Is plate tectonics really occurring today?

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I address the evidences from Dr John Baumgardner's recent *Journal of Creation* article on whether plate tectonics is occurring today. GPS motions are not proof of plate tectonics because the suggested forces to move plates are inadequate. According to catastrophic plate tectonics (CPT), the driving force of plate motion should have stopped during or shortly after the Flood, so CPT could not be the mechanism for modern plate motions. Evidence is presented that plates have not moved thousands of kilometres. Wadati-Benioff zones show many anomalies and can be explained by phenomena other than subduction, and the same is true of mid-ocean ridges.

I thank Dr Baumgardner for raising important issues.[1] There are many aspects of plate tectonics (PT) and catastrophic plate tectonics (CPT) worth investigating; many more than those raised by Baumgardner.

Plate tectonics is an elaborate paradigm that seems to explain much geological and geophysical data. But when examined in detail, its explanations are seen to show many anomalies. Some have been documented by creationists[2,3] and some by secular scientists.[4] Anomalies have caused the simple PT model of the 1960s and 1970s to undergo a transformation with the addition of numerous, seemingly *ad hoc* subsidiary hypotheses. CPT has also been extensively discussed in a comprehensive Flood movie review.[5] This model needs a lot of work, like all the rest:

> "What we saw in this Review is all the models were seriously challenged. This is a good thing for the Creation Community which should be embraced and encouraged to continue. Only through the peer review process can we refine our models, and ever hope to reach a level of high confidence that one of our models could truly stand up to secular scrutiny and challenging."[6]

In addition to his Flood model, and apparently in support of residual plate motions, Baumgardner believes geodetic measurements, mid-ocean ridges, and 'subduction zones' offer evidence of this ongoing PT.

What is the meaning of GPS measurements?

Baumgardner first brings up GPS data as proof that plates are moving and that PT is therefore occurring today. He says: "These measurements demonstrate, with little room for debate, that plates are real entities and that they are currently in motion across the face of the earth."[7] I never said plates were not real, *if* defined by boundary faults, volcanoes, and earthquakes.

Looking further into geodetic data indicates that plate motions are not necessarily evidence for PT occurring today. For instance, we can reasonably ask whether the *local* measurements gathered by scientists can be extrapolated into plate motions. Realistically, to do so would require them to zero out all local influences, such as faults, folding, subsidence, and uplift, which are *not* so thoroughly documented. In other words, GPS stations do measure absolute movement, but do not say anything about the cause of this movement. Since Earth is a dynamic planet, we would expect crustal motion to some degree, agreeing with Baumgardner that it is likely to be residual Flood effects. Moreover, motions detected today do not necessarily mean that plates have sailed around the earth *thousands of kilometres* in the past, and this is the real issue. The logic is similar to extrapolating diversity in kinds, ostensibly called microevolution by evolutionists, to claim that macroevolution is a fact. Baumgardner needs to show two things: that the forces for continued plate movement are sufficient and that plates have moved long distances in the past. I will address these two aspects, since they are crucial to both the PT and CPT paradigms.

Are the PT forces sufficient to move plates?

If plates are moving today by PT or a residual CPT, then the forces that move plates today must be adequate. If the forces are not adequate, it would point to other forces that cause the motion of plates or portions of plates. Are the forces to move plates sufficient? These forces have to act on the bottom and/or sides of the plates. The forces on the bottom of plates are the horizontal forces below the lithosphere caused by putative convection currents, while the forces on the sides are called 'ridge push' near mid-ocean ridges (MORs) and 'slab pull' in 'subduction zones'.

Although many geophysicists simply assume these forces are sufficient, many experts on PT admit that the magnitude of these forces is a huge problem. Ridge push, an outward force caused by cooling of the plates as they move away from MORs, is believed by many geophysicists to be either non-existent or exceedingly weak, and so slab pull is believed to be the main sideways force on plates:

> "The lack of compressive deformation in young, thin oceanic lithosphere precludes the shortening that would occur were there a ridge-push force. Ridges form where ocean plates slide apart, and subduction provides the drive."[8]

Thus, ridge push is often acknowledged to be insignificant. But slab pull is also conceded by some geophysicists to be only a minor force:

> "Oceanic lithosphere is strong in compression but weak in tension, so 'slab pull', although often invoked, can be only a minor complication. 'Ridge push' is another popular misconception."[9]

Slab pull, even with the possible added negative buoyancy of basalt and gabbro transforming to eclogite at about 50 km depth, would cause a pulling or tensional force *only* where the force is applied. Such a force is *not* transmitted into the rest of the plate. So these lateral forces do not seem able to move large plates, especially over the long distances required for plate tectonics. Would slab pull be sufficient to move the 70-km-thick, hemispheric-sized Pacific Plate?

