70 GEOLOGY OF THE EARTH

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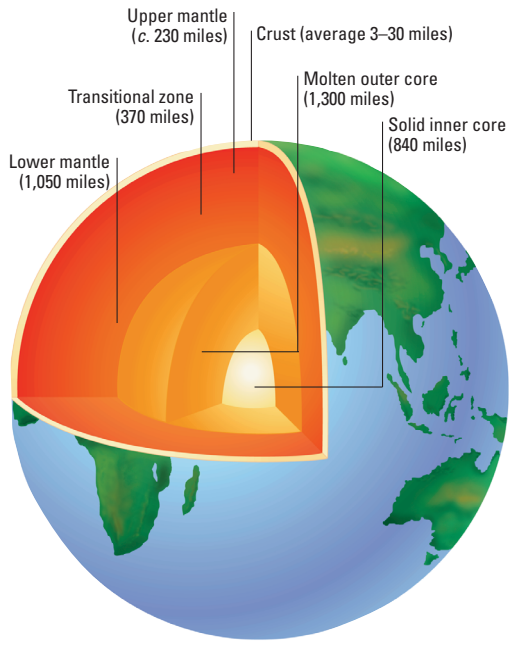
Every year, earthquakes and volcanic eruptions cause much destruction throughout the world. Such phenomena were once thought to be unconnected, but since the late 1960s, scientists have understood that these events are surface manifestations of the tremendous forces operating in the Earth's interior that are slowly but constantly changing the face of our planet.

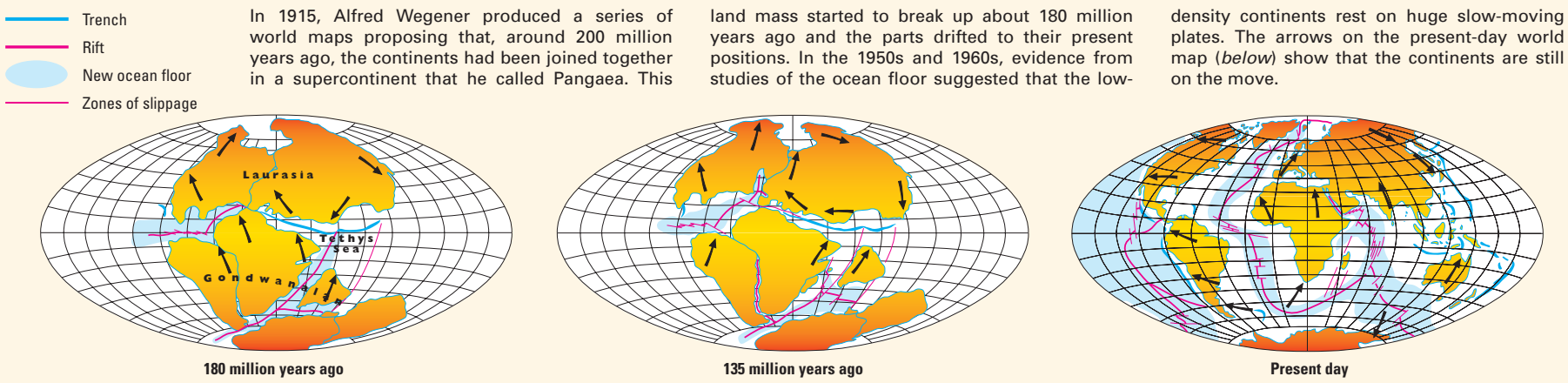
The Earth is divided into three zones. The crust, a brittle, low-density zone, overlies the dense mantle. Separating the crust from the mantle is a distinct boundary called the Mohorovičić (or Moho) discontinuity. Enclosed by the mantle is the Earth's core, which consists mainly of iron and nickel.

Temperatures inside the Earth range from about 1,600°F in the upper mantle to perhaps 9,000°F in the core. Heat creates convection currents in a semimolten part of the mantle called the asthenosphere. Above the asthenosphere is the lithosphere, a solid layer about 40 miles thick, consisting of the crust and part of the mantle. The lithosphere is divided into rigid plates, moved around by the currents in the asthenosphere, a process named plate tectonics.

The Earth was formed around 4.6 billion years ago. Lighter elements floated toward the surface, where they formed crustal rocks. The oldest rocks so far discovered are about 4 billion years old, while the oldest fossils occur in rocks formed around 3.5 billion years ago. An explosion of life occurred at the start of the Cambrian period, 570 million years ago. The fossil record since the start of the Cambrian has enabled scientists to piece together the story of life on Earth.

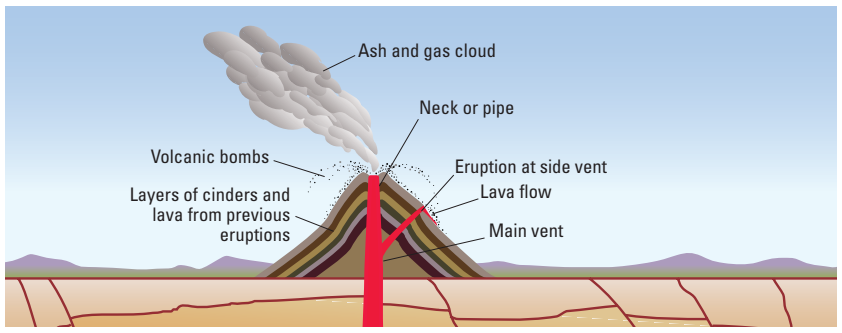


CONTINENTAL DRIFT



In 1915, Alfred Wegener produced a series of world maps proposing that, around 200 million years ago, the continents had been joined together in a supercontinent that he called Pangaea. This land mass started to break up about 180 million years ago and the parts drifted to their present positions. In the 1950s and 1960s, evidence from studies of the ocean floor suggested that the low-density continents rest on huge slow-moving plates. The arrows on the present-day world map (*below*) show that the continents are still on the move.

DISTRIBUTION OF VOLCANOES



Volcanoes occur when hot liquefied rock beneath the Earth's crust is pushed up by pressure to the surface as molten lava. There are some 550 known active volcanoes, around 20 of which are erupting at any one time.

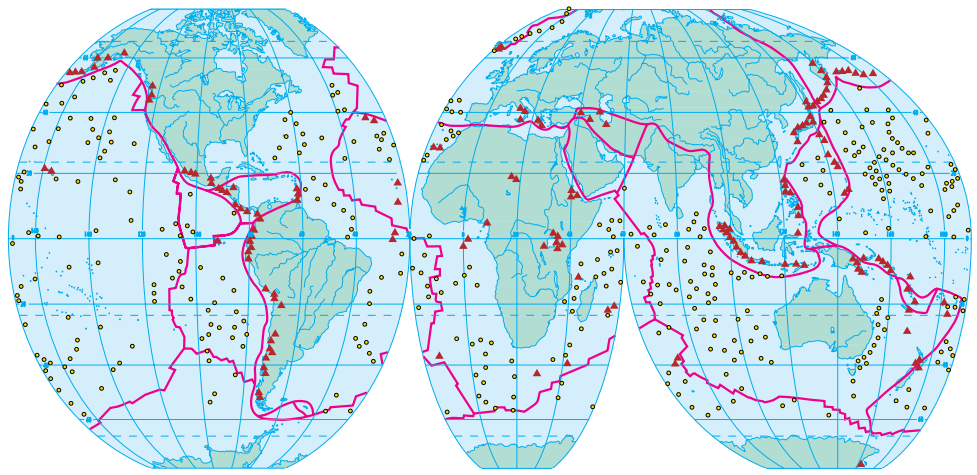
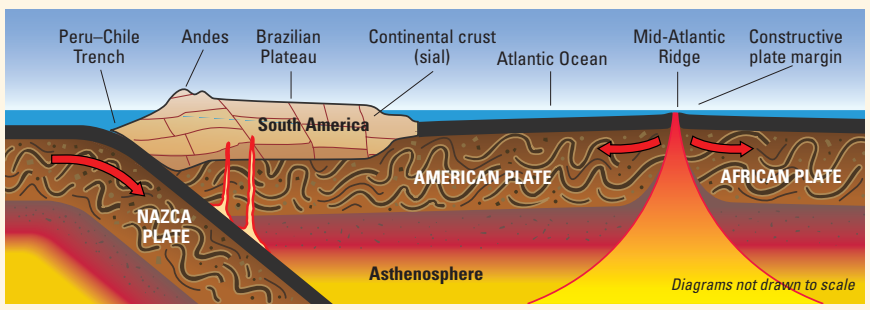


PLATE TECTONICS

The huge ridges that run through the oceans represent boundaries between plates. Here plates are diverging and molten magma from the mantle rises along a central rift valley to form new crustal rock. These ocean ridges, which are active zones where earthquakes and volcanic eruptions are common, are called constructive plate margins. Destructive plate margins, which occur when two plates converge, are marked by deep-ocean trenches as one plate is forced under the other. The descending plate is melted to produce the magma that fuels volcanoes alongside the trenches. Movements of descending plates are often sudden, triggering earthquakes in overlying continental areas.

Sea-floor spreading in the Atlantic Ocean and plate collision



Sea-floor spreading in the Indian Ocean and continental plate collision