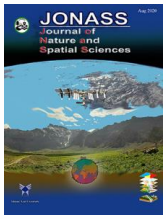
Available online at www.jonass.ir

Journal of Nature and Spatial Sciences

Journal homepage: www.jonass.ir



Original Article

The effect of active tectonic to the morphology of Derakht Tangan River fan of Shahdad in the west of Lut (Iran)

Somayeh Sadat Shahzeidi[a], Tooba Panahi[b]

[a]*Assistant professor, Department of geography, Geomorphology , Faculty of Literature and Humanities,University of Guilan ,Rasht,Iran*
[b]*MA.Student, Department of Geography and Urban Planning , Faculty of Geographical Sciences and Planning , University of Isfahan, Isfahan, Iran*

ARTICLE INFO

Article history:
Received 31 January 2021
Received in revised form 15 April 2021
Accepted 08 April 2021

Keywords:
Active tectonic; alluvial fan; effect of faults; morphology; Shahdad

ABSTRACT

Background and objective: The alluvial fan of the Shahdad is one of the huge alluvial in perfectly dry regions in the north eastern Kerman. This alluvial fan is formed by the effect of different materials erosion into the drainage basin of Shahdad River and laying these materials in the final part of this drainage basin called Lut plain. Tectonic acts with efficacy in the place of the settlements of the fan and this place is one of the active tectonic regions. The aim of this article is the morphology of the Derakhtangan river fan indicative of neotectonics in the region.
Materials and methods: The method of this research is descriptive-analytical. In the descriptive part, the changes in the region were studied using documentary studies and then using aerial photographs, Google Earth, geological maps and field studies.
Results and conclusion: One of the most important pieces of evidence in the region is the various faults in the area and imply to fan alluvium (from head to end), study line profile in past and present. The most important fault of the region is the great fault of Naiband, the southern fault of Shahdad and the series of faults having the direction of northwestern to southeastern and northern and Southern. The drainage basin of the alluvial fan of Shahdad leads from east to Lut and from west to the mountains of Bagbala and Kalisakie from north to the altitudes of Deahran and from south to the mountains of Joftan.

1. Introduction

The earth has not been static since birth, and changes in the crust, the site of human habitation, have been especially important to geomorphologists during the Fourth Period. This period has been accompanied by climate change and the evolution and spread of erosive phenomena, but it is a short time that the importance of the Quaternary has become clear to researchers. Less than a decade ago, this period was shown only in white and without any specifications and explanations in geological maps, but gradually, by

* *Corresponding author.* Tel.: +0-133-369-0274; fax: +0-133-369-0280.
E-mail address: s.shahzeidi@guilan.ac.ir , ORCID: *0000-0003-2960-2112*
Peer review under responsibility of Maybod Branch, Islamic Azad University

DOI: 10.30495/jonass.2021.1922292.1004

studying and recognizing the surface of the earth and recognizing the importance of the evolution of phenomena at this time, the fourth period in research The researches of geosciences caused new scientific divisions in various fields such as tectonics, glaciology, soil science, and etc. Meanwhile, geomorphologists have thought about this period with a special perspective and epistemology and describe phenomena. In their opinion, many processes and developments of phenomena can't be described in a short and limited time, and about how they evolved. In this article, the alluvial fans of the Shahdad past and present have been studied and the role and function of faults in the region in changing these centers can be mentioned. Faults, seams, and fissures are some of the most prominent phenomena and by evaluating them, one can understand the tectonic activities of those areas.

Various studies have been conducted in the field of alluvial fans, which can be mentioned as follows.

Drew did interesting studies the alluvial fans of the Northern Himalayas in 1873. Bull (1972) Classifies alluvial fans into three types based on longitudinal or radial sections of geometric shape. According to Bull (1972-1977), and Nilsson (1987) alluvial sediments are deposited under the influence of two general processes, river flows and debris flows. Shyom et al (1997) also conducted studies on alluvial fans and according to Ritter et al. (1993, 2000), the geomorphology of alluvial fans is based on environmental factors such as weather regimes, tectonic status, and lithology of highland basins. Beaumont (1972) studied the alluvial fans in Alborz for the first time in Iran.

