GENERAL SCIENCE NOTES

THE UPPER LIMIT OF C-14 AGE?

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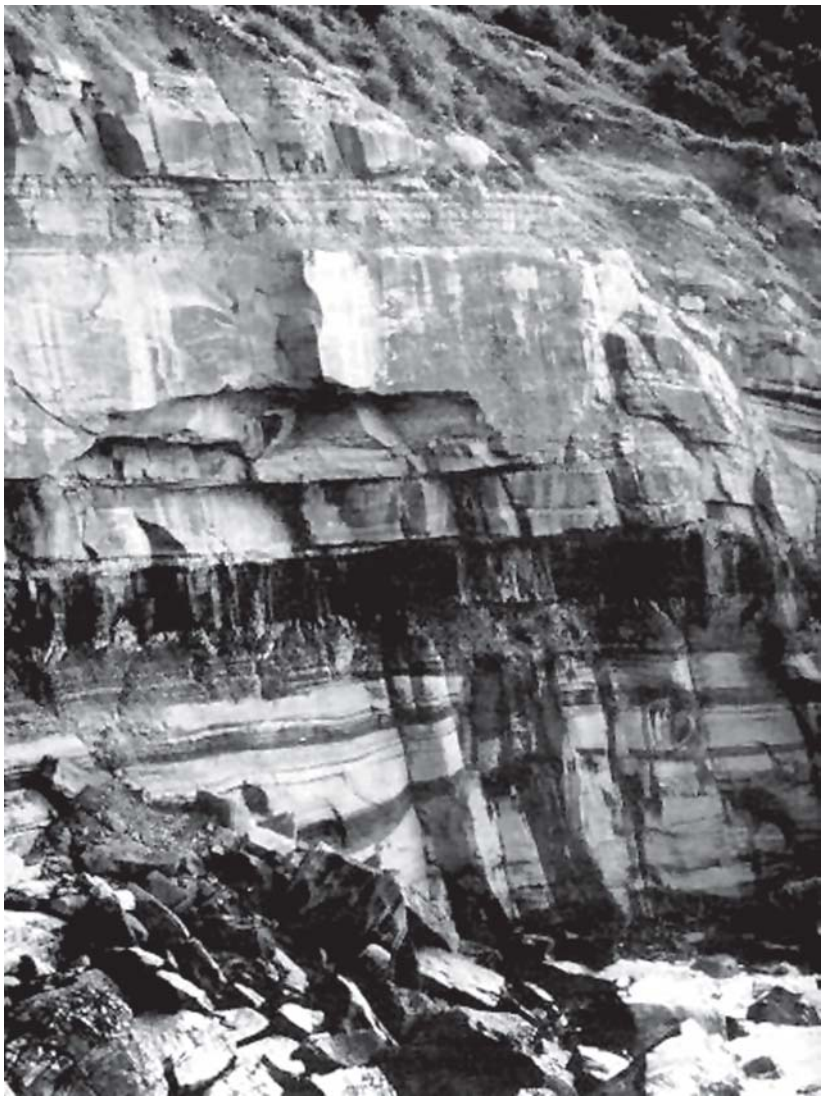
WHAT THIS ARTICLE IS ABOUT

Some recent radiocarbon dates derived from sources assumed to be geologically very old give dates in the 40,000-year range. These relatively young dates may reflect the concentration of Carbon-14 in the antediluvian atmosphere. Implications related to the antediluvian Carbon-14 production rate and the size of the biosphere are considered.

The development of the Accelerator Mass Spectrometry (AMS) technique for measurement of radiocarbon (C-14) activity has renewed interest in the C-14 activity levels of "infinite" age samples. Infinite age samples are those considered too old to be dated by radiocarbon techniques. Over a period of time equal to ten half-lives, the activity of an isolated radioactive specimen will diminish by a factor of 2^{10} or 1024. For 5730-year half-life C-14 this time period is 57,300 years. The sensitivity of the AMS technique is such that samples from a biosphere such as that which is now characteristic of planet Earth should exhibit detectable residual C-14 activity into the 60th millennium after isolation (i.e., over about 12 C-14 half-lives). As far as this technique is concerned, samples with a real-time age greater than 70,000 years would be in the "infinite age" classification.

"Infinite age" samples such as anthracite coal from deep mines in Carboniferous geologic formations (270-350 millions years conventional age assignment) have yielded AMS C-14 ages in the 40,000-year range at laboratories in Europe, Canada, and the U.S.A. (Brown et al. 1983; Jull et al. 1986; Beukens, Gurfinkel, & Lee 1986; Grootes et al. 1986; Nelson et al. 1986; and Bonani et al. 1986). The ready explanation for this unexpected result is contamination from the contemporary biosphere. *Radiocarbon* [Vol. 29, No. 3 (1987)] contains reports of two attempts to determine the limits of such contamination, one at Simon Frazer University in British Columbia (Vogel, Nelson & Southon 1987), and the other at the University of Toronto in Ontario (Gurfinkel 1987).

