A new magnetic field theory and Flood model—part 1

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This paper proposes that the interior of the pre-Flood earth was cool and accelerated radioactive decay during the Flood year rapidly heated the mantle, causing rapid whole-mantle convection currents which drove a major plate tectonic event. Before the Flood, Earth's core was likewise cool and completely solid, and also well below its Curie temperature, enabling it to retain a permanent magnetization. During the Flood, the core began heating and melting from the outside inward—a process which continued for thousands of years after the Flood, as heat from the mantle was transferred to the core, primarily via radiation from the mantle and convection in the melting outer core. As the core melted after the Flood, the originally strong magnetic field gradually weakened as the core progressively lost its permanent magnetization.

Evidences for accelerated radioactive decay

Creation scientists have recently made a very exciting scientific discovery; there is now objective evidence for accelerated nuclear decay in the 'recent' past, 'only' thousands of years ago. Many independent lines of evidence exist to demonstrate the reality of this accelerated decay, including the following two: 1) helium retention in zircons,[1] and 2) the formation of 'orphan' polonium radiohalos.[2]

Helium retention evidence

As radioactive elements decay, they often emit particles. One type of decay (α-decay) emits a particle that consists of two protons and two neutrons; a particle identical to the nucleus of a helium atom. When the concentration of this radioactively produced helium in a given crystal is compared to the rate at which it leaks out, the historical rate of radioactive decay in the crystal can be objectively determined. Secular scientists believe that the rates of radioactive decay seen today have been constant over billions of years. If that is true, then most of the helium produced by that decay would have leaked out of the crystal lattice by now, based on observed rates of helium diffusion. However, if in the recent past radioactive decay had been greatly accelerated, then much of the helium produced would have remained in the crystal. What creation scientists discovered was that, indeed, most of the helium produced has remained in the crystal, providing strong evidence for recent accelerated nuclear decay.[3,4]

Polonium radiohalos

When some radioactive isotopes decay, they give off alpha particles that damage the crystal structure a certain distance away from the decaying atom, which varies depending on the energy of the emitted alpha particle. So when a small quantity of a certain radioactive isotope is concentrated in a very small space, this radiation damage forms a concentric sphere around that radioactive point with a radius that is consistent with the alpha particles emitted. And since each radioactive isotope emits a particle with a different energy, the radius of that radiohalo enables scientists to determine the isotope that created it. Sometimes scientists find radiohalos of polonium, which is an isotope with a very short half-life, but it seems to only be formed as the decay product of uranium. This has been a puzzle for scientists, but recently a model has been proposed that seems to account for the formation of these orphan polonium radiohalos during the Flood, when water transported the polonium from a nearby pocket of uranium to a single point that was a fissure in the cooling rock. This water transport could only take place after the rock had cooled sufficiently for the radiohalos to form (assumed to be 150°C), but would have ceased once the rock cooled to the point that heat would no longer be causing the water to move, so there was a narrow, approximately 1-week (maximum) window during which about 100 million years of

Figure 1. An example of a Polonium radiohalo, which is evidence for accelerated radioactive decay at the time of the Flood.

uranium decay would have had to take place in order for these polonium radiohalos (figure 1) to form.[5] Interestingly, this provides a way to estimate the 'rate' of decay acceleration during the Flood, roughly 15 million 'years' of decay per day. At this rate, all of the radioactive decay that we see throughout the solar system (~4.6 billion 'years' equivalent) could have taken place during the Flood year.[6]

