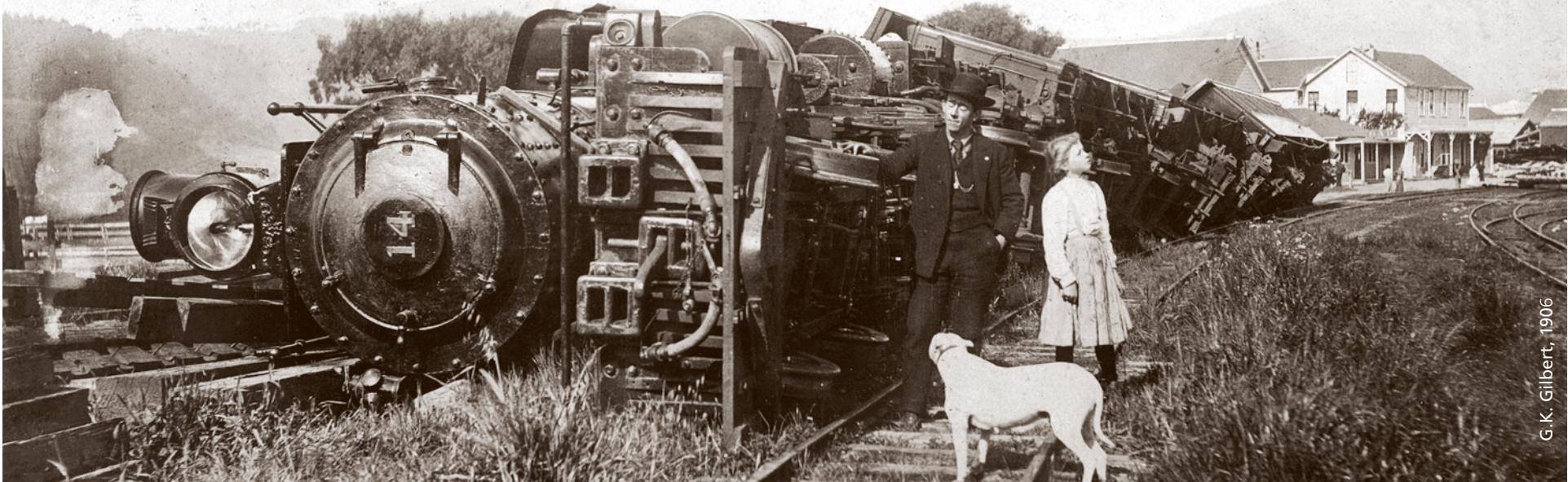




# 1906 Earthquake Centennial

Point Reyes National Seashore  
Resource Newsletter



G.K. Gilbert, 1906

*“At Point Reyes Station at the head of Tomales Bay the 5:15 train for San Francisco was just ready. The conductor had just swung himself on when the train gave a great lurch to the east, followed by another to the west, which threw the whole train on its side.”*  
—Lawson Report, 1908

At 5:13 am on the morning of April 18, 1906, a magnitude 7.8 earthquake violently shook Californians from their sleep. Almost immediately, a devastating fire engulfed San Francisco and burned for four days, forever linking the earthquake with the city. However, the 1906 quake was felt beyond the city from Coos Bay, Oregon to Los Angeles and across the state boundary in central Nevada, and the zone of destruction was as much as 400 miles long and 25 miles wide.

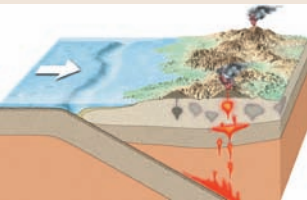
As many as 3,000 people died, although estimates at the time were far lower. The financial cost, in 1906 dollars, is estimated at over \$500,000,000. The survivors were forever altered by the losses they endured, and by the strength of character in those around them. After a century, their stories and photographs captivate us.

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The magnitude of the event is matched by the wealth of knowledge gained in its wake. Contemporary geologists were puzzled by the length of the rupture and the large horizontal displacements along its path. Decades passed before plate-tectonic theory emerged to explain this movement, but the report prepared by Andrew Lawson and others in 1908 led to the recognition of the effect the underlying geology had on the extent of devastation. San Francisco’s Marina district, built largely on fill, collapsed in the earthquake. Development in areas with granite bedrock experienced the least movement.

Join us in exploring what we know about movement along this fault zone, how this rupture has shaped our lives, and why we need to prepare for the inevitable next big quake.



Botanist Alice Eastwood stands at the edge of the fault trace 2 miles north of the old Skinner Ranch at Olema. View is looking north.

G.K. Gilbert, 1906



# The 1906 Quake Ignites a New Era



G.K. Gilbert, 1906

*Main fault at the Skinner Ranch, one mile west of Olema, looking northwest. . . . The fault passes under the barn to the right of center. While the main part of the barn remained on its foundation, the shed on the right was dragged 15 feet due to the San Francisco earthquake.*

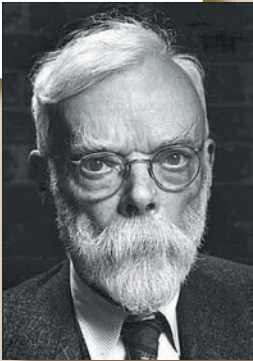
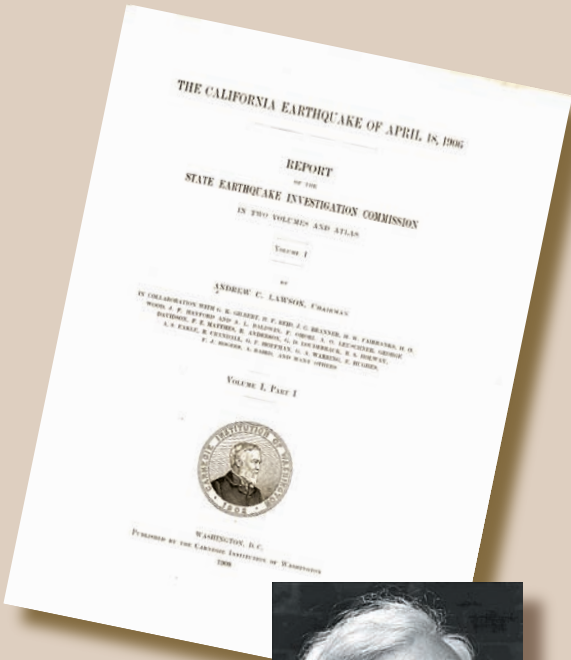
*Lawson Report, 1908*

