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Tethys Subduction History in Caucasus Region

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ABSTRACT

Caucasus region is located in the center of Alpine-Himalayan orogenic belt. It is made of two Great and Lesser Caucasus fold thrust belts and an intramountain area called Trans caucasus or Mid caucasus. This region contains a system of oceanic crust subduction, island arcs, volcanic arcs, back arc basins and rifts. The earthquakes of 60 km in depth are the evidences of deep brittle zone under Great Caucasus. Without considering Prototethys, Paleotethys and Neotethys Oceans, the tectonic situation of this region is not possible to study. The oceanic lithosphere under oceanic lithosphere subduction made Trans caucasus containing a trans crust. The subduction of Prototethys under Baltic made Great Caucasus and the subduction of Paleotethys under Iran, made Lesser Caucasus. The earth sutures caused by the closure of Prototethys and Paleotethys Oceans are clear in the region. The direction of Paleotethys subduction in lesser Caucasus is a considerable issue. Most of the existing evidences prove the southward direction which is different from Paleotethys subduction in Alborz of Iran. The lithospheric type of Midcaucasus is different from Caspian. Midcaucasus plays the role of determining collision type in the region.

Keywords: Moghan; Tethys; Caucasus; Subduction; Gondwana; Baltic

1. Introduction

According to lots of authors, Middle East region contains 10 unites: 1) Helmend and Farah in Afghanistan; 2) Southwest Pakistan and southeast Turkmenistan; 3) Alborz; 4) Central Iran; 5) Sanandaj-Sirjan; 6) Northwest Iran (probably up to east of turkey); 7) Pontides (Turkey); 8) Taurides (Turkey); 9) Great Caucasus; 10) Lesser Caucasus. Lesser and Great Caucasus are located between Caspian Sea and Black Sea. They contain Armenia, Azerbaijan, Georgia, southwest Russia and northwest of Iran. With a high probability, the studies show that all ten terranes are separated from each other. Middle East is an obvious sample of mosaic tectonic. Most of these terranes are highly deformed and are involved in a wide tectonic belt between Eurasia, Arabia and India. Northwest of Iran, east of turkey, Armenia, Azerbaijan and around have different structural units related to their middle east tectonic. The classification scale does not let to study these smaller units. Midcaucasus is one of the unites studied in this article. Moreover, by combining the new and old information, we tried to make an almost complete history of Caucasus tectonic.

In the other hand, according to some of the authors, in Iranian geological classifications the northwest part of this country is considered as a part of central Iran and according others is considered as a part of Alborz.

The tectonically differences between Gharedagh and Moghan with other parts of Iran, made us to study the history of Caucasus which later can be used in reclassification of structural unites of this country. Also, according to some of the researchers believing Caspian oceanic lithosphere and Black Sea are trapped, more study on Midcaucasus is required since it seems to have an important effect on lithospheres trapping.

2. Three Tethys Oceans

The structure interpretation of Caucasus is impossible without Tethys Oceans. Therefore, Tethys and the related expressions are going to be described in advance. According to geology, Paleobiography and paleomagnetism information, great longtime horizontal displacements occurred on Caucasus terranes before they could join to each other in a fold-thrust belt in Tethys Ocean [1-3].

During Paleozoic, the seaway developed in North of Middle East is called Paleotethys by some of the authors [4,5]. Some others called Prototethys Ocean (or Asian Ocean). The oceans in which Middle Silurian was created in the edges of Hun super terranes are called Prototethys [6-10]. The oceans created between Africa-Arabia (Gondwana) in middle Permian-Triassic called Neotethys

by most of the authors [8], Mezotethys [11], Pindose Ocean [12]. Ruban *et al*. [13] used Prototethys for early-Paleozoic Oceans while late-Paleozoic Oceans are called Paleotethys and Neotethys by them. Adamia *et al*. [14] used Prototethys Ocean for late Proterozoic, Paleotethys for late Proterozoic-early Paleozoic and Neotethys for Triassic-Jurassic.

