This is the inside of the original publication, of 1999. It served as starting point for my most recent 2016 booklet--*Spread and Growth Tectonics: The Eocene Transition*

Planet Earth Expanding and the Eocene Tectonic Event

Paradigm Shift toward Expansion Tectonics

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Portions of tomography images redrawn after Grand, Van der Hilst, Widiyantoro, and Engdahl, in *Nature* and *GSA Today*, April 1997—please consult the originals for color and precision—pages 70, 72.

Gray-tone excerpt from NOAA map, *Surface of the Earth*, 1994, page 32.

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I thank all those who have responded to my earlier web-site offerings. The ones who honestly have disagreed with me over the years have probably helped me most. I am forever grateful toward them. Thanks to D. C. Dean for reading the manuscript and for detecting some communication pitfalls. Of course, all the mistakes that have survived are mine. Closing this statement on a futuristic note, I thank all those who will open and read this booklet—for lending it to a friend.

KWL

Portland, October 1999

1

The Plate Tectonics Revolution —from Pebbles to Jewels

During one of his more humble semi-public moments the great Sir Isaac Newton (1642-1727) opined:

> I do not know what I may appear to the world; but to myself I seem to have been only a boy playing on the seashore, and diverting myself in now and then finding **a smoother pebble or a prettier shell** than ordinary whilst **the great ocean of truth** lay all undiscovered before me.... (emphases added).

Henry William Menard has quoted this passage at the opening of his fourth chapter, in his book *The Ocean of Truth, a Personal History of Global Tectonics*. He thereby has, in effect, acknowledged the source of the title of his book. Menard's work was published by Princeton University Press in 1986, the year of his death. Throughout he has made an effort at cultivating his image as that of a wise historian and impartial patriot of the scientific Plate Tectonics revolution. But even at that, the choice of his book title betrays some of the bravado that inspired him and his compatriots. Not only a few smoother pebbles or prettier shells were the discoveries of this scientific revolution—the whole great Ocean of Truth was claimed as a trophy.

Of course, Menard merely made use of another man's metaphor. When Newton referred to a great ocean of truth, he surely had the whole universe in mind. **Menard imploded Newton's metaphor and applied it to the oceans of the world** that in the course of the Plate Tectonics revolution, and with the discovery of a continuous earth-encircling spreading ridge or rift, had become a single world ocean. The specific portion of this world ocean, where Menard himself has found most of his pebbles of truth, was the Pacific. William Wertenbaker, the biographer of William Maurice Ewing at the Lamont Geological Observatory, referred to Henry W. Menard, Ewing's counterpart at the Scripps Institution of Oceanography, as the one who almost single-handedly was discovering and explaining the sea-floor geography of the Pacific.[1]

Since January 1997, when I began posting my Expansion Tectonics theory on my web site <www.kwluckert.com> (now located at <www.triplehood.com> under Hood Two), I received frequent inquires from students who were assigned to write research papers on Plate Tectonics. Yes, occasionally I was tempted to guide them straightway to the Earth Expansion literature. But I did not do so. These students had to earn their grades in established academic environments. Therefore I usually recommended to them that they begin with H. W. Menard,

The Ocean of Truth…, and work from that body of information outward. At least one graduate student wrote back, thanking me for the good advice. Her paper had turned out well.

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[1] William Wertenbaker, *The Floor of the Sea, Maurice Ewing and the Search to Understand the Earth.* Little, Brown and Co., Boston, 1974, p. 176.

Now that I am about to write my own essay, I feel obligated to heed my own advice. Start with Menard! A better inside history of the Plate Tectonics revolution will probably never be written. Typical polemics against the present plate tectonics stampede, against the mindset that has closed itself off to any older and newer considerations—of which I have written occasional pages and usually torn up—definitely seem out of bounds after meeting as fair a man as Henry William Menard.

But no! Neither he nor any of the other heroes of the Plate Tectonics revolution—the Ewing brothers, Heezen, Dietz, Revelle, Bullard, Raitt, Wilson, Fisher, Worzel, Hess, Vine, Matthews, Meinesz, Heirtzler, Pitman, Sykes, McKenzie, Morgan, and more—have touched bottom in Newton's "great ocean of truth." They explored only one type of ocean, the kind that holds saltwater. And certainly, they came to understand more of it than anyone did before they started. They found many hitherto unnoticed "smoother pebbles" and "prettier shells."

According to Menard, the problem of Continental Drift as Alfred Wegener had defined it, has been solved by the scientists that gave us the Plate Tectonics revolution. However, to this writer it looks as though they only solved half of that puzzle. They have proven the fact that oceans do spread along mid-ocean ridges and rifts. Their evidence implies that while the present set of oceans has been spreading, continents must have been distancing themselves from each other. If anyone asked them for specifics regarding this spreading, the easy Atlantic usually was offered as an illustration. The continents in Wegener's All-Earth (Pangaea), adjoining the Atlantic, now could indeed be shown to "drift apart" as a result of obvious ocean floor spreading.

But "continental drift" is something that happens horizontally, and on that account the idea has been pampered within the limited context of two-dimensional thinking. However, a scientific determination of "drift" depends as well on one's orientation in the third dimension. For example, tree branches that are being swayed horizontally by the wind are not considered to be drifting relative to the third dimension of height and depth. In similar fashion, the continental crusts that became separated as a result of ocean floor spreading may not have been drifting at all if the sphere was expanding. Relative to the core they simply may have been rising—as Klaus Vogel has illustrated by way of his concentric terrella models. He happens to explain all apparent continental drift three-dimensionally and, without exception, as continental rising and separation.[2]

Inasmuch as on my own terrella models I have arranged the Jurassic surface of the planet somewhat differently, I personally do make a few exceptions in favor of differential horizontal movement.[3] Uneven mantle expansion and unequal horizontal separation have resulted in above-average expansion in the Pacific and in the southern oceans. In the case of three continents there has been some extra horizontal movement—or leaning—away from their original position relative to the Earth's core. Australia has pulled away from South America, north and eastward, and subsequently has adjusted itself westward. (In this book, all references to directions pertain to alignments relative to the present globe). In the opposite direction, South America has pulled away from Australia, but over a shorter distance. And Antarctica has managed to twist itself out of the Pacific Ocean cavity, away from the general area where it originated. While these irregularities do imply some amount of horizontal "drifting," they do not come anywhere close to supporting Wegener's vagabond paradigm, of "wandernde Kontinente" that supposedly drift about in an All-Ocean.

In any case, "ocean-floor spreading," as it was demonstrated by the Plate Tectonics revolution, **is no more and is no less than what its name implies—spreading or widening of the ocean**

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[2] Klaus Vogel, "The Expansion of the Earth, an Alternative Model to the Plate Tectonics Theory." In *Critical Aspects of the Plate Tectonics Theory, II,* 19-34. Athens, Greece: Theophrastus Publications, S.A., 1990.

[3] Karl W. Luckert, "A Unified Theory of Earth Expansion, Pacific Evacuation and Orogenesis," in *Theophrastus Publications,* 61-73. Athens, Greece: Theophrastus Publications, S.A., 1996.

floors. It does not necessitate the "wandering" or "drifting" of continents, nor does it consign patches of ocean floor to a fiery abyss in the mantle. The presence of Benioff earthquake zones and volcanoes along the famous Ring of Fire does not provide meaningful evidence in favor of convection currents in the mantle or ocean floor subduction.[4]

Ocean floor spreading happens along ridges and rifts in the Atlantic, the Pacific, the Arctic, the Antarctic and the Indian oceans. Inasmuch as no one so far has shown that continental crusts are shrinking, the oceans all together cannot be expanding at the expense of the continents. And sediments at the floors of the deep marginal trenches, where subduction of ocean floor crusts is supposed to happen, appeared peaceably undisturbed from the outset. In addition, and in spite of claims to the contrary, global seismic tomography has failed to show subducted slabs of ocean crust in the mantle. Judged solely on the basis of empirical evidence, it does not appear as though, to this day, ocean floor subduction ever has happened outside of a human mind. When it comes to the disposal of fictitious old ocean floor, we must hold ourselves to the same standards of honesty that our scientists were able to maintain while they learned about the creation of the present floors along mid-ocean ridges, amidst magnetic reversals.[5]

"Smoother pebbles" and "prettier shells" were indeed discovered. They were polished as jewels and were inlaid to adorn the crown of Earth science. The crowning achievement of the Plate Tectonics revolution was the discovery of ocean floor spreading based on magnetic, paleontological, and radiometric profiling. **The finished crown of the Plate Tectonics revolution was subsequently displayed, and published, in the form of an ocean floor chronology.**

For the moment I am satisfied to let Menard explain his revolution. It is always wise to let an insider have the first word.

> After a decade, by 1960, the ad hoc explanations for individual groups of observations were no longer very satisfying. It was time to integrate all the new data with the old and to generate testable syntheses.... I shall group them in three classes: (1) "sequential" hypotheses in which ridges are of different ages and convection acts at different times; (2) "expansion" hypotheses in which crust is created but not destroyed by expansion of the earth; and (3) "sea-floor spreading" hypotheses in which crust is created and destroyed by mantle convection. All the phenomena can act at once. The earth can expand while convection subducts some crust into the mantle and ridges are created and destroyed. ...Bruce Heezen synthesized the new data in relation to the expansion hypothesis in 1960, and I [Menard] did the same for the sequential hypothesis.[6]

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[4] Volcanoes served as a model for Dante's notion of purgatory—a place for reforming and remodeling human souls. In Melanesia some of the volcanoes are proof of the campfires of deceased tribesmen, who dwell beneath in a different state. The subduction and recycling of ocean floor crust seems to belong to a similar category of mythology. Someone has begun the habit of hiding intangible objects of faith— old ocean floors— in "the magma fires of hell!"

[5] This is not to say that proponents of Earth Expansion have as a rule faced new data more objectively. Some among them were frustrated by the new chronology and have rejected the magnetic record outright. The new ocean floor chronology suited neither the preconceived notions of Plate Tectonics revolutionaries nor those of Earth expansionists. However, after solving the puzzle of the Eocene tectonic event, those initial objections do seem unnecessary.

[6] H. W. Menard, *The Ocean of Truth…,* Princeton, 1986, p. 132.

The second- and third-last sentences of this quotation display Menard's resignation to a fate of not having resolved all the issues to his own satisfaction. It is, in effect, a statement of capitulation. When all proposed hypotheses are accepted as possibly being true together, without specific reference to data, then the process of critical scientific investigation has been abandoned.

Bruce Heezen's theory of Earth Expansion appears to have contributed considerably to the ferment of the Plate Tectonics revolution. Elsewhere Menard has characterized Heezen's synthesis regarding Earth expansion as somewhat indecisive. He bemoans the fact that Heezen has presented papers favoring expansion while also offering alternate hypotheses, such as classical continental drift and mantle convection.

How much of Bruce Heezen's conflict with Maurice Ewing, at Lamont, was the result of his rebellious temperament? And how much of that rebellious temperament itself was a result of having been diminished for preferring the expansion hypothesis? The answer will probably never be fully known. The last joint paper published by Heezen and Ewing, in 1961, after which Heezen refused to co-author with his former mentor, discloses their difference: **"Ewing favors a mechanism drawn by mantle convection currents, while Heezen believes that the extension results primarily from the internal expansion of the earth."**[7] This last joint paper appears to mark the moment, at the Lamont Observatory, after which the expansion hypothesis has become some sort of unacceptable assumption. A lot of ego and personal pride was at stake from then on.

Maurice Ewing's hope was to find pre-Jurassic ocean floors. He made no secret of what he was after. In 1963 he described his own agenda as follows:

> Some of us hope to find a record of much earlier times, believing that the rough surface of the solid basement rocks beneath the deep-sea sediments may be billions of years old and, in fact, may be the original surface of the planet.[8]

The ocean floor that is "billions of years old" was never found. So far all our present oceans score less than 200 million years. Already in 1963 the same scientist found "thin sediment on bare rock ridge crests, suggesting spreading of some sort. He had not found any disturbance of sediment in the trenches, suggesting… that it was not being pushed into the continent." Menard therefore commented, with some amusement, that Maurice Ewing in those days "seemed to be proving that the earth was expanding."[9]

The fluid state of Plate Tectonics theory, in those days, was evident everywhere. Even the famous Tuzo Wilson at one point covered his bases for the eventuality that some day he might go the expansion route. According to Menard, he proposed "expansion of the earth along mid-ocean ridges, but on an acceptable scale."[10] It was the time scale that was objectionable in those days, not the process of expansion itself! **Finally, at the very conference where the Eltanin-19 results were announced, Fred Vine referred to convection cells as being "presumed" and "mythical."**[11] We are left to contemplate the implications of this statement for as long as the current versions of Plate Tectonics are taught in our schools.

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[7] *Ibid.,* pp. 106-107. Reference is made to Heezen, B. C. and M. Ewing, 1961, p. 640. "The mid-ocean ridge and its extension through the Arctic Basin," in *Geology of the Arctic,* Toronto: University of Toronto Press.

[8] Ewing, M. "Sediments of Ocean Basins." In *Man, Science, Learning and Education,* 41-59. Houston: Rice University, 1963; quoted in Menard, *The Ocean of Truth…,* p. 201.

[9] Menard, *The Ocean of Truth…,* p. 203.

[10] *Ibid.,* pp. 147-151.

[11] *Ibid.,* p. 276.

In any case, there is ample evidence that, at the moment of the Eltanin-19 victory in 1966, when Heirtzler and Pitman discovered parallel magnetic anomalies and began to establish sequences of ocean floor spreading, nothing beyond ocean floor spreading itself was theoretically fixed.[12] The speed of spreading was still debated, and at least for Vine and Heezen convection cells and subduction processes seemed unlikely.

The exorbitant rate of Earth expansion that the young oceans called for—to the effect that all the deep ocean basins were added to the planet's surface in the course of a short 200 million years—was a notion that lay quite outside the reach of the Plate Tectonics revolutionaries. Even Heezen—as Menard bemoans that fact—never formulated his expansion theory in a sufficiently clear and scientific manner. He has not added anything new to what S. Warren Carey had already published.[13]

The Eltanin-19 discovery generated enormous enthusiasm. And when the excitement of this breakthrough rolled over the participating scientists, certain considerations, which until then had been important checks and balances, suddenly ceased to be of great concern. Among the issues that were quickly disregarded was, first, the expansion hypothesis of Heezen. It was most easily rejected because of the estrangement that existed between him and the director of the Observatory. Second, there was the ephemeral or transitory character of the spreading ridges in the Pacific that had impressed Menard all along.[14] And third, there was the general youthfulness of the ocean floors, together with the tranquillity that characterized sediments in the deep trenches—facts that Maurice Ewing had admitted already in 1963 while he was also still hoping to find ocean floors that are billions of years old.

None of these crucial data seemed to matter anymore in light of the new knowledge and excitement about actual ocean floor spreading. "Create ocean floor crust now and worry about the precise manner of its disposal later," appears to have been the unspoken motto. It all paralleled nicely the manufacture of atomic bombs in those days, with the postponement of the problem of waste disposal. Perhaps the two mind-sets—agreeing that a problem of disposal should never stop a process—were not entirely unrelated. But then, euphoria of winning cannot last or hide this problem forever.

It was for these social-scientific reasons and emotions that convection currents in the mantle and the subduction of ocean floors got accepted and became majority opinion. And who can blame these scientists? No law of physics is known that can render possible an increase in the planet's volume at a scope that satisfies the new ocean floor chronology.[15] Who in his sane political mind would risk his academic reputation pursuing a theory that disregards physics? Physics reigns as uncontested queen among the sciences. It has done a superb job identifying forces that can be

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[12] Eltanin-19 refers to the nineteenth research excursion of the ship Eltanin, cruising under the auspices of the Lamont Observatory of which Maurice Ewing was director. They returned with excellent records of symmetric and parallel anomalies along mid-ocean spreading rifts.

[13] Menard, *The Ocean of Truth…*, pp. 149-150.

[14] Menard's long insistence on the ephemeral character of the mid-ocean ridges, based on his Pacific data, is most interesting from the point of view of my theory of Expansion Tectonics and Pacific Evacuation. The overall pattern of spreading ridges in the Pacific, and of ridges that surround Antarctica, is indeed younger than that in the Atlantic. The great Eocene tectonic upheaval has created conditions for fresh crusts and spreading ridges to form in the eastern Pacific.

[15] This is not to say that theoretically the possibility for an increase in volume does not exist. The simplest notion implies nuclear and chemical reactions happening in the mantle, feeding on older and denser mantle or possibly on the core itself, creating a more voluminous mass. But then, the presence of neutrinos or other micro-particles in the universe, penetrating a planet, offers the possibility that under certain conditions in the mantle environment these can add mass and volume.

harnessed for the planet's modification and destruction—but has remained amazingly unable to comprehend the forces of creation.

The question of mechanism vis-à-vis dynamism continues to lurk in the background of the debate. Nevertheless, in this regard the Earth Expansion theory stands at least as strong as does the presently winning hypothesis to which everyone since Eltanin-19 has been flocking. "Convection currents in the Earth's mantle" is a mechanical metaphor that often is used ambiguously to help conceal the fact that popular Plate Tectonics, likewise, has no known dynamic.[16] The mechanical metaphor serves to explain the transportation of ocean floors away from the ridges of their creation. So, at that formal level the Convection Currents theory has the same shortcomings as Earth Expansion theory—and has a host of additional conflicts with the chronological data. The kinetic paradigm of a beaker, heated by a Bunsen burner, does make sense only if one postulates some kind of beaker walls in the mantle. This is a very unlikely arrangement in a planet with a single core and a continuous mantle. While the new global seismic tomography does show areas of greater and lesser heat in the mantle, these are nevertheless found at the wrong places for convection currents and ocean floor subduction to work (see global seismic tomography, Chapter 10).

"Convection currents" and "ocean floor subduction" are ideas that became attached to "ocean floor spreading" as parasitic hypotheses by reason of a social-scientific accident. They were postulated for no better reason than to avoid having to consider the possibility of rapid Earth expansion. However, trusting the scientific mind as I still do, I believe that it will only be a matter of time before the theory of "ocean floor spreading" will assert its elementary status in the study of Plate Tectonics. I suspect that its ill-sustained freeloaders will sooner or later be shaken off.

The new ocean floor chronology has been available since 1985 from such map compilers as R. L. Larson, W. C. Pitman (III), X. Golovchenko, S. C. Cande, J. F. Dewey, W. F. Haxby, and LaBrecque, in *The Bedrock Geology of the World*, Freeman and Co., New York. Internationally the information was made available, in 1988, with the *UNESCO Geological World Atlas*. And finally, in November 1996 the NOAA map "Age of the Ocean Floor" was released at the Denver meeting of the Geological Society of America.

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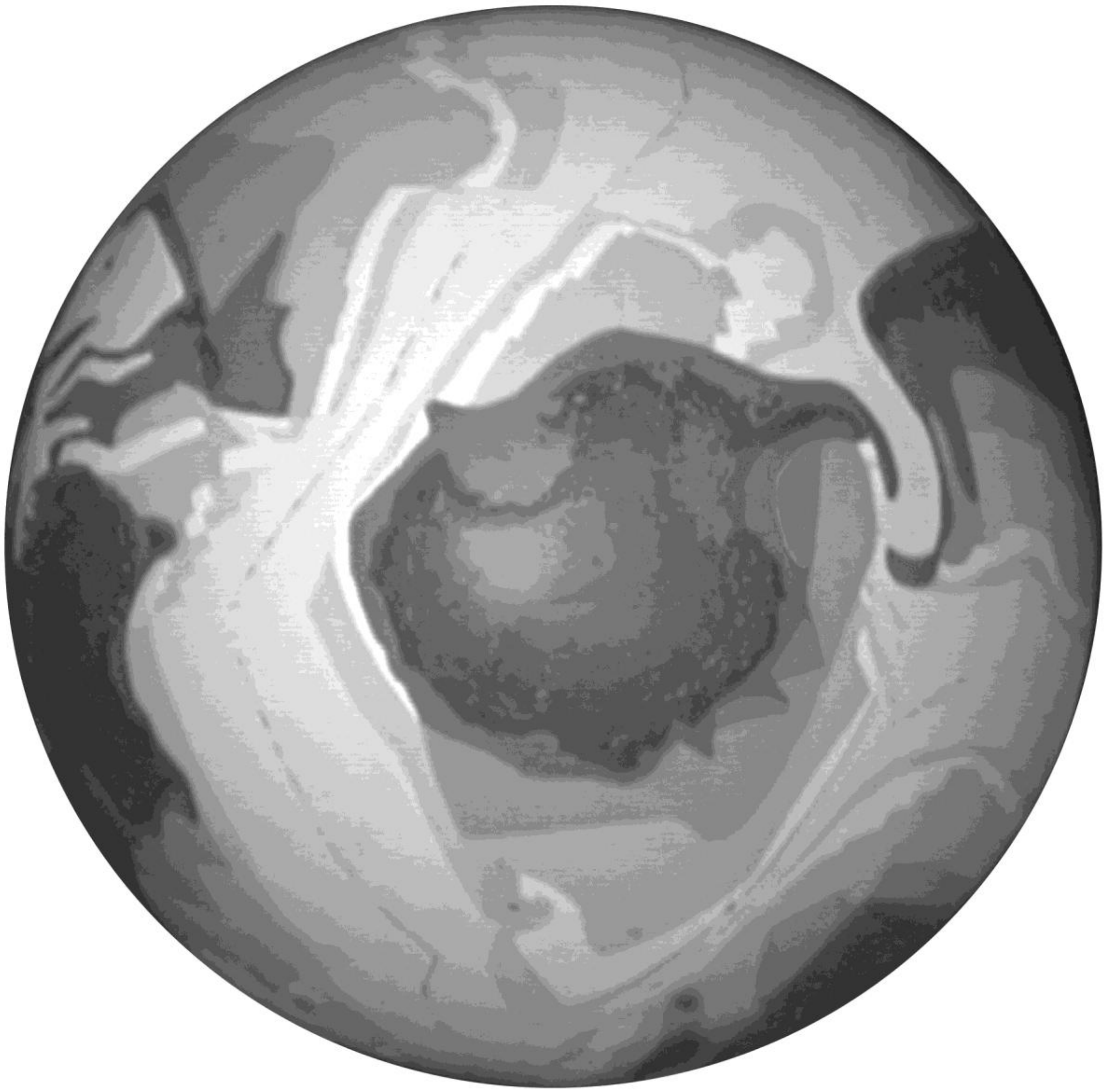
[16] The demand that any new geological theory should offer a full disclosure of its implied dynamics does here come across somewhat disingenuous. First, there is the typical ambiguity that is being maintained between dynamics and mechanisms. Earth expansion and convection currents in the mantle are both mechanisms, and the implied dynamism in either case is not understood. Copernicus and Kepler described the mechanism of our solar system, and for five centuries we have evolved astronomy from their discoveries without having been able to securely establish the dynamics. Of course, since Newton we have increasingly been talking about the dynamics dimension. But mathematical ratios are not the dynamic itself; they are simply imagined mechanisms constructed of numerically imaginable and manageable "levers" or "pulleys." A serious ethnological study of the evolution and the uses of mathematics, if it were done, would reveal that the application of numbers to nature has always been a theoretical first handle for gaining control—not for neutral understanding. Let anyone give me a precise and neutral explanation of our planet's dynamics, of the "force of gravity" and of "gravitational variations," and I will rewrite this note.



The realization, that there was an Eocene tectonic event, has dawned on me while contemplating the Southern Hemisphere of my chronological globe. The Bight of Australia still now faces the tip of its partner, South America. Of course, the layout is made complicated by the intrusion of Antarctica. On this particular globe the Paleocene is indicated in a lighter tone than the Eocene.

2

From Ocean Floor Chronology to Expansion Tectonics

When in 1979 I published my first essay on the expansion of planet Earth, I was still unaware that an ocean floor chronology was being compiled somewhere. I based my work almost entirely on matching continental contours and on common sense geology.[17] At the time I was even unaware of the fact that others before me had attempted making terrella models. Soon it became obvious that I was not the first creature on Planet Earth who independently has noticed its expansion. If I were to do historical research, I reckon that I could identify several dozen of us. Each time, since 1979, when I heard of yet another independent discoverer, I was elated. At least humanity's judgment regarding my mental state was not unanimous. But still, my conclusions have turned out to be different than those of my co-discoverers.

Today there may be three of us who think that ocean floor chronology holds the key for demonstrating Earth expansion—Jan Koziar in Poland, James Maxlow in Australia, and myself. I have found the *UNESCO Geological World Atlas* with its ocean floor chronology about five days after the California earthquake, in January of 1994, while I was trying to understand the experts who publicly explained that event, and I began working with it immediately. To this day I feel embarrassed about the fact that this information had been resting in our university library for five years before I found it—and to my astonishment, I was still the first person there to open some of the pages and maps.

All the while, I do not believe that I was the first to explain the formation of mountains as a consequence of continental slabs adjusting to an expanding sphere and to its flattening surface. This process seemed obvious to me from the outset. How upon an expanding planet could it be otherwise? As a former craftsman, who apprenticed in the Maler Handwerk, I assumed that many people would know how crusts and skins stick, sag, wrinkle, crack, or peel upon a viscous substratum. How my explanations differ in every detail from those of all my predecessors I gladly leave to future generations to sort out.

There are four points on which I find myself standing alone right now, for which I must take personal responsibility, and without these four points I myself would remain unconvinced of Earth expansion.

First, there is the incremental formation of the Pacific Ocean, marked by isochrons of the new ocean floor chronology, that implies the breaking out of Antarctica as a single round-like segment of crust.

Second, there is the original placement of Australia at the tip of South America. The severance of these two continents has triggered a sequence of position adjustments among Antarctica, Austral-Asia, and South America. By contemplating and synthesizing the chronological maps—which the Plate Tectonics revolution has produced and the heirs of that revolution have neglected—I have noticed and outlined the Eocene Tectonic Event on a global scale. Whatever explanations of Eocene

[17] Karl W. Luckert, *Mother Earth Once Was a Girl: a Scientific Theory on the Expansion of Planet Earth.* ATR Supplement 1. Flagstaff: The Museum of Northern Arizona Press, February 1979.

ocean-floors I am presenting here, they are not topics for mere rhetorical debate. They are recommendations and challenges for more scientific study. They shall either be verified by scientific exploration, or be rejected thereby. My theory presupposes numerous points of former continental association, and these are being suggested for comparative study.