### Clues in the Landscape

Before 1906, our knowledge of earthquakes was incomplete. Seismographs at U.C. Berkeley and Mount Hamilton’s Lick Observatory had recorded earthquake activity in California since 1887. Scientists relied largely on clues in the landscape to draw conclusions about the underlying geology. This type of observation led Andrew Lawson to identify the San Andreas fault in 1895. Straight lines on the earth’s surface are not a normal sight. Lawson knew that the long narrow valleys and parallel coastal mountain ranges that characterize the local landscape were indicators of a bigger geologic story. He concluded that a fault running parallel to the coastline must be shaping the landscape. Lawson correctly assessed the local geology, but he and his contemporaries had neither experienced the San Andreas Fault in motion nor seen the immediate effects of its movement.

### Unanswered Questions

The devastating 1906 earthquake ignited fires of scientific inquiry as geologists throughout California began studying the earthquake and its effects. Most confounding was the length of the surface rupture. The earthquake caused a crack in the earth’s surface from San Juan Bautista in central California north to Cape Mendocino, a distance of nearly 300 miles. Geologists observed that the land on the west side of the rift jumped to the north/northwest as much as 20 feet in some places. Having no experience with an event of this magnitude, scientists were mystified. At the time of the 1906 quake, scientists though earthquakes caused faults, rather than vice versa. A deeper understanding of the significance of faults and the offset resulting from earthquakes required more than 60 years of study and the advent of the theory of plate tectonics.



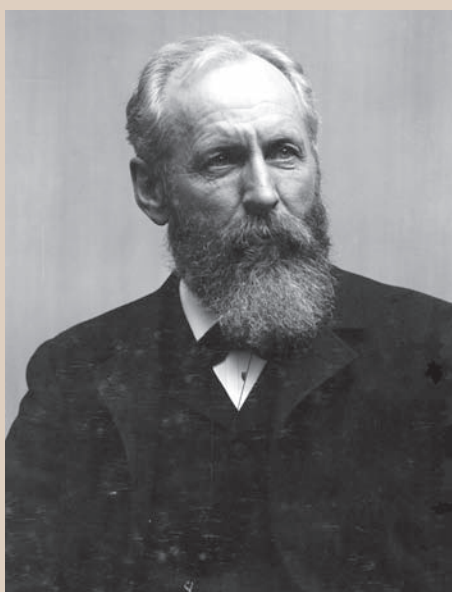
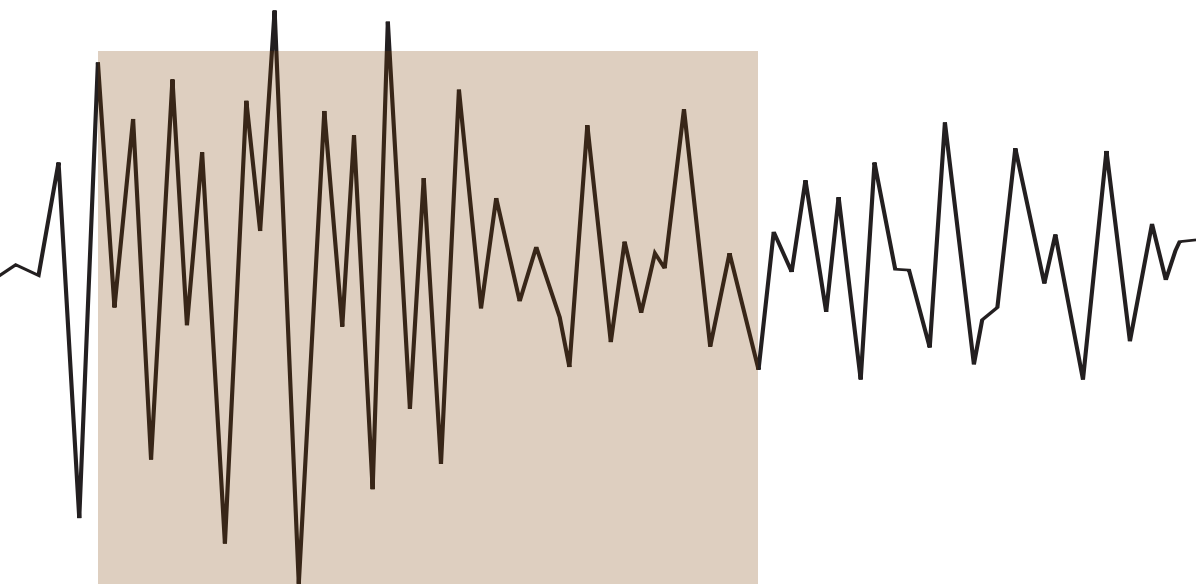
G. Paul Bishop 1950

**Professor Andrew C. Lawson (1861-1952),** chairman of the geology department at the University of California, Berkeley, led the State Earthquake Investigation Commission. The commission, formed by Governor George C. Pardee, included geologists and astronomers from Stanford University, the Lick Observatory, the Chabot Observatory in Oakland, University of California, Johns Hopkins University and the U.S. Geological Survey. The 1908 report was the first integrated, government-commissioned scientific investigation into earthquakes in the U.S. No California funds were available to support the effort, so funding was provided by the Carnegie Institution of Washington.

