J. Basic. Appl. Sci. Res., 1(11)2394-2400, 2011

ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

Cenozoic Diastrophism and Deformational Events in the East -Central Alborz

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ABSTRACT

In this paper, diastrophic movements of the Cenozoic in the East - Central Alborz as the main cause of the formation of structural features are introduced, described and compared with known movements in the global scale.
Therefore, we have introduced several diastrophic movements on the late Eocene-early Oligocene, Late Oligocene-early Miocene, Lower Miocene, Middle Miocene, Late Miocene-early Pliocene, Late Pliocene-early Pleistocene, middle Pleistocene, Late Pleistocene and Holocene time ranges.
Finally, five dominant orogenic phases and four deformational events in Alborz Mounting building processes have suggested.
KEY WORDS: Diastrophism, Cenozoic, Alborz, Deformation, Collision.

INTRODUCTION

Diastrophism is a type of crust movements which is the result of internal forces of the earth. In this way; we can consider the orogenic and epirogenic movements as the most important diastrophic movements.

Recognition, division and determining the history of paleogeography is the most important purpose in tectonic studies. So, in this paper, based on the analysis of the observable structures and the Geologic time tables (Hag & Vaneysinga ,1987 and Gradstein & Ogg,1996) and also orogenic phases suggested by Jackson and Bates (1997), extensive Cenozoic diastrophic movements in studied area, are introduced, described and compared with recognized movements in global scale.

Morever, in this paper, it is tried to specify the time correspondence between extension and stretching phases of Red Sea with the movements of this area. Before that, the diastrophic movements related to time range before Cenozoic is briefly introduced. These movements are proposed based on paleontology and stratigraphy considerations done by Geologic Survey of Iran:

-Ambiguity and changing the metamorphism age of the Gorgan Schists from Precambrian (Stocklin, 1968) to late Triassic (Alavi, 1996) caused that, Pan African orogenic equivalent movements in Alborz did not to be clear. Relative concordance of Kahar and upper Precambrian formations are also refereed to the weak result of mentioned movement.

-The sedimentary gaps of upper Ordovician, Silurian and lower Devonian in Alborz can shows the orogenic equivalent movement of Caledonian.

- The sedimentary gap of upper Carboniferous in Central Iran and Alborz can shows the orogenic equivalent movements of Hercynian.
- The sedimentary gap of upper Triassic in Central Iran and Alborz can shows the orogenic equivalent movement of early Cimmerian.
- The sedimentary gap of lower Cretaceous in Central Iran and Alborz can shows the orogenic equivalent movement of late Cimmerian.
- The sedimentary gap of upper Cretaceous in Central Iran and Alborz can shows the orogenic equivalent movement of Austrian.
- Placing the Fajan formation on deposits from upper Cretaceous or older as angular unconformity can shows the orogenic equivalent movements of Laramian.

Also, according to Arian and Pourkermani(2004), creative and activities of the fault systems in a sinistral displacement shear zone that had been elongated from south Semnan to north Gonbad – e Kavus was suggested as a cause to forming of above curvatures and thinning of Alborz width(Fig1) at north

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Bastam. Therefore, deformation in this region is a combination of compressional and left – lateral strike slip components that (Transpression) demonstrated by field evidences and focal mechanism solutions.

Geographic location of the area

This area has the extent about 46390 km² from east of Tehran to north of Shahrod(Fig 2). From the view point of civil portions, this area is placed in Tehran, Semnan and Mazandaran provinces, but based on geological divisions it includes the East-Central Alborz. So, regarding to convergence of Arabia and Eurasia plates, this area is compressing and extending like other pointes of Iran.

This process is confirmable by extensive presentation of folded and thrusted structural features.

1. Late Eocene-Early Oligocene movements

In this area, after late Cretaceous movements, a period of compressional reduction and erosion phase is continued and followed by depositing the base conglomerate of Fajan formation from Paleocene-Eocene. Generally, from this time submarine volcanic activities are occurred in shallow sea during sedimentation, but from middle-late Eocene, it is replaced by land basin in Oligocene.

