TexNet and CISR: An Update on Monitoring and Understanding Seismicity in Texas

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UIC Conference
February 23, 2017

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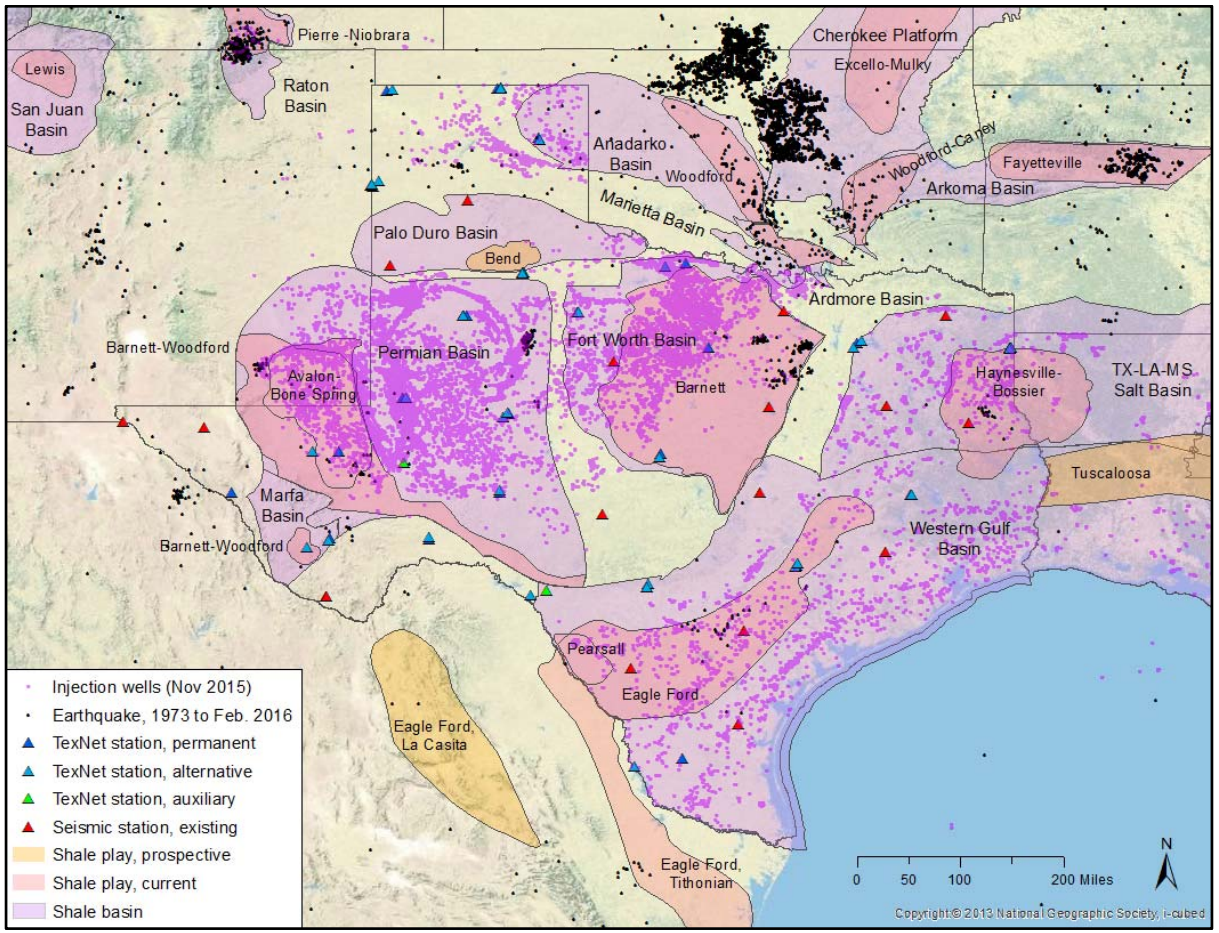
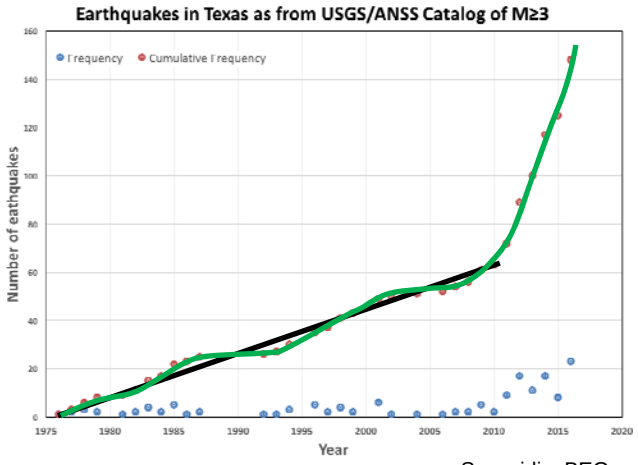
Texas Shale Basins, Injection, Seismicity

