



nees@UCSB

The University of California at Santa Barbara

The George E. Brown, Jr. Network for Earthquake Engineering Simulation

# Virtual Tour of the NEES@UCSB Permanently Instrumented Field Sites

Your Tour Guide  
Jamison Steidl  
UC Santa Barbara



<http://nees.ucsb.edu>



# NEES

- The George E. Brown Jr., Network for Earthquake Engineering Simulation
- NSF Large Facility Program of 14 shared use equipment sites

# What is NEES?

- A National Shared Use Resource of 14 experimental earthquake engineering research facilities
- All linked by Cyber-Infrastructure
  - NEEShub, NEEScommIT
- A Collaborative Research Environment
- Open Access to Facilities and Data
- A New Paradigm in Experimental Research
  - Remote Participation and Collaboration Through “Telepresence” and “Teleoperation”.

# nees@UCSB

Permanently Instrumented Field Sites  
Garner Valley Downhole Array near Hemet, CA  
Wildlife Liquefaction Array in the Imperial Valley

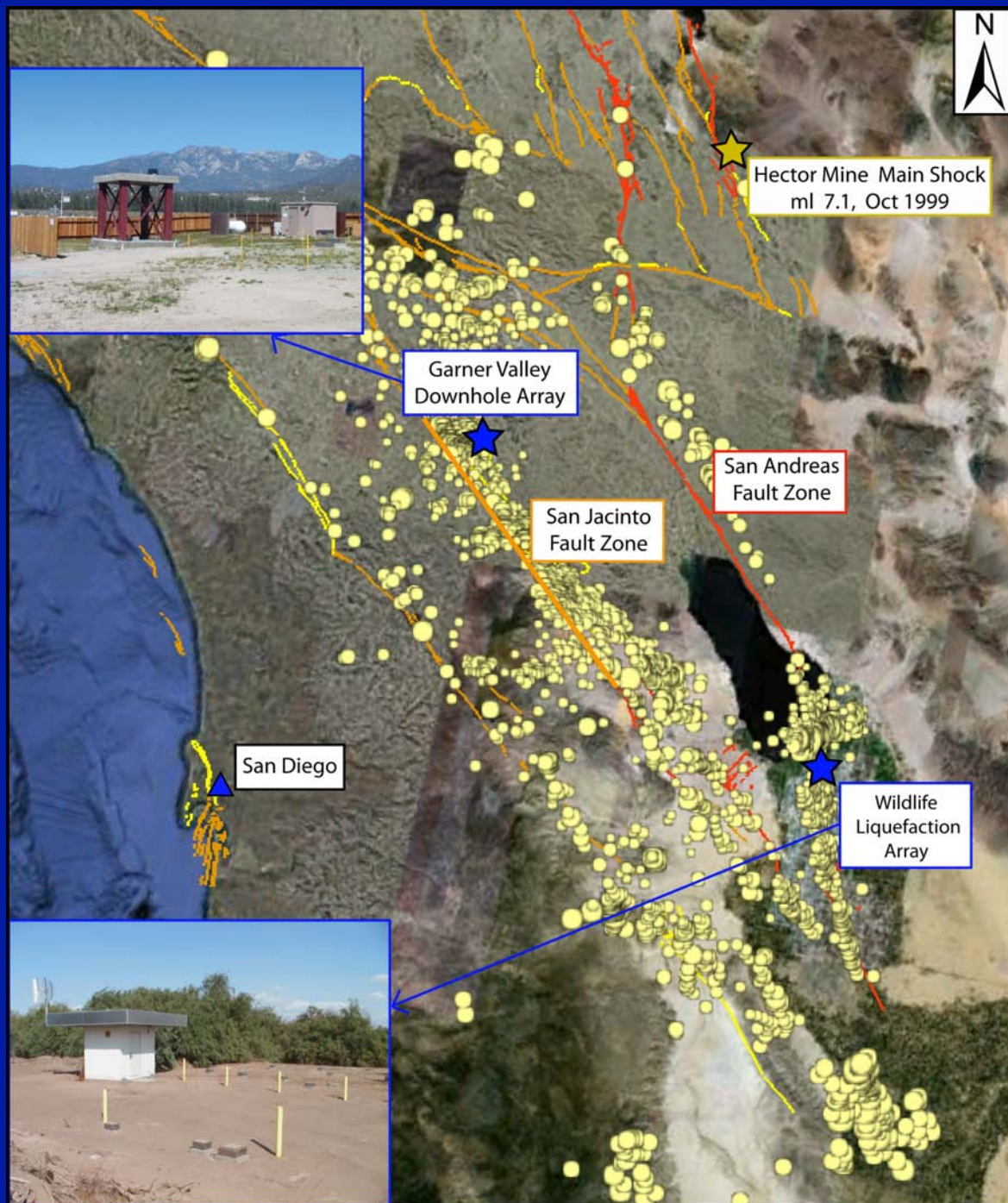


nees@UCSB  
Permanently  
Instrumented  
Field Sites

Garner Valley  
Downhole Array  
GVDA

Wildlife Liquefaction  
Array  
WLA

Over 9500 Events  
recorded from 01/2004  
Thru 02/2011





# GVDA (top) and WLA (bottom) Field Sites



# Today's Tour Schedule

- Introduction & brief background
- Visit the WLA site (via web telepresence)
  - Outside camera – sensors & site layout
  - Inside camera – data acquisition systems & site infrastructure (power, communications)
- Visit the GVDA site (via web telepresence)
  - Outside camera – SFSI, sensors & site layout

# Today's Tour Schedule

- Preview of the “Greatest Hits” of the best observations from the permanent field sites
- Research Vision and Future Potential
- Tour the web-based data dissemination tools for access to the observed acceleration and pore pressure time histories from earthquakes



# Introduction

- Why permanent field sites in NEES
  - Provide densely instrumented Case Histories
  - Calibration and validation of the many new and sometimes complicated models for estimation of site response and nonlinear dynamic soil behavior
  - Development and validation of models that include pore pressure generation in the formulation
  - Validation of models that include ground failure and permanent deformations

# Introduction (cont.)

- Why permanent field sites in NEES
  - Provide a simple, densely instrumented, reconfigurable experimental structure to examine the site/structure interactions
  - Improve our understanding of the physics behind soil-foundation-structure interaction
  - Provide well characterized test sites to conduct active and passive source experiments
  - Provide densely instrumented SFSI Case Histories

# Lets tour the WLA field site

The screenshot shows a web browser window titled "NEES@UCSB - Telepresence" with the URL "http://nees.ucsb.edu/telepresence". The page header includes the "nees@UCSB" logo and the text "The University of California at Santa Barbara" and "The George E. Brown Jr. Network for Earthquake Engineering". A navigation menu contains links for "Facilities", "Projects", "Training", "Personnel", "Outreach", "Partners", "Telepresence", and "Contact Us".

On the left side, there is a "Public Video Feeds" section with two entries:

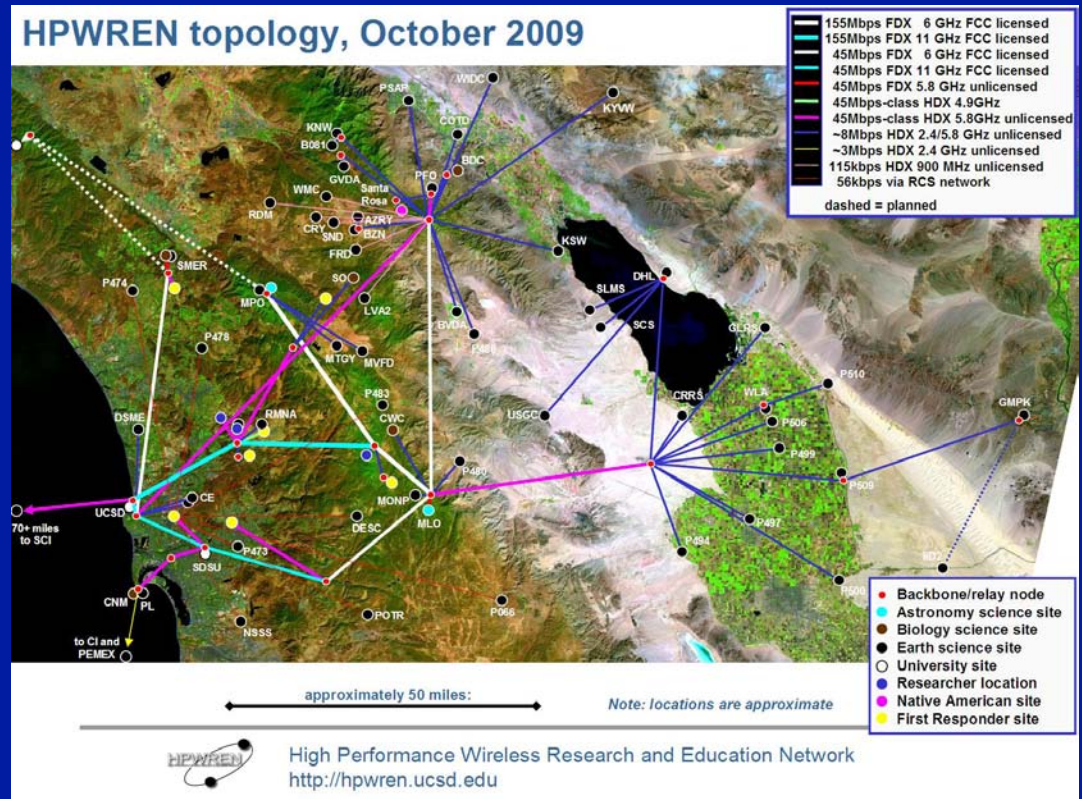
- Garner Valley SFSI Field Site**
  - Full-Size
  - Half-Size
  - Inside
- Wildlife Liquefaction Array**
  - Full-Size
  - Half-Size
  - Internal - when personnel onsite

The main content area displays a live video feed titled "Wildlife Liquefaction Array: Full-Size". The video shows a dirt path with several yellow markers in a field. The video player interface includes controls for "CLOSE", "IRIS CONTROL", "OPEN", "NEAR", "FOCUS CONTROL", "FAR", "ZOOM CONTROL", and "TILT CONTROL". A timestamp "2010-05-29 09:51:18" is visible above the video frame. The browser's status bar at the bottom shows "Done".

