Factors Affecting the Fluctuation of ^{14}C Dating

By: Arnold Mendez

The Importance of ^{14}C Dates From an Evolutionary Perspective

Carbon dating, sometimes called Carbon 14 and abbreviated—^{14}C, has been used to date many fossils. It is used to date objects that contain carbon atoms, specifically the radioactive isotope of carbon. This means that carbon dating is used to date formerly living thing. These can include, but it is not limited to, wood, charcoal, animal and human tissue, non-mineralized bones, shells, or any other substance that was once living. It has a limited dating range of 100 years-70,000 years. For older material potassium-argon dating is usually used.

Carbon dating has been used to date the recent history of man. Neanderthal fossils, *Homo erectus* fossils, and archaic modern human fossils and artifacts (1) have all been dated by carbon dating (fig. 1). Many of these carbon dates imply that modern men have existed for at least 70,000 years. These dates are then used to establish the various later cultural periods that supposedly show that man has evolved.

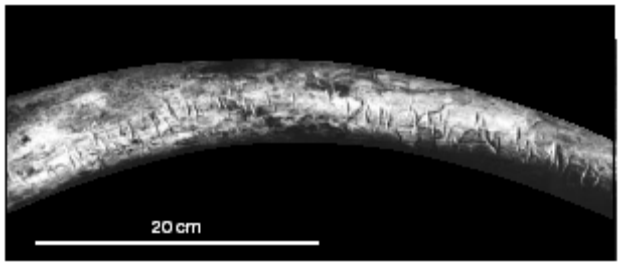

Figure 1. Mammoth tusk with grooves cut by humans. This find has been ^{14}C dated to 36,000 years before the present.

Carbon dating has been used to support the idea that the relatively recent ages of a few thousand years implied in the Biblical book of Genesis is incorrect. All evolutionists and many compromising Christians believe science, through carbon dating, shows men actually existed for hundreds of thousands of years, since man's recent past stretches back to a time period much longer than the time calculated from genealogical records of the Bible. The following quote from a university geology textbook is typical.

> Radiocarbon dating tells us that Neanderthals vanished from eastern Europe about 40,000 years ago and from western Europe perhaps 5000 years later. At this time, the Cro-Magnon people, who were undisputed members of the species *Homo sapiens* and were anatomically almost identical to modern humans, spread throughout Europe. The fact that Cro-Magnon suddenly replaced Neanderthals in Europe suggests that the two did not interbreed successfully and thus may well have been distinct species. (2)

Using carbon dating as a foundation the author establishes several points including the time of the extinction of Neanderthal man. These dating scenarios then seem to indicate that Neanderthal man is another species of man as compared to anatomically modern Cro-Magnon man. Such is the power of carbon dating in the manipulation of the data, which concerns early man. Either carbon dating is correct and the genealogical records in Genesis is incorrect or the Genesis record is correct and carbon dating is incorrect—since there is so much disagreement they both can not be correct!

The purpose of this paper is to show that carbon dating is based on many assumptions that are not correct. It can be shown that the production of atmospheric carbon-14 is capable of large-

scale variances. When these assumptions and production variances are examined they reveal that the use of carbon dating has many systemic problems that invalidates the use of carbon dating for dates greater than a few thousand years. Although carbon dating has worthwhile uses for dating recent material it is wholly inadequate for older material

Production of ^{14}C

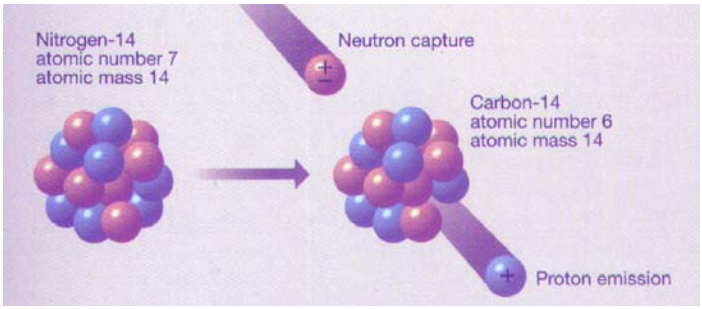

Figure 2. Carbon-14 is produced when a nitrogen atoms captures a neutron and emits a proton.

