What's Shaking?

Earthquake Hazards and Preparedness in Richmond & El Sobrante

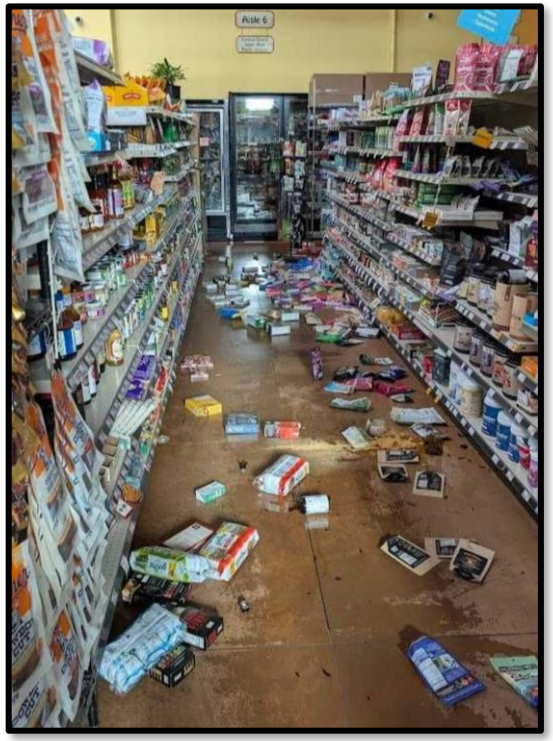
Amy Williamson
UC Berkeley Seismology Lab



Over 19,000 earthquakes in California so far in 2026

Most are very small and not felt.

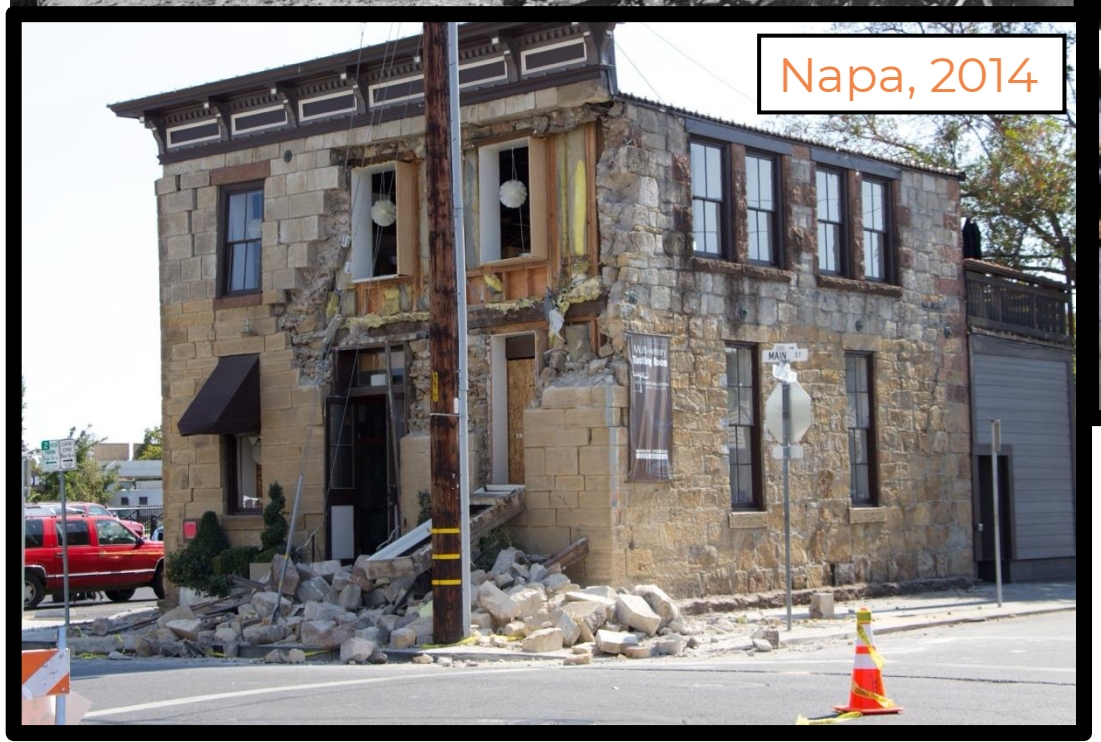
Sometimes bigger earthquakes occur and can cause minor damage



June 24, near Willits





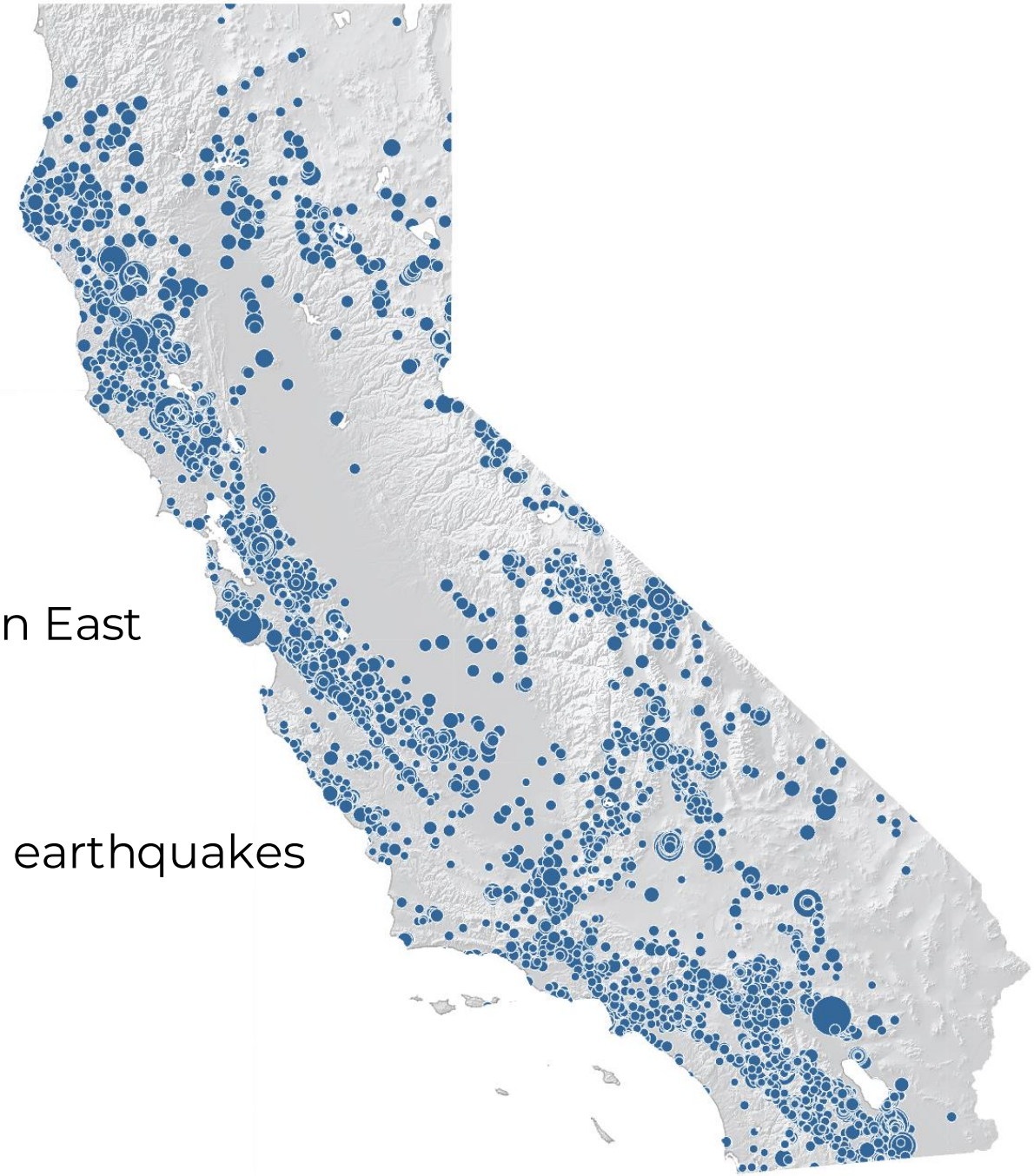


Sometimes, large earthquakes occur, causing a lot of damage



Let’s talk about earthquakes

- Earthquakes 101 (what is an earthquake, where do they happen, how do we talk about them)
    - Where do we expect earthquakes in East Bay
        - How do I prepare for future earthquakes

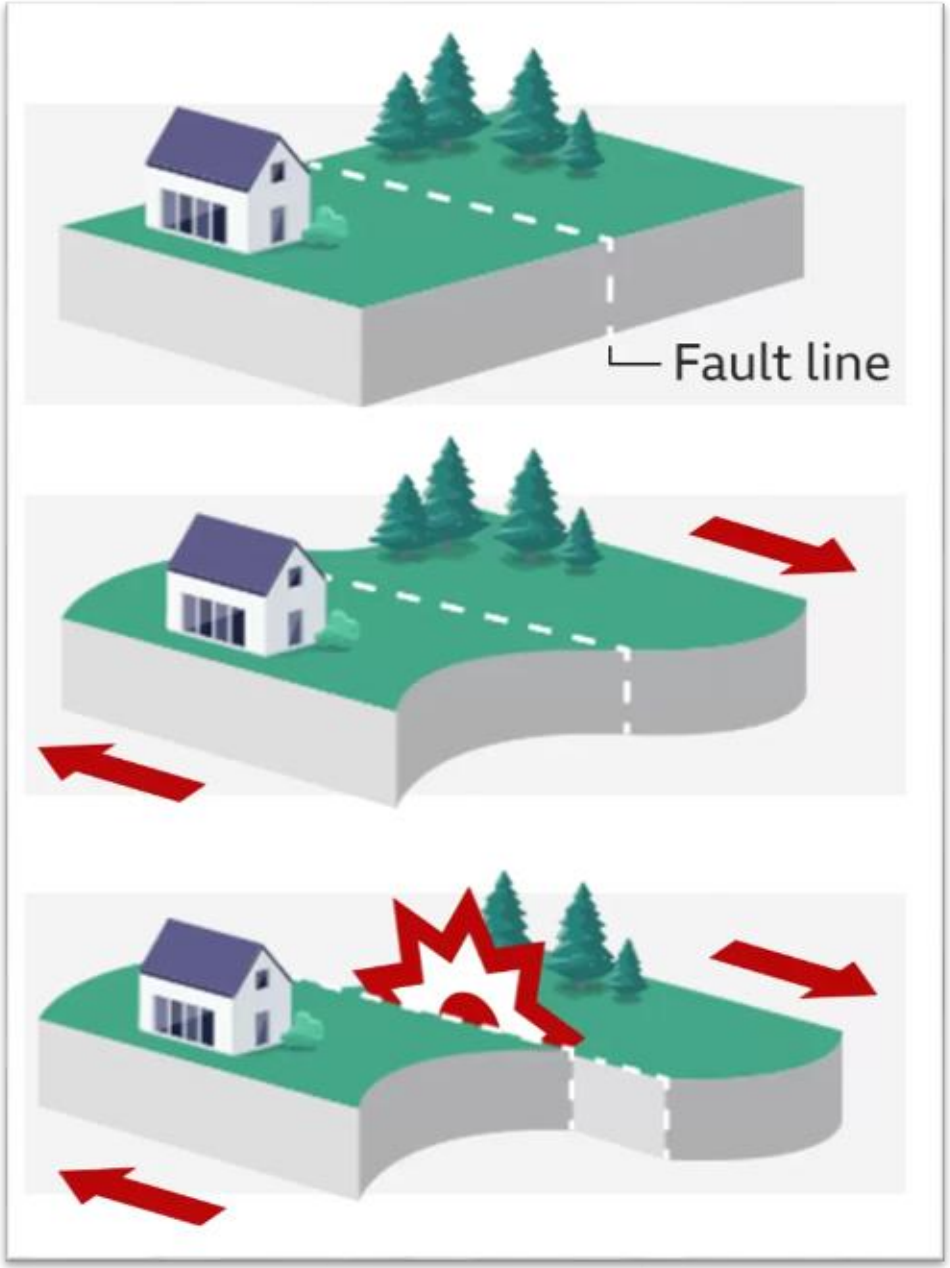


Earthquakes 101: What is an earthquake?