<http://nees.ucsb.edu/telepresence>

# Wireless Video & Data Telemetry

## UCSD's NSF Funded HPWREN



HPWREN Provides Network Connectivity here too!



# Quick tour the GVDA field site

The screenshot displays the nees@UCSB website interface. At the top, the logo for nees@UCSB is shown alongside the text "The University of California at Santa Barbara" and "The George E. Brown Jr. Network for Earthquake Engineering". A navigation bar contains links for "Facilities", "Projects", "Training", "Personnel", "Outreach", "Partners", "Telepresence", and "Contact Us".

The main content area is titled "Public Video Feeds" and lists two categories:

- Garner Valley SFSI**
  - Full-Size
  - Half-Size
  - Inside
- Wildlife Liquefactio**
  - Full-Size
  - Half-Size
  - Internal - when pers

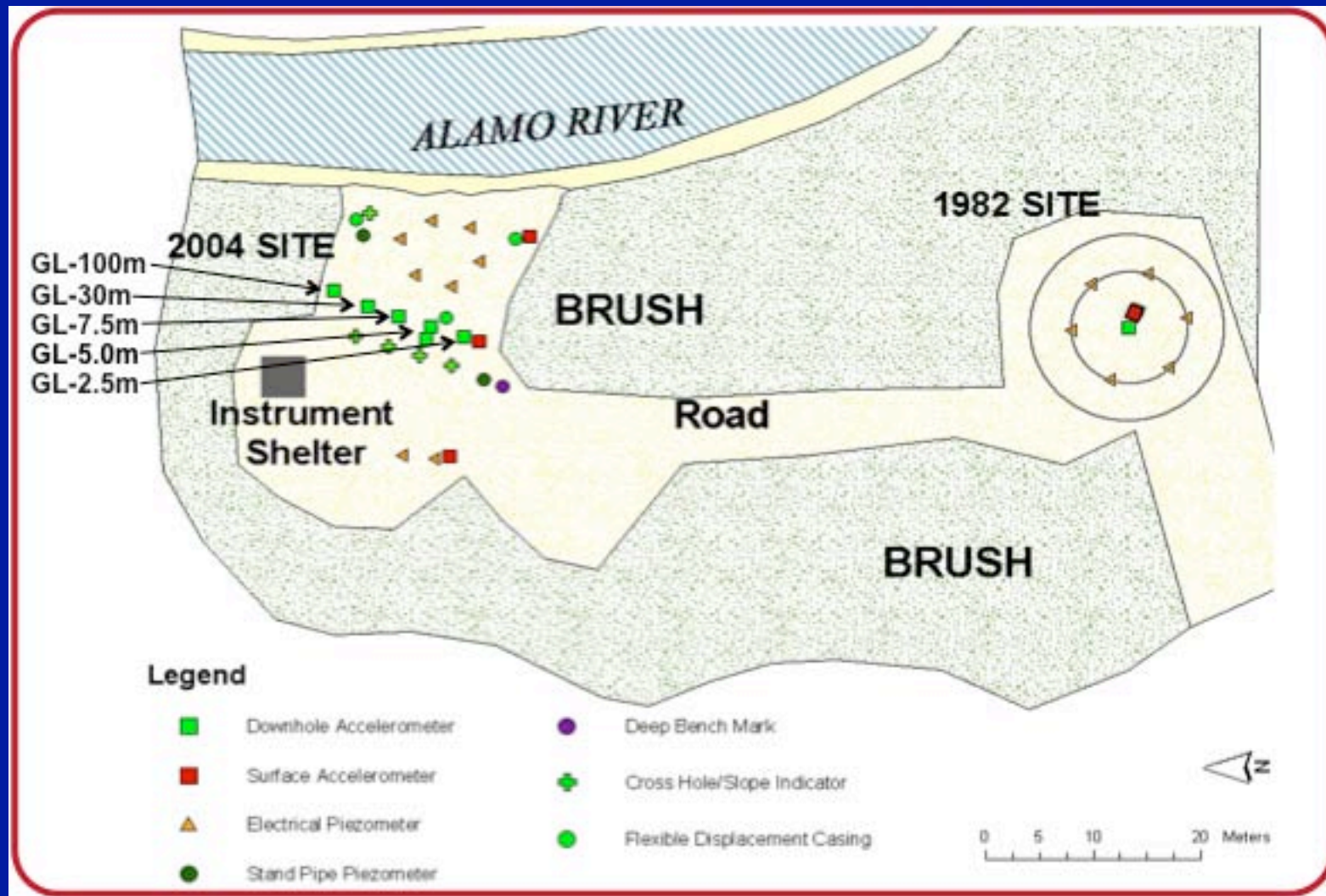
The selected video feed is titled "Garner Valley SFSI Field Site: Full-Size". The interface includes a control panel with the following elements:

- CLOSE** button
- IRIS CONTROL** slider
- OPEN** button
- NEAR** button
- FOCUS CONTROL** slider
- FAR** button
- ZOOM CONTROL** slider
- +** button
- TILT CONTROL** slider

The video feed shows a concrete structure under construction in an open field. The timestamp "gvacam1 2010-05-29 18:16:49" is visible above the video frame.