This leaves only mantle convection, but it is difficult to demonstrate the magnitude, if any, of this force on the bottom of a plate. Many geophysicists simply *assume* convection drives plates.[10] But other scientists believe the shear stress at the base of the lithosphere is likely too weak to move plates, and it may even be in the opposite direction:

> "If convection currents dragged plates around, the bottom drag force would be the most important. However, there is no evidence that this is a strong force, and even its sign is unknown (driving or resisting drag)."[11]

Thus, the bottom shear stress could be a resisting force for plate motion.[12]

Therefore, there is no mechanism sufficient for PT—a major problem: "Understanding the mechanism of plate tectonics is one of the most important problems in the geosciences."[10] Without an adequate mechanism, GPS data are evidence only of surface crustal motions at the location of the stations, *not* evidence of PT.

It could be claimed that the GPS motions are what PT predicts. However, I believe it is the other way around. The PT model was employed to explain geodetic motions, many of which were already generally known by ground-based geodetic measurements before the advent of PT.

Can CPT provide a PT mechanism?

Baumgardner has claimed that the mechanism problem of conventional PT is solved by his CPT model, where runaway subduction of lithospheric plates to the base of the mantle provides the force that drove plate motion during the Flood.[13] Before this can be accepted, there are two issues to consider.

The first issue deals with whether residual plate motions are still occurring, even assuming CPT is true. According to the CPT mechanism of runaway subduction, once subduction began, the strain rate that allows plate motions dramatically increased by lowering mantle viscosity by orders of magnitude. This mechanism is well supported theoretically and on a laboratory scale, but it is unknown whether it actually occurred on a global scale during the Flood. Once the runaway subduction stopped, mantle viscosity returned to its normal value and CPT plate motions should have come to a *complete stop*. There should be no residual CPT motions today.

A second issue is more philosophical. If PT can be shown to be inadequate, why should CPT be allowed to rescue the paradigm? Maybe the paradigm is wrong in the first place. There would be no point in rescuing such a paradigm. This gets back to the relationship between PT and CPT, which has never really been explored in depth, especially to the extent of evaluating the influence of uniformitarian assumptions and methods on the CPT model.

Evidence against long distance movement of plates

If plates have really moved hundreds to thousands of kilometres, there should be distinct boundaries around all major plates as well as geological evidence of those motions at many boundaries. In some areas it appears that there is a lack of a boundary or a poorly defined boundary between some plates or portions of plates.[14] An instance of this is the old boundary between the Eurasian and North American plates in Japan or the eastern Sea of Japan,[15] which now has been subdivided into several microplates.

It is well known that Africa is surrounded by spreading ridges with few 'subduction zones', mainly claimed for the northeast Mediterranean Sea (figure 1).[16] A similar situation occurs around Antarctica. So, convergence is focused on Africa from practically all directions (see arrow heads along lines in figure 1). Africa should show abundant convergence features but instead has extensional features, such as the Rift Valley. This pattern makes no sense and strongly suggests the absence of extensive horizontal plate movement. The lack

