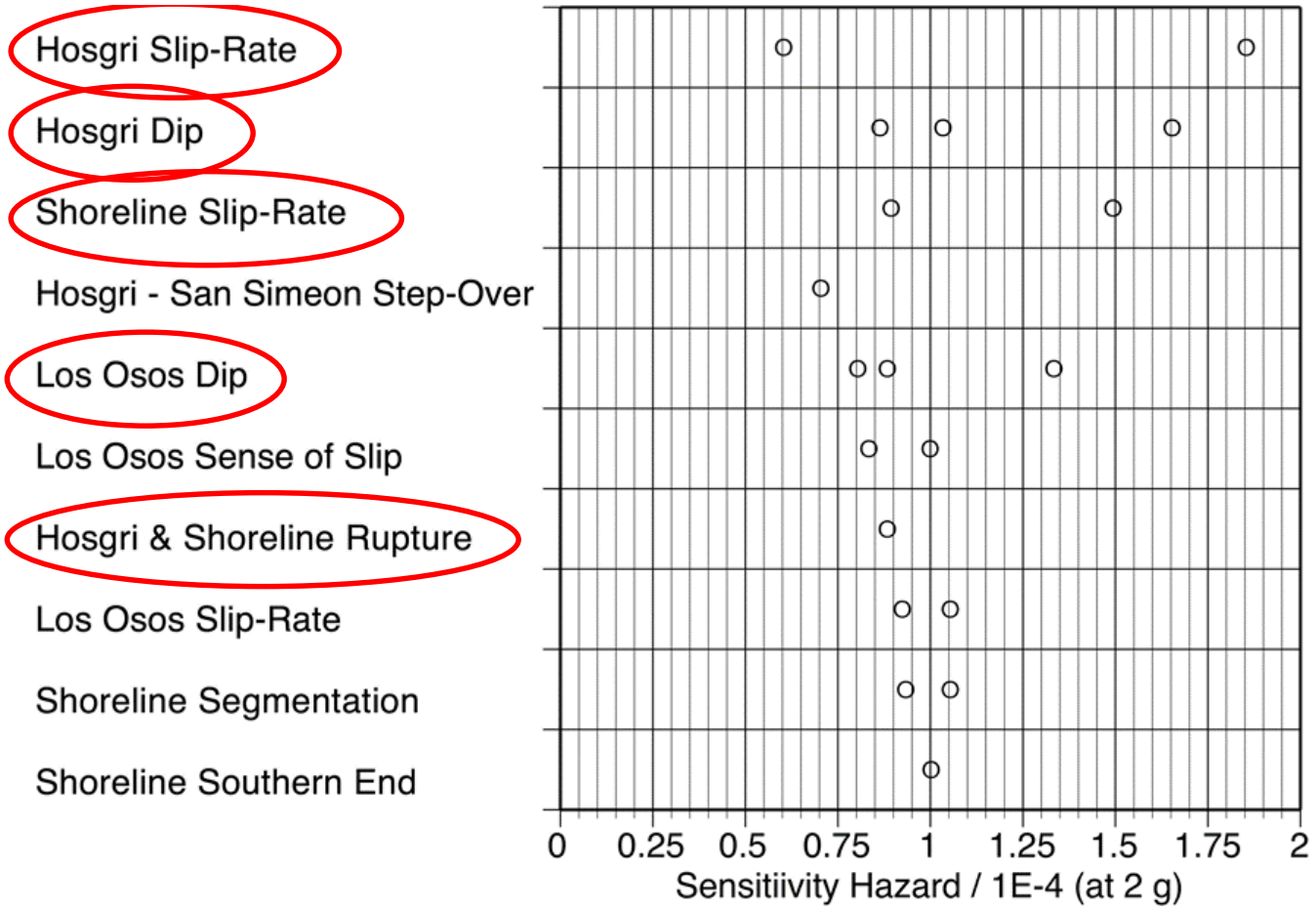
IPRP Report No. 3 *April 6, 2012*
Comments on PG&E's Enhanced Seismic Study Plans for Diablo Canyon Power Plant

IPRP Report No. 2 *September 7, 2011*
Comments on PG&E's Enhanced Seismic Study Plans for Diablo Canyon Power Plant

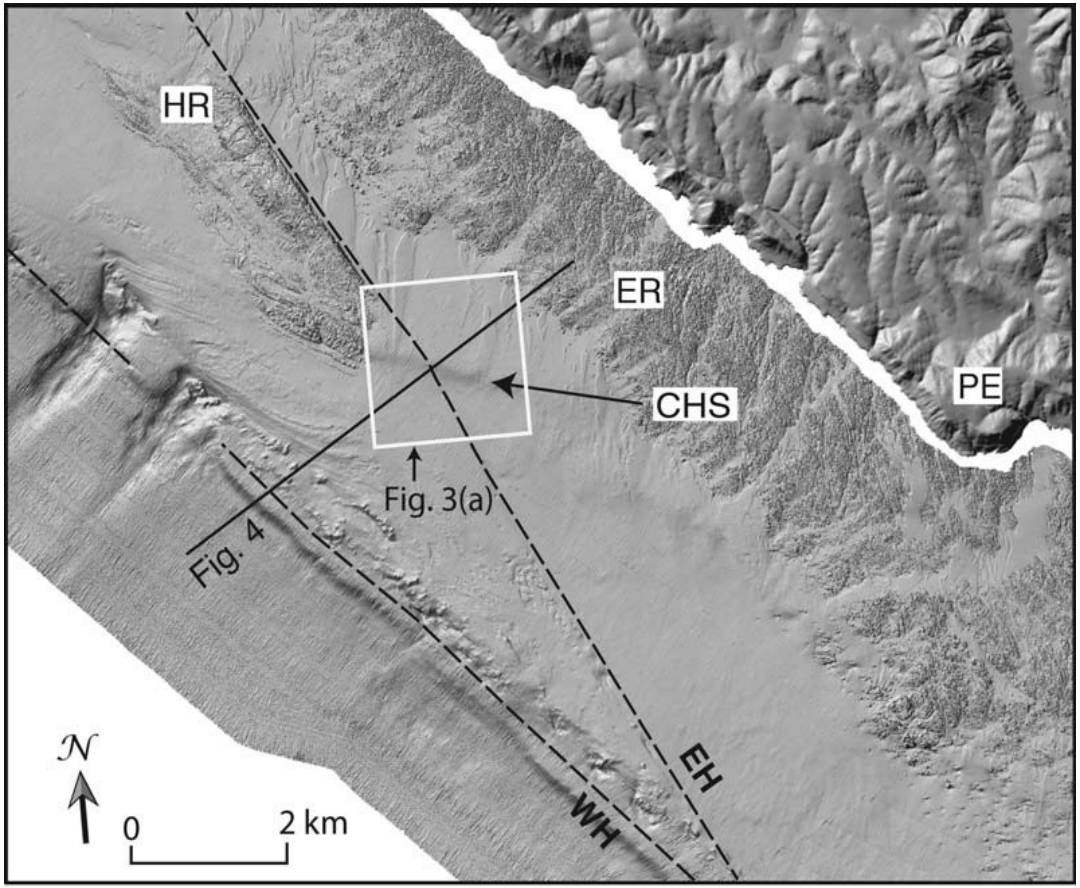
http://www.cpuc.ca.gov/PUC/energy/nuclear.htm

At the July 26, 2011 Independent Peer Review Panel (IPRP) review meeting, IPRP requested that PG&E 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.

Site conditions/site amplification



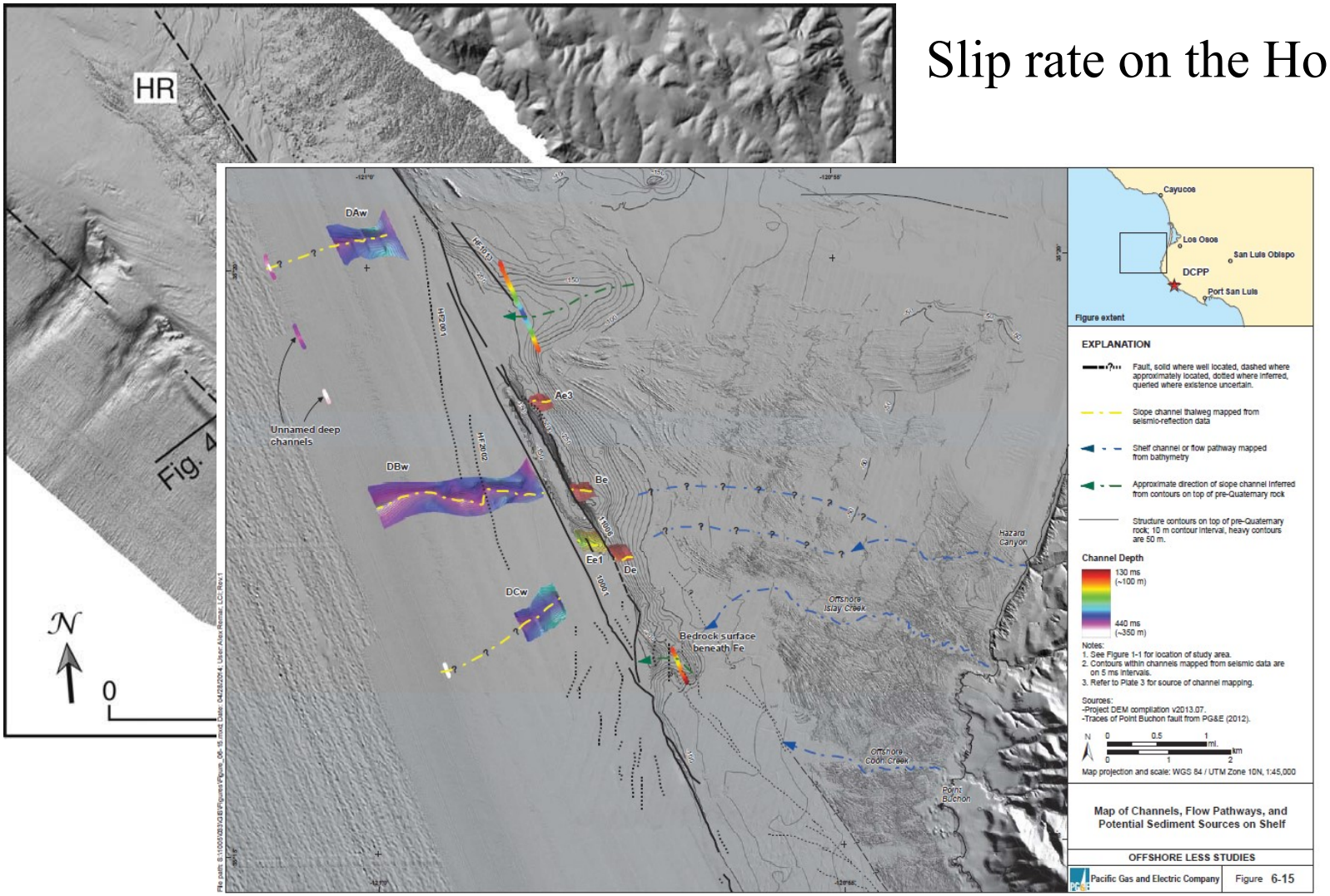
Response to IPRP Request for Hazard Sensitivity for Targets for the DCPP Geophysical Surveys
Prepared by PG&E Geosciences Department August 8, 2011



