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M6.0 South Napa EQ – Downtown Napa, CA

DFW Region - Human-Induced Earthquakes, Lessons for Real Estate

Presented By:

Joshua Marrow, P.E.

Principal

Technical Director | Structural Engineering Group

FREDERIKSEN & FREDERIKSEN

HUSCH BLACKWELL

Drash CONSULTANTS

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Presentation and Panel

- Joshua Marrow, P.E.
  - Partner Engineering and Science
  - ***Structural / Seismic Engineering***
- Kassandra McLaughlin
  - Husch Blackwell
  - ***Real Estate Law***
- Joe Willoughby
  - Frederiksen & Frederiksen
  - ***Catastrophic Risk Insurance***
- Tony Adamo
  - Drash Consultants
  - ***Geotechnical Engineering***

Presentation Topics

1. Earthquake Science 101 for Texans
2. Strong Correlation Between Hydraulic Fracturing and Earthquakes
3. Recent Earthquakes in the DFW Region
4. Earthquake Hazard is Relative and Uncertain
5. What the Future Holds
6. Panel Discussion and Questions

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Part 1

Earthquake Science 101 for Texans

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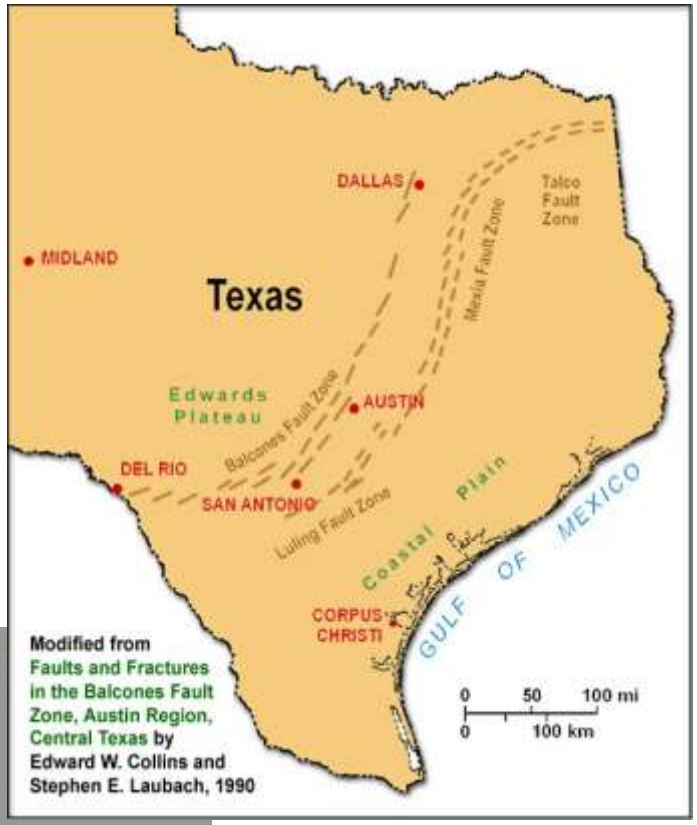
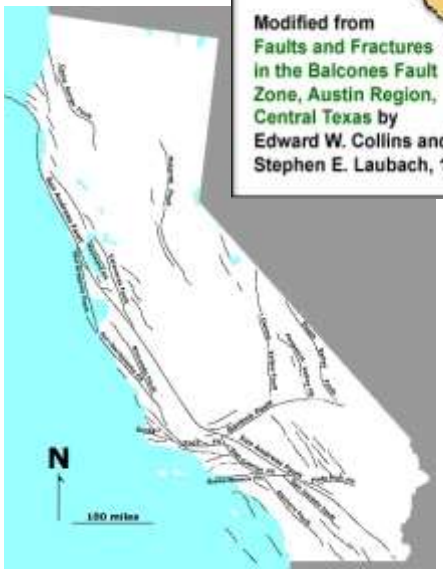
Earthquake Terminology

- Earthquake Fault
  - Strike-slip
  - Thrust
  - Intra-crustal
  - Subduction zones
- Shaking Intensity
  - Modified Mercalli Intensity(MMI)
  - Perceived and observed

Modified Mercalli Scale

I.	Not felt.
II.	Felt by persons at rest, on upper floors, or favorably placed.
III.	Felt indoors. Vibration like passing of light trucks.
IV.	Vibration like passing of heavy trucks.
V.	Felt outdoors. Small unstable objects displaced or upset.
VI.	Felt by all. Furniture moved. Weak plaster/masonry cracks.
VII.	Difficult to stand. Damage to masonry and chimneys.
VIII.	Partial collapse of masonry. Frame houses moved.
IX.	Masonry seriously damaged or destroyed.
X.	Many buildings and bridges destroyed.
XI.	Rails bent greatly. Pipelines severely damaged.
XII.	Damage nearly total.





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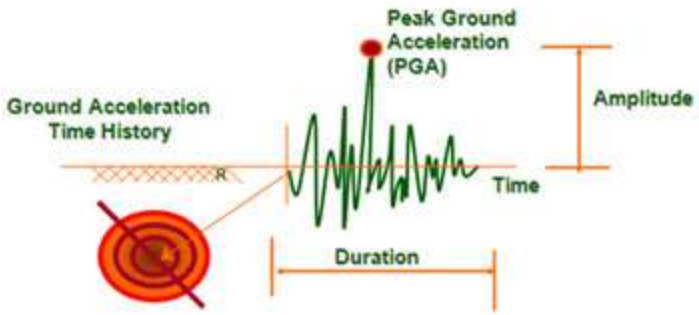
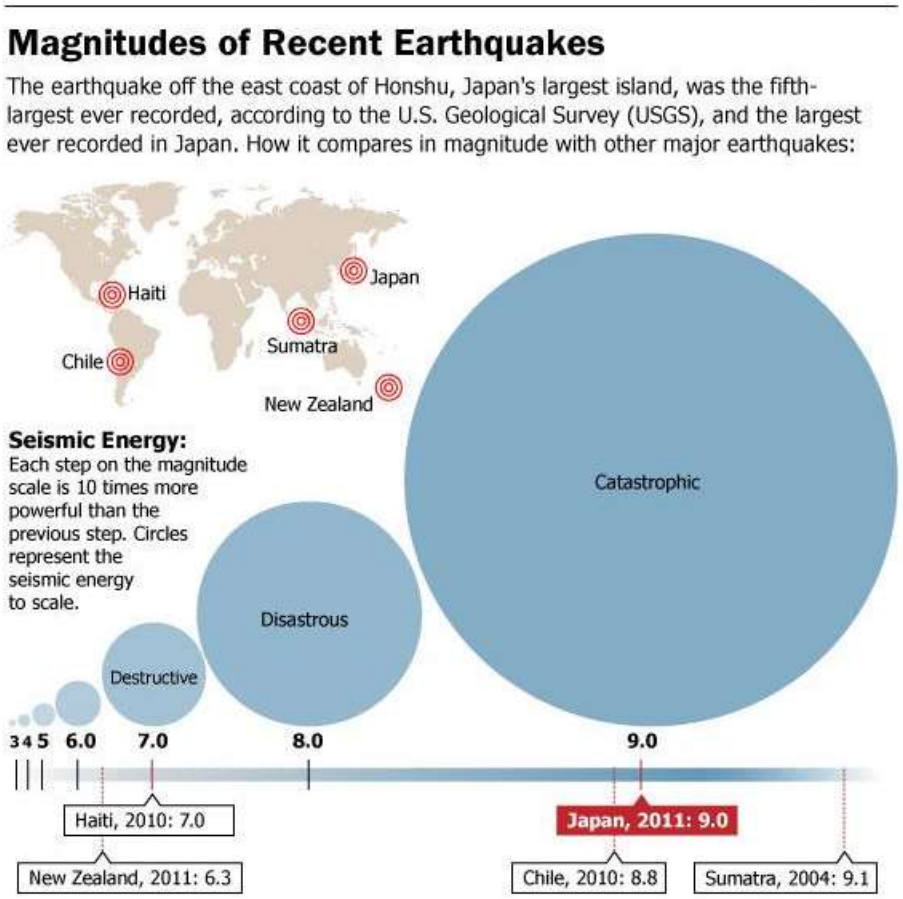
Earthquake Terminology

- Magnitude
  - Richter Scale
  - Measure of total energy
  - Logarithmic scale
  - M4 = 31.6 X M3
  - **M6.0 is 1 million X M3.0**
- Ground Motion Parameters
  - Acceleration
  - Velocity
  - Displacement





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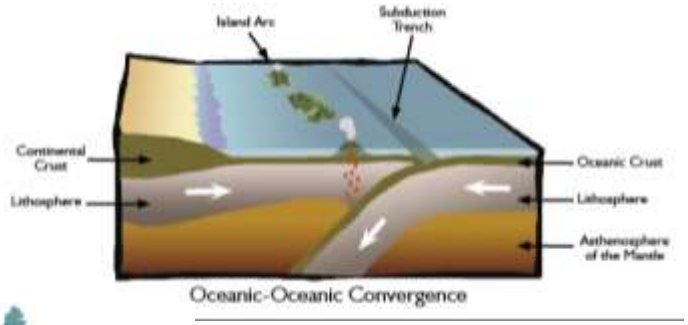
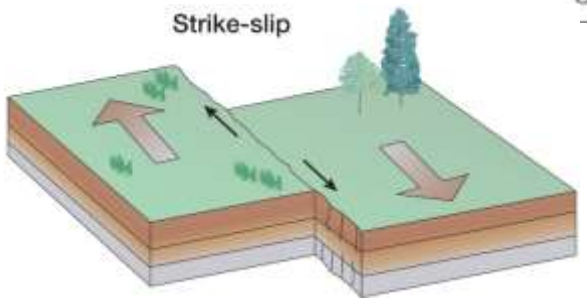
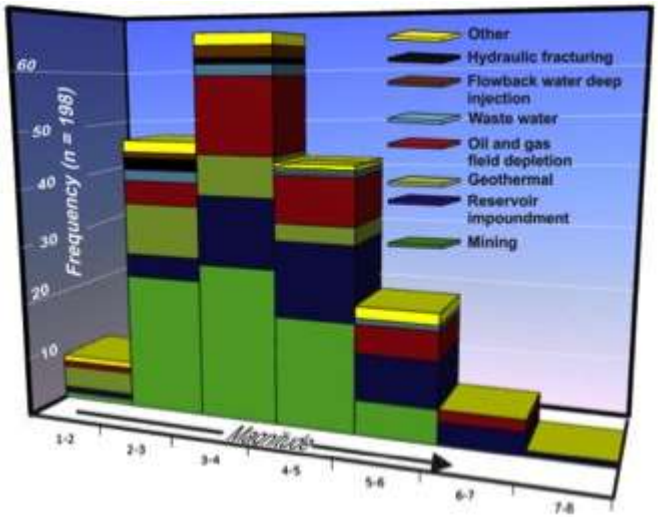
Sources of Earthquakes

- Naturally occurring
  - Tectonic activity and faulting
  - Volcanoes and subduction
- Human-made seismicity
  - Mining blasts
  - Explosions (controlled or otherwise)
  - Heavy construction
  - Oil drilling / fracturing
- "Human-induced"
  - Waste water injection wells reactivating previously inactive (dormant) fault systems







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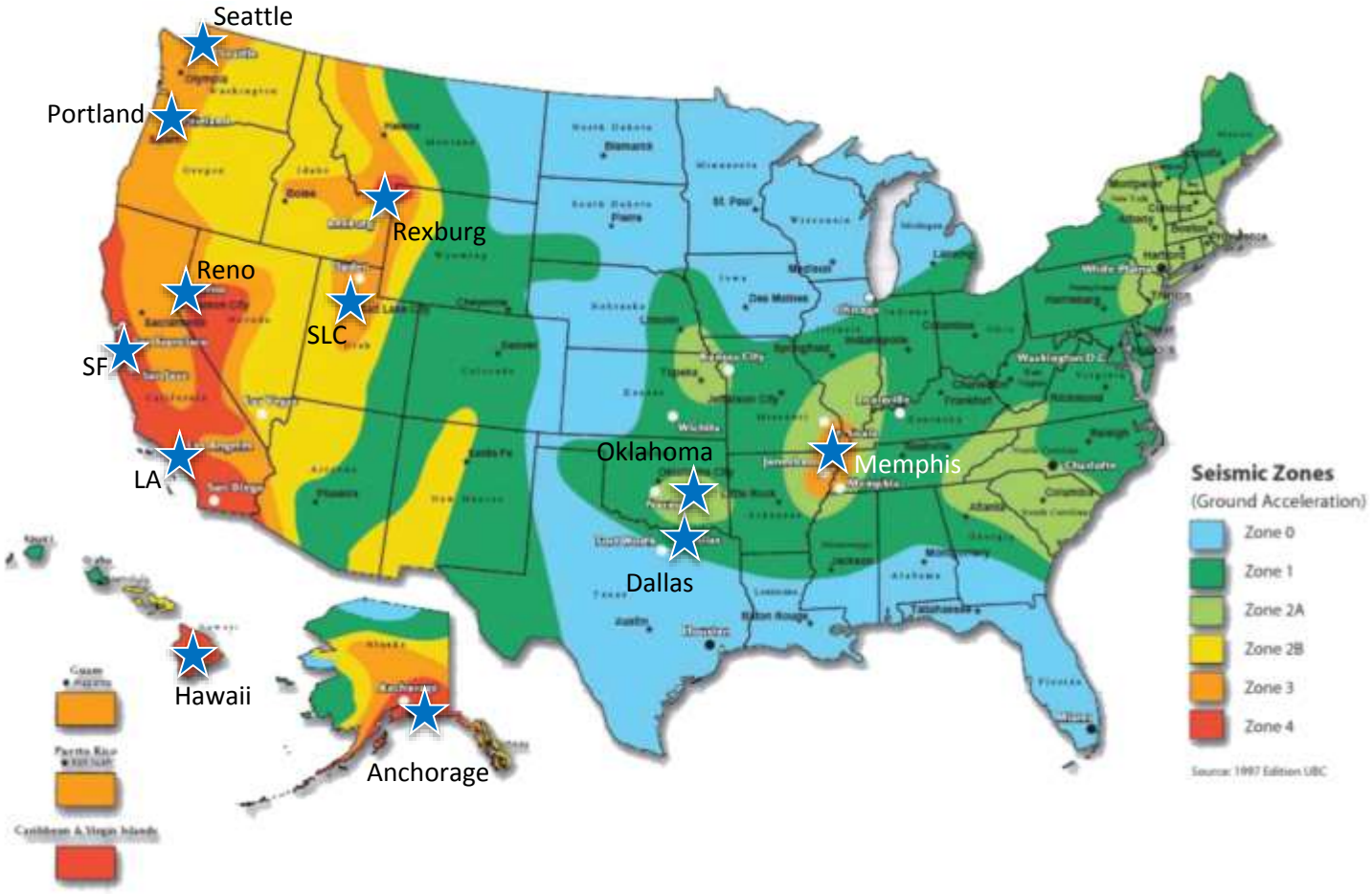
1997 UBC Seismic Zone Map – "Old School"



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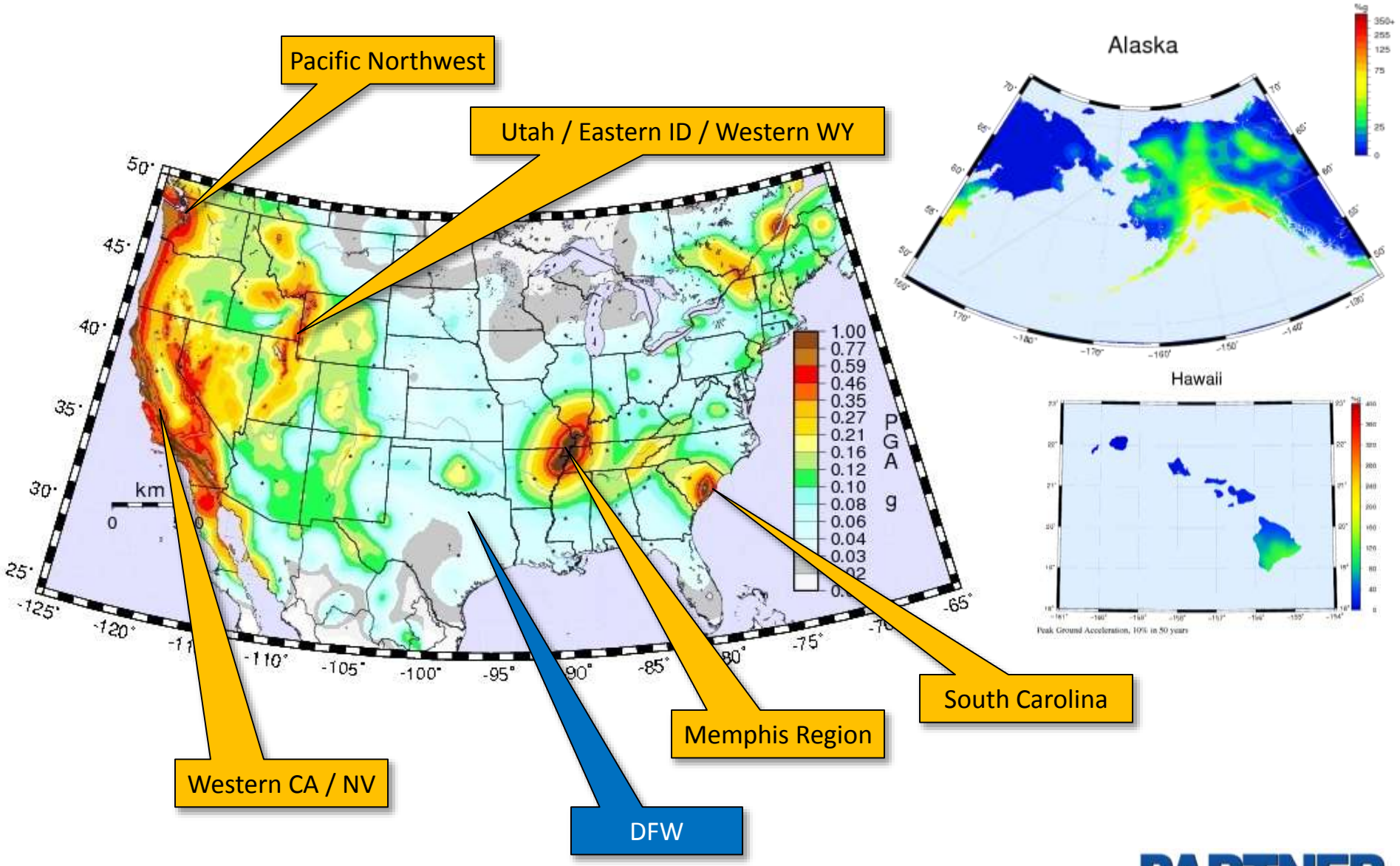
USGS Seismic Hazard Maps – "New School"



