

# The Role of Razak Fault in Controlling the Sedimentary Basin and Hydrocarbon Systems in External Fars Region, Zagros, Iran

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**Abstract**—Fars sub-basin is located in the Zagros fold-thrust belt and includes a large number of hydrocarbon reserves, especially gas. The existence of numerous basement faults and strike-slip in this region along with the uplift and depocenter of basement blocks has been considered effective factors in controlling sedimentary basins before, after, and synchronous with sedimentation. In this study, the role of the Razak fault basin in the external Fars area as an effective factor in controlling the sedimentary basin was evaluated. For this purpose, by providing isopach maps and 3D modeling from the basin floor at synsedimentary formations, the activity of the Razak fault along with its role in increasing or decreasing the hydrocarbon potential of the region and adjacent anticlines, was investigated. The results show that the inactivity of this fault at the sedimentation time of the Dalan, Gadvan, Darian, and Kazhdumi formations, while at the deposition time, the formations of Kangan, Dashtak, Hith, Fahlian, Laffan, Ilam, and Pabadeh remained active and controlled the sedimentation in the basin. Also, the uplift and depocenter of the basement blocks occurred to the Razak fault's performance, caused an increase in the hydrocarbon potential of the Dehram Group in the anticlines of Marz, Varavi, Tabnak, Dehnow, Khalfani, Chiru, and Madar. While the northeastern part of the study area and the anticlines of Bonashkatu, Pishvar, Bavush, Gavbast, and Gezzeh are less important. In addition, Khami and Bangestan reservoirs are also without hydrocarbon potential due to the Razak fault's performance.

**Keywords:** hydrocarbon systems, Razak fault, Fars, Zagros, Basement Fault

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## INTRODUCTION

The Zagros fold and thrust belt are one of the most important hydrocarbon areas in the world, which has always been the focus and discussion of many researchers [3, 4, 20, 37].

This region is divided into several parts in terms of alluvial and structural patterns, and consisted of Lorestan, Dezful Embayment, Abadan Plain, Izeh, Fars, and Hinterland of Bandar Abbas respectively from northwest to southeast [13]. The studied area is located in the Fars Basin (Fig. 1).