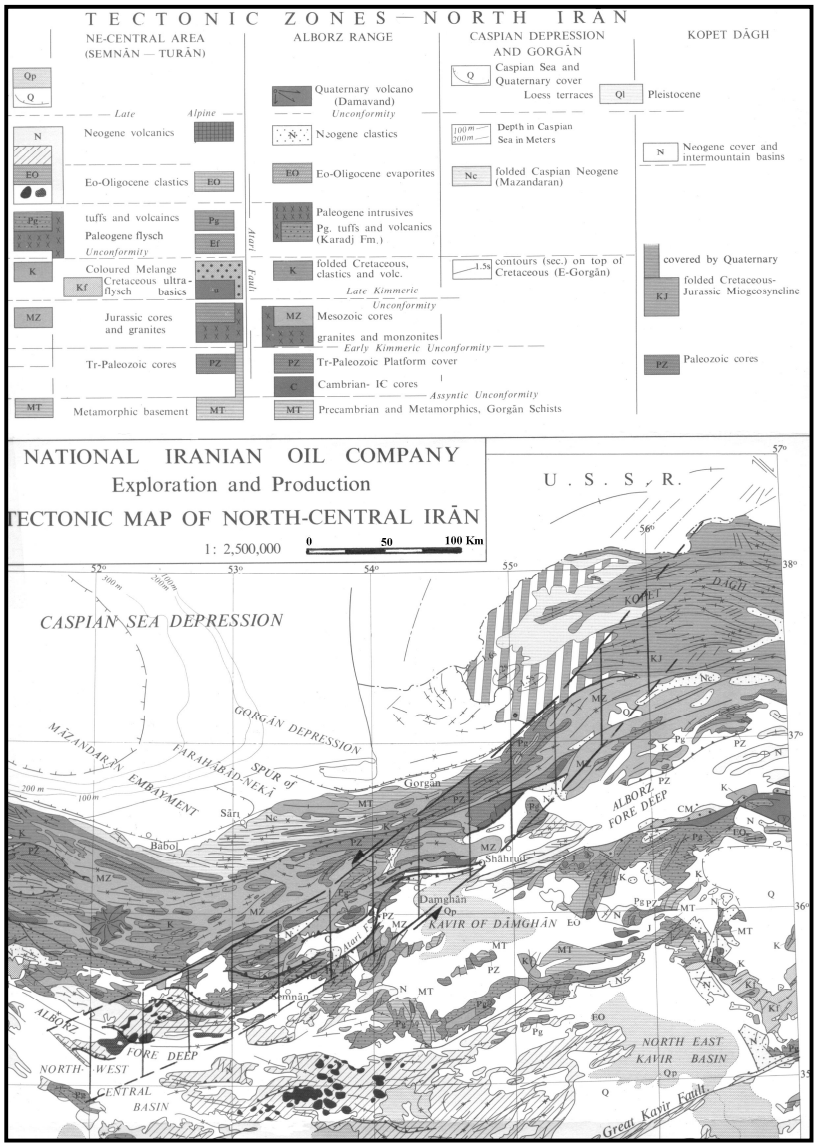

Figure1: Tectonic map of North-Central Iran, adapted from NIOC (1978).

