CARBON-14 DATING

Carbon dating uses the half-life of Carbon-14 to find the approximate age of an object that is 40,000 years old or younger.

What exactly is radiocarbon dating?

Radiocarbon dating is a method of estimating the age of organic material. It was developed right after World War II by Willard F. Libby and coworkers, and it has provided a way to determine the ages of different materials in archeology, geology, geophysics, and other branches of science. Some examples of the types of material that radiocarbon can determine the ages of are wood, charcoal, marine and freshwater shell, bone and antler, and peat and organic-bearing sediments. Age determinations can also be obtained from carbonate deposits such as calcite, dissolved carbon dioxide, and carbonates in ocean, lake, and groundwater sources.

How is carbon-14 produced?

Cosmic rays enter the earth's atmosphere in large numbers every day and when one collides with an atom in the atmosphere, it can create a secondary cosmic ray in the form of an energetic neutron. When these energetic neutrons collide with a nitrogen-14 (seven protons, seven neutrons) atom it turns into a carbon-14 atom (six protons, eight neutrons) and a hydrogen atom (one proton, zero neutrons). Since Nitrogen gas makes up about 78 percent of the Earth's air, by volume, a considerable amount of Carbon-14 is produced. The carbon-14 atoms combine with oxygen to form carbon dioxide, which plants absorb naturally and incorporate into plant fibers by photosynthesis. Animals and people take in carbon-14 by eating the plants.

The ratio of normal carbon (carbon-12) to carbon-14 in the air and in all living things at any given time is nearly constant. Maybe one in a trillion carbon atoms are carbon-14. Both Carbon-12 and Carbon-13 are stable, but Carbon-14 decays by very weak beta decay to nitrogen-14 with a half-life of approximately 5,730 years. After the organism dies it stops taking in new carbon.
How do scientist use Carbon-14 to determine the age of a fossil?

To measure the amount of radiocarbon left in a fossil, scientists burn a small piece to convert it into carbon dioxide gas. Radiation counters are used to detect the electrons given off by decaying Carbon-14 as it turns into nitrogen. In order to date the fossil, the amount of Carbon-14 is compared to the amount of Carbon-12 (the stable form of carbon) to determine how much radiocarbon has decayed. The ratio of carbon-12 to carbon-14 is the same in all living things. However, at the moment of death, the amount of carbon-14 begins to decrease because it is unstable, while the amount of carbon-12 remains constant in the sample. Half of the carbon-14 degrades every 5,730 years as indicated by its half-life. By measuring the ratio of carbon-12 to carbon-14 in the sample and comparing it to the ratio in a living organism, it is possible to determine the age of the fossil.

Review:

Carbon-14 dating can determine the age of a fossil that is up to 40,000 years old.

Living organisms absorb carbon by eating and breathing.

After burning a small piece of a fossil, scientists compare the amount of Carbon-14 to the amount of Carbon-12 to determine the age of the fossil.

This information was extracted from the following web site: