Difficulties with plate tectonics—Pacific Ocean bottom features

Michael J. Oard

Plate tectonics assumes that crustal plates have moved thousands of kilometres. Examples include the Pacific Ocean bottom. Some biblical creationists accept the movement, though not the slow pace of events. Others do not accept major plate movement. Evidence for a lack of large-scale tectonic plate movement is presented from features on the bottom of the Pacific Ocean. If the Pacific Plate has moved thousands of kilometres northwest with respect to the North American Plate, as uniformitarian scientists believe, Monterey Canyon and Fan would have become offset by around 150 km, but little relative movement is indicated. Moreover, the Zodiac Fan that originated from western Alaska on the Pacific Plate has moved little relative to the North American Plate and the eastern Aleutian Trench did not exist during fan formation. Finally, the Meiji sediment tongue in the northwest part of the Pacific Plate lacks a sediment source at its origin presumed by plate tectonics in the middle of the Pacific Ocean. It is hoped that this paper will advance the current discussion toward a fuller and more unified view of Flood geology.

The large-scale picture of biology and sedimentary rocks with their contained fossils overwhelmingly favours creation and the Flood, as described in the early chapters of Genesis. In regard to sedimentary rocks, the fact that some formations can be traced thousands of kilometres with little evidence of erosion between, and within, the sedimentary rock layers is powerful evidence for rapid Flood deposition.[1] These observations are contrary to uniformitarian ideals.

Nevertheless, building a Flood model is a difficult task, and several have been proposed. One of these is the catastrophic plate tectonics (CPT) model, which has many issues to work out.[2–5] Based on geodetic measurements and tomographic data, it is claimed that plate tectonics (PT) is still occurring today.[6,7]

Regardless, the real evidence for CPT and PT should be evidence that *plates have moved thousands of kilometres* in the past. (For the purpose of clarity, plates are defined as areas of the Earth's lithosphere that are separated by major faults and/or volcanism.) In my view this is the *definitive* test regarding the explanatory efficacy of CPT and PT. The issue of whether there is present movement of plates or portions of plates is secondary and can be interpreted differently. For example, the GPS data that Baumgardner claims support CPT[8] can also be explained by residual horizontal and vertical motions after the Flood.[9]

Evidence for the claimed thousands of kilometres of plate movement in the past comes from issues such as the magnetic anomalies (or 'stripes', as they are nicknamed) in the ocean-bottom rocks and the 'fit' of the continents across the Atlantic Ocean. However, these magnetic anomalies are *not* reversed and normal ocean crust, as believed for many years, but are less than 1% changes in magnetic *intensity*.[10] Drilling into the basalt on the ocean bottom has revealed a hodge-podge of normal and reversed directions, which does not accord with systematic reversed and normal magnetic directions in lava that are parallel to the mid-ocean ridges.[11] Thus the anomalies mainly originate deeper than the basalt layer. They likely derive from the gabbro of the lower ocean crust and the peridotite of the upper mantle. Moreover, since the magnetic anomalies are intensity variations, the depth of magnetization could imply that the stripes are in fact systematic changes in the magnetic properties of the lower crust and/or upper mantle, such as magnetic susceptibility (a measure of the degree to which a rock can be magnetized).

The Pacific Plate is supposedly moving at a rate of about 6 cm/year in a northwest direction with respect to the North American Plate, which actually starts in Central America and wraps itself around the northern Pacific Plate through Alaska and northeast Asia to about Japan. This paper will show that the Pacific Plate has moved little with respect to the North American Plate.

Monterey Submarine Canyon and Fan show little movement on San Gregorio Fault

The San Andreas Fault, considered a long transform fault, passes to the east of Monterey Bay in west-central California, USA. However, it is actually a wide fault *zone* with several different smaller faults from the San Gregorio fault offshore of Monterey Bay in the west to western Nevada in the east (figure 1). The fault zone in western Nevada is called the Walker Lane, where 25% of the relative plate motion between the North American and Pacific

Plates presently takes place.[12] Based on geodetic data, the current relative motion between the Pacific Plate, moving northwest, and the North American Plate, moving west, is estimated to be about 6.5 cm/yr.