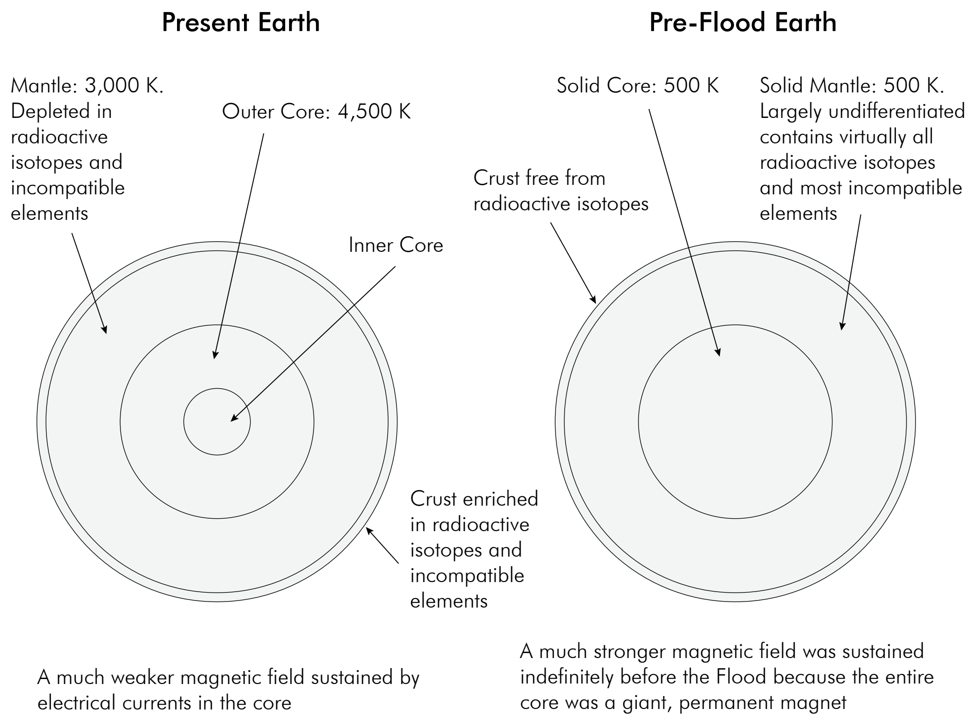

Figure 2. Comparison of present Earth with proposed pre-Flood Earth

Some implications for accelerated radioactive decay

One of the major implications of this finding is that during the accelerated nuclear decay event, huge quantities of energy would have been released; more than enough to completely obliterate the *crust* of the earth at that time, given the current distribution of radioactive isotopes. This has been one of the major objections to accelerated radioactive decay in some quarters, since it is difficult to conceive of how so much energy could have been dissipated. After examining many potential solutions to this problem, one stood out as perhaps the only possible way to account for this heat, given known laws of physics; the heat is still inside the earth. If these radioactive materials existed in the earth's *mantle* prior to the Flood, then such a massive release of energy from the accelerated decay provides a mechanism that could have begun and driven a catastrophic plate tectonic event (similar to the system described and modelled very powerfully by John Baumgardner[7]) and the Flood, as uneven heating of the earth's mantle would have caused powerful convection currents to form therein. These powerful mantle convection currents would have rapidly moved the continents. Due to their lower density, the hottest mantle materials (the most radioactive) would have risen to just below the solid crust, where they would have erupted in massive lava flows and caused a catastrophic plate tectonic event to occur. During this rapid mantle convection, many of the earth's incompatible elements (including the major elements that produce heat via decay) would have been extracted from the mantle due to well-known chemical fractionation processes, but at rates much higher than previously proposed.[8] This heating and separation of the mantle could have begun weeks, months or even years before affecting Earth's surface to the point of causing the Flood. But the end result would be that the earth would be much hotter and the radioactive materials that were previously located deep in the mantle would now be concentrated in Earth's crust, which is what we find today.

If this is correct, then the temperature of the interior of the earth before the Flood was much lower than it is now; perhaps not much greater than room temperature throughout. The major implication for this theory is that even the outer iron core, which is currently molten, would have also been solid prior to accelerated nuclear decay and the Flood, and well below the Curie temperature. As it continued melting inward for hundreds or thousands of years after the Flood, the phase change of all this iron from solid to liquid would have continued to absorb enormous quantities of energy (figure 2).

In order to calculate the total amount of energy released by accelerated radioactive decay, it is necessary to know how much of each radioactive isotope was present initially. Fortunately, this can be approximated by taking the current amounts and current decay rates and extrapolating them back about 4.5 billion years at their current decay rates.[9] But to know the current amounts of radioactive isotopes, it is necessary to know what their concentration is in the earth, and then multiply it by the mass (volume times density). However, the present concentration of radioactive isotopes is not uniform throughout the earth—radioactive isotopes have been concentrated in the continental crust and are depleted (but still significant) in the mantle.

