

# Plate tectonics—inconsistencies in the model

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1 Thessalonians 5:21 instructs Christians to examine ideas carefully. For the creationist, this admonition can be applied to plate tectonics. On the surface, plate tectonics is a simple and elegant model that explains many features of Earth's geology. A closer look reveals a number of inconsistencies. These can be found in several key areas, including the number of boundaries of the plates, plate mechanics, mechanisms of plate motion, and the nature of the famous sea-floor magnetic stripes. In its transition from model to paradigm, plate tectonics has lost internal mechanisms to distinguish data from interpretation and to evaluate other potential explanations.

Following early, unsuccessful theories of continental drift, such as that of Alfred Wegener in the early 1900s,<sup>1</sup> plate tectonics (PT) was introduced in the early 1960s and was quickly adopted by most geologists. Despite widespread acceptance, it remains essentially unchanged and continues to include nagging unresolved problems.

Creationists have debated a form of catastrophic plate tectonics (CPT) since the 1990s.<sup>2</sup> However, it is linked closely to uniformitarian PT, and is thus prone to many of the unresolved problems that plague uniformitarian PT. These problems need to be addressed to determine if or to what extent they are relevant to CPT and whether CPT offers ways to resolve those tensions.

Many of these problems are inconsistencies. New data may be inconsistent with old interpretations. Interpretations may imply propositions that are inconsistent with other interpretations. Several of these inconsistencies are described and discussed in an attempt to better understand PT and its role in Earth history.

## Inconsistencies in defining the plates

One of the most basic propositions of PT is the definition and number of crustal plates. Early articles noted as few as six<sup>3</sup>, but as fieldwork began to challenge proposed boundaries and mechanisms, the number increased rapidly, primarily due to the addition of small 'microplates' in ambiguous areas. For example, the apparent lack of clear traditional plate boundaries (i.e. rifts, subduction zones, and transform faults) between Africa and Europe resulted in the addition of numerous small plates in that region.

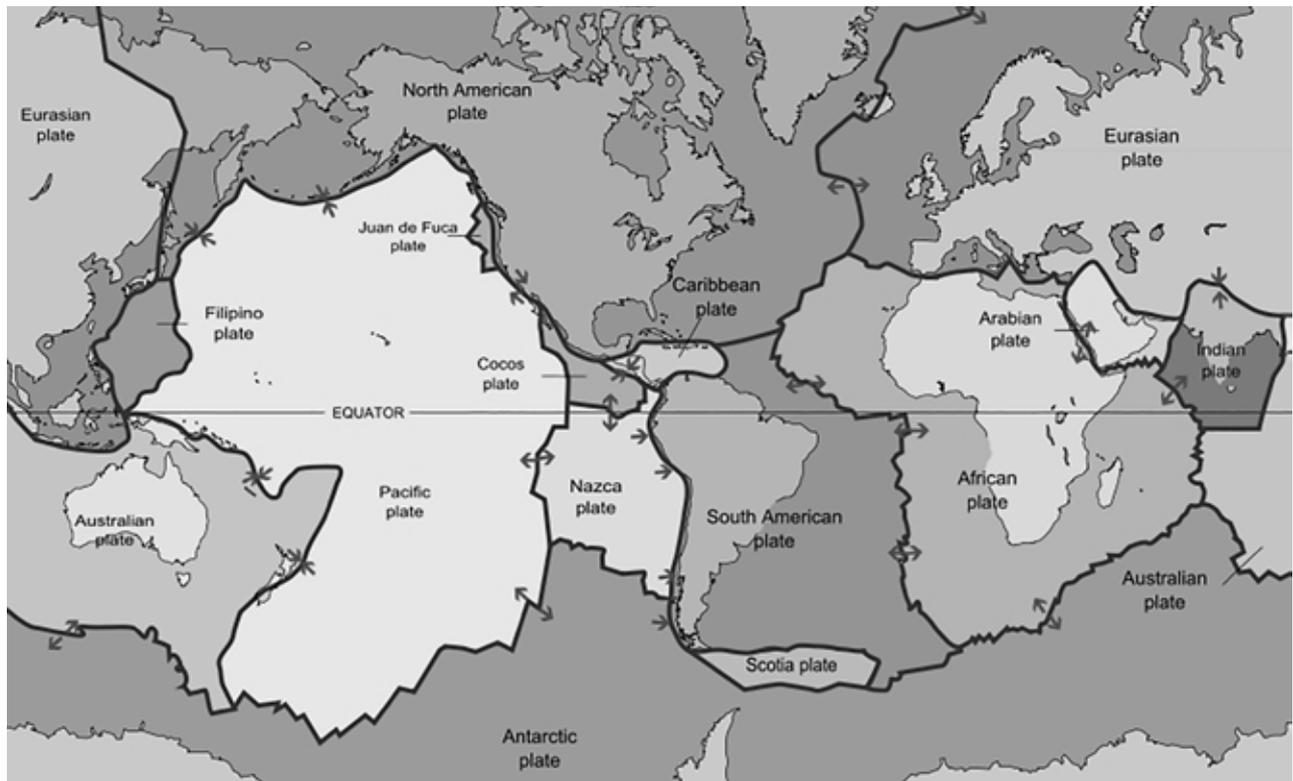
Today there is no consensus. One early map in 1968 showed 20 plates; another published a few months later showed only 6.<sup>3</sup> Many geologists think there are seven primary plates (African, Antarctic, Eurasian, Indo-Australian, North American, Pacific, and South American Plates) and seven secondary plates (Arabian, Caribbean, Cocos, Juan de Fuca, Nazca, Philippine Sea, and Scotia

Plates) (figure 1) and numerous tertiary plates. These currently total 72 active plates; although the number and location of the tertiary plates may change.<sup>4</sup> Table 1 compares the active plates as listed from several different sources. The fact that there are several different maps implies that there are problems defining plate boundaries.

It is reasonable to expect that ongoing research may show small changes, especially to small plates, but the main criteria for defining plates are their boundaries. Plate boundaries can be identified into seven types (subduction zone, oceanic convergent boundary, oceanic transform fault, oceanic spreading ridge, continental rift, continental transform fault, and continental convergence zone). However, there are areas where boundary identification is very difficult due to anelastic deformation.<sup>5</sup> Even so, there have been a number of inconsistencies in defining plates by their boundaries.

