Study on Gourband Fault Activity on the basis of Neotectonic Evidences (Northeast of Torbat-e-Jam)

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Abstract
Gourband is the largest fault in the Alluvial Sediments of Torbt-e-Jam Plain. This fault is extended from northwest to southeast. Regarding its adjacency to the town and various villages, it is important to study Geotectonic activity. It is found that there are various geomorphologic abnormities along Gourband Fault. In this research, the effect of current movements of this fault on the structural Geomorphology of this zone has been studied. Fault scarps redirecting rivers and channels, folds of quaternary deposits and discoloration of sediments in the fault fields are important geomorphologic indicators that found in the desert site and in association with movement on Gourband Fault. The dip of fault is 50-60 degrees. The reverse component causes uplifting that forms maintains and it controls the current topography of the areas. Also, direct of waterways indicates direct of moving strike-slip of fault. Regarding dextral displacement of these waterways, it is found dextral strike-slip movement in the fault. Elevation of Neogene’s Sediments of the fault surface indicates uplifting and reverse component in the fault.

Keywords: Fault Scarps Torbat-e-Jam, Geomorphology, Iran

1. Introduction
Faults and Folds are affected by moving plates. Gourband Dextral strike-slip from Geomorphologic Structure is placed on northeast of Iran (Torbat-e-Jam Plain). Generally, the fault has been extended from northwest to southeast and caused complex geotectonic processes in this zone. It is arch form and displaces several meters. A lot of studies have been done to examine the relationship between external form and internal tectonic factors. There are various structural forms such as folds and faults in many areas such as northeast of Kordestan Province that they are affected by tectonic movements and deformatonal cycle of final Alpine. (Pourkermani and Ariyan, 2004)

Also, tectonic movements and its related structures will influence on geomorphology of the rivers. So that deformations of Karkhe River in Khouzestan Province are also affected by tectonic structures and its active tectonic. (Pourmohammadi 1996) This study has considered the effects of Gourband Fault Movements on regional geomorphology.

2. Methodology
Geological map, 1to100000, and topography of studied area and its conformity with Land sat pictures have been used to study structural geomorphology of area and desert data has been also used in final study. Therefore, three southeast stations named Ghalegak Station, north of Toqoz Village and northwest of Gourband Village have been used.

3. Geology and Tectonic Position
Torbat-e-Jam, 35°14’ in north and 60°38’ in south is located on northeast of Iran, its altitude from the sea is 2100m in the highest point named Panjmorgh. Its deepest place, 719m in high is located in the southeast of Varaghe in Jamroud River Bed. The most important regional mountains include Golbanoo Yakhak, Mir Amir, Oshtor Kuh, Lakh-e- Kuh on the north of Varaghe and Chang-e- Kalagh mounts and Rishbaste in the southwest of studied area. From the Morphological point of view, this area can be divided into three distinct sections. Northern Height of Varaghe whre is extended from northwest to southeast and the most rockiness units in this area include Torbat-e-Jam Granite, Conglomerate and Sandstones. Kashafrud Formation and Tertiary Daceite Domes and Megapophirs, soft Miocene Marl Formation that are soft-erosion create rough countries in this area. Rivers are seasonal and the most important of them include: Jamrud River comes from Shahan Kuh and Rus River where located at the end of southeast of Varaghe in Kajab Area. (Figure 1)
4.1 Structural Sediment Kope Dagh

From a geographical and graphic point of view, Kope Dagh is located on the eastern part of Alborz Mountains but its geological and structural features are different from adjacent areas (Nabavi, 1976). Northern border of this area with Toran plateau is overlapping the Ishkabad Fault in 310° N. There are different ideas about southern border but this boundary is identified with discontinues outcrops of old accretion prisms which are exposed in northeast of Fariman (Sefid Sang) and southwest of Mashhad.

4.2 Loot

Area loot, 900km, is the most eastern part of central Iran. It is limited to Nehbandan Fault from the east and Nayband Fault and Tabas Block from the west (Agha Nabati, 2004). According to Iran Geotectonic Map (Sttuklin 1973), this block is limited to Kashmar Garben and Jazmouyian Subsidence.

Loot area is divided in Three sections: 1- North 2- Central 3- South. In the Northern and Central Loot, the Tertiary rocks are dominant and the southern loot is covered by wind-laid deposits and yardange.

5. Important Regional Structures

Some of the important regional elements include faults, folds and uplifts. The first type is strike-slip faults which have normal component and include two series. The first series are right-lateral faults which decorated in stepped form from north, northwest to south, and southeast in steep slope to northeast. It is interesting to note that the azimuth of these faults gradually deceases southward and joints to reverse and post-reverse lysteric faults and sometimes cut them. Timeng and Firoozkuh Faults in the north are one of them. These folds are extended from the northwest to the southeast but there are other minor folds. For example, the Golbanoo syncline in the east is extended from the northeast to the southwest. Mechanisms of Oblique-Slip Faults have created these changes and led to the plunging folds.

6. Neotectonic Evidence

Neotectonic includes studying on the movement and Deformation of the earth’s crust that are occurring currently (geologic and geomorphologic processes). Neotectonic Word is associated to Vladimir Obruchev. Since there is no consensus about what age should be considered for the recent activities, the general definition for Neotectonic includes the young movements which haven’t yet ended.

7. Geomorphologic Results from Active Strike-slip Faults

These results are divided into two parts: Primary and Secondary.