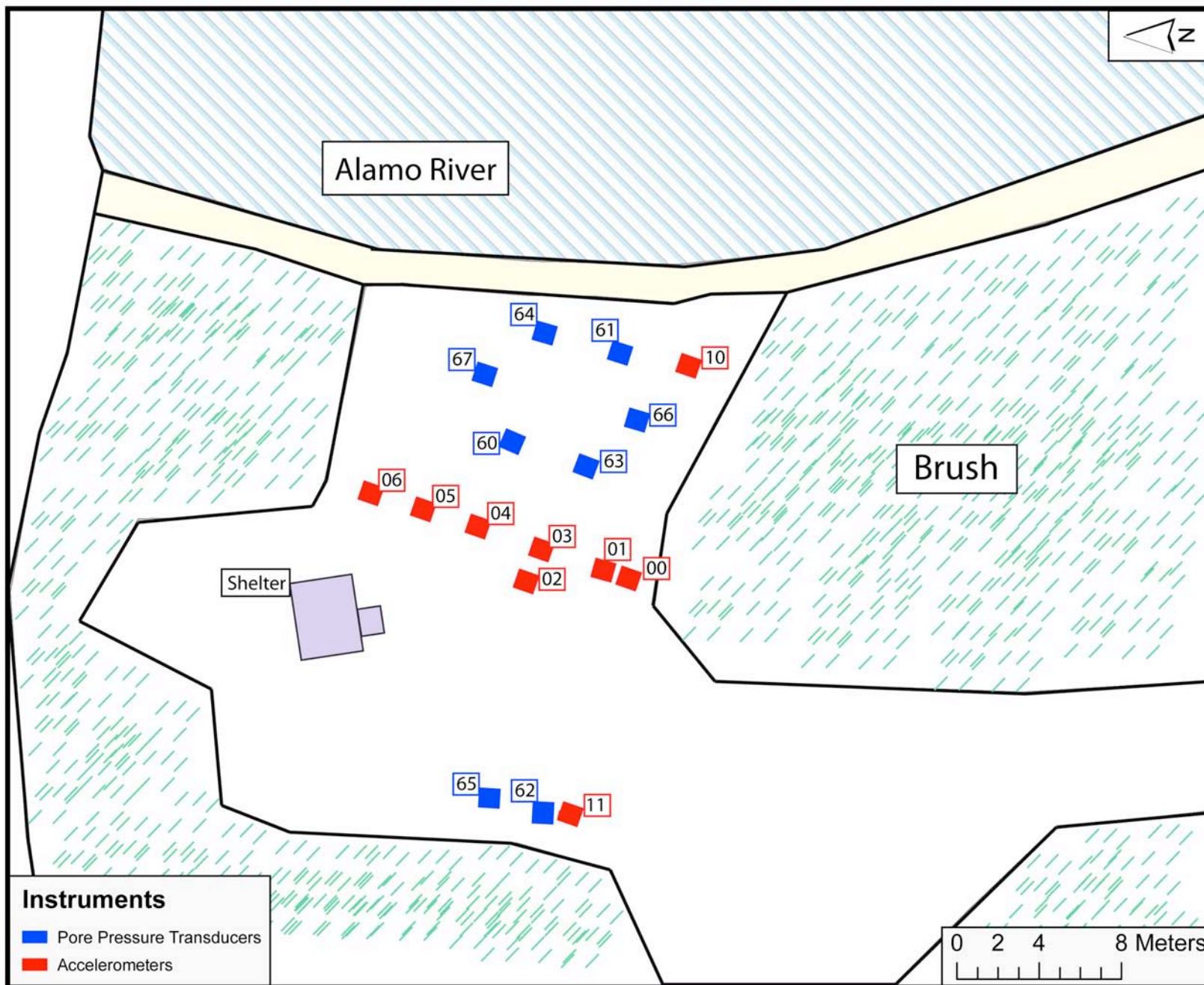
<http://nees.ucsb.edu/telepresence>

# WLA Instrumentation Details



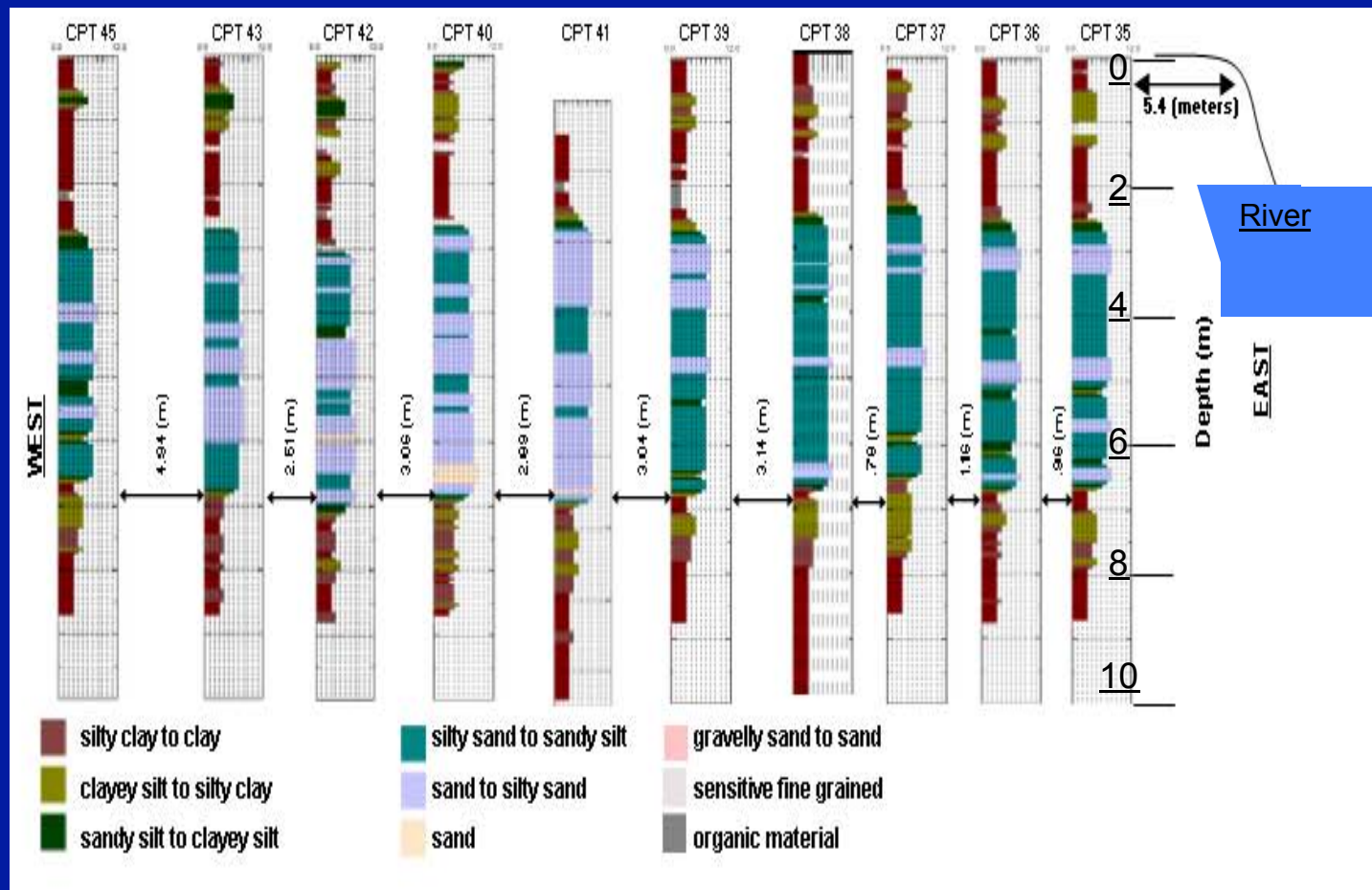


# 2004 Wildlife Liquefaction Array (WLA)



# Extensive Site Condition Information at WLA CPT logs

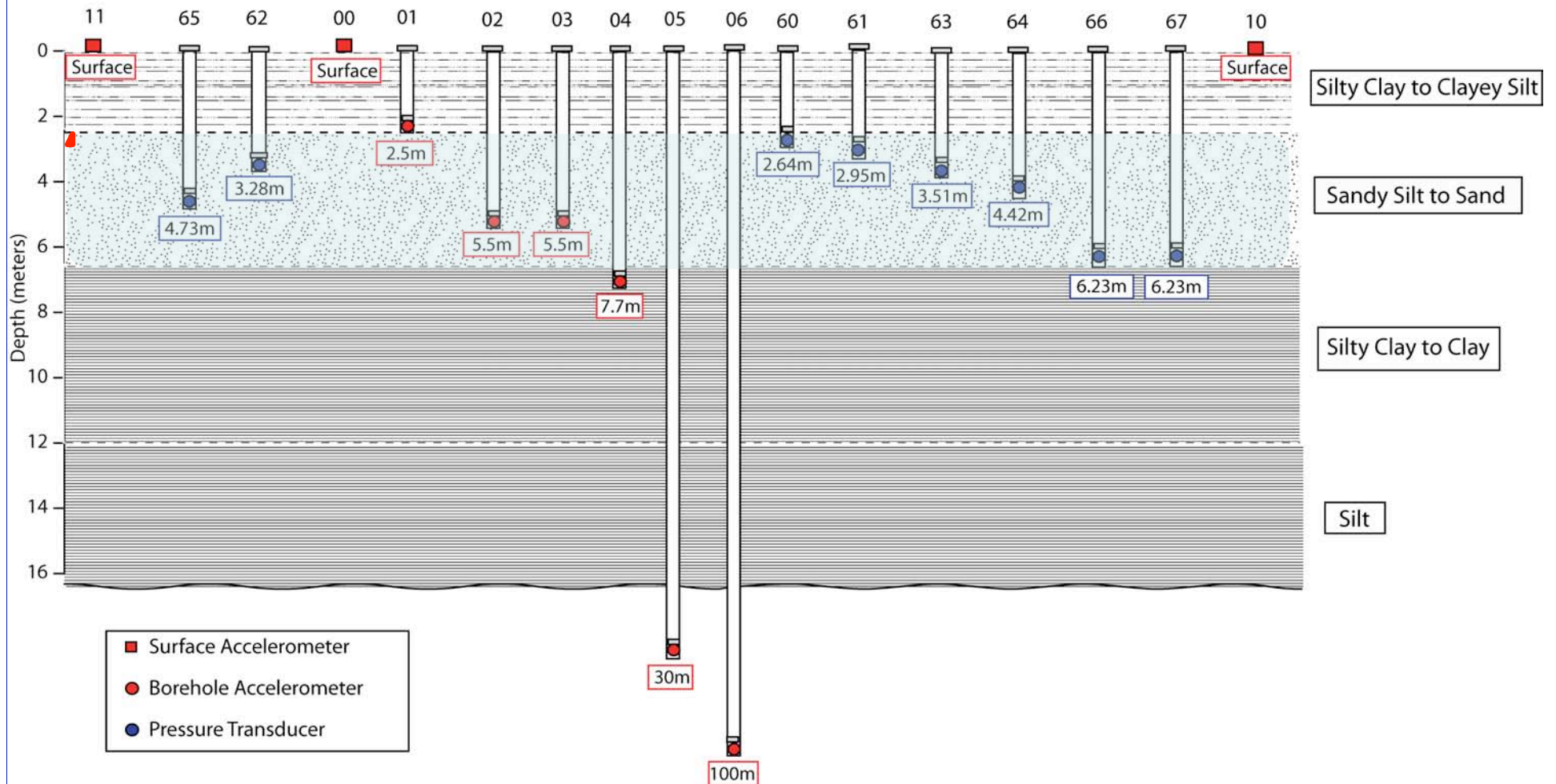
Saturated Sand Layer 2.5m – 6.8m, Clay Layers Above and Below





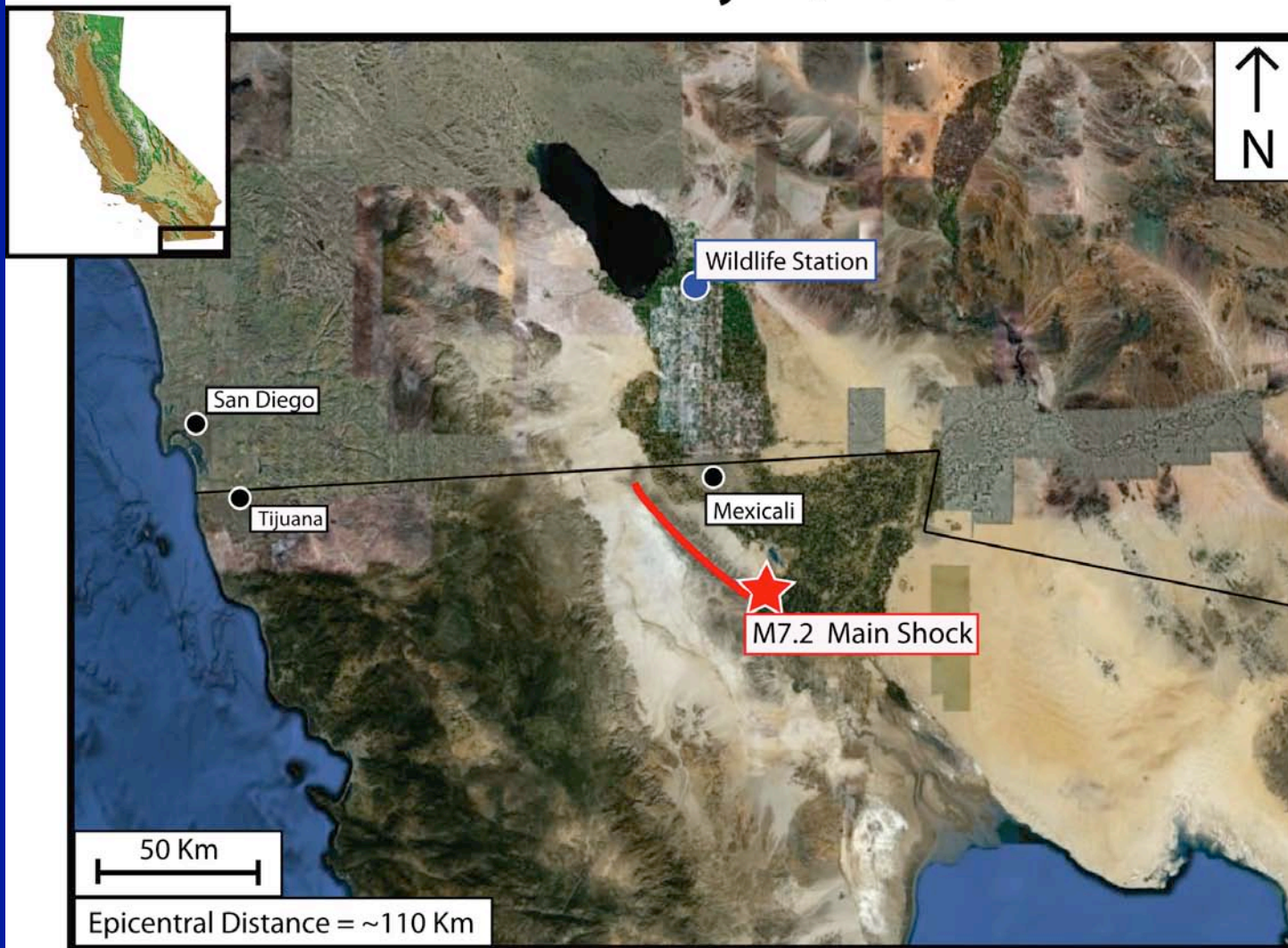
# Instrumentation Cross-Section (note location codes)