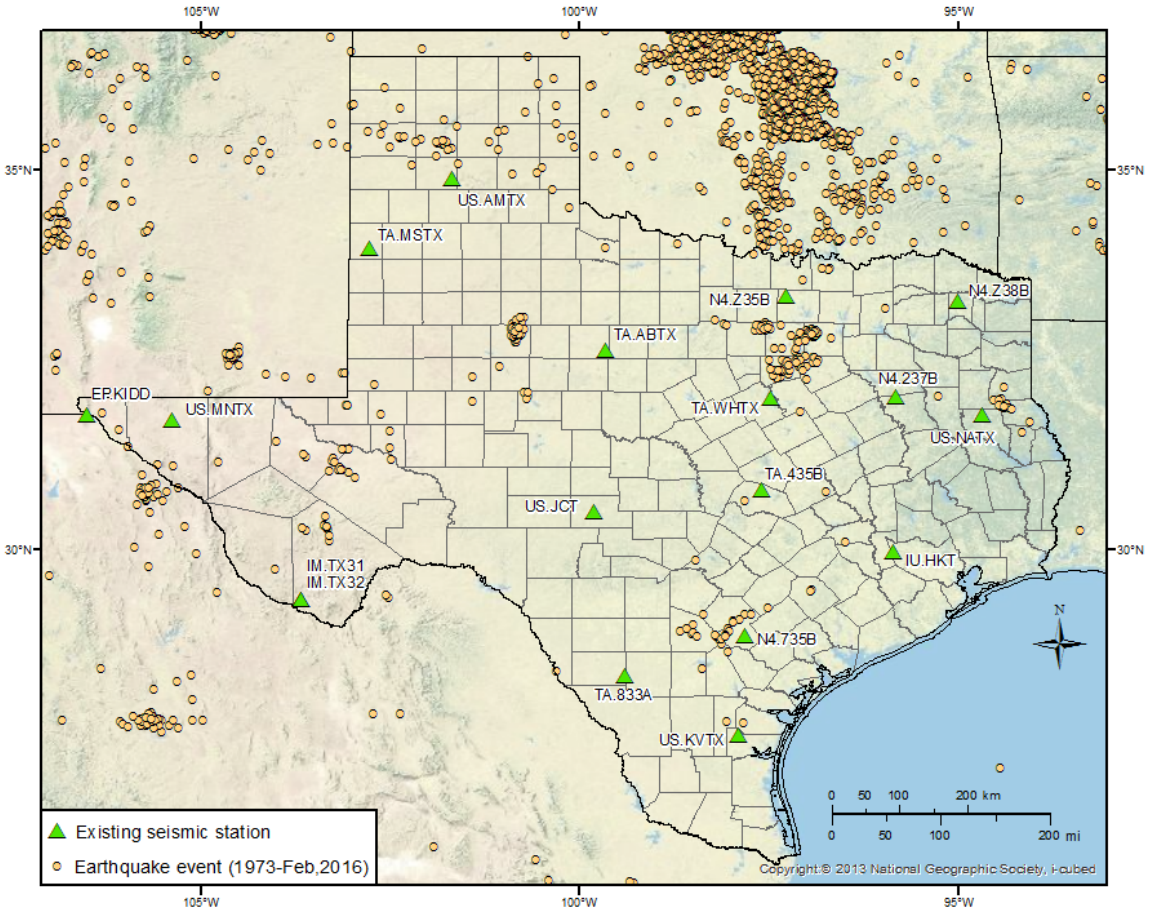
- ~50,000 injection wells permitted since 1930's
- ~34,000 active injection wells for enhanced oil production
- ~8,000 permitted UIC Class II disposal wells



Seismic Activity in Texas



Savvaidis, BEG



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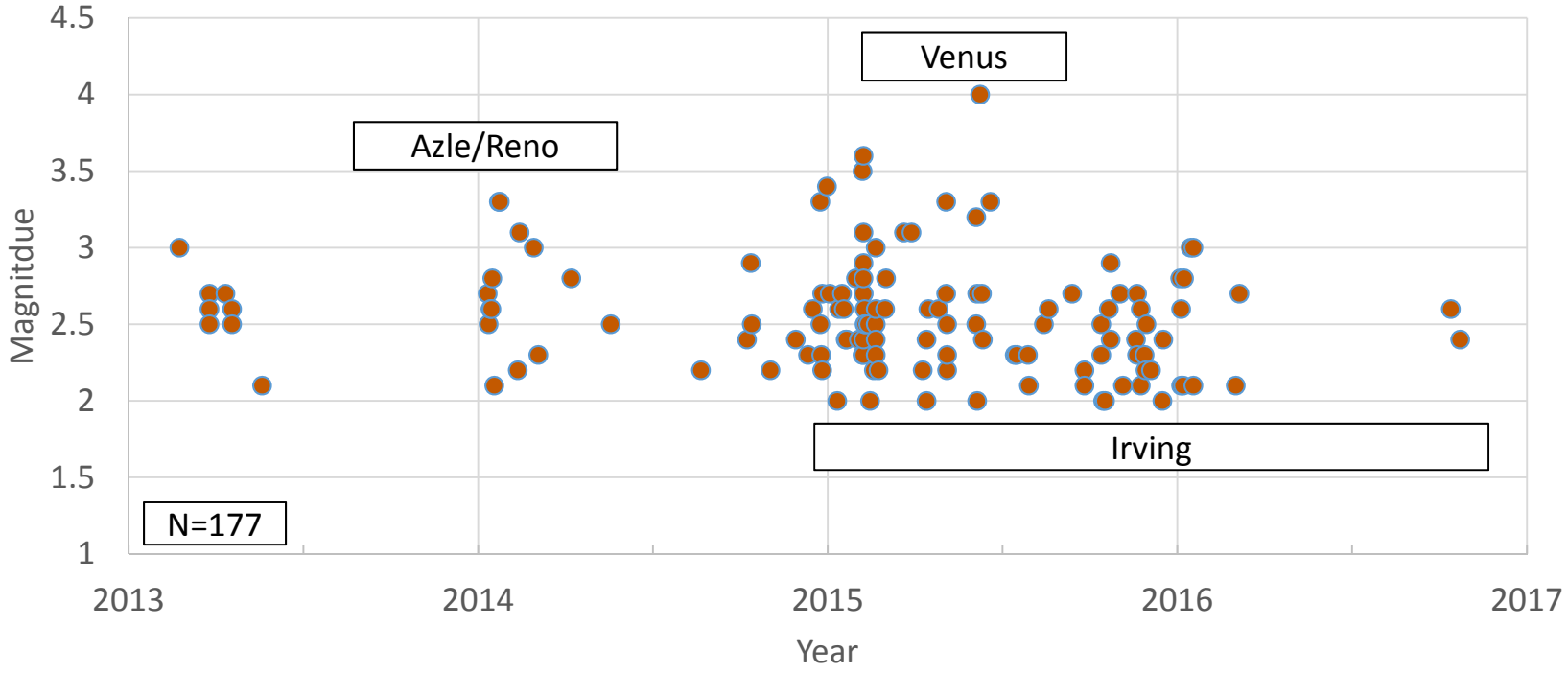
Activity (>M2.0) in DFW Area (since 1/2013)