Valvoa et al (1998) studied Controls on modern fan morphology in Calabria, Southern Italy and

Al-Farraj and Harvey (2000) studied Desert pavement characteristics on wadi terrace and alluvial fan surfaces, Wadi AI-Bih, U.A.E. and Oman. Arzanie 2005 in the Abarkooh region of Yazd have focused their studies on alluvial fans. Kumar et al (2007) studied the Evolution of the Quaternary alluvial fan system in the Himalayan foreland basin and emphasized the role of tectonic factors.Youliang Ji et al., (2020) studied the facies and sedimentary model of alluvial fans dominated by episodic flood events with dry conditions in northwestern China.

Thus according to the background, the objective was studying the effect of active tectonic to the morphology of Derakht Tangan River fan of Shahdad in the west of Lut (Iran).

2. Methodology

To study the alluvial fan of Derakht Tangan using topography maps of 1:50000 (including seven maps) and map of 1:250000 of the region and then using geological maps of 1:100000 and 1.250000 scales and main map and information prepared. Then, check it by field study, and then using Arc GIs, Cad map, and Surfer software were drawn map and analysed with satellite images.

2.1. The study area

The location of the study area is 30º 14' 30" to ' 30º36'12" N and 57º 2' 40" to 57º 45' E in Kerman province. The coniferous river of Derakhtangan river is limited from the east to Lut desert, from the west to Bagh-e Bala and Kliski mountains, from the north to the heights of Dehran, and from the south to Jaftan Mountain and located 95 km from Kerman. The total area is about 1042 square kilometers its environment is approximately equal to 334.2 square kilometers. The maximum height in the region is 3800 meters and the lowest point is 370 meters around Lut plain.

