What are earthquakes ? Why do they occur ? and Why can't we predict them ?

Although we still can't predict when an earthquake will happen, we have learned much about earthquakes as well as the Earth itself from studying them.

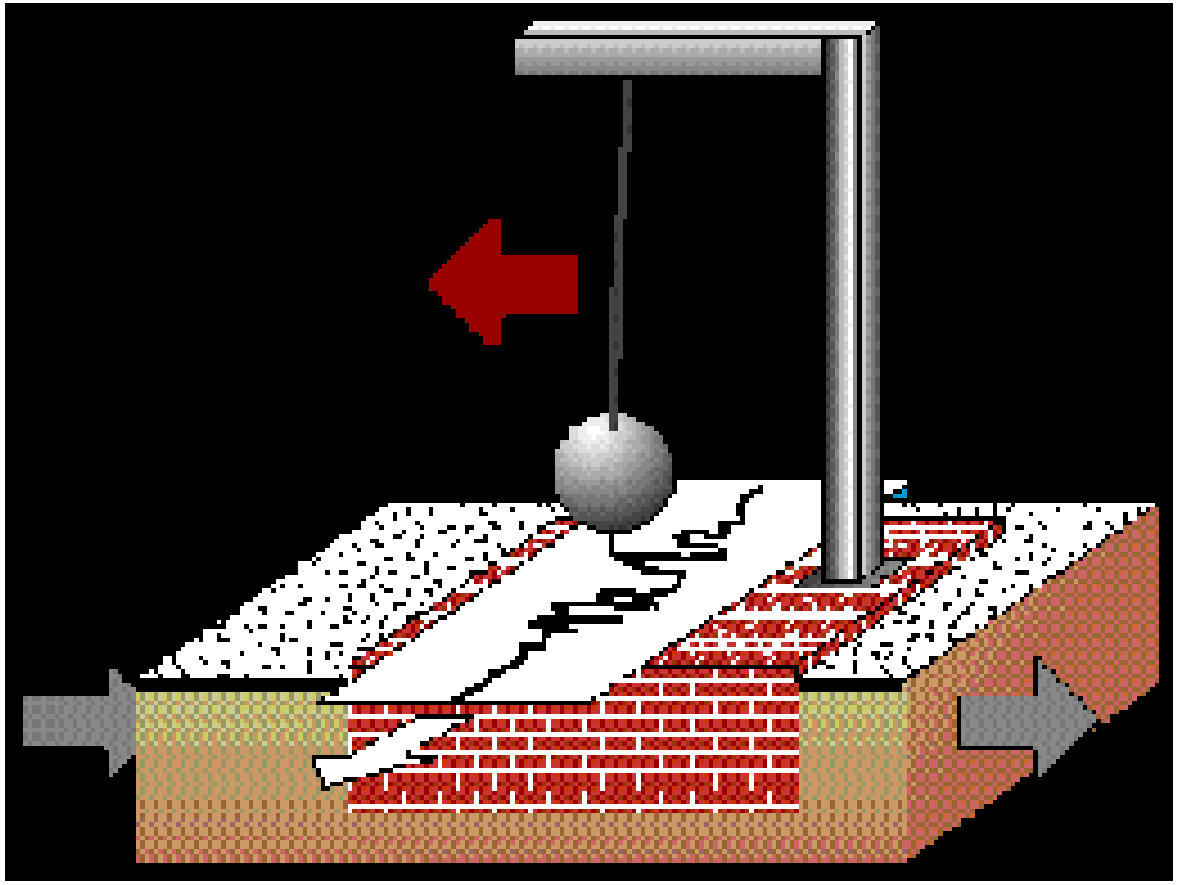
We have learned how to pinpoint the locations of earthquakes, how to accurately measure their sizes, and how to build flexible structures that can withstand the strong shaking produced by earthquakes.