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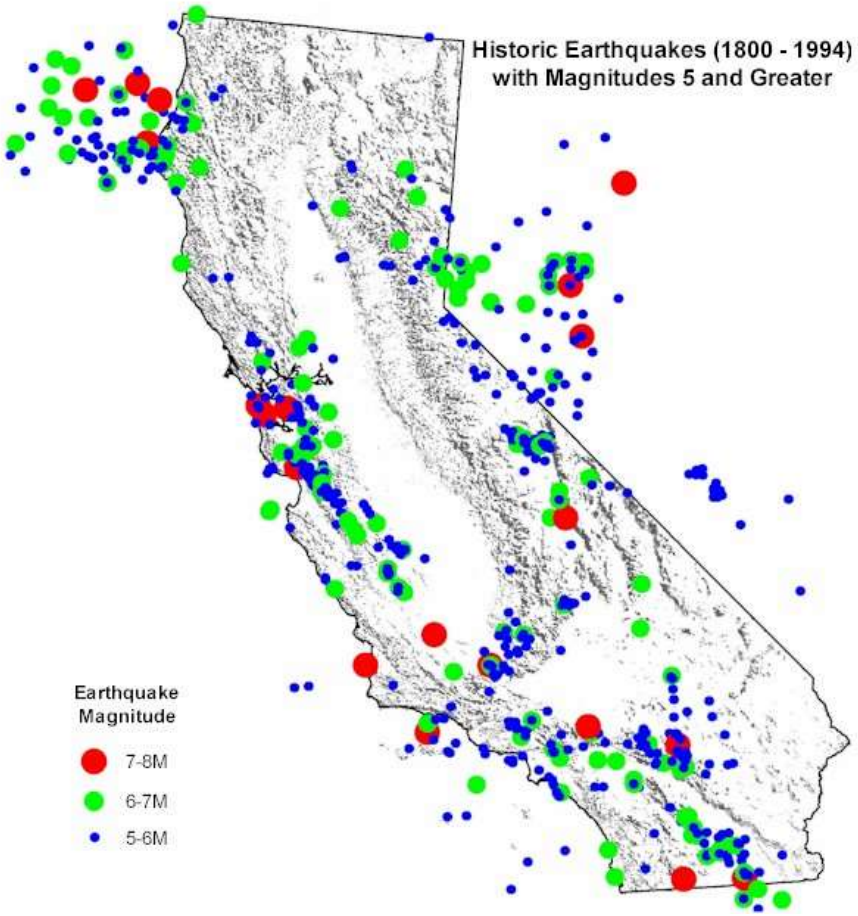
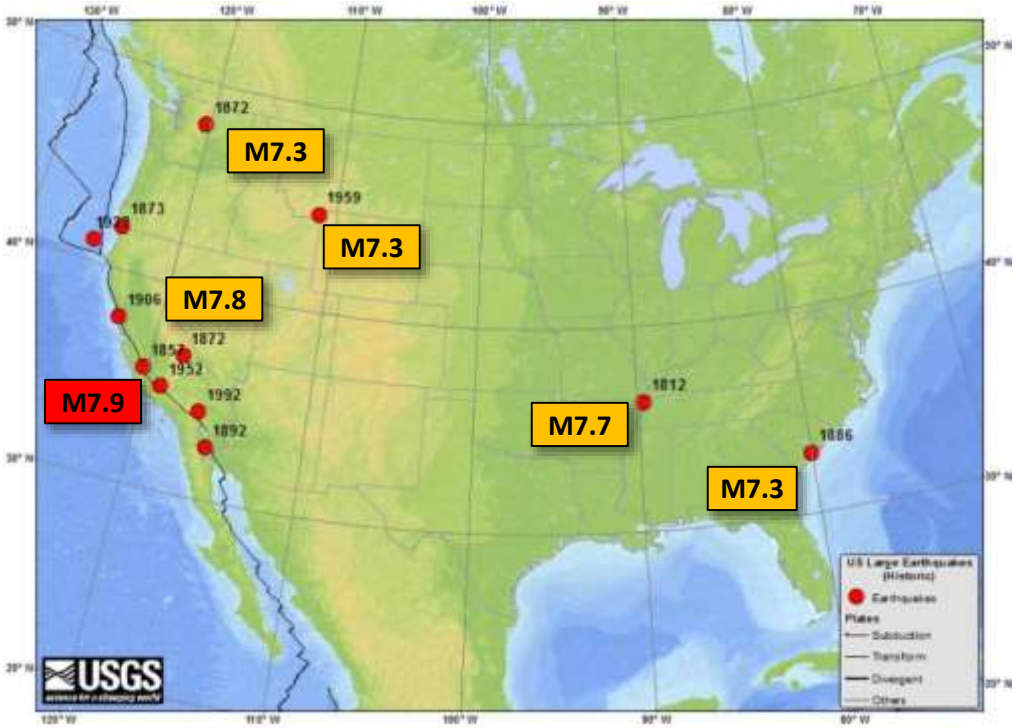
Significant Earthquakes in the US





Source: USGS large historic earthquakes in the 48 contiguous states

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Part 2

Strange Correlation - Hydraulic Fracturing and Earthquakes

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Hydraulic Fracturing – Class II Wells

Hydraulic Fracturing Well Head

Regulated by the Railroad Commission of Texas, not the EPA UIC Program like the rest of the United States

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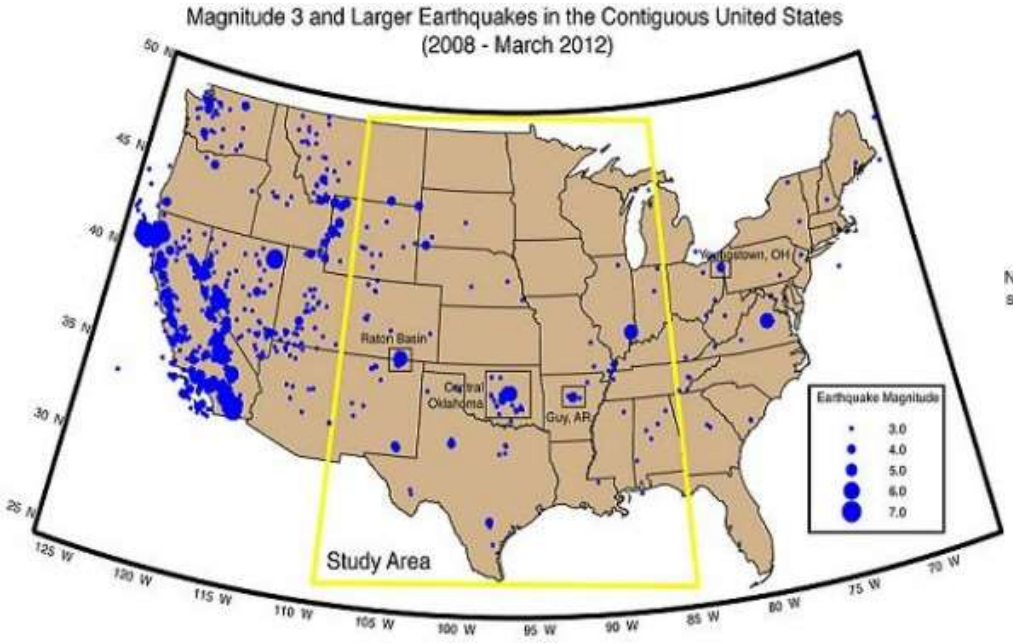
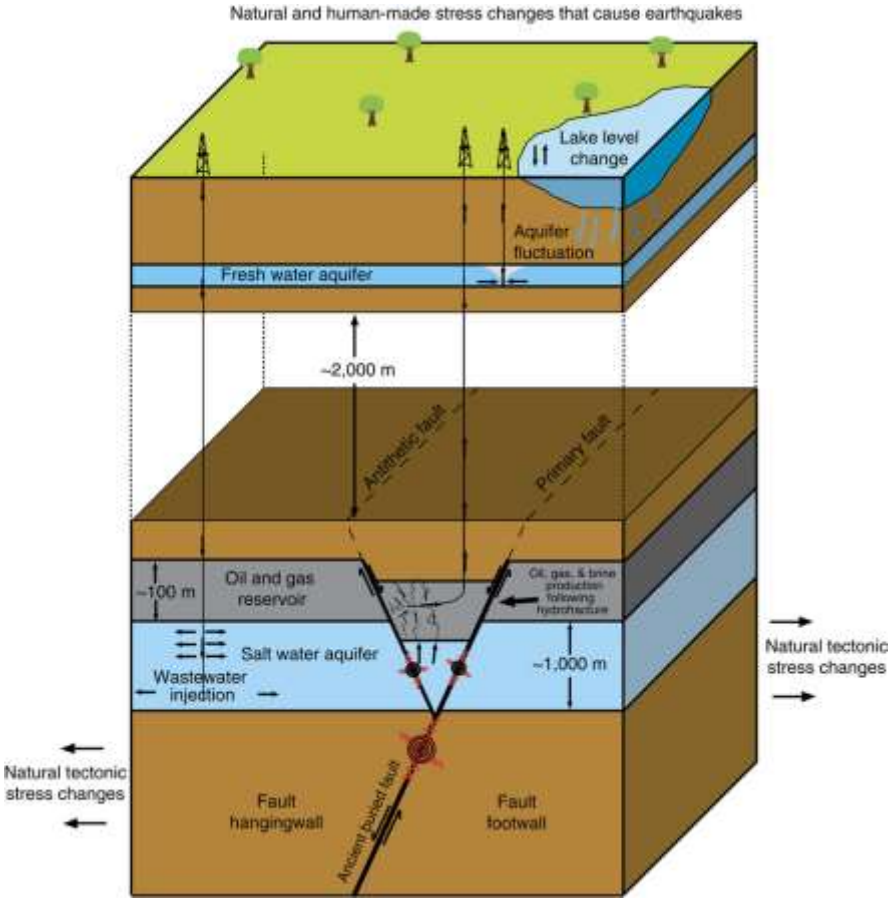
Increasing Number of Earthquakes in Central States

