Magnetized moon rocks shed light on Precambrian mystery

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The moon's former magnetic field is a key that unlocks the mystery of where to fit the Precambrian geologic era into the short biblical history of the world. Moon rocks record an initially strong magnetic field which decayed by several orders of magnitude while the rocks were also recording several billion years worth of nuclear decay. Various data constrain the natural decay of the moon's magnetic field to a half-life of roughly 100 years. That is far too long for the magnetic decay to have happened by natural laws within the few ordinary-length days of the Creation Week. On the other hand, it is far too short for the moon's magnetic field to still have a significant strength by the time the Genesis Flood was occurring on Earth. I propose that the large decays, both of the moon's magnetic field and of radioactive nuclei in its rocks, took place during the Antediluvian age, the 1,656 years between the Fall of Adam and the Genesis Flood. If nuclear decay rates were constant during that period, then to account for the nuclear data they would have to be roughly two million times faster than today's rates. If this period of accelerated nuclear decay was uniform throughout the solar system, then during the Antediluvian age most radioactive isotopes on Earth would have to have been underground, so life at the surface would be preserved. Nonetheless, the Antediluvian age would have considerably been less tranquil physically than most of us have pictured it.

"It shall be established forever like the Moon, And the witness in the sky is faithful" (Psalm 89:37).

Precambrian rocks are a mystery to both uniformitarian and creationist geoscientists. Figure 1 shows the radioisotope ages by which the Geological Society of America currently defines the Precambrian geologic era, from 4.5 Ga to 0.54 Ga ago.[1] (1 Ga = 1 Giga-annum = 1 billion years.) Three eons comprise the Precambrian. Most meteorites give ages of about 4.56 Ga,[2] marking the beginning of the Hadean eon. Only a few things on Earth, a rock dated at 4.03 Ga and some zircons dated at 4.4 Ga, represent the Hadean eon, the period during which the uniformitarians imagine the earth was very hot and forming by accretion. On the moon, some impact-formed rocks are Hadean, with ages up to 4.3 Ga.[3] A mudstone on Mars gives a date of 4.2 Ga.[4] On both Earth and the moon, rocks dated between 4.0 Ga and 2.5 Ga are assigned to the Archean eon. Rocks dated from 2.5 Ga to 0.54 Ga are called Proterozoic.

On Earth, few multicellular fossils appear below the Cambrian–Precambrian boundary (assigned an age of 0.54 Ga), yet they are abundant above it, in the Phanerozoic eon. For that reason many (not all) creationists once thought that boundary marked the beginning of the Genesis Flood. Most would now consider that the pre-Flood boundary is below the base of the Cambrian.[5,6]

The Radioisotopes and the Age of the Earth (RATE) research initiative,[7] of which I was a part, found several lines of evidence that God speeded up the decay of long-half-life radioactive isotopes by a factor of roughly 500 million during the year of the Genesis Flood. Such an acceleration of nuclear decay would account for the span of 540 Ma years assigned to the Phanerozoic. RATE postulated an accelerated volume-cooling mechanism during the same year to limit—not eliminate—the great heat generated by such rapid nuclear decay.

RATE also postulated that the nuclear decay acceleration occurred simultaneously through the solar system (and possibly the cosmos), in order to account for the observed large radioisotope ages of meteorites and the moon rocks brought back by the Apollo astronauts. 'Simultaneously' means that at any given instant the decay rate of each of the various isotopes would be the same everywhere, at least within the solar system.[8] This requires a deep and general cause, probably a change in the very fabric of space itself.[9]

This uniformity of rates implies that radioisotope dates would be (at least approximately) valid in a relative sense throughout the solar system, giving the proper sequence of geologic events, but not their absolute ages. This would compress the radioisotope age scale from billions of years down to thousands of years. But that kind of compression would not obliterate the relative order of the dates,[10] though some creationists disagree.[11]

Where to put the Precambrian?

Many thousands of terrestrial samples, and hundreds of extra-terrestrial ones, give radioisotope ages that are deep into the Precambrian. This would require at least one additional period of accelerated nuclear decay besides the year of the Genesis Flood. RATE considered several hypotheses for when the additional period(s) might have occurred: [12]

1. *During Creation Week*, preferably before the land plants appeared during Day 3.
2. *During the Antediluvian age*, between the Fall of Adam (not long after Creation Week) and the Genesis Flood, 1,656 years after creation.[13]
3. *Just before the Genesis Flood*, or pos-sibly in the beginning of that year.