Major radioactive isotopes currently in continental crust

- Earth's surface area: 5.1×10^{8} km^{2}
- Percent continental area: 30%
- Depth of continental crust: 35 km
- Density of continental crust: 2,700 kg/m^{3} (or 2.7×10^{12} kg/km^{3})
- Mass of continental crust: (5.1×10^{8} km^{2}) × (0.30) × (35 km) × (2.7×10^{12} kg/km^{3}) = $\underline{1.5 \times 10^{22}\text{ kg}}$

- Concentration of U in continental crust: 3.0×10^{-6} kg/kg
- Concentration of Th in continental crust: 9.6×10^{-6} kg/kg
- Concentration of ^{40}K in continental crust: 3.0×10^{-6} kg/kg

- Mass of continental U: (3.0×10^{-6} kg/kg) × (1.5×10^{22} kg) = 4.5×10^{16} kg U
- Mass of continental Th: (9.6×10^{-6} kg/kg) × (1.5×10^{22} kg) = 1.4×10^{17} kg Th
- Mass of continental ^{40}K: (3.0×10^{-6} kg/kg) × (1.5×10^{22} kg) = 4.5×10^{16} kg ^{40}K

Major radioactive isotopes currently in mantle

- Earth's volume: 1.083×10^{12} km^{3}
- Percent mantle: 84%
- Mantle volume: 9.1×10^{11} km^{3}
- Mantle density: 4,500 kg/m^{3} (or 4.5×10^{12} kg/km^{3})
- Mantle Mass: (9.1×10^{11} km^{3}) × (4.5×10^{12} kg/km^{3}) = $\underline{4.1 \times 10^{24}\text{ kg}}$

- Concentration of U in mantle: 3.1×10^{-8} kg U/kg
- Concentration of Th in mantle: 1.24×10^{-7} kg Th/kg
- Concentration of ^{40}K in mantle: 3.7×10^{-8} kg ^{40}K/kg

- Mass of mantle U: (3.1×10^{-8} kg/kg) × (4.1×10^{24} kg) = 1.3×10^{17} kg U
- Mass of mantle Th: (1.24×10^{-7} kg/kg) × (4.1×10^{24} kg) = 5.1×10^{17} kg Th
- Mass of mantle ^{40}K: (3.7×10^{-8} kg/kg) × (4.1×10^{24} kg) = 1.5×10^{17} kg ^{40}K

- Total current Earth mass of U: (4.5×10^{16} kg U) + (1.3×10^{17} kg U) = 1.8×10^{17} kg U
- Total current mass of ^{235}U: (0.0072) × (1.8×10^{17} kg U) = 1.3×10^{15} kg ^{235}U
- Total current mass of ^{238}U: (0.9927) × (1.8×10^{17} kg U) = 1.8×10^{17} kg ^{238}U
- Total current Earth mass of Th: (1.4×10^{17} kg Th) + (5.1×10^{17} kg Th) = 6.5×10^{17} kg Th
- Total current Earth mass of ^{40}K: (4.5×10^{16} kg K) + (1.5×10^{17} kg K) = 2.0×10^{17} kg ^{40}K

- Half-life of ^{235}U: 7.038×10^{8} yrs
- Half-life of ^{238}U: 4.468×10^{9} yrs
- Half-life of Th: 1.405×10^{10} yrs
- Half-life of ^{40}K: 1.248×10^{9} yrs

- Total Original ^{235}U:

$$\frac{\left(1.3\times10^{15}\,kg^{235}U\right)}{\left(1-\frac{1}{2^{\frac{\left(7.038\times10^{8}\,yrs\right)}{\left(4.5\times10^{9}\,yrs\right)}}}\right)} = 1.3\times10^{16}\,kg^{235}U$$

- Total Original ^{238}U:

$$\frac{\left(1.8\times10^{17}\,kg^{238}U\right)}{\left(1-\frac{1}{2^{\frac{\left(4.468\times10^{9}\,yrs\right)}{\left(4.5\times10^{9}\,yrs\right)}}}\right)} = 3.6\times10^{17}\,kg^{238}U$$