Earthquake: the shaking of the ground as two parts of the earth's crust suddenly move past each other

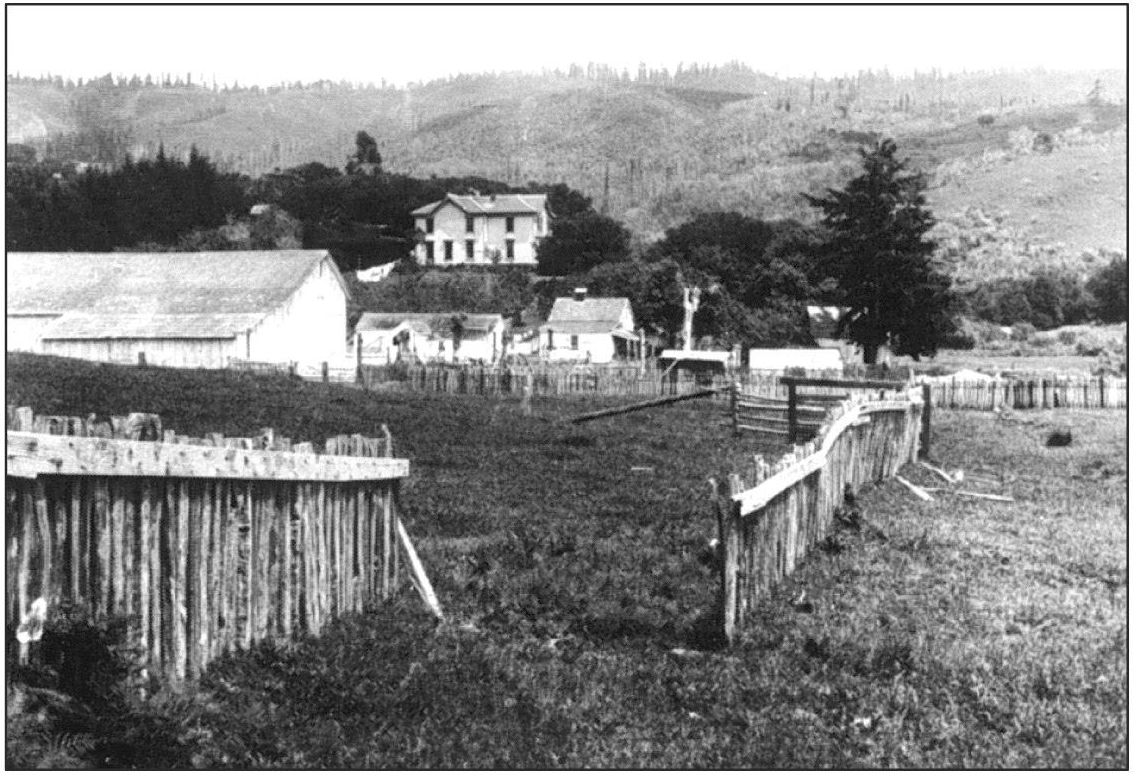
Earthquakes create seismic waves that can be measured with seismometers

Earthquakes occur on faults.. Some of these faults are mapped… some are not.



Earthquakes 101: What is an earthquake?

During large earthquakes, scientists can measure the amount of offset (slip) along a fault.



A fence built across the San Andreas fault near Bolinas, California, is offset by nearly 3 m after the great San Francisco earthquake

A road in Naval Air Weapons Station China Lake.



Photo by Brian Olson / California Geological Survey

Los Angeles Times

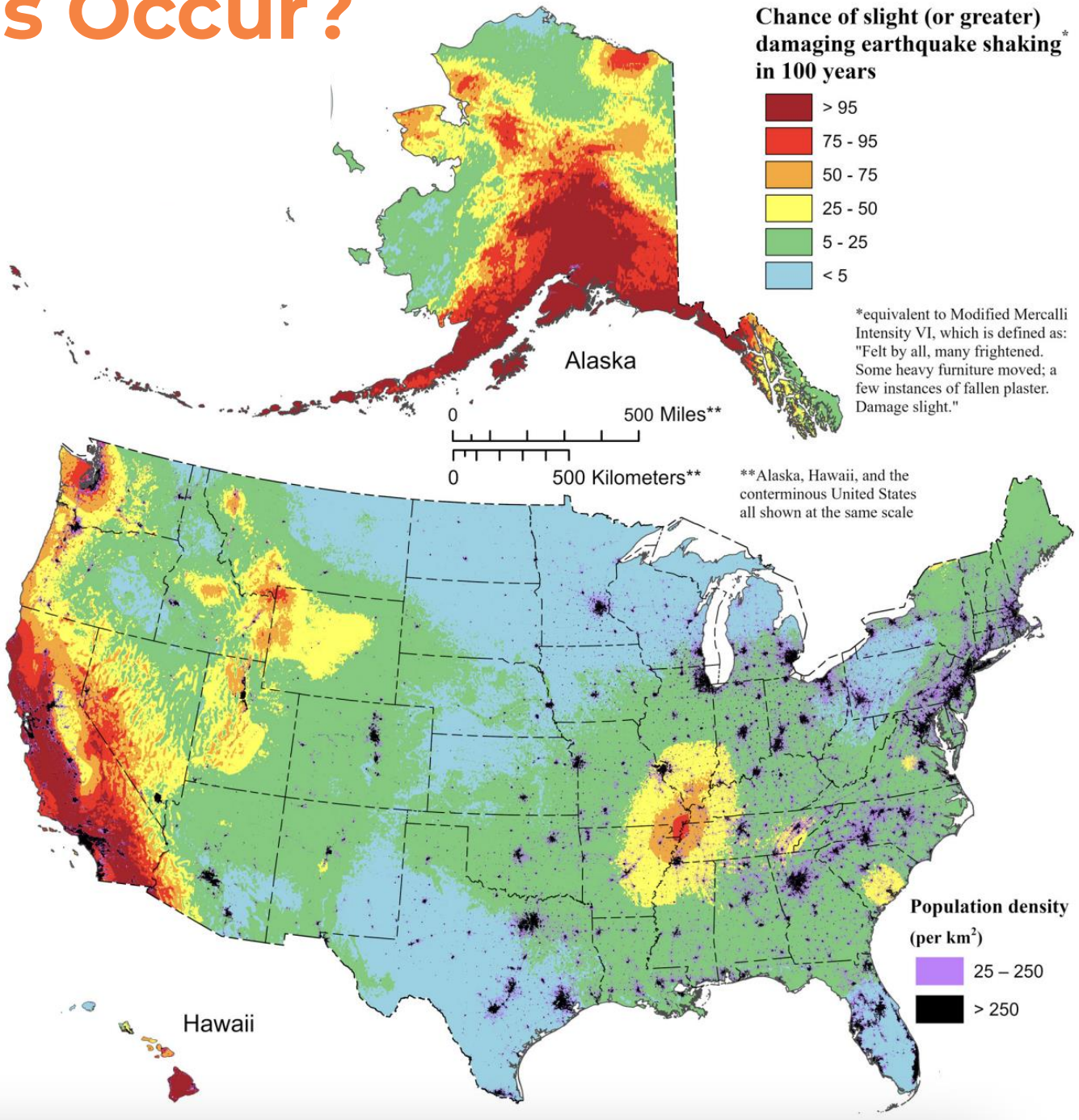
Where do Earthquakes Occur?

Top 5 States with the most earthquakes:

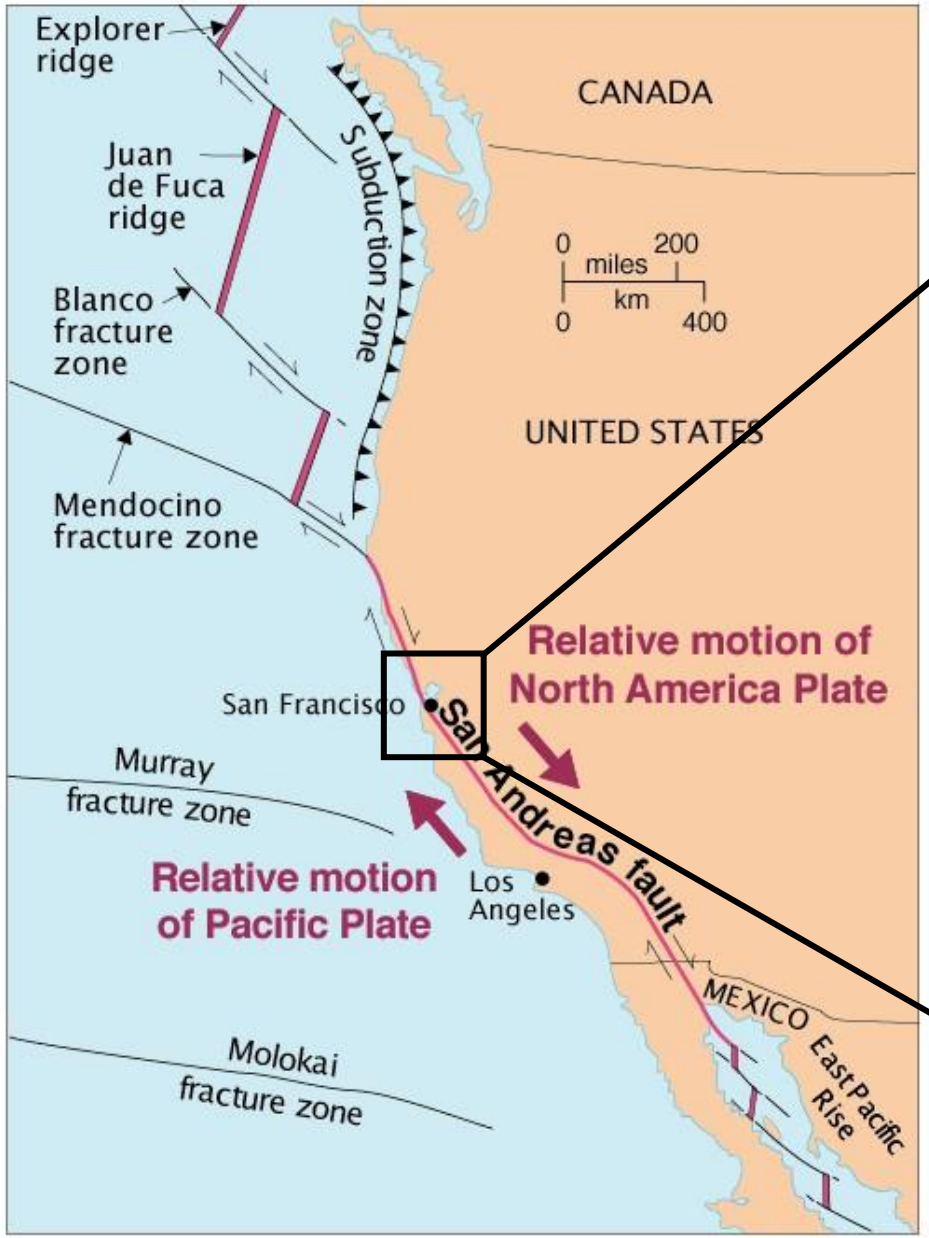
1. Alaska
2. California
3. Hawaii
4. Nevada
5. Washington State

