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FALSIFICATION OF THE EULERIAN MOTIONS OF LITHOSPHERIC PLATES

Warsaw, December 2016
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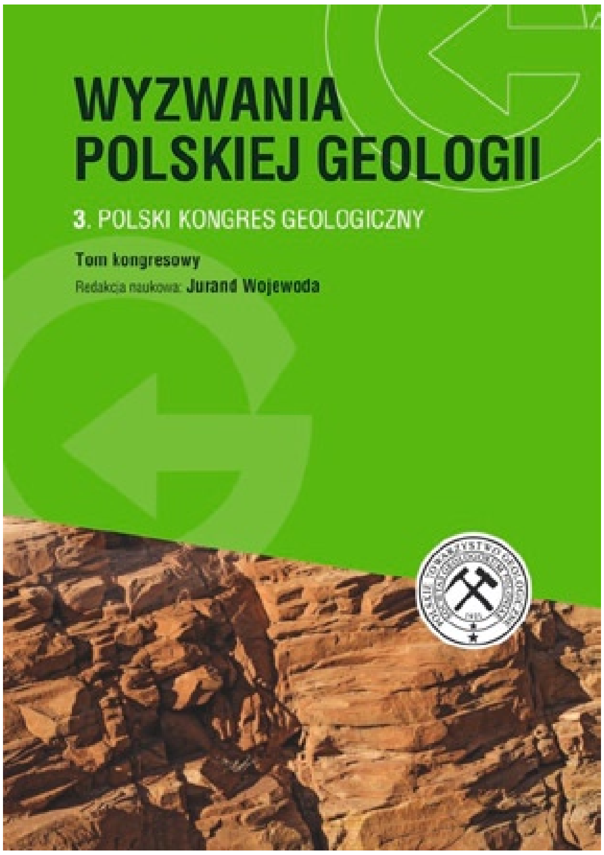
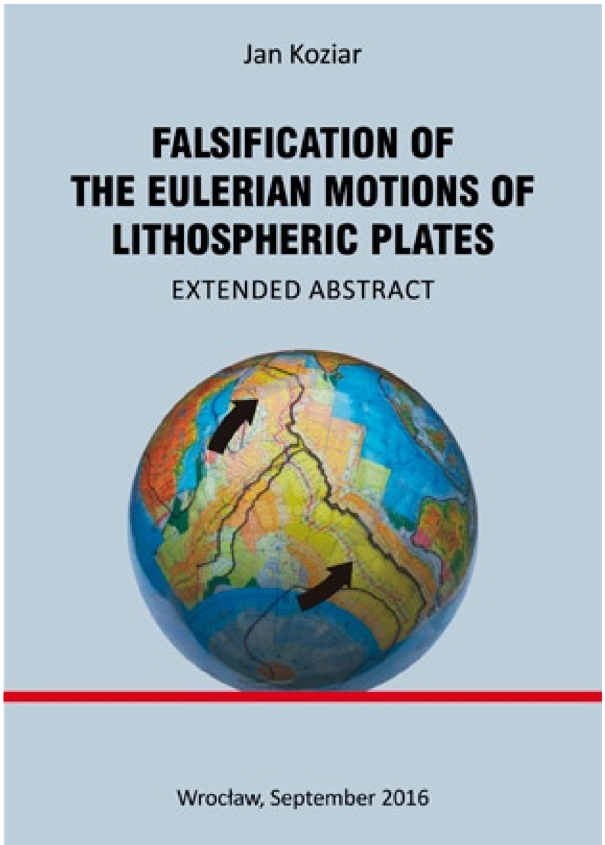
Introduction

I. Editorial context of the presented paper

The presented paper **Falsification of the Eulerian motions of lithospheric plates** is a full text of the topic lectured at the **3rd Polish Geological Congress** held in Wrocław, 13-18 September 2016. The Congress was organized by the Lower Silesian Branch of the Polish Geological Society under the management of Dr. Jurand Wojewoda, the director of the branch. An extended abstract of the topic was published in English in the abstracts volume for the Congress, delivered at the conference (front cover 1).

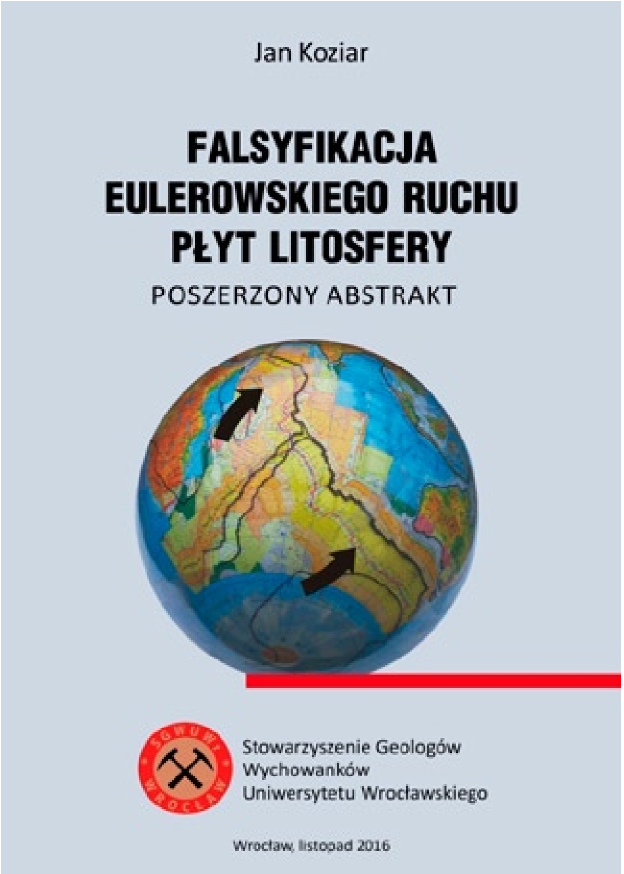


Front cover 1



Front cover 2

The extended abstract is now available as a separate digital brochure on my expanding-Earth website (front cover 2): www.wrocgeolab.pl/falsification1.pdf. The translated Polish version of the abstract was printed as a separate brochure in November 2016 by the Society of Geologist Alumni of Wrocław University (front cover 3).



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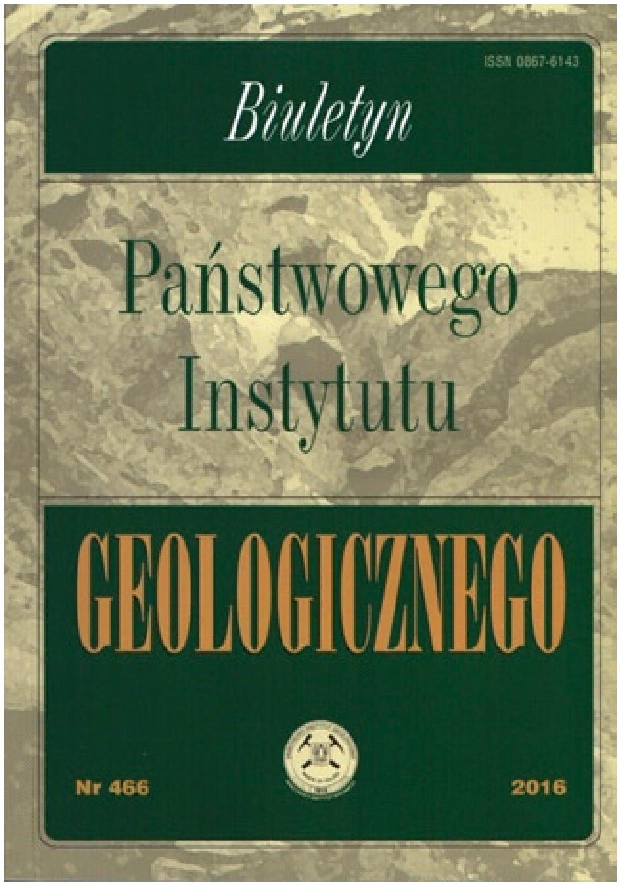


Front cover 4

The full text as presented now, was published in December 2016, in the Bulletin of the National Geological Institute (PIG Bulletin, front cover 4), No. 466, p. 147-178, DOI: 10.5604/01.3001.0009.4576. This issue of the Bulletin comprises full texts of selected papers presented at the Congress. The present full text of my paper is now available on my website: www.wrocgeolab.pl/falsification2.pdf ,

II. Technical remarks on the presented paper

In the paper all Polish-language accessory texts (included in the publication by the Bulletin of the National Geological Institute) have been removed. In accordance with the editorial rules of the PIG Bulletin the paper, though lengthy, was presented without an outline of its contents, here included.

Following this brochure I have written an extensive supplement, elaborated as an separate digital brochure: **PLATE TECTONICS: A theory founded on circular arguments**. It is available at:
www.wrocgeolab.pl/falsification3.pdf.

J. Koziar
March 2017 (updated May 2018)

Falsification of the Eulerian motions of lithospheric plates

CONTENTS

.BIULETYN PAŃSTWOWEGO INSTYTUTU GEOLOGICZNEGO 466: 147–178, 2016 R. DOI: 10.5604/01.3001.0009.4576

Falsification of the Eulerian motion of lithospheric plates

Abstract: *Morgan (1968) tested the supposed Eulerian motion of lithospheric plates by calculation on a circuit around the Indian Ocean triple junction. The present analysis performed on a physical model shows that on a non-expanding Earth, the reconstructed Southwest Indian Ocean Ridge fails to close as it should according to the allegedly positive result of Morgan's test, which is thereby shown to be in error.*

Wedge-shaped openings, appearing along all arms of the Indian Ocean triple junction during its reconstruction, are examples of Carey's artifactual "gaping gores" which in general are one of the proofs of the Earth's expansion. A global plan of plate motions based on the Eulerian principle is impossible and confirms Carey's Arctic Paradox which is other proof of the expansion of the Earth. Space geodesy testing of expanding Earth is in fact testing of possible expansion of the plate tectonics model, not the real Earth. V-shaped openings between plates, when real, are not of Eulerian origin but are large sphenochasms in Carey's sense caused by an expanding interior of the Earth.

Key words: *Morgan's test, Indian Ocean triple junction, gaping gores, diffuse plate boundaries, plate tectonics absolute reference frames, Carey's Arctic Paradox, sphenochasms, Earth expansion.*

1. Introduction

Supposed Eulerian motions of lithospheric plates are the essential basis of the plate tectonics paradigm. This type of motions is falsified in this paper. The right alternative is exclusively divergent non-Eulerian motions of plates, driven by significant expansion of the Earth interior. On an expanding Earth the stretched sublithospheric mantle directly drives the plates and provides an absolute reference frame for the description of their motion. In the plate tectonics paradigm, both driving mechanism and absolute reference frame are elusive.

2. Supposed Eulerian motions of lithospheric plates

According to Euler's theorem any relative movement of two elements on a sphere is equivalent to a rotation around an axis (Euler's axis) crossing the centre of the sphere. The points where the axis crosses the sphere are called poles of rotation (Fig. 1).

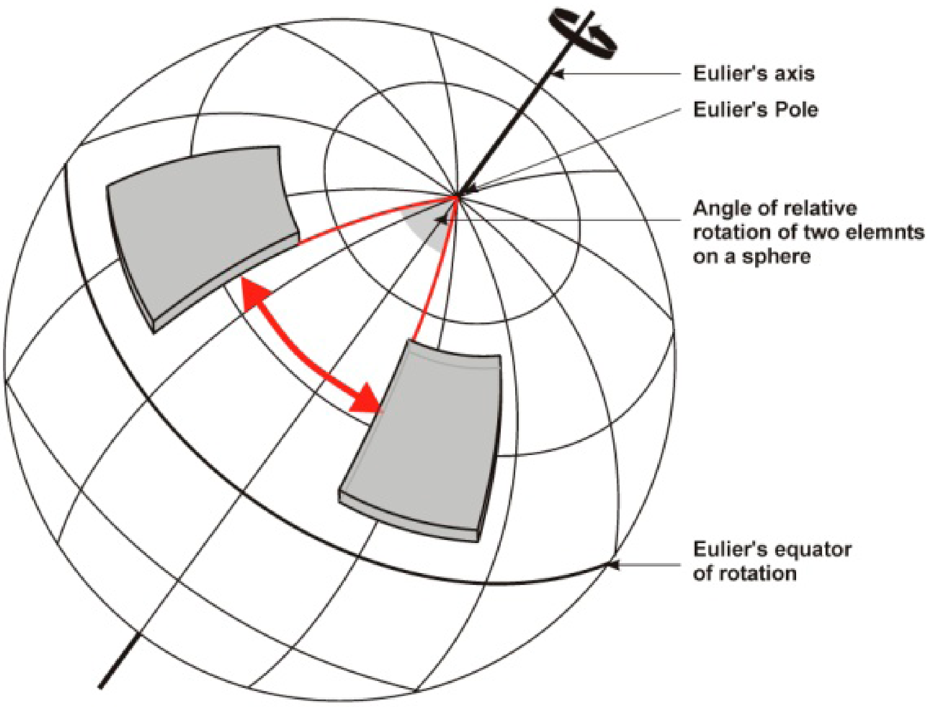


Fig. 1. *Axis and pole of relative rotation of two elements on a sphere (after Kearey &Vine, 1996)*

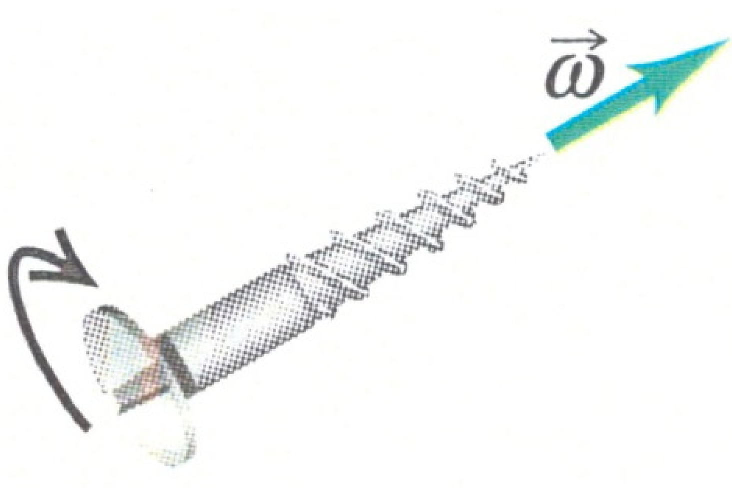


Fig. 2. *Dextrorotatory-screw rule determining the sense of vector of angular velocity*

The Euler theorem was first used in geotectonics by Bullard *et al.* (1965) as a basis of their reconstruction of the Atlantic Ocean.

Euler's purely geometrical theorem was extended to today's plate tectonic kinematics by Jason Morgan in his lecture delivered on April 17, 1967 at the AGU meeting and later in a paper published in April 1968. And though McKenzie and Parker published earlier a similar paper (December 1967) Morgan has a priority in formulating kinematic rules of plate tectonics. The extension of Euler's theorem is as follows in accordance with rotation rules of rigid body.

When a relative angular speed (ω**)** of two plates is known we can represent it by a vector collinear with the Euler axis. The length of the vector corresponds to the scalar quantity of the relative angular speed. The sense of this vector, bound with the relative movement of the plates, is determined by the dextrorotatory screw rule (Fig. 2).

Such vector of angular velocity **ω** (this time in bold) fully describes the relative kinematics of the two plates. Such a vector is called by plate tectonicists an "Euler vector" but Euler did not engage so far in the problem and so it should perhaps be called a "Morgan vector". In spite of this I will use the previous conventional term.

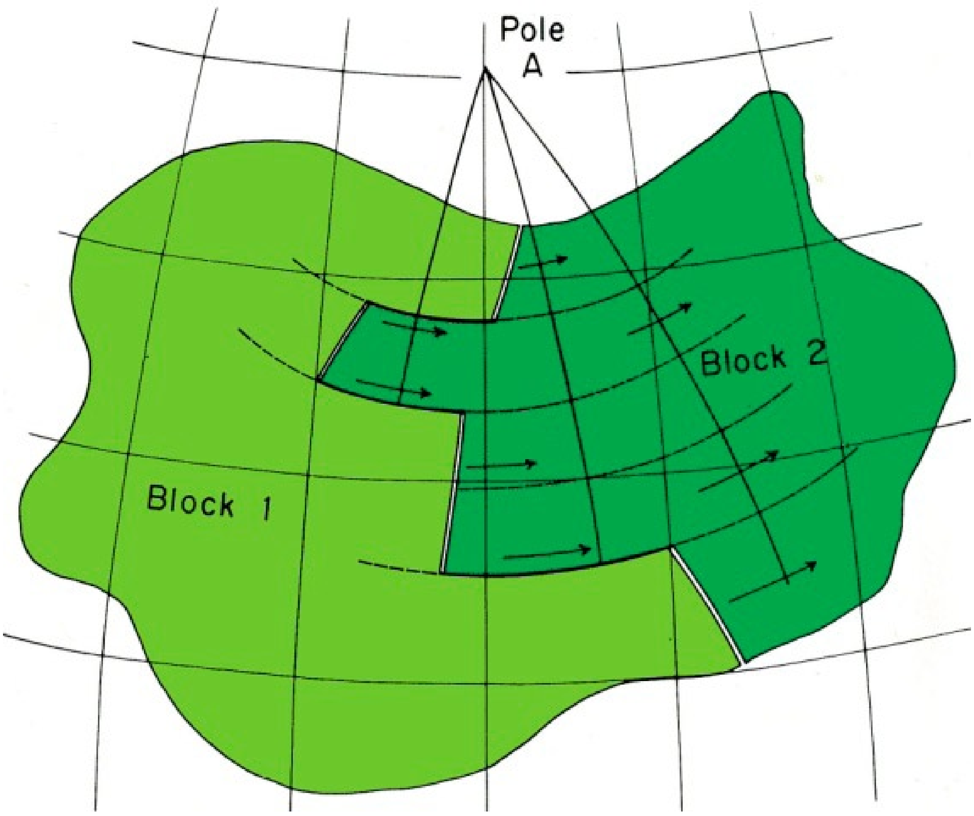
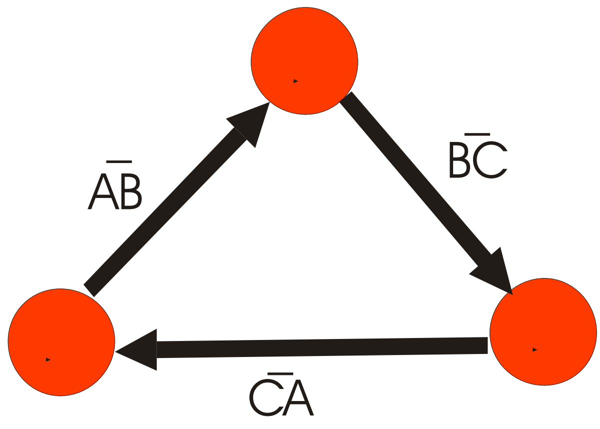


Fig. 3. *Pole of rotation determined as an intersection point of great circles perpendicular to transform*



$$\bar{AB} + \bar{BC} + \bar{CA} = \bar{0}$$

Fig. 4. *Circuit built of three vectors of relative angular speeds of three plates (explanation in text)*

Morgan found poles of relative rotation of two plates as intersection points of great circles perpendicular to transform faults between the plates (Fig. 3). In practice these points are very scattered and determine only a fairly large region in which the pole of rotation should be. The areas are marked on maps by quite large 95% confidence ellipses the centres of which are treated as Euler poles and used in "precise" calculations.

Morgan calculated a relative angular velocity of the plates from the spreading rates between them. This means that Euler vectors can be directly determined <u>only for divergent plate boundaries,</u> *i.e.* only for plates situated on both sides of oceanic ridges.

However, Euler vectors can be added or subtracted according to the general rules of vectorial calculus and in this way other vectors of relative plate movement, which cannot be measured directly, can be calculated.

An important property of this calculus is that a sum of vectors along a closed circuit of vectors is equal to zero. The smallest closed circuit is composed of three vectors (Fig. 4). In plate tectonics it corresponds to three plates joined together at a so-called "triple junction". If any element of the sum is unknown it can be transferred to right side of the equation and calculated as the sum of the remaining vectors. The same is true in circuits composed of more than three vectors.

If the sum in a closed circuit is different from zero it means that something is wrong.

Morgan used this formal opportunity to prove that Eulerian motions of the plates (*i.e.* their supposed gliding on a constant-size Earth) is correct.

He and his successors believed that the result of his test was positive and on that basis constructed the whole ω-space (the term by McKenzie and Parker, 1974) in which they forced the geotectonics and geology as well.

It will be shown below that the result of the Morgan test was wrong.

3. Morgan's test of Eulerian motions of plates

Morgan (Morgan, 1968) presented his test of the Eulerian motions of the plates in a section entitled: *„The motion of the Antarctica block relative to the African block"*. He was able to determine Euler vectors for three pairs of plates:

1. Antarctic and Pacific,
2. Pacific and North American,
3. North American and African.

It was difficult to determine the spreading rate for the African and Antarctic plates and Morgan calculated it by summing up the vectors mentioned above along a circuit which can be called "Morgan's great circuit" – Fig. 5A. He obtained the value of 1.5 cm/year.

