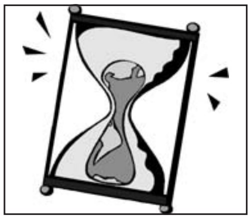

Communication

Residual Radiocarbon in an Old-Earth Scenario

Robert Rogland

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A Challenge to Conventional Geological Dates

In 1997, seven scientists from three major creationist organizations initiated a research initiative they styled Radioisotopes and the Age of the Earth (RATE). The RATE initiative focused on interpreting the geological evidence for large amounts of nuclear decay according to a young earth model. Several of the RATE scientists were convinced that episodes of greatly accelerated nuclear decay rates had occurred within thousands of years, only a few thousand years ago.[1]

In 2003 Baumgardner, et al. published a paper, "Measurable ^{14}C in Fossilized Organic Materials: Confirming the Young Earth Creation-Flood Model.[2] The RATE group ^{14}C paper analyzes data from 90 studies (tabulated by Giem[3]) which report residual radiocarbon in organic samples taken from various parts of the geological column. The abstract of the paper summarizes its findings and conclusions:

> Given the short ^{14}C half life of 5730 years, organic materials purportedly older than 250,000 years, corresponding to 43.6 half-lives, should contain absolutely no detectable ^{14}C … An astonishing discovery made over the past twenty years is that, almost without exception, when tested by highly sensitive accelerator mass spectrometer (AMS) methods, organic samples from every portion of the Phanerozoic record show detectable amounts of ^{14}C! $^{14}C/C$ ratios from all but the youngest Phanerozoic samples appear to be clustered in the range 0.1–0.5 pmc (percent modern carbon), regardless of geological "age." A straightforward conclusion that can be drawn from these observations is that all but the very youngest Phanerozoic organic material was buried contemporaneously much less than 250,000 years ago. This is consistent with the biblical account of a global Flood that destroyed most of the air breathing life on the planet in a single brief cataclysm only a few thousand years ago.

Accounting for Residual Radiocarbon in the Conventional Geological Time Frame

As an old earth creationist (OEC), I believe that the data cited by the RATE group ^{14}C paper can be accounted for in an old earth framework, i.e., the conventional geological time frame accepted by the vast majority of geologists.

RATE scientists have anticipated and endeavored to refute several explanations of residual radiocarbon consistent with the conventional geological time scale. These are: the creation of ^{14}C by nuclear synthesis *in situ* after the fossil remains were deposited, contamination of the samples with ^{14}C from elsewhere (in the ground or during sample preparation), and measurement error.[4] Although I would not be surprised if these explanations proved to be correct, I do not intend to argue for them here. Instead, for the sake of argument, I assume that the data represent genuine residual radiocarbon. But the conclusions I draw are very different from those of Baumgardner, et al. My analysis follows.

The equation for exponential decay with an invariant rate constant is well known: $N = N_0 e^{-kt}$, where N = the quantity of material remaining after elapsed time = t, k = the rate constant , and N_0 = the quantity of material present when the organic sample was

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deposited (i.e., when t = 0). If we follow Baumgardner and Giem and arbitrarily let N_0 = 1, then N = the decimal equivalent of the pmc. The equation for exponential decay becomes

$$N = e^{-kt}$$

For the sake of argument, let us agree with Baumgardner, et al. that k is *not* constant, but rather time-dependent. However, rather than supposing that there was a burst of accelerated nuclear decay at the time of the Fall or the Flood, I hypothesize that k increases in a regular way with time: Let $k = At^B$, where A and B are constants. Substituting At^B for k we have:

$$N = e^{-At^{1+B}}$$

The RATE group ^{14}C paper presents two frequency distributions of $^{14}C/C$ ratios drawn from the 90 studies summarized by Giem, one for non-biological Precambrian samples and one for biological Phanerozoic samples. The authors report that the mean $^{14}C/C$ ratio for the Precambrian non-biogenic samples is .062 pmc, with a standard deviation of .034 pmc. They do not report the mean age of the Precambrian samples, but let's suppose it is 2.5 billion years, the midpoint, more or less, of Precambrian time. The authors also report that the mean $^{14}C/C$ ratio for the Phanerozoic biogenic samples is .29 pmc, with a standard deviation of .162 pmc. Let's suppose the mean age of the Phanerozoic samples is 275 million years, the midpoint, more or less, of Phanerozoic time.