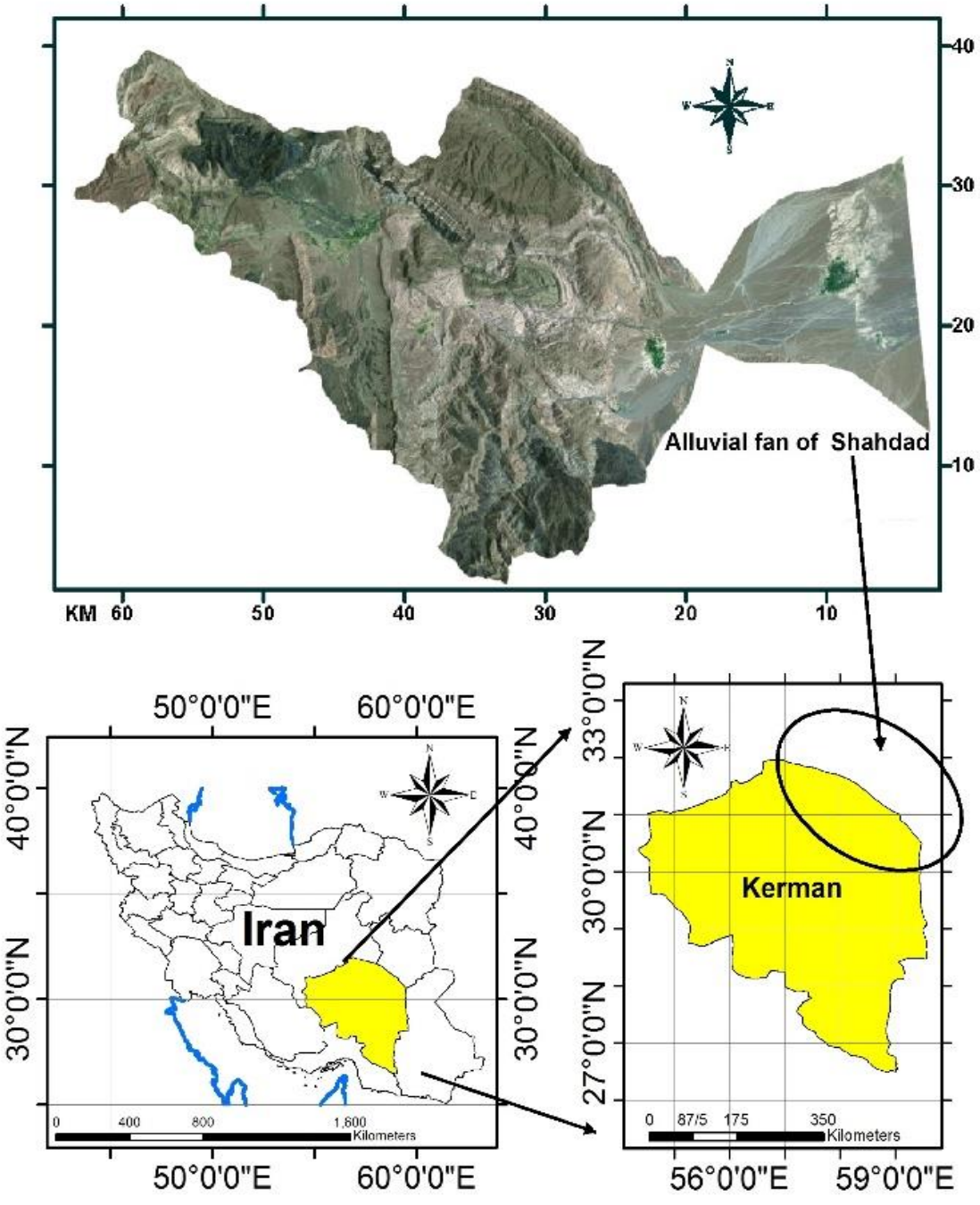


Fig. 1- Location of Alluvial fan of Kerman province (Authors)

3. Results and Discussions

One of the condensation phenomena in stream geomorphology is alluvial fans. The name of this phenomenon shifted on its almost conical shape. These phenomena usually at the junction of plains and mountains where the slope suddenly decreases (Fema, 1996). By entering the Loot, you see reducing the slope, the flow of the river reduced, its

sediments deposited in the foothills, and the alluvial fan is formed (Figure 3). This processing started during the Paleogene organic. Nayband fault (in the west of Loot) and the mountain front (current) have started rising, so the eastern it has suddenly fallen (Nayband fault, exactly on head of the alluvial fan). Continuity of these movements has caused the landform in Neogene changed and created two different levels so the alluvial fan tends to current shape in stages (geology map: scale: 1:100000).