Carbon-14 is continuously produced in the upper atmosphere. This production is caused by the interaction of cosmic rays with nitrogen atoms (3). Solar flares or supernova explosions produce cosmic rays. These rays, which are composed of protons, alpha particles, neutrons, and electrons, enter the atmosphere traveling at high velocities; some approach the speed of light moving at 186,000 miles per second.

These high-speed rays strike the gases in the upper atmosphere. These gases are composed of nitrogen and oxygen atoms. After striking these gases secondary rays of slower moving neutrons are then produced. These slower moving neutrons then interact with additional nitrogen atoms (fig. 2). The nitrogen atom has an atomic weight of 14 (^{14}N), it has seven protons and seven neutrons. When this nitrogen atom collides with a slow moving secondary neutron it ejects a proton and absorbs a nucleus. The nitrogen is converted into a Carbon-14 atom. This newly created radioactive carbon atoms has six protons and eight neutrons and has an atomic weight of fourteen, hence the designation carbon-14.

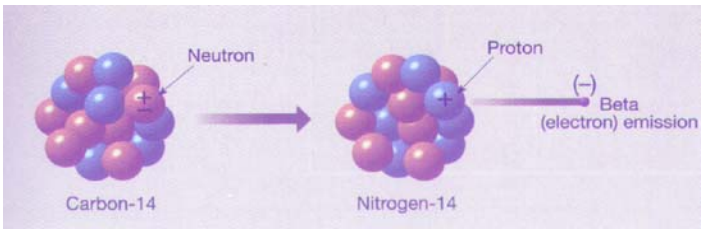

Figure 3. Carbon-14 atoms decays when an electron is emitted. This causes a neutron to be converted into a proton thus forming a Nitrogen atom.

In approximately 5730 years the carbon-14 atoms decays back into nitrogen-14 (fig. 3). This occurs because the carbon-14 atom is radioactive and unstable. It eventually emits an electron also know as a beta particle, which is negatively charge. Since a neutron is made up of an electron and a proton which each have opposite charges, when the electron is emitted the neutron is converted into a proton, which is positively charged. This increases the number of protons to seven and decreases the number of neutrons to seven—Nitrogen-14 is produced.

The carbon-14 produced in the upper atmosphere is integrated into atmospheric carbon dioxide (CO_2). This radioactive carbon dioxide is metabolically identical to the carbon dioxide, which is composed of carbon-12. The carbon-14 then enters the biosphere where it is incorporated in the living tissue of plants and animals through respiration and metabolism. As long as the organism

is alive the ratio between carbon-12 and carbon-14 remains constant. At the death of the organism the carbon-14 begins to decay since it is no longer being absorbed. Carbon-14 has a half-life ($t_{½}$) of 5730 years. In other words one-half of the carbon-14 will have decayed and be converted back into nitrogen during 5730 years. Scientists measuring the amount of carbon-14 that is left can theoretically determine the number of years since the death of the organism.

The determination of the age of organic material being dated depends on the ratio of the amount of radioactive carbon-14 and stable carbon-12. Since carbon-14 is radioactive it will slowly be converted into nitrogen. The stable carbon-12 theoretically will not vary over time. Therefore what scientists are actually doing is measuring the ratio of these two carbon atoms. A difference in the amount of either carbon will affect the implied date. An important factor is that the carbon date can be affected not only by the amount of carbon-14 that has decayed but also by the amount of carbon-12 that is in the organism. Since living organisms can only contain a finite amount of carbon the amount of either carbon will affect the ratio of the other.

Factors Affecting the ^{12}C and ^{14}C Ratios

Most laymen are under the mistaken idea that the dates given by the various radioactive decay processes are *absolute*. This is not true. Many geology books take great pains in comparing "relative" and "absolute" dates. Relative dates are dates that are in a certain sequence. For example, fossils found in strata that have been deposited in an orderly fashion can be dated relative to each other. This means that fossils in deeper strata are older than fossils in higher strata, since the deeper fossils have been buried first. The time order of the fossils can be determined but not the time in years between the various fossils. Thus relative dating depends on the order of burial.

Absolute dating has the advantage of actually providing a date in years based on the radioactive decay of various isotopes including radiocarbon. These types of dates are called "absolute" because they are supposedly independent dating mechanisms. If the term absolute is referenced in any large dictionary the following words are used in its definition: 1) being free from imperfection 2) completely free from other restraint 3) having no restriction or qualification 4) indubitable, unquestionable, independent 5) fundamental, ultimate 6) having no external reference. Therefore what the geologists are trying to imply is that absolute dating methods, including carbon dating, are independent and free from outside influence.

In reality the radiocarbon years given for a sample may contain large-scale errors based on many factors. These errors can include errors for a particular sample but more importantly there are wide scale systemic errors that can produce inaccurate and false dates. The term absolute as applied to radiocarbon dates is extremely misleading and is not correct. Many factors affect the dates that are supposedly absolute carbon dates. These factors can include, but are not limited to: magnetic field strength of the earth, magnetic field reversals, solar flares, sunspots including the 11 years sunspot cycle, atomic and nuclear bomb explosions, supernovas, atmospheric nitrogen levels, volcanic eruptions, and earth wide carbon levels. In reality large-scale fluctuations in many of these and other factors can invalidate the various carbon dates provided by the decay of carbon-14. In reality carbon dating is not absolute.

> The general success of the C 14 dating method implies that to a first approximation the production rate of C14 has been essentially constant for the last several millennia. However, a variety of phenomena cause changes in the production rate, which in turn may produce measurable perturbation in the biospheric C 14 activity (4).

We are going to examine some of the various processes that are used in the carbon dating cycle. Please bear in mind that this will not include all the factors that can cause systemic false dates. Also many other undiscovered processes may yet be discovered that may further invalidate the system.

The Earth's Magnetic Field

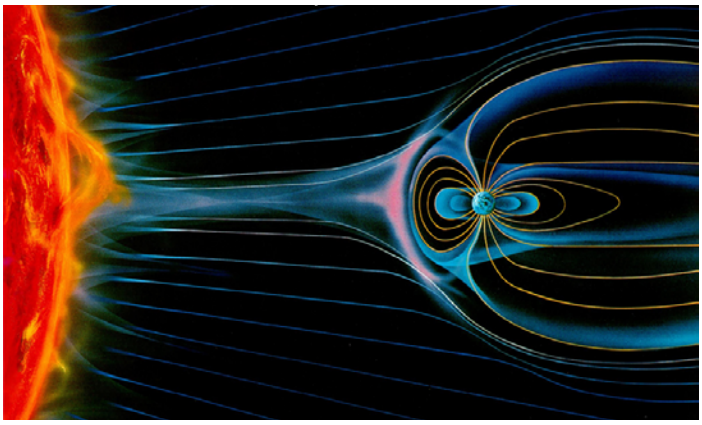

Figure 4. The protective magnetosphere of the Earth is distended by the cosmic rays of the solar wind.

All magnetic objects produce invisible lines of magnetic force. These lines of force, called magnetic flux, run between the poles of the magnetic object. Spreading out iron filings on a sheet of paper and placing a magnet underneath can easily show this. The lines of magnetic flux will be visible as the iron filings arrange themselves around the north and south poles in patterns corresponding to the lines of magnetic force.

The earth is much like a giant magnet. It has a north and a south pole and lines of magnetic flux, which surround the earth. Magnetic properties were discovered more than 700 years ago when Petrus Peregrinus in 1269 discovered the magnetic properties of a spherical shaped piece of magnetite. He suspended this lodestone from a cord and placed iron needles around it. He noticed that the needles revealed the shape and direction of the magnetic lines of force. Later, William Gilbert, the personal physician to Queen Elizabeth I, discovered that the earth was much like a giant magnet. He used this to explain why ships compasses tended to dip downward in the northern hemisphere.

Since the earth has magnetic properties charged particles entering from outer space become trapped in these flux lines and form the magnetosphere (fig. 4). The lines of magnetic flux are compressed by the solar wind on the side facing the sun. On the night side of the earth the solar wind stretches out the magnetosphere much like the tail of a comet. The magnetosphere extends out about 70 to 55,000 km (45 to 34,000 miles) on the sunlit side and more than 275,000 km (170,500 miles) on the side away from the sun (5).

The strength of the earth's magnetic field will affect the amount of cosmic rays that come into the upper atmosphere. This will then affect the amount of carbon-14 produced. If more cosmic rays strike the earth more carbon-14 will be produced, if less cosmic rays enter the atmosphere less carbon-14 will be produced. Therefore the amount of atmospheric carbon-14 produced will be inversely proportional to the strength of the earth's magnetic field.

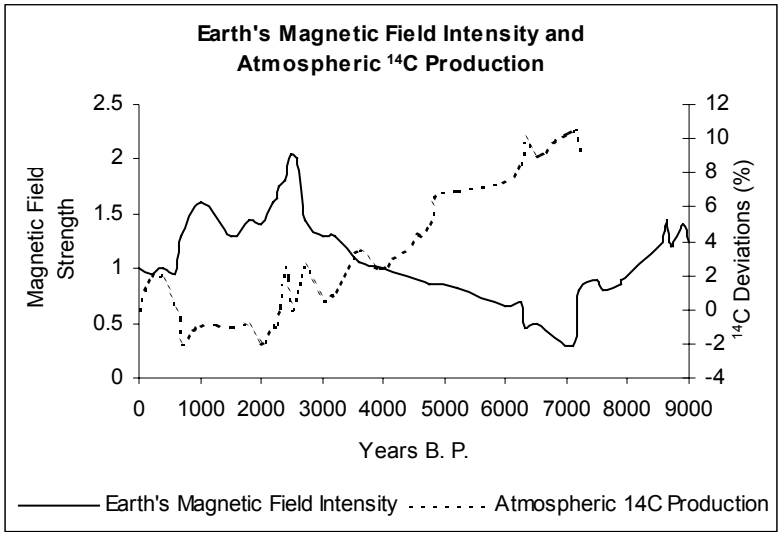

Figure 5. The Strength of the Earth's magnetic field affects the production of atmospheric ^{14}C production. Adapted from Bucha.

The relationship between magnetic field strength and atmospheric carbon-14 production is shown in figure 5. As the strength of the magnetic field goes up the production of carbon-14 diminishes and vice versa. Notice how the two graphed lines inversely mirror each other. Also many scientists are beginning to realize that the earth's magnetic field can reverse very rapidly. It had long been thought that magnetic reversals took thousands of years to accomplish this, this is no longer true (6). During these times of rapid magnetic reversal the strength of the field can vary widely. In one recent study by Coe and Pervot (7,8) it was found that the earth had had a field reversal that moved 1000 times faster than had ever been observed. These changes include field shifts as much as 50 degrees in one week. Also other studies have shown that the magnetic field strength was much stronger in the past. Tarduno and other researchers report that the magnetic field strength was three times stronger in the past, during the Mid-Cretaceous (9). This would have led to less carbon-14 being produced. The implication for carbon dating being based on unchangeable factors is obviously fallacious.

> New values for the changes of the earth's magnetic moment provide a basis for a study of the dependence of C14 production on the earth's magnetic field. The decrease of the magnetic moment is followed by an increase of the cosmic-ray flux and therefore by an increase in the production of C14. Higher values of the field have the opposite effect. Hitherto, it had not been determined in what manner this influence was manifested…we see a good correlation between the radiocarbon deviations and the magnetic-moment changes. The increase of magnetic moment around A.D. 900 is immediately accompanied by the decrease of C14 deviations. The same is true of the changes around A.D. 1200, as well as for those between A.D. 1 and 700 B.C. (10).
>
> This correlation is definitely significant. The overall trend of the change in the C14 level corresponds to what one expects from the secular changes in the magnetic-dipole moment of the earth during the past 10,000 years (11).

Solar Activity

Closely related to the earth magnetic field and carbon-14 production is the activity of the sun. The sun produces cosmic rays, which continually bathe the earth in high-speed atomic particles. These particles are composed of neutrons, proton, electrons, and alpha particles. Alpha particles are composed of two protons, and two neutrons, they are essential ionized helium atoms without electrons. These high-speed alpha particles are also known as cosmic rays and they have tremendous kinetic energy.

These solar cosmic ray particles are given off during time periods of intense solar activity. This can include those produced by solar flares, and also by the periodic fluctuations caused by the 11-year sunspot cycle. Solar flares produce intense one-time increases of cosmic rays (12). On the other hand, the production of cosmic rays during the sunspot cycle is more moderate and long term. Also the sunspot solar wind may affect the entrance of galactic cosmic rays into the earth biosphere (fig 6).

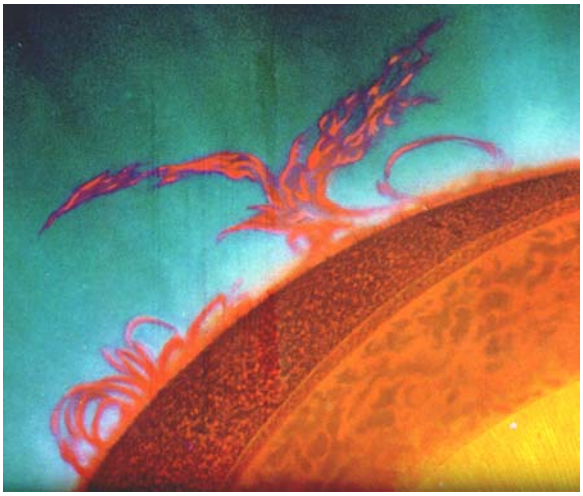

Figure 6. In this cross-section of the sun solar flares, which extend hundreds of thousands of miles high, produce cosmic rays. These rays then bombard the earth producing carbon-14.

> It now seems established that there exist an anticorrelation between sunspot numbers and production of radiocarbon, at least for the solar cycle with the period of 80-90 years. It is believed that this effect is due to the modulation of galactic wind.
>
> However, the most prominent cycle in the solar activity is the 11-year solar cycle. It seems reasonable to investigate if the 11-year solar cycle has a similar influence on radiocarbon production as the 80-year solar cycle.
>
> Calculations of radiocarbon production rate performed by Lingenfelter and Aramaty for the solar cycle 19 has shown that a global, average radiocarbon production rate during solar minimum (1953), which corresponds to the maximum cosmic ray flux, was 2.4×10^4 14C atoms. $m^{-2}s^{-1}$, while during solar maximum (1957) it decreased to 1.93×10^4 14C atoms. m^{-2} s^{-1}. This would indicate about 25% variation of the radiocarbon production rate during the solar cycle 19 (13).

In order to substantially change the amount of carbon-14 in the earth's inventory there must be a huge amount of change in the atmospheric carbon-14 production rate.

> Statistically significant correlations have also been found to exist between sunspot numbers and the atmospheric C14 level during the past three centuries, for which sunspot numbers are known from historical records. The variations in the C14 inventory are of the order of 3 per cent, their explanations requiring changes in the C14 production rate of the order of 50 percent (11).

The production of atmospheric carbon-14 is related to the action of the magnetic strength of the earth and the activity of the sun. Bear in mind that these large-scale changes in carbon-14 production can be decreased or increased depending on the earth magnetic field, which can vary over time.

Solar flares, which only last a few hours or days can produce large amount of atmospheric carbon-14. These flares, which can extend hundreds of thousands of miles from the surface of the sun, can pummel the earth with a thousand-fold increase in cosmic ray activity. This leads to large-scale production of carbon-14 in a quantity that is unbelievable. Solar flares can also insert carbon-14 that is made in the interior of the sun directly into the atmosphere. If the solar flare production has varied in the past then the implications for carbon dating are immense.

> Occasionally the C14 level seems to have changed by more than 1 per cent in less than 10 years. Such rapid changes probably cannot be caused by modulation in the cosmic-ray flux by solar activity. A rapid increase in the C 14 level could possibly indicate solar-flare production or influx of radiocarbon from the sun … (11)
>
> In particular we shall consider changes in C 14 production caused by …enhanced fluxes of particles produced by solar flares …
>
> The total C 14 production per unit surface area for any event is thus 3×10^7 time the value tabulated. This is between 14% and 6% for the solar-cycle-averaged, cosmic ray, C14 production and, as can be seen, the bulk of the C 14 is made in one or two events. Moreover such solar flares produce enough C14 to greatly modify the solar-cycle dependence for the total C 14- production rate. Therefore, for particularly active solar cycles, such as the last, the 11-year periodicity resulting from solar modulation is complete obscured by solar-flare effect. As a result, for very active cycles one should not expect to find anti-correlation between the atmospheric C 14 production and sunspot number or other indicators of the 11-year solar-cycle activity variation (4).

According to this study solar flares produce in a few hours large amounts of carbon-14. So much, in fact, that this solar flare produced radiocarbon completely masks out the more slowly produced carbon-14. If solar flares can and do produce the bulk of the atmospheric carbon-14 then consider what would happen if the sun produced less solar flares in the past. These changes would certainly vary or invalidate the dates given by the carbon-14 system.

Supernovas Explosions and Stellar Activity

Supernovas are stars that explode in a blinding flash of light and energy. An exploding supernova will throw off about 10 percent of its mass into outer space. The best know supernova explosion was the Crab Nebula (figure 7). It became visible on earth in 1054 A.D. It was so bright that it was visible for many months during the daytime. It is approximately 4,000 light years away. All that remains of the exploded star is a nebula of gas and debris (12).

Figure 7. The Crab Nebula, the remnants of a supernova explosion. Supernovas produce and accelerate cosmic rays.

Supernovas release tremendous amounts of energy in an ever-expanding shell. This shell of energy called a supernova remnant shell causes interstellar particles to speed up and move away from the explosion, much like ping-pong balls caught in a violent wind. These high-speed particles, along with the exploded stellar particles, strike the earth as cosmic rays and are a factor in the carbon-14 production scenario. After the explosion the collapsed star usually becomes a pulsar and emits radio waves. The center of the crab nebula contains a pulsar.

> Lastly, we shall consider possible C 14 variations caused by supernovae, which is collectively the most likely source of most cosmic-ray particles. There are two type of increases in C 14 production which may result from a relatively nearby supernova explosion: short-term increase proceeded by a possible gamma-ray burst associated with the explosion, and a much longer-term increase and subsequent decrease resulting form enhancement of the local background cosmic-ray flux by

the arrival of cosmic rays accelerated in the explosion.

Konstantinov and Kocharov have shown that measurable increases in the atmospheric C 14 activity would have been produced by historical supernovae if their gamma-ray emissions energies were greater than 10^{49} erg. Like the C 14 increases associated with solar flares, these increases would decay with a mean life of T*. At present no systematic search has been made for such increases, but such a search would prove quite valuable in at least setting an upper limit on the supernova energy emitted in gamma rays.

Surveying the available pulsar data, we find that for a constant W_{SN} the largest cosmic-ray flux at present would be from PSR 1929+10 (pulsar)…variations suggest that C 14 production rate 8000 years ago could have been as much as 5% greater. A nearby source such as PSR 1928+10 could produce increases of this magnitude…If the cosmic-ray flux was as much as 5% higher 8000 years ago and this excess resulted solely form a 10^5-year-old nearby source, the cosmic ray from this source would make up 38% of the total flux at the present (4).

Volcanic Activity

As has been previously mentioned carbon dating is based on the measurement of the carbon-14 and carbon-12 ratio. As the radioactive carbon disintegrates the ratios between these two carbons will change. It is important that both amounts of carbon are known at the beginning of the process or systemic problems will occur. If the carbon-12 ratio has varied in the past and this is not understood the geochronologist will have invalid dates. The processes we have examined up to this point have affected the production of carbon-14. This next process, volcanic activity affects the amount of carbon-12 in the system.

As a simplistic example consider what would happen to a hypothetical sample that had a reduced amount of radioactive carbon-14. Since there is only one carbon-14 atom for every trillion carbon-12 atoms a small reduction in the amount of carbon-14 atoms would yield radiocarbon years that were too old when compared with chronological years. Once again, from a simplistic point of view if there were only one carbon-14 atom for every two trillion carbon-12 atoms you would have an apparent age at death of 5730 years.

Volcanic eruptions bring large amounts of non-radioactive carbon to the surface of the earth. This excess carbon mixes with the carbon-14 and the result is a diluting of the carbon-14 atoms, which yield systemic problems. Coupled with this is the fact that many people do not realize the amount of volcanic activity that the earth has undergone in the last few thousand years. Volcanism was so widespread in the past that it has been implicated in many of the geologic mass extinctions.

Figure 8. The Northwestern United States has thousands of square miles covered in volcanic basalt and ash. These eruptions affected the radiocarbon dating systems.

Volcanic eruptions have created large landforms and plateaus (3). In times past volcanic activity occurred to a larger extent than it does now. Along the pacific coast is evidence of the earth's past volcanic history. The pacific area of the United States has many active and semi-active volcanoes

including Mt. Shasta, Mt. Rainer, Mt. Hood, Mt. Baker, Lassen Peak, and the famous Mt. St. Helens.

The Columbia River basin is made up of basalt, a volcanic rock; it covers more than 200,000 square kilometers (80,000 square miles). Lava poured out of large fissures and produced a plateau that is more than 1 kilometer thick. Molten rock flowed to parts of the surface of Oregon, Idaho, and California covering thousands of square miles (fig. 8). The South American countries of Argentina and Brazil have giant lava plateaus. Plateaus also cover parts of South Africa. In India the Deccan Plateau was formed by volcanic activity. In some places in India the hardened magma is 10,000 ft deep.