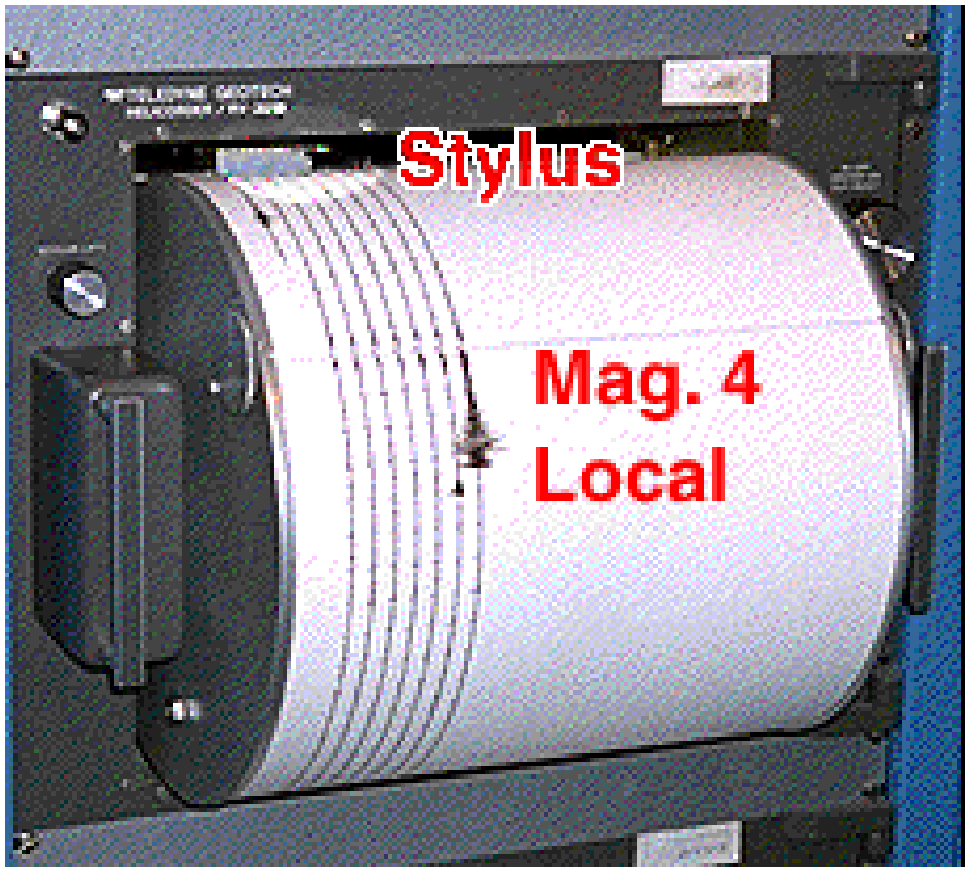
An earthquake is a sudden shaking of the ground. They generate **seismic waves** which can be recorded on a sensitive instrument called a **seismograph**.

The record of ground shaking recorded by the seismograph is called a **seismogram**.

What is a Seismograph?

Earthquakes generate seismic waves which can be detected with a sensitive instrument called a **seismograph**.





Because a magnet moving inside a coil creates a current within the coil, the movement of the ground during an earthquake can be converted into an electrical signal.
This signal could then be used to modify the projection of light onto photographic paper, or to move a needle across paper and trace out the wiggles of the Earth's shaking.