- Total Original Th:

$$\frac{\left(6.5\times10^{17}\,kgTh\right)}{\left(1-\frac{1}{2^{\frac{\left(1.405\times10^{10}\,yrs\right)}{\left(4.5\times10^{9}\,yrs\right)}}}\right)} = 7.3\times10^{17}\,kgTh$$

- Total Original ^{40}K:

$$\frac{\left(2.0\times10^{17}\,kg^{40}K\right)}{\left(1-\frac{1}{2^{\frac{\left(1.248\times10^{9}\,yrs\right)}{\left(4.5\times10^{9}\,yrs\right)}}}\right)} = 1.1\times10^{18}\,kg^{40}K$$

- Energy produced by ^{235}U decay series: 1.90×10^{13} J/kg ^{235}U
- Energy produced by ^{238}U decay series: 2.11×10^{13} J/kg ^{238}U
- Energy produced by Th decay series: 1.77×10^{13} J/kg Th
- Energy produced by ^{40}K decay (average): 3.21×10^{12} J/kg ^{40}K

- Total energy from ^{235}U during accelerated decay: (1.3×10^{16} kg ^{235}U – 1.3×10^{15} kg ^{235}U) × 1.90×10^{13} J/kg ^{235}U = 2.2×10^{29} J
- Total energy from ^{238}U during accelerated decay: (3.6×10^{17} kg ^{238}U – 1.8×10^{17} kg ^{238}U) × 2.11×10^{13} J/kg ^{238}U = 3.8×10^{30} J
- Total energy from Th during accelerated decay: (7.3×10^{17} kg T – 6.5×10^{17} kg Th) × 1.77×10^{13} J/kg Th = 1.4×10^{30} J
- Total energy from ^{40}K during accelerated decay: (1.1×10^{18} kg ^{40}K – 2.0×10^{17} kg ^{40}K) × 3.21×10^{12} J/kg ^{40}K = 2.9×10^{30} J
- Total energy from major heat-producing radioactive isotopes during accelerated decay: 2.2×10^{29} J + 3.8×10^{30} J + 1.4×10^{30} J + 2.9×10^{30} J = $\underline{8.3 \times 10^{30}\text{ J}}$

Specifically, it seems as though about 8.3×10^{30} J of energy were released during accelerated decay by the four major heat-producing isotopes; ^{238}U, ^{235}U, ^{232}Th and ^{40}K. Some additional heat may have been supplied by isotopes that are now fully decayed. It is difficult to be more precise than this because scientists can only make educated guesses about current concentrations of the various radioactive isotopes in the earth (and thus indirectly what initial concentrations would have been).

Some additional heat may have been released as potential energy was given up as the mantle separated based on density:

- Earth's mass: 5.97×10^{24} kg
- Possible net mass exchange[10]: 4%
- Average distance of falling heavier materials[11]: 1.5×10^6 m
- Average force due to gravity[12]: 8.65 m/s^2
- Heat potentially released due to partial mantle separation: 5.97×10^{24} kg × .04 × 1.5×10^6 m × 8.65 m/s^2 = $\underline{3.1 \times 10^{30}\ \text{J}}$
- Total of heat released during Flood: 8.3×10^{30} J + 3.1×10^{30} J = 1.1×10^{31} J

So another about 3.1×10^{30} J could have been released as the mantle separated based on density (or perhaps a bit more or less, depending on what the assumed initial condition of the mantle was). However, it appears as though about 1.1×10^{31} J total of energy was converted into heat during the Flood. Interestingly, the total amount of heat energy required to raise the temperature of the earth from 500 K to its current temperature is also about 1.1×10^{31} J, as shown below:

Heat required for Earth to heat up from 500 K to current temperature:

Mantle

- Mass of mantle: 4.2×10^{24} kg
- Initial temperature: 500 K
- Current average temperature: 3,000 K
- Average specific heat of mantle: 7.0×10^2 J/kg/K

- Energy to heat mantle: (3,000 K – 500 K) × 4.2×10^{24} kg × 7.0×10^2 J/kg/K = 7.4×10^{30} J

