Structural analysis of Fariman plain as a Piggy back basin structure in Binalood structural zone (NE of Iran)

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ABSTRACT: Fariman plain is surround by two Fault that there are NW-SE. Fariman Fault and Band – e – Fariman activity is cause form this plain . This Faults are Boundary between metamorphic and sedimentary units . This Faults are thrust with dextral-strikeslip . Existance uplift , rupture and displacement in drainages , change in structures trend around Faults, all show that study area is active . My observations indicate that Band – e – Fariman Fault activity is more than Fariman Fault . Structures similar this plain that between two fault formed, have two Structural justification . My observation and research indicate that this plain is a Piggy back basin .

Key words: Fariman Plain , Piggy back basin, Fariman Fault, Band – e – Fariman Fault, Binalood Structural zone, NE Iran.

INTRODUCTION

Fariman Plain is in the Eastern North of Iran and 70 km far from south of Mashhad between E59˚30 and E60˚40 Eastern and N35˚20 and 36˚ northern latitudes (Figure 1).

Figure 1. Location of the studied area

The plain is located approximately at the eastern of Binalood and Capedagh Mountains. Metamorphic units show altitudes and sedimentary units show lowland areas (Alavi 1979). The general trend of plain is from Western North to Eastern South. Boundaries of the Western North and Eastern South of the plains are metamorphic units that their height is greater than the sedimentary units so that the highest of the mountain with an altitude of 2942 meters is Dylaqthatis composed of metamorphic units and the lowest area is sedimentary units that have 740 meters (Kamali1978).

Surrounding heights of pain to the west have convergence shape that has been reduced space of pain to the West. These pains have not been structurally analyzed. Remnants of the Paleotethys have been studied by Alavi (1991) that determined three stage in folding. Momenzadehet al. in 1983 studied iron and lead track on the
south of Binalood. MortazaviMehrizi 1997 studied Shurijeh formations and old dark in the area Sefidsang(North and Western of NorthFariman) in the form of a master’s thesis.

**MATERIAL AND METHODS**

In order to become familiar with the geology of the area, studied some material and maps to gather information about the area and get general knowledge of the area. Then we obtained some sample from the pain and studied its structural information, and then the obtained data was interpreted and analyzed using basic methods and various processing software. Finally by the integration of painstudies and results of data interpretation, it was provided the consistent model for plain.

**Tectonic Zone**

The studied area is a part of the structural zone of Binalood. Binalood structural zone is located in the Western North of Iran. This zone is as a faulted and folded narrow strip that has a trend northwest to the southwest. Based on movements in the crust of the region, Iran area can be divided into stable and deformation zones. Therefore based this deviation, the structural zone of Binalood is a deformation zones is undergoing shortening (Vernant et al., 2002).

Miami or Shahrrood fault is its southern boundary, its northern border is Kashafroos sinking and the northwest boundary is Semnan fault. There is three generations of thrust faults within this zone. In the Middle Triassic, and after the clashing of Iran micro-continent and Turan additive charter set have been driven on the edge of Iran micro-continent and the first generation of thrust faults were formed. The activities of faults have formed metamorphism (greenschist face to amphibolite). This fault is considered as the ductile faults because of the great depth along the fault zone. These activities range these faults are from Permian to Middle Triassic (Alavi 1991).

With the clashing, Triassic sediments formdemolition sediments of the upper Triassic. After the clashing, the erosion is formed in the acted area of and demolition Kashafrood. Dagh area is generated with the relative stopping of area tectonic activity and alleviation of DaghandCretaceous continental sediments are formed. In Paleocene and possibly by the closing of Neotethys during the Alpine orogeny (Paleocene - Eocene), the studied area is activatedtectonically, and the next generation of the thrust faults are formed. This faults as well as the first generation of thrust faults have dip to the north and their direction is to the Western south. Second-generation thrusts have less steep than the first generation, and cut them. Their age is younger from north to south. The activity of these thrusts are began from Paleocene and continues to now (Alavi 1991).

On the surface of these faults are formed faulty cuts so that these faults can be seen in the figural. With the activity of these faults, water is removed from the bedding of area and continental sediments is formed by erosion of older units. Third generation have many difference with previous Trusts region. Concurrent with the closing of Neotethys in the south and the stress placed from on Arabic plate and also the pressure of Afghan blocks in east, Iran micro-continentis rotated in a clockwise direction to activity generate length-riddle faults. Length-riddle faults have become thrust faults in the apical portion bent (Alavi 1991).

The slope and the direction of thrust, is unlike to the previous two generations of trust so that the slope of the fault is to the south and vibrationaldirection is to the north is. These faults are also fragile. The active of these faults have been began from Eocene and has been continued to the present.

**Plain structural explanation of Fariman**

Breakdown between the two trust faults can be formed in two ways:

A) Co-slope thrust faults that in this way basins Piggy back is formed.
B) The no co-slope of thrust faults that in this way basins Pop_up is formed.