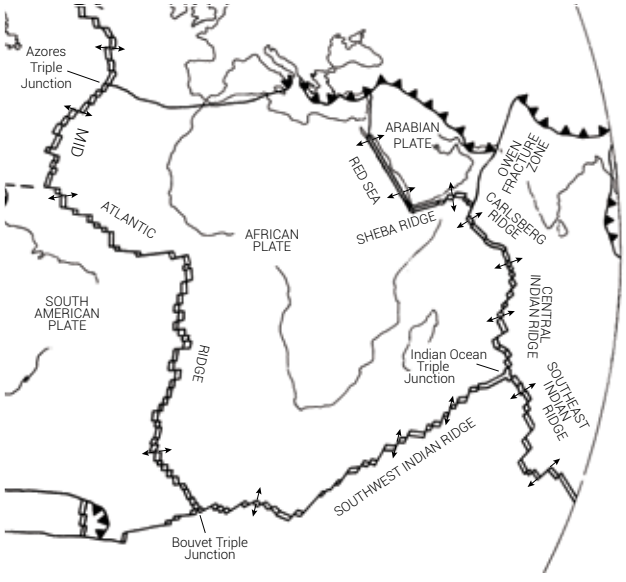

Figure 1. Mid-ocean ridges surround practically all of Africa and convergence is focused on the continent (arrow heads). Notice the bifurcating Southwest and Southeast Indian ridges with convergence between. (Modified from Fowler.[63])

of motion is also supported by the deep roots of continental shields, some extending down hundreds of kilometres.[17]

Plate tectonics advocates claim they can account for this anomaly if the Mid-Atlantic Ridge moves westward at the same time the ridge spreads, generally balancing out spreading toward Africa. The Southwest Indian Ridge south of Africa would also have to move south, and the Central Indian and Carlsberg Ridges to the east of Africa would have to move east (figure 1). But the Southwest Indian ridge is part of the ridge system surrounding Antarctica, so it would have to move north for the same argument to hold for Antarctica. So, how can this ridge move both south and north? Baumgardner believes he can explain such anomalies with subduction balancing ridge divergence taken up elsewhere, for example spreading at the Mid-Atlantic Ridge is balanced by subduction at the Peru–Chile Trench and in the southern part of Europe and Asia.[18] While these kinds of explanations might be locally feasible, they quickly run into insoluble problems when looking at the planet as a whole.

Are plate motions a residual of the Flood?

Baumgardner argued that I did not provide any details of a non-PT mechanism, but that was because I had *no space to develop any ideas*. Besides, his argumentation is another example of the 'best-in-the-field' fallacy.[19] His continuing demand for a viable alternative has nothing to do with whether his model is right or wrong and should be irrelevant. I suggested that the motions detected by GPS and other geodetic systems are residual motions from Flood tectonics, specifically differential vertical tectonics with a horizontal component left over from the Recessive Stage of the Flood.[20] The differential vertical tectonics could be caused by restoring forces after impacts early in the Flood left the earth in variable isostatic imbalance. The Recessive Stage of the Flood was characterized by continents and mountains rising and ocean basins and valleys sinking. I would estimate that about 3,000 m of sediments and sedimentary rocks covered the continents midway in the Flood and that about half that amount was eroded off the continents during uplift, forming the thick continental shelves, slopes, and rises around all continents. I do not believe the earth has recovered from all this differential vertical tectonics, erosion, and deposition, and that is why we observe residual motions of the crust.

The meaning of 'subduction zones'

Baumgardner presents four sections that relate to 'subduction zones': 1) the dipping zone of earthquakes called Wadati-Benioff zone, 2) the mechanisms of deep earthquakes, 3) mega-earthquakes such as the 2011 Tohoku earthquake off Japan, and 4) volcanoes above Wadati-Benioff zones. These are all related, so I will combine them and discuss other aspects of 'subduction zones'. Figure 2 shows a classic subduction zone as visualized in the 1970s.[21]

Wadati-Benioff zones

In regard to the dipping zones of earthquakes that sometimes descend down to about 700 km vertical depth, called Wadati-Benioff zones, Baumgardner claims:

> "Again, he [Oard] provides no clue as to what those other explanations might be. Like the GPS measurements, the distribution and character of earthquakes that occur on a daily basis across the world testify powerfully to the present reality of plate motion. … Furthermore, the deep events are associated exclusively with the zones of plate convergence."[7]

Just like with the GPS data, I had no space to give my views, which actually have been expressed elsewhere.[22] Baumgardner simply believes that the motions that cause earthquakes prove PT:

> "… the focal mechanism, the slip plane, the area and magnitude of slip on the slip plane, and the earthquake magnitude can be determined. Such analyses reveal, as in the case of the Tohoku event, the reality of subduction in these contexts."[23]