The geoscientists on the RATE steering committee felt that the large amount of Precambrian geologic activity, much greater than in the Phanerozoic, would not fit well into just a month or so before, or in the year of, the Flood. That made option (3) seem unlikely. Lately, however, some creationists have begun to consider that possibility.[14]

The RATE team felt that option (2) was not a likely possibility either. Although Precambrian geologic activity would have been spread over more than a millennium, it would still have made the Antediluvian age more violent geologically than we usually picture it. Not only that, but most radioisotopes on Earth would have to have been underground to protect living creatures at the surface from the enhanced radiation due to the accelerated decay. Over the years, however, I have encountered a few creationists who suggested there was significant geologic activity during the Fall-to-Flood period.

Most of the committee, myself included, decided to go with option (1), accelerated decay during Creation Week, though a few members felt that nuclear decay did not fit well into God's pronouncement of "very good" upon all that He had made during Creation Week (Genesis 1:31). Our project leader, Dr Larry Vardiman, outlined the issues of that (gentlemanly) discussion in his summary of the RATE results,[15] concluding that we had not resolved them to everyone's satisfaction.

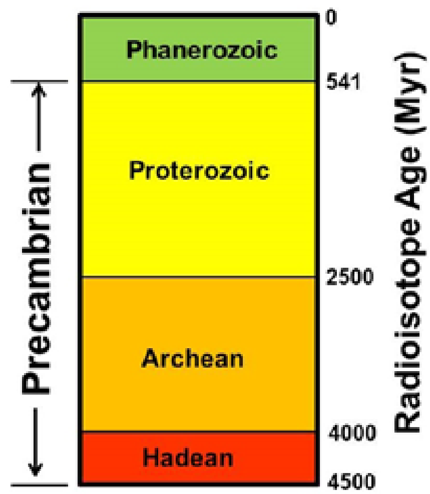

Figure 1. Radioisotope ages defining the Precambrian. 1000 Ma = 1000 million years = 1 Ga.

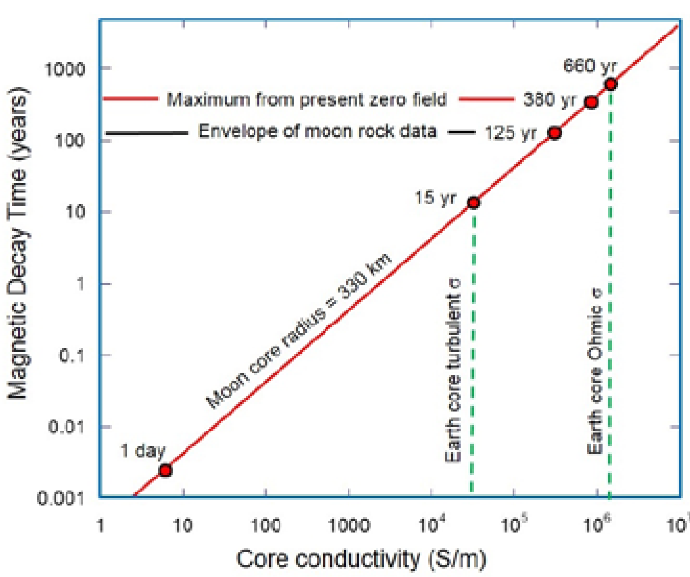

Figure 2. Decay time, τ, of the moon's magnetic field depends on the electrical conductivity of its core. (1 S/m = 1 mho/m.) Vertical dashed lines are the estimated turbulent and Ohmic conductivities of the earth's core, between which is the likely conductivity of the moon's core.

Moon magnetism to the rescue!

A better solution appears to exist. The rock record of the moon's former magnetic field points strongly to option (2), putting the Precambrian into the Antediluvian age, between the Fall and the Flood. In this section I show the moon rock magnetic data and estimate the decay time of the lunar magnetic field. In the next section I explain how these data favour option (2) over the other two options.

Today the moon has no detectable overall magnetic field. But rocks the astronauts brought back to Earth turn out to have been magnetized by a field the moon once had. The most ancient (by radioisotope dating) of them formed in a magnetic field about as strong as the earth's field is today. Less ancient rocks show a lesser field, and the most recent ones show essentially no field, as measured today. Clearly something destroyed the lunar magnetic field.

The uniformitarian 'dynamo' theories to explain the magnetic fields of both the earth and the moon continue to fall short of working quantitatively, after nearly a century of strenuous effort.[16] The only theory that explains the fields is the creationist model of an exponential decrease (constant % decay per year), probably modulated by polarity reversals as I explain below, of the electric currents within the conducting cores involved. The magnetic decay time, τ, depends on the radius, R, of the core, and its electrical conductivity, σ :[17]

$$\tau = \frac{\mu_0 \sigma R^2}{\pi^2} \qquad (1)$$

where μ_0 is an electromagnetic constant having the value $4\pi \times 10^{-7}$ Newtons per Ampere^2. An array of seismic sensors left on the moon by the astronauts give data indicating the moon has a fluid core 330 km in radius with a density like that of molten iron, like that of the earth's core.[18] Figure 2 shows how the decay time, τ, of the moon's core would depend on its electrical conductivity according to eq. (1).

