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Analysis of Main Zagros Recent Fault Strike-Slip Evidence from Dorud to Dena

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Abstract- Zagros orogenic belt as a part of Himalaya-Alp mountains- range is a young zone exposed to getting short, thick and horizontal displacement as the result of crashing Arabic and central Iran plates. This happens while final Alp orogenic movements (pasadnin) haven't been ended yet. In the other words, the final balance hasn't been established. Hence, active tectonic movements are continuing.

The analyzing of the geomorphic evidence of active tectonics on a digital elevation model (DEM) using Geographic ArcView Software and Global Mapper with field observations indicate that Main Zagros Recent Fault (MRF), isn't an isolated structure, But a narrow zone of lonely dextral fault segments which is general and with its vertical performance and slippery length can cause mountain erosion, subsidence of holes, moving streams, karst expansion and, instability range.

Activity of these faults which associated with earthquakes and landslides has caused of those a lot of deaths living in the area. Unfortunately, it is anticipated that these events will repeat again.

Keywords- *Geomorphological evidence, Right-slip fault, Zagros Fault, Central part of Iran*

I. INTRODUCTION

The term "tectonics" refers to deformed structures and the outer part of the earth, and to evaluating the effects of architecture and construction throughout geological time [1]. The term "Active Tectonics" is also derived from this term, referring to the most recent transformations, particularly during the Late Quaternary era that has already taken place [1].

It is expected that active faults located in this area in the future will have relative displacements and in any structure on which it is placed will create incisions [2].

To identify active regions, different methods used in seismology, history, archeology, geodesy, geomorphology and geology are used, each containing a specific time period and have their own methods [3].

The science of geomorphology which is focused on the identification of landforms includes morphology elements and factors which cause it [4]. Earth's internal forces during the past thousand years have produced the forms on the surface of the earth by which we can detect unstable regions. These forms include a network of waterways, the existence of escarpment precipice of stream flow, river slope increase, the shape of the basin, the mountains front, the valleys forms, etc.

Fortunately, recent studies due have been of great important to utilizing Geographic Information System (GIS) that studies a wide geographical spread quickly and inexpensively. The final appearance of Iran ripples in the late Tertiary period has been the result of orogenic movements and its frame was fixed definitely in this time and during the Quaternary due to erosion factors has taken the current forms [5].

However, the final Alpine orogenic movement has not ended yet, in other words , the final balance has not been made[6] ; Thus, the active tectonic activities which are in fact the continuing tectonic movements of Pasadnin, continue due to opening of the Red Sea floor. [7] (Figure 1-a & 1-b).

Figure 1. (a). Location of the Main Zagros Reverse Fault between the Arabian and Iran plates in the folded belt

Figure 1. (b). Location of the Main Zagros Reverse Fault between the Arabian and Iran plates in the folded belt

In the years 1999-2001 geodesy studies have shown that because of the movement of the Arabian plate toward the Eurasian plate, the width of the Zagros mountain range has shortened 0.8 cm, annually [8].

The Main Zagros Reverse Fault isn't just a thrust, but it is in fact the two main thrust faults that are sometimes parallel, sometimes unite and sometimes considerably are distant from each other. The Main Zagros Recent Fault (MRF) is a near-vertical angle reverse fault with a dextral component. Geological observations confirm that the fault is right-lateral motion [6]. This fault has great seismic activity and many present earthquakes have occurred along. Parts of this fault stretches from the North West to south east, including parts of piranshahr, Morvarid, Sahneh, Nahavand, Ghale Hatam and Dorud (Fig. 2). In all reports Dorud fault is known as the last south east piece of Main Zagros Recent Fault (MRF), has the general trend of 315 in north and is approximately 100 kilometers which stretches from borojerd to Arjanak village at the south of Dorud [9] (Figure 2).