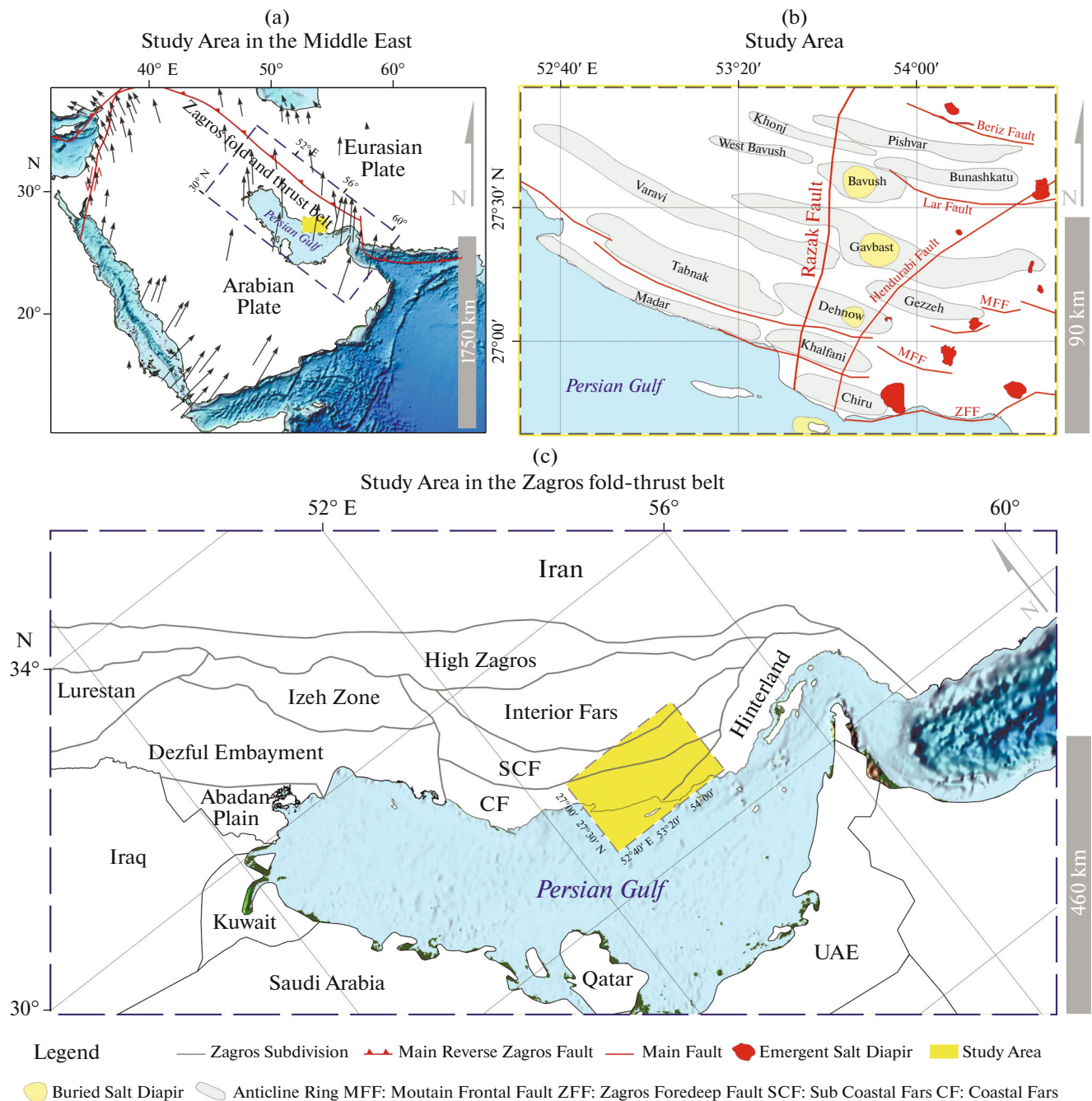
The Fars Basin is from the east to the Bastak fault, from the west to the Kazerun and Borazjan faults, from the north to the Karebas and Qir faults, and from the south to the Persian Gulf. The faults of Razak, Hendurabi, Mountain Frontal Fault (MFF), Zagros Foredeep Fault (ZFF), and Bastak fault are important in this basin [13, 21, 22, 47, 53].

The presence of numerous basement faults in the Fars region is considered an important tectonic and effective factor, so these faults, due to their function, cause changes in the axial folds and also the expansion of salt diapirs [15, 23, 56]. There is also the question of

whether the function of these faults has affected the sedimentation in the area. And how have these changes in different periods?

The presence of numerous deep faults in the Fars region has caused the basement of this area to be divided into separate blocks [10]. Therefore, large changes in the thickness of the formations in this area could lead to a displacement of bedrock blocks, followed by numerous uplifts and depocenters. Because the changes in the thickness of the formations indicate several tectonic activities that controlled the sedimentary basin and caused several sedimentation cycles due to the advance and retreat of seawater [63]. Among the latest studies in this field, the following one should be mentioned. Urbaniec et al. [60] based on Seismostratigraphic Interpretation in Southern Poland, found that changes in the thickness of formations could be a result of tectonic activities and erosional processes. In addition, the sedimentation in the first stages clearly indicates the paleomorphology of the older substrate.

The purpose of the present paper is to investigate the role of the Razak fault in controlling the sedimen-



**Fig. 1.** (a) The tectonics setting of the study area in the Middle East, the direction of the Arabian plate movement and the impact of Red Sea rifting on the Zagros fold-thrust belt have been shown with pink arrows (after [18, 58] modified); (b) The structural map of the study area in which the location of basement faults and emergent and buried salt diapirs has been identified; (c) The location of the study area in Zagros fold-thrust belt along with its sub basins (after [12, 41], modified).

tary basin and hydrocarbon systems in the External Fars region, Zagros.