Slip rate on the Hosgri fault

Cross-Hosgri slope
Estero Bay
Pt Sal

Slip rate on the Hosgri fault

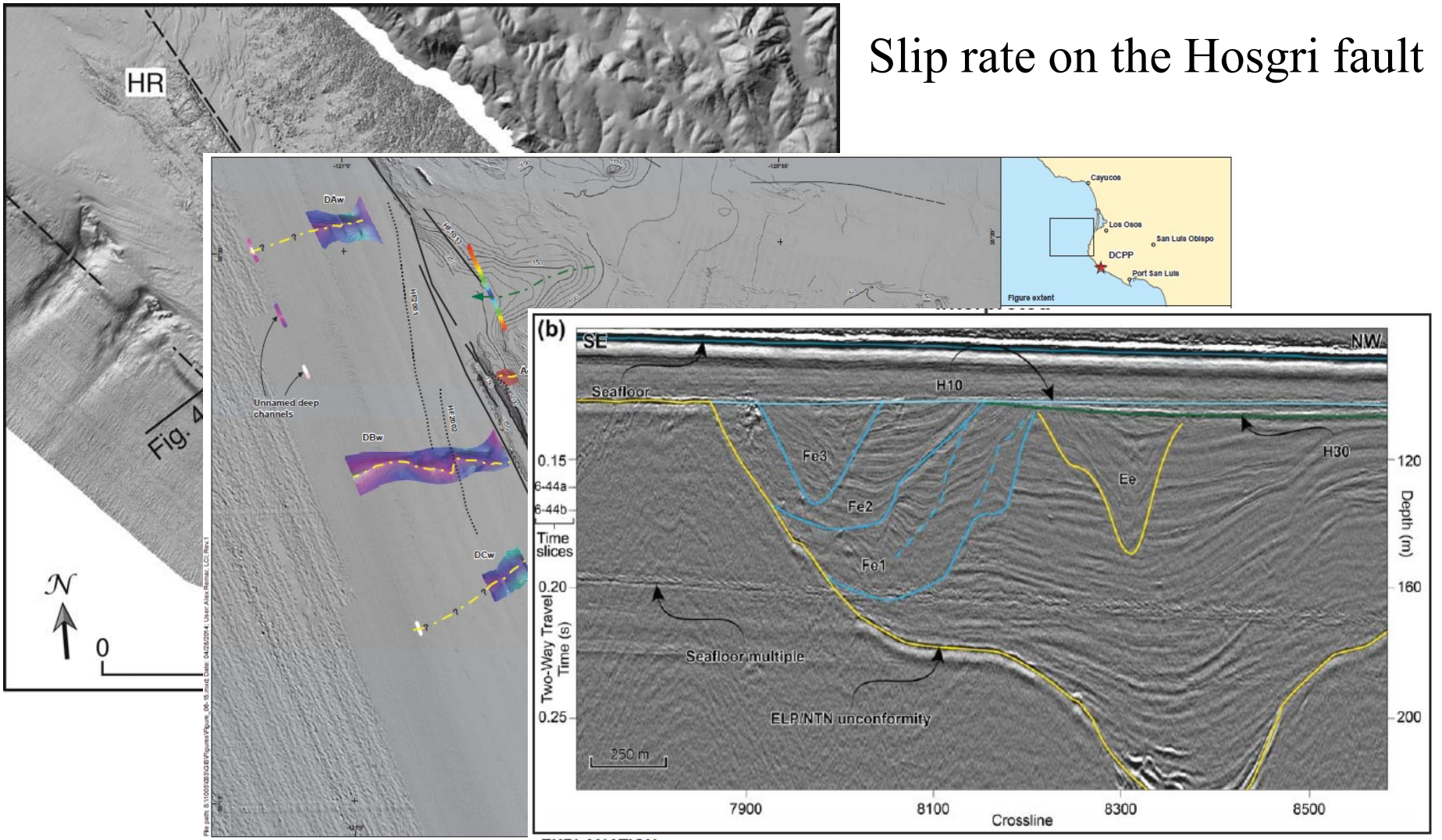


Cross-Hosgri slope

Estero Bay

Pt Sal

Slip rate on the Hosgri fault

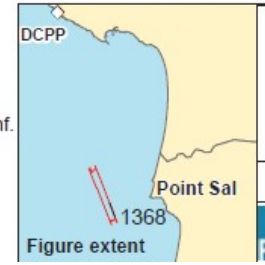


Cross-Hosgri slope
Estero Bay
Pt Sal

EXPLANATION

- Seafloor
- H10 unconformity
- H30 unconformity
- Early-late Pliocene / near top of Neogene (ELP/NTN) unconf.
- Channel E margin
- Channel F margin
- 2012 Point Sal 3D high-resolution survey extent

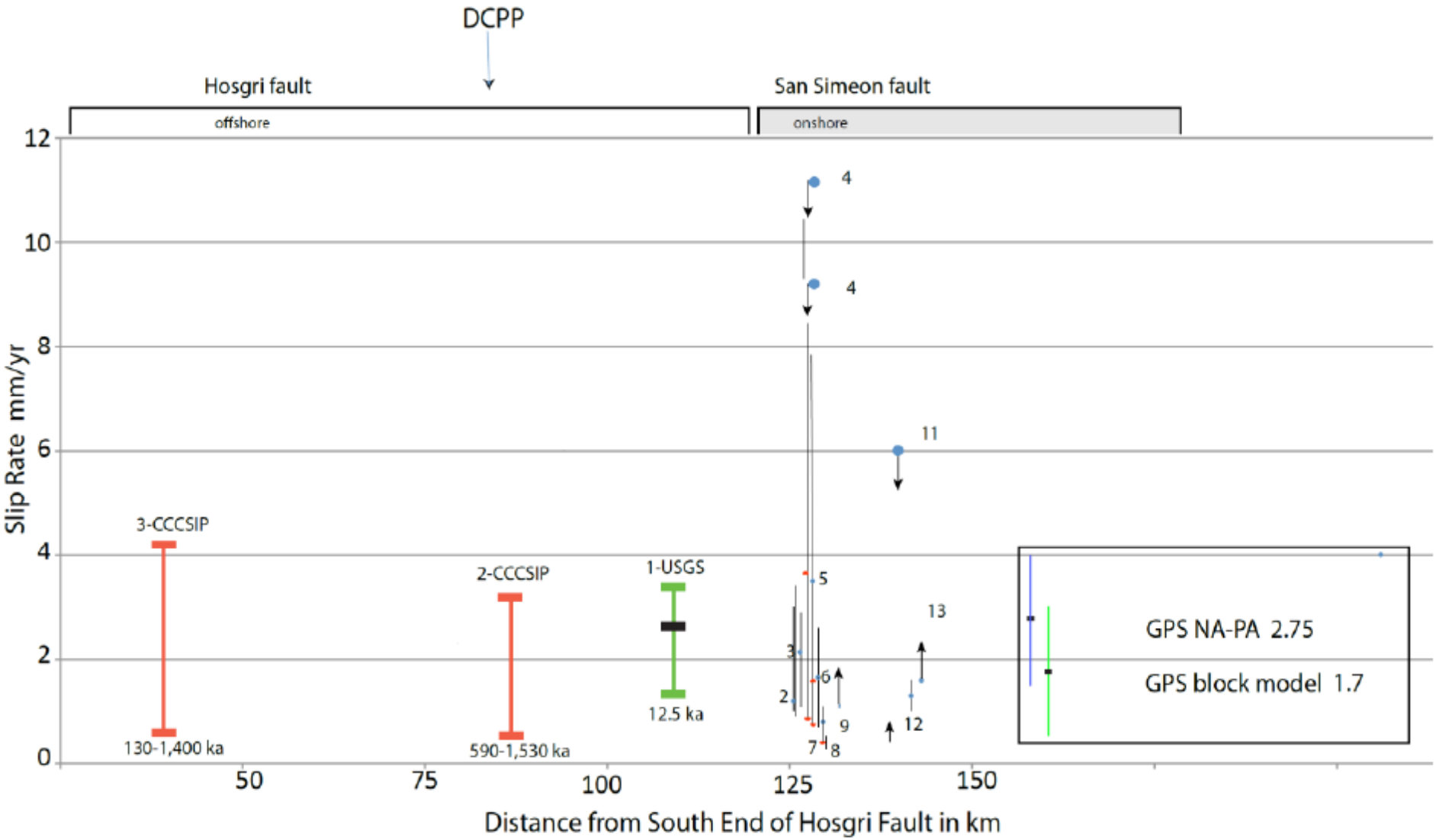
Note: See Figure 6-27 for line location.