In this study, the great ocean located between Baltic and Arabia-Africa is named Prototethys (the ocean between Great Caucasus and Trans Caucasus), Paleotethys is used for the ocean between Africa-Arabia and Trans Caucasus (the ocean between Trans Caucasus and Lesser Caucasus) and recent ocean located in Zagros-Bitlis is named Neotethys.

3. Caucasus Classification

Caucasus is located between the still converging Eurasian and African-Arabian lithospheric plates in the center of Alp-Himalayas orogenic belt. In late Proterozoic-early Cenozoic, this region belonged to Tethys Ocean and Eurasian and African-Arabian margins. Island arcs, active and passive continental margins and rifts existed in this region. Regarding crust type, we divide Caucasus into three blocks or terranes from north to south called Great Caucasus, Trans Caucasus and Lesser Caucasus (**Figure 1**). The common trend of Great Caucasus and Trans Caucasus is northwest-southeast, while it is approximately east-west for Lesser Caucasus in western part (near Black Sea) and it follows northwest-southeast direction in the central and eastern part. Golonka. [12] considered Trans Caucasus as a distinct unit. Rustamov [15] considered Trans Caucasus massif and south Caspian as a tectonic unit. Ruban *et al*. [13] considered Trans Caucasus as a part of Great Caucasus, and Adamia *et al*. [14] considered Trans Caucasus and Great Caucasus as a unique unit called North Caucasus.

4. Late Precambrian

According to Adamia *et al*. [14], before construction of Great Caucasus and Lesser Caucasus in late Proterozoic-early Paleozoic, there was a mass with undistinguished crust type called Trans Caucasus. Aiming to reach to depth of 15,000 meter, the Russian Science Academy designed an ultra deep well in Saatlee region, where Aras and Kura rivers get connected. Reaching to the depth of about 8000 meters, they could gain accurate information of underneath rocks. According to our classification, this well was located in Trans Caucasus. The results of petrochemical and geochemical studies of volcanics beside the distribution data of rare elements in these deposits showed that these volcanoes similar with island arcs, had been originated from Calsic-Alkaline magmas [16]. The Trans Caucasus basement rocks belong to Late Proterozoic-Early Paleozoic. The studies of igneous masses in Trans Caucasus gave them the characteristics of island arcs [14]. Saatlee well contained some kilometers of

Figure 1. Physical map of the Caucasus and adjacent areas of the Black Sea-Caspian Sea region [14].

Mesozoic sedimentary and showed a very important hiatus in sedimentation of late Cretaceous to Miocene [17]. They could distinguish some volcanic complexes in this region. One of them is the wide developed sedimentary-volcanic series in 4784 meter with Basalt, Andesite, Dolerite and Diorite during early-middle Jurassic. Two others are the developing of these series in 390 meter during late Jurassic and in 320 meter during late cretaceous with Carbonate and Basalt.

For the creation of Trans Caucasus with old basement rocks, we suggest a subduction inside Prototethys Ocean and using Adamia *et al*. [14] studies, a south direction is assumed for the subduction (**Figure 2**). This subduction is the reason of the construction of island arcs which are considered as the initial core of Trans Caucasus. As a transferring crust, Trans Caucasus didn't have a remarkable extension. According to petrochemical studies of Adamia *et al*. [14] the region was made of volcanic and plutonic rocks in late Paleozoic, which shows the characteristics of island arcs. Prototethys was separated into two north and south parts in this period. The melted oceanic crust of Prototethys sounds to have a rift step in southern part which was later the cause of Paleotethys construction. Paleotethys ocean had been opening between Trans Caucasus and Africa-Arabia from late Proterozoic up to early Paleozoic while Prototethys Ocean had been closing between Trans Caucasus and Baltic (**Figure 3**).