- USGS finds 6x increase in M3.0 or greater earthquakes
- Inconclusive data to categorize man-made versus naturally occurring





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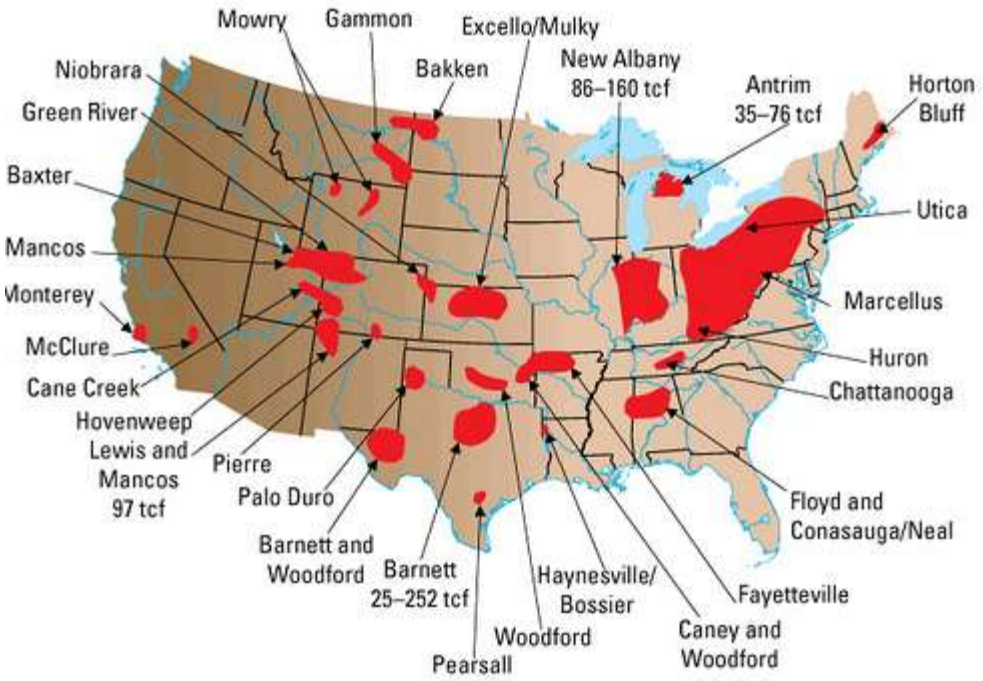
Hydraulic Fracturing Regions

- Strong correlation between hydraulic fracturing and increased seismic activity
- Some recent hot spots
  - Ohio
  - Southern Illinois
  - Arkansas
  - Louisiana
  - DFW metro
  - Snyder – West Texas
  - Timpson – East Texas
    - As high as M4.9



Regions with hydraulic fracturing activity

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Part 3

Recent Earthquakes in the DFW Region

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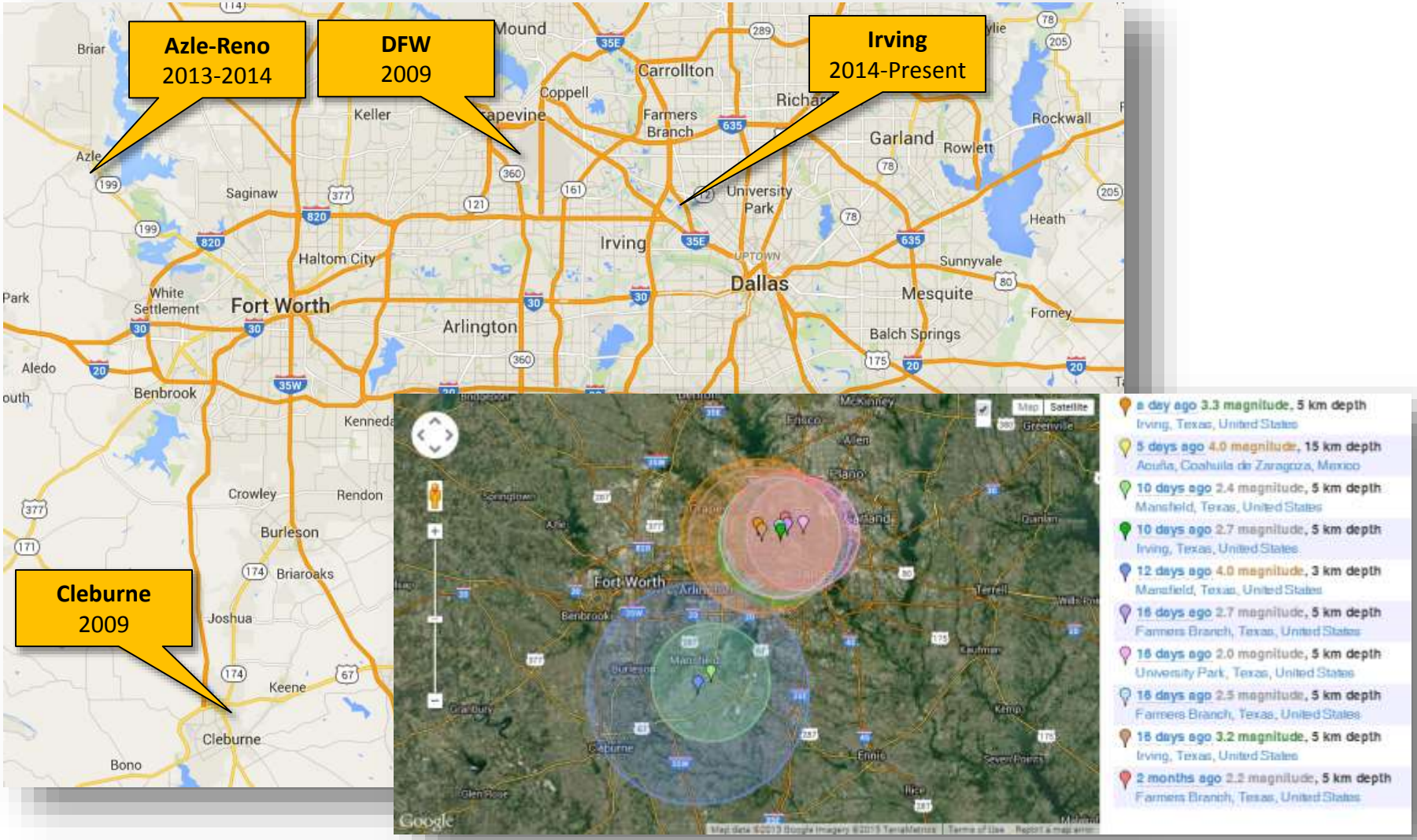
DFW is Earthquake Country (after 2008)



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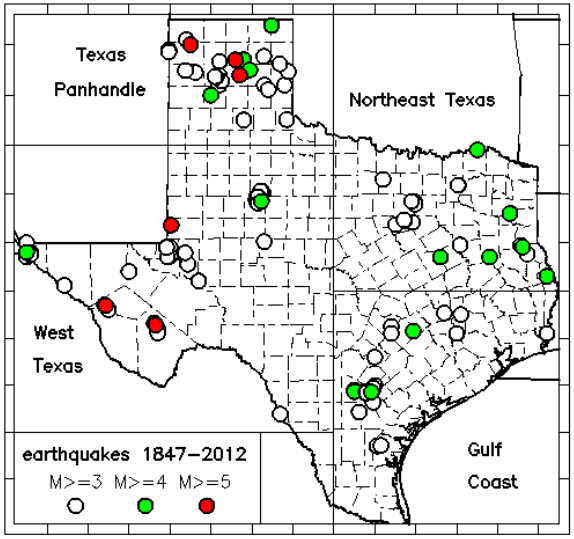
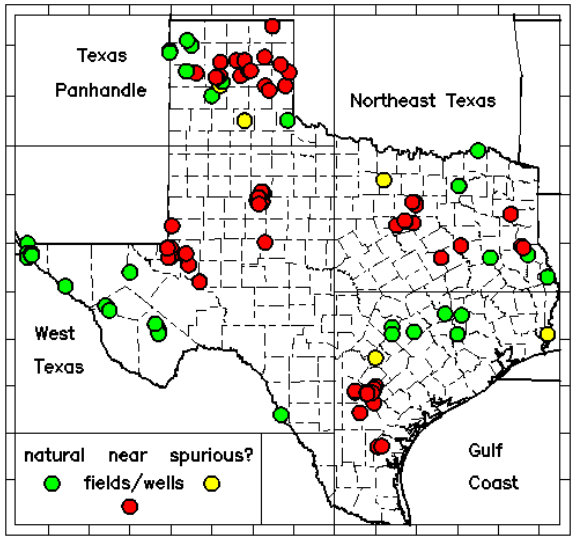
Texas Earthquake History