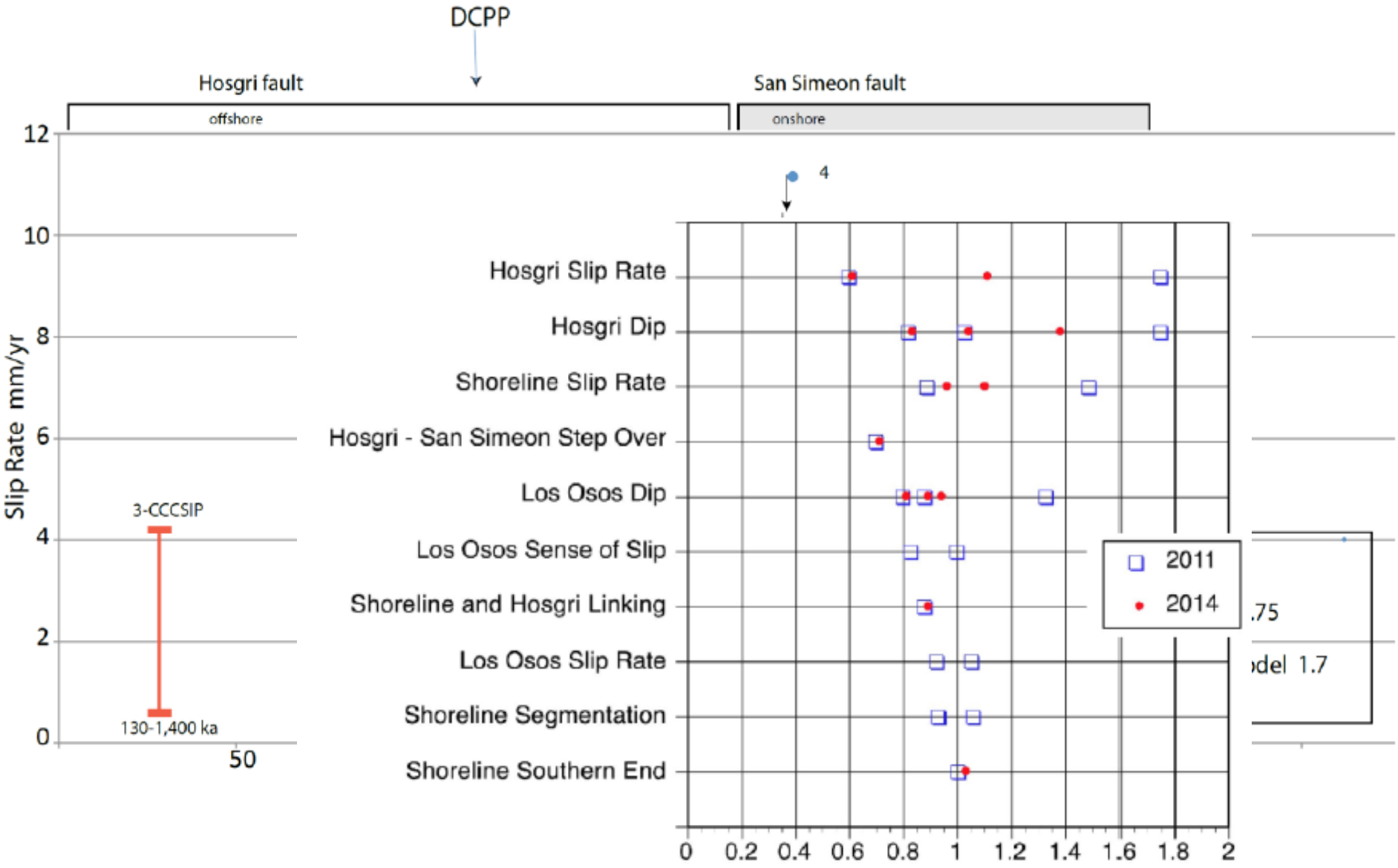


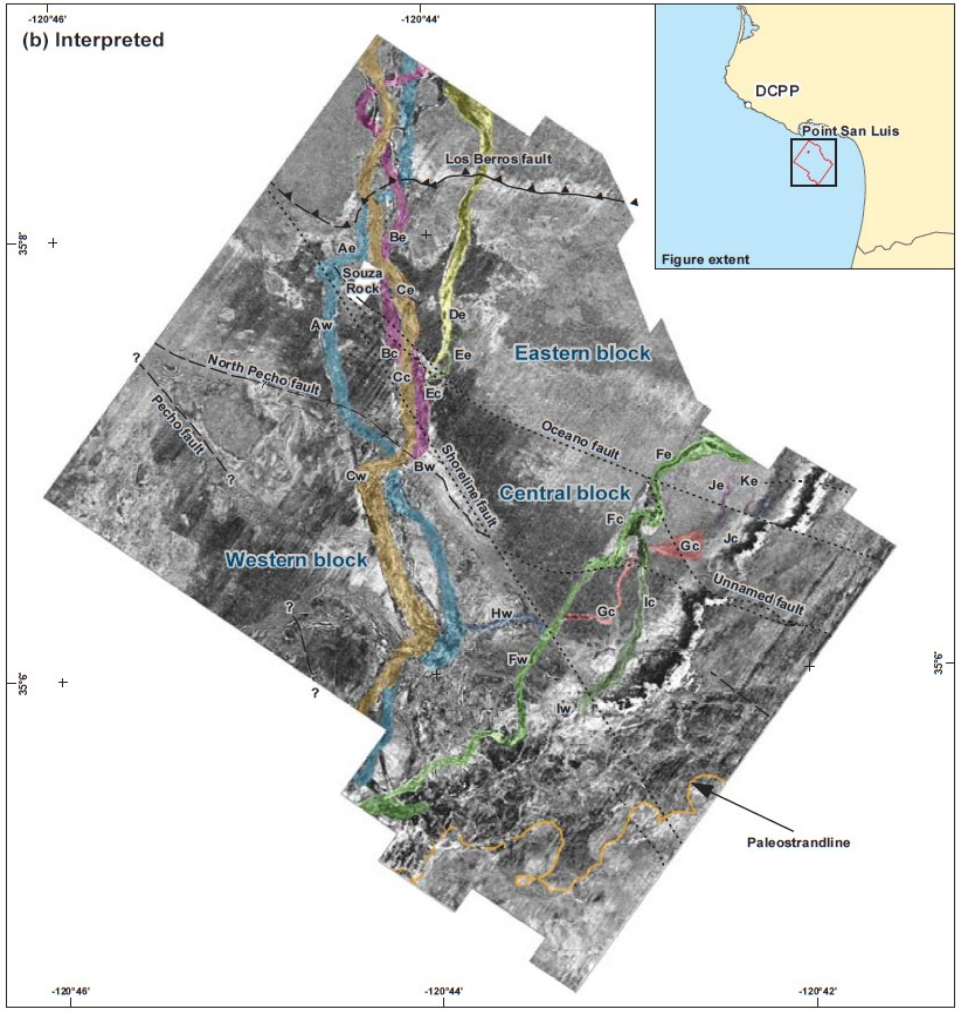
Line 1368 Channel F Amplitude Section East of HFZ, Uninterpreted and Interpreted, with Labeled Channel Fe1-3

OFFSHORE LESS STUDIES

Pacific Gas and Electric Company | Figure **6-43**


DCPP
Hosgri fault
offshore
San Simeon fault
onshore
Slip Rate mm/yr
Distance from South End of Hosgri Fault in km
0
2
4
6
8
10
12
50
75
100
125
150
3-CCCSIP
130-1,400 ka
2-CCCSIP
590-1,530 ka
1-USGS
12.5 ka
GPS NA-PA 2.75
GPS block model 1.7
1
2
3
4
4
5
6
7
8
9
11
12
13


DCPP
Hosgri fault
offshore
San Simeon fault
onshore
12
10
8
6
4
2
0
Slip Rate mm/yr
50
3-CCCSIP
130-1,400 ka
4
Hosgri Slip Rate
Hosgri Dip
Shoreline Slip Rate
Hosgri - San Simeon Step Over
Los Osos Dip
Los Osos Sense of Slip
Shoreline and Hosgri Linking
Los Osos Slip Rate
Shoreline Segmentation
Shoreline Southern End
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2011
2014
.75
del 1.7



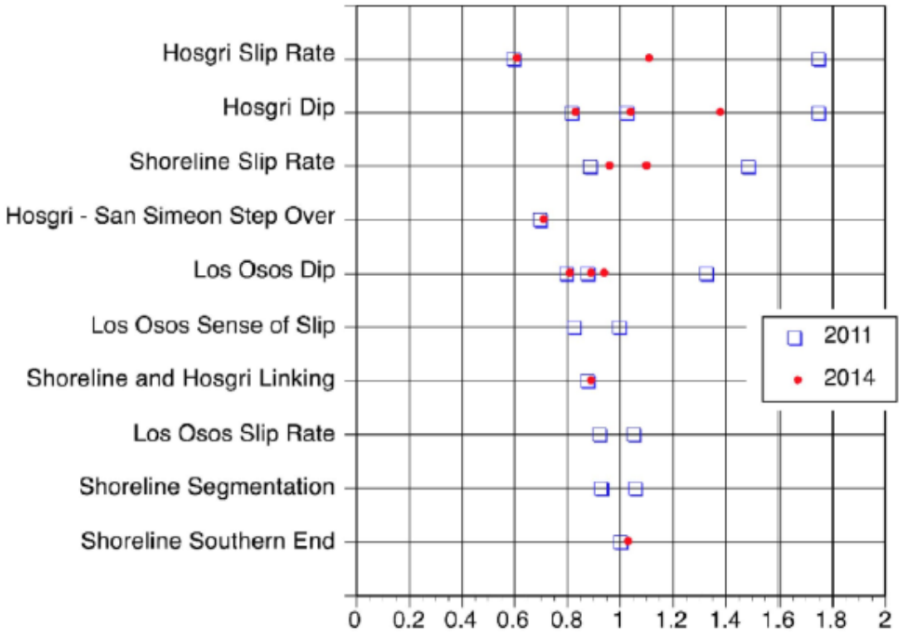
N 0 0.25 0.5 1 mi.
0 0.5 1 2 km
Map projection and scale: WGS 84 / UTM Zone 10N, 1:40,000

