

Problems in Accepting Plate Tectonics and Subduction as a Mechanism of Himalaya Evolution.

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Abstract: The available geological and structural data from Chaman fault and Indus-Tsangpo regions does not support the new global tectonic concept and the presence of suture zone between Indian and the northern landmass. Instead, it is suggested that the Indus-Tsangpo is a rift valley that appeared in the Triassic and became dormant in the Cretaceous, after a spurt of volcanic activity long before the supposed suturing in the Eocene. The paleontological evidences based on plants, marine and fresh-water invertebrates, insects and vertebrates indicate that Gondwanaland was never a separate entity. Paleoclimatic continuity was maintained over this landmass of India and Tibet from the Paleozoic through Cenozoic eras up to the Pleistocene Epoch. Similarly, the widespread glacial deposits of northern Tibet bespeak of a continental landmass extending from Peninsular India up to northern Tibet, and may be beyond. Thus, Pangaea existed till its breakup beginning in the Triassic and Tethys was an epicontinental sea from west Proto-Pacific to east Proto-Pacific. At no stage was it oceanic in character, although narrow shifting belts along and across it, became rift or geosynclines in the process of crustal development. Thus, the Tethys did not form a wide, funnel shaped gulf, opening into the Pacific as depicted in many reconstructions. On the other hand, the Himalayan sequence is dominantly non-geosynclinal sediments, and therefore, genetically different from such classic mountains as the Caledonian, Hercynian, Urals, and Aravallis etc. It is significant that the Himalayan orogeny was initiated in the Cretaceous, and the major episode was Eocene, i.e. earlier than the supposed collision, rules neither out continental collision and subduction nor even in geosynclines. However, the Himalayas, could, then, not have been borne due to collision of landmasses as suggested by plate-tectonics. Instead, they are an interplatform type of mountain range formed by vertical uplift, by intrusive magmas and gravity gliding played an important part too. Terrestrial gravity, seismic (including DSS), geodetic, geomorphologic and field tectonic studies independently and collectively support the above contention. The Himalaya along with some other ranges in Central Asia may be unique in Earth history, and all the mountain ranges of the past seem apparently to have been originated in geosynclines. The plate tectonic concept, however, considers the term geosynclines redundant.

Keywords: Indus Tsangpo Suture, Himalaya, Great Gondwanaland, Pangaea, Plate Tectonics.

I. Introduction

Undoubtedly, the advent of new global tectonics more than half century ago has been taken as a great revolution in the history of Earth Science. Perhaps never again is it likely to happen, for a more or less strong opposition to any new concept crops up almost simultaneously, howsoever well founded the hypothesis be. This almost did not happen to Plate Tectonic - almost, but not entirely – for Belousov (1979), Dewey et al., (1988), Sengor (1990, 2012), Valdiya (2015), Jain et al., (2012) of the “fixists” and Carey (1988, 2000), Shield (1993, 1999), Ahmad (1982, 1987), Raiverman (2002), Scalera (2006), Maxlow (2012), Hurrell (2016) from amongst the “mobilistics” or “new global tectonics” remained unconvinced, the latter group invoked Earth expansion, as an alternative. Both the plate tectonics and Earth expansion concepts agree that ocean floor spreading is taking place and is responsible for the progressive separation of the continents. However, these schools differ thereafter. The plate tectonics envisage creation of new crust along the mid-oceanic ridges, a more or less equal amount of oceanic crust is consumed in the deep sea trenches, “subducted”, at a given time, and the Earth continues to be of constant diameter. On the contrary, Earth expansion concept does not accept “subduction”, and consequently the Earth is progressively increasing in diameter, the southern hemisphere somewhat faster than the northern hemisphere. The Plate tectonics explains that the oceanic crust is subducted into deep sea trenches, the continental slabs on the opposite ‘plates’ are brought together till they collide, “suture”, and form mountain ranges. Thus, Wilson (1966) suggested that the Atlantic Ocean had opened along the Appalachian and then closed to form the Caledonian and Hercynian ranges in the region. This model was applied to all the erstwhile geosynclinal belts and in the new dispensation they became the ‘suture zone’. And, when the jaws closed some oceanic crust was ‘obducted’ on to the continental crust, the basic eruptive of the geosynclinal regimen, and came to be recognized as ‘ophiolites’. Thus, while the term ‘geosynclines’ became redundant

(Sengor and Burke, 1979), 'ophiolites' became the signatures of subduction. The so-called "Indus-Tsangpo Suture Zone (ITSZ)" is cited as an example along which a northward drifting Greater India is supposed to have collided with the northern continent, Angaraland. At least 1500 km of oceanic crust are believed since to have been subducted, leaving behind a few hundred meters or so of oceanic floor slices – basic rocks, cherts, turbidities, radiolarites etc., whereas the uplifted continental crust formed the Himalayan Range. The Tethys was about 6000 km wide along the Pacific, and to the north of India it might have been around 5000 km in the east and 3000 km in the west. What happened to the rest of the ocean floor and how did the northern continental crust happen to be at the suture zone with a gap perfectly to fit the outline of the migrating Indian plate is, however, not clear. Even if India had earlier separated from Pangaea the odds against its returning to the same place from point to point to fit in the original gap are very high. Also, during the millions of years of the separation of the two Blocks, their coastal outlines must have changed materially through erosion and sedimentation. Their perfect refitting would be nothing short of a miracle. An attempt is made here to re-examine the modern global tectonic hypothesis in the light of the currently available geological and structural evidences for the Himalayas evolution. This will necessitate a review of the associated phenomena, subduction and suturing. Equally important would be to comment on the former position of India vis-a-vis the northern continents on the one hand, and the independent Gondwanaland on the other.

Plate Tectonic Speculative

Ever since Alfred Wegner's (1924) Origin of Oceans and Continents appeared, and Alex Du Toit's (1937) attempt assembling an independent Gondwanaland, countless assemblies have been offered. Of particular interest in these was a 'draft' assembly by Carey (1976) suggesting that the 'gaping gore' of the Tethys was unacceptable and a globe of smaller diameter should be adopted to make it disappear (see also: Owen, 1982). Subsequently, Dietz and Holden (1970) and Smith and Hallam (1978) brought out their assemblies by computer matching the coastal outlines. Although widely accepted, there is inherent weakness because matching of geology of the opposite coastal areas is given only a secondary importance. Thus, for example, Western Australia has got to fit besides Peninsular India (Ahmad, 1960; Sastri et al., 1974; Veevers et al., 1999), but the computer match does not bring the same. May be, the coast lines had materially changed through time or else the computer analyzes only the data ignoring human error. These reconstructions envisage a wide oceanic Tethys between Gondwanaland and the northern continents or else they are for Pangaea, and the Tethys appears as a wide gulf on the Pacific coast tapering down towards the west to near Black Sea or farther west. In either case, if the continents have to come together and coalesce, some landmass/landmasses have to travel over thousands of kilometer and paleomagnetism seems to confirm that India drifted from a southern hemisphere to its present location (McElhinny, 1968; Klootwijk, 1979; Klootwijk et al., 1985, 1992; Vandamme et al., 1991). The drift is believed to have started about 80 Ma in the Late Cretaceous, around 30° S latitude (the southern tip of India having been to the south of 40° S latitude), and the collision took place around 20 Ma (Powell, 1979, p. 8, Molnar and Tapponnier, 1975, fig. 1, Acharyya, 1990; Sinha, 2002; Jain et al., 2012). Thus, India was crossing the Equator in various interpretations, from Eocene to even Miocene (McElhinny, 1970, p. 979), and the Equator was passing through the middle of Peninsular India around 38 Ma (Molnar and Tapponnier, 1975). The total distance India has travelled is believed to be around 7000 km (Molnar and Tapponnier, 1975, fig. 2) in about 50-60 Ma at an average rate of about 11.5 cm/year—a fantastic speed when compared to the maximum rate obtained along the oceanic ridge today, about 12 cm/year, i.e. about 6 cm/year on either side of the ridge. Indeed, the rate must have been considerably higher as discussed later, there might have been a long break in the drift. Yet, there is no reason why a much faster rate of spreading could not have obtained, even as an exception, one should nevertheless be able to recognize the counterpart of India, on the other side of the ridge, and that too, must have similarly drifted. This has not been identified, and the explanation could be that it comprised an oceanic crust that has been subducted elsewhere. Figures 1 and 2 of Powell (1979) indicated that before 80 Ma India was around 30° S latitude (Molnar and Tapponnier, 1975, put it around 40° S) and it started drifting northward.

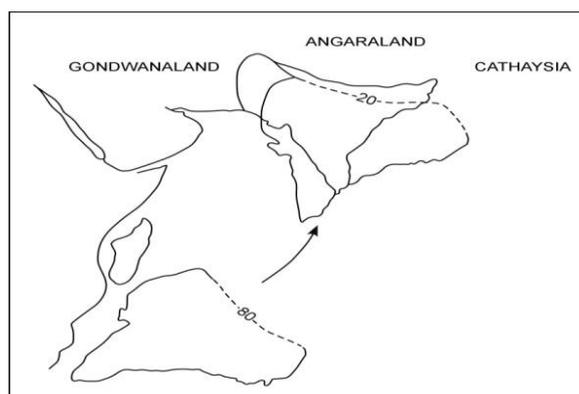


Figure.1. Greater India migrated from a temporary location in the southern hemisphere rejoined northern

Gondwanaland on the northwest, Angaraland on the north and Cathaysia on the northeast. This junction line should exist all along the Arabian Sea to Bay of Bengal (After Powell, 1979).

