Chapter 1
WHY WE STUDY EARTH

• Natural resources
• Natural hazards
• History
• Interaction of Earth systems
• Because we live here!

Field work

Geologists examine rocks inside Spider Cave at Carlsbad Caverns, New Mexico.

A geochemist readies a rock sample for analysis by a mass spectrometer.

Study of hazardous natural processes

Earth monitoring

Geology – the branch of Earth science that studies Earth’s history, its composition, its internal structure, surface features, and processes.

San Gabriel Mountains to 3000 m above Los Angeles.

Earthquakes, landslides, and floods rework the rock.
Our environment is the uniquely habitable region near Earth’s surface that humans share with all other organisms. [Gary Brettnacher/Getty Images.]

Renewable vs. nonrenewable resources


Total energy consumption in the United States from 1850 to 2000 in quads (1 quad = 10^{15} Btu) (b) Percentages of various types of energy consumed in the United States from 1850 to 2000. [U.S. Energy Information Agency.]
Edwin L. Drake (right) in front of the oil well that initiated the "age of petroleum." This photo was taken by John Mather in 1866. Titusville, Pennsylvania. [Bettmann/CORBIS.]

Japan’s Kashiwazaki-Kariwa facility --world’s largest nuclear power plant,--generating capacity exceeding 8200 megawatts. It was damaged by a powerful earthquake (magnitude 6.8) that struck the region on July 16, 2007. The plant was shut down and required extensive repairs. [STR/AFP/Getty Images.]


The Geco Topaz, a vessel operated by WesternGeco Inc., conducting a three-dimensional seismic survey in the North Sea.

Depiction of a three-dimensional seismic survey, showing acquisition system and a subsurface "cube" of seismic data. The colors show the layers of sediments beneath the seafloor, some trapping oil and natural gas. [b) Courtesy of Satoil, Veritas, and BP.]
The prices of six important metals have risen substantially during the last several years, fueled by increasing global demand. All prices are in U.S. dollars per metric ton. [London Metal Exchange.]

Mine dumps near Johannesburg, South Africa

Irrigation in California’s Imperial Valley, a natural desert. [David McNew/Getty Images.]

CA water:
81% --irrigation
16% --municipalities
3% --industries
Lake Powell, in Utah, showing “bathtub rings” from recent drought. [Christopher J. Morris/Redux.]

The water cycle.

Angel Falls, Venezuela, is the highest waterfall on Earth. The falls plunge 914 m from a flat-topped mountain composed of 1.7-billion-year-old sandstones.

The Ogallala aquifer, supplies the southern Great Plains with much of its fresh water.

>170,000 wells have depleted water extensively, lowering the level more than 30 m.

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Disaster in Chittagong, Bangladesh, caused by a cyclone on February 5, 1991.

Satellite photo of the great flood of the Mississippi River, 1993. [NASA images created by Jesse Allen, Earth Observatory, from data courtesy of the Landsat Project Science Office.]

Scarp formed by slip (left side downward) along a dipping fault surface during the 1954 Fairview Peak earthquake in Nevada. [Karl V. Steinbugge Collection, Earthquake Engineering Research Center.]

School collapse caused by an earthquake in 2005 in Kashmir. [AP Photo/Aamir Qureshi, pool.]

Partly buried school bus in Kalapana, Hawaii. The village was buried by a lava flow from Kilauea. [Roger Ressmeyer/CORBIS]

Armero, Colombia, submerged by mudflows, after an eruption of the long-dormant Nevado del Ruiz volcano, in 1985. [STF/ASP/Getty Images]
A massive mudslide buried homes in La Conchita, California, in 2005. 10 people died. [AP Photo/Kevork Djansezian.]

Town of Yungay and Ranrahirca in Peru before the 1970 Ancash earthquake (~ Mg. 8) triggered a landslide from Mount Huascarán. [Lloyd Cluff/CORBIS.]

The landslide traveled 17 km at a speed of up to 280 km/hour; ~100 million cubic meters of water, mud, and rocks. The death toll from earthquake and landslide was 66,700. [Lloyd Cluff/CORBIS.]

Tunguska explosion in 1908, photographed by the Kulik expedition of 1927. Flattened 2,000 sq km.

September 1985 earthquake in Mexico City, Mexico. More than 10,000 people were killed in Mexico City by the earthquake.

Earth’s biosphere, represented by the global distribution of plant material in the oceans and on land, as mapped by NASA’s SeaWiFS satellite.
Amazon deforestation by slash and burn.

**FIGURE 1.37 (a)** A monument before deterioration caused by acid rain. [Westfalisches Amt für Denkmalpflege.]

**FIGURE 1.37 (b)** A monument after deterioration caused by acid rain. [Westfalisches Amt für Denkmalpflege.]

September 2001, the area of the Antarctic ozone hole extended over 50 million square km, larger than the combined area of the United States, Canada, and Mexico. So what??

Life adapts to effects of climate change.
Tom Jordan (right) at a depth of 2800 m in the Mponeng gold mine, South Africa.

John Grotzinger (left) on Namibia’s Skeleton Coast.