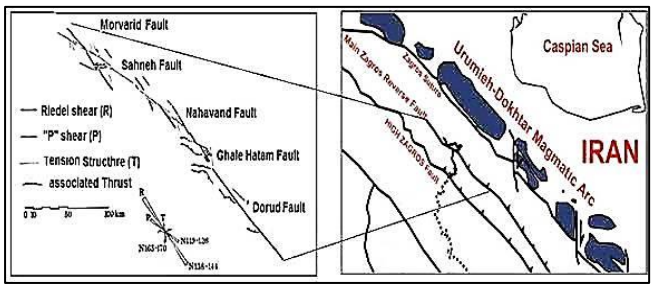

Figure 2. Location of the Main Zagros Reverse Fault between the Arabian and Iran plates in the folded belt

Talebiyan and Jackson [2002] In their recent studies, with emphasis on evidence of geology and geomorphology have estimated the length of horizontal displacement about 50 to 70 km (at a speed of 10 to 17 mm per year) and the amount of vertical displacement is approximately 500 m (with speeds between 1/0 to 2/0 mm per year) (Figure 3). Whether Main Zagros Recent Fault (MRF) is stretching after the Dorud segment or not is not clearly known [10].

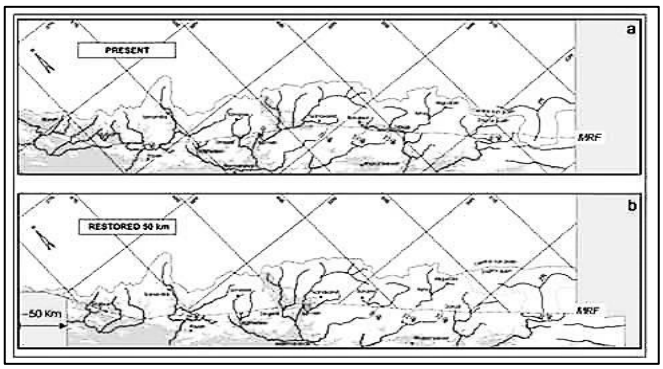

Figure 3. Present-day (a) and restored (b) drainage maps of the main Recent fault (Talebia and Jackson, 2002).

Aghanabati (2004) In the same way, studied the Ardal fault with the northwest - south east direction and the length of about 150 kilometers to the northeast slope and parallel to the Zagros thrust stretches in range Ardal–Naghan. He introduced its mechanism as a compressive fault which is through the Paleozoic formations along with Bangestan Cretaceous group (from north-east) and (south-west) have been pushed on the plains of Cretaceous rocks [11].The purpose of this paper is to study the expansion of south-east Main Zagros Recent Fault (MRF) (from Dorud to Dena fault) in order to find evidences of fault activity in the region. It is assumed that the fault is extended to Dena's fault.

A. Case study area

Study area is between latitudes 49 º 13' 26" to 51 º 24 ' 17 " east and latitude 31 º 40 ' 3 ' 'to 33 º 19 ' 29 north (Figure 4).

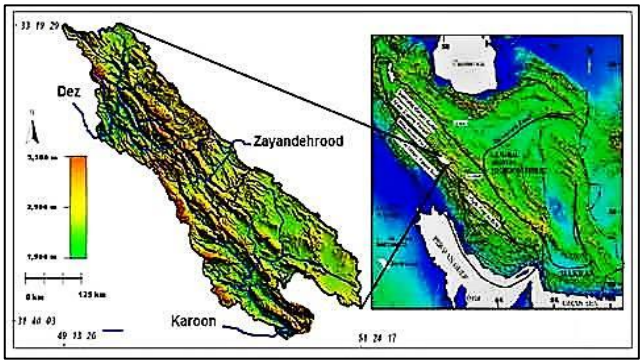

Figure 4. Present-day (a) and restored (b) drainage maps of the main Recent fault (Talebia and Jackson, 2002).

Considering the geological division of Iran [11], the area is located in the zone of Sanandaj - Sirjan and the High Zagros and it follows the geological characteristics of this zones (Figure 5).