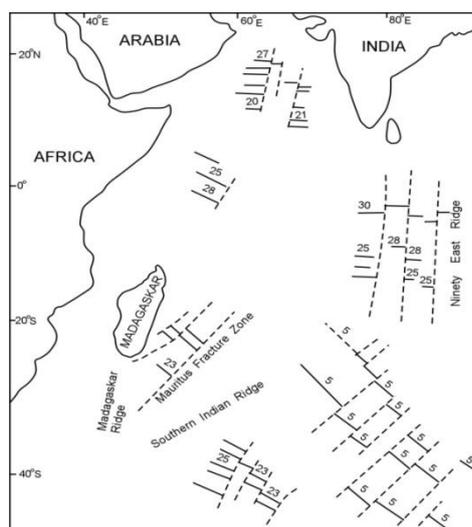


Figure.2. Map showing marine magnetic anomalies of Indian Ocean (After Powell, 1979).

Powell (1979) placed India besides Madagascar, and a northwest-southeast ridge must have existed in the area, and was responsible for ocean floor spreading, the oldest anomaly having been anomaly 33. Greater India, thus, migrated to the area east of the Indian Ocean ridge before it came into being (Anomaly 5), and then moved northward. However, further north a Proto-Carlsberg Ridge must have existed from anomaly 28 to 22, and Scrutton (1973) agreed that a ridge besides Seychelles already exist 70 Ma. Owen (1982, fig. 5) suggested an age of 60 Ma. Stripes produced by this ridge must have formed topographic highs and thus must have been directly in India's route; however, Powell (1979) avoided the situation and migrate the ridge itself. Nevertheless, it is interesting that between anomaly 22 and anomaly 5 there was no ocean floor spreading anywhere in the Indian Ocean, and it is not explained what motive force was responsible for the drift of India from around 50 Ma to about 20 Ma i.e. from Middle Eocene to Lower Miocene times. If Powell's (1979, figure5) suggestion is accepted, India, somehow, kept on moving.

Molnar and Tapponnier (1975, p. 419) stated that "because of the buoyancy of continental lithosphere, subduction of one continent beneath another is often assumed to be impossible. Instead, the motion between the two continents is presumed to stop abruptly, suturing them along a young orogenic belt, and causing a marked change in the relative plate motion or the formation of a subduction zone elsewhere". Molnar and Tapponnier (1975) further stated "We estimate that shortening and underthrusting of India beneath the Himalayas and Tibet accounts for at least 300 km and perhaps 700 km even 1400 km according to Li and Harrison (2000)." If this is correct there should be a displacement of about 1000 km on the Baluchistan coast. Instead, the coast is straight. Although contradictory, yet both the views appear too accepted in plate tectonics. Moreover, there is no explanation as to why the Himalayas have been uplifted some 500 kilometer away from the suture zone instead of being along the collision zone itself. On the contrary, the beds near the suture zone are slightly disturbed, and why were the Kun Lun ranges uplifted simultaneously to the north of the plateau? What, however, is crucial is that such progressive underthrusting could only have been at a level below the root of the Himalayas, and yet "no intermediate or deep earthquakes have been reliably located in the Himalayas" (Molnar and Tapponnier, 1975, p.420; Bai et al., 2012), nor, indeed, in Tibet (Priestley et al., 2007).

Plate tectonic models of the area envisage that the Himalayas were formed as a result of continent-continent collision (Sinha, 2002; Jain et al., 2012; Valdiya, 2015). Yet, Gansser (1964, p.142) pointed out that the earliest tectonic activity in the Himalayas occurred in the Upper Cretaceous i.e. around the time India began its northward drift from 30° S latitude, and the major episode was Eocene, i.e. the tectonic activity was undoubtedly earlier than the supposed collision and no explanation has been offered for this anomaly. Wadia (1983, p.307) suggested the first upheaval in post-Nummulitic times, culminating in the Oligocene, i.e. perhaps it started in the Eocene. The first upheaval "ridged up the central axis of ancient sedimentary and crystalline rocks". The second phase, relatively of greater intensity, was in the Miocene and the last is post-Pliocene. Collision, according to Powell (1979), took place prior to 20 Ma and according to Molnar and Tapponnier (1975) after Anomaly 5. There could not have been any tectonism prior to this envisaged collision. The first two phases, thus, remain anomalous. If it is speculated that an island is existed beyond Greater India, it seems to have left no evidence behind (Stocklin, 1982). Instead, as is well known, Gondwana glacial and associated plant

fossils are reported from northern area of Tibet, i.e. from the other side of the suture zone from every exposure of Permian-Triassic rock (Wang Naiwen, 1984; Chang Chengfa et al., 1986; Upadhyay, 1999; Xiaochi, 2002) right up to Kun Lun Range. The ice seems to have moved from south to north, perhaps transporting the glacial material from Peninsular India (Casshyap et al., 1993). It implies that the northern Tibet and India were together in the Paleozoic times, as also in the Mesozoic i.e. they have always been together. The above concept recognizes that Greater India should have sutured with the Iran-Afghanistan plate around the Paleocene before the collision along the Indus-Tsangpo Suture. Prior to that Chaman/Ornach-Nal faults could not have existed. Yet, Auden (1974) pointed out that in Afghanistan there is evidence of movement along the former throughout the Cenozoic. It had probably come into being in the Cretaceous (Lawrence and Yeats, 1979). Similarly, much importance is attached to the Zhob, Muslim Bagh and other ophiolites in Baluchistan and the North West Province, speculatively believed to have been obducted oceanic crust, as a result of the envisaged collision. Yet, the oldest sediments, overlying deeply eroded and weathered (sometimes lateralized) ophiolite occurrences in the area are Lower Eocene. The eruptions are considered to have been in Cretaceous i.e. from before India started its northward drift (Mehmood et al., 1995). Also, it is significant that not a bit of ophiolite occurs along the Chaman fault itself, and most of the occurrences are well to the east, and one is well to the west near Saindak (Baluchistan), some 250 km away (Figure.3).

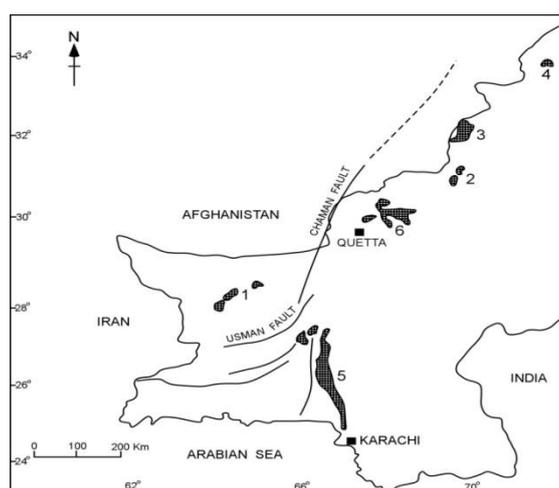


Figure.3. The ophiolites, believed to have resulted from the collision along the Chaman Fault, however, lie well to the east of the fault, with no trace of its supposed former existence along the so called line of junction. 1=RasKoh, 2=Zhob, 3=Waziristan, 4= Dargai, 5=Bela, 6=Muslim Bagh. (After Asrarullah, Ahmad and Abbas, 1979)

The ophiolites must have come up through fissures, and could be of little significance, except that they would, perhaps, suggest a state of tension. Those on the Indian plate obviously must have been emplaced while India was still in the southern hemisphere.

It implies that the long northward drift of India is doubtful and entire edifice has been built on a single line of evidence – paleomagnetic data of Indian rocks. Admittedly the data have been rechecked by several workers, and the only course that appears justified is to reject them if they do not corroborate geological data. Thus, Wensink (1973) opined that Kashmir was in the south and Peninsular India in the north, rotated by almost 180° in its Gondwanaland position. Obviously, it would be unacceptable, and Klootwijk (1979, fig.3, and p. 52) stated that well-defined and well-cleaned results from the Permo-Triassic and Cretaceous “indicate that during this time span, Greater India underwent approximately 30° counter-clockwise rotation with hardly any northward movement”. During the Permo-Triassic, India was undoubtedly a part of Pangaea, surrounded on all sides by landmasses and could not be rotated. Similarly McElhinny et al., (1974) concluded that Malay Peninsula was not a part of Gondwanaland, and instead, it was possibly adjacent to North Africa in the Paleozoic, somewhere, presumably to the north of Algeria. Also, that between Permian-Triassic and Cretaceous it underwent a clockwise rotation of 70°. On the other hand, they seem to accept the Yunnan-Malay Geosynclines, which continued, perhaps, into Australia, and existed from the Ordovician through Jurassic. The contradiction between the two conclusions, perhaps, being of no consequence to McElhinny et al., (1974). Similarly, Briden (1976) admitted that four different reconstructions of Africa are possible on the same set of paleomagnetic data. Likewise, it has been suggested that the state of Oregon has been rotated (Wesson, 1970, p. 322). This would obviously necessitate that a slice be taken out, rotated and then fitted back to the American mainland. The proposition would be a wonder if it has happened.

On the other hand, remnant magnetization derived from red bed sediments and from igneous basalts is likely to yield diverse paleopole positions, as in the case of red beds from Indian Gondwana and Deccan basalts (Klootwijk; 1979; Molnar, 2016). Secondly, paleomagnetic poles determined from continental basalts and from oceanic magnetic anomalies of the same age may fall far apart, by as much as 2000 km (Molnar and Francheteau, 1975), raising doubts about the very tenants of plate tectonics and inadequacies in data quality or suggesting that the paleomagnetic principle is not applicable in interpretation of plate motions. A review of the literature reveals that the oceanic magnetic anomalies are less understood and not confirmed by hard control on basement samples beyond the quaternary Period. The most serious of all baseless assumptions is that of linking magnetic and rotational poles of the Earth for all geologic periods. On the eve of these discrepancy the authors suggests that the best alternative is to look at the paleomagnetic evidence in the light of polar wandering, involving movement of the magnetic field without movement in space of the planet's surface features. It seems appropriate that the results arrived from paleomagnetism should be tested against geological observations. A possibility, however, exists that the suggested northward movement of India is in fact a reflection of the northward movement of the North Pole from around Verkhoyansk to its present location. On the other hand, the close resemblance of the Archaean formations of India, Sri Lanka, Madagascar, central, west and east Africa, south-west Australia and East Antarctica, permit no alternative but to accept that these areas stayed together (Ahmad, 1960, 1961;Katz, 1972).

