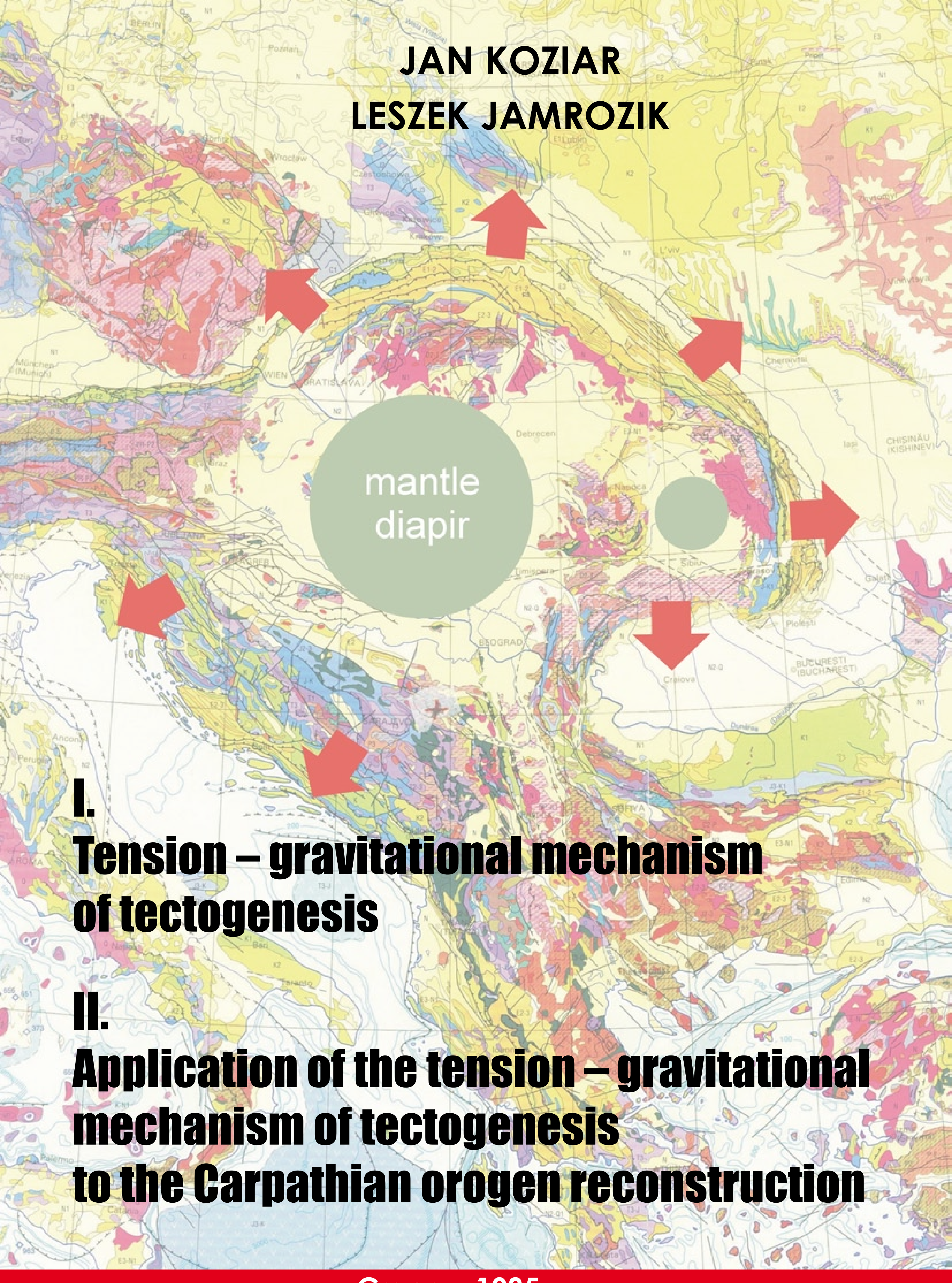
JAN KOZIAR
LESZEK JAMROZIK




# I.
# Tension – gravitational mechanism of tectogenesis

# II.
# Application of the tension – gravitational mechanism of tectogenesis to the Carpathian orogen reconstruction

Cracow 1985
Digital edition, Wrocław 2013

14208

CARPATHO — BALKAN
GEOLOGICAL ASSOCIATION

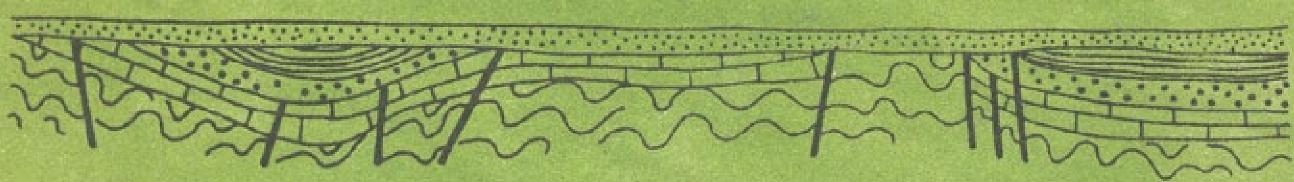
# Proceeding reports
## of the XIII-th Congress of KBGA

Part I

Poland — Cracow
september 5—10 1985

Published by Geological Institute

KOMISJA TEKTONIKI KOMITETU NAUK GEOLOGICZNYCH
POLSKIEJ AKADEMII NAUK
INSTYTUT NAUK GEOLOGICZNYCH UNIWERSYTETU WROCŁAWSKIEGO
INSTYTUT GEOLOGICZNY – ODDZIAŁ KARPACKI



# HISTORIA RUCHÓW TEKTONICZNYCH NA ZIEMIACH POLSKICH

## CYKL ALPEJSKI

(streszczenia referatów)

Kraków 17-18 marzec 1986

WROCŁAW 1986

*History of tectonic movements on the Polish territory*
*The Alpine cycle*

## *Front cover*

*Almost radial outward tectonic transport of folds, napes and allochthonous massifs in the Carpathians and Dinarides belts.*

*Mantle diapirs are marked. These are geophysically recorded structures that caused gravitational outward folding and thrusting during their extreme upwelling in the Upper Miocene. After that, their top parts collapsed and were transformed into intermontane depressions.*

*Both diapirs and earlier geosynclines were formed by tensional rifting of the lithosphere.*

## *First page*

*The cover of the Proceedings in which the title papers were published.*

## *Second page*

*The cover of another Proceedings in which the title topic was published for a second time as one paper under a common title.*


## ACKNOWLEDGEMENTS

I would like to thank again my former boss the late Professor Józef Oberc who hit upon the idea to present the topic on KBGA 1985 Congress, discussed it and used his authority to include it in the conference program.

I also thank Professor Cliff Ollier for discussion and for improving the English of my 2013 introduction, supplement as well as the editorial English translation of original (1985) Polish texts.

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# I. Introduction 2013

## A. Before the KBGA 1985 conference

### 1. Origin of the two reproduced papers

Two papers presented here were published in English in the proceedings of the XIII$^{th}$ Congress of the Carpatho – Balkan Geological Association (KBGA). The Congress was held in Cracow (Poland) in September 5 – 10, 1985.

The basis of both papers was a draft of my doctoral thesis prepared in 1981 and entitled "Reinterpretation of the theory of the orogen". In fact it dealt generally with fold belts. The thesis consisted of two parts. The first concerned the island arcs and active continental margins, the second the intra-continental fold belts. The data used in analysis of both types of structures were different and so were the ways of analyses. However the results were almost the same. The main difference was that the processes at island arcs reach deeper – as far as to the bottom of the upper mantle. This difference is caused by the different rock material of which both kinds of lithosphere are built. The granitic continental crust cannot sink deep even in the tensionally decompressed and thinned upper mantle. The totally basaltic oceanic lithosphere can sink and sinks, as tensionally produced debris, deep along Wadati-Benioff zone. However the general tension-diapir-gravitational mechanism in both cases is the same.

Both analyses were done in an inductive way without any deduction from global hypothetical assumptions. The final result was obtained by summing up direct conclusions based on firmly recorded facts.

The doctoral thesis was not finished. In December 1981 martial law was introduced in Poland. I became totally involved in the underground anticommunist movement and since October 1982 had to continue opposition work in hiding being wanted by the communist police. This lasted until the collapse of the communist system in Poland in February 1989.

In the meantime the XIII$^{th}$ Congress of KBGA was announced, to be held in Cracow in 1985. My boss, Professor Józef Oberc hit upon an idea that my results concerning intra-continental fold belts and their application to the Carpathians Mts. could be presented at the Congress in the section "Tectonics" by my co-worker Leszek Jamrozik as a co-author. The idea was very good since in this way the political barrier was bypassed. Apart from that Leszek Jamrozik was deeply involved in the topic because we both discussed all the issues of the expanding Earth since the early 1970$^{s}$. The presentation was planned in the form of two lectures and two papers – on a general tensional mechanism of tectogenesis, and on the development of the Carpathian fold belt respectively.

Both the lectures and papers were prepared secretly by all three of us (Professor Oberc, Leszek Jamrozik and me) during an excursion outside Wrocław in a grove on the Odra river bank on a fine spring day in 1985. After that, both papers were prepared and sent to Cracow. For technical reasons Leszek Jamrozik did not present the lectures but the papers were published.

The conference lectures and papers had to be very short and so the presentation of the broader historical background of the topic was impossible. Two very important authors – Carey and Egyed were not even mentioned. This neglect is now remedied below. In 1985 there was only the then background of the fold belt topics and the papers reproduced here. Today there is the further background that has appeared since 1985. Some aspects of both are presented in the Introduction and the Supplement.

### 2. From compressional to dilatational fold belts

Geological thinking about fold belts was first based on the theory of contraction of the Earth. The theory introduced an idea of tangential (horizontal) forces exerted by colliding continents (cratons). The theory has been rejected, but this way of thinking has survived. The great opportunity to change this way of thinking was brought by Wegener's theory which for the first time introduced and proved big divergent motions of the continents. These quite new and revolutionary motions could be employed at least to explain a geosynclinal stage of fold belts. However Wegener introduced also big convergent motions as a consequence of the proved divergent ones and a tacit (and of course not proved) assumption that the Earth is not expanding. The inferred convergent movements of continents were to be much bigger than in the case of the theory of contraction of the Earth and thus so-called "ultranapism" was developed. It assumed convergent motion of continents and respectively horizontal displacement of the nappes in the order of hundreds of kilometers. The nappes would be driven these long distances by traditional "tangential" forces.

Then in 1940s and 1950s Alpine geologists began to record empirically that the Alpine geosynclinal stage had an extensional origin. The change started with the paper by Güntzler-Siefert (1941)[1] and ended with the paper by Trümphy (1958). Unfortunately it was a time of total rejection of Wegener's theory. Not only convergent movements of continents together with tangential forces were rejected but also the divergent ones.

It was a time of so called stabilism, as an opposite idea to Wegener's mobilism. Continents were considered to stay firmly in place and only vertical movements were allowed. As a consequence, gravitational tectonics began to develop. In 1930 an ingenious idea of primary and secondary tectogenesis was introduced by Erich Haarmann and later developed by Van Bemmelen. Primary tectogenesis is uplift and nearby sinking which together create a topographic gradient. Secondary tectogenesis is the gravitational leveling of the gradient. James Hutton already understood gravitational tectonics in such a way. But now the two mechanisms were precisely defined and distinguished. The secondary tectonics was at the start understood only as a sliding (gliding) of the rock masses but Jefrreys (1931) and Bucher (1956) recognized the process of gravitational spreading which is much larger and reaches deeper in the Earth's crust than sliding. The primary tectogenesis was the cause of the secondary tectogenesis. But the cause of the first, remained unclear. Its explanation by Haarmann was particularly unconvincing (see Fig.1 of the first reproduced paper).

Van Bemmelen recognized the uplift as caused by a growing diapir of the upper mantle. He also recognized intermontane depressions as places in which diapirs collapsed by outgassing after doing their work of thrusting napes. Thus Van Bemmelen was able to localize precisely all collapsed diapirs in Mediterranean Alpides and so explain extremely tangled directions of tectonic transport there, which cannot be explained by " tangential force" (by collision of Africa with Europe in this case). But how do the mantle diapirs originate? The connection of gravitational tectonics with stabilism was a blind alley. So the solution was given only by Samuel Warren Carey in 1958.

## 3. Carey's dilatational fold belt

Carey was a key person in revitalizing mobilism in the postwar years. He did it in his very successful scientific trips across United States in 1959 and 1960. All his lectures were delivered to packed halls and followed by long discussions.

Carey was at this time a promoter of the expansion of the Earth (which means only divergent motions of continents) but it was too much for the stabilistic geologists of those days. So his effort led only to revitalize Wegener's theory and later to its more modern version – plate tectonics.

Carey solved the main problems of the origin of fold belts in his scheme: the "dilatational orogen" presented in the proceedings of the Tasmanian conference (1958). The geosynclinal stage is tensional and so is the "regurgitation" stage when geosynclines throw back their contents. The second process is caused by upwelling of the hot mantle which is an inevitable result of the continuation of stretching and rifting.

This process is now well known under oceanic ridges and was also recognized there by Carey (1958) together with the whole process of spreading of the ocean floor. Bruce Heezen, a discoverer of central rift fissure in oceanic ridges and co-author of wonderful topographic maps of the ocean floor, joined Carey's

[1] Additional references (2013) are placed at the end of this brochure.

interpretation (Heezen, 1959, 1960). Today these facts are almost forgotten though even Wilson (1965) admitted that he owed his concept of transform faults to Carey's ideas[2]. Some years ago this genesis was revived by Gordon (1998). The recognition by this and other authors of the so called "diffusive plate boundaries" also fits with Carey's tectonic analyses.

Carey recognized that the whole process of formation of fold belts is caused by stretching and rifting and specifically by gravitational compensation of gravitational imbalance caused by these processes. These two processes occur at all stages of the development of fold belts. That is at:

1 – tensional origin of a geosyncline

2 – filling the geosyncline with sediments and volcanic rocks

3 – tensional upwelling of the upper mantle

5 – outward horizontal transport of the geosynclinal deposits (tectogenesis)

6 – collapse of the top of the diapir and formation of intermontane depression

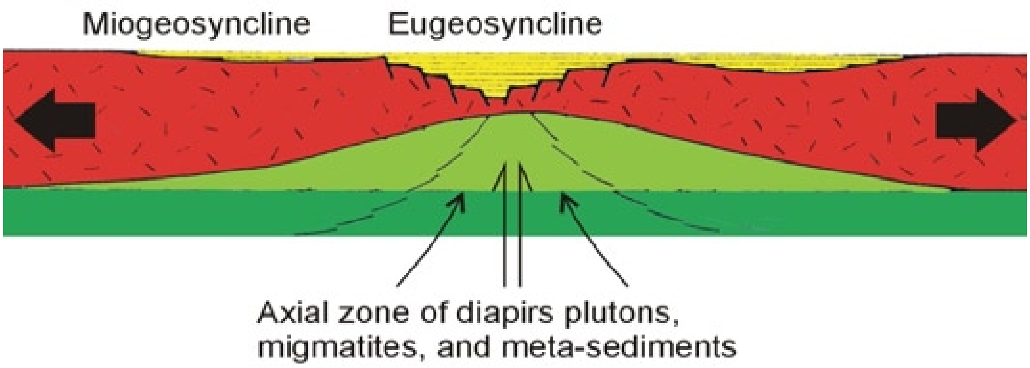
7 – lateral migration of mantle upwelling under folded belts and their uplifting (orogenesis)

8 – filing of the intermontane depression with sediments and volcanic rocks.

The outward horizontal transport of geosynclinal series takes place by gravitational spreading and sliding. Carey compared the "regurgitation" of geosynclines to the motion of glaciers and salt diapirs, while internal small structures of the latter compared to tectonic and metamorphic fabrics of folded rocks. This topic awaits further elaboration. Today it is overwhelmed by plate tectonics big strike-slip movements.

Carey demonstrated the schemes of the geosynclinal and regurgitation stages of the dilatational orogen in 1976 (Fig. 1a,b). In 1996 he supplemented them by a scheme of the origin of the intermontane depression (Fig. 1c). The first rifting stage presented by Carey in 1976 and 1996 is omitted below.

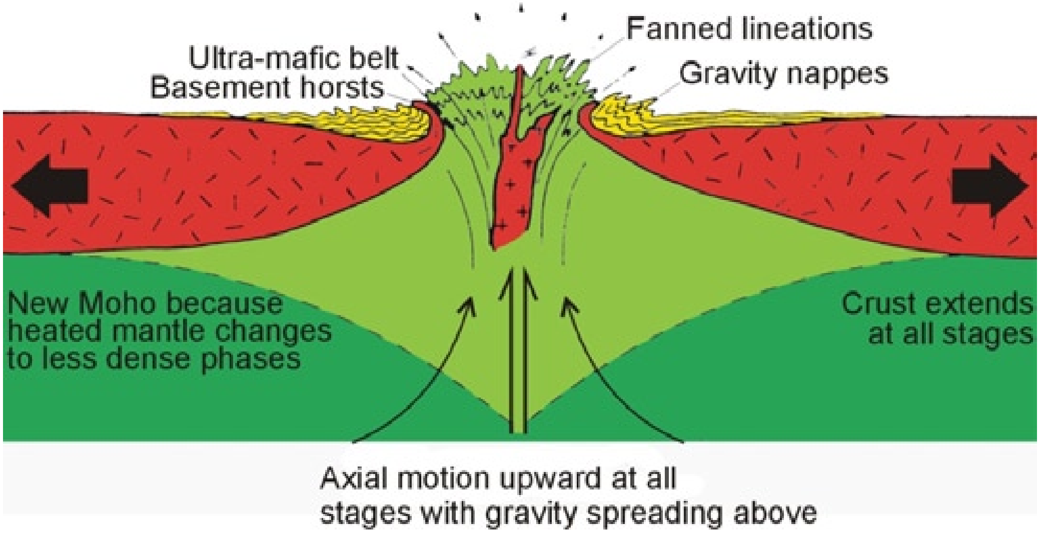
All these processes are driven by regional tension and stretching. This does not mean that stretching occurs everywhere on Earth or that it stays in the same place all the time. The expansion of the Earth is a continuous process and in the deep plastic interior of our globe it is roughly uniform. However in the rigid lithosphere it is discharged only in some places and it can jump to other places. A good example is the spreading of the ocean floor which is linear (not aerial) and which sometimes jumps to another region leaving behind the dead spreading axis[3]. On land, in the Western European orogenic (tectogenic) stretching jumped successively to the South – from the Variscan to the Alpine belt and then to the Mediterranean Sea. Older belts became the zone of consolidation more resistant to stretching. However sometimes stretching



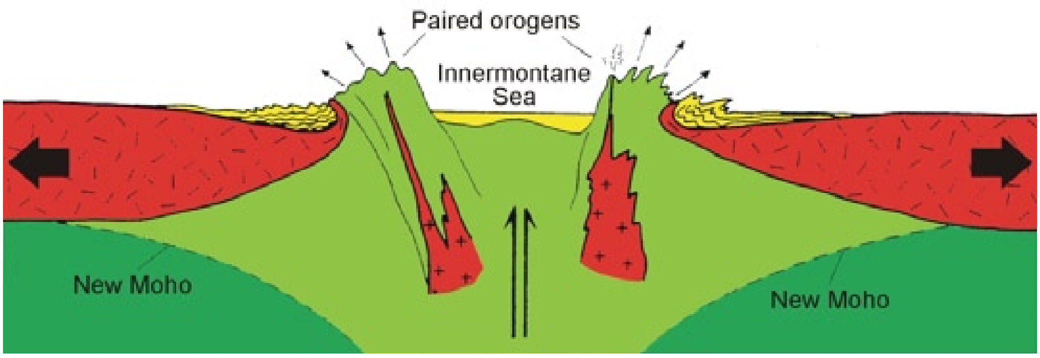

**a**

[2] In fact Carey's rhombochasms (Carey 1958, p. 192) are bordered by two transform faults. But Carey's transform faults differ from Wilson's ones as they link only divergent zones. Today these structures are called "pull apart basins". But the original term "rhombochasm" is much better, since it describes also the geometry (rhomb) of the basins (chasms). Apart from that this one-word term can be easily connected with a sense of motion on the bordering transform faults in the form of complex but only two-word terms: "dextral rhombochasm" or "sinistral rhombochasm" used already by Carey. The term rhombochasm (rombochazma) was introduced to Polish tectonic terminology in the textbook of tectonics by Dadlez and Jaroszewski (1994).

[3] A phenomenon which is contrary to the plate tectonics.




b




c

***Fig. 1 Carey's tension – diapir – gravitational mechanism of the development of fold belts,***
***a** – geosynclinal stage, **b** – folding and thrusting stage (tectogenesis), **c** – uplifting of folded series (orogenesis) and intramontane collapse stage (explanation by JK[4])*

does not stop and the "innermontane sea" in Carey's Fig. 1c transforms to a vast ocean basin. This happened to the South Appalachians and Mauritanides which were in the Variscan time symmetrical fold belts, being a starting stage of separation of North America from Africa and the formation of the whole central Atlantic. Apart from that some paroxysms can appear in the expansion of the Earth. They can be the causes of global orogeneses and orogenic phases which were recognized long ago as some mysterious phenomena. The youngest example is the global Neotectonic Period (Ollier and Pain, 2001).

## 4. Egyed's dilatational fold belt

A person who contributed very early to the dilatational fold belt concept was a Hungarian geophysicist Laszlo Egyed (1960a). He did it using the Carpathians fold belt as an example.

Egyed was an expansionist (Egyed, 1955, 1956, 1957, 1960a,b). However he is rather associated by today's geotectonists with paleomagnetic tests which contributed heavily to the rejection of the expansion of the Earth before the establishment of the plate tectonics paradigm in the late 1960s. But in fact the cause of this rejection were not his tests (Egyed 1960, 1961) but the incorrect method of Ward (1963). The incorrectness of Ward's method was pointed out by Carey (1976) and Chudinov (1984) but without any impact on the ever more popular plate tectonics.

[4] Carey's original explanations are:
1976 (p. 61)– Simplified symmetrical model of geosynclines and orogenesis in dilating orogen. This pattern is commonly modified by crustal or rotational asymmetry.
1996 (p. 40) – Diapiric orogenesis.

Egyed's dilatational fold belt is almost the same as Carey's one. His own contribution is pointing out the concordance of vergencies of Mediterranean Alpides with negative gravity anomalies (Fig. 2) which he did after Scheffer (1955). The vergencies are everywhere directed to negative gravitational anomalies.


Fig. 1. The Alpidic zones of orogeny and the isostatic anomaly zones indicating mass deficit; according to V. Scheffer.

***Fig. 2. Egyed's explanation is shown in the figure***

This clearly indicates the gravitational transport of the fold belts, not a transport by "tangential forces". He also showed an analogy between profiles of gravitational anomalies across north-eastern Carpathians and Japan Islands and Japan Trench as well (Fig. 3).

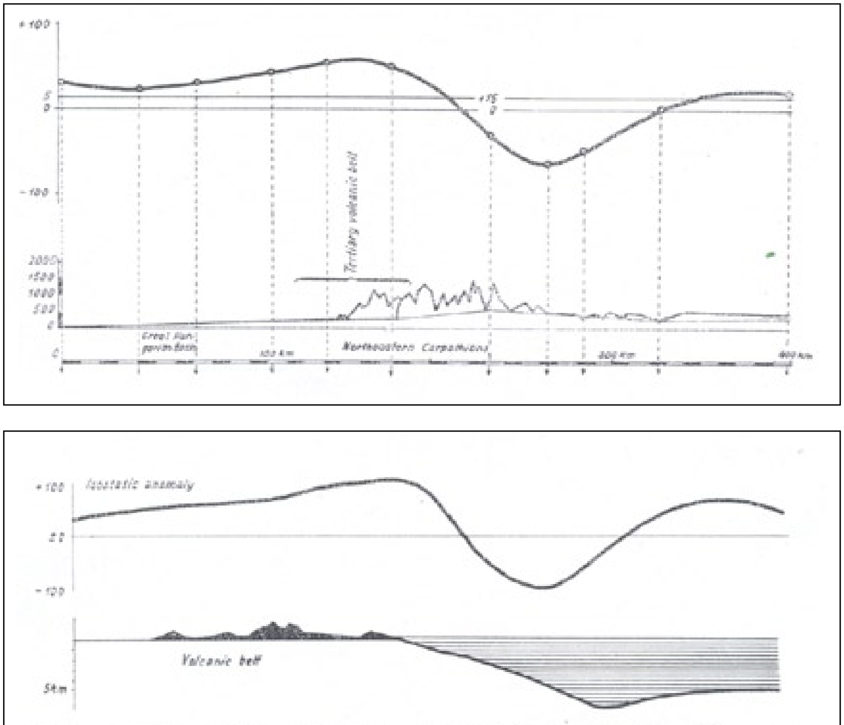



Fig. 3. Isostatic anomaly profile through the Northeastern Carpathians, in comparison with a profile through Japan.

***Fig. 3. Egyed's explanation is visible in the figure***

The highest mass deficiency is in the Japan Trench and in the Carpathian fore-deep. The highest excess of mass is along volcanic lines of both structures. The mass excess behind a fold belt contributed to the outward gravitational transport.

Egyed also showed that with continuing rifting an intermontane depression can be transformed into an oceanic basin. This was also shown by Carey but only in 1996 (see Fig. 1c).

## 5. Contribution of the two reproduced papers to the former concept of dilatational fold belt

Both our papers, presented later, confirm and develop Carey's and Egyed's schemes. In doing so they leave the basics of the former schemes untouched and differ from them only in some aspects:

**1.** First of all, our tension – gravitational scheme is not deduced from the expansion of the Earth. The theory is not even mentioned in the papers. The scheme is constructed in opposite way by induction, by putting together evident stretching below a fold belt's foredeep, evident tensional origin of the root of the fold belt (the so called asthenolit) and evident stretching in an intermontane area that lasted from the geosynclinal to intermontane depression stages. In this way, tension – gravitational mechanism of the fold belts is not a conclusion from expansion of the Earth but on contrary, the expansion of our globe is a conclusion from this mechanism because the fold belts do not compensate for the spreading of the ocean floor (as plate tectonics assumes) but contribute to it. So tension – gravitational mechanism of fold belts is one of several proofs of the expansion of the Earth. However even in such a context the theory was not mentioned in our papers in order not to irritate too much the traditionally thinking geologists.

**2.** Our papers employed Haarmann – van Bemmelen's idea of primary and secondary tectogenesis.

**3.** Our papers used the freshly recorded tensional deformation of the foreland basement under foredeeps of fold belts and frontal parts of their napes. The deformation occurs along gravitational (normal) faults. Today it is a well known phenomenon which stays in open contradiction to the collisional model. This tensional deformation delivers the sinking component of the primary tectogenesis. It is a new and very important contribution.

In the case of island arcs and active continental margins this deformation causes deep sinking of ocean lithosphere tensionaly produced debris and so it develops the seismic Wadati – Benioff zone (Fig. 4) see (Koziar, 2003; www.wrocgeolab.pl/margins2.pdf)[5].

Such sinking explains in a simple way the presence of the cold oceanic lithosphere in the Wadati – Benioff zone which seems to be impossible on an expanding Earth.

There is no need for the sinking debris to be in a close mutual contact to provide a good seismic communication along the whole seismic zone because it produces a laminar structure in the surrounding upper mantle and so it locally changes the mantle into a good wave-conductor.

The tensional processes at island arcs and active continental margins are without any direct connection with spreading on oceanic ridges. Thus the young age of these zones, slow rate of destruction of oceanic lithosphere and their small total length in comparison with oceanic ridges are no problem. But these features are a great problem for plate tectonics.

**4.** Finally, the presented tension – gravitational scheme was for the first time employed to reconstruct at specific fold belt – the Carpathians Mountains.

[5] In fact the solution presented in the Fig. 4 was found by me much earlier and lectured on at our Institute in 1980. It was also a part of my unfinished doctoral thesis in 1981. Then it was lectured on by Leszek Jamrozik in 1988 at the Silesian University in the co-authorship on the same reason as the discussed papers, since the communist regime was still at work. After that the topic was published twice in the co-authorship in 1991 and 1994 and then by me alone in 2003. Recently the scheme was significantly improved but yet unpublished. The basic principles remain unchanged. Carey referred to this scheme in his 1996 book.

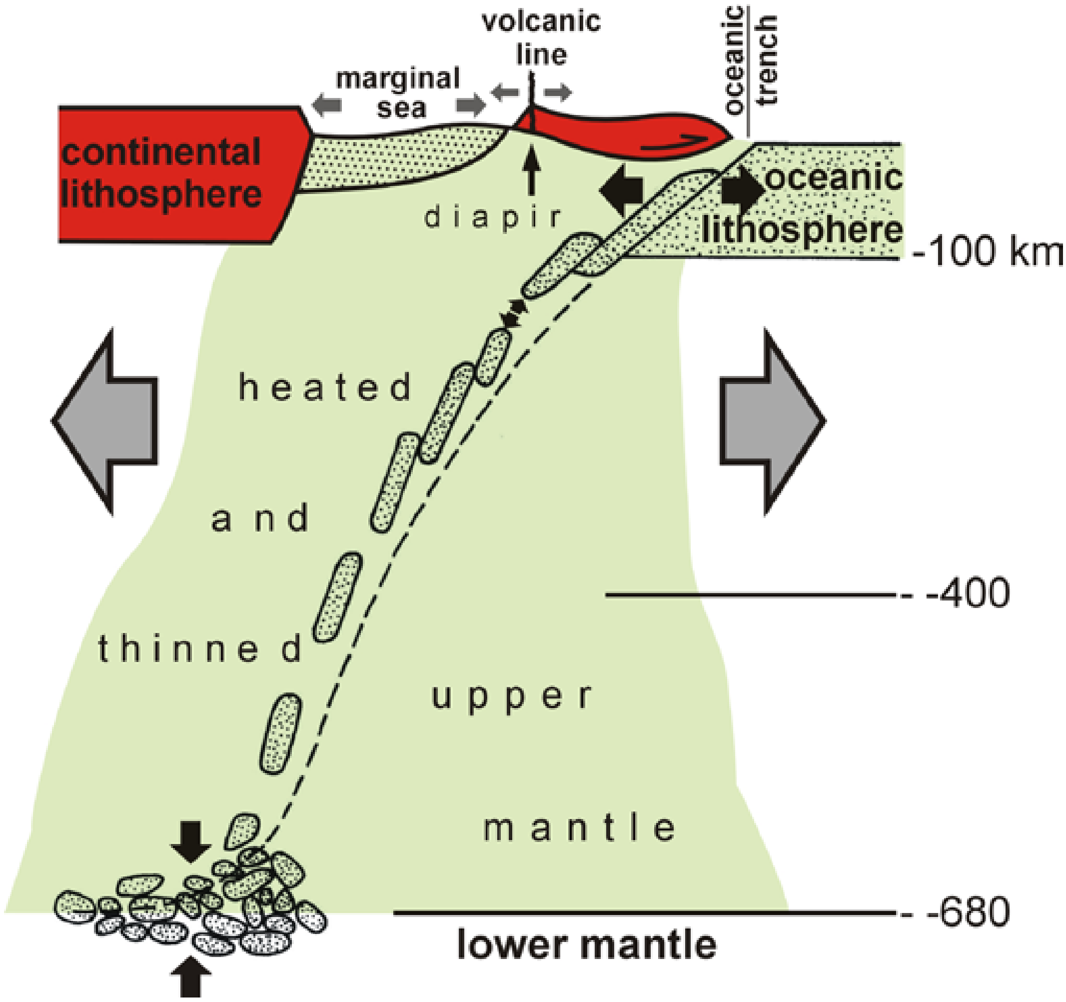



***Fig. 4. Tension – diapir – gravitational mechanism of island arcs*** *(after Koziar, 2003)*

## 6. Some terminological explanations

Two terms are used in this brochure which should be explained in advance. These are: " the folding massif" and "the fold belt area".

### a. The folding massif

"The folding massif " is an old term elaborated on the compressional concept of fold belts but today it can be not understood by English speaking geologists.

By "folding massifs" there were considered both:

1. hypothetical intermontane massifs allegedly hidden under a sedimentary cover of intermontane depressions
2. visible on the Earth surface, real crystalline old massifs at the back of folded geosynclinal series.

Both were thought to transmit tangential pressure from an advancing craton (continent) to a folded geosynclinal series. The forelands of these series were considered as "resistant massifs". The folding massifs were seen as active components of the whole mechanism. They were understood as battering rams of advancing continents. The plate tectonics concept of variety of rigid promontories of allegedly advancing continents as well as "microcontinents" inside the fold belts are a present incarnation of this old concept of the folding massifs.

Analysis leading to tension – diapiric – gravitational mechanism of the fold belts demonstrates that the second type of the folding massifs i.e. the real old crystalline massifs at the rear of folded geosynclinal series are also gravitationally transported elements of the whole system of nappes. Because they press on the folded series in front of them they can still be called "the folding massifs". But they have nothing in common with traditional tangential compression. They press on the series in front of them just as rocks in the central part of landslides press on rocks in their frontal parts.

At the geosynclinal stage future folding massifs usually separated a miogeosyncline from an eugeosyncline and were parts of future so called "internides". In the Carpathians such gravitationaly shifted folding massifs are the Slovak and Marmarosha massifs.

**b. The fold belt area**

The tension – diapiric – gravitational mechanism occupies much bigger territory than a fold belt itself and than compressional models, especially as developed by plate tectonics. It can be demonstrated on the Zagros Mts. example (see III.A.4, Fig. 4).

In plate tectonics interpretation the Zagros ophiolite suture separates quite different territories which were allegedly separated in the past by the vast Tethys ocean. In fact the Isfahan – Hamadan Jurassic metamorphic zone, adjoining to the suture from NE is a folding massif. Then the Kuh – Rud volcanic elevation is a marginal part of the mantle diapirism, remnants of it is hidden now under Central Iranian depressions. This diapirism (elevation) and sinking under the Mesopotamian foredeep (primary tectogenesis) caused gravitational superficial transport of the folding massif and the fold belt to SW. All the territory was stretched, not shortened, as compressional models suggest.

Because the tension – diapiric – gravitational mechanism of the fold belt occupies much bigger territory than the fold belt itself it is justified to use a more general term "the fold belt area".

## 7. Tensional regional context of the tensional development of the Carpathian fold belt

**a. Tensional development of the whole Mediterranean region**

Tensional tectonic development is nothing exceptional in the geological neighbourhood of the Carpathians. In the South, the whole Mediterranean region with its oceanic basins and the rest of the Alpine fold belts is stretched throughout its geological history. I lectured on this topic in March 1978 at our Institute. In 1980 my colleague and former student Andrzej Muszyński presented it in the co-authorship in Sofia (Bulgaria) and the topic was published there (Koziar and Muszyński, 1980). In the paper the reconstruction of a young stage of dilatational development of the Mediterranean region was presented. Below, there is this reconstruction (Fig. 5) in a form presented on posters at my Institute (1992) and at an International Conference on Frontiers of Fundamental Physics, held September 27-30, 1993, in Olympia, Greece. Expanding Earth was included in the scientific program of this conference.

Carey pointed out already in his paper of 1958 that "*not a march of Africa of 500 or 1000 km on to Europe during Alpine revolution, but a dilatation of 700 km*!" (Carey, 1958, p. 331).

**b. Tensional development of the Polish Basin and its inversion**

To the North and West of the Carpathians the tension is visible in tensional disintegration of the European Variscides and formation of post-Variscan sedimentary basins, particularly the Polish Basin. Up to the end of 1970s the development of the basin and its central swell (the basin inversion) was considered in the traditional compressive manner.

At the beginnings of my geotectonic investigations it became clear that the Polish Basin has a tensional origin. In 1974 when the subject of Leszek Jamrozik's doctoral thesis was discussed I proposed this topic. However it was rejected as too difficult.

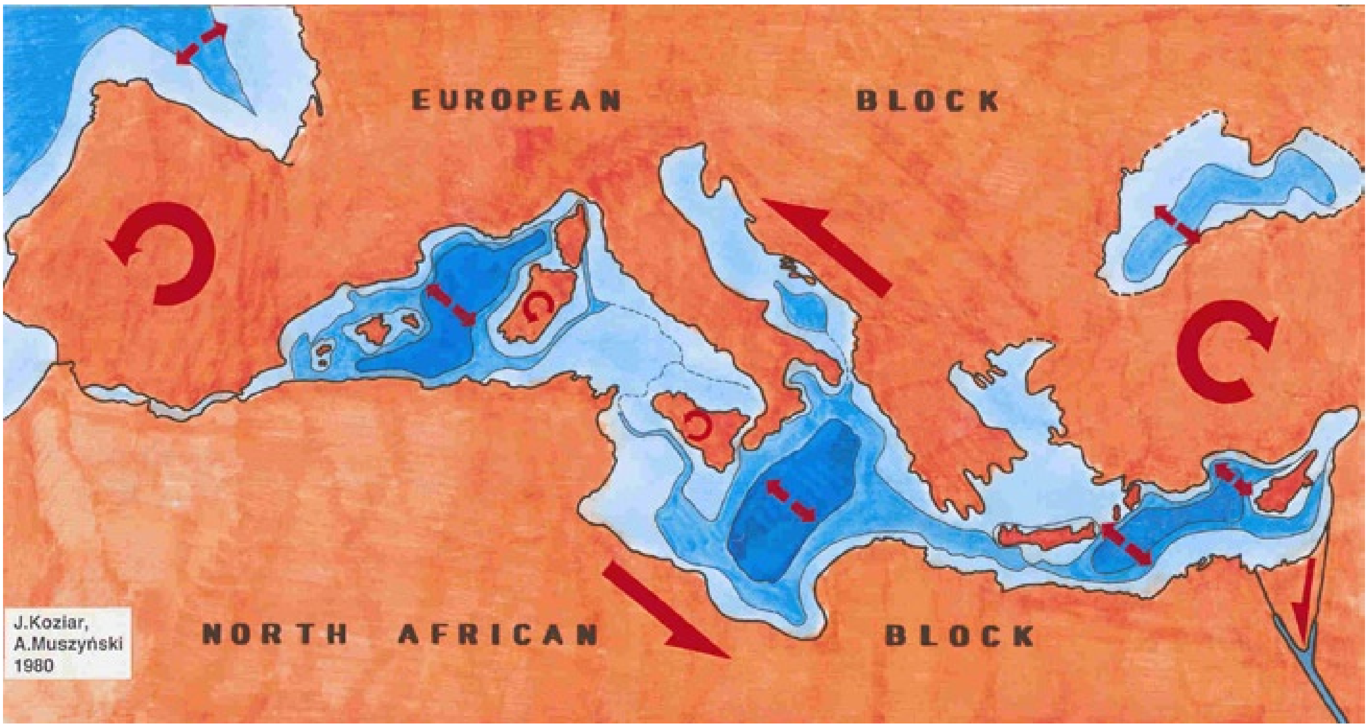



***Fig. 5. Reconstruction of the Mediterranean region, which is developing by tension***
*(after Koziar and Muszyński, 1980)*

In 1978 McKenzie, one of the "founding fathers" of plate tectonics, comprehended tensional development of sedimentary basins. McKenzie's voice meant acceptance of the process in the whole plate tectonics community[6]. Thus the tensional development of the Polish Basin was accepted at the end of 1980s without much publicity. It was a silent but very positive revolution in Polish geology.

However plate tectonics has also developed the collisional concept of so called "basin inversion" to preserve balance between divergent and convergent motions on a non-expanding Earth. It is an analogy between spreading of the ocean floor and its speculative compensation by subduction. The concept of compressional inversion was also applied to the Polish Basin (Krzywiec, 2000, 2002, 2005; Mazur et al. 2005). However it is easy to show that such an inversion is also a result of tension and stretching (Koziar, 2007, www.wrocgeolab.pl/inversion.pdf). It is simply a frozen stage of Carey's "regurgitation" of geosynclines.

So, north of the Carpathians there is also a permanent tensional regime and tensional structures (Fig. 6).

6 McKenzie came to the idea of stretching lithosphere under sedimentary basins studying stretching of the Aegean Sea area. The same year (1978) I presented at our Institute the reconstruction of the Mediterranean region in which the Aegean area is reduced (see Fig. 7). However in this reconstruction the whole Mediterranean area is reduced while plate tectonics assumes (and McKenzie himself) that it was greater. The precise mechanism of stretching of the Aegean area is shown in Fig 8 in the Supplement.

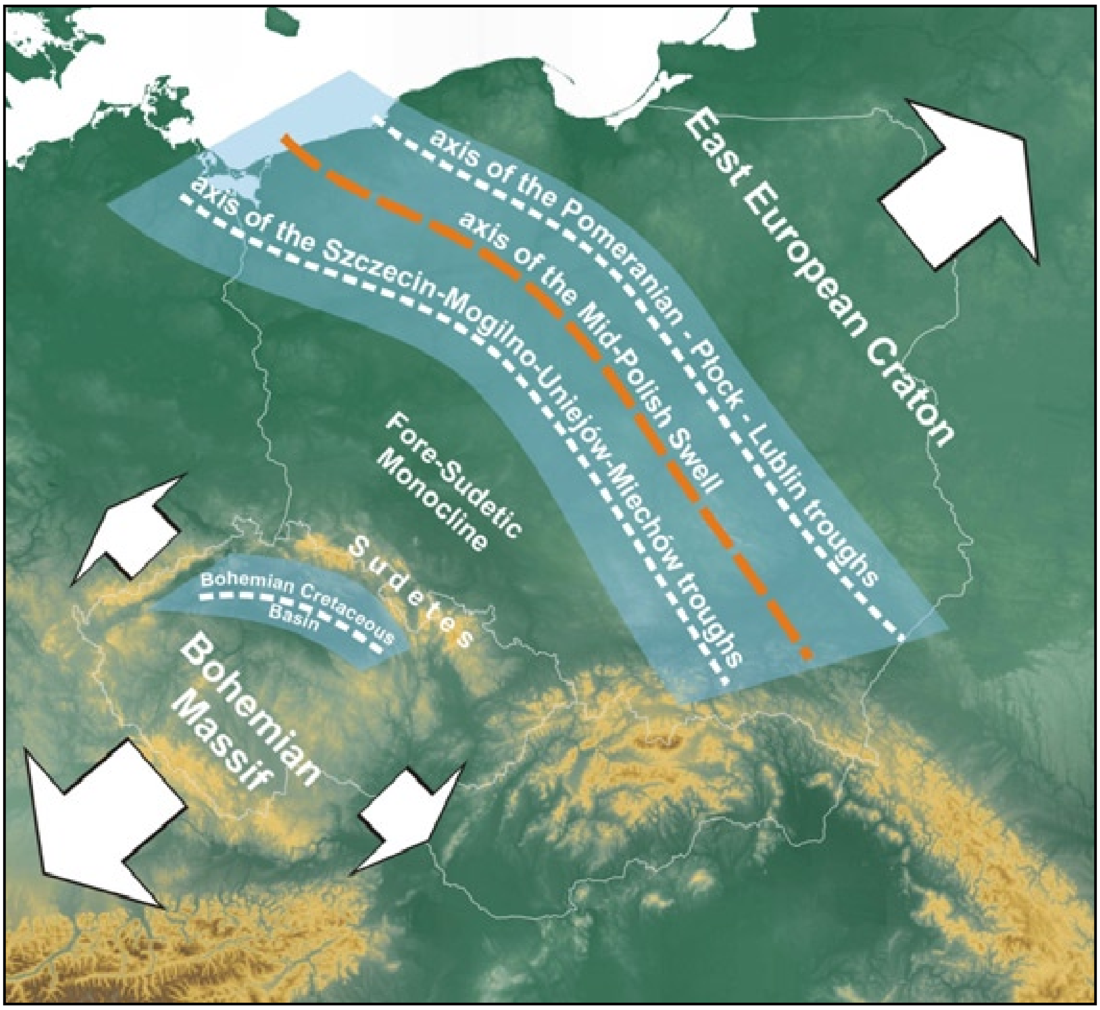



***Fig. 6. Tectonic tensional plan of development of the Polish Basin and Bohemian Massif.***
*Laramide phase of this tension triggered the inversion of the Polish Basin along the axis of the Mid-Polish-Swell (Koziar, 2007)*

# B. After the KBGA 1985 conference

## 1. Presentation of the topic at the Cracow 1986 conference

One year after the 1985 KBGA conference, Leszek Jamrozik lectured on the topic at the next conference “History of tectonic movements on Polish territory. Alpine cycle”, held also in Cracow 17-18 March 1986. It was organized by the Commission of Tectonics of the Committee of Geological Sciences of the Polish Academy of Sciences, the Institute of Geological Sciences of Wrocław University and the State Geological Institute – Carpathian Branch. The topic was presented as only one lecture and again published (Jamrozik and Koziar, 1986)[7], this time in Polish.

## 2. Presentation of the topic at the Wrocław – Sosnówka 1994 conference

In 1994 Leszek Jamrozik presented the topic with my co-authorship one more time (Fig. 7) at the international conference “Problems of the expanding Earth” organized by me and Stefan Cwojdziński under the patronage of Professor Józef Oberc, and held in Wrocław and Sosnówka (Sudety Mts.).

[7] Additional references (2013) are placed at the end of this brochure.

***Fig. 7. Leszek Jamrozik giving the lecture on tensional origin of fold belts at the Wrocław – Sosnówka 1994 conference***

The topic was then a little broadened and entitled: “Tension-gravitational development of the Alpine – Carpathian belts”.

This time Professor S.W. Carey was among participants of the conference (Fig. 8).

***Fig. 8. Professor S.W. Carey at the Wrocław – Sosnówka 1994 conference***

At the Wrocław – Sosnówka 1994 conference Andrzej Muszyński (now Professor at Poznań University) lectured on again the topic of tensional origin of Mediterranean region under the title: "Extensional development of the Mediterranean Sea". This time Professor Carey listened to the lecture (Fig. 9).


***Fig. 9. Andrzej Muszyński giving the lecture on tensional origin of the Mediterranean region at the Wrocław – Sosnówka 1994 conference.*** *Professor Carey was a chairman of this session*

### 3. Development of the topic in Koziar's 2005 papers

Let's go back to the fold belts. Their tension-diapir-gravitational mechanism has been further developed by me and presented many times. In 2005 it was published in two expanded papers ***"Tensional development of the intracontinental fold belts. Mechanism."*** and ***"Tensional development of the intracontinental fold belts. Regional examples."*** (Koziar, 2005ab). The first paper consists of 25 pages and 33 figures, the second of 40 pages and 52 figures.

Unfortunately both papers are still accessible only in Polish. It will still take some time before I will be able to present them in English. Because of the importance of the topic I present below only the contents of the two papers and after that, some figures in the Supplement:

# Tensional development of intracontinental fold belts. Mechanism

## Contents

# Tensional development of intracontinental fold belts. Regional examples

## Contents

In the second paper the US Rocky Mts., the US Sevier belt, the Transantarctic Mts., Zagros and the Andes are not described. This is because the first four belts are described in the first paper. US Rockies and Transantarctic Mts. are described as elevated flanks of rifts (tensional of course) – east flank of Rio Grande Rift and east flank of West Antarctic Rift respectively.

The Zagros Mts. are described at explanation of an origin of ophiolite suture. The suture is an inferior eugeosyncline gravitationally jammed by diapir raising in the neighbouring superior eugeosyncline (see the Supplement, Figs. 3 and 4).

While the Andes belongs to a separate kind of fold belts connected with Wadati-Benioff zones (active continental margins and island arcs, see Fig. 4 of introduction). They are explained separately (Koziar and Jamrozik, 1991, 1994; Koziar, 2003) but basically in the same way as intracontinental fold belts.

## 4. The "great blunder"

Carey's dilatational fold belt and its tension-diapir-gravitational mechanism turned out to be testable and have been verified as a real phenomenon.

After the Wrocław – Sosnówka (1994) conference, in a letter published in the report from the conference (Cwojdziński and Koziar, 1995), Carey called the explanation of the fold belts by crustal compression as "*the great blunder which geology has suffered for the last century"*. Certainly this blunder, rooted deeply in geological thinking since the time of the contracting Earth theory, is one of the main reasons of popularity of the plate tectonics paradigm.

## 5. The need for a supplement to the reproduced papers

After presentation of the discussed paper some other issues should be discussed. First of all some solutions presented in my 2005 papers which are strictly connected with the Carpathians. Then the relation of the presented tensional mechanism of fold belts to plate tectonics paradigm and finally the contribution of professor Cliff Ollier to the explanation of the origin of mountains on an expanding Earth. Thus a supplement is needed and it was placed in the final part of this brochure.

## 6. Information about formal improvements in the reproduced papers

All the figures of the reproduced papers are now in colour and are improved with use of computer graphics. The original ones were black-and-white. The Haarmman's scheme, now Fig. 1, in the first paper has been shifted to the front of the paper. Originally it was put together with the present Fig. 5 as an (**a)** and (**b)** component of one figure. The present figure 4 is added, but it corresponds precisely to the verbal explanation in the original text. Some subtitles are added. The English of the former editorial translation is improved. Some contemporary comments were added in footnotes and these are provided with the 2013 date. A little change is also made in the titles. The former word "model"[8] was changed to "mechanism" and the word "gravitation" was changed to "gravitational". The word "model" implies some rough and weakly justified solution. If some solution is well justified it stops being a "model".

***J. Koziar (2013)***

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8 The original titles were: "Tension – gravitation model of tectogenesis" and "Application of tension – gravitation model of tectogenesis to the Carpathian orogen reconstruction.

# II. Reproduced 1985 papers

## A. Tension – gravitational mechanism of tectogenesis

**Proceeding reports of the XIII-th Congress of Carpatho-Balkan Geological Association, Part I, Poland - Cracow, September 5-10 1985, p. 195 - 199.**

**Jan Koziar, Leszek Jamrozik**
Institute of Geological Sciences
University of Wrocław

## Contents

# 1. Introduction

From the beginning of the 19th century observations on strongly deformed rock series in fold belts, brought about a model of the collisional orogen. According to this model the filling of a geosyncline was to be compressed between two rigid fragments of the lithosphere. The compression, evident within a fold belt, has been extrapolated in this model (from the time of Ellie de Beaumont to plate tectonics) over adjacent areas and over the whole vertical profile of the lithosphere.

Parallel with the collisional model, the gravitational model has been developed by Reyer, Haarmann (Fig. 1), and van Bemmelen. In the latter model, horizontal displacements of rock series are considered as gravitational transportation (the secondary tectogenesis) caused by deep vertical movements (the primary tectogenesis). The vague character of the primary tectogenesis was a weak point of this model.

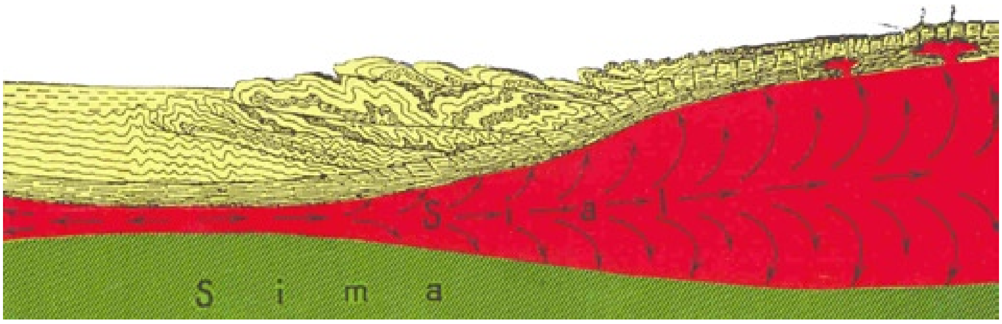


***Fig. 1. Model of gravitational tectogenesis by Haarmann (1930).*** *The primary tectogenesis is caused in this model by a supposed deep flow of magma from the front of the fold belt to its hinterland. It causes differences in heights necessary for the secondary tectogenesis, i.e. gravitational displacement of the fold belt*

Recent data from the fold belts zones show, that an opposite process to the collision occurs there. It is demonstrated below that these data and processes also explain the problem of the primary tectogenesis in the Haarmann - van Bemmelen's gravitational model.

# 2. Tensional foreland of a fold belt

A basement of a foreland of a fold belt develops under tensional regime. This can be demonstrated on the basement of the Carpathian foredeep (Fig. 2).

Teisseyre (1921) showed that this basement sinks stepwise southwards (on the northern section of the Carpathians) and breaks off abruptly as a steep scarp (Sikora, 1973 and 1976) under the overthrusted flysch nappes. Such a structure shows that the foreland margin is an edge of a large gravitational graben[9].

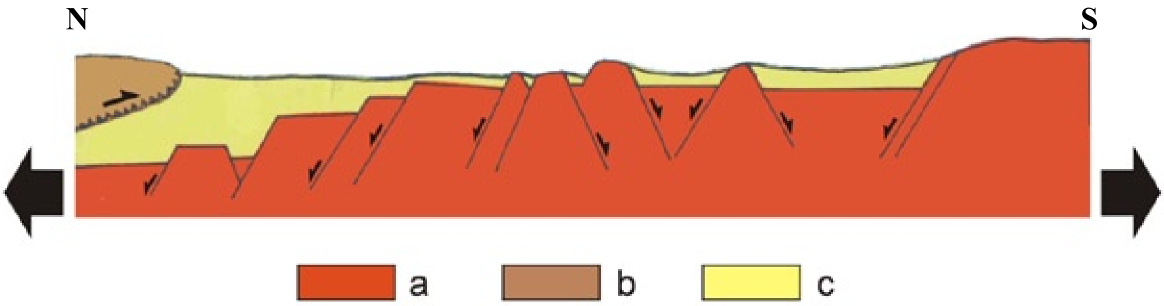


***Fig. 2. General cross-section of the Carpathian foredeep, aproximately along the Cracow meridian*** *(after Gradziński 1972), a – basement of the foreland of the Carpathians, b - overthrusted nappes of the Carpathian flysch, c - Miocene deposits of the Carpathian foredeep*

[9] In active continental margins and island arcs, fragments of the oceanic lithosphere being destroyed in this way can sink deeply into the tensionally thinned upper mantle and form seismic Wadati-Benioff zone interpreted in the frame of plate tectonics in a compressional way as so called "descending slab" (hypothesis of subduction). *Footnote 2013.*

## 3. Tensional root zone of a fold belt

It has been known for a long time that the Moho discontinuity is lowered under uplifted fold belts and marks their so-called "root". This structure was interpreted in the collisional model as a compressive downwelling of the granitic layer (Fig. 3a) and became important confirmation of the model. However, the confirmation is based on a circular argument.