The Monterey Submarine Canyon extends westward from Monterey Bay. It is 95 km long, and,like so many other submarine canyons, it extends westward on top of a large submarine fan, called the Monterey Fan (figure 2).[13] If the westward-extending fan valley entrenched on the Monterey submarine fan is included, the total length of the canyon is 470 km.[14] Its maximum wall height is 1,700 m, and its maximum rim-to-rim width is 12 km. It is similar in depth and width to the Grand Canyon. The Monterey Fan covers over 100,000 km^2 and has an average thickness of 1.5 km with an estimated volume of 150,000 km^3. The Monterey Submarine Canyon and Fan would have been formed late in the Flood by channelized Flood currents during the Dispersive Phase of the Flood.[15,16]

The San Gregorio fault, the boundary between the Pacific Plate, to the west, and the western San Andreas Fault zone, passes through Monterey Submarine Canyon at about 1,800 m below sea level.[17] The fault is delineated by earthquake epicenters and small topographical features within Monterey Canyon. The lower part of the canyon and the submarine fan is on the Pacific Plate. Based on geodetic measurements on land to the north, the San Gregorio Fault is presently moving at about 6 mm/yr.[18] At that rate, it would have slipped 6 km in a million years and 180 km in 30 Ma, according to the uniformitarian timescale. It has also been assumed that the west side of the San Gregorio Fault has moved northwest 70 to 150 km with respect to the east side since the mid Miocene Epoch within the uniformitarian timescale, but some think the movement is less.[17,19] Dickenson recently reanalyzed the fault movement and, based on geology, he came up with a fault movement of 156 km since it first developed in the late Miocene.[20]

However, the geomorphology of the canyon suggests there has been very little contrastive movement between the upper canyon and the lower canyon and fan. Slip appears to have been much less along the San Gregorio Fault, especially for the past few million years within the evolutionary timescale.[21] In fact, there is little evidence of significant fault movement from sonar images and topographical relief on the upper continental slope and shelf north of the canyon.[17,22] The linear Carmel Canyon, which runs into Monterey Canyon from the south, and the displacement in Monterey Canyon where the fault crosses the canyon are thought to be manifestations of the fault. It appears that the displacement is only about 3 km, if really caused by fault movement. So, though it seems likely that the fault runs through Monterey Canyon, the geomorphology suggests that there has been *little horizontal movement* on the fault, contrary to the extensive movement predicted by the plate tectonics model.[23]

