Structural analysis of faults system in the West of Shahrood

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Abstract

Case study in the West of Shahrood to Tazare Valley is a part of Southern East Alborz. Area is bounded on the north and south by two faults are called North and South faults. These fault's boundaries with east-west trend and dip to north caused variation in the area's structural and morphological properties. Minute field investigations distinguished on the North and South faults and structural data perpendicular to the faulting, reverse kinematics with left-lateral movement on these faults.

Key words: *Eastern Alborz, Shahrood, Tazare, reverse fault, left-lateral movement*.

1- Introduction

Case study is between Tazareh Valley (Mehmandoost) to Shahrood from 54˚ 30΄ to 55˚ 00΄ Eastern longitude and 36˚ 20΄ to 36˚ 25΄ Northern latitude and it is 12.5Km wide and 45km long in the part of south eastern Alborz (fig.1). Access ways to the area Are Damghan-Shahrood asphalt road and several dirt roads branching from it, transversal valleys in the area and Tazareh asphalt road too (same fig.). With structural analysis of this area, it is realized Kinematic and dynamic properties of faults.

2- Data and procedures

Study methods in this research include studying of previous researches, remote sensing data processing and studying, field study included surveying properties of bedding, jointing and faulting, office and laboratory studies and data software analysis.

2-1- Geology setting

Stratigraphy: Precambrian, Mesozoic and Cenozoic rocks successions occurrence is proved with east-west spreading in this area [1], [2]. Bayandor formation as oldest rocks and Quaternary deposits as youngest units have outcrops in the area. Paleozoic rock units in the area include Soltanieh, Barut, Zagun, Lalun and Jeyrud formations; Mesozoic rock units in the area include Elika, Shemshak, Delichay, Lar formations, upper cretaceous rocks and Cenozoic rock units include Neogene Conglomerates and Quaternary sediments.

Structural geology: Structurally there are main faults with nearly east-west trend, synthetic faults with northeast-southwest or northwest-southeast trends, folding with northeast-southwest and east-west trends in the case study. Complete recognition obtained from these structures with studying of maps, air photographs, data satellites and field studying and surveying for defining of area deformation model.

Main fault: The case study is bounded by tow faults named north and south faults (N.F., S.F.) with east-west trend. Both of north and south faults relate together by F_1 fault with NE-SW trend.

North fault: It shows east-west trend from Tazareh valley (Mehmandoost town) to Deh-molla valley and north east-south west trend from Deh-molla valley to the west of Shahrood city. This fault is drawn as a lineament at continuation of Astaneh fault [2], [3]. Hallingworth (2006) indicated and named it as an east-continuation of Astaneh fault too [4]. Traces of this fault have outcrops on the north west of Shahrood city in the Lar and Delichay formations in the Deh-molla valley in the Shemshak formation and in the Tazareh valley in the Elika formation. Traces of north fault can be seen easily as a parallel lineament on the air-photographs and satellite imagery (fig. 2). With using mentioned remote sensing data can be said north fault as a fault zone has two main trends Kinematically: NE-SW and E-W. Regarding curved geometry of north fault in the case study, we can divide it to two east and west main parts. Stereograms in fig. 2 include cyclographic images, contours diagrams of fault planes of 19 compiled field data from east part of north fault. These diagrams show NE-SW trend and dip to NW in the east part (same fig.). Data density contour diagram about fault plane poles in the east part show that fault plane dominant trend position is 296˚/69˚ (N26˚E/69˚NW). This trend is concordant with measurement trend on the satellite imagery and air-photos, so that average of nearly azimuth of fault branches trace is about 35˚ on the satellite imagery and air photos. On the basis of compiled field data, cyclographic diagrams of fault planes and pole contour diagram of north fault-west part is drawn. Studying of these faults show two main trends: ENE-WSW, NE-SW. Rose diagram indicates ENE-WSW and NE-SW trend as a dominant trend. Dip of most fault plane is to north and northwest. Data density contour diagram of fault plane poles show that average of fault plane in the west part has a N66˚E/74˚NW position (same fig.). Schematic figure of north fault trace is seen in the fig. 3 with left-lateral reverse kinematic and curved geometry with two trends of E-W and NE-SW.