Third, I have become convinced that for continental separation to occur, upon an expanding planet, a proper field of horizontal stresses must be present. The tearing out of Antarctica from the original Earth crust, and all subsequent tearing apart of continents, must be accounted for not only in terms of matching continental areas and contours, but also within the total budget of intercontinental cohesion. The factor of crust-strengthening, by cooling, may be added to that budget. The tensions that are being relieved by stretching, tearing, or rifting may be subtracted. Continental segments were torn away from the total crust by the planet's own force of expansion. They were torn apart—not born apart to drift in conformity with Wegener's "vagabond paradigm" of Continental Drift.

And fourth, I explain the formation of deep-ocean trenches, together with the seismic activity along Benioff zones, in relation to the breakup of coastal synclines. I explain synclines as a product of continental "flanging." Seismic activity along Benioff zones is the result of high-pressure "inverted erosion" along the undersides of continental edges. "Relative expansion flow" creates for itself the smoothest possible slope of transition, upward from under the thicker continent, toward the bottom of the thinner ocean floor.

* * *

H. W. Menard, in his 1986 book, has erupted with jubilation history. He noted that at some point for him "the revolution was over; the flowering of geology could begin."[18]

While the revolution appears to be only half over—let Earth science blossom, all the same! And would that the smoother pebble which I, a lonely wanderer along the shore of that same great ocean of truth, have noticed in the heap of data that celebrating revolutionaries have neglected also unfold as a flower and bear fruit!

* * *

From among all the people who profess a theory of Earth expansion, my approach comes closest to that of James Maxlow, in Australia. Both of us do assign basic importance to the new ocean floor chronology, and both have worked with the same chronological data and maps. Nevertheless, our conclusions are different. Inasmuch as we have arrived at our respective conclusions quite unaware of one another, this happenstance may turn out to be an advantage for both. In science it is equally important to be able to show what something is not, as it is to explain what something is. The difference between our conclusions will help stimulate healthy adjustments at both sides. Without the objections raised by others, this booklet and this chapter surely would have been written differently.

James and Anita Maxlow attended the International Symposium on "New Concepts in Global Tectonics" (NCGT98) at Tsukuba, Japan. I was privileged to be there also, and to present my version of Expansion Tectonics next to James. Our discussion has remained a memorable occasion for me. Between the two of us we could think of only one more person, Jan Koziar, in Poland, who publicly is on record for insisting that the new ocean floor chronology is the key for understanding Plate tectonics and Earth expansion.

Maxlow mentioned three points of criticism against my version of Expansion Tectonics. First, I could have taken more time to discover the obvious match of contours between the bight of Australia and the round of Antarctica. **Second,** comparative geology on the continents in question does support his own way of arranging the continents, and not mine. **And third,** the similarity of

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[18] H. W. Menard, *The Ocean of Truth…,* p. 294.

some marine animals along the coasts of Australia and Middle America lends support to assuming an earlier connection there.

My three-point response, pre-published at my web-site, goes approximately as follows:

First, I have indeed looked at the shapes of both the bight and the round, and I have concluded that they do not match well enough. The round is larger than the bight, and I would have had to postulate that greater stretching has occurred on the part of Antarctica. Had the proportion been reversed, I possibly could have fallen for the match. But upon a growing globe the bight of Australia would probably have been widening faster than the freely floating Antarctica would have enlarged its round. Moreover, I believe that the present age configuration of the Pacific ocean-floors would be impossible if Australia originally had been positioned north of Antarctica and next to North America. Moreover, I interpret Middle America, the Bering Strait, and all of Austral-Asia as circum-Pacific areas where extraordinary stretching occurred. By way of simulating globe reduction backward in time, tightening up these loosened areas will close the Pacific Ocean without leaving a need for Australia to fill a gap up north. Then I also ask myself—are the matching Jurassic ocean-floors that I have shown in my video program *Expansion Tectonics* sheer coincidences?[19]

Second, the geology of the continents in question has, in my opinion, been insufficiently explored to permit reliable matching. No serious attempts have been made, yet, to examine local geology in relation to my hypotheses. Theorists who deal with original inter-continental continuities usually do seek out the supportive similarities that interest them. They never get around to the immense task of checking continuities that might support other theories.

The great Eocene tectonic event, which I have identified in relation to ocean floor chronology, has left its tracks dispersed over two thirds of the globe. There should be no shortage of places at which one can find relevant strata for scientific verification. If I had the vigor, time and resources, I would like to explore the geology of the Great Bight of Australia comparatively with the shelf along the Cape of South America—especially along the less disturbed curve running northwest from Cape Horn. Because of the enormous tension that preceded the separation of Australia and South America, I would expect much of the relevant geology on the South American side to be in the continental shelf or beneath. The aforementioned must be studied in relation to the displaced Scotia Ridge and the Falkland Plateau. Next, I would be interested in the comparative geology between the coast of Antarctica that now faces the South Pacific and the corresponding coast of Chile. A comparison of the Jurassic floors in the Northwest Pacific, with those found along Antarctica facing the South Atlantic, is a must. And if I had only one more project to select after that, I would go for a reexamination of all Paleocene, Eocene, and Oligocene horizons along the path that I have postulated for the Antarctic Plate. In addition, I have already written earlier at my web site about what more I would like to learn from the depths. We need from global seismic tomography additional crosscuts, down to the 2750km level, along many lines that do cut across significant areas of the Eocene tectonic event.

Third, take what similar marine life you can find along the coasts of Middle America and Australia, these creatures also could have been in contact along the connecting coast of Antarctica, during the Eocene, while that continent moved out of the Pacific and scraped past New Zealand/Australia. Another chance for contact came later during the Oligocene, farther north, when New Zealand/Australia again came close to South America (see pages 28, 31-32). In any case, the biology

[19] See page 22, below. In addition, there is the happenstance that I have matched the tip of South America with the Bight of Australia already in 1979, based on available continental areas and contours. The video program titled *Expansion Tectonics* has been published in 1996 by Lufa Studio. Content and ordering information can be found at <www.triplehood.com>.

of Antarctica was altered if and when that continent became polar.[20] I have a vague anticipation that a comparative study of the evolution of marsupials, and their distribution, will some day help us answer additional questions about geological sequences since the great Eocene continental separation. But all suggestions pertaining to the distribution of the species are secondary to the new ocean floor chronology that still needs to be verified by comparative continental geology.

James Maxlow has published an illustrated booklet, titled *Global Expansion Tectonics: Small Earth Modelling of an Exponentially Expanding Earth* (January 1996) and has released two CD disks with illustrations and animation bearing that same title. His new web site can be found at <http://www.geocities.com/CapeCanaveral/Launchpad/6520/>.

Regarding the Atlantic ocean-floor, no disagreement exists between Maxlow's interpretation and my own—as also I am in agreement there with proponents of mainline Plate Tectonics theory that exempt the Atlantic of the need for doing subduction. However, our differences regarding the Pacific/Antarctic and the Indian oceans are considerable. I admit that Maxlow's solution for the northern Pacific would be an improvement over Klaus Vogel's hypothetical slip fault between the Asian and North American crustal masses—that is, it would be an improvement if it worked. Both he and Vogel match the Bight of Australia with the round of Antarctica and place Australia into the North Pacific.

The placement of Australia upon a Jurassic globe and the shape and formation of Austral-Asia during Earth expansion, in relation to a worldwide inter-continental pattern of cohesive forces, constitute our greatest difference of view. According to Maxlow's terrella sequences (January 1996, especially pages 43 and 50), the opening of the Jurassic Pacific takes Australia away from North America.[21] And all the while, the southbound Australia pulls away a somehow loose portion of East Asia, southeastward to create Austral-Asia. This process calls for pulling Borneo and the Philippine Islands away from Japan, and Sumatra away from the coast of China.

I can appreciate Maxlow's reasoning, and how the chronological puzzle of the Northwest Pacific has led him to his conclusion. For a while, in 1994, I also considered twisting New Guinea out from the Philippine Sea. But that would have run against the logic of ocean floor chronology in that region, as I perceive it. Had Australia pulled all of Austral-Asia out of East-Asia's hide, I reckon that the northward-squeezed Mariana scar would now be absent, and the Java Trench and coastline would now coil into Celebes in the opposite direction.

By contrast, I explain the overall shape of Austral-Asia, and the existence of the "marginal seas" along the East Asian coast, as the result of a widespread Eocene tectonic event. Eocene ocean-floors, worldwide, contribute to the overall record and story of this great event.

The western edge of Austral-Asia calls for chronological rethinking, according to my view. (See illustrations on pages 42-43). Sumatra, Java, and I believe even the western edge of Australia, have formerly been aligned and stretched southward along the present Ninety-east Ridge. The latter extended southward and included the so-called Broken Ridge. **The triangle of ocean floor, bounded by Sumatra and by the northern one-third of the Ninety-east Ridge, happens to be Eocene. This means that before the Eocene epoch Austral-Asia must have been stretched southward along the line of that ridge for a considerable distance.** It must have been bent eastward at the moment when the rift of the Indian Ocean has begun to open northwest/southeast. **At the same time Asia's marginal seas were being opened and, during the Eocene, the**

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[20] I do not know whether Antarctica traveled to the geographical South Pole or whether the pole had always been associated with it. The axis of our planet could have shifted.

[21] James Maxlow, *Global Expansion Tectonics: Small Earth Modelling of an Exponentially Expanding Earth.* Glen Forrest, Australia: Terrella Consultants, January 1996.

eastern Pacific became a distinct geological entity as well. All this suggests that a major tectonic event occurred during the Eocene.

Where could Australia have come from if it did not come from the northern Pacific? My conclusion has been reached after contemplating the southern hemisphere of my chrono-logical globe (see page 12).[22] The Bight of Australia still now faces its partner, namely, the tip of South America. Of course, I realize that the layout has been made complicated by the interfering presence of Antarctica. **So, according to my theory, an Earth-encircling "rubber-band" of continents—comprised of the Americas, Asia, and Austral-Asia— has snapped along the bight of Australia and the tip of South America.** Austral-Asia was then pulled north and it leaned eastward into the soft trail of Antarctica as the latter was departing from there. The Antarctic plate leaned and "twisted itself" out of the South Pacific and, in counter-clockwise movement, bumped against the cape of South America. After twisting itself into the widening space between Australia and South America, the tip of Antarctica's triangular plate came to rest in the southern Indian Ocean.

Among theoretical assumptions that seem to distinguish my approach from that of Maxlow is my consideration of crustal tensions on a global scale. It is quite true that ocean floor chronology suggests a budget of crustal areas that must be accommodated on terrella models. But in addition to spatial considerations, the Earth expansion process also implies a budget of cohesive forces that must be explained throughout. Various shapes of continents were torn from a total crust under different and constantly modified tensions. I must summarize again. **Continents were not born apart to drift, to associate, or to wander as they please. They were torn apart! And the process of tearing them apart has required forces that must be identified tectonically.**

For instance, if Antarctica and Australia together were pulling Austral-Asia away from eastern Asia, as Maxlow proposes, then what gave them their foothold and leverage to do the pulling? And if after that feat Antarctica wanted to tear itself loose from Australia, what gave it the necessary foothold and leverage? I suspect we are here up against a vestige of the Wegenerian legacy, which assumes that continents were somehow born as natural wanderers and drifters.

Beyond these basic points there appears to be no need to differentiate, or to explain further what my theory is not. The remainder of this booklet is designed to explain, in a more positive manner, what it is.

[22] The actual geometric shapes on the published ocean-floor chronology maps are difficult to visualize. Shapes on any flat map projection are distorted. For that reason I have, immediately upon finding them, transferred the data unto a twelve-inch globe—subsequently unto globes with a sixteen-inch diameter.

3

Continents were Torn Apart, not Born Apart to Drift

The scientists who gave us Plate Tectonics also gave us Ocean-floor Chronology. In 1994 I became fascinated by this chronology and instantly noticed some agreement with my 1979 conclusions about Earth expansion and the original position of continents. I wrote about my updated conclusions in 1994, and the essay was published in 1996.[23] At the time only a few people understood, and fewer still believed.

"Torn apart" by Earth expansion, not "born apart" to drift, were the continents on our planet. They were torn apart with great tensile force. Moreover, specific directional forces were required to break the continents—especially the first one—out of the planet's total shell. I am convinced that such tearing conforms to natural law and that the principles of such law can be experimentally investigated. In order to get a little closer to the suspected principle that determines the shape of a planet's first continent, I turn to analogous experimentation.

Already in 1979, at my first reaction to Wegenerian "continental drift," I did a variety of experiments by way of inflating balloons. For instance, I observed slabs of putty upon an expanding and flattening surface. A slab of putty was sprayed with a fast-drying paint to obtain some sort of a brittle crust. Photographs of the basic results were given in my 1979 publication. They illustrate flanging, relative expansion flow, syncline formation, and the breaking away of island chains along continental contours. In 1999 the problem was refocused and a different kind of balloon experiment was devised, pertinent to the following observations:

Antarctica is our most round continent and the Pacific is our most round ocean. Though the continent no longer is located in its ocean, the two are situated still close enough together to suggest a relationship. There seems to be a natural law at work that governs the formation of continental and oceanic contours. At this point in time it is not my aim to define this natural law mathematically, rather, to describe the process just well enough to be visualized.

Already in 1979 I was convinced that a first continent, that is slowly broken out from the crust of an expanding planet, would necessarily have to be round. I had been reflecting back then on tensions that hold the surface of a sphere together. The paradigm that guided me at the time came from the unlikely field of ornithology. Somewhere I have seen a chick hatch from an eggshell by cutting a circular opening with its beak. I assumed that nature usually follows its own easiest path. Personally I had no difficulty applying this logic to the shell of an expanding planet. **The "eggshell and breakage paradigm" seemed more appropriate than the "vagabond paradigm" that Wegener has applied to explain merely the behavior of the shell fragments after breakage.** It seemed more reasonable even if, in my case, a living chick and its beak in the process of hatching augmented the role of the expansive force. While my own sense of logic was satisfied, it turned out that readers

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[23] Karl W. Luckert, "A Unified Theory of Earth Expansion, Pacific Evacuation and Orogenesis." In *Theophrastus Publications,* 61-73. Athens, Greece: Theophrastus, S.A., 1996.

would not easily follow my paradigm leap. Their need for scientific experimental proof, regarding the shapes of first continents, must therefore be acknowledged.

As a first step toward analogous experimentation I propose the following hypothesis: The most natural form of a first continent, broken from the crust of a sphere that internally generates and equalizes expansion pressure, will be a circle.

An experiment was devised that translates the "expanding eggshell paradigm" into a more manageable "expanding balloon paradigm." Applied to a balloon, the problem emerged as follows: When an inflated balloon bursts, air pressure is released radially. The sudden outward pressure tears up the balloon skin differently than a simulation of horizontal crustal tension, caused by slow Earth expansion, would require. Though basically a planet's expansion pressure is radial, the pressure is being translated into horizontal tension within its crust—thus analogously along the skin of the experimental balloon. The speed of bursting had to be slowed to a degree where slower horizontal tearing would occur.

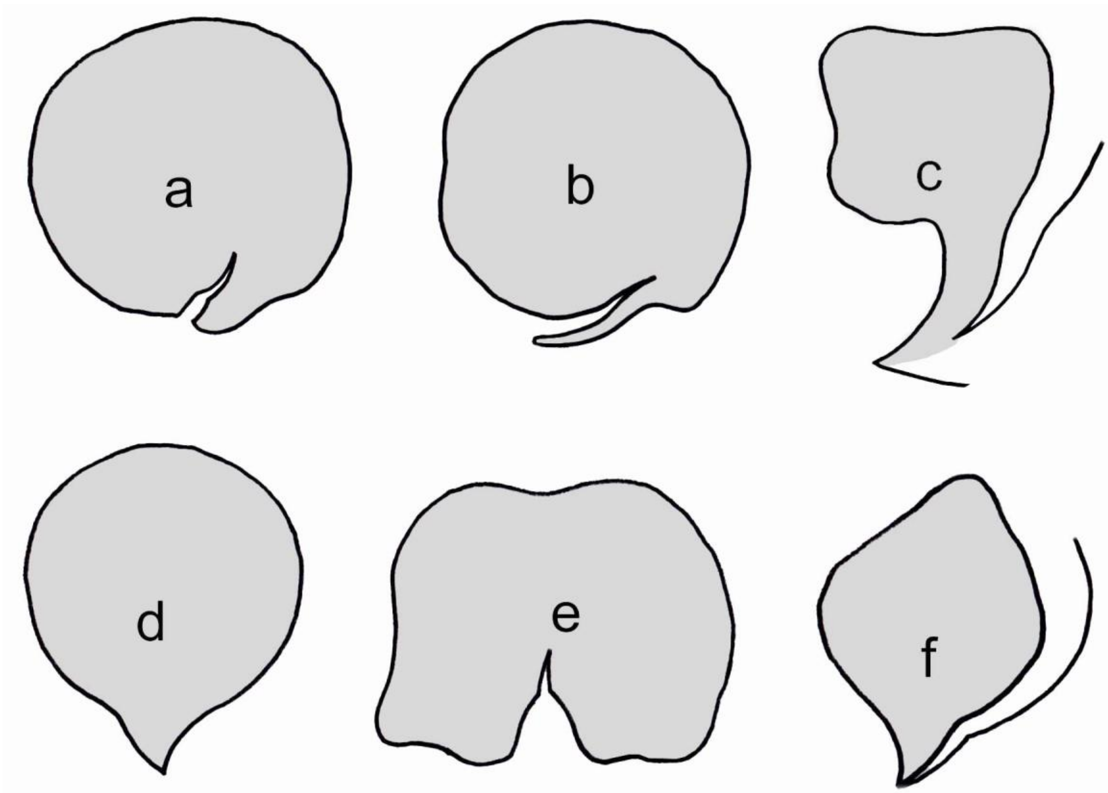
Of course, every scientific simulation has limitations. The balloons available to me are not exactly spherical. They have the shape of a teardrop oval, and only a little more than half of the shape of a balloon can therefore approximately represent an expanding round planet. But then, the teardrop oval shape of a balloon need not be seen as a disadvantage. The working hypothesis may simply anticipate the possibility of a rounded teardrop oval as a first continental fragment. To slow the breaking process, another balloon was slipped inside the experimental balloon skin. The outer skin was punctured, so that it would start tearing sooner and less violently.

Experiment 1

The outer balloon was pre-punctured exactly at the top, and it held to an inflation diameter of about 16 inches. When it finally broke, the skin was divided into equal halves. The result was a truism. Two portions of a spherical crust, broken by expansion pressure into equal halves, necessarily do assume round shapes. This result was achieved several times when the balloon had been pre-punctured exactly at the top. Inasmuch as this result can easily enough be imagined it need not be illustrated here.

Experiment 2

The outer balloon was pre-punctured about 20° from the top. This time the resulting parts were of unequal size. A smaller roundish "continental" patch was being peeled free, more or less proportionate with the size of Antarctica in relation to the other continents upon our planet. Several attempts produced a continent with a genuine Antarctica tail! See the typical figures "a," "b" and "c."

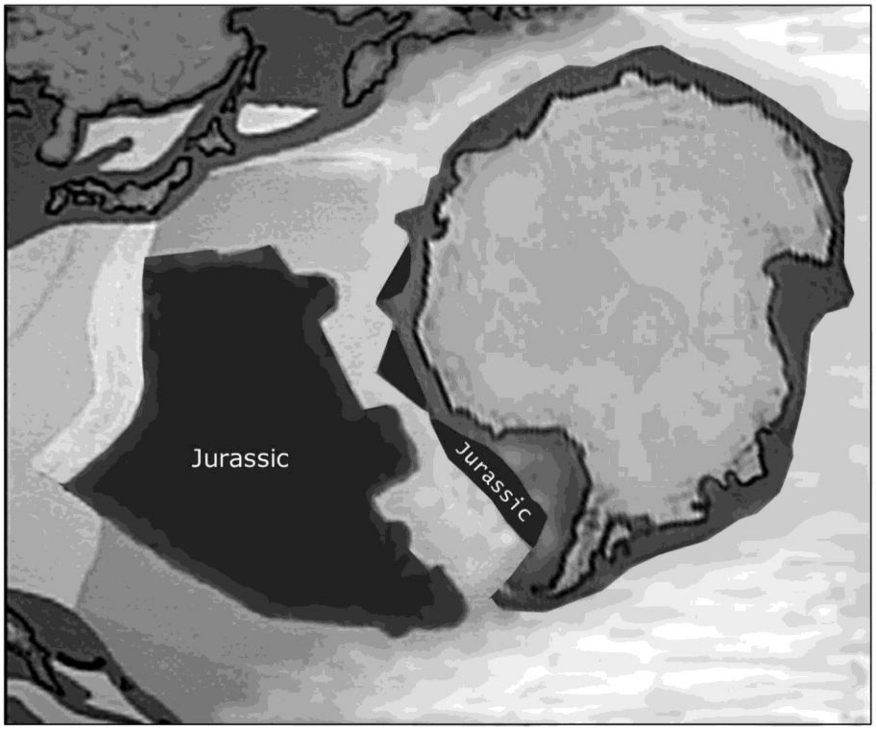


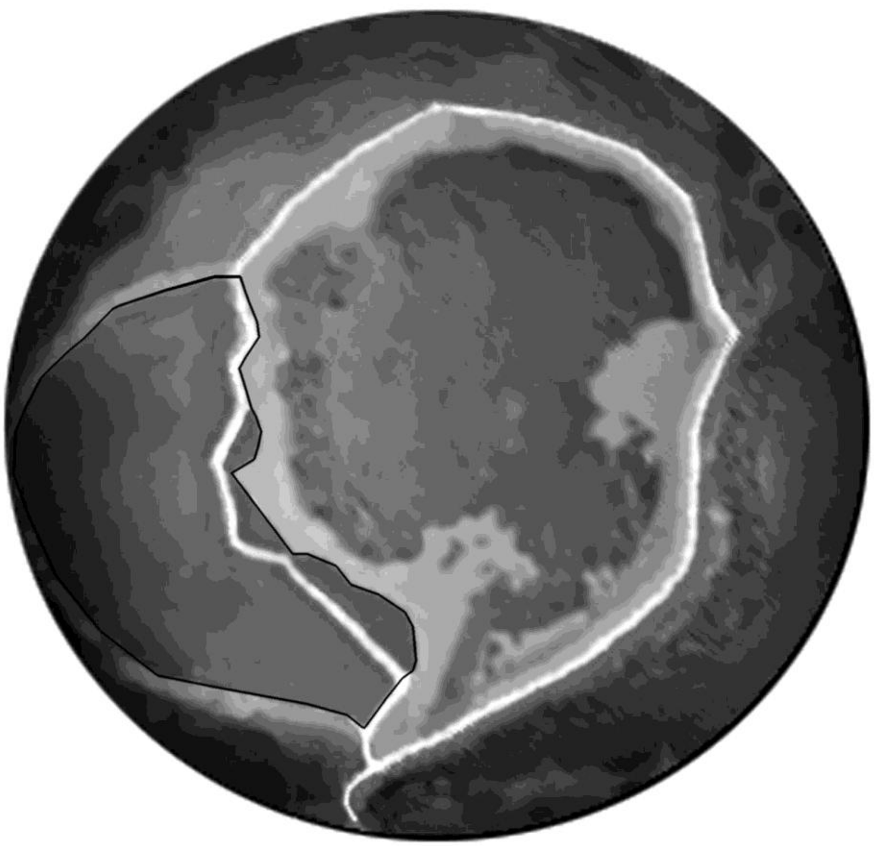
Typical fragments from double-balloon breaking experiments

The presence of these tails is intriguing and appears significant for understanding the formation of a continent like Antarctica as well as of the Pacific Ocean. Tails were formed at the opposite side from the point of puncture. This means that the initial tear traveled in both directions. My balloon skin tore along a curved path, almost symmetrically, in both directions. But because the tension was not quite equal in both directions, the curved paths failed to complete a circle. The distance between the two paths, along their end runs, created the tail.

While the shape of an Antarctica is thus shown to be clearly among the possibilities for first continents upon an expanding sphere, some variations could also happen. If the two paths had met as they did in figures "d" and "f," the continent would now not sport a shrunk "mammalian" but perhaps more of a "reptilian" tail. If the crust would have begun tearing and then hesitated, and the paths would have reversed direction for a while, as in figures "c," "e" and "f," the continent would not have turned out to be very round. If the tearing would have changed direction, and the curves still had met at the other side with force, two stubs could have resulted instead of a tail, as in "e."

The variations do not negate the overall positive result of these balloon experiments. There must indeed be a natural pattern that determines the possible shapes of first continents, as these are broken out of whole crusts upon expanding spheres. If only one of these experiments had produced a shape similar to Antarctica, we would have to accept the possibility





Reconstruction of the Jurassic Pacific Ocean that this continent was the first that was carved by expansion of the planet. This is not at all a question of experimental statistics. The basic reality is that Planet Earth does indeed have one round continent with a tail. And it also does have one expanded round cavity next to it in the shape of the Pacific Ocean. So, insofar as our planet already has these features, we are not establishing the probability of obtaining them by the ratio of positive experimental results. In the case of our planet that probability is *a posteriori* 100 percent.[24] And inasmuch as no other viable mechanism for these shapes has been suggested, aside from Earth expansion, the probability that Earth expansion has created these features stands presently at 100 percent as well.

The most natural form of a first continent, broken from the crust of a sphere that generates and then equalizes expansion pressure internally, tends to be a circle. Based on careful observation, a more detailed description of the process is now possible. **A round continent, breaking out from the crust of an expanding sphere, that on account of irregularities in crustal composition and cohesion, or for reasons of uneven expansion pressure, cannot complete a true circle, may manifest the differential in the form of a tail.**

The oldest Jurassic ocean-floor patch on our planet has been found in the northwest Pacific Ocean, where it may be expected if the first and round continent originated in that ocean. A corresponding stretch of Jurassic ocean-floor, albeit not yet very well investigated, is found precisely along the edge of Antarctica where according to my theory such a one should be. The figures on the facing page illustrate this point.

