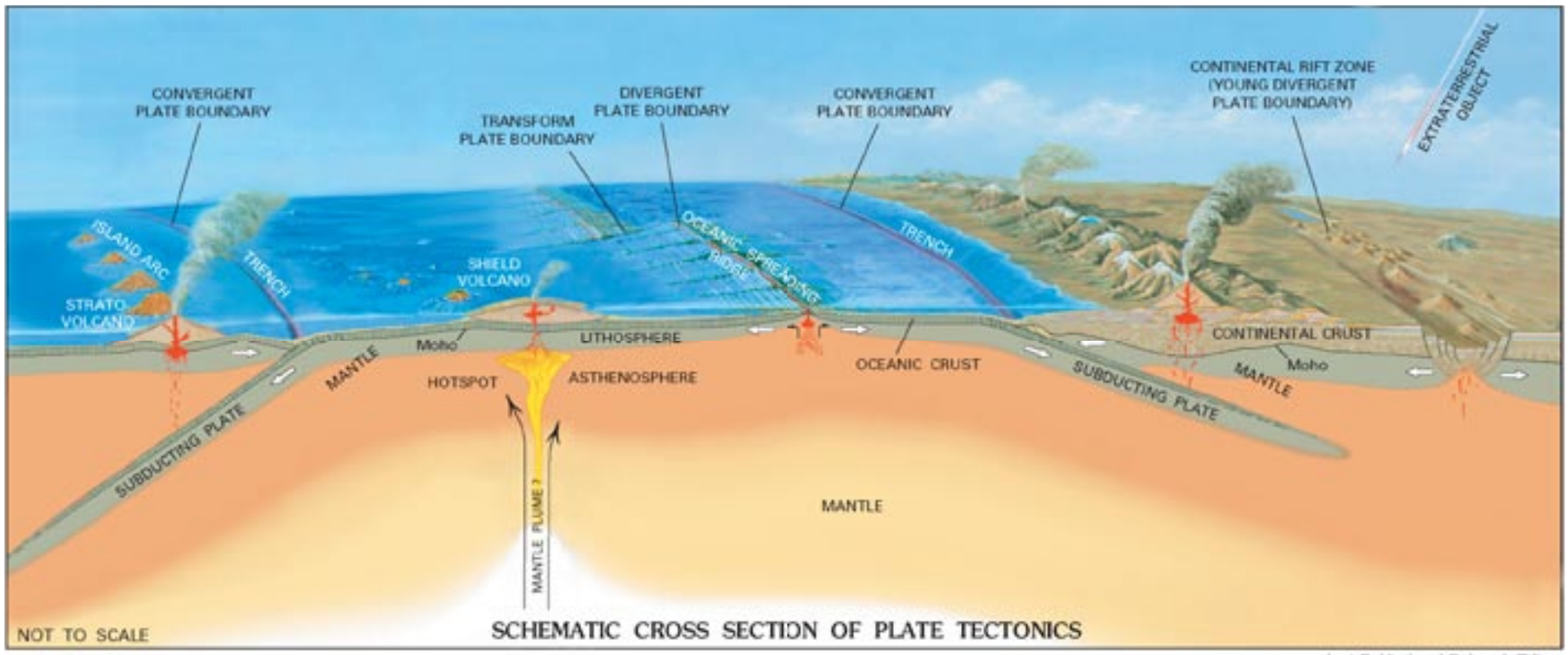
This Dynamic Planet — Special Poster Pullout



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Earthquake Basics

The Fundamentals and Terminology of Earthquake Science

An **earthquake** is a sudden movement of the Earth's crust caused by the abrupt release of pressure that has accumulated over a long time. The energy it releases can be generated by a sudden dislocation of segments of the crust; by a volcanic eruption; or by human activities, such as mining, oil extraction and filling reservoirs. Most destructive earthquakes are caused by dislocations of the crust. The crust may first bend, and then, when the stress exceeds the strength of the rocks, break and "snap" to a new position.

The Earth is formed of several distinct layers that have very different physical and chemical properties. The outer layer, which averages about 22 miles in thickness, consists of about a dozen large, irregularly shaped, brittle **plates** on top of a pliable inner layer. These plates are constantly moving, their edges sliding over, under, away from or past each other. Most earthquakes occur at the boundaries where the plates meet.

All earthquakes occur along faults, which reflect zones of weakness in the Earth's crust. A **fault** is a fracture in the Earth's crust where two blocks of the crust have slipped with respect to each other. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the pressure has been relieved. Another earthquake could still occur within a short period of time. Many of the most active faults are deep within the crust and are not visible at the surface, especially where the plates are colliding with each other.

Aerial view of the San Andreas Fault slicing through the Carrizo Plain in the Temblor Range east of the city of San Luis Obispo, Calif. Photo: Robert E. Wallace.

The **hypocenter** of an earthquake is the location beneath the surface where the rupture of the fault begins. The **epicenter** of an earthquake is the location directly above the hypocenter on the surface of the Earth. The **focal depth** of an earthquake is the depth from the Earth's surface to the hypocenter. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Measuring Earthquakes

When an earthquake occurs, vibrations called **seismic waves** are generated. These waves travel outward from the source of the earthquake along the surface and through the Earth at varying speeds depending on the material through which they move. The vibrations produced by earthquakes are detected, recorded and measured by instruments called **seismographs**. By responding to the motion of the ground surface beneath it, a seismograph creates a zigzag line called a **seismogram** that reflects the changing intensity of the vibrations. From the data expressed in seismograms, scientists can estimate how much energy was released and determine the time, the hypocenter and the type of faulting of an earthquake.

Magnitude verses Intensity

The severity of an earthquake can be expressed in several ways. The **magnitude** of an earthquake describes its size. Most magnitude computation procedures (sometimes referred to as the **Richter scale**) measure the amplitude of various seismic waves. The **moment magnitude** is a measure of the physical dimensions of the zone that ruptured in the earthquake (i.e., the area of the fault that ruptured) times the amount of offset, and that too can be estimated from data processed by modern seismographs. [See "Measuring Magnitude" page 25.]

In general, each earthquake has one preferred magnitude, but each person who feels or observes a quake can describe its intensity at their location. The **intensity** is an observation of how strongly a shock was felt at a particular location.

To quantify the effect or intensity of an earthquake, scientists use the **Modified Mercalli Intensity Scale**. While magnitudes are expressed as Arabic numbers and in theory have no upper or lower limits, intensity is expressed in Roman numerals I-XII. Evaluation of earthquake intensity can be made only after eyewitness reports and results of field investigations are studied and interpreted. (Was it barely felt, did it knock dishes off shelves, destroy poorly constructed buildings or destroy almost all buildings?)

Although magnitude is an important factor in the effect of an earthquake, earthquakes of large magnitude do not necessarily cause the most intense surface effects. An earthquake's destructiveness depends on many factors: magnitude, focal depth and local geologic conditions, as well as the distance from the epicenter, the population density, and the design and construction types of buildings and other structures. The combination of these factors is often what determines the difference between slight damage and catastrophe.

Compiled by Steve Vandas with assistance from Diane Noserale. Much of the information was obtained from the USGS publication "Earthquakes" by Kaye M. Shedlock and Louis C. Pakiser.