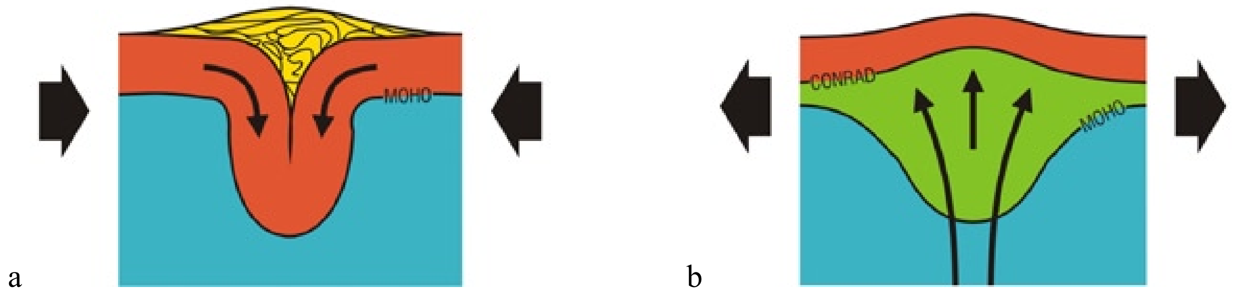


***Fig. 3. Two opposite models of the origin of the fold belt root, a*** *– fold belt's root is made by downwelling of the granitic layer in a compressional regime (false traditional model),* ***b*** *– fold belt's root is made by upwelling of the thinned upper mantle in a tensional regime (a real process)*

Recently, deep seismic sounding has indicated that under the uplifted fold belt the granitic layer is thinned and a thickening of the basaltic layer between the Moho and granitic layer occurs there. So the uplifted fold belt is isostatically supported not by the "granitic root" but by so called "basaltic pillow". The basaltic pillow has not been explained on the basis of the collisional model. Basaltic pillow has been also detected beneath both – continental rifts and the north Atlantic part of the Mid-Ocean Ridge (Zverev et al. 1975). Both structures are of undoubted tensional origin and the same regime should be ascribed to the root of an uplifted fold belt (Koziar et al. 1984).

The phenomenon of the "basaltic pillow" is easy explained if we consider the Moho as a phase boundary as was already suggested by Fermor (1913, 1914), Holmes (1926a and b, and 1927) and de Sitter (1960). Under great continental and oceanic rifts the diapirism of the upper mantle rises the temperature and the heat flow. Intersection of this vertical higher-temperature zone with the horizontal phase boundaries lowers the latter (Fig. 3b). So, the "basaltic pillow" defines a mechanism diametrically different from the mechanism implied by fictitious "granitic root" (compare Fig. 3a and b).

The deep tensional regime inferred from the "basaltic pillow" is consistent with the deep tensional regime deduced from the gravitational faults under a foredeep of a fold belt.

## 4. Tensional intermontane depression

Until recently these structures have been regarded as sunken rigid intermontane massifs inferred in the same way as "granitic roots" – from the collisional model (the resistant massifs to hypothetical tangential pressure). However, recent geophysical investigations have shown that the "granitic layer" is here fragmentary or almost lacking. Moreover, it has been demonstrated that back-arc seas, structurally corresponding to intermontane depressions, grow by back-arc spreading. Dilatation processes have also been recognized within continental intermontane zones themselves, for example, in the Nevada Basin (Gilluly, 1970). At the same time it has been recorded that diapirs of the upper mantle are present beneath these structures.

## 5. Tensional mechanism of the primary tectogenesis

Combining the three structures discussed above (foredeep, root zone, and intermontane depression) and disregarding for now the fold belt itself, one obtains the image of a huge rift (Fig. 4) in which regional tension and stretching leads to two opposed processes:

1) gravitational destruction of the lithosphere at the edge of the rift (subsidence)

2) diapirism of a deep basement (asthenosphere) inside the rift (elevation).

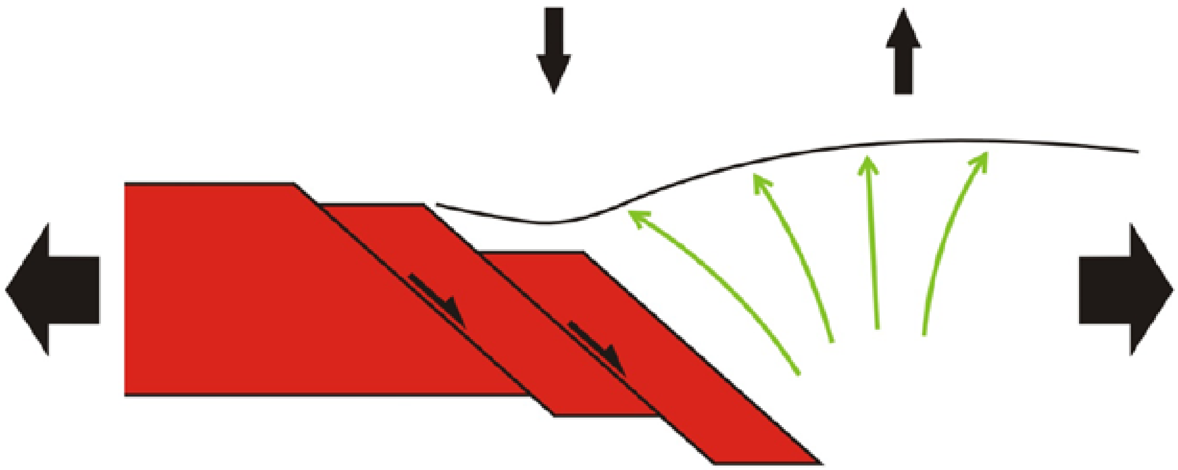

***Fig. 4. Primary tectogenesis in the tension – gravitational mechanism*** *(explanations in the text)*

These two, not very distant and opposed vertical movements, create a mechanism of the primary tectogenesis in the tension - gravitational mechanism.

## 6. Full tension – gravitational mechanism

The tensional primary tectogenesis causes gravitational displacement of the fold belt towards the foredeep, that is the secondary tectogenesis (Fig. 5).

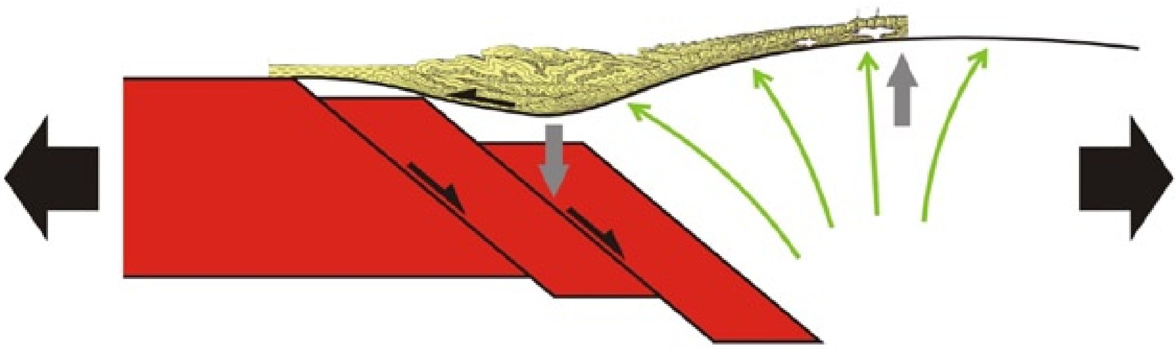

***Fig. 5. Full tension – gravitational mechanism.*** *Compare with Haarmann's scheme (Fig. 1), from which the folded series are taken (his secondary tectogenesis)*

## 7. Mechanism of origin of the intermontane depression

It is known that an intermontane depression develops as a negative form just after the overthrusting of the nappes (after the secondary tectogenesis). Its development should be explained by degasification (dehydration) of the top of the upper mantle diapir. A common volcanic caldera is a mini-model of this process.

## 8. Hints on reconstruction of a fold belt area

Below, some important hints on a reconstruction of a fold belt, resulting from the mechanism outlined above, are given:

1. The area of an intermontane depression is an area of a deep gravitational denudation.
2. The so called "folding massifs" (intermontane massifs which separate folded miogeosynclinal series from intermontane depressions), are allochthons.
3. The intermontane depression areas should be reconstructed by pulling back the allochthonous intermontane massifs to autochthonous positions regarding their geometric shape and lithology. The result should be consistent with a palinspastic reconstruction of folded series in a front of a massifs (two independent methods of reconstruction)[10].

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[10] See the scheme of such a reconstruction placed in the Supplement, Fig. 2. *Footnote, 2013.*

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# B. Application of the tension - gravitational mechanism of tectogenesis to the Carpathian orogen reconstruction

**Proceeding reports of -the XIII-th Congress of Carpatho-Balkan Geological Association, Part I, Poland - Cracow, September 5 – 10 1985, p. 200 – 205.**

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## Contents

## 1. Van Bemmelen's contribution to gravitational tectogenesis of the Carpathian fold belt

The present attempt at application of the gravity tectonics to the Carpathian tectogenesis is not a new one. It was roughly undertaken by van Bemmelen (1960)[11] who pointed at radial directions of tectonic transportation around the Pannonian Depression. Such directions of transportation are incompatible with the so-called "tangential pressure".

## 2. Allochthonism and authochthonism of the Carpathian massifs

According to the tension - gravitational mechanism of the tectogenesis shown by the present authors (this volume p. 195-199), the Pannonian Basin (for the West Carpathians) and the Transilvanian Basin (for the East Carpathians) are the areas of deep tectonic denudation behind the fold belts. The Southern Carpathian and the Apuseni massifs seem to be autochthons with gravitational overthrusts limited only to their epidermal horizons. On the other hand, the Marmarosha and the Slovak massifs are allochthons. Also the Bakony-Vertes and Mescek massifs are probably allochthonous.

The Slovak Massif had adjoined approximately the northern edge of the buried Szolnok Flysch (Fig. 1) then it was gravitationally displaced some 100 km north-westward. The distance is in accord with the results of palinspastic analyses of the north Carpathian flysch (Świdziński, 1971 and Unrug, 1979). The tectonic denudation was accompanied by intense volcanism at the hinterland of the massif. The products of the volcanism occur all over the area between the Szolnok Flysch Zone and the Slovak Massif in its present position.

## 3. Significance of the allochthonism of the Slovak Massif

At the beginning of the theory of nappes the allochthonous nature of the Slovak Massif was pointed out by Uhlig (1907) on the base of its correlation with the Eastern Alp Massif. The Pennide Basin, which peeks out from tectonic windows, is a counterpart of the Carpathian Flysch Basin (flysch geosyncline).

But later, the Slovak Massif was treated as an autochthon (shifted only as a microcontinent). This alleged autochthonous character of the massif became the main argument against the gravitational origin of flysch nappes (Książkiewicz, 1972) because in this situation it was impossible to find the area of tectonic denudation for these nappes.

This argument cannot be maintained in the case of allochthonism of the massif because in this situation the area of tectonic denudation behind the flysh nappes lies under this massif. Such a situation is visible directly in the Alps, in the tectonic windows of Tauern and Engadine.

When including the Slovak Massif in the Carpathian allochthons, we notice, that the tension – gravitational mechanism explains better and on a much larger scale the nappe tectonics than the collisional model[12].

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[11] And Egyed (1960a). *Footnote, 2013.*

[12] The presented tensional mechanism is based on geological facts without any reference to expansion of the Earth. But expansion of the Earth results from this mechanism amongst others. One of the main arguments of the opponents of the expanding Earth is a statement that EE cannot explain the origin of thrusts and nappes. In fact on the expanding Earth they develop better than on all global compressional models from the contracting Earth theory to plate tectonics. *Footnote, 2013.*

## 4. The end of the Carpathian geosynclinal stage

Figure 1 presents the general reconstruction of the Carpathian area at the stage directly preceding the secondary tectogenesis. It is the stage of the mature geosynclines which precedes directly the piercing of diapirs of the deep basement near the Earth surface in places of later intermontane depressions. The culmination moment of the upwelling of the diapirs corresponds with the gravitational secondary tectogenesis.

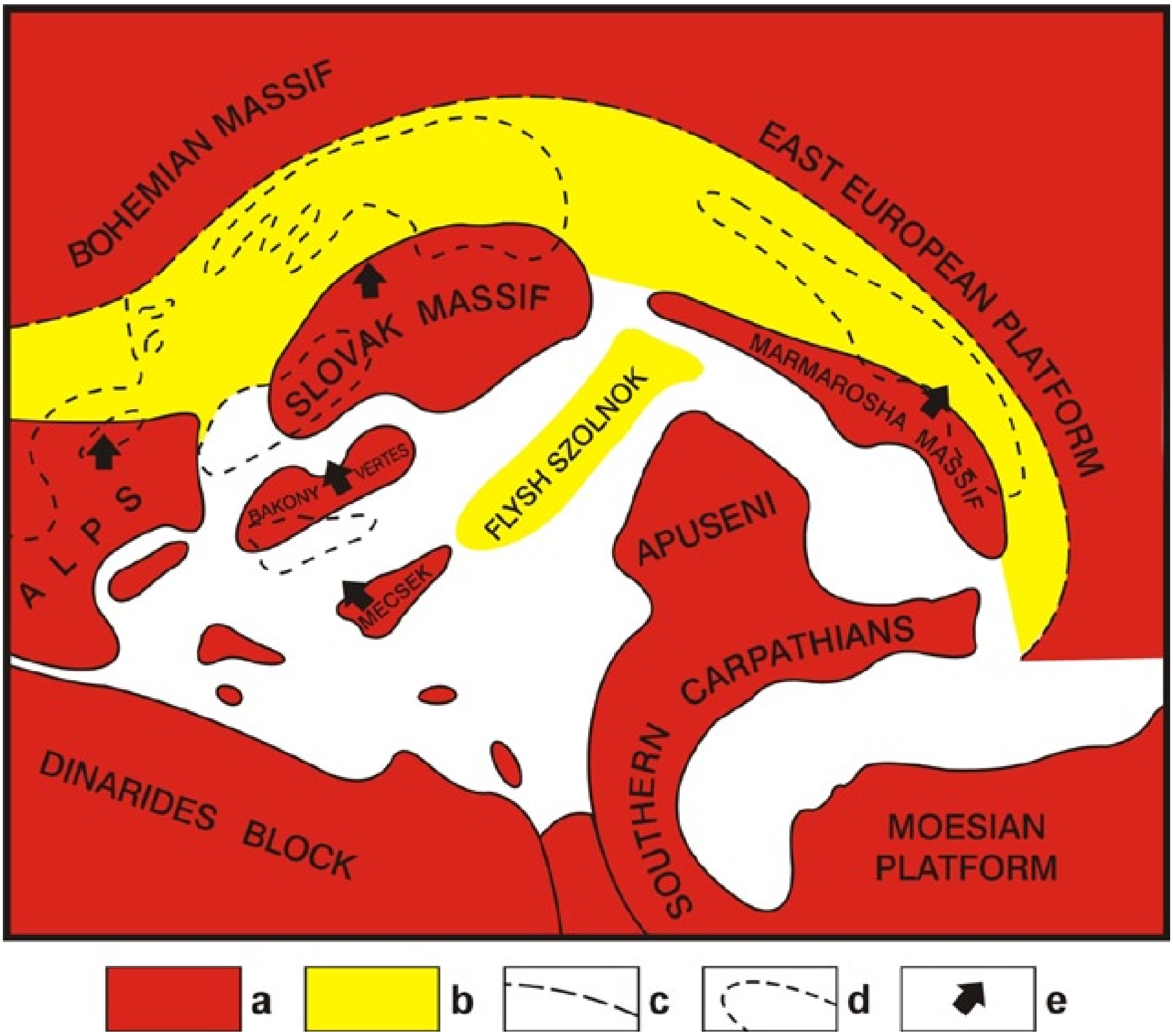


***Fig. 1. General reconstruction of the Carpathian region at the stage directly antecedent to the secondary tectogenesis (Lower Miocene),*** *a – platforms, massifs and blocks, b – flysch, c – probable borders, d – present position of the allochthonous massifs, e – directions of displacements of the allochthonous massifs*

## 5. Carpathian pre-geosynclinal stage

The reconstruction demonstrated above can be extended back in time to the closure of the Carpathian geosynclines (Fig. 2).

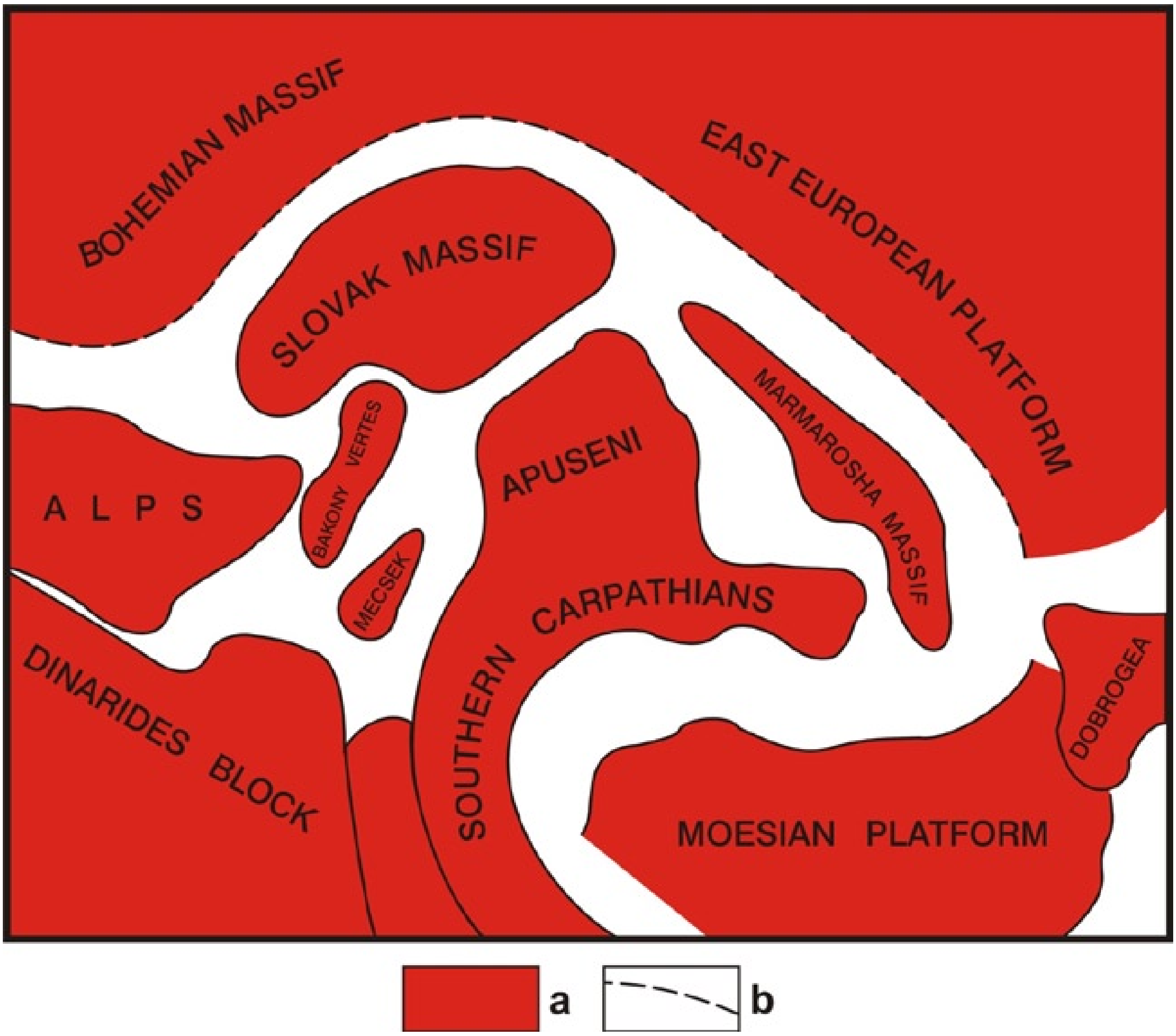


***Fig. 2. General reconstruction of the Carpathian region (Middle Mesozoic)***
*a - platforms, massifs and blocks, b – probable borders*

## 6. More general significance of tension which formed the Carpathian fold belt

It can be demonstrated that the regional dilatation forming the discussed segment of the European Alpides is just one element indicating a persistent tensional regime connected with the permanently increasing distance between Africa and Europe. During the post-Alpine stage the tension has been mainly released by dilatational developing of the Mediterranean Sea (Koziar and Muszyński, 1980). During the pre-Alpine stage the tension was mainly released by dilatational disintegration of the European Variscides.

