Hunter's mantle/ core model

John Woodmorappe

In order that I not potentially misunderstand Hunter's mantle/core model,[1] I have the following questions of him:

1. Does your paper indicate that the bulk of the andesitic continental-crust material differentiated from the mantle and intruded, mostly as plutonic rock, all during the Flood year?

If so, then:

2. Geochemical differentiation of sialic from mafic material is governed not only by pressure, but also by chemistry. How could sufficient volume (to make an average of perhaps 30-km thickness of continental crust worldwide) of mostly-andesitic crustal material, have differentiated in just one year?

3. Assuming that it did, how could the 'new crust', then consisting of molten plutonic crustal material and covering an aggregate area of some 21% of Earth's surface to an average depth of 30 km, have cooled in thousands of years, let alone in one year? (Cooling individual plutons is one thing: cooling 30 km worldwide of granitic-andesitic magma to make new solid post-Flood continental crust is another).

4. Assuming that #3 could happen, where would all the heat from so much plutonic material cooling have gone to without sterilizing the Earth?

5. How could stable layers of thick sedimentary material have been deposited by floodwaters if the entire mass of water and sediment was, when over the soon-to-become continents, sitting on an average of 30 km of molten plutonic material? What was to prevent the water and sediment from sinking into the magmatic morass and/or preventing the 30 km of molten plutonic material largely breaking through to the surface, and turning the Earth's surface into one vast 'parking lot' made of andesitic extrusive and/or tuff?

Max Hunter replies:

John Woodmorappe asks some important fundamental questions regarding my proposed gravitational decompression-Earth expansion-recompression model of mantle differentiation and continental crust formation during the Genesis Flood.[2]

The gravitational decompression hypothesis presents an alternative to the creationist catastrophic plate tectonic model of origin of the continental crust and the crustal sedimentary pile. The catastrophic plate tectonic model '… begins with a pre-Flood Earth ... with the crust horizontally differentiated into sialic craton and mafic ocean floor',[3] and requires the pre-Flood continents to have remained relatively stationary while a pre-Flood accumulation of sediments was washed onto them from the pre-Flood seas.

The gravitational de-compression model of '*in-situ*' continental crust formation, on the other hand, equates the cratonic early 'Archean' strata to early Flood. The model accepts the conclusion of 'secular' researchers that the continental crust was formed by differentiation from the mantle during the early 'Archean'[4–7] and is thus, in this young-Earth model, early Flood, rather than pre-Flood.

Woodmorappe's main concern is the assumed requirement for dissipation of large amounts of crustal heat to permit life in the biosphere after the Flood catastrophe. This concern has been considered by some in the scientific community as a stumbling block to belief in a young-Earth Flood model,[8] and by creationists as a major problem in the construction of a credible Genesis Flood geological model.[9]

I suspect that when the physics of the decompression-expansion-recompression model is fully understood, the perceived heat dissipation problem may turn out to be a non-problem.

There are, I believe, satisfying answers to each of Woodmorappe's questions, and I attempt to answer them below, in the same order that they appear in his letter.

1. '... does your paper indicate that the bulk of the andesitic continental-crust material differentiated from the mantle and intruded ... all during the Flood year?'

In my paper *Scriptural constraints on variation of water level during the Genesis flood*,[10] I concluded, after a careful exegesis of the Flood narrative in Genesis Chapters 7 and 8 that, as agreed by several creationists,[11–14] the Scriptures clearly teach that the Flood waters reached their maximum level by the end of Day 40. I think this interpretation is beyond question, on both scriptural and geographical grounds, however not all creationists agree.[15]

The gravitational decompression model of early Flood ('Archean') differentiation of the 'new' post Flood continental crust requires that the crust must have formed not just within the Flood year, but **by the end of Day 40.**

2. ' … How could sufficient volume … of mostly andesitic crustal material, have differentiated in just one year?'

The fact that we can, on scriptural grounds, be reasonably assured that enough water to cover the whole Earth to a depth of the order of 5 km above present sea-level differentiated from the earth's mantle **in just forty days**[9–11,16,17] indicates that, during this stage of the Flood, mantle differentiation processes were very rapid.