Geological time scale for the beginning of periods and epochs under discussion

Jurassic	205 million years ago
Lower Cretaceous	135 million years ago
Upper Cretaceous	100 million years ago
Paleocene	66 million years ago
Eocene	58 million years ago
Oligocene	37 million years ago
Miocene, Pliocene, Pleistocene, Recent	24 m.y.a. to present

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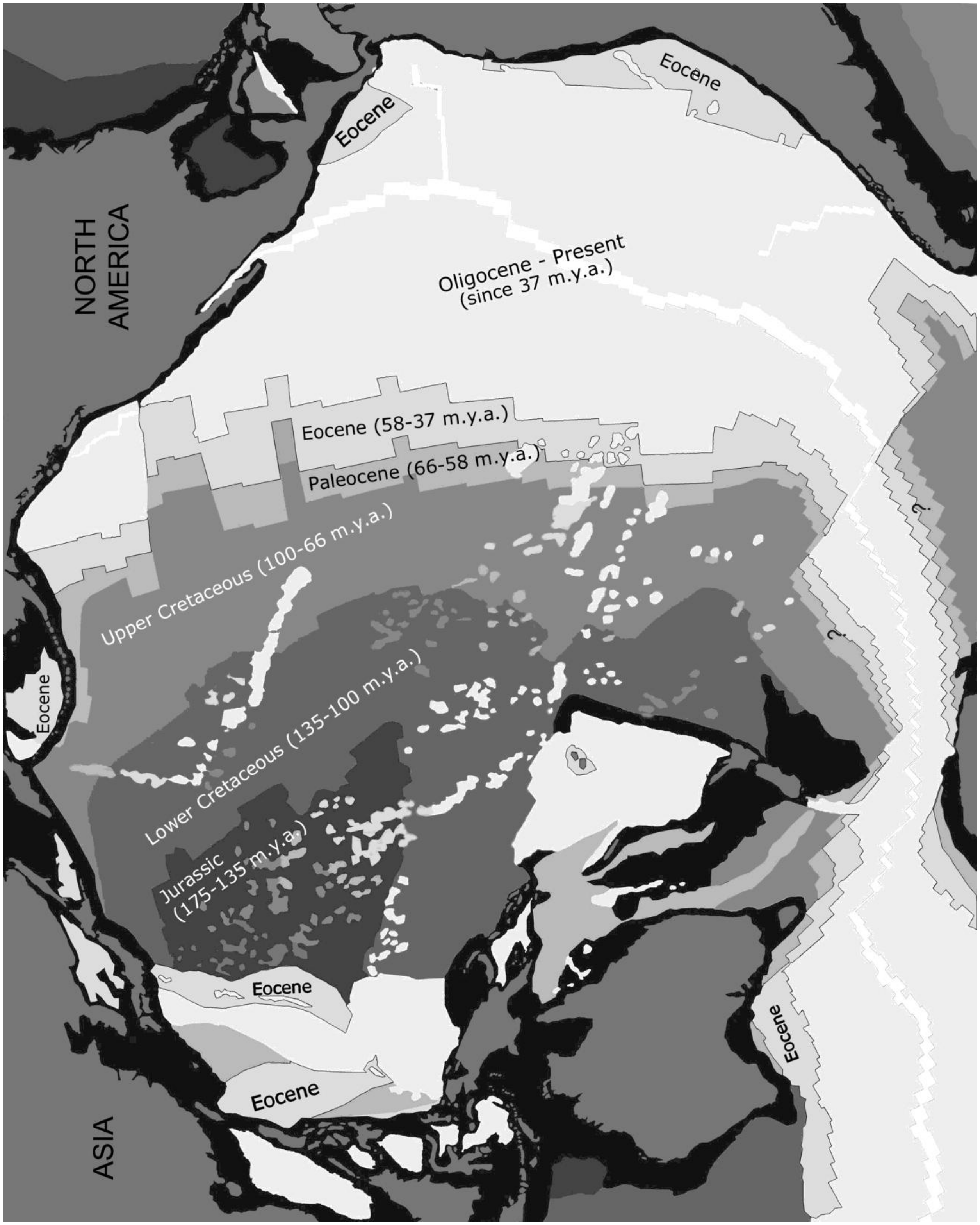
[24] A similar round-like continent can be found at the frosted North Pole of the planet Mars. Its placement at a pole, and the presence of round Antarctica at our South Pole, raises the question of whether poles determine the place at which round continents originate or are destined to be. The Martian coincidence suggests at least a working hypothesis. We might begin to investigate whether the axis of our planet has shifted together with the movement of Antarctica, or whether the remainder of the planet's crust simply has retreated from Antarctica.


NORTH AMERICA
Eocene
Eocene
Oligocene - Present (since 37 m.y.a.)
Eocene (58-37 m.y.a.)
Paleocene (66-58 m.y.a.)
Upper Cretaceous (100-66 m.y.a.)
Eocene
Lower Cretaceous (135-100 m.y.a.)
Jurassic (175-135 m.y.a.)
?
?
Eocene
Eocene
Eocene
ASIA

4

Ocean Floor Chronology and the Eocene Tectonic Event along the Pacific Ocean and Antarctica

Wegener's idea of "Pangaea" appears to have been habitually on the mind of most who, since Hilgenberg in 1933, have attempted to reduce the Earth crust to a near zero-ocean globe. Derivative notions like "Laurasia" and "Gondwanaland" were retained as acceptable categories for communication—and so was the habit of fitting a larger arc of Antarctica into the smaller Great Bight of Australia.

To get back to a globe with a single crust, most early terrella makers simply subtracted the oceans and then tried to rearrange Pangaea as the original shell of a smaller sphere. They did not hesitate arranging continental fragments anywhere they seemed to fit, because they were indeed still under the spell of Wegener's vagabond paradigm—to the effect that once upon a time the continents have wandered and come together to form the mythical all-lands Pangaea. After the fashion that continents drifted in from anywhere across the mythical all-ocean Panthalassa they also disassembled and dispersed to open up the Atlantic, just as they pleased. Such free drifting seemed all the more reasonable on an expanding globe where extra space was being created continuously to increase the freedom of the continental fragments, to wander.

Until recently all reduced globes or "terrella models" were constructed—as I myself have still done in 1979—as if to restore the original globe in a single-stage reduction. It was done in the same straightforward manner in which Wegener himself had assembled and then again disassembled his Pangaea. But thanks to worldwide ocean floor exploration, to drilling and magnetic profiling done by ocean-going vessels, and thanks to having obtained a chronology and a better topography of our planet's crust, **this single-step procedure is no longer satisfactory.** Now we have a nearly complete ocean floor chronology. Earth scientists have plotted patterns of magnetic anomalies from along mid-ocean ridges, for relative dating, and they succeeded in establishing the magnetic profile of the sedimentary layers in vertical drilling cores as well. The same sedimentary layers were dated by paleontologists on the basis of fossils they contained, which were already known from parallel strata on land. Basement rock could be dated by measuring radioactivity.

The Pacific Ocean can be divided into three parts, the older Northwest, the younger East, and the greatly irregular Southwest. This ocean is essentially round, a fact that is emphasized by the presence of a seismically active Ring of Fire—albeit, the Ring is severely distorted and bent inward in the southwest. I propose that this ring of fire, and of strong seismic activity, outlines the expanded scar from which the first continent, Antarctica, has been peeled.

However, the first and round continent was torn loose gradually—beginning in the northwestern Pacific by Jurassic ocean-floor spreading. Afterward the process of severance was continued by Cretaceous and by Paleocene spreading. At the beginning of the Eocene the original round continent still was located in the south-eastern portion of the Pacific Ocean. The plate of Antarctica was embraced along the western flank of the Americas.

Land and shallow seas upon the smaller Earth have been undulating up and down, long before and into the Jurassic period (205-135 mya), and the seas have been rifting at shallower depths, producing ophiolites. But during the Jurassic a deeper set of oceans began to open up, by way of deeper rifting. At that initial stage, the spreading of deep oceans naturally happened at the expense of distorting the adjacent coastlines of the future continental segments. The oldest Jurassic patch of ocean floor, in the northwestern Pacific, initiated the separation of four future continents—Asia, North America, Antarctica, and Australia. At that time Australia still was embracing New Zealand and the cape of South America.

The Jurassic ocean in the Northwest Pacific represents the first phase of continental separation on planet Earth. The starting date that is given for this process, in the *UNESCO Geological World Atlas* (1988), is 160 million years. A revised age of 175 million years (ODP, Leg 129) has since been suggested for the oldest floor in the Northwest Pacific. This contrasts with 150 million years for the North Atlantic (ODP, Leg 149) and with still less for the Indian Ocean. My zero ocean terrella reconstruction returns the Jurassic patches that are found alongside Antarctica's Weddell Sea and Queen Maud Land to the northeastern edge of the Jurassic floor in the Pacific—the two sides were separated by Cretaceous spreading (page 22). The irregular edge of the world's oldest ocean patch corresponds in size approximately to the width of the Jurassic portions that still are adhering to the rim of Antarctica. Such reverse modeling of globe expansion can reunite not only the two remnants of the Jurassic Pacific and Antarctic oceans, but also bring together pairs of Jurassic ocean floor that have become separated by Cretaceous spreading, in the North Atlantic and Indian oceans.

The Eastern Pacific is the younger portion of this great round ocean, and the oldest floors that can be found along the American coasts are Eocene. Therefore, for the time being—until the chronology of the *UNESCO Geological World Atlas* of 1988, and the drilling cores, can be reexamined in light of my theory—the Eocene epoch (58-37 mya) will have to be postulated as the time of the great displacements. **Antarctica's exit from the Eastern Pacific must have happened during the Eocene.**

The now north-western flank of the Antarctic Plate, facing Africa, had all along been pre-cut along the Pacific mid-ocean spreading rift that functioned from the Jurassic until the Eocene. The other side of this spreading rift is indicated in the Pacific, elongated meanwhile by Earth expansion, by the strip of Eocene floor that now runs longitudinally through the middle of the Pacific. Together with the rift that has cut Antarctica and its older plate away from the Americas, this mid-ocean rift loosened during the Eocene while Earth expansion manifested itself lopsidedly in the Southern Hemisphere. It let the triangular Antarctic plate slip southward. The enormous soft area left behind by the southbound Antarctic plate began **H. W. Menard has said early on that spreading ridges in the eastern Pacific Ocean are ephemeral**. The ridges that he explored have indeed begun to form after the great Eocene upheaval. They could rise as ridges only after new oceanic crust and lithosphere, of sufficient hardening first along the edges, leaving the soft middle for the new Pacific spreading ridge to form, ever so gradually.[25]

strength, had been cooled to allow hydraulic uplift by plate-wide "flanging" (Chapter 9). By contrast, the spreading rift in the Atlantic Ocean had been in place over three times longer. It had been a spreading rift from the start. In the Atlantic Ocean it is the mountain ranges, at each side of the central rift, that can be characterized as being more temporary and recent than the rift. These mountains could be uplifted only after a certain width of the ocean-floor curvature had been spread and hardened to endure the necessary amount of hydraulic pressure. In the Atlantic Ocean the rift is the central feature, and it should come as no surprise when the Lamont group of oceanographers,

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[25] This Eocene upheaval, postulated by my theory, sufficiently explains why attempts at ocean floor drilling, in the "Southern Ocean," have so far yielded rather ambiguously stratified cores.

who concentrated on that ocean, was adamant about finding the spreading rift as a universal feature in all the oceans. Magnetic profiling was needed to find the hidden "rift" under the Pacific ridges.

Antarctica—the round continent with a tail and shaped like a figure 9—is outlined by the contour of the Pacific Ocean, along the Ring of Fire. Younger rings of expansion of that oceanic cavity have now come into view. Like a rock thrown into water does broadcast expanding rings of the impact, so the initial violence of tearing out the first continent from the Earth crust is reverberating, still, along its outermost circle in the form of the Ring of Fire. Subsequent geological epochs have contributed echo-outlines of the first continent, and these have recently become visible as isochrons in the new ocean floor chronology, produced by the Plate Tectonics revolution. See page 24.

The increments by which the Pacific Ocean expanded have continually maintained the original outline of Antarctica. From the Upper Jurassic through the Lower and Upper Cretaceous, through the Paleocene, and into the Eocene—with Antarctica itself still occupying space west of South America—the isochrons conform to the pattern of a **9**. Of course, one has to retrace the evolution of the Pacific by keeping an expanding scale in mind, beginning with the original size of Antarctica as the smaller figure **9**. Even later, after the southwestern region of the Pacific had been "distorted" by Austral-Asia's northeastward intrusion, the basic shape of the Pacific Ocean has remained a circular cavity with room for a tail.

My statement about "distortion" is negotiable. By switching one's time perspective it is possible to ask the question differently. What, in this process, has been the real distortion? Our "distorted" ocean still shows the cavity true to the original shape of a **9**. Perhaps we should think of the extreme circum-Pacific stretching, that preceded Austral-Asia's northeastward return, as having been the actual distortion. In this case, what appears as a distortion later during the Eocene could be re-evaluated as an attempt at rectification.

The fact that this immense oceanic cavity has remained true to Antarctica's continental shape suggests a tremendous amount of viscous coherence in the mantle substratum, underneath, possibly even involving the whole depth of the mantle. It may also reflect a tendency for mantle materials to expand evenly overall, by way of changing their nuclear-chemical configuration into something less dense. Either hypothesis explains the preservation of the **9**-shape as part of the expansion process. At different levels of depth in the asthenosphere and mantle, both possibilities may be interrelated. Nevertheless, in light of the new global seismic tomography, I am at the moment inclined to suspect that the second possibility dominates in the ocean area itself. On the other hand, the overall twisted shape of Austral-Asia demonstrates that a rubber-like resilience in the asthenosphere must have been available under the continental crust.

Australia, with the rest of Austral-Asia in tow, quickly pulled north and traveled eastward after its severance from the tip of South America. It traveled to a place marked by the Kermadec-Tonga Trench. Inasmuch as the remaining distance to South America consists of recent ocean floor, the Kermadec-Tonga Ridge must at the beginning of the Oligocene epoch have been very close to South America and to the back of Antarctica

Present-day sea depths also attest to the Eocene tectonic event. Looking at the Pacific Ocean overall, I notice that it is most shallow along a broad quadrangular stretch, sweeping from an eastern line marked by the Kermadec-Tonga Ridge northwesterly to a line stretching roughly from Java to Japan. This broad bulging of the ocean floor means that the force with which Austral-Asia has snapped loose and pulled northeastward was powerful enough to push up this entire region. It also means that the "rubber-band" quality that did the northeastward pulling must reside in the asthenosphere.

There are no Eocene ocean-floors east of Australia between the Paleocene and Oligocene spreads—other than a small twist-eruption around Fiji. This means that Australia's eastward movement absorbed all the Eocene expansion spread that could have taken shape in that direction. **The Australian plate reached its eastern limit during the Oligocene, and after that it began to return westward backed for a little while by Antarctica's continuous swing.** The wedge of the Antarctic Plate continued swinging counter-clockwise into the Indian Ocean, and the plate's "heel" (which contained the encrusted "tail") began backing away from its collision with the tip of South America. The width of the Oligocene Scotia Sea (Drake Passage) is approximately the distance by which the new South Pacific spreading ridge has in the process been offset westward. **So, becoming separated from the Antarctic Plate by the active spreading ridge, Australia continued to rebound westward to tighten the conspicuous knot of the Banda Sea and the Celebes swirl.**

The bending and twisting of Austral-Asia will be more convincingly explained in relation to evidence in the eastern Indian Ocean, in the next chapter. For now we must linger a while longer in the Pacific to show additional important results of the Eocene event.

The Marginal Seas of East Asia throw light on events that happened worldwide during the Eocene. Making allowance for a Paleocene sliver in the Philippine Sea that had been rifted earlier, and an Oligocene expansion added later—which together bracket an Eocene spreading rift—all of East Asia's marginal seas have been opened during the Eocene. Such uniformity, ranging from the Bering Sea to the Sea of Okhotsk, continuing to the Sea of Japan and running through the already present Philippine Sea, cannot be accidental. **During the Eocene all of East Asia has left segments of its shoreline behind, as island chains in the ocean, anchored along Benioff Zones and deep-cooled trenches that were being jarred in the process** (see pages 42 and 43)**.**

The formation of East Asia's marginal seas can be visualized best in terms of the larger Eocene tectonic event—namely, the general release of tension that occurred when Austral-Asia snapped loose from the tip of South America. How is such a sudden and widespread event even thinkable? Yes, within the confines of eastern Asia alone it almost seems unbelievable. However, if one brings the remainder of Austral-Asia and worldwide expansion stresses into the picture, all becomes rather obvious. In the global context one should notice that today not much continental crust remains in the Pacific or along its edges to hug that hemisphere. Consequently there was upon this expanding planet not much continental curvature left by which Asia's eastern edge—once it had been jolted by Austral-Asia's slippage—could hold on to the sphere.

"Global circumferential slippage" is a consequence of horizontal tension created by Earth expansion, acting on the cohesive forces that continue to hold together the continental crusts.[26] Inasmuch as our Earth still has a largely coherent pattern of continental crust, and because most of the continents have by now ended up hugging the same hemisphere, continental shores along the Pacific may continue to slip back and widen the marginal seas, and thereby jar still deeper ocean trenches.[27] More will have to be said about this process later, in chapters 8 and 9, in relation to mountain formation on land and in the oceans. While the planet's gravity will take care that the continental crusts do not fall off their hemisphere, the Pacific Ocean nevertheless is destined to grow a little faster than the other oceans, as a result of slippage.

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[26] The idea concerning "global circumferential slippage" in eastern Asia occurred to me while doing balloon experiments. Continental "skins" that cover only slightly more than one-half of a balloon, have a tendency to creep and to slip from the curvature of the expanding substratum.

[27] Whether circumferential slippage may eventually affect the western coasts of the Americas is difficult to tell. The coast of eastern Asia had 130 million years to build up tension for its circumferential slippage. Some forty-three million years ago the latitudinal stress-gauge along the western American coasts was reset to zero.

The same Eocene tectonic event that initiated circumferential slippage to form Asia's "marginal seas" has agitated and readjusted all the continents that host the Ring of Fire. The severance of the Antarctic Plate from the western flank of the Americas has stretched and straightened the western coastlines of the latter. This stretching itself was a process that implied a certain amount of slippage, especially in the case of South America which, after having been stretched, was jolted northeastward. The Eocene tectonic event has agitated the lithosphere and quickened the asthenosphere underneath the western one-third of both Americas. But most severe among all has been the "circumferential slippage" that was experienced by Asia's Austral-Asian appendage. The latter had been stretched, on account of its prior adherence to the tip of South America, to a point of disintegration. **Loosened from its moorings by snapping away from the tip of South America, Austral-Asia's foothold on the Pacific hemisphere remains now rather weak.** It cannot possibly counter-weigh the combined curvature of the circumpolar association of all the other continents. This association of continents, at the other hemisphere, includes mainland Asia and Europe which both are still holding on to Africa in the south, Greenland, and then North America which still is holding on to South America.[28]

Intercontinental "stretching" is an important consequence of Earth expansion. Stretching is a phenomenon that scores somewhere between continental "cohesion" and "separation." Stretching and separation are both direct results of Earth expansion. North and South America have been stretched apart along Middle America since the Jurassic. The Gulf of Mexico opened up first, and then followed the Caribbean Sea. More recently a rift has opened at the West Indies Ridge, and another one has developed south of Cuba running east and west. Up north, Asia and North America do seem only superficially separated—"superficially" in relation to land-dwelling creatures that dread shallow waters as much as they do deep oceans. By far the highest degree of continental stretching and bending, on our globe, is evident in the thinned and twisted stretch of crust between Australia/New Zealand and Southeast Asia. That topic will be addressed more efficiently in relation to what happened during the Eocene in the Indian Ocean.

"Surge Tectonics" is a geological theory that explains the formation of Asia's marginal seas from a more circumscribed perspective, and nothing is expressed in my statement that would amount to a serious disagreement. What Arthur A. Meyerhoff has postulated as low velocity surge channels, carrying partial melt at about 80 kilometers depth, preferentially eastward, can easily be harmonized with my Expansion Tectonics.[29] The "eastward flow" that he recognizes I call "relative expansion flow." It happens to be a westward flow under the Rocky Mountains and the Andes in the Americas. And the "barrier to eastward flow" that he identifies along eastern Asia as the existing Benioff zone, I associate, in addition, with broken synclines and their ability to dam relative expansion flow for uplift. **However,** the dynamic of the Earth's rotation, that Meyerhoff postulates as an efficient cause for spreading the marginal seas, I regard as untenable in light of the seismo-tomographic cross-sections that we now have available. The continental "root" or remnant of the early Jurassic mantle, under East Asia, shows no westward displacement of the continent. Reaching

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[28]All the continents, with the exception of Antarctica, are still adjoined to their former neighboring continental crusts. Europe and Asia never were but one super continent. From Gibraltar across much of the western Mediterranean Sea, as well as along the Sea's eastern shores, Africa still is attached to the Eurasian continental mass. Asia and North America are still nicely connected at the Bering Strait and around the Polar Sea along northern Greenland. Only a small rift in the North Atlantic, at Spitzbergen, cuts North America from Europe. The two Americas are still connected across Middle America, and Australia is still geologically part of Austral-Asia. Antarctica appears to be the only fully liberated continent on our planet, but even this "vagabond" still points its tail nostalgically in the direction of South America, the continent that used to be its Siamese twin.

[29]Arthur A. Meyerhoff, "Surge-tectonic evolution of southeastern Asia: a geohydrodynamics approach.," in *Journal of Southeast Asian Earth Sciences*. Vol. 12, No 3-4, pp. 145-247, 1995.

upward, it appears to split at a depth of 600 kilometers to accommodate, overhead, the soft foundation of the "kobergen" that widens the Japan Sea.[30]

I credit Earth expansion, relative expansion flow, and circumferential slippage with having formed the East Asian marginal seas and the circum-Pacific trenches. And of course, one can still continue to use Meyerhoff's "Kobergen" model to explain uplift on a local scale, in terms of surging and spreading on land or in the oceans. All motion on an expanding sphere is relative. What at the local scope of a marginal sea may look like kobergen- or diapir-spreading may, at the continental scale, be observed as margin tearing. At the global scale it may be perceived as circumferential slippage.

The Eocene tectonic event in the Pacific has above all changed the location of the old Antarctic plate. It affected most the continent of Antarctica and its triangular older ocean floor crust that had become attached to its northern end and previously reached into the vicinity of Alaska. It corresponds to the triangular cavity of the post-Paleocene northeastern Pacific. This triangular plate can now be seen pointing into the Indian Ocean. The old Antarctic plate that traveled southward did not yet have attached to it the portion of older Paleocene and Cretaceous ocean floor which now sits at the back of Antarctica and faces the South Pacific. **The old Antarctic plate slid southward and then continued to twist counter-clockwise.** For a while the plate's heel, which includes the continent's tail, bumped against the eastern portion of the tip of South America and raised havoc there (see page 32).[31] After the heel of the Antarctic plate swung away and cleared Drake Passage, its counter-clock swing came to a halt when its former mid-Pacific flank touched the edge of the African plate.

Was there enough space for the Antarctic plate to exit from its Pacific Ocean womb? And what might have triggered the movement? The answer lies in the early Eocene positions of the tip of South America and Australia/New Zealand. Yes, with a little lateral flexibility on the part of Austral-Asia and South America—and such flexibility during the Eocene is quite evident—the Antarctic plate could slide through the gap created by the severance of Australia from South America and then twist itself into the Indian Ocean. It was made possible because, in effect, Australia and Antarctica simply exchanged places. While Antarctica twisted itself into the space vacated by Australia, counter-clockwise, the latter was already on its way in a clockwise motion toward the place where Antarctica had been. Australia and New Zealand were leaning north and eastward after their partition—by way of a "twist" as well.[32]

The Scotia Sea or Drake Passage did not exist prior to the Oligocene. The round end of the Antarctic Plate was grinding against the Scotia Ridge and pushing as far as the Sandwich Islands. Then, during the Oligocene the round end of the Antarctic Plate cleared the Scotia Sea and swung westward against old ocean floors that were being shoved unto its bare back by the Australian Plate, with New Zealand up front.

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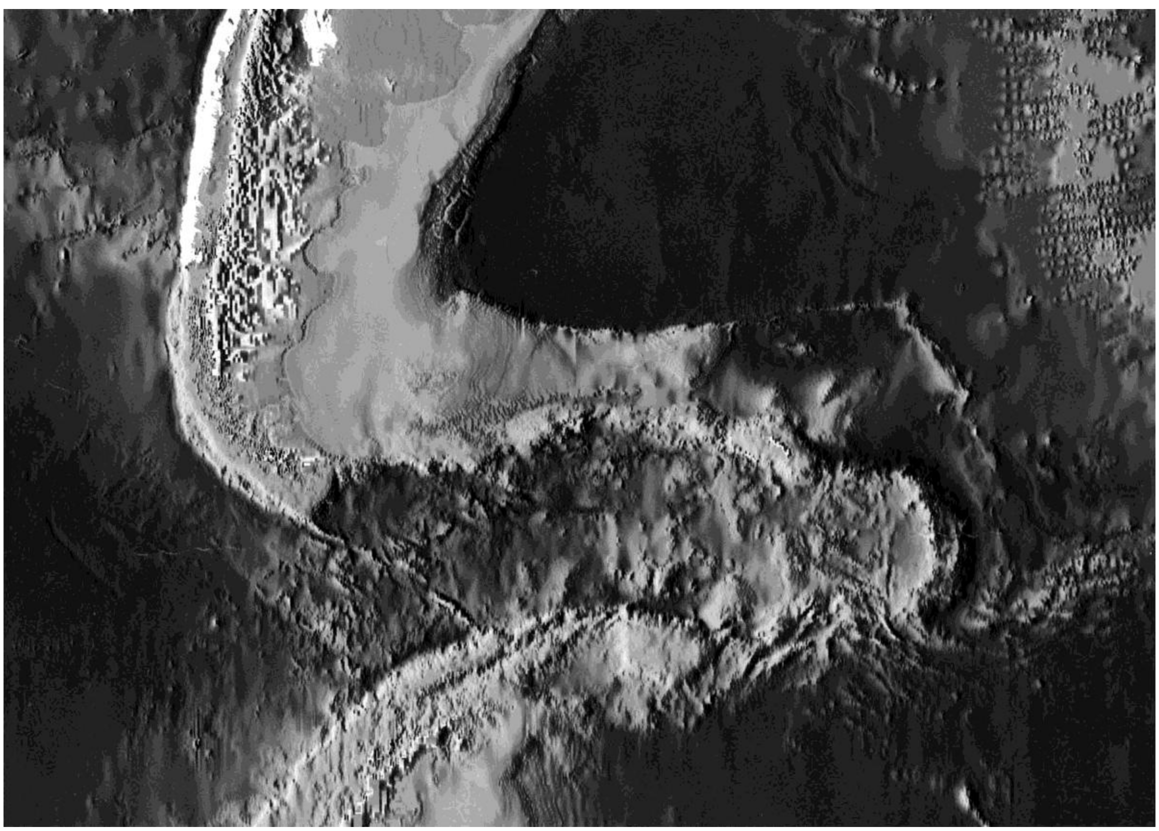
[30] See Rob D. van der Hilst, S. Widiyantoro and E. R. Engdahl. "Evidence for deep mantle circulation from global tomography." In *Nature,* vol. 386, 10 April 1997. No such "evidence" is apparent in this article. In all likelihood the configuration in question represents a continental stem, a remnant from a time when the mantle was still smaller. The stem appears split near the top to accommodate the spreading of the Japan Sea. See page 70, figure "d."