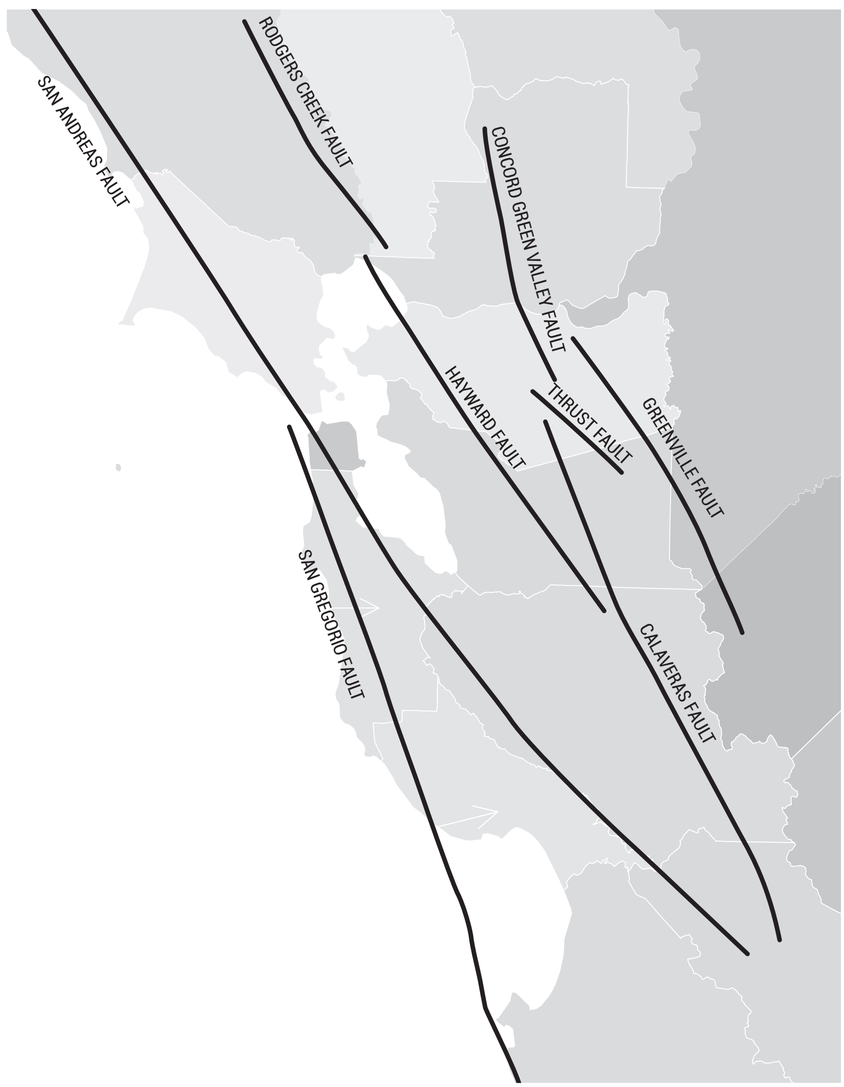

Figure 1. San Andreas Fault zone in Central California. Note that the San Gregorio Fault passes through the western Monterey Bay (redrawn by Mrs Melanie Richard from a USGS map).

Thus, it is likely that the Monterey Fan is a depositional product derived from sediments eroded around, and to the east of, Monterey Canyon during the formation of the canyon late in the Flood and afterwards.[16,24] This would imply that there was not 150 km of horizontal movement between the Pacific Plate and the San Andreas Fault zone, and probably the North American Plate.

Advocates of CPT could claim either that the San Gregorio Fault is a very new fault (a post-Flood fault) or its movement has been much less than uniformitarian scientists claim. But in so doing, they would be going against the 'calculated' claims of movement by the uniformitarian scientists.

The Zodiac Fan from western Alaska

Granted that there has been little movement of the lower Monterey Submarine Canyon and Fan with respect to the upper part of the canyon, there are other bottom features on the Pacific Plate that indicate even more of a discrepancy. In the northern North Pacific, the huge Zodiac Fan lies just to the south of the Aleutian Trench and west of the Patton-Murray Seamount Chain in the northwestern Gulf of Alaska, and extends down to about 44°N at 160°W (figure 3).[25] The fan is estimated to cover an area greater than 1,000,000 km^2 with a volume of 280,000 km^3, giving it an average thickness of 280 m.[25] The most striking feature of the fan is the well-developed channels network that trends north to northeast with levee overbank deposits, indicating that the fan was built up from a south to southwest flow of sediments. Furthermore, the sediments are terrigenous, meaning they came from a continental land mass. Based on fossils, the fan is dated from the late Eocene to early Oligocene, around 24 to 40 Ma ago within the uniformitarian timescale. The source of the sediments gives indications of originating from the Alaskan Peninsula and western Alaska.

It is interesting that before the Alaska Range uplifted, the sedimentary rocks of the late- to mid-Cenozoic Usibelli Group were deposited by paleocurrents flowing toward the *south to southwest*.[26,27] The Usibelli is about 600 m thick, widespread, and consists of pebbly sandstone interbedded with coal and mudstone. Paleocurrent directions can be determined, especially from cross-beds in sandstones and the imbrication of oblong rocks in the gravel. The continuation of the paleocurrents during the denudation of Alaska in the Recessive Stage of the Flood would have helped build the Zodiac Fan.