Great Gondwanaland or Pangaea

Although Suess (1888) used the terms “Gondwanaland” and “Tethys”, and Alfred Wegner (1924) adopted these, but did not seem to have envisaged that Gondwanaland was an altogether independent entity i.e. that it was separated from the northern landmasses, Laurasia, Angaraland and Cathaysia by an oceanic Tethys, joining western Pacific to eastern Pacific. The concept was introduced by Alex Du Toit (1937) that in the Permian these landmasses were independent and, accordingly had distinct floras. Dietz and Holden (1970) retained independent Laurasia and Gondwanaland. Similarly, the concept that the Himalayas have originated as the result of collision and suturing of India with the northern landmasses was envisaged by Du Toit, and became an integral part of the Plate tectonics philosophy (see: Valdiya, 2015, for references). Yet, a collisional origin of the Himalayas involving the convergence of India towards Tibet has been advocated since before the Tethyan Ocean concept was actually introduced and was a part of the geosynclinals origin of these ranges. Ahmad (1968), prior to the Plate tectonics philosophy was introduced, argued that the Himalayas did not originate from geosynclines, and geosynclines were not a prerequisite for mountains. Of late, paleomagnetic data have further fragmented the landmasses, and Burrett (1982) illustrated them for the Lower, Middle and Upper Ordovician, whereas Tarling (1982) has plotted them for the Devonian. This revolutionary vision envisages that all these scattered fragments coalesced into a single landmass, Pangaea, in the Permian, and soon after Pangaea fragmented as a result of ocean floor spreading to form the present continental configuration. Since there is no evidence of ocean floor spreading prior to about 150-180 Ma, the mechanism for these earlier multi-pronged movements of landmasses, large and small, is not yet clear.

Thus, to both Alfred Wegner and Alex Du Toit the evidence that seemed to clinch the issue was the occurrence of glacial climatic conditions more or less simultaneously in all the Gondwana continents, in contrast to a warm climate in Europe and North America; Siberia with Permian glacial deposits, then, having been *terra incognita* and so was northern Tibet. Accordingly, there were supposed to have been significant differences in the northern and southern fauna and flora. Ahmad (1978) reviewed the occurrence of life over continents in Earth history, and concluded that there seems to be no escape from accepting continental ligations allowing for free two way migrations throughout the Paleozoic and Lower Mesozoic of all forms of life – marine and freshwater fauna, vertebrates and a variety of plants. The migration is indicated by the fact that the forms appeared in Early Permian in Gondwanaland reached the northern landmasses in Upper Permian time, and vice-versa (Wagner, 1965; Ahmad. 1978; Xiaochi, 2002). But, if the distribution of common plants, marine faunas, freshwater forms and even the lowly insects have posed a problem, the distribution of vertebrates virtually clinches the issue. Indeed, the similarities between the Triassic vertebrates of South Africa and Russia had long been a veritable enigma, and although migration was accepted, with an ocean in between, no route could be agreed upon. Elliot et al, (1970) discussing the Antarctic teratopods conceded that “In the case of the terrestrial vertebrates there would seem to be no assumption or mitigating consideration: these animals could have migrated from one to another landmass only by means of land connections”. Such a land-bridge had got to be direct and not circuitous, via Spain, for example, often suggested in the past to account for the similarities between South African and Russian Triassic teratopods. Romer (1973), however, admitted that these “suggested free communications”. Thus, in the Triassic beds of Russia there are remains of South African *thecodonts*, *therapsids*, *cynodonts*, *dicynodonts*, *Proterosuchians*, *saurichia* etc. and that is formidable by any measure. Elliot et al., (1970, p.1200) insisted that Antarctic vertebrates could have migrated to other continents “only by means of land connections”. His other continents represent not only South Africa and India, but also Siberia,

China, Mongolia and Southeast Asia. Similarly, the Lower Permian vertebrates of Kashmir, *Archaeosaurus*, *Actinodont*, *Lysipterigium* and *Cheledosaurus* had been recorded from Europe. More significantly, Romer (1973) has drawn attention to the work of Sun Ai Lin, who has described reptiles from Shansi and Sinkiang provinces of China which include conodonts, comparable to the bizarre *Kannemeyeria* and *Cynognathus*, now also reported from Argentina and India. But the discovery that really settled the issue was the presence of reptiles of the *Lystrosaurus* zone of South Africa – *Preteresuchus*, *Erythrosuchus* and indeed, the *Lystrosaurus* itself in Shansi and Sinkiang (China); the latter occurring in Indo-China as well. Thus, at least *Lystrosaurus*, *Kannemeyeria* and *Cynognathus* were present in South America, Antarctica, South and East Africa, India, South East Asia, Mongolia, and China; whereas *Erythrosuchus* was present in Russia, South Africa and China; *Metaposaurus* and *Plesiosaurus* are among the other forms that had wide distribution (see also: Sahni, 1984). Similarly, Qui Hongrong (1980, p. 101) studied the Paleozoic and Triassic conodonts from both the northern and southern flanks of the so-called Indus-Tsangpo suture and found that most of them were common. It obviously means common migration route and the traffic had apparently been two-way, with northern forms penetrating into the southern continents and *vice versa*, had no obstruction, physical, nutritional, climatic etc.

Cosgriff (1974) studied the Triassic vertebrate fauna of Tasmania and noted that several forms, some specifically identical, had been known from the northern landmasses, reaching even such insular areas as Greenland and Spitsbergen. The list of common forms is formidable, and includes *Brachyopidae*, *Lyddekerinidae*, *Rhytidostidae*, *Trematosauridae*, and *Chasmatosauridae*. Cosgriff (1974, p. 113) further pointed out that some of these animals were so built that they “could not easily have crossed even a limited stretch of open sea”. Bhatia et al, (1996) has shown that several non-marine ostracode assemblage of the intertrappean beds of India show remarkable similarity at the specific level with the Upper Cretaceous fauna of Central Asia, Mongolia, Siberia and China. It was not only the mammals that immigrated, there were also frogs – which are highly allergic of saline sea water – that hopped their way through the land corridor and reached as far as south as the Deccan, where their remains are found in the infratrappean and intertrappean beds (Sahni, 1984; Sahni and Bajpai, 1991). Throughout the Paleozoic a transgressive sea covered the middle part of Pangaea from western Proto-Pacific to eastern Proto-Pacific (Ahmad, 1982). It started withdrawing after the appearance of mid-oceanic ridges in the Atlantic and elsewhere. However, in the Jurassic and Cretaceous this sea still existed over the northern and eastern part of India. In the Eocene it was still present in Tibet and the Himalayan region, but gradually withdrew westward and a widening land bridge came to be established from India to Tibet and up to China. It is immediately reflected in the faunal distribution becoming cosmopolitan (Sahni and Kumar, 1974). Colbert (1973, p.408) questioned that if India was drifting northward like an island in the Jurassic and Cretaceous, how is it that its dinosaurs are very similar to those of other landmasses. Thus, the concept of the great northward drift of Greater India is refuted, and the paleomagnetic evidence used to support this drift shall have to be revised or reinterpreted. The contention corroborates Crawford (1979) who described the great northward drift of India as mythical.

The above evidences suggest that Gondwanaland was never a separate entity and it was, all through the geological history, continuous with the northern continents and the Tethys was an epicontinental sea (Crawford, 1974). Belousov et al, (1979) are emphatic that the Tethys Sea existed over Tibetan continental crust. Ahmad (1983) has shown that it continued much further north, entirely as a transgressive sea. Stocklin (1982, p. 120) stated “the geological history, as recorded in the Tethyan rocks themselves, however, wholly contradicts the paleomagnetic inferences. These rocks tell us with all desirable clarity that the Tethys was essentially, not a wide ocean, but an epicontinental sea since the Paleozoic. Recently Khan and Tewari (2016) ruled out any possibility of independent Gondwanaland on the basis of geological and paleontological evidences.

Suturing and Subduction

Suturing and subduction are considered as great evidences of migrating Indian plate. Therefore, being the type area, the Indus-Tsangpo Suture and its continuation on either side needs re-examination. It was Gansser (1966) who used the term ‘Suture and Subduction’ that led to the formation of the entire hypothesis, though he was, not very specific about its genesis and thought that it represented a deep down-bulging, some sort of a junction line between geosynclinal formation on one side and the Himalayan succession formed exclusively of non-geosynclinal, shallow, platform type of sediments on the other, along which large areas of *continental crustal material* had disappeared (emphasis by the authors). It will be desirable to examine the subduction concept, which got much a ready and unquestioned acceptance. Dewey (1977, p. 56) opined that “The simplest kind of orogenic suture is a high strain zone, containing mangled ophiolite remnants, and, occasionally, blueschist mélanges, that separate two continental terrains with dissimilar pre-collision strain histories”. While introducing the term “suture” in Tibet area, Gansser never mentioned that the collision was between a Gondwana element, and some northern elements, although such a collision was well recognized and discussed ever since Alex Du Toit suggested an independent Gondwanaland, with India as a part of it, and even before that

(Argand, 1924). However, the term, as used today, envisages that only oceanic crust is subducted in deep sea trenches, and the continental crust, as it arrived at the site, got “sutured”. The suture around Greater India is, thus, in three parts: [1] The Chaman-Ornach-Nal faults along the west, [2] The Indus-Tsangpo, along the north, and [3] a not well defined Burmese section along the Arakan Yomas in the east. It is supposed to join the Ninety East Ridge or the Sunda Trench.