### Examining the Evidence

To unify the work of the scientific community, a State Earthquake Investigation Commission was established. Funded by the Carnegie Institute of Washington, this was the first integrated, government-commissioned, scientific investigation into earthquakes. By hiking virtually the entire length of the earthquake rupture, scientists discovered where and how much the fault had slipped. They worked tirelessly, documenting structural damage, reviewing seismograph records, and making detailed observations about the underlying geology in Northern California. Scientists conducted triangulation surveys to measure the surface displacement. The detailed report of their findings is commonly referred to as the Lawson report. This document includes extensive photographs and maps of the extensive damage and underlying geology and became the foundation for future monitoring. Today it is an invaluable record against which geologic change since 1906 can be compared.





USGS Photo Library 1898

**Grove Karl Gilbert (1843 - 1918)** remains one of the most famous geologists to explore the American West. Many of Gilbert's personal photographs depicting earthquake damage in West Marin following the 1906 earthquake can be found throughout this publication. His many credits include serving as a prominent member of the Earthquake Investigation Commission headed by A.C. Lawson. Gilbert's early insights into earthquake processes are the foundation upon which our modern-day understanding of earthquakes has been built. His work was later expanded upon by H.F. Reid in the theory of elastic rebound.

**The Birth of Earthquake Science**

From the comprehensive scientific study of 1906, much of our modern-day understanding of earthquakes and their effects was born. Damage reports showed that destruction to buildings was strongly related to design and construction, as well as the type of ground upon which structures were built. Maps showed that shaking was most intense in areas where the ground was comprised of soft sedimentary soils, as was proven again in the San Francisco's Marina District following the 1989 Loma Prieta earthquake. Triangulation surveys revealed that displacement was greatest at the fault and decreased with distance from it. In 1910, Prof. H.F. Reid of Johns Hopkins University expanded this information in his "theory of elastic rebound" to explain the process that leads up to an earthquake event. Over time, pressure builds up along a fault. Eventually that pressure becomes so great that a breaking point is reached. All of the accumulated strain is released,

generating seismic waves that radiate out from that breaking point like ripples on a pond. Those waves are what produce the shaking that occurs during an earthquake. This concept plays a key role in making predictions about how much and when the San Andreas fault is expected to slip in the future.

**Predictions and Probabilities**

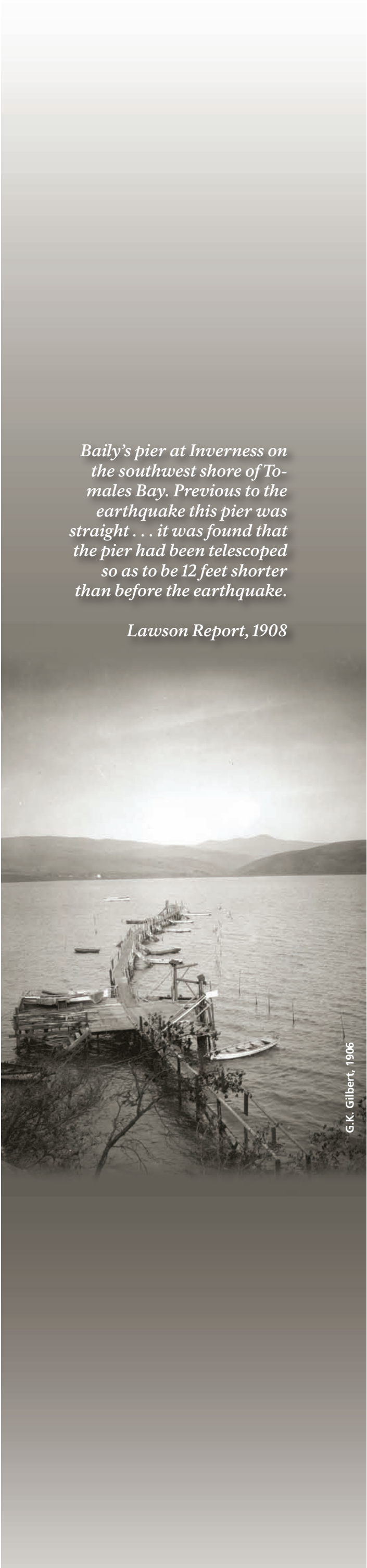
Today, advanced monitoring has expanded research opportunities and preparedness even further. Seismographs measure shaking activity at over 1000 sites in California. Specialized equipment such as geodetic instruments track plate motion and related stressing and distortion of the Earth's crust. High powered computers help scientists track and analyze data. Because of this additional technology, scientists now know that there are hundreds of faults that make up the San Andreas Fault System. This information allows scientists to make skilled predictions about the probability, strength and intensity of potential earthquakes. From these predictions, scientists create maps indicating shaking intensity, which helps guide zoning and land-use decisions. Based on all this information, engineers develop building codes and plans for structures that can withstand shaking, while insurance companies rely on this data to create actuarial tables.

**Questions Persist**

When we assess all that has been learned since 1906, it is clear that tremendous strides have been made because of the foresight of those early scientists. Still, there are a number of questions that remain unanswered. Most notably, we are still unable to predict exactly when earthquakes will occur. Although we may be more prepared today, the forces at work beneath the earth's surface still hold the potential to change our lives. Perhaps it is that fate that ties us inextricably to the lives and times of those people who endured the great earthquake over a century ago.

