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Non-chaotic emplacements of trench-arc zones in the Pacific Hemisphere

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Abstract
It is shown how similarities of shape between certain ocean basins and continents create serious difficulties to the concept of subduction and can be considered evidence of a non-chaotic emplacement of the arc-trench zones along pre-existing deep geofractures, which are related to shapes of far continents. These similarities point to a fundamental process which cannot be described by the plate tectonics and other tectonic hypotheses, and which is till now mostly hidden to our understanding. Because the similarities are also clues of a former proximity of the circumpacific continents, an expanding earth appears favoured by this new observational evidence.

Key words *global tectonics – geomorphology*

1. Introduction

It is possible to recognize matching similarities between margins (*e.g.* North American Cordillera – series of trenches of New Guinea, Manus, Salomon, Vityaz; Chilean continental margin – East Australian continental margin) in the Pacific (Scalera, 1988, 1990), which cannot be explained by the classical version of plate tectonics.

Nevertheless the possibility of connecting the continents by matching Pacific continental margins (only the Pacific parts of the shelf break contours) and trenches can be explained by global tectonic hypotheses different from plate tectonics: the expanding earth (Carey, 1988; Owen, 1981), the contraction of continents (Chevallier, quoted in Cailleux, 1968; Jordan, 1989), and the «continental dance» or «repeated Wilson cycle» (Nance *et al.*, 1988; essentially an extension of plate tectonics to pre-Pangaean time). The above theories are totally different as far as the kinematics, which led to the similarities, is concerned. Fixism also could explain the margin similarities hypothesizing a parallel slice «oceanization» of the ocean floor.

It is very difficult to choose among the different hypotheses taking into account only similarities of parts of shelves perimeters. However a different kind of similarity is observable in the Pacific region, which can help to determine such a choice.

2. New similarities: «entire shape similarities»

Another kind of similarity exists in the Pacific, which we can call «entire surface shape similarity». This kind of similarity is a further step in the rank of similarities because we have to consider now not matching portions of contours, as was done for the Atlantic similarities, but matching of shapes of entire areas. The first pair of this second kind of similarity is that between the entire Australian continent and the Nazca plate (fig. 1). If we compare, by means of cartographical transformations, the shapes of the Australian continent to that one of the Nazca plate we can see that there is a remarkable good conformity between the two.