Networking Information

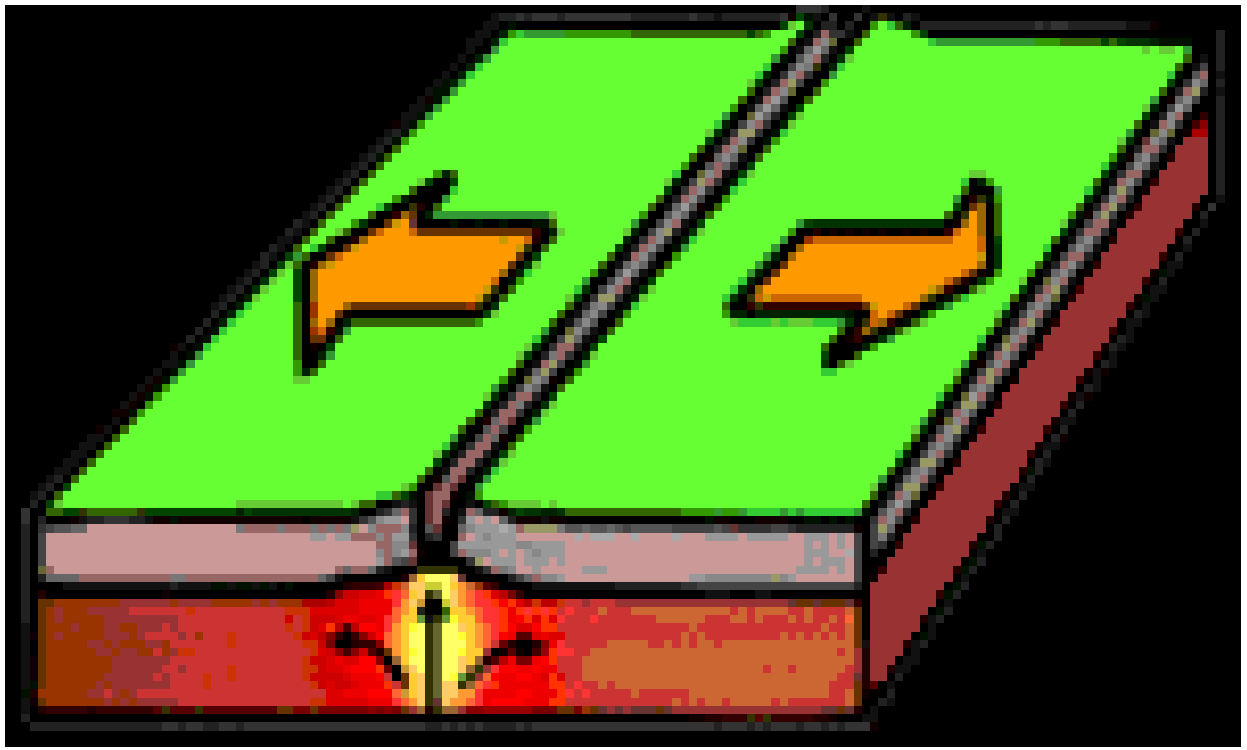
Beginning in the 1960s, significant strides were made in the study of earthquakes and the Earth's structure with the deployment of the World-Wide Seismographic Station Network (WWSSN). This network consists of over 120 seismographs in 60 countries.

This "global observatory" illustrates the international nature of global seismology and the essential cooperation in data exchange needed to study earthquakes.