The subduction direction of Prototethys was two-sided in the beginning (under Trans Caucasus and under Baltic). Then, while the subduction direction was enhuncing to north it was diminishing to south (**Figure 4**). The main reason came from the density difference between three oceanic plate, Baltic continental plate and Trans Caucasus plate and oceanic plate. Except granitoid massifs penetration inside Trans Caucasus, there are no clear indications about south subduction among available data [14,12].

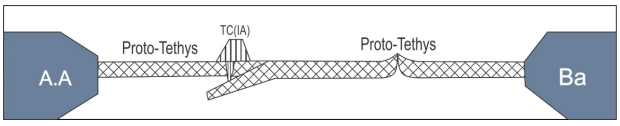

Figure 2. Schematic section of Baltic (Grate Caucasus), Mid Caucasus and Africa-Arabia super continent (Lesser Caucasus) Locations in late protrozoic and intra ocean subduction. (GC: Grate Caucasus, TC: Trans Caucasus and AA: Africa-Arabia super continent).

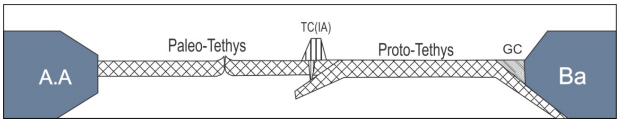

Figure 3. Schematic section of Midcaucasus, prototethys and paleotethys locations in 600 - 800 Ma. Two-sided subduction in Prototethys.

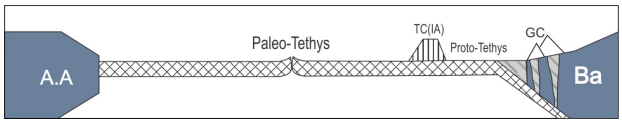

Figure 4. Schematic section of Paleotethys development and Prototethys subduction under Baltic and Great Caucasus. As a single arc with transcrust, Trans Caucasus is approaching to Great Caucasus. Due to inadequate compression caused by reduced Paleotethys development, Under Trans Caucasus subduction is decreased (400 - 500 Ma).

While there are many available signs confirming the northward Prototethys subduction under Baltic which caused Great Caucasus. Ophiolites and Metaophiolites of Great Caucasus confirm this fact. Northward subduction is corroborated by Brunet *et al*. [18], Allen *et al*. [19], Adamia *et al*. [14]. The data obtained from surveying the epicenter of 1973 up to 2012 earthquakes show that at least 20 earthquakes with more than 60 kilometers in depth happened in the center and north of Great Caucasus. Considering the thickness of the crust in Great Caucasus (60 Km [20] and 55 Km [16]), we come into conclusion that a thick skin tectonic happened in the region.

5. Paleozoic

Matching the sedimentary cores show that most of the mosaic terranes of Middle East in Paleozoic have a same origin. Middle east was affected by the evolution of Paleozoic Tethys Oceans, Hun and Cimmeria superterranes and Pangea and Gondwana super continents [8-10,21-28]. Three important rifts of Paleozoic through Gondwana and Pangea borders are discussed in the model presented by Ruban *et al*. [13] for Middle East. When Avolunia and Gondwana were separating from each other in early Ordovician, the first rift happened. Since this rift is 6000 kilometers away from the region, it can not affect Middle East. The second period goes back to middle Silurian which contained the division of Hun superterranes. Since some parts of super terranes contain tectonic units of Middle East, this division can affect the region. Permian-Triassic is the third period in which some Cimmeria Middle East terranes were separated from Gondwana or part of Pangea. According to Sharland *et al*. [4] and Stampfli *et al*. [7] in Paleozoic up to middle Permian-Triassic (when Cimmeria started to separate and construct Neotethys), the region of Middle East is interpreted like passive Gondwana and Pangea margins. Moreover, two regional unconformities are detected. The first one is the absence of middle Silurian up to middle Devonian (middle Paleozoic hiatus) which sometimes is matched with Caledonian orogeny [29]. The second one contains the absence of middle carboniferous which usually is matched with Hercynian orogeny [30]. This match can not be considered as a model of Paleozoic plate evo-

lution in Middle East, because their locations are in a great distance from the listed orogenies.