For example, is the American plate one plate or two?<sup>6</sup> According to PT theory, an active plate boundary ending in a triple junction should exist between North and South America. But seismic maps<sup>7</sup> show no such boundary, suggesting that the American plate is one. However, spreading from the Mid-Atlantic Ridge is greater in the North Atlantic, and the distance between North America and Europe is greater than that between South America and Africa. Geologists think that North America broke off from Africa/Europe around 200 Ma, moving north and west and then rotating counterclockwise to its present location. South America separated from Africa around 150 Ma, moving south and west and rotating clockwise to its present position.<sup>8</sup> This suggests two America plates, not one. PT advocates attempt to explain this problem using fracture zones along the mid-Atlantic Ridge.

"One has only to glance at the world geologic map of the ocean floors, Figure 7.31, to appreciate the value of the transforms (FZs) normal to the anomalies as displays of the paths of motion of the separating continents. The North and South Atlantic



**Figure 1.** 15 major plates as shown from Wikipedia—note that Eastern Siberia is a part of the North American Plate.

basins, especially, resemble an open book telling us when and where the breakup began, and at what rate it continued.”<sup>8</sup>

Thus, the fracture zones are transform faults—boundaries where plates slide past each other, offsetting rifts. In the early 1960s, these fracture zones were interpreted as transcurrent faults, i.e. two plates slipping past one another, rather than as transform scars, i.e. a result of relative motion of the same plate. The former interpretation did not fit the PT model well as one of its consequences was that it would add hundreds of plates to the model as there are over 200 fracture zones. On the other hand, the latter interpretation predicted that seismic activity would be limited to a very narrow zone along the spreading ridge and transform faults. This was supported several years later and greatly enhanced the theory of PT as it provided a solution for relative movement.<sup>9</sup>

However, it should be pointed out that the length of these fracture zones varies significantly. Some reach lengths of hundreds of kilometres but none transect the entire width of the ocean floor, reaching the continents. Moreover, some fracture zones are not linked to the mid-ocean ridges. They begin some distance away from the ridge, and then traverse varying distances. Finally, if the Atlantic fracture zones are transform faults, they generally show a clockwise

rotation, but North America has supposedly rotated counterclockwise.<sup>10</sup> This seems to indicate that fracture zones were not caused by sea-floor spreading. Other possible causes include crustal shrinkage during cooling and variable vertical subsidence.<sup>11</sup>

The Indo-Australian Plate has the same problem—no apparent active plate boundary between India and Australia. Yet India is said to have moved east and north, rotating counterclockwise, while Australia first moved south and east and rotated clockwise with the Antarctic Plate before breaking away and moving north and rotating in a counterclockwise direction to its present position. Possible plate boundaries at Owen Fracture Zone and the Ninety East Ridge in the Indian Ocean are questionable.<sup>8</sup> Past motion suggests two plates but most maps show it as one plate.<sup>12</sup>

Another problem is found at the Eurasian plate. Is Eastern Siberia part of the Eurasian Plate or the North American plate?<sup>13</sup> Some maps show it as part of North America and some do not. The African–Eurasian boundary has a similar problem in the Atlantic Ocean. There is no active seismic zone between them. One possible location is a fracture zone at approximately 20°N latitude that ties into West Africa near the Morocco–Mauritania border. Another problem between Africa and Eurasia is noted as follows:

“So it turns out that where we have referred in earlier

pages and chapters to ‘collision of the African Plate with the Eurasian plate’, that generalization is not confirmed by our example. The correct version in this one example is a collision between the independent Adriatic plate which then lay to the south of Europe, separated from it by the Piemont Ocean, whereas the African plate lay much farther to the south (Belderson, 1989, p. 35). Of the many problems that need to be addressed is the history of the deep Mediterranean basins. Are they parts of the Tethys ocean floor that have not yet been closed by collision between African and Europe?”<sup>14</sup>

In other words, geologic reality is overly simplified on plate tectonic maps between Europe and the Mediterranean Sea. That boundary is not easily explained or well defined.

There is a zone stretching all the way from Western Europe to the Pacific where there is considerable ambiguity (figure 2). Many tertiary plates proliferate between the Eurasian plate to the north and the African, Arabian, and Indian plates to the south.<sup>15</sup> The fundamental problem is that major plates use oceanic crust and geophysics—i.e. seismic data, mapping of the ocean floors that show ocean ridges and deep sea trenches, paleomagnetism, and geodetic data—to delineate their boundaries. On the other hand, the proliferation of plates primarily involves continental crust, and the plate boundaries are defined by different criteria, mainly geoscience data—i.e. history/age of rock, its type, location, and orientation—and the two sets of criteria do not always agree.<sup>16</sup>

The zone noted above is generally continental crust made up of mountainous regions including the Pyrenees, Apennines, Alps, Zagros, Himalayan, and Kunlun Mountains. In the PT model, mountains are explained as collision sites between plates but this area just does not fit the model well.<sup>17</sup> For example, the Alpine system of

