ARE POLONIUM $^{210}$Po) HALOS IN COALIFIED WOOD EVIDENCE FOR THE NOACHIAN FLOOD?

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INTRODUCTION

Robert Gentry is a physicist who has attempted to find scientific support for the interpretation that the world-wide Noachian Flood actually occurred as reported in the book of Genesis in the Bible. His ideas are presented in a book, Creation's Tiny Mystery, where he suggests (pp. 51-62) that elliptical and dual $^{210}$Po halos in coalified wood in uranium deposits in Triassic, Jurassic, and Eocene rocks of the Colorado Plateau are evidence for a young age for the creation of coal as well as for the age of the Noachian Flood (Gentry, 1988). In the following sections I show that the $^{210}$Po halos in coalified wood can also be explained by natural processes without relying on miracles or supernatural events such as the Flood.

GENTRY'S HYPOTHESIS

In Gentry's description of the coalified wood fragments that occur in Triassic, Jurassic, and Eocene formations of the Colorado Plateau, he claims that the wood came from trees that were growing immediately prior to the Flood (Gentry, 1988). This wood consists of both compressed or uncompressed material, can be black or brown, and contains original pithy cores that may or may not contain siliceous, calcitic, or dolomitic fillings. Some coalified fragments are still flexible when first collected but become brittle when dried. Gentry cites the flexibility as evidence for rapid deposition during the Noachian Flood. He believes that the sediments in which these wood fragments are found do not have natural origins that result from processes involved in geological uniformitarianism, but result from "supernaturally induced, catastrophic events associated with a world-wide flood." Part of his argument is that the fossils found in these rocks provide evidence for rapid burial.

Gentry found $^{210}$Po halos in the coalified wood but not any $^{214}$Po or $^{218}$Po halos. The halos are dark spheres in the wood where the wood has been damaged by alpha particles (helium nuclei) that were emitted from radioactive polonium atoms as they decayed to atoms of lower atomic number. The radius of damage in the wood is different for each isotope (kind) of polonium, and the number of concentric spheres depends on which isotope is the starting point for the decay sequence. Three concentric spheres occur $^{218}$Po atoms decay to $^{214}$Po, then to $^{210}$Po, and finally to $^{206}$Pb (lead). Two spheres occur where $^{214}$Po decays to $^{210}$Po and then to lead, and one sphere occurs where only $^{210}$Po is present and decays to lead. In the coalified wood of Triassic and Jurassic age the $^{210}$Po halos are a special case of dual halos in which former spherical halos that are now elliptical (flattened) halos with relatively dense radiation damage are enclosed by outer spherical halos of nearly the same radius and having less dense radiation damage (Fig. 1).

Fig. 1 (GIF, 6k)

In coalified wood of Eocene age, only the elliptical halos were found, but Gentry believes that inadequate sampling may account for the absence of dual halos. On the basis of the elliptical shapes Gentry suggest that the halos "all originated at about the same time, in agreement with the flood-related scenario," Gentry notes that the halo centers are composed of lead and selenium. He uses this relationship to suggest that the spherical halos result from the beta-decay of radioactive $^{210}$Pb, twenty years later following compaction of the Flood deposits. The isotope $^{210}$Pb is a possible daughter product of $^{214}$Po, has a half-life of 22 years, and decays by loss of a beta particle (an electron) to form $^{210}$Po,
which then eventually decays to produce the $^{210}\text{Po}$ halo. He believes that radiometric dates of 55 million to 80 million years, which have been assigned by Stieff et al. (1953) "to some of the Colorado Plateau formations where the coalified wood specimens are found," are spurious because of misplaced confidence in the uniformitarian principle of constant decay rates.

The basic ingredients of Gentry's hypothesis are the following: "(1) water, (2) uprooted trees as the source of the logs and smaller wood fragments, (3) a rich uranium concentration near the wood, and (4) a compression event occurring after the uranium solution invaded the wood, but prior to its becoming coalified (Gentry, 1988, p. 56)." A rich uranium source is needed to supply the daughter $^{210}\text{Po}$ isotopes that eventually produce the $^{210}\text{Po}$ halos. He believes that a natural origin of these halos is improbably on the basis that a uniformitarian explanation would require three different periods of introduction of uranium-bearing water. In that case, Gentry says that the first event would have occurred in Triassic rocks, followed 10 million years later in the Jurassic rocks, and then 50 million years later in the Eocene rocks and all events prior to coalification. He believes that these great lengths of time are unlikely on the basis (1) that the enclosing formations represent three geological periods: Triassic, 180-230 million years ago; Jurassic, 135 to 180 million years ago; and Eocene, 35 to 60 million years ago, and (2) that all the wood that contains the elliptical, secondary, $^{210}\text{Po}$ halos would have had to be in the same gel-like condition is not possible through millions of years of time, and, therefore, the wood fragments and logs must have been buried quickly during the Flood, and that soon after the formations containing this wood were penetrated by the uranium-bearing fluids and prior to compaction of the sediments. He believes that all halo-creating events had to be nearly simultaneous without separate compactions of the wood and that millions of years of time between separate events would have turned Triassic wood into coal before the Eocene layer was deposited.