The Zodiac Fan presents a major problem for plate tectonics. The Pacific Plate was supposedly moving northwestward during the Cenozoic and so the fan would have been in the middle of the Pacific Ocean, 1,500 to 3,000 km away, and far from any continental landmass during most of the Cenozoic![25] If this were the case, where would the fan sediments have originated? The most straightforward interpretation of the data is that the fan was caused by massive erosion of Alaska during the Recessional Stage of the Flood, in which case it makes sense that there has been *little or no movement* of the Pacific Plate with regard to Alaska, which is on the North American plate.[28]

Moreover, the sediments had to cross the location of the Aleutian Trench, which implies that the trench was either non-existent or filled up:

> "The sedimentary record from the Aleutian Abyssal Plain has important implications for plate tectonics in this area. If, as seems likely, the turbidite source was from Alaska to the north and northeast, then either no trench, or a filled trench, must have separated Alaska from the plain from middle Eocene to middle Oligocene times."[29]

Since the eastern Aleutian Trench is not totally filled today, it is much more likely that the Aleutian Trench is a new feature formed after the Zodiac Fan, and therefore a late Flood structure formed by differential vertical tectonics.

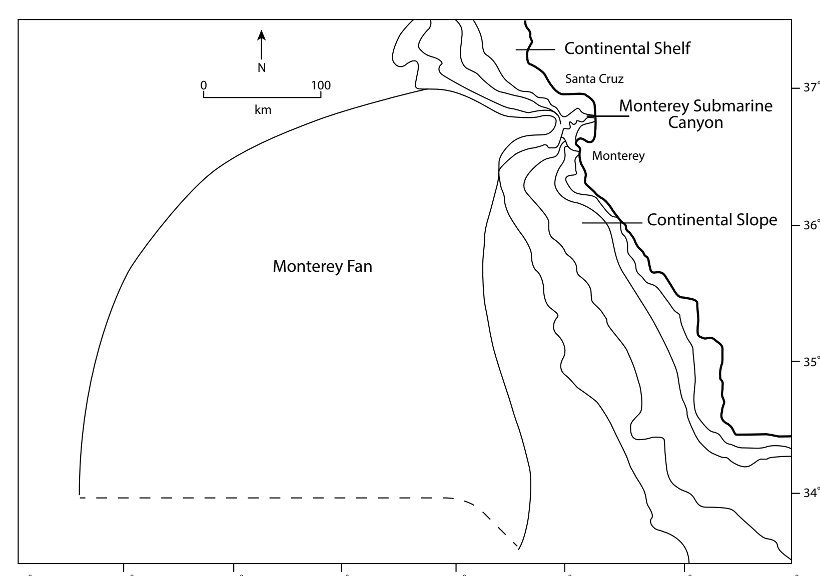

Figure 2. The Monterey Submarine Fan offshore from Monterey Canyon (redrawn from Fildani and Normark, 2004[13], by Mrs Melanie Richard).

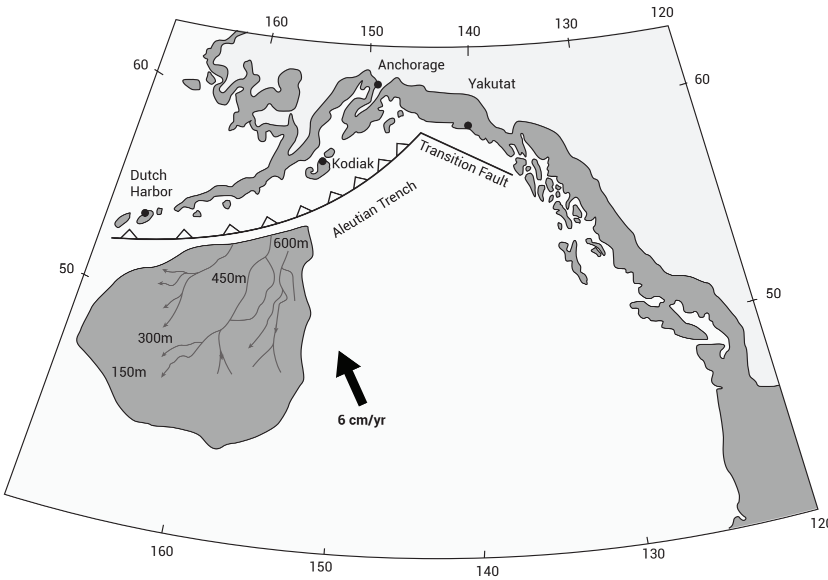

Figure 3. The Zodiac Fan, south to southwest of Alaska, south of the Aleutian Trench, which has features indicating the huge fan sediments originated in Alaska (redrawn from Stevenson *et al.*, 1983,[25] by Mrs Melanie Richard). However, if the Pacific Plate moved northwest, the fan would have been in the middle of the northeast Pacific in the early to mid Cenozoic.