A

B

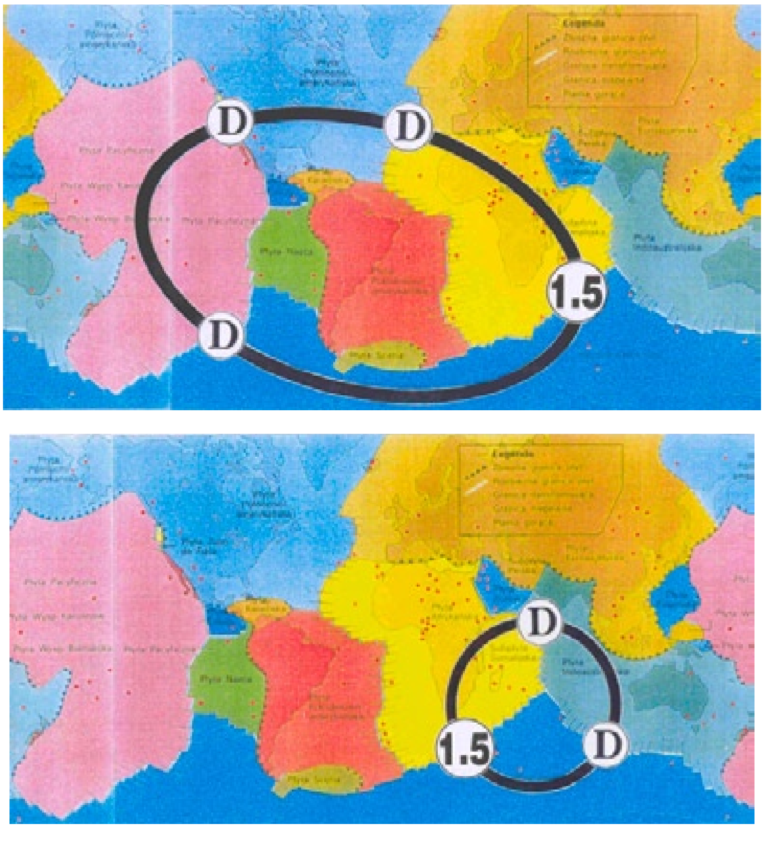


Fig. 5. *Structure of Morgan's test,* **A** *– Morgan's great circuit,* **B** *– Morgan's small circuit,* **D** *– data (measured spreading rate), 1.5 – calculated spreading rate (cm/year). The schemes are made by the present author. Detailed explanation in text*

Then he tried to confirm this result by an independent calculation along another circuit, around the Indian Ocean triple junction, which can be called "Morgan's small circuit" or "Morgan's testing circuit" (Fig. 5B). The result was apparently (see text below) also 1.5 cm/year which was treated as a proof of the Eulerian movement of the plates on a non-expanding Earth.

However, a proof of such a great significance should be based on at least a few similar confirmations to avoid the possibility it is merely accidental. Doubts are the more justified because the second Morgan calculation <u>was not made precisely on his vectors</u> but in a "more or less" way (!) as can be seen below:

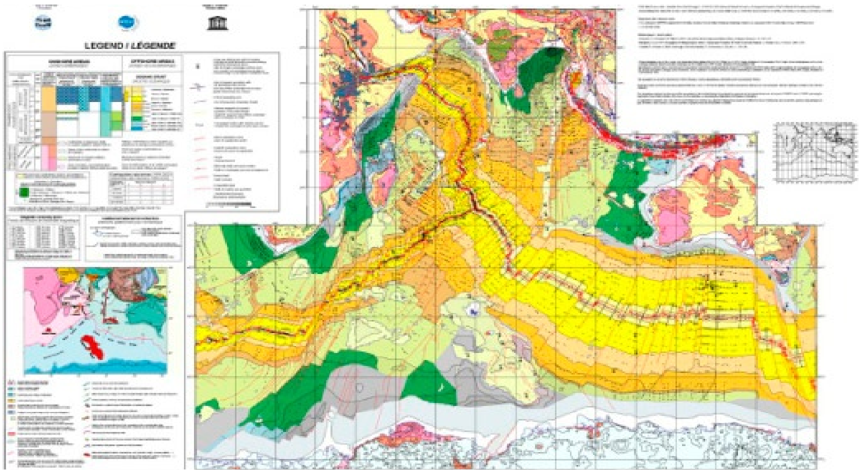
> *The mid–Indian Ocean rise between Antarctica and Australia is opening north to south at a rate of about 3.0 cm/yr (Le Pichon, 1968), and the Carlsberg ridge is opening **more or less** [bold by J.K.] north to south at a rate of about 1.5 cm/yr. The difference between these rates agrees with the value of 1.5 cm/yr listed in Table 8–5.* (Morgan, 1968; p. 1982).

The „*value of 1.5 cm/yr listed in Table 8-5*" is the value seen in Fig. 5A.

4. South-west gaping gore in the Indian Ocean triple junction falsifies apparent positive result of Morgan's test

The falsification was carried out by the author of the present paper on a physical model comprising a geographical globe on which the geological structure of the Indian Ocean has been superposed, and transparent plastic spherical caps imitating lithospheric plates.

The map used for this purpose was the Structural Map of the Indian Ocean by Ségoufin *et al.* (2004); Fig. 6A., taken from the Internet. The map was digitally segmented into suitable strips (Fig. 6B) and the strips were digitally transformed into globe's wedges or peels (Fig. 6C). Then the wedges were printed on a self-adhesive paper and pasted onto the geographical globe (Fig. 6D).



A

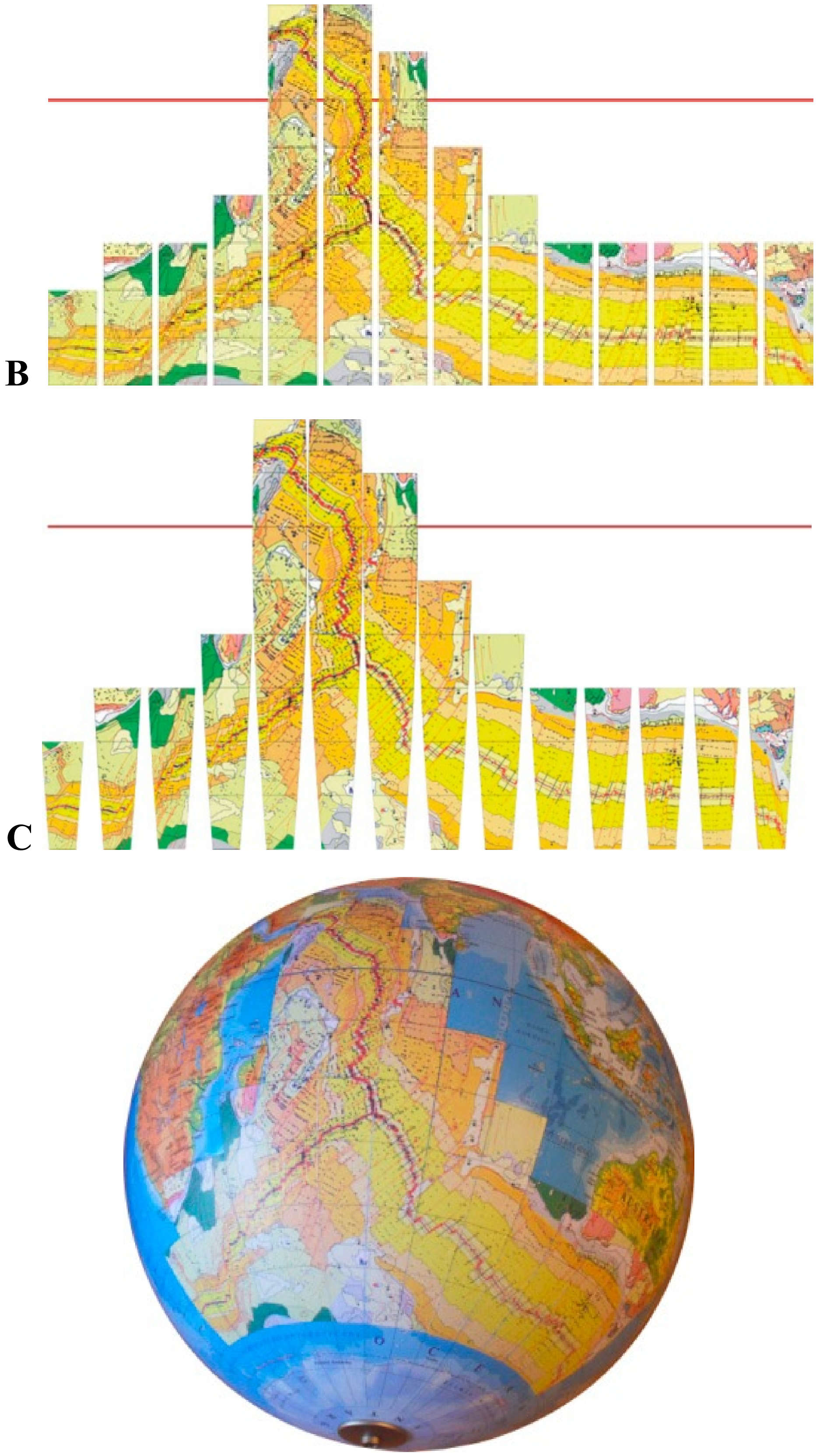
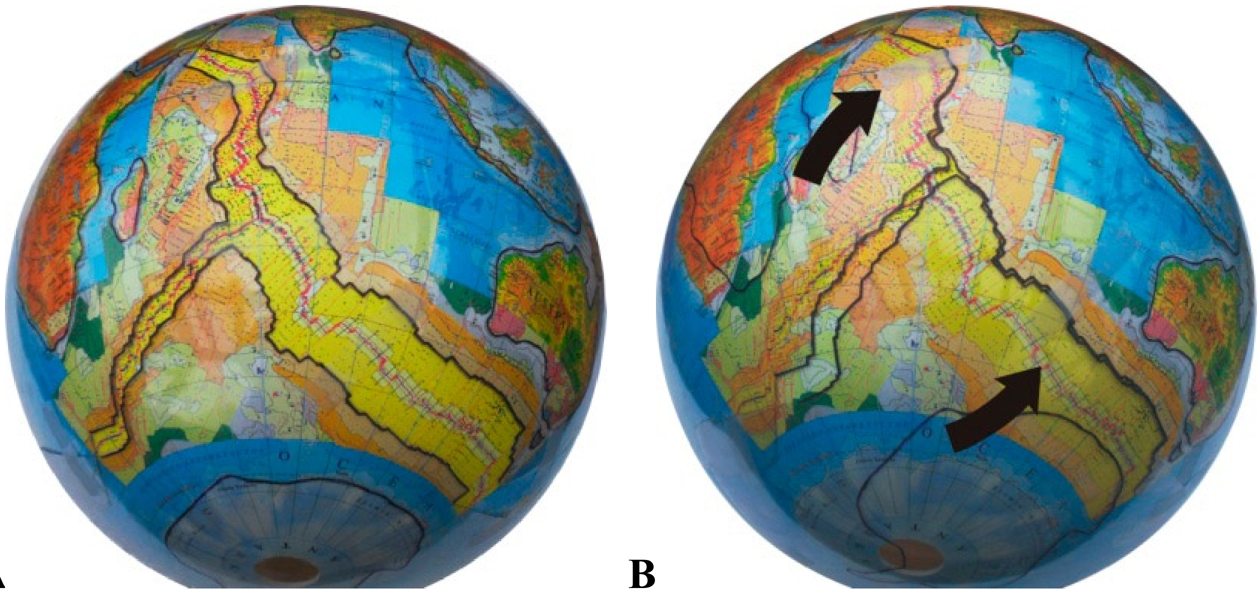


Fig. 6. *Procedure of putting the Structural Map of the Indian Ocean on a globe (explanation in text)*

After that three plates: the African, Antarctic and Indo-Australian were cut from the plastic caps. The cutting was made along the 20 Ma isochrones (turn of the Paleogene/Neogene) that define their common boundary as it was at the time. These old borders were colored in black. Then, the plates were put on the globe in their present positions (Fig. 7A).



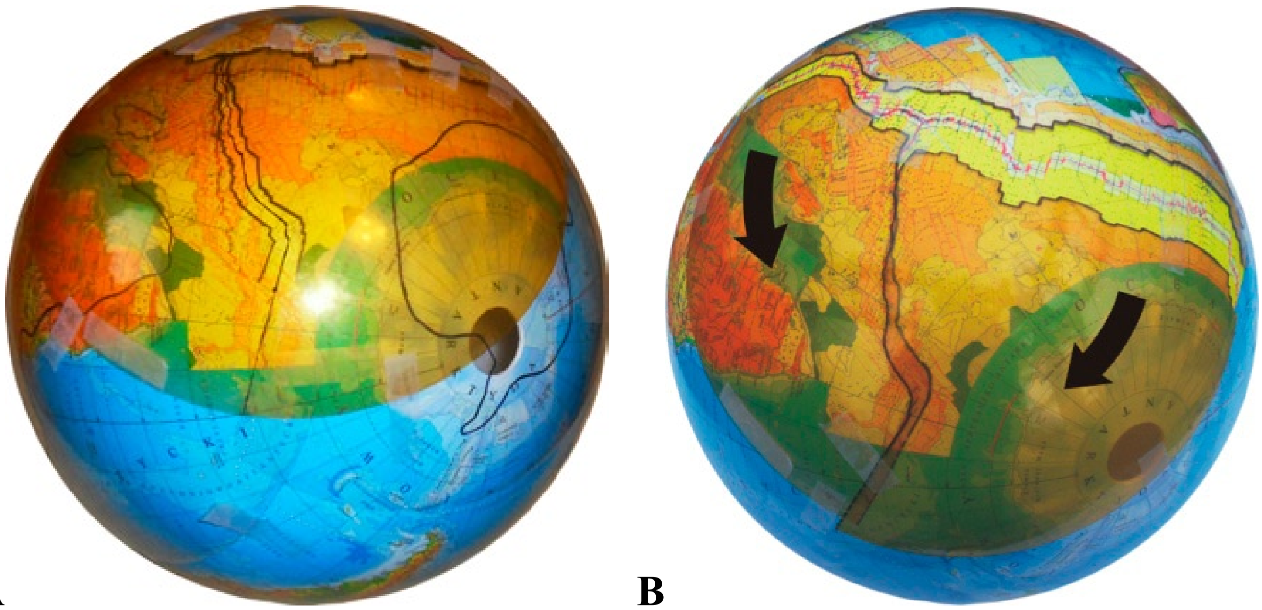
A **B**

***Fig.** 7. Appearance of an artificial gaping gore between the African and Antarctic plates on a non-expanding Earth (explanation in text)*

After that the African and Antarctic plates were pushed into position against to the Indo-Australian one, along the transform faults (Fig. 7B) in order to restore the relative position of all three plates before 20 Ma.

The significance of the gaping gore is that this opening comes about when <u>reversing</u> the real spreading history along the boundary between these two plates and the Indo-Australian one. Consequently, the real spreading along the latter boundary should imply that the border between Africa and Antarctica is a convergent one, whereas in fact this border is also divergent. We can also model the specific form of the implied (counterfactual) convergence with the use of plastic caps.

Natura horret vacuum. The empty space of the gaping gore is impossible and so older oceanic lithosphere should have been present there. The 20 Ma boundary between the African and Antarctic plates in this lithosphere can be represented by a line bisecting the gaping gore in Fig. 7B. Thus, a less-transparent plastic cap was placed over the previous plates and the bisecting line drawn on it (Fig. 8A). The cap was then cut apart along this bisecting line. Next, the now-separated plates were moved into alignment with the present location of the -20 Ma isochrones to their NE (Fig. 8B).



A B

Fig. 8. *Artificial convergence between the African and Antarctic plates on a non-expanding Earth (explanation in text)*

Since this movement represents the real movement of the plates (forward in time) general divergence along the common boundary of the two plates should be found. But in fact the mutual border of the two plates is divergent only in a small initial section near the triple junction. Beyond the longitude of Madagascar, the two plates converge (overlap). What is more, the divergence in the small eastern section is much smaller than their real divergence.

These relationships show that the Euler pole for the two plates lies near the triple junction and the rate on the equatorial plane perpendicular to the Euler axis (and on the southwest side of the Euler pole) is negative. Thus, along the Southwest Indian Ocean Ridge there should be subduction not spreading. Something is here evidently wrong.

If Morgan had performed a correct vectorial calculation along his small circle (Fig. 5B) he should have obtained negative relative velocity on the African – Antarctic Ridge instead of his positive value of 1.5 cm/year. So, his result obtained in the "more or less" way is not only quantitatively but also qualitatively wrong.

Because the Southwest Indian Ridge is in fact divergent it means, in plate tectonic's language, that the Indian Ocean triple junction circuit is not closed. This was found later by plate tectonicists, and their way of treating the problem will be discussed in subsequent sections.

5. Carey's "gaping gores" as a proof of the expansion of the Earth

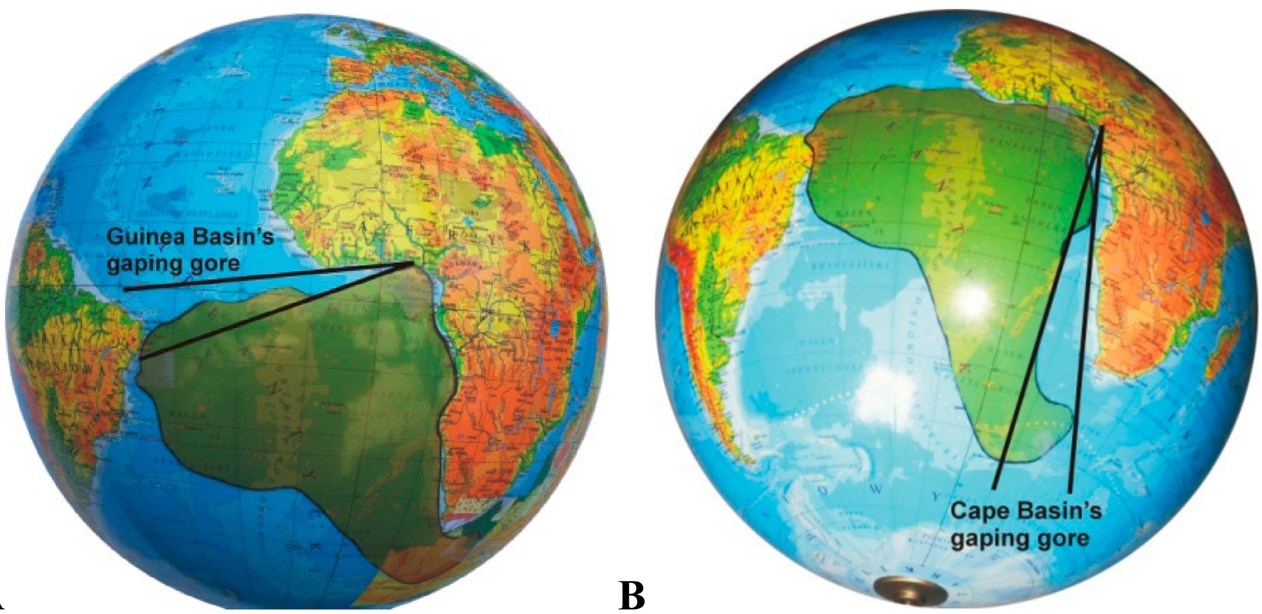
The term "gaping gore", used in the previous section, is exactly the same that was used by Carey to denote artificial wedge-shaped gaps, appearing on reconstructions which neglect the greater curvature of the Earth's surface in the past (smaller radius of the ancient Earth). The name of these artefacts was introduced by him in 1976 (Carey, 1976) but the problem had already been described in 1958 (Carey, 1958). It led Carey, after strenuous attempts at better assembling of Wegener's Pangaea on a non-expanding Earth, to understanding the expansion of the Earth (see subsection "Tethys zone gaping gores").

In more formal language "gaping gores" may be called "openings of an underestimated curvature".

Existence of the artificial gaping gores is one of the proofs of the Earth's expansion.

a. South Atlantic gaping gores

A good example of gaping gores are the ones (noticed already by Carey) appearing attempting to assemble South America with Africa. When the southern borders of both continents are put together the Guinea Basin's gaping gore appears (Fig. 9A). When the northern borders are put together, the Cape Basin's gaping gore appears (Fig. 9B).



A **B**

Fig. 9. *Gaping gores on a non-expanding Earth,* **A** *– Guinea Basin's gaping gore,* **B** *– Cape basin's gaping gore (explanation in text)*

Both South Atlantic artificial gaping gores disappear on Maxlow's proper reconstructions made on an expanding Earth (Fig. 10).

Fig. 10. *Maxlow's (1995) reconstruction of the Atlantic Ocean on the expanding Earth without gaping gores*

b. South-west Pacific gaping gores

Another example of gaping gores are those appearing along the southwest Pacific rise (my findings). My big geotectonic globe of 85 cm in diameter (scale 1:15 mln), made from Russian geological globe strips and magnetic linear anomalies from about 300 papers (Fig. 11), will be used for their demonstration.

Fig. 11. *My big geotectonic globe (85 cm in diameter) watched by professor Cliff Ollier. Construction of this item of the globe was sponsored by the Polish industrial group KGHM POLSKA MIEDŹ. The photo was taken in Geological Museum of Institute of Geological Sciences of Wrocław University*

The Southwest Pacific rise and its geotectonic vicinity are presented in Fig. 12A. The Paleogene-Neogene border is marked there by a light-brown line. Adjacent parts of the Pacific and Antarctic plates were cut along these boundaries from opaque plastic caps. After putting them on the globe in accordance with the present structures, they imitate the old Pacific and Antarctic plate fragments from before 20 Ma, in their present position (Fig. 12B).

After juxtaposition of this old Antarctic plate with the Pacific one along the NE part of their common border, a gaping gore appears in their SW part of the border (Fig. 12C). This artificial gap can be called the “Balleny Islands gaping gore”.

Then, after juxtaposition of the old Antarctic plate with the Pacific one along the southwest part of their common border, a gaping gore appears in their northeast part of the border (Fig. 12D). This artificial gap can be called the “Easter Island gaping gore”.