[31] Had Antarctica not obliterated most of the shoreline of the South American cape, and thereby disguised the match with the Bight of Australia, the content of this book would probably have been discovered long ago on the basis of matching contours, without my contribution. It could have found its way into our schoolbooks long before the dawn of the Third Millennium.

[32] The notion of a "Euler pole" may be used to visualize the movement of the Australian plate. But in effect, such movement in the Eocene "global mud slide" was possible because several plates adjusted concurrently and utilized the space that became available after expansion stress in the crust suddenly was relieved. The Euler geometry, as such, is of little practical use to discern these facts.

I suspect that the transitional narrow Paleocene and Eocene slivers, indicated on the chronological map on page 24 with question marks—at either side of the recent spreading ridge that divides the Cretaceous portion—do not conform to reality but are a map-maker's projection. Why should a cartographer who is unaware of the Eocene tectonic event suspect a discontinuity at this place? Magnetic reversals along these narrow strips, I suggest, are of a later time. The Cretaceous horizons at each side of the present spreading ridge match too well to be unrelated. Moreover, the entire westward path of New Zealand/Australia—from the scar that delimits the Cretaceous floor at the back of Antarctica to the Campbell Plateau and the Louisville Ridge—is still evident in the topography as a relatively smooth course.

Antarctica's partition from the South Pacific, and its collision with the tip of South America, has been animated in my video-lecture *Expansion Tectonics* (1966) several months before I chanced upon a good enough map that showed the actual havoc that was created by that collision. Accordingly, my 1996 video may be regarded as a hypothesis for which proof has, unbeknown to me, already been published on the 1994 NOAA map titled "Surface of the Earth." One thing is obvious on this map; this continental collision—the only significant collision on this planet of which I can find evidence—did not lift up a mountain range after the manner of popular expectations. It only made a mess of the continental edge.



Antarctica leaving the scene of its collision with South America

Austral-Asia's pulling away from the tip of South America has sprung loose the Antarctic plate from the embrace of the Americas. Australia's actual breakaway happened at a place that, relative to the planet's core, is now occupied by Antarctica. From the moment of the great severance onward—

after the "rubber-band" that was stretched by Earth expansion suddenly snapped—all of Austral-Asia was pulled north and eastward. At the other side of the globe, South America snapped northeastward as well, though not quite as far. The sheer mass of South America and its continuity with North America absorbed much of the shock. However, the Middle American stretch area was bent, and the isthmus at Panama and the East Indies Ridge were made to buckle northeastward.

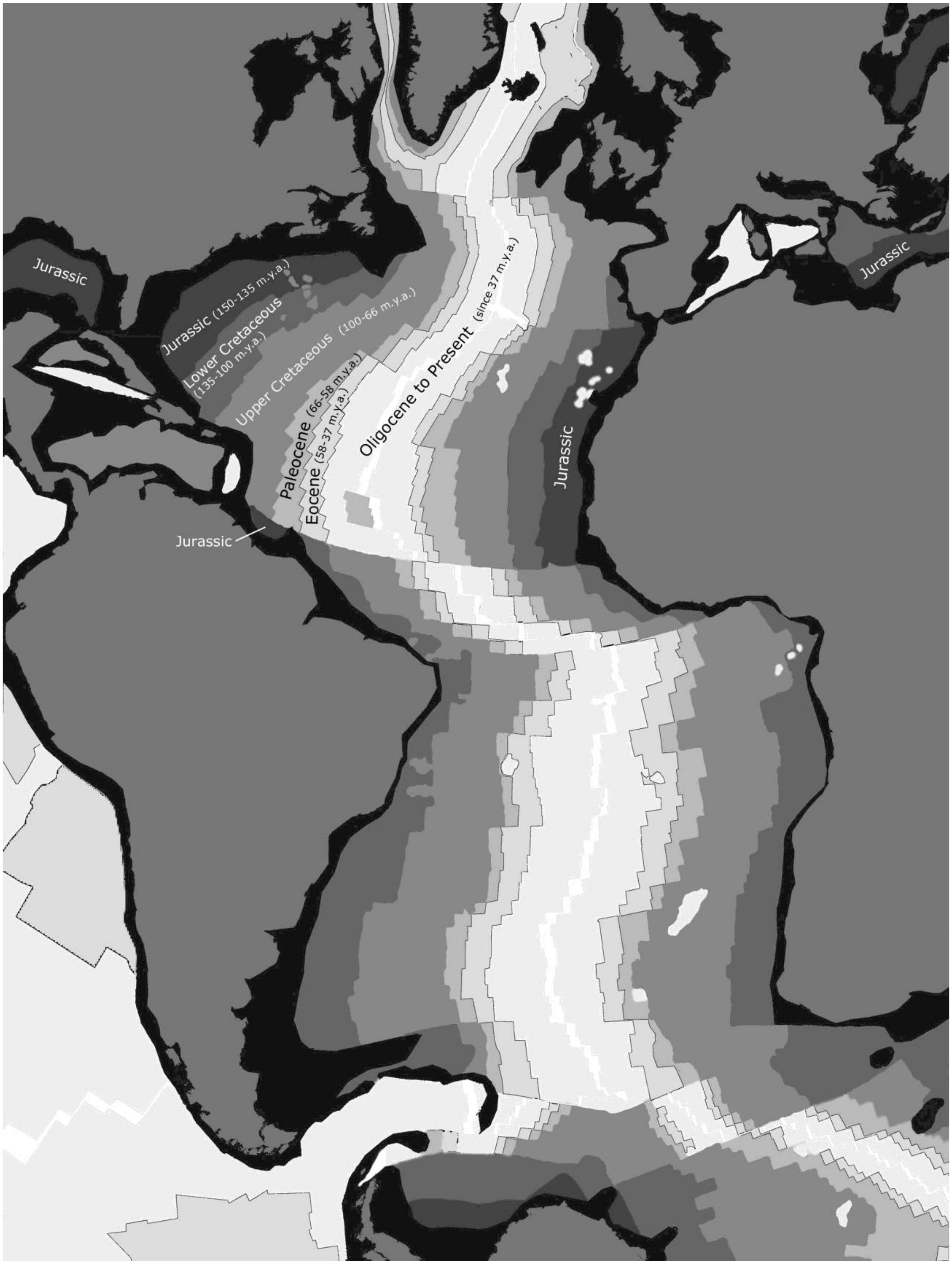
As a result of these considerations the present shape of the Pacific Spreading Ridge comes into better focus as well. South America's separation from Australia and Antarctica's severance from South America, together, have caused South America to pull back northeastward. Antarctica's subsequent collision with the tip of South America has added to that same directional movement. So it happened that South America moved away northeastward from its breakaway scar in the substratum. That scar promptly reinvented itself as a mid-ocean spreading ridge. If one allows for expansion since the Eocene, one can see that the present curve of the Pacific spreading-ridge, south of he equator, still mimics the contour of South America. Moreover, Middle America appears twisted eastward approximately by the width of the so-called Cocos Plate. Approximately the same distance exists in the Atlantic between the Jurassic sliver in the North American bight and its severed toe, east of Trinidad.

The jack-knifed movement that has caused Middle America to buckle northeastward has nudged North America a little westward, from the southeast. The evidence for this event lies along North America's western edge. One only need to ask the question, why does the Pacific Rift run into the Gulf of California and continue under the mainland the length of the state of California?

Of course, spreading rifts can run under land, and one is doing so elsewhere. The Indian Ocean rift cuts into continental crust to open up the Red Sea. But in that case there exists a situation of intercontinental stress, and it is reasonable to expect that some such separation would want to occur there. But none of these conditions are present along North America's western edge. Why would a mid-ocean rift want to be so ornery and slice off a narrow continental sliver for no good reason at all?

In answer to this question I suggest that down in the lithosphere and asthenosphere, this hot scar formerly was the boundary line between the Americas and the Antarctic plate. Along that scar the Antarctic plate broke away during the Eocene. In a similar manner, as the Ninety-east Ridge in the Indian Ocean constitutes the scar along which Austral-Asia has been stretched southward, so the East Pacific spreading ridge constitutes the scar along which the Americas and the Antarctic plate were stretched and where they finally came apart. There is a difference, however. The former Ninety-east (coastal) rift has been replaced by an active diagonal (mid-ocean) spreading ridge whereas the eastern Pacific coastal rift became a festering scar running under California. The South Pacific Ocean itself has expanded disproportionately along this area of weakness.

It is therefore not so much the spreading rift that intrudes into the space of California; rather, it is the land of California itself that got shoved on top of a pre-existent wound. California's presence there confounds the rift's normal function of "ocean spreading." Will the continental edge pacify the ocean rift by weighing it into place, or, will the ocean rift cut off a piece of land? Time will tell.


Jurassic
Jurassic (150-135 m.y.a.)
Lower Cretaceous (135-100 m.y.a.)
Upper Cretaceous (100-66 m.y.a.)
Paleocene (66-58 m.y.a.)
Eocene (58-37 m.y.a.)
Oligocene to Present (since 37 m.y.a.)
Jurassic
Jurassic
Jurassic

5

Ocean Floor Chronology and the Eocene Tectonic Event in the Atlantic Ocean

The simplicity of the Atlantic Ocean literally teases scientific minds to attempt a realignment of its coastlines. The Dutch geographer, Abraham Ortelius, has noted the matching shorelines of the Atlantic Ocean already in 1596. On the basis of fairly regular shorelines it is easy to see how the arc of northwest Africa must have come from the bight of North America, and how the knee of South America once occupied the Gulf of Guinea. Two regular Jurassic slivers of ocean floor are found exactly where they can be expected to be if the Atlantic Ocean experienced simple rifting and spreading. They run along both sides of the North Atlantic curve and indicate that gradual deep ocean-floor spreading had begun there by 150 million years ago.

The Atlantic Ocean has a clearly defined mid-ocean rift along which east-west expansion happens. Transform faults resulting from north-south expansion are distributed evenly along the ocean's entire length. During the Upper Cretaceous the Atlantic rift tore into Baffin Bay, west of Greenland. However, its main northern spread, east of Greenland, was opened later during the Paleocene. Iceland was extruded along that main North Atlantic rift, at a point of extra stress between Greenland and Europe. There the Atlantic mid-ocean ridge has erupted to appear above sea level. A triangular peninsula, Greenland, now splits the "fork" of the North Atlantic. If one ponders continental sepa-rations in relation to the deep-rifted oceans, then the so-called "continental shelves" must be counted with the continental crust. By that reckoning, Greenland appears not as a large island, but as a triangular peninsula, somewhat like India and Sinai.

Evidence of the Eocene tectonic event in the Atlantic is limited to two areas—Middle America and the toe of South America. The Panamanian Isthmus and the West Indies Ridge, both were pushed northeastward, and when that happened they passed on their impulse to the Atlantic ocean-floor. Their disfiguration suggests that during the Eocene some differential movement has occurred between the South- and North-American plates. **A patch of Paleocene ocean-floor has been pinched off in the Atlantic, above the Vema Fracture Zone, at latitudes corresponding to the West Indies bulge** (see chronological map, page 34). Even though the map makers have rounded out the primary Paleocene strip near the bulge, it is clear that a significant stretch of Paleocene ocean floor there has been pinched off from the regular Paleocene areas by a sudden onset of Eocene rifting. And this process of separation continued into the Oligocene. At that same event, it appears, the southern tip of the Jurassic curve (now east of Trinidad) was displaced eastward by about 20 degrees of longitude.

Beyond basic ocean floor chronology, recent JOIDES ocean floor drilling (ODP, Leg 165) has all across the Caribbean Sea found some surprising amounts of volcanic ash from the Eocene. ODP, Leg 171B, has in addition noticed an Eocene change of sea level. All across Middle America these anomalies fit into the time frame of the larger Eocene tectonic event that has been unfolding primarily in the Pacific-Antarctic and Indian oceans. Here along the Atlantic, the effects of that event are all related to the sudden northeasterly movement of South America. And that same general event which has caused the Panama Isthmus and the West Indies Ridge to bulge northeastward must also have nudged North America a little westward.

At the southern end of the Atlantic Ocean, at the place where Africa's Cape of Good Hope still was embedded during the Jurassic, a portion of the Lower Cretaceous floor has been forced eastward. I am inclined to blame this irregularity on two phases that belong to the aforementioned Eocene event. First there was the partition of the old Antarctic plate from the eastern Pacific that has nudged the southern portion of South America eastward. Then, during the second half of the Eocene tectonic event, the counter-clockwise turning Antarctic plate bumped its rear against the eastern portion along the cape of South America.

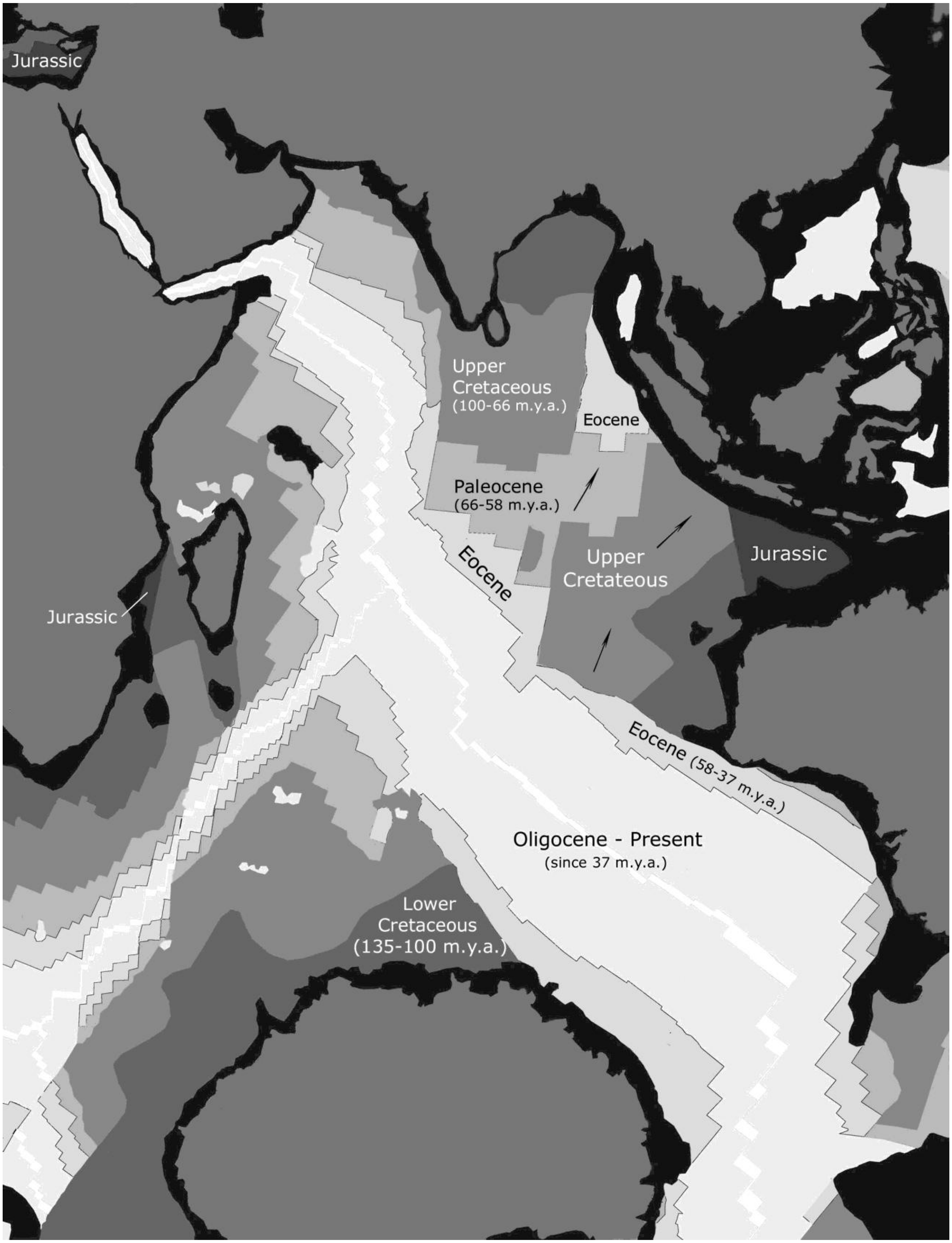
The initial severance had left both the South American cape and the Antarctic heel without any adjacent ocean floor crust that could have cushioned their impact on one another. In this manner Antarctica has dozed the Falkland Plateau, the Scotia Ridge, and the Sandwich and Orkney Islands into their state of fractured existence. And it has thereby obliterated the South American contour that once matched the Great Bight of Australia.

The narrowing trunk of South America was sliced southward by horizontal tension from both sides. Three huge continents had their "wedges" sliced in a sequence of decreasing width. In their own ways, all three of them are still trying to point homeward to the place where their mother, the Bight of Australia, used to be! They all tore away from the same continental unit with a final curve. Africa tore out a curve above the toe of South America. Since that severance, during the Lower Cretaceous, South America was stretched and elongated southward some more by the circum-Pacific and circum-global belt that still held together—into the Eocene. This amount of stretching, which increased the length of South America, now accounts for the difference that one finds in the match between its longer contour and the shorter one of Africa. Then, in preparation for the great Eocene tectonic event, already during the Paleocene, South America begun cutting its own "liberation curve" along the Great Bight of Australia. At the same time, while these two continents separated, Antarctica completed the severance of its pre-rifted tail from South America.

The Mediterranean Sea and the Black Sea must be mentioned in connection with the general worldwide stretching and slicing that happened in the Atlantic. **The eastern Mediterranean and the Black Sea were being pulled open together during the Jurassic, southward, while Africa still had a foothold on the overall circum-Pacific belt of continents, along the toe of South America.** When that toehold was lost, during the Lower Cretaceous, growth in these northern stretches of Eurasian-African "marginal seas" promptly ceased. **By contrast, the western Mediterranean Sea was pulled open northward.** This happened later, while Europe and Greenland were still pulling at each other, trying to help the Atlantic Ocean break into the Arctic Ocean.

In summary: Already in the beginning, when the round Pacific began to open, and when Antarctica still was being peeled out of the planet's virgin crust, the global pattern of tensions for the remaining crust was adjusting and changing. Some 150 million years ago the North Atlantic opened along a westward curve, like a **(** cutting southward. Eventually it ran southeastward and then reversed itself at a near right angle around the knee of South America. After that it sliced a more-or-less straight line southwest. So, while the Pacific gave birth to its legitimate circular continent with a tail, the Atlantic rift gave us a similar amount of curvature by way of reversing itself midway, to tear away Africa from South America. But by way of cutting the shape of a rather elongated S, the Atlantic has become overall the most linear among our oceans.

The elongated and modified S of the Atlantic Ocean suggests that natural laws involving global expansion, gravity, and tensile cohesion were interacting in the formation of this ocean—as they did interact to cut out the shape of a **9** for the Pacific. This happenstance also suggests that upon an expanding sphere a crust necessarily tends to tear along curves, as well as the possibility that curves may compromise by changing into opposite curves, angles, or straight lines. It is Earth expansion pressure, affecting overall the tensile pattern in the arched crust, that imposes a preference for tearing the crust along curves. It is the modification of the overall tensile pattern of the crust, by the very fact of tearing, which tends to change these curves into angles and straight lines while the tearing is under way.


Jurassic
Upper
Cretaceous
(100-66 m.y.a.)
Eocene
Paleocene
(66-58 m.y.a.)
Eocene
Upper
Cretateous
Jurassic
Jurassic
Eocene (58-37 m.y.a.)
Oligocene - Present
(since 37 m.y.a.)
Lower
Cretaceous
(135-100 m.y.a.)

6

Ocean Floor Chronology and the Eocene Tectonic Event in the Indian Ocean and Austral-Asia

After the Atlantic rift had found and established its path of rupture southward there remained, to the east, still a huge land-mass that needed to break open and adjust to the expanding and flattening surface of the sphere. So, another few tens of millions of years after the Atlantic had begun rifting, toward the end of the Jurassic, the upstart Indian Ocean tore into the remaining African/Eurasian/Austral-Asian super-continent along a line that on the present globe points due north. The initial rift followed more or less a straight line.

Our planet's culmination in regard to basic expansion geometry is the Ninety-east Ridge, the straightest natural line on our planet. First formed was the Pacific circle. Then followed a curve in the North Atlantic that, going southward, has added a near right angle at the knee of South America. All together it seems as though the veering and twisting Atlantic rift has more or less tried to remain linear—reacting to the circum-Pacific stretching that was happening the width of a continent farther west. And finally there came the straight line itself that cut the Indian Ocean. It could only happen while north-south tension pulled initial synclines and while east-west tension was in step with Earth expansion to spread the rift. The Great African Rift, and the line of tension illustrated on page 48, both run parallel to the rift that has created the Indian Ocean.

The age of the straight ocean-rift along the eastern coast of Africa was left in doubt for some time. The makers of the UNESCO Indian Ocean map forgot to indicate the Jurassic portion in the Mozambique Channel. However, the missing information could easily be retrieved near the edge of their Atlantic map. Meanwhile this gap of information has been filled by the 1996 NOAA-map titled "Age of the Ocean Floor." The Jurassic rift that ran along East Africa is indicated there clearly—almost as if with a vengeance.

During the Lower Cretaceous the island of Madagascar was still close to Africa. Then during the Upper Cretaceous this large island and its plateau have slid southward. For many years this solution has been disputed by established Earth scientists as well as by some that argued for Earth expansion. But today there remains no longer a need for doubt. The scar along which Madagascar has slid southward is now clearly visible on the new "World Satellite Map" that shows the topography of the ocean floors in remarkable detail.[33]

Chronological reconstruction of the eastern Indian Ocean still is a subject of considerable controversy. My own interpretation differs from solutions offered by other proponents of Earth Expansion theory. During the Lower Cretaceous the Ninety-east Ridge still was combined with the Chagos Laccadive Plateau. And together these scars in the ocean floor still indicate the original rift that severed Africa from Austral-Asia. The rift has divided in the north to outline the triangular shape of India. One branch opened up what nowadays is known as the Bay of Bengal, and the other

[33] "The World Satellite Map," NASA-Jet Propulsion Laboratory and National Geography Society, 1998.

branch veered northwest to separate India from Arabia and the Horn of Africa. The northwestern branch now has become the primary rift in the northern portion of the Indian Ocean. It is presently engaged in opening up the Red Sea.

The subcontinent of India never could have drifted across the ocean that now bears its name. This much becomes clear upon contemplating the Jurassic rift that has become the Indian Ocean. The fact that such a possibility is still taken seriously by the avant-garde of popular Plate Tectonics may forebode a whirlwind of controversy for this booklet. I happen to be convinced that India never was farther away from the continent of Asia than it is now—though, at one time it surely was much closer to Africa, Arabia, and Indochina than it is now. Moreover, I believe that India's crust only "appears" to be diving down under the Himalayas because that crust has suffered structural collapse under the weight of the rising and spreading diapir.

The global tensile forces that have torn the outline of India are the same that gave similar triangular shapes to Greenland in the North Atlantic and to the Sinai peninsula at the northern end of the Red Sea. If one considers land-masses in terms of their general cohesion—and not by the arbitrary criterion of sea levels where a few meters difference can classify land as sea—then Greenland is a peninsula of approximately the shape and size of India. While a small cut near Spitzbergen indicates that the Atlantic is making inroads on the Arctic Ocean, continental crust still surrounds the young Arctic Ocean everywhere else. In any case, all these triangular peninsulas were torn from the original Earth crust by the same force of above-average Earth expansion in the southern hemisphere. But there is, of course, some significant difference between India and Greenland in their relation to neighboring continental crust. Along Greenland's northern edge there is no large continent that could flange a mountain range comparable to the Himalayas. Nevertheless, it seems noteworthy that the two most linear-tending oceans, the Atlantic and Indian Ocean, both are aligned south and north and both have rifted a **V** figure at their northern end. Why did one or the other of these rifts not split its **V** upside down as a **Λ**, down south? The answer is clear from observations already given. What the Atlantic rift did to Greenland, what the Indian Ocean rift did to India, and what the Red Sea presently is doing to the Sinai peninsula, has been happening down south in reverse. "Down under" there was no huge continent left into which triangles could be cut. The preponderance of Earth expansion happened in the Southern Hemisphere, and the continental portions that remained there were wedges that pointed south—albeit pointing in the same direction as Greenland and India. They all were slicing their own wedges in the direction of the Australian Great Bight.

When the three great oceans—the **9**-shaped Pacific, the S-shaped Atlantic with a **V** up north, and the **I**-shaped Indian Ocean with a **V** up north—had been spread open, the narrow remainder of the original Earth crust, that encircled the globe, still held together until the Eocene. The continents that comprised the remaining belt are the ones that now line the Ring of Fire. They include the Americas and Asia all the way down to Australia which, until the Eocene, was still holding on to the tip of South America.

Many a creative vision appears to be rooted in childhood. And to that effect, four geographical features have impressed themselves foremost upon the mind of this writer when he was still a boy, back in a one-room village school, in Germany. These were the Dog of Scandinavia, the Boot of Italy, the swerving Tail of Antarctica that suggested motion at first sight, and the severely twisted shape of all of Austral-Asia. While the first two served the playful imagination about Platonic prototypes in geography, the other two awakened a primitive curiosity about our planet that appeared to be alive and in motion. I will now attempt to satisfy this youthful curiosity concerning the fourth of these geographical wonders.