[1] Chaman-Ornach-Nal is an active sinistral fault, and has been instrumental for strong earthquakes. It extends from the Makran coast, past west of Quetta, and thereafter in the east of Kabul (Sengor, 1990) where it joins the equally prominent dextral Herat fault, that continues to the south of Pamir (Figure 4).

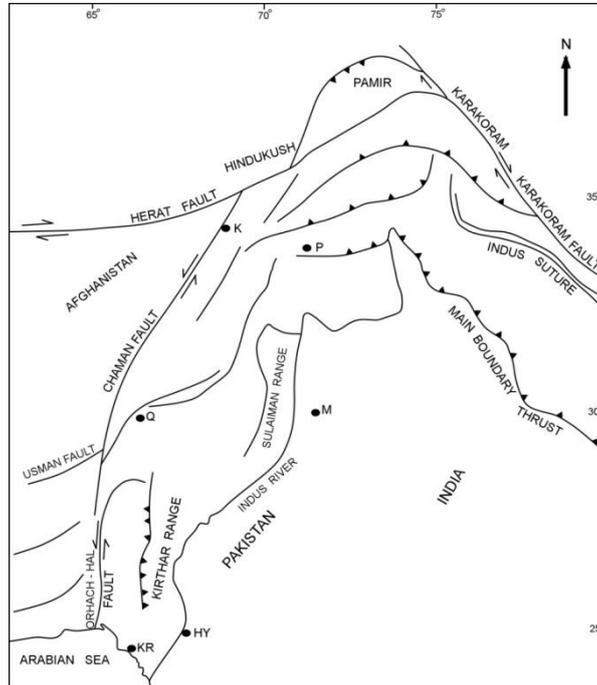


Figure.4. Sketch map showing major tectonic trends on and around the northwest part of the Indo-Pakistan subcontinent. KR=Karachi, HKS= Hazara-Kashmir Syntaxes, Q= Quetta, P= Peshawar= Multan, K= Kabul, HY= Hyderabad (After Sarwar and DeJong, 1979).

In Baluchistan, however, it does not reach the coast, as believed in the past (Figure 5), and comes to an end near Ras Koh (Lawrence and Yeats, 1979, p. 351).

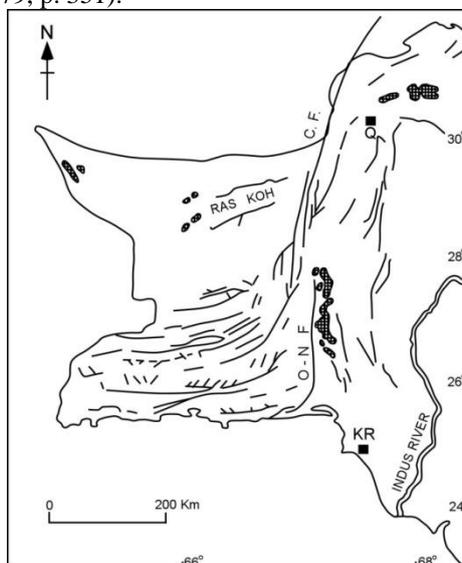


Figure.5. NNE-SSW faulting in Baluchistan, all the faults either takes a sharp turn to the west or comes to an end much before reaching the coast. C.F=Chaman fault, O.N=Ornach-Nal Fault, Q=Quetta, K.R=Kirthar Range, K=Karachi, HY=Hyderabad (After Quittmeyer, Farah and Jacob, 1979).

The *en echelon* Ornach-Nal fault continues further south. However, it, too, does not cut across the coast, and on the continental shelf it takes a sharp turn to the west. Had these faults been the suture zone, with a long travelled Indian Block on one side and the Iran-Afghanistan Block on the other, it would certainly have continued into the oceanic area cutting across continental shelf. Lawrence and Yeats (1979) revealed that its southern part, the Nushki section, is not continuous. There are some *eight or nine breaks* in it, ranging from 2-9 km in length (Figure 6).

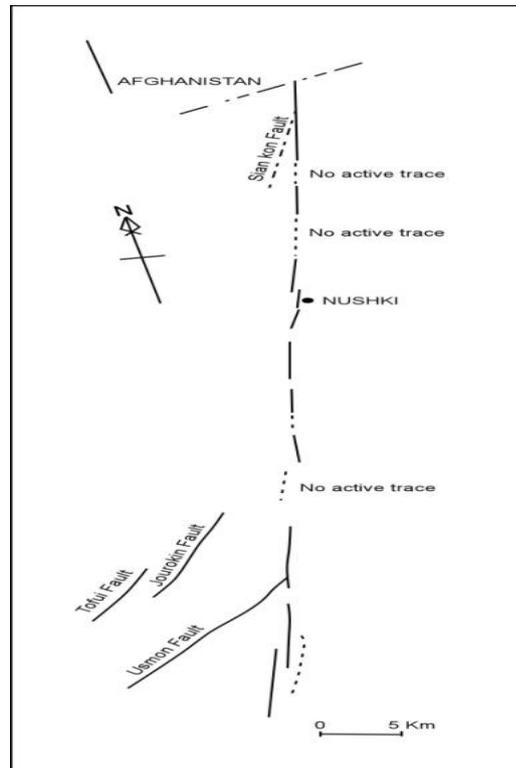


Figure.6. The Chaman Fault has its maximum displacement in Afghanistan and progressively weakens southward. Note in the Nushki area it has a number of breaks (After Lawrence and Yeats, 1979).

This is the area north of the *en echelon* Ornach-Nal fault, and hence not covered by the latter. What is even more significant is that the Chaman fault repeatedly branches off to the west, and Lawrence and Yeats (1979) concluded that this is suggestive of progressive younging of the fault towards the south. In 1943 there was a high intensity earthquake over the beach area of the Ornach-Nal fault and recently in 2013 there was a powerful earthquake of 7.7 magnitude along the southern strand of Chaman fault confirming that both the faults are still active, and therefore do not support the suture zone concept.

More significant, all the Baluchistan faults (Figure 5) take a sharp turn to the west (see, e.g. Kazmi, 1979, Fig. 1; Jacob and Quittmeyer, 1979, Fig. 3). This bespeaks of a counter clock-wise oroclinal rotation (Carey, 1976), with compression developing within the subtended angle, and tension outside (Ahmad and Ahmad, 1980). However, Powell (1979, p.5) stated that “a similar geometry could have been produced without substantial rotation”. Yet, subsequently he envisaged several stages of counter clock-wise rotation of India that has produced the observed features. Lawrence and Yeats (1979) and Lawrence et al., (1992) have estimated a transcurrent movement of about 200 km in northern Baluchistan whereas Auden (1974) has arrived at a figure of 300 km by matching the geological formations on its two sides. Gawad (1971) suggested that the Baluchistan faults are left lateral by matching geology since the Mesozoic. Had the Chaman fault been really a suture, it would have been involved in a transcurrent movement of about 1300 km and not merely 200 or 300 km. Moreover, it would have suggested younging northward and hence lesser movement in Afghanistan than in Baluchistan.

The Chaman fault is stated to pass into the Owen Fracture Zone (Powell, 1979, Figs. 8-12). The former is, however, sinistral, the latter dextral (Powell incorrectly depicts it as sinistral to fit it with the Chaman fault movement) having clearly displaced dextrally the Carlsberg Ridge at the mouth of the Gulf of Aden. But the area between the northern end of the Owen fracture Zone and the Chaman fault zone is occupied by the Murray Ridge, which runs to near the coastal area to the east of Karachi (Figure 7).

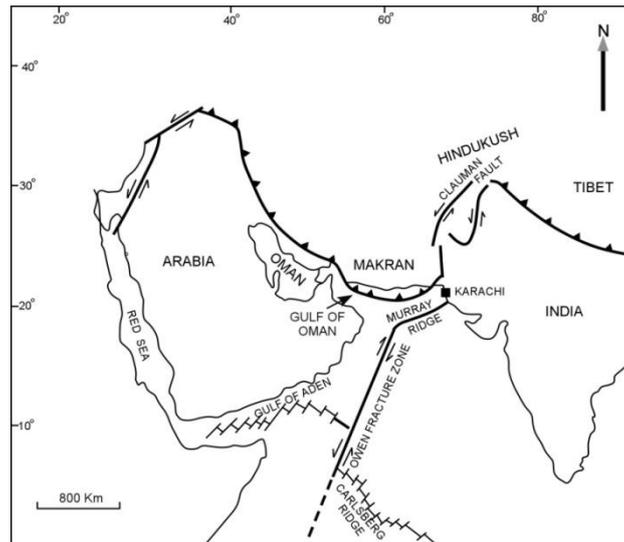


Figure.7. Index map showing structural and geomorphologic features in Indian Ocean. CF= Chaman Fault. (Modified after Sinha, 1992)

If it is a ridge in the true sense, it is a spreading belt separating landmasses. If the Murray Ridge is ignored, there is a gap of over 400 km between the Chaman group of faults and the Owen Fracture Zone (Powell, 1979, fig.1). They do not, and cannot, run into each other and India could not have moved northward along the Owen Fracture Zone. Of particular interest in connection with the alleged northward shift of India is the evidence available from the Kirthar Fracture Zone, supposed to be continuation of the Owen Fracture Zone – Murray Ridge, and a line of junction (Suture) of the Indian landmass with Iran and Afghanistan. However, it is by no means certain that the Owen Fracture Zone continues into Murray Ridge, for there is a gap in between – hence the two names. Sarwar and De Jong (1979, p. 23, fig. 3) depicted 225 km long Kirthar fault as a reverse fault, thrust partly to the east and partly to the west, ending some 100 km or more from the northernmost known point of the right lateral Murray Ridge (Jacob and Quittmeyer, 1979, p. 306, fig. 1). The area between is cut by the east-west Cutch Fault System (Figure 8). Why the simple Kirthar fault was transformed into transform fault to fit the plate tectonics and subduction concepts is incomprehensible.