South fault: South fault can be seen from Tazareh valley (north of Mehmandoost town) to Deh-molla valley (north east of Deh-molla village) and between east longitude 54˚ 43′- 54˚ 30′ and north latitude 36˚ 19′ 04″- 36˚ 19′ 24″ as a lineament with nearly east-west trend and 16.5 Km long. This lineament is showed as a thrust fault named Tazareh thrust on the Geology map of Shahrood.

This fault is showed between Astaneh and Attary faults without name on the Geology maps of Damghan [3] and Gorgan [2]. This fault also mentioned as north of Damghan reverse fault [5]. Satellite imagery and air-photos show trace of this fault as an E-W lineament with E-W parallel discontinuous branches. In addition to remote sensing studying, field data show east-west trend too and dip to north. Fault plane pole contour diagram is representative of fault planes average with N83˚E/74˚NW. Strike rose diagram of measurement south fault planes shows dominant east-west trend (fig. 4).

F_1 fault: A fault is seen with nearly 3 kilometer long in Deh-molla valley on the east-north of Deh-molla village at the east longitude 54˚ 45′ 58″ to 54˚ 36′ 7.2″ and north latitude 36˚ 20′ 37″ to 36˚ 19′ 54″on the boundary between Soltanieh dolomitic unit and alluvium named as F_1 on the satellite imagery and or air-photos. The best access way to it is Deh-molla road. This lineament is seen clearly on the air-photos and satellite imagery (fig. 5). Just as remote sensing studying shows F_1 fault seen with NNE-SSW trend (Azimuth= 15˚) on the boundary between Soltanieh dolomitic unit and alluvium. Fault planes cyclographic with poles of them is observed in the fig. 5. Mentioned diagram surveying shows NE-SW trend and dip to Se as N12˚E/54˚SE.

Synthetic faults: Some of existing faults in the case study have small outcrop long and they are between two north and south main faults. They are studied as a minor faults or synthetic faults. Geometry position of them is oblique to main structure such as north and south main faults and folds. According to position of these faults, their source can be related to activity of north and south faults or folds in some states. Some of these faults have most clarity on the satellite imagery, recognizing on the land and showing two dominant NE-SW and NW-SE trends. Their predominant kinematic is oblique-slip.

3- Discussion

Faults system: In the case study two main north and south faults with similar east-west trend and dip to north construct north and south boundaries. F_1 fault with nearly north-south trend is at the east-end of south fault. F_1 is joined to zone of north fault where its trend changes from E-W in the west part of area to NE-SW in the east part of area (fig. 6). Both of the south and north faults have reverse kinematic with strike-slip left lateral movements. On the basis of remote sensing documents, field data and kinematic evidences, theses faults are defined kinematically as a thrust with left-lateral strike-slip. Evidences include traces of left-lateral movements such as striation traces with existing steps on the fault planes, brecciation, crescent joints and continuous trend fault with left-lateral movements. But F_1 fault has normal kinematic.

We can say about Kinematic model of faults that any of them movement connected to another fault activity and for this reason we named them a faults system. For displaying Arrangement of discussed three faults can be said that environment area of them is dividable to three blocks of A, B and C. F_1 fault isn't able to movement and activity separately and independently, so it is called a Transfer fault relating to south fault. Strike-slip movement of A-block is amortized to B-block at the bearing of south fault in contact with F_1 as a normal fault. In other words, it is foreseen that a pull-apart is forming at the direction of F_1 trend.

Studying of kinematic and dynamic relation between north, south and F_1 faults necessitate that these structures be compared and checked with known deformation models. Since present structural properties of this area can be known indebted to force left-lateral movement reverse faulting, area's structures compare with left-lateral Transpression deformation model. Inclined transpression is a composition of compression and oblique-slip shear components contemporaneously. Oblique-slip shear can be structured from composition of dip-slip and strike-slip movements. Existing of normal fault, releasing step-over and transfer fault is a part of inherent properties of such model [6]. With studying fig. 6, we can say formation of compression and shear forces between two north and south faults is caused to creation of extention and F_1 fault in conclusion.