>M3 Earthquakes from 1847 to 2012



Naturally occurring and human-induced

- 100 earthquakes in the last century, large enough to feel
- 5 quakes between M5 and M6
- El Paso and Panhandle expect M5.5 to M6.0 every 50-100 years

Top earthquake states 2013	
The top 10 states for earthquakes in 2013, looking at onshore quakes of magnitude 3.0 or greater in the contiguous United States, which excludes Alaska and Hawaii.	
California	236
Oklahoma	99
Nevada	35
Wyoming	26
Montana	24
Texas	16
Washington	15
Idaho	8
Utah	6
Arkansas	4

Source: USGS

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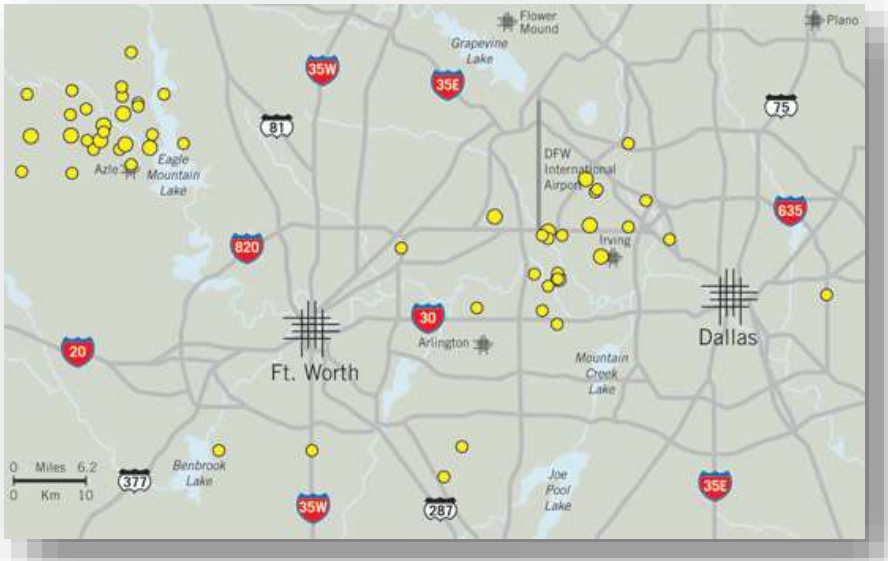
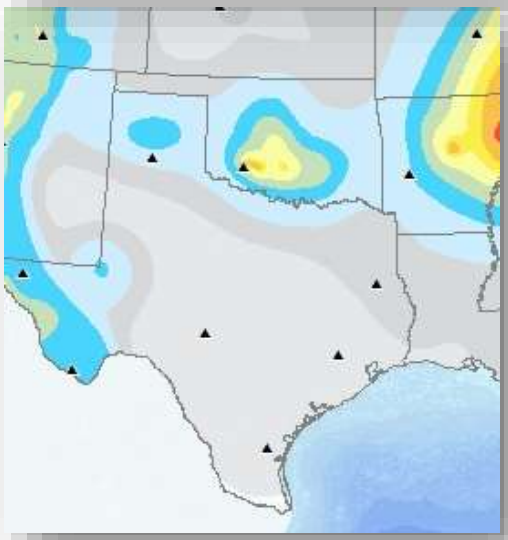
Earthquakes are Frequent, Not Damaging

- Significant DFW Events
  - 2008-2009 DFW sequence
  - 2009 Cleburne sequence
    - May 7, 2015 M4.0
  - 2013-2014 Azle-Reno cluster
  - 2014-2015 Irving cluster
- Considered “low” seismic region
- Funding is allocated to other, more prevalent natural disasters
  - Floods
  - Tornadoes
  - Hurricanes
  - Fires
  - Drought





ANSS Seismic Monitoring Stations

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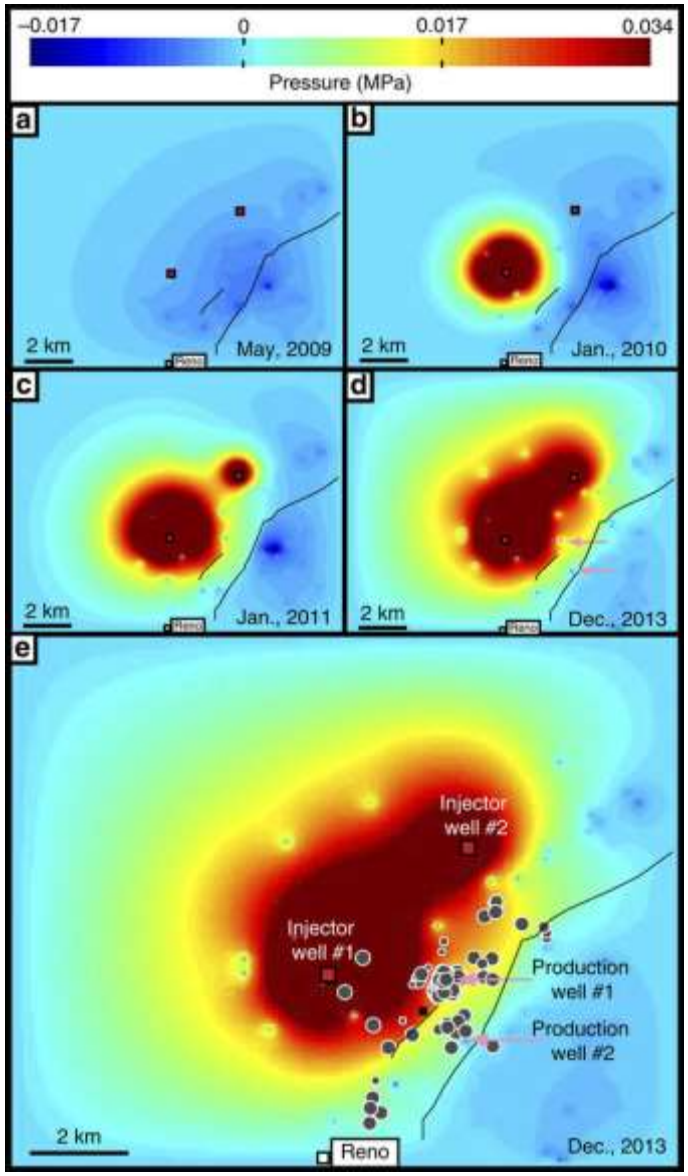
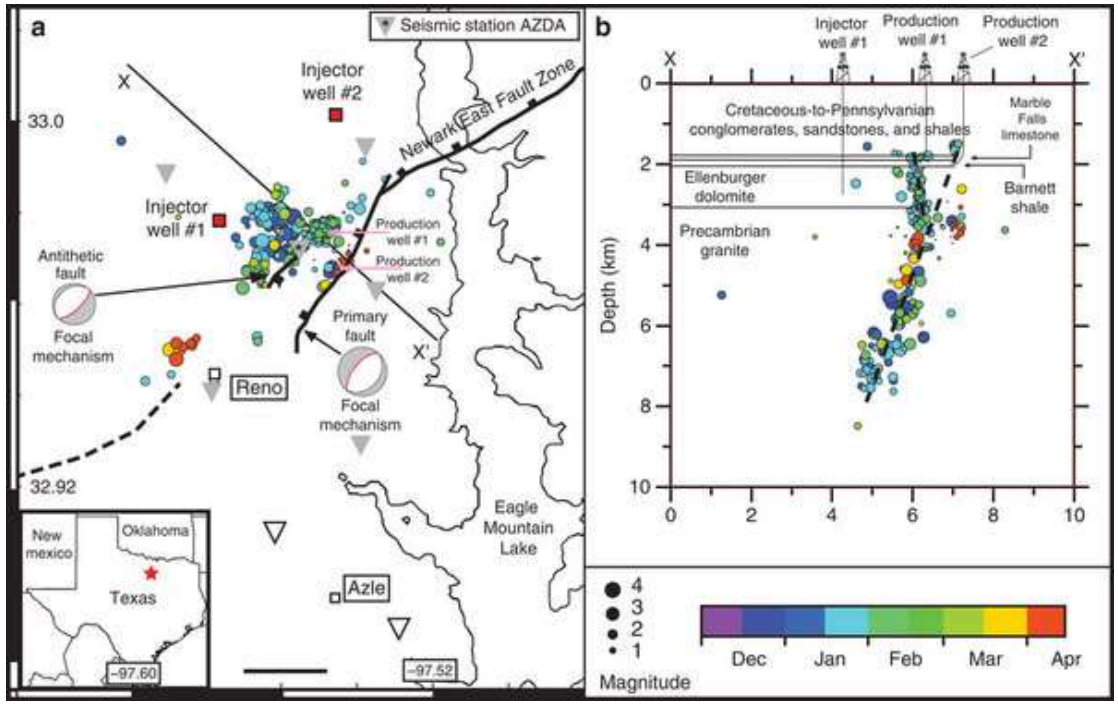
2013 – 2014 Azle Earthquakes





ARTICLE

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Causal factors for seismicity near Azle, Texas

Matthew J. Hornbach[1], Heather R. DeShon[1], William L. Ellsworth[2], Brian W. Stump[1], Chris Hayward[1], Cliff Frohlich[3], Harrison R. Oldham[1], Jon E. Olson[4], M. Beatrice Magnani[1], Casey Brokaw[1] & James H. Luetgert[2]

