

Seismic Activity and Fractal Geometry of Kareh Bas Fault System in Zagros, South of Iran

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Abstract

Kareh Bas is one the transverse fault systems in Zagros fold-thrust belt. Kareh Bas Transcurrent Fault System with a total length of 200 Km is situated about 80 Km east of the Borazjan segment (a part of Kazerun fault zone) and 40 Km west of Shiraz. It is a nearly N-S trending right-lateral linked strike-slip fault system, and several anticlinal axes have been displaced by it. Strike separation (109 Km) of Mountain Front Fault/Flexure (MFF) of Zagros is the most important function of Kareh Bas Transcurrent Fault System. According to fractal analysis (Box-counting method) on space image maps (1:50,000) prepared from Spot data, fault related surface ruptures have non-linear patterns and fault segments have nearly plane form fractal dimensions; specially at north and south terminations. It means that, the north and south terminations of Kareh Bas Transcurrent Fault System are active (earthquake fault segments) and latter case is more active, because it is coinciding on Zagros mountain front faults (MFF).

Keywords

Fractal, Fault, Kareh Bas, Zagros, Transverse, Iran

1. Introduction

Kareh Bas is one of the transverse fault systems (**Figure 1**) in 28° to 30° north latitude and 52° to 58°30' east longitude. Kareh Bas Transcurrent fault system with a total length of 200 Km is situated at about 40 Km west of Shiraz and continued to south of Deh Ram.

In this research, fractal analysis of Kareh Bas fault system in Zagros, south of Iran has investigated. It has located in the Zagros-East Taurus Hinterland [1]. Dominant structural trends in Zagros province (**Figure 2**) are



Figure 1. Position of Karez Bas transverse fault system in Central Zagros on Satellite Image ETM+.

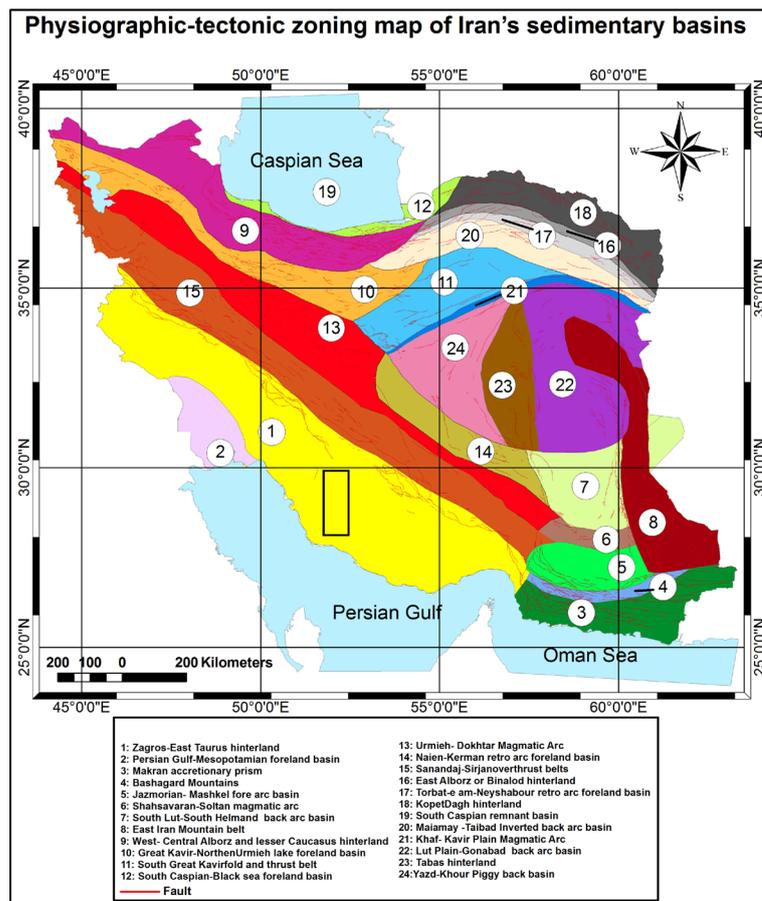


Figure 2. Physiographic-tectonic zoning map of Iran's sedimentary basins Iran modified from [1]. The study area is shown in the black rectangle.