We need to estimate roughly what that decay time was. To do that, we need to estimate the electric conductivity of the lunar core. We can use data from the earth to set an upper limit and a lower limit on it. First, a first-principles numerical simulation of the molten iron alloy in the earth's core gives its average *Ohmic* (or 'molecular') conductivity, the conductivity in a motionless fluid, as 1.5 million S/m.[19] (1 S = 1 Siemens = 1 mho = 1 Ohm^{-1}.)

Because the earth's core is highly turbulent (even though fluid speeds are low),[20] it has a *turbulent* conductivity which turbulence theory says would be several orders of magnitude lower than the Ohmic conductivity.[21] An accurate fit to the exponential part of the decay of the earth's magnetic dipole gives a turbulent conductivity of 33,000 (±200) S/m.[22] Figure 2 shows these two values as vertical dashed lines. They intercept the solid line (decay time) at 15 years and 660 years. The moon's core is at a lower pressure and temperature than the earth's core, so its Ohmic conductivity would be somewhat lower than the earth's.[23] Because the moon's core is much smaller than the earth's, it is probably less turbulent.[24] So the turbulent conductivity in the moon's core would be greater than in the earth's core. Thus the moon's conductivity would probably fall between the two dashed lines. That would mean the moon's magnetic decay time, τ, was considerably more than 15 years and considerably less than 660 years.

Moreover, if we fit an exponential decay to my theoretical created field of 349 μT (item 0 in table 1) and to the estimated upper limit from the absence of a measurable present field, 0.00005 μT (item 23 in table 1), 6,000 years after creation, we can conclude a maximum for the decay time of 380 years. This further constrains the moon's magnetic decay time, τ, to considerably more than 15 years and less than 380 years.

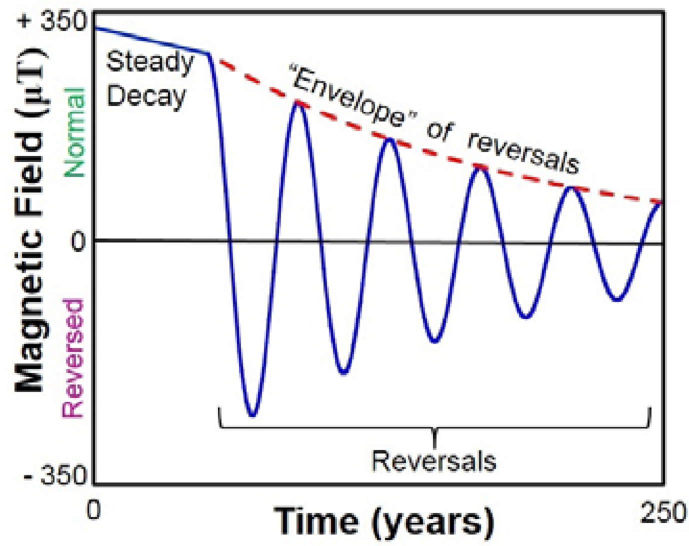

Figure 3. After a short period of steady decay, the field starts reversing while also decaying faster.

There are other ways the moon rocks can further constrain τ. All of them are igneous, including the breccia, which are composed of impact-formed pieces of igneous rocks. They show many mineralogical signs of having crystallized from a melt, just like igneous rocks on Earth. Basalts from the lunar maria clearly formed from vast lava flows. Some of the impact-formed rocks apparently were remelted by shock heating.

After the rocks cooled and became solid, they began accumulating nuclear decay products. As they cooled down further through their Curie temperature (500 to 700°C), iron-containing minerals within them became magnetized by the field then in existence. Paleomagnetism experts use various techniques to determine the *paleointensity*, the strength of the ancient field that did the magnetization. Unfortunately the most reliable paleointensity measurement technique, involving heating in steps, cannot be used with most moon rocks, because they change chemically when heated. The other techniques which must be used give paleointensities with more scatter, sometimes underestimating the true paleointensity,[25] as can happen in the case of similar rocks from Earth.

Another factor causing scatter may be reversals of the lunar field's polarity, which were also occurring on Earth[26] during the Precambrian. Figure 3 illustrates a brief period of slow decay with no reversals, followed by faster exponential decay while magnetic polarity reversals are going on. The

Table 1. Ages and magnetic fields on the moon are related. 100 μT = 1 Gauss. Most items are measured paleointensities and radioisotope ages from ref. 45. Item 0 is the theoretical created field from ref. 46, placed at a radioisotope age of 4.5 Ga. Item 1 is a measured range of paleointensities from ref. 47. Item 2 is theoretical, postulating the moon's created field decayed slowly until the lunar core melted at 4.0 Ga. Item 12 is a recently-measured paleointensity from ref. 48. Item 23 is an upper limit on the field today determined by the lack of any measureable large-scale field at present, from ref. 49. Model Time, in years since Creation, is based on eq. (2).