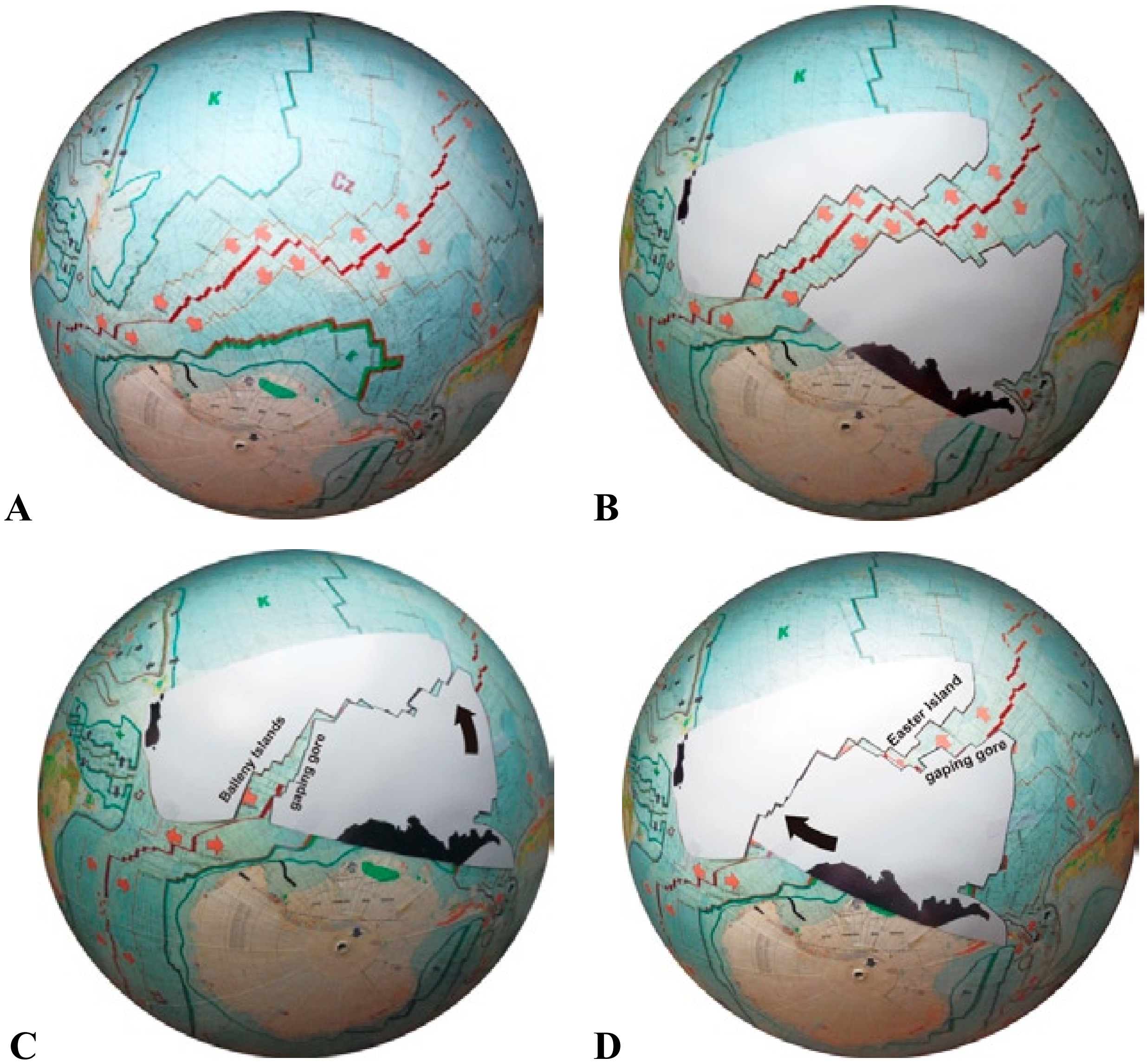


Fig. 12. Gaping gores in the southwest Pacific (explanation in text)

Both gaping gores disappear on a smaller Earth reduced by 20 the Ma (post-Paleogene) increment in oceanic lithosphere. This is accomplished by Maxlow's reconstructions (Fig. 13).

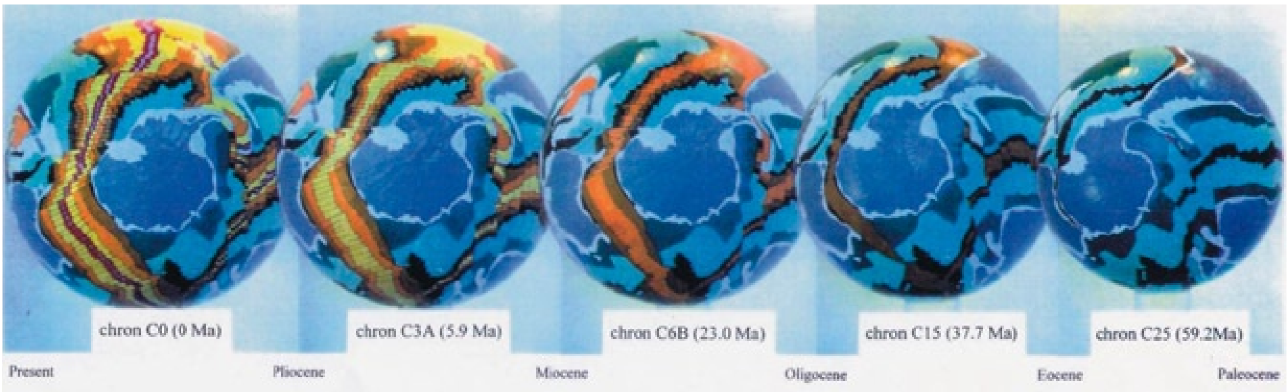


Fig. 13. *Maxlow's (1995) reconstruction of Antarctic region on the expanding Earth without gaping gores on the southwest section of the Pacific Rise*

c. Tethys zone gaping gores

Deeper in the past, the Earth's surface curvature was greater and so the gaping gores are also greater. The biggest gaping gore is, the artificial Tethys Sea gaping to the East on the Dietz and Holden (1970) reconstruction (Fig. 14A).

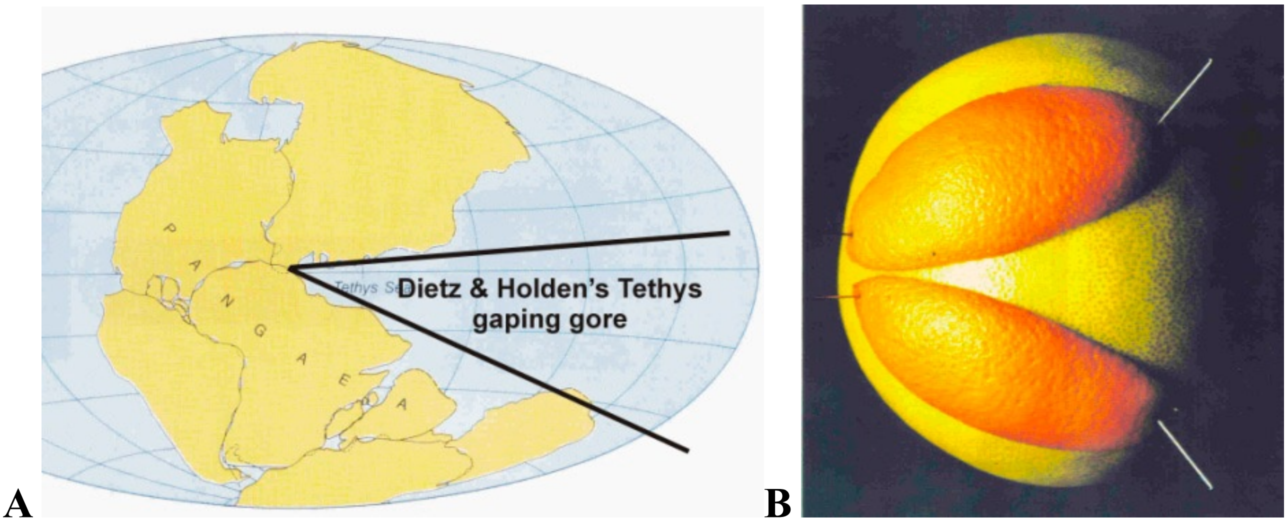
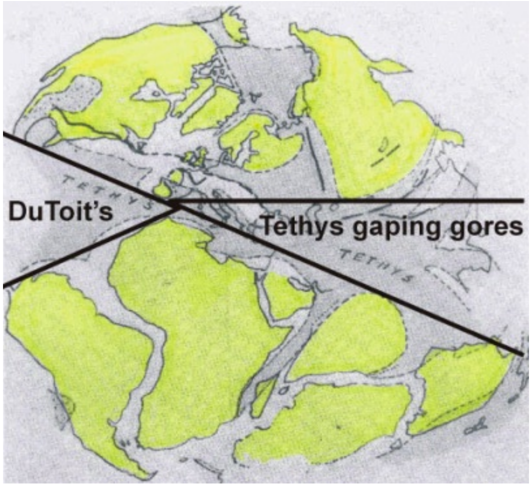


Fig. 14. **A** *– Dietz & Holden's Tethys gaping gore,* **B** *– explanation of Dietz and Holden's Tethys gaping gore by Van Hilten's orange peel effect – own model (explanation in text)*

This phenomenon can be also described by Van Hilten's (1963) "orange peel effect" which consists in the appearance of gaping gores when attempting to put together an orange peel on a bigger sphere (grapefruit) than the orange from which it came (Fig. 14B).

Another example of this kind, but more balanced, are the two Tethys gaping gores (Fig. 15A) in Du Toit's (1937) Pangaea. An analogous orange peel model is given in Fig. 15B.



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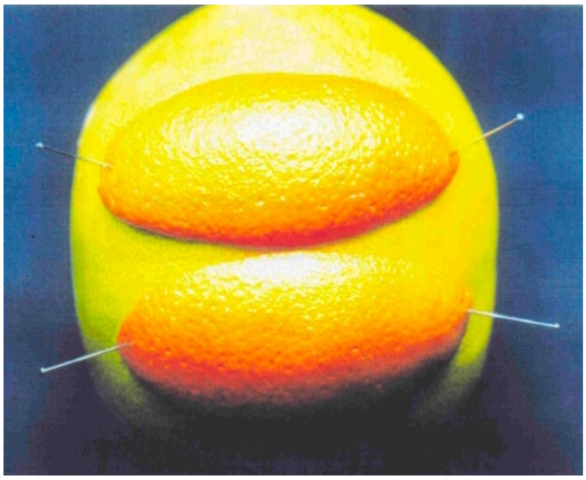
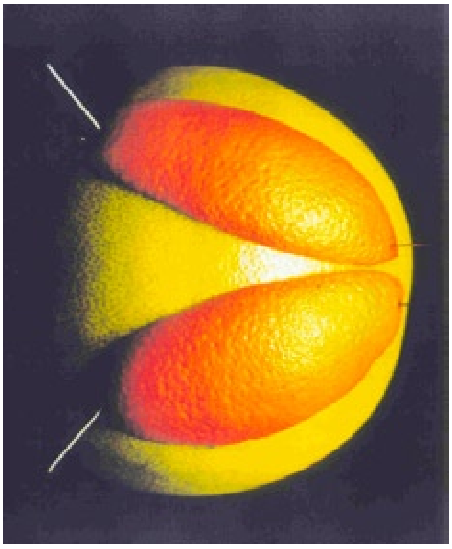


B

Fig. 15. **A** *– Du Toit's Thetys gaping gores,* **B** *– explanation of Du Toit's Thetys gaping gores by Van Hilten's orange peel effect (own model)*

The orange peel in Fig. 14B can also be reunited in the opposite way (Fig. 16A) and in the same way can be reunited Gondwana and Laurasia (Fig. 16B).



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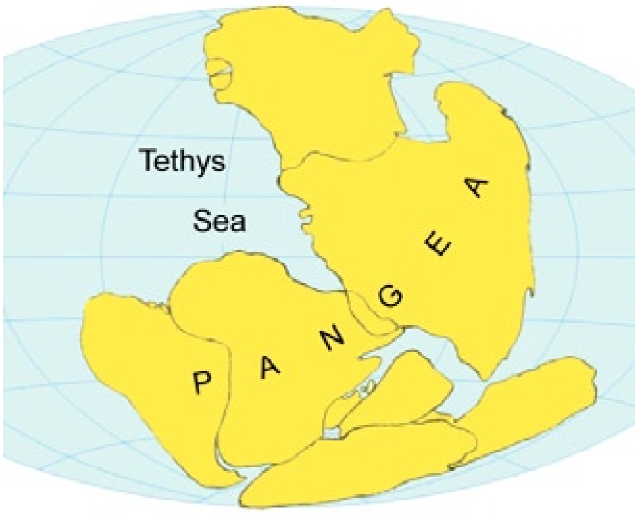


B

Fig. 16. **A** *– another possible arrangement of orange peels in style presented in Fig. 14,* **B** *– extreme West Tethys "Ocean" gaping gore (my figures)*

Carey, as an Australian geologist, was better aware of the Paleozoic connection of Australia with south-east Asia than western geologists. He reported (Carey, 1988, p. 158-159) that when he tried to connect Gondwana with Laurasia in the East, a big gaping gore appeared in the West, just as in Fig. 16B. Let us to quote:

> *Confident that the gap [in the East –JK] was false, I started a reconstruction of Pangaea from Australia-Indonesia without any gap, but*

as I proceeded to assemble the other continents, a new gap appeared, widening to 50 degrees, between the Americas, which was also false. Whatever I tried, I always ended with a gaping gore from about the middle of the assembly to a 50-degree gap at the periphery, opposite where I had started. Finally, after months of frustration and anguish, I realized that my troubles arose because I was trying to reassemble Pangaea on a spherical table the same size as my globe, whereas I should have been using a table of smaller radius, because the earth had expanded significantly since the time of Pangaea. I was trying to button a waste-coat over an enlarged belly! Every seamstress knows to insert a tapering gore into a skirt to increase the flare. I had been working on continental drift for a quarter of century, taking it for granted that the Earth's radius was constant.

d. Wegener's improper avoidance of Tethys zone gaping gores

One can wonder how Wegener was able to make his Pangaea without any gaping gores. He was able to do it by extreme stretching of the peripheral areas of his supercontinent. I have transferred Wegener's (1929) Pangaea onto an equal-area hemispheric net (Fig. 17).

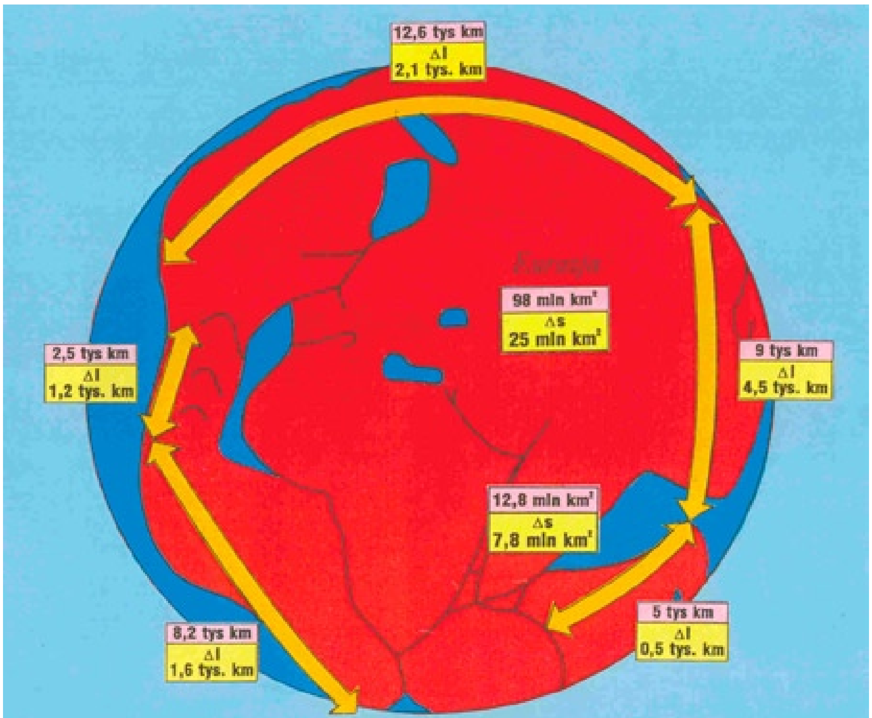


Fig. 17. *Artificial stretching of the peripheral parts of Wegener's Pangaea. In the upper parts of the frames there are Wegener's values for distances and areas. In the lower parts are increments of Wegener's values above the real values*

Surface areas of the continents were measured by a planimeter. Peripheral distances were measured by transferring their end points onto a geographical globe (using their geographical coordinates) and measuring there the distances by means of a string. The results are given in Fig. 17 and Table I.

Table I. Wegener's increment of peripheral distances in his Pangaea

Section	Distance		Wegener's increment [10^3 km]
	Real [10^3 km]	Wegener's [10^3 km]	
Australia	4.5	5.0	0.5
East Asia	4.5	9.0	4.5
North Laurasia	10.5	12.6	2.1
Central America	1.3	2.5	1.2
South America	6.6	8.2	1.6

As is seen, all the peripheral distances are stretched – East Asia and Central America even doubled. There are no geological evidences of their subsequent contraction during dispersion of Wegener's Pangaea. Just the opposite, they were stretched during dispersion, especially Central America.

The same is true with surface areas of Eurasia and India in Wegener's Pangaea as is seen from Fig. 17 and Table II.

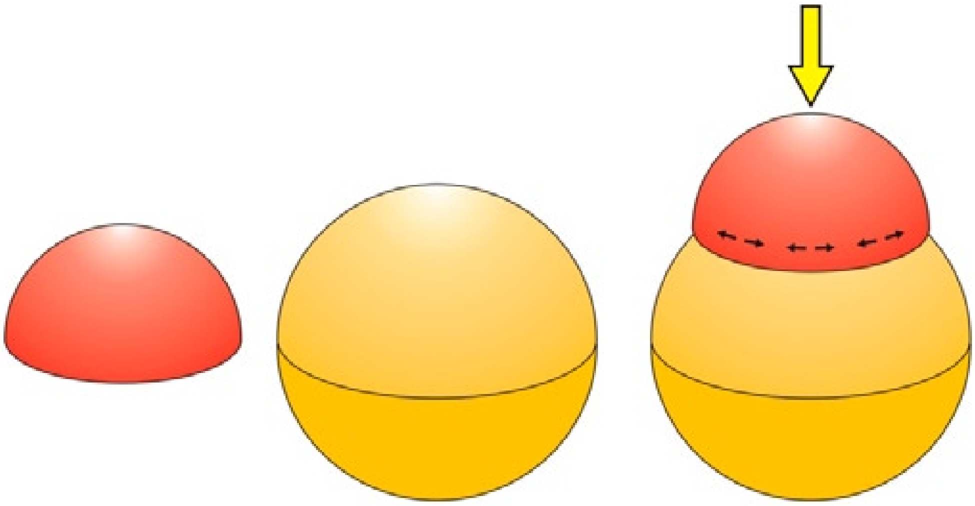
Table II. Wegener's increment in areas of Eurasia and India

Region	Area [10^6 km^2]		Wegener's increment [10^6 km^2]
	Real	Wegener's	
Eurasia	73.0	98.0	25.0
India	5.0	12.8	7.8

As is seen, India is inflated in Wegener's reconstruction over 2.5 times.

Wegener gradually diminished the artificially inflated peripheral regions of his Pangaea during its dispersion. In this way he was able to disperse them despite Meservey's (1969) topological objection that Pangaea occupying one hemisphere cannot disperse on a non-expanding Earth. It is immediately jammed on its perimeter.

The properties of Wegener's Pangaea given above can be presented visually on the following model (Fig. 18):



A

B

Fig. 18. **A** *– own model illustrating artificial stretching of the peripheral parts of Wegener's Pangaea (explanation in the text),* **B** *– Carey's model illustrating the origin of artificial Tethys "Ocean" as an extreme gaping gore (explanation in the text)*

Let us put a small bowl (red) on a bigger sphere (yellow). When we press on the bowl in order to match it to the bigger sphere, the peripheral parts of the bowl will be stretched, just as in Wegener's Pangaea.

If the bowl does not resist the pressure and is torn, a gaping gore will appear (Fig. 18B). This Carey (1976) model exhibits properties of Pangaeas of Wegener's successors who prefer the latter type of solution.

6. Remaining gaping gores in Morgan's testing circuit

The gap between the African and Antarctic plates in Fig. 6B is another example of a gaping gore in Carey's sense. It can be called "Southwest Indian Ocean gaping gore". It is an artefact which disappears on a smaller Earth.

Similarly, pushing the 20 Ma Indo-Australian and African plates against the

Antarctic one produces an analogous gaping gore between them (Fig. 19A). It can be called the “Northwest Indian Ocean gaping gore”.