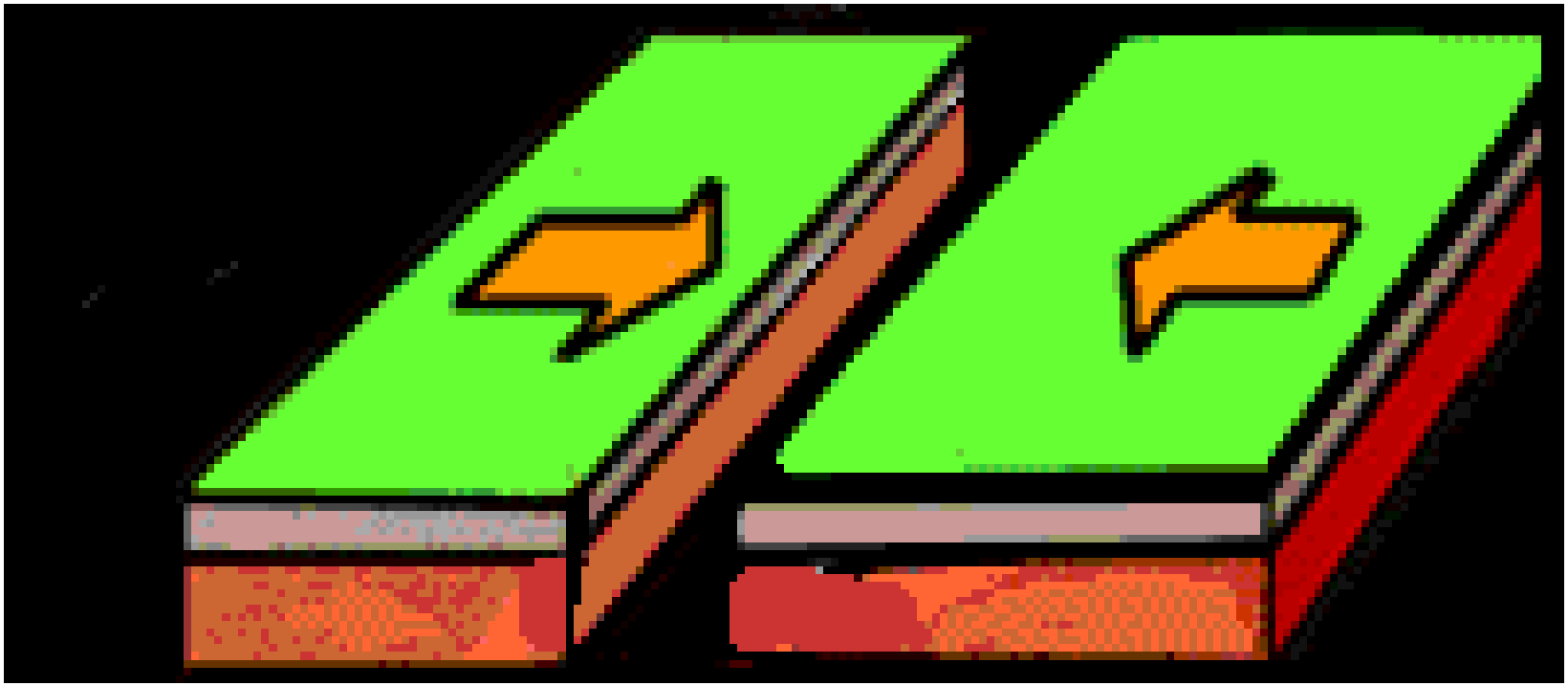
Floating Plates

To better understand how and why earthquakes occur, we must understand the theory of Plate Tectonics.

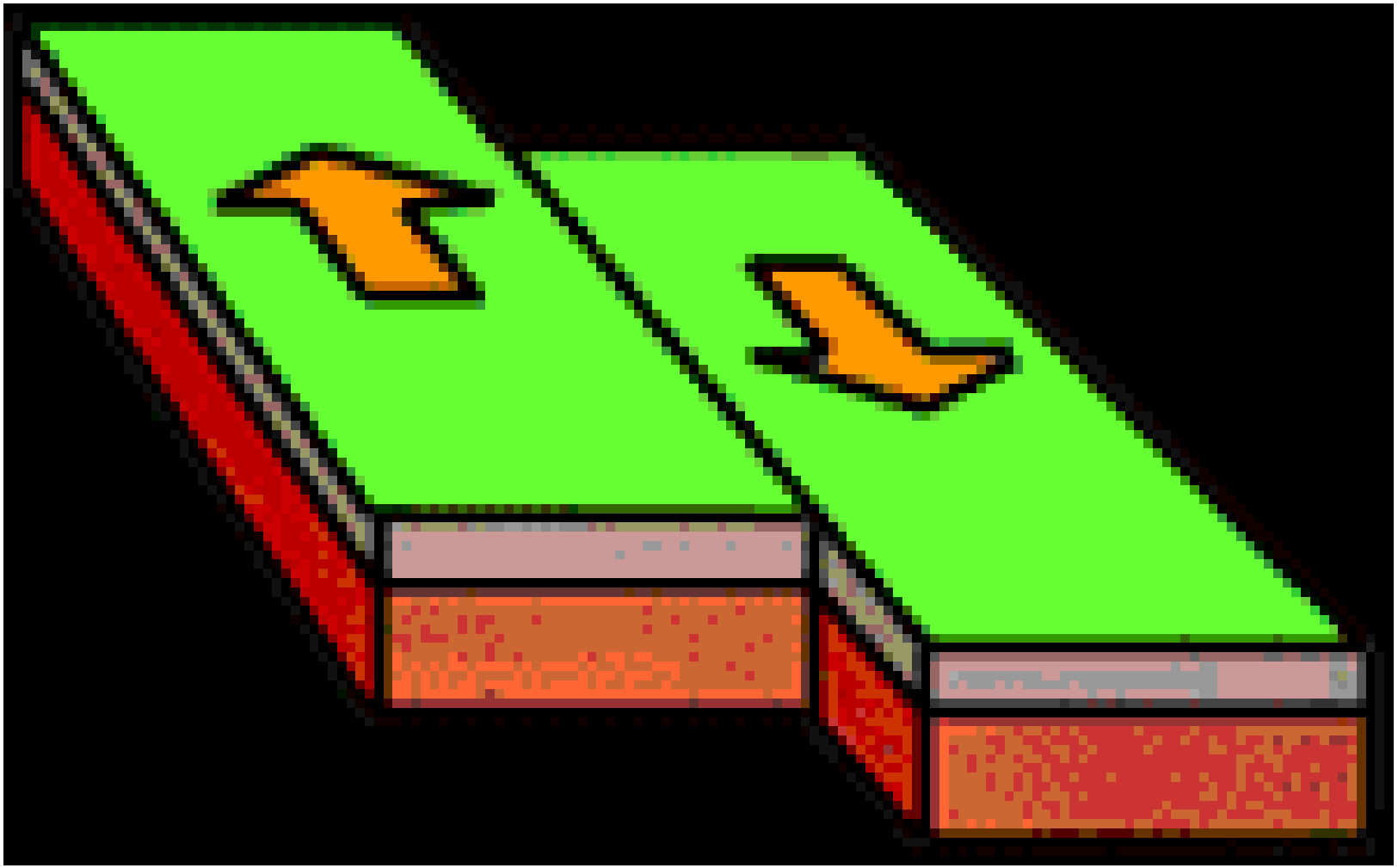
The Earth's outermost surface is broken into 12 rigid plates which are 60-200 km thick and float on top of a more fluid zone, much in the way that icebergs float on top of the ocean.