## 2004 Wildlife Liquefaction Array (WLA)



# Lets tour the observed “greatest hits”

## M7.2 Sierra el Mayor, 4/4/2010



# A Snapshot of Conditions before the Onset of Liquefaction:

$$r_u \sim 10-20\%$$

Peak Acceleration  $\sim 10\% g$

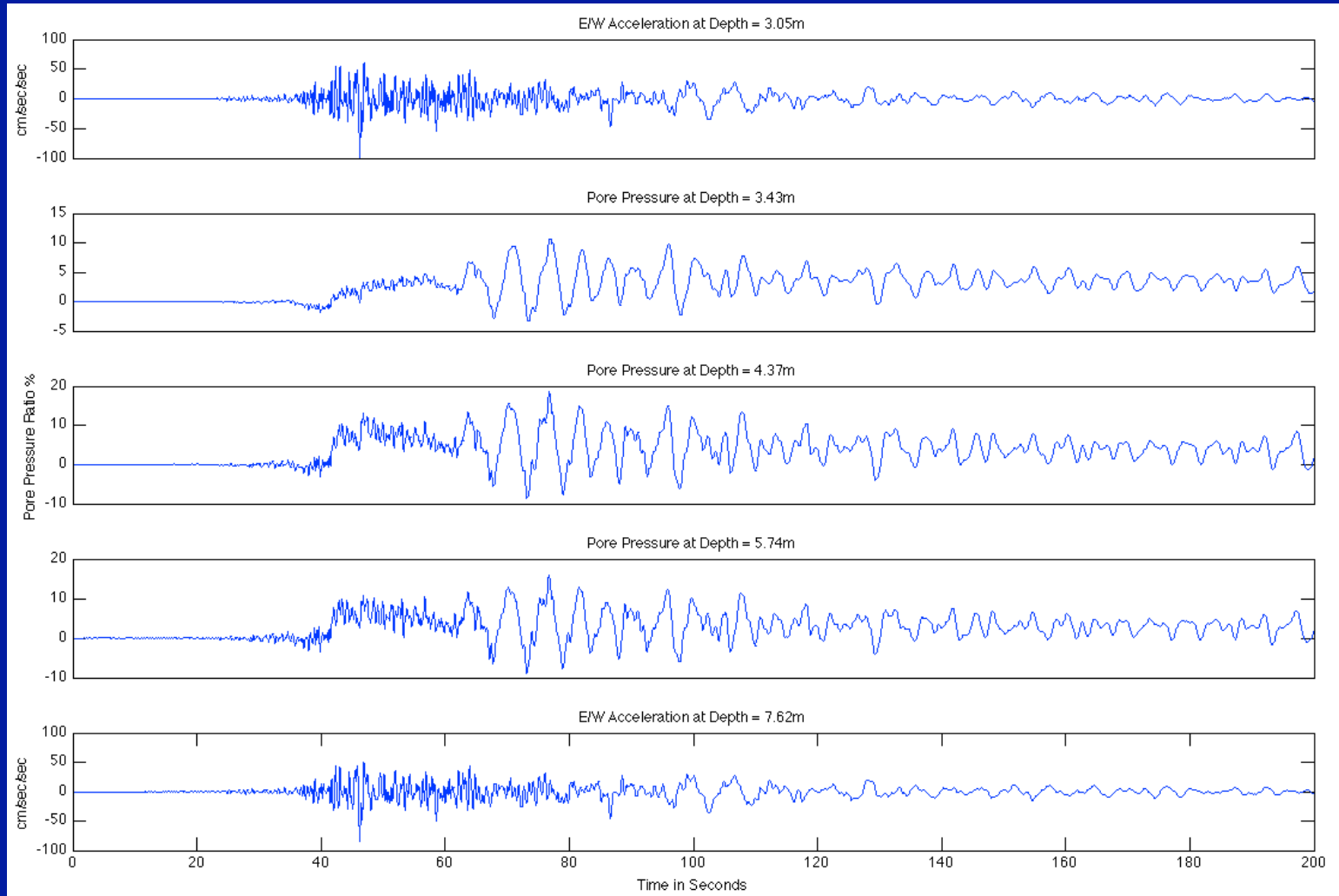
Acceleration  
Above Sand  
Layer  
GL-3.0m