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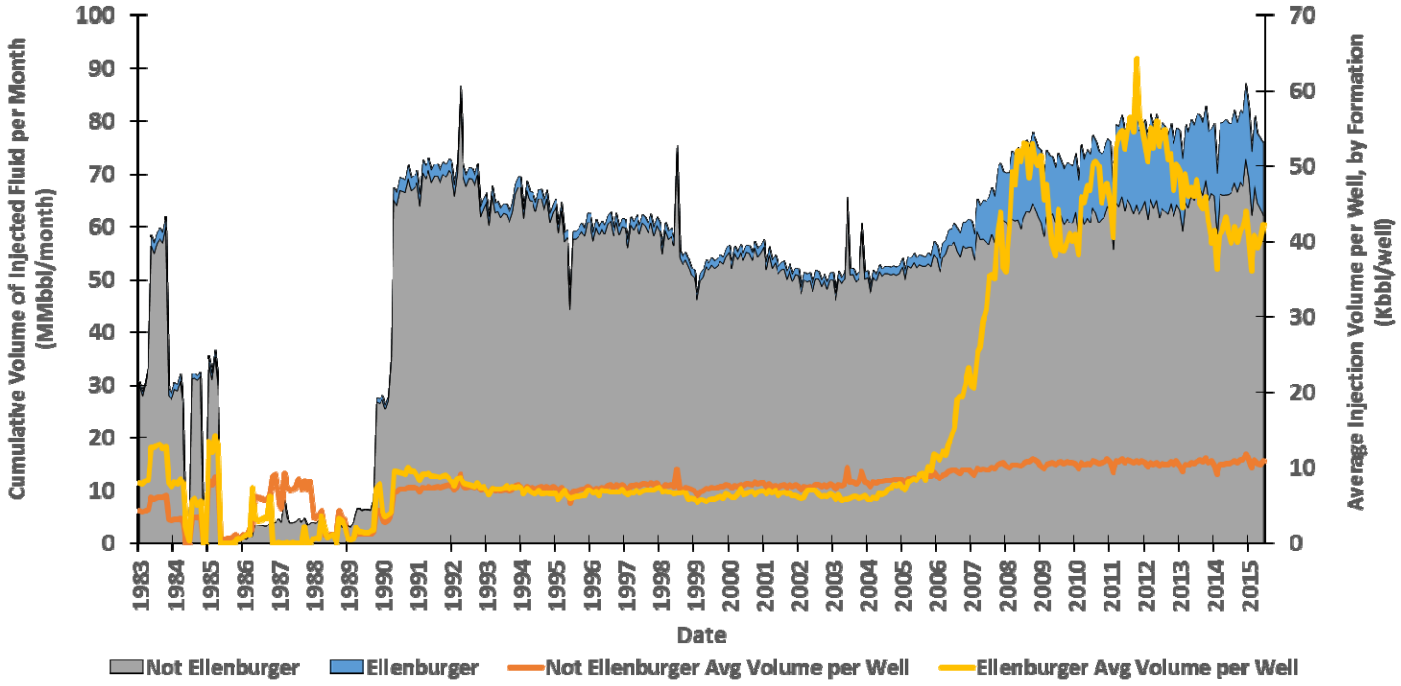
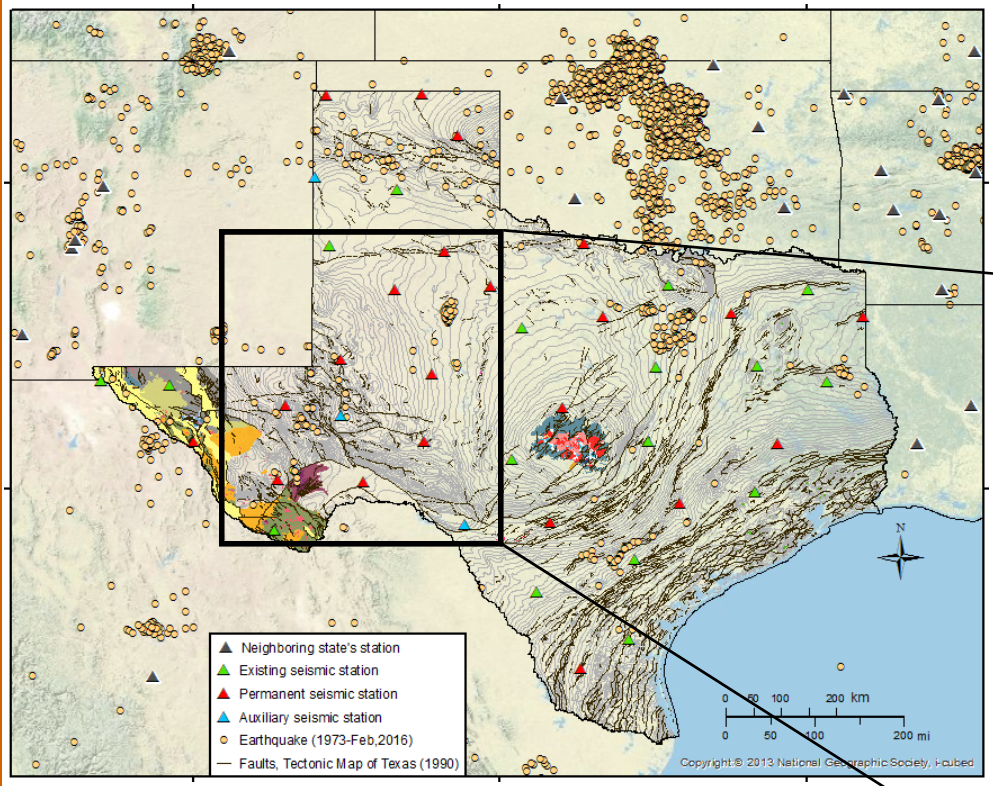
Data source: IRIS