*Baily's pier at Inverness on the southwest shore of Tomales Bay. Previous to the earthquake this pier was straight . . . it was found that the pier had been telescoped so as to be 12 feet shorter than before the earthquake.*

*Lawson Report, 1908*



G.K. Gilbert, 1906

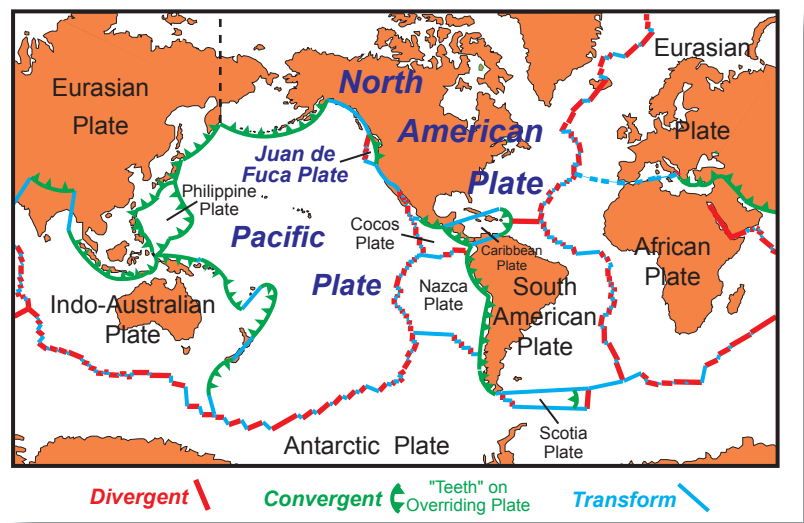


# On the Boundary of Change

Boundaries limit and divide. They mark where one thing ends and another begins. Boundaries are also places of dynamic change. Along the air/water boundary light bends, or refracts, as it leaves one medium and enters another. Along the cell membrane hormones initiate chemical reactions within the cell. Along geologic boundaries landscapes are shaped. The San Andreas Fault is such a boundary, the division between two great tectonic plates, the Pacific Plate and the North American Plate. It is also the site of geologic forces that give rise to earthquakes and shape the land as we know it.

## Along Plate Boundaries

Point Reyes National Seashore lies on the eastern edge of the Pacific plate, an oceanic plate underlying nearly the entire Pacific



From *Parks and Plates*, Robert J. Lillie, 2005

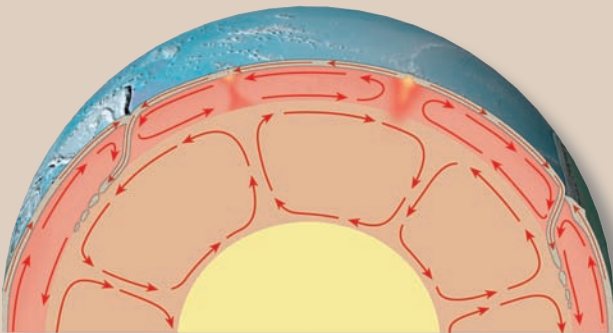
The major tectonic plates of the world form a global moving jigsaw puzzle where plates diverge, converge or slide past one another along plate boundaries.

Ocean from the North American west coast north to Alaska, west to Japan, and south to New Zealand. East of the Seashore across the Olema Valley the North American plate underlies all of North America and Greenland to the center of the Atlantic Ocean. Tomales Bay and the narrow 12-mile long Olema Valley that cradles the Shoreline Highway is the San Andreas Fault. The fault divides two landmasses of differing geologies. East of the fault lie rocks known as the Franciscan series, a combination of greywacke, shale, chert, limestone, and volcanics. The Seashore west of the fault is grounded in granite, the same found in Monterey. The juxtaposition of these two land masses results from geologic forces along the San Andreas Fault.

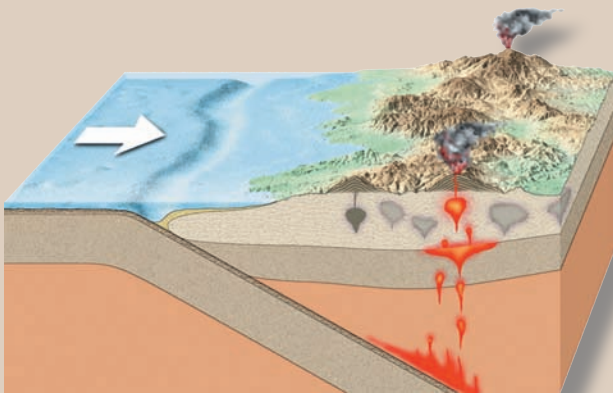
Not only do two plates meet along the San Andreas Fault, but they move against each other. The forces causing this movement lie more than 90 miles (150 km) below our feet in the earth's mantle. Currents of magma slowly circulate up from within the mantle, spread out under the oceanic and continental crusts, carry the plates along then sink to circulate again. Like a crowded bumper car rink, the plates crash and grind into each other as they move. It is along plate boundaries where the action takes place.

## Types of Plate Boundaries

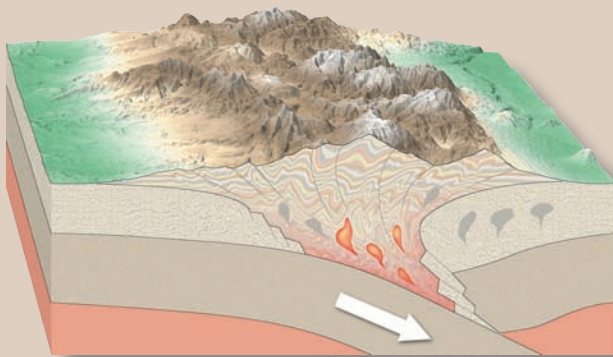
Monumental change occurs along plate boundaries. When oceanic and continental plates collide, they ignite volcanoes and raise mountains. The Sierra Nevada, Cascades, and Andean Ranges emerged when oceanic plates sank below, or subducted beneath, continental plates. The impact of two continental plates compresses the crust along the boundary thrusting land into mountains thousands of feet high, as in the Himalayas. Diverging plate boundaries, most often between oceanic plates, spawn new crust as hot magma bleeds up between the plates, hardens into new seafloor, and pushes the existing seafloor away from the rift on both sides. The San Andreas Fault is not the site of plate collisions or diversions but of lateral, or transform, movement where the plates slide past one another, the Pacific Plate traveling northwest relative to the North American Plate.