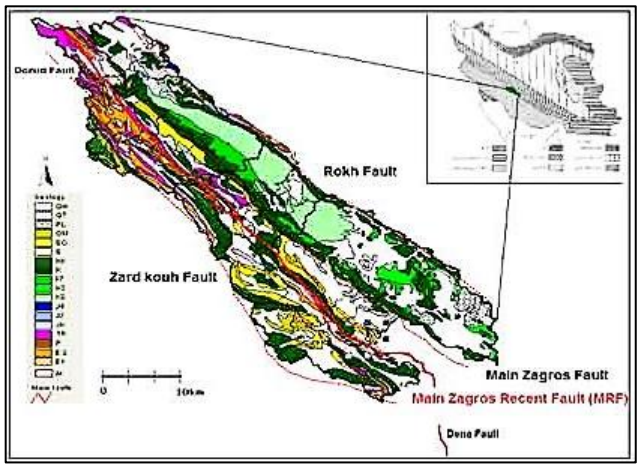

Figure 5. Geological map of the study area

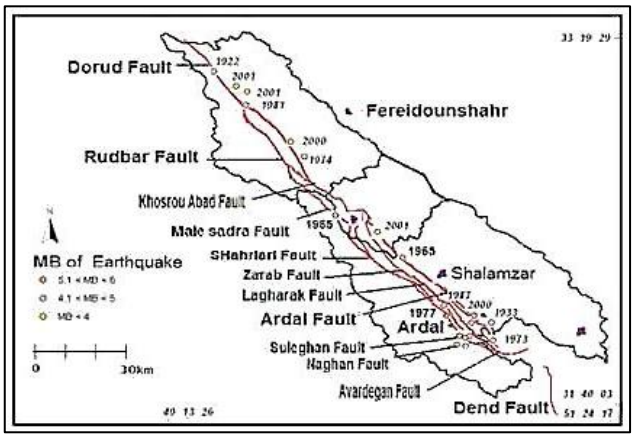

Figure 7. Main Zagros Recent Fault (MRF) segments between Dorud to Dena

Maximum and minimum altitudes of the area are 1018 m and 4174 and the difference is 3160 meters which shows the roughness of the landscape of this region. Dez, Zayandeh roud and Karun are the three rivers that are originated from this studied region. Among these invers, Dez and Karun rivers through a winding path end in Persian Gulf bat Zayandeh roud-e- Gavkhouni Pit.

B. Methodological And Approaches

To evaluate the proposed hypothesis, first, raw needed data, such as topography and geology maps, seismology data, and images obtained from satellite were provided. Then, using geographic software ArcView and Global Mpr on digital elevation model (DEM) of drainage, earthquakes, landslides, the distribution of voids in Kars tic and other potential problems associated with the activities of possible faults (Figure 6) have been field and software studied and finally, "the relationship between these phenomena and the Main Zagros Recent Fault (MRF) was analyzed.

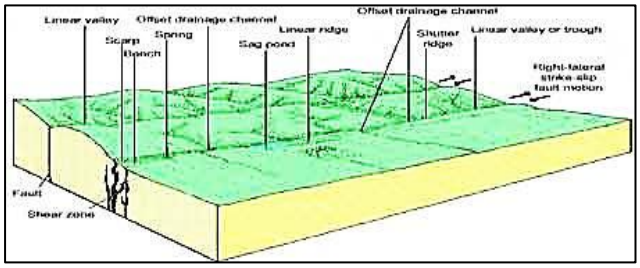

Figure 6. Types of form creating associated with strike-slip faults[1]

II. RESULTS AND CONCLUSIONS

The study of geomorphic evidences and matching the topographic maps and geology show that that the trend of Main Zagros Recent Fault (MRF) in this region is complex and includes several fault segments (Figure 7).

Roudbar fault or Ghalikouh segment: In the South of Dorud fault segment and parallel to the Main Zagros Reverse Fault, there is a fault whishes introduced as an inverted fault on geological maps. This fault starts from the southeast Dorud fault and extends about 75 kilometers southeast with an almost vertical slope near the village Sraqasyd. But along this fault, the pressure ridges diverting stream is observed (Fig. 8).

Figure 8. Pressure ridges caused by deflected streams (in the way Dorud to Aligoodarz)

Also, part of the fault which is located along the river Roudbar has created sag ponds (Figure 9). This fault has deflected Kezandeeh steam about 500 meters and Gashan strem about 800 meters (Figure 10). Landslide scratches in the surface of Roudbar fault in southern Byrahang in the way of Chelgerd show recent activities (Figure 11).

Figure 9. Sag pond along the Roudbar segment (Dareh mahi Village on the way Aligoodarz to Boznavid).