Outer Core

- Mass of outer core: 1.7×10^{24} kg
- Initial temperature: 500 K
- Current average temperature: 4,500 K
- Specific heat: 4.4×10^2 J/kg/K
- Heat of fusion: 2.7×10^5 J/kg

- Energy to heat and melt outer core: ((4,500 K – 500 K) × 1.7×10^{24} kg × 4.4×10^2 J/kg/K) + (1.7×10^{24} kg × 2.7×10^5 J/kg) = 3.5×10^{30} J

- Total heat needed to raise Earth's temperature to present values[13]: 7.4×10^{30} J + 3.5×10^{30} J = $\underline{1.1 \times 10^{31}\ \text{J}}$

In other words, this model can solve the heat problem associated with accelerated radioactive decay, if the radioactive isotopes began in Earth's mantle instead of being concentrated in the crust as they currently are, and if Earth's initial internal temperature was much lower than it is now.

Magnetic field model

In addition, this paper proposes that Earth's magnetic field was originally generated by the core, which was a giant permanent magnet that began a lengthy melting process during the Flood and continued for thousands of years. As the core progressively heated past the Curie temperature, the permanent magnetization was slowly lost. However, electric currents were induced in the core during the Flood as newly melted metallic core materials moved through the remaining magnetic field. These currents continue to produce our much weaker present magnetic field. During the Flood, these electric currents were responsible for the rapid field reversals recorded in Flood granites such as those on the ocean floor.[14]

Scientific observations/tests of the model

If this theory is correct, then there should be evidence of phenomena such as a decaying magnetic field on Earth, a cooler pre-Flood Earth, and of large-scale volcanism near the end of the Flood to supply the radioactive elements to Earth's surface. Is this what we find?

Enormous post-Flood volcanoes—injecting additional radioactive material

The Flood itself would have released radioactive elements into the environment. In addition, there is compelling evidence that at or near the end of the Flood, there were a series of enormous volcanoes that erupted worldwide.[15] The clear trend of these supervolcanoes is that over time they lose intensity and produce less ash (although still far more than any volcano observed in the last several millennia). This is readily explainable, because as the accelerated radioactive decay tapered off or stopped, the residual heat in the mantle would dissipate over a long period of time, primarily by transferring its heat to the melting core, contributing to a decline in volcano intensity. It is entirely logical to conclude that this trend continued for several hundred years after the Flood, and would in turn provide an explanation of how the atmosphere cooled quickly to create a post-Flood ice age,[16] as the ash reflected sunlight back into space and provided many cloud condensation nuclei, which served to lower the atmosphere's capacity to retain greenhouse-effect-inducing water vapour. This continuing large-scale volcanism would have continued injecting radioactive materials such as ^{40}K into the environment.

Additional Phenomena

If the earth's mantle melted and separated based on chemical composition and temperature (and thus content of radioactive elements heating them up) during the Flood, then there should be some evidence of this. One possible line of evidence is the existence of 'hot spots' under crustal plates, such as the one that appears to have formed the Hawaiian Islands (figure 3). These 'hot spots' might have floated to the surface of the mantle during the Flood as a result of their higher temperatures (and thus lower densities). As accelerated radioactive decay continued driving the rapid creation of these islands, the first islands would have looked millions of years older than the last islands, which is what we find.[17] Likewise, the hotspots found in the 'ring of fire' around the edge of the Pacific Ocean could have risen to the mantle surface and then been 'pushed' into the plate boundary area as the sea floor spread and then subducted, leaving the hot pockets of magma just below the continental plates.