Fluid Injection Volumes – Ft. Worth Basin



Lemons and Hennings, *unpublished*

Texas is Geologically Diverse

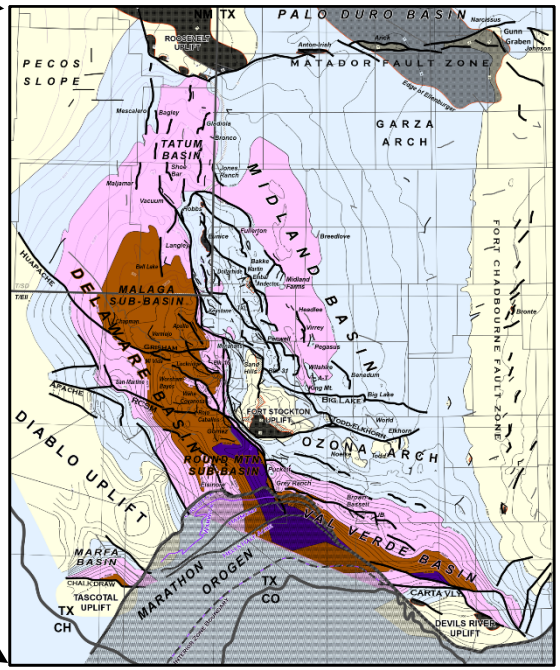


BEG after Ewing

Many known subsurface fault systems that are poorly documented publically

12+ distinct tectonic areas

- Anadarko Basin
- Amarillo Uplift
- Palo Duro Arch
- Midland Basin
- Delaware Basin
- Marathon
- Far West
- Val Verde
- Gulf Coast
- Talco/Mexia/Balcones
- East Texas Basin
- Sabine Uplift
- Ft Worth Basin
- Llano/Bend Arch



Ewing, *in press*

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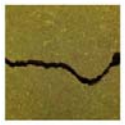
Known Unknowns

- Knowledge of subsurface fault architecture – 3D seismic data, crucial to understanding subsurface conditions, often maintained in house with operators and services companies and are not public
- High resolution data on injection volumes and rates – currently monthly averaged injection volumes are made available once per year, daily values needed
- Downhole pressures – pressure responses radiate from injection wells. Monitoring wells or monitored injection wells would better define subsurface conditions
- Sufficient understanding of rock and fault properties (for modeling) – including porosity, permeability, offsets, stress states, fault planes, etc.

Public/Media Response to Texas Seismicity

STATEIMPACT



How Oil and Gas Disposal Wells Can Cause Earthquakes

INTERNATIONAL BUSINESS TIMES
FRIDAY, JUNE 12, 2015 AS OF 4:39 PM EDT

BUSINESS

Energy's New Legal Threat: Earthquake Suits

The New York Times

BUSINESS

Study Ties Fracking to Quakes in England

U.S. Maps Pinpoint Earthquakes Linked to Quest for Oil and Gas

Fracking The Reason For Texas' Earthquakes? Report Rules Out 'Natural' Causes For More Tremors

BUSINESS

New Studies Link Earthquakes With Oil, Gas Drilling

THE WALL STREET JOURNAL.

Metro

Exxon subsidiary: Quakes not caused by injection wells

The Dallas Morning News

Metro

State orders well tests for links to Venus-Midlothian quakes

Editorials

Editorial: Texas regulators, get your head out of the shale

Biz Beat Blog

Railroad Commission rules "no conclusive evidence" Venus quake linked to oil and gas

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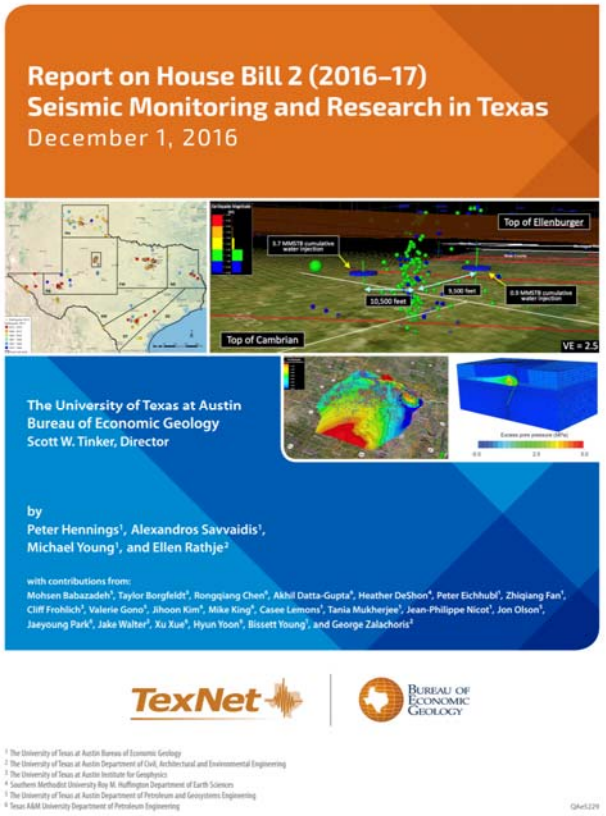
Texas' Response to Public Concerns

Bill Text: TX HB2 | 2015-2016 | 84th Legislature

Texas House Bill 2 (*In Recess*)

TX State Legislature page for HB2

SECTION 16. THE UNIVERSITY OF TEXAS AT AUSTIN: BUREAU FOR ECONOMIC GEOLOGY. (a) In addition to amounts previously appropriated for the state fiscal biennium ending August 31, 2015, $4,471,800 is appropriated out of the general revenue fund to The University of Texas at Austin for the two-year period beginning on the effective date of this Act for the purchase and deployment of seismic equipment, maintenance of seismic networks, modeling of reservoir behavior for systems of wells in the vicinity of faults, and establishment of a technical advisory committee.