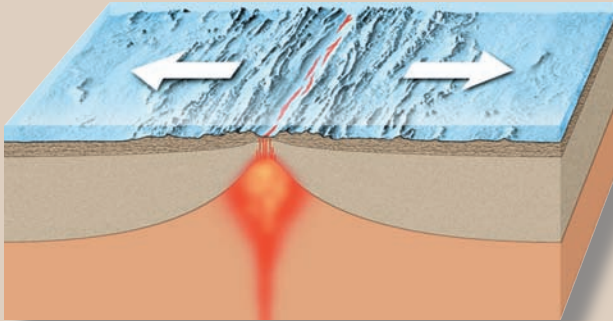
The earth's tectonic plates travel on currents of circulating magma.



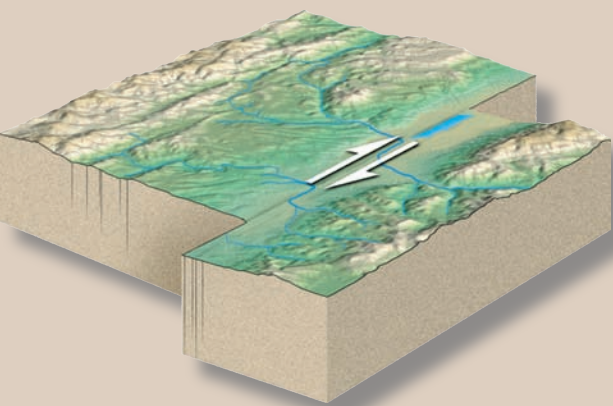
Subduction of an ancient oceanic plate under the North American plate ignites volcanoes and raises the mountains of the Sierra Nevada.



Converging continental plates compress and thrust land up to form the world's highest peaks, the Himalayas.



Hot magma emerges and cools creating new crust between diverging plate boundaries as in the middle of the Atlantic Ocean.



Along the San Andreas fault, the Pacific and North American plates slide past one another in transform movement.

Tasa Graphic Arts, Inc.





The San Andreas Fault System comprises thousands of faults accommodating transform movement between the Pacific and North American plates.



Numerous major faults, including the San Andreas Fault, slice through the Bay Area.

### The San Andreas Fault

The Pacific and North American Plates do not always glide smoothly past each other. The movements are often erratic, jerky and sudden. We call these movements earthquakes. Although currents of magma below each plate power them, friction between the rocks along the fault prevents the plates from moving. This friction causes stress to build up along the San Andreas Fault, bending and deforming the rocks within as they store potential energy as in a stretched rubber band. When the rocks can no longer resist the strain, they fracture suddenly, releasing decades of accumulated energy in a few seconds. Moments like these dramatically alter landscapes.

### Millions of Years of Motion

The cumulative effect of countless earthquakes and gradual plate movement along the San Andreas Fault over the past 16 million years has shaped the land around it. The Point Reyes peninsula has traveled over 100 miles along the fault from near Monterey. Movement along the fault sculpts the long, parallel ridgelines defining the Olema Valley. Within this valley, plate movement molds shutter ridges, small hills along the fault formed as a result of local compression and uplift, and sag ponds, basins created by the downdropping of earth as land stretches apart. These features occur elsewhere in California along the San Andreas Fault marking its path and connecting Point Reyes to other areas in the state with a shared geologic history.

### A Community of Faults


The San Andreas Fault is part of a large community of faults along the tectonic boundary; one of hundreds of faults in the Bay Area alone and among thousands of others along its length. The San Andreas Fault System, the broad collection of faults between the Pacific and North American plates, accommodates overall transform movement between them. Each fault within the system helps shape the land we see today. The fault system itself also undergoes transformation. Individual faults lock up and new ones rupture. Some scientists speculate that transform movement between the plates will abandon the San Andreas and concentrate along faults east of the Sierra ripping California from North America.

### Our Everchanging World

The tectonic boundary divides and shapes the landscape along the San Andreas Fault, but tectonic activity shapes our entire planet. Throughout the world, circulating magma energizes tectonic boundaries that mold land into mountains, volcanoes, valleys and hills. Although tectonic boundaries may divide plates, they unite areas around the earth in a shared global geologic heritage.

### Log On for More Information about Plate Tectonics and Earthquake Science

- National Park Service:**  
<https://www.nps.gov/subjects/geology/index.htm>
- U.S. Geological Survey:**  
<https://www.usgs.gov/natural-hazards/earthquake-hazards>
- UCSB Geology Department:**  
<http://emvc.geol.ucsb.edu/>
- Bancroft Library:**  
<https://bancroft.berkeley.edu/collections/earthquakeandfire/index2.html>
- San Francisco Museum:**  
<https://www.sfmuseum.org>
- Public Broadcasting System:**  
<http://www.pbs.org/wgbh/aso/tryit/tectonics/>
- Association of Bay Area Governments:**  
<https://homequakequiz.org>



National Park Service  
U.S. Department of the Interior

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The National Park Service cares for the special places saved by the American people so that all may experience our heritage.

EXPERIENCE YOUR AMERICA





Refugees set up tents among their salvaged belongings on Jefferson Square, San Francisco, April 1906.

No matter where you live, there is a chance of a natural disaster occurring. Earthquakes, floods, fires, and hurricanes happen without warning. Whatever the catastrophe may be, it pays to be prepared.

Don't wait for an emergency to do your planning. A little thought and a few simple steps could make your crisis response safer and easier. The ideas listed here are intended only as a starting point to develop an Emergency Plan. Consult the list of additional resources below for specific steps to protect yourself.