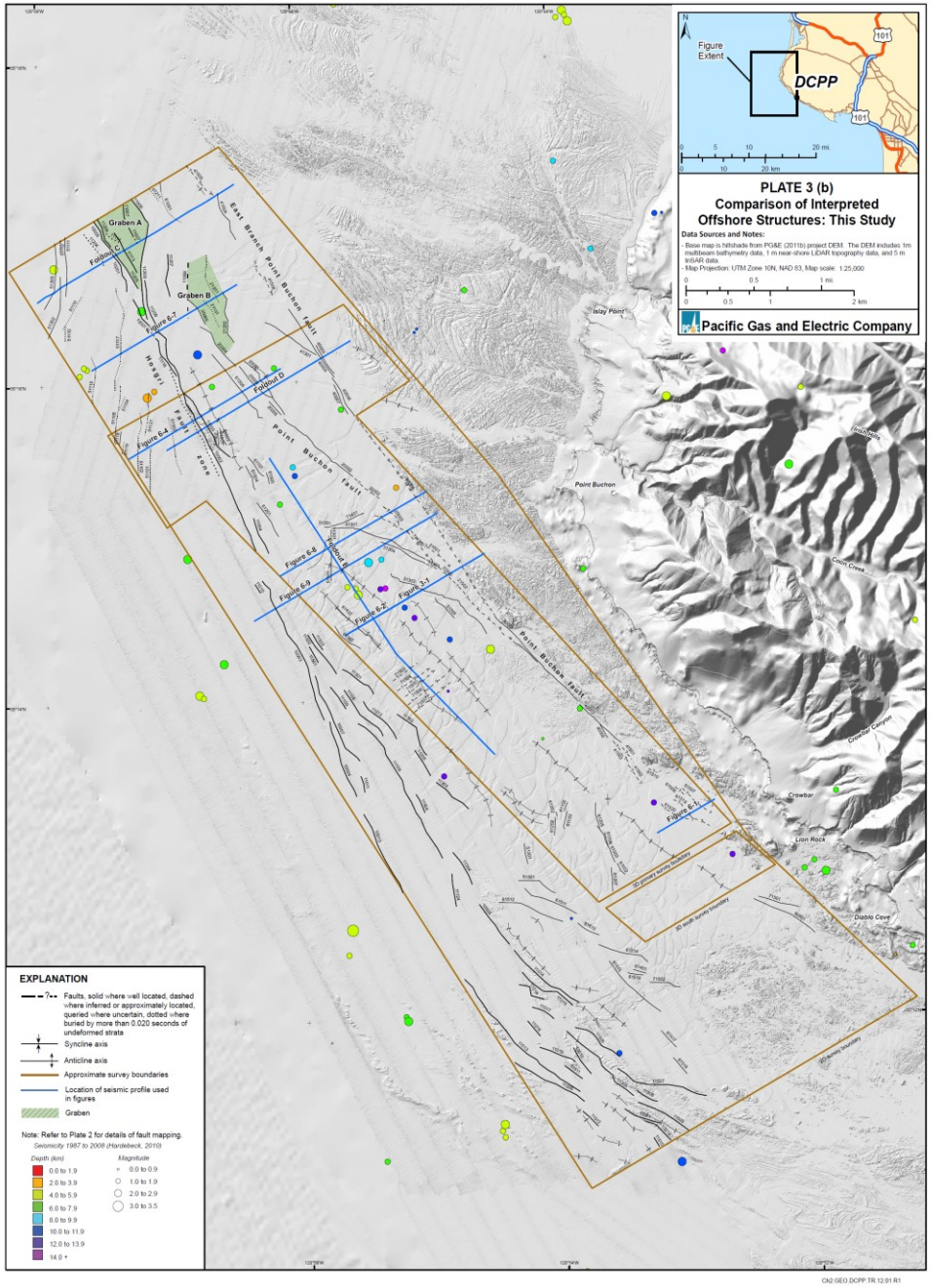
Amplitude Inclined Slice, Uninterpreted and Interpreted, with Faults, Paleochannels, and Paleoshoreline, San Luis Obispo Bay

OFFSHORE LESS STUDIES

Pacific Gas and Electric Company Figure 7-22

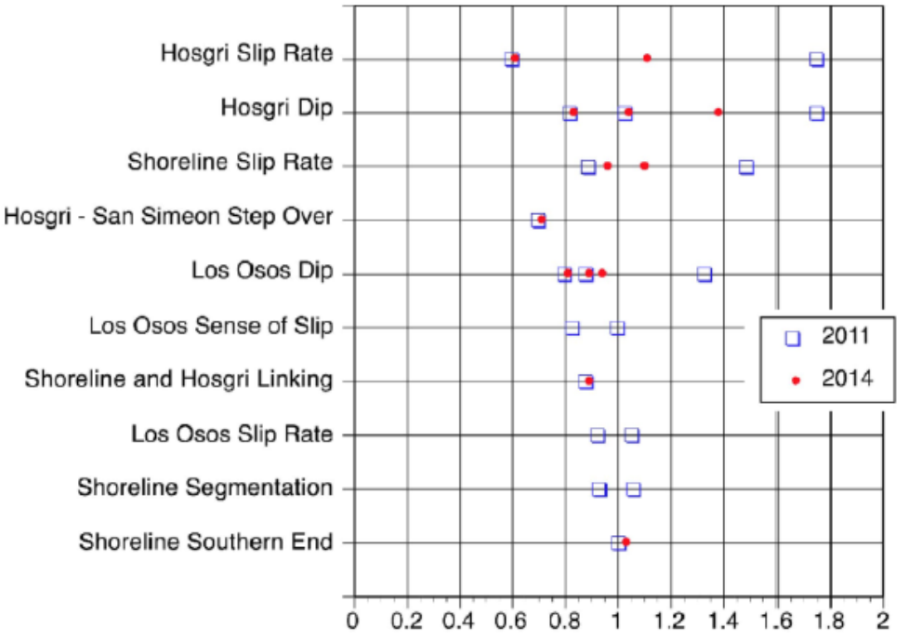
Slip rate on the Shoreline fault: Offset of paleostrand line and age estimate allow improved constraints on slip rate.



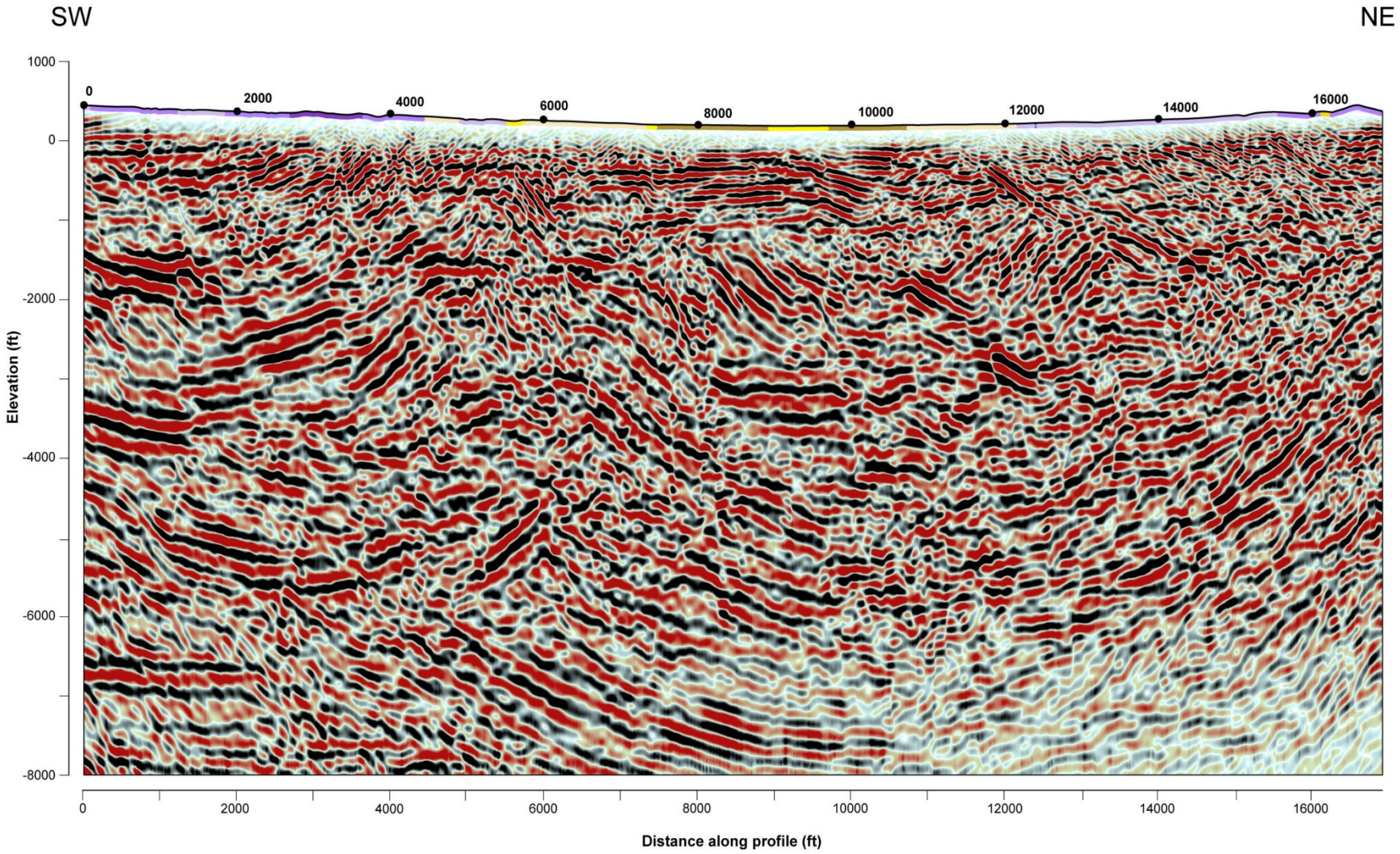


Connection between Shoreline and Hosgri faults demonstrated by Point Buchon 3-D seismic survey.

