ACTIVITY 4— EARTHQUAKE HISTORY OF YOUR COMMUNITY

Background Information

The global distribution of earthquakes is controlled for the most part by plate tectonics, the universally accepted theory that the outermost layer of the Earth consists of rigid plates that are in motion relative to each other. Most earthquakes, large and small, occur where these plates diverge, converge, or slide parallel to one another. This is a good place for you and the students to review the material in **Chapter 2** of this module.

Throughout this activity, study the map *This Dynamic Planet*. It contains a wealth of information about earthquakes, volcanoes, sea-floor topography, and plate tectonics. A quick look at the map reveals that earthquakes tend to occur along well-defined belts, most prominently in ocean basins and along the edges of continents around the Pacific basin. A much broader belt extends from India and Tibet to southeastern Europe. Scattered earthquakes occur in the interiors of some continents. The earthquakes in ocean basins tend to have a linear distribution that is offset in many places. On closer examination they all have depths less than 60 km and, in general, lower magnitudes than earthquakes along the edges of continents. These earthquakes are located along the mid-ocean ridges. The Mid-Atlantic Ridge, down the center of the North Atlantic and South Atlantic oceans, is a classic example. Earthquakes in these systems occur where new lithospheric plates are created and spread apart. Much of this earthquake activity is associated with local slip of two adjacent plates along the transform faults that connect the offset segments of the ridge crests. The San Andreas Fault in California is an unusually long transform fault of this kind.

The earthquakes along the edges of the continents that rim the Pacific Ocean form linear or curvilinear belts that tend to be wider than those in ocean basins. In most of these earthquake belts, the shallowest earthquakes (< 60 km) are closest to the ocean, near the ocean trenches, and the earthquake depths increase continuously toward the interior of the continents. These are the earthquakes that are generated in the plates as they go down subduction zones. The deepest of these earthquakes are as deep as several hundred kilometers. Many of the largest-magnitude earthquakes occur in these belts. This pattern of earthquake foci descending toward the interior of continents is well developed below Japan and parts of South America. All of these belts are associated with volcanoes as well.

A belt of earthquakes much broader than those described above extends from India and Tibet to southeastern Europe. All of the earthquakes in this belt are shallow (< 60 km). Many of the largest-magnitude earthquakes occur in this belt. These earthquakes are the result of the collision of two continental plates. There are no volcanoes in this zone, but there are very high mountains, including the Himalayas.

In the interiors of some continents, far from trenches, earthquakes have a scattered pattern. All of the earthquakes are shallow

(< 60 km). They are not at the active edges of plates, and their origin is more difficult to explain. Some are probably located along ancient faults that become reactivated because of changes in stress across the plate. A famous example is the New Madrid fault in the central United States.

Most earthquakes are associated with faults (see the figure on page 151 of the Student Book). Some earthquakes, however, cannot be traced back to a known fault. This is common in the eastern United States. Recent glaciation has destroyed the surface topographic expression (called scarps, which are step-like topographic features on the land surface) of young active faults. Many (in fact, most) of the faults on geologic maps are geologically ancient and are no longer a source of earthquakes because they are no longer active. Many faults, both active and inactive, do not reach the surface and cannot be observed and studied directly by geologists, although many of them can be imaged using geophysical techniques of studying the reflection of seismic waves at surfaces where rock properties change abruptly, as across faults.

Areas with high seismic risk are shown on page 153 in *Figure 1* of the Student Book. Notable areas include southern and coastal California, the Pacific Northwest, the Inter-Mountain Seismic Belt, and several areas in the eastern states. Most of the earthquakes in California are associated with the San Andreas fault system. Only recently has the high seismic risk of the Pacific Northwest been recognized. Earthquakes in this part of the country are the result of subduction of an oceanic plate beneath the edge of the North American continent. The Inter-Mountain Seismic Belt includes western Nevada and a belt that runs from central Utah northward toward northwest Wyoming and southwest Montana. The two north–south trending belts mark the active edges of the Basin and Range Province, where faults lift up mountains and drop the intervening valleys. In the eastern states, high-risk areas include the New Madrid area (southern Illinois to the Tennessee–Arkansas border); Charleston, South Carolina; and a zone extending from Vermont to eastern Massachusetts.

Ground subsidence is a lowering of the ground surface due to shifting of fault blocks, gravitational slumping, or landsliding. In Hawaii, the coastline was submerged 3.5 m during a magnitude 7.1 earthquake in 1975.

The *EarthComm* web site www.agiweb.org/earthcomm contains a variety of carefully selected links to web sites that will help you to deepen your understanding of content and prepare you to teach this activity. Many of the sites also contain images which can be downloaded and made into overheads for incorporation into class discussions.