NW-SE in northwestern part and E-W in southeastern part. From tectonics view, it contains the over thrust and simple fold belts of Zagros that are formed on the northeastern part of Arabian plate's passive margin. Zagros Mountains have continued to East Taurus Mountains in Turkey and have named Zagros-East Taurus hinterland. Zagros-East Taurus hinterland is external platform (fold and thrust belt) of north margin of Arabian Craton. Vergence of folding in this hinterland is toward south and southwest [2] [3].

2. Materials and Methods

In this research, the box-counting method has used for fractal analysis Kareh Bas fault system in Zagros and fractal dimension of each segments were calculated by determining of linear regressions in logarithmic diagrams.

Kareh Bas fault system is a nearly N-S trending right-lateral linked strike slip fault system and Dalu, Salamati, Bakak, Dadenjan, Siakh, Khartu-Surmeh [4] and Bahar Anticlines has displaced by it (Figure 3). Kareh BasTranscurrent Fault System consists of six structural segments with relay and anastomosing arrays (Figure 4).

Most of fault segments have smooth continuous mapped traces, because; Jogs had smoothed-out by abrasion and short-cut faults, with increasing displacement. Therefore, there are hard-linkages [5] and shear lens that occurred by development of acognate horses [6]. Also, seven Hormoz salt plugs (Figure 3) have intruded along MTFS [7].

Focal mechanisms of numerous earthquakes are reversed and thrust [11] such as Naghan and Ardal ($M_s = 6.1$, 1977) and or right slip in related to N-S strike slip faults such as Kazeran (SE Boshehr $M_s = 6.2$, 2013) or Kareh Bas (Firozabad-Fars $M_s = 6.1$, 1994).

Zagros province experiences low to moderate earthquakes with high frequency, short repeat time and 10 - 20 Km focal depth. Intensity of earthquakes is in middle levels in which there are several ductile rocks (thick evaporates) in sedimentary covers such as Hormuz, Dashtak, and Gachsaran formations. Sometimes in northern margin of this province, focal depths exceed to 70 Km [12] which is an indication of initial stages of thick-skinned tectonics.

Also, based on previous work on the salt diapirism [13]-[22] and neotectonics regime in Iran [23], Zagros in south Iran is the most active zone [24]-[36]. Then, Alborz in north Iran [37]-[66] and Central Iran [68]-[76] have been situated in the next orders.

3. Results and Discussion

Dominant mechanism of Kareh BasTranscurrent Fault System is Dextral strike slip and the most important function of that, is strike separation of Mountain front fault/flexure (MFF) about 109 Km (Figure 5).

Thus, this large-displacement strike-slip fault system that cut north margin of continental basement of Arabian plate as well as sedimentary cover, should be termed "Transcurrent Fault System" [78]. Also, Isopach and facies maps are indicatives of surface ruptures concerns to post folding of Zagros, because the anticlines had dragged and displaced by Kareh BasTranscurrent Fault System that makes non-gas bearing trend in the Fars area.

Box-counting method has used for fractal analysis [79] and squares with a side of 0.5, 1 and 2 Km have chosen because space image maps have 1:50,000 scale.

Then, fractal dimension of each segments with all related master joints were calculated by determining of linear regressions in logarithmic diagrams. These diagrams show the number of squares in the axis Y and the inverse length of side squares in the axis X. Fractal dimensions of structural segments have been shown in Table 1.

Fractal Dimension of segments in Kareh BasTranscurrent Fault System is near to plane-form and therefore, surface development of these, is non-linear.