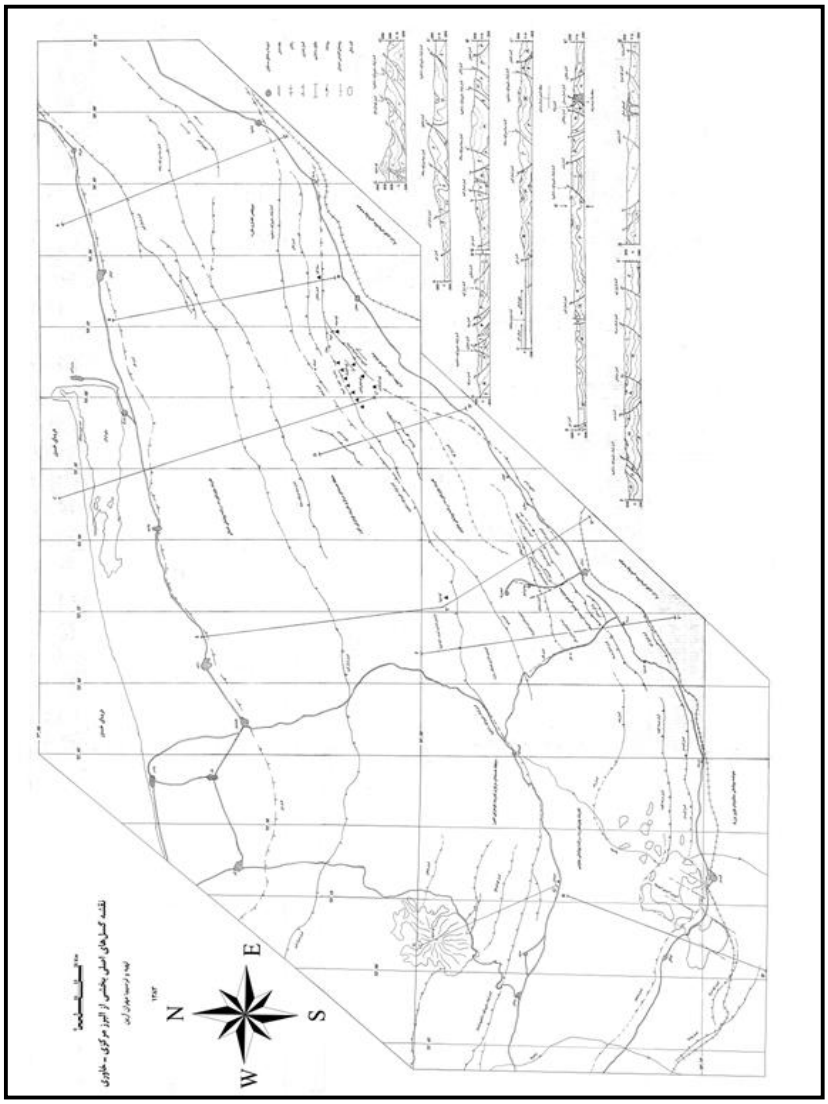

Figure 2: Structural map of the East-Central Alborz.

This change is attributed to Pyrenees phase of middle Alpine deformational cycle in global scale. The dominant operation of this area had been positive epirogenic movement as disconformities. Thus, Karaj formation with a shallow facies or the evaporitic deposits of upper Eocene (Kond formation) are placed as concordant, but after an erosive surface , under a set of terrigenous and evaporitic rocks of the lower- Red formation.

Regarding to regional tectonic regime, this location changing is justifiable well, because it happens contemporary with initial suturing of Arabia and Eurasia plates and forming the Bitlis-Zagros suture zone (Hempton, 1987).

The sedimentary gaps in time ranges between Late Eocene and early Oligocene are a key to tectonic activities of the area. These activities in Lavasan and saran are caused some disconformities in a distance between Kond and Lower- Red (in Saran) and Kond and Neogene Red formations (in Lavasan).

But, it is necessary to say that these movements are happened in north part of the area, in other words, in south part of the Mosha fault which has the orogenic operation and cause the Karaj formation to be placed as angular unconformity under the upper-Red formation (Fig 3).

So, it is possible to consider this kind of change from disconformities to angular unconformity as a proof on uplifting and differential erosion (Brookfield, 2004) or closing to the main axis of orogenic activities.

Figure 3: Karaj formation under the upper-Red formation (view to North).