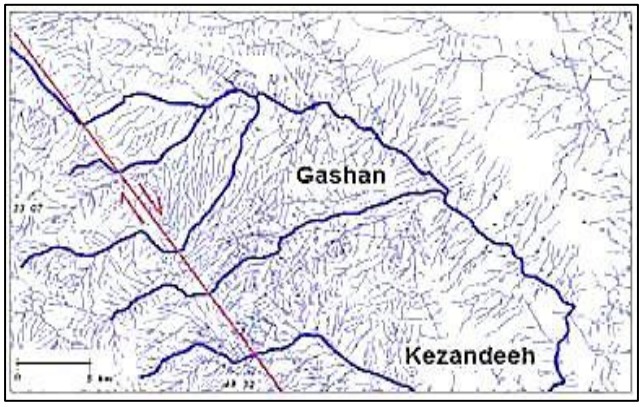

Figure 10. Dextral strike-slip fault along the fault Roudbar (se Gashan villae)

Figure 11. Scratched fault on the surface of the Roudbar fault segment (South of the Birahegan village)

Therefore, it can be considered as a part of the Main Zagros Recent Fault (MRF).

A. Male Sadra fault segment

Male Sadra fault consists of several faults in parallel with the line NW – SE which one of its branches along the river Kouhrang forms the northern border of high Zard kooh and Male sadra. Dextral movements on this fault are recognizable by clear bending which it made along the formation ranges (Figure 12).

Figure 12. Male sadra fault southeast of Male sadra mountain

B. Khosrow Abad fault segment

Khosrow Abad fault has a trend of northwest - southeast direction and the direction has changed in east Niakan village toward west of north - south and then north-east - south-west line. The fault in the North of Male sadra caused over thrust Cretaceous units over the Permian units. The Continue of it in Posht kuh Fereidoonshahr along Bahramabad-masyr is detectable (Figure 13).

Figure 13. Linear valley along the Khosrow Abad Fault (Posht kuh, way My Bahram Abad to Masir)

The fault stretches until it is divided into several parallel faults:

Shahriari segemant that stretches N130W, 13 km long and about 500 meters wide joins kuhsokhteh (zarab), around Chelgard City by going round the salt dome. Shahriari's fault like thrust fault zone has caused movements of Cretaceous limestone Shahriari on younger deposits (marl Miocene). Zarab fault (Kuh-e- sorkh) is located in Triassic dolomites and has erased and hydrated the stone. Due to the hardness of limestone in the area, water infiltration into the ground is more through cracks and gaps. For this reason, around tectonics, many passages are made in the direction of water flow in rock masses.

While penetrating in depth, water causes the dissolution of the walls of fractures and can develop karst gradually. The rock masses are more affected by tectonic pressure. There are more possibilities for the creation and development of karst. With the development of karst in the faults direction and by replacing hole instead of waterways, the major part of the surface water is transferred to the underground network.

Laghark faults has been made in Sarvak Kars tic limestone northern of the anticline Zrab – Saldoran and has led to a highly developed Kars tic surrounding structures and created a lot of pole, , holes, karst springs, caves, dry valleys (Figures 14 and 15).

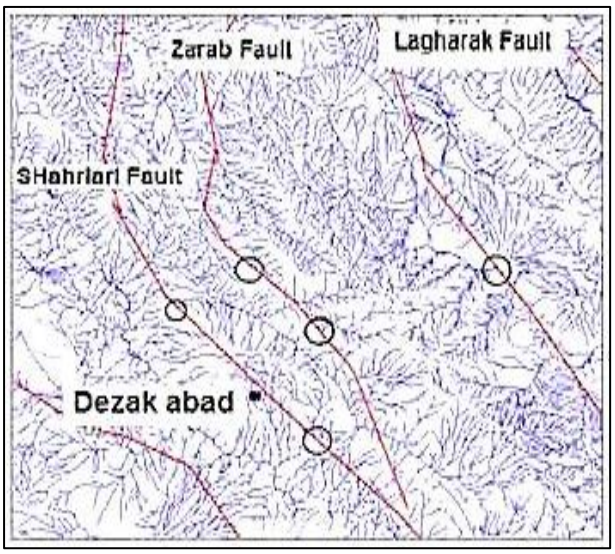

Figure 14. Adaptation of channels map with fault map at Saldvran and Zarab faults in the area.As we can see faults caused disrupted rivers and karst development

Nal-e-Ashknan Fault River stuck to the bottom of the canyon. Around Nal-e-Ashknan and the southern slopes of Sabz kouh, there is terrace that is made due to Uplift area along the branches of the Nal-e-Ashknan from Main Zagros Recent Fault (MRF) (Figure 16).