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# III. Supplement 2013

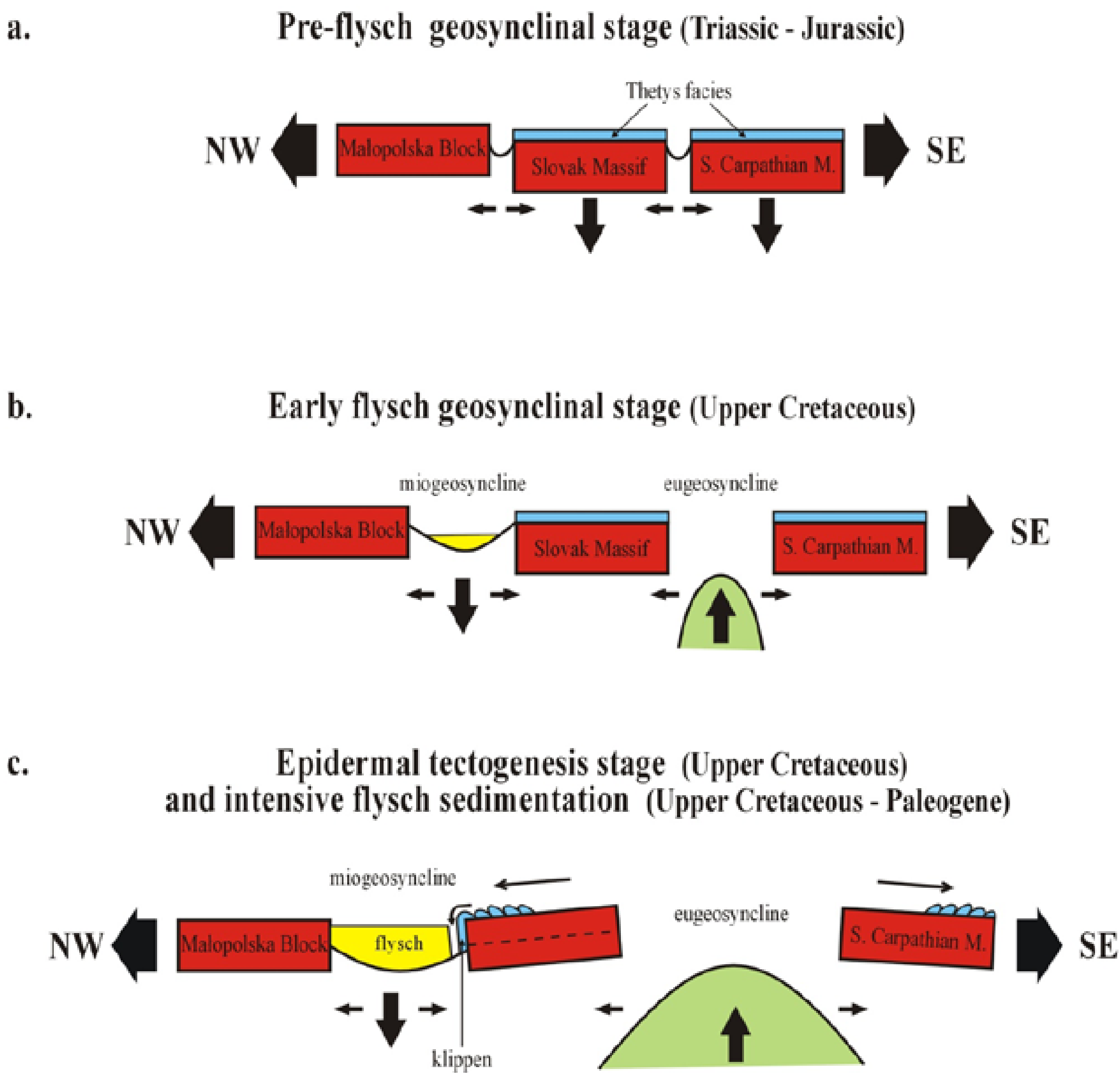
## Contents

# A. Still about Carpathians

In this section some schemes are reproduced from my 2005a paper **"Tensional development of the intracontinental fold belts. Part I, Mechanism.**

## 1. Scheme of the development of a fold belt based on the example of the Carpathians Mts.

Below the general schemes of tension – diapir – gravitational development of a fold belt area are presented based on the example of the Carpathians Mts. on their schematic vertical NW-SE section. On this section the Apuseni Massif was omitted for simplification.



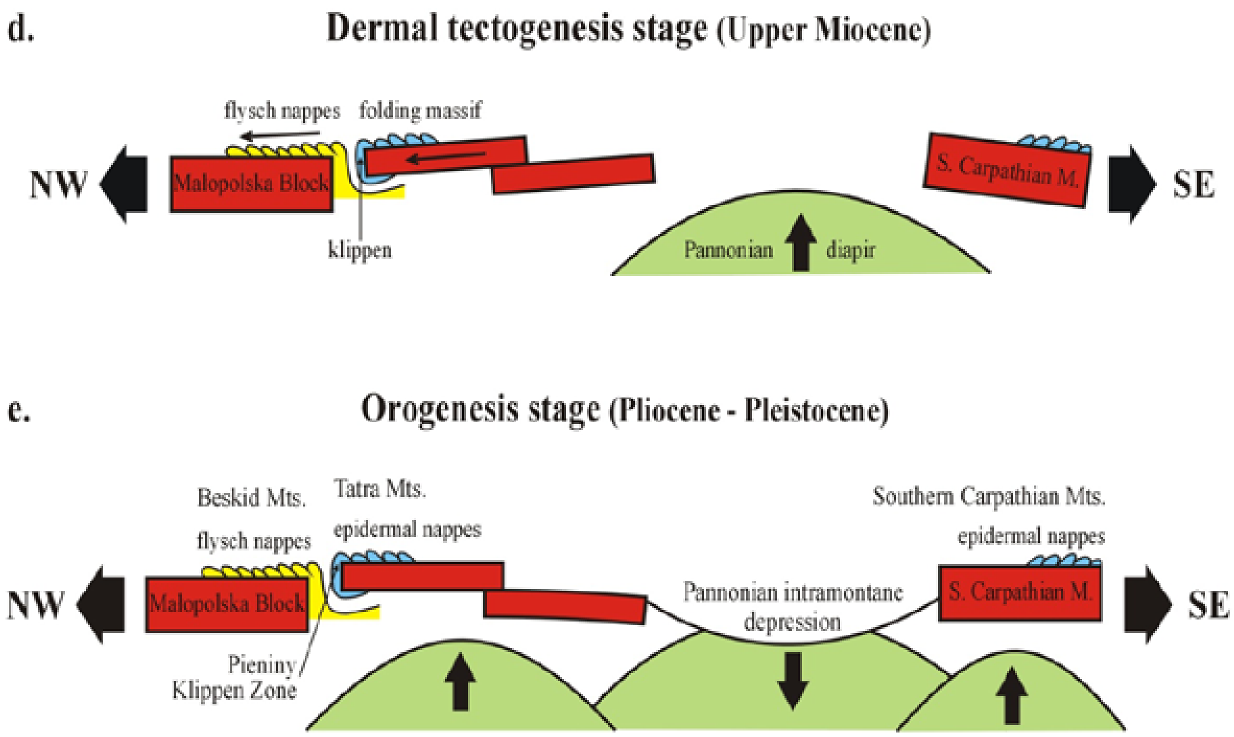



***Fig 1. Scheme of the development of a fold belt area based on the example of the Carpathians Mts***. *(after Koziar, 2005a)*

***a. Beginnings of the geosynclinal stage (Triassic – Jurassic)****. The inner massifs (Slovak Massif and Southern Carpathian Massif) of the area sink as a result of tension. Tethys calcareous facies and embryonic geosynclines appear.*

***b. Eugeosynclinal stage – beginnings of primary tectogenesis (Early Cretaceous)****. Development of geosynclines is continued. Flysch sedimentation appears. Beneath the present Pannonian Lowland (in the place of maximal tearing apart of the lithosphere) eugeosyncline is formed with initial mantle diapirism.*

***c. Beginnings of the secondary tectogenesis (the turn of Late Cretaceous – Paleogene)****. As a result of continuing stretching of the lithosphere the mantle diapir is growing in the place of present Pannonian Lowland. Epidermal tectogenesis begins. Tatra nappes develop. Part of their formations falls to the rift of the later Pieniny Klippen Zone. Flysch sedimentation increases.*

***d. Dermal secondary tectogenesis (Late Miocene)****. Subsequent growth of the mantle diapir causes gravitational transport along deep horizon of sliding. Slovak Massif is transformed to a folding massif which throws the contents of flysch miogeosyncline onto its foreland. The folding of flysch is almost at the sea level because marine Miocene sediments lie on the top of the flysh nappes.*

***e. Orogenesis (Pliocene – Pleistocene)****. The top of the diapir collapses by outgassing. The intermontane depression of the Pannonian Lowland develops above it. Diapirism migrates laterally and uplifts gravitationally transferred folded strata and border massifs of the fold belt area.*

All the stages are tensional and cause gradual enlargement of the fold belt area. Now the stretching is stopped. About its continuity see comments at the end of the section 3 of introduction ("Carey's dilatational fold belt").

## 2. Scheme of the reconstruction of a fold belt area

In 1985b paper only verbal hints on reconstruction of a fold belt were given. Below is the graphic scheme of the basic principle of such reconstruction (Koziar, 2005a).

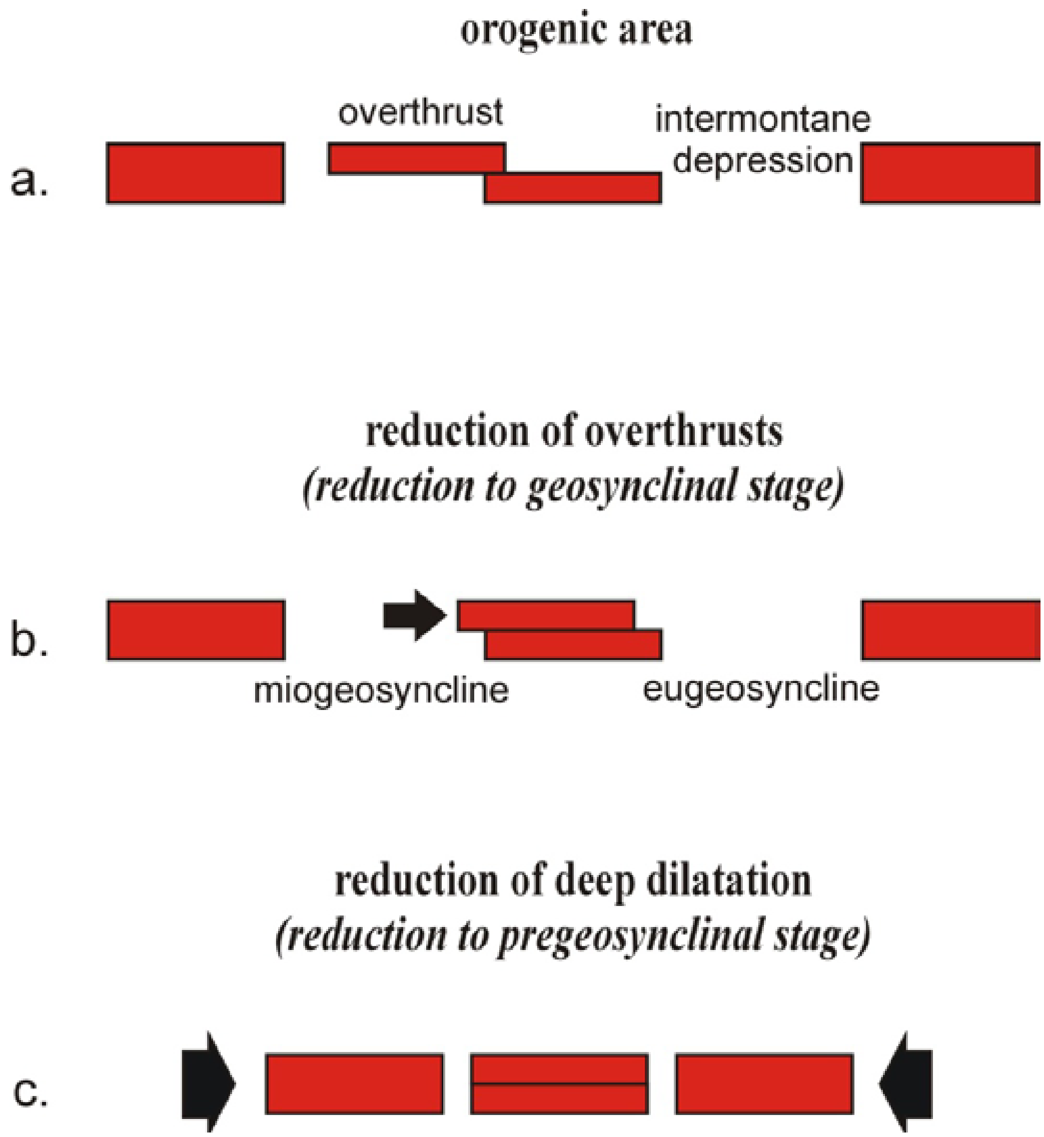



***Fig. 2. Scheme of the reconstruction of a fold belt area*** *(after Koziar, 2005a)*
***a*** *– the starting point is a present day fold belt area*
***b*** *– first, the effect of secondary tectogenesis must be removed. It is done by authochtonization of gravitationally shifted rocks. Thus we go back to the close of the geosynclinal stage*
***c*** *– then the geosynclines must be closed, so we go back to the pregeosynclinal stage.*

The reconstructed area is lesser than the area occupied by a mature fold belt.

## 3. Scheme of tension – diapir – gravitational development of an ophiolite suture
### *(with analogy to the Carpathian Pieniny Klippen Zone)*

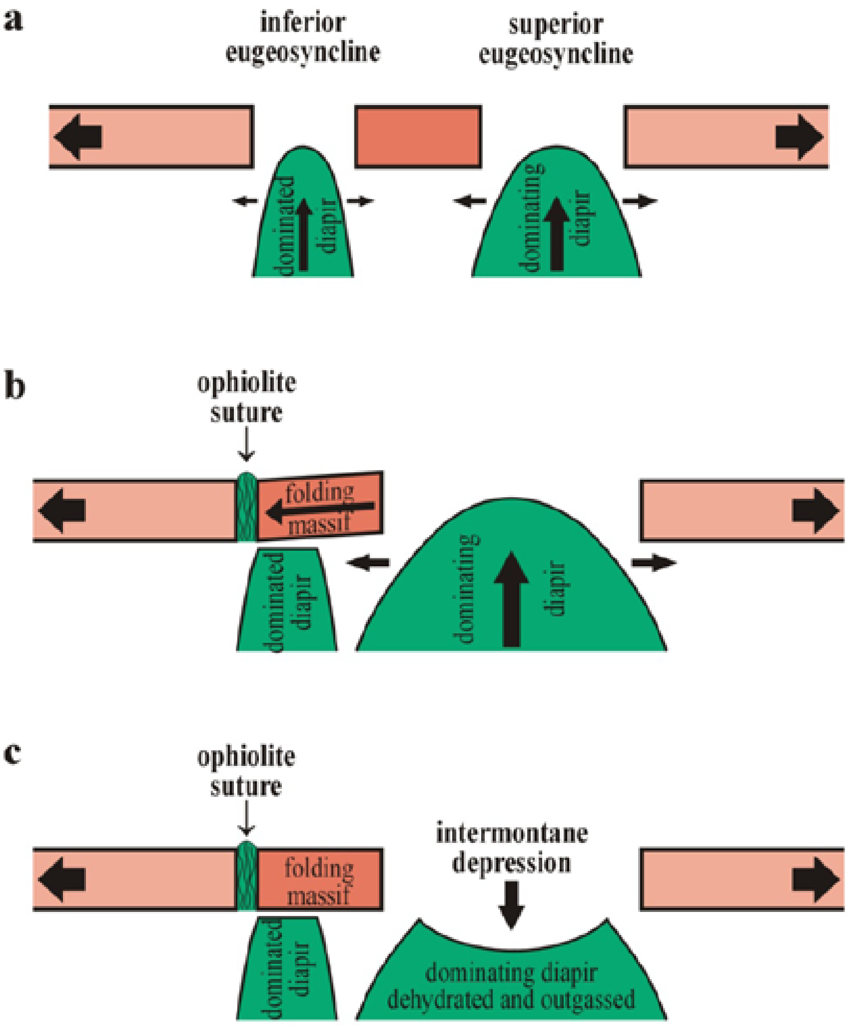



***Fig. 3. Tension – diapir – gravitational origin of an ophiolite suture*** *(after Koziar, 2005a)*
***a*** *– regional stretching develops two eugeosynclines with two mantle diapirs. One eugeosyncline is better developed (superior eugeosyncline) than the other (inferior eugeosyncline). One mantle diapir is bigger (dominating) than the second one (dominated). Both geosynclines are separated by the future folding massif*
***b*** *– during culmination of the dominating diapir the separating massif is transformed into a folding massif. It cuts and jams the top of the dominated diapir, transforming it into an ophiolite suture*
***c*** *– after dehydration and outgassing of the top of the dominating diapir the intermontane depression develops above it*

***Analogy to the Carpathian Pieniny Klippen Zone***

The Pieniny Klippen Zone in the Northern Carpathians has similar origin as an ophiolite suture (compare with supplement's Fig. 1c,). The zone has developed from the rift which occurred in the Late Cretaceous in the northern flysch miogeosyncline at the front of the Slovak Massif.