Item	Radioisotope Age (Ga)			Magnetic Field (μT)			Model Time (yr)
	Mean	Min	Max	Mean	Min	Max	
0	4.50			349			0
1	4.20	3.90	4.60	220	0.6	440	124
2	4.00			247			207
3	3.91	3.82	4.00	7.2	4.2		244
4	3.89	3.85	3.98	1.1			253
5	3.89	3.80	3.96	19	13	22	253
6	3.85			41	19	71	269
7	3.86			130	70		265
8	3.81	3.77	3.89	115			286
9	3.70	3.67	3.74	36		43	331
10	3.68	3.60	3.78	40	32	70	339
11	3.60	3.56	3.64	2.2	1.3		373
12	3.56			69	53	85	389
13	3.56	3.52	3.59	14.5	4.1		389
14	3.54	3.49	3.60	1.8	1.5	2	397
15	3.40	3.36	3.44	9	7.2	10	455
16	3.34	3.27	3.44	2.2		9.5	480
17	3.34	3.27	3.42	4.9			480
18	3.34	3.27	3.45	8			480
19	3.06	3.00	3.10	3.7	3	10.5	596
20	1.50	0.10	2.90	0.006		0.29	1242
21	1.30	0.00	2.90	0.032	0.02	0.05	1325
22	0.10	0.00	0.15	0.011	0	0.25	1656
23	0.00					0.00005	6000

dashed line represents what radio engineers would call the 'envelope' of the decaying sinusoid.

If the time a rock cooled was during a transition from one polarity to the other, the rock would record a less intense field than the peak field that occurred just previously. This would contribute to the apparent scatter in the paleomagnetic intensities. The original orientations of the loose rocks brought back by the astronauts are not known. So the lunar paleointensities give us only the magnitude of the moon's field, not its sign or direction. Figure 4 illustrates what we would see in the magnitude data, representing samples at random times.

Next, we need to relate the very long radioisotope ages of moon rocks to their real age of thousands of years. The simplest model is that the accelerated rates of decay were constant during the 1,656 years between the Fall and the Flood. The 4.0 Ga worth of nuclear decay, from 4.5 Ga to 0.5 Ga, would have occurred during that period. Then the time, *t*, in years after creation, corresponding to a radioisotope age of *T*, in Ga, would be:

$$t = (1656 \text{ yr}) \left[1 - \frac{(T - 0.5 \text{ Ga})}{4.0 \text{ Ga}}\right] \quad \text{for } 4.5 \text{ Ga} \geq T \geq 0.5 \text{ Ga} \qquad (2)$$

Now we are ready to analyze the magnetic data from moon rocks. Table 1 shows all such data that I know of, along with the radioisotope ages of the rocks.

Figure 5 shows the paleointensities and radioisotope ages of table 1. Though the scatter is large, greater than the statistical errors, it is clear the intensities tend to decrease with time. The two straight sloped lines represent exponential decays. The lines approximate the envelope of the field, based on the theoretical model I describe in the text below.

For the first line I assume the lunar core was *solid* (but still at high temperature) for the first 200 years after creation. Next I use the calculated Ohmic conductivity of Earth's core (1.5 million S/m, see text near figure 2) as an estimate of the conductivity of solid iron in the lunar core. That would give a decay time of 660 years (see uppermost dot in figure 2). This would cause the field to decay smoothly, from an initial value of 349 μT at 4.5 Ga (item 0 of the table) down to 247 μT at 4.0 Ga (item 2). The initial (created) field intensity of 349 μT comes from a biblically based theory of mine that has had remarkable success explaining the present intensities of large-scale magnetic fields in the solar system.[27]

Next, I assume that heat from accelerated decay of radioisotopes in the lunar core was enough to *melt* the lunar core after two centuries. Continued nuclear heating would cause the molten iron to rise and fall convectively within the core. The resulting turbulent resistivity would decrease the conductivity of the lunar core and thus decrease the exponential decay time below 660 years (see figure 2). The convection flows would probably be enough to start polarity reversals of the field.[28] Then the data from that period would resemble figure 4, except that the vertical axis of figure 5 is logarithmic instead of linear.

The exponential 'envelope' of the data would resemble the second sloped straight line of figure 5, which decays from 247 µT at 4.0 Ga down through 0.032 µT at 1.3 Ga (item 21).