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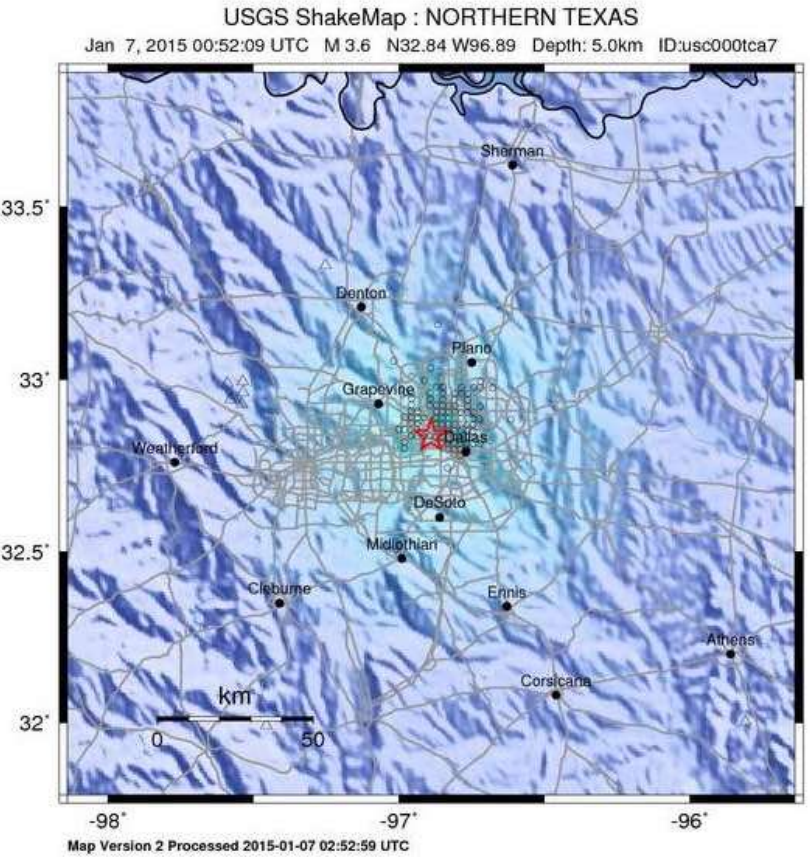
2014 - 2015 Irving Earthquakes

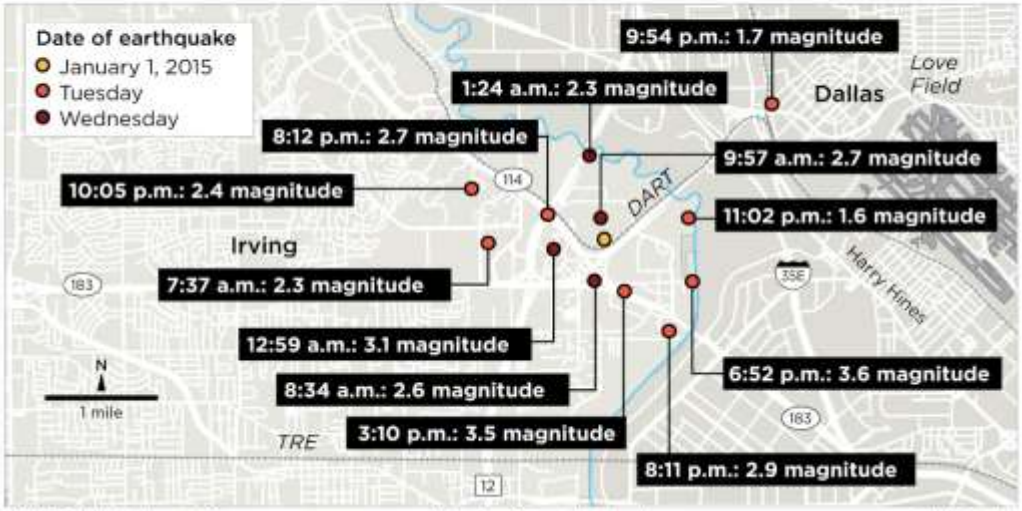


PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.007	0.08	1.0	5.0	8.8	15	27	47	>83
PEAK VEL.(cm/s)	*<0.003*	*0.04*	*0.5*	*3.0*	*6.5*	*14*	*30*	*63*	*>136*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Atkinson & Kaka, 2007

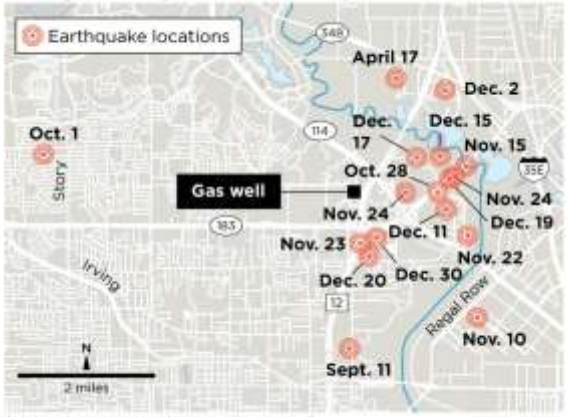
Irving-area earthquakes

Thirteen earthquakes have been recorded near State Highways 114 and 183 in Irving since the beginning of 2015.



SOURCE: U.S. Geological Survey Note: As of 5 p.m. Wednesday Staff Graphic

Irving earthquakes since April 17



SOURCES: USGS; *Dallas Morning News* research Staff Graphic

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Part 4

Earthquake Hazard is Uncertain and Relative

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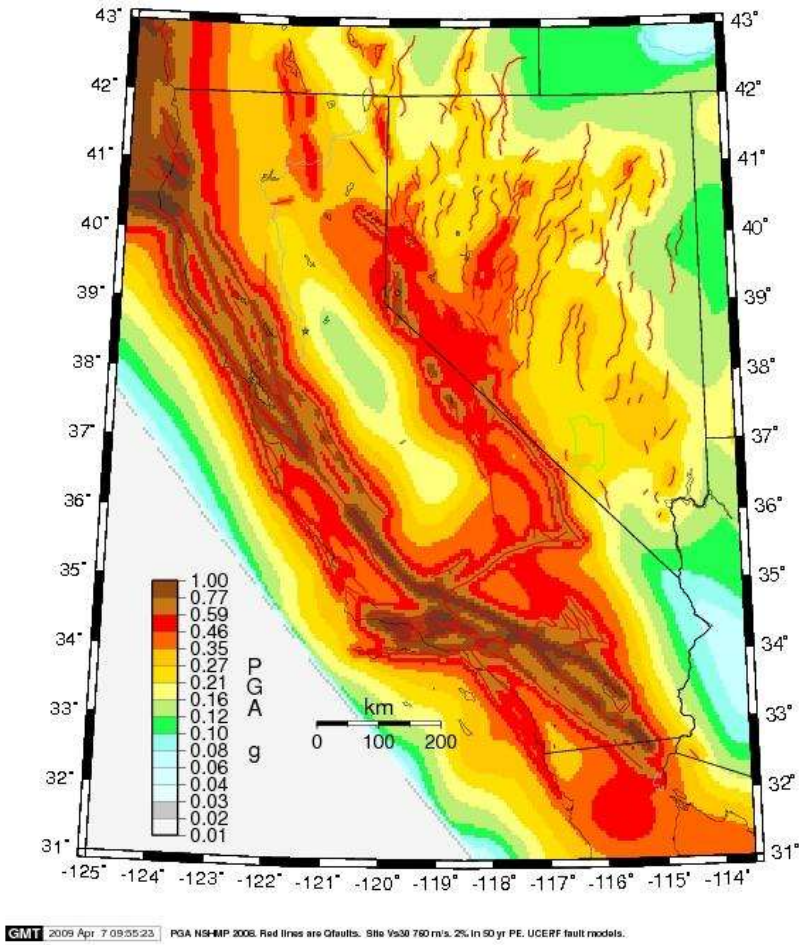
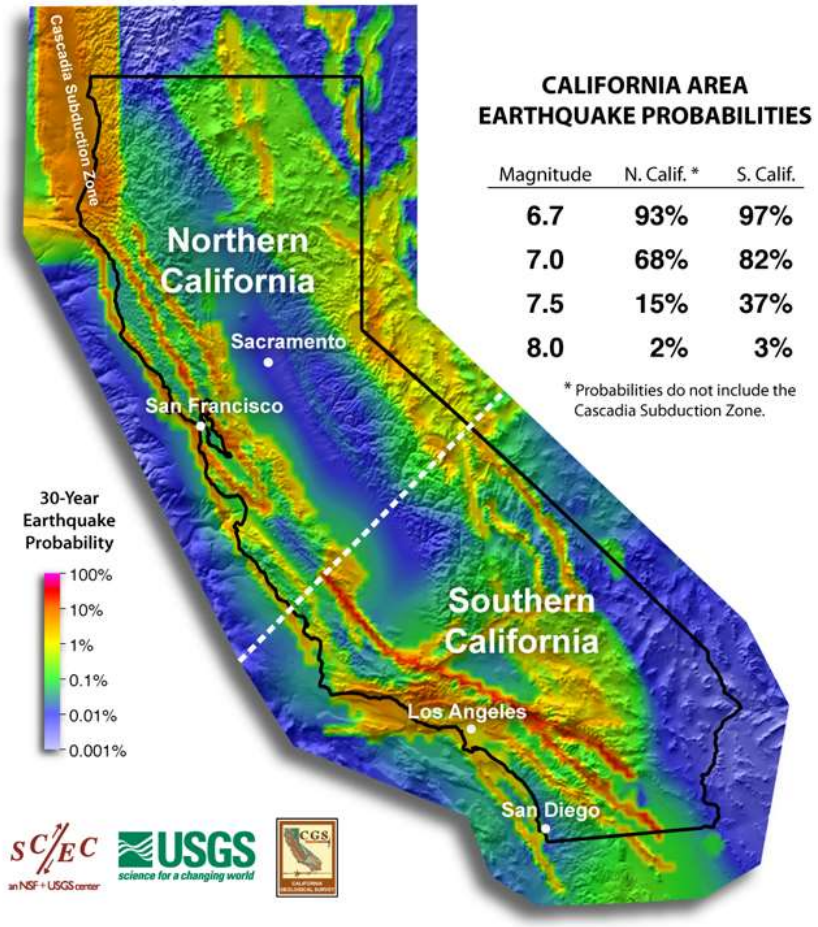
California Seismic Hazard Map





CALIFORNIA AREA EARTHQUAKE PROBABILITIES

Magnitude	N. Calif. *	S. Calif.
6.7	93%	97%
7.0	68%	82%
7.5	15%	37%
8.0	2%	3%

* Probabilities do not include the Cascadia Subduction Zone.