Baumgardner in seeking to explain rapid plate tectonic movements during the Genesis Flood discusses, 'the [mantle] viscosity issue'[8] as one of 'the major difficulties in attempting to understand and model the geological and tectonic change … occurring during the span of but a single year in the biblical Flood'.[8] He notes the extreme sensitivity of the deformation properties of mantle rock to temperature, stating in 1990:

> ' … viscosity … depends exponentially on the local temperature … . The strong temperature dependence suggests one conceivable way to have the mantle deform more readily—namely to **make its temperature closer to its melting temperature** [emphasis added].'[18]

In the gravitational decompression-recompression model, the mantle temperature is brought suddenly closer to its melting temperature, and the viscosity thereby temporarily reduced, by the postulated **decompression** of the Earth, due to a sudden, temporary reduction of the gravitational force. In this manner, it is postulated, mantle viscosity may have been reduced **without addition of any heat.**

Thus, it is postulated, decompression of the Earth reduced mantle viscosity sufficiently to allow rapid mantle differentiation during the first forty days of the Flood, and provided the energy required to lift sialic continental crustal material rapidly from the mantle to the surface of the Earth. The presence of abundant exsolving water (and a thickening volcano-sedimentary layer) prevented the rapid catastrophe from extinguishing all life.

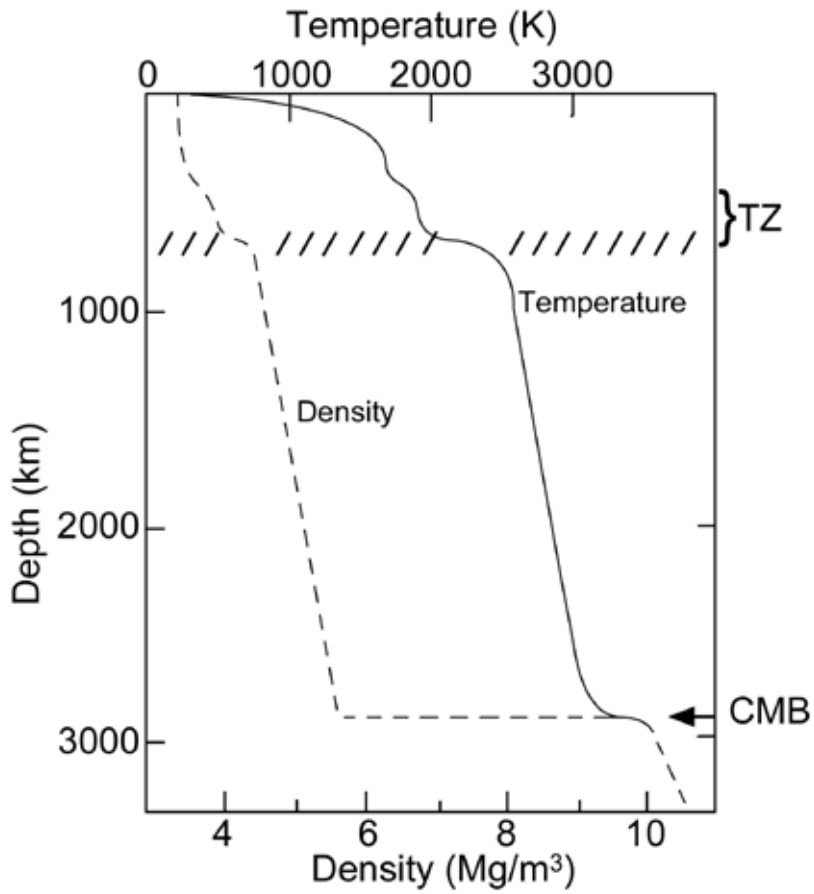

Figure 1. *Temperature profile through the Earth's mantle and crust (after Jeanloz and Morris, 1986).*[24]

3. '… how could the " new crust " then consisting of molten plutonic crustal material … to an average depth of 30 km, have cooled in thousands of years, let alone in one year?'