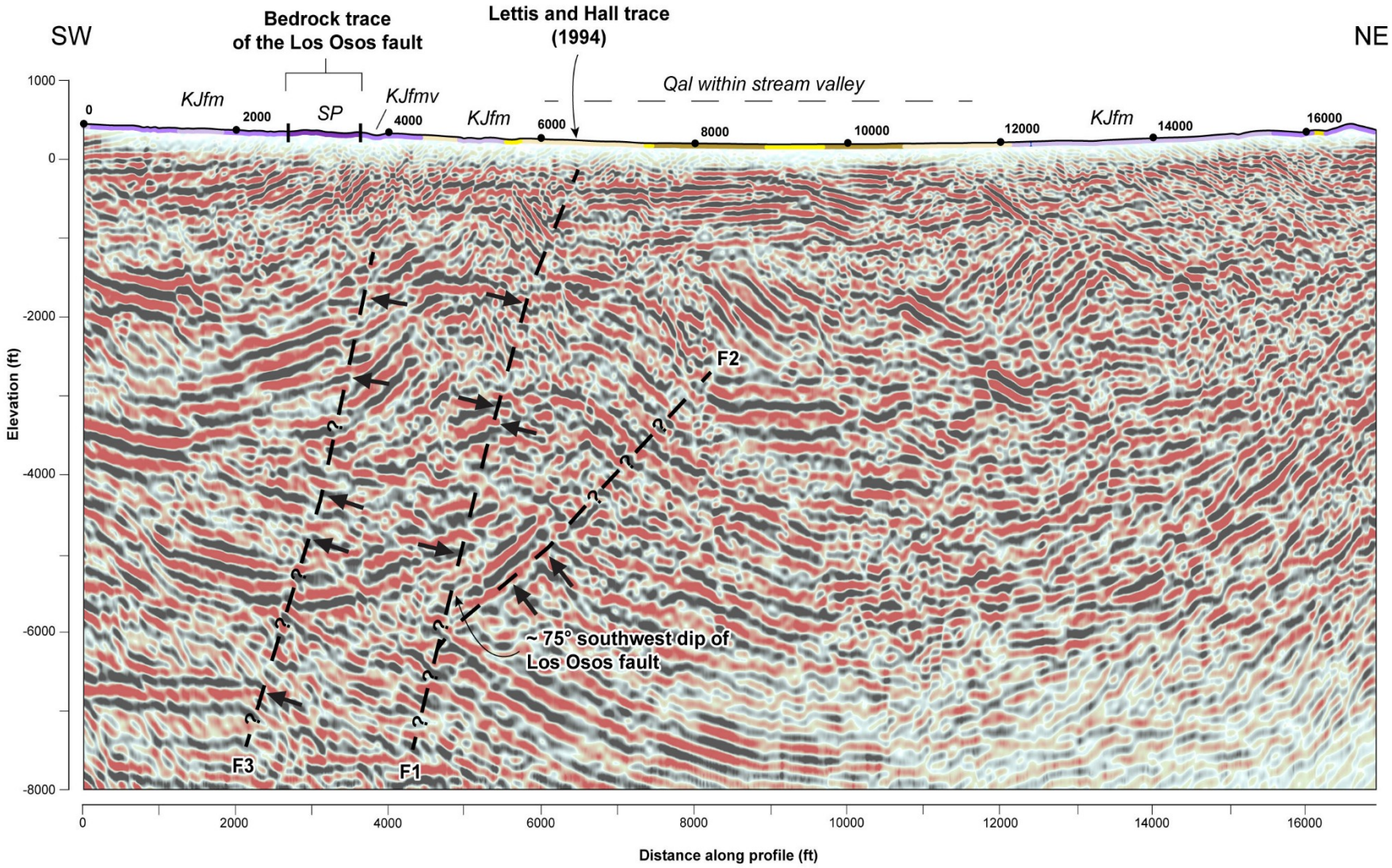
Dip of Hosgri fault inferred from connection of surface trace and hypocenters



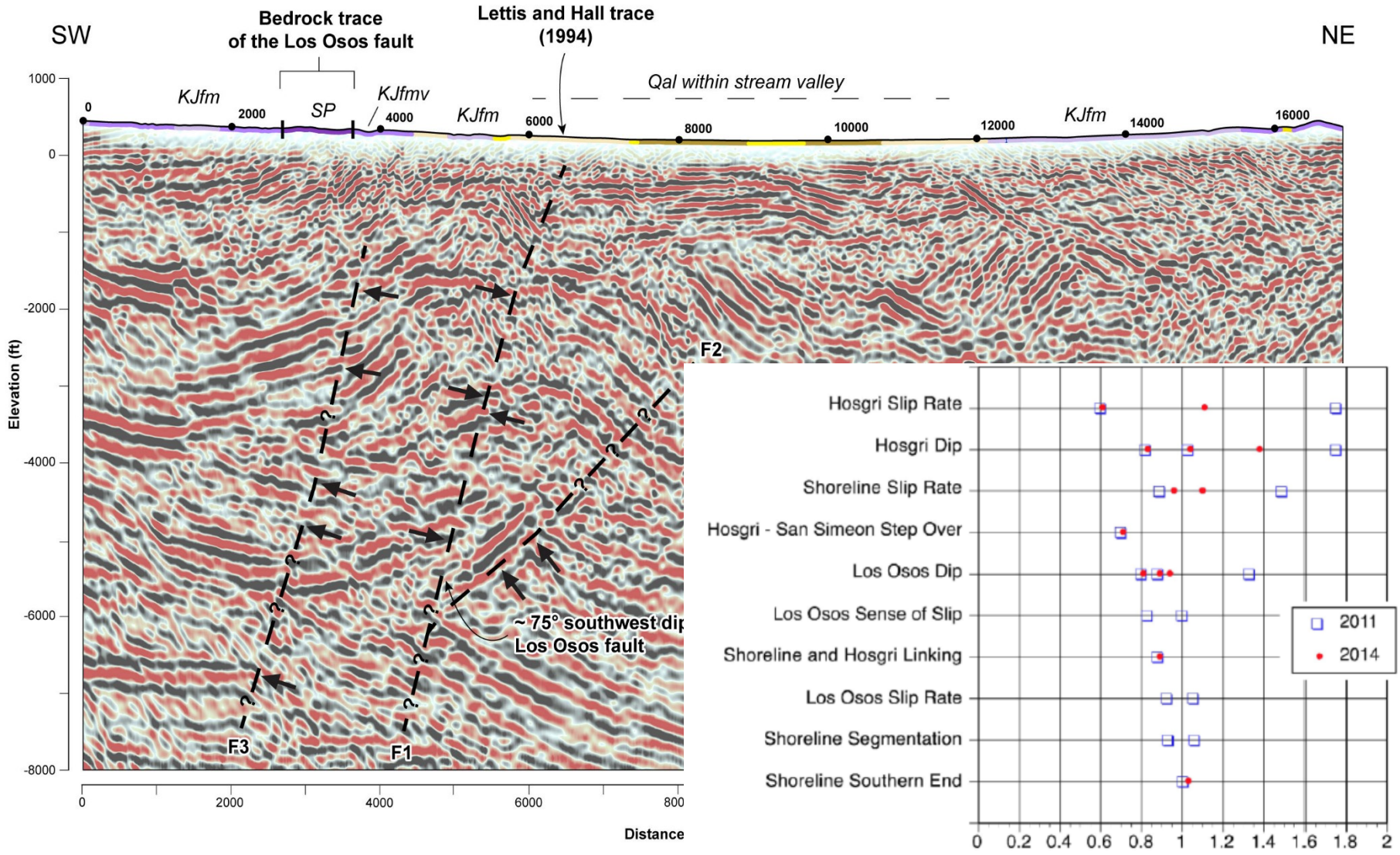
Dip of the Los Osos fault:
Reflection seismic surveys do not provide convincing constraints on geometry of subsurface faults



