REACTIONS

Readers are invited to submit their reactions to the articles in our journal. Please address contributions to: ORIGINS, Geoscience Research Institute, 11060 Campus St., Loma Linda, California 92350 USA.

RE: SMITH: QUESTIONS ON THE METHODOLOGY OF GEOLOGY (ORIGINS 6:85-87)

In the middle of Dr. Smith's review of Kitts' book are two paragraphs about flood geology, sort of wedged into the discussion of the book. These two paragraphs raise the question whether flood geologists can define a methodology for the study of a miraculous event. The answer to that question is neither obscure nor complicated.

If we ask the question "Did God cause a worldwide flood?" we have asked a question that science cannot answer. Many scientists assume that there has never been any supernatural invention in earth history, but that assumption is really just an untested hypothesis, not a fact that has been demonstrated or ever can be demonstrated by scientific data. Not only can science never prove that God *has not* influenced our geologic history, but it is equally impossible for science to prove that He *has* influenced our geologic history. These are philosophical questions of ultimate causation that we cannot test by any conceivable experiment. However, there are valid, testable questions that a flood geologist can ask — testable hypotheses that can be drawn up.

The approach of the flood geologist is to propose that at some time in the past there was a disturbance in the earth's crust that temporarily disrupted the normal relationships between land and water bodies, initiating a period of rapid geologic activity on a worldwide scale, and this period of rapid erosion and sedimentation produced a significant portion of the geologic column. According to this hypothesis the geologic and geophysical processes occurring during that event produced the characteristics of the rock formations formed at that time, including the distribution of fossils and the orderly arrangement of the levels of radioactivity in those minerals used in radiometric dating.

Any alert person would probably guess that the idea for this theory came from the book of Genesis, but where it came from is beside the point. A flood theory expressed in this form is a simple descriptive statement and says nothing about the untestable question of whether God was involved in initiating this geologic event. It does not attempt to explain any process or event that may have operated outside the known laws of chemistry or physics. This descriptive theory can be used as a basis for defining specific hypotheses concerning the sedimentary processes and the amount of time involved in depositing individual formations, or the processes that produced various other geologic features. These hypotheses can be tested in the same way that any geologist tests his hypotheses.

Two geologists could be doing research on the same rock formation, perhaps one of the Paleozoic formations in the Grand Canyon. One geologist believes that the formation (like other geologic formations) must have had a long time — thousands or millions of years — in which to be deposited. The other geologist believes that the formation must have been deposited far more quickly than that. They both look for the same general type of data as they study the rocks. Each one must analyze the data that he finds, as well as other published data, and interpret what they mean. When they disagree, each geologist will analyze the other's work and his own work, and try to determine what additional data are needed to clarify the issue. If both are doing good work, each one will then publish his findings in a scientific journal so that other scientists will benefit from their work. In time, as more data accumulate, hopefully the conflict will be resolved, and the total body of data will clearly favor one explanation — it will point to rapid deposition or very slow deposition of the formation.

Both flood geologists and other geologists believe that if we are completely fair with the data, *eventually* the data will tell us which theory is true (*unless* we are not able to collect the types of data that can give us the information without being able to go back in time and directly observe what happened in the past). Both types of geologists will also use the same observational and experimental procedures in their research. There is only one real difference in the research of flood geologists and other geologists. The flood geologist believes that when all, or at least a significant portion, of the data are in, they will indicate that much of the geologic column was deposited in a short time. A conventional geologist approaches his research with the conscious or unconscious belief that when the data are all or mostly in, the data will indicate that all of the geologic column was deposited very slowly, or in rapid spurts with long periods of time in between. The flood geologist notes with interest the definite trend toward catastrophism that is evident in geology in recent years, but judging from the history of other fields of science, it could take many decades, or hundreds of years, before there are adequate data to fully resolve the issue.

The suggestion in Dr. Smith's review that flood geologists are methodologically uniformitarian (i.e., they assume that natural laws have always been the same) is definitely correct. Furthermore, that is not an inconsistency in flood geology methodology; it is simply being realistic and recognizing that science can study only those aspects of the flood process that have followed known natural laws. That is why we can study the erosional and depositional processes occurring during the flood, but not any "miraculous" processes used to initiate the flood.

