

A Shrine to Earth's Power



Welcome to the San Andreas fault zone. Here where the North American and Pacific plates scrape against one another, we witness forces of change. This world-famous fault holds secrets of geologic processes under its long bays and valleys. Looking closely, you may find clues about earth's restlessness that shape the land, its inhabitants and all our lives.



Where earth's plates collide, the land is subject to unpredictable and potentially disastrous earthquakes. While a few people may have experienced big quakes like Loma Prieta, many more know the lore of the great quake that devastated San Francisco in 1906.

The San Andreas fault system is more than a mere unnerving, inevitable force of destruction; as millennia pass, it is a force of creation. As you walk this trail, enjoy the landscape, a gift of earthquakes.



Damage caused by the Loma Prieta Quake



Looking northwest at the fault continues under Tomales Bay

Prepare yourself for the uncertainty of walking in the fault zone...

Sculpting Land and Life

National Park Service
Point Reyes National Seashore



The San Andreas fault has sculpted the California landscape. Yet the mile-wide fault zone is hard for the untrained eye to discern – until it is seen from above. Study this picture looking south down the Olema Valley. Under the veneer of towns, forests and meadows, you will discover the San Andreas, a force of change that shapes the land and life upon it.



Looking northwest towards Tomales Bay

Shaping the Landscape

As the fault continues under Tomales Bay, its straight path is hard to mistake. Erosion, grinding and movement borrows are the hands that shape the land.

Olema Valley looking south from Point Reyes Station to Bolinas Lagoon

San Andreas Fault Zone

Life Linked to Land

While elk graze on the bluffs, salmon run in the streams, and harbor seals pup in the estuaries, the fault continues its complex work, shaping diverse habitats.



Elk, coho salmon and harbor seals

Living in a Geologic Moment



If lifetimes were measured in eons rather than years, we would witness tremendous movement and change along the western edge of North America. The San Andreas fault, the boundary between the North American and Pacific plates, is part of a 30 million-year geologic story that is still unfolding.

20 million years ago



The first continental sliver that included Point Reyes broke off the landmass and joined the Pacific plate as it moved northwest.

11 million years ago



More of present-day Southern California was transferred to the Pacific plate and Point Reyes continued traveling northwest along the fault boundary.

Today



Much of coastal California and Baja have now joined the Pacific plate. Point Reyes has traveled almost 300 miles along the San Andreas fault.