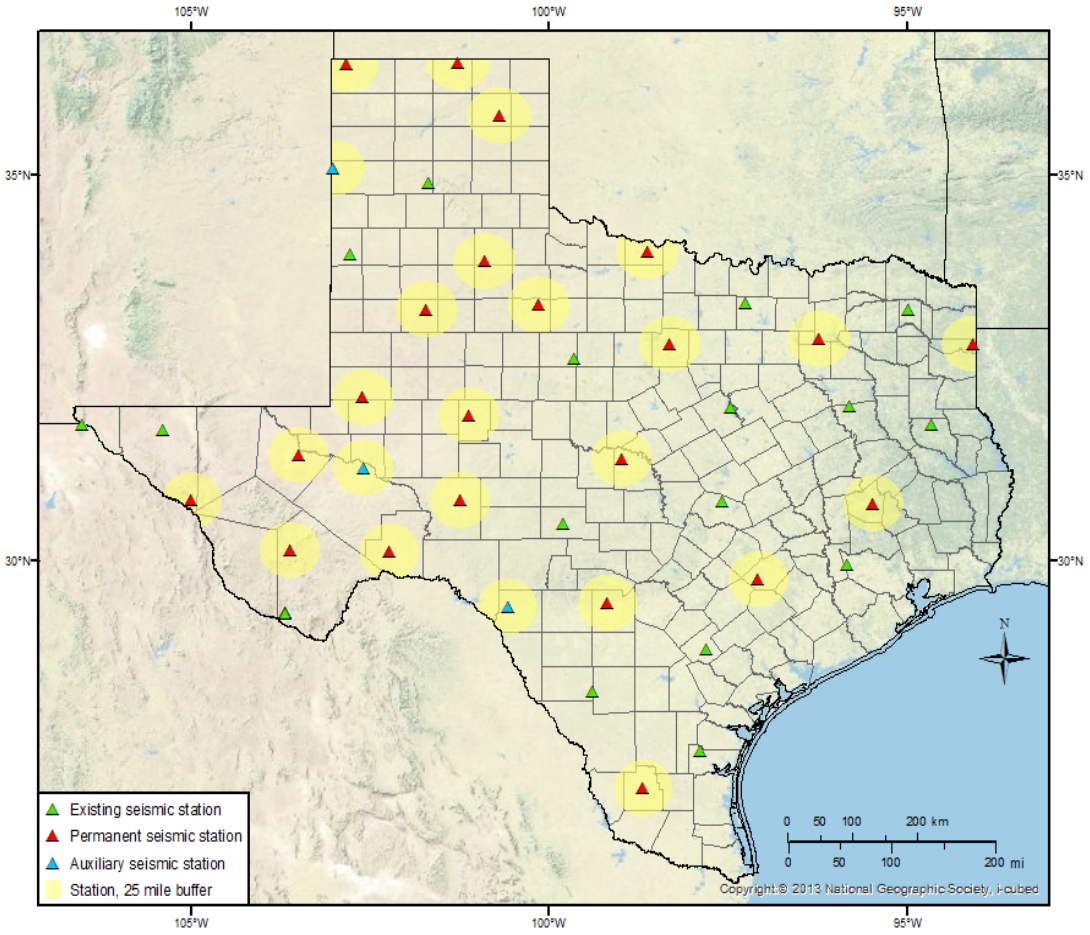
http://www.beg.utexas.edu/files/content/texnet/docs/TexNet-Report-2016.pdf

TexNet Goals

- To monitor, locate, and catalog seismicity across Texas, capable of detecting and locating earthquakes with magnitudes ≥M2.0 (aka—Backbone)
- To improve investigations of ongoing sequences by deploying temporary seismic monitoring stations and conducting site-specific assessments, especially for
  - Events >M3.0 in or near urban areas, or
  - Events co-located where ongoing human activities may be related to earthquake activity

TexNet – Integrated Monitoring Network

- Add 22 additional broadband stations, providing 40 station backbone
- Include auxiliary sites
- Deploy up to 36 additional, short-period, temporary stations



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Portable Station Deployment Plan 2016-17

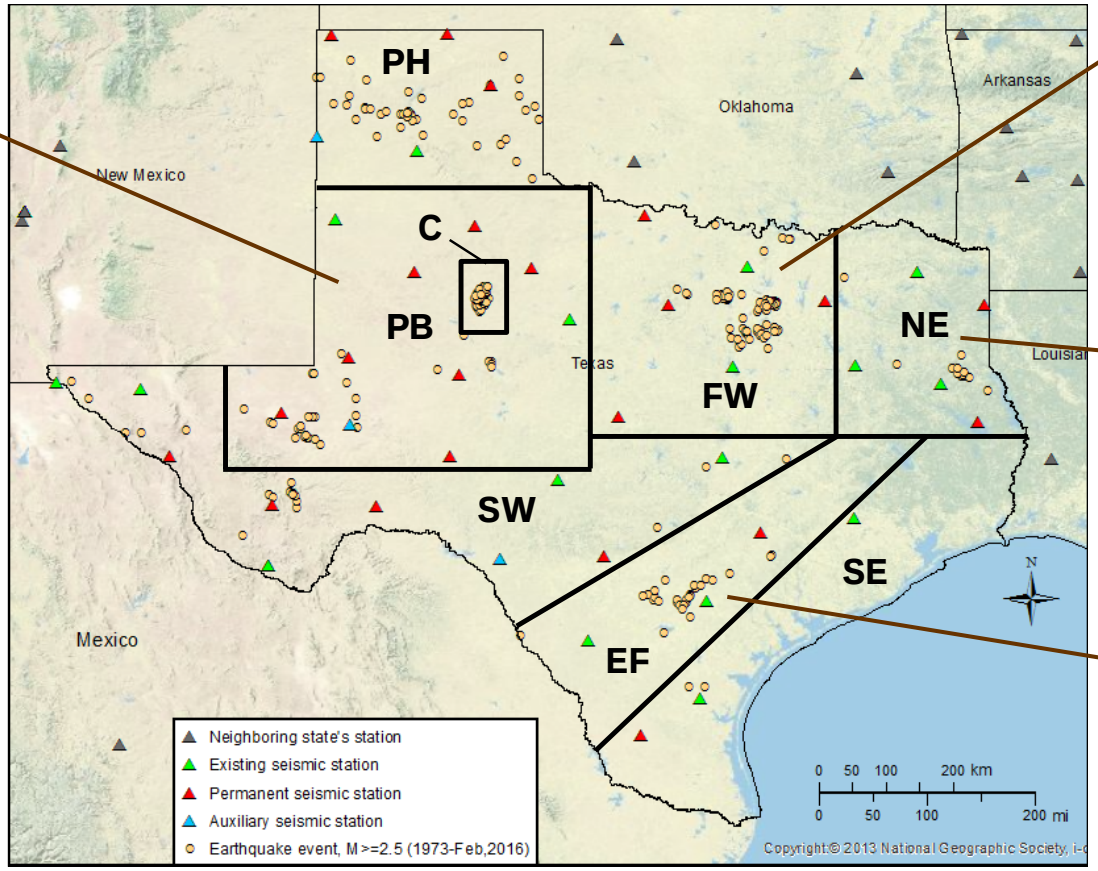
Permian Basin
2016-2017
- 6 stations near Pecos
- 9 at Cogdell Field