Finally, Gentry notes that some uranium-to-lead ratios have been found in various Colorado formations that indicate ages of several thousand years instead of millions of years and that some laboratory experiments show that wood can be coalified in a year or less or even just a few days. He uses these data to support his hypothesis for a young age of the coalified wood and its source as the Noachian Flood deposits.

**RESPONSE TO GENTRY'S HYPOTHESIS**

My response to Gentry's hypothesis and arguments is divided into three parts: (1) the geologic setting, (2) age dating methods, and (3) the formation of the Po halos.

1. The geologic setting.

The formations in the Colorado Plateau, which contain the Po-halo-bearing, petrified-tree logs are primarily sandstones and conglomerates that were deposited in former stream channels that have eroded into underlying flood-plain muds (shales). During modern-day floods, trees become undercut along river banks and are washed into the rapidly-flowing flood waters. Somewhere, farther down stream, the heavy base of an uprooted tree trunk lodges in the bank, and the tip of the tree swings around like a weather vane to point down stream. Similar flooding of rivers could have occurred in Triassic, Jurassic, and Eocene time so that when uprooted trees were buried in river sands and muds, the wood later became the deposition sites for uranium introduced by fluids from an outside source.

Because of the way in which the trees were deposited in the flood waters, geologists from the U. S. Geological Survey in the 1940s looked for these logs and determined their orientations so that channel directions could be estimated. In this way possible hidden uranium concentrations might be predicted to occur along the buried channel, projecting into the exposed cliff.

Certainly, the locations of the petrified wood in stream channels support rapid (catastrophic) deposition for the sands and gravels that contain the coalified logs. But these occurrences are not evidence for a world-wide flood. In 1993, for example, the mid-West experienced catastrophic flood, which undoubtedly undercut river banks and washed some trees into the channels. Some of these trees are doubtless buried in muds and still preserved because the enclosing clay prevents contact with oxygen adequate for decomposition. But we know that this event was not a world-wide flood and, therefore, future discovery of these buried trees cannot be used to indicate that a world-wide flood occurred.
Furthermore, in spite of Gentry's wish to set aside uniformitarianism, his catastrophic Noachian Flood model has to be consistent with a one-year-long flood that deposited the formations that enclose the wood fragments in the Colorado Plateau. For example, Gentry's model must also explain the larger picture in the Plateau rocks of the associated giant, wind-blown sand dunes of the lower-Jurassic Navajo Formation, the presence of both marine limestones and non-marine red beds, the occurrence of gypsum beds in the Triassic Moenkopi Formation which require arid climates, and the occurrence of trees in which the Po halos occur and which are chiefly conifers (gymnosperms) rather than flower-bearing trees (angiosperms). Gentry can not choose only data that support his Flood hypothesis and ignore data that do not and still make his model for the origin of the coalified wood and the associated Po halos convincing.

2. Age-dating methods.

In determining the young age of the earth, Gentry apparently uses the hypothesis of Archbishop Ussher of the Irish Protestant Church who assumed that the Bible contains a complete record of the world's history. Ussher added up all the genealogies and asserted that the earth was formed on October 24, 4,004 B.C., nearly 6,000 years ago (Brice, 1982). Gentry suggests that isotopic methods for age dating are not reliable. Obviously, there must be evidence for reliability before anyone can properly use isotopic age-dating methods. This reliability is obtained for the $^{14}$C-isotopic age-dating method, for example, by comparing isotopic $^{14}$C-ages obtained from tree rings (dendrochronology). Because trees in temperate areas add one growth layer each year and because the width of a growth ring is a function of climatic conditions, ring patterns establish ages of trees from place to place. On that basis, by describing and counting rings in living and dead bristle-cone pines in the Panamint Range of eastern California, dendrochronologists have assembled a master, tree-ring template for a time span of 8,200 years (Fritts, 1976; Larsen and Birkeland, 1982).

By comparing $^{14}$C-dates of the wood with bristle-cone pine tree-ring dates or with historic dates of old cultures from wood fragments in tombs have been obtained, scientists can check the $^{14}$C-dates for accuracy. Systematic errors have been discovered for young ages as well as old ages, and some of these errors occur because of the burning of fossil fuels which change the carbon isotope contents of the atmosphere and because of certain effects of $^{14}$C production in the atmosphere during cyclic sunspot activities (Faure, 1977). Knowing that errors exist and estimating their size allow scientists to make corrections of $^{14}$C-dates. For ages older than 2,100 years, however, the errors are in the direction of making the $^{14}$C-dates younger than the actual ages.