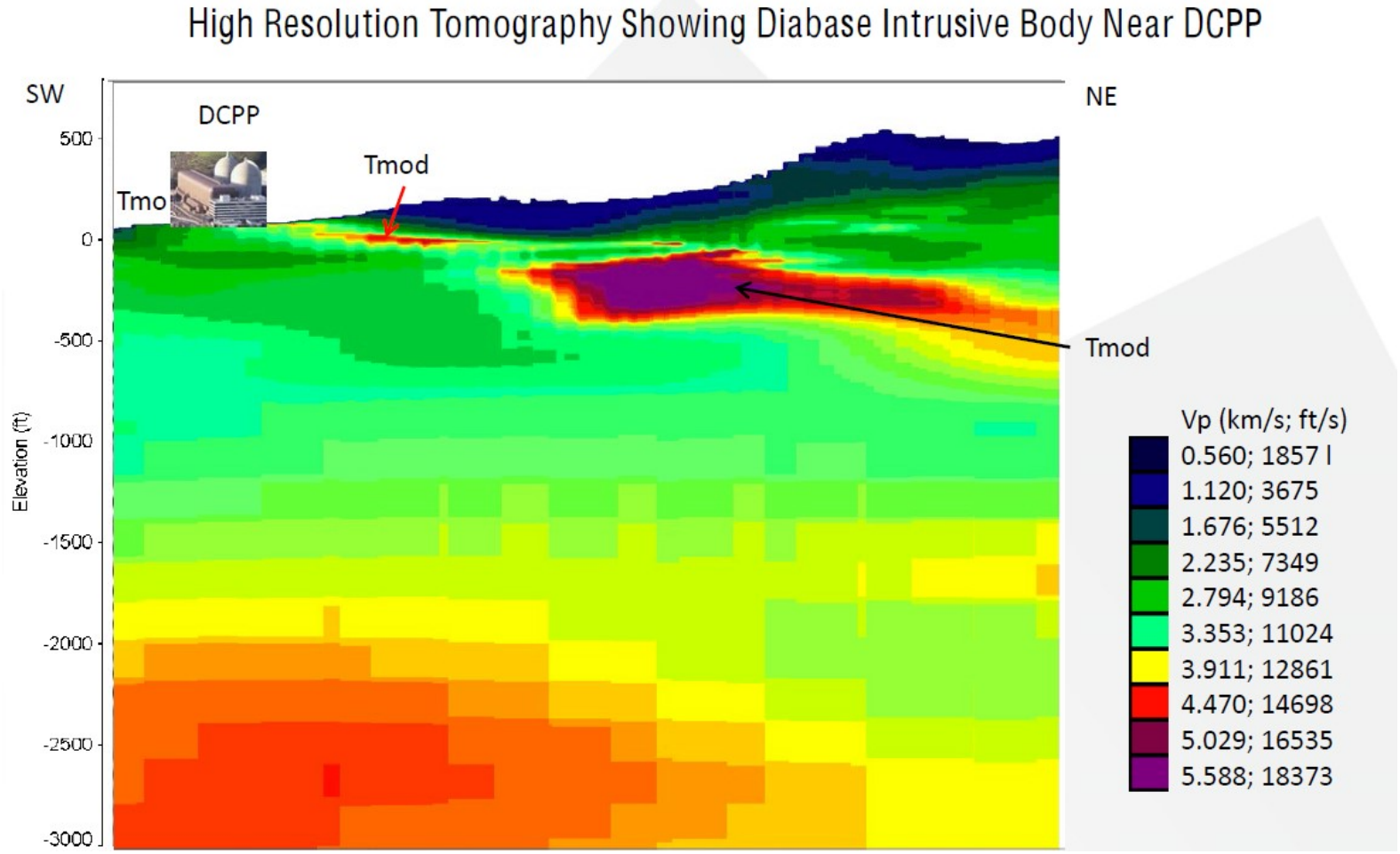
Dip of the Los Osos fault:
Reflection seismic surveys do not provide convincing constraints on geometry of subsurface faults

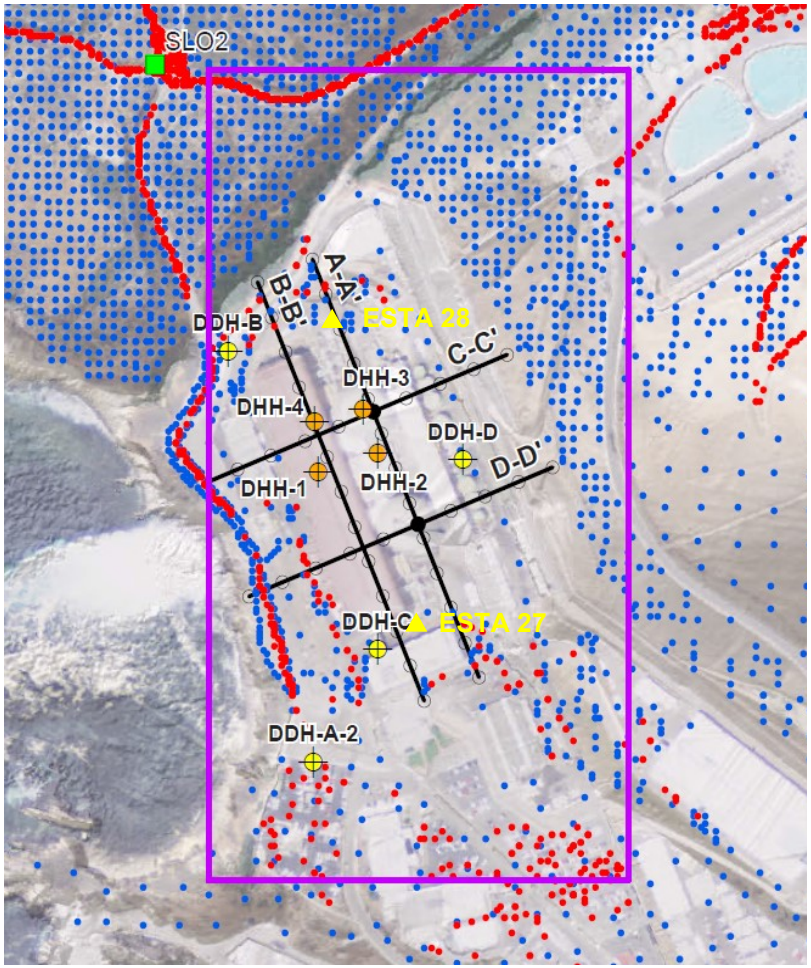


Dip of the Los Osos fault:
Reflection seismic surveys do not provide convincing constraints on geometry of subsurface faults



3-D tomographic survey shows details of seismic velocity of rocks beneath Irish Hills – including irregular areas of very high velocity material interpreted to be diabase.





Borehole location (Blume, 1968)

Downhole log location (1978)

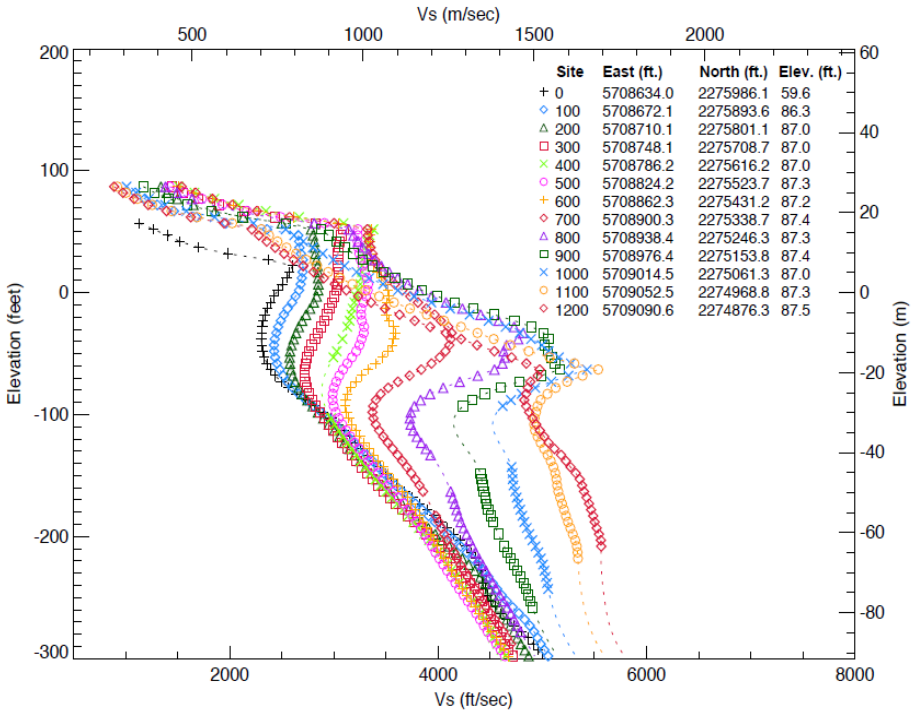
Obispo velocity location

Source location

Receiver location

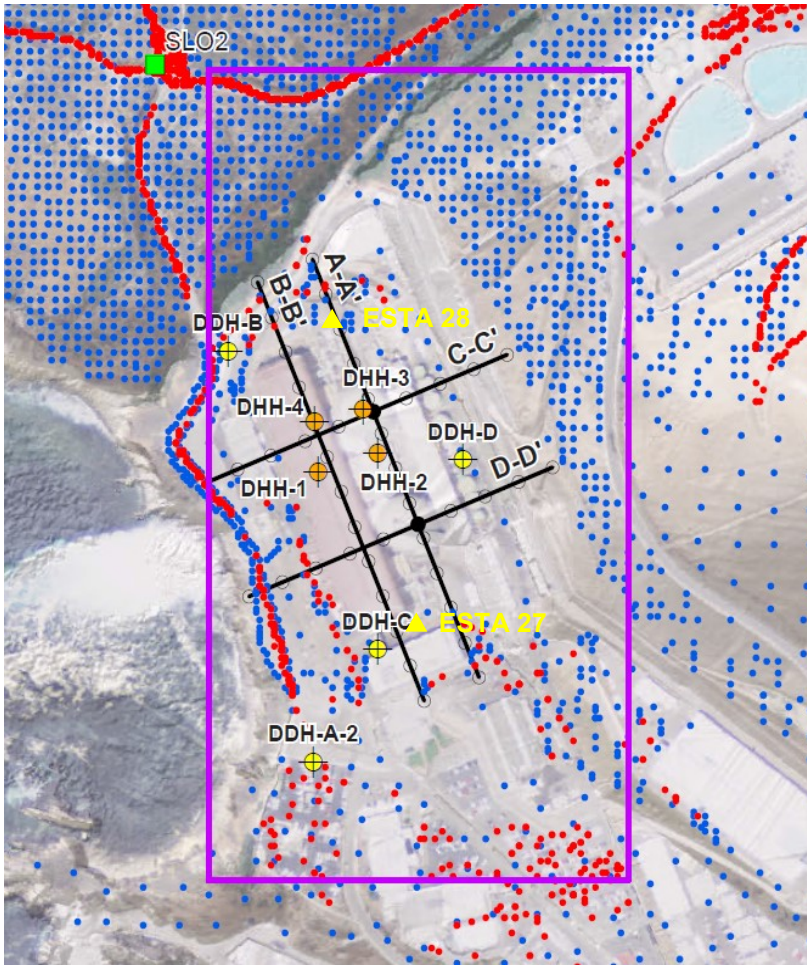
Boundary of 3D velocity output

Seismic survey used to develop 3-D velocity model of foundation area and standard "site conditions" where previous earthquakes were recorded.