**Table 1.** List of tectonic plates from different sources. Numbers indicate running total of plates.

PLATES – PRIMARY, SECONDARY, & TERTIARY	WIKI	STRA	DEWEY	BAUM	1968-M	1968-P
<b>AFRICAN PLATE</b>		1	1	1*	1	1
AFRICAN (NUBIAN) PLATE	1					
MADAGASCAR PLATE	2					
SEYCHELLES PLATE	3					
SOMALI PLATE	4	2				
<b>AMERICAN PLATE</b>					2	2
ALTIPLANO PLATE	5					
FALKLANDS MICROPLATE	6					
GREENLAND PLATE	7			2*		
NORTH ANDES PLATE	8					
NORTH AMERICAN PLATE	9	3	2	3*		
OKHOTSK PLATE	10					
SOUTH AMERICAN PLATE	11	4	3	4*	3	
<b>ANTARCTIC PLATE</b>		5	4	5*	4	3
ANTARCTIC PLATE	12					
KERGUELEN MICROCONTINENT	13					
SHETLAND PLATE	14					
SOUTH SANDWICH PLATE	15					
<b>ARABIAN PLATE</b>	16	6	5		5	
<b>CARIBBEAN PLATE</b>	17	7	6		6	
PANAMA PLATE	18					
GONAVE MICROPLATE	19					
<b>COCOS PLATE</b>	20	8	7	6A*	7	
RIVERA PLATE	21				8	
<b>EURASIAN PLATE</b>	22	9	8	7*	9	4
ADRIATIC OR APULIAN PLATE	23	X	9			
AEGEAN SEA PLATE (HELLENIC PLATE)	24	X	10			
AMURIAN PLATE	25					
ANATOLIAN (TURKISH) PLATE	26		11			
BANDA SEA PLATE	27					
BURMA PLATE	28					
IBERIAN PLATE	29					
IRANIAN (PERSIAN) PLATE	30	10	12		10	
MOLUCCA SEA PLATE	31					
HALMAHERA PLATE	32					
SANGIHE PLATE	33					
OKINAWA PLATE	34					
PELSO PLATE	35					
SUNDA PLATE	36				11	
TIMOR PLATE	37					
TISZA PLATE	38					
YANGTZE PLATE	39					

Table 1. (cont.)

PLATES – PRIMARY, SECONDARY, & TERTIARY	WIKI	STRA	DEWEY	BAUM	1968-M	1968-P
ALPS – WESTERN		X				
ALPS – EASTERN & SOUTHERN		X				
APENINES		X				
ATLAS		X				
BELTICS		X				
DINARIDES		X				
PO PLAIN		X				
PYRENEES		X				
TELL		X				
<b>INDO-AUSTRALIAN PLATE</b>		11	13		12	5
AUSTRALIAN PLATE	40			8*		
CAPRICORN PLATE	41					
FUTUNA PLATE	42					
INDIAN PLATE	43			9*		
KERMADEC PLATE	44					
MAOKE PLATE	45					
NIUAFO'OU PLATE	46					
SRI LANKA PLATE	47					
TONGA PLATE	48					
WOODLARK PLATE	49					
<b>JUAN DE FUCA PLATE</b>	50	12			13	
EXPLORER PLATE	51				14*	
GORDA PLATE	52		14			
<b>NAZCA</b>	53	13	15	6B*	15	
<b>PACIFIC PLATE</b>	54	14	16	10*	16	6
BALMORAL REEF PLATE	55					
BIRD'S HEAD PLATE	56					
CAROLINE PLATE	57	15				
CONWAY REEF PLATE	58					
EASTER PLATE	59					
GALÁPAGOS PLATE	60					
JUAN FERNANDEZ PLATE	61					
KULA PLATE	62					
MANUS PLATE	63					
NEW HEBRIDES (FIJI) PLATE	64		17		17	
NORTH BISMARCK PLATE	65	16A†	18A†		18A*†	
NORTH GALÁPAGOS MICROPLATE	66					
SOLOMON SEA PLATE	67		19		19*	
SOUTH BISMARCK PLATE	68	16B	18B		18B*	
<b>PHILIPPINE SEA PLATE</b>	69	17	20		20	
MARIANA PLATE	70					
PHILIPPINE MICROPLATE	71					
<b>SCOTIA PLATE</b>	72	18				

Wiki = from en.Wikipedia.Org/wiki/list\_of\_tectonic\_plates.

Str = from Strahler (see reference 4); plates marked by "x" identified elsewhere.

Dewey = from John F. Dewey plate tectonics (see reference 33).

Baum = from Baumgardner<sup>77</sup>—cocos and nazcas plate are remnants.

1968-M = March 1968 map by W. J. Morgan (see reference 3).

1968-P = June 1968 map by X. Le Pichon (see reference 3).

\* Plates were not labeled on map however these plates appeared to be identified.

† Strahler, Dewey, and 1968—m consider north and south bismark plate as one.

Europe<sup>18</sup> is extremely complex with widely varying orientation, location, and type of crust, and a dozen or so subplates are added based on geoscience to explain the data.<sup>19</sup>

To sum up, there are a number of inconsistencies in defining plates by their boundaries. There is fairly good consensus as to the primary and secondary plates using data from geophysics to define their boundaries. However, many secondary and tertiary plates are added mainly on the continental crust as different criteria are used. So how many plates are there? The question is still unresolved.

### Inconsistencies in the mechanics of plates

The PT model is based on rigid plates floating on a 'soft' layer known as the asthenosphere. Yet these rigid plates can bend (referring to flexural-type bending), break or rift, buckle, bulge, shear (slip), appear and disappear as required to explain the data. Only flexural-type bending will be considered here.

Flexural bending of plates at deep-sea trenches

Subduction zones are considered powerful evidence for the PT model. They are marked by deep trenches where the lithosphere bends and moves into the mantle at widely varying angles.<sup>20</sup> But how does the rigid crust bend without breaking? One explanation is that high temperature and pressure is applied over long periods of time.<sup>21</sup> Another is to compare the plate to a bar of iron heated in a forge that bends under its own weight.<sup>22</sup> Subduction has been described as follows:

“Because of its greater crustal buoyancy, the continental plate remains in place, while the thinner, denser oceanic plate bends down and plunges into the astheno-sphere . . . . The leading edge of the descending

plate is cooler than the surrounding asthenosphere—cooler enough, in fact, that this descending slab of brittle rock is denser than its surrounding asthenosphere. Consequently, once subduction has begun, the slab can be said to ‘sink under its own weight’.<sup>23</sup>

This appears to present an inconsistency in uniformitarian plate tectonics. How can cold, dense, ‘brittle’ rock bend at these sharp angles without breaking when the bending of rocks requires heat and/or pressure?