There have been a number of unlikely PT explanations for the anomaly of the Zodiac Fan. In 1986, Byrne proposed that, while the Zodiac Fan always collected sediments from Alaska, it was once much larger, and the northern portion subducted under the Aleutian Island arc.[30] This would mean the fan was several hundreds of kilometers larger in its north-south extent. But what about its extent up to 3,000 km to the southeast during the early Cenozoic?

In 1987, Harbert proposed a solution to the problem, positing that the source of the terrigenous sediments was the northwest United States,[31] although the fan was far from western North America in the early Cenozoic and has current directional indicators from the north. He states that the fan stopped collecting sediments when seamounts blocked the path of the sediments from the northwest United States.

Two years later, Pickering *et al.* proposed a different solution to the Zodiac Fan paradox. They assumed a weakly active trench due to discontinuous plate motion from the beginning of fan deposition up until the middle Oligocene, which allowed erosional sediments from Alaska to pass over the trench.[29] Then the trench became more active until the Pliocene to isolate the source from the fan. However, this still does not explain how the Zodiac Fan was deposited up to 3,000 km away toward the southeast, far from any land mass.

An advocate of CPT has offered an answer to this dilemma:

> "This fan was formed almost certainly during the early runoff stage of the Flood when the plate was located further to the east, adjacent to the Alaskan coast, and east of the eastern end of the Alaska trench."[32]

However, in light of the material presented above, this explanation seems weak. The problem is that though both models assume that the fan formed during the early runoff stage of the Flood, its location to the east and not to the southeast, according to the northwest motion of the Pacific plate extrapolated backwards, is *ad hoc* and contrary to PT doctrine. Moreover, there is another large fan in the northeast Pacific Ocean called the Surveyor Fan.[33] GPS data shows the Pacific plate moving northwest, and the explanation for the Emperor/Hawaiian Islands as a hotspot trace depends upon this northwest movement. There is a glaring problem with the origin of the Monterey Fan if the Pacific Plate moved thousands of kilometres west during the late Flood as required by CPT.

The straightforward interpretation of the Zodiac Fan is that it represents sediments deposited during the early Recessive Stage runoff from western Alaska, and that the Aleutian Trench did not exist at the time and, hence, is a young feature formed late in the Flood. This fits well with the differential vertical tectonics that drained the floodwater when the continents rose and the ocean basins sank.[24,34,35] The GPS data showing relative movement now would then be residual motion left over from Flood tectonics.

The Meiji sediment tongue

Another perplexing ocean-bottom feature of the Pacific Plate for PT advocates is the Meiji sediment tongue, also called the Meiji Drift, in the northwest North Pacific Ocean. This is a deposit of sediments between the western Aleutian volcanic arc and trench and the Emperor Seamount Chain. The Meiji sediment tongue is greater than 1,500 km long, 300 km wide, and up to 2,000 m thick (figure 4).[36,37] The sediment tongue is thickest with a narrow width in the northwest and thins vertically with the width increasing toward the southeast, as expected if deposition was from the west or north, possibly through the 4,000-m-deep Kamchatka Strait. The Meiji sediment tongue has been accumulating sediment from southeastward-moving currents since the early Oligocene, 34 Ma in the uniformitarian timescale.[36] The origin of all this sediment is a mystery within PT.