**A) Co-slope thrust faults**

To understand the formation mechanism of these structures, we can use laboratories model. To perform this test, we usually use non-homogeneity of the material. Condition and type of used material in these experiments, will have a direct impact on the results, for example, Costa and colleagues (Costa, E., Vendeville - B, C., 2002) were investigated Folding associated with thrust belts on a fragile layer (evaporation) (Fig. 2). In Figure 2, in two(a and b) states condition and the materials used are quite similar and the only difference between the two modes is in foundation stone so that in state a implemented on Vyskazthefoundation stone and in state b is implemented on a frail foundation stone.
Regardless their errors in this method, these tests can somewhat wider the researchers on the natural process. Figure 3 can explain the basins and the reason of their formation in the active thrust sheets. The state a is for the homogeneous material. In this case, a two-sided prism is formed. The disrupted strain vectors of distribution pathways are strain. With the continuing of the convergence a uniform topography is formed in Forland and Hinterland. The reason is the uniform distribution prism in the back of strain. The state a is for the Non-homogeneity material. In this case after prism formation, with the continuing of the convergence there isn’t a uniform topography, and the materials are passed to the prism through a shadow is formed in the middle of shadow strain (blue range) and therefore a basin Piggy back s formed in the surface.
B) No co-slope of thrust faults

If two thrust branches be slope in the opposite direction of each other, therefore a disability between is formed between the two branches that this disability can be a good place to form a new Sedimentary Basin that is called Pop-up (Fig. 4).

In addition, there is the other difference in the structure of the basin. Piggy back Basins is formed when the level of activity of two Thrust faults be different so that the performance onetrust is less than another trust or is inactive.

In experimental methods that Astortyet al., (2003) the structure of Pop-up is formed fartherthan Piggy back basin rather than the place of collision so that the structures of Pop-up is called externalprisms and structures of Piggy back is called internal prisms. As the Figure 5 shows the Structures of Piggy back are relatively higher than the surrounding structures, however, Pop – up Structures aren’t This is not the height of the structure. The distribution of strain pains in structures Pop - up are not higher than the surrounding structures. Distribution of strain axisin structures Pop - up is more regular and two sides prisms is formed however in the structures Piggy back, prisms are asymmetric and distribution of strain axes are more complex. To infer about the nature of pains, first we study the faults of Fariman.


**Fault Fariman**

This fault is the main fault of the north of plain, which is referred as Fariman thrust fault. 60 km length of the fault is traceable on the ground and it is disappeared on both sides of the sedimentary units. This fault is connected to some thrust branch in the west. The 39 km west of the fault is the N65W and the 21 km east of it is the N54W (Figure…). This fault is placed a metamorphic unit with N70W/35SW position to a the sedimentary unit with N70E/20SE position. Slope of units in around of fault varies 90 degrees in the vicinity of the fault to 20 degrees in the away from the fault (Mahdeva 1998).

This separating fault is the East Heights of Fariman of Fariman plain. The inverse rate of fault is unknown, but the rate right-lateral motion of the fault on aerial photographs and satellite images show 300 m displacement at least. (Fig. 6). Sedimentary and metamorphic units around the fault are outcrop (Fig. 7).

**Fault Band-e-Fariman**

The Fault Band-e-Fariman has similar length to the Fault Fariman. This fault that have an important role in the geology of region start from Ghale village and after Band-e-Fariman continues to of the 60 km south-east section of Fariman. Vast differences in lithology and high on both side of the fault has caused easily traceable of the fault outcrops (Fig. 8).

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**Figure 6.** Waterways movement by dextral movement of Fariman

**Figure 7.** Farima fault that separate the sedimentary units from metamorphic units in the northern highlands
The oldest sediments in the region that have been affected by regional metamorphism associated with high temperature is related to Orogeny in pre-Cambrian. The motion was accompanied by folding so that the deposits belong to the Soltanieh formation can be seen by unconformity on Precambrian metamorphic set. Precambrian orogenic movements on both side of the fault has not done the same. So, in the eastern part of the Precambrian faults are highly metamorphosed and

The southwest of fault is characterized the Chilean facies. Most of Soltanieh formation Barootcover on Kahr Chile formation co-slope. Another major difference between the two sides of the fault zone is that in the northeast zone, the formation have changed older than ShemshakSazand. However in the southwest of this fault zone sedimentary was not found similar as said before (Shirzadeh, 1993).

According to studies the slope of the both faults is to Western North direction and both faults are active. The following evidence suggests that the activity of the fault Band-e-Fariman is more than the fault Fariman. A) the height of the South West of plain is more than the height of the Western North. B) Metamorphic stone of South of plain is significantly more mesomorph than thw metamorphic north of plain. Figure 9 shows a geological cut of a disability in the western part Fariman faults. This structure is composed between of two trust branches and with survey it was found that the structure is also the Piggy back basin.

CONCLUSION

Plain plain with the Western North - Easter South trend is in Binalood zone. Due to the difference of trends in the Fariman fault and the FarimanBand-e- fault, the wide of plain is decrease in the Western North and increase in the Easter South. Based on previous studies it was found that the theFariman fault and the FarimanBand-e-fault are both co-slope and the slope of the two faults is in the Western North. Both are the active faults and according to the samples and more topographicsmetamorphic in the area south of West Plains it was found that activity of the FarimanBand-e- fault is more than Fariman. All evidence and samples show that this is a Piggy back desert basin.
Figure 9. Fractures Map of East of N &nNE Fariman.

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REFERENCES