How could Carbon-14 be in diamonds?

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Are there "incontrovertible" reasons to affirm a young Earth? What does it mean to be incontrovertible? Some Young Earth Creationists (YEC) seem to believe that this means that it is claimed by any YEC author that they appreciate. It is easy to list claims that might sound impressive. What happens if we dig into those claims? Can they stand up to analysis?

A common YEC claim is that things scientifically interpreted to be millions of years old have characteristics that tell us that they are much younger. If some radioactive elements decay rapidly, then why would we find them in ancient rocks? This concern is from "Reasons to Affirm a Young Earth". (Humber 2013)

The reason given in this case is:

25 Carbon 14 in diamonds

Imagine that you are looking at a photograph from the U.S. Civil War (1861-1865). It is an impressive scene that will serve to document an otherwise unknown conspiracy that caused the South to lose an important battle. You begin to look carefully at it and over in the shadows to the side, you identify an automobile outline, probably a 2020 Nissan Pathfinder, but regardless of the year or model, you know that the photo is fake. That is exactly what YEC believe that the identification of carbon-14 (C-14) represents in materials conventionally dated millions of years old. They believe that it demonstrates that diamonds and coal must be no more than a few thousand years old.

To understand how this works, you need to understand C-14 decay. It is documented that most C-14 was generated from cosmic rays interacting with nitrogen atoms in the Earth's upper atmosphere, creating a small amount of radioactive C-14 which then is taken in by plants and also passed to animals that consume plants or plant-eaters. As an unstable isotope of Carbon, it decays at a predictable rate. The amount of C-14 decreases by half every 5,700 ±30 years. For easy numbers, if a material had 1 gram of C-14 at the start, it would have ½ of a gram after 5,700 years and ¼ gram after 11,400 years. It would keep decreasing and eventually effectively all be gone. Conventional thinking is that too little C-14 remains to reliably date plant or animal material after approximately 50,000 years. The newest work may date things back to 60,000 years ago. It is easy to see the point that YEC make. Why would they detect C-14 at all in coal and diamonds that are conventionally dated as hundreds of millions of years old or perhaps over a billion-years-old in the case of diamonds.

Diamonds

Considering diamonds, we will start by considering C-14 reported in diamonds. It should help to recognize first how diamonds are formed in nature. If you are old enough, you might remember the words of an old country song sung by John Anderson and many others. It began this way:

"Hey, I'm just an old chunk of coal,
But I'm gonna be a diamond someday"

I hate to break this to you, but diamonds didn't come from coal. It does require carbon but not from shallow sources. Natural diamonds form at temperatures and pressures that only exist deep in the Earth, at depths typically of 150–200 kilometers (93–125 miles) below the Earth's surface. Thankfully tectonic forces have brought them up to the surface in places. Today, we can reproduce these temperatures and pressures industrially and make diamonds synthetically.

Just to give an example of where diamonds are found, let's consider diamonds from the Crater of Diamonds State Park, Arkansas. Yes, actual diamonds have been found in the continental U.S.A. and they even attempted to economically mine them at one time. The diamonds are found in weathered igneous rock that originated over 93 miles down below the surface. (Howard and Hanson 2008) They are found in an igneous rock that was part of a volcano that formed when this region was part of a very active tectonic margin. Rocks from deep basins to the south were shoved up to form the Ouachita Mountains. Howard and Hanson, 2008 describe how this volcano sourced material from the Earth's mantle. Rising material from the mantle traveled quickly up the volcanic pipe from great depths at speeds that may have been 60 to 250 miles per hour. The material caught up pieces from the mantle, known as xenoliths and xenocrysts that included diamonds in a host rock known as lamproite. The diamonds themselves were clearly formed deep and sometime earlier than the volcano, which geologists believe exploded around one hundred million years ago in the Cretaceous Period during the time of the dinosaurs. Much of the volcano was eroded away and the region was buried by later Cretaceous sandstones. Fortunately, later erosion exposed the lamproite and as it weathered, apparently over a long time, it became possible to dig through and retrieve diamonds. You can try your hand at digging through weathered remains of the ancient volcanic pipe at the state park. I tried but had no success, but some do retrieve small gem grade diamonds.

Diamonds are basically found in ancient igneous rocks as in the Arkansas example or in gravels where they have presumably weathered out of older igneous rocks. Conventional dating suggests that they are typically hundreds of millions of years old. One would not expect to find C-14 but that is just what YEC investigators report ((Baumgardner 2005; Clarey 2020; Snelling 2007). They report ratios of C-14 to C-12 that correspond approximately to ages of 30,000 to 70,000 years ago and that is a long way from conventional interpreted ages. What is going on?