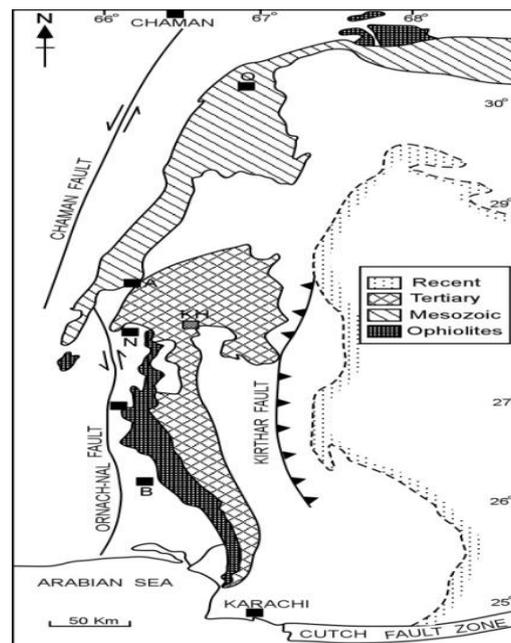


Figure.8. Tectonic sketch map between the Quetta Syntaxes and the Arabian Sea., Q= Quetta, KH=Khuzdar, O N F=Ornach-Nal Fault, B= Bela. (Modified after Ahmad, 1983)

[2] In the paleomagnetic interpretation and plate tectonic model, India is believed to have migrated from the southern hemisphere from around 60-70 Ma to about 20 Ma. The width of the ocean north of India may

be around 3000 km in the west and 5000 km in the east, north of Assam. The Indian plate, beyond the Greater India continental crust must have consisted of oceanic crust. All this oceanic crust must, then, have been subducted into the Indus-Tsangpo Suture. This part of the Indian plate is variously estimated at around 6000 km and some 1500 km of sialic crust is believed to be thrust below the Tibetan Block to make it double thickness area. However, the thickness of the continental crust decreases gradually south of the Indus-Tsangpo Suture. Thus, immediately to the south of the Suture, the crust thickness is still of the order of 60 km. How is this area of double thickness to be explained? Moreover, 1500 km of the Indian crust have been accommodated underneath Tibet whereas the total width of Tibet between the Himalayas and Kun Lun is of the order of 800-900 km. The rest of the Indian plate must have passed underneath the latter range and beyond that needs a suitable explanation. More important, the Indus-Tsangpo Suture Zone is not continuous all around the outline of the erstwhile Greater India (Sinha, 2002, Fig. 1). Thus, eastward to the north of Myanmar i.e. from near Lhizu to the southwest of Lhasa *it does not exist* (Belousov et al, 1979; Girardeau et al, 1985). Its place, instead, is taken by a wide band of Jurassic phyllites, intruded by granites, diabbases, diorite, gabbros and serpentinites. The band continues northward of the Indus-Tsangpo Suture Zone (Belousov et al, 1979). This certainly needs an explanation for where has the area of Greater India north of Assam been subducted is not clear. This must have been of the same order as north of the rest of India.

Similarly, at the western end of the Indus-Tsangpo suture zone, there is a meridional gap of about 300 km between the suture and the north-east end of the dextral Herat Fault in the Pamir region which seemingly has nothing to do with the movement of the subcontinent. This, too, remains enigmatic. What is even more surprising is that over the Lhasa block and the South Qiangtang block, Tengchong block in Yunnan exist typical Gondwana glacial deposits, carrying typical Gondwana flora and fauna, overlying a metamorphic basement right up to Kun Lun Range (Tapponnier et al, 1981, p.405; Li Xiangxu, 1984; Acharyya, 1992; Xiaochi et al., 2011). These glacial deposits have moved from the south to north and would it be impossible to explain these if a vast ocean existed in the area during the Permo-Carboniferous when India was in southern hemisphere. And all the maps depicting a vast oceanic Tethys in the region do not recognize this vast land area over which these glacial deposits were deposited. But surprising, they reinterpret the glacial deposit as “rift-in-fill” just to justify that plate tectonic interpretation. Nor do they accept the presence of typical Gondwana flora and fauna in the area, in spite of scores of Chinese reports confirming their wide distribution. These glacial deposits exist underneath every Permo-Carboniferous succession over the entire northern Tibet, thereby covering thousands of sq km and ranging in about 600 m in thickness, were originally reported by Norin (1946), and later confirmed by the American Plate Tectonicists delegation (Bally et al, 1980). It is possible that they did so because a Gondwana glacial deposit in the area did not fit-in with the Indus-Tsangpo Suture concept which they supported unreservedly. Nor do they accept the presence of typical Gondwana flora and fauna in the area, in spite of scores of Chinese reports confirming their wide distribution. What is most unexpected is that some of the Chinese authors of the latter study did not agree with this reinterpretation (Wang Naiwen, Pers. Com.).

Ophiolites are invariably believed to mark the zone of subduction, their infallible signatures of subduction. Yet, in this case, as also in Pakistan’s Zhob, Muslim Bagh and other areas, and those in Iran, Oman and Turkey etc. they are invariably Cretaceous in age. This would mean that intrusion or obduction preceded the collision by 50-60 Ma Thus, Stoneley (1974, p.899) admitted that “the ophiolites were emplaced while the Indian continent was presumably still some hundred of km away. Moreover, it was thousands of km away from Eurasia as suggested recently by Khan and Tewari (2016). Even Tapponnier et al., (1981, p.410) are worried that the emplacement of the ophiolites “occurred earlier than the end of the Eocene, *which would place new constraints speculations based on plate tectonic reconstruction*” (emphasis by the present authors). Girardeau et al., (1985) asserted that “The ophiolites were probably obducted during Eocene”, apparently in harmony with the plate tectonic concept. What is equally intriguing is that if the Indian plate did not extend beyond the Chaman fault zone, in what way are the ophiolites of Oman, Iran and Turkey influenced by this suturing that they behaved similarly? Belousov, et al., (1979, p. 422) wondered why it should be that from an ocean several thousand km wide, which existed from the Paleozoic through Mesozoic, only these few small beads of the pressed out material of the subducted crust were preserved and everywhere they are of the same Late Cretaceous age. They are, indeed, where there was no subduction. Yet, the most interesting evidence from the recent work by the Sino-French team was that in many places, the ophiolite belt along the Yarlung-Zhangbo seems to be limited to the north and south by steeply dipping faults. In other words the ophiolites occupy a rift valley, presumably initiated in the Triassic and continued to be active till the Cretaceous. Fein Ding et al, (1981) agreed that the Yarlung-Zhangbo is a rift, and yet, amazingly, they think that it was a suture, it seems, realizing that the terms are self contradictory. The former is observational; the latter seems to be interpretational. Ophiolite emplacement took place twice, firstly in the Upper Jurassic to Lower Cretaceous and then later again in the Lower Cretaceous. These two are chemically *significantly* different, the latter occupying the northern part of the suture. That contact metamorphism is widespread, and the bulk of the ophiolite is essentially represented by a mantle sequence, which comprises harzburgite, dunites and chromitites. A variety of ultra high pressure

minerals such as diamonds, poissanite, native metal and PGE alloys have been recovered from the latter ophiolites (Liang Rixuan et al., 1984; Bai et al, 2000; Robinson et al., 2004), bespeak of a temperature of 1105-1240°C and a pressure of 27-46 kbar, confirming to a depth of origin of the magmas at 80-140 km. (Liang Rixuan and Bai Wanji, 1984). This is far from ocean floor obduction.

Shaobai et al, (1984) carried out geophysical investigation in the area and concluded that the northern side of the so-called Indus-Tsangpo Suture Zone (ITSZ) has evidently risen and the southern subsided by as much as 5 km, the two forming a deep trench in between. They accordingly suggested that the southern block in the Triassic was where it exists and not in the southern hemisphere. The ophiolites carry pisolitic and warty structures, form pillow, and have produced extensive contact metamorphism. Crystal settling abounds, producing acidic rocks at the top and ultrabasic at the bottom of every exposure (Cui Junwen, 1981). Gopel et al., (1984) believed that the very existence of two magmas is a strong constraint to plate tectonic speculations. The magma emplacements are, thus, confined to the rift valley that apparently was deep. The associated sediments now thrown up by the magma emplacement indicate deep water deposits in this rift, and now form the *mélange*. Major rift zones bounded by vertical faults have been described as “key-board tectonics”, which brought up basic extrusive, and the rifts became the sites of geosynclinal sedimentation and deformation. Stocklin (1974) and Raiverman (1992) compared the belt to the Red Sea, however, would mean the existence of an oceanic ridge. Yet, perhaps, a simple rift valley seems to be more satisfying, for the feature, 8-20 km wide, seems to die out at both ends and has several breaks along its length. This rift is said to be clearly seen on Landsat images and Lake Mansarovar is a depressed part of the valley. Similarly, Nicolas et al., (1981) thought that the ophiolite marked a “spreading centre with a particularly slow spreading rate”. Gopel et al., (1984) consider it a “propagating ridge”; whereas Deng Wanming (1980) noted that the ophiolites were similar to those found along the mid-oceanic ridges. Similarly, Wang Xibin et al. (1980) describe it as tensional feature and Cheng Chengfa (1980) believed that Late Permian-Triassic tensional rifting has resulted in this feature and produced the Panjal Volcanic of Kashmir, and their equivalents in Mandi, Bhowali and Abor Hills. It may also be significant that the occurrences of Carboniferous-Triassic ophiolites in Kashmir, and their equivalents in Mandi, Bhowali and Abor Hills, seem to have equally, indeed more, widespread counterparts in western and northwestern and southern Siberia indicates that perhaps these areas were formerly part of a single crustal block and were separated as a result of ocean spreading.