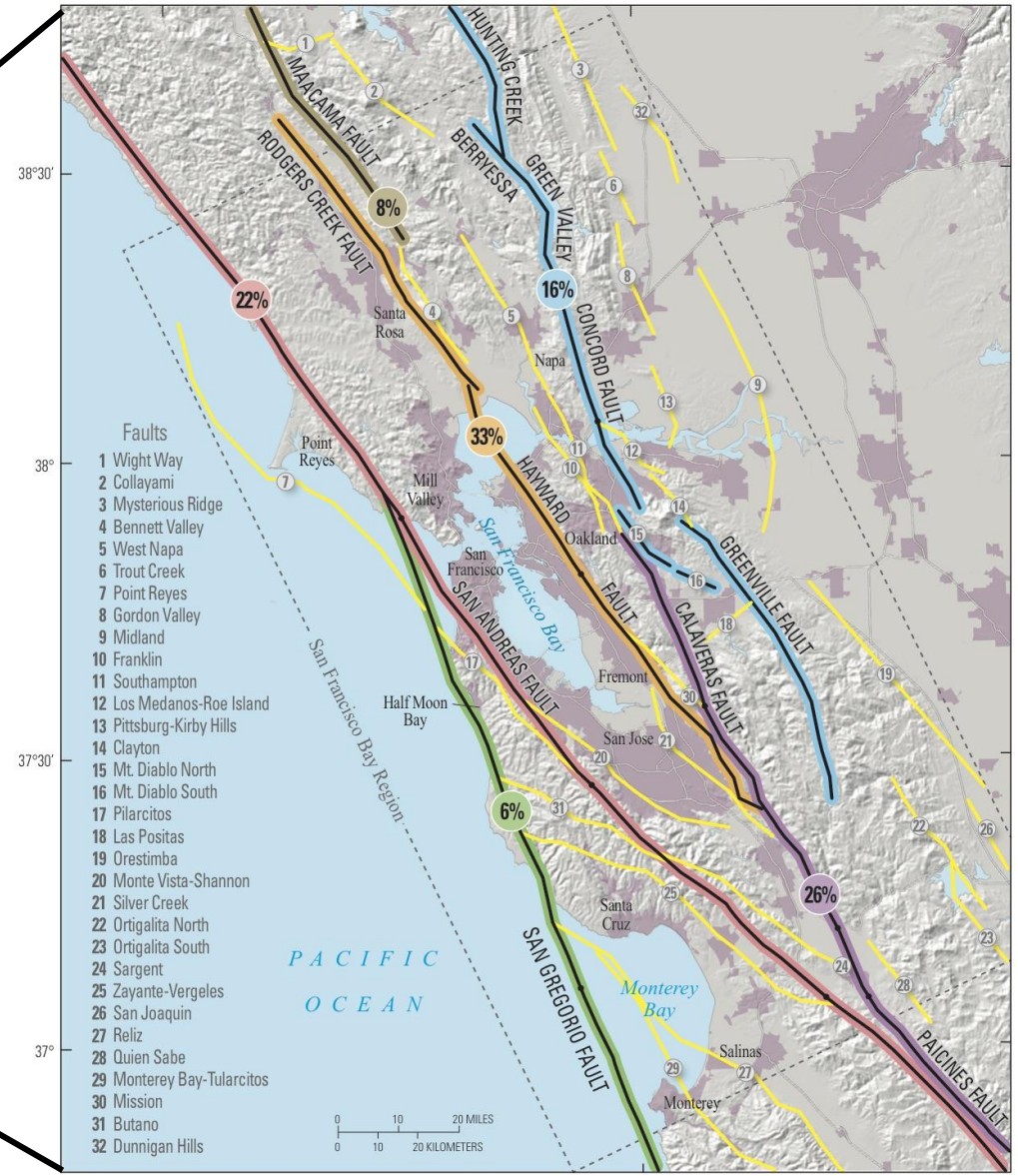
Largest (recent) earthquakes:

- 2019 M7.1 Ridgecrest
- 2024 M7.0 offshore Cape Mendocino
- 1989 M6.9 Loma Prieta



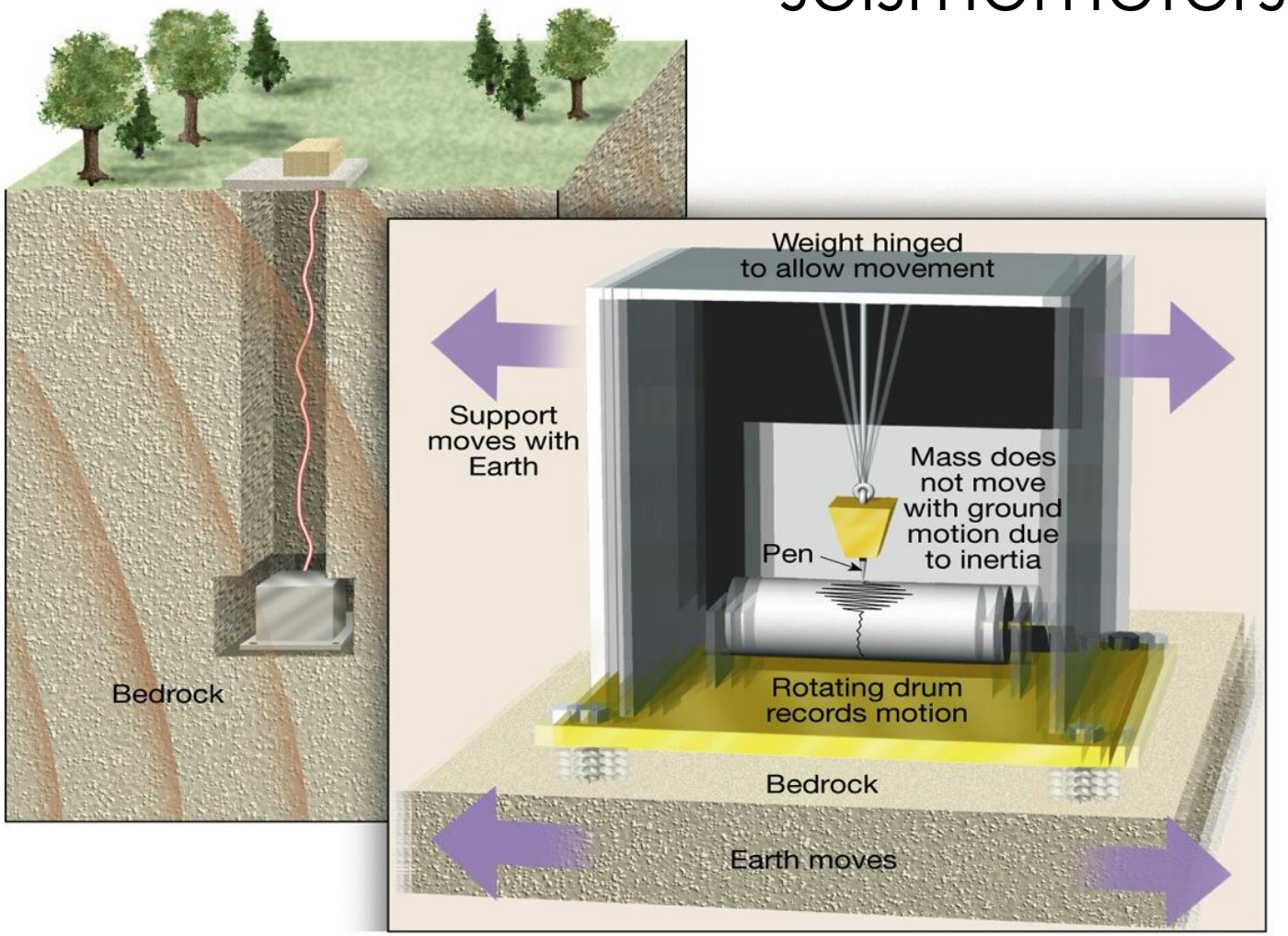
Earthquakes 101





Earthquakes 101: How do we measure earthquakes?