2018
- 9 near Pecos and elsewhere

UT-BEG rapid deployment reserve
2016-2017
- 3 stations

2018
- 3 stations

(other deployed portable stations can be repositioned to augment rapid deployment reserve)



Ft Worth Basin
2016-2018
- 12 stations to be adjusted depending on seismicity trends and availability of other sensors

Northeast Texas
2016-2017
- 0 stations

2018
- 3 stations

Eagle Ford
2016-2017
- 3 near Fashing

2018
- 6 near Fashing and elsewhere

Hardware Setup of Permanent Station

Pole mount hardware Installation:

- 6 Channel Datalogger
- Wireless Modem
- 200Ah Battery
- 150W Solar Panel, and
- 120sec – 3 Component Post-Hole Seismometer

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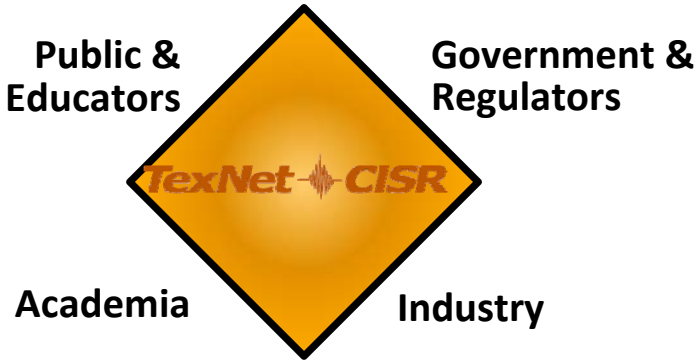
TexNet-CISR Goals and Stakeholders

TexNet - Monitor, locate, and catalog seismicity across Texas, minimizing uncertainties, with magnitudes ≥M2.0 using the new *backbone* network and improve investigations of ongoing sequences by deploying temporary seismic monitoring stations and conducting site-specific assessments.

Center for Integrated Seismicity Research - CISR will conduct fundamental and applied research to better understand naturally occurring and potentially induced seismicity and the associated risks, and to discern strategies for communicating with stakeholders and responding to public concerns regarding seismicity.



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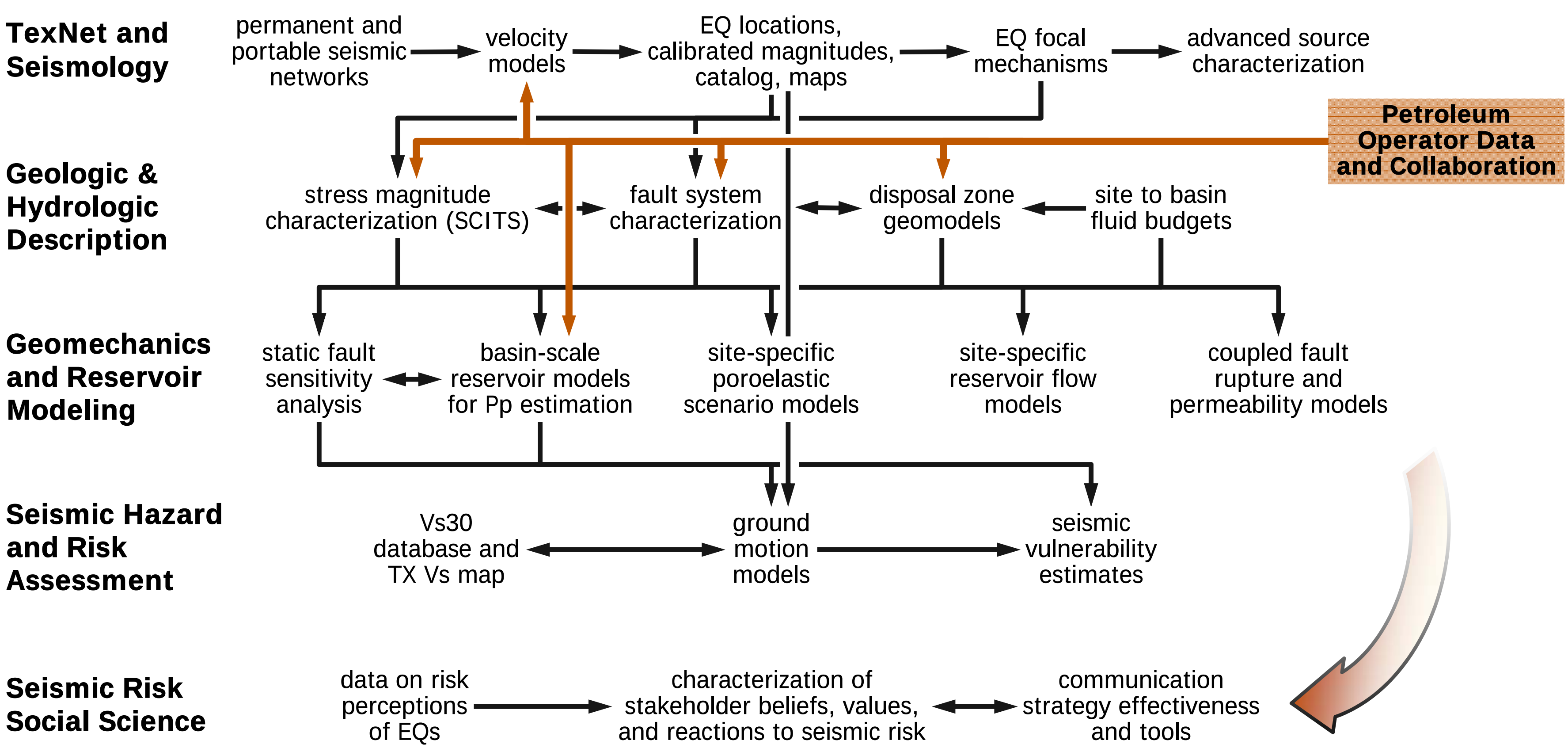
Research Project Integration