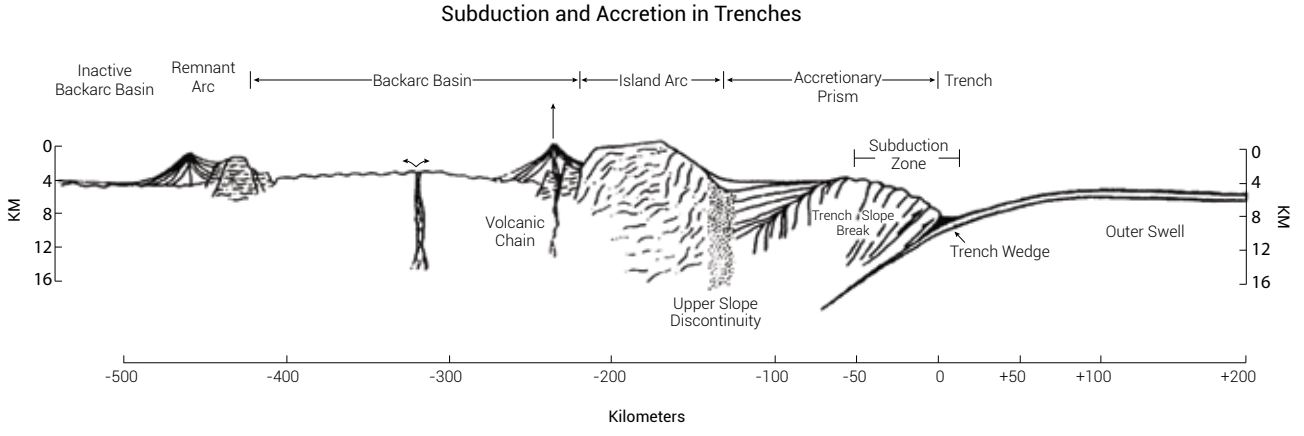

Figure 2. A classic subduction zone with back arc basin, island arc, accretionary prism, and trench as envisioned in the 1970s (with vertical exaggeration 5:1).[21]

The Wadati-Benioff zones, as well as other observations of 'subduction zones', are especially significant for any hypothesis on Earth tectonics. It is these earthquake zones and the apparent fit of the continents across the Atlantic that offers evidence to show that plate motions may have happened, even though the majority of the problems have not been adequately answered by Baumgardner or secular advocates. The answer to that question is complicated by a lack of data, misinterpretation of existing data, a paradigm-driven approach, reliance on imperfect geophysical models, and the failure of lab data to correspond to the real world. So, there is room for other ideas.

I certainly agree with the observations stated by Baumgardner that most earthquakes are on plate boundaries, such as the Tohoku earthquake off Japan, and that deep quakes, those down to around 700 km, are associated with Wadati-Benioff zones. There are a few notable exceptions, however, in that not all deep earthquakes are associated with 'subduction zones', for instance the strong earthquakes below Vrancea, Romania, at depths of 80 to 110 km and the series of strong quakes over the years at about 630 km depth below southeast Spain.[24]

In addition, there are anomalies associated with Wadati-Benioff zones that suggest that the simple plate convergence mechanism is inadequate,[22] pointing to another mechanism. First, some Wadati-Benioff zones are flat to nearly flat, such as below western South America. Is this predicted by CPT? In Baumgardner's computer simulations, subduction goes straight down. The supposedly consumed Farallon 'subduction zone' under North America is believed to have moved horizontally eastward for hundreds of kilometres before diving down into the deep mantle. Such horizontal subduction is used to explain anomalous geochemical observations in igneous rocks in the western US. But how does a plate move horizontally under tens of kilometres of rock?

Second, the first motion of earthquakes, which shows the direction of motion at plate boundaries, is downdip extensional at intermediate depths. One would assume that a subduction zone would be converging all the way down to 700 km and into the deep mantle. I know Baumgardner has attempted to explain this, but I found his explanation unsatisfactory.

Third, the direction of shear of intermediate and deep earthquakes is usually not in the plane of the Wadati-Benioff zones, but is offset a few tens of degrees on the average from the plane.[24] What is the meaning of this?