This is the most common kind of motion along the mid-ocean ridges. This is a system of undersea mountain ranges that extends beneath the world's oceans and connects together like the seams on a baseball.

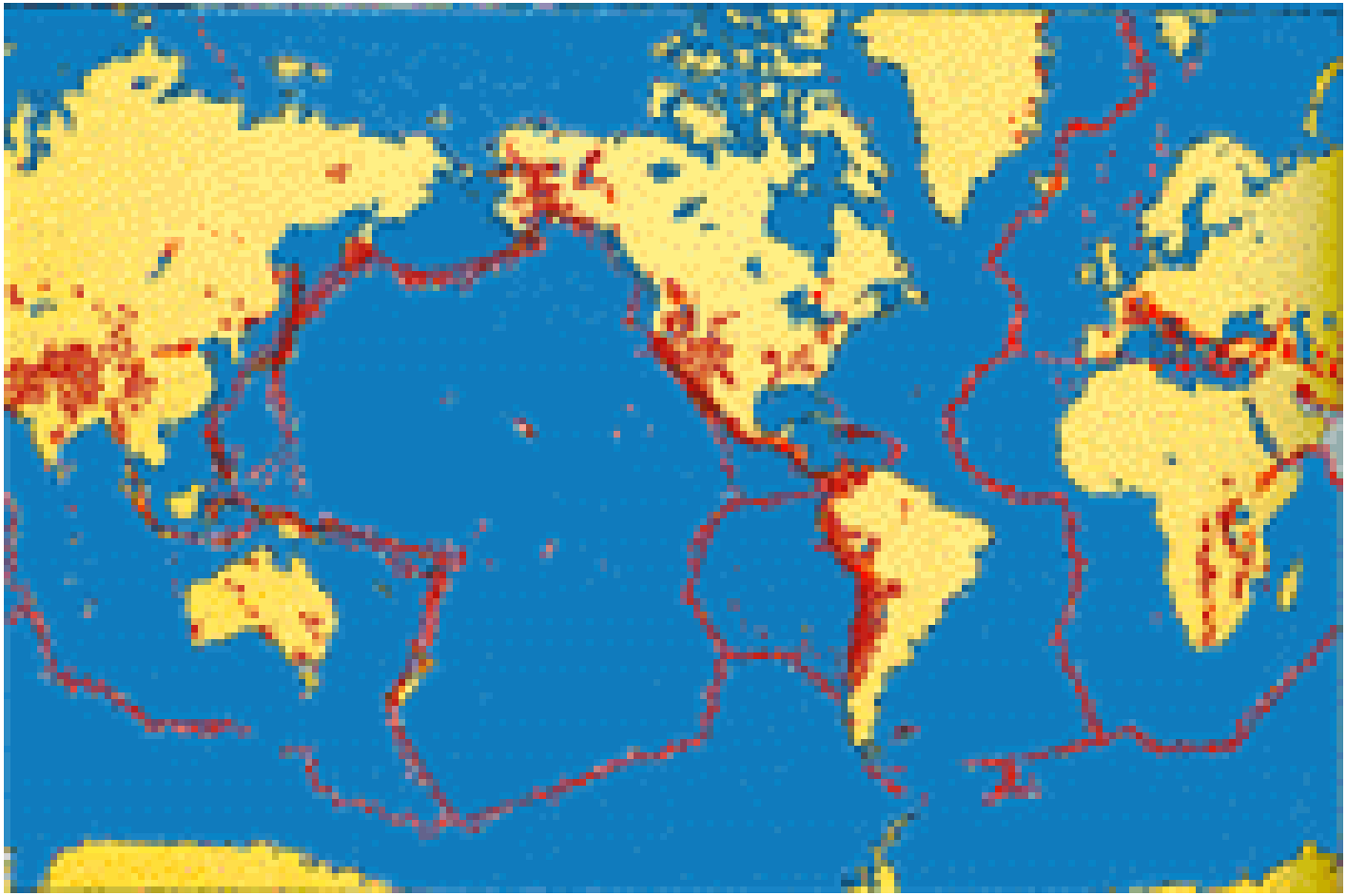


This is the most common kind of motion at subduction zones. This motion happens where dense oceanic plates colide and slide beneath continental plates.