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Longer-Term Science and Application Timing

State-Wide and General Topics

1. network procurement and installation
2. network management and data stream
3. R&D products to improve network performance
4. EQ compilations and characterizations
5. fault mapping and disposal zone characterizations
6. seismic risk communication and outreach

Ft Worth Basin Integrated Study

1. local seismic networks and EQ studies
2. basin-scale fluid budgets and pore pressure
3. stress characterization (Stanford)
4. fault characterization
5. 3D basin geo and hydrologic and modeling
6. fault reactivation analysis and mapping
7. reservoir modeling of seismicity mechanics
8. assessment of basin seismogenic potential

* (items 2–6)

Greater West Texas Basin Integrated Study

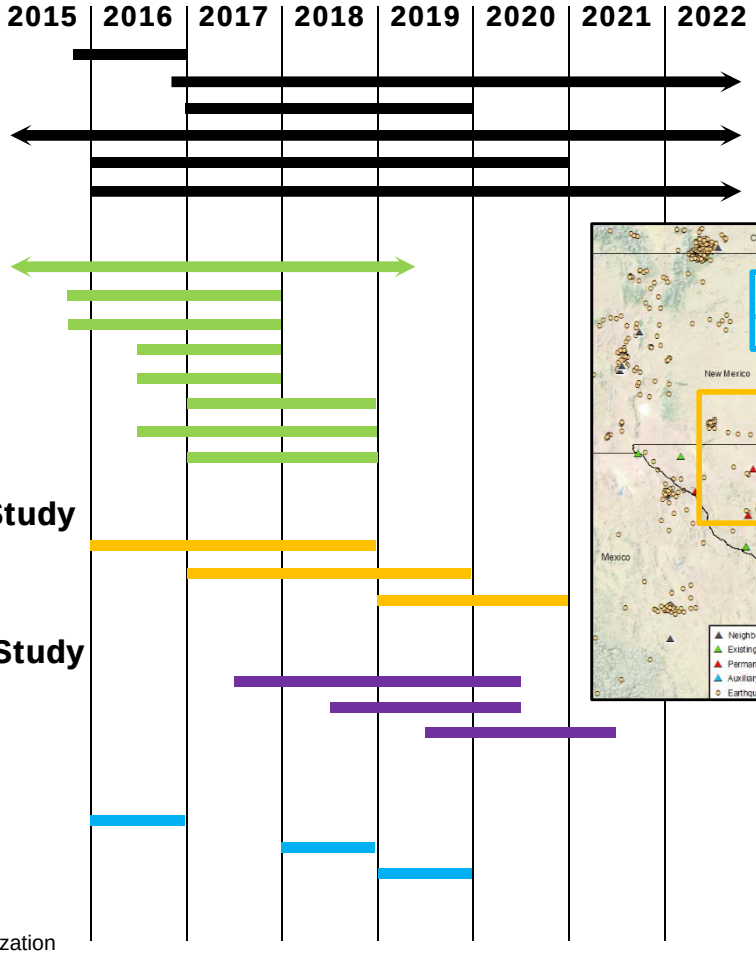
1. local seismicity base-line studies and analyses
2. *integrated geological characterization
3. assessment of basin seismogenic potential

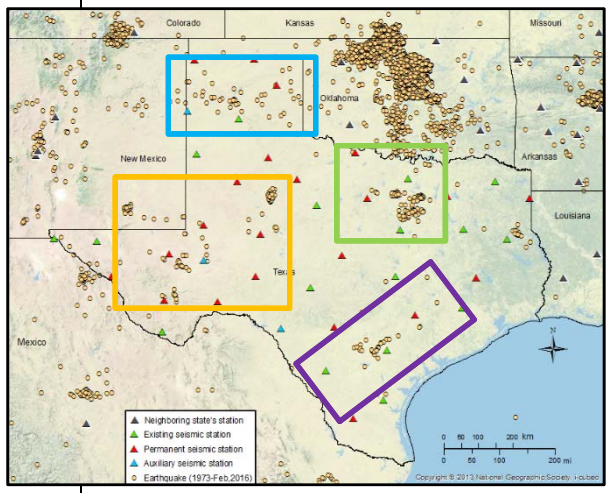
Eagle Ford Operating Area Integrated Study

1. local seismicity base-line studies and analyses
2. *integrated geological characterization
3. assessment of basin seismogenic potential

Panhandle Seismicity Study

1. seismicity analysis (existing and TA stations)
2. *integrated geological characterization
3. assessment of basin seismogenic potential





