

NO.9 Formation of Atmosphere and Carbon Circulation

When the solar system was formed approximately 4.6 billions years ago, the air in the primordial earth consisted of 30 pressures and 97% of carbonic acid gas similar to the Venus, which was not the atmosphere that organism could survive. Then after a billion years, approximately 3.5 billions years ago, unicellular organisms which consisted of only one cell appeared in primordial ocean. This is the birth of life. It is believed that those microorganisms have changed the atmospheric composition so that it would be adequate for organism to live, by transforming the carbonic acid gas to the organic matters such as calcium carbonate and fossil fuels (called "solidification") through a variety of evolutionary procedures.

More than 90% of the current atmospheric composition was formed about 500 millions years ago, which means it took as much as 3 billion years for microorganisms to form the current atmosphere. During these 3 billion years, organisms kept being evolved in the ocean. While there was almost no oxygen in the ocean, the number of microorganisms dramatically increased. They consumed abundant organic matters and released nitrogen, carbonic acid gas, ammonia, and methane into the ocean and the air. Then the plants that produced oxygen by photosynthesis using the solar energy emerged, through which the ozone layer was formed. The ozone layer blocked an ultraviolet light, a harmful component of sunlight, to reach the earth ground. Before that, organisms could only live in the ocean because no direct sunlight came into the ocean. However, the existence of the ozone layer made it possible for organisms to live outside of the ocean and find their way into the land.

About 430 millions years ago, some plants acquired a capability to live on the land, followed by the Amphibia that had been evolved from the Pisces. Since then, the evolution of organisms became diversified and accelerated. The Reptilia evolved from the Amphibia dominated the dinosaur era which lasted more than ten billion years.

About 4.5 million years ago, the Australopithecine, the ancestor of human beings, appeared (their fossils have been discovered).

Since then, human beings began to acquire the ability distinct from other creatures – producing artificial objects using hands. This resulted in the accelerated development of human beings.

The current atmosphere is the result (or gift) of microorganisms' three billion-year activity. The carbon circulation, one of the earth ecosystems, kept the constant atmospheric component, which preserved the environment so that every organism including human beings could live.

There exist three big carbon storerooms: atmosphere, hydrosphere, and land-biosphere. The carbon circulates among these storerooms, transforming to the carbon acid gas, carbonate, and organic matters.

In the atmosphere, 750 billion tons of carbon is stored in the form of carbon acid gas. In hydrosphere, nearly 40 trillions of carbon is stored, a trillion tons in the outer layer of the ocean (until 75 meter in depth) and 38 trillions tons in the middle layer.

In land-biosphere, there is 550 billion tons of carbon in organisms' bodies such as plants in the forests and 1.5 trillion in carcasses (or dead bodies) and soils in the form of organic matters.

Moreover, in underground there is about ten trillions of carbon in the form of fossil fuels of organisms which existed trillions years ago.

Fossil fuels were made through solidification, by transforming the carbonic acid gas to the organic matters by photosynthesis using the solar energy, and being stably stored under the ground. Therefore, burning fossil fuels, or oxidation, is to release these organic matters with the form of carbonic acid gas and water, which results in the increase of the density of carbonic acid gas.

It is assumed that the atmospheric composition was constant before the Industrial Revolution and the carbon circulation was well balanced among the three carbonic storerooms. Therefore it is assumed that those nature processes were stable at that time. However, this carbon circulation lost its balance when the Industrial Revolution was occurred and, especially, when human beings began to consume a huge amount of fossil fuels in the 20th century.

Since two hundreds years ago, or since the Industrial Revolution, human beings began to consume fossil fuels, which provoked the annual increase of the density of carbonic acid gas. Nowadays nearly 7 billion tons of the carbonic acid gas is released to the air annually through industrial activities. This is 200 times of the amount of carbon released through eruptions and volcano activities (20 ~ 30 million tons). Especially, this amount

was drastically increased recently along with an increase in population and the industrial growths in developing countries.

The amount of carbon artificially released to the air is less than the amount of carbon circulation. However, since this release is irreversible and constantly increasing, the amount of released carbon to the air is big enough to destroy the balance of nature.

In addition to the enormous consumption of fossil fuels, deforestation is another factor to destroy the balance of nature. Especially, tropical rain forests which effectively absorb the carbonic acid gas have been drastically destroyed for 30 years. The area annually destroyed is more than 20 hectares, which is equal to half of the Honshu Island in Japan. The forest area used to be more than 5 billion hectares, one fourth of the whole land, in the 1950s. However, it has been decreased to 2.5 billion hectares now. This destruction of forests practically releases nearly 2 billion tons of carbon acid gas to the air annually.

The Industrial Revolution supported the drastically increased population and brought wealth (and richness). However at the same time, human beings are double-damaging the carbon circulation through releasing the carbonic acid gas by consuming fossil fuels and destroying forests which are necessary for the carbonic acid gas to be absorbed.

It is estimated that the density of the carbonic acid gas will be as twice of that of the Industrial Revolution through the industrial activities, or energy consumptions. Combined the release of carbonic acid gas and that of the greenhouse effect gas, the average temperature of the earth is gradually rising.

“There is no meaning to argue only the environmental issues. There is no way but each person reconsiders and reforms his/her own thought and life style. There is no meaning to argue the environmental issues while not including us. There is no way but each of us considers the environmental issues as our own problems and ventures to change old thoughts and customs.” (by Edward Hall, Smithsonian Conference)

- Amount of energy per person in areas (1992) -

<i>Area</i>	<i>Gigajoule (GJ)/person</i>
Advanced Industry Areas	207
North America	351

Western Europe	167
Central Europe	161
Australia	160
Developing Areas	33
China	33
Asia	27
Africa, Middle East	36
Latin America	49

(World Watch, Earth Databook, 1998)

* The copyright of this article belongs to Creature National Institute for Environmental Studies.