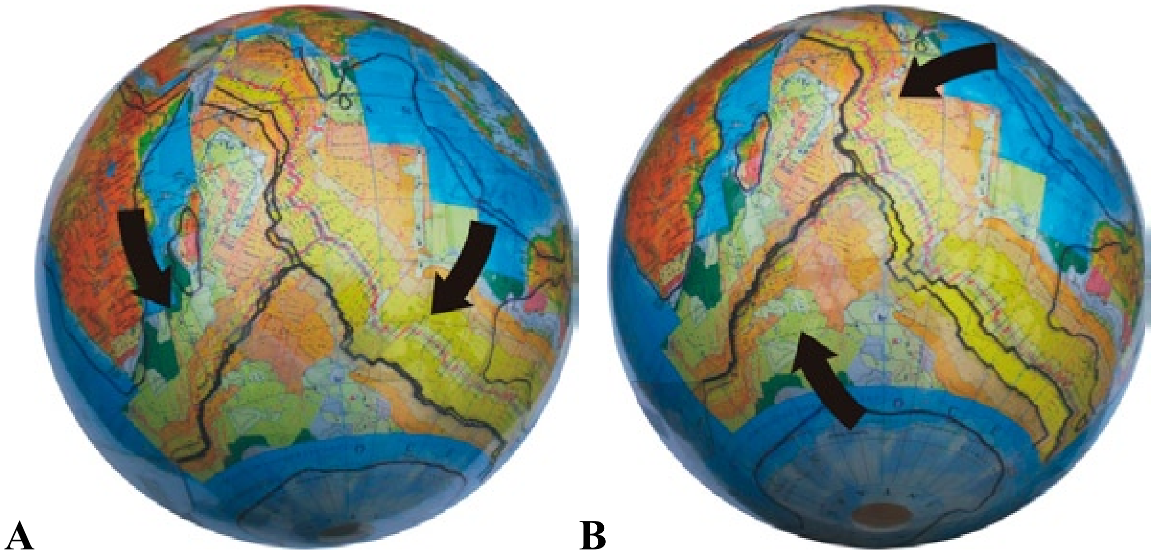


Fig. 19. **A** *– northwest Indian Ocean gaping gore,* **B** *– southeast Indian Ocean gaping gore*

In the same way, pushing the -20 Ma Indo-Australian and Antarctic plates close to the African one produces a subsequent gaping gore between them (Fig. 19B). It can be called “Southeast Indian Ocean gaping gore”.

All three gaping gores disappear on a smaller Earth. This is accomplished by Maxlow’s (1995) reconstructions (Fig. 20)

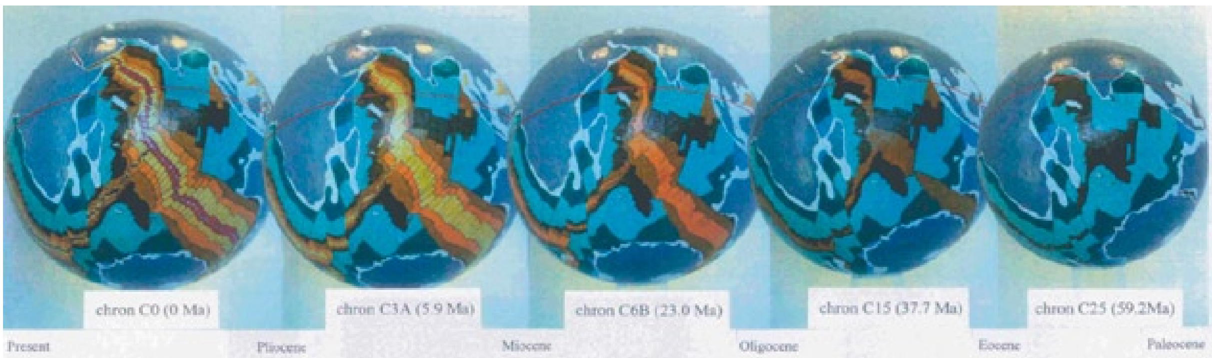


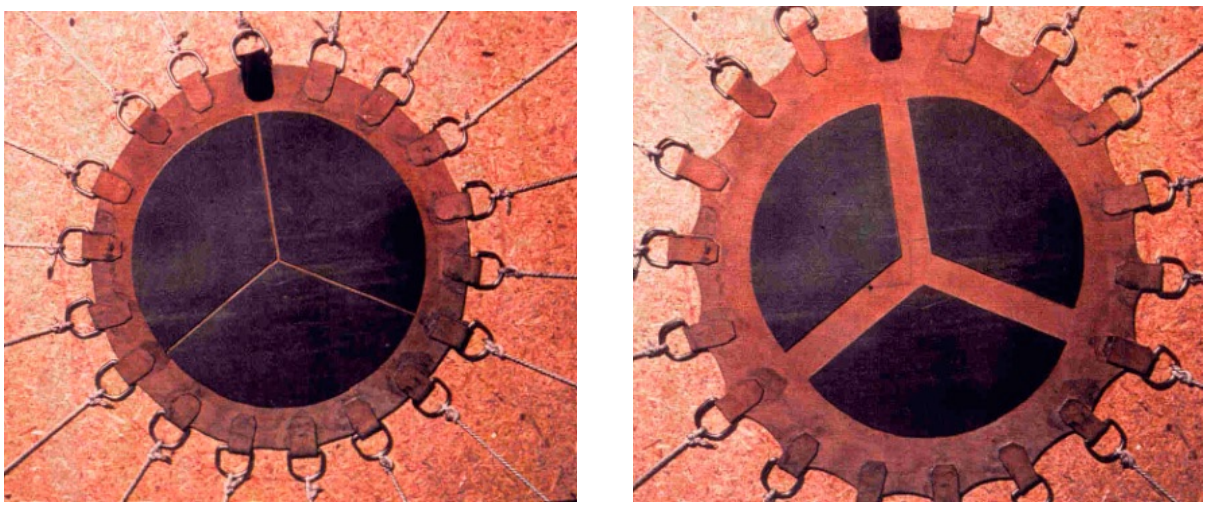
Fig. 20 *Maxlow’s (1995) reconstruction of the Indian Ocean on the expanding Earth. The Ocean is closing without gaping gores*

7. Real geodynamics in the Indian ocean and other triple junctions

Oceanic ridges in the Indian Ocean form the greatest triple junction structure on our globe which denotes divergent movement of three plates that cover almost one hemisphere (Fig. 21A). Kinetic and dynamic explanation of such a structure is very simple on an expanding Earth. It can be demonstrated on a physical model (Fig. 21B, C); see for details (Koziar, 1980) www.wrocgeolab.pl/floor.pdf and geometrical model (Koziar, 1994) see for details www.wrocgeolab.pl/plates.pdf

A

B



C

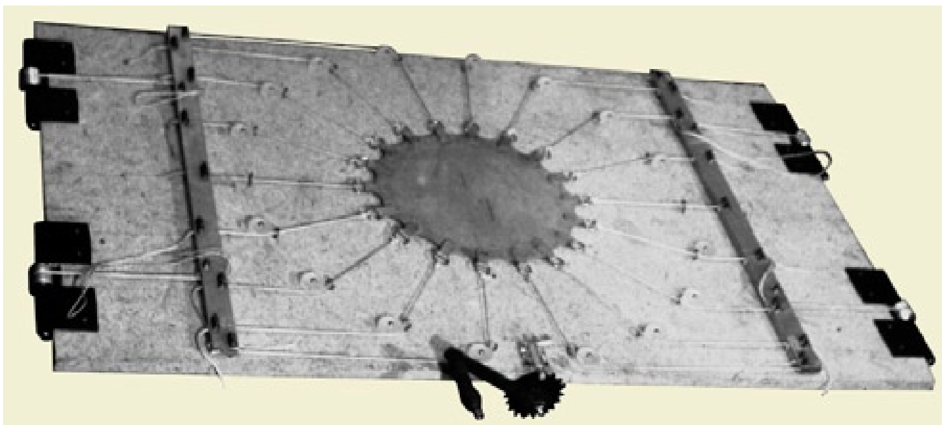


Fig. 21. **A** *– Indian Ocean triple junction with removed post-Paleogene lithosphere,* **B** *– evolution of the triple junction on the expanding Earth demonstrated on a physical model,* **C** *– full view of the device for physical modelling (own construction)*

8. Assumed pivotal diffuse plate boundaries: an attempt to save plate tectonics

a. Discovery of the non-closure of the Indian triple junction by plate tectonicists

The problem described in section 3 was noticed in the frame of plate tectonics several years after Morgan's test was carried out, when the paradigm was already at a full speed. It was done in two subsequent abstracts (Jordan *et al.,* 1976; Minster and Jordan, 1977) and a full paper by Minster and Jordan (1978). In these papers the global pattern of relative plate movement was calculated as the so-called RM2 (Relative Motion 2). The RM1 was calculated four years earlier by Minster *et al*. (1974) and the authors had then already noticed that *"the closure condition applied to different circuits did not yield consistent answers"* (p. 542). In the 1978 paper they wrote that the plate motion <u>in the Indian Ocean</u> [underlining, J.K.]:

> *(...) brings us to the major difficulty that we encountered in constructing RM2 (...) each of three legs of the Indian triple junction are populated by internally consistent data, but the three best fitting vectors sum to a vector (the closure vector) significantly different from zero.* (p. 5344).

The situation became paradoxical. First, plate tectonics had been "proved" on the basis of the Indian Ocean triple junction and now that very structure had become the main problem for the paradigm. Under these circumstances the fundamentals of this paradigm should have been revisited. However by this time plate tectonics had become so popular that another approach was chosen.

b. Assumed bending of the Indo-Australian plate

This other approach was the assumption that an internal deformation of at least one of the Indian Ocean plates is a cause of this difficult situation. To avoid, on a non-expanding Earth, all Indian Ocean gaping gores at least one of the plates should be bending over geological time so that its frontal (Indian Ocean) border has become more convex now than it was in the past. The authors (Minster and Jordan, 1978) examined all three plates in this respect. The Antarctic plate was ruled out at the start because of its very low seismicity. The African plate has a strong seismicity in the east African rift system.

However the mechanics of this system are well-constrained and work in the opposite direction than required. This means that Indian Ocean edge of the African plate has become progressively less convex. So this plate was ruled out too. The only remaining candidate was the Indo-Australian plate with its area of tectonic activity in its equatorial region.

To avoid the strange behaviour of the plates in the Indian Ocean (on a non-expanding Earth) the authors assumed the bending of the Indo-Australian plate to NE direction (Fig. 22A). Such bending allows to change the convergent movement of the kind shown in Fig. 8 to a divergent one.

It must be forcefully stressed that the above *ad hoc* hypothesis is not something added on to the remote periphery of the plate tectonics paradigm but but concerns the analysis of a region critical to the original acceptance of that paradigm. So, plate tectonicists themselves discovered that Morgan's test failed, but they did not point it out.

The task of justifying such assumed bending was undertaken in numerous works starting from the one by Stein and Okal (1978). The single Indo-Australian plate was divided into two independent plates: Indian and Australian, separated by broad diffuse *"nonsubducting convergent plate boundary"* (the term introduced by Gordon *et al*., 1990). It is marked in Fig. 22B.

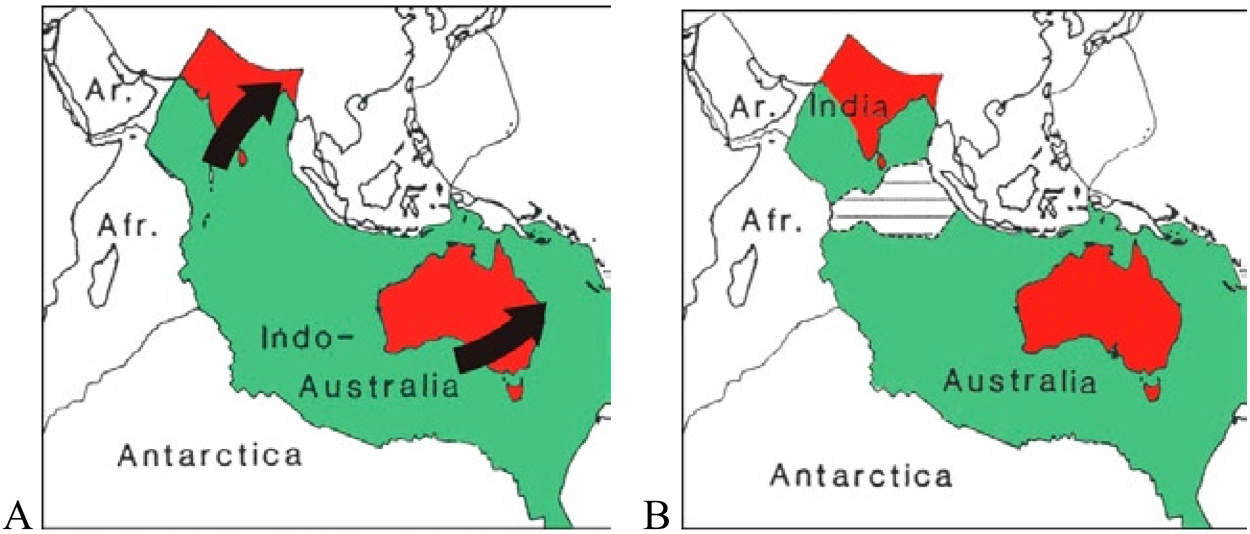


Fig. 22. *Ad hoc attempt to avoid convergence between African and Antarctic plates by:* **A** *– assuming bending out of the Indo-Australian plate to its concave side,* **B** *– breaking this single plate into Indian and Australian ones, separated by a diffuse boundary which is to facilitate such bending out (figures after Gordon et al. 1990, colours and arrows – J.K.)*

Establishing of such a new category of boundary was problematic for plate tectonics, which earlier acknowledged only linear boundaries in oceanic lithosphere. The range of the problem was well expressed by the title of Gordon's (1991) paper: "*Indian Ocean Violates Conventional Plate Tectonic Theory*". In fact the Indian Ocean violates plate tectonics in general and at a much deeper level.

c. Strange position of the introduced Indo-Australian Euler pole and its pivotal mechanics

Invention of the strange bending of the Indo-Australian plate only a transferred of an unacceptable situation from the arms of the Indian Ocean triple junction to the interior of one of three plates, where the situation is unclear and thus susceptible to different interpretations. This 'solution' is analogous to the clearly unacceptable bending toward the interior of the combined Antarctic-African plate shown in Fig. 8B. In further analogy to the situation presented in Fig. 8B, an Euler pole between the newly established plates should lie within the diffuse boundary between them. And so it has been proposed (Wiens *et al.*, 1985; Gordon *et al.*, 1990) – Fig. 23A.

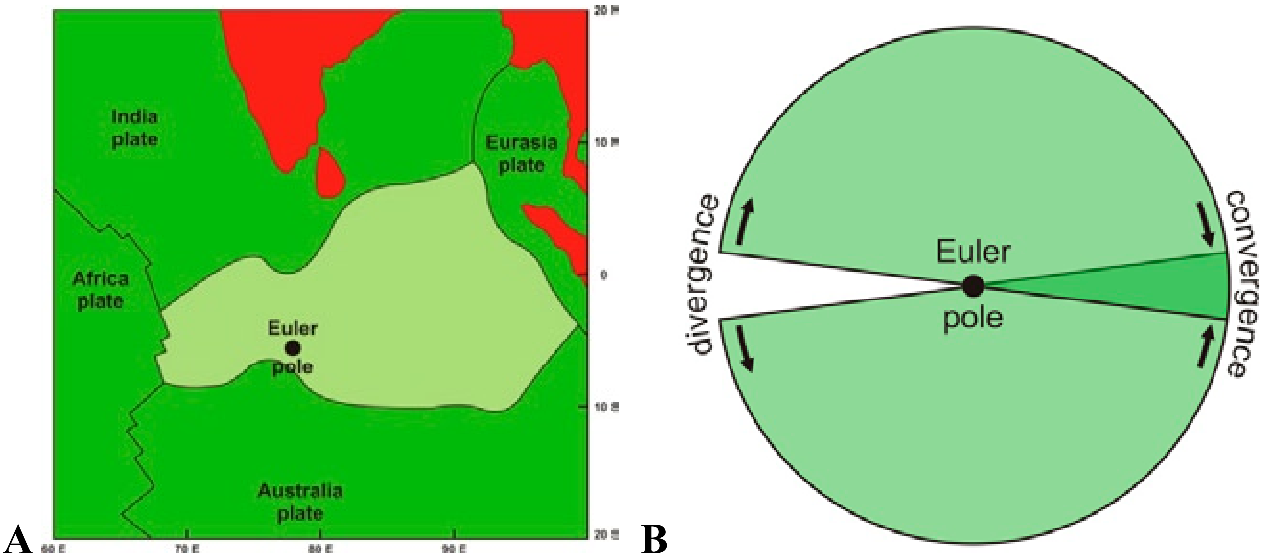


Fig. 23. **A** – *alleged position of Euler pole in Indo-Australian diffuse plate boundary (after Gordon et al. 1990),* **B** – *illustration of the alleged pivotal character of diffuse boundaries on a non-expanding Earth*

Such a position of the Euler pole means that the boundary is scissors-like or pivotal (by analogy to pivotal faults) – Fig. 23B. In Fig. 23A the short western part of the diffuse boundary is divergent but the much larger eastern part should be convergent. This is analogous to the fictitious mechanism presented in Fig. 8B.

Oceanic diffuse plate boundaries have proliferated with time and such a mechanism is now considered typical. Gordon (2009) wrote:

(...) poles of rotation across diffuse oceanic boundaries tend to lie within the diffuse boundary itself, thus separating a region of contractional deformation from one of extensional deformation. (p. 287).

Also the above diffuse boundary within the Indo-Australian plate was widened and supplemented and thus the former single plate was broken into three pieces. The third piece is called the Capricorn plate (Royer, Gordon, 1997) – see Fig. 27A.

d. Apparent shortening of the east part of the Indo-Australian diffuse boundary

Tectonic activity within the Indo-Australian diffuse boundary is displayed by seismicity of generally N-S directed compressional stress (Petroy and Wiens, 1989) and by compressional faults in basaltic basement which generated compressional faults and folds in sedimentary cover in the southernmost part of the Ganges fan. The general shortening is calculated from these faults, which for Ceylon's meridian should be 22-37 km (Chamot-Rocke *et al.,* 1993) or only 11.2 km (Van Orman, *et al.,* 1995). The compressional faulting was an extremely short episode. It started in Late Miocene about 7 Ma ago and finished at about 5 Ma ago. Its end is marked by a prominent unconformity in uppermost Miocene (Weissel, *et al.,* 1980). It seems that recent seismic activity is only reactivation of this old event and has yet to cause any new recorded deformation in the sedimentary cover.

The compressional faults are generally considered to be previously normal faults connected with an old spreading centre (the local crust is of Cretaceous age), reversed at 7 Ma. However, an exclusively Cretaceous age of the tensional stage of the reversed folds is dubious. The short and intensive event of reversing is exactly the same as in continental basin inversions. Continental basins were earlier recognized as diffuse boundaries and they are generally tensional with short events of inversion connected with reversion of normal faults. The normal faulting lasted up to inversion and had not caused significant deformation in sedimentary cover. So, in case of the central Indian Ocean diffuse boundary, the normal faulting should also be in part of Miocene age. But that is not all.

In the frame of plate tectonics, basin inversion is connected with regional shortening and convergent plate movement. This leads to very big problems in explaining a sudden reversal of relative plate movement involving an assumed long-distance transfer of pressure through weak parts of the crust which until then have been stretching.

The simplest and most natural solution is to explain the inversion by a stronger tensional event of (the same motion as before), causing isostatic uplift and changing the normal faults to reverse ones. The contact of both walls of the reversed faults during the uplift is maintained by gravitational spreading of uplifted parts. Such a solution was applied to inversion of the Polish Basin in Late Cretaceous (Koziar, 2007; www.wrocgeolab.pl/inversion.pdf). So, reverse faulting is in fact connected with stretching not shortening of the lithosphere and its direct cause is uplifting.

The Central Indian diffuse boundary has a high heat flow. The flow should be linked with tensional decompression and subsequent thermal activation of upper mantle.

According to Stein and Okal (1978) "*If the NE-SW trending furrows and ridges to the west of the ridge* [Ninetyeast – J.K.] *are tectonic in origin they suggest NW-SE compression*" (p. 2240). However, according to the accepted interpretation of the west American Basin & Range province, they suggest NW-SE tension.

According to Petroy and Wiens (1989) recent seismicity confirms also contraction of the eastern part of the Indo-Australian diffuse boundary marked by compressional stresses deduced from earthquakes. Lines of these stresses are parallel to the Sumatra-Nicobar trench. However we can consider the tension directions resulting from focal mechanism solutions as a real cause of the earthquakes. Then the earthquakes denote tensional stresses perpendicular to Sumatra-Nicobar trench (Fig. 24) which is (as all trenches) a tensional structure.

Plate tectonicists, dealing with the Indo-Australian diffuse boundary, try to attribute recent left-lateral motion to the Ninetyeast ridge (Stein and Okal, 1978; Wiens *et al.* 1985; Wiens et al. 1986; Gordon et al.1990). However the general motion along the Ninetyeast transform fault was dextral (Fig. 25) before it ceased 32 Ma ago.