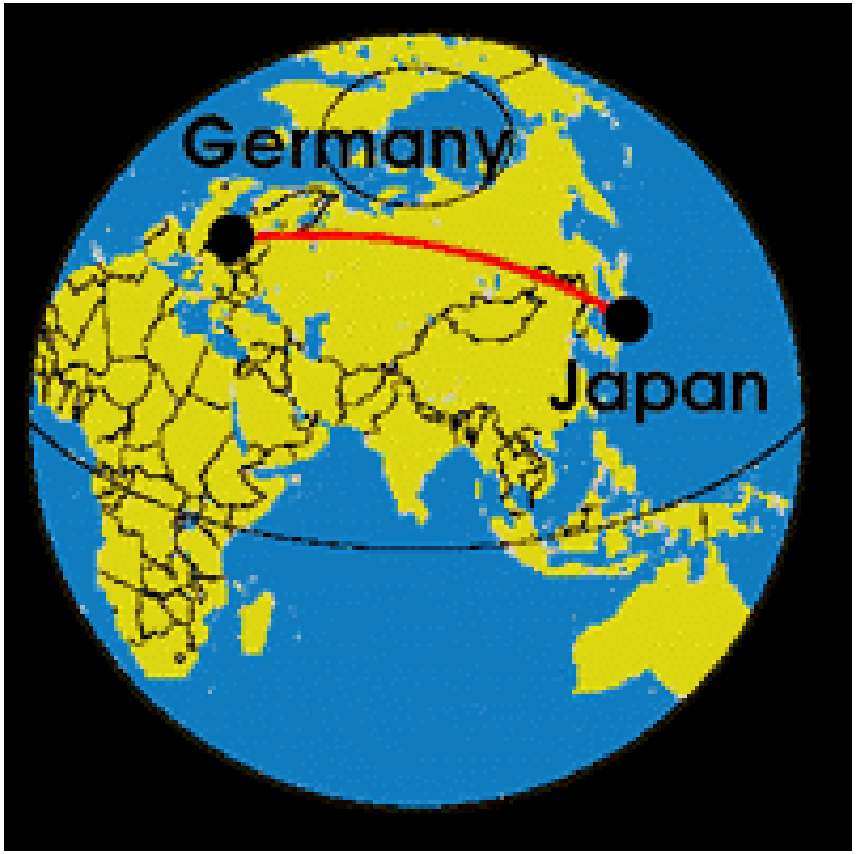
A good example of this type of motion is the San Andreas Fault which runs through California

The movement between plates and along faults is not smooth. They move in jerks, giving rise to earthquakes. The locations of earthquakes throughout the world delineate the major tectonic boundaries.



Earthquakes create seismic waves which shake the ground as they pass. Earthquakes create waves just like waves of water moving across the ocean.

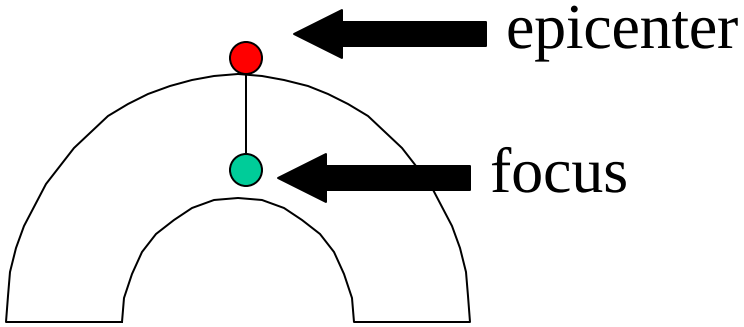
Consider what happens when a drop of rain hits a pond of water. The drop disturbs the flat surface of the water and creates waves that travel outward in all directions from the disturbance. These waves travel on the surface of the pond, along the interface between the water and the air.



Earthquakes generate seismic waves which travel all around the world and can be detected with a seismograph.
This was first discovered in 1889 by E. von Rebleur Paschwitz who noted that waves recorded on a horizontal pendulum in Potsdam, Germany were generated by an earthquake far away in Tokyo, Japan.

