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Carbon-14 and the Age of the Earth

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What is Carbon-14?

Carbon is an element that is required for life. All plants and animals contain carbon. Most of the carbon in the world is either Carbon-12 or Carbon-13 (^{12}C or ^{13}C), which are both stable, but a tiny fraction is ^{14}C, which is radioactive, releasing a weak beta particle. The radioactive half-life for this emission is 5,730 years. Since there's very little ^{13}C, we'll ignore it in this discussion of dating.

While a plant is alive, its growth cycle causes it to absorb CO_2 from the atmosphere, absorb sunlight, and undergo photosynthesis -- the carbon is used as food to cause the plant to grow, while the oxygen is released back into the atmosphere.

Animals (and humans) eat plants and meat (both of which contain carbon), and breathe the air, which contains a mixture of oxygen and carbon dioxide. They retain the carbon and oxygen, and exhale CO_2 as waste. In this way, both plants and animals are constantly exchanging carbon and oxygen with that in the atmosphere. While they are alive, their bodies contain the same fraction of the three carbon isotopes as does the atmosphere, but at death, respiration ceases and the exchange stops. Since ^{14}C constantly decays (with a 5,730-year half-life), the fraction of ^{14}C in a dead body is always diminishing. After 5,730 years, the fraction of ^{14}C in the remaining total carbon is only half as much as when the plant or animal was alive.

Where does the ^{14}C come from?

As cosmic rays come in from outer space, they interact with gas molecules in the upper atmosphere, knocking off neutrons. Some of these neutrons react with the Nitrogen-14 in the surrounding region, producing ^{14}C and a free proton.

$$^{14}N_7 + {}^{1}n_0 = => {}^{14}C_6 + {}^{1}p_1$$

The ^{14}C easily combines with nearby free oxygen, producing carbon dioxide ($^{14}CO_2$). Air circulation causes mixing, and the atmosphere contains this mixture, spreading it around the world.

When the radioactive ^{14}C decays, emitting an electron (beta particle), the reaction is like this:

$$^{14}C_6 - {}^{0}e_{-1} \Longrightarrow {}^{14}N_7$$

Radio-Dating with ^{14}C

In this short article, we can't go into much detail. However, the process can be described in fairly simple terms. The basic idea is to measure the ratio of ^{14}C / ^{12}C in the sample to be age-dated. This is then compared with the same ratio at the time of death of the sample material. Therein lies the biggest problem -- how does the laboratory operator know what that ratio was many thousands of years ago? No one knows this answer, so they assume that the atmosphere has always been like it was in 1950. But this is known to be wrong!

The Specific Production Rate (SPR) of ^{14}C is known to be 18.8 atoms per gram of total carbon per minute. The Specific Decay Rate (SDR) is known to be only 16.1 + / - 0.5 disintegrations per gram per minute. The difference between these two numbers shows that the buildup in the biosphere hasn't had time to catch up with production in the stratosphere. In other words, the earth's atmosphere must be less than some fifty thousand years old! This, in itself, is a strong evidence of creationist claims. But the ^{14}C establishment's response is that it's merely a problem not yet solved.

The usual procedure (today) is to use an Oxalic Acid standard which is synthesized by the National Bureau of Standards, and is carefully maintained and calibrated to represent the ^{14}C / ^{12}C ratio in the atmosphere as of A.D.1950. Ages are reported in "years BP," (before present), where "present" is by definition 1950. Laboratories can purchase secondary standards from the NBS, for use with their own equipment.

When this method was invented during the late 1940's, the radioactive beta emission from ^{14}C was measured by radioactive counting techniques. This required the sample being dated to contain at least 10 grams of carbon, and the sample was destroyed by the measurement. This limited the kinds of measurements that could be done. During the 1980's, a much better technique was developed. This is called "Accelerator Mass Spectrometry," and requires only milligrams of carbon. It increases the age range and accuracy of the dating, and is commonly used today.

But still, ^{14}C dating measurements are limited to samples thought to be less than perhaps 75,000 years old**, never for millions-of-years such as most of the rocks thought to be in the sub-surface parts of the Geologic Column.** Within this limitation, and with proper corrections, ^{14}C is probably the most accurate dating method available.

An Amazing ^{14}C Measurement

The Hawkesbury Sandstone formation, near Sydney, Australia, is a massive and spectacular mass of hard rock, often used for construction of buildings in Sydney. There are three principle layers of rock -- massive sandstone, sheet sandstone, and some thin mudstone. Although it is massive (7,700 square miles in area and up to 820 feet thick) it shows many of the features of deposition in fast-flowing waters. There are cross-beds, sloping at about 20^{o}, within the flat-lying strata. These were probably formed by huge sand-waves, swept by massive water flows. A number of lenses of mudstone contain many fossils, mostly of fish, sharks, and aquatic plants. Geologists have assigned it to the Middle Triassic 'age' (225 - 230 million years old), based on fossil content and the relative sequence of rock layers in the Sydney Basin. This "stratigraphic dating" is the technique most widely used by conventional geologists who believe in the long timescale of the Geologic Column.

The Bundanoon quarry found a finger-size piece of wood impregnated within the hard sandstone. Some Australian creationist scientists obtained part of this wood, and sent it to Geochron Lab in Boston for careful ^{14}C analysis. Contrary to usual practice, they didn't tell the lab where it had been found, or what 'age' they expected it to reveal. This was to prevent possible bias in the dating tests.

The lab applied normal procedures, treating it with hot dilute hydrochloric acid to remove all the carbonates, then with hot dilute caustic soda to remove any humic acids or other organic contaminents. The sample wood was found to contain measureable ^{14}C, and the final age was determined to be 33,720 +/- 430 years BP. This 'age' was after a ^{13}C correction had been applied.

What is the significance of this 'age'?

For creationists, it's quite a bit too old to conform to the Biblical chronology, but this discrepancy can be expected, and corrected for the errors in the assumption of the ancient ^{14}C / ^{12}C ratio, or differences in SPR and SDR (see previous page). This wood must have been moving along in the sand as it was swept by the Great Flood, then settled and enclosed in the hardening sand as it lithified. There's no way it could have later been put into a cavity in the hard sandstone.

The almost devastating significance for conventional geologists is the blow this 'age' strikes against the 225 - 230 million-year age assigned to the Triassic Hawkesbury Sandstone formation. Geochron Laboratory (and another lab) insisted that their methods had ensured that there was no contamination, and that the 'age' could be relied on. But that age is totally incompatible with conventional scientific beliefs. ***It's a very good evidence against the naturalistic uniformitarian ideas of earth's development, and a good argument that the Earth's atmosphere is young.***

Information for this article was taken primarily from the book "God at Ground Zero," by Curt Sewell, and the article "Dating Dilemma," by Andrew Snelling, in the June-August 1999 issue of "Creation ex nihilo."