2. Early Miocene-Late Oligocene movements

Late Eocene movements caused to form extensive continental basins, this condition continued by depositing a set of rocks from lower Red formation up to Miocene. In global scale, late Oligocene movement which are attributed to Savian phase from deformation cycle of middle Alpine, have positive epirogeny. Because, generally the evaporitic condition of late Oligocene changes to early Miocene. This condition causes some erosion in upper part of the lower Red formation where Qom formation with some disconformities is placed on lower Red formation.

3. Lower Miocene movements

These movements are happened in a range between Aquitanian and Burdigalian. In global scale, lower Miocene movements are attributed to Styrian phase form deformation cycle of Late Alpine where there is negative epirogeny operation in which a set of continental rocks from lower Red formation are transformed in straight direction and toward shallow rocks of Qom formation.

It is related to tensional tectonic regime in back arc basin of Central Iran. At this time, the first step of Red sea extension happens and the thickness of thin flank of Arabia plate is continually added to length of Bitlis-Zagros suture zone.

4. Middle Miocene movements

The mentioned sea conditions continued up to Middle Miocene and from this time, it replaced by continental conditions.

In global scale, this condition changing is attributed to Attican phase from deformation cycle of late Alpine this area has the positive epirogenic operation in a disconformity way, and it happened in Kalarz mountain gradually.

So, the sea stone of Qom formation is transformed little by little toward the straight direction of continental deposits of upper Red formation.

In regional scale, changing the sea conditions of land basin in middle Miocene is the result of terminal suturing of Arabia and Eurasia plates. Because, at this time the continental margin thickness of Arabian plate is reached to usual amount (35 kilometers).

Therefore, the free and northward motion of Arabia plate in comparison with Africa is stopped and from this time, the Africa plate is moving toward north.

5. Late Miocene-early Pliocene movements

After going the area out of water in middle Miocene and depositing the upper Red formation, the way for regional formation prepared. The deformation event continued up to Late Miocene and then it appeared contemporary with second step of Red sea extension.

The result of this deformation has caused a generation of structures which are the result of early faulting and extension the surface faulting in the area.

So, this movement has the orogenic operation and cause folding and erosion of the appeared units especially the upper Red formation.

In north part of Garmsar, Eyvanaki and parchin(Rieben,1966), the Hezardareh formation is placed on upper- Red formation(Miocene-Pleistocene , NIOC, 1959) with a gradual bedding .

This condition is continued toward the West or Ghazvin. However, Engalence (1968) in Tehran, introduce a band between upper Red formation and the Hezardareh alluvial formation as a disconformity.

In global scale, this movement is attributed to Rhodanian phase from deformation cycle of late Alpine orogeny and according to Allen et al., (2004), has complete correspondence with the time of beginning the Alborz shortening.

6. Early Pleistocene-Late Pliocene movements

After sedimentation of Hezardareh formation in intramountainous basins which are the result of Rhodanian orogenic phase, the condition is prepared for occurrence of an epirogeny phase.

This phase cause up lifting and consequently erosion in Hezardareh and also in lower parts of this formation, that it has upper Pliocene age.

In global scale, it is attributed to Walachian phase from deformation cycle of late Alpine orogeny.

7. Middle Pleistocene movements

These movements cause some folding in Hezardareh formation and because of this the kahrizak formation is deposited in deformation way on it. So, in global scale, it is attributed to pasadenian phase from deformation cycle of late Alpine orogeny and it has orogenic operation in this area.

8. Late Pleistocene movements

It is very probable to say; these movements cause a little folding in Kahrizak formation, because the sedimentation of alluvium formation in Tehran (C alluviums) is finished after an erosion period between 50.000 up to 4000 or 10.000 years ago (Vita-Finzi,1969).

9. Holocene movements

Although the alluviums of Khorramabad formation is placed on alluvium formation of Tehran in west of the Eyvanaki about 4000 years ago, existence of epirogenic movements from 10.000 years ago (the early Holocene) has considered.