The Simon Frazer University study indicates that machine background and sample preparation procedures do introduce uncertainty in C-14 age



Coal seam (black layer) from the Permian deposits along the east coast of Australia south of Sydney. See this article regarding the unexpected presence of Carbon-14 in such seams.

determinations on samples of anthracite smaller than about 400 micrograms. Forty-three samples of anthracite from Pennsylvania, U.S.A., that had been given the best-known pretreatment to remove contamination by modern carbon, and ranged in size from 0.5 to 20 milligrams, yielded a 43,000-year C-14 age, regardless of sample size. According to the authors' Table 1, less than 30% of the C-14 activity associated with this 43,000-year age limit could be assigned to machine background and contamination during sample preparation.

The University of Toronto investigator (Gurfinkel 1987) stated that "One of the major problems encountered in this study was the apparent presence of ^{14}C contamination in samples that were assumed dead....it could not be assumed that even the oldest samples were necessarily ^{14}C free" (p 342). Her meticulous investigation using graphite, calcite, limestone, and anthracite samples concluded that "infinite age" samples should be expected to have "contamination" up to as great as that represented by a conventional 43,000-year C-14 age, similar to the results obtained by the Simon Frazer University group.

These findings are of particular interest to individuals who are looking for models that relate the historical data in the Bible to modern scientific observations. Chapters 6-8 of the book of Genesis describe a universal catastrophe that reasonably may be expected to have produced most of the coal and shell fossil material, much of the limestone, and some of the calcite accessible today. Since terrestrial C-14 is produced almost entirely by the interaction of cosmic rays with atmospheric nitrogen, C-14 should have been present in the antediluvian biosphere as well as in the immediate postdiluvian and the contemporary biosphere.

The C-14 production rate (R) and the active biosphere carbon inventory (I) may not have been the same in antediluvian time as at present. Consequently the equilibrium activity level (A) which is proportional to the ratio R/I may not have been the same then as that which characterizes the modern environment (13.6 spontaneous C-14 disintegrations per minute per gram of carbon).

The precise date for the Deluge of Genesis 6-8 cannot be determined because of variations in the source documents (Samaritan, Septuagint, and Masoretic manuscripts). The best we can affirm is that the source material specifies a universal destruction and reorganization of planet Earth's surface most probably sometime within the range 2500-3500 years BC (Brown 1987). Accordingly, organic material buried in this catastrophe would now have a real-time age since burial in the range 4500-5500 years,

and should now exhibit about 55% of the C-14 activity level that characterized the antediluvian world. Any C-14 age in excess of about 5000 years for such material could be attributed to a lower R/I ratio than that which characterizes the modern biosphere — a lower C-14 production rate (R), and/or a larger active biosphere carbon inventory (I).

According to the two research reports reviewed here, carbon from the antediluvian biosphere should now have a radiocarbon age of at lest 43,000 years. Allowing 5000 years since the Deluge leaves 38,000 years for the radiocarbon age characteristic of this material at the time of the Deluge. A 38,000-year C-14 age is equivalent to a C-14 specific activity 1.01% of the contemporary reference standard. This could indicate C-14 production at 1/99 of the present production rate, an active biosphere carbon inventory 99 times greater than that of the modern world, or any combination between these extremes as required for an R/I ratio of 1/99.

If the sample preparation procedures introduce unidentifiable contamination by modern carbon, or do not remove all contamination that may be developed naturally, the radiocarbon age indicated for material at the time of the Deluge would be greater than 38,000 years. With a contamination effect as great as 30%, as possibly indicated by the Table 1 data supplied by the Simon Frazer University group, the C-14 age of Deluge deposits would be increased from 43,000 to about 46,000, or about 41,000 at the time of the Deluge. Such increase would lower the R/I ratio relative to that of the modern world to about $^{1}/_{143}$.

The approximate equivalence of C-14 age with real-time age over at least the last 3500 years indicates that C-14 concentrations in the upper biosphere (all but the deep ocean and ocean sediment) have been essentially at R/I equilibrium levels over this period of time. If for some reason C-14 levels had not reached equilibrium by the time of the Deluge, the antediluvian biosphere could be modeled on the basis of an R/I ratio higher than the $^{1}/_{99}$-$^{1}/_{143}$ range [antediluvian biosphere carbon inventory lower than 99-143 times the current value, assuming the C-14 generation rate (R) was the same for both epochs].

Individuals who wish to develop a model for the carbon content of the antediluvian biosphere within the constraints of the available data have considerable latitude. Without exceeding the constraints provided by paleomagnetic intensity data, the C-14 generation rate might be postulated to have been as low as $^{1}/_{4}$ the modern value as a consequence of a higher geomagnetic field intensity that reduced the hazard of damage to organisms by cosmic radiation. The active carbon exchange inventory in the

antediluvian biosphere then needs to be postulated in the range of only 25-40 times the present value, rather than 99-143. Since the total "fossil" organic carbon inventory on planet Earth is estimated to be roughly 250 times the carbon inventory in the present carbon exchange system (Olson 1985; compare 175-fold in Rubey 1951), and most of Earth's surface is now desert (combined marine, arctic, temperate, and tropical deserts), an antediluvian world that is consistent with both modern C-14 data and biblical chronological data does not appear unreasonable.

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