On the basis of $^{14}$C-studies of the bristle cone pines, dendrochronologists have also found that the time span of 8,200 years is followed by a 1,000-year gap, because of missing trees, and then by older trees that give ages of 9,200 to 10,000 years. Therefore, on the basis of the above studies, the 8,200 years recorded in the bristle-cone pine tree rings, alone, make the Earth older than Ussher's time of origin.

Two observations of the live and dead bristle-cone pine trees are of interest. (1) They are preserved because of the cold, arid climate in which they grow. And (2), some of the very old dead trunks and branches are somewhat coalified or carbonize in some places. Thus, admittedly, coalification can happen without deep burial or high temperatures or pressures.

A discussion of $^{14}$C-dating of bristle-cone pines in California is applicable to the $^{14}$C-dating of coalified Douglas fir logs that are buried in glacial till near Two Creeks, Wisconsin. These logs appear almost as fresh as any modern tree that died and lay exposed to the weather for a few years. The wood and cones are both brown and black and locally partially carbonized. Headward erosion by a stream has uncovered the logs and wood fragments that were once buried beneath the glacial till.

Apparently, as the last glacial period came to a close, a forest grew at the margin of the retreating continental ice mass, and then for some reason, the ice made a brief re-advance to override the forest and bury some of the trees in glacial till. The clay in the till kept oxygen from reaching the wood and preserved the logs until erosion exposed them. On the basis of $^{14}$C-dating methods, these logs are 10,000 years in age. This age is a value that is well within the $^{14}$C accuracy that is verified by the dendrochronology and $^{14}$C-dating of the bristle-cone pines in California.
Now, if Gentry is correct, that the brown and black coalified wood in the uranium-bearing formations in the Colorado Plateau was buried 6,000 to 10,000 years ago during the Noachian Flood, then the Plateau wood fragments should also give verifiable 14C-age dates in this age range. None of them does because they are much too old. Because the half-life of 14C is so short (5,730 years), after a time of 50,000 years essentially all 14C is gone, and, therefore, all former 14C in wood fragments in the Colorado Plateau has long since decayed and disappeared in rocks having ages of millions of years (Faure, 1977).

Although there is plenty of evidence, both experimentally and in nature, that it is possible to carbonize or coalify wood relatively quickly under the right conditions, these observations are not proof that relatively long ages of millions of years necessarily result in coalification. As long as wood cellulose is cut off from oxygen and if fluids are not free to move through the enclosing rocks to carry away volatile materials, then there is no reason for the wood to become completely coalified, regardless of age. Thus, Gentry's arguments are not valid that the Triassic and Jurassic rocks cannot have great ages.

When Gentry reported the ages of 55 to 80 million years for the age of formations that contain the coalified fragments in the Colorado Plateau, he implied that some error must have been made because he later indicated the older ages of 180 to 230 million years for the Triassic period and of 135 to 180 million years for the Jurassic period in which these formations were found. There is no error in age determination here because the range of 55 to 80 million years represents the range of time in which the uranium-bearing fluids were introduced in multiple events into the older Triassic and Jurassic rocks --- not the age of the formations that host the uranium.

Moreover, Gentry's final point that some uranium deposits give ages of a few thousand years, which he suggested lends support for the Flood model, is not proof of the Flood model, either. In some places the original uranium ore deposits, now exposed by erosion at the surface, have been remobilized by hydrous fluids, so that some of the uranium was separated from its daughter decay-products and deposited in new sites. Therefore, for this uranium the radiological clock has been reset to produce new, associated daughter products whose ratios with the parent uranium indicate the young ages of a few thousand years. Furthermore, Gentry has no justification for using these radiogenic young ages that fit his theory and ignoring data for old ages that do not. Gentry either trusts the isotopic age-dating methods, properly used, or he does not; he cannot have it both ways.

3. The formation of the Po halos.

The association of polonium with uranium concentrations is logical because 218Po, 214Po, and 210Po are the final three daughter products in the uranium (238U), alpha-particle, decay scheme before the production of the stable lead isotope 206Pb. The location of 210Po halos surrounding a nuclei of selenium and lead is also logical because selenium and lead commonly accompany uranium in hydrous fluids from whatever source these elements originated. The joint deposition of polonium with lead and selenium in the same favorable place is logical because all three elements have ions of +4 charge, and, therefore, they would precipitate in similar sites and in sites separate from uranium whose chemical properties and atomic size are different.

As an aside, because selenium is associated with uranium, geologists from the U. S. Geological Survey during the "uranium boom" of the 1940s used selenium-indicator plants in order to locate hidden uranium concentrations. Certain plants (about 30 different kinds) tend to grow in selenium-rich soils. For example, one of these selenium-loving plants is a vetch (loco weed). Ranchers grub this plant out of the grazing lands because cattle, eating this weed, become poisoned by the selenium and go "loco" and die.