Paleozoic tectonic configuration of Middle East is determined by three Gondwana, Lurasia and Pangea super continents [7-10,24,31-35].

In the Middle East model presented by Ruban *et al.* [13] three proto, paleo and neo Tethys Oceans are considered in Paleozoic period beside Great Caucasus and Lesser Caucasus. They put Prototethys between Lurasia and Hun while Paleotethys is put between Cimmeria and Hun in the model. Considering the facts that Great Caucasus is a part of Hun and Lesser Caucasus with Trans Caucasus are parts of Cimmeria, hence just one subduction can be presented for three Caucasus terranes collision. This model is not compatible with our studies because at least two Ophiolitic sequences, one in Great Caucasus and the other in Lesser Caucasus are observable. Thus, according to the distance between two Caucasus areas and the age difference of the Ophiolites, at least two subductions in two different oceans (proto and paleo Tethys) are considered to Caucasus evolution (**Figure 3**).

Great Caucasus is now located in south of Russian platform [36,37] and the Paleozoic sedimentary complexes are outcropped in central mountains of it [38]. About 4500 kilometers of volcanic and pyroclastic rocks had been sedimented in middle and late Devonian up to Famenin [39]. Periodic volcanic activities can be a sign of tectonics existing between Great Caucasus and other Hun's terranes. Magmatic activities are related to the closure of Rheic Ocean [8]. Following the Tawadros *et al.* [37], Ruban *et al.* [13] considered Great Caucasus as a subset of Hun superterranes and probably its cordillera. Before Hun's breakage, the location of Great Caucasus in early Paleozoic is not exactly determined. But without any certain information, Tawadros *et al.* [37] located it in African-Arabian margin. Great caucuses were located beside the east of Hun Cordillerain middle Paleozoic. It moved to west by strike motions in north of Paleotethys breccia zone in carboniferous-middle Triassic and in late Triassic-early Jurassic to east. Late Paleozoic breccia zone up to Mesozoic also developed along the southern margin of Lurasia and joined to one of the breccia zones inside Pangea [5,8,27,37,40-46]. In Paleozoic period Great and Trans Caucasus had the tectonic characteristics of the volcanoes up subduction zone and the penetration of Granite brought deep regional metamorphism, deformation and orogeny [14].

Northward subduction of Paleotethys under Trans Caucasus along with ignesious materials (caused by partial melting of oceanic crust) penetration affected Trans Caucasus and reduced the density of island arc transcrust. (**Figure 5**).

Lesser Caucasus is now located in south of Great

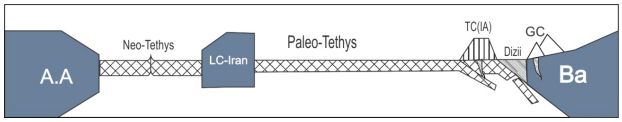

Figure 5. Schematic section of Neotethys opening, Paleotethys subduction, and Trans Caucasus and Great Caucasus collision. A slab of subducted lithosphere is plotted According to the depth of earthquakes (320 Ma).

Caucasus and north of Iran and Turkey. The interpretation of paleomagnetism and Paleontology data show that [47,48] Lesser Caucasus is apparently a separated terranes. Lesser Caucasus along with Cimmeria is separated northward. Ruban *et al*. [13] suggested that lesser Caucasus was part of Cimmeria. They also concluded that the ancient location of Caucasus was the margin of Gondwana or inside the two remaining super terrans of it. Lesser Caucasus was also considered as a part of Gondwana in Paleozoic [14].