GeoTomo Vs Profile B-B' sites using Vp/Vs depth relation

Seismic survey used to develop 3-D velocity model of foundation area and standard “site conditions” where previous earthquakes were recorded.



Borehole location (Blume, 1968)

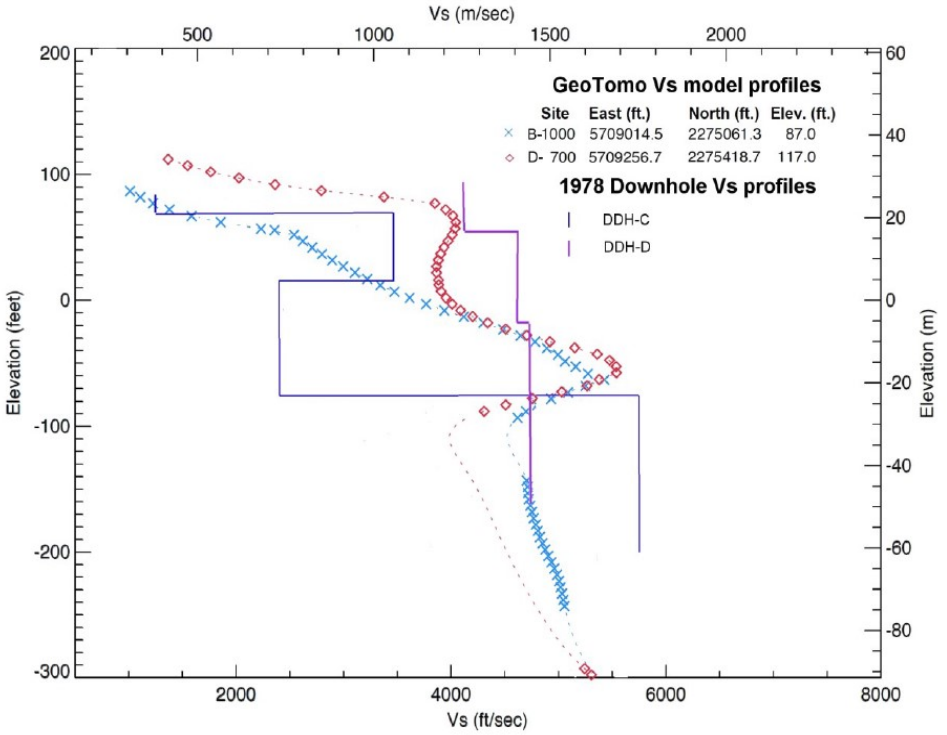
Downhole log location (1978)

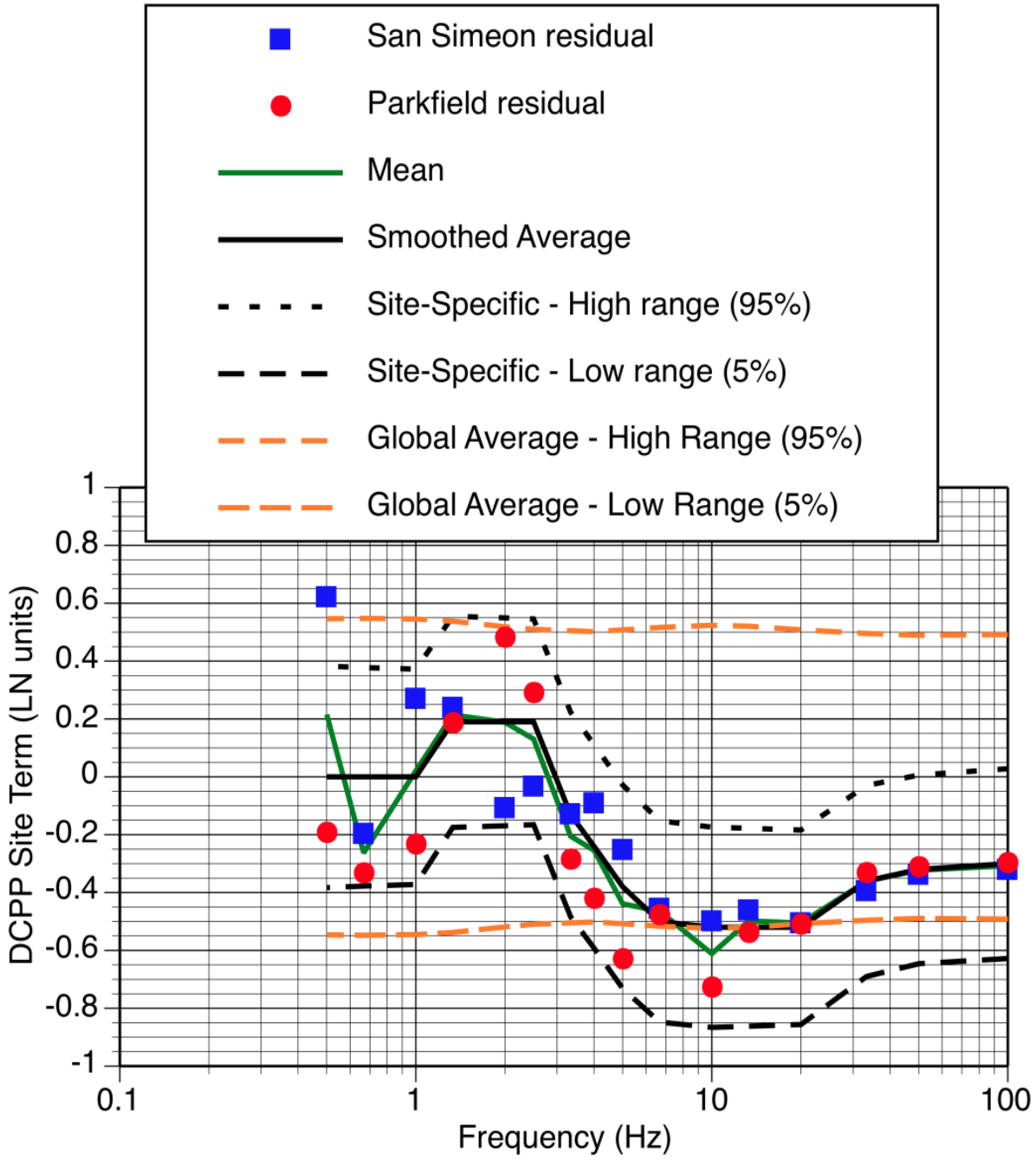
Obispo velocity location

Source location

Receiver location

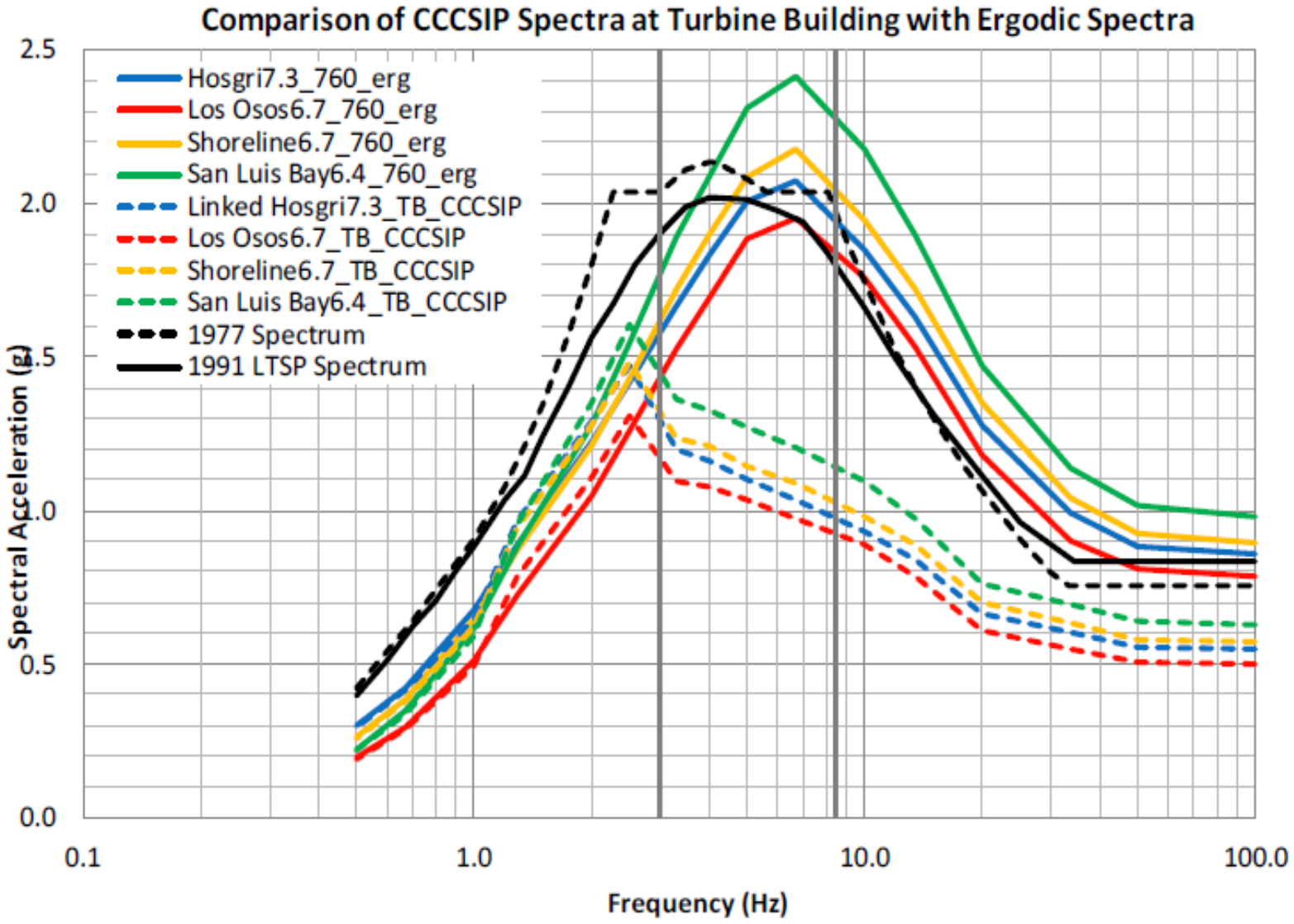
Boundary of 3D velocity output

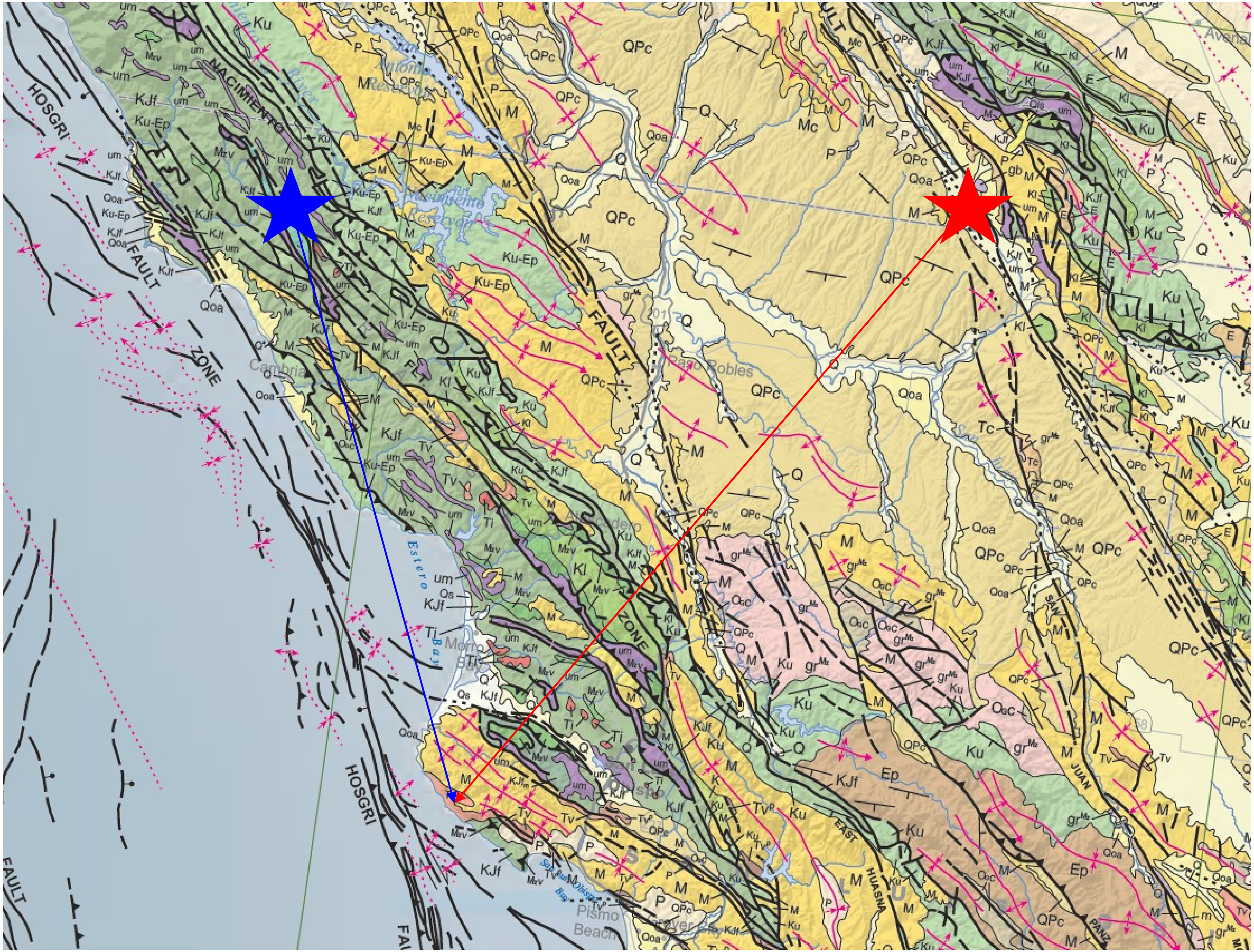




An empirical site amplification factor has been developed by PG&E to explain relatively low ground motions from the San Simeon 2003 and Parkfield 2004 earthquakes.
If this factor is due to some intrinsic properties of the site, then it would apply to any earthquake.

If the “site term” does apply to all earthquakes, it would change the shape of the response spectra and substantially lower shaking hazard in the range of frequencies of most concern to DCPP



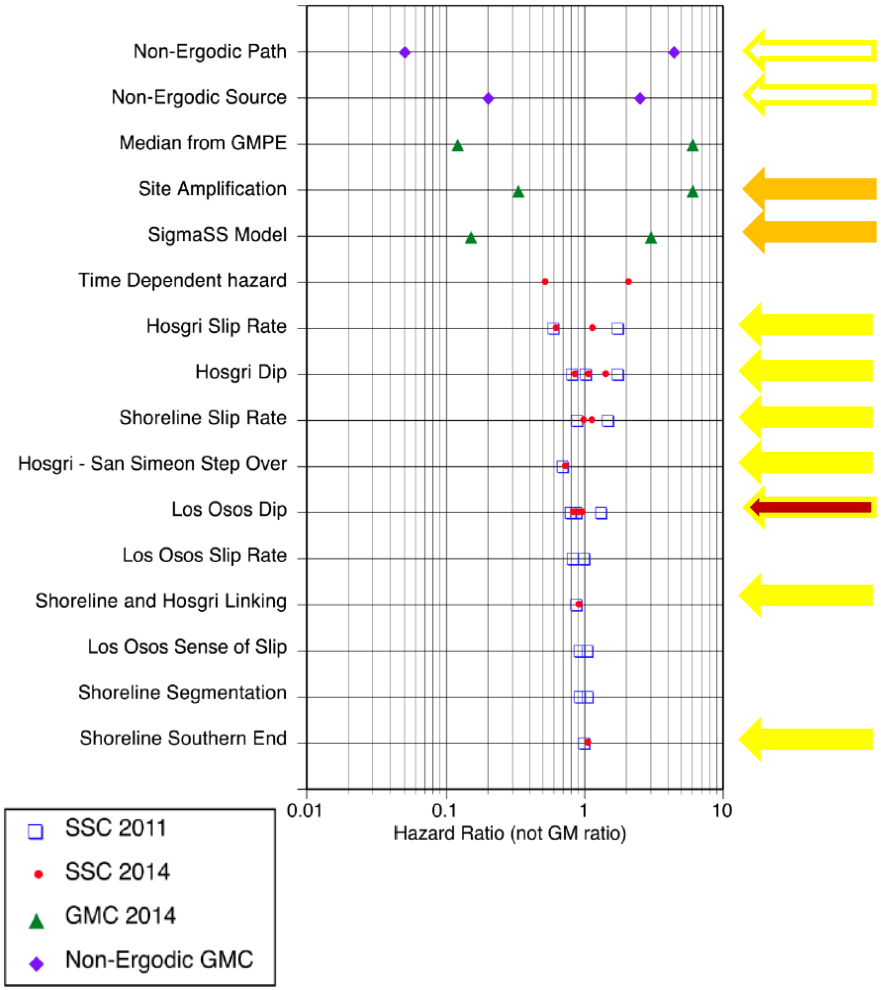

HOSGRI
FAULT
ZONE
NACIMIENTO
FAULT
ZONE
Cambria
Paso Robles
Estero
Morro
Bay
Pismo
Beach
HOSGRI
SAN
JUAN
EAST
HUASNA
Avenal

PG&E indicated that they plan to conduct further studies to improve the quantification of site amplification:

1. PG&E will use new data from recently completed on-land exploration geophysics surveys to develop a new model of Vs beneath the plant site.
2. PG&E will analyze broad band ground motion data to rule out path effects in the current site-specific amplification terms. Since data from two earthquakes are not sufficient to demonstrate that the amplification factors include only modifications of the shaking due to site effects, recorded motion from other earthquakes, particularly earthquakes from the south and west, may help rule out path effects in the amplification terms.
3. PG&E will evaluate site amplification using analytical approaches in which seismic waves are propagated through a velocity model.

Conclusions:

IPRP review since 2011 has focused on “advanced techniques to explore fault zones near Diablo Canyon” and to “help resolve uncertainties surrounding the seismic hazard at Diablo Canyon”



Categories of seismic hazard parameters:

- Studies of faults have helped decrease uncertainty in seismic hazard
- Studies of faults that were inconclusive
- Studies where significant uncertainties remain.
- Studies that will require more recordings of earthquakes at DCPP to resolve.