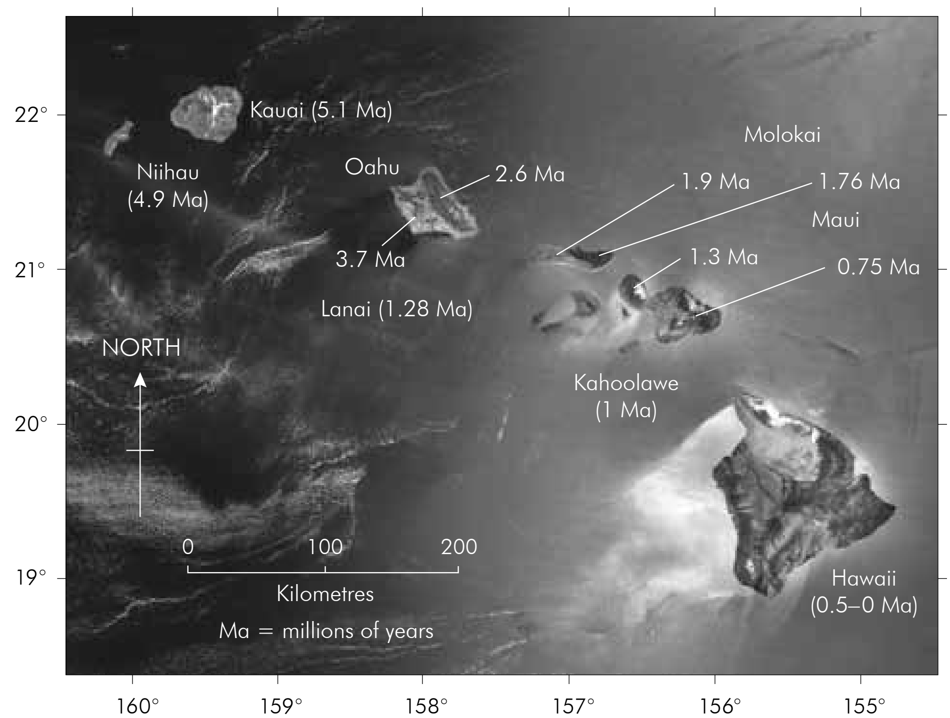

Figure 3. Hawaiian Island Chain radioisotope apparent ages (after ref. 20).

Since this model postulates that accelerated radioactive decay was the cause of rapid plate tectonics during the Flood, it also predicts that the ocean floor was quickly laid down during that process of accelerated radioactive decay. Thus, ocean floor near the continents should have older apparent radioisotope dates than ocean floor near the mid-ocean ridges. This is consistent with what scientists have found.[18] Samples of the ocean floor show that nearest the continents it has undergone more radioactive decay than the younger areas of sea floor near the mid-ocean ridges, with a smooth progression from older to younger apparent dates moving from the continents to the ridges. This finding is fully consistent with this model.

Furthermore, if the rate of accelerated decay was about 15 million apparent years per actual day (as suggested above), and that rate was consistent throughout the Flood (which it may not have been—it may have tapered off toward the end) then we come to the fairly astonishing conclusion that it may only have taken 10–15 days to form the current ocean basins at the end of the Flood! The ridges may be thicker than the rest of the ocean floor because the rate of plate movement slowed slightly faster than the rate at which mantle materials were upwelling through the mid ocean ridges as the Flood came to an end. This would also be consistent with the formation of the Hawaiian Islands (figure 3), which exhibit a noticeable trend of 'older' islands being smaller and 'younger' islands being larger, again due to tectonic plate motion slowing down more quickly than the upwelling in the mantle of the hot spot which gave rise to the islands. Note, too, that if the Hawaiian Island chain formed during the Flood, then it logically follows that to generate the rapid lava flows which formed them, it would have required a huge amount of heat, which most likely was supplied by accelerated radioactive decay.[19]

Conclusion

This paper proposes a new model of a cool pre-Flood interior for the earth, the mantle of which melted completely prior to, and during, the Flood due to the accelerated nuclear decay of radioactive materials then present therein and the solid, permanently magnetized core of which has been melting ever since. A second paper will further develop and test this model by considering various phenomena on Earth and in the solar system.