Great fractal dimension of the sixth segment of Kareh BasTranscurrent Fault System is result of high activity on south termination and development of Kalagh and Daryai fault propagation folds confirms it. Increasing of fractal dimension on structural segments No. 2, 1 to northward and No. 4, 5, 6 (Figure 5) to southward is result of strain concentration at north and south terminations of Kareh BasTranscurrent Fault System. In the other words, increasing of fractal dimension caused to the more non-Linear geometry and frictional behavior. Therefore, there are more seismic events.

4. Conclusions

Based on fractal analysis (Box-counting method) on space image maps (1:50,000) prepared from Spot data, fault

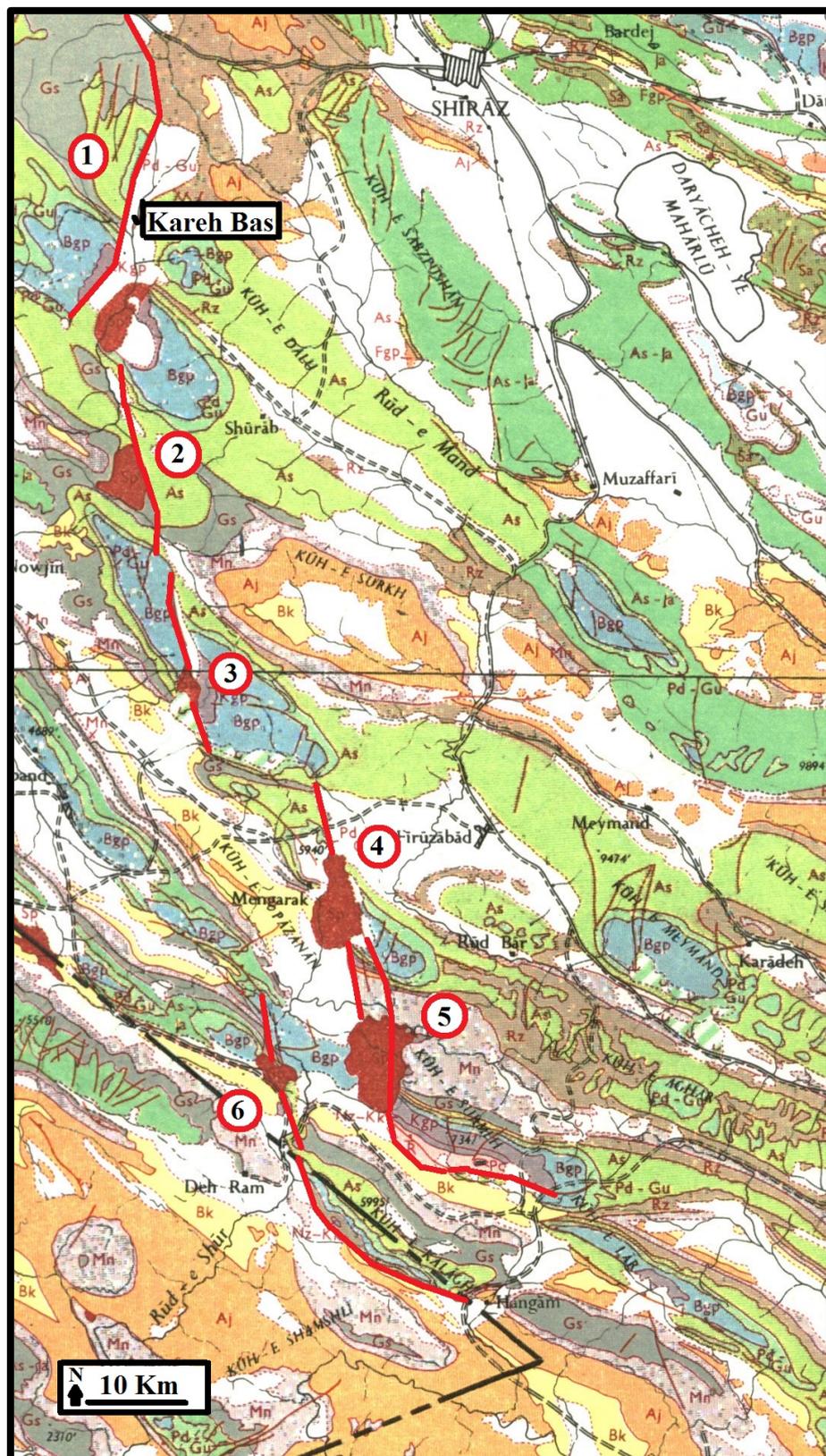


Figure 3. Position of Karez Bas transverse fault system related to Surrounding Structures on the part of Geological Map of South-West Iran (1:1,000,000), modified from [8].

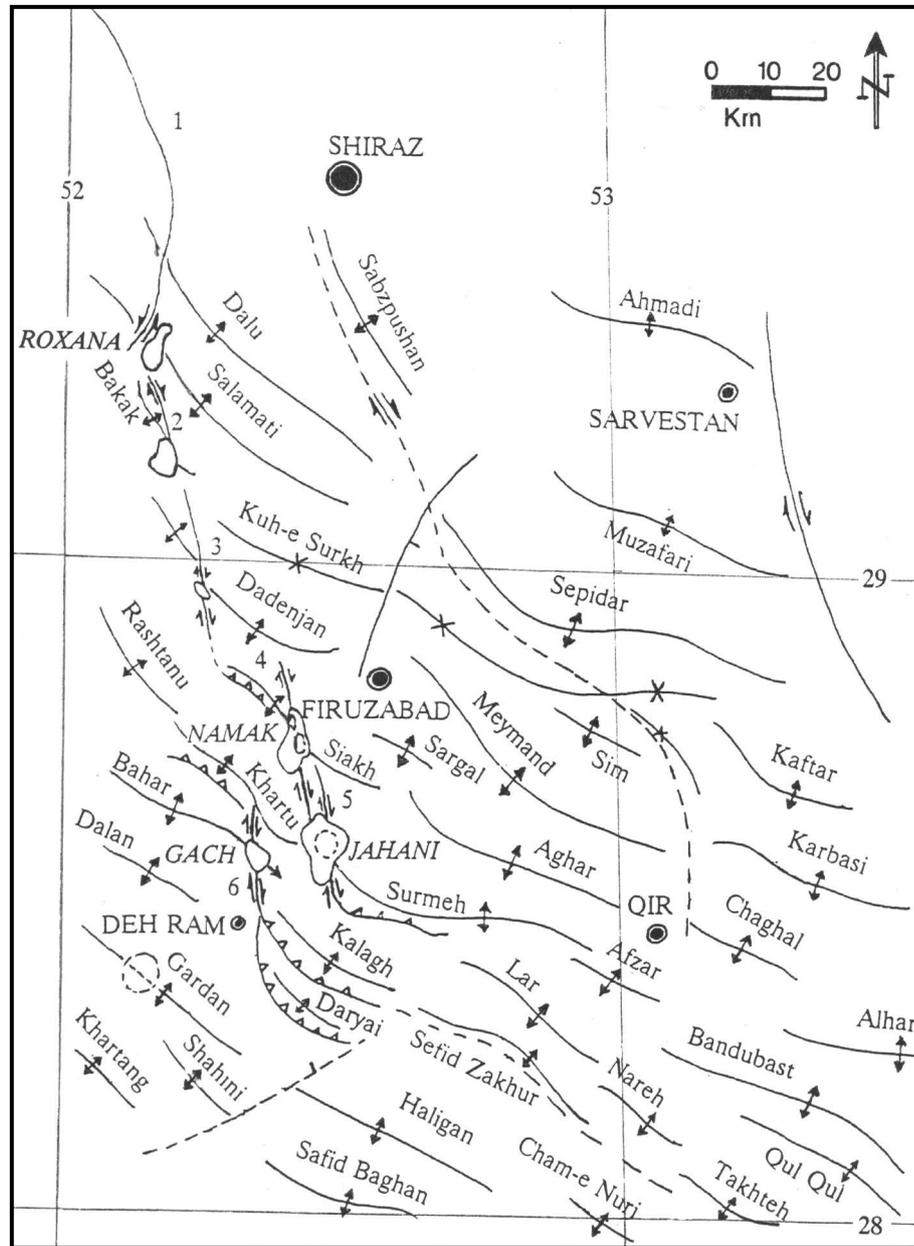


Figure 4. Structural map of Kareh Bas transverse fault system, based on [9] and Shiraz 1:250000 Geological Map [10].