7.1 Primary Geomorphology

Cliff is one of the primary Geomorphologies. Generally, exposed faults create a step in the topography called cliff. Cliffs along the strike-slip faults may be formed by two different mechanisms:

- A small component of vertical displacement in some parts of the fault can cause local vertical separation on
- Topographic Relief on the displaced geomorphologies can lead to form cliffs in parallel to strike slip faults. Fault Cliffs, 23m in high, is found in the various points along Gourband Fault. They indicate active faulting and their young movements. (Figures 2,3&4).

Fig.2. Fault Scarp in the place of surface effect on Quartz Sediments

Fig.3. It shows Fault Scarp. Red Line shows Gourband Fault. Reference: Author
Fig.4. Earth slip at the place of surface effect of Gourband Fault on Quartz Sediments. Reference: Author

7.1.1 Height Changes of Fault

It is found that uplifting in the northwest is more than the southeast that can be result of 1) Fault in the northern part is more active. 2) lithology properties have close relation with erosion. The fault where located on the near of Gourband Village has very high (23 m). (Figure 5)

Figure 9 shows that the value is 18m in middle part at the near of Lower Toqoz Village. (Figure 6) shows that the lowest Fault in the southeast is about 13m. Height difference between scarps in the northwestern and southeast of fault is 13m that indicate more active faults in the northwest.

Fig.5. Fault Scarp at the near Gourband Village

Fig.6. Fault Scarp at the near Ghale Gak Village, Reference: Author

7.2 Secondary Geomorphology

Different types of the secondary Geomorphologies can be used to study an active geomorphology in a region.

Horizontal and vertical movements of the young earth can be created by transverse and relief displacements deformation in the earth such as channels, waterways, downstream crest, scarp, river terraces, alluvial ridge and forming geomorphologies such as a dam border, pressure ridge, liner border, liner valleys, springs, fault platforms and subsidence pools. In this study, the evidences of secondary geomorphology on the basis of Neotectonic actions of Gourband Fault are described.

Fig.7& 8. River Deviation along Fault

7.2.1 Offset Drainage Channel

There are rivers that enter the fault transversely and run along it and then take their main direction (Figures 7& 8). River Deviation may be taken place to the left or right (Vedder & Wallance, 1970). Offset Rivers are those which diverted with the fault. There rivers show the relative diversion along the fault (Figures 9& 10).

Fig.9. Diverted River by a fault. East of Gourband River, Reference: Author
7.2.2 Pressure Ridge

Pressure Ridges are small curved areas where formed by pressure of materials between the branches of faults.

If a fault cuts the Pressure Ridge and moves it, the blocker ridge will be created. It indicates pressure component in the fault. In other words, pressure ridge indicates the reverse component in the fault. (Figure 11) shows various pressure ridges that indicates the reverse component in the fault.

Fig.11. Pressure Ridged created by Gourband Fault, Reference: Author

8. The Rising Layer of the two sides of the Fault

The slope of layers around its fault line and vicinity of Gourband Village is 43°. It is 32° near the Toqoz Village and 23° around Qalegak Village. The angle of this slop was measured at a distance of 1 km from Fault Line in the northern Block of Gourband Village and angle of its slope is 3°, while the slop of layers at the Fault Line is 43° (Gourband Village). The value of lifting is obtained by subtracting these values that are 40 and 29 for two parts, respectively. (Figures 12 & 13) show it is 17° in the southeastern part of the fault (Qalegak Village). This value shows that there is more dynamism in the northwestern part of this area.

9. Discussion

Geomorphologic studies on Gourban Fault (between Qalegak and Gourband Villages) show various geomorphologic forms around Gourband Fault.

Geomorphologic Phenomena including displacement, interruption of waterways, height difference and creating fault cliff. Comparative comparisons between structures and geomorphologic elements with topography suggest that the main structures such as faults, folds and uplifting on the topography of area. Fault movements as a result of compressive stress cause to folds and uplifts and lead to difference of altitude and topography of mountains and plain in the region.

Gourband Fault has conveyed eastern rivers of Qalegak Village dextrally. According to Desert Studies, it is found that waterways have also been conveyed dextrally (Fig.__). Discoloration of sediments in the northern block than southern block is created by outcropping Neocene sediments as result from uplifting and erosion in the northern block.

Also, Topographic and geomorphologic changes as results of movements of Gourband Faults is clear. High altitude of river channels at the near of heigths and lowering height toward plain indicates greater uplift and rising at the foot of heights. Regarding direction of measured slope of this region where is toward to the northeast (Jami 2011), it is concluded that the heights of this are hanging wall of Gourband Fault that the reverse component of this fault has been caused to uplift and creation of the heights. The flat forehead mounts also indicates the current active tectonic and current geomorphologic and topographic changes in the range.

Fig.12. Angle of layer slop in the fault area at the near to Gourband Village, Reference: Author

Fig.13. Angle of layer slop in the fault area at the near to Toqoz Village, Reference: Author
10. Conclusion

Along Gourband Fault, there are various Geomorphologic Results such as: diverted rivers, fault scarps… Because of various geomorphologies related to active faulting, this fault is important. Displacement in Channels indicates the youngest movement in the fault. In the channels, Direction of displacement indicates direction of moving strike-slip in the fault. According to dextral displacement of the channels, movement of dextral strike-slip is evident for Gourband Fault. Various Fault uplifts are clear in all Gourband. These uplifts are as results from vertical component in the fault. Also, a block of fault that is affected by uplifting can be specified by these uplifts. Uplifting of river bed sediments at surface effect of Gourband Fault also indicate uplifting and reverse component in the fault. Therefore, the population who reside in these areas should be informed about occurring earthquake and any constructional projects and development, road construction, mining, watershed management; surface water control and digging well should be based on convention to prevent from future financial losses and causalities as far as possible.

11. References

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