Appendix 1

What Caused Vertical Tectonics Late in the Flood?

All over the Earth, the evidence is clear that parts of the Earth's crust (and probably the upper mantle) uplifted while parts sank during the Retreating Stage of the Flood (see Part II). I am frequently asked: What caused this differential vertical tectonics? However, I must admit that I do not know. But this should not be surprising. Scientists still do not know that much about the earth sciences. One of the main reasons for lack of knowledge of the mechanism or mechanisms for differential vertical tectonics is that we need to know more about the rocks below our feet. We need to know the characteristics of the middle and lower crust and the upper mantle. We can obtain a little information from the field of geophysics.

Geophysics is the geological subfield that probes the subsurface by seismic waves, gravity anomalies, magnetism, electrical conductivity, heat flow, etc. These probes can provide us with general information. However, each of these probes is limited and the information is sometimes difficult to interpret.

Uniformitarian Scientists Do Not Know

Encouragingly, uniformitarian scientists and Flood geologists are in the same predicament. Neither paradigm knows the reasons for vertical tectonics, although the uniformitarians have a number of hypotheses, which could also be applied to Flood geology. Uniformitarian geomorphologists Cliff Ollier and Colin Pain wrote a book called *The Origin of Mountains*.[1] They were especially interested in the cause of uplift. Ollier and Pain made a strong case that sedimentary rocks underwent four processes of change late in the uniformitarian timescale.

They first posit that sedimentary rocks were folded and faulted. Second, they were planed off to form planation surfaces in the "middle Cenozoic." (see the in-depth section at the end of chapter 5 for the meaning of the Cenozoic within the uniformitarian geological column.)

(a)

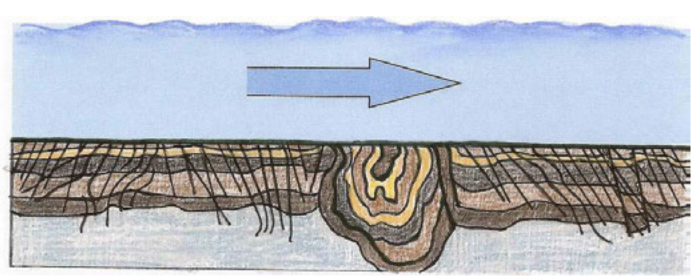

Figure A1.1. Schematic of a) faulting, folding, and planning of the surface, and b) uplift and erosion of the planation surface according to Ollier and Pain, 2000 (drawn by Mrs. Melanie Richard).

Third, the planation surfaces were uplifted, and fourth, erosion eroded the surface into mountains (Figure A1.1). The latter two processes mostly occurred simultaneously during the "late Cenozoic" of their timescale. This is very late within the uniformitarian

[1] Ollier C. and C. Pain, 2000. *The Origin of Mountains*, Routledge, London, U.K.

(b) 

timescale. Sometimes erosion was so strong that no trace of a planation surface was left, but other times, erosion was not strong enough to erase at least a few planation surface remnants. That is why we have so many flat-topped, truncated mountains around the Earth.

This scenario presented by Ollier and Pain agrees in relative sequence with the Retreating Stage of the Flood.[2] The planation of strata will be discussed in Volume II of this book. In other words the last major geological event of the Flood was the *uplift* and erosion of the mountains. Such a recent uplift for the mountains is contrary to strict uniformitarianism:

> Uplift occurred over a relatively short and distinct time. Some earth processes switched on and created mountains after a period with little or no significant uplift [to produce the planation]. … We are seeing the results of a distinct and *remarkably young mountain building period. This is a deviation from strict uniformitarianism* (emphasis mine).[3]

Near the end of their book, Ollier and Pain address the question of the mechanism or mechanisms of uplift. They listed twenty possible mechanisms, none of which can be demonstrated to be occurring today.[4] Ollier and Pain were forced to conclude that they do not know. Wilson and others also admitted that they do not know why the ocean basins sank causing guyots to go from near sea level to an average of 5,000 feet (1,525 m) below sea level (see Chapter 7).[5]

Scientists simply deduce that all over the Earth great uplift and subsidence has occurred in the past. So, both Flood geologists and uniformitarians can agree on one thing: the need for more research in geology and geophysics in order to discover a viable mechanism or mechanisms for global differential vertical tectonics.