All but item 22 of the table fit beneath the line (the lower limit of item 22 would also fit beneath the line). This is not a statistical fit to the data (which would be misleading), but rather an attempt to find the 'envelope' (see text near figure 3) of the reversals. The slope shown is merely a rough estimate, giving an exponential decay time, τ, of 125 years, which is a half-life of 87 years. That fits well between the limits for τ we established above, considerably more than 15 years and definitely less than 380 years. These considerations give me confidence that for most of its history the moon's magnetic field had a decay time, τ, between one and two centuries. Conveniently for quick estimates, this means the lunar field had a *half-life* on the order of *100 years*.

Magnetic data put the Precambrian into the Antediluvian age

Recently a friend who favoured option (1) asked me, "Why couldn't most of the moon's magnetic decay have happened in one day during Creation Week?" That is possible but, in my opinion, not very likely. During that day, God would presumably have had to decrease the electrical conductivity of the lunar core by a factor of hundreds of thousands below that of a metal, making it nearly an insulator.[29] See the '1 day' point in figure 2. After that day, He would presumably have had to restore the core conductivity to that of a metal again, as present-day observations suggest.[30] Such acts would be supernatural. Of course, God did many supernatural things during creation, but why would He do this one? It would mean that He would eliminate more than 99% of the lunar magnetic field He had created just a few days before. Like bombardments and lunar maria, this appears to be a destructive rather than a creative act. I can think of no reason why God should have gone out of His way to destroy nearly all the moon's magnetic field during Creation Week.

The roughly 100-year natural half-life of the lunar field also eliminates option (3), having the Precambrian occur right before the year of the Genesis Flood, or right at the beginning of that year. That is because the lunar field would be about 100,000 times less intense by the time of the Flood than at Creation—essentially zero. In that case, the moon rocks would not have recorded a detectable magnetic field while they were recording the Precambrian 4 Ga worth of nuclear decay.

Thus, in the interest of explaining the maximum amount of data with the least number of hypotheses, it seems simplest to go with option (2). We let the magnetic decay proceed at the natural rate during the 1,656 years, while at the same time nuclear decay takes place at a relatively moderate acceleration of rates. Figure 5 fits that picture of things in an unforced way. That puts the Precambrian geologic era into the Antediluvian age.

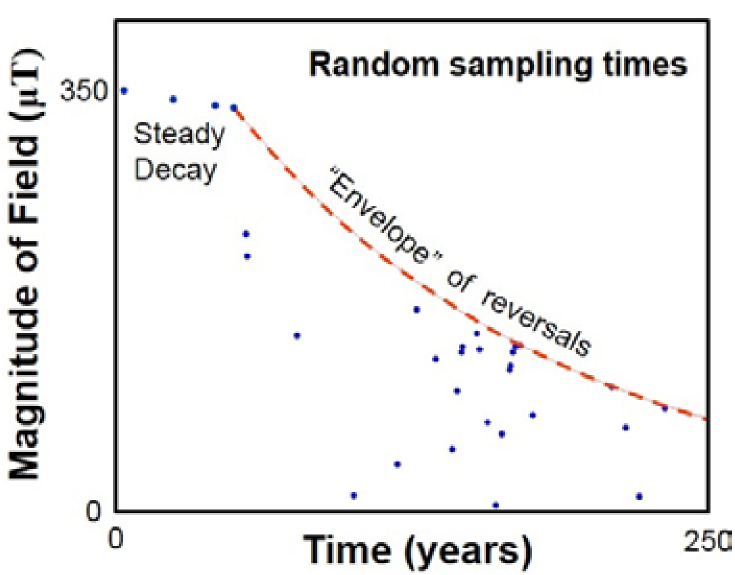

Figure 4. Unoriented moon rocks give only the magnitudes of the field in figure 3 at random times, resulting in seeming scatter.

Astronomy in the Antediluvian age

Very soon after the Fall, some catastrophe appears to have produced the meteoroids. Soon after that meteors began to make craters in the solar system. Most meteorites have a radioisotope age of 4.56 Ga, as determined from many studies.[2] The model timescale of eq. (2) would place the Late Heavy Bombardment (LHB) of the moon (second item in third section), 3.9 to 4.0 Ga, as occurring during the third century after the Fall. Most of the moon's 5,000 craters greater than 20 km in diameter would have been made during that time, at the rate of about one large impact per week. These impacts would have been spectacular for Adam and Eve, their surviving children (including Cain and Seth but not Abel), plus several more generations. It takes an impact with the energy of about 7,500 Megatons of TNT to make a 20-km crater.[31] That is seventy-five times stronger than the largest thermonuclear weapon ever exploded.