10 million years from now

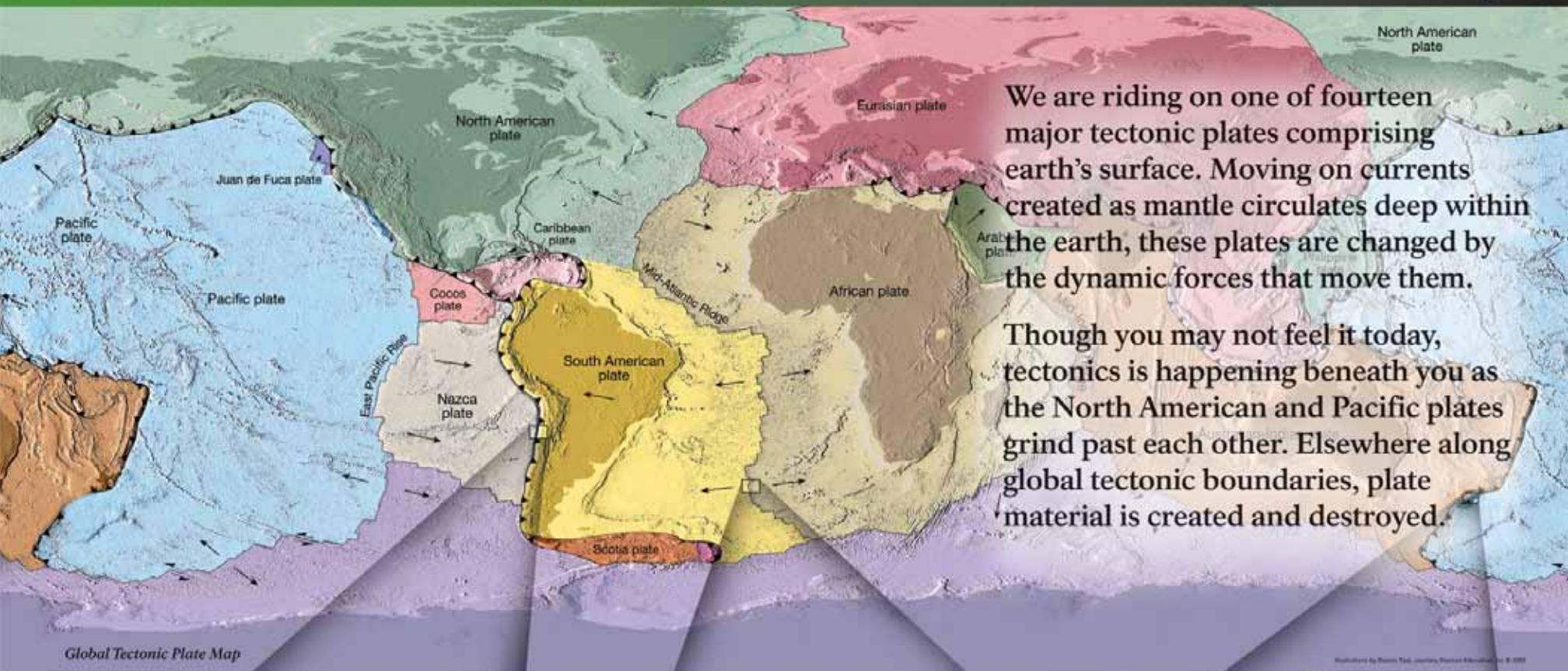


The plate boundary will likely shift inland east of the Sierras. The Gulf of California will expand and most of California will be transferred to the Pacific plate.

Over millennia, the tectonic boundary has shifted inland as small pieces of the continent have joined the Pacific plate. Today, the San Andreas fault is the active plate boundary where relative movement between the plates averages two inches annually. In the future, the plate boundary will move inland east of the Sierras. As the process continues, North America will be radically altered.

Plate Tectonics is Happening Beneath You

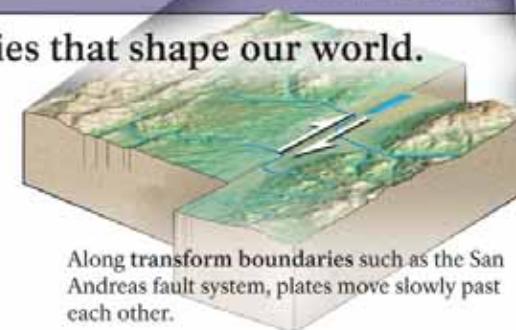
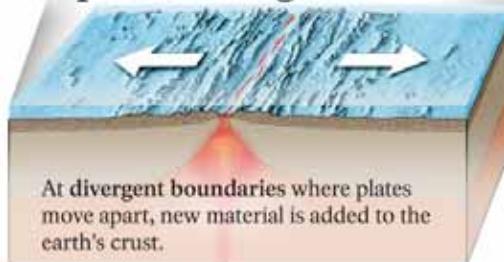
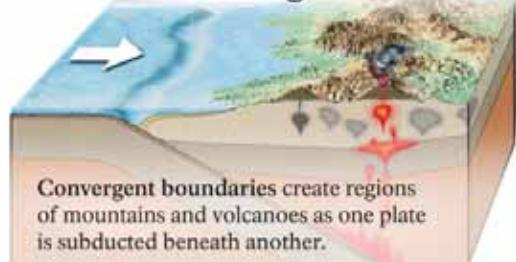
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We are riding on one of fourteen major tectonic plates comprising earth's surface. Moving on currents created as mantle circulates deep within the earth, these plates are changed by the dynamic forces that move them.

Though you may not feel it today, tectonics is happening beneath you as the North American and Pacific plates grind past each other. Elsewhere along global tectonic boundaries, plate material is created and destroyed.

Plates fit together like a complicated puzzle along tectonic boundaries that shape our world.