Some slices of oceanic crust (Ophiolite) and trans crust are added to the easternmost part of Europe in late Paleozoic (middle-late carboniferous) [49-51]. The southernmost strip of Great Caucasus crystalline core is determined by metaophiliotic thrust slices [52,53]. These Metaophiolites contain ultrabasic rocks, Gabro-Amphi-boliteand Mica schist, Plagioclase gneiss and Marble. The amphibolite facieses show a high and medium pressure metamorphism. The metaophiolites of Great Caucasus are dated to late Devonian-early Carboniferous which is simultaneous with the closure of Prototethys and complete extension of Paleotethys. This is the reason of Trans Caucasus and Great Caucasus collision in that period because according to our interpretations, the Trans Caucasus crust is a kind of transferring crust. (**Figure 5**).

5.1. The Evidences of Trans and Great Caucasus Collision

- Thrust metaophiolitic slices in southernmost part of Great Caucasus.
- Amphibolites facieses and middle and high pressure metamorphism.
- Slices of oceanic and transcrust addition to easternmost part of Europe in late Paleozoic especially in middle-early carboniferous.
- I and S type Granites from south to northand after Ophiolitic belt in Great Caucasus that represent subduction and collision depression.

Conodonts containing slices of lime exist in Lesser Caucasus Ophiolite belt in middle carboniferous-Permian. They are visible in Gharabagh [54]. It shows that Paleotethys Ocean wasn't closed in that period. The ophiolites of Paleozoic also are known in Rasht [55,56] Alborz and Binalood [57,58].

6. Mesozoic

Oceanic subduction, obduction, addition of small lithospheric plates and other later motions in Caucasus mostly happened from late Cretaceous to Eocene [8,59]. Some Microplates were attached to Eurasia margin and caused Paleotethys closure during late Triassic-early Jurassic. The northward subduction boundaries developed along this new continental margin in south Pontaides, south Trans Caucasus and Iran. Lesser Caucasus, Sanandaj-Sirjan in Caucasus-Caspian region were joined to Iran during late cretaceous [12]. Lesser Caucasus contained dolomite, Marl and sandstone in Triassic. Trans Caucasus and Great Caucasus are presented by shallow coal containing deposits. The deposits of Jurassic and early cretaceous are rare in Lesser Caucasus. Meanwhile late cretaceous period is wide in this area and shows shallow sea constructions containing clay, Trijenous, organic, sandy-clay and marl Limestones. The sediments of Great and Trans Caucasus contain thickness of 12 - 15 kilometers from Jurassic up to Paleocene. They are deformed: Isoclinal folds, over thrust and thrust, Boodinage, cleavage and small scale nappes.

Rolland *et al* [60], considered lesser Caucasus as an ocean region with a slow expansion in early middle Jurassic. The northwest Armenia Ophiolites of upper middle Jurassic up to late cretaceous confirms the developing of Lesser Caucasus oceanic crust in this Time [61]. Some slices of Paleotethys crust along the southern border of Trans Caucasus and inside the Ophiolite Sevan-Akra complex in Pontaides are visible [14]. Also the evidences of Paleotethys crust are outcropped in Iran, Garabagh and east Lesser Caucasus [15]. Studying the Sevan-Akra Ophiolites shows a complete circle of Ultramafic-mafic. They are generally dated to upper-Triassic and in northwest Armenia show late Cretaceous. Trans Caucasus was an island-arc unit which moved upward in Triassic up to Eocene [14]. Sevan-Akra Ophiolites are two types: Telloeitic and Benonitic. Both of them show a complete Ophiolite sequence. Ur/Pb dating of Benonites gave an age of 160 Ma. The petrochemical and geochemical data show that the Telloeitic sequence of Sevan-Akra has an origin of up subduction [62]. Studying Jurassic Ophiolites in Armenia show ocean remaining Ophiolite rocks and also show arc type volcanic rocks which are probably from upper cretaceous [63]. Studying Radiolarites of Ophiolite volcanic rocks in three regions of Armenia (east Sevan Lake, northwest Armenia and center of Armenia) suggests the age of middle-upper Jurassic and lower cretaceous. K/Ar dating of Amphibolite-Gabro Ophiolites of Sevan-Akra by Galoyan *et al*. [63] gave the age of middle Jurassic for them.