Earthquakes are measured using seismometers

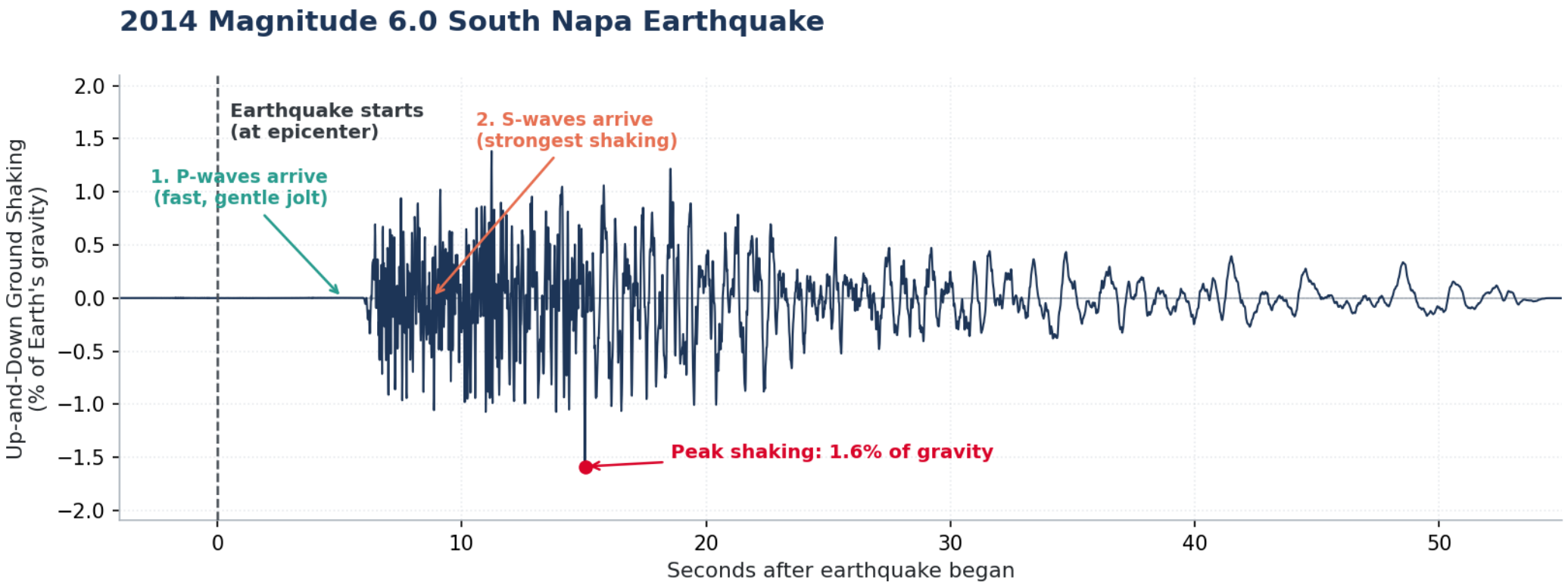






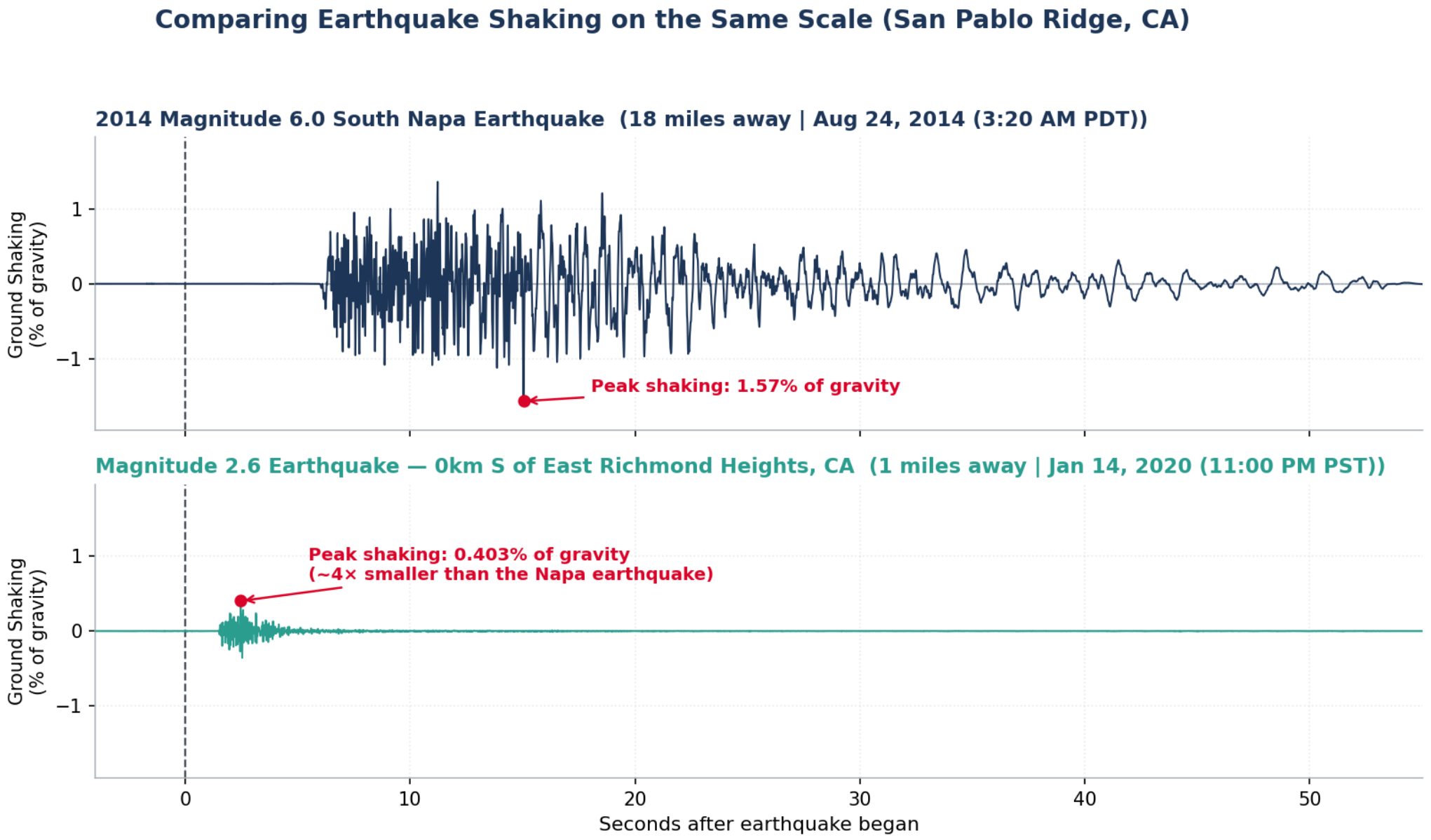
Earthquakes 101: How do we measure earthquakes?

Recorded at San Pablo Ridge, CA — 18 miles (29 km) south of the epicenter | Aug 24, 2014 (3:20 AM PDT)



Data: USGS & Northern California Earthquake Data Center (Station CSPB)

Earthquakes 101: How do we measure earthquakes?

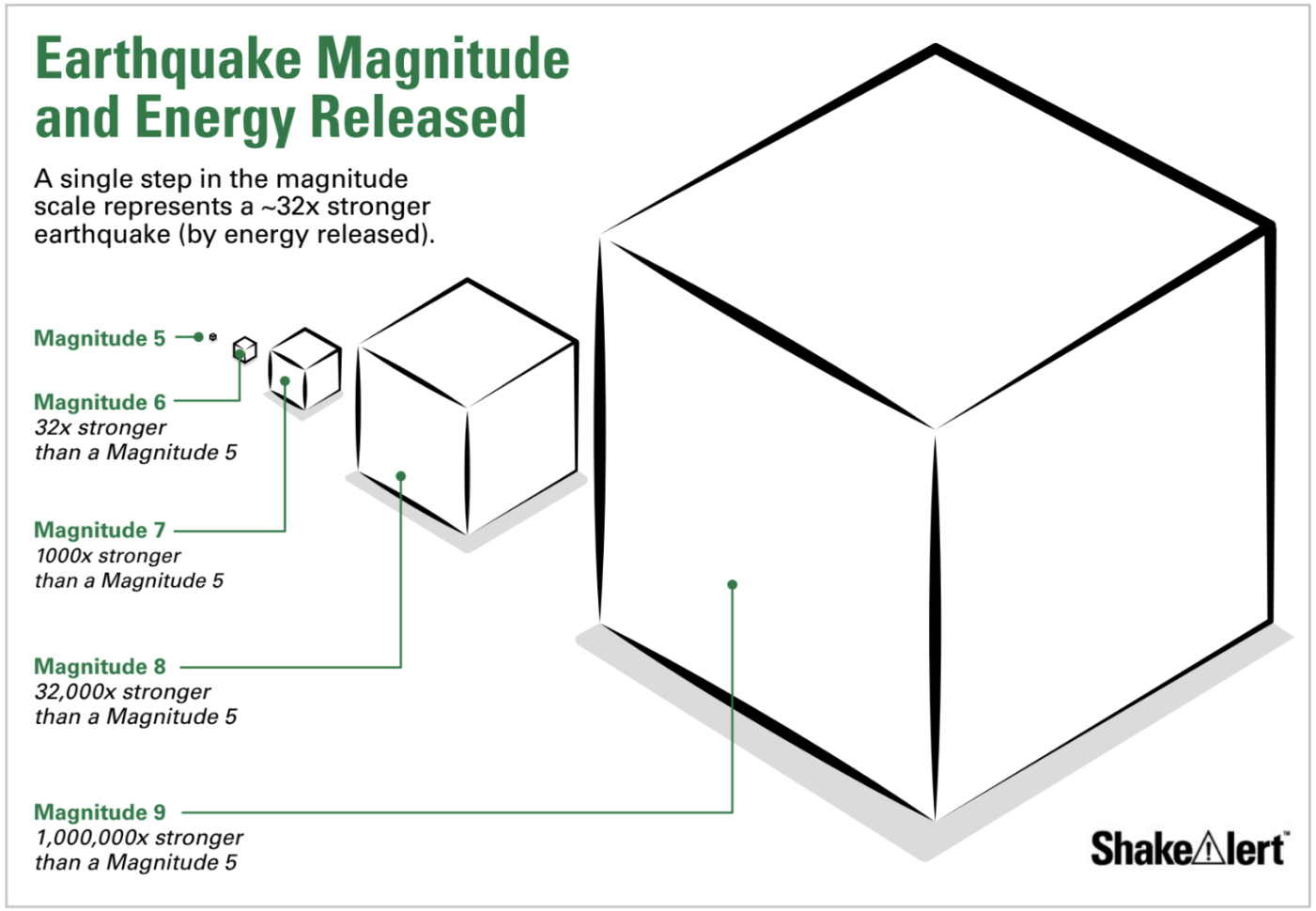


Data: USGS & Northern California Earthquake Data Center (Station CSPB)

Earthquakes 101: How do we measure earthquakes?

Assign a “size” to an earthquake by calculating its magnitude

Magnitude is based on the amount of energy that is released during the earthquake.



We don’t technically use the “Richter Scale” anymore, but the term is still sometimes used

Earthquakes 101: How do we measure earthquakes?

Intensity: the amount of shaking that you feel

Depends on:

- Earthquake magnitude
- How far you are from the earthquake
- Your environment

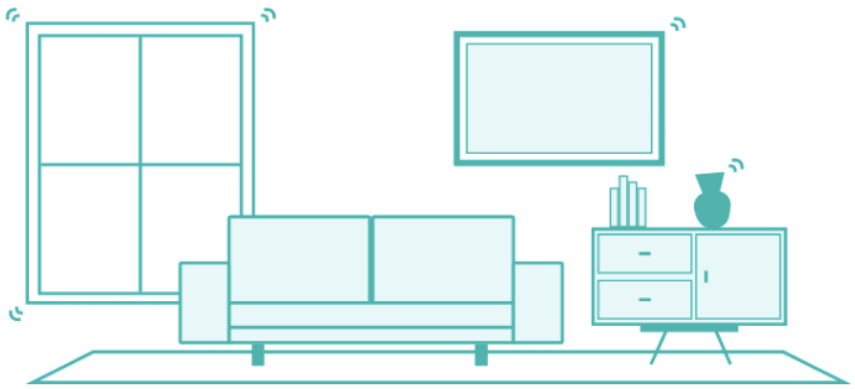
You will feel more intense shaking close to an earthquake, and less intense shaking further away …

… all for the same magnitude

Mercalli Intensity Scale

Intensity	Shaking	Description
I	Not Felt	Not likely felt
II	Weak	
III	Weak	Felt indoors- may not recognize as earthquake
IV	Light	
V	Moderate	Unstable objects fall
VI	Strong	Slight building damage
VII	Very Strong	
VIII	Severe	Chimneys fall, building damage
IX	Violent	
X	Extreme	Most masonry structures destroyed

Earthquakes 101: How do we measure earthquakes?