The earth's oceans also have evidence of much tectonic activity. The Hawaiian and Icelandic islands are the products of volcanic activity. The Tonga islands, Easter islands, Galapagos Islands, New Zealand, and Japan also are all volcanic islands.

In North America the past eruption of La Garita, which today is a 75-kilometer depression, created environmental havoc. The ash flow from this volcano was 20,000 times larger than the eruption of Mt. St. Helens, which erupted in the mid 1980s. Another ash-flow eruption that took place thousands of years ago was the Toba eruption that took place in Indonesia (14). It buried 25,000 square kilometers (10,000 square miles) under a layer of ash 300 meters thick (1000 ft). The amount of carbon-based material that was ejected into the atmosphere was so great that many scientists credit this explosion with initiating a glacial expansion. Shortly after this eruption global temperatures fell by 6º C (12º F). All of these eruptions put massive amount of carbon dioxide into the atmosphere. This volcanic carbon dioxide would be ingested by living thing. The result would be organic matter free of carbon-14.

It is evident that most of the earth in the past had to deal with increased volcanic activity. Consider the following quote from the prestigious Radiocarbon Journal that dealt with the relationship between carbon-14 and volcanic processes.

> Abstract—Wood from regular timbering of a shallow seated mine in Tuscany gave ^{14}C ages of 5730 ± 100 year BP, much too old to be attributed to one of the known civilizations of Italy. This mine is located in a region of declining volcanic activity, noticeable especially through numerous emanations (natural or incidentally induced by drillings). It was suspected that the analyzed wood had grown in an environment where the normal atmosphere had been diluted by volcanic emanations. To check this hypothesis, living plants (trees, bushes and reeds) and volcanic emanations have been sampled and their ^{14}C content measures. All present day plants are depleted in ^{14}C giving a fictitious age different from 0 (1805, 1820, 2540, 4350 years BP). Of the gaseous emanations sampled, two have a high pressure and show virtually no ^{14}C (>41,000 BP). Two others have pressure closes to atmospheric, and a small amount of ^{14}C was introduced by atmospheric contamination (22,570 and 30,580 years BP).
>
> Conclusion—An overestimation of ages measured by ^{14}C methods can occur in plants grown in a volcanic environment, even at a solfataric (sulfurous vents) stage, because part of the atmospheric CO_2 is of volcanic origin and contains no ^{14}C. The dilution of atmospheric CO_2 by volcanic CO_2 can be considered as a natural ^{14}C dilution. It was previously noted for Hawaii (15).

The above quote shows that the carbon ratios can be changed without affecting the production of carbon-14. During volcanic eruptions large amount of gases are belched into the atmosphere. Most volcanic gases are composed of 96% carbon dioxide. This affects the apparent radiocarbon

age since volcanic carbon dioxide contains no carbon-14. If the earth in the past had been blanketed with carbon dioxide (CO_2) from volcanic eruptions, which is not radioactive, this would invalidate carbon-14 as a viable dating system.

Conclusion

In this paper we have only touched the surface of many of the problems with carbon dating. There are many factors that could influence the workings of the carbon dating system. The earth being impacted by a large astral body would be a good instance. This would throw up immense amounts of carbon into the atmosphere. Astral impacts would change the nitrogen production in the upper atmosphere (16). Another would be a change in the carbon holding capacity of the oceans which would affect carbon dating. The point is that there are literally hundreds of factors that can impinge on the carbon dating scheme.

One final detail worth noting is that most of the radiocarbon dates are valid and accurate for about the last 4,000-5,000 years. The flood of Genesis occurred within this time frame. Carbon dates before this period are too old when compared to chronological years. This change in the accuracy of the carbon dating system can be attributed to the climatic and geologic changes that were produced by the Noachian flood. The Bible states that the earth was to be destroyed during the deluge (Genesis 6:13). These changes included atmospheric changes in the concentration of many of the gases in the atmosphere. This would include changes to the ozone composition and the ^{14}N composition, among others. These changes would affect the working of the carbon dating methods, hence dates older than 5,000 before the present are inaccurate.

The efficiency of the carbon dating system is only as good as the assumptions that it is based on. In reality carbon dating is not an absolute dating method. If the foundational assumptions can be made to shift then we are only dealing with suppositions and educated guessing.

With this understanding carbon dating is an excellent tool for dating material a few thousand years old. For older dates it is totally insufficient. For dates older than the flood of Noah the historical record of the scriptures is a better guide.

Email: acm@amendez.com
Website: www.amendez.com

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