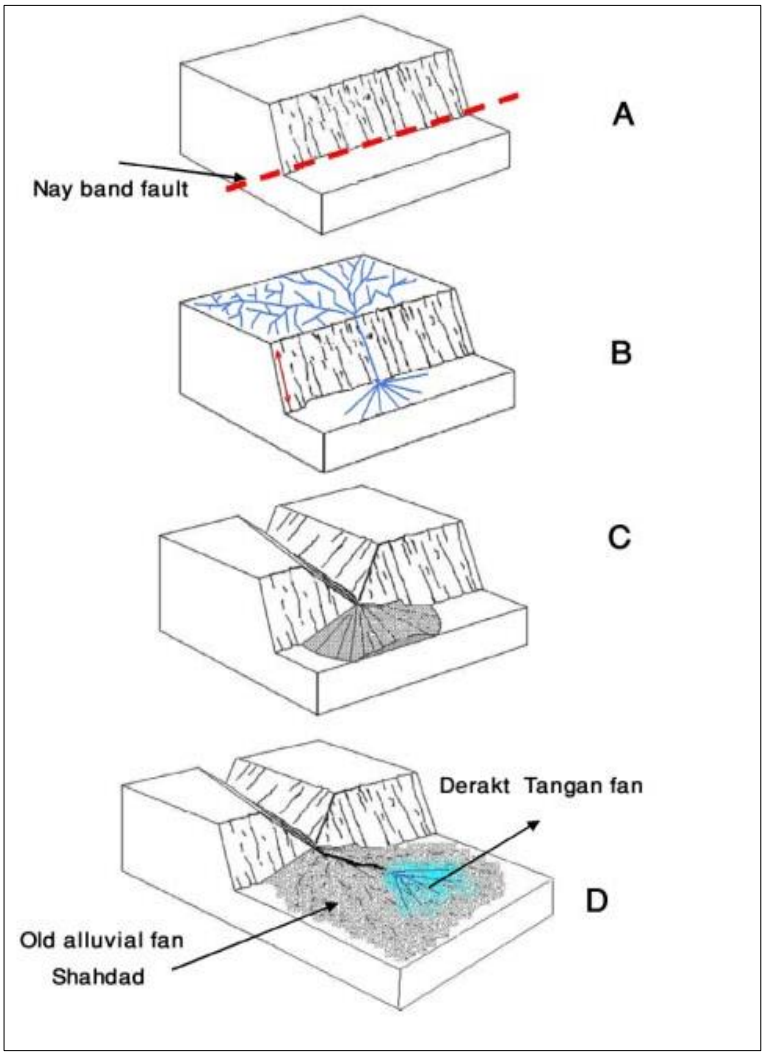


Fig. 2- Alluvial fan features (Authors)

The alluvial fans in this area are multi-layered on top of each other. The oldest of them is below, the youngest fans happen on it. These alluvial fans are certainly remnants of wet and rainy periods or strong currents of the past. Examples of such alluvial fans can see in the study area. Relative Age of alluvial fan analyzed from satellite imagery and map (Topography, 1:50000, 7550-IV). According to the waterways and pattern map was drawn.

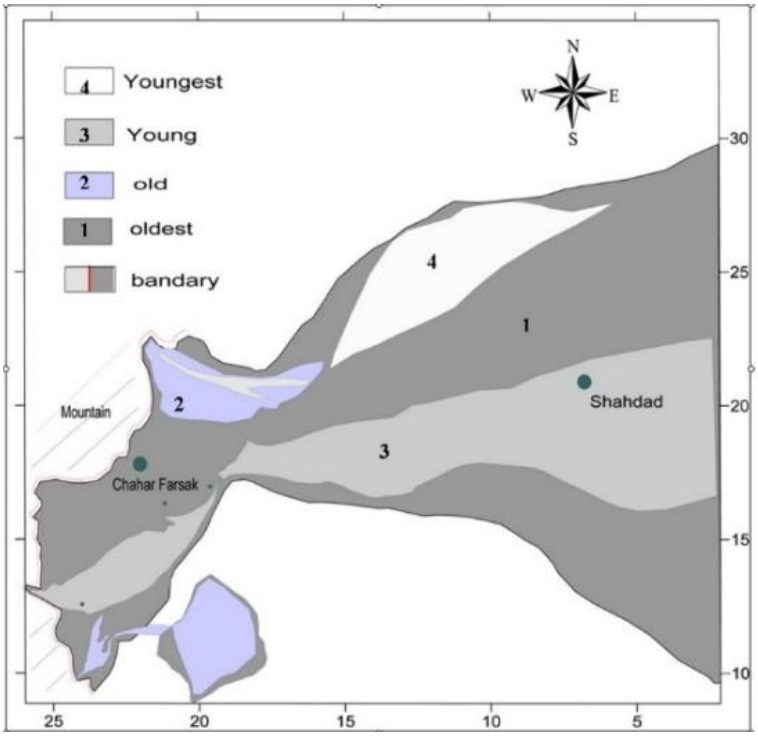


Fig .3- Drawing the relative age of alluvial fans from a satellite image based on the pattern of waterways and water movement (Authors)

3.1. The tectonic activities and several evidences

The tectonic movement was high and affected geology formation. We investigated the geology map (Index: 1/250000, 1/100000) of the studied case and separated it into two parts. One included a wide and vast plain covered with Quaternary deposits, Aeolians, sand dunes, around the Loot. The second elevation covers the hard formation and a little thin alluvial area. Geology sequence exists Precambrian to Quaternary. The important stones are limestone, sandstone, shale, and conglomerate. Active tectonic provided by several observations. Geologist and geomorphologist find some ways to show tectonic activities, so we explain some of them that Contain (Keller and Pinter, 1996)

Ratio of valley –floor width to valley height: Vf=2Vfw [(Eld- Esc) +(Erd- Esc)]

Where (Vf) is the valley- floor width – to height ratio, (Vfw) is the width of the valley floor, (Eld and Erd) are elevations of the left and right valley divides, (Esc) is the elevation of the valley floor. (Vf) values are different : (Vf) <1 tectonic is very active and show increasing uplift rates , .(Vf) between 1-2 semi-active , .(Vf)>2 low uplift rates.