GL-3.4m

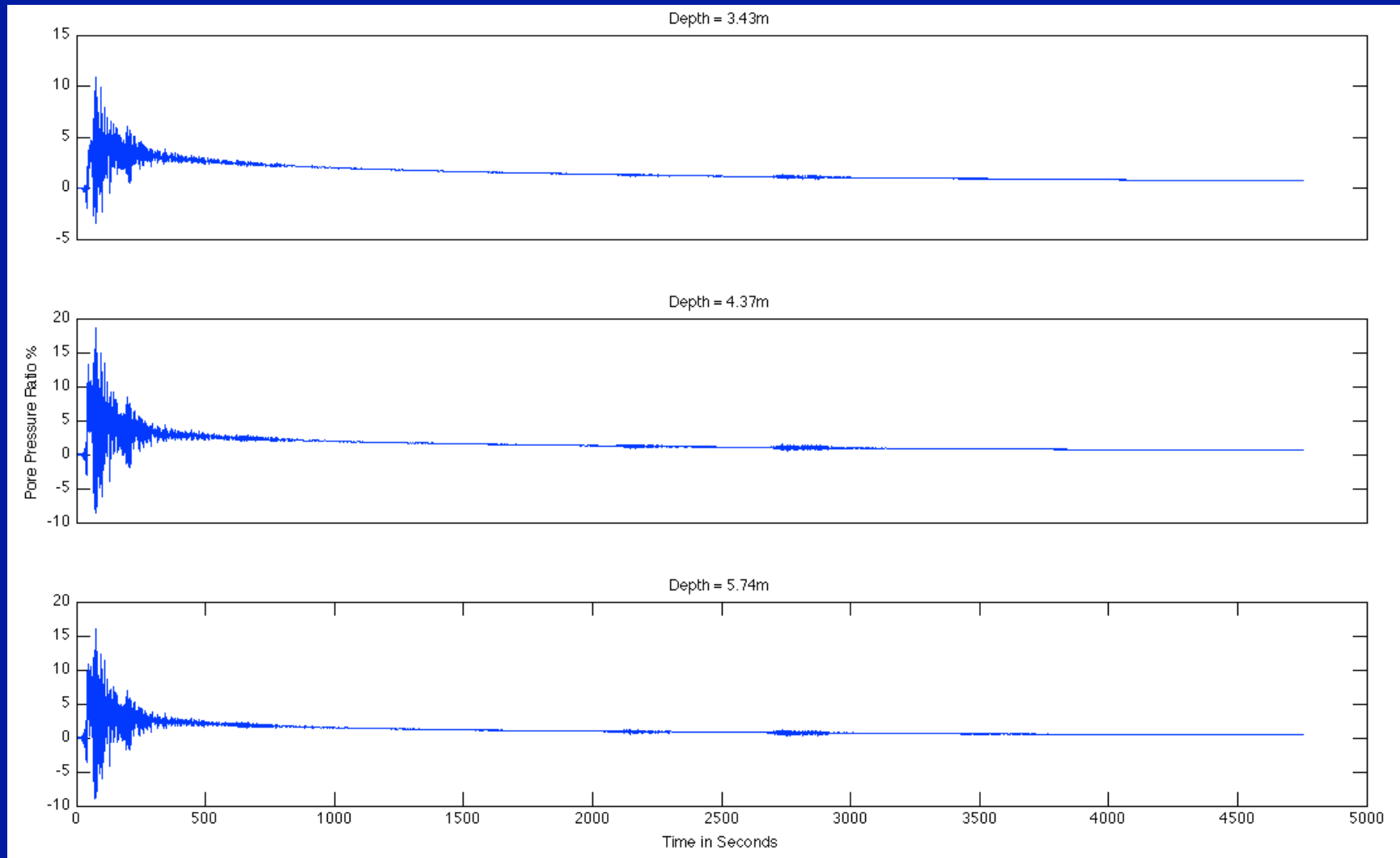
GL-4.4m

GL-5.7m

Acceleration  
Below Sand  
Layer  
GL-7.6m



## Pore Pressure Response - Long (1.5 hrs!) Recovery Time



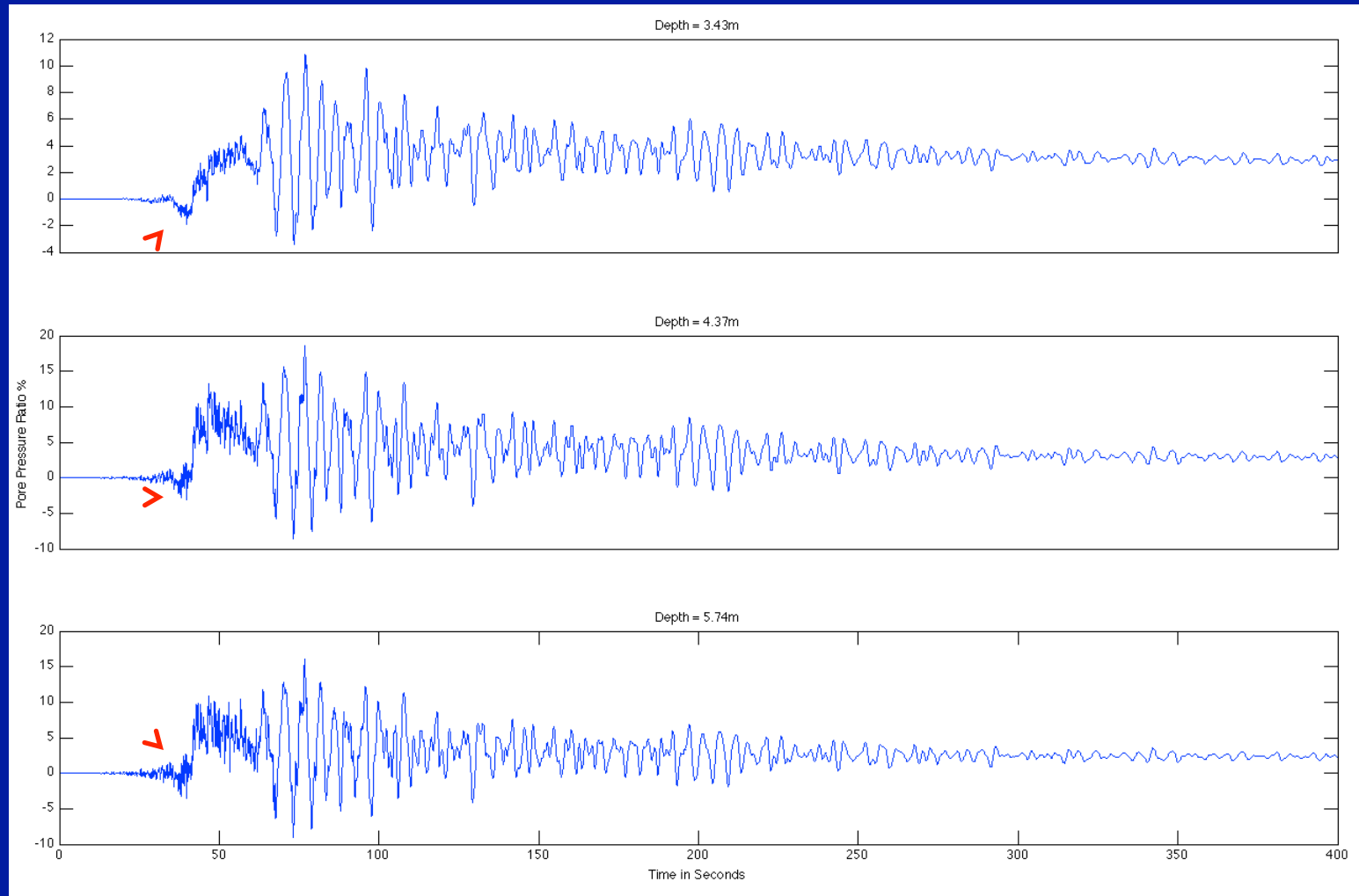
Data is recorded continuously, not triggered, so we can observe these effects



# Unique Observations

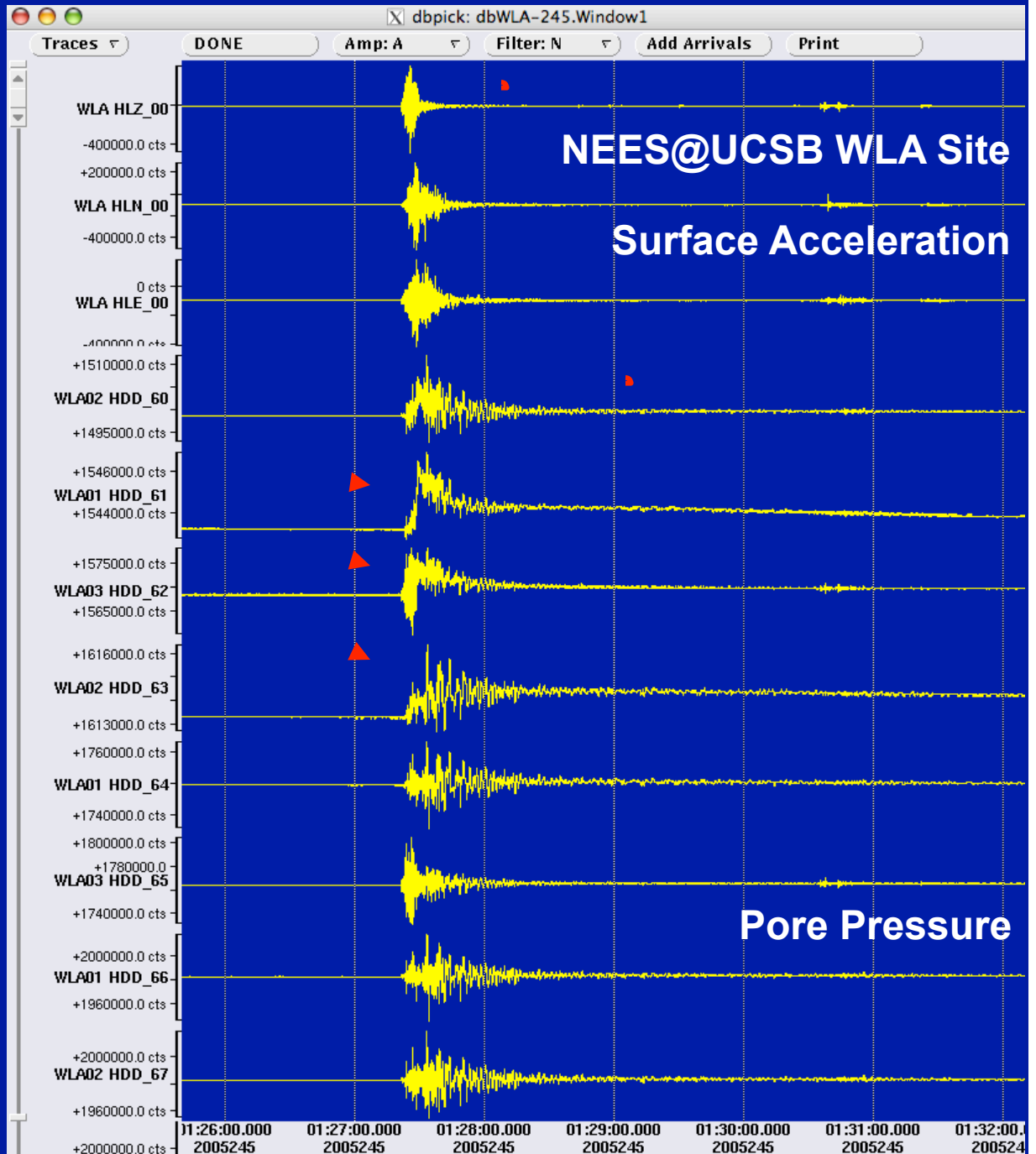
## Pore Pressure Response - Pressure decreases before Increase!

Pore Pressure  
Decreases  
before  
Increasing



Over 6 minutes of pore pressure ratio shown  
Note the effect of Surface Waves in the Imperial Valley

- Pore Pressure Increase
- Slow recovery back to pre-event pore pressure level
- 2005 M5.1 Obsidian Buttes Mainshock Event
- Imperial Valley, CA