To make it more interesting, YEC are not the only ones to look for C-14 in diamonds and report such ages! Andrew Snelling reported that C-14 in diamonds was published in conventional literature, literature not written by YEC advocates. (Snelling 2007). When I first heard about this report, I knew that I needed to get the actual report! I wanted to know what the researchers actually did and what they concluded.

The reference report is "Use of natural diamonds to monitor ^{14}C AMS instrument backgrounds" by R.E. Taylor and John Southon, published in 2007 in the journal, *Nuclear Instruments and Methods in Physics Research*. (Taylor and Southon 2007). They were not trying to use C-14 to date diamonds. Their purpose was to see if diamonds that would not be expected to have natural C-14 in them could be used as a standard to compare other analysis to and possibly extend back farther the age range over which materials could be dated using C-14. It sounded like a good thing to test. Diamonds are obviously very hard, relatively available and might be relatively consistent. They knew that in order to extend the range, any real C-14 would be at a very low concentration. This is a real limitation. Instruments will give numbers at low concentrations but those numbers are often not real. It is a bit like trying to us a ruler to measure the width of a human hair. You can give a number, but it is not meaningful.

First, what did Taylor and Southon, 2007 do? They analyzed 14 diamond samples, six of which were cut from a single diamond. The diamonds were from sedimentary rock in Brazil. They will have been eroded out of older rocks and then deposited in the sedimentary rocks and are deemed to be clearly older than 100 million years old by conventional geologic dating. Any C-14 that was there when the diamonds were formed should have been long gone. They reported that the C-14 detected in the lab would be have been consistent with ages of 64.9 to 80.0 thousand years ago.

They did not immediately announce to the world that these diamonds were formed just this many thousand years ago. Why? Were they just blinded by their biases? Notice that they did not bury the results. They published them. While they might have hoped that the concentrations of C-14 were less, in order to extend the useful range of C-14 dating, they were not surprised that it was detected. Why? They list six possible sources of "pseudo-14C signal in AMS-based 14C measurements".

These include:

1. **Pseudo ^{14}C-free sample.** This includes the isotope introduced during chemical or physical pretreatment.

2. **Combustion/acidification background.** The device could retain a tiny amount from previous work.

3. **Graphitization background.** Again, this is another way that the material handling or device could contain contamination.

4. **Transfer background.** During sample preparation and transfer, some isotope could be introduced.

5. **Storage Background.** C-14 is naturally in the air and in dust, and tiny amounts could adhere to the samples

6. **Instrument background.** Physical devices and processes can be fooled. Anomalies occur.

None of these are issues when dealing when the C-14 ratios are in the normal range, but looking at the edges of the detection range, numbers have to be suspect. Taylor and Southon, 2007 have suggested methods by which extraneous C-14 might be introduced and measured in the lab and they report that this fits what they found. If contamination is the source of the C-14 and they have suggested multiple points at which it might be introduced, then how much contamination would be involved? Based on ideas from Sean Ovis, a Facebook friend, it is indeed possible to do some calculations that help to understand this. If we were to analyze a sample of carbon with C-14 in it, then if there is no contamination and the mass spectrometer is working perfectly, it should calculate the proper age at any concentration. However, what if by one of the methods named above or by some other method not recognized, a tiny amount of C-14 were introduced as contamination? That would make the sample appear not to be quite

as old as it really is. At first the effect would be minor, but for older samples, less of the original C-14 would be present, meaning that the C-14 from contamination would represent a more and more significant portion of the C-14. Eventually the age calculated would converge on a number that represents just the apparent age of the contamination. **Table 1** shows how this looks. Notice that depending on the amount of contamination, the values converge on apparent ages that reflect the amount of extraneous C-14. Taylor and Southon 2007 reported ages of 64.9 to 80.0 thousand years ago. This would be consistent with 0.01 to 0.001 percent contamination. This seems like a very reasonable explanation for the results that they found and also for the results reported by the YEC RATE study (Baumgardner 2005). It is very difficult for a laboratory to eliminate sources of contamination to the levels required to remove this probability.

Taylor and Southon 2007 also analyzed samples of graphite. Pure natural graphite is pure carbon just as diamond is. Its crystal structure is very different and it formed under very different temperatures and pressure conditions. Apparent ages for the graphite samples analyzed ranged from 58,400 to 70,100 years old. Slightly younger ages calculated mean that somewhat more C-14 was measured. That makes sense because the graphite structure would have provided more opportunity for contamination to adhere to the sample.