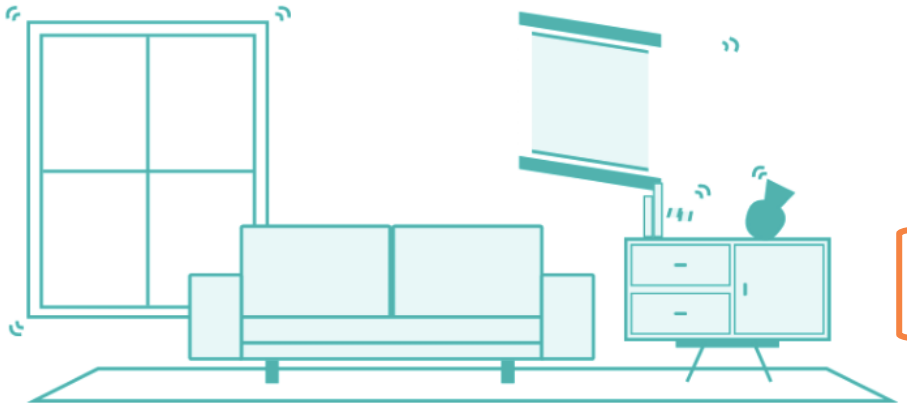
Light Shaking

Light shaking, might be confused for a large truck passing by

Mercalli Intensity Scale

Intensity	Shaking	Description
I	Not Felt	Not likely felt
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Earthquakes 101: How do we measure earthquakes?



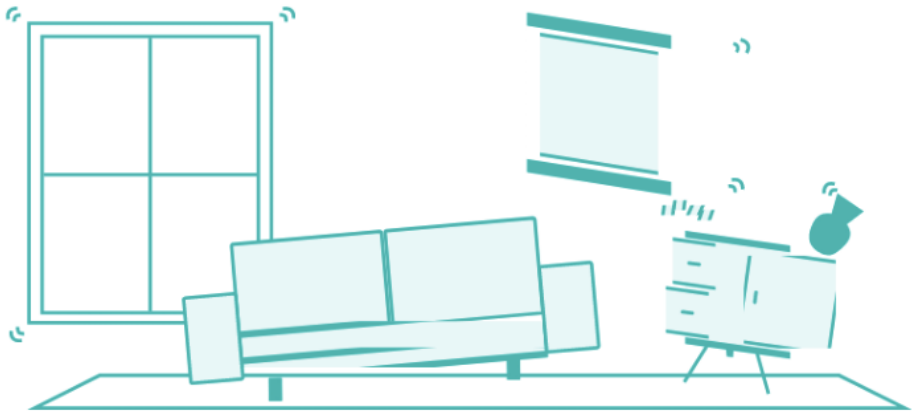
Moderate Shaking

Felt by most, may wake you at night. Heavy furniture may shake, items on shelves may fall

Mercalli Intensity Scale

Intensity	Shaking	Description
I	Not Felt	Not likely felt
II	Weak	
III	Weak	Felt indoors- may not recognize as earthquake
IV	Light	
V	Moderate	Unstable objects fall
VI	Strong	Slight building damage
VII	Very Strong	
VIII	Severe	Chimneys fall, building damage
IX	Violent	
X	Extreme	Most masonry structures destroyed

Earthquakes 101: How do we measure earthquakes?



Strong Shaking

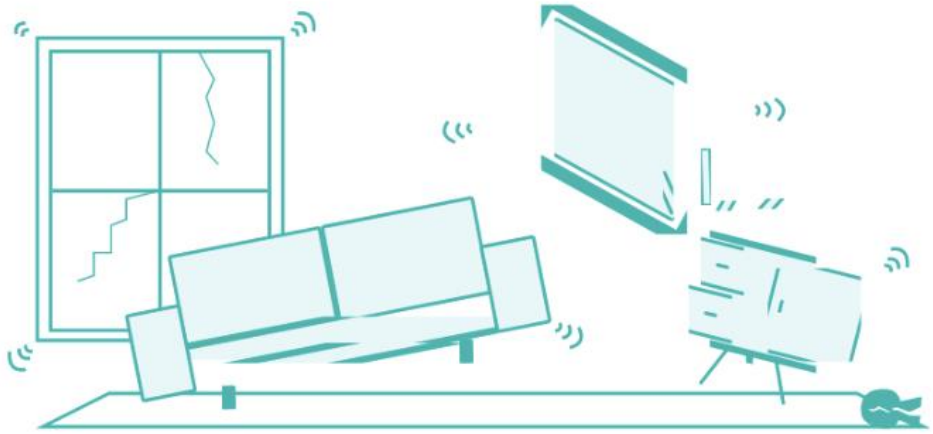
Felt by all. Slight damage to buildings

Mercalli Intensity Scale

Intensity	Shaking	Description
I	Not Felt	Not likely felt
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III	Weak	Felt indoors- may not recognize as earthquake
IV	Light	
V	Moderate	Unstable objects fall
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IX	Violent	
X	Extreme	Most masonry structures destroyed

Earthquakes 101: How do we measure earthquakes?

Damage to buildings (windows breaking, cracks in walls, chimney collapse, etc)



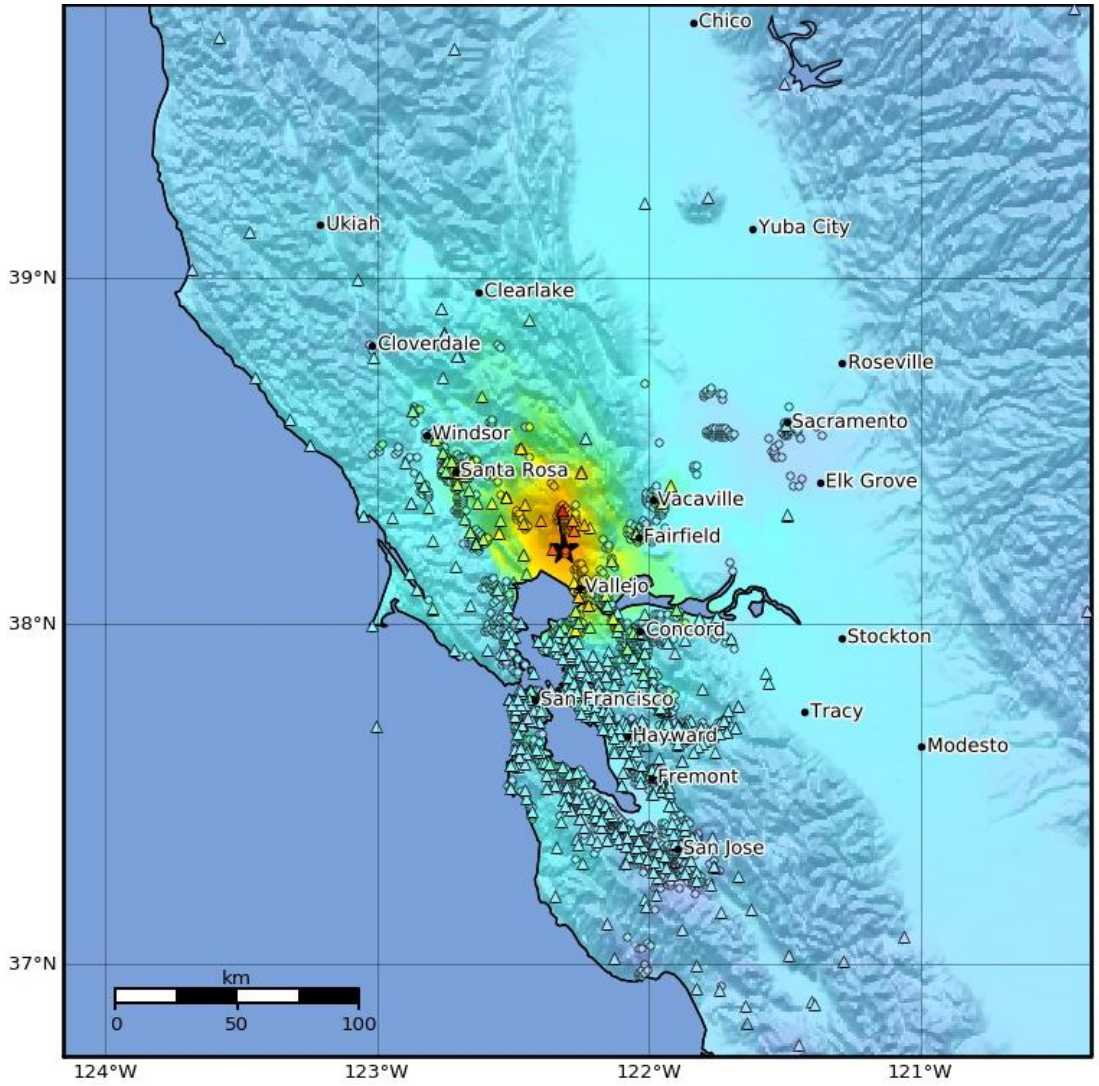
Severe Shaking

Mercalli Intensity Scale

Intensity	Shaking	Description
I	Not Felt	Not likely felt
II	Weak	
III	Weak	Felt indoors- may not recognize as earthquake
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IX	Violent	
X	Extreme	Most masonry structures destroyed

Earthquakes 101: How do we measure earthquakes?