1. Start with a home inspection. Many earthquake injuries are caused not by collapsing buildings, but by items being thrown around during an earthquake.
2. Make an earthquake kit. Put together a collection of supplies and materials that your family would need for three to five days. Store your supplies in a solid, water tight container like a garbage can or heavy box and keep it someplace accessible. Take a course in first aid and CPR. You never know when an emergency will hit, but these skills will be priceless when you need them.
3. Plan your response to an emergency. How will you reach members of your family if you are away from home? What can you do to safeguard your family and friends?

You've considered the risks, made your plans, and have set aside supplies. When an earthquake hits, the most important thing is to stay calm and think about what you are doing.

After the initial quake and the shock of what has happened have passed, you will see the real value of your preparations. Earthquakes and most natural disasters can be terrifying, but you can respond to them better if you prepare for them.

## What to Do When an Earthquake Happens

### Inside a Building

- Get under a desk or heavy table and protect your head and neck with your arms.
- If no cover is available, drop to the floor next to an interior wall and protect your head and neck.
- Avoid exterior walls, windows, tall furniture, and heavy appliances.
- Wait until the shaking stops then carefully go outside.

### Outside

- Seek out an open space, if you can.
- Avoid hazards like buildings, tall windows, power lines, and trees. Watch for falling debris.
- You may be more protected in a safe building than out in the street.
- If you are driving, pull over to the side of the road, stop, and set the brake.
- Avoid overpasses, power lines, bridges, and things that could fall onto the vehicle.

### After the Shaking Stops

- Check yourself then others for serious injuries. Use your first aid and CPR skills, if necessary.
- Look for fire and put out small ones if you can.
- Shut off your gas at the main valve if you smell or hear it leaking. Don't turn it back on; wait for the gas company to check it.
- Turn off the electricity at the main breaker if you see damage to the wiring.
- Put your Emergency Plan to work for you.

.....

KIDS—check out the back page for how you can help your family prepare for an earthquake.

# Are You Prepared?

W.C. Mendenhall, 1906

### In Your Earthquake Kit

- Food and Utensils – Canned and dried foods, a can opener, utensils, etc.
- Water – at least 1 gallon per person for 5 days.
- A first aid kit, necessary medications, and personal hygiene supplies like toilet paper, soap, and toothpaste.
- Warm clothes, a waterproof poncho, and sturdy shoes.
- Blankets, sleeping bags, and perhaps a tent.
- Flashlights, a radio, extra batteries, and light bulbs.
- Books, games, or some favorite toy that would help entertain and calm your children.
- Pet food and a way to restrain your pets if you have to.

- Copies of important papers such as home and health insurance policies and personal identification.

### Your Emergency Response Plan

- Decide on a place to meet after an emergency.
- Know the Emergency Plans for your work and school.
- Decide on a person you can call outside of the area who can coordinate information on the location and condition of family members.
- Make sure everyone in your family has that contact number.
- Call your contact, but keep your calls to a minimum. Expect phones lines to be congested with emergency traffic.

## California National Parks and the San Andreas Fault

Point Reyes National Seashore isn't the only National Park along the path of the San Andreas Fault. The fault's power to create astounding landscapes has led to the preservation of:

- Golden Gate National Recreation Area
- Pinnacles National Monument
- Channel Islands National Park
- Santa Monica Mountains National Recreation Area
- Cabrillo National Monument
- Joshua Tree National Park

The geologic processes described in this publication are factors in the natural beauty of other National Parks in California including:

- Lava Beds National Monument
- Lassen Volcanic National Park
- Yosemite National Park
- Devil's Postpile National Monument
- Kings Canyon National Park
- Sequoia National Park
- Death Valley National Park
- Mojave National Preserve



Marshak, S., 2005, Earth: Portrait of a Planet, 2nd Ed., NY: W.W. Norton and Co.