The temperature of the crust in subduction zones varies from approximately 0°C at the ocean floor to about 100–150°C at the bottom (approximately 5 km thick).<sup>24</sup> This is compared to the melting temperature for olivine of 1,800°C.<sup>25</sup> The pressure at the ocean floor due to the hydraulic gradient ranges from 61 MPa (8,910 psi) at 6,100 m (20,000 ft) depth to 111 MPa (16,124 psi) at 11,033 m (36,198 ft) in the deepest point of the ocean at the Mariana Trench.<sup>26</sup> Add to that 5 km of lithostatic gradient due to the oceanic crust and it increases the pressure at the bottom approximately 150 MPa (22,000 psi)<sup>27</sup> for a total pressure of 210–260 MPa. By comparison the pressure at the bottom of the Grand Canyon is about 40 MPa (5,800 psi).<sup>28</sup> This temperature and pressure will not cause metamorphism or a phase change.<sup>29</sup> However, the increased confining pressure increases the allowable stress in the rock as it changes from the elastic to plastic state. For example, the elastic state for marble is very brittle and fails at around 75 MPa (11,000 psi) under ambient conditions (0.1 MPa); however, under a confining pressure of 100 MPa (14,500 psi) the marble becomes plastic and fails around 225 MPa (32,600 psi) or three times its ambient strength.<sup>30</sup>

Watts describes several methods that have been used to determine the stress in the rock.<sup>31</sup> He mentions that Hanks used an elastic model that required vertical and horizontal loads. These horizontal loads were introduced to reduce tension in the crust. He then discusses how, Parsons and Molnar, and later Caldwell *et al.*, showed that horizontal forces were not required and only vertical end-load forces acting on an elastic plate could explain the deep-sea trenches (figure 3). One of the problems with this model was that it generated high stresses in the oceanic plate on the order of several hundred megapascals. Some thought that these stresses were too high and the oceanic crust would not be able to support it. Other models were proposed that would reduce the stress in the crust.<sup>31</sup>

In fact, there was evidence that normal faulting had occurred in the seaward wall of the Japan Trench.<sup>31</sup> In his schematic, Strahler shows these faults as tensional cracks near the surface of the oceanic crust.<sup>32</sup> This poses a potential problem with the PT model. If cracks occurred due to the forces applied, then how can a reduced section which causes increased stress carry the same load? PT depends upon subduction and plates pulling the slab into the asthenosphere.

But if there are normal faults that extend across the crust, the tensional force will not be transmitted through it and subduction stops.

The mechanics of rocks are very complicated and there are many unknowns so there could be other factors involved. However, this problem vanishes in the vertical tectonics model. If normal cracks occur in the deep-sea trenches the slab readjusts until it reaches isostatic equilibrium.

Although subduction zones are powerful evidence for the PT model there are problems associated with the concept. Other processes such as vertical tectonics can explain the evidence.<sup>33</sup>

### Inconsistencies in plate motions

In the PT model, plate motion usually refers to movement of one plate relative to another as the actual motion with respect to the inner mantle and core (which is very difficult to measure). Space-geodetic measurements in the present have been used to infer movements in the past. However, this may not be a valid assumption if the present movement cannot be determined to be local, regional, or plate-wide.<sup>34,35</sup> As a result most maps use Africa as a fixed plate and all other plates move with respect to it.<sup>36</sup> This does not mean that Africa has not moved, as some have suggested that it was located over the South Pole in the Devonian Period (370 Ma in the uniformitarian timescale).<sup>37</sup>

One of the best sources for tracking plate movements is the GPS Time Series, which uses 30 satellites and over 2,000 receivers. This data has been analyzed by the Jet Propulsion Laboratory, California Institute of Technology under contract with NASA.<sup>38</sup>

However, there are some inconsistencies as data does not reflect movements as normally perceived in the PT model. For example, Alaska is shown moving southward whereas most of North America is moving westward (figure 4). South America is shown slowly moving to the north (except for one location) when most maps show it moving to the west. New Zealand is probably the most enigmatic of all as the South Island is partially on the Australian plate and partially on the Pacific Plate. According to the model, the Pacific plate is moving westward but that is not the case as it is generally moving towards the northwest (figure 5). It appears that both the North and South Islands exhibit the same trends as the eastern half of the islands tend to move northwest and the west half of the islands tend to move in a more northerly direction. The Alpine Fault of the South Island is a supposedly dextral transcurrent fault that connects the Hikarungi-Kermadec Trench to the north with the Puysegur Trench to the south.<sup>39</sup> This brings up the question of why there is a transform fault as the geodetic data does not reflect this. However, there is geologic data to support

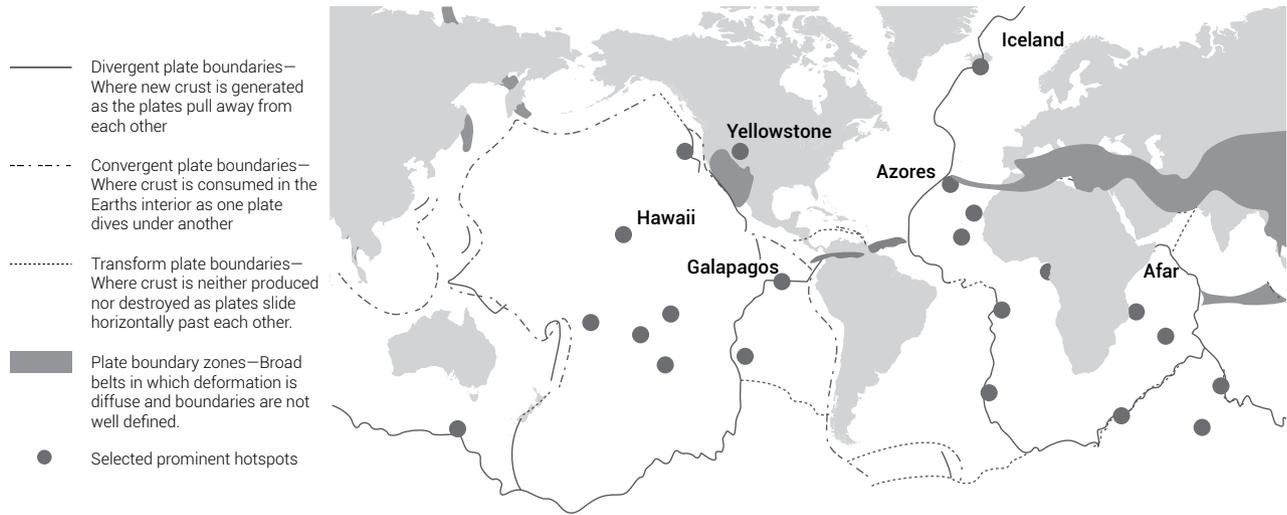


Figure 2. Plate Boundary Zones (from USGS website).

it, which is a good reason not to depend exclusively upon geodetic measurements. Furthermore, vertical movement is significant in almost all of the sites. The vertical movement has increased/decreased as much as 12 cm in one reading in several places (figure 6). Thousands of metres of vertical movement has occurred here in the past.<sup>40</sup> This permits other interpretations. Is it possible that the rise of the mountains caused the subsequent horizontal motion?