There are other strange features of these supposed subduction zones.[22] All these observations indicate that there are thrust earthquakes at Wadati-Benioff zones, but that is not the same as the large-scale subduction required in the PT and CPT models. Thanks to the monolithic nature of plate tectonics, other explanations are rarely even considered.

In regard to the eastward upper plate motion during the Tohoku earthquake, Baumgardner states that the Pacific plate should have been subducted an equal distance of several metres westward at the same time: "The elastic rebound of the downgoing plate presumably was of similar amplitude but in the opposite direction."[23] Did such motion of the Pacific plate really occur at the same time as the Tohoku earthquake? This needs to be verified, not simply assumed.

Volcanoes behind trenches

Volcanoes are adjacent to deep-ocean trenches. Baumgardner asks: "Why should there be volcanism associated with plate convergence?"[23] There have been several explanations for this association over the years. The current understanding is that the volcanoes are caused by fluids derived from the subducting slab, which leak upwards and locally lower the melting point of the mantle wedge, forming magma. But there are now problems associated with this latest idea. Andesite, supposedly the product of mantle wedge melting, may originate in the crust,[25,26] and have little to do with 'subduction'.

The problem of deep earthquakes

Baumgardner suggests that for earthquakes to occur, especially deep earthquakes, 300 to 700 km depth, the rocks must be cooler than 600°C in the mantle. This is uncertain. There are many unknowns associated with deep earthquakes.[24] According to Cliff Frohlich, deep earthquakes can possibly occur with hot temperatures by dehydration embrittlement, shear instabilities and stress-induced melting, and transformational faulting and anticracks.[27] Just recently the largest strike-slip earthquakes on Earth, magnitude 8.6 and 8.2, occurred in the *oceanic mantle* at focal depths of about 40 and 54 km, respectively, far from a subduction zone.[28] The temperature of the mantle at these depths is supposed to be 600° to 800°C. Researchers willing to think about non-PT explanations have a fertile field before them.

Other anomalous observations in 'subduction zones'

There are other anomalies that do not fit the PT model. First, trenches have a very low gravity anomaly and the adjacent island arcs have a very high gravity anomaly. They are not in isostatic equilibrium, but the fluids that cause volcanism released from the subduction zones into the mantle wedge should cause a lower gravity anomaly.

Second, the 'subduction zone' is supposed to be a convergence zone, yet there are extensional features throughout the *whole* system, even on the forearc side of the trench. Figure 3 shows a schematic of the forearc off Peru.[29] McNeill *et al.* state:

> "Listric normal faulting is a common feature of passive margins, where fault movement contributes to crustal thinning and margin subsidence. Extension and normal faulting are *also a fairly common phenomenon on convergent margins [subduction zones] throughout the world*. … Discovery of these