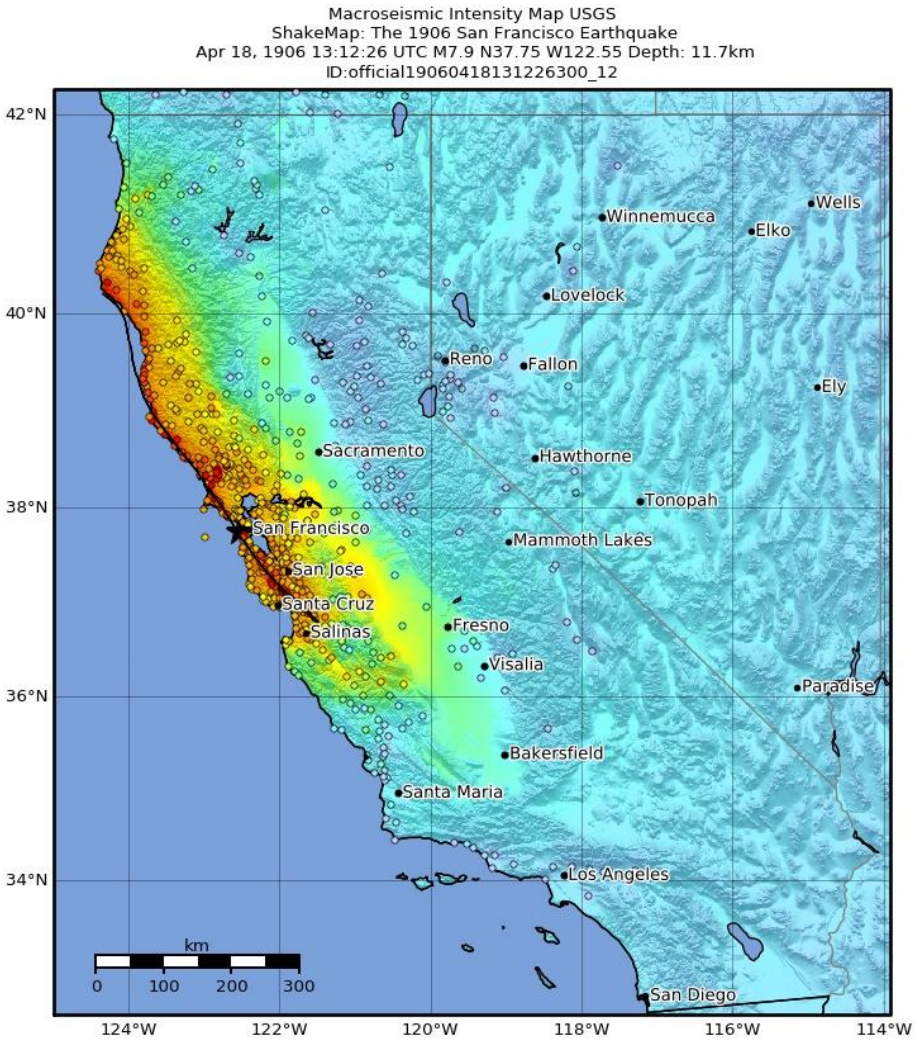
2014, M6.0 Napa earthquake



Mercalli Intensity Scale

Intensity	Shaking	Description
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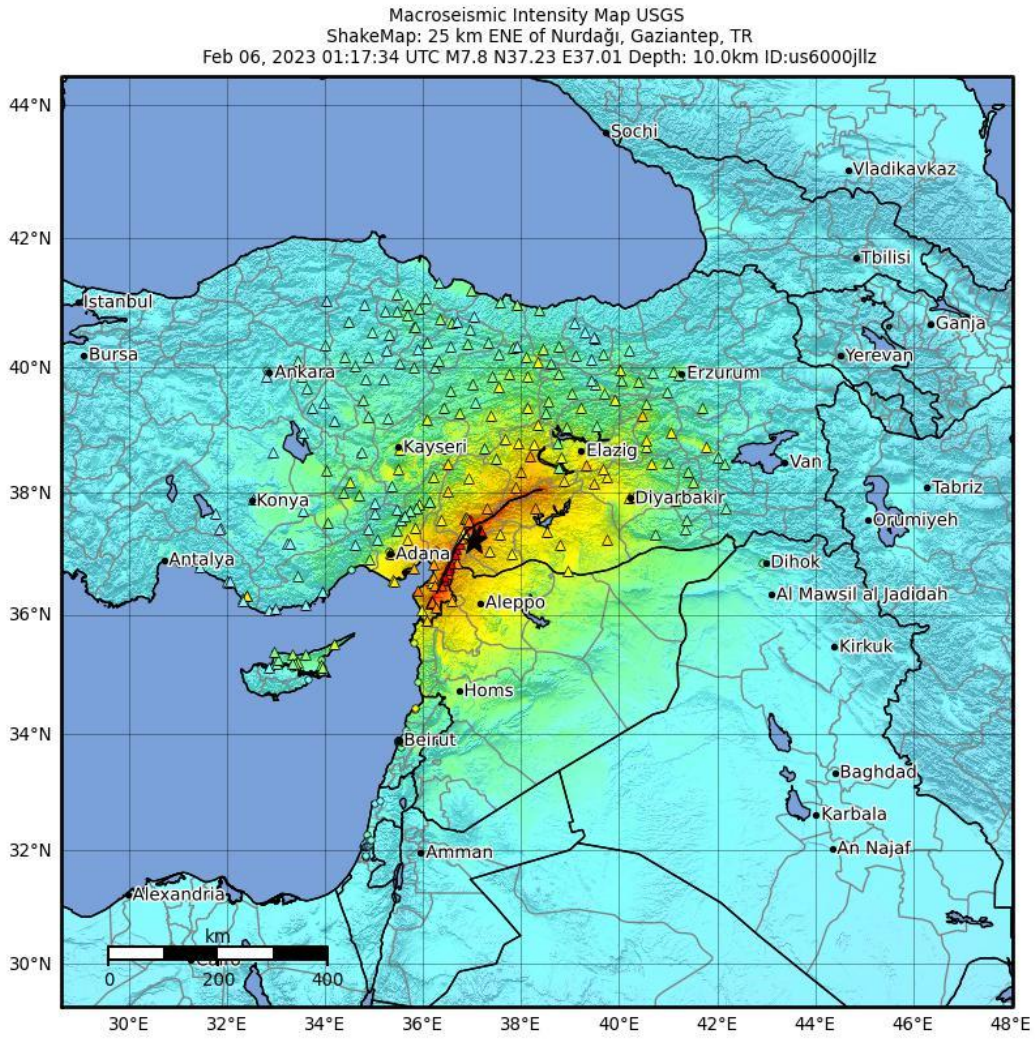
Earthquakes 101: How do we measure earthquakes?



SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based on Worden et al. (2012) Version 1: Processed 2020-06-03T04:25:10Z

△ Seismic Instrument ○ Reported Intensity ★ Epicenter ▭ Rupture

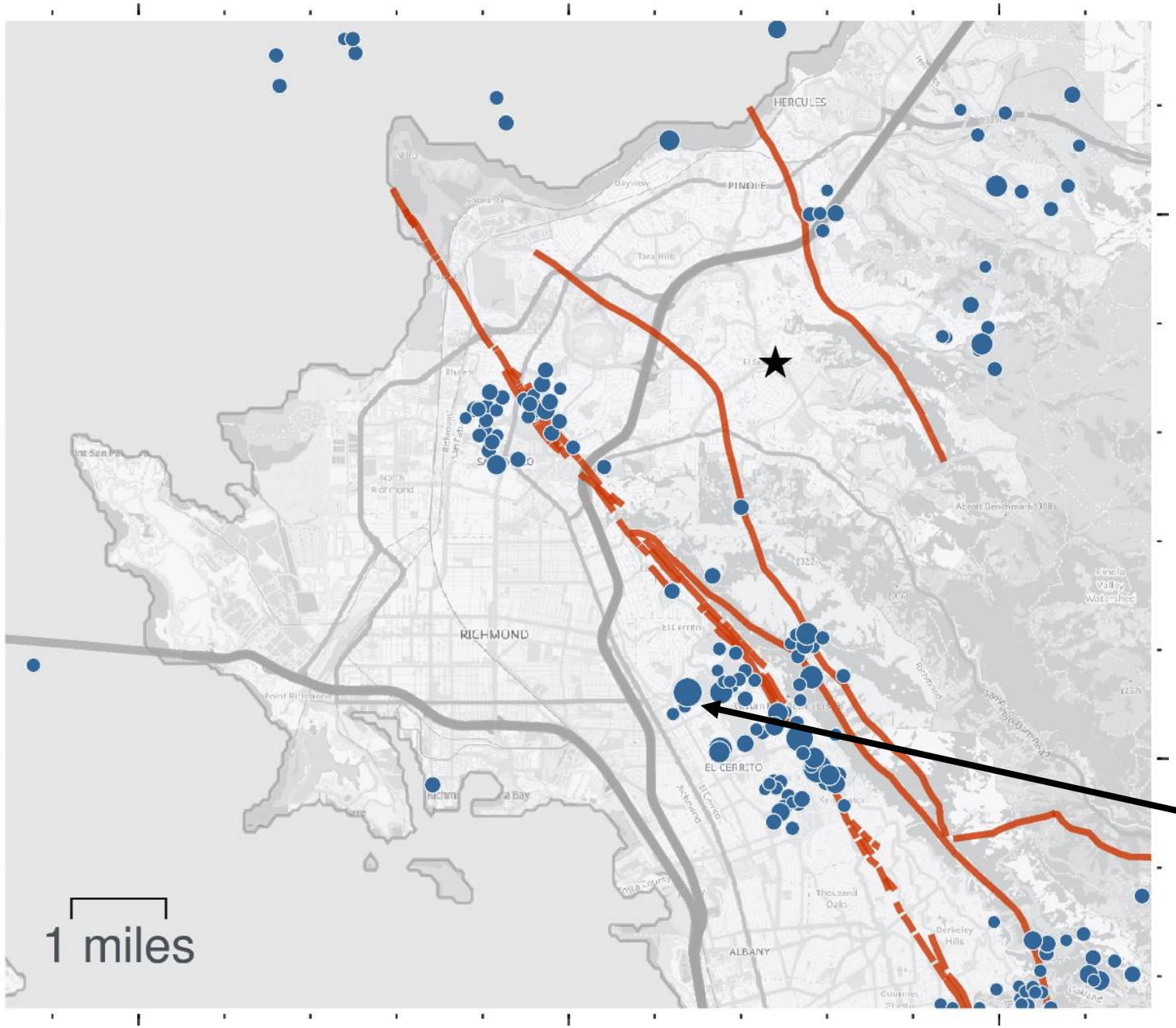


SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based on Worden et al. (2012) Version 17: Processed 2023-04-14T18:03:10Z