Most of natural transpression zones are recognized by very non-homogeneous strain. Outcrop structures have transpression deformation including compression, left-lateral strike-slip and dip-slip and left-lateral oblique-slip kinematic [7], [8].

4- conclusion:

With comparing left-lateral inclined Transpression with area deformation model (fig.6) and with regards to left-lateral and reverse kinematic of main faults and relatively short distance between of them, case study should take into consideration as a left-lateral inclined transpression. This result shows existing stress field toward N-NE and crust movement toward north in this area of Iran country. It's compatible with obtained former results in southern margin of east-Alborz [9], [10], [11].

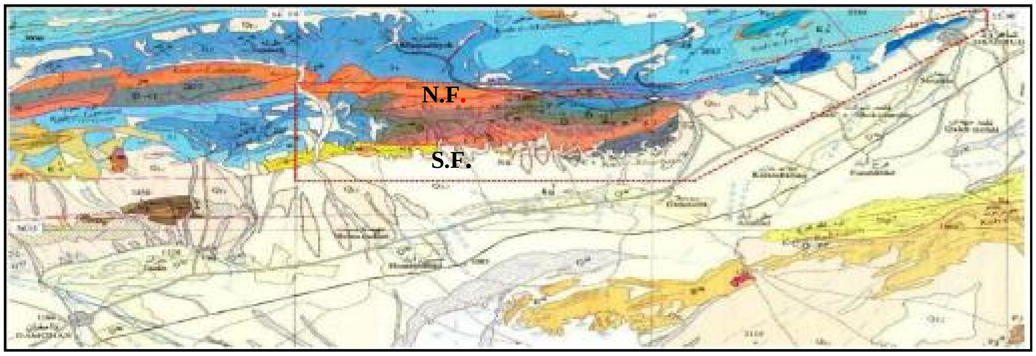

Figure 1- The case study is showed by red-dashed. North and south faults marked. (A part of Geology quadrangle of Gorgan [2]).

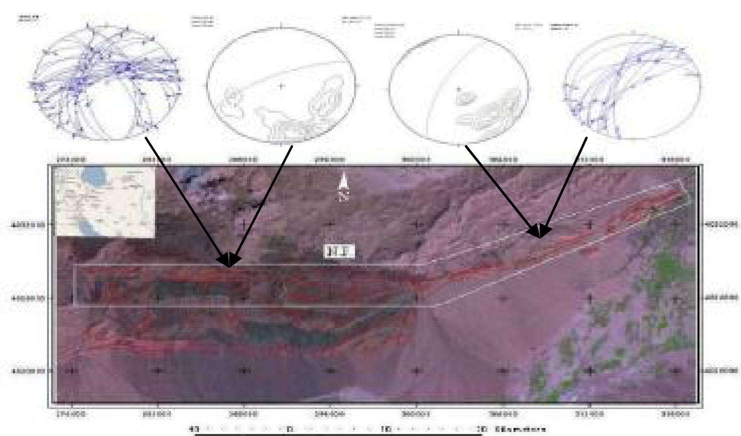

Figure 2- north Fault (N.F.) marked by white boundaries.

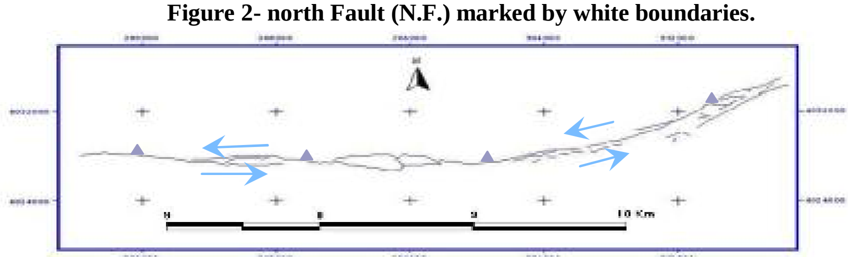

Figure 3- Schematic trace of North fault.