The broad sequence of geological events, during the Eocene, has been outlined repeatedly in this treatise, in relation to the formation of the Pacific and the Atlantic oceans. The same events needed to be repeated to place specifics within the larger flow of things. Now we have arrived at the point where the shape of the Austral-Asian continental configuration itself is at issue. How did Austral-Asia get its twisted appearance?

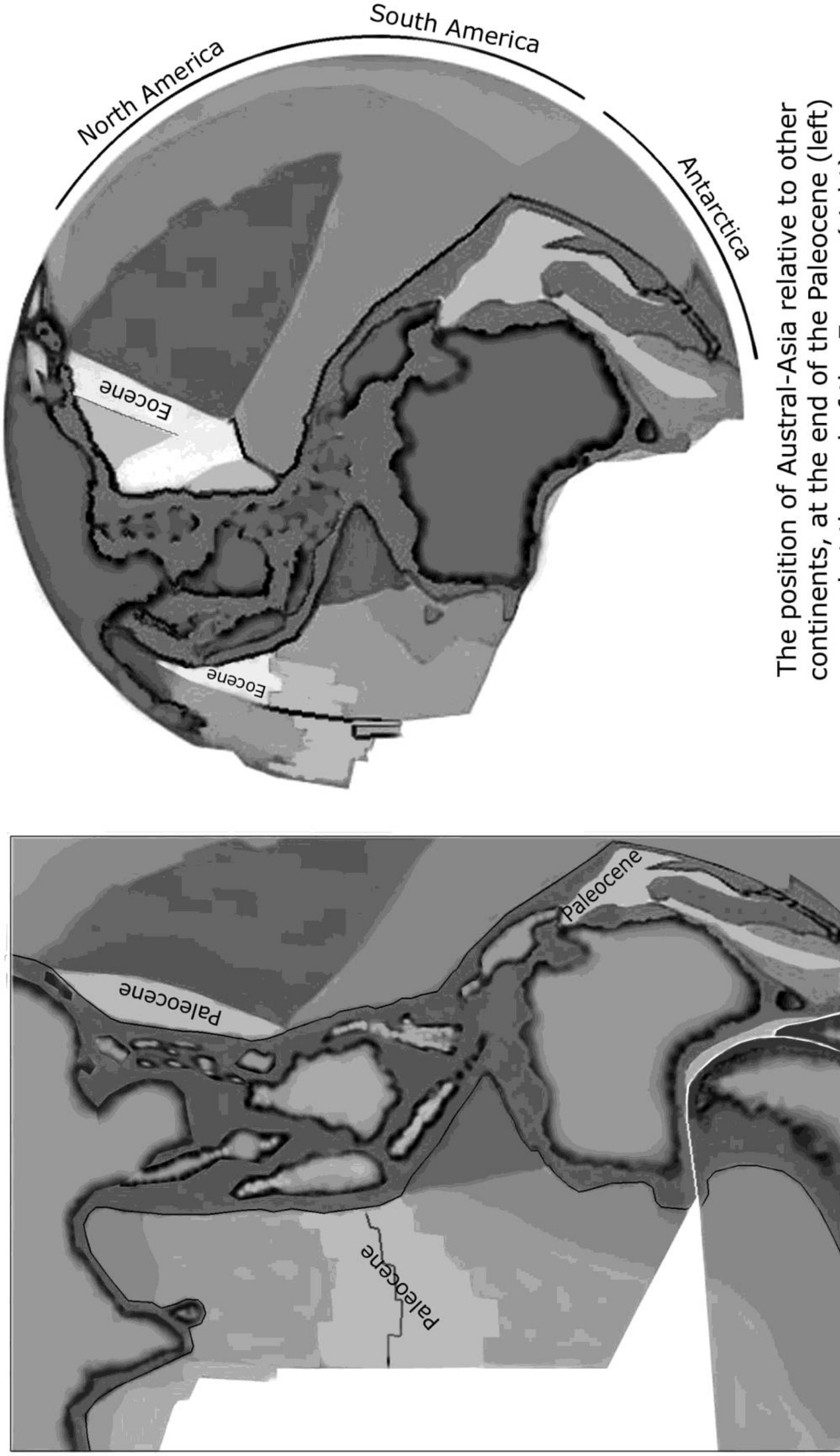
The Paleocene epoch saw the beginning of some rifting along the Great Bight of Australia. This advance stress during the Paleocene prepared the way for the breakaway that decisively changed the face of the Earth—namely, the severance of Australia from South America, a little later during the Eocene. During the Paleocene serious rifting occurred also between Australia and New Zealand.

The tensile pattern of Austral-Asia can be traced all the way from the stressed continental patches south of Tasmania and New Zealand northward into China, to the mountain ranges that run northerly along the eastern edge of the Tibetan Plateau. The same tension that has stretched Austral-Asia southward, to the tip of South America, also has begun to buckle the eastern Himalayas, and to some extent the Kunlun Mountains, southward and in alignment with the mountain ranges of Indochina.

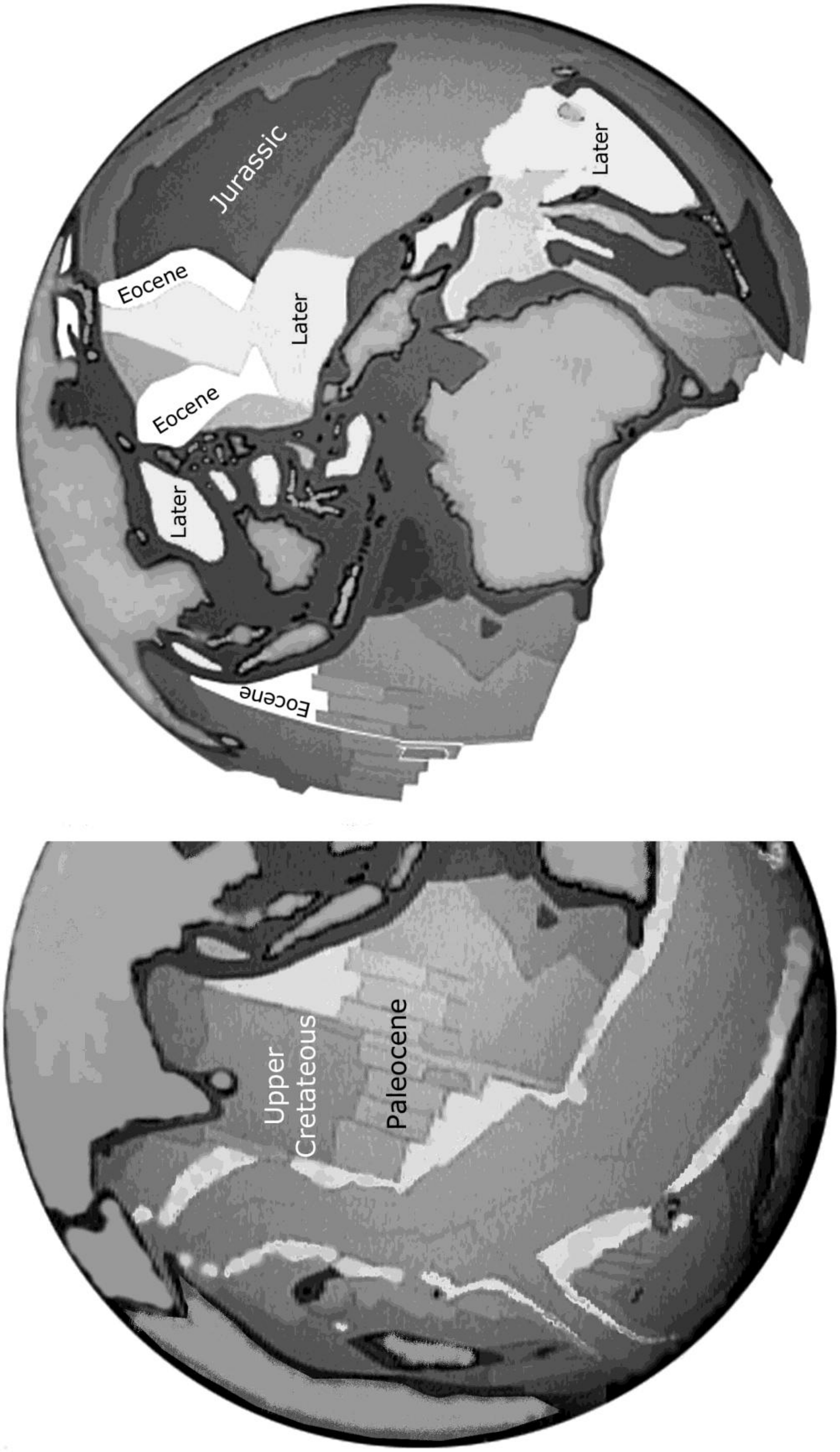
Two sets of ridges, overlaying each other on the ocean floor west of Sumatra, are visible on the NASA World Satellite Map.[34] One of these sets runs north and south, parallel to the Ninety-east Ridge, and the other set crosses the former in a northeasterly direction. **The lines that run parallel to the Ninety-east Ridge** I interpret as representing deeper cracks, or magma surge channels, that got established after the pattern of the first Jurassic rift. They were dominant throughout the Paleocene. The Ninety-east Ridge is by far the most obvious of these scars and marks the pre-Eocene western coastline of Austral-Asia.

The overlying ridges that run northeasterly indicate the direction in which ocean floors, that used to lie south of an east/west Paleocene rift, were moved by the Eocene tectonic event. This means that at the end of the Cretaceous the increasingly rounder Indian Ocean no longer could accommodate all-around Earth expansion stress parallel to its Jurassic linear rift. All the while, tension along the entire Austral-Asian and South American connection was increasing.

[34] "The World Satellite Map," NASA Jet Propulsion Laboratory, produced for the National Geographic Society, 1998.



The position of Austral-Asia relative to other continents, at the end of the Paleocene (left) and at the end of the Eocene (right)



Views of a present chronological globe, indicating the Eocene event along ocean floors

A latitudinal transform fault to the Jurassic-Cretaceous ridge, so it now appears in reconstruction, was pulled apart wide enough to become the dominant Paleocene spreading rift—and it, generally, ran east and west. It was this east-west rift which later, for the occasion of the great Eocene tectonic event, provided a soft edge along which the southern half of Paleocene crust could slide east and north. It happened while Australia broke loose from the tip of South America and while all of Austral-Asia was being pulled north and eastward. At that moment the new diagonal South Indian Rift—in fact, the entire diagonal spreading rift in the present Indian Ocean—replaced the Paleocene rift that had run east and west. H. W. Menard would have loved to hear that these Jurassic and Paleocene spreading-rifts had indeed been ephemeral.

All of Austral-Asia pulled north and veered east after it had snapped loose from the tip of South America. **The Paleocene and Upper Cretaceous ocean-floors from south of the Paleocene rift were pulled east and northward. They wedged themselves along the eastern flank of the northern portion that had remained aligned with India.** The southern portion slid east and northward quite naturally—following first the soft Paleocene spreading-rift eastward. Then it moved northward into the triangular space that had been torn open by the northeastward veering of Austral-Asia's continental crust. Fortunately, the mobile Paleocene floor from down south did not fill in and obliterate the entire crotch that had opened between the Ninety-east Ridge and the coastline of Sumatra. **A triangle of raw asthenosphere and lithosphere was left there to harden as dateable Eocene ocean-floor.** Before I can say more about this telltale Eocene triangle, I must tarry a while to support my interpretation with evidence from the larger picture.

Verification of this tectonic event can also be found along the eastern edge of the Austral-Asian unit. The fate of the spreading rift in the Philippine Sea verifies my interpretation of the event. The Paleocene rift there ran north and south and paralleled the general direction of Austral-Asia's stretching—that is, along the eastern flank of Austral-Asia it ran parallel to the Ninety-east Ridge in the Indian Ocean. This shows, on both sides, that during the Paleocene the connection between Australia and the tip of South America was still intact. When the Eocene tectonic event let all of Austral-Asia pull north and veer eastward, the direction of this spreading rift in the Philippine Sea was changed to match the diagonal direction that overall the spreading rift of the Indian Ocean had assumed. See the chronological maps on pages 42 and 43. The Sea opened, and the Mariana ridge got its double bent as a result of being squeezed form the south— "squeezed from the south" relatively speaking, while all of East Asia experienced circumferential slippage, westward.

The Paleocene and Upper Cretaceous portions in the Indian Ocean, that slid northeastward along with Australia, are bounded in the south by the Broken Ridge, which appears to have been pulled along by the movement of the entire area. This Broken Ridge represents the rear edge of an Upper Cretaceous piece of crust that got pulled northeastward by Australia when the latter departed from the tip of South America. The Cretaceous portions of ocean floor, west of Australia, were originally joined with similar portions in the southwestern Atlantic Ocean. **The Broken Ridge appears to have been a southward continuation of the Ninety-east Ridge, and Australia is the continent that had been stretching and thinning the entire assembly of Indonesian islands southward.** Stretched and elongated by global expansion, tension has initiated all the straight lines in the Indian Ocean that now still run longitudinally and have left traces as linear faults in the lithosphere.

The triangle of Eocene ocean-floor that lies between Sumatra and the upper one-third of the Ninety-east Ridge is crucial for interpreting the chronology of the Indian Ocean. The presence of this crotch of Eocene ocean floor—in relation to nearby Paleocene and Cretaceous floors, and in relation to the present contours of Austral-Asia—is evidence that the whole of Austral-Asia has indeed pulled northward and bent east during the Eocene.

Of course, such a massive displacement eastward required a prior vacuum toward which that continental crust could lean. In 1994 I wrote, "Australia was twisted north-eastward." At that time, before global seismic tomography showed us cross-sectional views, I was postulating dense stems of magma underneath all of the Earth's continents, that is, stems that are in process of being thinned and extended upward. I visualized them as being separated from each other by hotter magma that expands and fills the growing spaces between them. In light of the tomographic data, which is still incomplete, Australia and Antarctica now seem to have "twisted off" their stems at approximately 2000km depth.

The Eocene tectonic event in the Indian Ocean is dateable. "Leg 121" of the Ocean Drilling Program (ODP), which refers to a research voyage to the Indian Ocean by the drilling ship JOIDES Resolution, had as its objective to drill into the Ninety-east and Broken ridges. It set out to investigate "the evolution of the Kerguelen/Ninety-east hot spot and problems related to the rapid northward movement of the Indian Plate during the late Cretaceous and Tertiary."[35] The scientific reckoning, after having drilled into Broken Ridge, was as follows: the "results indicate >1,000m uplift in response to a Middle Eocene rifting event. The short duration of the rifting event (3-7.5 million years) and low present-day heat flow suggest a mechanical rather than a thermal mechanism for uplift."[36] A specified span of time, of 3 to 7,5 million years, during the middle of the Eocene, does get our attention. It matches our theory quite nicely.

Jonathan Dehn, a tephrochronologist who participated on that voyage, echoes the same conclusion to the effect that in the mid-Eocene "the Ninety-east Ridge and the Broken Ridge were separated from the Kerguelen Plateau and Hotspot for the formation of the South East Indian Rift."

In my own mind I put brackets of doubt around most explanations that link the aforementioned ridges to the Kerguelen Plateau—it is enough if for the time being these explanations are kept bundled together under "Leg 121." Nevertheless, the Eocene tectonic event in the northeastern Indian Ocean is corroborated by the ocean floor chronology of the aforementioned Eocene "crotch" between the Ninety-east Ridge and the coast of Sumatra. With Australia/New Zealand pulling north and veering east, the Eocene indeed was the time when something like the South East Indian Rift would have begun cutting into the Indian Ocean diagonally. The diagonal South East Indian Rift that has resulted, down south, was a necessary consequence of Australia's separation from the tip of South America.

Jonathan Dehn was able to date this mid-Eocene tectonic event, tephrochronologically, at 42.7 million years ago.[37]

Eureka! We can now see the finger of Chronos point directly at the moment in tectonic evolution when Sumatra was bent away eastward from the line of the Ninety-east Ridge. This event could only have happened after the viscous asthenospheric "rubber-band," that held the tip of South America to the Bight of Australia, had snapped. The rest is Austral-Asian and Pacific-Antarctic geological history.

In global perspective, it appears that a single process of Earth expansion has torn open our planet's crust and spread its oceans, with accelerated spreading happening in the south. This spreading has severed the Americas, Africa, and Austral-Asia like three petals of a flower that opens to the sun. This southern expansion has united the three regional oceans—the Pacific, Atlantic, and

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[35] There is a point of good news contained in this message. At least this particular science writer, and the scientists who participated in that expedition, saw problems with the Wegenerian theory of India's association with the fictitious Gondwanaland and its subsequent collision with South Asia. If sea-floor drilling is required to disprove this impossible notion, then by all means, let us drill!

[36] http://www.odp.tamu.edu/sciops/Leg_Summaries/Leg_121-140/Leg121.html

[37] web site: <http://www.aist.go.jp/GSJ/~jdehn/research/diss.htm>

Indian—into a single world ocean. Then from the open flower has come forth the round continent of Antarctica, to occupy the opening as if it were a visiting bumblebee.

Of course, I make no pretense of knowing where our planet received direct sun-rays during that time. Geologists and paleontologists (Prothero and others), noticing the onset of glaciation on Antarctica during the Oligocene, have concluded that the whole planet became colder then.[38] Their generalization for the entire Earth assumes that Antarctica has remained stationary and can therefore be used as a reliable thermometer for the whole planet. In light of my theory, however, the change in Antarctica's climate could have been the result of the continent's movement away from sunshine. But I hesitate to render a final opinion. Antarctica has been moving earlier than the alleged epoch of its cooling. I do not know whether the tilt of the planet's axis has, as a result of this shifting of continental mass, been changing as well.

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[38] Four essays on Eocene and Oligocene climatic events are published in Donald R. Prothero and William A. Berggren, *Eocene-Oligocene Climatic and Biotic Evolution,* pages 131-217. Princeton University Press, 1992.

7

Ocean-Floor Chronology of the Smaller Oceans and Seas

The Arctic Ocean is a relatively young basin that is developing at a far away and very inhospitable place of the planet. From the larger global perspective, which I have chosen for this treatise, this young ocean basin need not be introduced in great detail. So far the Arctic Ocean has not affected the total tectonic picture of the globe very much. However, the mid-Atlantic Rift has been cutting northward into this region recently, and this cut could possibly have slowed rifting in the western Mediterranean Sea.

During the Lower Cretaceous the Atlantic rift had opened all the way south. Then, for some time during the Upper Cretaceous, it resumed cutting northward between Greenland and North America, in the direction of Baffin Bay. This zone of weakness was anticipated by the first rift in the Arctic Ocean, up north, already during the Lower Cretaceous. However, a deep connection with the Baffin Bay rift never was made. The dominant direction of global tension must have changed over time. As a result, a rift east of Greenland expanded the Atlantic northward during the Paleocene and, presently, it is in the process of cutting through into the polar basin. But even after this break is completed—and in part because some day it will be completed—Asia and North America still remain well connected along the shallow Bering Strait. In any case, for the time being the Arctic Ocean basin represents an example of stretching between circum-Pacific continents, between North America and Eurasia.

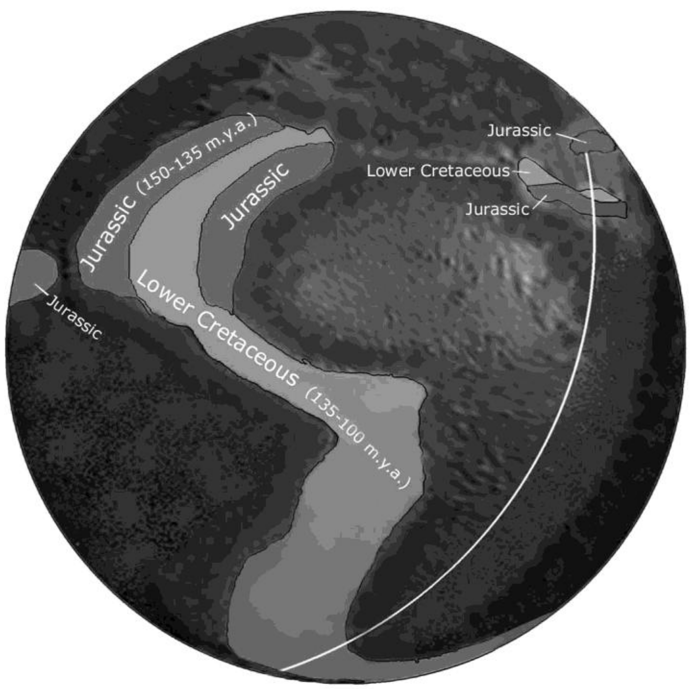
The Gulf of Mexico and the Caribbean Sea together are in the process of becoming another "ocean" like the Arctic Ocean, produced by intercontinental stretching. This inter-American ocean has only some narrow continental slivers available to keep it properly framed. The Gulf of Mexico opened up first, during the Jurassic, and then followed the Caribbean Sea during the Upper Cretaceous. More recently a rift has developed along the West Indies Ridge and another one is opening south of Cuba running east and west.

The eastern Mediterranean Sea and the Black Sea are intercontinental "marginal" seas that, together with the Gulf of Mexico, were torn open during the Jurassic. The creation of all three happened quite normally, in a proper context of worldwide circum-global tension. The eastern Mediterranean and Black seas, together, could be torn open because Africa at the time still had a foothold at the circum-Pacific and circum-global belt, down at the toe of South America. When that toehold broke, during the Lower Cretaceous, spreading in these northern small oceans practically ceased (see illustration page 48).

By contrast, the western Mediterranean Sea was pulled open northward, with Greenland pulling Europe away from Africa. This process may have slowed when the Atlantic Rift was able to cut into the Arctic Ocean. So, in accordance with all the chronological indicators, Europe and Africa never were farther apart from each other than they are now; though, formerly they were much closer. Prior to the Jurassic they both formed a continuous "continental" crust together with Asia, the Americas, and Austral-Asia. There never was a chance for Africa to collide with Europe, only a chance to rift and to break away.

Among the reasons for a JOIDES expedition, for doing deep-sea drilling in the western Mediterranean, was given the existing "paradox" of having "extensional basin formation and crustal stretching during the collision of the Eurasian and Africa plates." (ODP, Leg 161, Introduction to the Preliminary Report). I agree with the Preliminary Report, verbatim, that indeed this has "been a long-standing problem in Mediterranean tectonics." And I might add that it is bound to remain a problem so long as we keep doing Plate Tectonics with Wegener's vagabond paradigm.

What has happened when the Himalayas rose in southern Asia, when they weighed down upon India's crust, is what also happened with the Alps in southern Europe. The basement rock under southern Europe is the continent's own by virtue of its severance from Africa. It slants downward not because there has been a process of collision and underthrustment, but because structural collapse occurred under the rising mass and weight of the Alpine diapir. The mountains of southern Europe were not pushed up by a collision. Uplift along this continental periphery happened, as it happens elsewhere on the planet, by the continent's own flanging. Continental crusts adjust to the flattening mantle of an expanding sphere by tensile folding, flanging, and relative expansion flow. These phenomena will be explained in the next chapter.



The eastern Mediterranean and Black Sea, together, were pulled open during the Jurassic and Lower Cretaceous, when Africa was still anchored at the toe of South America. By a process of "tensile folding" that same tension initiated the mountain folds along the flank of eastern Africa, as well as the first Jurassic rift in the Indian Ocean. The western Mediterranean was pulled open northward, later.

8
How Continents got their Mountains

A treatise on Expansion Tectonics, based on ocean floor chronology, cannot be published without an explanation of mountain formation—that is, of mountain formation in the oceans as well as on land. Because much of ocean floor topography is still a heavily disputed subject matter, it would almost be suicidal of me to include a chapter on that topic without first defining my theoretical baseline along the better known topography on land. **The same forces that uplift mountains on continental crusts also uplift mountains on oceanic crusts.** The essential difference between the ocean-floor and continental crusts is their thickness and age-related composition—and, of course, there is the difference between the air and the water that define their respective upper environments.

From the spreading ridges, outward in either direction, the chronology and topography of the ocean floors are closely interrelated. Chronological epochs frequently have left some topographical boundary markers. Moreover, the evolutionary pattern that ocean floor chronology has revealed has overhauled our understanding of mountain formation on land as well—and for the better. **When the time is ripe, and when the patchwork of old paradigms no longer can hold back the flood of questions and doubts, it is time to pause and to rethink.** I have no illusions that my radical revision of basic assumptions in Earth science will find instant recognition, and neither do I fancy that the first time around I have gotten everything right. Decades, and more life spans than mine, will be required to make all of Earth science hang reasonably well together. So, for what it may be worth, I am adding here—gratis—an extra chapter on the formation of mountains on continents, so that afterward I can more easily explain topographical features in the oceans.

When in 1915 Alfred Wegener published his "continental drift" theory in *Die Entstehung der Kontinente und Ozeane*, and still in 1933 when Ott Christoph Hilgenberg published *Vom wachsenden Erdball* backed up by terrella models, our knowledge about the topography of our planet was still slanted in favor of land. Geological processes on land were perceived reasonably accurate. We had evidence of uplift and sinking, of over- and under-thrusting strata, of faulting, vaulting, volcanic eruptions, and more. Nevertheless, **the basic phenomenon that begs to be explained most, in the new context of improved oceanography, pertains to the great mountain ranges in the oceans as well as on land.** How are they uplifted, and how are they sustained? How can widespread uplift happen at a slow and even pace? Somehow I have a hypothetical apprehension—in the case that convection currents and ocean floor subduction were to be accepted as real—that our planet would have to be a much more chaotic place than it actually is.[39]

From seismic data we know that there are bulges of magma under the high mountain ranges, and this fact suggests that magma may, somehow, also be involved in their uplift. While to me the assumption that mountain ranges are raised by plate collision and underthrustment appears to be completely mistaken, a major problem of communication nevertheless remains. How can anyone hope to

[39] Chaos is a marketable product among people whose brains are wired like ours. Somebody other than I will probably take my "Eocene Tectonic Event," will speed it up and write an apocalyptic thriller. It is a pity that Tyrannicus Rex has already been disposed of by Alvarez's Paleocene meteorite. But someone will think of something that is terrible enough to sell books, and to make some people wonder about what it was that I wrote in 1999.

modify a basic instinct, such as the human partiality and daily need for lateral push? Perhaps a return to the playful logic of the theater might help break that ancient habit. The lead actor in the musical "Fiddler on the Roof," a milk peddler, at one point suddenly realizes that he does not necessarily have to pull his cart like a draft animal—he can just as easily push it.