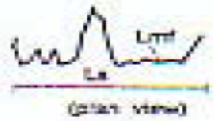
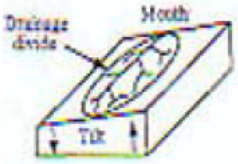
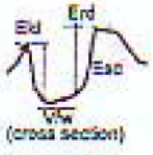
Mountain –front sinuosity: SMF = Lmf /Ls

SMF is the mountain–front sinuseity, (Lmf) is the length of the mountain front, where junction of the hillside and the mountain. A value near 1 shows uplift and active tectonic.

Drainage basin asymmetry: AF =100(Ar/At)

Ar: Basin area on the right side of the main waterway (facing downstream), At: it is the total area of the drainage basin, Af: should equal about 50. AF is asymmetry index. If the numerical values of this index are around 50, it will indicate the symmetry of the sub-drains to the main waterway and as a result, there is no skew due to erosion. (Keller and Pinter, 1996)

Table1- Table of values of equation (show active, semi-active, and none activity) (Authors)

Equation	conclusion	Measurement methods
S=Lmf/Ls	Between 1.1 -1.45 (Active)	
AF =100(Ar/At)	(Active) 68.98	
$V_f=2V_{fw}$ $[(E_{ld}- E_{sc}) + (E_{rd}- E_{sc})]$	Between 0.5 -1.04. (Active and in some place semi active)	

3.2. The hypsometric integral

Quantitative analysis of topography can be done with landscapes at any scale, from a single drainage basin to the entire planet. Compare results from a different area can be difficult without some technique for removing the effects of scale. The hypsometric curve is a graph of area-altitude distribution that is dimensionless. Factors out both the total size of the area being study and the total amount of relief. The hypsometric curve is a plot of relative height (h/H) area (a/A), which compares different areas to study the effects of bedrock types, plate tectonic settings, or the balance between tectonics and erosion. The hypsometric curve of the drainage basin of the alluvial fan of the Shahdad in Derakt Tangan River is in Figure3. It shows that tectonics conquest to erosion (Fig 4)

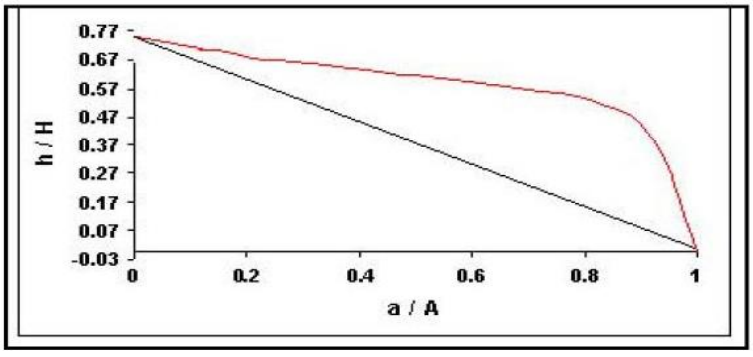


Fig. 4 - Hypsometric integral of drainage basin of The Derakt – Tangan River fan

3.3. Morphology of alluvial fan have three reasons:

Shahdad South Fault: This fault change morphology of the shahdad fan. Topography and separate parts of the fan show change morphology affected by active tectonic (Fig 5, 6).