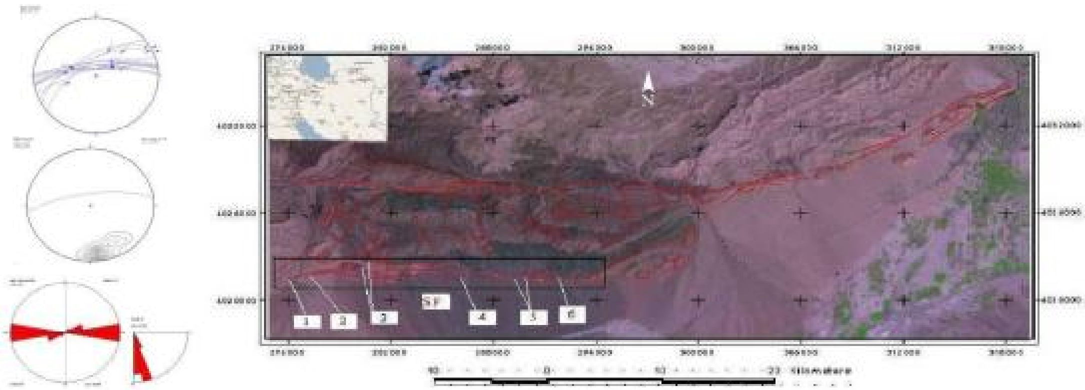

Figure 4- South fault and station of field data with cyclographic, contour and Rose diagrams.

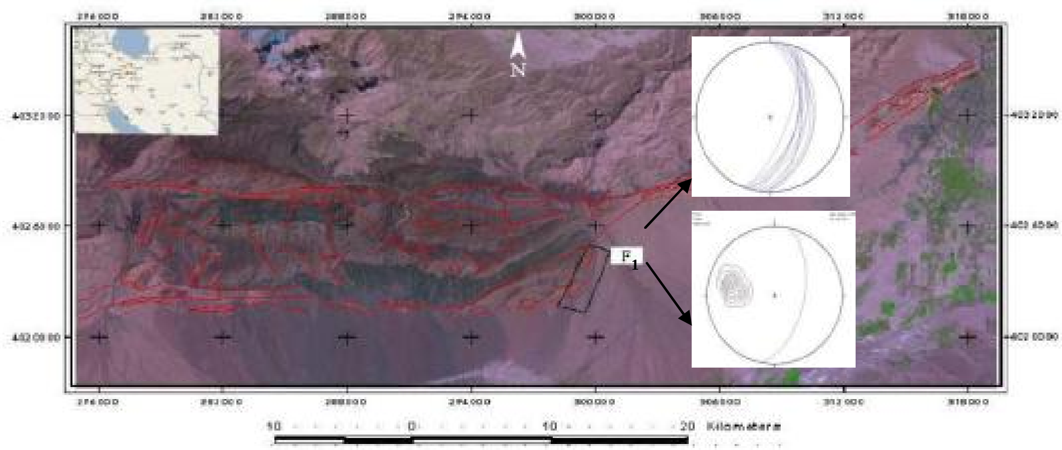

Figure 5- F_1 fault trace setting with cyclographic diagram of plane fault.

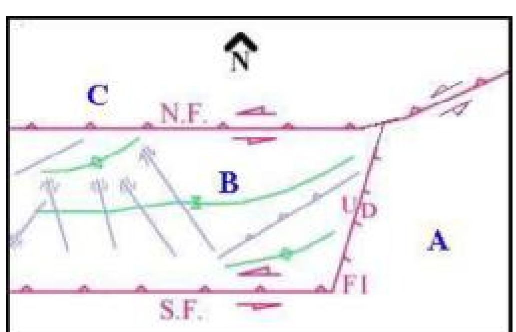

Figure 6- Existing Structures in the case study.

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