If the rift had been deeper it would has generated ophiolites which after activation of the Slovak Masiff, as a folding massif, would has been transformed into an ophiolite suture. The Pieniny Klippen sedimentary series are jammed in front of the folding massif in just the same way as opiolites are in an ophiolite suture.

## 4. Tension – diapir – gravitational development of an ophiolite suture shown on the Zagros Mts. example

The Zagros fold belt has the best developed ophiolite suture (Fig.4). The belt is also a good example of the tension – diapir – gravitational development presented above.

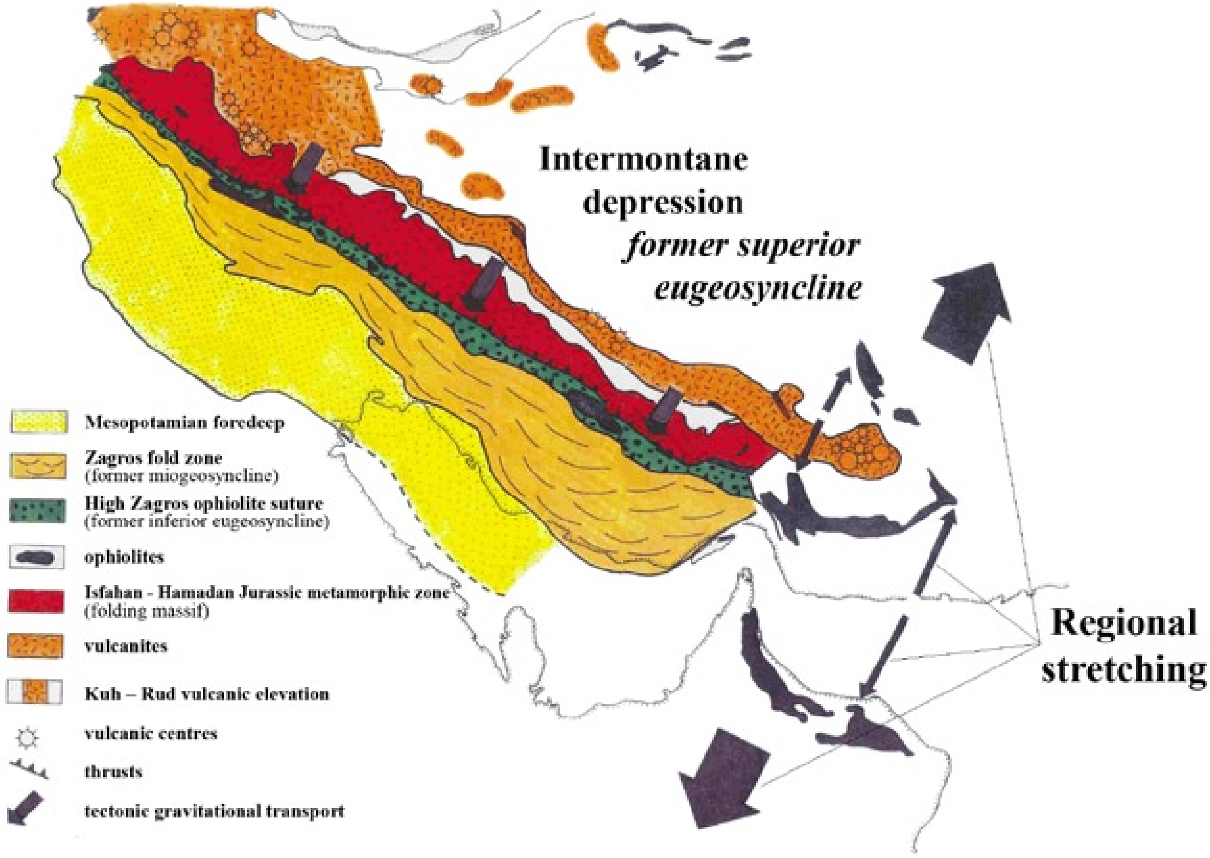



***Fig. 4. Tension – diapir – gravitational development of the Zagros fold belt*** *(after Koziar, 2005a)*

Below the explanation from my 2005a paper is given.

> *"The superior Zagros eugeosyncline was placed NE of the Hamadan – Isfahan folding massif. The inferior Zagros eugeosynccline was placed SW of the massif and separated it from the Zagros miogeosyncline. Diapirism in the superior eugeosyncline shifted gravitationally the folding massif to SW and jammed the inferior eugeosyncline transforming it into an ophiolite suture. Continued tectonic transport directed to SW, folded Zagros miogeosynclinal series and thrusted them onto Mesopotamian foredeep. Collapse of the superior diapir led to formation of Central Iran intermontane depressions. The whole of this processes were driven by NE-SW oriented regional tension and stretching".*

In the plate tectonics paradigm ophiolite sutures are interpreted as relicts of closed oceans. As such, they became, by a feed-back mechanism (more traditionally speaking – by a circular argument), a proof of this paradigm. It is possible only if the former classic understanding of ophiolites is forgotten. This formation (Steinman's Trinity) was recognized already at the beginnings of the past century and was at once interpreted as a product of a narrow eugeosynclinal furrow (not a relic of a closed ocean). Later geosynclines were recognized as tensional structures and ophiolites were recognized as a product of eugeosynclinal mantle diapir. In such a way Oman ophiolites (Fig. 4) were explained by Reinhard (1969). In a more detailed way I present this topic in my paper falsifying the plate tectonics concept of terranes (Koziar, 2006).

The other wrong "proof" of the closed oceans are paleomagnetic interpretations based on the non-expanding-Earth assumption. It is another example of circular argument explained in my 2006 paper.

In 2000, H. Hugh Wilson, the former Chief Geologist of Petroleum Development Oman Ltd. sent me (on Carey's recommendation) his fresh paper (Wilson, 2000). The author points out that the Oman ophiolite was developed from a mantle diapir in a tensional NE-SW regime. The author underlined that this process is in concordance with *"extensional movements in the Indian Ocean"*. It can be added that it is also in concordance with extensional movements in the Red See. In the Zagros fold belt and Oman ophiolites there is no compensation of the divergent movement of Africa and the Arabian Peninsula. There is a divergent movement too and both indicate the larger scale divergent movement between Eurasia and Africa (in the whole Tethys tectonic zone). In this movement Asia has torn the India Peninsula from Africa (as well as the Arabian Peninsula at the Red Sea rift) and pulled it to NE. There is a tensional regime in the whole continental area between India and the Siberian shield. Stretching under Tibet area results in development of a huge Tibetan mantle diapir, and then – Himalaya and Kun-Lun Mts.

The general divergent development of the Tethys tectonic zone (see also the tensional development of the whole Mediterranean region – Fig. 5 of the Introduction) is demonstrated in my paper on the reconstruction of the Gondwana supercontinent on the expanding Earth
(Koziar, 1991, www.wrocgeolab.pl/gondwana.pdf).

## 5. Plate tectonics bizarre explanation of folding of the Carpathians

From the very beginning the concept of tangential pressure and collision of Africa with Europe encountered a big problem with complicated directions of folding in the Mediterranean area. Staub (1924) for example tried to explain them by analogy to propagation of water waves in "the Alpine-Carpathians Gulf" (Fig. 5).

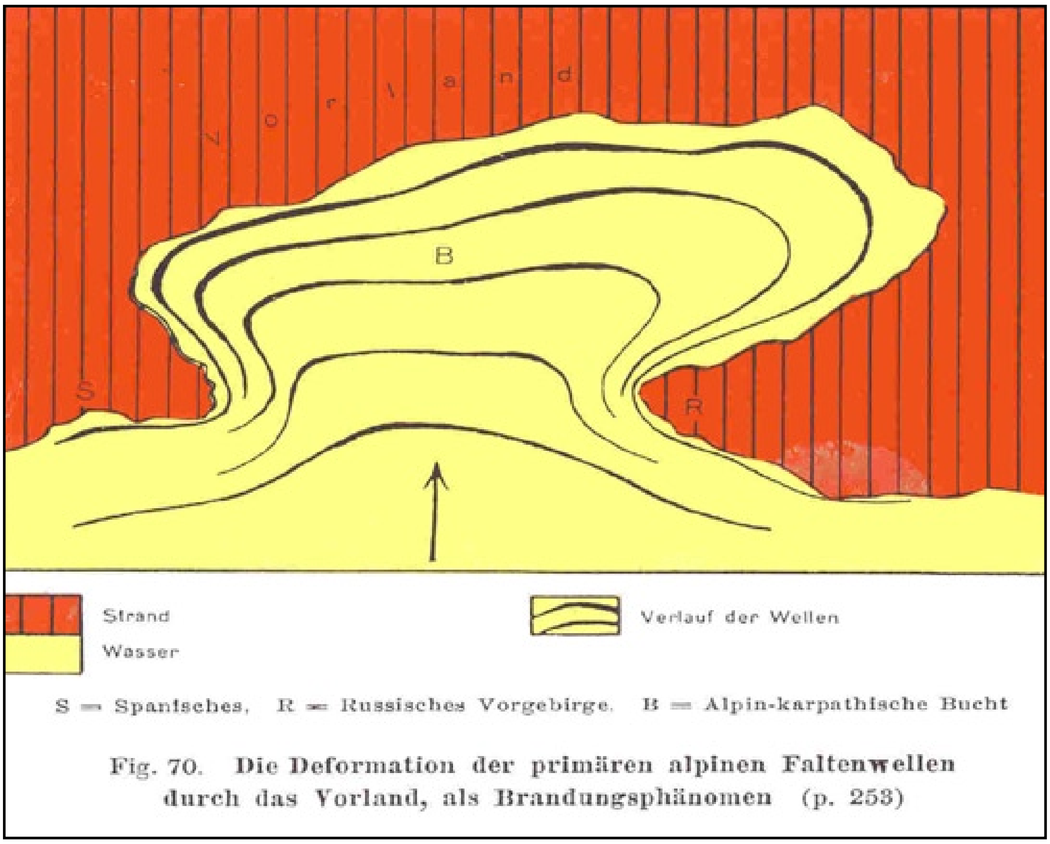



***Fig. 5. Attempt at explaining of directions of the Alpine and Carpathian folding by analogy to propagation of water waves in "Alpine – Carpathian Gulf",*** *by Staub (1924)*

Plate tectonics has developed a similar bizarre idea, this time of "escaping tectonics" (Fig. 6).

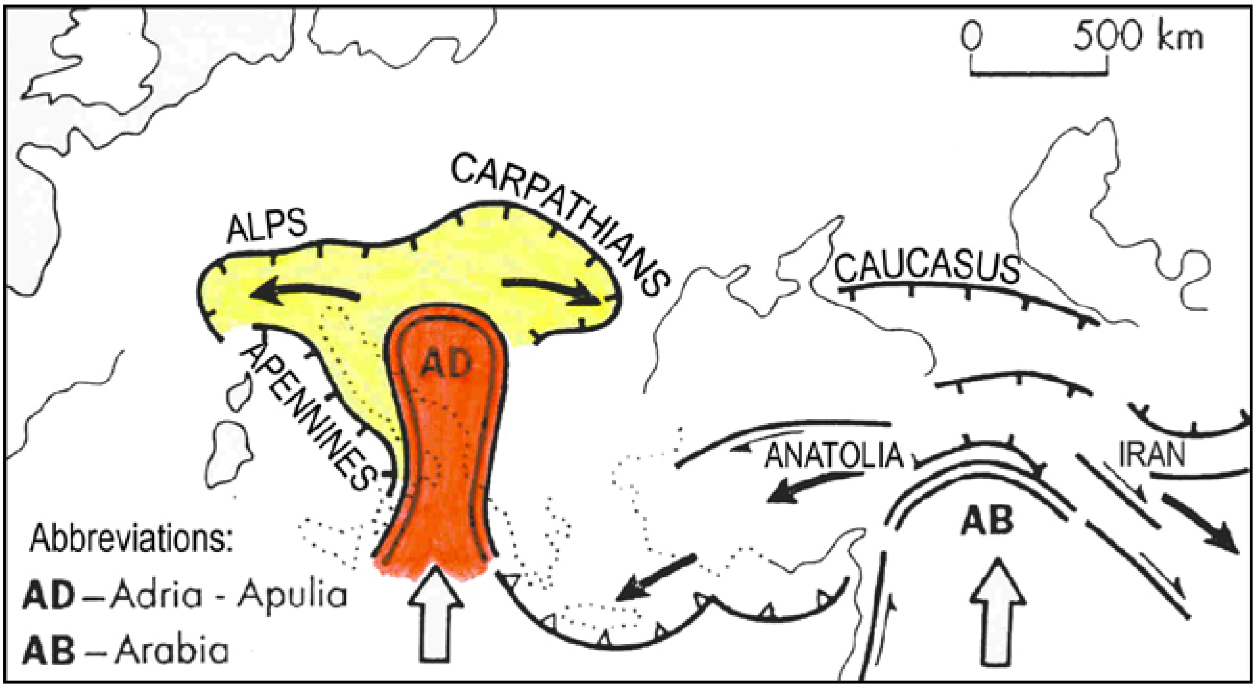



***Fig. 6. Plate tectonics attempt at explanation of direction of Alpine and Carpathian folding by "escape tectonic",*** *(after Dadlez and Jaroszewski, 1994)*

In this scheme Africa is supposed to push onto Europe by two promontories – Adriatic (AD) and Arabian (AB). While the latter is a real geological structure (but in fact moves in the opposite direction), the first is a pure geological phantom. The Arabian promontory is supposed to push the Caucasus to NE and squeeze the Anatolian Peninsula to SW. However the real situation is demonstrated in Fig. 7.

This is Africa moving southward which pulls in the same direction the whole Aegean area together with its neighborhood.

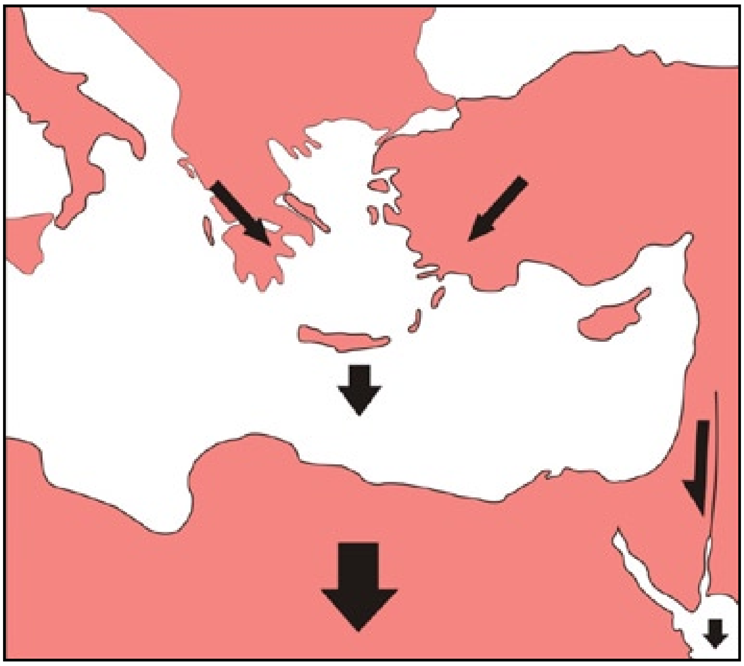


***Fig. 7. Southward tectonic movement in Aegean area is caused by southward movement of the whole Africa relative to Europe*** *(Koziar, 2005b)*

The Adriatic promontory is supposed to push rocks to the west and east. But the latter movement should explain also the northward and southward faulting in the Carpathians and this does not work. The latter is opposite to the assumed northward motion of Africa. The first has no direct connection with it. Thus there are attempts to explain them both by two subsequent supporters of "pushing" Africa – the Alcapa and Tisza-Dacia pistons (Fig. 8).

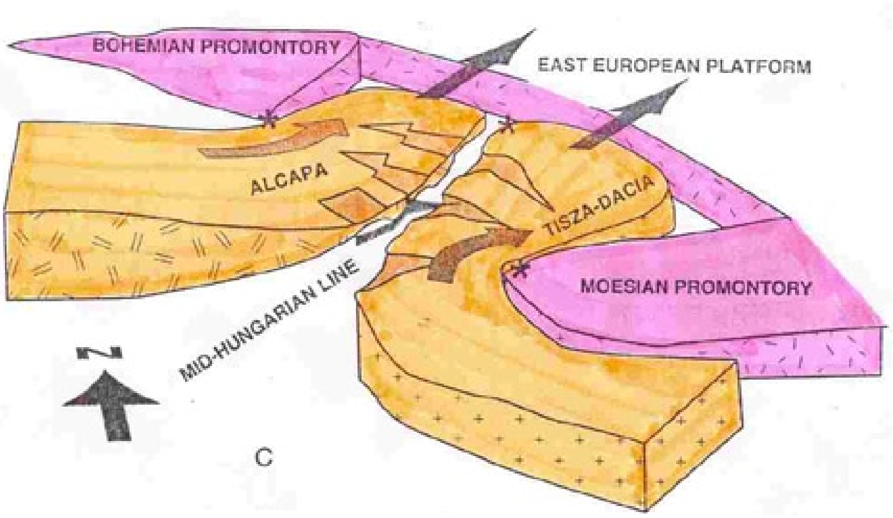



***Fig. 8. Alcapa and Tisza Dacia phantom pistons which are to explain divergent folding of the Carpathian belt*** *(by Csontos and Nagymarosy, 1998)*

It is still unclear how the South and North-West Carpathians were folded. Apart from that both pistons are additional geological phantoms. After all it has been known for a long time that below the Pannonian Lowland there is no "resistant massif" – the hypothetical being introduced in the beginnings of "tangential pressure" concept. The Pannonian Depression is tectonically "empty" space, being filled by a thick cover of post-folding sediments. Below them there is also no rigid crust but a new exotic crust being processed material of the top part of the mantle diapir (Panonnian Diapir – Carey, 1996, p. 58) visible below (Fig. 9).