The 2011 Tohoku earthquake—plate or local movement?

Baumgardner argued that the 2011 Tohoku earthquake on Japan’s main island, Honshu, showed the reality of plate tectonics (figure 7), but the data show inconsistencies.<sup>41</sup> The data documented by over 450 GPS stations showed that the surface displacement of the island moved in an east-southeast direction as much as 8 m (26 ft) in the eastern part of the island to less than 1 m in the western part. The area closest to the epicentre of the earthquake resulted in the greatest movement, and movement was greatly reduced with increased distance.

In the PT model the movement is explained as ‘elastic rebound’. This should be clarified. The northern part of Honshu is part of the North American Plate and is in the Okhotsk sub-plate. The movement of the North American Plate is generally westward. Moreover, the Okhotsk Plate is generally considered to be rotating clockwise with its centre north of the island of Sakhalin, which is north of Honshu;<sup>42</sup> this would also generate a westward movement. This appears to be inconsistent with the east-southeast displacement caused by the Tohoku earthquake as one would think that any movement should be westward. Hence the interpretation for ‘elastic rebound’. Also, in the PT model plates are rigid and should move as a unit. This is not the case here as movement

is greater closest to the epicentre and reduces as it moves farther away. Hence the interpretation of elastic shortening of the plates as this portion of the fault had been ‘locked’ for over 100 years, and this earthquake released enough energy to cause elastic rebound.

But this is just one interpretation. It could also be interpreted as a local movement as the eastern part of the island moved farther and movement decreased as it moved away from the epicentre. Moreover, as much as 400 km (250 mi) of northern Honshu coastline dropped by 0.6 m (2 ft) while the seabed off the coast of the Miyagi prefecture (Sendai) rose 3 m (10 ft).<sup>43</sup> This type of movement could be interpreted as a gravity slide or some other mechanism which caused one area to sink and another to rise, e.g. normal faulting. As noted previously, there was evidence that normal faulting had occurred in the Japan Trench. Furthermore, it has been estimated that a 400-km (250 mi)-long by 100-km (62 mi)-wide section of the Pacific Plate moved westward as much

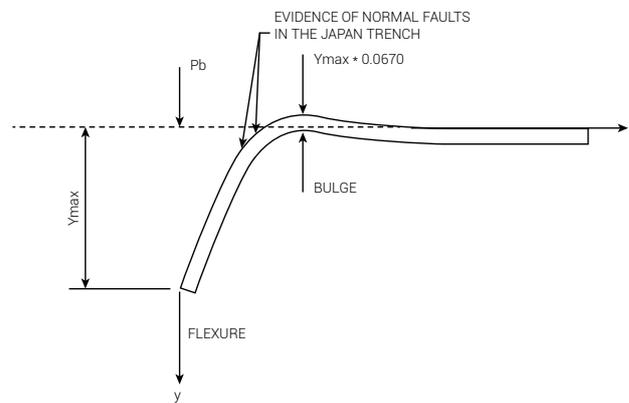


Figure 3. Flexure of a Semi-infinite Beam based on the equation  $Y = (Y_{max}) e^{-2\lambda x} \cos \lambda x$  (after Watts<sup>11</sup>).

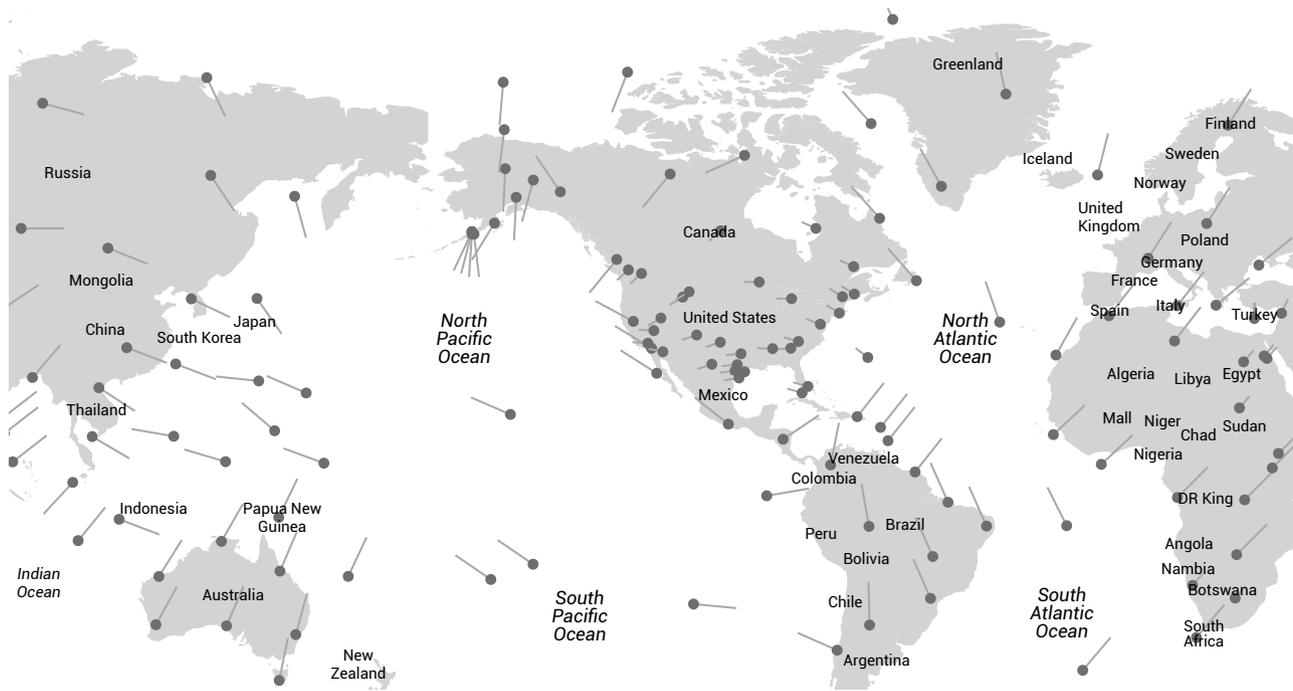


Figure 4. Global Velocities as shown on NASA website.