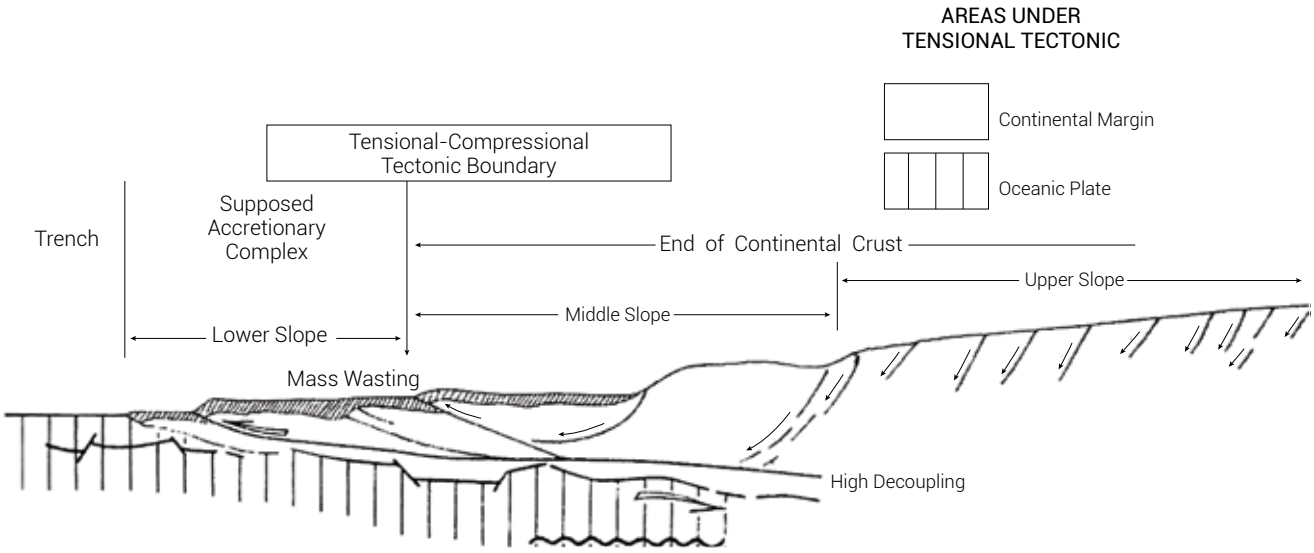

Figure 3. Schematic of the Andean margin off Peru in the Paita area.[29] Notice the listric normal faults on the upper slope and the large rotational slumping on the middle and lower slope.

> extensional structures requires a reevaluation of structures previously interpreted as folds and faults related to plate convergence [emphasis added].”[30]

Von Huene notes the paradox: “At first glance it may seem paradoxical that in a dynamic system dominated by plate convergence, this convergence does not control structural style.”[31] Figure 2 shows the locations of these features in association with the Wadati-Benioff zone. All these observations are explained away by *ad hoc* subsidiary hypotheses, such as an oceanic spreading centre in the backarc and the collapse of the forearc.

Third, there is high heat flow in the island arc, which is not surprising because of the volcanoes on the arc. But there is also high heat flow in the backarc zone. Remember that a cool subduction zone is supposed to underlie the forearc, island arc, and backarc.

Fourth, the trenches and forearcs have enumerable anomalies, assuming convergence,[22] such as a lack of trench sediments in some trenches, horizontal strata in other trenches, lack of oceanic sediments in the trenches and the forearc, lack of an accretionary prism along 44% of the total length of all trenches, and extensional features in the trench sediments that do contain sediments when there are supposed to be convergence features.[22,32]

Fifth, a new puzzling observation related to ‘subduction zones’ is that seismic anisotropy is mostly oriented in the wrong direction. Seismic waves travel faster in one preferred direction due to several mechanisms. Many geologists assume that the anisotropy is a result of the orientation of the long axis of olivine by shear flow, and it points to the rheological movement of the rock in the upper mantle. In subduction zones, the fast direction of olivine, indicating the direction of movement, is predicted to be perpendicular to the trench.[33] However, there is variability in the fast orientation within subduction zones; often the fast direction is *parallel* to the trench, 90° in the wrong direction.[34–36] Possible explanations have been floated for this anomaly, but it is still a puzzle for geologists.

An alternative hypothesis for ‘subduction zones’

If PT fails to explain the data and is not true, then how can we explain the observations at ‘subduction zones’? Some seem favourable to PT; some do not.

A suggestion was made many years ago by uniformitarian scientists skeptical of PT.[37,38] They proposed that the observations are better explained by an uplifting arc or uplifting edge of a continent (i.e. the Andes Mountains), moving at a slant (overthrusting). Such a model would account for high heat flow, volcanism, and high gravity anomalies on the island arc because hot mantle has been uplifted. It would also explain arc, forearc, and back arc extension. The forearc could simply be a huge slump (figure 4) at the edge of an uplift but without the lower portion becoming chaotic. Such a slump would fit the ocean bottom morphology and seismic reflectors of the ‘accretionary prism’ shown on figure 2, namely a forearc basin, an outer ridge, and reflectors dipping toward the arc or continent.

Figure 4. A rotational slump (from Foster[64]). Notice the similarity to the ‘accretionary prism’ in figure 2.