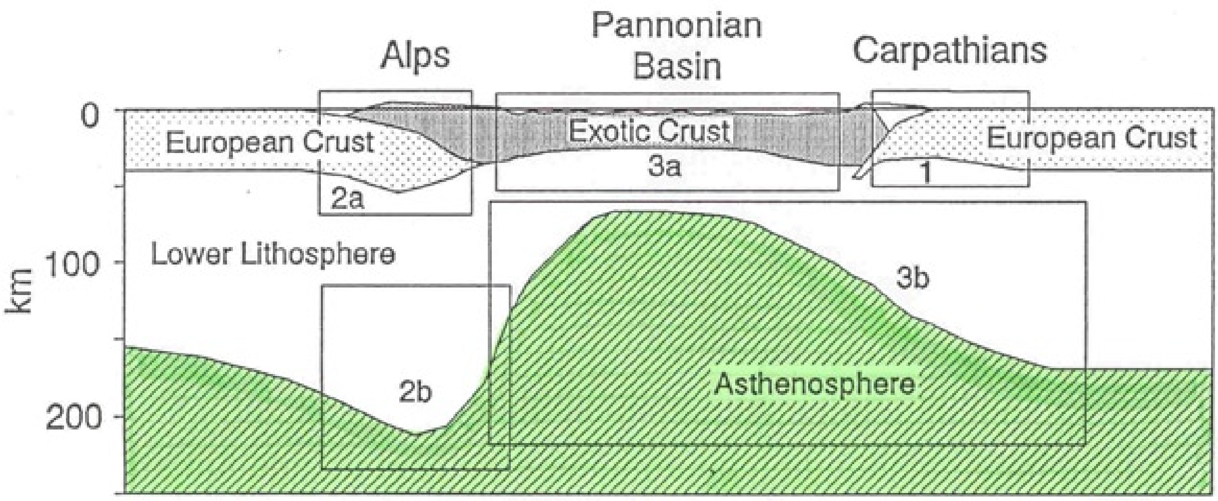



***Fig. 9. Pannonian upper mantle diapir*** *(by Lillie et al., 1994)*

This diapir is a real, "promontory" causing multidirectional folding of the Carpathians (and Dinarides). But this time it is an upward directed promontory of the upper mantle, not Africa. Such mantle promontories worked in all cases of fold belts. Plate tectonics is aware of existence of the Panonian Diapir (Fig. 10).

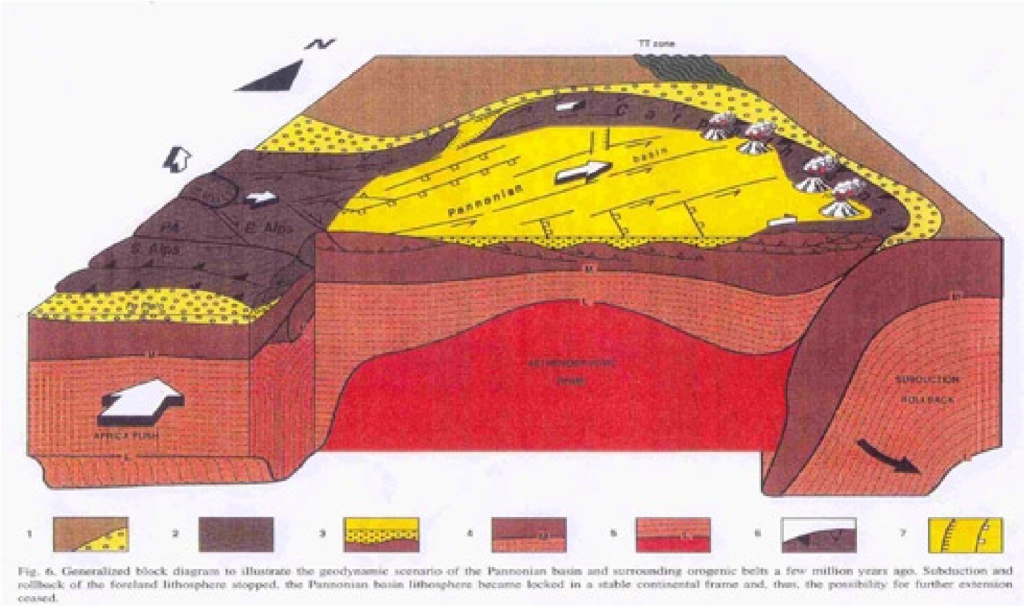



***Fig. 10. "Escape tectonic" in the Carpathian belt recording the existence of the Panonian Diapir which is here without any mechanical significance,*** *(by Horváth, F. and Cloetingh, S. 1996)*

But it makes not use of it.

Diapiric folding in all directions is natural. But in the frame of plate tectonics such diversity of directions demands subduction from all directions which is mechanical and geometrical impossibility.

The relations are demonstrated by Ollier (2003), Fig. 11

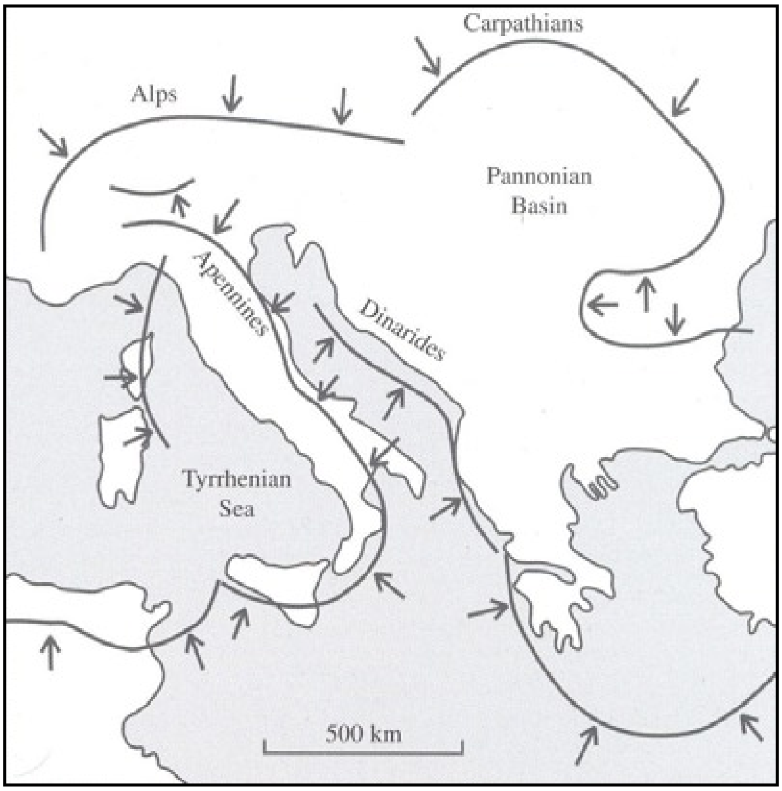



***Fig. 11. A map of European Alpine mountains.*** *The arrows show apparent directions of subduction, on the plate tectonic hypothesis. It seems impossible for reasonably rigid European plate to be moving in so many different directions simultaneously. If the arrows were reversed they would show the direction of gravity spreading from an uplifted core region (after Ollier, 2003)*

# B. Some more general issues

## 1. Plate tectonics – a theory on the wheels of circular arguments

The plate tectonics paradigm is based on the well-proved process of the spreading of the ocean floor (discovered by the expansionists: Carey and Heezen), and on the unproved assumption that the Earth is not expanding. This made-up assumption is the most essential and also the most damaging input of plate tectonics to modern geotectonics. Several models had been built on this assumption. After some time, they started to be treated as facts. In this way several fictitious ‘confirmations’ of the plate tectonics paradigm have appeared: in fact they are only circular arguments.

Let us look at this procedure visible in some quotations of prominent authors of plate tectonics papers:

> *If we assume that the earth is spherical and that the length of its radius does not change with time, we can then proceed to the complete determination of the movement of the major crustal blocks relative to each other (Le Pichon, 1968, p. 3674).*

And other quotation of the same author strictly connected with the topic of fold belts:

> *If the earth is not expanding, there should be other boundaries of crustal blocks along which surface crust is shortened or destroyed (Le Pichon, 1968, p. 3673).*

From this starting point the scheme of shortening the lithosphere by subduction was devised by Isacks at al., 1968.

The above authors wrote (p. 5866):

> *If crustal material is to descend into mantle, the island arcs are suspect as sites of the sink.*

So, the subduction is known a priori. The only problem is where does it take place?

Acting in this way the biggest convergent motion of tectonic plates was worked out to be in the west Pacific in contact with Asia. However in this region the biggest **divergent** motion of plates (beyond oceanic ridges) is seen directly (Fig. 12).

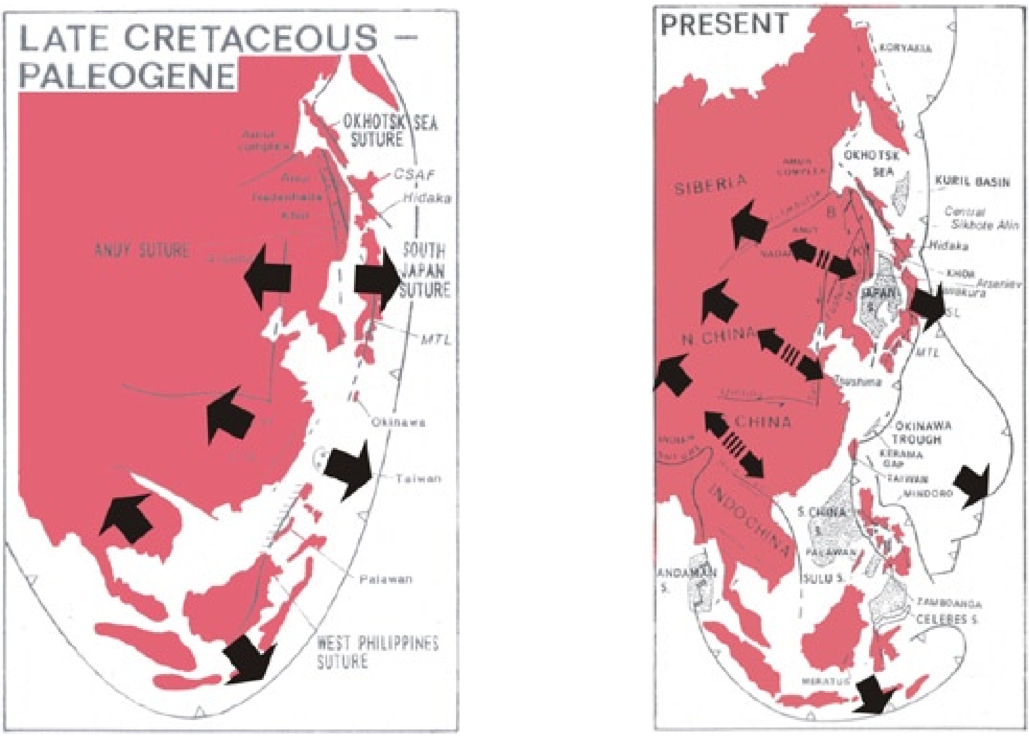



***Fig. 12. Reconstruction of the east and south-east Asian margins***
*(after Faure and Natalin, 1992; arrows are added by J.K.)*

It provides a good example of domination of dogma in plate tectonics paradigm over directly observed processes (the topic is continued in the following section).

The empiric approach to island arcs (without any deduction from dogmas) leads to the tension – diapiric – gravitational mechanism presented in Fig. 4 (of Introduction). And also to the analogical mechanism of intra-continental fold belts, presented in this brochure.

But plate tectonics applies here again a circular argument. The fundamental paper on fold belts was written by Bird and Dewey (1970). The authors started their text (abstract) as follows (p. 2625):

> *Analysis of the sedimentary, volcanic, structural, and metamorphic chronology in mountain belts, and consideration of the implications of the new global tectonics (plate tectonics) [underlined by J.K.], strongly indicate that the mountain belts are a consequences of plate evolution.*

Here, in one sentence, we see the whole circular argument. Starting from plate tectonics the authors conclude that mountain belts result from plate tectonics!

Similar circular arguments are produced by the assumption of non-expanding-Earth and Eulerian motions of lithospheric plates used by plate tectonics. Their legacy results from the first quotation of Le Pichon's paper.

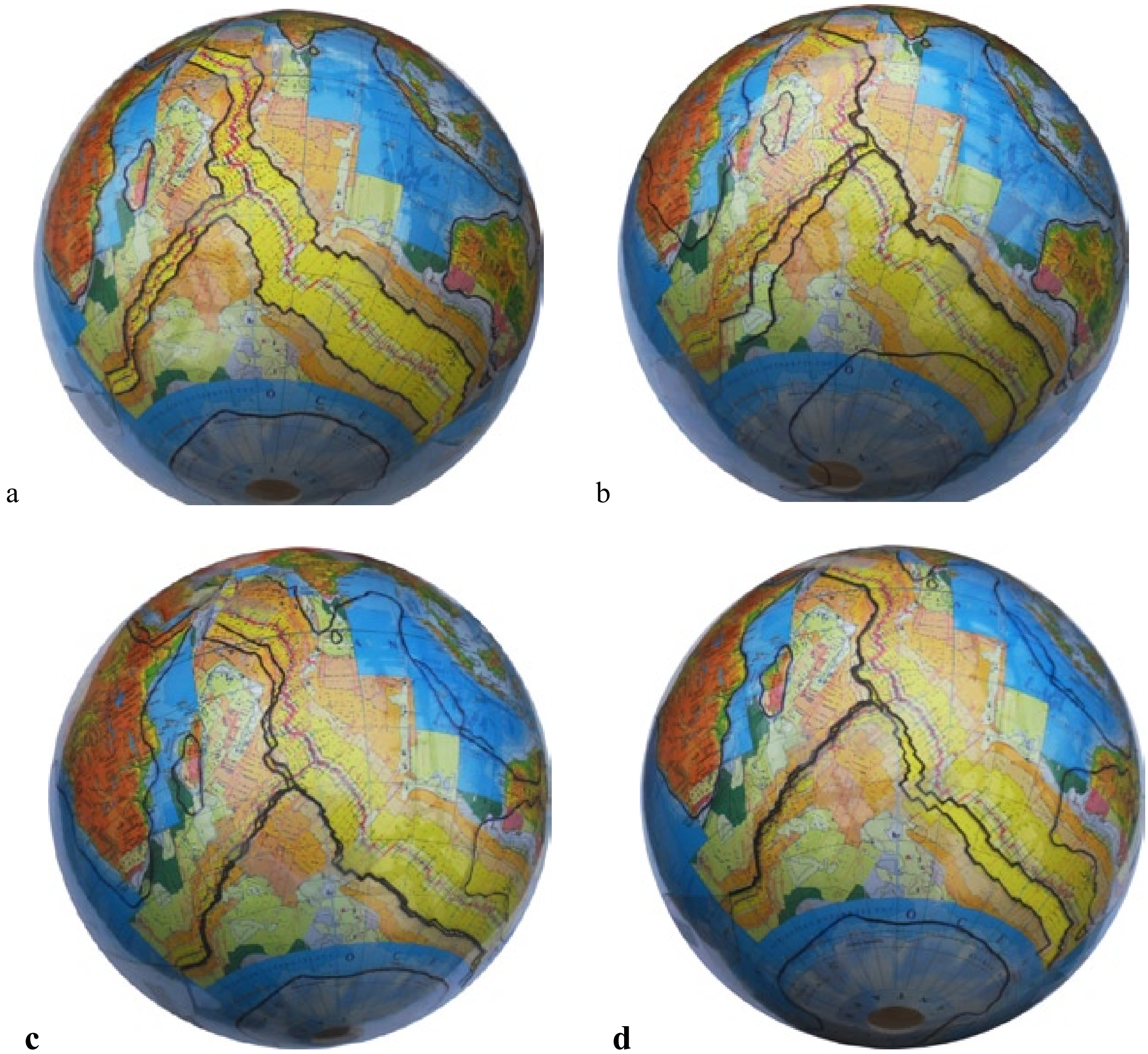



***Fig. 13. Carey's gaping gores in the Indian Ocean,*** *according to Koziar, 2013 (explanation in the text)*

Eulerian motions, by their nature, can be used only on a fixed-radius-Earth. Morgan (1968) tried to prove the validity of such motions assuming that the plates around the Indian Ocean triple junction satisfy the Eulerian rules. However several years later it appeared that they do not satisfy. So, started from the paper by Wiens *et al.* (1984) an enormous pile of other papers were published whose authors tried to deform Indian Ocean plates in different ways in order to close this ocean Eulerian circuit on a non-expanding-Earth. However the real problem is that plate tectonics is failing to cope here with Carey's gaping gores[13] (Fig. 13), which are one of the proofs of the expanding Earth.

On the first globe (Fig. 13a) there are three Indian Ocean plates of – 23 Ma age. They are cut of plastic bowls and put in their present positions. On the three next globes the plates are put together in turn to the one of them which is left in present position. Each time Carey's gaping gore emerges in SE (Fig. 13b), NW (Fig. 13c) and SE (Fig.13d) of the Indian Ocean. The gores result from increased size of the Earth since the start of the Neogene Period. They will disappear and the plates will be close together if the Earth radius is reduced.

In 1991 Richard G. Gordon wrote a paper entitled „Indian Ocean violates conventional plate tectonics theory". Yes, it violates and it does this in a very fundamental way – just like the Pacific (Koziar, 1993) and Atlantic Ocean do (Koziar, 1980); www.wrocgeolab.pl/floor.pdf– for both papers.

Despite of failure of Morgan's confirmation of Eulerian motions in geotectonics, plate tectonics has developed many sophisticated systems of vectorial calculations to determine such motions (vectorial velocities) of all individual plates. Recently the systems gained a general name MORVEL that is: Mid-Ocean-Ridges-VELocities. This name reflects very well their essence. Because the only contact of these systems with a real world is at oceanic ridges (which are the most visible manifestation of the expansion of the Earth). All these ridges are divergent structures and from them plate tectonics takes its empirical data. All convergent movements in MORVELs are only mathematical deductions from spreading and the most important input of plate tectonics – the non-expanding-Earth assumption. If such deduced convergent movements are treated as a confirmation of this starting assumption (and generally they are treated so) then a very clear circular argument emerges though mathematically very sophisticated.