Paleotethys, the ocean between Trans Caucasus and Lesser Caucasus, was closing and subducting under Trans Caucasus and Iranin Mesozoic period. But still no collision happened up to the end of Mesozoic between Trans and Lesser Caucasus. The Neotethys Ocean was created and expanded behind Lesser Caucasus and between central Iran and Arabia in the time of middle late Mesozoic. It accelerated the northward subduction of Paleotethys (**Figure 6**).

There are several different ideas about the direction of Paleotethys subduction. According to Alavi. [64], Trans Caucasus (Moghan) is part of south Caspian oceanic plate and the subduction is northward. According to Sengor, Yılmaz. [59], Rice *et al*. [65,66], the direction along the sutures of late Mesozoic is to north. Adamia *et al*. [67], Sengor, Yilmaz [59], Boztug [68], believe that the great thickness of the arc type igneous rocks located on east pontaides crust show northward subduction of Tethys. Vernant *et al*. [69], Adamia *et al*. [14] consider the direction to north and Golonka [12], Ruban *et al*. [13], Hisarli [70], consider it to south. The southward subduction is also presented by Kozur [71] and their followers [72,73]. Brunet *et al*. [18] believe that during early Eocene, the subduction zone was southward from Lesser Caucasus up to Iran, and during late cretaceous and early Paleocene, the result of this subduction was the appearance of south Armenia and probably Sanandaj Sirjan. According to all field observations, economical geology and tectonic relations, along with evidences like Gharadagh and Sevan and Akra Ophiolites, we assume the southward subduction under Iran for Paleotethys Ocean (**Figure 6**).

7. Cenozoic

As the rift of carboniferous-early Permian, Neotethys Ocean was constructed in Cimmerid plate during Permian period [74,75]. This ocean located Great India and Australia in one side and Loot, Farh, south of Pamir, Giantang and Southeast Asia in the other side [12].

The oceanic lithosphere subduction under Lesser Caucasus finished at the end of cretaceous. After Ophiolite obduction in Conyaceane [76], the Sevan-Akra suture was constructed in late cretaceous or Paleogene [77]. As a result, the south Armenian continental terran (Lesser Caucasus) got added to the Trans caucasus block [18]. According to Bronet *et al*. [18], after Sevan-Akra Ophiolite obduction [76] at the end of cretaceous, the down Lesser Caucasus subduction zone got locked. The age of Lesser Caucasus and Eurasia collision is dated to 71 -

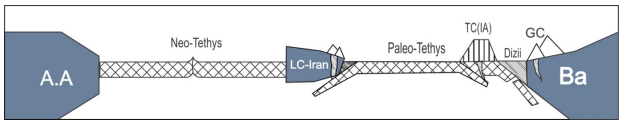

Figure 6. Schematic section of Neotethys development simultaneous with two-sided subduction (as south Caspian) under Lesser Caucasus and Trans Caucasus (65 - 205 Ma).

73.5 Ma by [60]. It is considered as an arc-continental collision by them. At the end of cretaceous or in Paleocene, Lesser Caucasus and probably Sanandaj-Sirjan and Makran joined to Transcaucasus-Talish-South Caspian-Loot system [12,77,78]. According to the unconformity of limestone, the age of the ocean closure and the sutures constructions in lesser Caucasus are dated to upper Conyaceane, late cretaceous. While according to Rolland *et al*. [60], this period belongs to Ophiolites obduction. They probably assumedeast of Ismir-Ankara-Irzinjan suture as the Sevan-Akra suture's developing direction. They also considered that the age of lesser Caucasus Ophiolites formation in Armenia was compatible with Sevan Ophiolites age.