Mountains do not necessarily have to be bulldozed up by horizontal collision, or heaved and floated up by angular underthrustment. The branch of science known as Plate Tectonics, today, is in need of discovering the opposite lesson of the milk peddler. The process of uplift can just as easily begin with being "pulled" into folds. Viscous semi-melt in the asthenosphere does cushion and augment the physical properties of a brittle lithosphere overhead and of an expanding mantle of magma underneath. It transforms lithosphere into more or less pliant "skin" that can take a measure of hot hydraulic pressure from underneath. All the while, gravity continually balances the topographic anomalies created by mantle expansion.

The problem of mechanism versus dynamism does haunt most of contemporary science. A typical critic demands that I identify my "mechanism" for Earth expansion. What he or she usually has in mind is "dynamism." So, let us reason together for a while. None of us understands the planet's physics well enough to know all the ingredients and transitional states that are possible in the continuum between potential energy and visible matter. Nor does anyone of us understand sufficiently the energy that causes variations in the apparently simple phenomenon of gravity. What precisely is the relationship between weight, mass, energy and gravity in the case of a "gravity anomaly"? Mathematical formulas provide shortcuts that help us, psychologically, to "get over" inconsistencies in the real physical world. Earth gravity varies across the globe. It appears to be higher in seismically active areas and it is much lower on our cold Moon. Variations in energy manifestation must have something to do with this. An increase in energy also can cause a decrease in density, as well as an increase in volume. Every cook knows that. But under how many different conditions such increases are possible in this universe, this we do not know.

Objections concerning the "mechanism" or "dynamism" for expansion do cut both ways. As many unknowns as do underlie expansion theory certainly also do underlie the popularly accepted tectonics theories. For instance, postulates about circular mantle convection— about processes that spin off, exude, and lift up mountain ranges along their upper boundaries— may be more inexplicable than are postulates about all-around mantle expansion. I am willing to consider any real empirical data, if I am shown such, because **any scientific theory, no matter how popular or revered, must at a moment's notice be collapsible down to its supporting data.**

As far as we can surmise from seismic and volcanic events, our cooler brittle continental crust and lithosphere (together ca. 140 km thick) float on hotter mantle materials. Between them and the mantle lies a zone of transition, the asthenosphere or upper mantle, that extends downward ca. 300 km from under the lithosphere, thus to a depth of about 440 kilometers. Its consistency varies from near liquid to tough viscosity. How does a brittle continental crust and lithosphere respond while floating on 300 kilometers of upper mantle semi-melt? At least a transitional zone in the upper mantle might be compared to a tough and viscous sheet of "taffy" that approaches the cohesion of a rubber tire. A whole range of fabrics and plastics can therefore provide us with suitable analogies.

An adequate vocabulary for discussing mountain formation does not yet exist. Language cannot simply be invented; it must grow by popular consensus. I therefore limit myself to adding only three descriptive markers to our vocabulary: **(1) tensile folding, (2) flanging, and (3) relative expansion flow. On hand of these labels I will begin to explain three interrelated aspects of the process of mountain formation.**

Tensile Folding is the first of three interrelated mechanisms of mountain formation that I would like to explain. Take a sheet of any fabric or plastic and stretch it evenly in the first dimension (lengthwise). A pattern of parallel folds will appear. This is the starter model for obtaining mountain ranges that run, by and large, parallel to each other along continental peripheries. **Tensile Folding does not by itself lift up the mountain ranges. It merely determines where along the weakened underside of synclines faulting and future intrusions of magma may occur.**

Similar to how it happens at the surface of the crust, where anticlines break along their crests to facilitate erosion by rain, so the vulnerability along the bottom of synclines is tectonically alike, only inverted in space. Faults and rifts do form along the underside of synclines, and these do invite intrusions of magma. To continue with this analogy—they invite a type of upside-down "erosion," of the kind that is normal in the dense environment of magma underneath.

As far as the process of tensile folding is concerned, circum-Pacific tension has initiated the high mountain ranges that run along the western flank of the Americas. Similar north-south tension has begun folding those that extend between Ethiopia and the Cape of Good Hope, in Africa. Tension has started the mountain ranges of Eurasia which, by and large, stretch east and west between the Himalayas and the Pyrenees, also those which run north-easterly from Indo-China to eastern Siberia.

Where there is enough tension to accomplish tensile folding there are bound to be places where continental crust is being stretched thin, even to the point of submersion or breaking. The same circum-Pacific tension, that has initiated the parallel folds of the Rocky Mountains and Andes, has pulled apart the continental crust along Middle America. At the northern edge of the Pacific, between North America and Asia, the polar region is being stretched likewise. Austral-Asia has been elongated in similar fashion, until it finally snapped away from the tip of South America. Much of the elongation in the crust and lithosphere appears to be irreversible.

Let me also point to the east-west tension between Indochina and Gibraltar. Along this stretch the Earth shell was not sheared quite as clean as it happened along the Pacific Rim, nor to this day has it been completed. Africa remains attached to Eurasia along the halfhearted Mediterranean spread. Ever since Africa has lost its foothold at the toe of South America, some time during the Lower Cretaceous, no anchorage has remained for that southern continent to pull away still farther from Eurasia.

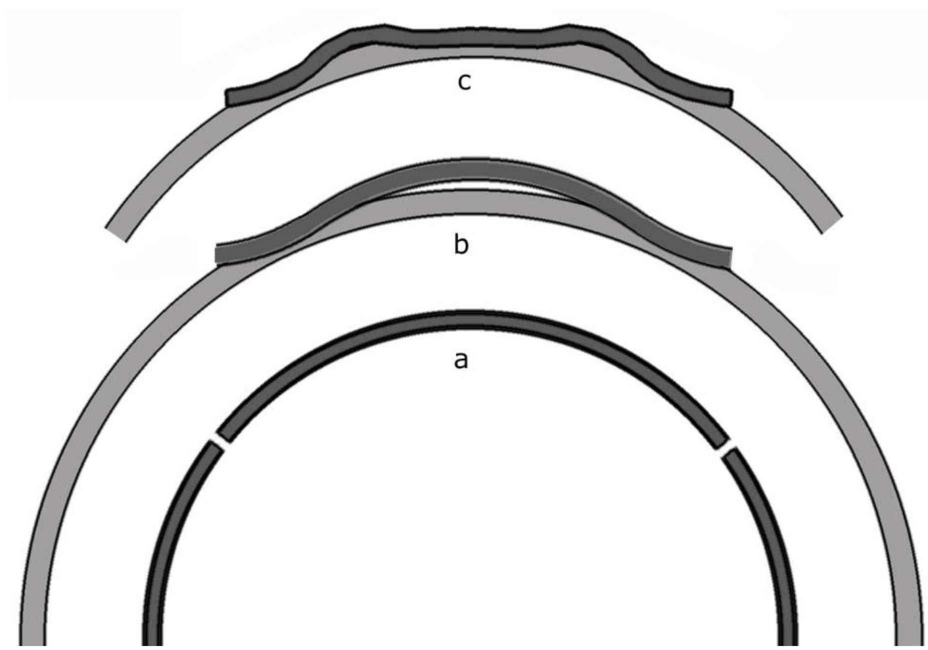
The southern coastline of Asia is made complicated on account of three peninsulas or sub-continental flaps. These were torn apart as a result of east-west tension (here as elsewhere in this book, directions pertain to the present globe). The tension that tore these continental flaps has sent South Asia's "tensile folding" further inland (see illustration page 54). Of course tensile folding, by itself, does not accomplish all there is to mountain formation. It accounts only for relatively low folds and initial cracks along the undersides of synclines. Massive magma intrusions, and general uplift, require another process or mechanism, which I will discuss next.

Flanging is the second interrelated mechanism in mountain formation that I like to explain. The intrusion of magma into faults and rifts from underneath, and the uplift of mountain ranges, must utilize a force that can interplay with the gravity of the planet. That utilization mechanism is best understood as another concomitance of Earth expansion, and I call it "flanging." The actual uplift of mountain ranges does happen hydraulically, and it is a rather simple process.

A continent is a fragment of the original and smaller Earth shell, and flanging happens whenever a segment of continental crust finds itself situated on an expanding sphere, thus upon a flattening substratum. While the sphere expands, the original curvature of the continent fits less and less on the decreasing curvature of the substratum. Magma support underneath the domed middle of a continental crust continually decreases and, in response, the original curvature is destined to crack and to sag.

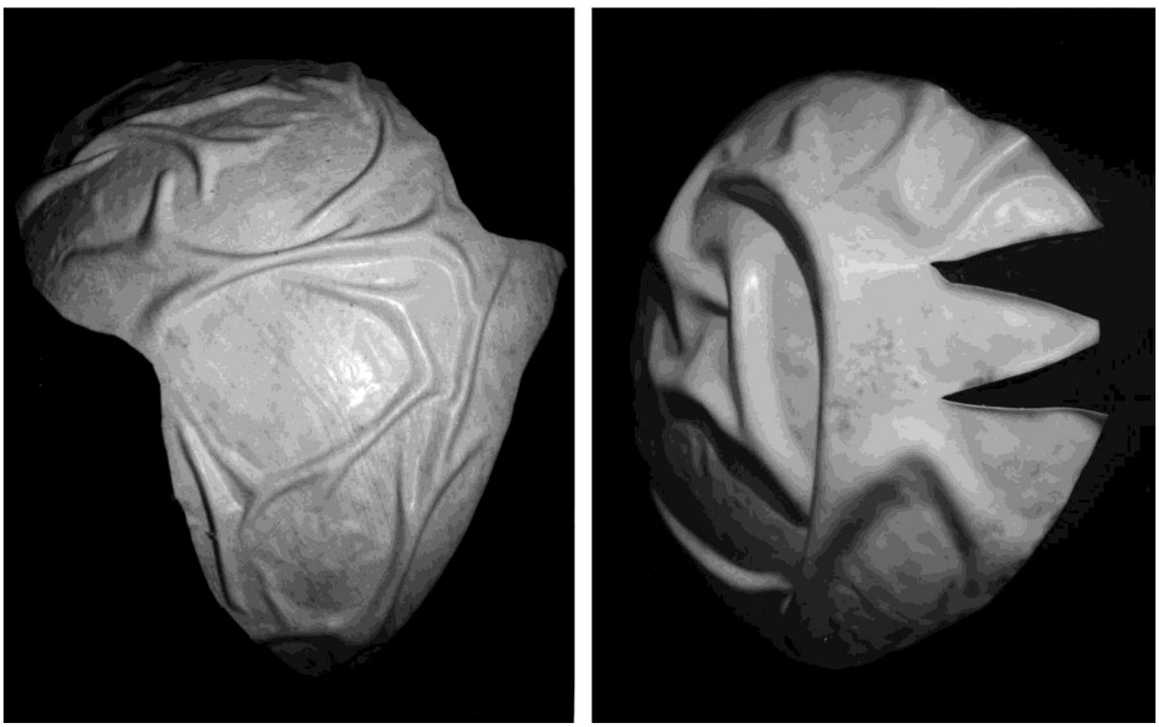
The still more convex continental crust, overhead, slowly sinks at its center and disposes of excess surface crust in essentially two ways. First, in the middle of a continent the results of crustal compression may range from simple buckling to severe over- and under-thrusting of the strata. This means that within a contained and flattening area, sections and layers of the brittle crust are being pushed over, under, or into each other. **And second,** the slouching vertical weight of the collapsing continental dome causes horizontal slippage and bulging, outward from the center toward the continent's perimeter. Riding upon magma bulges that accumulate underneath, some of the surface crust is compressed here and stretched there by the undulations of these bulges—or flanges—as they travel toward the continent's periphery.

As the acute dome of a continent settles in the middle and flanges itself outward, it adjusts somewhat unevenly to the flattening substratum produced by the expanding sphere. Surplus magma and lower strata of the lithosphere are being weighed down into the asthenosphere where magma slowly is being squeezed outward. As magma oozes toward the continental periphery under constant "hydraulic pressure," from the sagging middle of the continent, it uplifts and swells the lithosphere as it moves. Magma is being squeezed into every crack and crevice of the lithosphere and crust from underneath. As a continental unit ages, more and more magma will have traveled toward its periphery and the greater the swells and bulges overhead will tend to be. Bulges (anticlines) and depressions (synclines) will alternate. Such is the process that has been uplifting our planet's high plains, plateaus, and mountain ranges.



A dome-shaped continental fragment (a), preserving a measure of cohesion, settles upon the expanding and flattening mantle (c). To the extent that the periphery holds, the dome-shaped crust will weigh it into the mantle in the form of a flange (b). Along younger continental edges, such as the western coast of North America, the flange may still be visible at the surface in form of a wide syncline or valley. The combined San Joaquin and Sacramento valleys, in California, are an example. The Willamette valley continues the same syncline somewhat less obviously into Oregon. However, in Alaska, where the continent is narrower, a coherent wide syncline is absent along the southern coast. The consequences of this will be explained a little later in relation to the Alaskan 1964 earthquake. **Wherever the process of flanging does tear the periphery of a continental crust, as has happened along the subcontinent of India, there the major synclines and magma bulges are constrained to accumulate farther inland.** This has happened in the case of the Himalayas (see illustration page 54).

As a result of slow Earth expansion, and mantle flattening, magmas under North America are slowly being squeezed westward while the Great Plains and the Canadian Shield are continually sinking. This does not mean that uplift in the North American Rocky Mountains has always been a gradual and peaceful process. There are places where pressure has been building up for a time, and there were periods of seismic release. Numerous volcanic fields and lava flows in these mountains attest to the fact that the cooling of magma, the fortification of the crust and lithosphere, has not always kept pace with the amount of fresh magma pressure that arrived from the continent's interior.



Balloon models of Africa and Southern Asia, illustrating the availability of magma for mountain uplift upon an expanding substratum. The triangular flap, resembling India, naturally sends the major continental flange and magma bulges inland.

The largest of North America's western lava flows was perhaps the one that happened 17 million years ago and covered much of Idaho, Oregon, and the state of Washington. I am keenly aware of this substratum because I am writing these words while sitting upon it. A row of volcanoes has erupted atop the Cascades bulge that has since accumulated under the crusted lava flows. Uplift of this bulge could begin as soon as the lava flows had cooled enough to constrain the increasing hydraulic pressure from underneath. The Cascade volcanoes act as tiny safety valves for this western bulge of North America's western mountains. Of course, they are no permanent solutions for the immense bladders of magma that keep accumulating as far east as the high plains of eastern New Mexico and Colorado, Wyoming, and Montana. The process is ongoing. The Black Hills in South Dakota and the Ozarks in Missouri and Arkansas represent geological domes— bubbles of magma that rose and hardened. The lithosphere and crust together were unable to weigh them down into the asthenosphere and to squeeze them westward under the Rocky Mountains. But these remnant domes are exceptions; and exceptions help delineate the existence of a rule.

To the extent that a continental perimeter holds, slippage from the settling continental dome does add undulations and bulges along the way. Where the cohesive strength of the continent's perimeter is less than the increase in flanging pressure, there the shorelines will stretch, or tear and slip. The outlines of Arabia and India are products of such tearing. But please observe on a topographical map how the land areas of Arabia and India were large enough to flange their own coastal mountain ranges—as a result of Earth-flattening that happened under the interiors of these peninsulas.

The counterparts to our planet's peripheral mountain ranges are central saucer-shaped depressions. Some call them "cratons." Prime examples of continental depressions with flanged mountainous edges are the Canadian Shield, the Amazon Basin, the Congo Basin, the Northern European Plain, the Siberian Plateau, and the adjoining Takla Makan and Gobi deserts. Accordingly, the Ural Mountains constitute a line where the flanging efforts of two sagging continental saucers have run up against one another, and both have compromised their preferred curved flanges in a standoff. They have agreed to flange the Ural Mountains as a straight and rigid boundary line. Dish-shaped depressions of this sort, surrounded by mountainous rims, characterize all continents on our planet. They are, in fact, collapsing continental domes in the process of flanging and adjusting to the flattening Earth curvature.

The two largest earthquakes in North American history throw light on the process of continental flanging.

Great earthquakes have occurred over several months in 1811 and 1812, along the New Madrid Fault, in Missouri. They have raised and tilted the land, enough to cause the Mississippi flow backward to the city of Saint Louis for a time, a distance of about 150 kilometers. Such effects permit us to infer that some serious over- and under-thrusting of strata has been happening beneath the surface. The fact that this fault system is situated in the middle of the otherwise tranquil Great Plains is in full agreement with the presuppositions of Expansion Tectonics. The crust of every large continent suffers periodic collapse at the middle, and this happens because the curvature of the crust adjusts to the flattening mantle of an expanding Earth. And because this particular seismic event happened at the middle of a continental saucer, the over- and under-thrusting of strata was constrained and contained in an inland region. No continental edge needed to tear or slip outward onto adjacent ocean floor.

The 1964 earthquake in Alaska was different, as it has modified that state's entire southern coast. George Plafker has studied this event.[40] He carefully surveyed the surface dimensions that resulted from the earthquake. He found that the continental crust was uplifted several meters along the oceanfront. Had he been a blind believer in ocean-floor subduction, he could have stopped his investigation right there. But fortunately he turned in the right direction and began to re-survey some

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[40] George Plafker. Henry C. Berg, editor. *The Geology of Alaska* (The Geology of North America, Vol. G-1). Geological Society of America, 1994.

benchmarks on the continent itself. He found that the crust of Alaska had collapsed and spread outward and that, therefore, its edge had slipped up over the adjacent ocean floor. From previous sea-level platforms, along the shore, he could infer that such quakes had been repeating themselves on average about every 800 years.

While this discovery is immensely interesting, Plafker's theory appears to be even more so, especially for the epistemology of science. Based on some type of a steady-Earth paradigm he theorized that during intervals between earthquakes the continental crust, endowed with an elastic capacity, somehow springs back up to its former state. So, eight centuries later it can collapse again to raise the coastline another few meters.

Of elasticity there may be some. But most probably there was no elastic arching back of the land after past Alaskan earthquakes—other than normal movement caused by Earth expansion and flanging. The primary mechanism for the regularity of these quakes is gradual Earth expansion—is the slow flattening of the mantle curvature that underlies the continental crust. The Alaskan crust behaved very much like the crust did along the Mississippi River—with one important difference. In Missouri the continental "dome" sagged to cause over- and under-thrusting within a compressed inland region. The continental "dome" was constrained from spreading by the surrounding rim of a saucer.

In the preceding explanation of the process of continental flanging I have repeatedly used the qualifier "to the extent that the perimeter holds." In the case of the periodic southern Alaskan earthquakes the continental edge obviously had slipped. And as has happened everywhere along the Ring of Fire, magma underneath Alaska has been quickened while the Pacific Ocean has been widening. Continental rims there have repeatedly been cracked and jarred by tectonic adjustments.

Relative Expansion Flow is the third mechanism of mountain formation that I like to explain. Thus, our third perspective on the unified process of mountain building concerns mostly what happens in the asthenosphere of semi-melt magma, beneath the lithosphere. Let us suppose, for the sake of visualizing this mechanism, that a continental lithosphere and crust had zero cohesion. To the extent that they disintegrate and flow wherever the expanding mantle carries them, no Relative Expansion Flow would be present underneath.

As a result of Earth expansion and surface flattening, and as a result of continental cohesion, some excess mantle magma slowly must ooze outward from underneath the continental crust and lithosphere that sag overhead. The flow that concerns us here exists only relative to the undersides of continental saucers or, as in the next chapter, relative to the undersides of tectonic plates which grow ocean floor outward along their peripheries. So, one might say that at the exact middle of a flattening continental saucer—or a tectonic plate—there is no relative expansion flow. Magma at the middle merely is weighed down into the asthenosphere. However, horizontal pressure and flow begin at this midpoint and increase outward in all directions. Down in the asthenosphere, the further one moves outward under the continent, the quicker will be the movement of relative expansion flow. While magma creeps outward it agitates, intrudes, and bulges the lithosphere that rests overhead.

All movement upon and within an expanding sphere is relative. Movement which from the perspective of the asthenosphere, looking up at a continental crust, would be expansion flow can be seen as "slippage" from the perspective of the crust overhead. In my earlier discussion of the East Asian "marginal seas" I have, for a while, switched perspective from the asthenosphere to the Asian continental crust, and have explained relative expansion flow superficially as "circumferential slippage." In either case, new ocean floor is being created by magma that previously has been located— however deep— underneath the periphery of a continent or under its growing tectonic plate.

But please note that **"relative expansion flow" and continental "slippage" are the antithesis to the theory of ocean floor subduction and circular convection currents in the mantle.** While some magma from the mantle inevitably will bulge up into the lithosphere and crust, by hydraulic balancing, and will cause uplift as a result of crustal adjustments overhead, no convection currents in the mantle are hereby implied. In general—though there are occasional and small exceptions—the slippage of a continental crust, or of a growing plate, involves relative movement away from the spreading ridges along which new ocean floor is being created.

What happens at the surface of continental peripheries is interrelated with what happens beneath them. Earlier I have identified "tensile folding" as the process that initiates the directionality of peripheral synclines. After that I have added "flanging" and "relative expansion flow." By taking all of these concepts together it is possible to explain how coastal synclines behave geologically.

Synclines are down-folds of the "flanges" that are being created by the process I call "flanging." The crust of a syncline tends to crack open along its underside, parallel to the fold. As these cracks widen they are being filled continually by intruding magma. To the extent that magma intrusions have time to cool and to harden, cracks along the underside are being mended. Moreover, to the extent that the coastline remains strong and coherent, and as long as it withstands the magma pressures that come from the continent's interior, **the syncline with all its igneous intrusions will eventually be uplifted—hydraulically.** During and after uplift, surface erosion will wear away the mold and unveil the cores of jagged ridges and peaks. Everyone who has driven west to California, across the Great Basin, has traveled across a number of these youthful Alpine ridges—long uphill and downhill slopes, from one to another. Having driven across this geology several times, and having kept boredom at bay by wondering about its formation, the process could easily be visualized by having recourse to the paradigm of an expanding Earth. The Sierra Nevada and Cascade mountain ranges, that rise between the Great Basin and the outer syncline—the San Joaquin, Sacramento and Willamette valleys— represent the outermost of the large magma bulges that are being squeezed westward by the flattening interior of the North American continent.

Farther inland, along the southern boundary of Utah, another related phenomenon delights the traveler. Segments of continental crust have been grabbed along fault lines, at their bottom edges, by the slow magma current of relative expansion flow. Their bottoms have been carried ocean-ward while mesa tops, overhead, were being slanted inland.

So the bottoms of synclines are being massaged by relative expansion flow—to some extent even re-melted. Magmas are being squeezed into every fold and fissure, from underneath, regardless of whether these folds and fissures are conceptualized as results of tensile folding or flanging. All weaknesses and alterations along the underside of a syncline are thereby the result of a single combined process of global expansion. Some fissures are large enough to create severe slippage and earthquakes. Others are jarred open still more to invite volcanic eruptions. Cracks that widen still more invite major surges of magma, that mold Alpine peaks for uplift and for the spreading of immense diapirs.

The aforementioned lava flow in Idaho, Oregon, and Washington, west of the Rocky Mountains in North America, has its counterpart in the considerably older Deccan Traps of India. In each case I suspect that a major bulge of continental magma has broken during earlier stages of hydraulic uplift. Whether these have been the last such leaks, or whether more can be expected in the future, depends on the cooling and holding capacity of the great mountain ranges which, in effect, are poised to contain bladders of magma underneath them. It is the very structure and weight of the mountain ranges that keeps these bladders of magma contained.

As the Himalayas are being uplifted by magma pressure originating in Siberia, by gravitational balancing and hydraulics, they gain height as well as weight. A mountain range therefore tends to spread outward over the original crust, sideways, and its spreading is driven by increase in height and weight at the center of the diapir. **The overlap along the edge of the primary crust weighs and tilts the entire crust and lithosphere downward.** This structural collapse is what gave some Earth scientists the idea that India must be diving underneath the Himalayas in order to uplift that still rising mountain range. Exactly the opposite is happening. It is the mountain range itself that tilts down the northern edge of India. **An obvious implication of such structural collapse is the fact that the inclined crust and lithosphere is being weighed down to protrude deeper into the upper mantle and there to form a kind of barrier to relative expansion flow. This barrier, in turn, diverts more of the magma flow upward to convey more hydraulic pressure, for uplift.** All the while, the flattening Siberian Plateau continues to squeeze more magma in the direction of Asia's southern and eastern mountain ranges.

If continents had been created to float upon magma completely independent of each other, then the excessive magma would have been creeping outward from their interiors in even concentric rings of bulges—that is, in bulges that would flange and uplift mountain ranges evenly along the continental perimeter. But, of course, this is not how things have come about among most of our continents. Continents have broken away from each other gradually and in irregular increments. **The quickening of magma flow underneath some continental peripheries, during certain geological episodes, accounts for differential speeds in the process of mountain building.** With the exception of Antarctica, none of the continents has so far achieved complete freedom from continental neighborhood stresses.

Most continents have had time to stabilize some of their older edges, together with their affiliated mountain ranges. For example, the Atlantic rift had been quickening the eastern edge of North America some 100 million years before the Eocene upheaval in the Pacific agitated the western boundary. The breaking away of the Antarctic plate from along the west of the Americas, during the Eocene, has stretched the western coastline. Concerning the rim of Asia I have already accounted for the Eocene event in terms of "circumferential slippage." In any case, underneath the entire western one-third, of both North and South America, the Eocene tectonic event has agitated the lithosphere and asthenosphere. For this reason, magmas from the collapsing North American continental dome still flow and bulge predominantly westward. This fact accounts for the differential rising of the Appalachian and the Rocky Mountains now.

Likewise, the asthenospheric substratum under the Himalayas has been agitated when India was torn away from Indo-China in the east and from the Arabic Peninsula in the west. Moreover, quickening of the substratum along the entire eastern flank of Asia has happened during the "Eocene tectonic event" when all of Austral-Asia leaned northeastward and when all the marginal seas of eastern Asia were being spread open. The immense continental dome of Asia, as it settles and adjusts to the flattening substratum, squeezes therefore most of its excess magma south- and eastward—southward to uplift the Himalayas and eastward to respond to the agitation caused by Pacific circumferential slippage.