According to PT, the Pacific Plate has been moving northwest since the early Oligocene about 34 Ma ago. It is supposedly moving at about 6 cm/yr at present in relation to the northwest North American Plate of northeast Asia, which is west and north of the Meiji sediment tongue. At that rate the plate would have moved about 2,000 km. Therefore, the Meiji sediment tongue would have been greatly deformed and folded up against the Kamchatka continental margin. It seems unlikely that it has travelled anywhere near that far on the Pacific Plate because there would be no source for the fan sediments in the middle of the Pacific Ocean, 2,000 km to the southeast. The shape of the fan indicates that it has been collecting sediments right where it is since the early Oligocene. The straightforward interpretation is that there has been *very little movement of the Pacific Plate* northwest with respect to the North American Plate, contrary to the PT paradigm:

> "A powerful argument can therefore be made that both the lower Tertiary turbidites of the Gulf of Alaska [the Zodiac Fan] and the finer grained Neogene terrigenous deposits of the Meiji sediment tongue are *near* their source terranes. Accordingly, the two sedimentary bodies represent formidable geologic evidence that, since early Eocene time (approximately the past 50 m.y.), the total displacement of Pacific lithosphere relative to that of the American plate has not been great [emphasis added]."[38]

The negligible movement of the Pacific Plate deduced from both the Zodiac Fan and the Meiji sediment tongue weigh heavily against the significant and rapid movement deduced from the Hawaiian Islands/Emperor Seamount Chain. (Interestingly, volcanism also occurred at 24 to 42 Ma ago in the far northern Emperor Seamount Chain, which is much younger than the dates of construction of the seamounts, according to the hot spot track hypothesis. This raises serious suspicions that the nice linear series of age dates from northwest to southeast in this hot spot track were singled out because they matched the idea of the Pacific Plate moving northwest over a hot spot rather than any pattern evident in the whole dataset.)

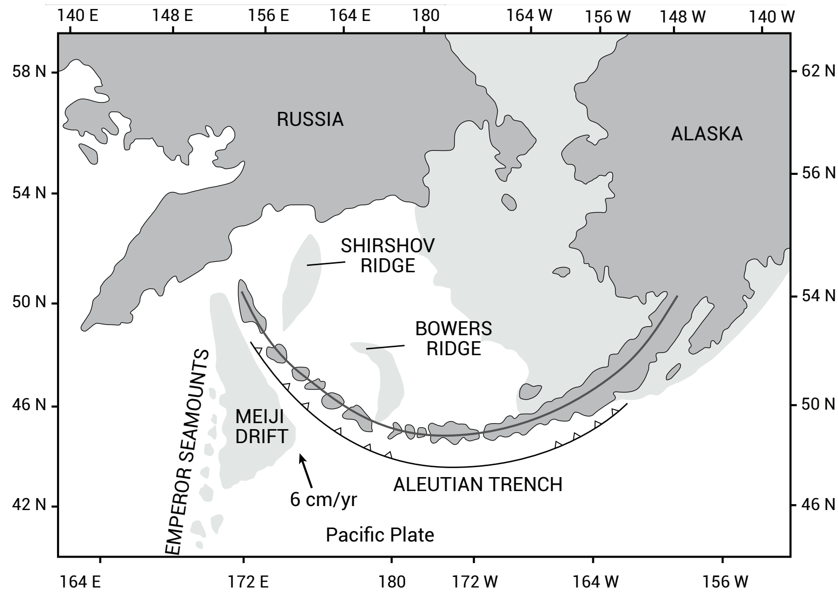

Figure 4. The Meiji sediment tongue in the northwest Pacific, showing evidence of having accumulated in its exact position, with little or no movement of the Pacific Plate relative to the North American Plate (drawn by Mrs Melanie Richard).

Like the Zodiac Fan, the Meiji sediment tongue collected sediments from Flood runoff during the early Recessive Stage of the Flood, with little horizontal plate movement.

Discussion and conclusion

Creationists have long puzzled over the meaning of plate tectonics and, in particular, catastrophic plate tectonics within a Flood model. Many geological and geophysical problems have developed since the advent of the paradigm in 1960s that have not been resolved by PT and CPT. Advocates of CPT need to do the research that advances their model, but little has been accomplished over the past 30 years or so.