As I mentioned earlier, science cannot demonstrate whether God was or was not involved in influencing our geologic history. Even if research eventually demonstrates that the best explanation for the geologic column is rapid sedimentation of most of the column in one short spurt of geologic activity,

that would not prove that God caused a flood. But it would demonstrate that it is perfectly reasonable to believe the flood story if our confidence in Scripture leads us to do so. God never promised us proof; He only promised us reasonable evidence on which to base our faith.

There is another important aspect of this topic that cannot be experimentally studied but can only be dealt with on a philosophical level. The scientist understands the universe as a complex physical system that functions according to natural laws. Many scientists would insist that for God to miraculously cause a worldwide flood is contrary to natural law, and thus unscientific. That would be a reasonable assertion only if we are willing to believe that science has discovered all natural laws; i.e., that there could not be any undiscovered laws which God could use to perform His "miracles." To make that claim is hardly even rational! There is much about the universe that we do not know. Another aspect of this same issue can be best explained with an example. I can hold a book in the air and drop it, and the law of gravity dictates that it will fall to the floor. However, since I am a mobile, reasoning being, I can decide to stick out my hand under the falling book. I have interjected an outside force into the system and changed the course of events, but I have not broken any laws. God could decide to interject an outside force into Earth's balanced geologic systems and change the course of events to bring on a flood, without breaking any laws of nature. One has only to be willing to admit that such a powerful and knowledgeable Being could exist in the universe — a Being who understands all natural law, and, in fact, made all natural law.

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RE: BROWN: THE INTERPRETATION OF C-14 DATES (ORIGINS 6:30-44)

Brown's article provides a long overdue attempt to deal with the geochemical mass balance problem implicit in flood geology modeling of the C-14 dating method. Brown mentions in passing the pioneering work 17 years ago of Henry Pearl in this area. Pearl covers much the same ground as Brown does. Brown goes beyond Pearl in estimating quantitative adjustments to the "apparent" preflood C-14 ages, caused by possible differences between preflood and contemporary environments. However, Pearl attempts to deal quantitatively with the problem of the apparent orders of magnitude greater preflood carbon exchange reservoir, a problem that Brown superficially passes over in his short paper.

Brown's use of the term "biosphere carbon inventory" may lead to confusion in some readers' minds. The term "active carbon exchange reservoir" would be more appropriate and is really what he means. More than 90% of the contemporary "biosphere" carbon in Brown's Table 1 is actually inorganic CO_2 and dissolved carbonate and bicarbonate, not organic carbon.

It should be emphasized that Brown's postulated 130× increase in the preflood carbon exchange reservoir must largely be sought in a much larger increase in the preflood organic carbon reservoir. Although reasonable limits on the possible size of a preflood biosphere may be a matter of conjecture, the simple chemical principles governing the size of the inorganic carbon exchange reservoir are well known and rule out a large increase over the present inorganic exchange reservoir listed in Brown's Table 1 (35.83×10^{12} metric tons). The primary limitation is the low solubility of carbonate minerals under environmental conditions suitable for most living organisms. Making some rough calculations, if the acidity of the oceans were increased 10× (1 pH unit) the total inorganic exchange reservoir would be increased to about 210×10^{12} metric tons, or less than six times the present inorganic carbon exchange reservoir. This is 12.5 times less than the figure adopted by Brown in Table 3 for precipitated carbonates. Even this small increase is questionable unless one can postulate a mechanism for maintaining this increased acidity in a preflood ocean. The problem is compounded if we adopt the common picture of greatly reduced preflood ocean areas and volumes.

Given the above limitation on increases in the inorganic exchange reservoir, the required increase in the active organic carbon reservoir is nearly 2000 times the present biospheric carbon inventory. Until some plausible model is presented for such a huge increase in the antediluvian organic carbon exchange reservoir, Brown's conclusion that "these considerations ... provide *justification for confidence* that C-14 age data for time prior to approximately 3500 B.P. are associated with a transition between the pre-biblical-flood biosphere and the contemporary biosphere" should be judged somewhat premature. In the meantime, Brown's straightforward statement of the problem provides much material for student research projects and master's theses for our new geology program at Loma Linda University.

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BROWN'S REPLY

Confusion regarding the term "biosphere carbon inventory" may be avoided by making specific that whatever term one may use for the concept, it is clearly understood to designate the active carbon inventory in the region of the planet that supports organisms.