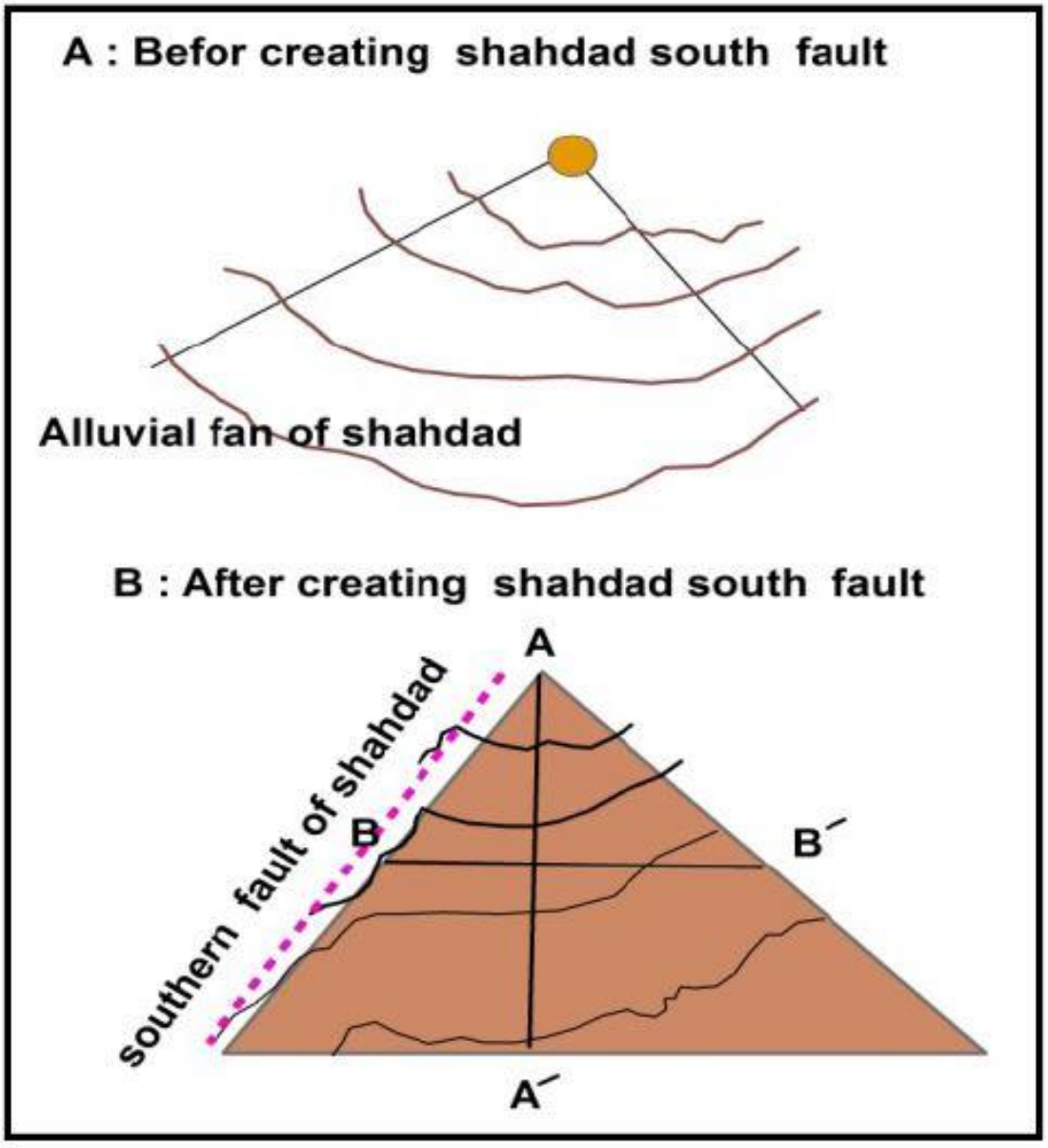


Fig. 5- Before and after creating shahdad south fault (Authors)

The series of a fault having a direction. Northwestern to SouthEastern and Northern and Southern in the drainage basin. Derakt Tangan River is on the Northwestern to South-Eastern fault and cut the drainage basin. This alluvial fan formed in the effect of different materials erosion into the drainage basin and laying these materials in the final name Loot (Fig 6).