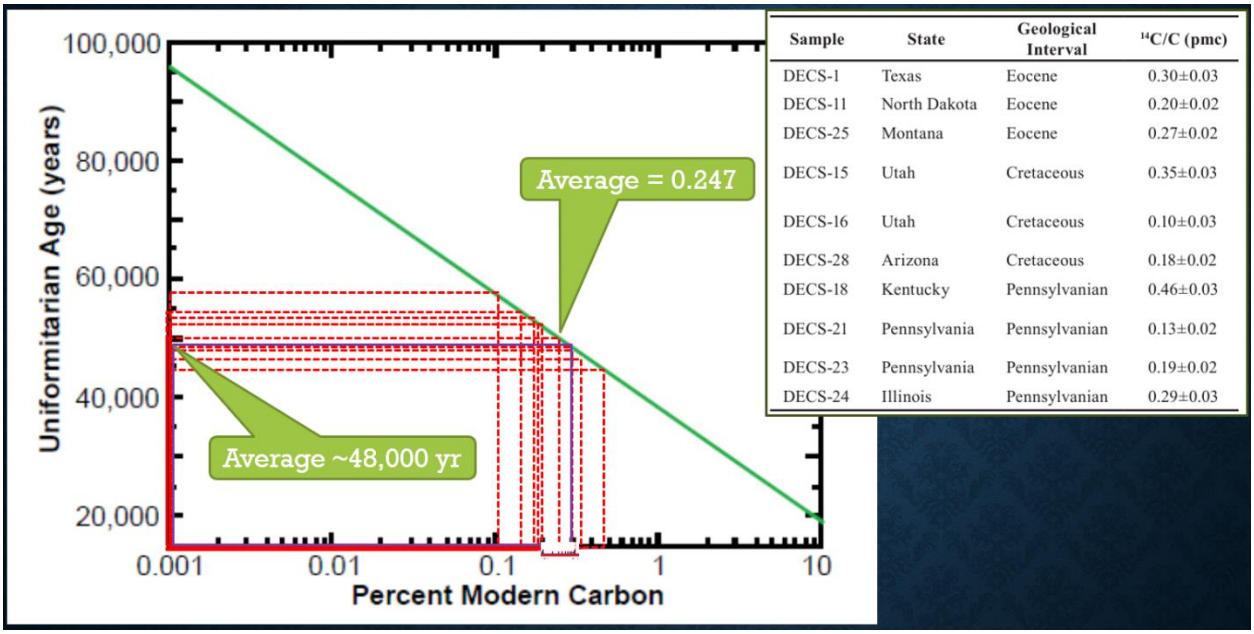
Actual Age	*Apparent age with % of contamination*			
	0.10%	**0.05%**	**0.01%**	**0.001%**
2,000	1,895	1,948	1,989	1,999
5,730	5,566	5,648	5,713	5,728
11,460	11,136	11,296	11,427	11,457
17,190	16,554	16,866	17,124	17,183
22,920	21,693	22,284	22,789	22,907
28,650	26,355	27,423	28,390	28,624
34,380	30,291	32,085	33,867	34,327
40,110	33,297	36,021	39,114	40,005
45,840	35,343	39,027	43,956	45,631
51,570	36,594	41,073	48,152	51,157
57,300	37,299	42,324	51,471	56,494
63,030	37,675	43,029	53,817	61,490
68,760	37,870	43,405	55,298	65,922
74,490	37,969	43,600	56,152	69,543
80,220	38,019	43,699	56,614	72,200
85,950	38,044	43,749	56,855	73,937
91,680	38,057	43,774	56,979	74,965
97,410	38,063	43,787	57,041	75,531
103,140	38,066	43,793	57,072	75,829
108,870	38,068	43,796	57,088	75,982

Table 1. *Calculations of the apparent age of C-14 samples with small amounts of contamination from some other source. Notice that the numbers converge on ages based on just the contamination as the original material decayed away.*

The fact that C-14 dating is not available in diamonds does not mean that radiometric dating is of no use. Remember that there are over 40 different radiometric methods available to date various things. It is now recognized that while the carbon in diamonds cannot be dated, some have tiny impurities as inclusions and some of these can be dated. (Pay, Shigley, and Padua 2014). All diamonds have some imperfections and a few have inclusions that have radioactive elements that are normally rare. In this case, these scientists have been looking at concentrations of rhenium-187 that slowly decays into osmium-187 and occurs as trace elements in the inclusion minerals. With a half-life of 41 billion years, this decaying process allows measurement of events from really long ago. By carefully cutting out sulfide minerals preserved in diamond inclusions, they have been able to date the inclusions in these diamonds. They have confirmed that diamonds grew at different depths. They found that diamonds from the deepest regions, known as “superdeep diamonds” also are the oldest and formed as early as 3.5 billion years ago. Such dates fit nicely into the geological deep time understanding of Earth’s history but are far removed from YEC proposed ages.