Baumgardner[19] also discusses 'the thermal problem … the cooling of vast bodies of rock on a short time scale' as one of the other major difficulties in attempting to understand and model the Flood, suggesting that, after the Flood;

> '… the need to remove large amounts of heat from extensive bodies of rock in the earth … involved a **decrease in thermal energy** throughout the planet [emphasis added].'

I have suggested above that reduced mantle viscosity during the Flood may have been achieved not by an increase of temperature, but rather by a decrease in pressure. The mantle may therefore never have been ' … a few hundred degrees warmer than at present … ' .[8]

The 'decrease in thermal energy' proposed by Baumgardner may have resulted upon **re**compression of the Earth, consequent upon the restoration by God of the gravitational force to its original, created magnitude possibly at the end of Day 40. This, I suggest, is the stopping of the 'fountains of the great deep' and the 'windows of heaven' (Genesis 8:2). The mantle's temperature would remain the same, but revert to its pre-Flood condition of being much less than its melting temperature, **without removal of any heat**. Most of the mantle material would thus, I suggest, solidify but remain very hot.

Notwithstanding all of this, when we consider the relative proportions of intrusive, volcanic and sedimentary rocks outcropping on the earth's surface[20–22] we see it is very likely that **not all** of the 'new crust' had to cool. This is especially so if the uppermost layer, probably the wet continental sedimentary pile, and perhaps the wet marine sedimentary layer on the continental shelves, acted as an efficient insulating 'blanket' between the Earth's surface and the hotter lower crust and outer mantle. Most of the 'new crust', I speculate, only had to solidify, not necessarily cool.

Ronov estimates that sedimentary cover overlies 119 x 10^6 km^2 or 80% of the total land area on the Earth's surface. Thus outcropping intrusive and volcanic rocks which would require cooling may have covered only about 20% of the land area (only about 6% of the total earth surface area.)

The only requirement regarding cooling of the new crust then may have been that the land surface and the oceans were cool enough to allow normal, or perhaps accelerated, biological processes to continue after the Flood. There was no need, so far as I can see, that the whole continental crust, to a depth of 30 km or deeper,[23] should be cooled prior to the end of the Flood.

Cooling of later outcropping intrusives and volcanics may have occurred by conductive transfer of heat from the hot rocks to the base of the wet continental sedimentary pile during the 110 days between the end of mantle differentiation on Day 40 and the start of the abatement of the waters on Day 150 (Stage II). This heat would then be carried into the present oceans in the receding floodwaters during Stage III (Days 150 to 371).

4. '... where would all the heat from so much plutonic material cooling have gone to …'

If the gravitational **de**compression-**re**compression hypothesis presented above is correct, and if the 'new crust', especially the uppermost sedimentary 'blanket' became, as seems likely, an efficient insulator, then the plutonic material may have solidified without cooling, and thus the heat need not have gone anywhere. Thermal data (Figure 1) indicates that most of the plutonic material below about 50 km depth may not have cooled, and remains to this day very hot (in excess of 1,000 K).[24,25]

The present sialic (silica-alumina) continental crust, especially the upper-most sedimentary layer, has a similar composition to insulating fire-bricks[21,26] and its density is markedly lower than that of the lower crust and outer mantle. The crust is thus a good insulator between the biosphere and the hot lower crust and mantle.

In addition, the gravitational decompression hypothesis postulates that the outer parts of the Earth, above the transition zone, probably expanded due to mineralogical phase changes during this period of the Flood. Just as a gas cools when it expands, so too might the rocks of the transition zone and outer mantle have cooled when they expanded due to decompression during Stage I of the Flood. Weinstein[27] notes that the phase transformation from olivine to spinel at the 410-km discontinuity is exothermic. It follows then that the postulated reverse phase transformation in the gravitational decompression model, from the higher density spinel phase to the lower density olivine phase, should be endothermic (i.e. absorbs heat).

5. 'How could stable layers of thick sedimentary material have been deposited by Floodwaters if the entire mass of water and sediment was … sitting on an average of 30 km of molten plutonic material?'

The answer to this question, I would suggest, has to do with the interactions of the rheological properties of the various outer layers of the Earth (outer mantle, tectosphere lithosphere asthenosphere, crust, etc.) at various pressures and temperatures as the mantle was differentiating.