A Few Possible Creationist Mechanisms

There are several possible mechanisms for late Flood vertical tectonics. These have been suggested by uniformitarian scientists and seem plausible within a Flood paradigm. One is by a pulse of hot or molten rock uplifted from below the Earth's surface. The rock could have started solid and as it uplifted vertically, it could have melted by decompression melting (pressure release lowers the melting point). The overburden or what is called the lithostatic pressure is reduced as the rock is uplifted.

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2 Oard, M.J., 2002. The mountains rose. *Journal of Creation* 16(3):40–43.
3 Ollier and Pain, Ref. 1, pp. 303, 306.
4 Ollier and Pain, Ref. 1, p. 308.
5 Wilson, P.A., H.C. Jenkyns, H. Elderfield, and R.L. Larson, 1998. The paradox of drowned carbonate platforms and the origin of Cretaceous Pacific guyots. *Nature* 392:889–894.

Another related possibility is that the asthenosphere could have been tapped, which would have uplifted the surface. The asthenosphere is a low seismic velocity zone, probably caused by hotter than average rock for that depth with perhaps a very small amount of melt. It is around a depth of 200 km below the surface but varies significantly in depth and thickness. Tapping asthenosphere rock is suggested by some scientists as causing the uplift of the Sierra Nevada Mountains of California, which have anomalously thin crust.[6]

Rock that is warmer than its surroundings would tend to raise the surface. The land surface rises because the warmer temperatures expand the rock. For the Sierra Nevada Mountains to raise 1.9 miles (3 km), it is estimated hot rock would need to replace 20.6 miles (33 km) of cold rock.[7]

Another possible mechanism for differential vertical tectonics is that the lower crust can undergo a phase change into a denser rock type through the rearrangement of the atoms by packing them more densely. Then the denser rock could sink into the upper mantle and be replaced by hotter rock from below.[8] This would result in a net uplift of the surface. The phase change commonly invoked is a lower crustal change to eclogite, a more densely packed form of basalt or gabbro, a basalt-like rock that did not flow on the surface but remained underground. Basalt that is transformed to eclogite under higher pressure would become about 15% more dense with a volume 15% less.[9] Conversely, if the eclogite does not sink into the mantle, the denser rock will cause subsidence of the crust above, forming a basin or valley on the surface. This is because the denser rock has less volume and will result in the surface sinking.

A fourth possible mechanism for differential vertical tectonics during the Flood is the horizontal transfer of subsurface rock from one place to another. The rock needs to be molten or readily deformable for this to be effective. The area that gains the molten material adds mass that causes uplift, while the area that loses mass will sink, if all other variables remain the same.

Variable Uplift Caused by Restoring Forces after Flood Impacts

A fifth and last possible mechanism discussed is the restoration of isostatic balance after numerous impacts early in the Flood. All the solid bodies of the solar system have been blasted by meteorite or comet impacts. The Earth could not have been missed. So, based on the closest body to the Earth, the Moon, and taking into account the Earth's larger cross sectional area and gravity, the Earth would have received more than 36,000 impacts with craters greater than 19 miles (30 km) in diameter during its history,[10] unless some other factor intervened to cause fewer impacts. It does not seem likely that these impacts occurred during Creation Week since the Moon was not made until Day 4. Furthermore, solar system wide impacting would destroy newly created life on Earth. The impacts could not have occurred between Creation and the Flood or after the Flood because they would have destroyed all life on the Earth. The most logical location is for

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6 Ducea, M.N. and J.B. Saleeby, 1996. Buoyancy sources for a large, unrooted mountain range, the Sierra Nevada, California: evidence from xenolith thermobarometry. *Journal of Geophysical Research* 101(B4):8,229–8,224.