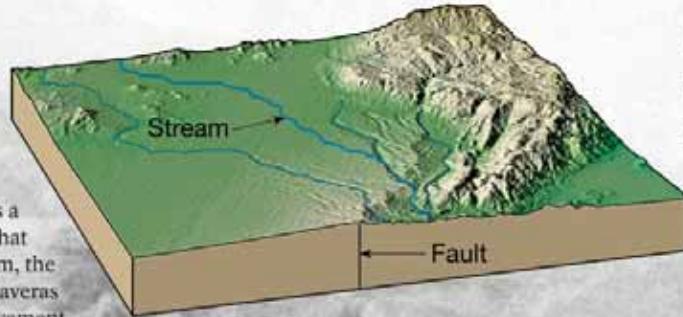
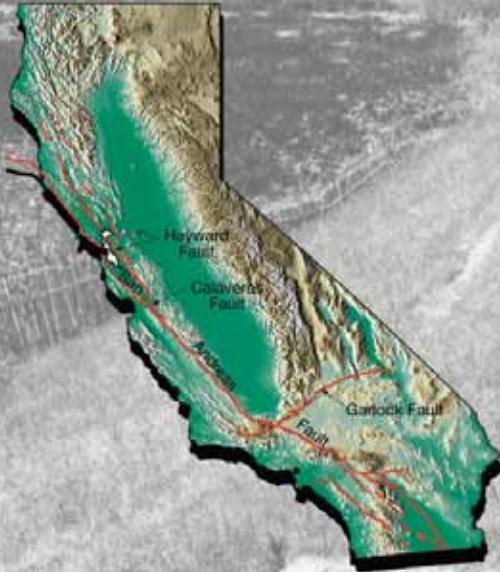
Anatomy of an Earthquake

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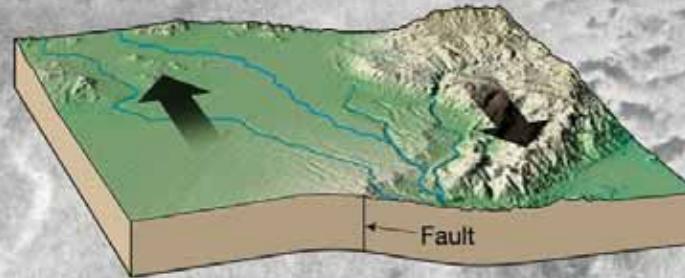


A System of Faults

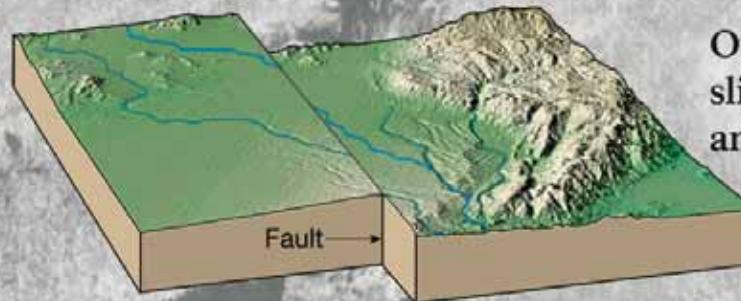
The San Andreas fault system is a complex series of many faults that extends 780 miles. In this system, the San Andreas, Hayward and Calaveras faults, among others, allow movement between the North American and Pacific plates.



Beneath us where the North American and Pacific plates meet, friction binds the fractured rock along the fault.



As decades turn to centuries, stress causes strain to build until rocks reach their breaking point.



Overcoming friction, the fault slips releasing seismic energy and causing earthquakes.

Earthquakes are forces of unpredictable change that rupture our world.