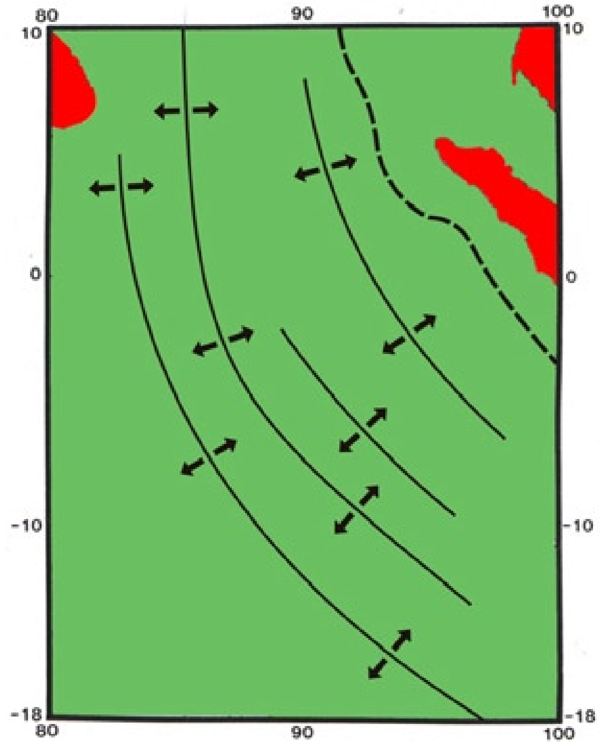


Fig. 24. *Lines of tension perpendicular to Sumatra-Nicobar trench – broken line (explanation in text)*

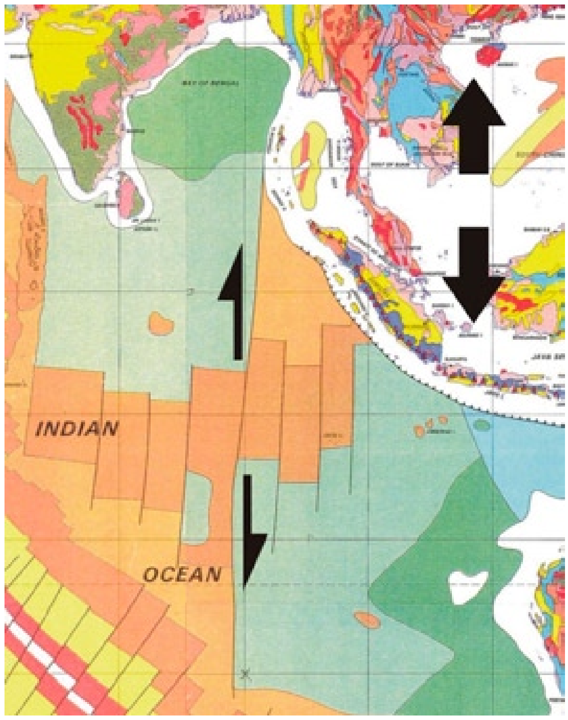


Fig. 25. *Dextral motion on Ninetyeast transform fault and divergence between Australia and southeast Asia (explanation in text)*

This dextral motion does not however signify a collision of India with the Asian continent but <u>moving away</u> of Australia from India <u>and the Asian continent</u>. The latter motion (another critical process for plate tectonics) is indicated by thick arrows in Fig. 25. The justification of the divergence between south-east Asia and Australia is given in my paper (Koziar, 1991); www.wrocgeolab.pl/Pacific.pdf .

Nonexistence of collision between India and the rest of Asia collide of course with a main tenet of the plate tectonics paradigm. However the fold belts develop in fact by the tension-diapiric-gravitational mechanism. This was first shown by Carey (1958, 1976) and is presented in the papers by Koziar and Jamrozik (1985); www.wrocgeolab.pl/Carpathians.pdf and Koziar (2005).

Thus the tension between Australia and southeast Asia is realised by bending-out of the Indo-Australian plate after dextral movement on the Ninetyeast transform fault ceased. The ceasing was caused by the tearing away Antarctica from Australia and thus a significant decrease of tension between Australia and southeast Asia. The bending-out is modelled below.

9. Real bending-out deformation of the Indo-Australian plate

Bending-out of the Indo-Australian plate can be modelled on similar device as the one (Fig. 21C) used for modelling of development of the Indian Ocean triple junction. This is a more recent version of the former device. The Indo-Australian plate is simulated by half of a compact disc (CD) covered by red self-adhesive paper. The model plate is cut in half and put on a map of the east hemisphere (Fig. 26A) for comparison with a real situation. Then both halves of the model plate (the future separate Indian plate and Australia plate) are connected by two pieces of rubber band glued at their ends to the paper. Then the whole model is put a silicon disc being stretched and simulating the expanding sublithospheric mantle (Fig. 26B).

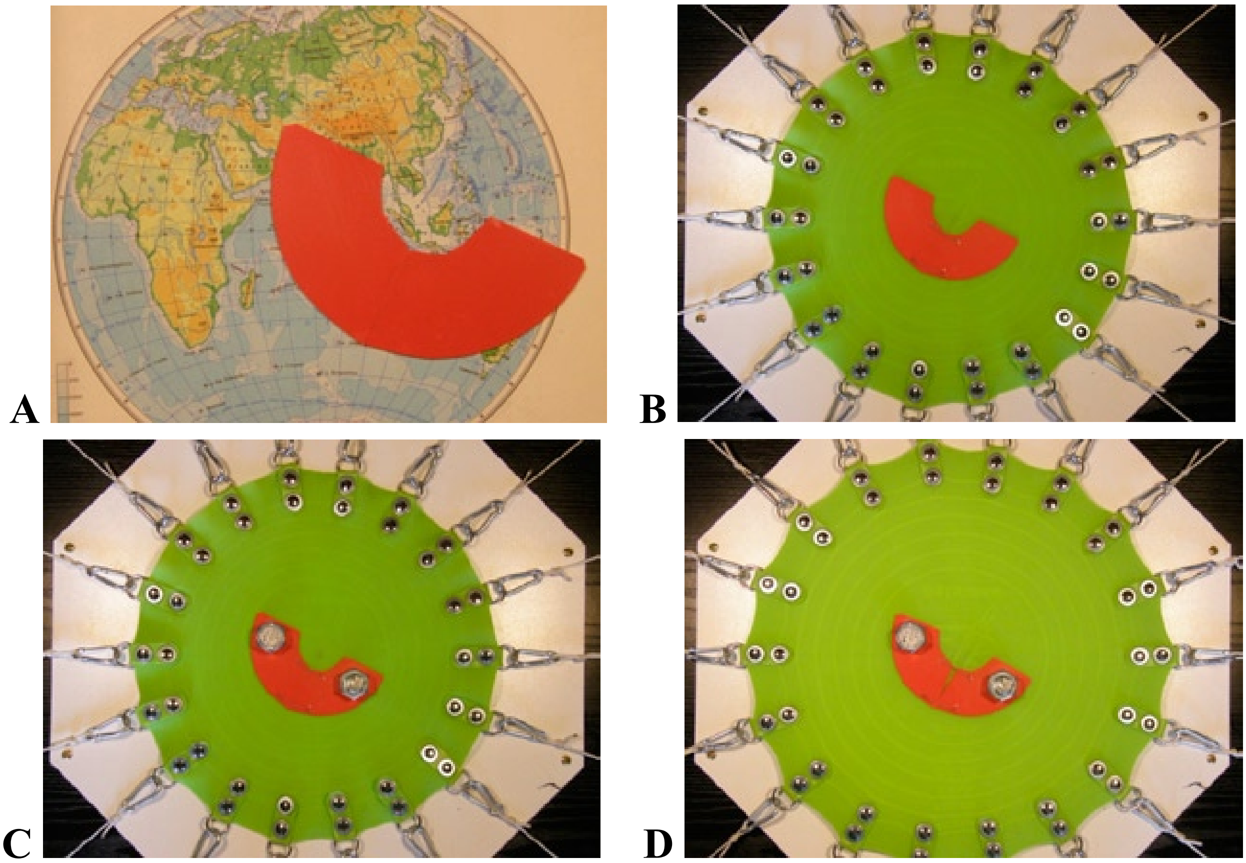
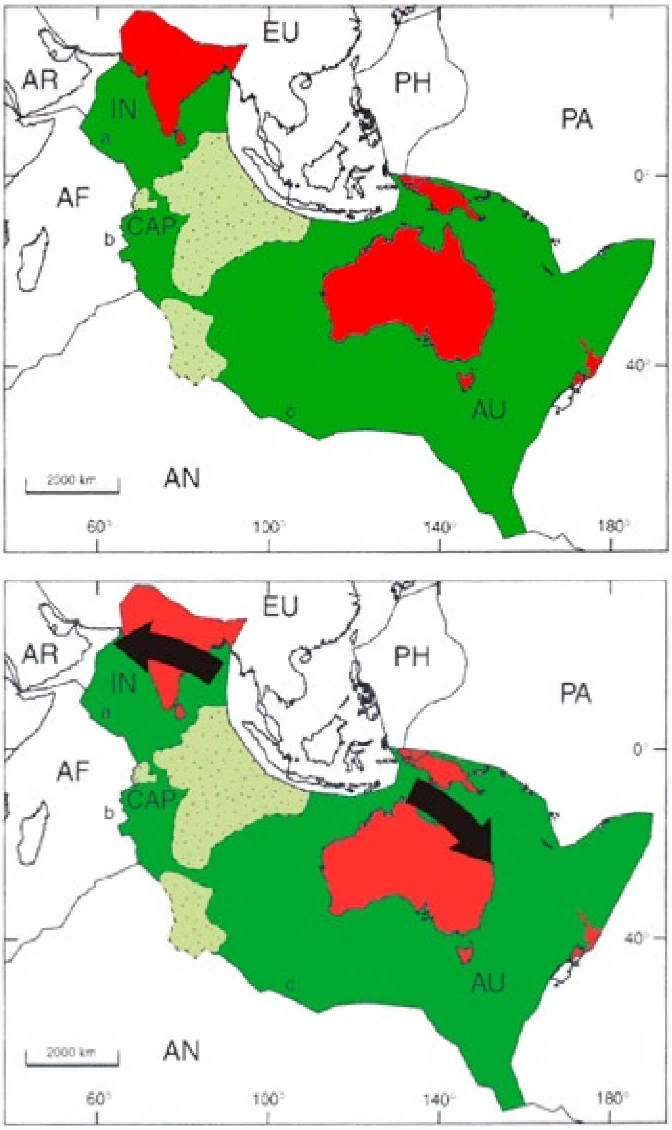


Fig. 26. *Modeling of bending-out of the Indo-Australian plate on the expanding basement (explanation in text)*

Because the CD plate is very light the ends of the model plate were burdened with metal weights (Fig. 26C) to assure friction able to overcome the elasticity of the rubber fibres. Weighting the model at its ends is justified because there is continental lithosphere more connected with sublithospheric mantle than is the oceanic lithosphere. During stretching the silicon disc the model of Indo-Australian plate is bending-out (Fig. 26D) as was expected.

As was mentioned in subsection "Strange position of the introduced Indo-Australian Euler pole and its pivotal mechanics" the diffuse boundary between India and Australia was enlarged by other authors and a third plate (the Capricorn plate) was postulated (Fig. 27A – according Vita-Finzi, 2004). Such a diffuse boundary fits better with bending-out of the Indo-Australian plate (Fig. 27B).

Of course bending-out of the Indo-Australian plate reduces the size of the Indian Ocean triple junction gaping gores (Figs 7B and 19A and B). Deformation within the African plate (separation of the Somalia plate) has a similar effect – see comment in subsection 7B.



A

B

Fig. 27. Bending-out of Indo-Australian plate (explanation in text)

Thus, if the plates bordering the Indian Ocean triple junction had been more rigid (as according the early assumption of plate tectonics), their gaping gores would have demonstrated the process of expansion of the Earth even more spectacularly.

Summing up – the geotectonics of the Indian Ocean is quite simply beyond the plate tectonics paradigm.

Chu and Gordon (1999), struggling with extraordinary complicated tectonics of the Indian Ocean on a non-expanding Earth, concluded that: *Simplicity has not been a good guide in predicting the tectonics of the Indian Ocean,* p. 66. The truth is quite opposite but on the expanding Earth.

10. Plate tectonics problems with triple junctions

Triple junctions have been on a losing streak in the frame of plate tectonics from the very beginning. No set of convection currents or slab-pull-ridge-push mechanisms could be harmonized with these structures and plate tectonics gave up very early and generally on its driving mechanism (its only "advantage" over an expanding Earth) and focused instead on its alleged success in describing the kinematics of plate movements.

However, as this paper has revealed, plate tectonics has not been successful as a kinematic theory, either – as its difficulties with triple junctions show.

McKenzie (1970) wrote:

> *Though McKenzie and Parker (1967) made and attempt to discuss points where three plates meet, they were not especially successful.* (p. 327).

In the paper (McKenzie and Morgan, 1969) devoted exclusively to the triple junctions the problem became even more intricate. The more it become in the quoted paper (McKenzie,1970) where the author wrote that the*"results will not be discussed here in detail, since the problem is somewhat complicated*"(p. 328). The problem was still complicated and still unsolved in the following paper (McKenzie and Parker, 1974). The authors wrote in their abstract:

> *an attempt is made to determine the value of o the relative acceleration of the plates forming a single triple junction when they are governed by kinematic effects alone, but the resulting values do not agree with the available observations.* (p. 285).

The non-closure of Eulerian circuits for triple junctions has now become typical for these structures. Apart from the one in the Indian Ocean, two other prominent triple junctions: Pacific-Cocos-Nazca and Sur-Nubia-Antarctic also fail to close (DeMets *et al.,* – 2010).

11. Global consequences of the acceptance of the false Eulerian plate motions

After Morgan established the vectorial principles of plate tectonics, subsequent global circuits were constructed for global calculations of plate motion. It is interesting that only the author of the first global calculation of plate motion (Chase, 1972) mentioned the assumption of "*constant area of the Earth*" (p. 117) which is crucial for the whole procedure.

Below, the global circuit constructed by DeMets *et al*. (1990) is presented (Fig. 28).

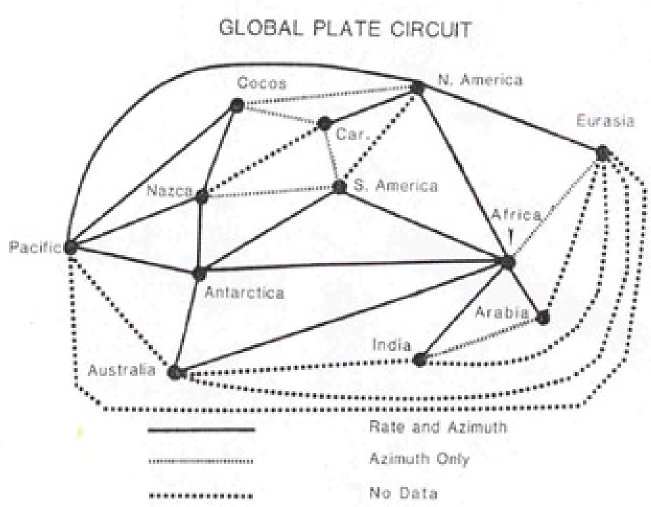


Fig. 28. *Global net of Euler vectors circuits (by DeMets et al., 1990)*

It must be pointed out again that all direct quantitative determinations of relative movement between plates were made only on the basis of spreading at oceanic ridges. These relations are represented in Fig. 29 by solid lines. <u>All these divergent motions agree with an expanding Earth</u>. Relative movements on assumed convergent plate boundaries were calculated <u>indirectly</u> (by summing Euler vectors), starting from divergent boundaries and assuming a "constant area of the Earth" (dotted lines). It is obvious that the real <u>empirical</u> divergence combined with the above assumption must lead to only <u>deduced</u> convergence.

Such a logical structure is clearly visible in Le Pichon's 1968) text:

> *If the earth is not expanding, there should be other boundaries of crustal blocks along which surface crust is shortened or destroyed.* (p. 3673).

In Eulerian calculations this approach gives quantitative results. These quantitative estimates of convergence, though obtained in a sophisticated, mathematical way, are not any proof of convergence. Such a "proof" is only one of plate tectonics' circular arguments[1], but here they are performed by means of mathematics. In particular, the total area of the oceanic lithosphere, produced by spreading (which is about 3.5 km^2/yr), must be in this way completely "consumed". So, referring to the *well maintained balance of the Earth surface area* as an argument against expanding Earth (Dziewoński, 1999, p. 28) is a complete misunderstanding.

Acceptance of Eulerian plates kinematics has had a special influence on space geodesy. Its mobile reference frames are based on this concept. This topic is discussed below and in a separate papers (Koziar, 2011, 2018 – www.wrocgeolab.pl/geodesy1.pdf ; www.wrocgeolab.pl/geodesy2.pdf).

Forcing of geotectonics into an artificial **ω**-space and cloaking it by sophisticated calculations is mainly responsible for the unjustified prestige success of plate tectonics and the marginalization of the geological and empirical way of thinking in geotectonics.

However, plate tectonics vectorial calculations, starting from real spreading areas, lead also to results contradictory to plate tectonics. Such is the global plan of plate motions which supports Carey's Arctic Paradox and consequently proves the expansion of the Earth (Koziar, 2011, www.wrocgeolab.pl/geodesy1.pdf).

12. Problems of Eulerian motion of plates with driving mechanism and absolute reference frames

Both driving mechanism and absolute reference frame of lithospheric plates are very simple on an expanding Earth. The driving forces are only the friction forces between rigid plates and the underlying stretched plastic mantle. The expanding mantle is simultaneously the absolute reference frame for the rigid plates (Koziar, 1980 and 1994; www.wrocgeolab.pl/floor.pdf and www.wrocgeolab.pl/plates.pdf), see also Figs 21, 26, 39 and 40 of this paper. The same topics are hopeless problems for Eulerian motion of plates i.e. the motion on a non-expanding Earth. I pass over the hopeless and ineffective attempts of plate tectonics with convection currents and slab-pull-ridge-push mechanisms and keep to the problem of its absolute reference frames. There are two frames in common use: the hot spots absolute reference frame and the NNR (no-net-rotation) absolute reference frame. The plans of global plate motion in both frames will be presented below. Apart

[1] Plate tectonics circular arguments consists in building of models based on a non-expanding-Earth assumption and then treating them as proofs of this assumption.

from differences in absolute reference frames there are differences in the data utilised. Some are geological (spreading rates and azimuths of transform faults) and some geodesic (space geodesy measurements). The first are averaged over the past 3 Ma the second over the last few decades. Eulerian results using of both kinds of measurement will be discussed separately.

a. Hot spots absolute reference frame – geological data

Hot spots over mantle plumes really exist but they are impossible on a non-expanding Earth because of the assumed great mobility of the upper mantle connected with assumed plate tectonics driving mechanisms. All mantle plumes are moving apart from one another. This was first noticed by Stewart (1976) and was properly treated by him as one of the proofs of Earth expansion (see Koziar, 2004; www.wrocgeolab.pl/handbook.pdf) This moving apart of mantle plumes on the expanding Earth is connected with their stable position relative to the mantle. On the non-expanding Earth the mantle plumes, moving relatively to each other are also moving relative to the mantle. Thus they are a poor base for an absolute reference frame for Eulerian motion of the plates. Despite this problem they were used by plate tectonicists to play this role. The first attempt was made by Minster *et al.* (1974). See Fig. 29.

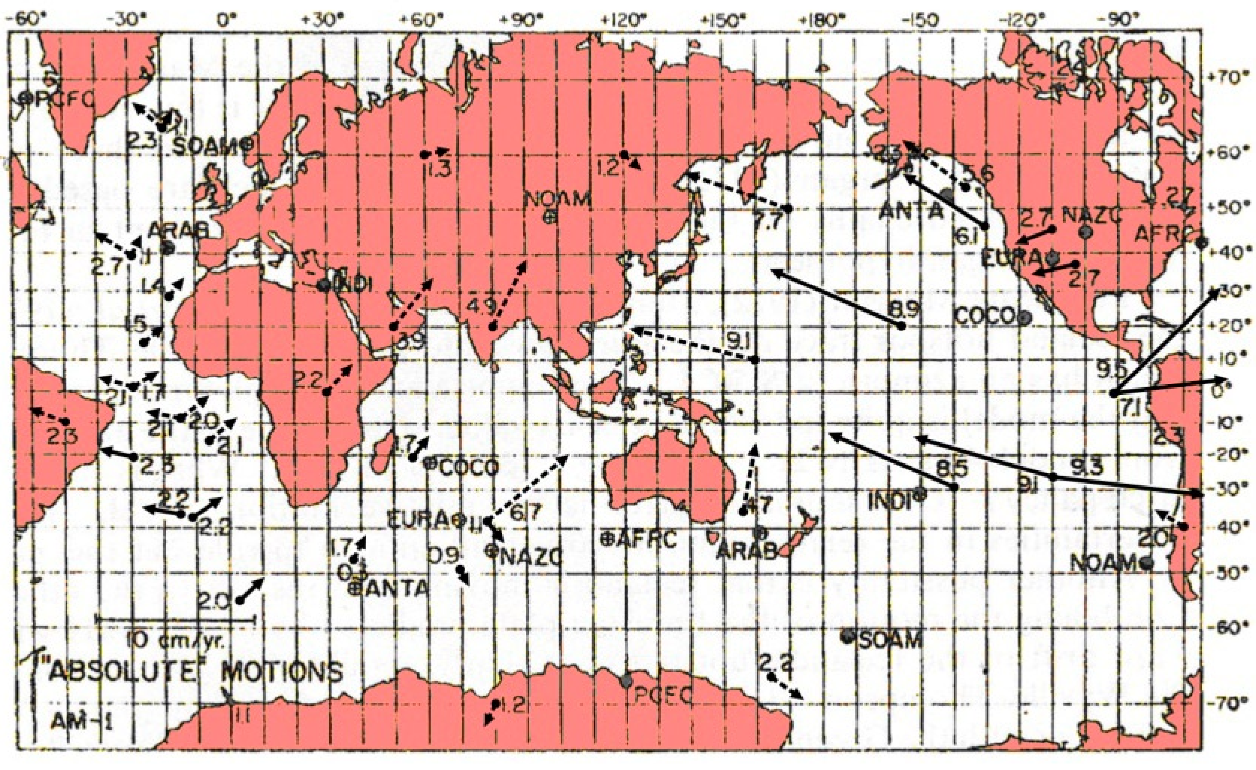


Fig. 29. *Present global plate motion in hot spots absolute reference frame (Minster et al. 1974)*

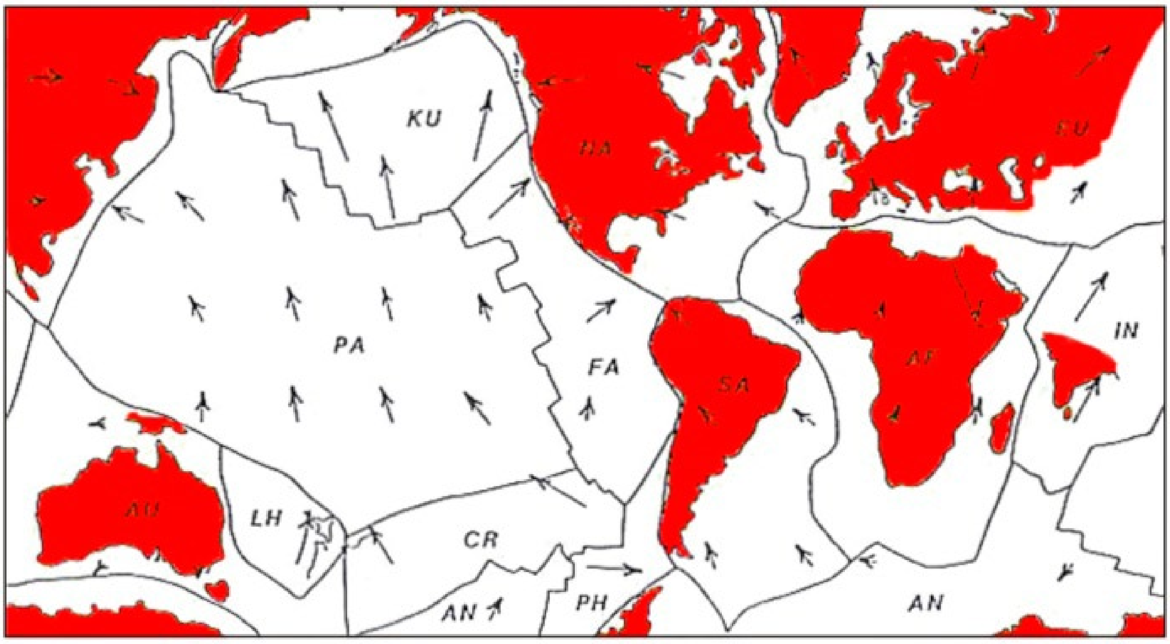


Fig. 30. *Global plate motion in hot spots absolute reference frame in Paleocene (Jurdy and Gordon, 1984)*

A peculiar feature of both obtained global plans is general northward motion of the plates away from the Antarctic plate. The pattern is repeated in other attempts of this kind These strange plans will be commented on later.

b. NNR absolute reference frame – geological data

NNR means no-net-rotation condition for the sought-after absolute reference frame. It means that in this reference frame the sum of all Euler vectors (of all plates) should be equal to zero. The method is based on so-called Tisserand condition for finding the simplest reference frames for various physical systems. The first attempts to apply the Tisserand condition to Eulerian plate motion was made by Lliboutry (1974) and Solomon and Sleep (1974). However the first transfer of global motions, calculated originally relative to the Pacific plate, to the NNR reference frame, was made by Minster and Jordan (1978). However the authors did not present a map of such absolute motions. This was done first by Argus and Gordon (1991) in their NNR-NUVEL-1 model (NUVEL is abbreviation from Northwestern University VELocities). The model was deduced from a basic model of movement relative to the Pacific plate – NUVEL-1 (DeMets *at al.* 1990). In 1994 the NNR-NUVEL-1 was updated using a revised geomagnetic timescale (DeMets *et al.* 1994) and labelled NNR-NUVEL-1a. A coloured map of this plan (Fig. 31) is available in Internet.