On the dark part of a crescent moon, such an impact would make a brilliant flash, much brighter than Venus, fading to a bright orange glow within a few seconds.[32] Dayside impacts would raise large clouds of dust, taking hours to settle in the low lunar gravity. Occasional large impacts would continue for centuries. Lesser impacts would be much more frequent, perhaps watched through telescopes as the pre-Flood civilization advanced technologically (Genesis 4:22), along with larger impacts in other parts of the solar system.

A frightening aspect of the lunar bombardment would have been the simultaneous bombardment of Earth. Though God may have aimed most of His rocks (or chunks of ice) at the moon, craters on Earth tell us that He allowed some to hit our planet. Of the 44 confirmed impact craters on Earth greater than 20 km in diameter, 9 have Precambrian dates.[33] There must have been thousands of smaller impacts, and there were probably intense meteor showers for many centuries.

Two of the Precambrian craters are the biggest ones yet found on Earth. The largest, at Vredefort in South Africa, with a radioisotope age of 2.02 Ga, has a diameter of 300 km. The crater is highly eroded, apparently by the floodwaters occurring centuries later. The impactor would have been seen, day or night, over perhaps half the earth, as a huge fireball streaking through the sky. Its impact had an estimated energy of 30 million megatons of TNT![34] That corresponds to the energy of an earthquake of stupendous magnitude, 12.2 on the Richter scale,[35] so the impact would have been heard and felt by people on the opposite side of the earth. The flash would have been so intense that its reflection from the moon would have been highly visible, even to people on Earth's dayside. Stratospheric dust from the impact probably circulated the earth for many decades, reddening sunsets and cooling the climate.

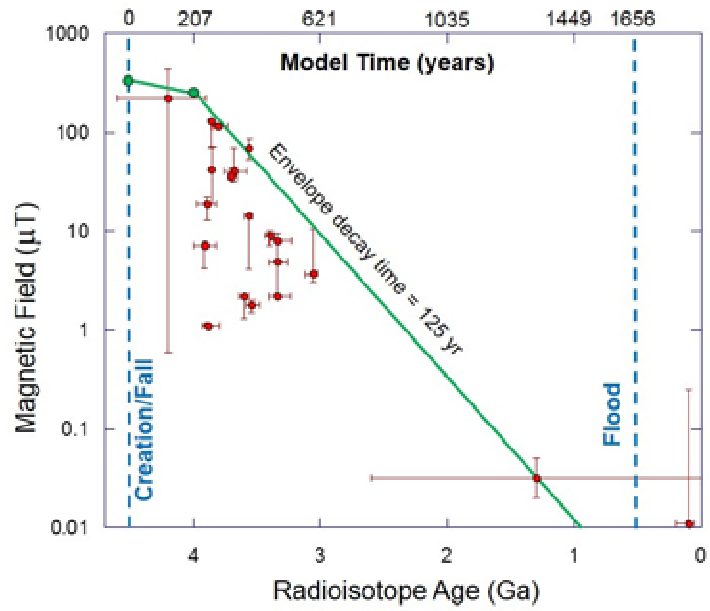

Figure 5. Lunar magnetic field decreased with time. Data from table 1. A straight line sloping downward in this logarithmic vertical scale graph represents an exponential decay. The lines shown, a theoretical model, contain all but one data point. According to the model timescale at top, the second straight line represents a decay time, τ, of 125 years, or a half-life of 87 years. It indicates the envelope of the postulated polarity reversals, figures 3 and 4.

By the model timescale in eq. (2), the Vredefort impact would have occurred about 1,000 years after creation, not long after Adam's death and the translation into heaven of Enoch (Genesis 5), who spoke out strongly against the ungodliness and sin of his generation (Jude 14, 15). Cities within a few hundred kilometres of the impact must have been obliterated, God perhaps making an example of them as He did (after the Flood) of Sodom and its neighbouring cities (Jude 7). Such a judgment of sin would be a specific example of one of God's purposes in causing destructive events in the pre-Flood world.

Another ominous sign in the Antediluvian sky would have been the growth of the lunar maria, vast flows of lava pouring forth on the moon's face and blackening it. Occurring after the LHB, the maria have radioisotope ages from 3.0 to 3.5 Ga, putting them at about 400 to 600 years after creation according to eq. (2). Some theorists think that large impacts caused the lava flows. However, the accelerated nuclear decay going on continually during this period would have heated rocks on and below the lunar surface. Though limited by accelerated cooling, such heat would have built up over the years and eventually melted the more radioactive rocks. That would make the maria similar to the large continental flood basalts that formed on Earth later, during and after the year of the Genesis Flood.