Acknowledgments

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6. Although the RATE team may have good reasons for postulating that much of the accelerated decay took place during days two and three of the creation week, this paper argues from several lines of evidence that it is more likely that all of the accelerated decay took place during the Flood event.
7. Baumgardner, J., Global Tectonics and the Flood (DVD), *Answers in Genesis*, 2009.
8. This process was described clearly and in detail in: Baumgardner, J.R., Distribution of radioactive isotopes in the Earth; in: Vardiman, L., Snelling, A.A., and Chaffin, E.F. (Eds.), *Radioisotopes and the Age of the Earth*, Vol. 1, ICR and CRS, CA, MO, pp. 49–94, 2000. While Baumgardner makes the assumption that the chemical fractionation of the earth occurred during the Creation Week, this author believes that much of it took place during the Flood. Indeed, some of Baumgardner's comments seem consistent with this alternate view. For example, he wrote, "The evidence from the distribution of trace elements seems compelling that indeed the continental crust itself was derived from the earth's mantle rock via partial melting processes in the presence of water … . This implies that a major aspect of the earth's formation involved the cycling of a major fraction of the mantle through a partial melting process near the planet's surface to produce the continental crust with its high concentrations of incompatible elements. This cycling presumably was driven by the mechanism of thermal convection, and this implies a vast amount of heat was removed from the earth's interior as a consequence … . To me it seems an inescapable conclusion that nuclear decay processes also had to accompany the chemical differentiation and be commensurately rapid" (p. 90). Furthermore he believes that the Flood "catastrophe was primarily tectonic in nature, enabled by weakening instabilities in the deformation properties of silicate rock … . It was a cataclysm that profoundly transformed the face of the planet" (p. 89). In his excellent modelling of the Flood, it appears as though he believes that a significant amount of mantle upwelling also accompanied the Flood. So although it is possible that the bulk of this fractionation process occurred during the Creation Week, it seems more likely that this process would have occurred during the Flood.
9. Several lines of evidence suggest that this is a reasonable assumption for accelerated radioactive decay. First, the RATE team analyzed different isotope ratios in the same rock, and although the 'ages' were different enough to cast doubt on the validity of their 'billions of years' ages, there was enough agreement to validate this assumption. Also, as old-agers have long pointed out, only those radioactive isotopes, the present half-lives of which are long enough to enable them to last about 4.5 billion years (and their daughter products) are still found in nature. See: Vardiman, L., Snelling, A.A. and Chaffin, E.F. (Eds.), *Radioisotopes and the Age of the Earth: A Young-Earth Creationist Research Initiative*, ICR and CRS, San Diego, CA, 2000; and Vardiman, L., Snelling, A.A. and Chaffin, E.F. (Eds.), *Radioisotopes and the Age of the Earth*, Vol. 2, ICR El Cajon, CA, and CRS, Chino Valley, AZ, 2005.
10. As the slightly heavier materials descended and lost potential energy, the slightly lighter materials would have ascended and gained potential energy. This proposed 4% net mass exchange could thus, in actuality, be 40% of the mantle materials changing places, if their difference in density is 10%.
11. This is about half way through the mantle.
12. This is not the usual 9.8 m/s^2 experienced at Earth's surface. Because the lower one descends inside the earth, the lower is the net downward acceleration due to gravity. The number used in the calculation is an approximate average for Earth's mantle.
13. This model is compatible with the possibility that the inner core of the earth is still cool and still melting, so the energy required to raise it to an average of 5,500 K was not included. However, if this had been included, it would only add a relatively insignificant 2.2×10^{29} J, so the earth would still require about 1.1×10^{31} J to heat.
14. Humphreys, D.R., The Earth's magnetic field is young, *Acts & Facts* **22**(8), 1993; www.icr.org/article/earths-magnetic-field-young/. On the other hand, some preliminary heat transfer calculations suggest that it's possible that heat from the mantle, generated during the Flood, may have only been carried as far at the bottom of the outer core, and so it's possible that the inner core has not yet heated up much and could potentially still be below its Curie temperature.
15. Austin, S.A., The declining power of post-Flood volcanoes, *Acts & Facts* **27**(8), 1998; www.icr.org/article/declining-power-post-flood-volcanoes/.
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19. If the formation of the Hawaiian Island chain required massive, rapid lava flows driven by massive heat flows derived from accelerated decay, then it serves as evidence against the speculation of the RATE team that God supernaturally removed the radiogenic heat by the expansion of space or something similar.
20. volcano.oregonstate.edu/vwdocs/vwlessons/hot_spots/introduction.html.

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