In fact all MORVEL's convergent movements are artefacts as well as the gaping gores visible in Fig. 13. The real motions of lithospheric plates happen on an expanding Earth. The mathematical principles of this motion are presented in my paper (Koziar, 1994; www.wrocgeolab.pl/plates.pdf). The solution obtained is in strict connection with a simple driving force which is the isotropically stretched (inflated) mantle. It is not necessary to mention here that the problem of the driving force is one of the most hopeless problems of plate tectonics.

Analogous circular arguments are delivered by space geodesy workers in the field of geodynamics. Space geodesy geodynamics is also based on Eulerian movements of plates, but the input data are not taken from spreading rates on oceanic ridges (geophysical data). They are taken from geodetic measurements (geodetic data). That is why the global patterns of plate movements obtained in this way have been recently called GEODVEL, that is: GEODetic-VELocities.

The geodetic measurements suggest a full independence from geological theories. But this is not true, because assuming Eulerian movements is tantamount to assuming a non-expanding-Earth. Thus, this speculative base of space geodesy in fields of geodynamics creates also circular arguments. In fact the problem is not restricted to geodynamics because space geodesy builds its terrestrial reference frames (of universal significance reaching beyond geodynamics) just on the plate tectonics paradigm.

I have pointed out circular arguments in space geodesy geodynamics already in 1992, 1993, 2002 and recently in 2011 (www.wrocgeolab.pl/geodesy1.pdf). The full version of the last paper (which was only an extended abstract) is now being prepared.

The same fault of space geodesy (of a circular argument) was pointed out by Scalera (2003 and 2012).

[13] Or „orange peel effect" (van Hilten, 1963). It is another name of the same artificial phenomenon on a false non-expanding-Earth

But the first authors who pointed out on fictitious shortening of geodetic arcs in non-expanding-Earth space geodesy were Blinov (1984) and Carey (1988). This fictitious shortening is an essential element of discussed circular arguments.

Sometime space geodesists who are aware of the existence of expanding Earth alternative, try to verify it. Such efforts were undertaken by Bajgarová and Kostelecký (2005) and by Wu et al. (2011). However in both cases the Eulerian motion of the plates was used in calculations. Of course the results appeared not very good for the expanding Earth but they are excellent examples of circular argument.

In contrast to plate tectonics, understanding of the expansion of the Earth is based on proofs (not on unproved assumptions leading to circular arguments). About seven such proofs can be formulated:

1 – Growth of the Pacific (Carey's test)

2 – Elongation of plate boundaries

3 – Carey's "gaping gores" (artificial openings of underestimated curvature)

4 – Mutual moving apart of hot spots

5 – Carey's Arctic paradox

6 – Deep mantle roots of the plates

7 – Perin's growing perimeter of the Earth

Five of them (1, 2, 3, 5, and 6) wear demonstrated by Carey (1, 2 and 3 already in 1958 and additionally 5 and 6 in 1976). Four of them (1, 2, 4 and 6) I have published already four times (Koziar, 1996, 1997, 2004 and 2006a). Just now I prepare an extensive presentation of the all above seven proofs for the Polish geological journal "Geologia Sudetica". In the meantime you may look at the:

1. proof no. 1, to Koziar (1993); www.wrocgeolab.pl/Pacific.pdf
2. proof no. 2, to Koziar (1980); www.wrocgeolab.pl/floor.pdf
3. proof no. 3, above (this section)
4. proof no. 4, to Stewart (1976)
5. proof no. 5, to Carey (1976)
6. proof no. 6, to Carey (1976) and Kremp (1990)
7. proof no. 7, to Perin (2003 and 2012)

## 2. Ollier's campaign against wrongly associating mountain building with folding, and folding with hypothetical lateral compression

A distinguished Australian geologist and geomorphologist, professor Cliff Ollier has declared a war against erroneous mixing up of folding of rocks and mountain building. He made it together with Colin Pain in the book "The origin of mountains" (2000), and then individually in several papers. The book (Fig. 14) is an excellent global survey on present mountains and their almost contemporary origin by uplift and erosion. The authors wrote (p. 11):

*"In the study of anything, scientists should work from observations to theory..",*

and pointed out that in the matter of explaining the origin of mountains opposite is mostly true. Their way is correct. Readers can see what in fact the particular mountains are and see their youngest stage of development; and most important – can learn about their age of uplift, much older age of folding, and often about the lack of folding at all.

Present day readers can watch directly the described objects by a new powerful tool which is the Google Earth together with its attached photographs. Such a study can be recommended to both starting and advanced geologists. After all, mountains were a starting point to tectonics and even geotectonics, and still are (including oceanic ridges) the most important geological structures on the Earth.


Fig. 14.

Unfortunately, tectonicists have developed a totally false scheme, identifying mountain building with folding and this with general compression (vice-like squeezing between two rigid blocks of lithosphere). The scheme was devised in time of the contracting Earth theory and reinforced in times of other "colliding continents" concepts like Wegener's theory and now plate tectonics. In the meantime the physically reasonable gravitational tectonics was developed. These periods were very fruitful, though very short. Carey for the first time linked the horizontal motion of lithospheric blocks (but only divergent) with fully gravitational tectonics of fold belts. However the solution together with gravitational tectonics as such was suppressed by plate tectonics. The authors quoted (p. 301) the prominent representative of gravitational tectonic – Van Bemmelen (1975), who complained about plate tectonics:

> *"This basic assumption suppresses alternative approaches to the dynamic history of our planet".*

Plate tectonics assumes that the supposed subduction, acting continuously between supposed convergent plates, folds and simultaneously uplifts the fold belts. And that is wrong. Ollier and Pain demonstrated that the uplift is very young (for instant in the Andes) and that the fold belts were folded earlier, and only later uplifted as a high plateau cut by erosion.

Thus plate tectonics fails in contact with the most direct knowledge of young fold belts. Competent geologists know the lull between folding and uplifting (of fold belts). Ollier and Pain quoted Jackson (1997) and Stille (1936). The latter wrote:

> *"As a matter of fact, orogeny in the tectonic sense[14] generally fails as an explanation for the topographically great mountains of the earth, such as the Alps of Europe or the Cordilleras of North America. These mountains exist – or still exist – as a result of post-orogenic en block movements, for the most part still going on, and belonging to the category of epeirogenic processes. Thus arises the terminological contradiction, that the mountains as we see them today owe their origin not what is called orogeny, but to an entirely different type of movement that is to be strongly contrasted with the orogenic process."*

In fact the processes are not only "entirely different" but quite <u>opposite</u>. As is seen in Haarmann's scheme developed in our (1985a) paper (Fig.1 and 5 there), folding is the process accompanying the gravitational <u>leveling</u> of the Earth surface. Generally the rock masses <u>are going down</u> at folding (also in geosynclines), <u>not up</u>. The uplifting of a fold belt is a later process and caused by lateral migration of the mantle diapir (supplement, Fig. 1e). The uplifting (after some time) of the fold belt can cause additional progressive gravitational tectonics at its front and retrogressive one at its rear (e.g. the Southern Alps) toward a collapsed diapir under an intermontane depression (the Po basin in case of the Southern Alps).

Stille's statement reveals a serious terminological problem resulting from wrong understanding of mountain building processes which is also a problem to the authors of "Origin of mountains" and is discussed by them. It is about the term "orogeny". The term was introduced by Gilbert (1890) together with the term "epeirogeny". The second means an uplift of a continent-scale territory, the first only a relatively narrow mountain belt. And that is exactly what this Greek word means. However because of wrong identifying of folding with uplifting of mountains the term "orogeny" was shifted to the folding process. Thus now the real orogeny is called uncomfortably by two words "mountain building". However it is not a common custom and this wrong usage should be stopped.

The way for proper understanding processes and using adequate terminology was open by Erich Haarmann. He used for folding the term "tectogenesis" (secondary) leaving the term "orogenesis" for its classical usage. In fact the classically understood orogenesis is part of primary tectogenesis which acts before and after folding and also without folding in case of different horst-like mountains.

Haarmann's way is followed by the authors of the Polish voluminous textbook "Tektonika" (Tectonics); Dadlez and Jaroszewski (1994). The authors wrote:

14 i.e. "folding" [J.K.].

*"Orogenese" literally means "mountain building" thus means uplift of a fragment of the Earth's crust independently of its mechanism. /…/ While there are different kinds of mechanism of mountain building, thus there are different orogenesis and different orogens. So it is better to limit the term "orogenesis" to the process of uplifting and development of mountainous relief, while the process of development of tectonic structures (including folds) describe by the term "tectogenesis"* (Haarmann, 1926).

Among Russian geologists there is a tendency to the usage of the same terminology as above.

In the central Asia there are almost exclusively young and big horst-like mountains built up of old crust without any young nappes. Wrong identifying of folding and thrusting with mountain building resulted in rejection by Russian geologists the nappes theory for many years. Finally, there were Russians who introduced a very useful division of mountains into: epigeosynclinal and epiplatformal orogens (Chain, 1974).

This division would be very useful also for Ollier and Pain's book. The book deals mainly with epiplatformal orogens, describing many examples of gravitational tectonics. In these cases the tectonics is also the secondary tectogenesis though on much lesser scale than in the case of epigeosynclinal orogens in which it occurred before uplifting.

The most important is, that the cause of the uplift of the epiplatformal orogens is local stretching (under general tension) of the continental lithosphere which produces asthenoliths of thinned upper mantle. Then the asthenoliths cause uplift of their thinned crustal roofs[15]. The same is in the case of epigeosynclinal orogens but stretching started there already at their geosynclinal stage. But in this case there are as much as two stages of uplift caused by a migrating mantle diapir[16]. Both are determined by stretching.

Thus in both cases, of epigeosynclinal and epiplatformal orogens, the more fundamental tectogenesis than Haarmann's primary one, is stretching of the lithosphere. This recorded stretching leads in empirical way to the expansion of the Earth.

In later papers Ollier (2003, 2005) wrote openly about expanding Earth. His and Pain's analyses of epiplatformal orogens are a very valuable supplement to Carey's solution of epigeosynclinal ones. Taking together the solutions give a full picture of origin of mountains of different kinds on an expanding Earth.

A very important aspect of the discussed book, as well as of the later papers, is the documentation of the so called Neotectonic Period – the time span of the latest 3 or 5 Ma, in which almost all contemporary mountains were uplifted. The process was noticed long ago by Russian geologists and the name "neotectonics" was created by Vladimir A. Obruchev already in 1940s. The authors refer to that. The Neotectonic Period itself shatters the plate tectonics paradigm.

It should be noticed finally, that the book helps us also to understand how important tool a geomorphology can be, reaching far back in time beyond the youngest Plio-Pleistocene period.

May be thanks to this tool another known geomorphologist – Lester C. King comprehended the expansion of the Earth (King, 1983).

Below some photos from Ollier's contacts with the Wrocław geological community are attached.

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[15] The rarefied mantle under Central Asiatic epiplatformal mountains with thinned crust was long ago recorded by Russian geologists. Victor Chain (1974) wrote: "*Many mountain chains have quite thin crust what should result with big positive isostatic anomalies. In fact the anomalies are absent because the mantle under such chains is rarefied. Such situation was observed for instant in Baykal mountain massifs. At first, using only gravimetry, the very thick crust was supposed. Then the seismic investigations show that it is significantly thinned.*" However the author did not point out stretching, though such a process results from "basin and range structure" (horst and graben structure) of the whole Central and East Asia. The connection of such structure of this region with stretching of the lithosphere was done by Gao (1998), quoted by Ollier and Pain (2000).

[16] At orogenic stage the uplifted roof of the shifted laterally diapir is thickened by a pile of nappes.

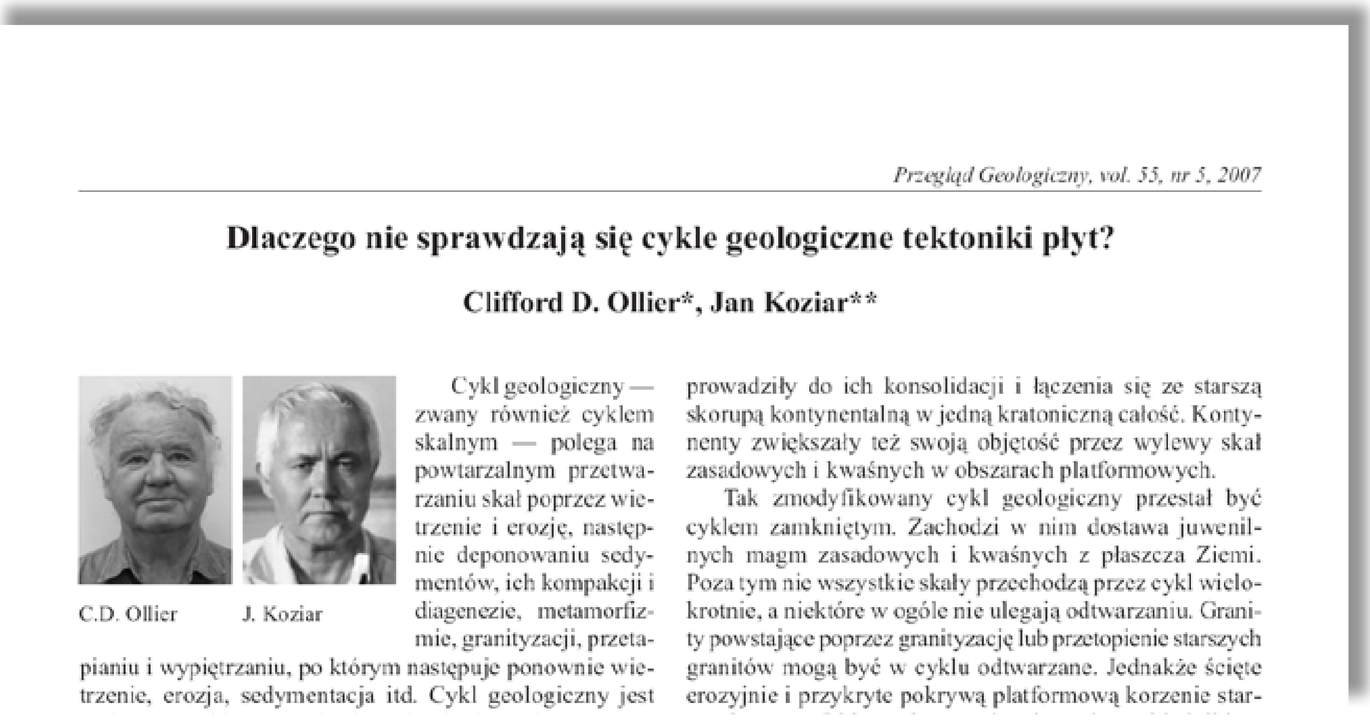

***Fig. 15. Prof. Cliff Ollier at my tectonic globe in the Geological Museum of the Institute of Geological Sciences of the Wrocław University***

***Fig. 16. Prof. Cliff Ollier with Dr. Stefan Cwojdzinski at the State Geological Institute, Lower Silesian Branch, in front of my tectonic globe***

***Fig. 17. Prof. Cliff Ollier and his wife Janetta with Prof. Jerzy Don, second from the right, and me. (Sudety Mts.)***

***Fig. 18. Prof. Cliff Ollier with Dr. Jurand Wojewoda (Sudety Mts.)***

Fig. 19. Cliff Ollier at my Wrocław Geotectonic Laboratory



*Przegląd Geologiczny, vol. 55, nr 5, 2007*

**Dlaczego nie sprawdzają się cykle geologiczne tektoniki płyt?**

**Clifford D. Ollier*, Jan Koziar****

C.D. Ollier J. Koziar

Cykl geologiczny — zwany również cyklem skalnym — polega na powtarzalnym przetwarzaniu skał poprzez wietrzenie i erozję, następnie deponowaniu sedymentów, ich kompakcji i diagenezie, metamorfizmie, granityzacji, przetapianiu i wypiętrzaniu, po którym następuje ponownie wietrzenie, erozja, sedymentacja itd. Cykl geologiczny jest

prowadziły do ich konsolidacji i łączenia się ze starszą skorupą kontynentalną w jedną kratoniczną całość. Kontynenty zwiększały też swoją objętość przez wylewy skał zasadowych i kwaśnych w obszarach platformowych.

Tak zmodyfikowany cykl geologiczny przestał być cyklem zamkniętym. Zachodzi w nim dostawa juwenilnych magm zasadowych i kwaśnych z płaszcza Ziemi. Poza tym nie wszystkie skały przechodzą przez cykl wielokrotnie, a niektóre w ogóle nie ulegają odtwarzaniu. Granity powstające poprzez granityzację lub przetopienie starszych granitów mogą być w cyklu odtwarzane. Jednakże ścięte erozyjnie i przykryte pokrywą platformową korzenie star-

Fig. 20. The front part of the paper "Why the plate tectonics geological cycles do not work", published by Cliff Ollier and me in the Polish journal "Geological Review", 55(5), 2007

## 3. Return to classic solutions to go forward

The plate tectonics paradigm has pushed geology, especially tectonics and our understanding of origin of fold belts, down a blind alley. Thus to go forward we must first return to the old well elaborated solutions which were rejected and suppressed by plate tectonics. These are: theory of geosynclines, and gravity tectonics, understood as basic processes in the development of fold belts.

In the theory of geosynclines of the first importance are eugeosynclines, recognized by pre-plate-tectonics geology as narrow intra-continental rifts reaching to simatic basement. Their nature and tectonic environment was quite clear and is still clear. Today's plate tectonicists treat their products (ophiolites ) as a relic of old closed oceans. Furthermore, it is assumed to be the only possible solution and so the existence of ophiolites is often treated as a proof of plate tectonics. It reveals the lack of knowledge and understanding of classic geology. More extensive discussion of the problem of eugeosynclines is in "Terranes, or geology in a wonderland" (Koziar, 2006).

The best, and unfortunately the latest book about geosynclines, before plate tectonics domination, is "Geosynclines" by Jean Auboin (1965). Today researchers should return to this book to gain a sound knowledge of the origin of fold belts. The same is with the book "Gravity and tectonics", Jong and Scholten editors (1973) which was the last voice of sound tectonics before the flood of plate-tectonics.

***J. Koziar, May 2013***

At the end I would like to remind Reader that my two extensive 2005 papers on fold belts will be accessible in some time in digital English edition. In meantime the Reader may look at my other papers on expanding Earth already accessible in Internet: www.wrocgeolab.pl

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