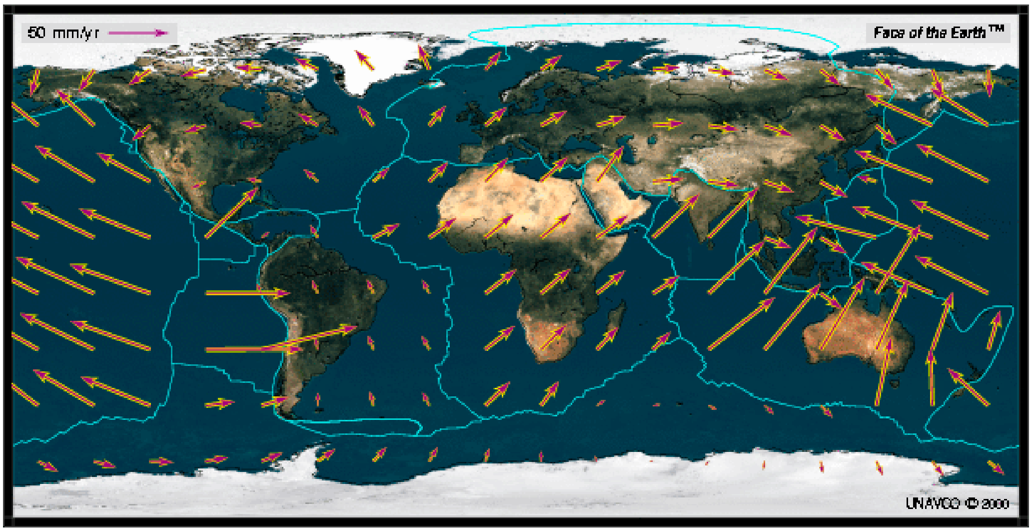


Fig. 31. *Present global plate motion obtained by plate tectonics in the NNR absolute reference frame (DeMets et al., 1994)*

As is visible the plan is almost the same as in Fig. 29.

c. NNR absolute reference frame – geodetic data

Space geodesy has developed its own absolute references frames also using NNR condition and Eulerian calculations. They are called International Terrestrial Reference Systems (ITRSs). Because they are evolving with time they are periodically updated and identified by the year of updating – for instance ITRF2005. The global plans of plate motions is also obtained by Eulerian calculations. The global plan for ITRF2005 was calculated by Altamini *et al*. (2007) and is presented below in Internet version (Fig. 32).

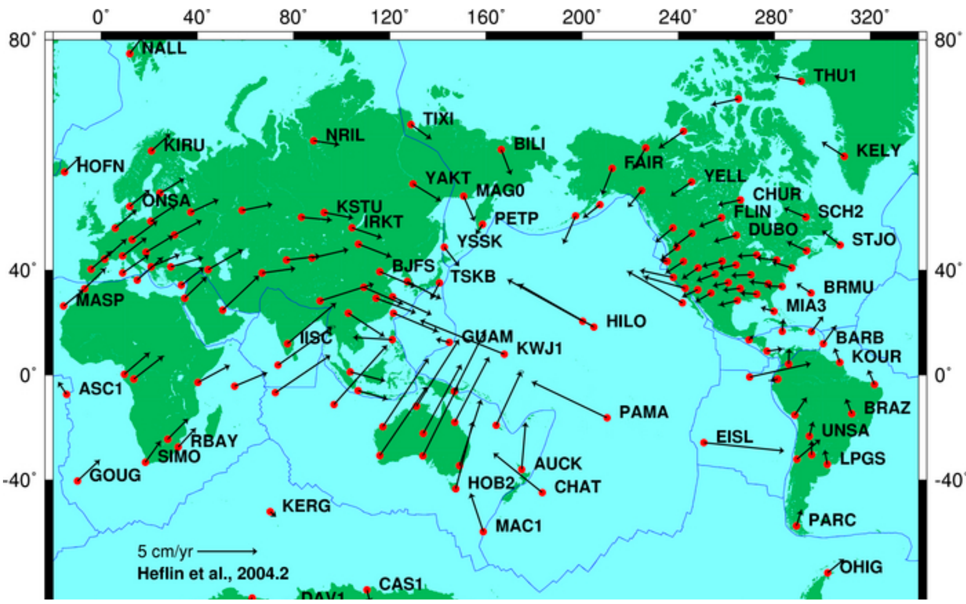


Fig. 32. *Global NNR plate motion based on geodetic data*
http://itrf.ensg.ign.fr/ITRF_solutions/2008/ITRF2008.php

As is visible the plan is almost the same as in Fig. 31.

d. MORVELs and GEODVELs

Global plans of plates motions are continuously updated and more and more plates are enumerated. Recently their number reached 56 (Argus *et al.,* 2011). The plans based on geological data are called MORVELs (Mid Ocean Ridges VELocities) and those based on space geodesic data GEODVELs (GEODesic VELocities). These are compared each other, *e.g.* (Argus *et al*., 2009; Altamini *et al*., 2012) but the differences are small and general global plan is always as in Figs. 31 and 32.

e. Impossibility of global Eulerian motion of plates

All plates (apart from the Antarctic plate) on all plans of Eulerian absolute global motions move northward and this is not balanced by proper southward motion. Reverse motion of plates is very weak and problematic. One main current, starting from Africa and Europe in north-east direction, turns indeed to south-east in east Asia but significantly and inexplicably ceases. The other main current, starting in north-west direction in the east part of north American plate, turns indeed to south-west in the west part of North America and should cause a collision with the Pacific plate. However there is not a convergent boundary but a transform fault boundary. What is more, in front of the San Andreas fault there is a very wide area of tension (Basin & Range province) not compression.

To sum up, the conclusion is that global Eulerian motion of lithospheric plates is impossible. The unreasonable plan of global plate motion that results when the motions are assumed to be of Eulerian character is resolved in the frame of Carey's Arctic Paradox that is – on the southwardly expanding Earth (see below). Of course on the expanding Earth relative and absolute motions of plates have nothing to do with Euler's theorem.

13. Carey's Arctic Paradox as a proof of the dominant southward expansion of the Earth

a. Carey's Arctic Paradox – schemes

Carey (1976) noticed that all plates apart from the Antarctic one move northward. The plan is well visible around the Antarctic plate (Fig. 33).

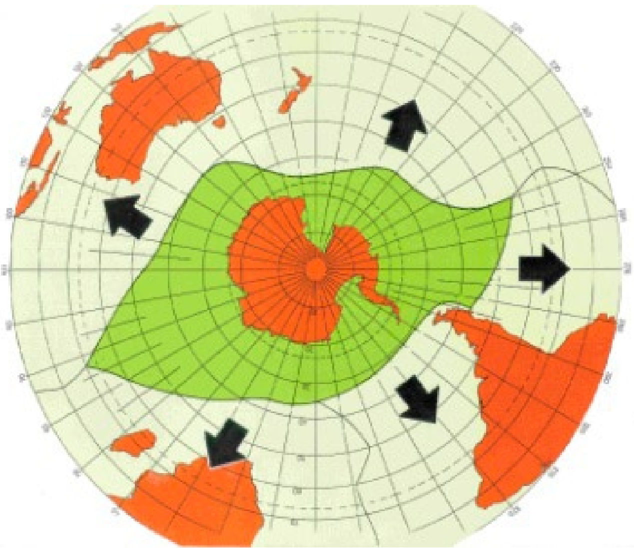


Fig. 33. *Northward movement of all plates surrounding the Antarctic plate*

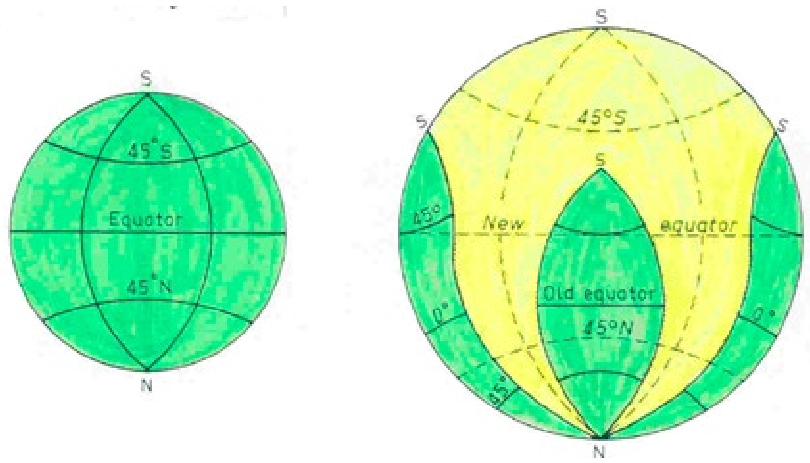


Fig. 34. *Arctic Paradox presented in Carey's model of a flower bud (Carey, 1976)*

Carey confirmed this movement in the northern hemisphere with data on the northward shifting of paleoclimatic zones and paleomagnetic latitudes. On an Earth of constant dimensions such a northward movement of the plates should result in convergence in the Arctic zone. However the dominating structure in this region is the Arctic Ocean which has a divergent origin. This structure documents a general southward movement of plates in the Arctic area. The two opposite movements are precisely what constitute the Arctic Paradox (but only on a constant-size Earth). The only solution of this paradox is an expanding Earth.

Carey demonstrated the solution on his model of a flower bud opening upwards (Fig. 34) but it plays better in reverse position (Fig. 35A) with conventional orientation of geographical poles. Carey's model can be compared with a real flower bud (Fig. 35B) and with professor Józef Oberc's "shabby soccer ball" model (Fig. 35C). The latter takes into account the position of the Antarctic plate.

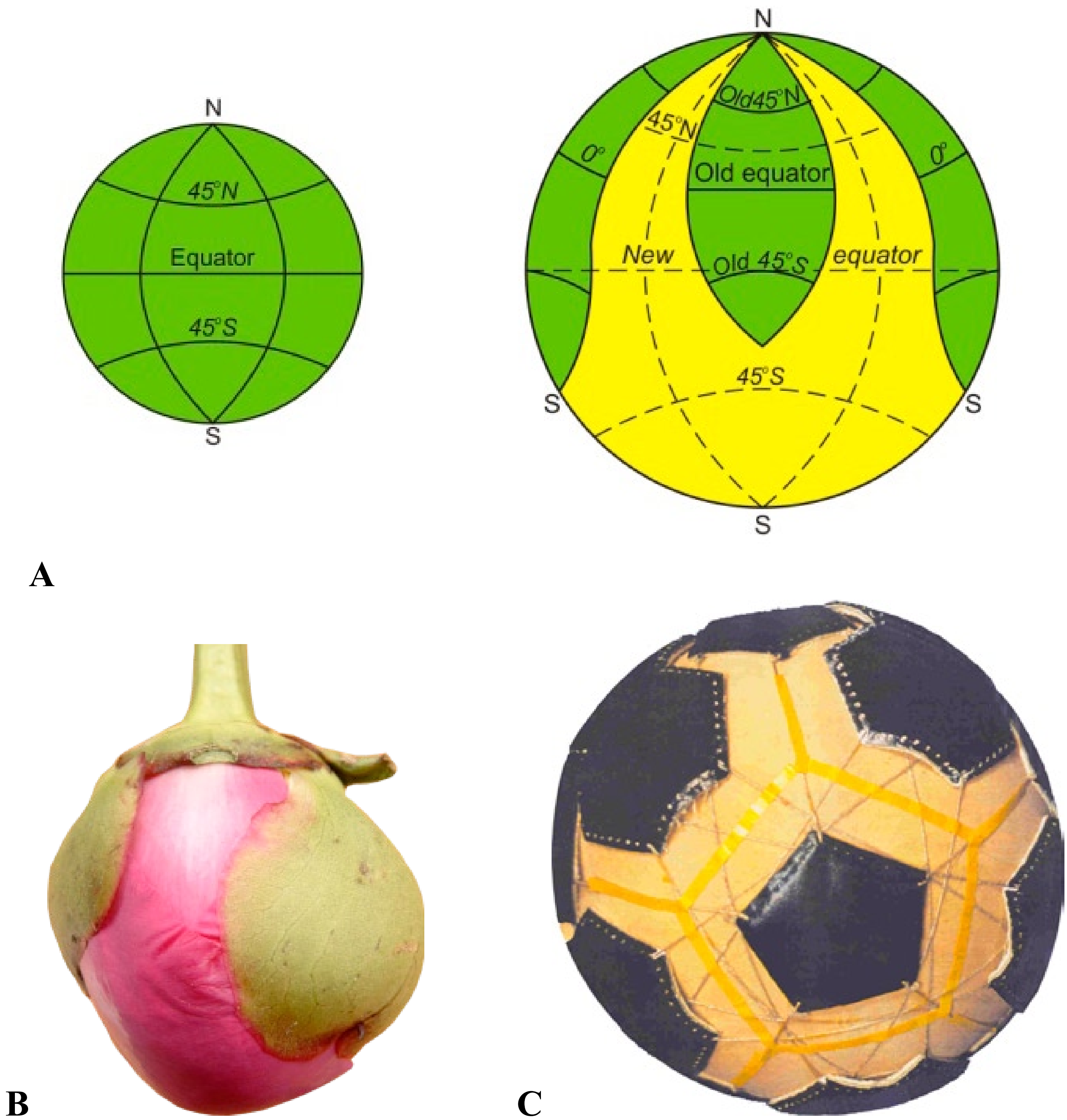


Fig. 35. *Various models of the Arctic Paradox:* **A** *– Carey's model of flower bud in inverted position,* **B** *– natural model of peony bud,* **C** *– Oberc's model of "shabby soccer ball"*

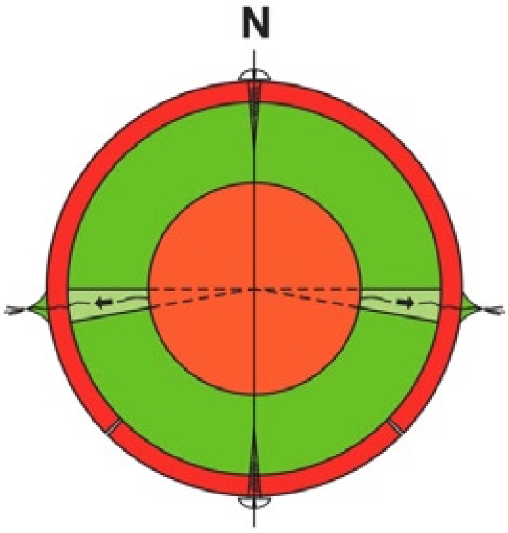
The solution of the Arctic Paradox is not only the expanding Earth but the asymmetrically southward expanding Earth. The essential movement is in fact the southward movement of the deep mantle relative to almost all plates except for the Antarctic one. The northward movement of plates relative to the mantle is only an apparent one.

All the plates in the Arctic Paradox pattern, apart from the Antarctic one, form one huge northern megaplate. This megaplate has global integrity despite large tears between its partially independent fragments.

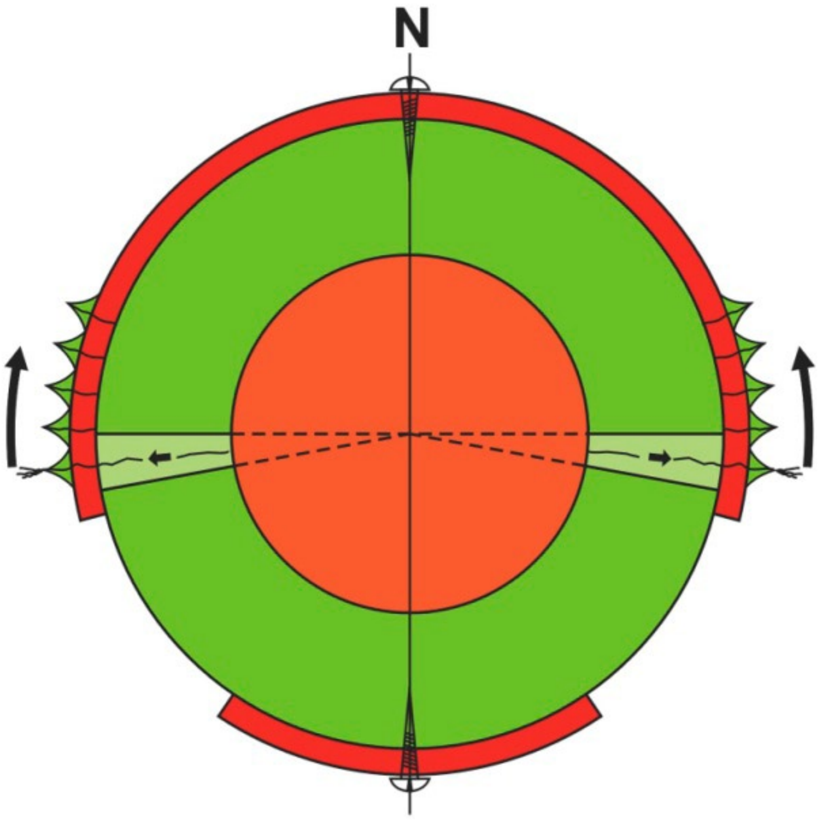
b. Hot spots and their volcanic chains confirm Carey's Arctic Paradox

Independent confirmation of the Arctic Paradox pattern (not used by Carey[2]) is provided by volcanic chains generated by hot spots.

Let us consider a small continental Earth with an initial northern megaplate, a small southern plate and two antipodal mantle plumes placed in its equatorial plane (Fig. 36A).



A



B

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[2] Carey's attitude to the concept of hot spots was critical.