Table 1. Fractal dimensions of structural segments in MTFS.

Fault Segment	Length (Km)	Fractal Dimension	Geometry	Earthquake Frequency
1	>60	1.69	Non-Linear	High
2	22	1.62	Non-Linear	High
3	28	1.74	Non-Linear	High
4	30	1.71	Non-Linear	High
5	>25	1.75	Non-Linear	High
6	34	1.76	Non-Linear	High

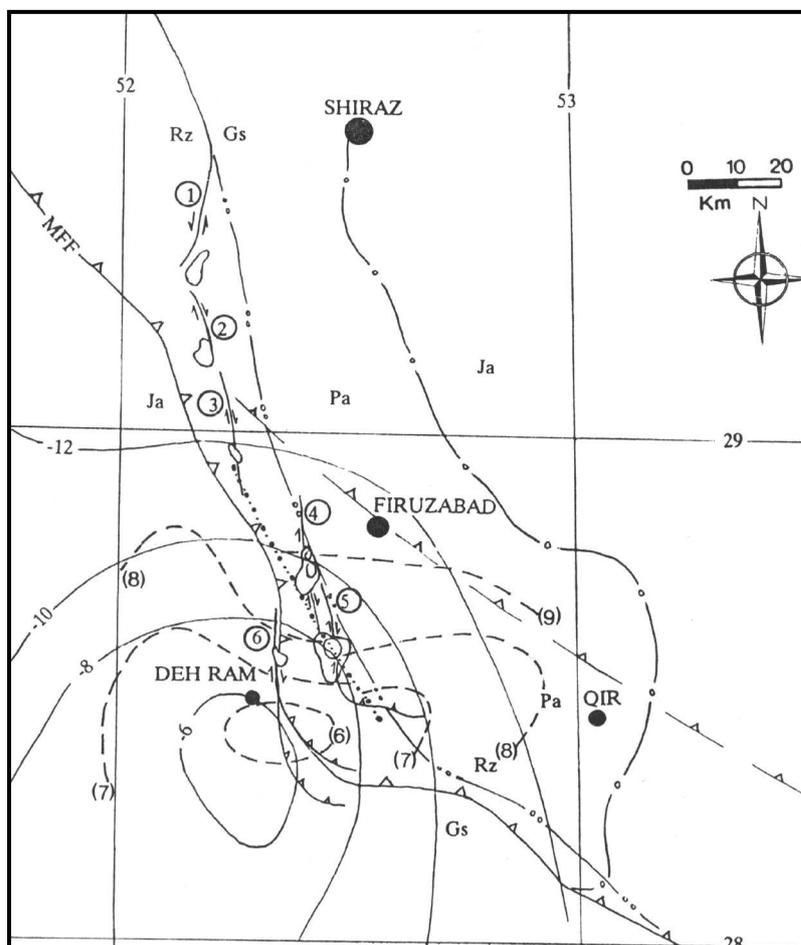


Figure 5. Subsurface Structural map of Kareh Bas transverse fault system and top of basement contour map, based on [9], [10] and [77].

related surface ruptures have non-linear patterns and fault segments have nearly plane form fractal dimensions; specially at north and south terminations. In other words, the north and south terminations of Kareh Bas Trans current Fault System are active, according to its non-linear dimension (1.62 - 1.76). In addition, the south termination is more active (with fractal dimension 1.76), because it is coinciding on Zagros mountain front faults (MFF).

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