The Wadati-Benioff zone could be the downgoing segment adjacent to the slantwise uplift, similar to a sinking continental foreland basin adjacent to slantwise uplift of some mountain ranges in the Rocky Mountains[39] and elsewhere. Earthquakes on the Wadati-Benioff zone would be caused by the shearing or other possible mechanisms mentioned above. The trench then could be the surface expression of the slantwise sinking zone. Krebs summarized:

> "Consequently, all geophysical, tectonic, and petrologic data confirm the extraordinary role of diapiric asthenoliths [his vertical tectonics model] in the inverted cores of mountain belts and island arc-trench systems. … Hence it follows that the oceanic lithosphere is not 'underthrust' beneath, but that the continental cores of the mountain belts and island arc trench system were overthrust toward the foreland or the ocean basins… ."[40]

Further evidence for such a model is provided by the uplift of all the mountains ranges late in the Flood to drain the floodwater. One would also expect uplift on the ocean floor, such as the uplift of island arcs. The Andes Mountains, for example, must have uplifted many thousands of metres late in the Flood. Such uplift could be slantwise toward the Pacific with the oceanward edge sinking, followed by slumping of the seaward edge of the uplift toward the trench.

The meaning of 'mid-ocean ridges'

I am aware that the MORs are at higher elevations with a higher average heat flow than the surrounding ridge flank and abyssal plains. It is an undeniable observation. The heat flow is high, although variable, right at the MORs, but decreases rapidly on the flanks of MORs and changes little away from the MORs.[41] The heat flow values along the flanks are lower than predicted by plate spreading models, and it is well known that for sea floor 'dated' at 60 to 70 million years or older,[42] the sea floor is too shallow for the half-space cooling model used.[43] One would expect a gradual decrease in heat flow from the MORs to the deep ocean, if PT were true, as plates slowly diverged with time, but the observations are otherwise.

I have already enumerated the many problems that plate tectonic theory encounters when trying to explain MORs as spreading ridges.[44] To recap, here are three. First, there is the problem of the *lack* of magma detected by geophysical methods below some MORs.[45] Moreover, the magma seems to be spread out several hundred kilometres on either side of the MORs, not concentrated as a linear injection system.[46] How does this magma configuration focus on the MORs?

Second, volcanic eruptions are surprisingly common along the *flanks* of MORs, when they should be happening at the ridge axis where the magma is supposed to extrude.[47] This flank volcanism is consistent with the underlying diffuse magma bodies detected far from the ridge axis.

Third, there are overlapping 'spreading ridges', as well as bifurcating MORs, such as the Southwest and Southeast Indian Ridges (figure 1), that show few, if any, features to accommodate convergence between these ridge features.[48,49] The pattern of MORS seems to be one of simple extension with little, if any, spreading, otherwise overlapping spreading ridges and bifurcating MORs would show compensating convergence features.

I propose that these and many other observations associated with MORs simply show differential vertical tectonics associated with the drainage of floodwaters off the continents and into the present-day ocean basins. The MORs and their amazingly sharp 90° fracture zone offsets, with some fracture zones crossing the entire ocean, represent an extensional pattern caused by uplift along and near the MORs and subsidence in the adjacent ocean basins.[50,51]

Black smokers

Black smokers are indeed a sign of hot rocks just below the surface caused by hydrothermal flow. They are often found at or near MORs, as Baumgardner states, but they are found elsewhere, such as within the 5,000-metre-deep Cayman trough, Caribbean Sea.[52] They are not unique to MORs.

Mistakes and misunderstandings

Baumgardner wrote a rather lengthy section hammering home *again*[53] a mistake I made in trying to understand his CPT mechanism at MORs. I have already acknowledged that error.[54] Baumgardner extrapolates wildly when he exclaims:

> "Apparently, Oard's failure to understand these aspects of mid-ocean ridges allowed him to construct a straw man picture of 50–100 km of *fully molten rock* beneath a ridge, a picture which he then used to ridicule the process of seafloor spreading."[55]

None of us are infallible, but the rules of logic, professional courtesy, and a Christian desire to believe the best of a brother are necessary parts of any of our debates. Even Baumgardner has made mistakes, and changes to CPT are evident in reading the corpus of his literature. For example, he now supposes that the Flood included the physical pole flipping of the planet, although that was previously not a part of his model. When Baumgardner keeps bringing up the mistakes of others as an argument for the validity of his model, he commits the *ad hominem* fallacy, which does not advance his case.