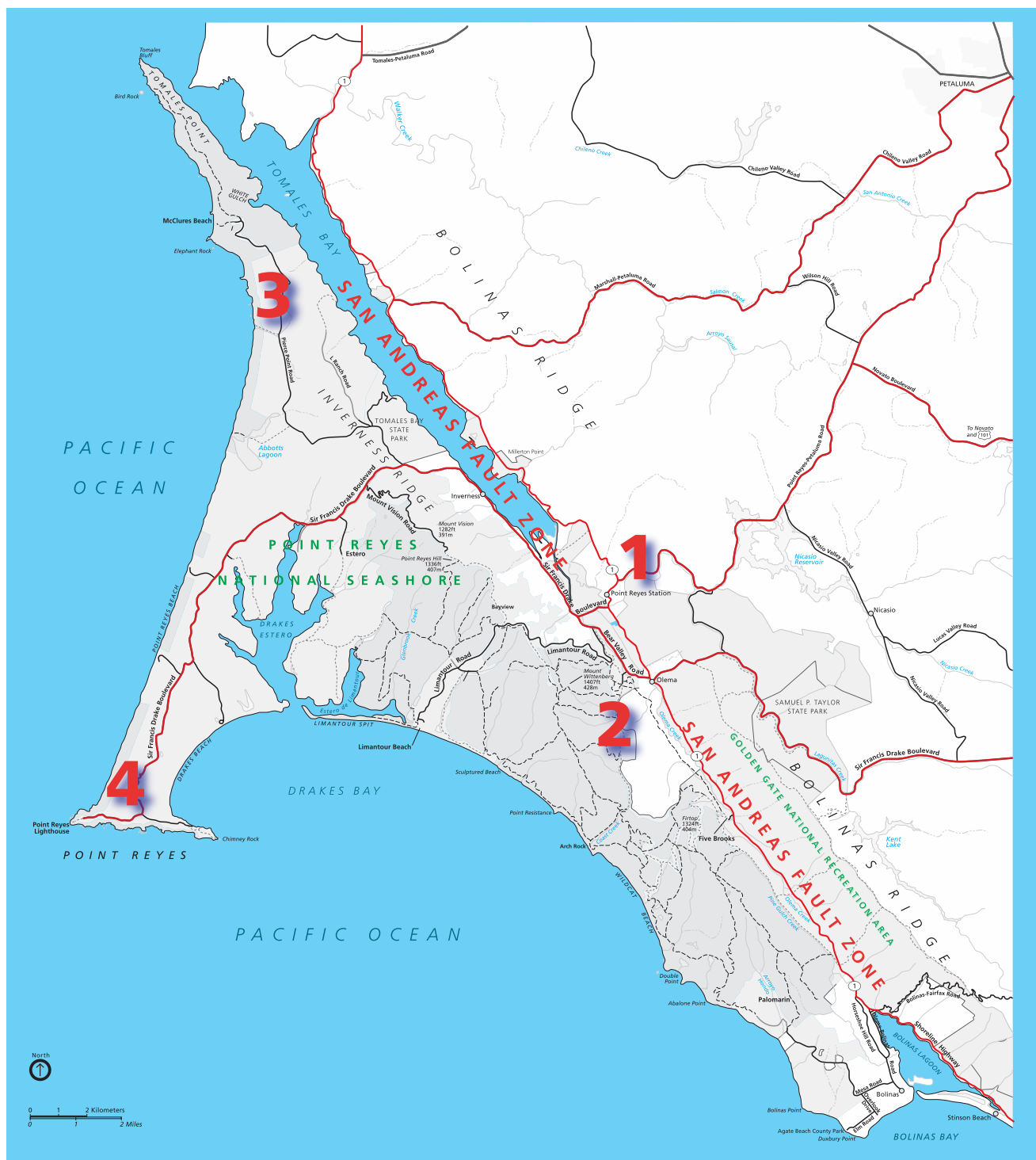


# Point Reyes Roadside Geology

Geologic processes over millions of years have shaped the changing landscape called Point Reyes. Moving as part of the Pacific Plate, the Point Reyes peninsula has been edging northward along the San Andreas Fault an average of 2 inches per year. About 7 million years ago, Point Reyes was approximately 80 miles to the south near San Gregorio, under seawater. Clues to this watery past are found alongside the roads and trails of the peninsula.

**1 Point Reyes—Petaluma Road**  
Large dark rocks lining road cuts along this prime route are a good place to look for clues about Point Reyes’ marine past. These lumpy, greenish-black formations are pillow basalts, igneous rocks created when magma cooled quickly underwater on the ocean floor. They are part of the Franciscan formation of the North American plate supporting the redwood forests and grasslands in this area.

**2 Bear Valley Area**  
Take a few minutes to walk the flat, ½ mile trail called the **Earthquake Trail**. As you reach the blue posts, the low round hill you are seeing is called a shutter ridge. Like a window shutter closing off light, the fault activity in this area has shut off the flow of water in the creek, changing from flowing north to Point Reyes into flowing east into Olema. Look for more shutter ridges along Highway 1 between Olema and Point Reyes Station.



## 3 Pierce Point Road Area McClures Beach

Travel through time from the oldest rocks to the youngest. Start your trip at McClures Beach. Core sampling reveals that the granitic rocks along this trail were formed some 89 million years ago and 7 miles beneath the surface of the earth. Along with the entire peninsula, they have migrated some 300 miles north from the Tehachapi Mountains near Los Angeles. Not only have these weathered granites traveled, they also have been uplifted by fault activity.

What geologists call an unconformity lies within the layers of rock along the trail. The 89 million year old granites are interspersed with much younger rock, called marine terrace deposits, which formed just below sea level and then uplifted along with the granite.

If you take the steep half-mile walk down to the beach, you’ll see the most ancient rocks in this area at the bottom of the trail: gneiss from the Sur series—metamorphic rock baked deep under the surface. The layered rock looks as if laid down as sediment, but the layering results from enormous compression. Minerals flows, including intrusions, and ribbon-like channels of granitic rock called dikes, can be seen in these ancient stones.

### Kehoe Beach

Take a look at the landscape near the restrooms next to the road. The rock is sandstone, a sedimentary rock, approximately 10–50 million years old. It formed as granite, was weathered by the elements, and eroded from beachfronts. Under a hand lens the sand reveals flakes of pink potassium feldspar, a mineral that originated in the granite.

Look to the north and right of the trail for a large white outcrop. It is a very soft diatomaceous rock, another clue to Point Reyes’ marine past. As it’s name indicates, diatomaceous rock comes from organic material such as diatoms and microscopic algae.

## 4 Point Reyes Area Drakes Beach

Step out onto the beach and take a quick look at the layered cliffs, called the Drakes Bay Formation, some of the youngest rocks on the peninsula.

Originally formed by marine deposits laid down underwater, the cliffs have been uplifted and weathered. You may note that the layers slope down toward Drakes Estero on the eastern end of the beach. This is evidence of the Point Reyes Syncline in which the rocks angle down from Drakes Beach towards the estero and then rise up on the Limantour Beach side. In the syncline, near the mouth of the estero, you can see the younger formations, normally out of view on the high cliff-tops, down near eye level.

In winter, the punishing waves remove the beach sand exposing the older layers of chert. This rock layer is re-covered by the returning beach sand in summer. The cliffs at Drakes Beach are very light-colored and are sometimes compared to the white cliffs of Dover in England, however, the Dover Cliffs are chalk, composed of much older marine sea shells.

### The Lighthouse

The 15-minute trail from the parking lot to the Visitor Center rewards you with views of a unique geologic feature that encompasses volcanic activity, earthquake faulting, and river action. These processes combine to create the commanding beauty at the end of the peninsula. The Point Reyes conglomerate looks like a cream colored layer cake rising behind the Visitor Center. Each layer has its own story. Ancient melting glaciers washed gravels and sands out to sea which combined with layers of mud, and waves of cobbles, the olive-sized rocks. These materials were stacked and compressed, then uplifted by earthquake activity. The conglomerate formation is 50 million years old, though embedded within it are older volcanic rocks. The round cobbles are as old as 120 million years. For example, the large reddish purple stones, called passionate purple porphyry for their color, are 140 million years old. Porphyry refers to volcanic rocks made up of large crystals in a fine grain base, volcanic material that cooled slowly allowing the crystals to form.