Although the $^{14}C/^{12}C$ ratio in the surface layer of the ocean is typically about 5% below that in air, freshwater, soil surface, and the organisms which populate them, for the purposes of the treatment in ORIGINS 6:30-44, it is convenient and satisfactory to treat these four regions as one subregion of the general biosphere, designated "upper biosphere" in the treatment cited. The active carbon exchange reservoir, to use Dr. Barnes' choice of terminology, in this subregion is reliably estimated to be 4.03×10^{12} metric tons (Table 1, Item 9).

Air and water contain 37.2% of this inventory in inorganic form; living and dead organic material represent the remaining 62.8%, 60.6% of which is associated with land and 39.4% is in the ocean (calculations from data in Table 1).

Assuming that flood sediments were formed about 5000 real time years ago, and that at their initial formation these sediments had a $^{14}C/^{12}C$ ratio no greater than the minimum detectable by current conventional gas or scintillation counting techniques, requires that 45,000-50,000 years of ^{14}C age be accounted for on some basis other than that given by a simplistic uniform conditions model, as discussed in ORIGINS 6:30-44. This range of ^{14}C age represents 7.85-8.73 half-lives for ^{14}C. The reduction in $^{14}C/^{12}C$ ratio over this half-life range is in the range 231-425 ($2^{7.85}$ -$2^{8.73}$). For the task at hand one can postulate that before the flood the ^{14}C production rate in the atmosphere was *less* in this ratio, the upper biosphere carbon inventory (active carbon exchange reservoir in the upper biosphere) was *greater* in this ratio, or any appropriate combination of intermediate factors for lower ^{14}C production and greater inventory. In the following discussion the "upper limit" factor 425 will be used, recognizing that the true situation might be approximately twice as easy (231 factor) to accommodate.

We can speculate that the CO_2 concentration in the preflood atmosphere was near 1%, approximately 20 times its contemporary value, since plants generally exhibit more vigorous growth as CO_2 levels are increased up to this level, and the atmosphere becomes toxic at higher levels. It may be assumed that the carbon concentration in the water components of the upper biosphere, being in contact with the atmosphere, would be identified with a similar increase. Accordingly the factor F by which living and dead organic material must be increased to secure a total upper biosphere carbon inventory increase by a factor of 425 is given by

$$0.372 \times 20 + 0.628 \times F = 425,$$

from which F = 665.

To model a preflood biosphere that might meet these requirements, one can postulate a 665-fold greater number of contemporary-sized plants and animals, worldwide total, assuming a constant ratio of living to dead organic material; or one can postulate a net 665-fold increase in the volume of the average individual organism. A 665-fold increase in volume is associated with an 8.71-fold ($\sqrt[3]{665}$) increase in lineal size. [Recall 30-inch wingspan of fossil dragonflies, the size of fossil *Equisetum*, etc.]. Doubling the average lineal size of organisms would require only an 83-fold increase in their numbers to provide a 665-fold increase in biomass.

I know of no objective basis for confidence that a particular model for the preflood biomass, land/water surface ratio, or ^{14}C production rate is "correct," but the development presented in this note seems to provide justification for confidence that models can be developed which are appropriate and also

contribute to an understanding of ^{14}C age data that is consistent with the chronological witness of Scripture.

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P.S. For the benefit of the students who may wish to look more closely into the modeling suggested in this note, I will append a tabulation of calculations I have made from data given in Table 1 of the paper by G.M. Woodwell et al., Science 199:141-146 (1978).

Ecosystem Type	% of Present World Surface Area, 510×10^6 Km^2	Present Average Plant Carbon Content in 10^3 Metric Tons per Km^2
Tropical rain forest	3.33	20.2
Tropical seasonal forest	1.47	15.6
Temperate evergreen forest	0.98	15.8
Temperate deciduous forest	1.37	13.6
Boreal forest	2.35	9.0
Woodland & shrubland	1.67	2.6
Savanna	2.94	1.8
Temperate grassland	1.76	0.70
Tundra & Alpine meadow	1.57	0.29
Desert scrub	3.53	0.33
Rock, ice & sand	4.71	0.008
Cultivated land	2.75	0.45
Swamp & marsh	0.39	6.7
Lake & stream	0.39	0.01
TOTAL CONTINENTAL	29.2	5.55
Open ocean	65.1	0.001
Upwelling zones	0.08	0.01
Continental shelf	5.2	0.005
Algal bed & reef	0.12	0.90
Estuaries	0.27	0.45
TOTAL MARINE	70.8	0.005
GLOBAL TOTAL	100	