In the case of the Oman ophiolites, Stoneley (1974, p. 902) agreed that tensional faulting was associated with the eruption. The above evidence bespeaks of tensional faulting in the Indus-Tsangpo Suture belt. He was, apparently not aware of this evidence, but recognized that magmatic injection inexplicably ***preceded the supposed collision***. Interestingly, he recognized contact metamorphism, as pointed out above, caused by ophiolites, which, however, obducted oceanic crust ***could not*** produce and rules out the island arc syndrome (see also: Stocklin, 1982; Sinha, 2002). Stocklin (1982, p. 126) is emphatic that “Subduction is not required either to explain the present structure of the Indus-Tsangpo Suture Zone, but is rather contradicted by such facts as its vertical attitude (Gansser, 1981) and present seismic inactivity”. Moreover, subduction would require a low angle movement of one plate below another for a distance more than 1000 km, whereas subduction is purportedly a ‘high angle’ process. Also of interest in this context is the fact that according to the plate tectonics, volcanism of island arcs resulted from partial melting of the down going slabs of oceanic lithosphere, yet in the case of the Indus-Tsangpo Suture, down slab which has gone thousands of km. of oceanic crust, no partial melting seems to have taken place, and consequently, no volcanoes exist in the Tibet area. There were few volcanoes associated with the Quaternary rift valleys, but all are dormant presently. Incidentally, their association with the rift valleys in Tibet, as in Africa, suggests that the rifts are tensional features, and not of compression as expected in a subduction/collision zone. Briden (1976, p. 415) admitted that “geological evidence of subduction is self-destructive on plate tectonic reasoning”.

These lines of evidences have convinced Wang Naiwen (1980) that “It is unbelievable that the Yarlung-Zhangbo-Indus belt is the suture between the North and the South continents”, whereas Zheng Haixiang (1984) thought that the “Y- belt is not entitled to be suture zone”. Owen (1976, p. 209) has stated that “there is, therefore, no need to infer the presence of Tethyan oceanic crust north of India nor to use ophiolite belts as evidence of its former existence.

[3] The suture zone over the Arakan Yomas simply does not exist. In fact, this should exist along the eastern margin of the Indian plate i.e. along the Assam/Bangladesh coast and the western margin of Myanmar and not ***within*** the latter, as often suggested (Acharyya, 1992, fig. 1; Sinha, 1992, fig. 4). Instead Acharyya (1992) suggested that Myanmar was itself moving north ward along with the Indian plate. This throws serious doubt about the eastern suture and therefore about the entire concept. The Ninety East Ridge is of the nature of inactive mid-oceanic ridge and the “plates” on its two sides must once have been moving away from it, i.e. to the east and the west. India could not have moved northward along it.

II. Discussion

The above evidences have demonstrated that the so-called Indus-Tsangpo Suture is not a collision belt, firstly because Gondwana marine glacial deposits overlain by Permian through Jurassic marine sediments with typical Gondwana overtones occur in the area almost from Lhasa to the Kun Lun Mountains, and secondly, the fauna and flora (including Permian and Triassic vertebrates) of Gondwana affinity from Ordovician through Triassic north of the so-called suture. Finally the ophiolites are restricted to a rift valley, which, came into being in the Triassic, but was active during the Upper Jurassic-Lowest Cretaceous and later again in the Lower Cretaceous. Thus, the magma outpouring occurred about 50-60 Ma *before* the speculated collision. Therefore, it is the need of the hour to explain the following before accepting the suturing and under-thrusting of Indian plate under widely accepted newly global tectonic concept.

[1] That although the magma emplacement occur 50-60 Ma before the envisaged continental collision, contact metamorphism has extensively affected the Indian plate as well. India, in the plate tectonic interpretation then, was supposedly at 35°S latitude.

[2] The magma emplacement was not only of two different ages but they differ chemically which is difficult to explain by the collision concept. Gopel et al., (1984) opined that the existence of two ophiolites itself places constraints on the plate tectonic model. The second phase of outpouring occupies the northern part of the suture zone, forms pillows, carries diamonds, poissanite, rare earth and PGE, must have originated, as pointed out elsewhere, at a temperature of 1105-1248°C and a pressure of 27-46 kbar, corresponding to 80-140 km depth. Each exposure shows extensive crystal settling, with the top being acidic and the bottom ultrabasic suggesting that the magma was in a molten stage.

[3] The magma is contained within two vertical walls of a typical rift valley and there is no true obduction.

What, perhaps, is equally important is : why do the Himalayas occur some 200-300km away from the actual Indus-Tsangpo Suture zone whereas the suture zone itself has not been uplifted, or even seriously disturbed? Continental crust arriving at the subduction zone would be prevented by buoyancy from going down, and as the oceanic crust continued to slip underneath, it should, theoretically, be this part – the actual leading continental edge – that piled up to form a mountain range. Perhaps it would not rise very high, and would instead, mess up the whole area, without forming an Everest height. In any case, the uplift has not taken place at the leading edge, in spite of Molnar and Tapponnier (1975, p. 419), admittedly as quoted above that a young mountain range appears along all such suture zones. Crawford (1975, p. 1179) is, apparently, correct when he raises the objection that if the Indus-Tsangpo Suture zone is a relic of oceanic subduction, it lies on the wrong side of the Himalayas and accordingly agreed that the Himalayas are not the product of continental-continental collision. Indeed, subduction has not been responsible at least for these mountains and some other activity must be looked for this connection. Stoneley (1974, p. 902) pointed out that the Oman Block has not yet arrived at the suture zone. Be that as it may, the leading edge of the Indian plate that did supposedly arrive at the suture zone 20-30 Ma or more remains singularly undisturbed and need proper explanation. On the other hand, Stoneley's (1974) suggestion that the ophiolites merely comprise mantle material intruded/extruded on to a continental crust is not justified. He, thus, does not find any reason why such mantle material cannot be intruded under tension and other suitable conditions: also that one need not “expect that the product should differ materially from those that are intruded/extruded at an active mid-oceanic ridge”, which, too, is basically a rift valley tapping the mantle zone, nor need they invariably from the “plate boundary”. It is not surprising; therefore, that the Indus-Tsangpo ophiolites are identical with those effused at the mid-oceanic ridges, but have come up from the mantle in a tensional set up.

Also, it is not explained how the Indian continental crust has underthrust the Tibetan crust for some 1500 km because this would involve the continental crust leap-frogging across 8-20 km thick wall of mantle/oceanic crust that intervene between the two plates, an altogether impossible preposition. Further it would require that immediately to the north of this wall the continental crust of the Indian plate dives underneath the Tibetan continental crust without leaving a trace behind on the surface. This appears to be an equally impossible proposition, and yet underthrusting is repeatedly stresses without any reservation. Cui Zuoxhou (1984) carried out extensive geophysical investigation in the area and concluded that although the crust was indeed 70 km thick, twin layer crustal structure was nowhere observed. Belousov et al, (1982, p. 429) have raised the question of the origin of Kun Lun, Tein Shan, Bogdo-Ola, Altai and Sayan ranges of central Asia. They all were uplifted more or less *simultaneously with the Himalayas* and there seems to be an undoubted kinship, a genetic relationship, among them. Yet, plate tectonic suturing and subduction do not seem to be involved in their genesis, and neither have these been invoked, nor are they geosynclinals in origin. The only alternative, then, is vertical uplift.

Greater India's great northward movement is based on paleomagnetism evidence, though it is pointed out that paleomagnetic data occasionally result in queer conclusions and should not be accepted unless corroborated by field geological data. Similarly, the Indian plate is said to have moved continuously, by ocean floor spreading, from 60 Ma or 70 Ma to 20 Ma ago. However, no magnetic anomalies between anomalies 22

and 5 exist and no ocean floor spreading seems to have been taking place during this period in the Indian Ocean. Also, if the movement is accepted, the Indian plate shall have to cross a ridge that existed since anomaly 28. To avoid this situation Powell (1979) envisaged that the ridge itself moved. Ridges are very deep features, going down into the mantle, and to move, they would have to plough through the entire crust and a large part of the mantle. A ridge may die out and another may come into being, a little away, once established cannot move a centimeter in any direction.