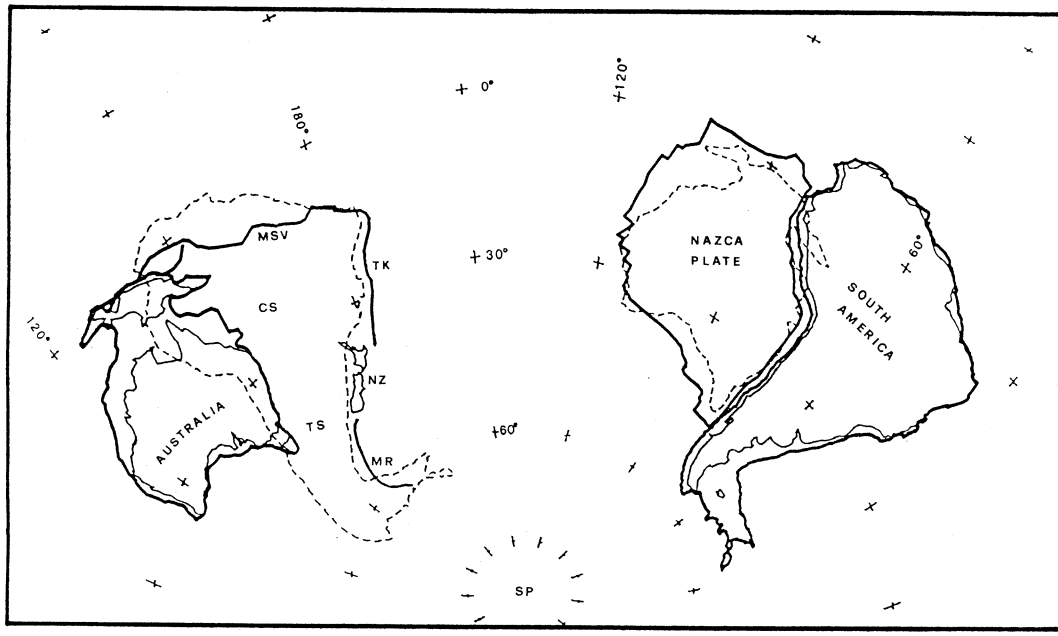

Fig. 1. Conformities and arrangement symmetry continent-basin and *viceversa* in Southern Hemisphere. South America corresponds in shape to Tasman and Coral sea basin, and Australia corresponds in shape to Nazca plate. Solid lines represent coast contour. Bold lines represent major tectonic discontinuities as continental shelves margins, trenches and spreading ridges. Dotted lines represent computer aided rotations of Australian and South American continental shelves contours. MSV = Manus, Salomon, Vityaz trenches; TK = Tonga Kermadec trench; NZ = New Zealand; MR = Macquarie ridge; CS = Coral Sea; TS = Tasman Sea; SP = South Pole.

Likewise, there is a conformity between the shape of the Tasman and Coral sea basin and the whole South American continent (fig. 1). In this case the match is not perfect regarding the northern part of the Coral sea basin due to the fact that it is cut by the Solomon Vityaz trenches. However this group of trenches corresponds to the setting of the Marajo Rift and the Amazon River in South America, and – because rivers have a propensity to follow pre-existing troughs or tectonic grabens (Potter, 1978) – this could suggest a record of the position of deep geofractures along which trenches and rivers preferentially tend to lie.

Because it is possible to recognize surface shape similarities in the South Pacific, we believed we would probably find the same kind of surface shape match for the North American continent by searching in the North Pacific. In fact, if Greenland is excluded, a third example of conformity is the one between the North American continent and the North Western Pacific basin (fig. 2), which is bounded by the series of trenches of New Guinea, Manus, Salomon, Vityaz, by the East Asiatic arcs and by the Emperor-Hawaii volcanic chain. There is a good comparison between the two shapes: each convexity of an Asiatic arc corresponds in shape and position to each concavity of the North American artic margin. Moreover the small ovoidal Juan de Fuca plate corresponds to the ovoidal New Britain plate, and this constitutes a fourth example.