Focus: location of the source of the earthquake

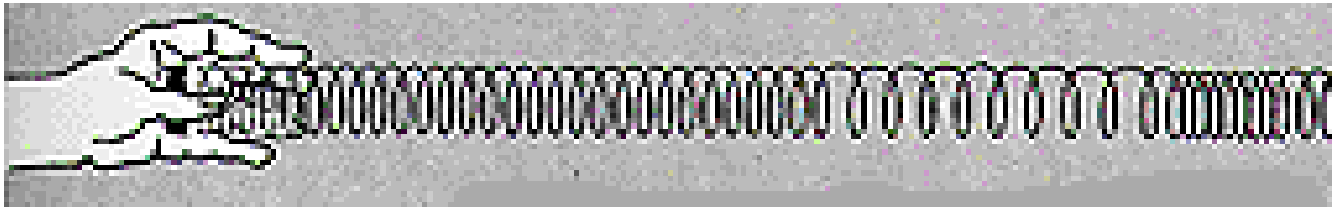
Epicenter: point on the earth's surface vertically above the focus



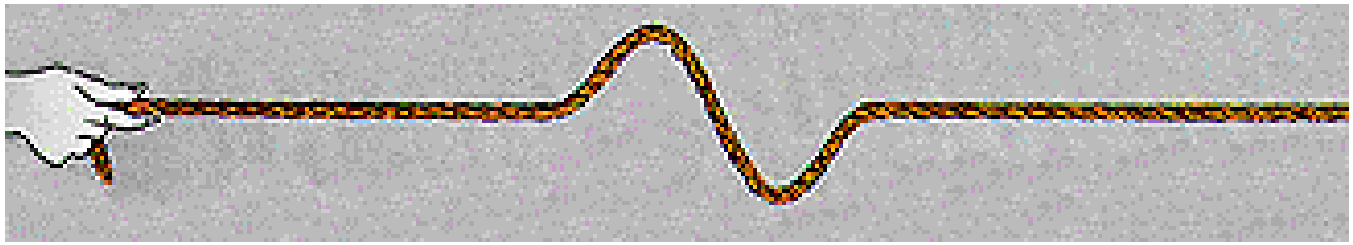
Earthquakes generate several kinds of seismic waves including P, for "Primary" and S, for "Secondary" waves.