Figure 15. Karst shapes in Zarab and Saldoran mounts that are associated with active faults

Figure 16. Fluvial terraces around the horseshoe Nale Ashknan River (south of the Bakhshabad village)

At different heights, great landslide can be seen which are likely made by an earthquake, it seems very likely. Among these are two Landslides occurred in the highlands south of the city Shalamzar and Dstna'. That is next to kooh - e- Sorkh fault of Main Zagros Recent Fault (MRF) causing the displacement of large quantities of debris and sediment, and has created a special form which can be seen from long distances (17, and the, 18).

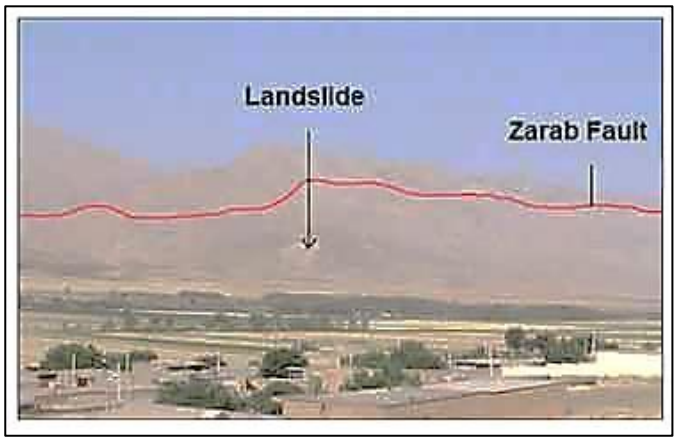

Figure 17. Old Landslide south of Shalamzar city

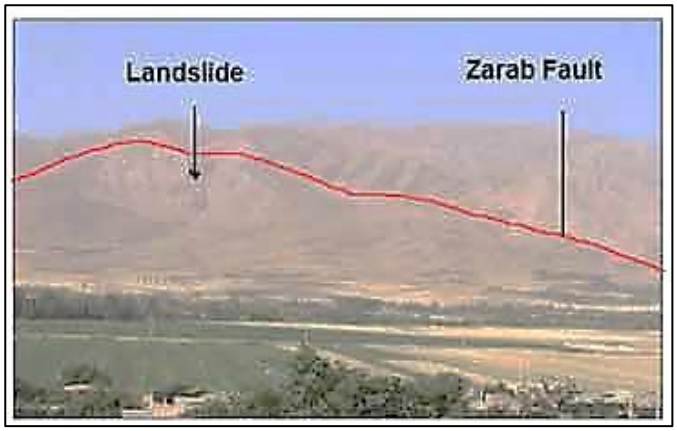

Figure 18. Old Landslide south of Dastna village

It should be noted that the lake Gahar is formed on the same fault segment Dorud fault from the same Main Zagros Recent Fault (MRF). It was formed due to the closure of Gohardareh valley by a massive rock fall (before the year 1268. S), while destructive earthquake [13].

C. Fault Ardal segment

The fault trending northwest - southeast and a length of 150 km, has a slope to the northeast and stretches parallel to the Zagros thrust range Ardal - Naghan. The mechanism of the fault is associated whit pressure along with Cretaceous Paleozoic formations have been pushed in its path on the plain of Bangestan (north-east) and Cretaceous rocks. In Ardal northwest along the fault Ardal, there are some salt domes overhang [10]. This fault continues after Khosrow Abad fault and continues as far as to the south east north - south Dena fault.