as 20 m (66 ft) and possibly as much as 40 m (130 ft).<sup>44</sup> The point is that this could be interpreted as a local movement as the area surrounding the epicentre moved towards it, similar to a sink hole.

Although the PT model can interpret the data to accommodate the model, it appears inconsistent with the data and can also be interpreted in other ways.

The San Andreas Fault

The San Andreas Fault (SAF) (figure 8) of the western United States is a shear, strike-slip, or wrench fault<sup>45</sup> (these are transform faults at plate boundaries). The term ‘shear’ is used loosely to indicate that movement between two plates is laterally in opposite directions rather than through compression (subduction), tension (rifting), or normal (vertical) movement.

The SAF is not really one fault but a wide fault zone ranging from Western Nevada to the San Gregorio fault just west of Monterey Bay, California. It generally runs northwest-southeast. However, it has a number of faults, especially in Southern California that run obliquely to it in an approximate east–west direction. The rate of movement based on uniformitarian assumptions has been estimated at about 5 cm (2 in) per year.<sup>46</sup> However, this is not the case as movement is not uniform and varies from place to place. Does averaging the movement over long periods of time distort the data?

For example, the northern segment of the fault is located in central California. It generally runs from the Golden Gate

Bay area to the Tehachapi Mountains, which is approximately 110 km (70 mi) north of Los Angeles. The rock formations appear to have been displaced as much as 255 km (160 mi). It has been suggested that this segment of the fault originated about 30 to 40 Ma ago, during Oligocene time, within the uniformitarian timescale.<sup>47</sup>

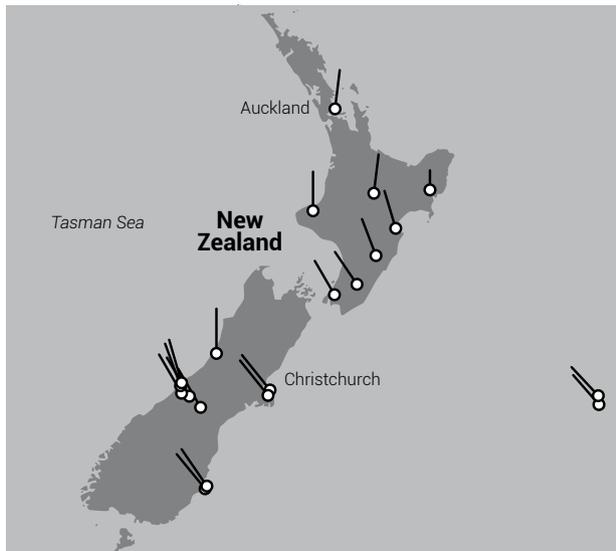
The central segment, which overlaps with the north, appears to have moved 315 km (195 mi) since the early Miocene, about 23.5 Ma.<sup>48</sup> This area extends from Pinnacles National Park near Soledad California (approximately 120 km (75 mi) southeast of San Jose) to the Neenach Volcanic Formation near Palmdale California (approximately 65 km (40 mi) north of Los Angeles).

In the southern segment, the fault is much younger. It has supposedly travelled 225 km (140 mi) from Soledad Pass (near Palmdale California) and the Salton Sea. This major right-lateral movement putatively began about 12 Ma ago, or during late Miocene time.<sup>49</sup>

Apparently this differential movement and time sequence is not a problem in the PT paradigm.

“Because of the fault’s great length, as much as 2,000 miles, movement is intermittent as to time, and random as to place. At any place along the fault, movement may be a one-time event, or movement may be recurrent over thousands of years. In any episode, displacement may be a fraction of an inch or it may be many feet.”<sup>50</sup>

This seems to be inconsistent with the PT model as plates are supposed to be rigid and move uniformly. The



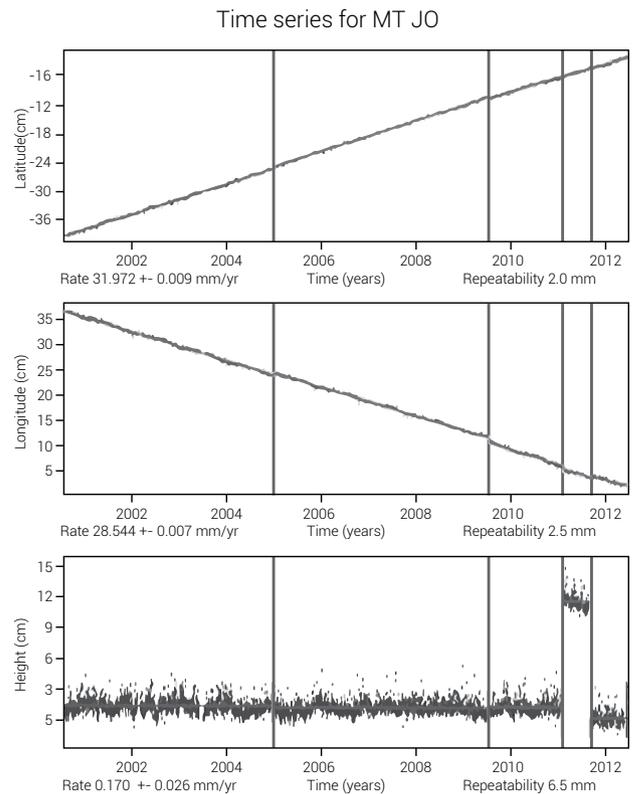
**Figure 5.** Velocities at New Zealand as shown on NASA website.

type of movements noted above would be more like a flexible spring with movement similar to an accordion. Dewey stated that rigid plates are essential to the PT model.<sup>36</sup> Can one part of a plate move while another remains stationary? If plates are not rigid, how would this affect the model?