Traces ▾ DONE Amp: A Filter: N Add Arrivals Print

# Obsidian Buttes Swarm at WLA site

P4 - LQ1 - 2.7m

M4.4 M4.6

P1 - LQ2 - 2.9m

P7 - LQ3 - 3.4m

Shallow Pore Pressure Increase and Slow Recovery

P3 - LQ4 - 3.7m

P4 - LQ5 - 4.4m

P8 - LQ6 - 4.4m

P2 - LQ7 - 6.4m

60 minutes of data from the Liquefaction Array

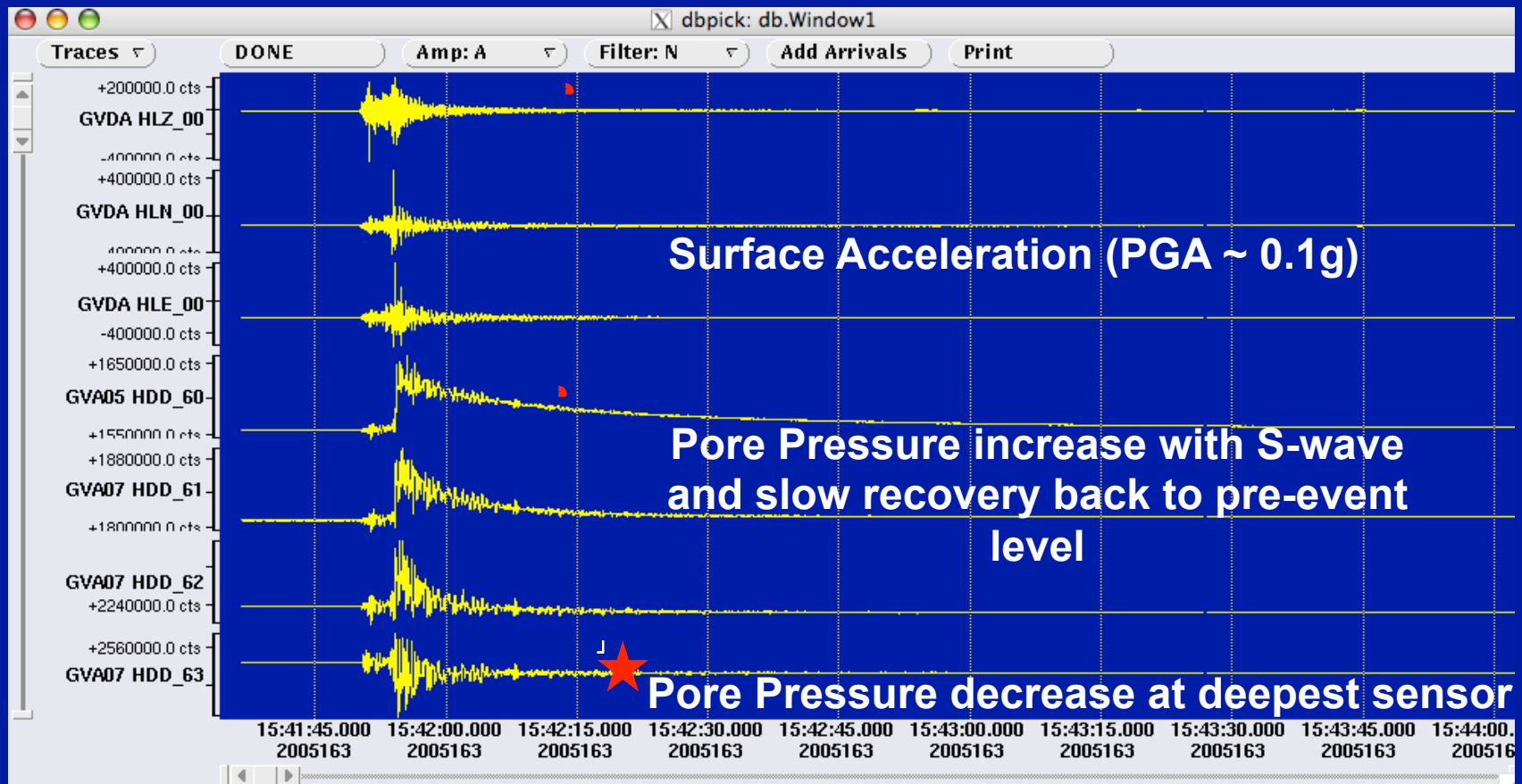
P5 - LQ8 - 6.4m

+111.6 nm  
WLA02 HDD\_60  
+111.2  
+110.8  
+110.4  
+110.0 nm  
+114.5 nm  
WLA01 HDD\_61  
+114.4  
+114.2  
+114.1 nm  
+116.8 nm  
WLA03 HDD\_62  
+116.4  
+116.0  
+115.6 nm  
+119.7 nm  
WLA02 HDD\_63  
+119.7  
+119.6  
+119.5  
+119.4 nm  
+130.4 nm  
WLA01 HDD\_64  
+130.0  
+129.2  
+128.8 nm  
+132.0 nm  
WLA03 HDD\_65  
+131.5  
+130.0  
+129.5 nm  
+149.0 nm  
WLA01 HDD\_66  
+148.0  
+147.0  
+145.0  
+144.0  
+143.0 nm  
+149.0 nm  
WLA02 HDD\_67  
+148.0  
+146.0  
+145.0 nm

22:45:00.000 2005243 22:50:00.000 2005243 22:55:00.000 2005243 23:00:00.000 2005243 23:05:00.000 2005243 23:10:00.000 2005243 23:15:00.000 2005243 23:20:00.000 2005243 23:25:00.000 2005243 23:30:00.000 2005243 23:35:00.000 2005243 23:40:00.000 2005243