C

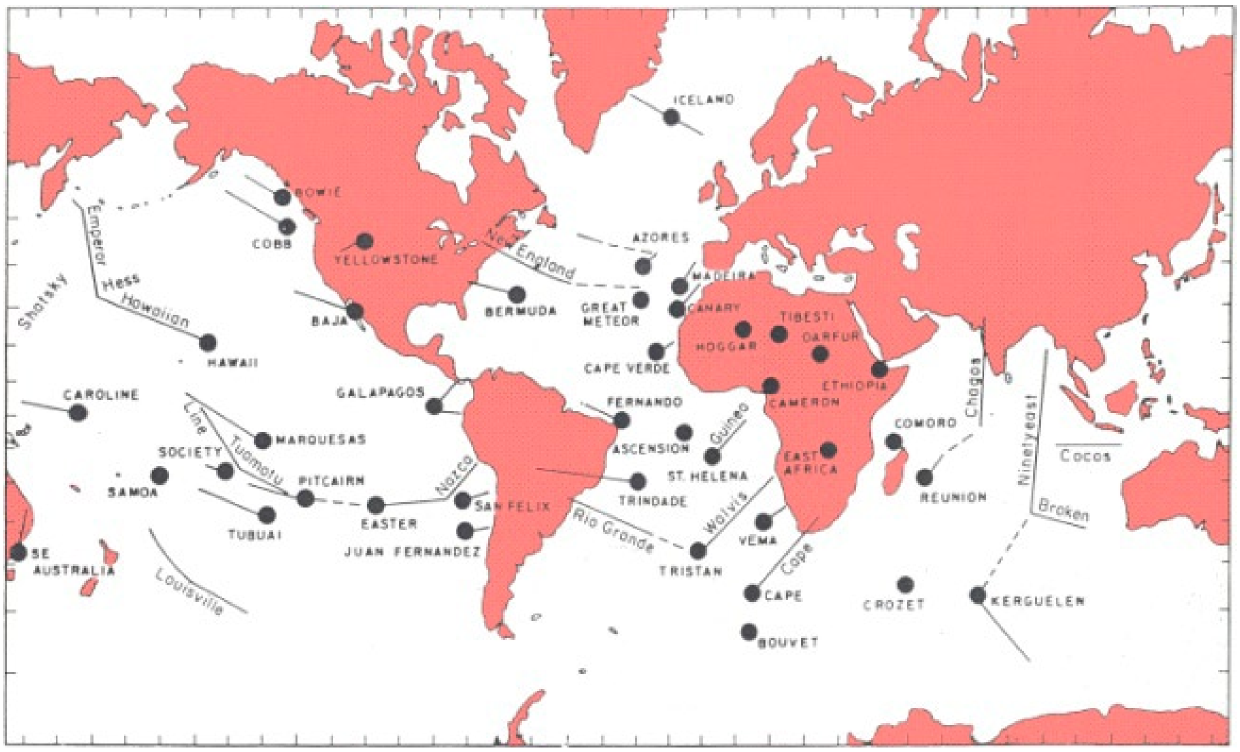


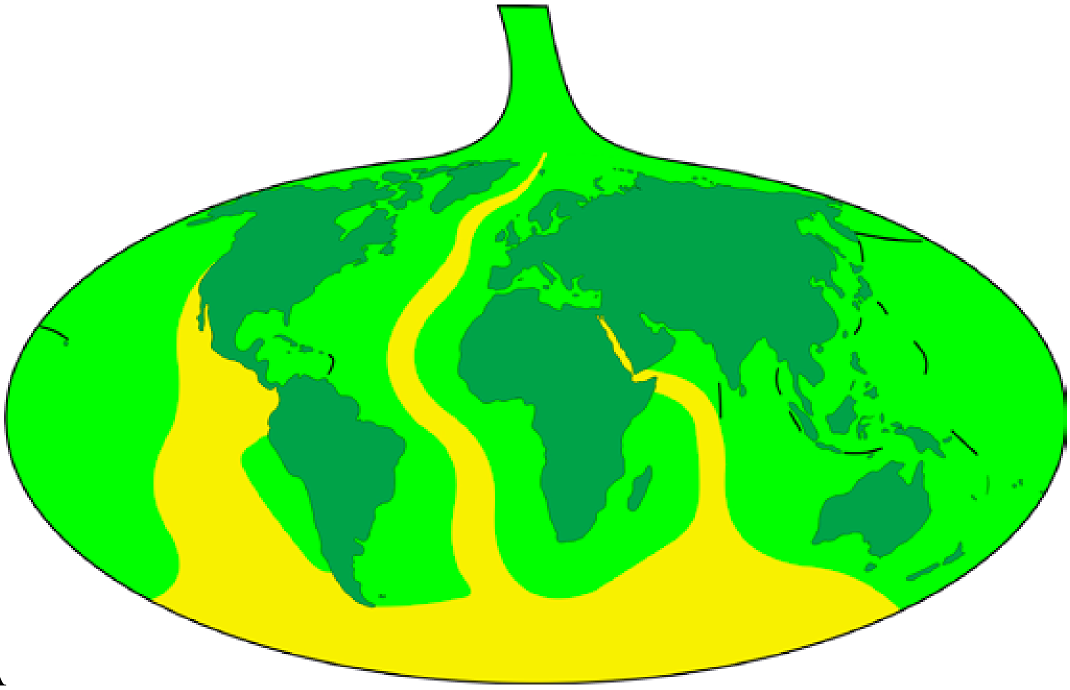
Fig. 36. *Own model of the Arctic paradox with hot spot volcanic chains,*
A *– initial situation,* **B** *– present situation (explanation in text),*
C *– global pattern of hot spot volcanic chains*
(Thompson and Morgan, 1988)

During expansion the whole megaplate apparently migrates northward (apart from north pole) and both mantle plumes (preserving constant position in the mantle) produce volcanic chains directed northward (Fig. 36B). This rule is valid for all chains on the northern megaplate. In fact the megaplate is being enlarged all the time by oceanic lithosphere and reaches all the time to the southern plate which is being enlarged in the same way (see Fig. 33).

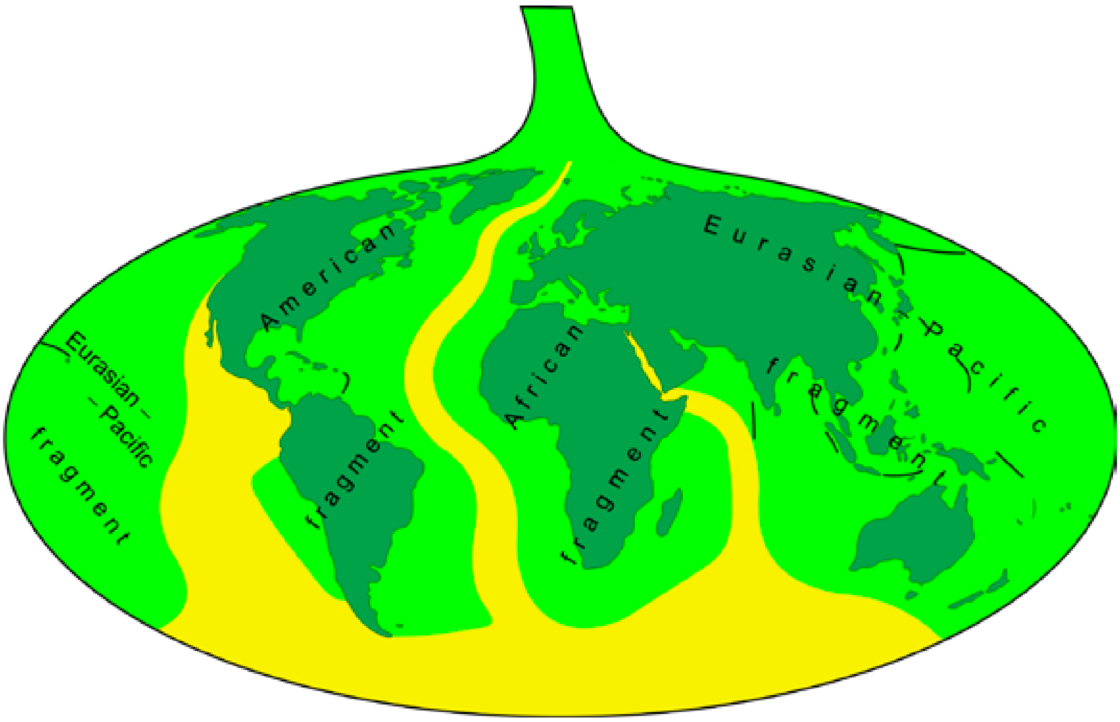
Because the megaplate had to be torn apart and lengthen latitudinally during expansion (see all models in Fig. 35), the volcanic chains will actually be oriented NW or NE, while always preserving their northern component. Such a situation is in fact observed (Fig. 36B).

c. Carey's Arctic Paradox based on a real geography of the plates

Carey's Arctic paradox pattern can be more precisely demonstrated using the real geography of continents and plates and removing all of the young post-Paleogene lithosphere together with the whole Antarctic plate. For better visualisation of the process of southward asymmetrical expansion, the whole structure can be compared with Carey's model of the opening flower bud. For this effect a stem was added at the North Pole (Fig. 37A). The green areas (parts of the northern megaplate) can be compared to sepals, and yellow (mantle basement) - to petals of a flower bud.



A



B

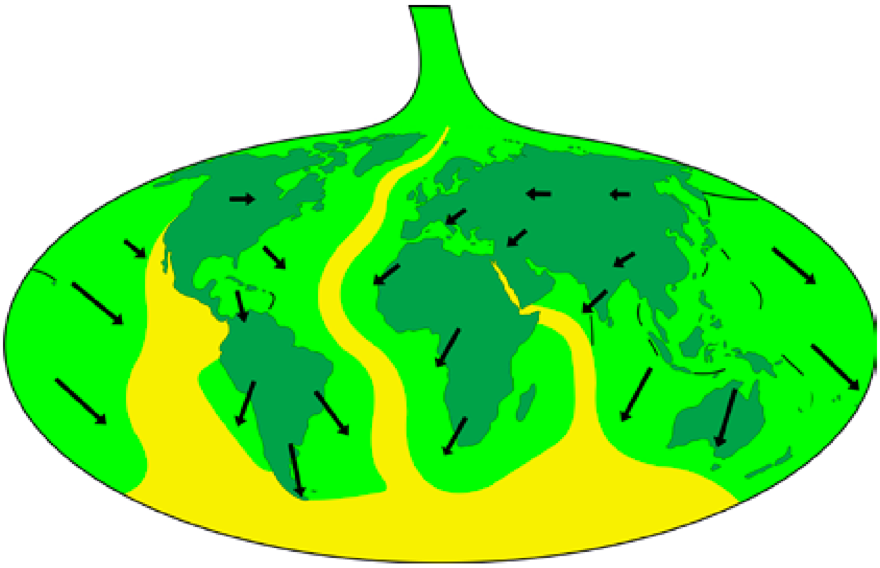
Fig. 37. **A** *– own model of the Arctic Paradox based on real geometry of continents and plates,* **B** *- division of the northern megaplate into three big fragments*

The northern megaplate is divided into three huge fragments: Eurasian-Pacific, American and African (Fig. 37B). Only the last of these three corresponds to a conventional plate.

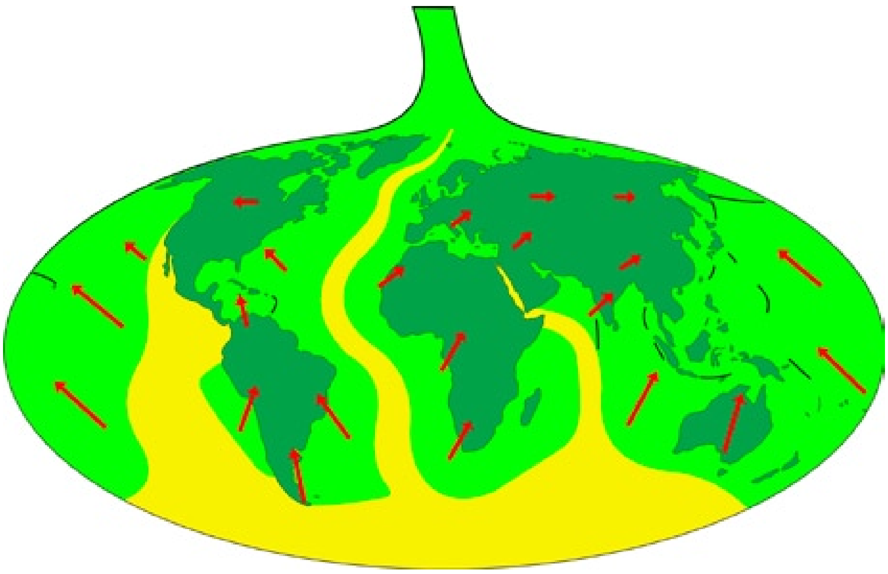
14. Global apparent Eulerian motion of plates confirms Carey's Arctic Paradox

The expanding basement is shifting relative to plates as indicated by the black arrows (Fig. 38A).

Notice that the black arrows are unequivocally determined only by expansion of the basement and geometry (geography) of tears (rifts) in the lithosphere and their intensity. The northernmost latitudinal arrows are determined by the North Atlantic Ridge which is the only tear acting at high latitude. Its prolongation *i.e.* the Nansen Ridge reaches even beyond the North Pole. The southern arrows in Africa are small in comparison with southern range of the continent. That is because Africa is being torn from Eurasia along Red Sea and Carlsberg Ridge which diminishes the southern movement of the basement relative to it.



A



B

Fig. 38. **A** – *motion of the expanding mantle relative to the megaplate,*
B – *apparent motion of parts of the megaplate relative to the expanding mantle*

Of course the movement of the lithosphere relative to the expanding basement is precisely opposite and presented by red arrows in Fig. 38B. These arrows must be treated on a non-expanding Earth as real ones, which is what produces the Arctic Paradox. This is the case with plate tectonics and contemporary space geodesy.

As is seen the arrows correspond very precisely to the arrows in Figs. 31 and 32. Thus, plate tectonics geodynamics recorded in the NNR reference frame proves in fact the process of the expansion of the Earth.

The collisions and contractions marked by the red arrows in Fig. 38B are only fictitious. In the frame of plate tectonics they are treated as real processes.

15. Attempted rejection of expanding Earth by space geodesy using Eulerian calculations – a circular argument

Space geodesy is a younger discipline than plate tectonics. The latter started towards the end of 1960s. The former established the first global geocentered ellipsoid GRS80 (Geodetic Reference System) as a global reference frame only in 1980. Prior to that, geodesy used only local ellipsoids pinned do the geoid at chosen points such as Potsdam for Western Europe and Pulkovo for the European communist countries. Subsequently space geodesy began to construct more precise mobile reference frames taking into account the motion of lithospheric plates. Thus the mentioned series of ITRFs appeared. The first was ITRF-89, *i.e.* two decades after plate tectonics appeared.

Of course the ITRFs are based on the supposed Eulerian motions. Then in an opposite way the space geodesy geodynamics (*i.e.* global plans of plate motion) is also calculated using Euler's theorem. In this way the Eulerian plate motions became for space geodesists something like a fundamental law of pure physics independent of any theory of Earth evolution. With this misguided approach the Eulerian (Morgan) calculations, which are tantamount to the hypothesis of a non-expanding Earth, may be used for checking the expansion of the Earth! Such a strange approach is presented in the paper by Wu *et al.* (2011). Their calculations are based on ITRF2008 and use the rotation (Eulerian) vectors of 15 major plates which, of course, are mutually moving apart <u>but also collide</u>. The authors obviously consider plate tectonics an established fact and logically prior to any evaluation of possible expansion of the Euler sphere. They calculated that any such expansion (in fact the expansion of the plate tectonics model, not the real Earth), is very small – the rate of the radius change of the Euler sphere (erroneously equated with the real Earth) must be lower than 0.2 mm per year.

The whole calculation is based on a deep misunderstanding and represents a spectacular circular argument. Testing the expansion of the Earth cannot be based on Eulerian motions of lithospheric plates which are specific feature of the non-expanding Earth hypothesis. Speaking more vividly – testing the reality of the heliocentric system cannot be based on the assumption that the geocentric system is true.

In fact there are several independent proofs of the significant expansion of the Earth. Some of them were presented in this paper. Four of them are presented in another paper (Koziar, 2004; www.wrocgeolab.pl/handbook.pdf).

So is with the rate of the Earth radius expansion. In fact the rate is about two orders higher (between 2.0 and 2.5 cm/year) than the acceptable one presented in Wu *et al.* (2011) paper. Interesting is that this high rate of expansion can also be deducted from space geodetic data. I presented both set of results, based on geodetic and geological data, in another paper (Koziar, 2018 – www.wrocgeolab.pl/geodesy2.pdf). They are reproduced here as Tables III and IV).

Table III. Present rates of the growth of the Earth's radius obtained by space geodesic methods

Author	Year	Rate [cm/yr]	Method
Blinov[1]	1987	2.43	Doppler Surveying (general uplift)
Carey[2]	1988	2.08 ± 0.8	SLR (chord analysis)
Maxlow[3]	2000	>1.8	VLBI (general uplift)
Koziar[4]	this paper	>1.0	VLBI (fictitious baselines contraction)

[1] correct interpretation of the results obtained by Anderle and Malyevac (1983)
[2] W.D. Parkinson's calculations
[3] correct interpretation of the results obtained by Robaudo and Harrison (1993)
[4] correct interpretation of the results obtained by Heki et al. (1989)

Table IV. Present rates of the growth of the Earth's radius obtained by geological methods

Author	Year	Rate [cm/yr]	Method
oziar	1980	2.59	Increase in the Earth's surface area (Phanerozoic)
Blinov & Schuber	1984	≅ 2.0	Increase in the Earth's surface area (Cenozoic)
Maxlow	2002	2.2	Increase in the Earth's surface area (from the Archean)
Koziar[1]	1996	2.7	Increase in the Earth's circumference
Koziar	this paper	>2.0	ratio of the lengths of Atlantic Ridge and the shore of Africa
[1]) correct interpretation of the result obtained by Le Pichon (1968)			

16. Broader geodynamic surroundings of the expanding Indian Ocean triple junction

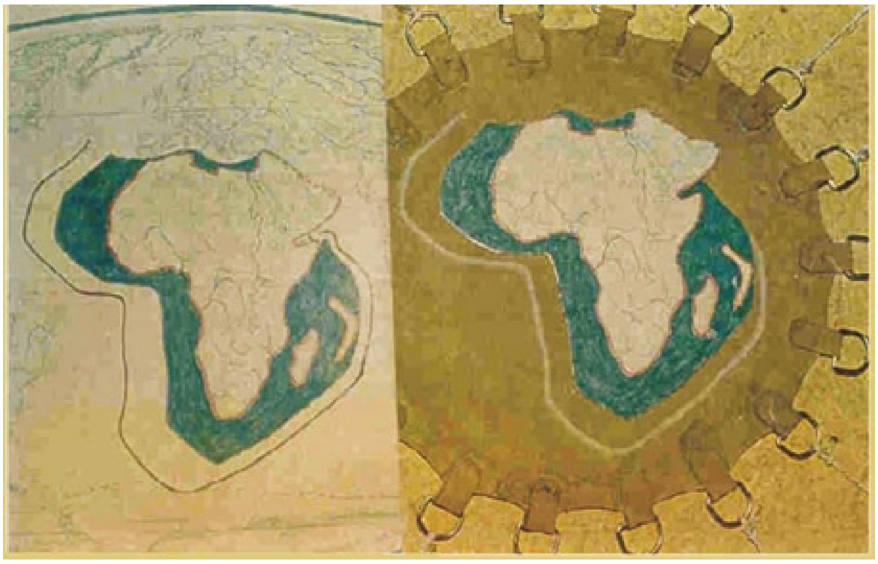
This surroundings will be described in counter clockwise direction, starting from the African plate.

a. Expanding African plate

The most striking and crucial geotectonic feature of our globe is enlargement of the outline of the African plate relatively to its initial shape *i.e.* relative to the contour of the African continent (Fig. 39A)

A

B



C

Fig. 39. *Modelling of the expansion of the African plate (explanation in text)*

The border of the plate is composed of segments of oceanic ridge and active transform faults. Its indisputable enlargement is not being explained in frame of plate tectonics. What is more, it is inexplicable in this frame. Whereas it is easily explained on an expanding Earth. This was already pointed out by Carey (1958) and Heezen (1960). The process of enlargement may be modelled on the same type of device (Fig. 21C) as the expansion of the Indian Ocean triple junction. Due to the limited stretchability of the rubber disc, the model of the starting plate includes some older oceanic lithosphere (green colour – Figs. 39B and C).

The model is placed on the rubber disc and then outlined with chalk (Fig. 39B). Then the rubber disc is stretched (Fig. 39C – right). The plate contour is enlarged and this is compared with the real contour of the present African plate (Fig. 39C – left). Before stretching the model was weighted in its NE area to reflect cohesion of the African plate with the Eurasian one. In other words, Eurasia pulls Africa to the NE.

It must be pointed out that the northern part of African plate expands too because Mediterranean Sea is in fact a divergent structure (Koziar and Muszyński, 1980; Koziar and Jamrozik, 1985 – www.wrocgeolab.pl/Carpathians.pdf).

b. Expanding Antarctic plate

Modelling of the expansion of the Antarctic plate is done in the same way. Fig. 40A shows the initial situation. The modelled expanded Antarctic plate contour (Fig. 40B – right) is compared with the real contour of the present Antarctic plate (Fig. 40B – left).