1906: The Fault Awakens

Date: April 18, 1906
Time: 5:13 a.m.
Magnitude: 7.8
Duration: 45 seconds
Damage: \$400 million
 Up to 5,000 dead
Epicenter: Offshore, south of the Golden Gate

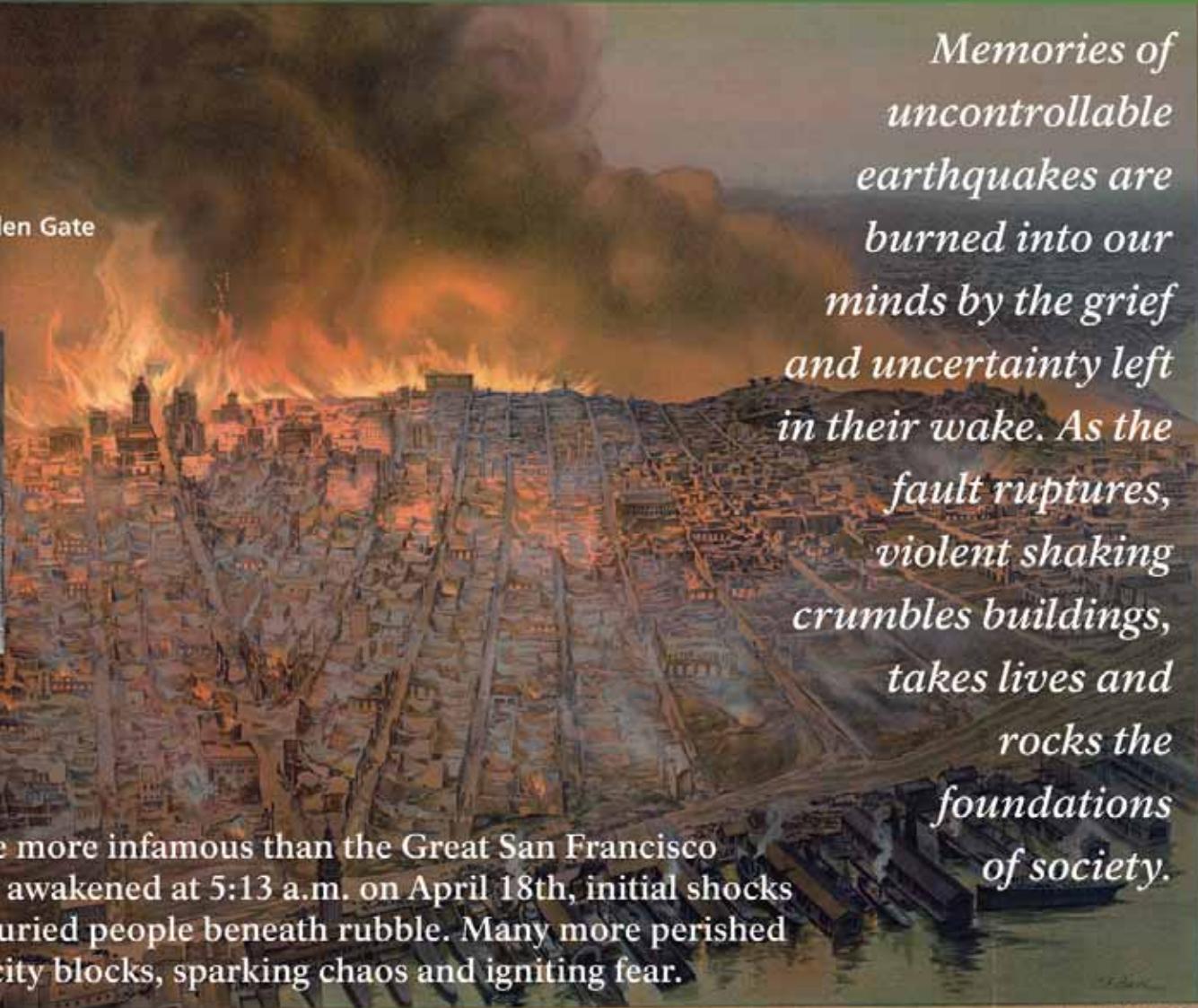
Memories of uncontrollable earthquakes are burned into our minds by the grief and uncertainty left in their wake. As the fault ruptures, violent shaking crumbles buildings, takes lives and rocks the foundations of society.



Caricature of Earthquake and Fire of 1906

Without the benefit of modern building codes, much of San Francisco was reduced to rubble and ash.

Perhaps there is no earthquake more infamous than the Great San Francisco Quake of 1906. When the fault awakened at 5:13 a.m. on April 18th, initial shocks tumbled some buildings and buried people beneath rubble. Many more perished as fires consumed almost 500 city blocks, sparking chaos and igniting fear.