One problem is that there is evidence from Pacific Ocean bottom features that the Pacific Plate has moved little with regard to the North American Plate, which wraps around to the north of the Pacific Plate. The lower Monterey Submarine Canyon and Fan should have moved 150 km or so northwest in relation to the San Andreas Fault zone. The lack of significant horizontal movement of the Zodiac Fan and Meiji sediment tongue shows little horizontal movement between the Pacific Plate, one of the fastest-moving plates, and the North American Plate. There should have been thousands of kilometres of relative movement during the deposition of these features. This lack of significant lateral movement indicates that PT and CPT did not occur.

References

1. Roth, A.A., *Origins: Linking Science and Scripture*, Review and Herald Publishing Association, Hagerstown, MD, 1998.
2. Reed, J.K. (Ed.), *Plate Tectonics: A Different View*, Creation Research Society Books, Chino Valley, AZ, 2000.
3. Oard, M.J., Lack of evidence for subduction renders plate tectonics unlikely: Part I—Trench sediments and accretionary prisms, *Creation Research Society Quarterly* **37**(3):142–152, 2000.
4. Brown, W., *In the Beginning: Compelling Evidence for Creation and the Flood*, 8th edn, Center for Scientific Creation, Phoenix, AZ, 2008.
5. McGuire, M., Plate tectonics—inconsistencies in the model, *J. Creation* **28**(2): 104–115, 2014.
6. Baumgardner, J., Is plate tectonics occurring today? *J. Creation* **26**(1): 101–105, 2012.
7. Baumgardner, J., Global tectonics—clarity, not confusion, *J. Creation* **27**(1): 99–106, 2013.
8. Baumgardner, J., Global tectonics—clarity, not confusion: John Baumgardner replies, *J. Creation* **27**(2):47–48, 2013.
9. Oard, M.J., Is plate tectonics really occurring today? *J. Creation* **26**(3): 120–127, 2012.
10. Fowler, C.M.R., *The Solid Earth: An Introduction to Global Geophysics*, Cambridge University Press, New York, NY, pp. 41–46, 1990.
11. Hall, J.M. and Robinson, P.T., Deep crustal drilling in the North Atlantic Ocean, *Science* **204**:573–586, 1979.
12. Surpless, B., Modern strain localization in the central Walker Lane, western United States: implications for the evolution of intraplate deformation in transtensional settings, *Tectonophysics* **457**:239–253, 2008.
13. Fildani, A. and Normark, W.R., Late Quaternary evolution of channel and lobe complexes of Monterey Fan, *Marine Geology* **206**:199–223, 2004.
14. Greene, H.G., Maher, N.M. and Paull, C.K., Physiography of the Monterey Bay National Marine Sanctuary and implications about continental margin development, *Marine Geology* **181**:55–82, 2002.
15. Walker, T., A biblical geologic model; in: Walsh, R.E. (Ed.), *Proceedings of the Third International Conference on Creationism*, technical symposium sessions, Creation Science Fellowship, Pittsburgh, PA, pp. 581–592, 1994.
16. Oard, M.J., *Flood by Design: Receding Water Shapes the Earth's Surface*, Master Books, Green Forest, AR, 2008.
17. McHugh, C.M.G., Ryan, W.B.F., Eittreim, S. and Reed, D., The influence of the San Gregorio fault on the morphology of Monterey Canyon, *Marine Geology* **146**:63–91, 1998.
18. Weber, G.E., Late Pleistocene slip rates on the San Gregorio Fault Zone at Point Ano Nuevo, San Mateo County, California; in: Garrison, R.E., Greene, H.B., Hicks, K.R., Weber, G.E. and Wright, T.L. (Eds.), *Geology and Tectonics of the Central California Coast Region, San Francisco to Monterey*, AAPG (Pacific Section) Book GB67, pp. 193–203, 1990.
19. Nagel, D.K., Mullins, H.T. and Greene, H.G., Ascension Submarine Canyon, California—evolution of a multi-head canyon system along a strike-slip continental margin, *Marine Geology* **73**:285–310, 1986.