This is just a taste of the geologic smorgasbord of Point Reyes National Seashore. In the dynamic and compelling landscape around us, there is abundant evidence of the powerful effects of crashing plates and pounding seas.



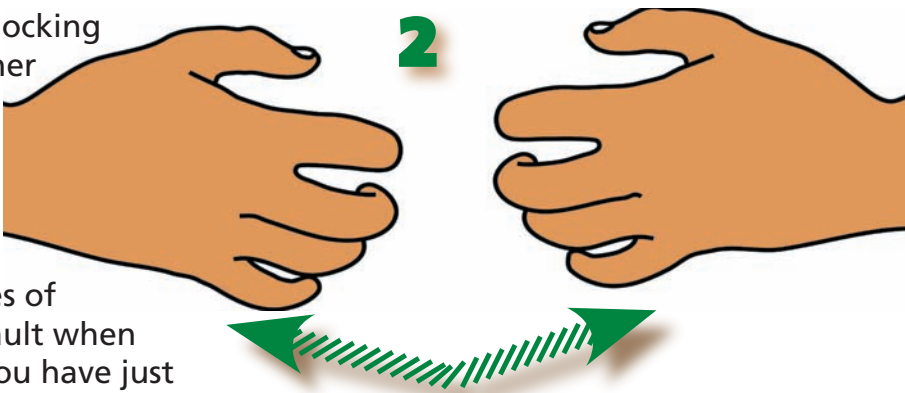
# Just for Kids



What is an earthquake?  
The answer is in your hands.  
Lock your fingers together (as shown in picture).

**1** With your fingers interlocked, slowly try to move your hands in opposite directions.

**2** When the force locking your fingers together is no longer strong enough to keep your fingers interlocked, your hands jump apart. This is like two sides of the San Andreas Fault when they jump apart. You have just created an earthquake.



## Help Your Family Get Ready

You can help your whole family prepare for an earthquake or other natural disaster. This can be a fun activity, if you all sit down, read page 6 of this newsletter, and have an earthquake drill.

Secure heavy things that could fall and hurt you like bookshelves, dishes and water heaters.

Make sure everyone has a pair of shoes under their beds so broken glass from windows won't cut your feet when you get out of bed.

Have an earthquake plan so that everyone will know where the safe places at home are, where to meet if you are apart when an earthquake hits, and any important phone numbers.

Create an earthquake kit, with food, water and first aid supplies.

## E.A.D.S. (Earthquake Amnesia and Denial Syndrome)—Take the Test

Medical professionals have identified a syndrome affecting millions of Californians along the San Andreas Fault System. It is known as Earthquake Amnesia and Denial Syndrome or EADS. Experts believe that EADS, if not treated, will result in enormous damage and loss of life in the next big quake. Kids—check and see if you or any of your family suffers from this syndrome. Take the test!

1. Do you know where the major faults in your area are? Yes/No **Yes=5 points**
2. Do you think about earthquakes when surrounded by tall buildings, in old brick structures, under an overpass or on a bridge? Yes/No **Yes=5 points**
3. Do you know what kind of soil your home is built on? Yes/No **Yes=10 points**
4. Do you know why this matters? Yes/No **Yes=10 points**
5. Have you or your family identified hazards in your home, work, or school environments? Yes/No **What are they? Yes=10 points**

Add one point for each item (*up to 5 points*).

6. Have you taken actions to correct them? Yes/No **Yes=20 points**
7. Do you have an Earthquake Plan? Yes/No **Yes=20 points**
8. Do you have food and water stored in case of an earthquake? Yes/No **Yes=20 points**

If you have scored a 75 or below on this test, you may have Earthquake Amnesia and Denial Syndrome. Don't worry E.A.D.S. is treatable and can be cured. Use the 1906 Earthquake Centennial as a chance to get ready for the next big quake. Read through the rest of this paper to find out more about earthquakes and preparedness.

## EARTHQUAKE SCRAMBLE

Q V A A R L S E D O D C Q E U R L Z C  
D H O U D O L G G J H N P R L E A Z G  
F G Y Z L T R T T E C M C N H N T D S  
U V Y E N T G L R R J G I Z S O E E C  
G E W A X B L T C Q E S D U V T T D T  
R R M U T X X Y U E A M B M H S E X B  
G Y A I T T A G W E R D O X N E C E D  
U L J N K B Z I R E U V L R U M T K N  
Y X G A I F B D X C O M E M D I O A N  
K S Z O V T N S T U G C W X A L N U Q  
J E R E V A E I D C N J X L C G I Q Q  
A L Y L N V O R B E I O V E W A C H F  
Y I J A C N Q U I H W N E G N X S T V  
R K S H D N R C T P U M A T I P E R W  
R L Y S E H S B G S N J A C P Q R A C  
A H E N J K N A L L V A V G L G X E J  
L W W T Y G O L O E G W X B M O M L O  
V V P O P D Z J R F Q P B G P A V V Z

- |                    |                 |
|--------------------|-----------------|
| 1. geology         | 9. earthquake   |
| 2. granite         | 10. san andreas |
| 3. science         | 11. chert       |
| 4. magma           | 12. shale       |
| 5. plate tectonics | 13. limestone   |
| 6. mantle          | 14. volcanic    |
| 7. tremor          | 15. subduction  |
| 8. fault           |                 |

Kari Carlsen, Beau Lino, and Gerald Tanner, West Marin School, 2005

**SUPER GEOMAN** lifts up the earth's surface so we can see the fault movement underneath. What color do you think he is?