Coals

This "reason to affirm a young earth" also included C-14 tested in coal samples (Humber 2013; Baumgardner 2005). They tested coals from three different geologic periods, all older than when natural C-14 would be expected, and they reported C-14 in all samples. That is consistent with the results in diamonds. With an average "age" of 48,000 years, they had a bit more C-14 than the diamonds. (**Figure 1**) That is consistent with results from the graphite that Taylor and Southon, 2007 reported. The additional C-14 could be just the result of contamination that more easily adheres to coal than the hard diamond surface.



Sample	State	Geological Interval	$^{14}C/C$ (pmc)
DECS-1	Texas	Eocene	0.30±0.03
DECS-11	North Dakota	Eocene	0.20±0.02
DECS-25	Montana	Eocene	0.27±0.02
DECS-15	Utah	Cretaceous	0.35±0.03
DECS-16	Utah	Cretaceous	0.10±0.03
DECS-28	Arizona	Cretaceous	0.18±0.02
DECS-18	Kentucky	Pennsylvanian	0.46±0.03
DECS-21	Pennsylvania	Pennsylvanian	0.13±0.02
DECS-23	Pennsylvania	Pennsylvanian	0.19±0.02
DECS-24	Illinois	Pennsylvanian	0.29±0.03

Figure 1. *Graphical determination of apparent ages for coal samples from Baumgardner, 2005. The base graph is also from Baumgardner, 2005.*

Coal offers additional options for sourcing C-14. It is recognized that uranium concentration increases in coal because of the reducing environment there. It has been suggested that neutrons released by uranium decay could hit nitrogen atoms and result in forming C-14. Although hypothetically this could have occurred, we don't know that it has and it is may be such a minor contributor that it is not significant. (Mason 2018)

Ancient coal was proposed as a source of C-14 free carbon and studied in the 1980's. David Lowe published a study proposing that the cause of C-14 contamination in coal is bacteria. (Lowe 1989) Studies have documented that coal is often host to bacteria in the subsurface. (Barnhart et al. 2016; Soares et al. 2023). Soares et al (2023) reported "*12–20 % of Earth's biomass is suggested to exist in the terrestrial deep subsurface, compared to ~1.8 % in the deep subseafloor*." In some cases, methane gas is generated by bacteria as they consume carbon. It is reasonable to assume that it is possible for C-14 to be carried in the bacteria.

Could the bacteria have been introduced when the RATES sample were collected? It is hard to rule that out, but the sample collection was apparently done carefully. The samples were obtained from

the U. S. Department of Energy Coal Sample Bank. Baumgartner wrote, "*The original samples were collected in 180 kg quantities from recently exposed areas of active mines, where they were placed in 115 liter steel drums with high-density gaskets and purged with argon*." This is all to say that they tried to keep the samples pristine.

Responding to a critical article (Bertsche 2008), John Baumgardner rejected bacteria in coal as a source of increased C-14, saying, "*It they are eating the coal, then how can the 14C levels within them be any different from that of the coal itself? It seems he's grasping for straws here*." (Baumgardner 2007)

It is true that if the bacteria are immobile, no new carbon isotopes would be introduced. This assumption seems to be challenging. We know that fluids move in the subsurface. This happens particularly at shallow depths where bacteria are most active. Normal mining operations are disruptive well behind the mining face. Fracturing allows fluids to pass through. If we were to take the readings on diamonds as what might be expected based on other contamination, then it is reasonable that the difference could have been contributed by bacteria that moved into the coals.

Conclusions

This article began by asking you to imagine a photograph from the U.S. Civil War (1861-1865) where you identified in the shadows what you interpreted to be the outline of a modern automobile. Identifying a modern automobile in the photograph would have been proof that the photo was a fake. What if that identification of the car in the shadows turned out not to be so sure? What if upon detailed study, what you thought was a car turned out to be a smudge on the negative? While the photo might not be true, the evidence that you used to make that call would have evaporated. It is true that when materials such as ancient diamonds or coal, mass spectrometers can detect the presence of C-14. We have seen that only tiny amounts are reported at rates beyond the limits commonly recognized for such study. No control tests that showed zero C-14 are presented. Such tests would support the view that the C-14 in the tests were not the result of contamination. If tests of higher concentrations were encountered, particularly repeatable and clustered, that also would be difficult to reconcile and need investigation. That is not the case for these results.

I would like YEC to consider what they would think if the situation were reversed. What if there were literally thousands of radiometric dates involved that pointed to a young earth? That would be pretty strong evidence. What if then scientists tested a few samples and reported evidence from these samples that the Earth is millions of years old? To go a little further down this imaginary scenario, imagine that the evidence for the old earth involved tiny fractions in the range that would often be considered noise or due to contamination. Regardless of the outlier nature of the results, the scientists declare that they have proven that the Earth is millions of years old. Would YEC be satisfied with evidence such as this? Radiometric dating from 40 different techniques confirm that the Earth is far older than 6,000 years old. It supports the interpretation that God created the universe and the Earth over deep time.

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