If, as postulated, the decompression-Earth expansion-recompression resulted in solidification of the mantle-crust without removal of heat, the bulk of the 'molten plutonic material' below the continental sedimentary pile, may never have comprised a 'magmatic morass' for any significant length of time.

6. 'What was to prevent the water and sediment from sinking into the magmatic morass … and turning the Earth's surface into one vast "parking lot" … of andesitic extrusive and/or tuff?'

The process of differentiation and crust formation may have been in part similar to that which forms the 'crust' on a submarine basalt lava flow.[28–30] The answer to this latter part of Woodmorappe's question 5 may then be; a similar process to that which prevents a submarine lava flow from dissipating into the surrounding sea-waters.

References

1. Hunter, M.J., The pre-Flood/Flood boundary at the base of the earth's transition zone, *CEN Tech. J.* **14**(1):60–74, 2000.
2. Hunter, M.J., The pre-Flood/Flood boundary at the base of the earth's transition zone, *CEN Tech. J.* **14**(1):60–74, 2000.
3. Austin, S.A., Baumgardner, J.R., Humphreys, D.R., Snelling, A.A., Vardiman, L. and Wise, K.P., Catastrophic plate tectonics: a global Flood model of Earth history; in: Walsh, R.E. (Ed.), *Proceedings of the Third International Conference on Creationism*, Creation Science Fellowship Inc., Pittsburgh, pp. 609–621, 1994.
4. Stein, M. and Goldstein, S., From plume head to continental lithosphere in the Arabian-Nubian shield, *Nature* **382**:773–778, 1996.
5. Albarede, F., The growth of continental crust, *Tectonophysics* **296**:1–14, 1998.
6. Jordan, T.H., Composition and development of the continental tectosphere, *Nature* **274**:544–548, 1978.
7. Christensen, U.R., Thermal evolution models for the Earth, *J. Geophys. Res.* **90**:2995–3007, 1984.
8. Snelling, A.A. and Woodmorappe, J., The cooling of thick igneous bodies on a young Earth; in: Walsh, R.E. (Ed.), *Proceedings of the Fourth International Conference on Creationism, Technical Symposium Sessions*, Creation Science Fellowship Inc., Pittsburgh, pp. 527–545, 1998.
9. Baumgardner, J., The numerical simulation of the large-scale tectonic changes accompanying the Flood; in: Walsh, R.E., Brooks, C.L. and Crowell, R.S. (Eds), *Proceedings of the First International Conference on Creationism: Volume II Technical Symposium Sessions and Additional Topics*, Creation Science Fellowship Inc., Pittsburgh, pp. 17–30, 1986.
10. Hunter, M.J., Scriptural constraints on variation of water level during the Genesis Flood, *CEN Tech. J.* **14**(2):91–95, 2000.
11. Leupold, H.C., *Exposition of Genesis*, The Warburg Press, Columbus, 1942.