Carey (1968) envisaged that India had been rotated counter-clockwise and collided with the northern continents to form the Himalayas. This seemed to fit in perfectly with the then accepted origin of these ranges. However, in the light of the present knowledge it does not seem to be valid, for apparently the Himalayas have not been formed as a result of collision. If the Indian landmass was continuous with the Siberian Craton, the northern margin of this Block must have been to the north of the Siberian Craton. A tensional feature acceptably exists all over India (Ahmad and Ahmad, 1980), the Himalayas, and extensively in central Asia, India, then, has not been rotated to the extent envisaged by Carey (1968). If the Indian Craton continued into the Siberian Craton, through a sialic ligation, and has not collided with the latter to form the Himalayas, the only alternative is that the mountain ranges have formed by domal uplift of mafic magma or ophiolite from the mantle, followed by gravity gliding. This model explains the emplacement of detached masses of mafic and ultramafic bodies of Malla Johar in the Kumaon Himalaya or of Spongtang in the Zaskar range of Ladakh. Numerous horizontal, perched terraces bespeak of tension and vertical movement (Ahmad, 1971), rather than compression and nappes (see also Oldham, 1891, p.18). Detailed field study in several areas has revealed that the Main Boundary Thrust and the Main Boundary Fault are high angle faults, perhaps normal. Thus it seems reasonable to conclude that the Himalayas are autochthonous, and not born out of collision of land masses. On the other hand, the mature topography of the Lesser Himalaya in contrast to that of Central Himalaya clearly indicates that the spatial emplacement of the former preceded that of the latter. In other words, the Main Boundary Thrust (MBT) marking the Lesser Himalayan front is older than the Main Central Thrust (MCT) marking the frontal limit of the Central Himalaya. This is contrary to Molnar (1986), according to whom Himalayan thrusts are progressively younger in a southern direction. Qureshy and Warsi (1981, p. 217) and Qureshy (2004) examined the gravity data of the Himalayan belt and suggested that a gravity high area runs north of the Main Boundary Fault (MBF) all along the Himalayas and concluded that the lower part of the crust below the middle Himalaya comprises a denser basaltic root (see also: Raiverman, 1992). A basification of the lower part of the crust by upward migration of the mantle material through the four suture zones and perhaps other fracture zones not reaching the surface is the most probable mechanism for crustal thickening and uplift of the Tibetan Plateau and the Himalaya. The final phase of uplift of Himalaya and the Tibet to their gigantic height was an event of very short duration, sometime between the Late Pleistocene and Holocene. This was an entirely vertical uplift with little or no horizontal translation of crustal mass as no low angle thrust sheets like those in the Lesser Himalaya exist in the Central and the Tibetan Himalaya, other than the detached ophiolitic masses of earlier age. It is significant that gravity studies indicate the thickness of the crust *south* of the main range to be of the order of about 80 km and earthquakes seem to correspond with this down bulging, rather than with the subducting slab model. This is entirely incompatible with the collision model or the subduction concept, and there is no evidence supporting Dewey and Bird (1970, p. 626) and Sinha (2002) that *continental crust* was being subducted under the Himalayas.

It may also be significant that north of the Indus-Tsangpo Suture (ITS) there are within Tibet three other so-called suture zones, Bongong-Nujiang, Jinshajing-Tungbianhe and Jinsha-Tongbian, and six more similar features exist farther north, progressively becoming older northward in the Chinese territory, the oldest being Kerameilli of Middle Devonian – Early Carboniferous age in the Zhungar basin, south of the Altai fold system. They are identical in character with Indus-Tsangpo Suture, and the effusive are very similar to those existing along the mid-oceanic ridges. All these, too, are identical with the Indus-Tsangpo Suture (ITS), and if the latter is a rift valley, as suggested elsewhere, all these features, too, may be rift valleys. In addition, there are around a hundred other minor occurrences of ophiolites that have come up through comparatively minor fault (Bally, 1980). It is accordingly suggested that the entire Central Asian region downwrapped quietly and accumulated immense quantities of sediments (~70 km) and the magma underneath was mobilized. It sought weak zones to move up. Where the thickness was very great it failed to uplift the mass and instead tore it apart in long narrow belts from Late Paleozoic to Mesozoic. Thus, beginning near the Siberian Craton, it moved step by step southward, till it opened up the Indus-Tsangpo Suture (ITS). Moving further south the thickness of sediments decreased (< 50 Km) and the magma uplifted the sediments as the Himalayas, and as other ranges elsewhere. The Himalayas, thus, formed of vertical uplift, by intrusive magmas, boudins, diapirs, sills and dykes. Kasumori Arita (1984), LeFort (1991) and Raiverman (2002) agreed a large volume of leucocratic granites play a major role in the uplift of the higher Himalayas and is intimately related to thrust movements. Gravity gliding played an important role too. Earlier, Ahmad and Ahmad (1981) suggested that the downwrapping of the Indo-Gangetic valley mobilized the mantle magma which uplifted the Himalayas on the

north and west and the Vindhyan-Aravallis on the south and east. The stupendous uplift of the Himalayas may, then, be due to the magma from the two sides joining hands, something that Kun Lun, Tein Shan, Altai etc. lacked. There is admittedly no explanation for the phenomenon of this step by step movement; southward in the present case, but a parallel exists in Peninsular India (Ahmad and Ahmad, 1980) where belts of strong tension, resulting in normal faults and rift valleys, moved step by step from Jurassic to Recent. Gilluly (1971, p.2388) wondered that "Despite this being the region of greatest tectonic activity on the Earth, there has been no sign of magmatic activity along the Himalayas". This is contradicted by the geophysical observations of Qureshy and Warsi, quoted above, but what makes it relevant here is that Gilluly admitted that "tectonics was assuredly no all related to plate motion and nor magmatism". Qureshy and Warsi (1981, p. 221) stated that "A number of geologic factors seem to cast doubt on the existence of a subduction zone along the Indus-Tsangpo Suture, so do the satellite and terrestrial gravity data". The deep seismic sounding profile (DSS) between Pamir and Kashmir (Belousov et al, 1980; Kaila and Narain, 1981) evidently proves that there is neither suture at Indus-Tsangpo Suture (ITS) Zone nor any subduction of the Indian plate beneath the Tibetan plate.

The Chaman-Ornach-Nal faults are not continuous and splay repeatedly, suggesting progressive *younging southward*. Had Greater India moved along it the younging would have been northward. What seems to be of utmost importance is that if the Indian plate has moved along the Chaman fault by as much as 1300 km and has underthrust Tibet by about 1500 km why is there no displacement along the Baluchistan coast? This was inevitable and hence is inexplicable, and does not fit-in with the plate tectonic concept. More importantly, Lawrence and Yeats (1979, p. 351) observed that the Chaman fault might have come into being in the Cretaceous, obviously *before* the speculated arrival of the Indian plate at the site. Of similar significance is the occurrence of ophiolites in the area that they occur to the east of the Chaman fault with one occurrence near Saindak (Baluchistan), to the west of it. If they represent the oceanic crust obducted on to continental crust, the occurrence should have been confined to the fault zone. Yet there is none along it, not a cubic centimeter of it. It is therefore inappropriate to connect the two features. Their occurrence on the Indian plate bespeaks of intrusion along tensional faults, and not of obduction.

It is significant that no deep earthquakes have been recorded from the Himalayan region; as also the Indus-Tsangpo Suture Zone is absolutely quiet. In fact Tibet is merely mildly seismic, with a well scattered activity, associated with recent faults, normal or wrench and rifts. Recently, Bai et al., (2012) concluded from tele-seismic waveform modeling of 97 earthquakes in central Tibet that earthquakes are restricted to the upper crust, typically shallower than 20 km, originate dominantly by strike slip faulting in agreement with low P wave velocity layers. In northern and southern Tibet, where the Asian and Indian plates descend beneath central Tibet, earthquakes appear to be distributed throughout the thickness of the crust and exhibit dominantly reverse faulting, strengthen above inference and refute the suggestions that earthquakes occur below the seismically defined Moho beneath the High and Tethyan Himalayas (Chen and Young, 2004). There is no evidence of a progressive deepening of the earthquake foci with the plunging crust as reported from the Andes region. Kaila and Narain (1981) analyzed ten earthquakes covering the entire length of the Himalayas and noted that the seismic plane progressively became steeper from about 30° in Assam to about 70° in the Pamir area. Deep seismic profile (DSS) has suggested that *all* the faults in the Pamir and Kashmir region are near vertical (Belousov et al, 1980). Similarly, Bird and Toksoz (1977) analyzed six earthquakes in the Tibetan region and concluded that the lower-most part was molten and that "The inferred high temperature of the Moho is inconsistent with the crustal thrusting model for the formation of Tibet". Recent geophysical studies support the existence of a partially molten layer in the middle and lower crust beneath southern Tibet and the Himalaya (Caldwell et al., 2009; Sheehan et al., 2014). Surprisingly, underthrusting of the Tibetan area is believed to be still in progress in spite of all arguments to the contrary. Thus, theories as well as available evidence are unequivocally against suturing and underthrusting.

Pascoe (1964), Ahmad (1971), Pande and Gupta (1974), Wang et al., (1982) and Raiverman (1992) have pointed out that all the known terraces and pane-planes in the Himalayas are nearly horizontal, or very nearly so and undoubtedly means vertical uplift. Wang et al., (1982, p. 554) recorded that the Survey of India has been carrying out leveling operations in northern Himalayas for the last 75 years. This has revealed that the area north of the Main Boundary Fault (MBF) is being uplifted at the rate of 4-5 mm/year and that the Ganges basin is downwrapping. This, indeed, is a very rapid rate of uplift. They believed, accordingly, that the Himalayas are being uplifted at an average rate of 0.6 mm/year relative to the Ganges basin and that this rate is higher than that of the vertical uplift of Tibet by about 0.2 mm/year. It would suggest that 2.0 Ma Tibet must have been higher than the Himalayas. Similarly, Pande and Gupta (1974, p. 55) concluded that "The area was vertically uplifted" for the Pleistocene lake deposits near Tibet border are entirely horizontally bedded, even though they have apparently been uplifted by several thousand meters. Wolfe (1975, p. 26) stated that "The Himalayas quiet clearly represent a series of uplifted blocks, but evidence of horizontal compression outside the blocks is quiet lacking". Crawford (1974, p. 374) and Raiverman (1992) observed that the uplift of the Nanga

Parbat, 8200 m high, is very young, “certainly Pleistocene”. Whittington (1996) estimated the uplift rate of Nanga Parbat to be between 3-4 mm/year.

Far more significant is the evidence, discussed recently by Khan and Tewari (2016 b), of faunal and floral distributions which leave one with no doubt that the northern and the Gondwana supercontinents atleast from early Paleozoic time, were not even separated from each other till ocean floor spreading began in the Triassic split them apart. The ligation between India and the northern continents was obviously continental and wide. The Tethys was epicontinental, transgressing and regressing, lasting at least from Cambrian to Cretaceous. It was still receding in the Eocene. At no stage it was oceanic across its entire width, although narrow belts across this sea became geosynclinals in character in the process of crustal evolution. These geosynclinals brought-in deep sedimentation, voluminous outpouring of lavas, granitic intrusions and batholiths, but rest of the sea continued as incursive. Kamen Kaye (1972, p.1990) opined that “In terms of a pre-drift configuration not only the Tethys, but discrete eastern and western oceans would be largely irrelevant”. But in the plate tectonic terminology, the term “geosynclinals” is “redundant” (Sengor and Burke, 1979). Yet, an oceanic Tethyan gulf on any reconstruction undoubtedly a misfit – can only be made to disappear on a globe of a smaller diameter (Carey, 1982; 2000; Owen, 1976; 1982; Maxlow, 2005) implying Earth expansion.