P-Waves

compressional motion similar to the motion of a slinky

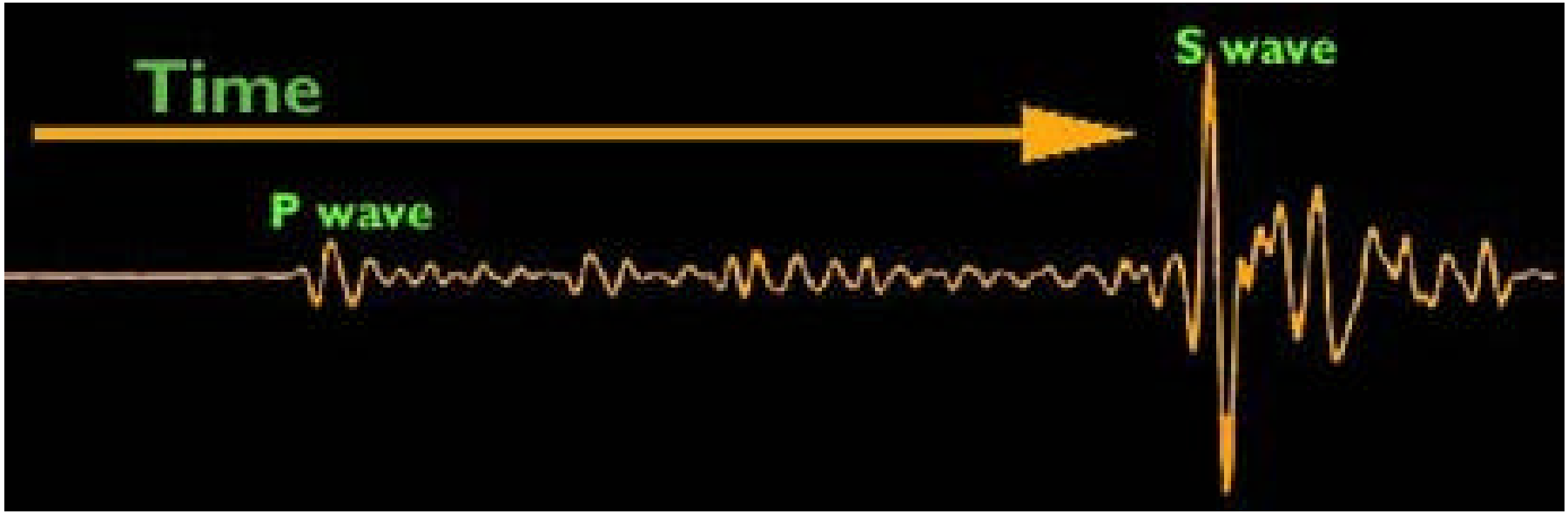


S-Waves



move in a shear motion perpendicular to the direction the wave is traveling

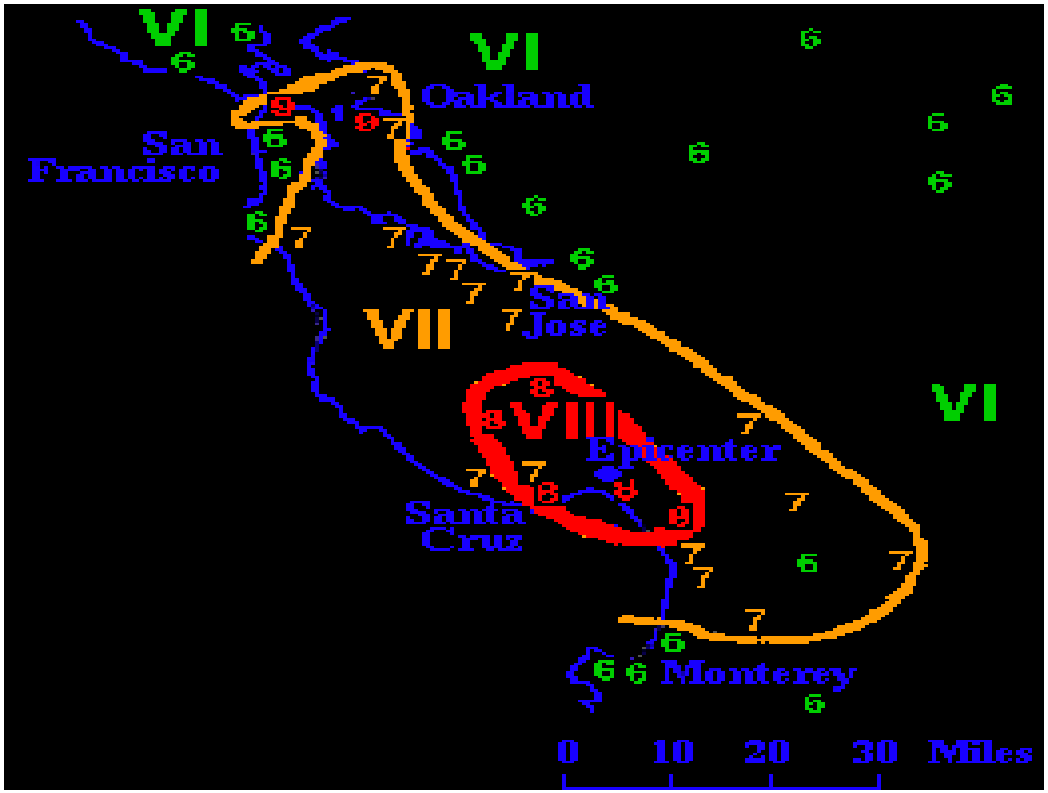
The P waves travel fastest through the Earth so they arrive at a seismograph first, followed by the S waves and lastly by the surface waves.



Measuring A Quake

- Mercalli Intensity Scale

assigns an intensity or rating to measure the effects of an earthquake at a particular location.



12 levels of Modified Mercalli intensity

I. Not felt except by a very few under especially favorable conditions.

II. Felt only by a few persons at rest, especially on upper floors of buildings.

XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.

XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

- Richter Magnitude Scale

The Richter magnitude is related to the maximum amplitude of the S wave measured from the seismogram.

Other Applications

•monitoring nuclear explosions detonated anywhere in the world

•As seismic waves travel through the Earth's interior on their way to distant recording stations, they are modified by the rock structures through which they pass.

•The imaging procedure, called seismic tomography, is very similar to the computer-aided tomography (CAT) scans in which doctors use X-rays to create an image the brain.