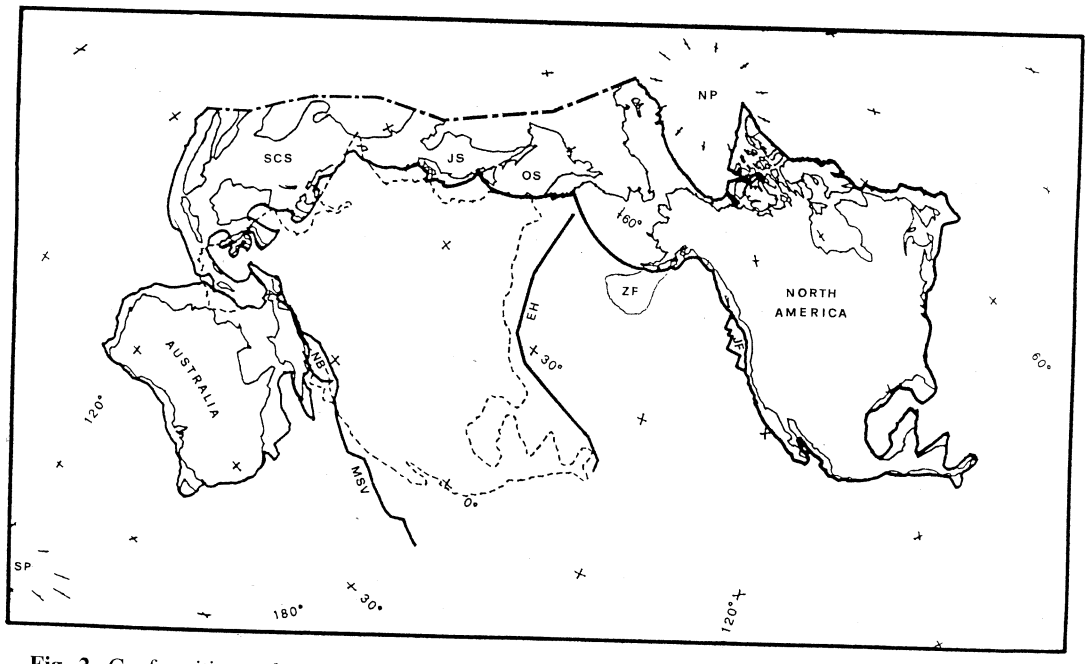

Fig. 2. Conformities and arrangement symmetry continent-basin and *viceversa* in Northern Hemisphere. North America corresponds in shape to Western Pacific. Juan de Fuca plate corresponds in shape to New Britain ovoidal plate. Solid lines represent coast contour. Bold lines represent major tectonic discontinuities as continental shelves margins, trenches and spreading ridges. The broken bold line is an arbitrary boundary between Asia (not represented in figure) and East Asiatic trench arc back-arc zones. Dotted lines represent computer aided rotations of the North American continental shelves and Juan de Fuca plate contours. SCS = South China Sea; JS = Japan Sea; OS = Ochotsk Sea; ZF = Zodiac Fan; EH = Emperor Hawaii volcanic chain; JF = Juan de Fuca plate; NB = The little New Britain ovoidal plate; MSV = Manus, Salomon, Vityaz trenches; NP = North Pole; SP = South Pole.

3. Discussion

If we consider the similarities of the Pacific region as being significant as the Atlantic ones, then we have to search in which tectonic framework their meaning lies.

The mentioned surface similarities represent symmetric emplacements where a basin corresponds to a continent and a continent to a basin respectively. A possible hypothesis is to consider the similarities as clues of early positions of the circum-pacific continents. Even if the pairs of entire shape similarities were not considered as being traces of ancient contacts or actual superimpositions of similar blocks, the resulting symmetry is a problem as it seems very difficult that subduction should work in such a way to reproduce (by opening the Coral Tasman back-arc basin and creating the asiatic arcs and Emperor Hawai chain) the shapes of very far continents, which were farther and unrelated to the arcs when Pangaea started its breakup (fig. 3).

In the case of the first two similarities (Australia – Nazca and South America – Coral Tasman basins), considering both the position of Australia in relation to that of South America in Pangaea, and Australia's kinematics which, in plate tectonics, should be northward, the contradiction becomes even more disconcerting.