7 Ducea and Saleeby, Ref. 6, p. 8,240.

8 Elkins-Tanton, L.T., 2007. Continental magmatism, volatile recycling, and a heterogeneous mantle caused by Lithospheric gravitational instabilities. *Journal of Geophysical Research* 112(B03405), 1–13.

9 Anderson, D.L., 2007. *New Theory of the Earth*, Cambridge University Press, New York.

10 Oard, M.J., 2009. How many impact craters should there be on the earth? *Journal of Creation* 23(3):61–69.

the impacts to have struck during the Flood. The huge amount of energy generated by the impacts would provide a powerful mechanism for the Flood.

The impacts would have blasted a variable amount of the crustal rock out of the crater that would have end up in the Floodwater. Sometimes mantle rocks would be blasted away in the larger impacts. This crustal rock would be mostly pulverized by the massive turbulence of multiple impacts. The sediments would be transported far from their place of origin and eventually deposited. Multiple impacts account for the huge amount of sedimentary rocks on Earth, most of which are composed of fine-grained particles like shale.

In loosing variable proportions of the crust, the Earth would be variably out of isostatic balance. This would cause a variable upward restoring force. Those areas that are far out of isostatic balance, in that they lost more rock, would be expected to rise more than those areas less so (Figure A1.2). So, the amount of uplift would vary all across the Earth, some areas uplifting more than others. The restoring forces after the major impacts were over could have been the cause of the differential vertical tectonics that happened during the Retreating Stage of the Flood.

Impacts can also cause phase changes to a denser lower crust, such as eclogite, which can cause areas to sink or rise depending upon what happens to the eclogite after formation..

(a)

(b)

(c)

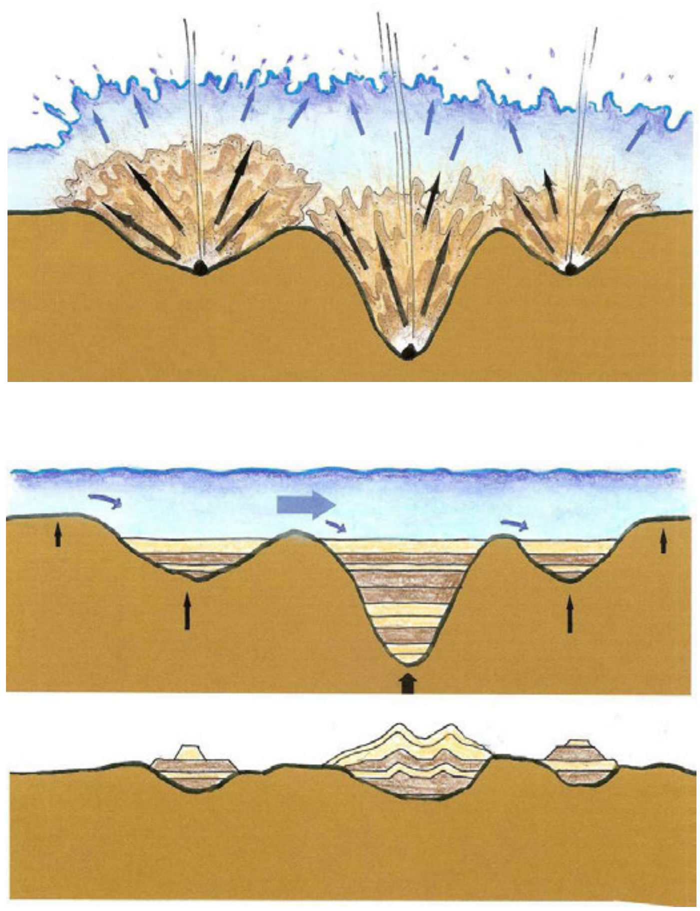

Figure A1.2. Schematic showing (a) multiple impacts early in the Flood, (b) craters fill with sediments, and (c) variable upward restoring forces cause differential vertical tectonics late in the Flood (drawn by Mrs. Melanie Richard).