GEOLOGICAL CONNECTIONS OF THE EARTH

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JOURNEY TO THE CENTER OF THE EARTH
“AND YET IT MOVES!”
CONTINENTAL DRIFT

PERMIAN
225 million years ago

TRIASSIC
200 million years ago

JURASSIC
135 million years ago

CRETACEOUS
65 million years ago

PRESENT DAY
CARIBBEAN PLATES

NORTH AMERICAN PLATE 1.1 cm/yr

CARIBBEAN PLATE

-20N

-10N COCOS PLATE 11.9 cm/yr

90 W

SOUTH AMERICAN PLATE 1.6 cm/yr
The source of the Earth’s magnetism lies in the molten outer core. As a result of the Earth’s rotation, the molten iron of the outer core flows continually around the solid inner core. The flowing stream of molten iron causes an electrical current in turn creates the magnetic field.
The Earth’s magnetic field (blue) shields the planet from charged particles in the solar wind (red).
EARTHQUAKES IN PLATE MARGINS

Divergent – They are Shallow and weak.
EARTHQUAKES IN PLATE MARGINS

Subduction – Deep (down to 700 km) and very strong.
Collision – Down to 300 km and sometimes strong.
EARTHQUAKES IN PLATE MARGINS

Transform Fault – Down to 100 km and often strong.
Tectonics in the Caribbean

Moving Plates
The Caribbean is an active seismic zone, crisscrossed by fault lines (gray). Below, orange ovals show the estimated sites of major earthquakes in the region since the 1800s.

Parallel Faults
The island of Hispaniola has two major faults running in parallel. The Enriquillo in Haiti was the site of the Jan. 12 quake, but the Septentrional in the northern Dominican Republic has not ruptured in 800 years and may be overdue for a large quake.
EARTHQUAKE IN HAITI

Jan. 12 earthquake epicenter: magnitude of 7.0

SOURCE: Wood's Hole Oceanographic Institute
SEQUENCE OF PROCESSES PRODUCING THE TSUNAMI

1. Before the earthquake
The plate holding the Indian Ocean was sliding under the continental plate (holding Indonesia and much of Asia) at about 6 cm per year. The continental crust was bent thanks to the constant pressure of collision.

2. During the quake
The fault ruptured violently, allowing the continental crust to unbend and causing portions of the sea floor to move up or down by several metres. The water above the fault responded in kind, creating a wave crest and trough.

3. The wave travels
One wave crashed towards the nearby shore of Indonesia. Another travelled westwards at about 800 km per hour in deep water, with a wavelength of 100 km and an average wave height of just tens of centimetres.

4. Collision
When the wave entered shallow waters, it slowed to tens of kilometres per hour. Its wavelength shortened to about 5 km, and its height is thought to have soared to more than ten metres. The trough of the wave often hits before the crest (as shown).
AN EARTHQUAKE PRODUCING A TSUNAMI ACROSS THE INDIAN OCEAN
DECEMBER 26, 2004
FORMATION OF VOLCANOES
MAJOR KINDS OF VOLCANOES IN A PLATE-TECTONIC SETTING

[Diagram showing various types of volcanoes and geological features]
Long-lived hot spots (magma sources) deep in the mantle can be used to determine the absolute motions of plates. Because the hot spots lie far below the lithosphere and do not move laterally, each is marked by a chain of volcanoes on the surface of the lithosphere. The youngest volcano in a chain lies directly above the hot spot.
PLATE TECTONICS AND EARTH CLIMATE
EARTH'S CLIMATE SYSTEM

Atmospheric Composition
- Gases, particles
- \( \text{H}_2\text{O}, \text{N}_2, \text{O}_2, \text{CO}_2, \text{O}_3, \text{SO}_2, \) dust

Incoming solar radiation

Reflective solar radiation

Active volcanoes

Snow and glacier ice

Weathering and erosion

ATMOSPHERE

Sea ice

Heat exchange

Precipitation

Evaporation

Wind stress

BIOSPHERE

Terrestrial radiation

LITHOSPHERE

Tectonic uplift

Land Features
- Relief, vegetation

CRYOSPHERE

Rising magma

OCEANS

Motion of lithospheric plates

Ocean Basins
- Shape, volume, deep circulation, salinity, sea level

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Estimated number of known living species.
TSUNAMI IN PUERTO RICO IN 1918
THE EARTH SYSTEM
THANK YOU!

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