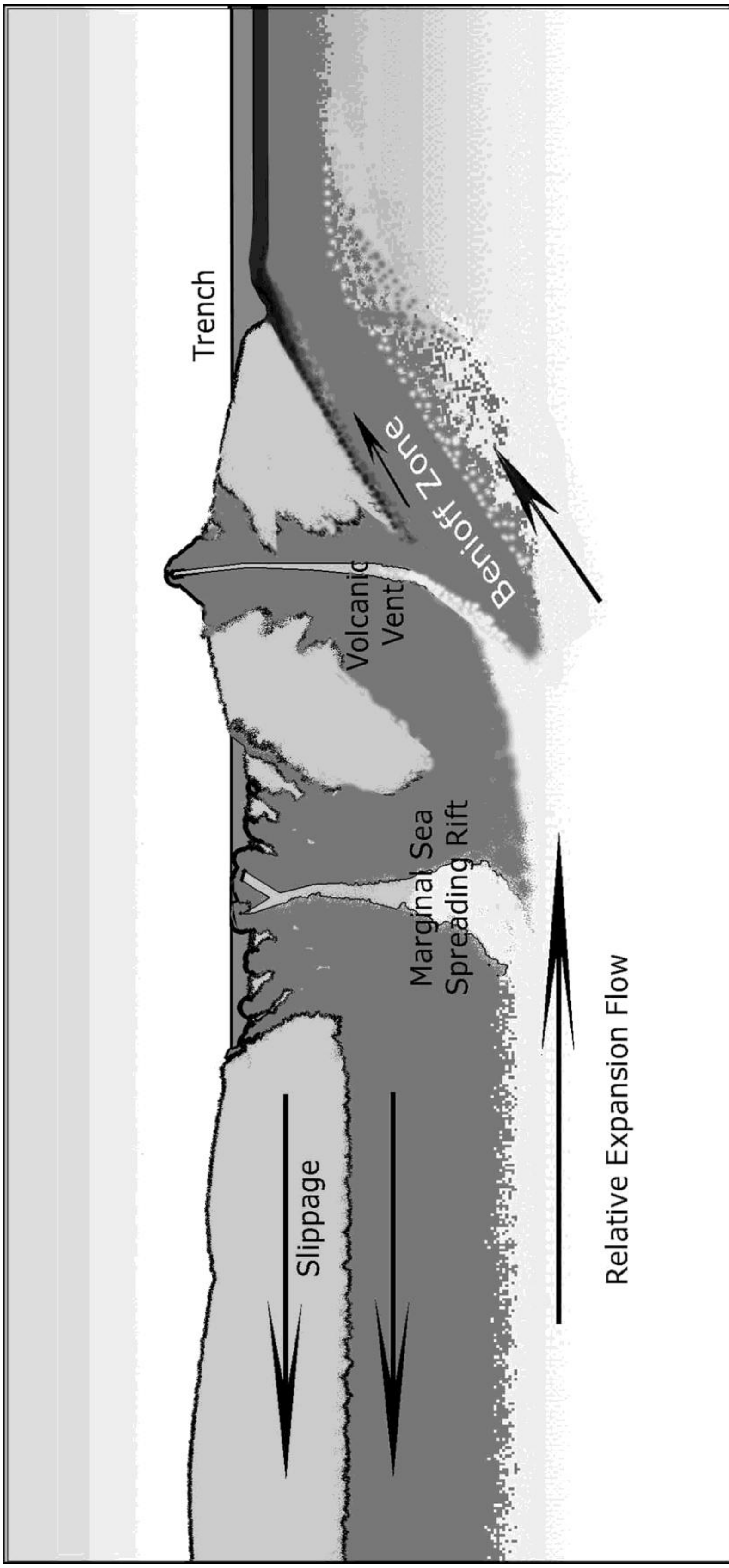
Similar quickening of magma is happening under southern Europe, initiated by the continent's severance from Africa. It accounts for the rising of the Alps. The northern European Plain and its adjacent shallow seas are settling and adjusting to the expanding and flattening mantle, they are squeezing magma toward the Alps and Carpathians in the south as well as northward to the Scandinavian rim. A portion undoubtedly also is being sent eastward into the Ural Mountains for boundary maintenance with the Siberian Plateau.

The size of a continental mountain range is determined by the amount of magma that is available for flanging. Materially speaking, the massive uplift of mountain ranges has been accomplished by massive infusion of magma from steadily collapsing continental domes. To accomplish general uplift, the magma, under pressure from sagging continental crust and lithosphere, works underneath mountain ranges like a thick hydraulic fluid. The larger a continent, the greater has been the supply of magma for causing uplift. This is why the highest mountain range on Earth is found on the largest continent.

Some meteorite hypothesis of the Eocene event is surely going to be proposed— according to contemporary fashion—if not to eliminate a species, then perhaps to introduce a trigger to release the tension that gradually had been building up by the process of Earth expansion. Such speculation is still premature. Some day, when all the dates of the great Eocene tectonic event have been reexamined and when they are securely established, worldwide, then the time will have come to consider extra-terrestrial candidates that might have functioned as triggers. Though, there is no real reason why expansion pressure from within could not have accomplished the final break by itself. An answer to this question lies perhaps decades in the future and I, personally, do not expect to see it.

The Chicxulub meteorite impact has been dated at the Cretaceous/Paleocene boundary at 65 million years ago, plus-or-minus 0.5 million. So far it has only very loosely, and probably wrongly, been associated with the demise of the dinosaurs.[41] This over-celebrated meteorite impact must eventually be harmonized with Paleocene events that are indicated by the new ocean floor chronology. Most of the excessive Paleocene rifting, so far, appears to have happened in the mid-Pacific and along some ocean floors surrounding Austral-Asia. Apparently it reflects the strains that had been building up for the great Eocene slippage to occur.

[41] The idea was first published by Luis W. Alvarez in 1980 (in *Science*). See also Walter Alvarez, *T. Rex and the Crater of Doom.* Princeton, N.J., 1997.



What "relative expansion flow" is from the perspective of magma, underneath, is "slippage" for the continents overhead. Benioff Zones are "erosion" adjustments along the bottom edges of continental rims. Marginal Seas are baby oceans; they begin rifting in the same manner as the great oceans did, and in the same manner they also grow. The deep ocean trenches are tensile features, jarred by relative expansion flow.

9
How Oceans got their Mountains and Deep Trenches

Tensile folding, flanging, and relative expansion flow happen in oceans as much as they happen on land—except that the oceanic crust is thinner and more vulnerable. H. W. Menard appears to have been correct when he concluded early on that the spreading ridges that he surveyed in the eastern Pacific were ephemeral. They do obtain their elevation and bulges relative to the strength and thickness of the crust—factors that are primarily a function of age and cooling. Segments of ocean floor crust, like segments of continental crust, collapse at their middles as a direct result of Earth expansion and curvature flattening. They weigh and squeeze magma down into the asthenosphere and concurrently sideways in the direction of their weakest and most agitated edges. In the case of the ocean crusts these agitated edges happen to be mostly along the spreading ridges and their still young and vulnerable flanks.

The typical Pacific mid-ocean ridge constitutes a slow rise from either side over hundreds of kilometers, culminating here and there in a mountain-studded crest. This is so because relative expansion flow is arriving from under the adjoining ocean "plates" at either side. A number of transform faults, along a spreading ridge, demonstrate that segments of the ridge can shift to one side or another to find a state of equilibrium for the entire length. Not only are the spreading ridges of Menard ephemeral, it follows that the shapes of the tectonic plates, defined by ridges and rifts, must be temporary as well. To the extent that ocean floors are spreading along ridges and rifts—however unevenly—the tectonic plates are growing.

Mid-ocean spreading ridges and rifts are the most conspicuous features in the deep oceans. The process of ocean floor spreading is concealed under the spreading ridges but it gapes open along some kind of a "linear volcano," the so-called "spreading rift." As regular smaller volcanoes do develop circular craters, so the spreading ridges represent hot rifts beneath their centerlines. **Together the active spreading rifts, and the less obvious spreading ridges, comprise a continuous earth-encircling system along which ocean floor spreading happens worldwide.** Their discovery during the mid-1950s, as an active boundary that outlines the planet's great tectonic plates, has brought together the different oceans to be perceived henceforth as a single world ocean.

The Atlantic Ocean provides the best example of a mid-ocean spreading rift. It is a linear rift that has been widened while Africa and Europe were severed from the Americas. The width of the Atlantic Ocean represents the scar of a single wound, a crack that during a process of its own slicing has continually mended itself with magma that welled up from the mantle. The width of the scar has grown to the magnitude of the ocean. The Atlantic mid-ocean rift has been able to accomplish this feat of spreading without interruption, and all by itself, because in contrast to the more circular Pacific and Indian oceans, the Atlantic Ocean has remained essentially linear and true to its original somewhat linear rift.

Transform faults are breaks that occur at regular intervals, and generally at regular angles, along a mid-ocean spreading ridge or rift. They are strike-slip faults with offset ridges. Some science writers have exaggerated the shearing activity of transform faults into an immense process by which the large tectonic plates, themselves, are shearing and grinding past each other. Transform faulting, for the most part, need not be understood as such a globally extensive and chaotic process at all. The strike-slip faults, which at certain intervals intersect with spreading ridges or rifts, do offset the latter for a rather obvious reason. This reason becomes apparent in the context of solving the larger Earth expansion puzzle.

Let us consider the Atlantic rift, inasmuch as it is the most simple to observe. For 150 million years it has been opening a more-or-less linear gap between two Old World and two New World continents. **Transform faults necessarily are forming along both flanks of the rift because the planet happens to be a sphere and is expanding all around. For every meter that the mid-ocean rift is being widened, relative to a given ocean width, the tension for a one-meter transform fault is added for the same distance in length.** Nevertheless, that tension is being distributed over this length, and it is being increased until the next slip can occur at the point of greatest vulnerability and tension. It becomes clear that not all transform faults can break and slip at the same moment. The mid-ocean rift or ridge is the line along which tectonic "plates" are joined, cushioned by magma that oozes upward along the length of the crack. Therefore, both edges of the adjacent plates cannot be expected to crack as one unit. One side breaks first, and at the T-juncture of the break the stress on the opposite plate-edge is increased. A break in that vicinity is likely to follow. Moreover, the flank along the rift that cracks and slips first will from then on be a step ahead of its counterpart at the other side.

Not only do faults that face each other across the ridge tend to slip at different times, transform faults tend to break and slip also at intervals along the length of the ridge. One slip follows another after enough stress for a next one has accumulated along the rift. The sequence of the breaks is determined by the total budget of tension created by Earth expansion, and the offset pattern along the length of the spreading rift develops as a result of sequential slippage.

In places where the direction of a mid-ocean rift adjusts to curves that are pre-ordained by continental contours, such as around the Mid-Atlantic, a spreading rift may conveniently follow a transform fault sideways for a shorter or longer distance. By such sidesteps a ridge or rift can adjust its direction or meet up with another spreading rift in another ocean. Transform sidesteps of this kind are numerous where the mid-ocean ridge/rift of an ocean connects with the spreading rift that encircles Antarctica.

The Pacific Ocean, being the oldest and most round, features the greatest variety of spreading solutions. This heterogeneity is necessary because a single linear spreading rift cannot resolve all the stresses that are being created in a widening round basin. **First,** there must be acknowledged some amount of general crustal stretching that happens everywhere on the globe as a result of simple all-around Earth expansion. **Second,** as already mentioned, the most visible spreading in the Pacific happens, as in the other oceans, along a spreading ridge or rift. The relatively young ridge in the Pacific Ocean runs through the eastern half. From the South Pacific it extends north into the Gulf of California, continues for a distance under land, and then exits into the Northwest Pacific along the so-called Juan de Fuca Plate.

Third, the spreading of marginal seas, along eastern Asia, has spared the Northwest Pacific the task of having to do large-scale spreading itself. Asia has compensated for circum-Pacific tensions by way of opening up marginal seas behind its old coastlines. Of course, such an observation is bound to be relativistic. From the perspective of ocean dwellers one could as well classify the Asian marginal seas as westward extensions of the Pacific Ocean. Marginal seas are marginal to both land and sea. The process of their formation remains the same for either perspective. Because those East Asian marginal seas have indeed been spread, no active spreading rift was needed in the older Pacific since the Eocene. Beyond these three means of spreading, the Northwest Pacific exhibits a fourth and a fifth type.

Fourth, increments of spreading occur in the Pacific plate along a number of major cracks. These cracks—I shall call them "spread faults"—appear in the Pacific well encrusted and cut in a northwest-southeasterly direction. A long spread fault can look and function like a transform fault in all aspects except one. It does not meet up with a spreading ridge, and therefore it does not "transform." Rather than trying to find a satisfactory name, it might be simpler to describe what spread faults do. They are responsible for having created a number of well-known volcanic island chains, such as the Line Islands, the Gilbert and Marshall Islands, as well as the Emperor Sea Mounts and the Hawaiian Islands. The knee that developed between these latter two conspicuous chains of sea-mountains suggests a still undated shift in the ocean's field of stresses.[42] The directionality of the well-encrusted cracks in the older (northwestern) Pacific is being continued and mimicked by fracture zones in the younger South Pacific—and all this suggests an interrelated field of global expansion stresses. Somewhat differently in the northeastern Pacific, a younger generation of fracture zones runs northeasterly and at near right angles to those of the Northwest Pacific. As they tear forward and widen, some of the spread faults are opening up to facilitate volcanic eruptions. Volcanic islands are being piled up overhead, and under their ballast, back along the spread fault, the cracks are being mended by magma infusions from below. They are at the same time being cooled by water that lies overhead.

And fifth, deep ocean trenches facilitate a very limited amount of ocean-floor spreading. I consider all the deep ocean trenches to be jarred and tensile features. The mid-ocean spreading ridges and rifts with their transform faults, and spread faults elsewhere, could not accommodate all the Earth's expansion stresses along the curved rims of roundly spreading oceans. This problem has become especially apparent during a period of globe-wide shifting. **Most deep ocean trenches are found along coastlines that mark the Ring of Fire.** Moreover, between Japan and the Tonga Ridge this "ring" of seismic activity has been severely distorted. The event that caused this distortion, and created the Pacific trenches, has also created a set of trenches along the eastern Indian Ocean and a few smaller ones in the Atlantic—along the Sandwich Islands Ridge in the south, and farther north along the West Indies Ridge. All these trenches are associated with surrounding geology that has been created by the Eocene tectonic event. Unlike the mid-ocean spreading ridges or rifts, trenches receive their "relative expansion flow" only from one direction—from underneath an adjacent continenal segment.

The Indian Ocean has means of spreading that are similar to those in the Pacific. Even while broad global events have determined most of the geometry of that ocean, the inadequacy of having a linear spreading rift relieve all the tensions of general Earth expansion, in what has become a round-like basin, is demonstrated clearly enough. **The Jurassic Indian Ocean** began with a linear longitudinal spreading rift. **Then during the Paleocene** a spreading rift began to run east and west—possibly beginning with a transform fault of the Upper Cretaceous. The southern edge of South Asia during that time has retreated northward, relative to the Southern Hemisphere. **Since the Eocene** the major

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[42] The "knee-event" has not been seriously investigated, because the prevalent answer so far has been that some oceanic plate is sliding over a hot spot. In that case the sliding plate would have to be subducting somewhere in the Kuril-Aleutian crotch. But where are the other boundaries of this plate that has been moving to its doom in that direction? It is not logical to postulate such plates without being able to show their boundaries. The implied movement cannot be reconciled with the presently available ocean floor chronology or topography. I do not rule out the possibility of having plates sliding somewhere, but I refuse to postulate one here without corroborating surface data.

spreading rift of the Indian Ocean has been cutting diagonally all the way from the southeast to the northwest.

Compared to continental crusts, ocean floors are quite thin and recent formations. However, older ocean crusts that are found nearer to some of the continental shores tend to be thicker. Relative expansion flow that accumulates under wide expanses of ocean crust naturally is being squeezed out toward the mid-ocean spreading ridges, where magma underneath is being quickened, and where younger and more vulnerable crusts lie overhead. In the case of established rifts, most of the relative expansion flow that the collapsing ocean plates are sending outward ends up under mountain ranges that flank these rifts. It contributes to their uplift.

Present Plate Tectonics theory places much emphasis on the structure and number of the "tectonic plates" that make up the lithosphere of our planet. Their number is arguable, and probably changing, and their shapes are as transient as Menard's mid-ocean ridges. This much is implied by the fact of "ocean floor spreading" that has now been established. However, plate outlines were mapped before ocean floor spreading could be chronologically determined. So, psychologically speaking, plates appeared tangible while the "process of spreading" had to be conceptualized in the dimension of time. The inert plates continued to lie around on our planet, and in our textbooks, to obstruct fresh thinking about processes. "Rift Tectonics" or "Expansion Tectonics" would be far better designations than "Plate Tectonics," because these names do place the emphasis where the action is. And the activity that can be observed demonstrates spreading and growth. There never was general drifting among all the continents on this planet, the way Alfred Wegener suspected. This means that there also never was a process by which these plates could habitually have been shearing past each other. There is visible among them even less of the juvenile habit of wanting to collide or to dive.

Upon an expanding globe the continental plates were "rising" upward in space, from the core. As these fragments of the original crust separate from each other they grow by way of accumulating oceanic lithosphere and crust along their edges. While some superficial sliding of continental crusts is quite conceivable, most of their movement appears to have been prepared deeper in the mantle. Uneven horizontal separation, or "apparent drift" at the surface, presupposes an uneven increase of magma volume in the mantle.

There are a few instances of conspicuous surface movement for which it appears that the "magma-roots" of certain continental crusts have been torn or severely weakened. **Madagascar** "slid" or "leaned" southward during the Cretaceous, relative to Africa. And during the Eocene the three continents of **Antarctica, Australia, and South America**—all three carrying with them some extension of ocean crust—adjusted their positions relative to each other and to the other continents. And yes, there was a small collision when the Antarctic plate bumped against the tip of South America. **The remaining continental movements since the Jurassic, as far as I can tell, have all been nicely balanced continental separations, caused by mantle expansion, by ocean-floor spreading and "plate growing."** Moreover, the process of plate growing has been going on in all the oceans without leaving any evidence of ocean floor subduction.

Occasional "accretionary prisms" along shorelines have been proposed to stand proxy for the missing evidence of crustal buckling in the trenches. To the extent that such prisms are present, they could easily have been brought up by relative expansion flow from underneath the continental edges. However, none of the so far alleged "prisms" do measure up to the scale required by the logic of having circular convection currents and ocean floor subduction happening upon a steady-size Earth.[43] Please consider. With ocean floor subduction, the equivalent of all the brittle deep-ocean crusts on this planet—which on average are seven kilometers thick—would have to lie piled up in heaps along our continental shelves. These ocean floors would all have been replaced during the past 180 million years. As an absolute minimum they would have filled the trenches several times over. Not even the gentler concept of "slab-pull," which some theorists have substituted for kinetically driven convection, could have kept these heaps of crust from accumulating. Yes, even at the unlikely circumstance that the one-hundred-kilometer thick lithosphere upon which the crust rests was being subducted, the brittle crust itself would have buckled against the continental edges. But such heaps are nowhere to be found.

A theory of ocean floor subduction also ignores other aspects of ocean floor topography. There is on our ocean floors no directional flow pattern along which the equivalent of all our present oceanic crust and lithosphere could have careened into subduction zones, for recycling in the fiery abyss. **And most significant of all, the theory of ocean floor subduction violates the very ocean floor chronology that the Plate Tectonics revolution has produced.** By the same token, global seismic tomography so far has failed to come up with images that look like subducted plates.

Of course, there are some slight topographical bulges noticeable along the edges of some of the deep-sea trenches, at the ocean side. The fact that none of these has buckled and cracked, suggests that we are looking at a normal process of bulging caused by a small differential of magma pressure from beneath. Inasmuch as these bulges do show up where relative expansion flow and pressure from under the continental edge is obliged to change its direction, such features are quite normal and intelligible. They must be understood in relation to another controversial phenomenon that I will explain next.

Benioff earthquake zones are seismically active inclines, slanting down under coasts adjacent to deep ocean trenches. Seismic studies have revealed heavy earthquake activity underneath certain continental rims, or under the rims of continental coastlines severed by marginal seas. The foci of the quakes are scattered along an inclined plane that slants downward under the continental edge several hundreds of kilometers deep. These planes of seismic activity have been named after Hugo Benioff, a seismologist who discovered them in the 1950's. While some Benioff zones are active along a more or less uniform inclined plane, others suggest an incline along which seismic activity happens in clusters or stepped planes.

I will explain Benioff zones from two perspectives—first from the larger perspective of the continental coastal syncline and its structural collapse, and second, on a smaller scale in relation to the "erosion" of lithosphere and the creation of the deep ocean trenches. Here is where land and oceans meet. I therefore must derive my first perspective from processes on land. My second perspective can be shown in relation to marginal features in the oceans.

First, Benioff zones are created by the structural collapse of continental crust, by a process brought about by coastal syncline and mountain formation. A coastal syncline, produced by continental flanging, tends to break open along the bottom of its lowest bend. As soon as a wide enough crack or system of cracks is present, and as soon as the first intrusion of magma has been cooled to seal the wound, the stage is set for uplift. Assuming that the coastal portion of the syncline manages to remain coherent, the diapir that surges and is being uplifted spreads over the edge of continental crust. It begins to weigh down that edge to cause structural collapse.

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[43] Together with a busload of Earth scientists, who attended the NCGT98 conference at Tsukuba, Japan, I toured Boso Peninsula, where some of these "accretionary prisms" were once believed to be present. The evidence relevant for this question pointed instead to bulges of relative expansion flow moving eastward in the direction of the Trench, bulging, bending and tilting the crust of the peninsula as it went. This much was obvious from exposed sedimentary strata, all the way to the coast.

But “structural collapse” is a surface-oriented concept. **From the point of view of magma, down below, the collapsed crust and lithosphere represents an obstacle, a kind of natural dam that obstructs the relative expansion flow arriving from under the interior of continents.** A typical scenario would be that a bulging uplift slowly forms a small diapir. The latter builds up, spreads, and weighs down the edges of the continental syncline. Sedimentary deposits from land erosion may add their share of weight. The more the ocean-ward half of the syncline collapses, the greater becomes its obstruction to magma flow down below; and then, the more this dam is weighed downward, the more it obstructs. More relative expansion flow is being deflected upward and converted into uplift. It is a self-perpetuating process, determined by the amount of relative expansion flow, by the tensile strength of the outer portion of the syncline, and by the gravity factor that arbitrates how high a mountain range with a given amount of coherence, density, and available “hydraulic magma-fluid” might rise. For example, among spreading diapirs in the marginal seas of East Asia, where coastlines have been torn from the continent and lateral coherence has gotten lost, uplift may not attain a height of sea level.

Second, the incline resulting from structural collapse translates, underneath, into a Benioff earthquake zone. The basic concept is simple. A down-weighed and collapsed continental crust creates the incline. Then, whatever relative expansion flow of magma the edge of the collapsed plate can scoop up goes into uplift. However, the amount of flow that pushes past, under the edge of the obstruction, slowly erodes and rolls boulders along the bottom of the lithosphere upward and ocean-ward along the slant. To visualize the slope of a Benioff zone, the metaphor of “inverted erosion” might be helpful.

Along with the aforementioned factor of structural collapse, one must also consider the difference in thickness that exists between continental and oceanic crust (an average thickness of about 40 to 7km). When as a result of the ongoing breakup of the original global crust some continental fragment is being severed, the lower edge of the thicker continental crust protrudes—even without the occurrence of structural collapse—down into the lithosphere of the adjacent developing ocean. At the same time, the lower edge of the continental lithosphere (on average 100km thick) protrudes quite prominently down into the asthenosphere under the adjacent ocean (which on average is 300km thick). Relative expansion flow is happening along these edges. The erosive force of the slow flow, that squeezes magma upward into the lithosphere and crust, and outward from under the continent, is intensified by the combined weight of the lithosphere and crust overhead. The result is friction and inverted “erosion” along the lower edges of the continental lithosphere and crust.

An analogy from the planet’s surface may be helpful. When low-pressure erosion, as by rain, happens at the surface of the planet, the edges of cliffs are gradually worn away. In similar manner, when high-pressure “erosion” grinds away at the underside of continental lithosphere, it carries along lumps of material and crushes away the edges as well. Relative expansion flow need not be fast in order to erode edges. The immense weight overhead will more than compensate for its slow speed.

In other words, **outward moving relative expansion flow, between lithosphere and asthenosphere, labors to arrange a smoother inverted “bed” for itself. It wears away the lower edge of the continent, to align that edge with the higher situated bottom of adjacent ocean floor.** The continental lithosphere, loosened and mobilized by this treatment, passes some of the manhandling that it experiences upward—to abrade the lower edge of the continental crust. Eventually that crust, too, will align its bottom edge with the bottom of the oceanic crust. The commotion along a slanted Benioff zone will not stop until the smoothest possible transitional slope between the continental and the oceanic lithospheres, and their respective crusts, has been achieved.

Our analogy of erosion, taken from the planet’s surface, may be extended to include waterfalls and rapids. For instance, younger Benioff zones produce their earthquakes at the distinct levels of inverted “falls” or “rapids” along the upward slope. Then, waterfalls in the surface world strike the ground beneath them with force and erode deep pools at their places of impact. "Magma-falls" that drop upward, or eddies of magma that whirl upward, would by their impact push up bulges along the surface of the crust. Some such bulges can be seen along the ocean-ward rim of deep ocean trenches. However, as the "falls and rapids" underneath are worn smooth, the bulges, and yes, even the entire ocean-ward edge of the ocean trench can subside. All the while the slopes of continental shelves, leading down into the deep ocean basins, may remain.

Benioff zones do not need ocean floor subduction in order to rumple. They can comfortably do so in accordance with nature's own flow. From the cliffs that support waterfalls, to the continental edges that invite erosion from below, man always has experienced difficulties visualizing the vast time frame and easy schemes of nature.

Visualized from underneath, the deep ocean trenches are spaces that are being bypassed—like dry zones behind waterfalls—by relative expansion flow as it extrudes lithosphere outward from under some quickened continental edges. As these extrusion gaps originate, they immediately become effective systems for water-cooling overhead, for thickening and strengthening the crust that forms upon extrusion. While the trench cools and hardens it becomes an obstacle, a kind of inverted dam, which down below may act for a time as a last continental brake to the outward movement of relative expansion flow.