In the case of the third example of con-

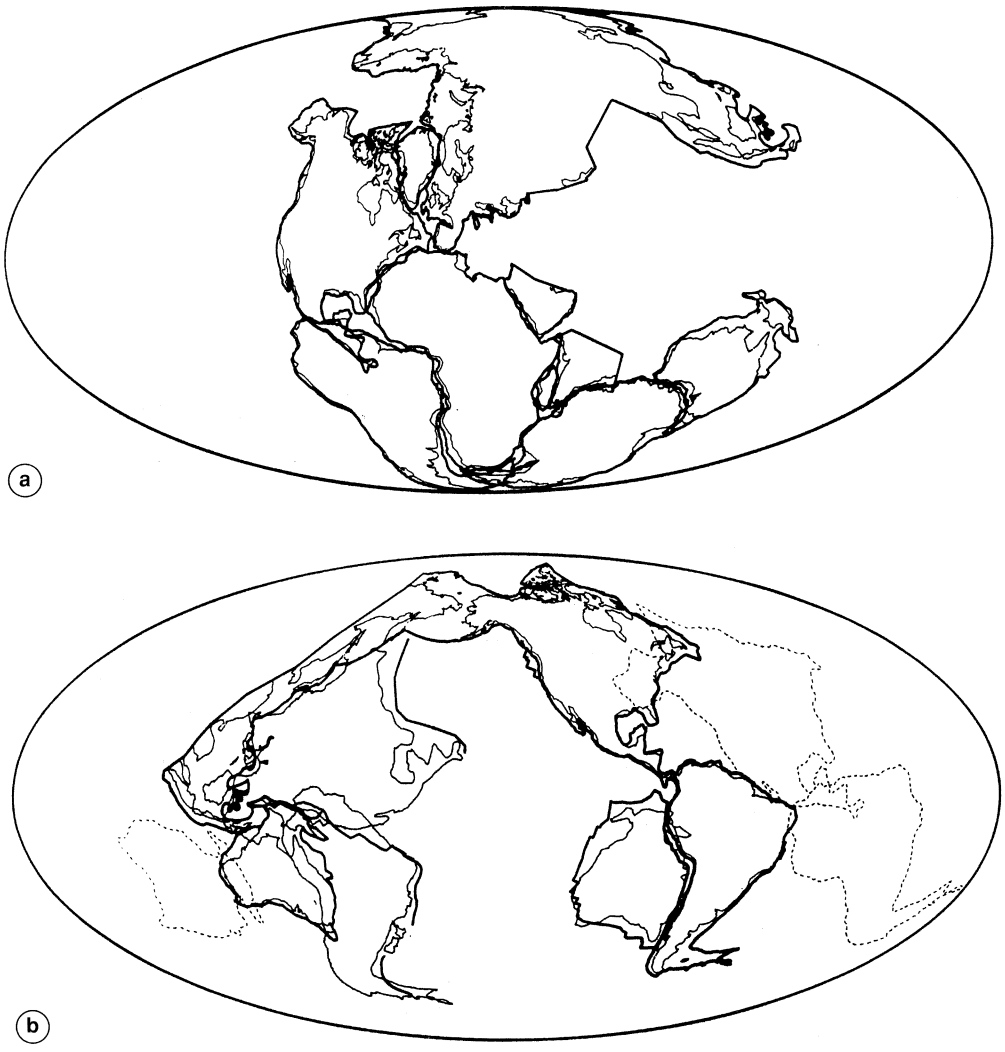

Fig. 3. a) Reference Pangaea. The supercontinent has been reconstructed following the classic work of Bullard, Everett and Smith (1965) and Smith and Hallam (1970). b) All the conformities among continents and basins together with the (dotted) outlines of Australia, Laurentia and South America in the positions which they assume in the reference Pangaea. It is hard to imagine that the conformities could be formed by convergence of Laurentia, South America and Australia towards the Pacific.

formity (North America – North Western Pacific), observing the Northern Pacific sea-floor topography on Heezen and Tharp's map, a great difference existing between the two areas can be noted. The eastern one is characterized by transform faults and parallel fracture zones which trace the outlines of an environment produced by plate tectonic processes,

while the western one is characterized by a higher seismicity (Walker, 1989), an uneven topography containing many seamounts, canyons, seamount chains and level differences. These two areas are separated by the Emperor-Hawaii chain, a prominent range of volcanic seamounts decreasing progressively in age and with a gravimetric profile (Haxby, 1987) which makes it very different from other similar chains.

The match of the North American shelf margin outline on this North Western Pacific area appears to be very good (fig. 2), and tends to confirm the North American block kinematics interpretation suggested by the clue of the Zodiac Fan paradox (Carey, 1988). The huge Zodiac Fan is located near the east side of the Aleutian trench in a position which, if taken back to the time of its formation (~40 Ma), it would end up, according to plate tectonics, right in the middle of the Pacific Ocean (Carey, 1988; Harbert, 1987), separated from North America by the hypothetical (but necessary for the plate tectonics congruency) Kula-Pacific and Farallon-Pacific ancient spreading ridges, which being topographic reliefs should have kept the sediments from overleaping it. On the other hand, according to a version of the expanding earth hypothesis, the Zodiac fan never moved from its place but the North American continent was the one to move away from it thus enlarging the Pacific, which opening started from the mentioned match just north of New Guinea. The same kinematics is compatible both with palaegeographic reconstructions constrained by palaeomagnetic data (Scalera, 1990) and with the model of earth expansion of Vogel (1984). Then the Zodiac fan and the shape similarities suggest a different interpretation for the Emperor Hawaii chain, which should be recognized as emplaced at a long deep geofracture, which is now boundary between oceanic plates.