The bombardments and the maria would warn pre-Flood mankind that all was not well with the world, and that God is willing to use great power to judge sin. These portents in the sky were an important validation of the apparently small amount of revelation the Antediluvians had from God, such as the accounts from Adam and Eve, and prophetic warnings from Enoch (Jude 14, 15) and Noah (2 Peter 2:5). These appear to be the main reasons God wrought so much destruction in the solar system after the Fall. In contrast, option (1) puts the destruction into Creation Week without offering any real reason for it.

Geology before and during the Flood

One difficulty creationist geoscientists may have with option (2) is the large amount of geologic activity recorded in Precambrian rocks. All the Precambrian rocks known on Earth are on the present continents. Some go as far down as continental core drilling can verify, about 12 km. Below the Phanerozoic strata, the Precambrian may comprise much of the present continental crust, which averages about 40 km thick. Most deep crustal rocks, often called 'basement' rocks, are metamorphic or igneous, showing the effects of great heat and distortion. If many of these rocks were formed at or near the surface of pre-Flood continents, the violent geologic activity and radioactivity could have greatly endangered terrestrial life.

It may make it easier on the imagination to note that the rate of formation of continental crust during the Antediluvian age would have been fairly low. Forty kilometres of crust forming during 1,656 years would be an average formation rate of about 1 inch per hour. Radioisotope evidence suggests that the crust formed in several spurts during the Precambrian, so it would have had periods of faster formation than the average. But then during other periods the rate would have been lower than the average. If the crust formed at roughly an inch per hour deep underground, with only occasional eruptions at the surface, it is not too hard to imagine that the process would not have been badly disruptive for surface life.

A second important factor in evaluating option (2) is the scarcity of multicellular fossils in the Precambrian. Evidence suggests single-celled life that lived on or in sea-floor sediments, such as (possible) stromatolites, formed by algae.[37]

About fifteen years ago a friend of mine, Roy Holt, now with the Lord, proposed an idea that now sheds light on the above problems. (Other creationists have proposed it as well.) He suggested that during the Genesis Flood sea and land somehow reversed their roles.[38] Before the Flood, during the Antediluvian age, the continents we now stand on would have been beneath the sediments of shallow seas or deep ocean floors. The 'dry land' of Genesis 1:9, which God called 'earth', would have been elsewhere on Earth.

Then the Genesis Flood would have swept the surface materials of the pre-Flood continents, mixed with land plants and animals, into the pre-Flood oceans. This fits a literal understanding of verses such as Genesis 6:7 and Genesis 7:23 (emphases my translation):

> "And the Lord said, 'I will *wipe off* man whom I have created *from* the face of the land, from man to animals to creeping things and to birds of the sky; for I am sorry that I have made them.'"
>
> "Thus He *wiped off* every living thing that was upon the face of the land, from man to animals to creeping things and to birds of the sky, and they were *wiped off from* the earth … ."

In these verses, the Hebrew word I have translated as '*wiped off*' is often translated as 'destroyed' (KJV) or 'blotted out' (NAS). But the primary meaning of the verb is more literal,[39] namely 'to wipe off', as dirt off a dish. Both the KJV and the NAS translate the same verb that way in 2 Kings 21:13 (NAS):

> "… and I will wipe Jerusalem as one wipes a dish, wiping it and turning it upside down."

This verse suggests the verb can include the idea of a complete wiping-off, leaving no dirt behind on the plate. The word 'from' I have *underlined* in the two Genesis verses above are there explicitly in the Hebrew. The first 'from' is literally 'from upon' the face of the land. That indicates the wiping-off left no creature upon the land surface. The second 'from' also implies that. The word for 'land' is often translated as 'ground'. The word for 'earth' often means 'dry land', as in Genesis 1:9. Taking these verses straightforwardly means the waters swept mud, plants, and animals completely off the formerly dry land, the pre-Flood continental surface. Unless God miraculously disposed of them, these materials would then have had to go

Image: Don Davis, NASA.

Figure 6. Known Precambrian impacts were probably at sea.

into lower-altitude areas that were not land, namely the pre-Flood ocean basins, either shallow or deep.

This scenario would give a certain degree of order to the fossils. Mud from the pre-Flood land would have immediately burried pre-Flood seafloor life, such as the shellfish fossils we find in Cambrian strata. Next the mud would have caught and burried more mobile sea life, such as the fish we find mainly in Devonian strata. Next we would have shoreline plants, amphibians, and small reptiles (Carboniferous and Permian strata), followed by low-altitude or swamp-dwelling animals such as the dinosaurs (Mesozoic strata). Finally there would be plants and larger mammals from the interior of the pre-Flood continent(s), high plains, and mountains. This would mean the Cenozoic (Cainozoic) strata would be deposited atop the others already in the pre-Flood ocean basins. We see this general order in the fossils, although there would be many local variations, as we would expect in such a chaotic event.