For example, Baumgardner, in a 2002 forum on PT in this journal, made his own error when he said:

> "Therefore, the discovery that basaltic rocks forming the ocean floor basement were magnetized in alternating directions in a spatially coherent pattern of stripes parallel to the ridge axis generated considerable interest."[56]

He failed to note that the magnetic anomalies (stripes) are actually less than 1% changes in magnetic *intensity*, not differences in magnetic direction.[57] Magnetic intensity anomalies are simply interpreted as magnetic direction anomalies. When confronted with this, he claimed

that I did not believe in reversals in continental lavas![58] Actually, changes in magnetic intensity bring up an alternative possibility that the ocean floor stripes can be caused by changes in the magnetic susceptibility of basalt, gabbro, or serpentinized peridotite in the ocean crust and upper mantle, probably caused by differential vertical tectonics.

As another example, in my first submission to the 2002 forum in the *Journal of Creation*, I made the statement that the Andes Mountains are believed by PT advocates to have resulted from melted rock bubbling up from the subduction zone and mantle wedge. In his second response, Baumgardner exclaimed: "In regard to mountain building, Oard's claim that the Andes are mostly volcanic in origin simply is not true."[13] But the following quotation shows that PT advocates account for both granite *and* volcanic rocks by the *same* subduction mechanism:

> "Igneous activity forming volcanic arcs [from subduction zones] along the margins of the continental lithosphere involves large-scale magma production that also gives rise to plutons of granite, granodiorite, and diorite. Reaching the surface, these same magmas emerge as lavas of acidic (felsic) and intermediate types, generating lava flows and pyroclastics of rhyolite and andesite."[59]

Let's move forward

Baumgardner then ends his article with a plea to move forward, but defines progress as support of his model—period! He is convinced that PT is a fact beyond debate and is bewildered at people's reticence to embrace CPT. I might add that I am far from alone in my views, as a number of articles[3] and the recent Flood model review showed.[5] Baumgardner asks in regard to my skepticism: "In his mind, just what in regard to creation science and the biblical account of earth history are at risk?"[55] I find such a question perplexing. I would say *the truth is the issue* and the need for an accurate and sophisticated geophysical and geological model of the Flood. The CPT model, so far, is not well developed and explains hardly any geology, in detail. A good model suggests areas of future research, but little research has been forthcoming from CPT advocates.

If we are to move forward, it first requires that we all admit that we see through a glass darkly (1 Corinthians 13:12), and that our models need a lot of work in attempting to explain the great volume of geological and geophysical data. The recent Flood model review demonstrated that above all else.[5] Another step forward is to acknowledge that biblical earth history differs from secular earth history on many levels, all the way down to the basics of the opposing worldviews. This has profound implications, and suggests caution in accepting conclusions of secular earth scientists; conclusions that are intricately layered with assumptions contrary to biblical truth.[60] I believe there are no shortcuts; simply assuming the truth of uniformitarian PT and microfossil biostratigraphy runs the risk of compromising biblical truth. Such conclusions need justification by well-reasoned arguments that show how they are congruent with creationism down to the worldview level. It is easy to get off track, unless all our steps are well documented. There are many creationists with doubts and questions about PT and CPT. Instead of ignoring them or dismissing their work, Baumgardner should respect their point of view and answer their questions. It would also help to see the CPT model fleshed out more, especially with regard to geology. One step that would help would be the generation of a timeline of the Flood that shows the events of CPT in their proper sequence, connected with major geological events such as orogenies, basin formation, and sedimentation. A series of maps showing the plate motions caused by runaway subduction, especially with regard to the problem of Wilson Cycles, would be a step forward, one that would allow creationist earth scientists to investigate specific features and their fit in CPT. Baumgardner's responses in the Flood movie review and in his *Journal of Creation* article[1] are indeed a step forward. Let us continue to move forward.

Since one of my long-range goals is to help develop a sophisticated Flood model, I have been motivated to look elsewhere than CPT. That is why I have tentatively advocated the meteorite or cometary impact model that starts the Flood[61] and differential vertical tectonics to drain the Floodwater and expose the continents (the IVT model).[62] I think it is worth noting that the Flood was a miracle that demonstrated God's amazing control over every facet of His creation. It is not only theologically possible, but perhaps even probably that the Flood in its entirety *cannot* be completely explained with reference to forensic methods and physical theories. That is why we are dependent upon empirical approaches.

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