Some authors believe that Oligocene was the start of collisions in Caucasus extension [79,80] (**Figure 7**). Great Caucasus, Talish and Lesser Caucasus mountains were constructed at deep basins in this period. By the start of late Miocene up to the end of Pleistocene, volcanic eruptions with surface conditions happened in the central part. Trans Caucasus was separated in to two parts in Peliocene, Drizola dependant on Black Sea in west and Kura dependant on Caspian Sea in east (**Figure 8**). Except some small terranes, whole Caucasus emerged from water in late Sarmatiane [14]. The Ophiolites of Lesser Caucasus are mostly represented by blue shiest and metamorphosed rocks with amphibolite facies [81].

At the central parts of Caucasus, volcanic eruptions with coarse clastic formations happened in lands in Miocene up to the end of Pleistocene [14]. The amount of different marine fossils in middle Miocene proves that Trans Caucasus was in relation with free water.

8. Discussion and Conclusion

South Caspian is considered as trapped remaining Paleotethys by some of the researchers [82] (**Figure 8**). Also Priestley *et al*. [83], consider it as a rigid unseismic block. The history of pre Paleocene is not clear enough and its boundary with south Caspian is not accurately determined [19]. East of great Caucasus is assumed to be affected by westward motion of south Caspian and shortening caused by Arabian-African convergence with Eurasia [19].

The formatting process of Today's structures (**Figure 9**) (high Caucasus Mountains, intramountain embayment and high volcanos) in this region especially were enhunced from late Miocene. Simultaneous and post collision horizontal shortening caused by northward African-Arabian plate motion is estimated to hundreds of kilometers. By several methods this remarkable shortening of the earth crust can be justified: 1) Crust deformation along with depressional structures, folds and thrusts developing; 2) slope and displacement of crust blocks along with uplifts, subductions and under thrusting (a process which occasionally is called continental subduction) and 3) Escape tectonic. The northwest Caucasus and Kura tectonic is converted to divide slab subducted tectonic from an indentation tectonic. This demonstrates a rearrangement of deformation zone [84].

According to GPS studies along Great and Lesser Caucasus mountains [85], the least north-south ward shortening rate is specified to be 10 ± 2 mm per year, which

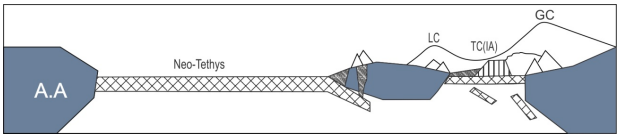

Figure 7. Schematic section of Caucasus collisions and Neotethys subduction and formation of Caucasus folded mountains. (Oligocene). Neotethys closure caused pressure increase which along with the pressure of Arabia made thrust faults in Caucasus folded belt. It is related to post Neotethys closure period. Locating two oceanic crusts on each other in Trans Caucasus justifies the crust thickness in this region.

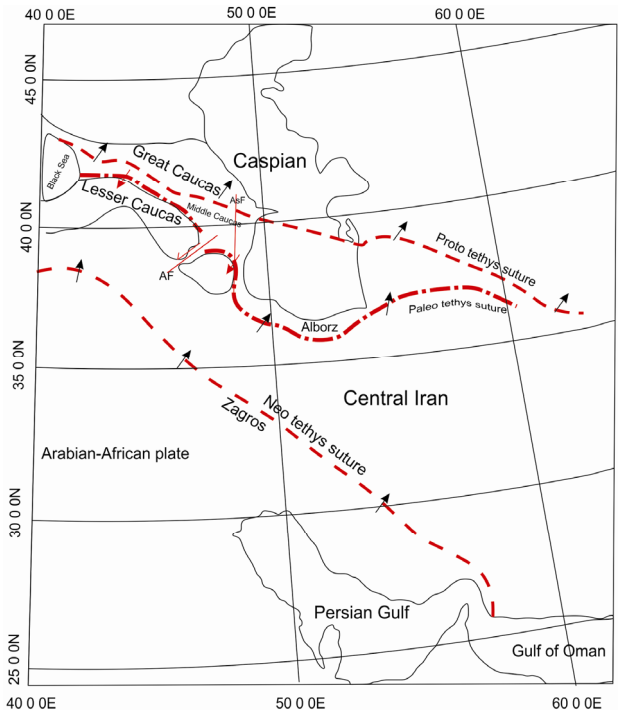

Figure 8. Present location of Tethys and Caucasus cracks. (Subduction directions are indicated by black arrows).