Roughly in the middle of the Flood year, the crustal rocks beneath the pre-Flood ocean floors, by then covered with fossil-bearing sediments, would have started rising, becoming our present continents. As the altitude of those regions increased, the waters would have begun running off into new ocean basins (Psalm 104:8). The runoff would have eroded the uppermost Cenozoic strata, and some lower strata as well, grinding up the larger fossils in partly hardened rock and dumping the pieces, much mud, and small fossils into our present continental shelves and ocean basins. Roy wryly called the now-missing parts of the land strata the 'Erodozoic'.

This simple picture explains the fossil order (mainly of ecological zones) in a more satisfying manner than any other creationist Flood model I know of. In particular, it explains how the more delicate of the fossils in the lower Paleozoic, such as crinoids, in some locations could have been buried in place without the rough transportation that might have destroyed them. Other seafloor locations (apparently shallow) were eroded bare by strong water currents from the land at the very beginning of the Flood. The sea–land role reversal also explains another difficult pair of puzzles: where most of the sedimentary material came from (the top of the pre-Flood continents), and why most of it is piled on the present continents (they were lower until mid-Flood).

I have elaborated on Roy Holt's scenario because it means that most of the Precambrian rocks would have been formed deep below the pre-Flood ocean floors. Many Precambrian rocks, particularly Archean ones, contain minerals formed at high pressures, a dozen or more kilometres below the surface.[40] The simple life-forms in the Precambrian could have been living in the sediments on those ocean floors.[41] In shallower seas the abundance of creatures living on the surface of the sediments would provide the 'explosion' of bottom-dweller fossils we see in the Cambrian. The great heat and radioactivity forming the Precambrian basement rocks would have occurred far below the sediment surface, with perhaps occasional eruptions onto the seafloor. The known Precambrian impacts on Earth, their craters being found on or beside our present continents, would have occurred in the pre-Flood oceans, (see figure 6). (Others may have hit pre-Flood land, but we apparently have no record of those.)

Moderately fast motions must have been going on in the earth's fluid core, because such flows would have caused the reversals of the earth's magnetic field recorded in rocks during the Precambrian.[26] The reversal periods may have been a few years to a few decades.[42] The Precambrian 'continents' of Rodinia, Laurentia, etc., would be crustal rocks being formed below pre-Flood ocean basins at the various locations shown in paleomagnetics textbooks (if paleomagnetic directions in Precambrian rocks are being interpreted correctly).[43] Humans and terrestrial animals were living elsewhere on Earth.

The erosion of some of these crustal rocks during the Flood would have distributed radioactive material onto our present continents and into our present soil. But the pre-Flood continents, having been designed by God from before the Fall, would not necessarily have as much radioactivity as today's continents have. This would explain why Noah and the creatures aboard the Ark were not killed by radioactive isotopes in their tissues during the decay acceleration that occurred at that time.[44]

Conclusion—a new window on the Antediluvian age

One of this paper's reviewers, who for decades has been strongly committed to option (1), Precambrian in Creation Week, says he cannot imagine a geophysical model for option (2), Precambrian between Fall and Flood, or for a land–sea role reversal during the Flood. But we should not allow our limited imaginations to prevent us from recognizing the strong scientific and biblical evidence for those things. The correlated magnetizations and billion-year radioisotope ages of moon rocks make an almost unassailable case for option (2), in my opinion. Genesis 1:16, Deuteronomy 32:22, and the incompatibility of Genesis 1 with destructive events argue against option (1). The short half-life of the moon's magnetic field argues against option (3), Precambrian during the Flood. Genesis 6:7 and 7:23 speak powerfully for a land–sea role reversal. The most reasonable course for creation scientists seems to be to acknowledge these scientific and Scriptural data and try to build geophysical models that fit within those constraints.

Aside from Genesis 4–6, we have no historical information about the Fall-to-Flood era, except for some highly distorted myths and legends that may stem from that period. The possibility that the Precambrian occurred during that time opens a new window on the age. Up to now, I, and other creationists, have been reluctant to deal with Precambrian data, not knowing where to fit them into the biblical view of Earth history. But now we can look at cratering in the solar system, the lunar maria, billions of years' worth of nuclear decay, the formation of Earth's present continental crust, Precambrian magnetic reversals, and other evidence of great events in a new light. I hope that this hypothesis will stimulate creation science into a new focus on exploring the Precambrian.

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Errata

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In figure 3 on p. 79, the two best-fit theoretical curves (Gamma on left, Normal on right) should be dashed and dot-dashed lines respectively, as shown below, and the x axis represents 'Magnitude of effects' instead of 'Magnitude of change'. The x axis in figure 4 on p. 80 also represents 'Magnitude of effects'.