There are several methods for determining large lateral movements such as lithologic, faunal, and facies similarities, which are hard to pin down and highly subjective. But the method most often used to demonstrate large right-lateral movements is that of locating similar rock units on opposite sides of the fault that are separated by some distance.<sup>51</sup>

The Pinnacles-Neenach Volcanic correlation is promoted as proof that large-scale lateral movement has occurred in central California.<sup>48</sup> But, it has some problems. For one, the Pinnacles Formation is not on the San Andreas Fault but approximately 6.5 km west. This requires an *ad hoc* interpretation to explain how it drifted away from the fault. Also, the rate of movement varied over time. Many interpretations have been proposed.<sup>52</sup> The data shows that there are three similar volcanic formations—the Pinnacles, the Parkfield, and the Neenach. Their apparent age and location does not match predictions of the PT model as the movement from the Neenach to Parkfield was slower than that from the Parkfield to Pinnacle. Could there not be other interpretations such as three separate volcanic flows that happen to be similar in content? That would be an indication that the flows came from the same source and not as a result of crustal movement. Yet, the Pinnacle-Neenach correlation is offered as proof positive that large-scale lateral movement has occurred on the SAF. Where does the data stop and the interpretation begin?

Local displacement is evident both laterally and vertically. In the Fort Tejon earthquake there was up to 9 m (30 ft) of



**Figure 6.** Global Velocities plots at New Zealand site MTJO, which is on the South Island near Lake Tekapo, as shown on NASA website.

lateral movement,<sup>46</sup> and in the Pinnacles Volcanic Formation there were hundreds of metres of vertical movement.<sup>53</sup> Isn't there another possibility that instead of lateral movement causing a corresponding vertical movement, the vertical movement caused the lateral movement?

B.D. Martin has studied this area in great detail. He documents large vertical movement, as much as 5,720 m (17,000 ft), in the Monterrey Bay area.<sup>54</sup> He also documents a number of constraints which limit right-lateral movement to localized events.<sup>55</sup> In one word he explains the data—erosion.

Erosion is used as a possible mechanism that wiped out any evidence of vertical movement at the surface. The resulting drainage patterns are some of the strong points against right-lateral movement. Unless vertical movement is historically documented it is very difficult to detect since erosion and gravity effects destroy the land surface features of uplifted blocks over time, while lateral movements would be expected to be preserved better due to lack of topographic relief.<sup>56</sup>

PT advocates have used similar rock formations separated by large distances as evidence for large right-lateral movement. However, there are other explanations:

“Eocene and other early Cenozoic rocks may have been deposited extensively atop Salinia between the two end localities (San Juan Bautista and the San Emigdio mountains), but these deposits could have



Figure 7. Approximate location of the epicentre of the 2011 Tohoku earthquake.



Figure 8. Selected features of the San Andreas Fault of California, USA.

been removed by erosion after the Eocene to have been deposited elsewhere as detritus. Therefore, the conclusion by Nilsen that the Eocene rocks in the two end localities were later separated by major right-lateral movement appears tenuous and incorrect, because these present end-locality deposits may represent in situ deposits at the ends of a once continuous deposit of Eocene sediments along the whole length of Salinia and the San Andreas fault.<sup>57</sup>

This reasoning could easily fit within the Flood model as this deposition could have occurred early, during the Ascending stage of the Flood (days 0–150), and the erosion taken place afterwards during the Recessive stage (days 150–371).<sup>58</sup>

To sum up, the data used for large right-lateral movement is highly subjective. Also there is a great deal of evidence against this movement. Although as much as 9 m of right-lateral movement has been documented in a single event, there is a great deal of evidence that vertical movement has occurred as much as hundreds to thousands of metres and this fits well in the vertical tectonics model.

### Inconsistencies in paleomagnetism

Paleomagnetism is the permanent magnetism that is acquired in igneous rock<sup>59</sup> as it cools at various points of geologic time.<sup>60</sup> Advocates of PT believe that the magnetic signature of sea-floor rocks exhibits a zebra-stripe pattern of magnetic polar reversals. The idealized view shows a symmetrical pattern around a mid-ocean ridge, indicating sea-floor spreading (figure 9). The stripes are then dated using radiometric dating methods—mainly the potassium-argon method.<sup>61</sup> Then by matching like stripes on either side of a

ridge it allows one to calculate the spreading rates of the two plates. This interpretation helped propel the acceptance of the PT paradigm.

However, some clarifications need to be made concerning the difference between ‘magnetic anomalies’ and ‘magnetic reversals’. There is a subtle difference that isn’t always made clear in the literature. Magnetic anomalies are variations in *intensity* with normal polarity having a higher intensity than reversed.<sup>62</sup> It is believed by PT advocates that this lower intensity is due to reversals of the earth’s magnetic field. On the other hand a magnetic reversal is a change in the earth’s magnetic field such that the positions of magnetic north and magnetic south are interchanged.<sup>63</sup>

This distinction isn’t always made clear as PT advocates imply that the magnetic stripes seen in many diagrams are indeed magnetic reversals.

“The stripes of normal polarity (positive anomalies) were referred to as ‘highs’; those of reversed polarity (negative anomalies) as ‘lows.’”<sup>64</sup>

This gives the impression that the stripes are positive or negative (normal or reversed) in direction, rather than one stripe being of higher intensity than the other. With this distinction made, PT advocates claim that reversals have happened in the past and are the cause for these variations.<sup>65</sup>

But there are some problems with this. First of all the idealized view is far from the norm as magnetic stripes vary in amplitude and are not necessarily symmetric.