Along the bottoms of some deep-ocean trenches research submarines have discovered still deeper cracks. These fresh crevices reach deep into the otherwise tranquil floors, and they generally run parallel to the alignment of the trenches. This happens to be the case in the Japan Trench. Earth expansion makes these cracks necessary. **Thus, relative expansion flow stretches and widens the trenches a little, ocean-ward, while deeper cracks are forming in the trench floors.** In turn these cracks will continue to cool deeper and will harden the de facto inverted dams. In the event that such a cracked "dam" suddenly breaks, the trench will disappear and some of its hardened walls may somersault unto the edge of the continent. I suspect that something like this has happened along the coast of California when the Antarctic plate broke away. Moreover, by contemplating ocean floor chronology, one notices that the deep ocean trenches in the Pacific and Indian oceans, and even the small ones along the West Indies Ridge and the Sandwich Islands, are all associated with geology of the Eocene tectonic event.

The Eocene tectonic event that has jarred the deep ocean trenches was global. It opened the East Pacific when the Antarctic plate leaned and twisted southward. The Bering Sea and all the marginal seas of East Asia were spread open. All of Austral-Asia was pulled north and bent eastward while the diagonal Southeast Indian Rift began to dominate the Indian Ocean. The rear of the Antarctic plate bumped against the tip of South America and pulled back from the Sandwich Islands. Later the Australian plate left the Tonga Ridge, dragging itself along a path westward, in coordination with Antarctica's counter-clockwise swing.

The deep ocean trenches on our planet are all age-mates. They were jarred along continents that still were trying to heal the primeval wound of the planet's first continental partition—the birth of round Antarctica. At the moment when Australia and Antarctica finally broke free from South America, that first circular wound, which generally is recognized as Ring of Fire, was reopened. Deep ocean trenches are the most recent scars of this primeval wound.

10

The Evidence from Global Seismic Tomography

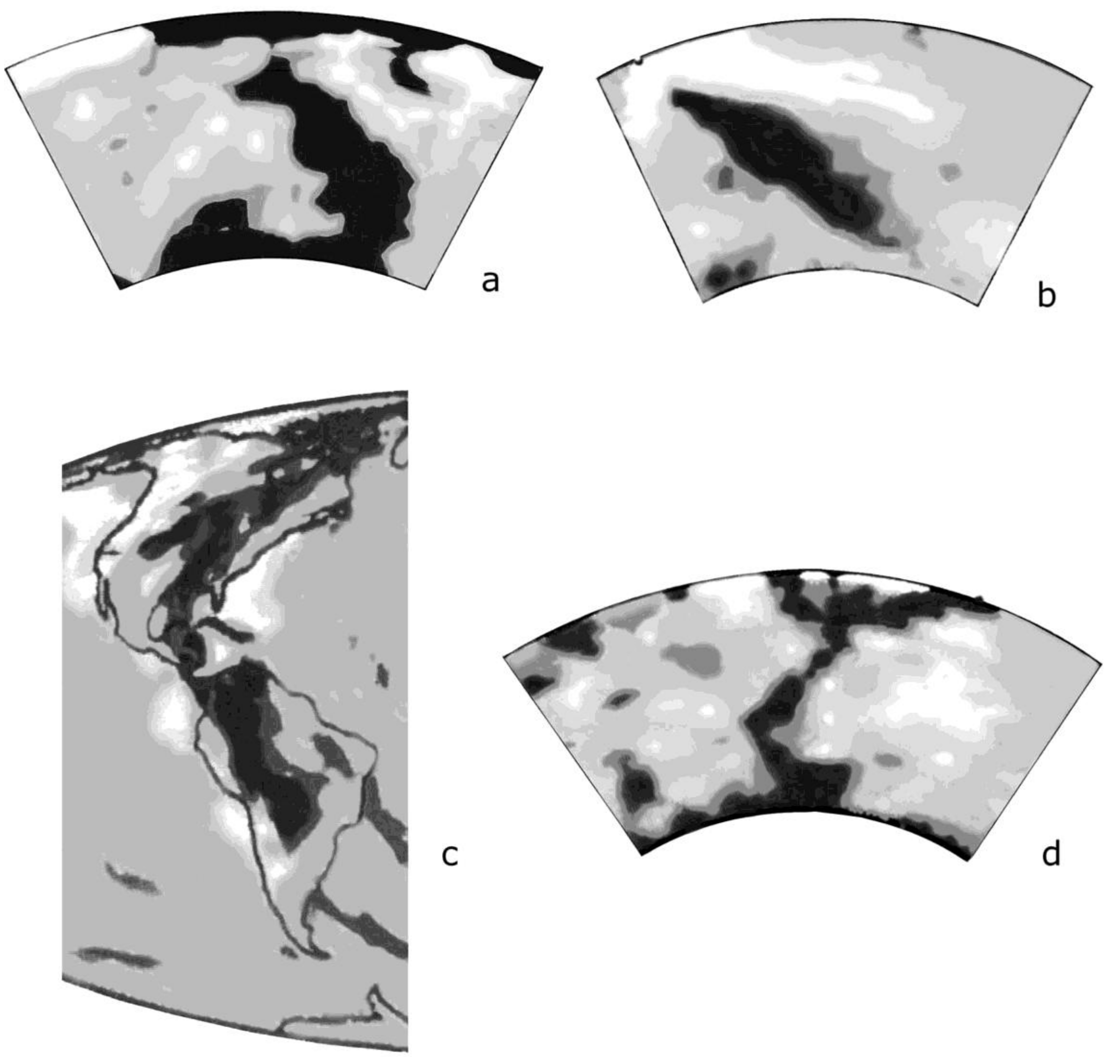
In April of 1997, in *GSA Today*, Stephen P. Grand, Rob D. van der Hilst, and Sri Widiyantoro published a treatise on "Global Seismic Tomography: A Snapshot of Convection in the Earth." A parallel essay by van der Hilst, Widiyantoro, and E. R. Engdahl, "Evidence for deep mantle circulation from global tomography," appeared in *Nature* (vol. 386, 10 April 1997). Both articles add up to an epoch-making breakthrough that has been in the making for some time, regarding our knowledge about tectonics in our planet's interior. Then in a summary, in *Science News*, vol. 152 (19 July 1997), Richard Monastersky popularized this scientific breakthrough by way of metaphorically renaming the Earth's mantle as a "Global Graveyard."

A major feature of this scientific breakthrough is the fact **that two different methods—one calculating on the basis of seismic P-waves, and the other on the basis of S-waves—have produced encouraging similar results.** Regardless of what from here on I might write or say on that subject, I heartily congratulate these scientists—along with all others who have been working in this direction—for their accomplishment. I welcome their "global seismic tomography" even while I have serious doubts about whether they actually have given us the "snapshot of convection in the Earth" which they claimed, or whether they really have demonstrated "deep mantle circulation." In any case, the tricky business of obtaining a lithosphere and crust light enough to float and to raise mountain ranges, which at the same time is heavy enough to dive all the way down to the core, was left to the care of hypothetical convection currents.

"Global Graveyard" is the name given to the Earth's mantle by Richard Monastersky. It refers to plates of ocean floor that are said to subduct in the deep ocean trenches and thence sink into the mantle, down as far as the core. So, with the stroke of a pen, this science writer has implicitly categorized the proponents of present-day Plate Tectonics as "undertakers." Proponents of Earth expansion, by contrast, will henceforth have to be regarded as "tectonic plate growers."

The new tomographic cross-sections of the mantle reveal chunks of dense materials that seem to slant downward, indeed, and some of these reach as deep as the core-mantle boundary. The fact that configurations of dense materials do exist somewhere in the mantle does seem, from the point of view of the prevailing "graveyard" theory, to be sufficient evidence for convection, subduction, and everything else that goes with these notions. **But, are these chunks of dense materials slanting downward or upward?**

The "principle of falsification" has been mentioned by philosophers of science as a standard method for checking scientific propositions. This test should have been applied all along, as a matter of course.



Tomographic cross-sections of (a) North America, (b) Central America, (d) Asia. The "root" of the Americas (c) is shown at 800km depth. Sketches are based on Grand, Van der Hilst, and Widiyantoro, *GSA Today*, April 1997, and Van der Hilst, Widiyantoro, Engdahl, in *Nature*, 10 April 1997. Light indicates softer and dark indicates harder and cooler areas.

First, where in the mantle should "downward moving ocean floor slabs" be expected to appear in the tomographic cross-sections, relative to the continental coastlines? Occurring at which places can they legitimately be suspected of having been subducted?

Second, can we actually perceive some signs of past or present motion at these places, in the topography?

And **third,** if for some reason our data should not fulfill expectations (in science we should remain open to opposite possibilities to the very end), where and how would the slabs have to be located to indicate an absence of subduction? If all possible data are eligible to prove subduction, then what might the word "subduction" mean in the end?

Let me illustrate what I mean, on hand of the now famous "Farallon Slab" cross-section (figure "a").[44] We are shown how it "descends" under the middle of North America. Are ocean floor subduction slabs supposed to be going down under the middle of huge continents? The crosscut through North America shows a hot upper mantle area that underlies the Rocky Mountains, and a cooler stretch extending eastward from approximately El Paso, Texas. The cool column (the so-called "Farallon Slab") is shown slanting down still farther east. Is a descent this far inland possible with an ocean floor subduction theory? Considering the horizontal dimension, this image could as well be a cross-section of the "root system" that runs longitudinally under both Americas (figure "c"). In my view, all this together adds credence to the thought that Central America represents a zone of stretching. A major vertical discontinuity in that root system can be inferred for the depth of 1800km which, possibly, corresponds to a dislocation caused by the Eocene tectonic event.

In addition, the "Farallon Slab" cross-section (figure "a") does show a small dark "tail" (my term) under the Northwest Atlantic. Is it a slab that is going down? How would it look different if it were only a "tail" or a piece of "root" that has been dragged upward? Could it be a remnant of the 200 million year-old mantle that was torn loose from its moorings when continental crusts were being lifted outward by expanding magma?

I am aware that the Central American cross-section (figure "b") is supposed to clinch the argument in favor of subduction. But in that cross-section, at the ocean trench—indicated by a notch—where underthrusting is supposed to be happening, no harder materials can be seen descending. There is a gap of 400km of soft materials that separates the Pacific Ocean floor crust, which is supposed to be subducting, from the cooler materials that supposedly have already gone down.[45] This alleged "descending slab" is far more likely associated with the Central American continental crust, overhead. A horizontal map of the "root" (figure "c") shows a narrowing at the place where the continental crust overhead is also narrowing.

It appears therefore that the harder "roots" or "tails," comprised of cooler materials, belong to the larger root system of the American continents. By contrast, the hotter areas appear to be the places where expansion volume is being added. The fact that hot blotches still do appear at the near-core level (2750km) suggests that the dynamics of the expansion process began indeed where I first suspected them—"by the core, and for the mantle."[46]

A cross-section of East Asia presents another example of acclaimed "subduction slabs" in the mantle (see d, page 70— an exaggerated outline of Mount Fuji is indicated along the horizon). A cooler and harder configuration reaches downward from Central Japan, which is the area of

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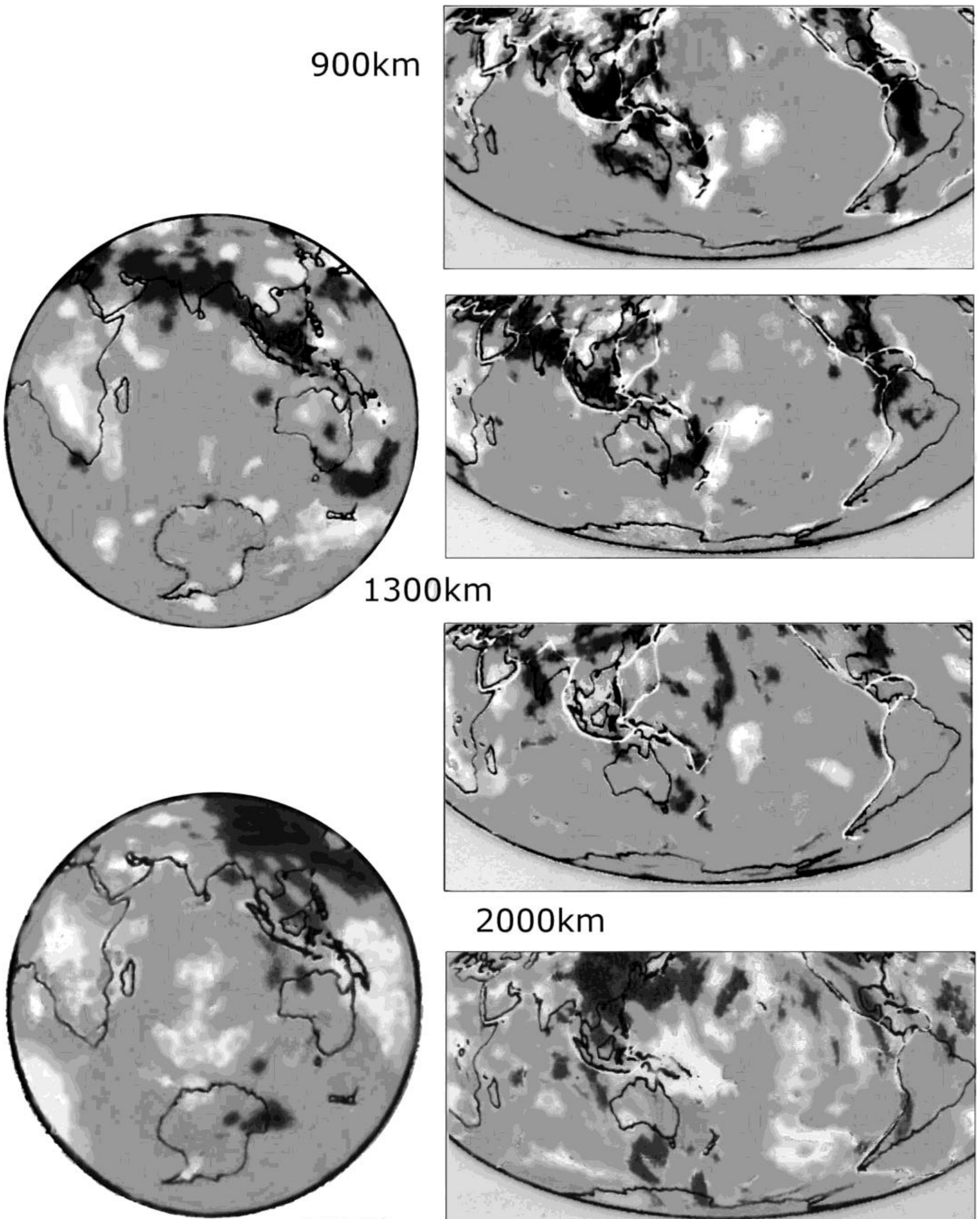
[44] Redrawn after Stephen P. Grand, Rob C. van der Hilst, and Sri Widiyantoro, "Global Seismic Tomography: A Snapshot of Convection in the Earth, " in *GSA Today,* April 1997.

[45] Redrawn after Rob C. van der Hilst, Sri Widiyantoro and E.R. Engdahl, "Evidenece for Deep Mantle Circulation from Global Tomography," in *Nature,* vol. 386, 10 April 1997.

[46] See my video script, *Expansion Tectonics,* Lufa Studio, 1996. For an indication of these hot blotches at the 2750km depth see especially "Figure F" in Grand, Van der Hilst, and Widiyantoro, "Global Seismic Tomography..." in *GSA Today,* April 1997. Frequently I have been asked, "Where did the water for these new oceans come from?" I do not have a quick answer. However, I suspect that the same nuclear/chemical process that gave us a fluffier mantle also gave us ocean water.



Tomography suggests (1) the cut-off and northward movement of Australia, below the 2000km level and (2) kinetic-nuclear activity near the core, northeast of Australia. Light indicates softer and hotter areas, while dark signifies continental roots as harder and colder areas. Sketches are based on Van der Hilst, Wideyantoro, and Engdahl, in *Nature,* 10 April, 1997 a well-known deep ocean trench.[47] The problem is that this "slab" appears forked at 600km depth. Its eastern branch connects with the base of Japan, and its western branch connects with the dense substratum of Asian lithosphere. The "root of Asia," that is, the stem of the two "branches," connects to a broad base of harder materials along the core. **Inasmuch as the Sea of Japan is a tensile feature in our planet's lithosphere (as are the other East Asian marginal seas), the bifurcation of the stem underneath that spreading zone does rule out a process of subduction.**

Just think of it! Two "subducting plates," coming together in marriage as tectonic Romeo and Juliet, positioned to descend into the Global Graveyard, this scenario surely would add interesting drama to tomographic plate tectonics! **Most of the dense "slabs" that have been shown tomographically as evidence for subduction, are situated under continents. The upper mantle regions, where subduction is supposed to happen right now, are relatively free of them.** At the present state of the art, the overall mantle view, provided by the new tomography, supports a model of Expansion Tectonics much better than it supports the notion of convection currents, subduction, and underthrustment. It endorses what the new ocean floor chronology had revealed to us earlier.

From the perspective of Expansion Tectonics it looks as though some 200 million years ago denser materials made up a smaller mantle around the core, of an Earth that roughly was 55 percent its present diameter. Then gradually along the planet's core, and in the mantle, nuclear and chemical reactions began heating and fluffing up the material. This expanded material is still dense enough to prevent the harder columns of mantle materials, as well as the harder slabs of continental crust overhead, from sinking back down toward the core. All dense features in the tomographic cross-sections, including the continental crusts, might therefore be older materials that have been lifted upward, more or less efficiently, by mantle expansion. Near the core we find the "roots" of continents, whereas overhead, from under the continental crusts, dangle some truncated appendages.

I am convinced that tomography, as it proceeds to refine itself, will eventually support Expansion Tectonics. When pertinent tomographic crosscuts are obtained from around the globe, I am confident that they will contribute to a three-dimensional Expansion Tectonics model. Continental roots near the core, and trailing tails beneath continental crusts, will suggest the direction of expansion movement in the case of some continents—their rising, their twisting, their twisting off, as well as their paths of relative horizontal slant. There has been far less horizontal movement or "drift" than most Earth scientists presently anticipate. The published tomographic materials of the Antarctic plate are still rather limited; nevertheless, the information at various levels of depth is amazingly suggestive regarding the path of Australia's movement (page 72). **With more tomographic global cross-sections of this sort, I believe that the Eocene changes at the surface of the planet, caused by Earth expansion, can someday be shown in the three dimensions of space as well as in the fourth dimension of time.**

[47] For more precise illustrations see the full color originals of Rob van der Hilst, S. Widiyantoro and E. R. Engdahl, in *Nature,* vol. 386, Fig. 6a.

Post-Script

Basic science can ill afford to be swayed by utilitarian goals and aspirations. But someone who comfortably is settled in the camp of established Plate Tectonics theory will, sooner or later, wonder about the usefulness of Expansion Tectonics theory. Indeed, life upon this planet at a primitive level, and to some extent even the pursuit of earth science, can continue happily without such a theory. But there are a few highly interesting dimensions that we all would be missing.

The greatest practical implications of Expansion Tectonics, by far, will result for continental seismology. If convection currents, subduction, and underthrustment no longer need to be taken into account, and if tensile folding, flanging, and relative expansion flow do take their place, then any small changes in the geometry of continental features, horizontal as well as vertical, will become extremely significant. Changes that occur farther inland upon continents will be helpful for anticipating earthquakes and volcanic eruptions. These are the concerns that motivated me, after the 1994 California earthquake, again to pay attention to the subject matter of Earth expansion.

Paleontology will be an obvious beneficiary. Now that a better pattern of original continental associations has emerged, and now that the evolutionary sequence of continental separations can be deduced directly from ocean floor chronology, many species and their lines of descent will come into clearer focus.

If I were interested in Earth science for the purpose of prospecting and mining, I reckon, I would very much be interested in early continental alignments and movements. Old global life zones, and belts, can someday be made visible when ancient poles and equators have been mapped. Even present-day debates about global warming, and the human responsibility for such, can be conducted a little more rationally when the mechanisms of the expansion process, the hot spots along our ocean floors and the El Niño causes, are better understood. Of course, I do not know of any measures that humankind could take against some of these natural phenomena. But if nothing else, then at least a quantum of Stoic pleasure will be won by creatures whose ultimate destiny is to explore and to understand. Expansion Tectonics must be, and sooner or later will be, researched to the outer limit—to the point where every weakness in the theory will have been found and exposed. Such are the destinies and toils of Homines sapientes who, for reasons still mostly unbeknown to themselves, have either been “elected” by inscrutable Divine Will, or “selected” by boundless Nature, to inherit upon this planet the shadow of a tree, perhaps, in which to wonder and to ponder, for a while.

Bibliography

Alvarez, Luis W. *T. Rex and the Crater of Doom,* Princeton: Princeton University Press, 1997.

Bevis, Michael and Barton Payne. "A New Palaeozoic Reconstruction of Antarctica, Australia, and South America," in Carey, S. W. *Expanding Earth Symposium*, Sydney, 1981, pages 207-213.

Carey, S. Warren. *Theories of the Earth and the Universe: A History of Dogma in the Earth Sciences*. Stanford: Stanford University Press, 1988.

_____. ed. *The Expanding Earth, a Symposium*. Sydney: Earth Resources Foundation, 1981.

Choubert, G. and Faure-Muret, *Geological World Atlas*. Paris: UNESCO, 1976-1988.

Grand, Stephen P. and Rob C. Van der Hilst, and Sri Widiyantoro, "Global Seismic Tomography, a Snapshot of Convection in the Earth," in *GSA Today*, April 1997.

Hoshino, Michihei. *The Expanding Earth: Evidence, Causes, and Effects*. Tokyo: Tokai University Press, 1998.

Hs⌉, Kenneth J. *Challenger at Sea: a Ship that Revolutionized Earth Science*. Princeton: Princeton University Press, 1992.

Lamb, Simon and David Sington. *Earth Story, the Shaping of Our World*. Princeton: Princeton University Press, 1998.

Luckert, Karl W. *Mother Earth Once Was a Girl: a Scientific Theory on the Expansion of Planet Earth.* Flagstaff: The Museum of Northern Arizona Press, 1979.

_____. "A Unified Theory of Earth Expansion, Pacific Evacuation and Orogenesis," in *Theophrastus' Contributions to Advanced Studies in Geology*, pages 61-73. Athens, Greece: Theophrastus Publications, S.A., 1996.

_____. *Expansion Tectonics*, a video program. Part One: the Formation of Oceans; Part Two: the Formation of Mountains; Part Three: Story of Discovery. VHS and PAL, 84 minutes. Springfield, MO (update at <www.triplehood.com>), 1996.

Maxlow, James. *Global Expansion Tectonics: Small Earth Modelling of an Exponentially Expanding Earth.* Glen Forrest, Australia: Terrella Consultants, 1996.

Menard. H. W. *The Ocean of Truth: a Personal History of Global Tectonics*. Princeton: Princeton University Press, 1986.

Meyerhoff, Arthur A. "Surge Tectonics evolution of southeastern Asia: a geohydrodynamics approach," in *Journal of Southeast Asian Earth Sciences*. Vol. 12, No 3-4, pp. 145-247, 1995.

NASA Jet Propulsion Laboratory and National Geographic Society. *The World Satellite Map*, 1998.

NOAA, GEMCO Paris, Geol. Survey Commission of Canada, Scripps Institution of Oceanography, Univ. of Sydney, Univ. of Texas. *Age of the Ocean Floor*. US Dept. of Commerce, National Geophysical Data Center, 1996.

Parker, Sybil P. ed. *Dictionary of Earth Science*. New York: McGraw-Hill, 1997.

Pflafker, George. Henry C. Berg, ed. *The Geology of Alaska* (The Geology of North America, Vol. G-1). Boulder: Geological Society of America, 1994.

Prothero, Donald R. and William A. Berggren. *Eocene-Oligocene Climatic and Biotic Evolution*. Princeton: Princeton University Press, 1992.

Schatzman, Evry. *Our Expanding Universe*. New York: McGraw-Hill, 1992.

Suzuki, Yasumoto and Takashi Mitsunashi, Kisaburo Kodama, Yoshijiro Shinada, Seiki Yamauchi, Atsushi Urabe, *Boso Peninsula: Guidebook of the Boso Peninsula*—International Symposium on New Concepts in Global Tectonics. Tsukuba, Japan, 1998.

Van der Hilst, Rob C., Sri Widiyantoro, and E. R. Engdahl, "Evidence for Deep Mantle Circulation from Global Tomography," in *Nature*, vol. 386, 10 April 1997.

Vogel, Klaus. "The Expansion of the Earth, an Alternative Model to the Plate Tectonics Theory," in *Critical Aspects of the Plate Tectonics Theory, II*, 19-34. Athens, Greece: Theophrastus Publications, S.A., 1990.

Wegener, Alfred. John Biram transl. *The Origin of Continents and Oceans.* New York: Dover Publications, 1966. Original publication in German, 1915.

Wertenbaker, William, *The Floor of the Sea, Maurice Ewing and the Search to Understand the Earth.* Boston: Little, Brown, and Co., 1974.

Yano, Takao, ed. *Proceedings of International Symposium on New Concepts in Global Tectonics*, Tsukuba 1998.

Internet Sites on Earth Expansion:

David Ford—a webmaster who exhibits materials by S. Warren Carey. Looking at the addresses, I suspect he also had something to do with the existence of the new Maxlow and the Tassos sites http://www.geocities.com/CapeCanaveral/Launchpad/8098/HomePage.htm-#Earth%20Universe

James Maxlow—Global Expansion Tectonics, http://www.geocities.com/CapeCanaveral/Launchpad/6520/

Stavros Tassos—Cognitive Tools of Earth Expansion, http://www.geocities.com/CapeCanaveral/Launchpad/8098/The-Cognitive-Tools-of-Earth-Expansion.htm

Karl W. Luckert— Expansion Tectonics, http://www.triplehood.com/expa.htm

Lawrence Meyers—Geophysics and the Expanding Earth, http://www.expanding-earth.org

John Harms—In the field of the Planetary Sciences, http://www.jps.net/physics/planetary.htm

Additional Internet Sites of Interest to this Treatise:

Ocean Drilling Project— www.odp.tamu.edu/sciops/LegSummaries

Jonathan Dehn— www.aist.go.jp/GSJ/~jdehn/research/diss.htm

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