12. Whitcomb, J.C. (Jr) and Morris, H.M., *The Genesis Flood: The Biblical Record and its Scientific Implications*, Presbyterian and Reformed Publishing Company, Philadelphia, 1974.
13. Robinson, S.J., Can Flood geology explain the fossil record? *CEN Tech. J.* **10**(1):32–69, 1996.
14. Garner, P., Where is the Flood/post-Flood boundary? Implications of dinosaur nests in the Mesozoic, *CEN Tech. J.* **10**(1):101–106, 1996.
15. Holt, R.D., Evidence for a late Cainozoic Flood/post-Flood boundary, *CEN Tech. J.* **10**(1):128–167, 1996.
16. Hunter, M.J., Is the pre-Flood/Flood boundary in the Earth's mantle? *CEN Tech. J.* **10**(3):344–357, 1996.
17. Hunter, M. J., Scriptural constraints on the variation of water level during the Genesis Flood, *CEN Tech. J.* **14**(2):91–94, 2000.
18. Baumgardner, J.R., The imperative of non-stationary law in relation to Noah's Flood. Mini-symposium on variable constants-IX, *CRSQ* **27**:98–100, 1990.
19. Baumgardner, Ref. 8.
20. Ronov, A.B., The Earth's sedimentary shell: quantitative patterns of its structure, compositions, and evolution, The 20th V. I. Vernadskiy Lecture, 12 March 1978, *Internat. Geology Rev.* **24**(11):1313–1363, 1978.
21. Blatt, H. and Jones, R.L., Proportions of exposed igneous, metamorphic and sedimentary rocks, *Geol. Soc. Amer. Bull.* **86**(8):1085–1088, 1975.
22. Wedepohl, K.H., The composition of the continental crust, *Geochimica Cosmochimica Acta.* **59**(7):1217–1232, 1995.
23. Dietz, R.S. and Holden, J.C., Reconstruction of Pangea: breakup and dispersion of the continents, Permian to present, *J. Geophysical Research* **75**:4939–4955, 1970.
24. Jeanloz, R. and Morris, S., Temperature distribution in the crust and mantle, *Ann. Rev. Earth Planet. Sci.* **14**:377–415, 1986.
25. Chapman, D.S., Thermal gradients in the continental crust; in: Dawson *et al.* (Eds), *The Nature of the Lower Continental Crust*, Blackwell, pp. 63–70, 1986.
26. Carslaw, H.S. and Jaeger, J.C., *Conduction of Heat in Solids*, Oxford University Press, Oxford, 1959.
27. Weinstein, S.A., Catastrophic overturn of the Earth's mantle driven by multiple phase changes and internal heat generation, *Geophys. Res. Lett.* **20**(2):101–104, 1993.
28. Taylor, S.R., Not mere scum of the Earth, *Nature* **346**:608–609, 1990.
29. Patchett, P.J., Scum of the Earth after all, *Nature* **382**:758–759, 1996.
30. Kirby, S.H., Rheology of the lithosphere, *Rev. Geophys. Space Phys.* **21**:1458–1487, 1983.

Flood level ambiguous?

Michael J. Oard

I would like to comment on Max Hunter's article about the variation in water level during the Genesis Flood.[1] It would be good to know the water levels during the Flood, but I believe Genesis 7 and 8 are too ambiguous to make too many definitive statements on the exact levels in relation to the mountains or higher terrain. Creationists disagree on the details of the Flood. Nevertheless, a strong case can be made that **most** of the floodwaters increased during the first 40 days and that the Flood ended on Day 371.

Despite the ambiguous wording of Genesis 8:3, I agree with Hunter that the Flood likely peaked on Day 150. Reasons for this belief are:

1. The waters **prevailed** for 150 days (Genesis 7:24) covering all the 'high' mountains during that time (Genesis 7:19,20),
2. The Ark grounded on Mt Ararat on Day 150 (Genesis 8:4), and
3. The water did not start to decrease until Day 150 (Genesis 8:3b).

I lean towards the belief that, at the end of the Flood, the ocean was constrained at **near** the present sea level, but not exactly where it is now. (Roy Holt, personal communication, on the other hand, leans toward the view that sea level was at the present level immediately after the Flood.) The text strongly indicates that the Flood had ended around at least the Mt Ararat region, where Noah could directly observe. Although it is a reasonable Scriptural and geological extrapolation to conclude that the Flood was finished worldwide,[2] there are differences of opinion. Froede, for instance, believes the Flood continued for several hundred more years at least in the southeast United States.[3,4] I emphasize **near** present sea level because of the nonexistence of the Greenland and Antarctic Ice Sheets and other smaller factors that would result in a sea level about 40 m higher than present.[2] These ice sheets, if they existed before the Flood, would have been destroyed during the global Flood. So, they must have been absent immediately after the Flood. These ice sheets built up during the post-Flood ice age and afterwards.[5,6]

Reading Genesis, I can see a case that the Flood could have peaked in 40 days or in 150 days. I do not believe Scripture is emphatic enough to say one way or other. Given that most of the Flood water was added to the pre-Flood ocean within 40 days, I can accept that the waters remained at steady state or increased slowly, up until Day 150. Even if all the water was produced within the first forty days of the Flood, it is also possible that not all of the higher terrain was covered until Day 150 or sometime in between,