Berberian has introduced Twentieth-century historical earthquakes along Ardal segment fault as following [2]:

- Earthquake of 1666 in the northwest Ardal magnitude Mw = 6.4 and intensity I0 = VIII
- Earthquake in February 1874 Choghak hour
- Ardal 1880 earthquake with magnitude Ms> 5.3 and the intensity I0> VII
- March 21, 1922 earthquake of magnitude Ms = 5.5 and intensity I0 = VII
- July 26, 1958 earthquake of magnitude Ms = 4.2 and intensity I0 = V
- September 21, 1960 AD earthquake with magnitude Ms = 5.0 and intensity I0 = VI
- 6 April 1977 earthquake of magnitude Ms = 5.5 and intensity I0 = VII

Berberian has stated that the investigation of Ardal fault during earthquakes since 1977 have shown no movement. However, this fault is introduced as compressional along the koohrang waterway and shows significant and dextral displacement (Figure 19).

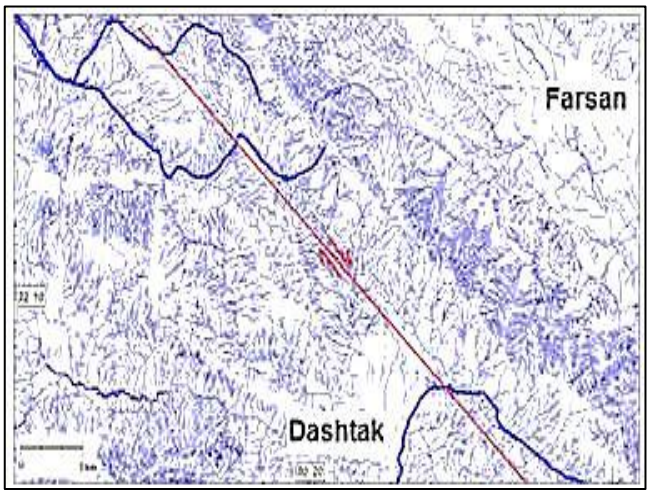

Figure 19. Dextral strike-slip displacement along the fault Ardal (NE Village Dashtak)

This fault also includes several parallel segments:

Averaging fault segments which follows Ardal fault which at first follows it, but then switch to bow mode and stretches along the south west - north east to the south of the Averaging village and finally joins Sabzkooh fault. Naghan thrust trending NW-SE and fault length of 39 km parallel to Ardal fault is in the northeast region and, the parts related to upper Cambrian sediments have been put beside the sedimentary of the Lower Cretaceous and Paleocene. Alluvial fan in south of Naghan with Area of approximately 20 square kilometers, near the foot of the mountain to the river stretches to Sabzkooh, and due to the fault some cuts have occurred in a way that a waterway is flown near the village Jahman is flown (Figure 20).

Figure 20. Effect of Naghan fault on Naghan alluvial fans along the waterway Jamhan village has been severely cut

Soleghan thrust trending NW-SE is parallel to Ardal fault. Next to this thrust there are some investments related to upper Cambrian beside lower Cretaceous Paleocene sediments. It has a length of 32 miles.

D. Regional analysis of fault activity

Main Zagros Recent Fault is a reverse almost-vertical angle fault with a dextral component that its parts of north-west to south-east include parts of piranshahr, Morvarid, Sahneh, Nahavand, Ghale Hatam and Dorud have been identified and introduced. In this article other faults have been introduced and Elva luteal along Main Zagros Recent Fault (MRF) which extends to Dena fault and Introduced and evaluated it has been proved on the basis of geomorphic evidence that those which were introduced the earlier "reverse, have dextral motion. Dena fault trending north-north-west and slop to the east of the Zagros fault is one of the Main Zagros Recent Fault (MRF). That is a hundred miles long and is divided into two different ports, seismotectonics and morphology having tectonic charactonics (Fig. 21).

Figure 21. Main Zagros Recent Fault (MRF) stretdes along the Dena fault study area (Hessami et al, 2003)

Dextral strike-slip movement of this fault has already been identified and evaluated and is likely that Hezardareh and Chero mountains are the continuing movement of mount Dena in the shape of Dextral [13]. The northern continue of this fault is divided into two branches: a branch that is diverted to the north west that is called segment Hezar dareh fault and other branches trending north Sabzkooh segment (Figure 22).