20. Dickinson, W.R., Net dextral slip, Neogene San Gregorio—Hosgri fault zone, coastal California: geologic evidence and tectonic implications, *GSA Special Paper 391*, Geological Society of America, Boulder, CO, 2005.
21. McHugh *et al.*, ref. 17, p. 67.
22. Eittreim, S.L., Anima, R.J. and Stevenson, A.J., Seafloor geology of Monterey Bay area continental shelf, *Marine Geology* **181**:3–34, 2002.
23. Martin, B.D., Constraints to major right-lateral movements, San Andreas fault system, central and northern California; in: Chatterjee, S. and Hotton III N. (Eds.), *New Concepts in Global Tectonics*, Texas Tech University Press, Lubbock, TX, pp. 131–148, 1992.
24. Oard, M.J., *Earth's Surface Shaped by Genesis Flood Runoff* (ebook), michael.oards.net/GenesisFloodRunoff.htm, chapters 70–74, 2013.
25. Stevenson, A.J., Scholl, D.W. and Vallier, T.L., Tectonic and geologic implications of the Zodiac fan, Aleutian Abyssal Plain, northeast Pacific, *GAS Bulletin* **94**:259–273, 1983.
26. Bemis, S.P., *Neotectonic Framework of the North-Central Alaska Range Foothills*, M.S. thesis, University of Alaska, Fairbanks, AK, 2004.
27. Ridgeway, K.D., Trop, J.M. and Jones, D.E., Petrology and provenance of the Neogene Usibelli Group and Nenana Gravel: implications for the denudation history of the central Alaska Range, *J. Sedimentary Research* **69**(6):1262–1275, 1999.
28. Oard, M.J., Literature criticisms of plate tectonics; in: Reed, J.K. (Ed.), *Plate Tectonics: A Different View*, Creation Research Society Books, Chino Valley, AZ, p. 45, 2000.
29. Pickering, K.T., Hiscott, R.N. and Hein, F.J., *Deep-Marine Environments: Clastic Sedimentation and Tectonics*, Unwin Hyman, London, p. 203, 1989.
30. Byrne, T., Eocene underplating along the Kodiak shelf, Alaska: implications and regional correlations, *Tectonics* **5**(3):403–421, 1986.
31. Harbert, W., New paleomagnetic data from the Aleutian Islands: implications for terrane migration and deposition of the Zodiac Fan, *Tectonics* **6**(5):585–602, 1987.
32. Baumgardner, J., Dealing carefully with the data, *J. Creation* **16**(1):70, 2002.
33. Reece, R.S., Gulick, S.P.S., Horton, B.K., Christeson, G.L. and Worthington, L.L., Tectonic and climatic influence on the evolution of the Surveyor Fan and Channel system, Gulf of Alaska, *Geosphere* **7**(4):830–844, 2011.
34. Oard, M.J., *Flood by Design: Receding Water Shapes the Earth's Surface*, Master Books, Green Forest, AR, 2008.
35. Oard, M.J., *Earth's Surface Shaped by Genesis Flood Runoff* (ebook), michael.oards.net/GenesisFloodRunoff.htm, 2013 and in press.
36. VanLaningham, S., Pisias, N.G., Duncan, R.A. and Clift, P.D., Glacial-interglacial sediments transported to the Meiji Drift, northwest Pacific Ocean: evidence for timing of Beringian outwashing, *Earth and Planetary Science Letters* **277**:64–72, 2009.
37. Kerr, B.C., Scholl, D.W. and Klemperer, S.L., Seismic stratigraphy of the Detroit seamount, Hawaiian-Emperor seamount chain: post-hot-spot shield-building volcanism and deposition of the Meiji Drift, *Geochemistry, Geophysics, Geosystems* **6**(7), Q07L10.doi:10.1029/2004GC000705, 2005.
38. Scholl, D.W., Hein, J.R., Marlow, M. and Buffington, E.C., Meiji sediment tongue: North Pacific evidence for limited movement between the Pacific and North American plates, *GSA Bulletin* **88**:1574, 1977.

Michael J. Oard *has an M.S. in atmospheric science from the University of Washington and is now retired after working as a meteorologist with the US National Weather Service in Montana for 30 years. He is the author of* Frozen in Time, Ancient Ice Ages or Gigantic Submarine Landslides?, Flood by Design, Dinosaur Challenges and Mysteries, *and* Exploring Geology with Mr. Hibb.. *He serves on the board of the Creation Research Society.*