The existence of the four shape similarities suggests that the disposition and shape of a trench-arc zone, and also of oceanic ridges, is not due simply to coincidence and to local causes (whether in space or in time) regarding each of them, but that causes exist which link all these zones, their disposition and their shape to a single huge fracture process related to very deeply rooted «density scarps», or «compositional scarps». In other words, the process of opening of a back-arc basin should be considered quite different from a near chaotic process independent from the other neighbouring back-arc basins, and also it should be considered very far from being related to nothing but the shape fortuitousness of the emplacement of subduction processes.

The observed conformities suggest the permanence into the mantle and lithosphere of a memory of ancient structures. This memory could express itself in very long density or compositional scarps and deep geofractures, along which the arcs tend to emplace. In this way it is also possible to explain the exception of the linear shape of the Tonga-Kermadec trench zone (which is the only non arcuate trench of Western Pacific) through its similarity with the eastern South American margin.

Moreover, an attempt to choose among the different global tectonic hypotheses becomes possible by means of the surface shape similarities.

The existence of a coherent aggregate of surface area conformities, if considered a set of traces of early continental positions, can invalidate just the mechanism of ocean floor generations proposed by fixism: an «oceanization» of a wide area cannot happen reproducing the entire shape of a far continental block.

The contraction of continent hypothesis (on a constant radius Earth) (Cailleux, 1968) expects the size of the continental part of a pair of similar shaped areas to be only about 1/3 of the oceanic part. On the contrary the oceanic and continental members of the similarities actually appear to be of equal size.

If we consider the existence of such surface matches to be the trace of ancient positions, and if the North Pacific sea-floor age pattern (Larson *et al.*, 1985) is taken as valid, then the North-West Pacific Ocean sea-floor would be stalled in its actual position. In the contrary case its mobility – the West Pacific subduction – should have destroyed any trace

of similarities. As consequence, the set of hypotheses on which the «repeated Wilson cycle» framework and the plate tectonics theory are founded should be considered incomplete.

Subduction process appears then not compatible with the existence of entire surface shape conformities. Lacking other zones able to consume the excess of crust created into the mid-oceanic spreading ridges, the expanding earth theory is the better supported by these observations. In particular, the disposition of the asiatic arcs which matches one side of the adjacent impressed image of Laurentia can mean that the opening of back arc basins has not taken place at the expense of oceanic areas but presumably by a mutual retreat of Asia and Pacific plate. In the contrary case the adjacent image would have been destroyed. A detailed model of the breakup of the lithosphere in the Pacific, suitable to explain this new set of similarities, is not yet provided by the expanding earth hypothesis but some further palaeontological and geological evidences (Hughes, 1975; Simpson, 1983; Shields, 1979, 1983; Tarling, 1981, 1983; Davidson, 1983; Sahni, 1984; Newton, 1988) can lead to the conclusion that, in this theory, the kinematics of the Laurentian block could have been just the one suggested by the Zodiac fan clue and by paleomagnetic constraints (Scalera, 1990).

4. Conclusions

Four continental masses are compared to four ocean basins and a match is found between the shapes of the four selected pairs. The remarkable comparison between the shapes of the continents and basins described above cannot be due simply to coincidence, and these conformities must therefore point to a fundamental process which cannot be described by plate tectonics or some other tectonic hypotheses. Only the expanding earth appears favoured by this new observational evidence.

However, apart from any decision in favour of a specific tectonic theory, the existence of entire surface area similarities, if considered not-chaotic, leads directly to the conclusion that also the disposition and the shape of trenches, arcs and major oceanic ridges is non-chaotic, and that they must follow pre-existing deep geofractures which are related to the continental shapes. All these conclusions have to be kept with caution because more detailed palaeomagnetic and palaeontological tests are needed to confirm their validity.

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