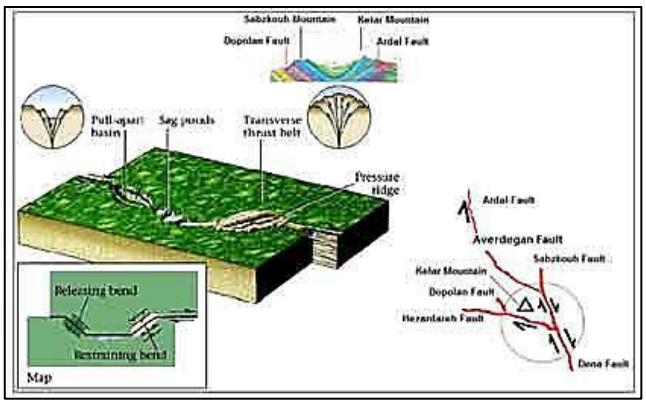

Figure 22. The relationship between Dend fault and Ardal fault activity

Avrdgan fault, as the last piece of Main Zagros Recent Fault (MRF) connects to Sabzkooh segment of Dena fault connected to Dena and creates a continuous fracture. Thus, movements of Main Zagros Recent Fault (MRF) in tithes region is associated with Dena fault movements.

III. CONCLUSION

Main Zagros Recent Fault (MRF), an almost-vertical angle reverse fault with a dextral component, including parts of piranshahr, Morvarid, Sahneh, Nahavand, Ghale Hatam and Dorud parts which have been already introduced. The results of this study indicate that the faults which lies in the continuation of this trend and were of reverse pressure kind show evidence of the dextral strike-slip activities. Thus, the activities of dextral strike-slip from Dena fault to Dorud fault can be imagined. The rout may have some risks in the future just as it had before.

REFERENCES

[1] E.A. keller, N. Pinter, "Active Tectonics: Earthquake, Uplift and Landscape", Prentice Hall Publication. London, 185P:1996.

[2] M. Berberian, S. R. Yeats, "Patterns of Historical Earthquake Rupture in the Iranian Plateau", Bul. of Seismological Soc. of America, Vol.89, No.1:1999. Pp.120-139.

[3] V. finzi, "Recent earth movements an introduction to geotectonic", university college London, academic press, 1986, 175P.

[4] M. H. Ramesht, "geomorphological map of Tehran", the United Press, first edition. 2005.

[5] A. Mahmoudi Faraj, "Quaternary evolution of the ripples in Iran", Tehran, Journal of Geographical Research, Tehran University. 1996.

[6] A. Darvishzadeh, "Geological Survey of Iran", Tehran, Amir Kabir Publishers Association publishing knowledge today. 1991.

[7] M. Alaei Taleghani , "Geomorphology of Iran ", Tehran , printing, publishes Ghomes .2003.

[8] J. Hassami, F. Jamal, H. Tabassi, “map of active faults”, the International Institute of Seismology and Earthquake Engineering, Tehran. 2003.

[9] J.S. Chalenko, J. Braud, “Seismicity and structure of the Zagros (Iran): the Main Recent Fault bet.1974.

[10] M. Talebian, J. Jackson, “Offset on the Main recent of NM Iran and implications for the late Cenozoic Tectonic of the Arabia-Eurasia Collision Zone", Geophysics. J. Int. 2002, 150,422-439.

[11] A. Aghanabati, “Geology of Iran”, Ministry of Industry and Mines, Geological Survey of Iran,2004. 582 p.

[12] K. Bahar Firuzi, S. Nvavjary, “Tectonic Evolution of the High Zagros and Sanandaj - Sirjan in the range of one hundred thousandth F. geologic map of the city”, the Symposium of Geological Society of Iran. 2006.

[13] A. R. Sarvqadm, Y. D. hessami khaled, “report the detection threshold of the door Silakhor 01/11/2006 earthquake”, the International Institute of Seismology and Earthquake Engineering, Tehran .2006.

[14] M. Berberian, S. R. Yeats, “Contribution of Archaeological Data to Studies of Earthquake History in the Iranian Plateau”, Journal of Structural Geology, Vol.23:2001, pp.563-584.

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