# NEES@UCSB Garner Valley

- Pore pressure on GVDA Liquefaction array
- 2005 M5.1 Anza Event



150 Seconds of data

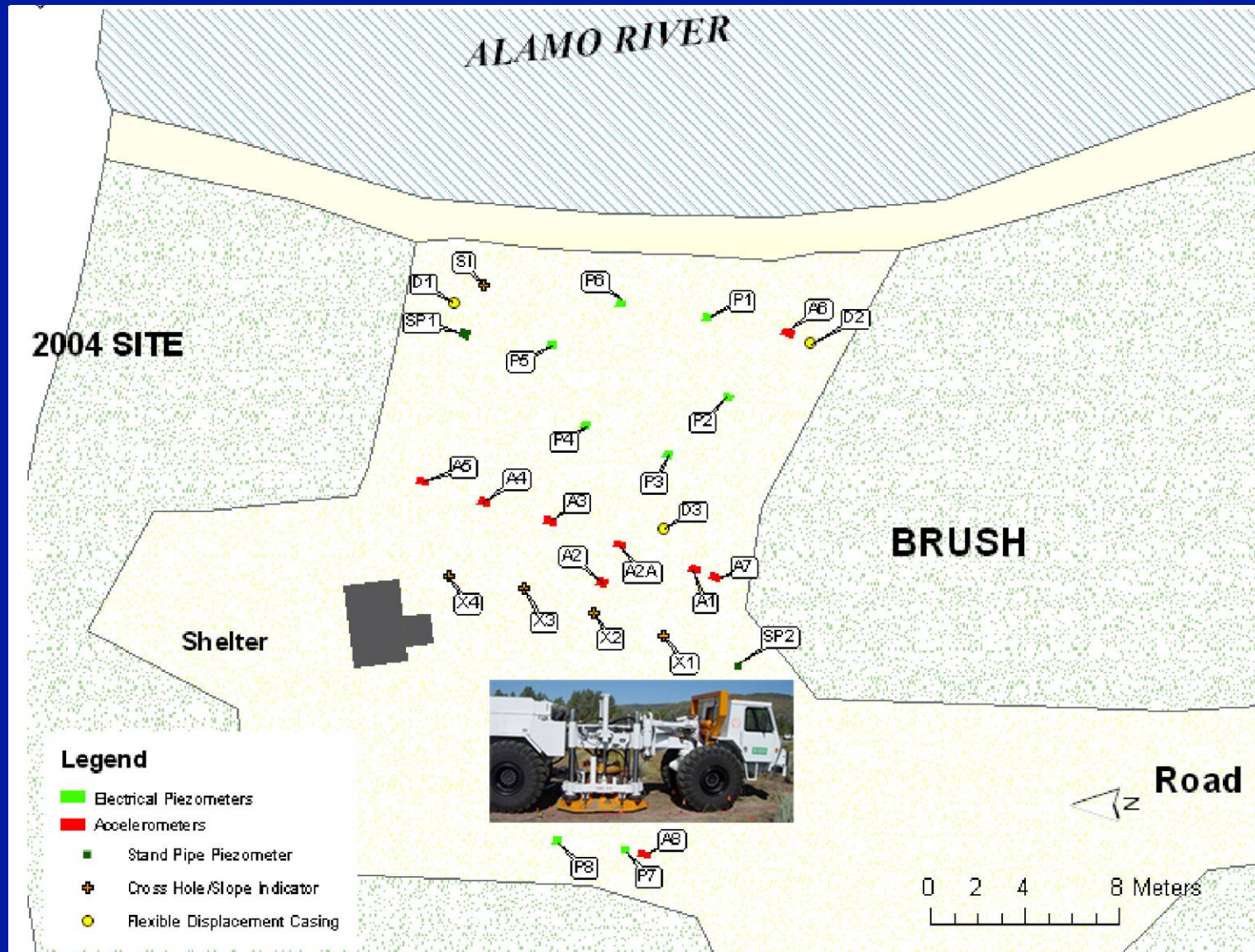


# Active Source Generation of Liquefaction NEES@UTA “T-Rex” Shaker WLA Site - Imperial Valley, CA





# T-Rex shaking relative to permanent array at WLA





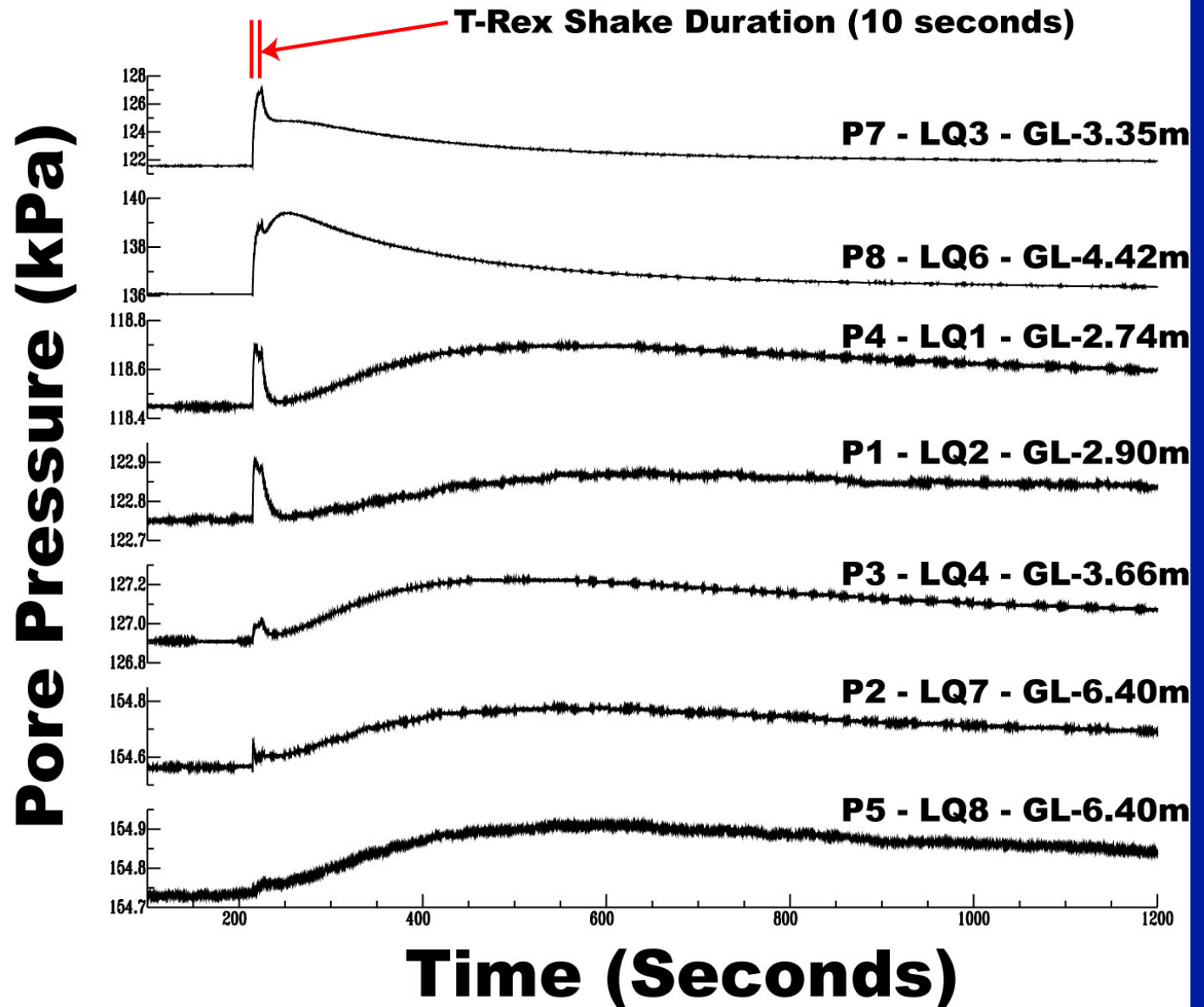
# T-Rex Shaking at WLA Site



# Learning about Liquefaction

“T-Rex”  
Excites the  
Liquefaction  
Array  
at WLA

T-Rex Shaking the Wildlife Liquefaction Array - August 10, 2005





# Use of WLA for SFSI Experiment

UC Berkeley NEESR Grand Challenge

NEES@UCLA and project co-PI Stewart testing at WLA



NEES@UCLA's "Mighty Mouse" shakes the temporary structure at WLA

# Soil-Foundation-Structure Interaction Test Facility at Garner Valley

Design Model

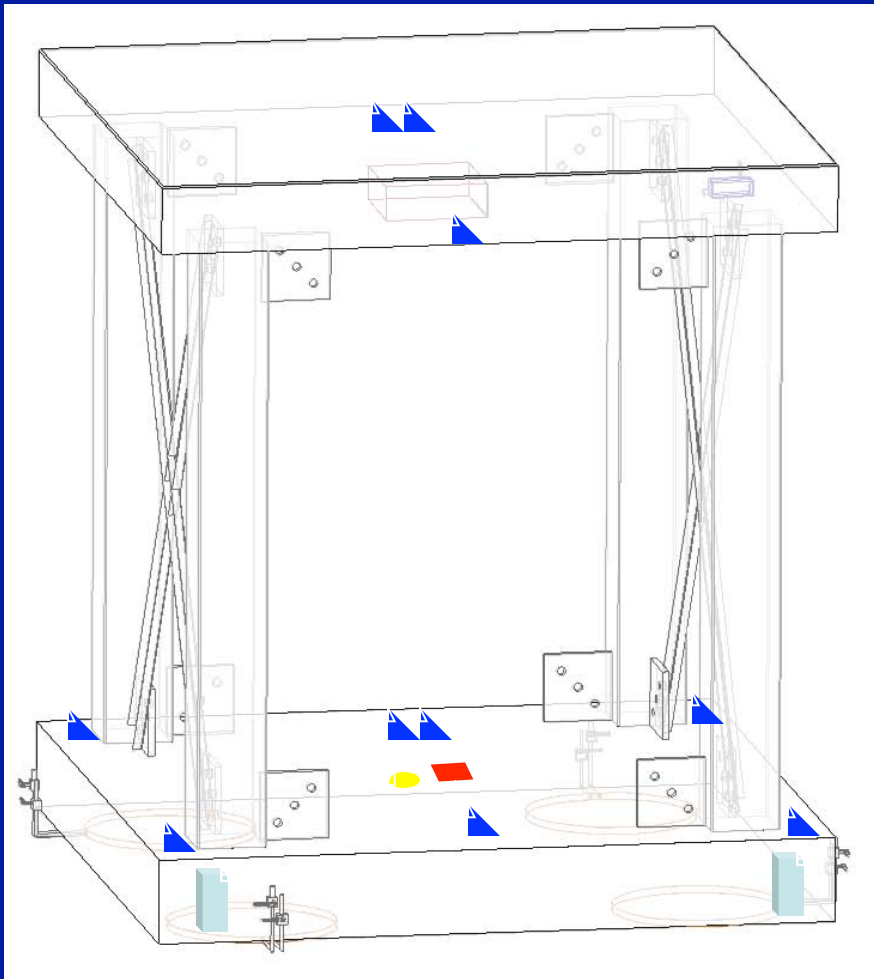


As-Built Test Structure at GVDA



Re-configurable Steel frame structure  
Stiffness and Mass can be modified

# SFSI Instrumentation



 Uni-axial Accelerometer



 Tri-axial Accelerometer

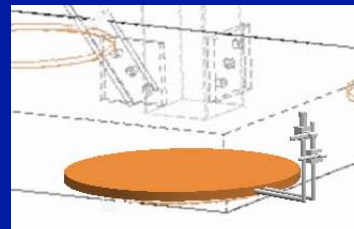


 Rotation Sensor

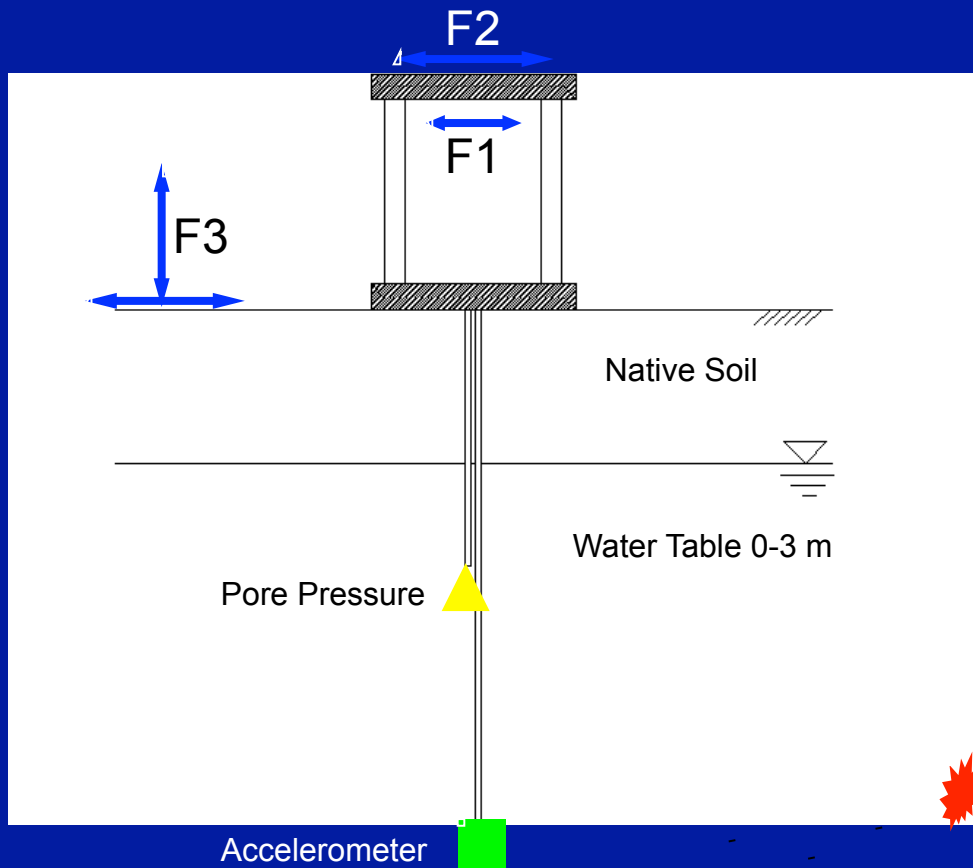
 Displacement Transducer



 Pressure Cell and Sensor



# SFSI Monitoring at Garner Valley



F1 : Permanent Shaker



F2 : NEES@UCLA Shaker



F3 : NEES@UTexas Shaker



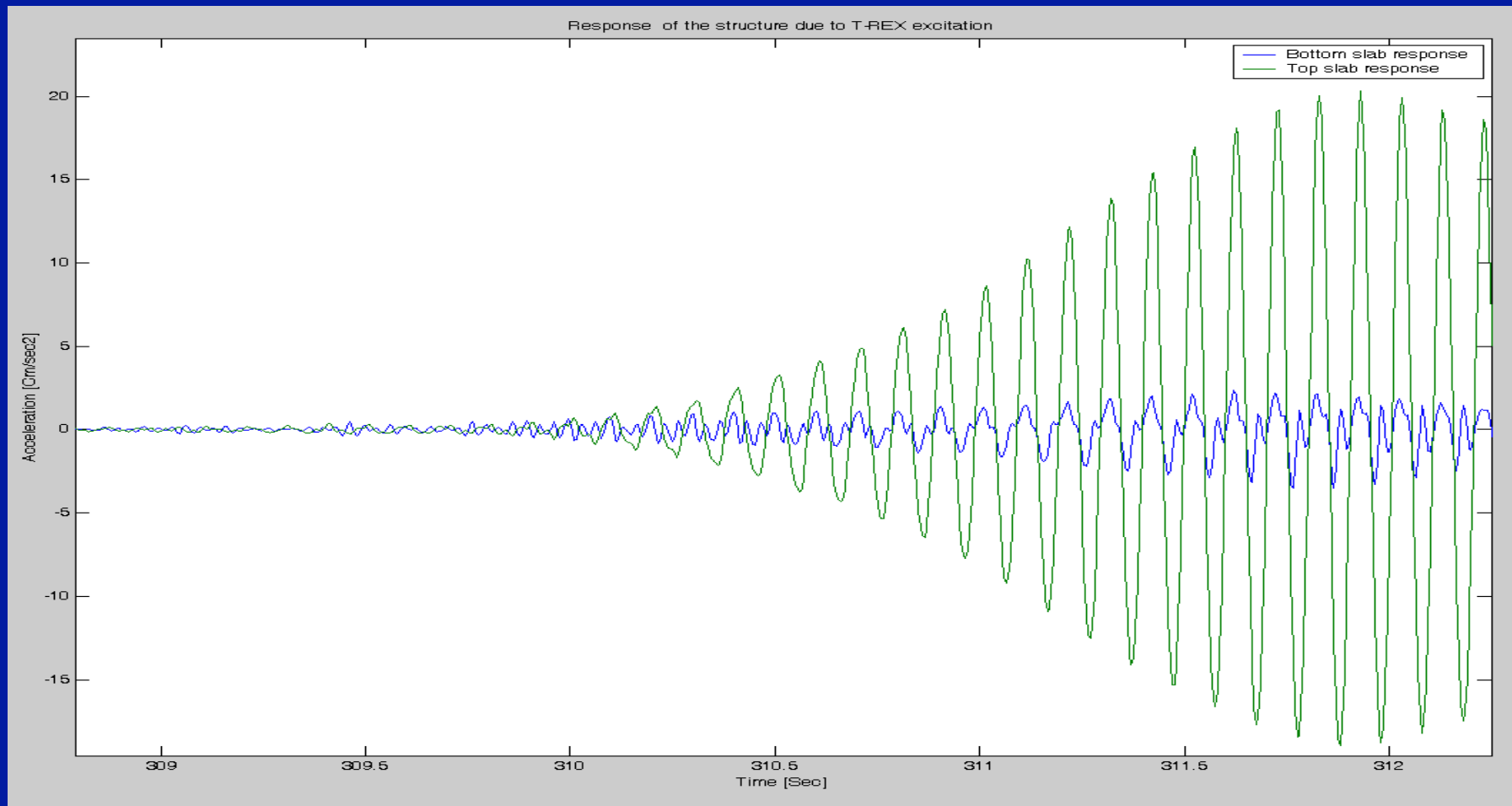
F4: Natural Earthquake





# Making Waves at GVDA with T-Rex

Response of the structure (Top slab and bottom slab )  
Excited by T-REX Shaker





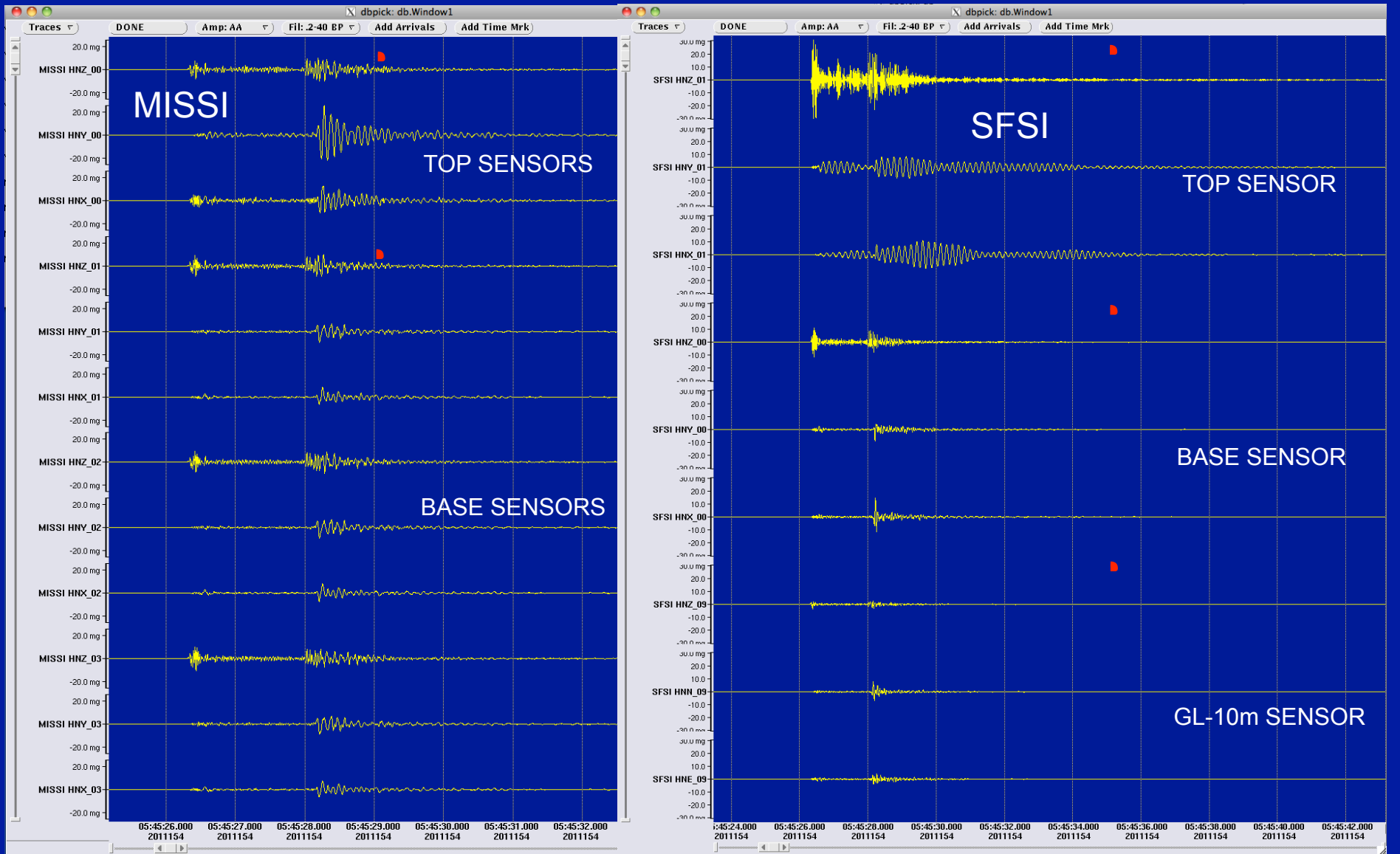
# SFSI Research @ GVDA

UC Berkeley NEESR Grand Challenge  
NEES@UCLA and project co-PI Stewart testing at GVDA



# SFSI Research @ GVDA

## Braced vs. Unbraced Response




# New Projects

- Looking forward to assisting researchers develop proposals to use the [nees@UCSB](mailto:nees@UCSB) facilities for future testing
- Potential Resources: NSF NEESR and USGS NEHRP solicitations, due yearly in Spring

# NSF NEESR Solicitation

Nov. 2, 2011  
RFP 11-566


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- Industrial Innovation and Partnerships (IIP)

Proposals and Awards

- Proposal and Award Policies and Procedures Guide
- Introduction
- Proposal Preparation and Submission
- Grant Proposal Guide
- Grants.gov Application Guide

Email Print Share

## George E. Brown, Jr. Network for Earthquake Engineering Simulation Research (NEESR)

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PROGRAM GUIDELINES

Solicitation [11-566](#)

DUE DATES

Full Proposal Deadline Date: November 2, 2011

SYNOPSIS

The Division of Civil, Mechanical and Manufacturing Innovation (CMMI) in the Directorate for Engineering (ENG) of the National Science Foundation (NSF) invites proposals for research that uses the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) to advance knowledge, discovery, and innovation for (1) earthquake and tsunami loss reduction of our nation's civil infrastructure, and (2) new experimental simulation techniques and instrumentation for NEES. NEES comprises a network of 14 earthquake engineering experimental equipment sites available for experimentation on-site or in the field and through telepresence. NEES equipment sites include shake tables, geotechnical centrifuges, a tsunami wave basin, unique large-scale testing laboratory facilities, and mobile and permanently installed field equipment. The NEEShub cyberinfrastructure connects, via Internet2, the equipment sites as well as provides telepresence; a curated central data repository known as the NEES Project Warehouse; simulation tools; collaborative tools for facilitating on-line planning, execution, and post-processing of experiments; and the NEES Academy for education and outreach. Projects proposed and supported under this solicitation must require significant use of one or more of the NEES equipment sites listed at <http://www.nees.org> and the related cyberinfrastructure and/or require significant reuse of data curated and archived in the NEES Project Warehouse at <http://nees.org/warehouse>. Proposals that seek new scientific inquiry through reuse of data curated and archived in the NEES Project Warehouse, either alone or in combination with use of the NEES equipment site(s), will be considered. The data eligible for reuse from the NEES Project Warehouse must be