“So much for the simple ‘piano keys’ Plate Tectonics model that slowly churns out nicely uniform magnetic stripes. It seems clear that the hot spreading surface lava of the ocean floor did indeed record electromagnetic disturbances at earth’s surface (or deeper). However, that activity was probably not the repeated overturning of the geomagnetic field. It appears instead to have

been oscillations that could be described as spasmodic noise or static.”<sup>66</sup>

In this case, the striping is nothing more than ‘noise’ and it can be very subjective depending on how one ‘smooths’ the profile.<sup>63</sup> Smoothing the profile is the technique of taking the data and developing the magnetic ‘stripes’. Furthermore, there are several cases of asymmetric sea-floor spreading<sup>67</sup> which have no simple solution, and those presented seem to be *ad hoc* and apply only to local circumstances.<sup>68</sup>

Several alternatives for the different intensities could be possible. As noted above it could be a matter of noise caused by the irregularities in the rock such as serpentinized peridotites, which heavily influences magnetization,<sup>69</sup> or by localized magnetic irregularities, which override global magnetism, or by other physical or chemical processes.<sup>70</sup> Other possibilities are secondary magnetization, vertical block rotations or tilts of in situ horizontal blocks.<sup>71</sup> Another explanation for magnetic striping is that it was caused by fault-related bands of rock with different magnetic properties and unrelated to sea-floor spreading.<sup>72</sup>

Also, it should be noted that the general age of the sea floor is questionable just by the very nature of the radiometric methods used.<sup>73</sup> The PT model predicts that oceanic crust is older the farther away from the mid-ocean ridge—which is generally the case—but there is very large scatter. Furthermore, the basalt layer in the ocean crust suggests ocean-wide magma flooding with volcanism later restricted to narrow zone centred on the ridge crests. This magma flooding was followed by progressive crustal subsidence.<sup>74</sup>

Finally, there are several problems in the Pacific Ocean concerning magnetic anomalies. The Great Magnetic Bight in the Gulf of Alaska is located approximately 50°N latitude and 160°W longitude (figure 10). There is an abrupt change in the magnetic striping pattern from a generally northwest–southeast trend to a generally east–west trend. The northwest–southeast trend generally parallels the North American coast line and the east–west trend generally parallels the Aleutian Trench. Magnetic striping is generally associated with spreading ridges as new crust is being formed and then moves away from the ridge. In the PT model this case is an R-R-R (rift-rift-rift) triple junction. But there is an obvious problem here in that there is no spreading ridge eastward but a transform fault (the San Andreas Fault). Neither is there a spreading ridge northward but a subduction zone (the Aleutian Trench).

### A solution to the Great Magnetic Bight is proposed as follows:

“The predicted triple junction existed during the late Cretaceous Period (75 Ma). One of the two presently missing plates was named the Kula plate, the

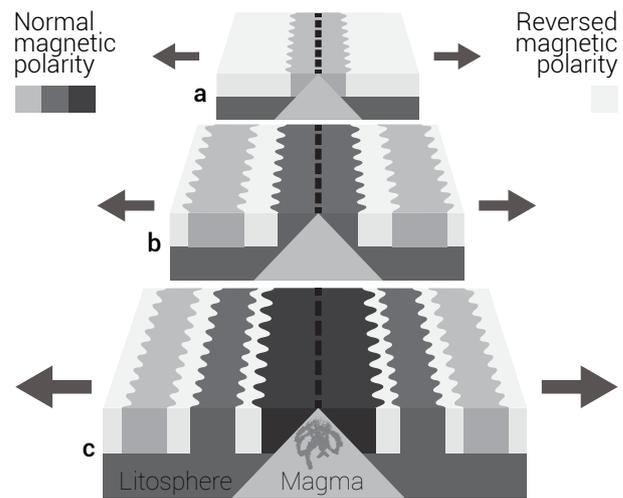


Figure 9. Idealized pattern of magnetic striping.

other, the Farallon plate. The triple junction migrated northeastward, producing the pattern of stripes we see today in the Great Magnetic Bight. When the western branch of the triple junction reached the subduction zone of the Aleutian Trench, the entire Kula plate simply disappeared—‘down the drain’ so to speak—and the spreading boundary disappeared with it. The east-moving Farallon plate headed toward a subduction boundary along the western margin of the American plate where it, too, was largely consumed, but small portions of it remain today: Gorda, Juan de Fuca, and Explorer to the north; Cocos and Rivera to the south.”<sup>75</sup>

Does the data reflect this or is it required per the PT/CPT model? The data shows lineations in an unexpected pattern in the PT model so a plate is added, the Kula Plate, which has since ‘disappeared’. How can we verify this? This almost sounds like magic.

A second problem similar to the first is the Japanese, Hawaiian, and Phoenix magnetic striping lineations. The problem here is that the Japanese lineations in the northwestern Pacific and the Phoenix lineations in the South Pacific are generally trending more or less east and west while the Hawaiian lineations in the central Pacific generally run northwest–southeast.

This same reasoning is used to solve the second problem and the Phoenix Plate simply disappeared under the Antarctic Plate.<sup>76</sup>

In the PT model magnetic striping is a result of the addition of new oceanic crust as it cools and moves away from spreading ridges. However, the striping pattern at the Great Magnetic Bight in the north and the Phoenix lineations in the south do not meet the predicted pattern. As a result the Kula and Phoenix Plates were proposed to explain the data and have since disappeared. Does the data reflect this



**Figure 10.** Approximate location and orientation of magnetic striping of the Great Magnetic Bight.

or is it required per the PT model? Could there not be other explanations?

Far from being the simple and final proof that sea-floor spreading has occurred, magnetic anomalies are complicated and fraught with problems.

### Summary

On the surface the PT model appears to have all the answers to explain the geology of the earth; however, there

are many inconsistencies involving plate boundaries, plate mechanics, plate motions, and even paleomagnetism. The information presented in this paper is not new and is a sample of the inconsistencies that can be found in the literature. The major evidence for plate tectonics is far from conclusive and in some cases is highly speculative. Often other possibilities are ignored or overlooked simply because they do not follow the PT paradigm. As Paul says to Timothy, “examine everything carefully” (1 Thess. 5:21).

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