THE GREATEST CONFLAGRATION IN THE HISTORY OF THE WORLD

"THE BURNING OF SAN FRANCISCO" APRIL 18, 19, 20, 1906.

1989: Without Warning

National Park Service
Point Reyes National Seashore



As the Great San Francisco Quake becomes part of the distant past, many of us ignore the faults that run under our roads and homes. Masked by development, they are easy to forget until a major quake strikes.

Date: October 17, 1989
Time: 5:04 p.m.
Magnitude: 6.9
Duration: 20 seconds
Damage: \$6.8 billion
64 dead, almost 4,000 injured
Epicenter: 60 miles south of San Francisco in the Santa Cruz Mountains



Loma Prieta Damage, San Francisco Marina District

Homes built on sediment and fill were demolished as soil liquefaction occurred and earthquake motion was magnified.

While 62,000 fans packed Candlestick Park for the 1989 World Series and the evening rush hour was underway, no one was expecting the Loma Prieta quake. Striking the Bay Area without warning, it collapsed sections of highway, caused major damage in San Francisco's Marina District and caught us by surprise.

Ruptured and Scarred

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Point Reyes National Seashore



Starting at the 1906 epicenter offshore near the Golden Gate, the San Andreas ruptured along its northern length. As the fault slipped and the ground shook, Point Reyes moved northwest up to twenty feet.

The fence above you, split by the rupture, remains as one piece of evidence marking the movement. The blue posts mark the active fault trace.

Climb the stairs, stand on the mended scar of 1906 and imagine it happening again.

Who is This Woman?

Assisting G.K. Gilbert in the documentation of the "great quake," Alice Eastwood, pictured here, was more than just an ordinary field assistant. In a world of science dominated by men, her accomplishments conveyed her love of science and the geology that shapes California.

Preserving the San Andreas



Point Reyes National Seashore contains one of the longest undeveloped sections of the San Andreas fault in Northern California. It is a reminder of earth's power and a laboratory for future study.