I first picked the mean Precambrian and Phanerozoic $^{14}C/C$ ratios cited by Baumgardner, et al. to solve for A and B, viz., an "average" Precambrian sample with N = .062 pmc and t arbitrarily set at 2.5×10^9 years ago (ya) and an "average" Phanerozoic sample with N = .29 pmc and t arbitrarily set at 2.75×10^8 ya.[5] Straightforward algebra gives $A = 1.00 \times 10^{-3}$ and 1 + B = .362. The equation for N then becomes:

$$N = e^{-\left(1.00\times10^{-3}\right)t^{.362}}$$

I then calculated N for other data reported by Baumgardner, et al., as well as for a sample just 5730 years old (i.e., one half-life old), and compared them with the observed values. Here are the results:

sample	*t*	N_{obs}	N_{cal}
Precambrian graphite	2×10^9 ya	.04	.10
Pennsylvanian coal (average of 4 samples)	3×10^8	.27	.31
Cretaceous coal (average of 3 samples)	1×10^8	.21	.46
Eocene coal (average of 3 samples)	4.5×10^7	.26	.55
Pleistocene foraminifera (average of 115 samples)	4.6×10^5	.23	.89
Hypothetical sample with $t_{½}$ = 1	5730	.50	.98

Here, as in the initial calculation of A and B, the times represent the midpoints of the particular periods, eras, or epochs that the samples represent. The equation with a time-dependent decay constant yields expected values of N well within an order of magnitude of the observed values. The average N_{calc} is almost twice the average N_{obs}, promising but not impressive.

We can achieve even better agreement between observed and predicted values of N with a modification of the calculation. Each of Baumgardner's frequency distributions had a pronounced mode: in the case of the Precambrian, the modal pmc, 0.04, represented 40% of the samples, and in the case of the Phanerozoic, the modal pmc, 0.16, represented nearly a quarter of the samples. If we take the modes rather than the means of Baumgardner's frequency distributions to calculate A and B, using the same values of t, the equation for N becomes

$$N = e^{-\left(1.3\times10^{-2}\right)t^{.255}}$$

And the results of comparing N_{obs} and N_{calc} are:

sample	*t*	N_{obs}	N_{calc}
Precambrian graphite	2×10^9 ya	.04	.05
Pennsylvanian coal (average of 4 samples)	3×10^8	.27	.16
Cretaceous coal (average of 3 samples)	1×10^8	.21	.24
Eocene coal (average of 3 samples)	4.5×10^7	.26	.31
Pleistocene foraminifera (average of 115 samples)	4.6×10^5	.23	.70
Hypothetical sample with $t_{½}$	5730	.50	.88

The results here are better: on average, N_{calc} is about 50% greater than N_{obs}.

Whether we use the mean or the modal values of the frequency distributions given by Baumgardner, et al. to derive the constants for the equation where k is time dependent, calculated values for residual radiocarbon agree tolerably well with the observed values considering the uncertainties in the values of N_{obs} and t used to derive the constants A and B. The standard deviations of the two frequency distributions are, in both cases, over 50% of the mean values; moreover, the choice of t representing the middle of the Precambrian and Phanerozoic periods, though reasonable, was entirely arbitrary.[6]

Conclusions

In the light of the numerical uncertainties in the values of N and t used to calculate values of A and B, I consider the results of my calculations satisfactory for my purposes. Starting with the general idea that decay rates might be increasing over time, we find that a simple hypothesis, viz., that $k = At^B$, allows us to demonstrate that residual radiocarbon should be present in even the oldest materials containing carbon; moreover, we find that the calculated values of pmc agree tolerably well with the observed values.

Let me stress that I am *not* proposing at this time that nuclear decay rates actually do increase over time. Indeed, I put little stock in the hypothesis underlying the above analysis. The chief difficulty, in my opinion, is that the accepted quantum mechanical understanding of radioactive decay would have to be radically revised if the hypothesis were true—a difficulty for Baumgardner, too, though he does not seem to recognize it (his paper contains no mention of it). I proposed the hypothesis of increasing nuclear decay rates simply to show that one can account for residual radiocarbon in "radioactively dead" samples within an old earth framework if in fact such residual radiocarbon really exists. (On the other hand, if the radiocarbon in old samples cannot be accounted for by contamination, measurement error, or ^{14}C synthesis *in situ*, i.e., if that radiocarbon is truly residual, then the hypothesis of increasing nuclear decay rates is worth a more serious look.) ▣

Notes

[1] *Creation Research Society Quarterly Journal* 41, no. 1 (June 2004).

[2] J. Baumgardner, et al., "Measurable ^{14}C in Fossilized Organic Materials: Confirming the Young Earth Creation-Flood Model," in *Proceedings of the Fifth International Conference on Creationism,* R. L. Ivey, Jr., ed. (Pittsburgh, PA: Creation Science Fellowship, 2003), 127–42.

[3] P. Giem, "Carbon-14 Content of Fossil Carbon," *Origins* 51 (2001): 6–30.

[4] Ibid.

[5] The values of t correspond to the midpoints of the Precambrian and Phanerozoic eras respectively.

[6] It is perhaps worth noting that the frequency distributions presented by Baumgardner, et al. are not symmetrical. Both are skewed right, toward higher pmc values.