George E. Brown, Jr. Network for Earthquake Engineering Simula

http://www.nsf.gov/pubs/2011/nsf11566/nsf11566.htm

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## George E. Brown, Jr. Network for Earthquake Engineering Simulation Research (NEESR)

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### PROGRAM SOLICITATION


#### NSF 11-566

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#### REPLACES DOCUMENT(S):

##### NSF 11-512

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**National Science Foundation**  
Directorate for Engineering  
Civil, Mechanical and Manufacturing Innovation

**Full Proposal Deadline(s)** (due by 5 p.m. proposer's local time):  
November 02, 2011

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#### IMPORTANT INFORMATION AND REVISION NOTES

A revised version of the *NSF Proposal & Award Policies & Procedures Guide (PAPPG)*, *NSF 11-1*, was issued on October 1, 2010 and is effective for proposals submitted, or due, on or after January 18, 2011. Please be advised that the guidelines contained in *NSF 11-1* apply to proposals submitted in response to this funding opportunity.

**Cost Sharing:** The PAPPG has been revised to implement the National Science Board's recommendations regarding cost sharing. Inclusion of voluntary committed cost sharing is prohibited. In order to assess the scope of the project, all organizational resources necessary for the project must be described in the Facilities, Equipment and Other Resources section of the proposal. The description should be narrative in nature and must not include any quantifiable financial information. Mandatory cost sharing will only be required when explicitly authorized by the NSF Director. See the PAPP Guide Part I: *Grant Proposal Guide (GPG) Chapter II.C.2.g(xi)* for further information about the implementation of these recommendations.

**Data Management Plan:** The PAPPG contains a clarification of NSF's long standing data policy. All proposals must describe plans for data management and sharing of the products of research, or assert the absence of the need for such plans. FastLane will not permit submission of a proposal that is missing a Data Management Plan. The Data Management Plan will be reviewed as part of the intellectual merit or broader impacts of the proposal, or both, as appropriate. Links to data management requirements and plans relevant to specific Directorates, Offices, Divisions, Programs, or other NSF units are available on the NSF website at: <http://www.nsf.gov/bfa/dias/policy/dmp.jsp>. See *Chapter II.C.2.j* of the GPG for further information about the implementation of this requirement.

**Postdoctoral Researcher Mentoring Plan:** As a reminder, each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document, a description of the mentoring activities that will be provided for such individuals. Please be advised that if required, FastLane will not permit submission of a proposal that is missing a Postdoctoral Researcher Mentoring Plan. See *Chapter II.C.2.j* of the GPG for further information about the implementation of this requirement.

<http://www.nsf.gov/pubs/2011/nsf11566/nsf11566.htm>

Please visit us at . . .  
<http://nees.ucsb.edu/>

Special Thanks to the nees@UCSB Team:

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Francesco Civiilini  
Robin Gee

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