Therefore, maybe it is possible to consider the uplifting and consequently an erosion period about 6000 years in Eyvanaki and 10.000 years in other areas.

In this way, it is probable to consider the condition of this area as a result of following factors:

a) Generally, we can con consider the Rhodanian, Walachian and Pasadenian phases as a three interrelated and continuous deformation which is caused to present structures.
   So, it is better to mention these phases as a last deformation event related to main Mountain building.
b) This deformational event plays an important role in formation and extension of alluvium deposits from Pliocene and Quaternary, because these movements cause pressing of intermountainous basins including alluviums in addition to installing their heights.
c) Probably, their area is passing an erosion period which is the result of installing related to Holocene movements. According to Marshak and Mitra(1988), a deformational event includes one or some deformational phase which are related to each other from the view point of formation time and source.
   In fact, a deformational phase is a time range in which unique race of structures is formed.

At first, Alavi (1996) considered the structural evolution of Alborz area.The unconformity between Upper Red and Karaj formation in South part of Firoozkooh - Gadok area (Fig 3) and placing the detrital deposit of Lower Red formation in south flank of that(Mahdi Shahr -Aftar area), makes forming of deformational phase possible during late Eocene- early Oligocene.

In this way, it is better suppose sedimentary Sequences of middle Jurassic and Cretaceous (Dalichai, Lar and Tizkoh formation) and also the Karaj and Qom formation as some evidence for proving the occurrence of at least three Subsiding phases , according to Dahlen, et al. (1984) modeling. Shemshak, Fajan, lower-Red, Hezardareh formations and also terrigenous deposits of Pleistocene-Holocene are placed in limitation between effective deformation phases in Structural evolution of Alborz orogenic as follows:

1. Early Cimmerian orogenic phase from deformational cycle of early Alpine.

2. Laramian orogenic phase from deformational cycle of early Alpine.
3. Pyrenean orogenic phase from deformational cycle of middle Alpine.
4. Rhodanian orogenic phase from deformational cycle of late Alpine.
5. Pasadenian orogenic phase from deformational cycle of late Alpine.

Therefore, if we can consider these phases as some superior phases of deformational events and especially the two last ones as superior phases of the latest deformational events, it is possible to suggest four deformational events in this area. From tectonic view, the first deformational event is one from the Syn- collision type between Cimmerian –Eurasia plates (late Triassic) and the other three ones are from post-collisional deformational events and also in relationship with the deformational of sedimentary cover which is result of shortening and increasing the thickness of passive continental crust of Central Iran.

So, because the orogenic event includes one or some deformational event related to one main period of tectonism or mountain-building, the Alborz orogeny in the area can be result of four deformational events from late Triassic up to now.

In other side, with pay attention to Alavi(1996) and the stratigraphy of Alborz basin (GSI, 1975-1994), tensional equivalent movements of Caledonian and Hercynian orogenies are from pre-collisional deformational events and related to syn to post- rifting of paleotethys.

So, we can figurate them as pre-orogenic deformational events in the Alborz area.

Conclusion

In this paper, diastrophic movements of the Cenozoic in the East-Central Alborz as the main cause of the formation of structural features are introduced, described and compared which known movements in the global scale. Here are the results:

a) Based on field observations and present evidence, we have introduced several diastrophic movements on the Late Eocene-early Oligocene, Late Oligocene-early Pliocene, Late Pliocene-early Pleistocene, Middle Pleistocene-late Pleistocene and Holocene time ranges.
b) Based on these studies, five dominant orogenic phases and four deformational events in Alborz mounting-building processes have suggested.
c) Tensional equivalent movements of Caledonian and Hercynian introduced as pre-collisional deformational events or pre-orogenic Alborz events in the area.

Acknowledgements

This work is funded by the Department of geology, Islamic Azad University, Science and Research branch, Tehran, Iran. Also, Special thanks to vice-president for research in Science and Research branch, Tehran.

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