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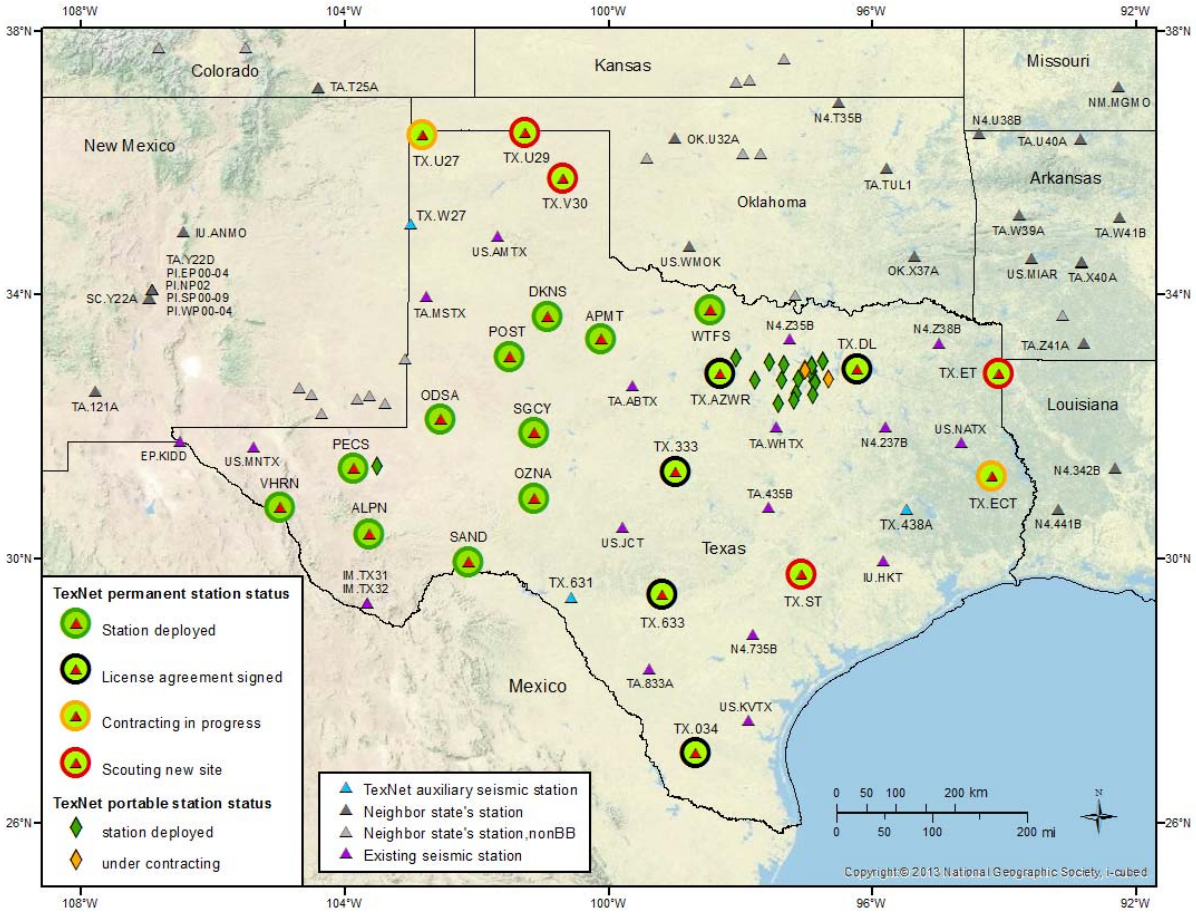
*integrated geological characterization

TexNet – Network Deployment Status (2/12/17)



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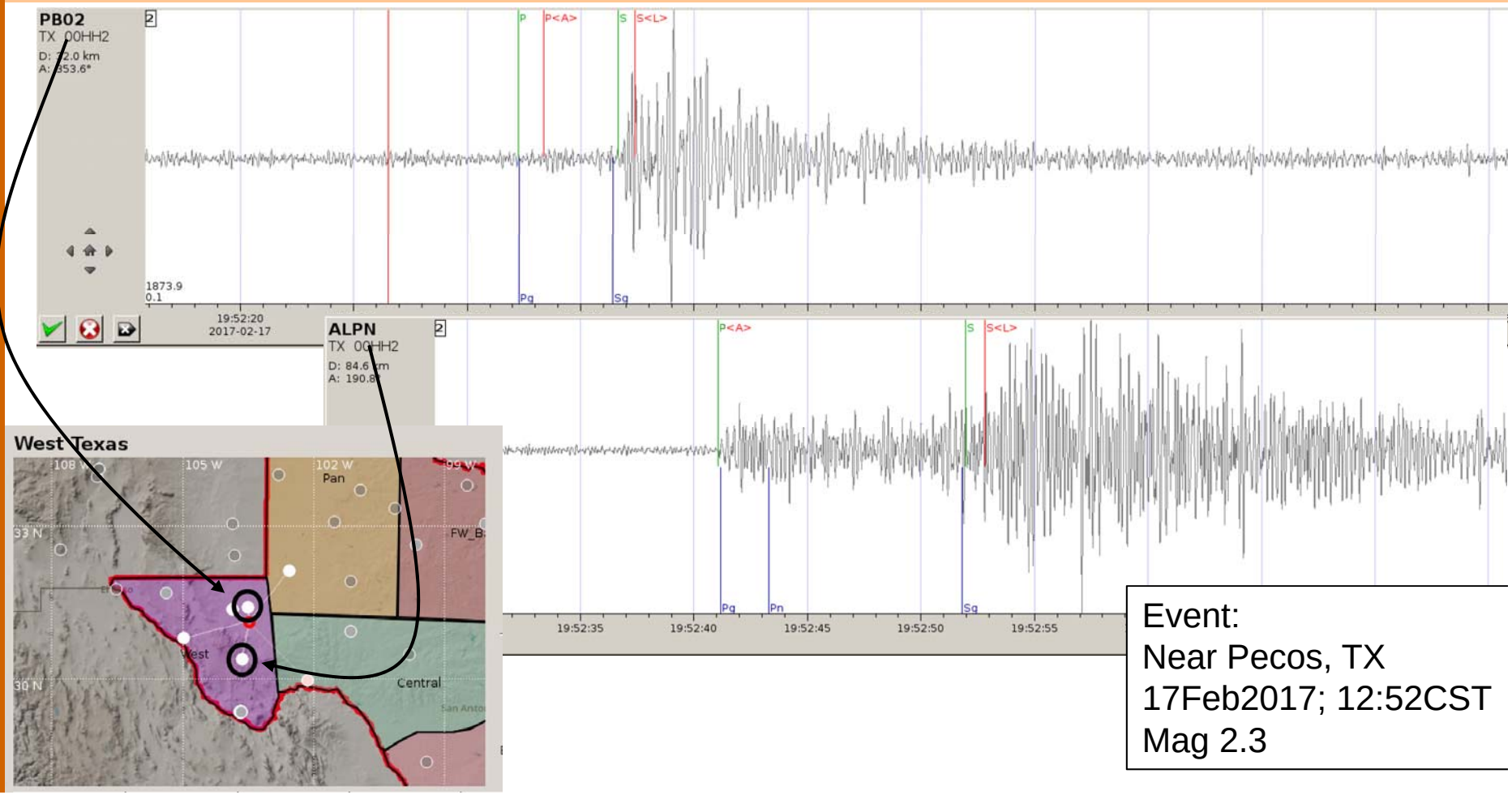
Screen Shot of Data Streaming



Event:
Near Pecos, TX
17Feb2017; 12:52CST
Mag 2.3

Thank You!!

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