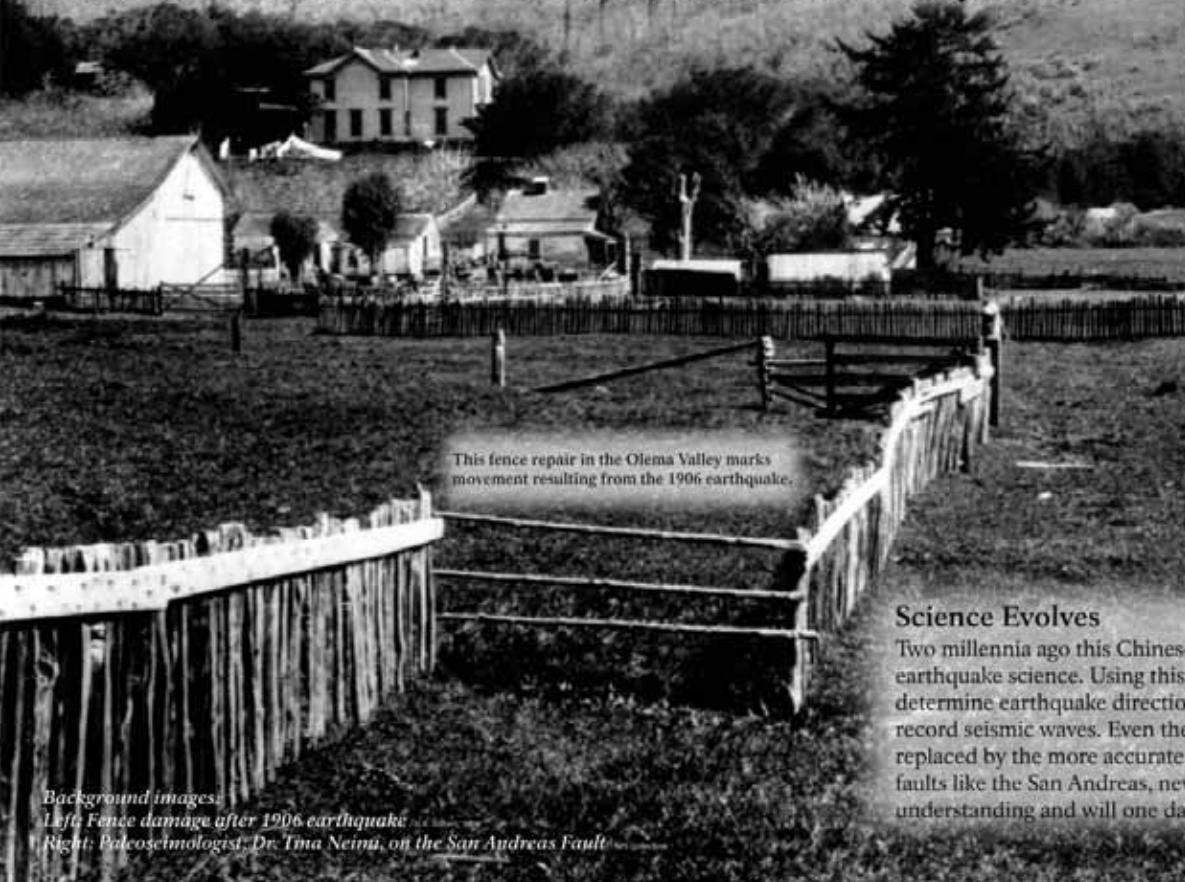
Point Reyes Satellite Image

Epicenter of Geologic Study

National Park Service
Point Reyes National Seashore



While aftershocks still rumbled in 1906, geologists sought to unlock the mysteries of the San Andreas. Tracing the rupture to Point Reyes, they encountered broken fences and shattered structures marking 16-20 feet of movement. Through their discoveries, modern seismology was born. Generations later, the fault and the science are still active at Point Reyes.



This fence repair in the Olema Valley marks movement resulting from the 1906 earthquake.

Science Evolves

Two millennia ago this Chinese artifact (right) was the apex of earthquake science. Using this instrument, the ancients could determine earthquake direction. Today, computer seismographs record seismic waves. Even the once familiar Richter scale has been replaced by the more accurate Moment Magnitude scale. Along faults like the San Andreas, new discoveries continue to shape our understanding and will one day eclipse our present day science.



Digging Up Earthquake History

Here along the San Andreas, paleoseismologists are uncovering the historic record of ancient earthquakes. By studying the active fault trace and searching for long-term patterns, these scientists hope their work will give new insight to the frequency of earthquakes.

Background images:

Left: Fence damage after 1906 earthquake

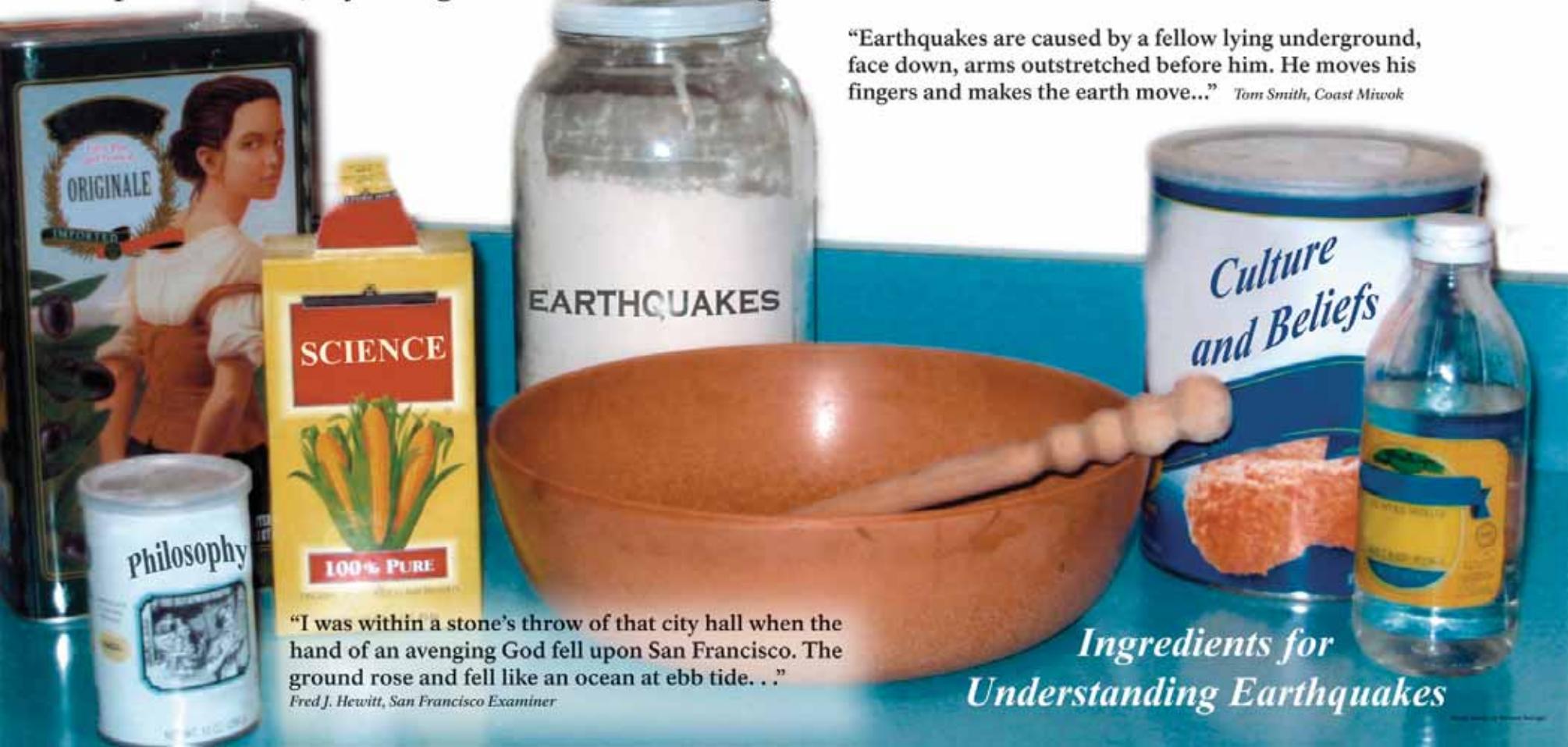
Right: Paleoseismologist, Dr. Tma Neimā, on the San Andreas Fault

Searching For Meaning



Since the beginning, people have used a recipe of science, culture and religion to explain unseen forces that shake the earth. While many of us believe that science offers the best explanation, some cultures interpret earthquakes as visits from vengeful gods. Locally, the Coast Miwok people also have a number of traditional stories to explain quakes. Whatever you believe, earthquakes have shaped our lives, mythologies and understanding of the world.

“Earthquakes are caused by a fellow lying underground, face down, arms outstretched before him. He moves his fingers and makes the earth move...” *Tom Smith, Coast Miwok*



“I was within a stone’s throw of that city hall when the hand of an avenging God fell upon San Francisco. The ground rose and fell like an ocean at ebb tide. . .”

Fred J. Hewitt, San Francisco Examiner

*Ingredients for
Understanding Earthquakes*

Are You at Risk?

National Park Service
Point Reyes National Seashore



Anyone who chooses to live or travel in this landscape shaped by the San Andreas fault system must know that earthquakes can strike at any time.

Whether standing here in the fault zone or elsewhere within its reach, we must examine our risk before the next big quake. Being prepared will help us cope with the inevitable damage and disruption.



Where We Choose to Live

The type of soil or rock we live on affects the amount of shaking we will experience. Solid rock will not increase earthquake shaking; soft materials such as mud, artificial fill, sand or clay will.

Where is your home and how safe are you?



House collapse near Loma Prieta epicenter

Are You Ready?

When an earthquake strikes, it is too late to think about preparedness. Make emergency plans, keep food and water on hand and secure potential falling objects. Indoors, find safe places to wait out quakes; outdoors, watch out for falling lines, trees and poles. Being prepared could save your life.



Retrofitting at USGS headquarters

Retrofitting Saves Lives

Using frames to anchor and support buildings and roadways, retrofitting strengthens structures built before modern earthquake safety codes. While costly, the expense of retrofitting is small compared to the value of life and property that will be saved.

