

Carbon dating uses the radioisotope carbon-14 to determine the age of organic materials up to about 50,000 years. Carbon-14 has a half-life of 5730 years. Atmospheric carbon dioxide has a concentration of about 1 atom of carbon-14 per every 10^{12} atoms of carbon-12. Living organisms take in carbon dioxide from the environment and have the same ratio of carbon-14 to carbon-12 as the atmosphere. When an organism dies, it stops taking in carbon. Then the carbon-14 in the organism starts to decay, which changes the ratio of carbon-14 to carbon-12. By measuring how much the ratio is lowered, it is possible to estimate how much time has passed since the organism lived.

EXAMPLE 4 Carbon Dating a Skeleton

You discover the skeleton of a mastodon. By having it tested, you find that the ratio of carbon-14 to carbon-12 is about one-quarter of that occurring in the atmosphere. How long ago did the mastodon live?

SOLUTION

The half-life of carbon-14 is 5730 years. Because the amount of carbon-14 in the sample is about one-quarter of the amount in the skeleton when the mastodon was alive, you can conclude that the mastodon lived about 2 half-lives ago, or about $2(5730) = 11,460$ years ago.



Fossils of the American mastodon have been found from Alaska to Florida. Its main habitat was cold, spruce woodlands, and it is believed to have traveled in herds. It is thought to have disappeared from North America about 10,000 years ago.



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In the article, soil samples were estimated to be 3000 years old. Estimate the ratio of carbon-14 to carbon-12 in the soil samples. Explain your reasoning.



“Whale remains found at a 3,000-year-old site in northwestern Alaska called Old Whaling, for instance, were once considered evidence of early hunting. But a re-examination of the site in recent years has suggested that people there were simply scavenging dead whales that had washed ashore. There are some dramatic rock carvings in southeastern Korea that show bands of hunters going after whales. But these are nearly impossible to pin down with an exact date, says Odess. In contrast, the newfound ivory carving was pegged as being 3,000 years old by nearly a dozen radiocarbon dates on the soil in which it was embedded. The previous eldest solid evidence for whaling is some 2,000 years old.”

“Whaling Scene Found in 3,000-Year-Old Picture,” Alexandra Witze