Chapter 8. The Earth as a Planet

Note. In this section we survey physical properties of the Earth.

Note. *Albedo* is the fraction of light reflected from a body. The albedo of the Earth is 30%.

Note. The Earth's atmosphere is 77% N_2, 21% O_2, and 2% other gases. See Table 8.2. Ozone (O_3) is also present in trace amounts in the upper atmosphere; it blocks ultraviolet light. Carbon dioxide (CO_2) is present in trace amounts and reflects infrared radiation emitted by the Earth producing a *greenhouse effect*.

Note. The layer's of the Earth's atmosphere are:

Name	Altitude	Temperature as Function of Height
troposphere	0–10 km	decreasing
stratosphere	10–50 km	increasing
mesosphere	50–80 km	decreasing
thermosphere	> 80 km	increasing to 200 km

Note. Heating causes air to rise. As it rises it cools. The cool air can then move laterally and sink elsewhere. This motion is called *convection*. This movement is complicated by the rotation of the Earth and differential warming of oceans and continents:

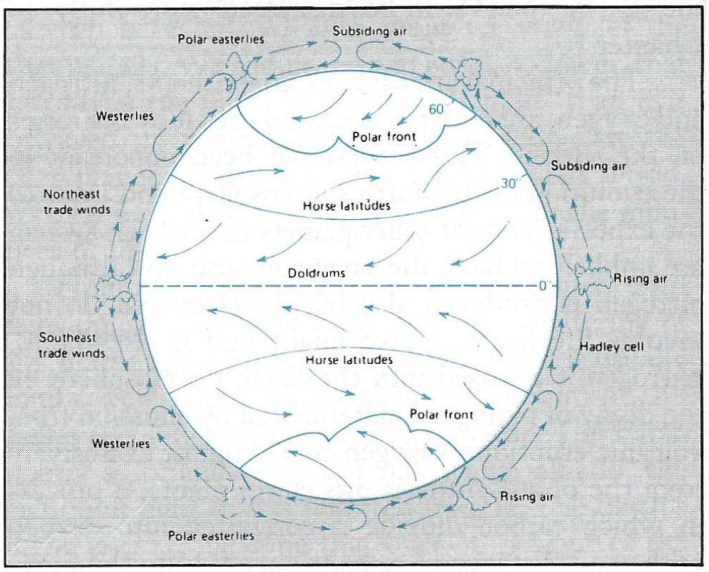

Figure 8.4 Page 154. The General Circulation of the Earth's Atmosphere.

Note. The interior of the Earth can be probed by studying the behavior of *seismic waves*. These waves may be *P waves* (compressional waves) in which oscillation occurs parallel to distinction of wave travel, or *S waves* (shear or transverse waves) in which vibrations occurs at right angles to the direction of motion. P waves can be transmitted through a liquid, but S waves cannot.

Note. The layers of the Earth are:

Name	Depth	State
Crust	0–30 km	solid
Mantle	30–2900 km	solid
Outer Core	2900–5100 km	liquid
Inner Core	5100–6378 km	solid

The mantle is broken into three layers:

Name	Depth	State
Lithosphere	30–70 km	rigid
Asthenosphere	70–1000 km	fluid ("mushy")
Mesosphere	1000-2900 km	rigid

Note. The crust of the Earth can be broken into two categories: (1) continental crust which is thick, and (2) oceanic crust which is relatively thin. These compose the continental plates which drift around altering their relative positions (this is the theory of *plate tectonics*). The primordial continent *Pangea* (consisting of Laurasia [Europe, Asia, North America] and Gondwanaland [India and the rest]) started breaking up 200 million years ago. Recall that the asthenosphere is low in *viscosity* and this is what the plates move on. Places where two plates meet can be sites of much geological activity.

Note. The Earth is 4.5 billion years old, but most surface rocks are only millions or hundreds of millions of years old. This is because there is a continual renewal of

the forms of surface rocks. Rocks can be classified as:

1. *Igneous*: formed from cooled and solidified magma.

2. *Sedimentary*: formed from layers of soil and gravel (these are the types that contain fossils).

3. *Metamorphic*: have been altered by heat or pressure.

Any one type can be converted to another type, giving the *rock cycle*:

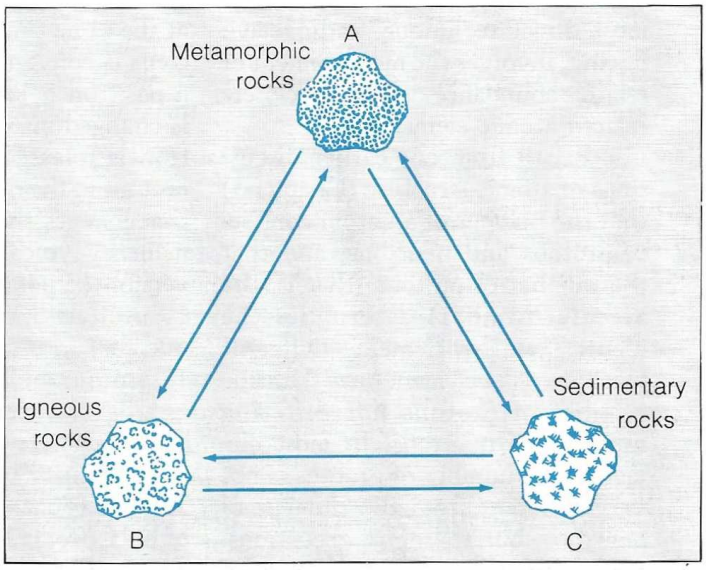

Figure 8.16 Page 161. The Rock Cycle.

Note. The Earth is surrounded by the *magnetosphere* which is a result of its magnetic filed. It acts to shield the Earth somewhat from charges particles from the Sun and cosmic ways from space. Due to its interaction with the *solar wind*, it is not symmetrical:

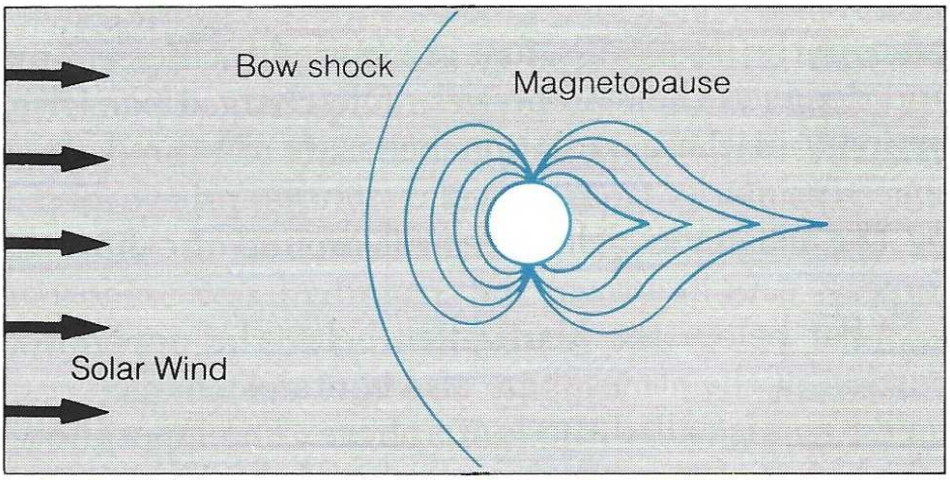

Figure 8.18 Page 163. The Eart's Magnetic Field Structure.

Note. The magnetic filed has been known to reverse in the past, producing a weakened magnetosphere. This could have affected the evolution of life.

Note. Above 60 km, is the *ionosphere* which contains charges particles. Emissions by these particles when they interact with the magnetic poles produces the *aurora borealis* (and *aurora australis*). At greater distances (10,000–30,000 km) are the *Van Allen belts* which are charges particles captured from the solar wind that follow the magnetic lines of the Earth's field.

Note. The Earth formed out of the coalescence of *planetesimals* (small bodies already condensed) 4.5 billion years ago as the solar nebula condensed. The early atmosphere was the result of gases emitted from molten rocks. The lighter gases (H_2 and He) escaped to space. O_2 is a direct product of the metabolism of living things. N_2 is from the decomposition of organic matter. 2 billion years ago, the atmosphere reached its present composition.

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