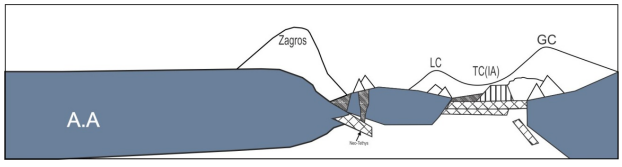

Figure 9. A schematic section from present location of African-Arabian plane, Lesser Caucasus, Great Caucasus and Trans Caucasus after Tethys closures.

60 percent of it is estimated to happen in Great Caucasus [86]. Seismic data show that the Velosity of P and S waves in Talish, under Kura and under south Caspian is high while it is low in west of Kura in Armenia, south of Talish and Alborz [84]. The under Kura high speed anomaly is attributed to an oceanic crust by Zonenshain &Le Pichon [87].

8.1. The Following Results Can Be Obtained in a Summary

Today's basin of Moghan was a part of great Kura-Aras basin and was constructed between two Caucasus regions. Considering tectonically, it is a part of Trans Caucasus and is located under Kura basin. The depth of Moho in Kura varies from 45 to 60 kilometers.

Paleotethys Ocean is located between Great and Lesser Caucasus. Its signs are visible in Iran, Turkey and Armenia. Prototethys Ocean is located between Great and Trans Caucasus with evidences in Great Caucasus. The oceanic subduction in Prototethys constructed island arc Trans Caucasus. The Prototethys subduction under Baltic caused Trans Caucasus and Baltic collision and consequently construction of Great Caucasus. The Paleotethys subduction caused Great and Trans Caucasus collision with northwest margin of Iran and consequently construction of Lesser Caucasus.

The subduction direction creating Great Caucasus was to north and the direction creating Lesser Caucasus was to south. In addition to mentioned signs of southward subduction, some other evidences can be discussed. On one side of Paleotethys, Transcaucasus crust was located and in the other side, Iranian-Arabian continental crust existed. Thus, the excessive density of Iranian-Arabian crust and Paleotethys in comparison with Transcaucasus crust and Paleotethys made southward subduction.

Deep seismic data confirm that in Great and Lesser Caucasus tectonic region change from thin tectonic to thick skin tectonics.

Lesser and Trans Caucasus are poor in deep earthquakes but had surface destructive ones. Deep earthquakes mostly happen in Great Caucasus, Caucasus boundaries and east of this region. Earthquakes in east probably show that brittle section of south Caspian crust is deeping.

Great, Trans and Lesser Caucasus collisions were harder in the center of Caucasus (Armenia region), while it was slight in east and west (Black Sea and Caspian Sea). The reason can be the low distance of Great and Lesser Caucasus in Armenia rather than margins. It illustrates an indentation tectonic. Another reason can be the more expansion of island arc Transcaucasus in east and west which acts as a barrier of Iran penetration to north and Eurasia. If this assumption is considered to be true, this theory can be mentioned that south Caspian and Black Sea crusts are the trapped basins of Iran Eurasia collision.

With more than 1000 km length, the Izmir, Ankara, Arzanjan suture separates Eurasia from Gondwana. This suture limits to Sevan, Akra, Gharabagh, Talish, Rasth and Binalood from east. It is a sign of Paleotethys.

Trans Caucasus is full of hydro carbonic resources. Old crust, thick sediments and igneous intrusions made proper conditions for hydro carbonic formations.

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