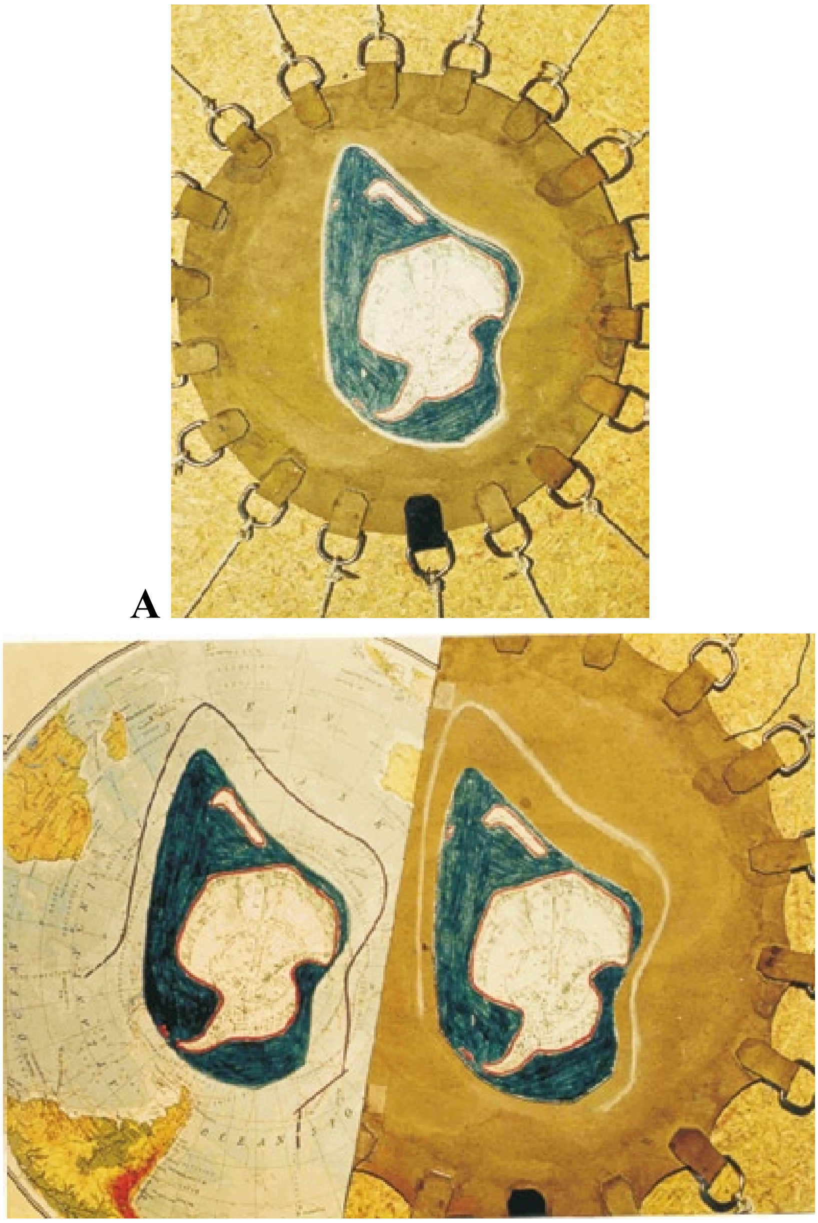


Fig. 40. *Modelling of the expansion of the Antarctic plate (explanation in text)*

The modelled expansion of both plates was presented in my early paper (Koziar, 1980 – www.wrocgeolab.pl/floor.pdf).

c. Divergence outside the Indo-Australian plate

The Indo-Australian plate does not expand in so spectacular way as the former two. What is more its NE boundary is entangled into plate tectonics convergent interpretations which are: the convergent interpretation of the development of intracontinental fold belts and an analogous interpretation of the development of island arcs. In fact both structures are divergent with a tension-diapiric-gravitational mechanism (Koziar and Jamrozik 1985 – www.wrocgeolab.pl/Carpathians.pdf; Koziar, 2005; Koziar and Jamrozik, 1994 – www.wrocgeolab.pl/margins1.pdf; Koziar, 2003 – www.wrocgeolab.pl/margins2.pdf.

Thus there is a wide area of tension between the India craton and Angara shield (Fig. 41) and also wide areas of tension connected with oceanic trenches (Fig. 42).

Fig. 41. *Mutal moving apart of India craton and Angara shield (Koziar, 2005)*

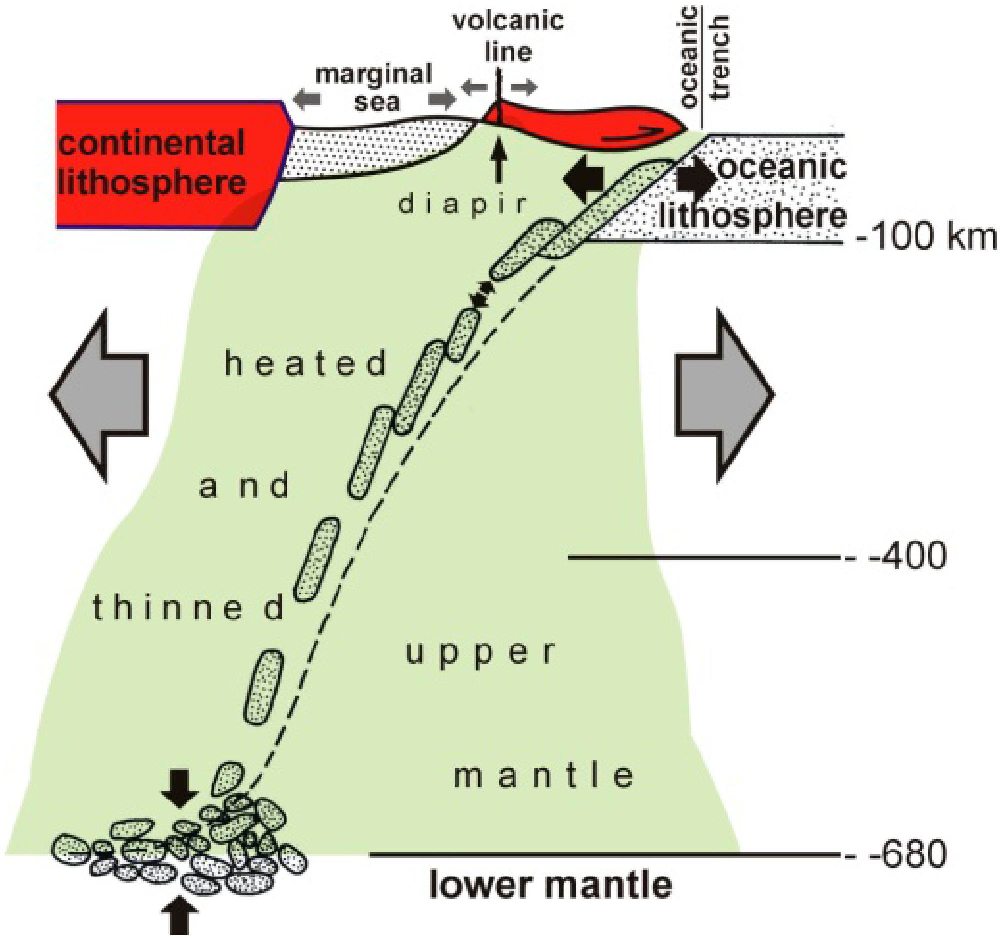


Fig. 42. *Tensional development of island arc (Koziar, 2003)*

In this way the Indo-Australian plate is expandingpanding too (Fig. 43).

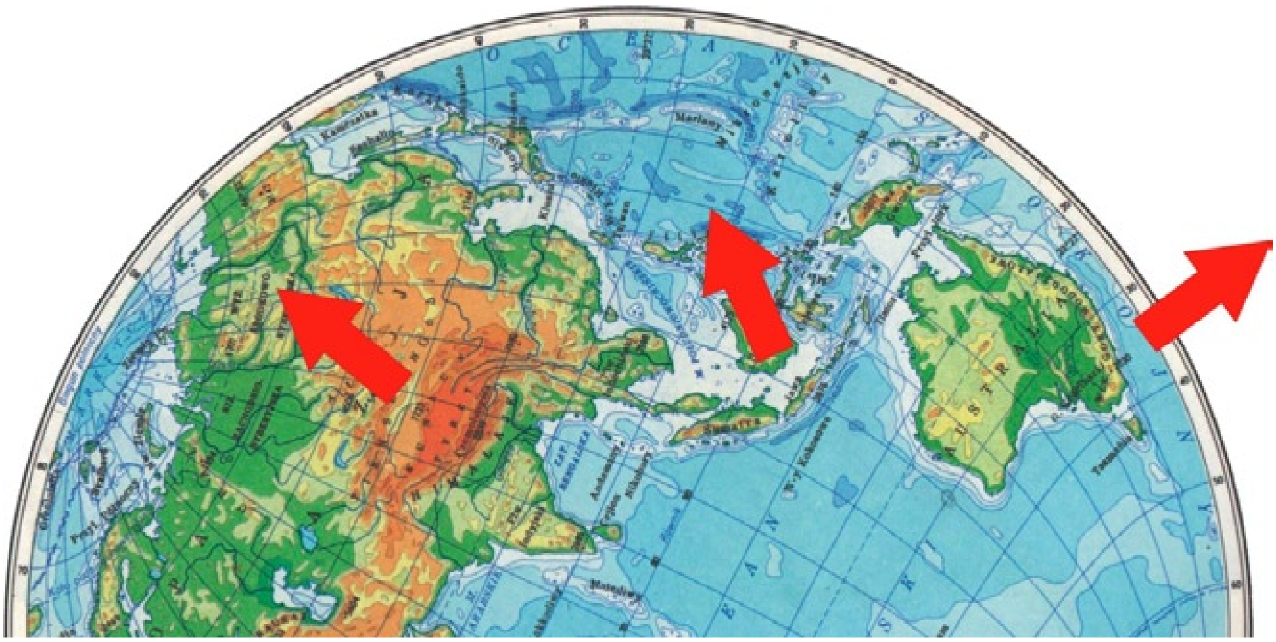


Fig. 43. *Expanding Indo-Australian plate (explanation in text)*

d. Expanding Pacific

Further to the east of the Indian Ocean triple junction there is the expanding Pacific (Fig. 44).

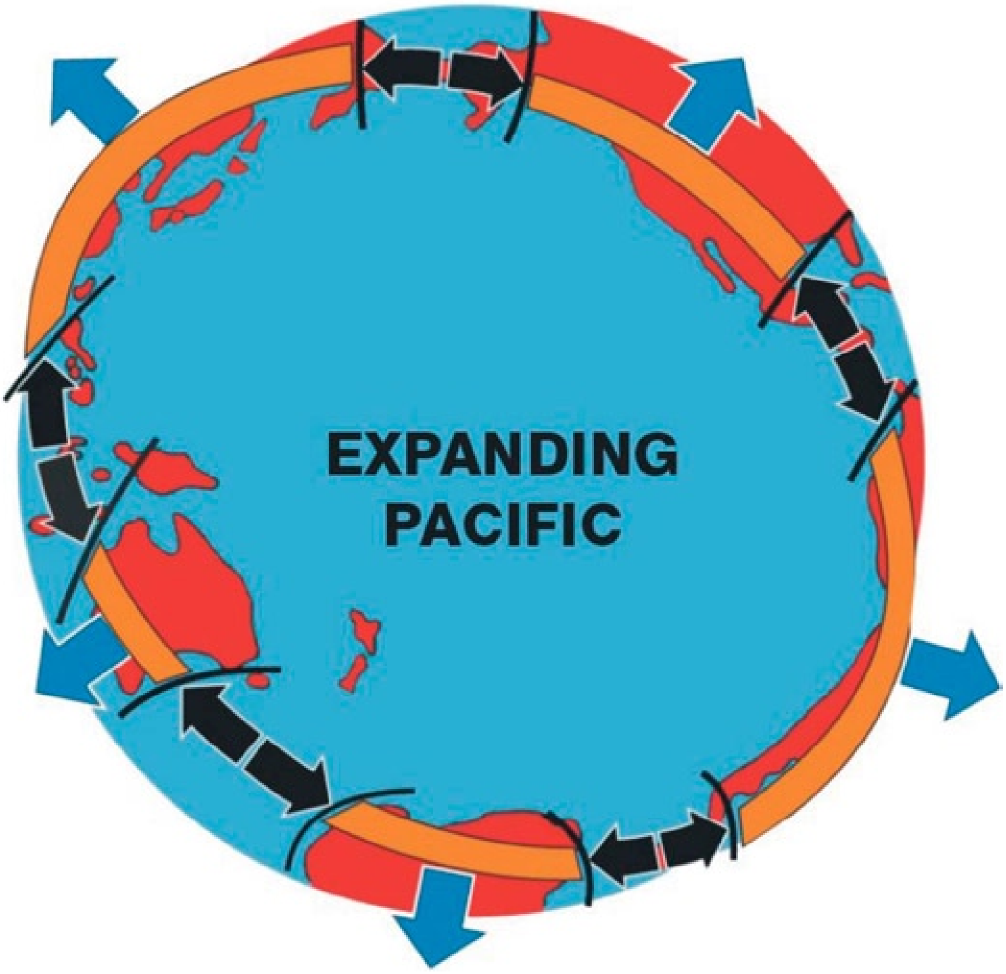


Fig. 44. *Expanding Pacific after Koziar (1993) –*
www.wrocgeolab.pl/Pacific.pdf .

The expanding Pacific, which is implied by the divergent development of all intercontinental gaps along the Pacific perimeter, is an independent proof of the expansion of the Earth. The proof was formulated by Carey (1958, 1976). The most crucial for the proof is the divergent development of the southeast Asia – Australia gap, pointed out in Fig. 25.

e. Expanding all diffuse plate boundaries

From all that is said above, it appears that all diffuse boundaries are divergent. These were put together globally by Gordon (1998) and taken from the Internet in coloured version (Fig. 45). I removed only the arrows of alleged subduction at oceanic tranches.

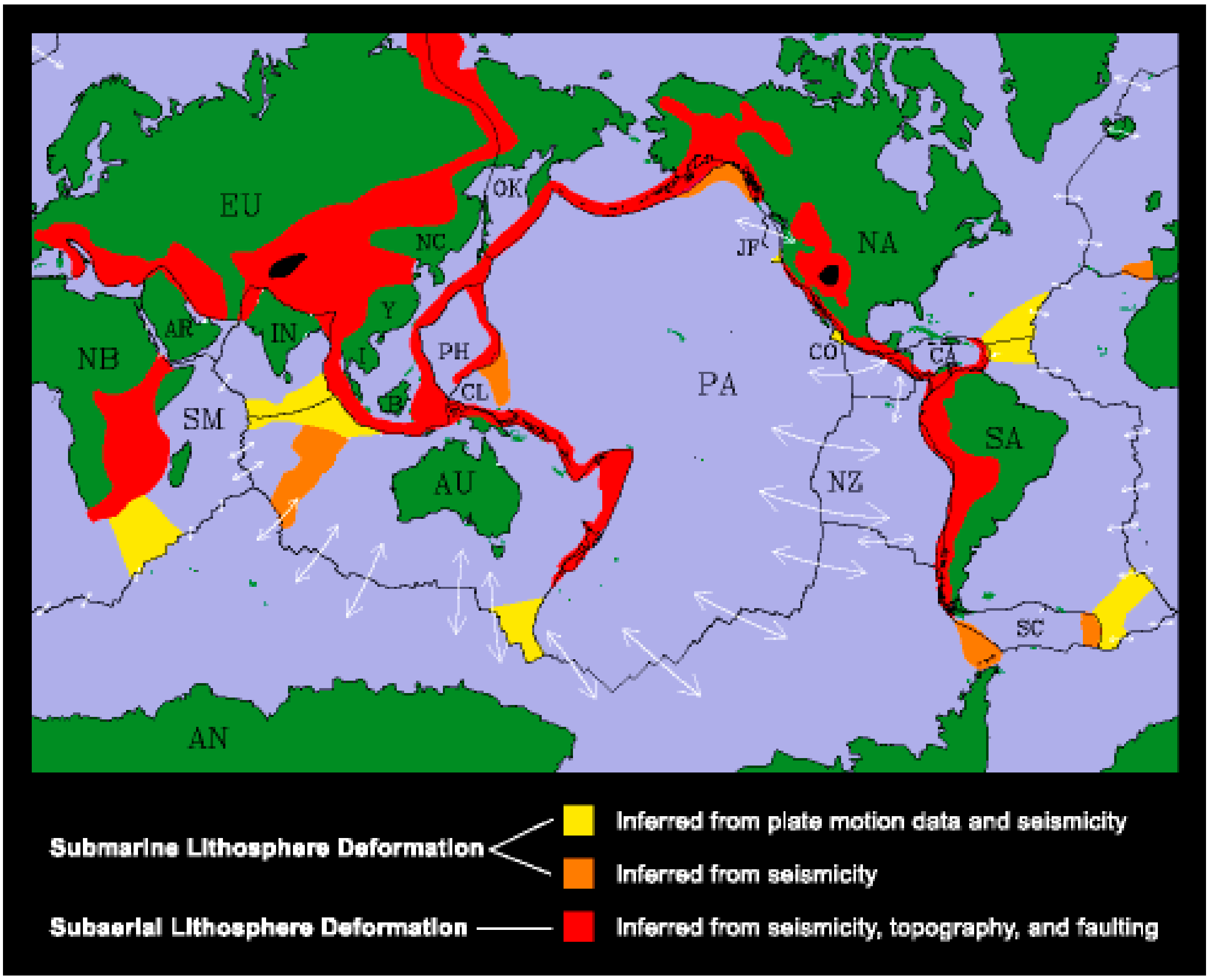


Fig. 45. *Global distribution of all diffuse plate boundaries (according to Gordon, 1998 – Internet version) with arrows of alleged collision removed.*

Thus all diffuse boundaries (which covers about 15% of the Earth surface) contribute slightly to global annual increment in the Earth surface area which results mainly from the uncompensated spreading of the ocean floor.

The resulting has only a logical nature (implication). Causally (physically) all these processes result from huge expansion of the Earth interior.

17. Interplate Carey's sphenochasms instead of Eulerian openings

One may wonder, why the divergent movements of plates on an expanding Earth can closely resemble the situation described by Eulerian theorem while actually having a different origin. This question is easily answered: because the ripping of the envelope of an expanding spherical object (Fig. 46A and B) is similar to the Eulerian model of rifting (Fig. 47). The later can be compared to cat's pupil mechanism (Dietz and Holden, 1973) – Fig. 47 – left, or helmet visor mechanism – Fig. 47 – right.

A

B

Fig. 46. **A** – *shabby soccer ball model of rifting on the expanding Earth,*
B – *Pacific with removed post-Paleogene lithosphere.*

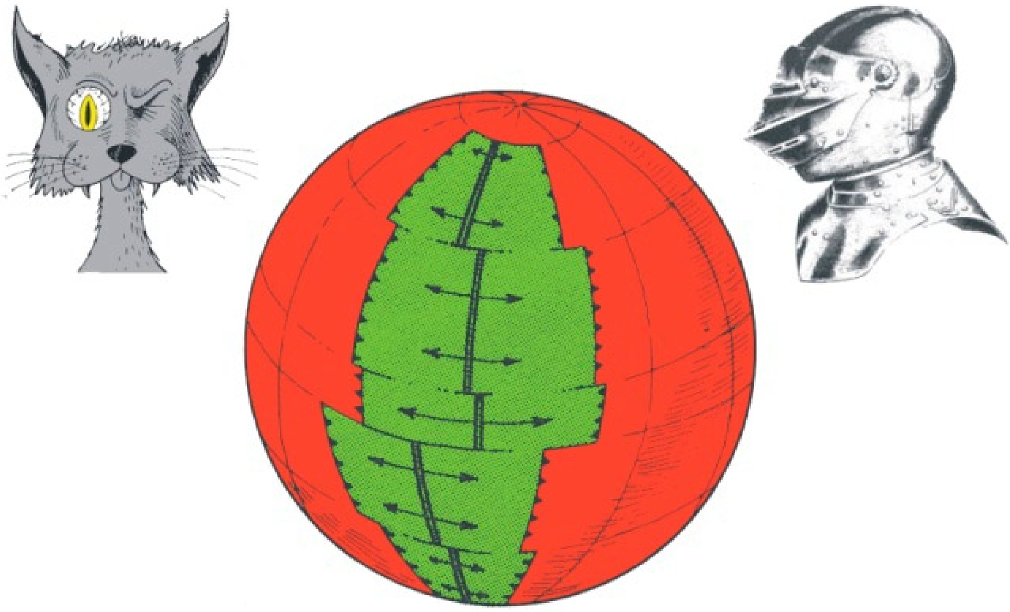


Fig. 47. *Eulerian model of rifting on a non-expanding Earth (Dietz and Holden, 1973 – centre). The model can be compared to cat's pupil motion – left (Dietz and Holden, 1973) or helmet visor motion – right (Internet).*

Long before plate tectonics appeared, Carey (1958) introduced to geotectonics a new class of structures he called "sphenochasms". After his definition (p.193) the sphenohasm is:

> *the triangular gap of oceanic crust separating two cratonic blocks with fault margins converging to a point, and interpreted as having originated by the rotation of one of the blocks with respect to the other.*

The sphenochasms can be of very different size and not necessary that they should be filled with oceanic crust. They can also be filled with sedimentary basin formations (exogenic filling) or by magmatic formations (endogenic filling). A sphenochasm consists of a V-shaped gap, arms and a vertex (Fig. 48).

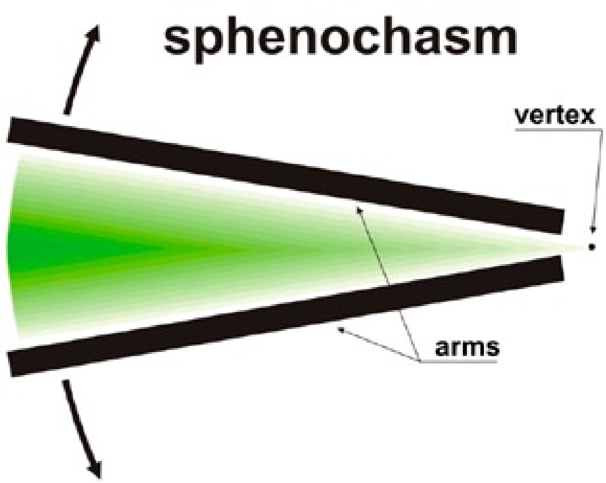


Fig. 48. *Carey's sphenochasm (explanation in text)*

The sphenochasm concept is also very useful for interpretating the tensional development of the lithosphere within continents. However, the larger sphenochasms are typically filled with oceanic crust and the largest of them are "interplate sphenochasms". Vertexes of such interplate sphenochasms are wrongly interpreted in plate tectonics as "Eulerian poles".

In case of the largest sphenochasms the position of the vertex is not stable because the tensional ripping (rift) propagates, as is seen in Fig. 46A.

Propagation of the oceanic ridges is a confirmed phenomenon and itself contradicts Eulerian plate motion.

18. Conclusions

Geology and subsequently space geodesy were trapped, a half century ago, in the plate tectonics paradigm based on supposed Eulerian motions of lithospheric plates.

In this paper the Eulerian motion of tectonic plates has been falsified. The right alternative to the wrong plate tectonics paradigm is the expanding Earth. However this time the expanding Earth is no paradigm but a real phenomenon.

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