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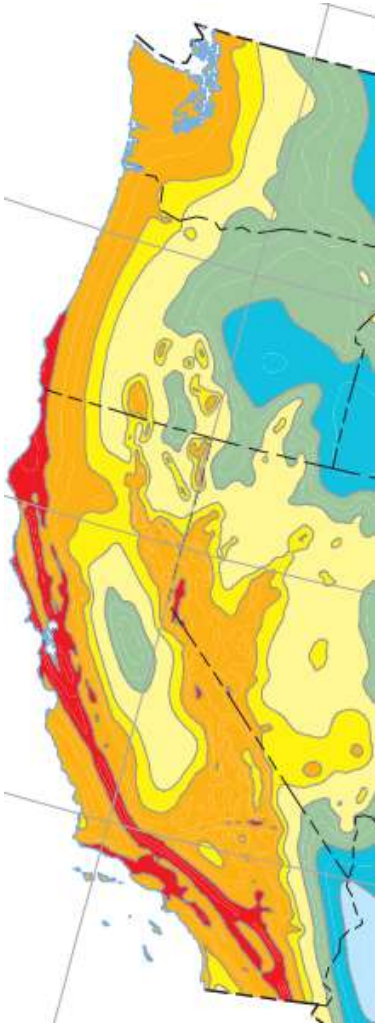
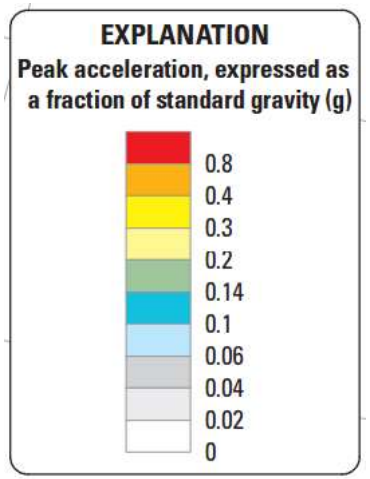
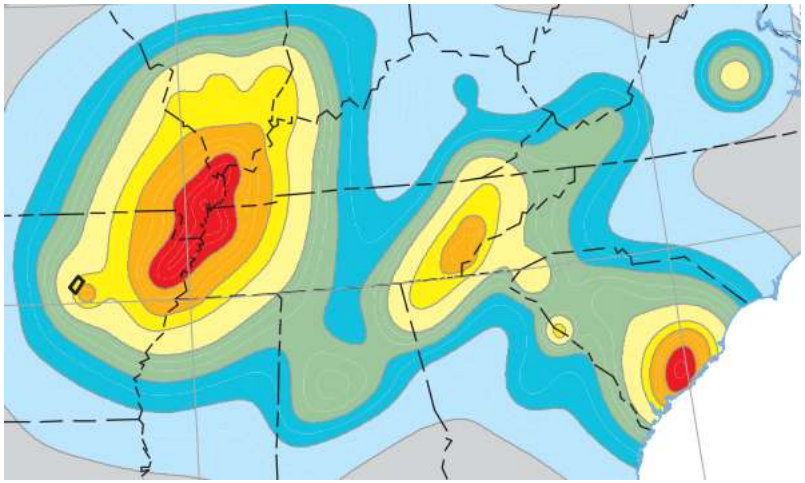
USGS Recognizes Human-Induced Seismic Events

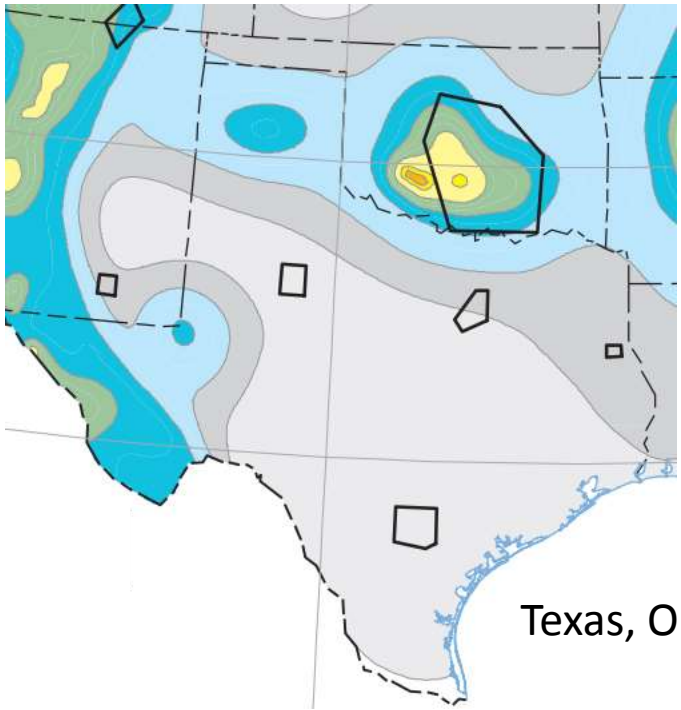


California, Oregon, Washington, Nevada





Tennessee, Arkansas, Missouri, Virginia, South Carolina



Texas, Oklahoma

Areas where suspected nontectonic earthquakes have been deleted

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Historic Earthquakes Drive Building Code Revisions

1927 UBC

1973 UBC

2000 IBC

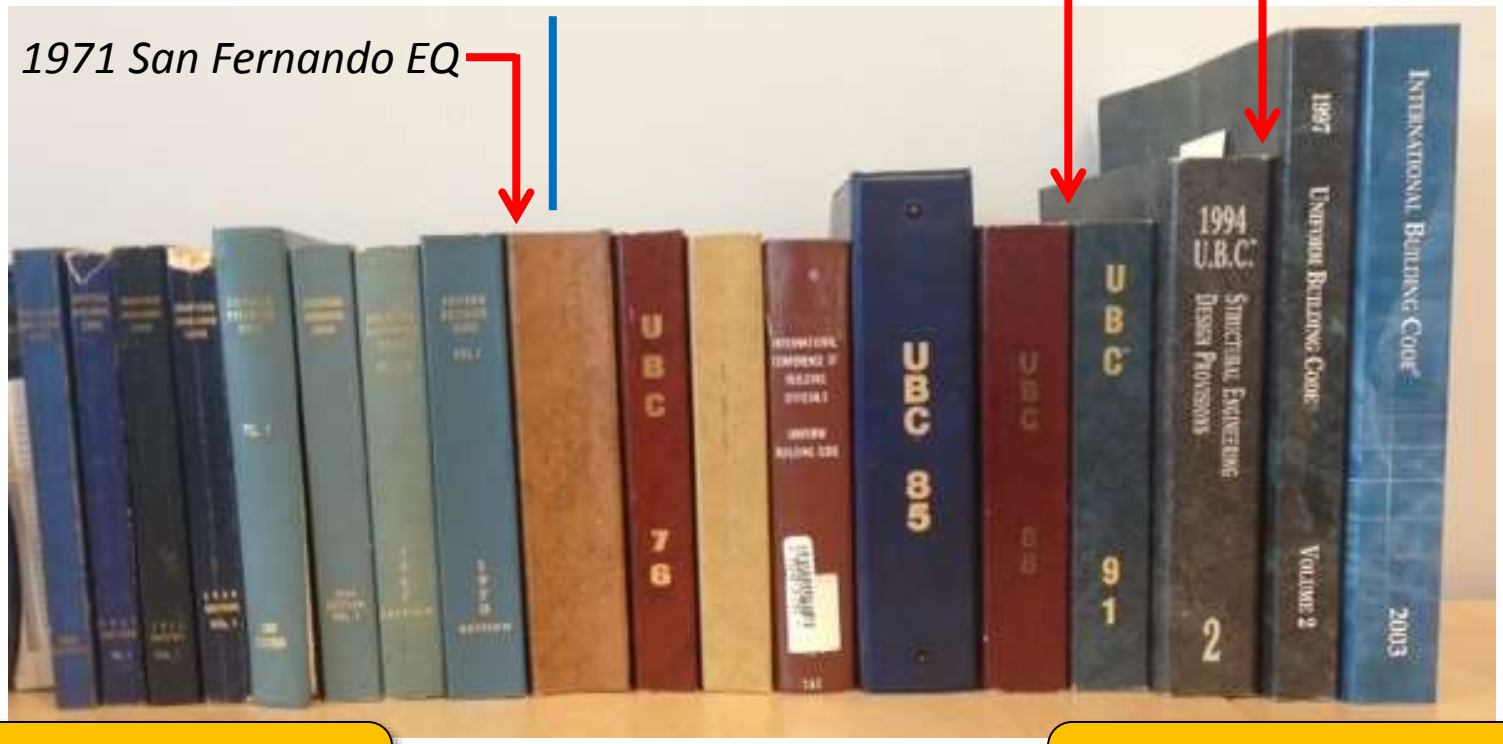
2012 IBC
Current

1994 Northridge EQ

1989 Loma Prieta EQ

1971 San Fernando EQ

First Uniform Building Code



International Building Codes
With State and Local Amendments
And Referenced Standards

Early Codes were smaller (physically) and less complex (and lacked adequate seismic provisions)

The seismic provisions of the Codes become more comprehensive, incorporating lessons learned from past earthquakes.