The Main Boundary Fault (MBF) is an important feature of the Himalayan region. Kumar et al, (1970) and Valdiya, (1992, 1998) concluded from geological study that far from being a thrust boundary, it was high angled, along which uplift had been near vertical; the faults are old and have been reactivated. Crawford (1974, p. 380) believed that the Himalayas were formed by block faulting, started in the Jurassic. They are horsts, like the Transat Arctic Mountain or the Andes. Indeed, block faulting has been recognized from the Thakkhola region of Nepal (Barale et al., 1978; see also: Dhital, 2014), from the Spiti area of India (Wadia, 1975) and elsewhere. Belousov et al, (1980) studied the lithosphere by deep seismic sounding in the Tein Shan-Pamir-Karakoram-Himalayas, right from the Pir Panjal ranges in Kashmir to Kirgiz Pass and noted that every single fault is vertical or nearly so. Belousov et al, (1980, Figure 3) further depicted this structure and several of the faults are deep, entering below the Moho, over 60 km in depth. Kaila and Narain (1981) stated that “the Himalayan Mountain is formed due to block uplift against steep angle faults, and not due to collision of continents neither of Indian and Asian plates (Jain, 2014) nor, by underthrusting (Ahmad, 1987; Raiverman, 2002). Molnar (1988) pointed out that the depth of the Moho is about 75 km beneath the southern edge of the Tibetan plateau, the Greater Himalayas and the Indus-Tsangpo Suture zone, seems to be well established. Thus Molnar (1988, p.81) further stated that in the north central Tibet there is an area of few thousand kilometer in diameter in which the thickness of the sediments appears to be only 50-60 km compare to 70 km over the Tibetan plateau in general. This suggests that crustal thickness is not due to underthrusting but due to sedimentation in a downwrapping basin of uneven depth.

Early generalizations regarding the Himalayan tectonism were based on the Alpine tectonism model. The breakthrough came when it was realized that the Himalayan sediments were not geosynclinals (Gansser, 1966, 1991; Ahmad, 1968; Wadia, 1975; Valdiya, 2015). Himalayas are, therefore, unlike the classical mountain ranges such as Caledonian, Hercynian, Alpine, Urals or Aravallis. Having, thus, ruled out a geosynclinals origin and hence extensive block faulting, the only option available was vertical uplift. As discussed above on various lines of evidence, it seems the motive force was provided by batholithic intrusions, boudins and basic magma mobilization. Much attention has been given to this approach (Belousov, 1968; Carey, 1976; Ahmad and Ahmad, 1981; Raiverman, 1992, 2002; Valdiya, 1998 and many more) whenever the commitment was not to plate tectonics and it's speculative, often unsupported interpretations. Thus, Crawford (1974) concluded that the Himalayas were formed intra-continentially along a zone within the Indo-Tibetan unit whereas, Russian geologists, also insisted that the Himalayas, like Tein Shan, are epi-platform in origin. Indeed, there are no mountains in geological history that was genetically similar to the Himalayan-Tein Shan-Kun Lun-Altai etc. group of central Asian ranges, because of their unprecedented height, become doubly unique. Thus, the Himalayas may be the first mountain range on the face of Earth, the others in history, interpreted as mountain in the past or those in existence, were comparatively puny, block-faulted horsts. This suggestion takes care of all available lines of evidences in all their details, but Smith (1971, p. 2040) admitted that “These inferences (based on plate tectonic concept) and speculations are meant to be assessed on the scale of the diagram 1: 10, 000, 00 or more rather as if the area is viewed from a space craft. On this scale many of the contradictions of field geology are invisible – for example, an area of 100 km² is reduced to one mm². This is the scale on which an internally consistent theory of plate tectonic has been set up and verified” or that (Smith, 1971, p.2041)” Some geologists may be unwilling to accept these conclusions because they appear to be inconsistent with field observations”. To plate tectonicists these inconsistencies are, indeed, of no consequences, but what purpose does a hypothesis serve unless it fits in with the minutest details geologist observes in the field? Shield (1997, p. 960) has pointed out that “the success of any scientific theory is not measured by being in fashion or by how many followers but whether it can stand up to the test of time.

III. Conclusions

The above discussion provides evidence to suggest that the speculations based on new global tectonics are doubtful. Thus, it is pointed out that the Chaman fault has several breaks along its length; splays repeatedly, show progressive younging towards the south and then take a sharp turn to the west long before reaching the coast. The *en echelon* Ornach-Nal fault also takes a turn to the west and so do *all* other associated faults, bespeaking of oroclinal rotation. In fact, no faults cut across the coast to join the Owen Fracture Zone. This cannot be reconciled with a long migrated Indian plate having sutured with the northern plates – Angaraland and Cathaysia. Moreover, whereas all the faults are sinistral, the Owen Fracture Zone is dextral and has displaced the Carlsberg Ridge dextrally in the Gulf of Aden. Also, the close match of geology on either sides of the Chaman fault indicates a 200-300 km displacement; moreover there is no break in the coastal outline of Baluchistan that would certainly have been there if the Indian plate had migrated along the Chaman-Ornach-Nal faults. It is still supposed to be moving yet the coast remains undisturbed. Significant also is the fact that the Owen Fracture Zone stops short of the coast by 500 km and its place is taken by Murray Ridge, which has a distinct trend slightly to the east of Karachi, some 500 km away from the Ornach-Nal fault. Each of these features evidently does not support the suture zone concept.

Similarly, the Indus-Tsangpo Suture (ITS) has typical Gondwana glacial marine beds to its north, and the ophiolites are confined to a rift valley. The emplacement occurred in the Upper Jurassic –Lowest Cretaceous and, again in the Lower Cretaceous, some 50-60 Ma, prior to the envisaged suturing. Also the two magmas differ in chemical and physical characters and the suture zone ends both to the east and the west in mappable geological formations. Nor is it explained why the Himalayas, supposed to be the product of continent-continent collision, are about 500 km away whereas the beds close to the suture are hardly disturbed. It is, thus, suggested that the so-called Indus-Tsangpo Suture Zone (ITSZ) is a rift valley, initiated in the Triassic that became dormant in the Cretaceous soon after the magmatic emplacement. The magma has produced widespread contact metamorphism on both the Indian and Tibetan flanks and occasionally carries diamond, poissanite crystals and PGE and rare earth element too suggesting a deep seated origin and certainly not the obducted cold oceanic crust. Possibly it was an extension of the ‘Yunnan-Malay Geosynclines’ and the ophiolites are the eruptives within this rift.

Paleontological evidence is unequivocal that Gondwanaland has continued into Angaraland, Cathaysia and Laurasia from at least the Ordovician, and may be earlier till Pangaea started breaking up in the Triassic. There is no evidence and thus no justification for the assertion that India was ever separated from the northern continents. Therefore, there is no evidence for the concept of a wide Tethyan Ocean intervening between India and Angaraland. Also, it may be noted that the drift of India from southern to northern hemisphere, from around 60-80Ma to about 20 Ma, is supposed to have been the consequence of ocean floor spreading in the Indian Ocean. Yet, between anomaly 22 and anomaly 5 i.e. from about 60 Ma to past 20 Ma there was no ocean floor spreading activity in the Indian Ocean that could move India northward. However, the speculated movement is claimed to have continued unabated even thereafter. What force is moving India northward as of today is not specified?

On the other hand, the Himalayan sediments as also those in Kun Lun, Tein Shan and Altai etc. are admittedly non-geosynclinal and these mountains could not be genetically similar to the classical mountains ranges like the Caledonian, the Hercynian, the Urals or the Aravallis. Since they are not the result of compression either, the only alternative is the vertical uplift in a tensional regimen. Bouguer gravity, seismic (including DSS), geomorphologic studies and field observations indicate that the uplift is entirely vertical, perhaps aided by batholithic intrusions and basic magma movement. If so, the continent-continent collision origin of Himalaya, suture zone concept and phenomenon of the plate tectonics need critical and objective reappraisal.

Ahmad (1987) suggested that the area between the Indian Craton in the south and the Siberian Craton in the north downwrapped progressively from Ordovician to Triassic and accumulated platform type sediments aggregating about 70 km or more. As a consequence, widespread magma mobilization underneath may have resulted in the uplifted the sediments. However, the sediment pile was too thick to be so uplifted, yet the magma managed to tear the crust apart, to start with in the northern area. Later on the activity moved step by step southward till the Indus-Tsangpo Suture (ITS) had been developed. In the next step the area affected about 50 km of sediments and these were uplifted as the Himalayas. On the other hand, the possibility exists that as the Gangetic valley downwrapped, the displaced mantle material went to uplift the Himalayas on one side and the Vindhyan-Aravallis on the other, the former being more uplifted because of the thicker pile of sediments in the region and the support provided from the other side, Kun Lun, Tein Shan, Altai etc. did not receive this additional support and did not develop into Everest heights. There is no explanation so far for this step by step movement phenomenon but a parallel was pointed out by Ahmad and Ahmad (1980) from Peninsular India where tension zone resulting in normal faults and rifts moved counter-clockwise from Jurassic to the Recent. To

sum up, it seems reasonable to conclude that Himalayas are autochthonous, and has been born out of collision neither of two land masses nor of subduction.

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