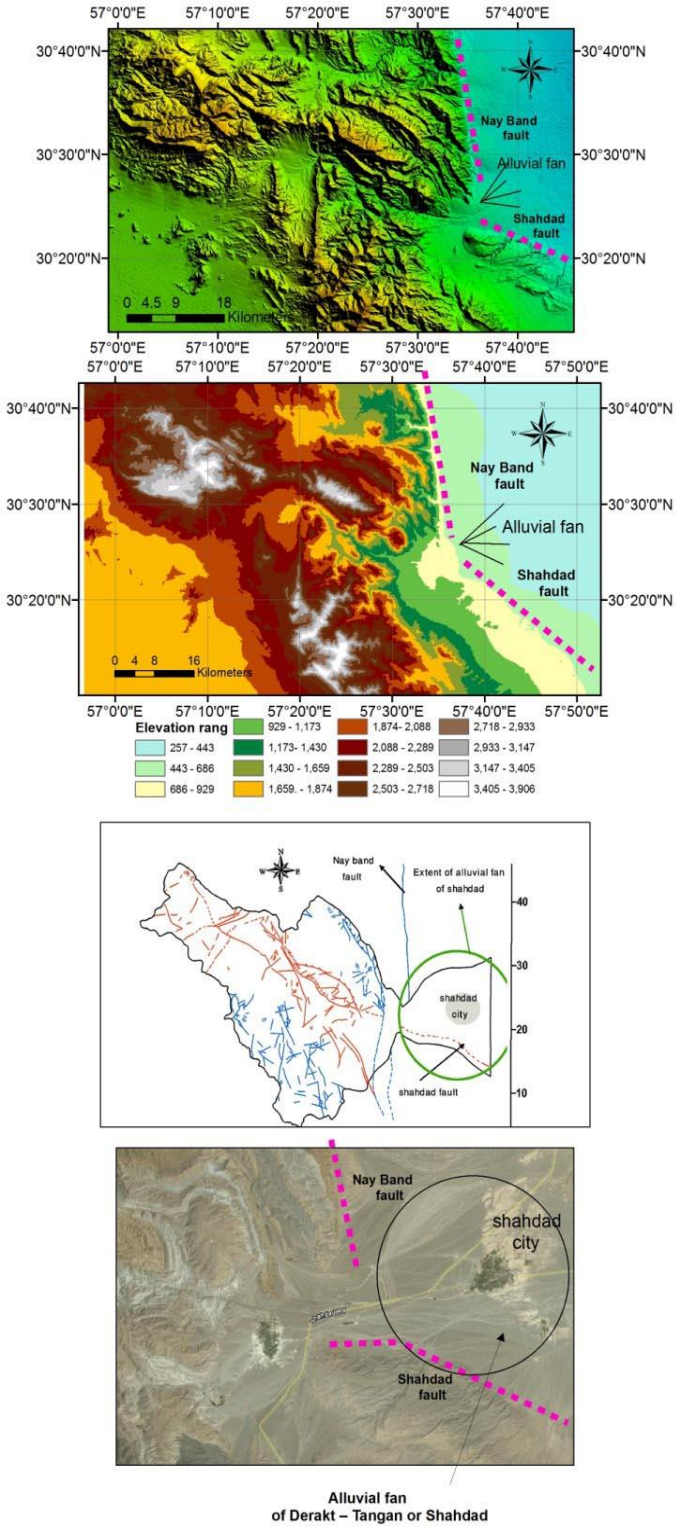


Fig. 6- Show main faults in field study (Authors)

4. Conclusion

Alluvial fans are known as divergent forms. These points important because if tectonic activities and climatic changes occur, these factors significant in the alluvial fan. And how they move and their effects on sedimentation, water flow, and pattern waterways can be studied and analyzed for us. The alluvial fan of Shahdad has undergone geological changes several times in past. These developments can understand in the shape changes according to the evidence. Young faults have played an essential role in its evolution by the impact and displacement of alluvial. The Fault, tension, gaps have extended in two directions - north-south and northwest-southeast. The southern Shahdad fault has caused the rise, south part of Shahdad and reduces the fan. The Nayband fault in the north-south direction has caused the change in level alluvial of fan Derakht Tangan. diversional of the main rivers and the establishment of the allovial fan of Shahdad to the north shows the role of faults.