At any rate, geologists mapping in the Circle Cliffs area of Utah, for example, kept their eyes open for these 30 different plants. When concentrations of five or more different species were found in a certain area, a mapping team would recommend drilling. In this way hidden uranium concentrations were found that the average prospector, walking around the base of exposed cliffs with a Geiger counter, would not discover.

The formation of only 210Po halos around the lead and selenium nuclei is logical because the long half-life of 210Po
(138 days) and of Pb (22 years) in comparison to 3.05 minutes for Po and micro-seconds for Po. The existence of only $^{210}$Po halos implies that the uranium-bearing fluids traveled considerable distances before arriving at their final deposition sites. There are no uranium-, lead-, selenium-, and polonium-bearing rocks in the sedimentary stratigraphic column of the Colorado Plateau that would provide the uranium-bearing fluids. Therefore, a deep, distant source is required. A long period of travel time from this distant source would permit the decay of polonium isotopes having short half-lives, so that most of the short-lived isotopes would disappear before they arrived at the formations that contain the wood fragments. Only the $^{210}$Po or $^{210}$Pb isotopes would remain, either of which eventually would generate the $^{210}$Po halos in the coalified wood.

Although the uranium source is unknown, fluids carrying the uranium and polonium could have accompanied volcanism that occurred during the 55 to 80 million year interval.

The production of the elliptical $^{210}$Po halos is also logical because once the Triassic, Jurassic, and Eocene rock systems were opened by tectonic forces that accompanied the volcanism, the uranium-bearing fluids could enter the wood-fragment-bearing sandstone and conglomerate formations. When that happened, not only could material move in, but also material could be subtracted. The subtraction would create volume losses that would also permit coalification because volatile material could then escape from the wood, which is necessary for coal to form. In turn, the squeezing during compression (as a result of volume losses) would eliminate conduits through which additional polonium-bearing fluids could move. On that basis, the secondary, spherical beta-decay of $^{210}$Po halos that surround the elliptical ones (paired as dual halos) could result from the beta-decay of $^{210}$Pb, as Gentry suggests, because of its long half-life of 22 years and subsequent decay following compression of the wood.

Because the time interval of 55 to 80 million years for the uranium deposition overlaps with the Eocene (35 to 60 million years ago), rocks of Eocene age can contain the $^{210}$Po halos and uranium concentrations, but younger rocks do not.

One final argument against the recent age of the supposed Noachian Flood deposits can be made by returning to a discussion of the glacial history that led to the burial of the afore-mentioned Douglas fir logs under glacial till at Two Creeks, Wisconsin. In the geologic record, here in North America and Europe, there are four separate glacial tills topped by soil horizons and containing wind-blown loess between them. Collectively, these relationship indicate at least four major glacial periods. The glacial deposits in the U. S. formed when thick sheets of ice covered Canada. From the physical properties of ice, the thicknesses of each ice cap had to average 18,000 feet in order for the ice to flow by gravity once almost to the southern tip of Illinois. After each glacial period, the ice cap melted and essentially disappeared before re-forming and advancing again. Moreover, because the glacial deposits rest on sedimentary rock containing fossils, the glacial ages must have been after the biblical Noachian Flood, if the literal creation story is correct. From the aforesaid information, volumes of ice can be estimated and also rates of snowfall necessary to transfer water from the oceans to the continents to produce the four ice caps in 6,000 years (or less). On the basis of calculations, if these glacial melting histories are to be condensed into 6,000 years, descendants of Noah would have had to endure fierce winter climates of greater than 40-foot snowfalls per year, followed by blow-torch periods of heat in which the ice melted prior to each of the next ice ages. Thus, the descendants of Noah either would have been frozen to death or cooked to death, if we are to believe that the recent ice ages were limited to such a short time interval.

The above information does not take into account other glacial and melting histories recorded in other parts of the world where thick glacial deposits are interlayered with fossil-bearing sediments. Invoking the Flood-model would require these glacial and interglacial deposits to form during the one-year Noachian Flood and prior to the end of the storm --- something that seems quite unfathomable.

The logic of the above arguments must cast further doubt on the proposed short interval of time in which Gentry proposed that the elliptical-spherical dual $^{210}$Po halos were formed in the geologic formations of the Colorado Plateau.

**CONCLUSION**
On the basis of the arguments in the above three sections, other explanations are possible for the dual $^{210}\text{Po}$ halos in coalified wood than those proposed by Gentry, and these explanations utilize natural causes rather than miracles. Additional arguments against other hypotheses presented by Gentry (1988) regarding the age and origin of the Earth are presented in Hunt et al. (1992) and Collins (1988).

REFERENCES


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- Return to top
- Return to index of topics

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