



NewFields Note

Radiocarbon Applications in Forensics

Tracking ancient and modern carbon sources

NewFields Note: Technical information in a condensed, easily digestible format that is intended to promote environmental science education, knowledge transfer, and empowerment ... *one note at a time.*

Clients are often responsible for assessing or remediating carbon impacts.

Radiocarbon (^{14}C) isotopes are a useful tool to distinguish between ancient and modern carbon sources in the environment. Carbon has three isotopes: ^{12}C , ^{13}C , and ^{14}C . The stable carbon isotopes (^{12}C and ^{13}C) are useful tracers for determining different processes the carbon has experienced, such as photosynthesis or methane formation. Radiocarbon, the unstable carbon isotope, also has forensic value as it indicates the time when the carbon was removed from the atmosphere, i.e., the “age” of the carbon source. Radiocarbon is produced naturally in the upper atmosphere becomes oxidized to form $^{14}\text{CO}_2$, which mixes around the world and is (was) taken up by terrestrial and aquatic photosynthesizers in both the modern and ancient world.

Upon death of an organism the ^{14}C in its cells begins to decay. The half-life of radiocarbon is 5,735 years. After 10-half-lives, or ~57,000 years, there is too little radiocarbon left to be measured. This is called “radiocarbon dead”. Petroleum products, formed from ancient carbon millions of years ago, are radiocarbon dead with a $\Delta^{14}\text{C} = -1000\text{‰}$.

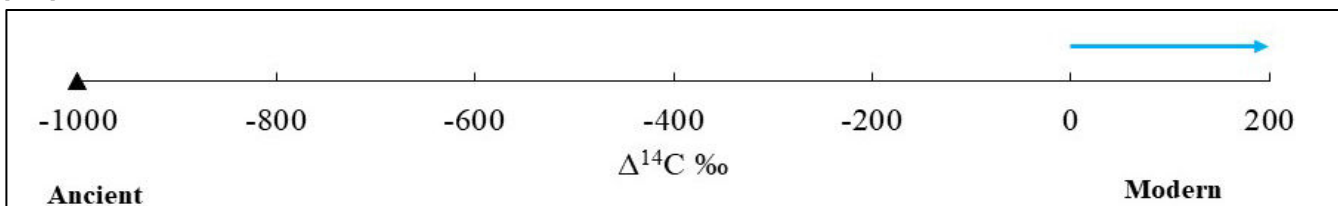
Atmospheric nuclear weapons testing, which ended in 1963, created a massive spike of atmospheric radiocarbon, reaching a $\Delta^{14}\text{C}$ signature over +700‰ that was tracked through global carbon pools. Since the early 60s, due to atmospheric CO_2 mixing with terrestrial and oceanic carbon pools and the burning of fossil fuels, the atmospheric $\Delta^{14}\text{C}$ today is ~ 0 ‰ or higher. **Measuring $\Delta^{14}\text{C}$ in organic materials in soils, sediments, and water can distinguish their “age”, i.e., ancient versus modern, and allocate the proportions derived from each.**

Radiocarbon Uses

- Distinguish between ancient and modern carbon sources
- Determine mixtures of carbon sources in various carbon pools

Carbon Sources

- **Ancient:** coal, crude oil and refined petroleum, natural gas, petroleum decay products
- **Modern:** terrestrial and aquatic photosynthetic production, landfill and sewer gas, modern organic detritus



Radiocarbon mixing line showing the overall range of possible radiocarbon signatures from ancient to modern sources. Mixing between these endmembers would plot along the line depending on how much of each component contributed to the signature.

For additional information, please contact your NewFields Technical Lead. Or send us an email at Science_Info@newfields.com!

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