Declarations

Funding Information (Private funding by authors, or funding's ID)
Conflict of Interest /Competing interests (None)
Availability of Data and Material (Data are available when requested)
Code availability (Not applicable)

REFERENCES

Arzani, N. (2005). The fluvial megafan of Abarkoh Basin (Central Iran): an example of flash-flood sedimentation in arid lands. *Geological Society, London,* Special Publications, 251(1), 41-59. https://doi.org/10.1144/GSL.SP.2005.251.01.04

Al-Farraj, A. , Harvey, A.M., (2000). Desert pavement characteristics on wadi terrace and alluvial fan surfaces: Wadi AI-Bih, U.A.E. and Oman.Geomorphology, 35, 279-297. https://doi.org/10.1016/S0169-555X (00) 00 0 49-0

Beaumont, P., (1972). Alluvial fans along the foothills of the Elburz Mountains, Iran: *Paleaeogeography, Palaeoclimatology, paleo ececology*.v 12,p. 251-273. https://doi.org/10.1016/0031-0182(72)90022-3

Bull, W.B., 1972. *Recognition of alluvial fan deposits in the stratigraphic record*. In: J.K. Rigby and W.K. Hamblin (Editors), Recognition of Ancient Sedimentary Environments. Society of Economic Paleontologists and Mineralogists, 16: 63–83. https://doi.org/10.1177/030913337700100202

Bull, W.B., (1964). Alluvial fans and near-surface subsidence in western Fresno County, California: *U.S. Geological Survey Professional* Paper 437-A, 70 p. https://doi.org/10.3133/pp437A

Drew, F.(1873). Alluvial and lacustrine deposits and glacial records of the Upper Indus Basin : *Geological Society of Landon Quarterly Journal*,v.29.P.441-471. https://doi.org/10.1144/GSL.JGS.1873.029.01-02.39

FEMA (Federal Emergency Management Agency).,(1996). *Alluvial fan flooding*: Nat'l Academy press, p: 1-4. https://doi.org/10.17226/5364.

Chonglong ,G ., Youliang ,J ., Chenliang, W., Jun, J., Ying, R., et.,(2020). Facies and depositional model of alluvial fan dominated by episodic flood events in arid conditions: An example from the Quaternary Poplar Fan, north-western China , *Sedemintology*, Volume67, Issue4, Pages 1750-1796, Error! Hyperlink reference not valid.

Geological Survey of Iran ,Geological map 1: 250,000 Kerman and 1: 100000 Kerman and Harjand Kerman

Keller E.A, Pinter N., (1996). *Active Tectonics: Earthquake, Uplift and landscape*, Prentice Hall Publication, London- p: 301,122-146. Active tectonics_Keller_Pinter_small.pdf .https://www.irsm.cas.cz › tectonic_geomorphology

Kumar, R., Suresh, N., Sangode, S.J., Kumaravel, V (2007). Evolution of the Quaternary alluvial fan system in the Himalayan foreland basin: Implications for tectonic and climatic decoupling. *Quaternary International*, 159, 6 20. https://doi.org/ 10.1016/j . quaint.2006.08.010

Nielsen, T.H., (1987). Alluvial fan deposits. In : Scholle, P,A., and Spearing,D. (eds)Sandstone depositional environments: *American Asociation of petroleum Geologists* Memoir 31,p.49-86. https://doi.org/10.1306/M31424C4

Province Natural Resources Organization. (1993). Shahdad Geological Report Geographical organization of the army, topographic maps of 50000/1 from Harjand (7451 III), Dehran (7451 II), Deh Mohammad Shah (7450 I), Kerman (7450 IV), Dehneh Ghar river (7551 III), Shahdad (7550IV), Mahan (7450 II).

Ritter,J.B.,et al., (1993) .Quaternary evolution of Cadar Creek alluvial fan , Montana. *Geomorphology* 8,287-307 .https://doi.org/10.1016/0169-555X(93)90025-W

Valvoa, M.S., Antronico a,L., Le Perab, E,.(1998) Controls on modern fan morphology in Calabria, Southern Italy , *Geomorphology* , Volume 24, Issues 2–3, Pages 169-187. https://doi.org/10.1016/S0169-555X(97)00079-2