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What is Carbon Dating?
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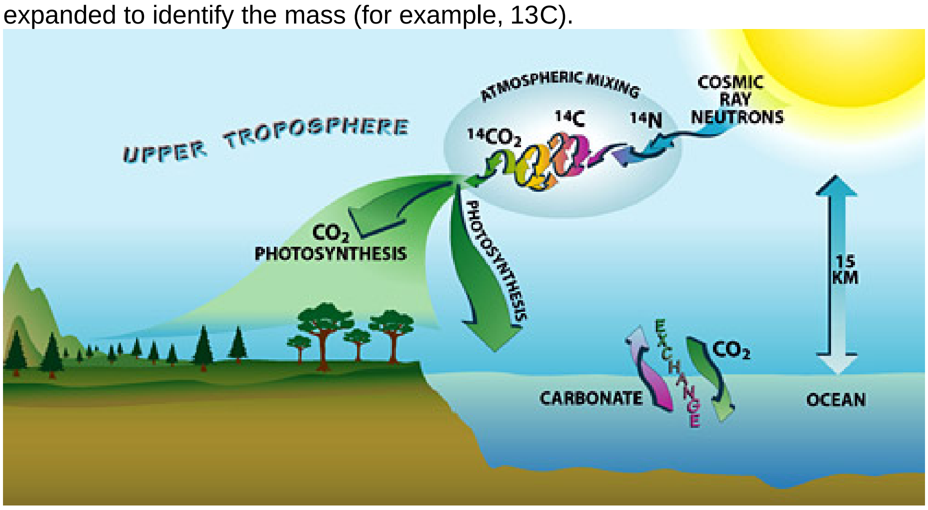
What is Carbon Dating?

Carbon is one of the chemical elements. Along with hydrogen, nitrogen, oxygen, phosphorus, and sulfur, carbon is a building block of biochemical molecules ranging from fats, proteins, and carbohydrates to active substances such as hormones. All carbon atoms have a nucleus containing six protons. Ninety-nine percent of these also contain six neutrons. The 6 proton + 6 neutron atoms are said to have a mass of 12 and are referred to as "carbon-12." The nuclei of the remaining one percent of carbon atoms contain not six but either seven or eight neutrons in addition to the standard six protons. They have masses of 13 and 14 respectively and are referred to as "carbon-13" and "carbon-14."

If two atoms have equal numbers of protons but differing numbers of neutrons, one is said to be an "isotope" of the other. Carbon-13 and carbon-14 are thus isotopes of carbon-12. Isotopes participate in the same chemical reactions but often at differing rates. When isotopes are to be designated specifically, the chemical symbol is expanded to identify the mass (for example, 13C).



(Illustration by Jayne Doucette, Woods Hole Oceanographic Institution)

Both 13C and 14C are present in nature. The former accounts for about 1% of all carbon. The abundance of 14C varies from (
trillion, a small, but measurable, level) down to zero. The highest abundances of 14C are found in atmospheric carbon dioxide
atmospheric carbon dioxide (for example, plants). Unlike 12C and 13C, 14C is not stable. As a result it is always undergoing n
the abundances of the other isotopes are unchanged. Carbon-14 is most abundant in atmospheric carbon dioxide because it is
collisions between nitrogen atoms and cosmic rays at the upper limits of the atmosphere.

The rate at which 14C decays is absolutely constant. Given any set of 14C atoms, half of them will decay in 5730 years. Since

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movement of carbon through food chains (from plants to animals to bacteria) all carbon in biomass at earth's surface contains
However, as soon as any carbon drops out of the cycle of biological processes - for example, through burial in mud or soil - the
decline. After 5730 years only half remains. After another 5730 years only a quarter remains. This process, which continues ur
of carbon dating.

A sample in which 14C is no longer detectable is said to be "radiocarbon dead." Fossil fuels provide a common example. They
initially contained atmospheric levels of 14C. But the transformation of sedimentary organic debris into oil or woody plants into
youngest deposits are radiocarbon dead.

The abundance of 14C in an organic molecule thus provides information about the source of its carbon. If 14C is present at atr
must derive from a recent plant product. The pathway from the plant to the molecule may have been indirect or lengthy, involvi
and biological processes. Levels of 14C are affected significantly only by the passage of time. If a molecule contains no detect
petrochemical feedstock or from some other ancient source. Intermediate levels of 14C can represent either mixtures of moder
that was fixed from the atmosphere less than 50,000 years ago.

Signals of this kind are often used by chemists studying natural environments. A hydrocarbon found in beach sediments, for ex
spill or from waxes produced by plants. If isotopic analyses show that the hydrocarbon contains 14C at atmospheric levels, it's
C, it's from an oil spill. If it contains some intermediate level, it's from a mixture of both sources.

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