△ Seismic Instrument ○ Reported Intensity ★ Epicenter ▭ Rupture

Earthquakes in Our Backyard



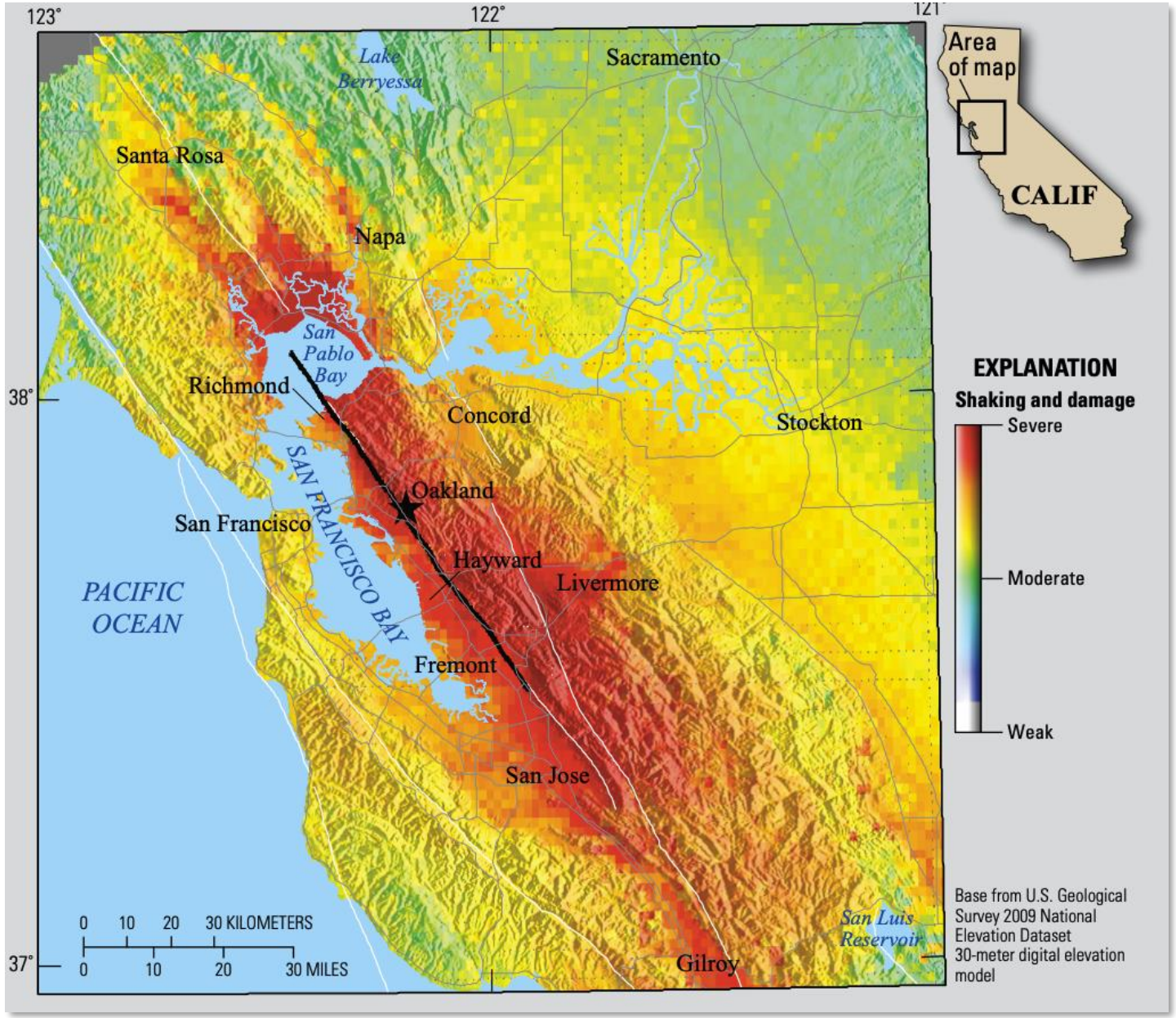
All earthquakes (M2.0+) from 1980 - *present*

Known faults are colored in **red**

Most earthquakes rupture on the Hayward Fault. But smaller faults (Wildcat, Moraga, Pinole) are located nearby

Largest nearby earthquake: M4.0 (2012) in El Cerrito

Earthquakes in Our Backyard



Estimates of shaking intensity for a largest-probable earthquake on the Hayward fault (M7.0)

Strong/Severe shaking can extend many miles away from the fault itself.

Moderate shaking extends even further.

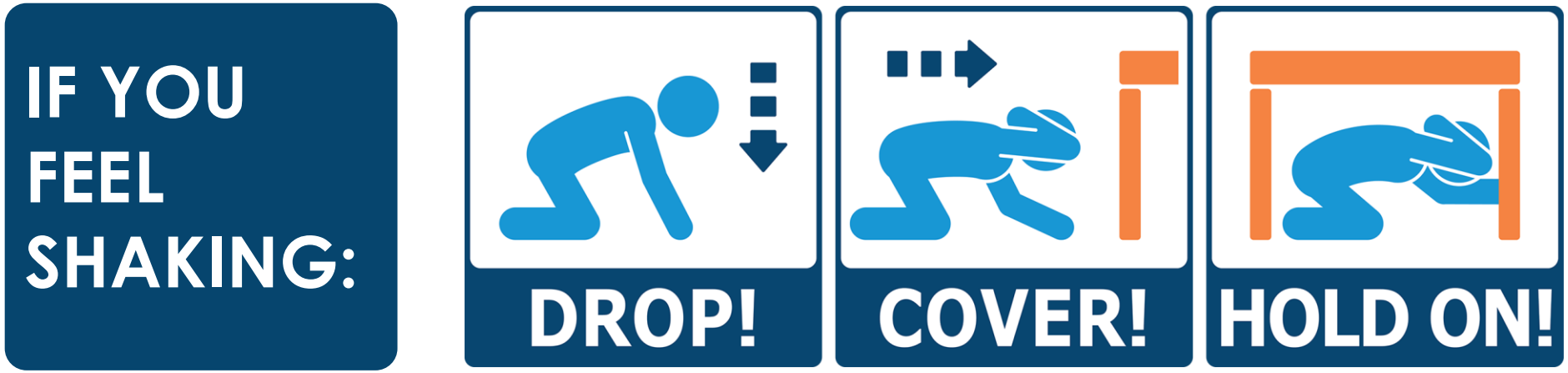
Earthquake Preparedness

What to do before, during, and after an earthquake



Earthquake Preparedness

What should you do during an earthquake?

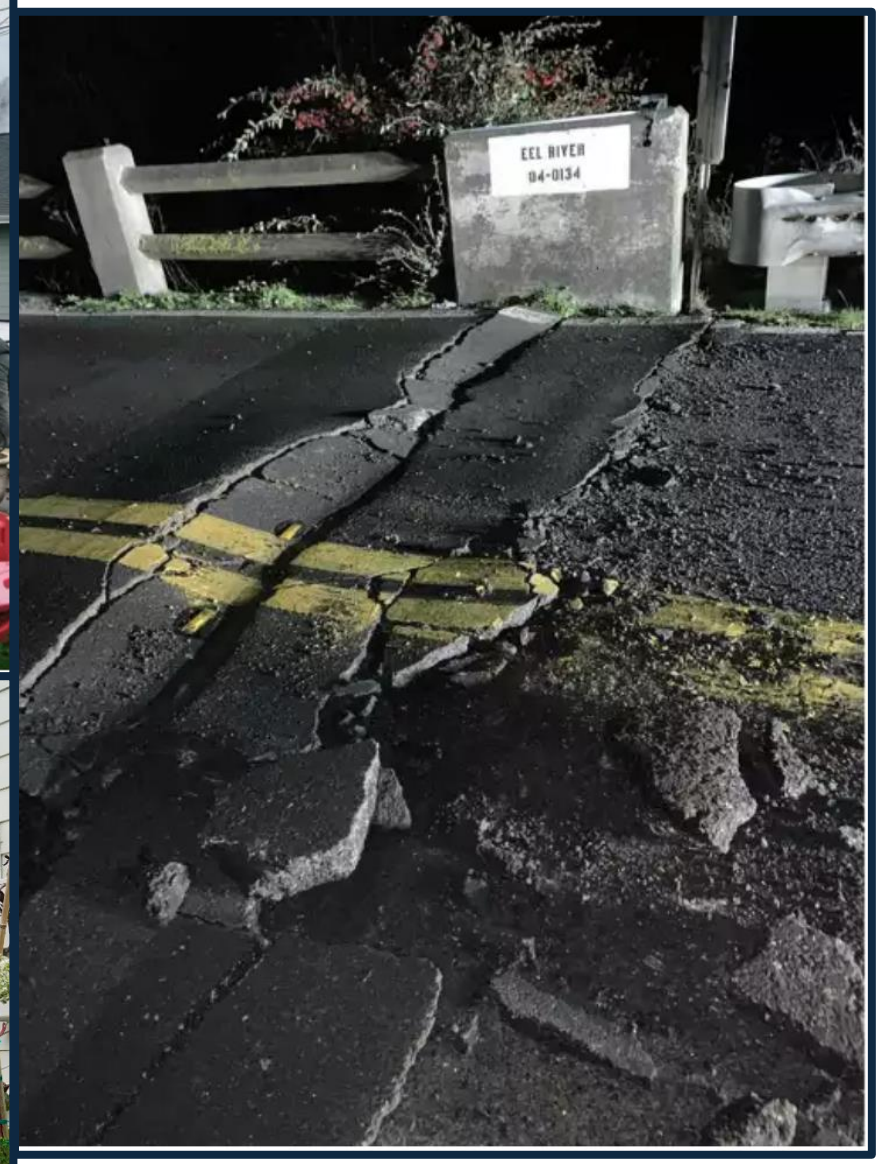


Do not run to a doorway

Do not run outside (United States)



SF Chronicle

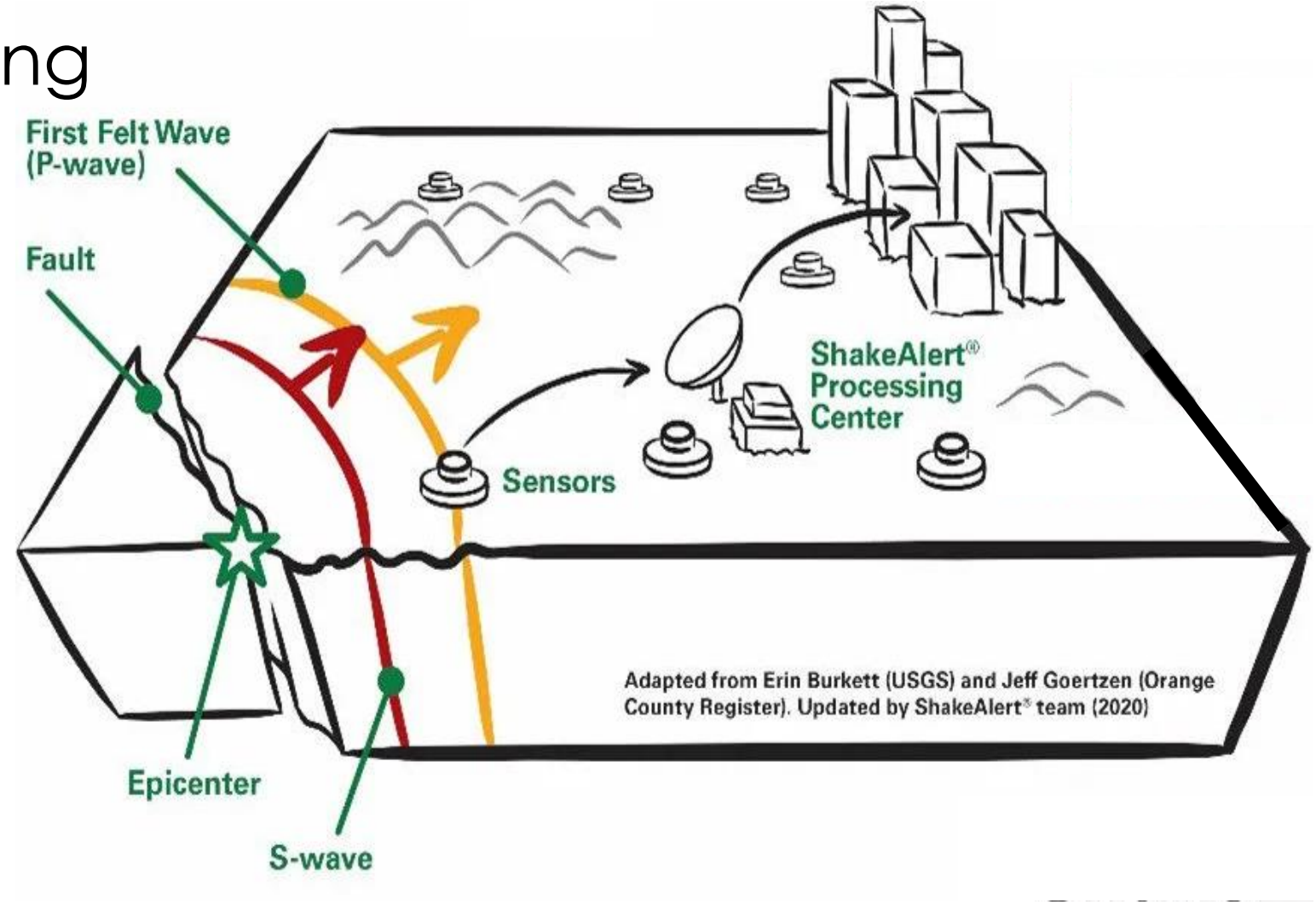




Earthquake Preparedness

Earthquake Early Warning

- Seismometers (and GPS) near the epicenter observe the passing seismic waves
- Observed data are used to calculate the location and magnitude.
- Areas where damaging shaking are estimated.
- In the US, EEW alerts are available through ShakeAlert in Oregon, Washington, and California



Earthquake Preparedness



Know where you might receive earthquake alerts

ShakeAlert provides information to partners who can quickly send alerts to the public

ShakeAlert™

MyShake™

android

Wireless Emergency Alerts



Some groups use alerts for automated actions, like BART trains slowing if an earthquake is detected

Earthquake Preparedness



Develop a household emergency plan

- If you need to evacuate, set a common place for family members to meet and an evacuation route.
- Save emergency phone numbers in each family member's phone. Include a common out of state contact that could be reached.
- Have a common/safe location to keep important information: Insurance information, banking information, phone numbers, vital records like social security cards & birth certificates



Earthquake Preparedness



Prepare and organize disaster supplies













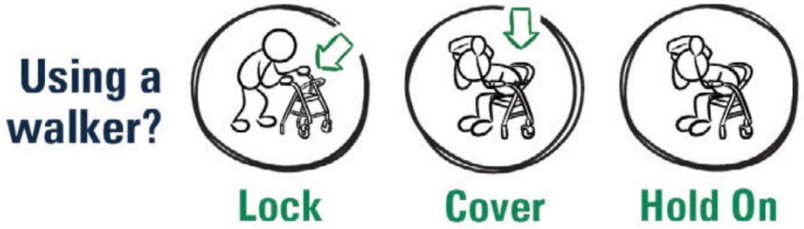


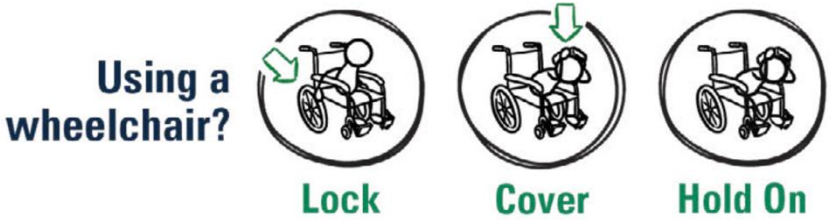
Earthquake Preparedness

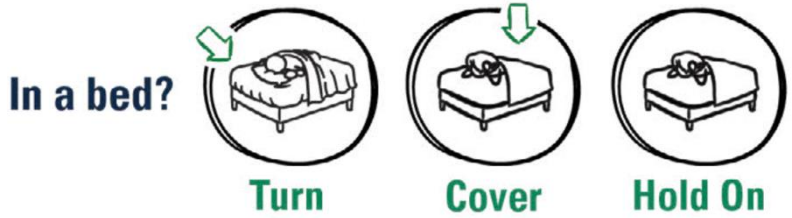


Know what to do if you feel shaking or receive an earthquake Alert



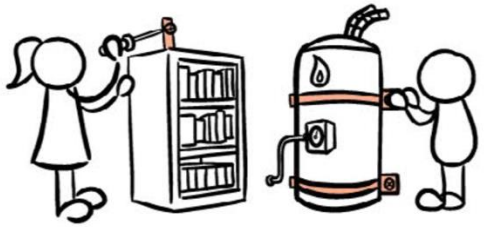






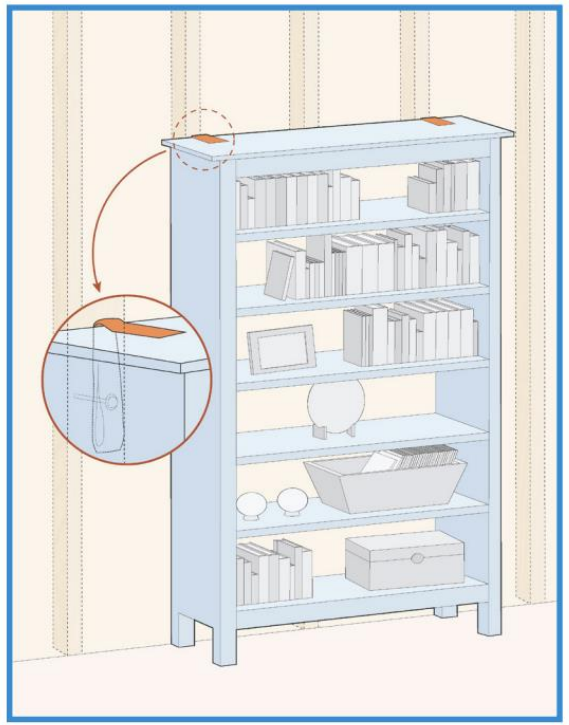


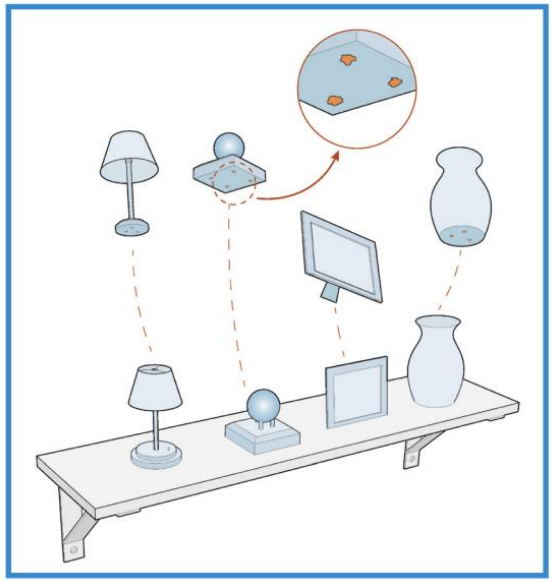
Earthquake Preparedness

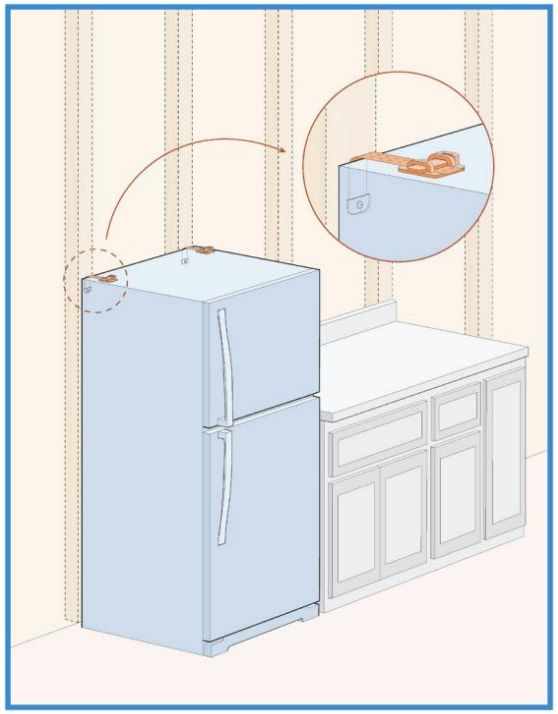


Secure top-heavy furniture and water heaters to walls

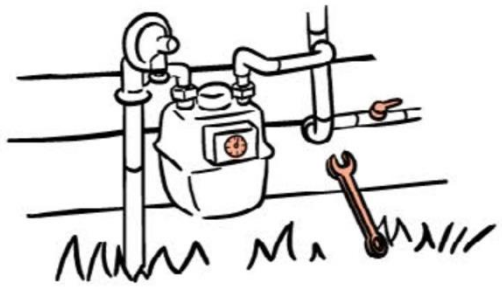
Over half of all injuries during the 1994 Northridge earthquake were caused by falling furniture or objects







Earthquake Preparedness



Know how to turn off gas valves in the event of a gas leak

(Also know how to turn off water!)

Fires, often related to gas leaks, are a common secondary hazard following an earthquake

If you smell a gas leak:

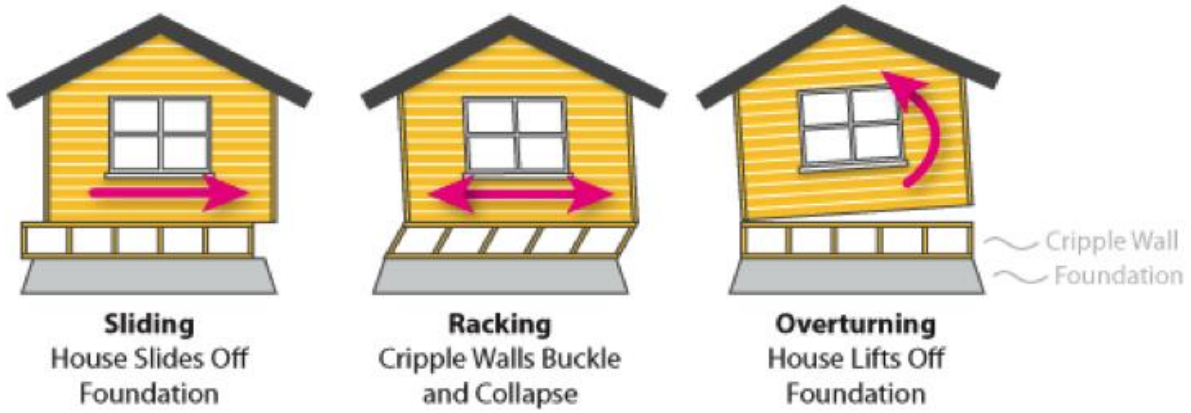
- Identify where your gas shutoff value is located.
- Make sure you have the correct sized wrench of the main valve (consider keeping a wrench close to meter)
- Turn valve by a quarter (90 degrees)

Earthquake Preparedness



Consider seismic retrofitting your home

Seismic retrofitting often involves strengthening weak parts of the home near the foundation and roof



Pro: can greatly reduce building damage during a large earthquake
Con: brace and bolt retrofits can be expensive

Grants/assistance to reduce the cost of retrofits do exist, but the program is not active all the time.
Can check status at: **www.crmp.org/**

Have an earthquake question later?

Just ask!: Amy.Williamson@Berkeley.edu

Resources

MyShake EEW Alerts

myshake.berkeley.edu

ShakeAlert

www.shakealert.org/

Earthquake Kit Checklist

www.ready.gov/kit