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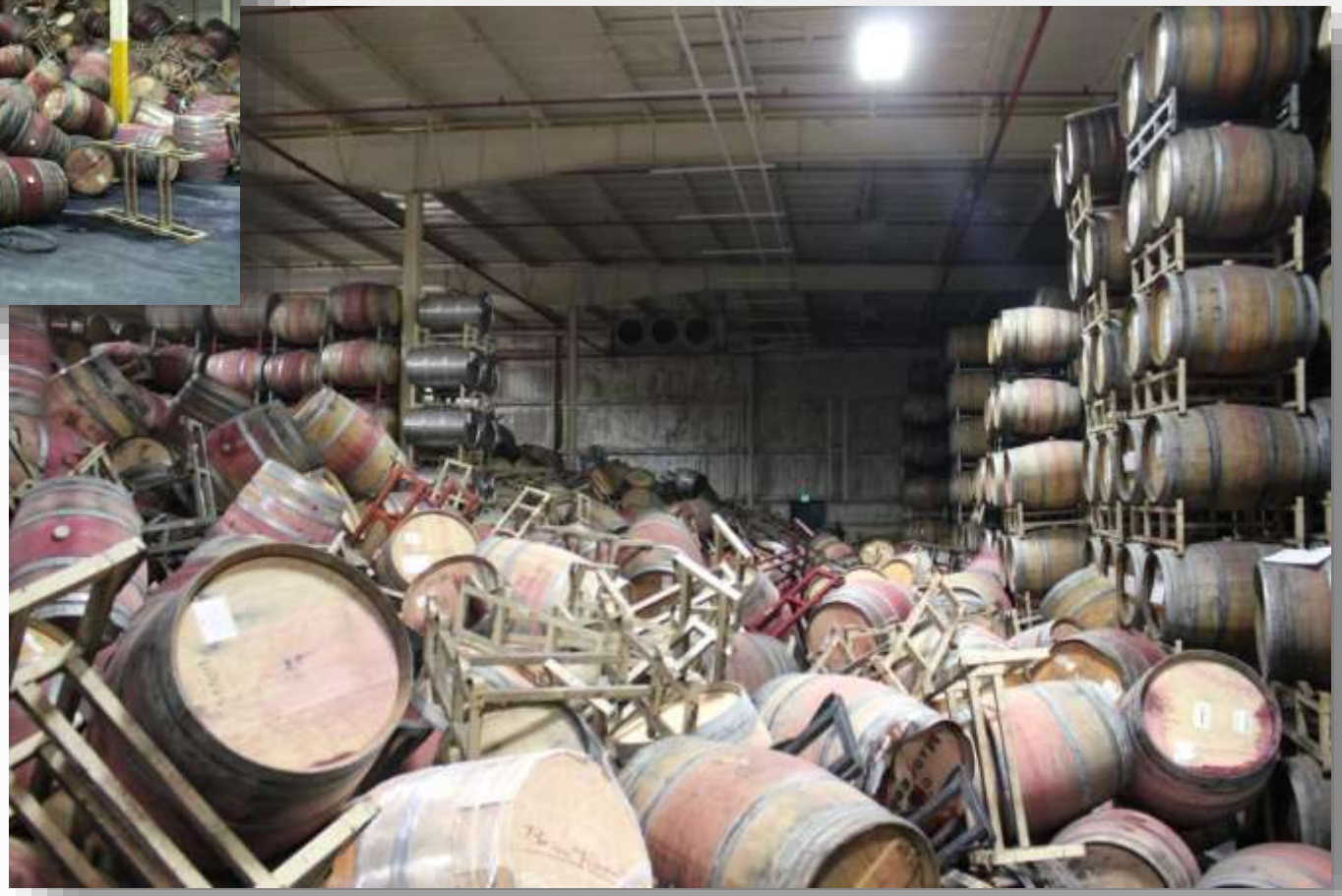
California Earthquakes = Spilled Wine

M6.0 South Napa Earthquake
Winery Damage



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Part 5

What Does the Future Holds

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This will NOT Happen

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DFW Earthquakes – The Lessons for CRE

1. Texas is not going to be beach front property someday
2. Earthquakes are not large enough to cause structural damage
   - Minor architectural finish damage, at best
3. Prior property damage may be mistaken as earthquake damage
   - Foundation movement due to expansive soils
   - Windstorm damage
   - Poor maintenance (weeds in existing cracks)
4. Older buildings are generally more vulnerable to shaking damage
   - Masonry structures
   - Wood frame structures with brittle plaster finishes
5. "Seismic zoning" not likely to change (no Alquist-Priolo)
6. University research lacks funding, conflict of interest with University donors. Our understanding of this issue may suffer and drag on.
7. Uncertain if earthquakes will increase in number and size

Improvements, One Step at a Time

- A good start is to cease placing Class II wells near known fault traces
  - Very few injection wells have been linked to an increase in earthquakes
- Railroad Commission adopts well rule amendments, Nov 17, 2014
  - Applicants for new wells to conduct a search of the U.S. Geological Survey seismic database for historical earthquakes within a circular area of 100 square miles around a proposed, new disposal well;
  - Provides power to the Commission to terminate permits on wells contributing to seismic activity
  - Operators may be required to disclose volumes and pressures annually if RRC determines a need
  - Applicants provide additional boundary pressure calculations to demonstrate containment of disposal fluids in an area where conditions exist that increase the risk that fluids may not be confined
- Alternative waste water disposal solutions
  - Treatment plants at the surface
  - Other options are generally more expensive vs. injection wells

Part 6

Enough of Me…
Now to the Panel

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Panel Discussion and Attendee Questions

- Joshua Marrow, P.E.
  - Partner Engineering and Science
  - ***Structural / Seismic Engineering***
- Kassandra McLaughlin
  - Husch Blackwell
  - ***Real Estate Law***
- Joe Willoughby
  - Frederiksen & Frederiksen
  - ***Catastrophic Risk Insurance***
- Tony Adamo
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  - ***Geotechnical Engineering***

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MINIMUM INSURANCE REQUIREMENTS

Realty Income suggests you provide a copy of the Minimum Insurance Requirements set forth above to your insurance agent or broker as soon as possible to ensure certificates timely will be issued evidencing compliance with the terms and conditions of the lease.

***** IMPORTANT *****
Please Read

Tenant's failure to timely provide Landlord with an ACORD Form 25 Certificate of Liability Insurance and an ACORD Form 28 Evidence of Commercial Property Insurance will constitute an Event of Default under the Lease Agreement.

Landlord (without the need for any notice or cure period) shall have the right to immediately procure and replace the deficient insurance coverage with a policy of insurance covering the Premises of the type and in the limits set forth in the Lease Agreement. Tenant shall immediately pay to Landlord, as additional rent, an amount equal to (i) the total cost of premiums and expense of such insurance placement plus (ii) actual and reasonable handling fees plus (iii) an administrative fee on all costs incurred by Landlord in procuring and maintaining such insurance, which administrative fee shall not exceed One Hundred Percent (100%) of such costs.

Insurance Company; Notification Requirements

- Insurer to hold a general policyholder's rating of A-VIII or better (per Best's Insurance Guide);
- Policies to provide 30 days' prior written notice of cancellation or reduction of coverage or other material modification.

Minimum Acceptable Insurance Coverage Requirements

Liability:

- Agent or Broker to issue Certificate of Liability Insurance evidencing coverage under all liability policy(ies).

Property:

- Special Form policy covering loss or damage to the leased premises;
- Total coverage equal to full guaranteed replacement cost of the building(s) (less slab, foundation, supports and other customarily excluded improvements);
- Containing standard printed exclusions only;
- Including an agreed value endorsement waiving any co-insurance penalty;
- Including an ordinance or law coverage endorsement;
- Including a waiver of subrogation;
- Including a "Loss Payable Provisions" endorsement (ISO Form CP 12 18 06 95 or equivalent) naming Landlord as "Loss Payee";
- Deductible not to exceed $10,000;
- Agent or Broker to issue Evidence of Property Insurance evidencing coverage under property policy.

Business Interruption:

- Covering all rent, taxes and insurance costs for six (6) months.

Flood:

- Required if the leased premises is located in Flood Zone A or V as defined by FEMA.

Earthquake:

- Required (1) if the leased premises is located in California or (2) if the county in which the leased premises is located is classified as being in an earthquake territory 1 through 11 by ISO or an earthquake zone of 1 through 3 by ISO.

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