Zhong et al. [63] studied the north-western Sichuan Basin located in South China and found that paleo-uplifts are effective in controlling the thickness of formations and control sedimentation. So these regional uplifts have caused the end of sedimentation and erosion to begin. Therefore, the change in the

thickness of the formations can reflect the ancient sedimentation conditions. Ramos et al. [44] found that the sedimentary record was strongly controlled by tectonics using the same thickness maps and their interpretation. Studies on how sedimentation and its relation with basement faults are still poor in the Fars region. Also high-resolution seismic data that would allow for multiple analyses are lacking or unavailable in this

area. Therefore, our main goal is to expand information using the results of excavations and 3D modelling around the Razak fault in the Fars region. The 3D modelling in this study will help us to understand better the effect of the Razak fault in controlling of the sedimentary basin and results can also be generalized to other studies.

## GEOLOGICAL SETTING

### *Geology and Stratigraphy of the Study Area*

The Zagros fold-thrust belt has resulted from a continental collision between the Arabian and Eurasian plates, after a long period of NE-dipping subduction of the Neo-Tethys Ocean since Late Triassic or Early Jurassic e.g. [1, 26, 42]. It extends from the Makran subduction zone in the southeast to the East Anatolian Fault in the northwest [26, 42, 61]. The Zagros is an orogen characterized by flexural processes that is a perfect storm for hydrocarbon generation and preservation. It is multiple stacked sources ensure continuous hydrocarbon generation [33].

The evolution of the Zagros fold-thrust belt can be summarized into three successive events that include the subduction of the Neo-Tethys ocean into the lithosphere of Iran during the early cretaceous to the late cretaceous, obduction of parts of the Neo-Tethys oceanic crust on the Afro-Arabian passive continental plate in the late cretaceous (Tournesian-Campanian) and finally the collision of the Afro-Arabian continental lithosphere with the central Iranian plate in the Miocene [2, 32]. The relationship between sedimentary basins [5, 6, 8, 16, 35] and basement faulting [9, 39, 40, 43, 45, 46] indicates the role of faults in the control of sedimentary basins in Iran. In terms of lithofacies, Iran divided into several large tectonostratigraphic units [7, 51, 59]. In the study region, structures have a northwest-southeast trend, and the role of the paleogeographic faults in basin separation is considerable.

The Zagros is subdivided into several tectonostratigraphic units based on their structural style and sedimentary history, including Fars Province (Interior and External Fars), Dezful Embayment, Izeh Zone, High Zagros, Lurestan Province, Abadan Plain and Bandar-Abbas Hinterland e.g. [19, 25] (Fig. 1). The External Fars sub-basin is divided into the Coastal Fars and Sub-Coastal Fars sub-basins and is located in the southeastern part of Zagros. This sub-basin is limited to the Bastak fault from the east to the Kazerun and Borazjan faults from the west, to the Karebas and Qir faults from the north, and to the Persian Gulf from the south and it contains a collection of folds and emergent or buried salt diapirs. The folds of the region mainly have an NW-SE trend and to the Bandar-Abbas hinterland the trend of folds shifts to the E-W. The basement thrust faults of the region also have a longitudinal and parallel trend with the Zagros fold-

thrust belt, and strike-slip faults have two major N-S and NE-SW trends. Salt diapirs that are widespread in the area can also be associated with basement faults [14, 15, 29, 34, 36].

The External Fars sub-basin has about 90 anticlinal structures which 35 anticlines have been drilled. The study area is located at the geographical positions of 52°30'00"-54°30'00" E and 26°30'00"-28°00'00" N and in the eastern part of the external Fars. Parts of the Razak, Hendurabi, and MFF faults are located in this range. In this area, the Pishvar, Khonj, Bavush, West Bavush (Marz), Bonashkatu, Gavbast, Varavi, Shanul, Tabnak, Dehnow, Gezzeh, Khalfani, Chiru and Madar anticlines are located around the Razak fault. In terms of hydrocarbon reservoirs, the Bavush anticline in the Khami Group and the Tabnak, Varavi, and Shanul anticlines in the Dehram Group contain gas reserves. The main source rock of this area is the Ordovician-Silurian shales and the gas reserves in the Dalan and Kangan reservoirs are the result of the Silurian shales performance [3, 17].

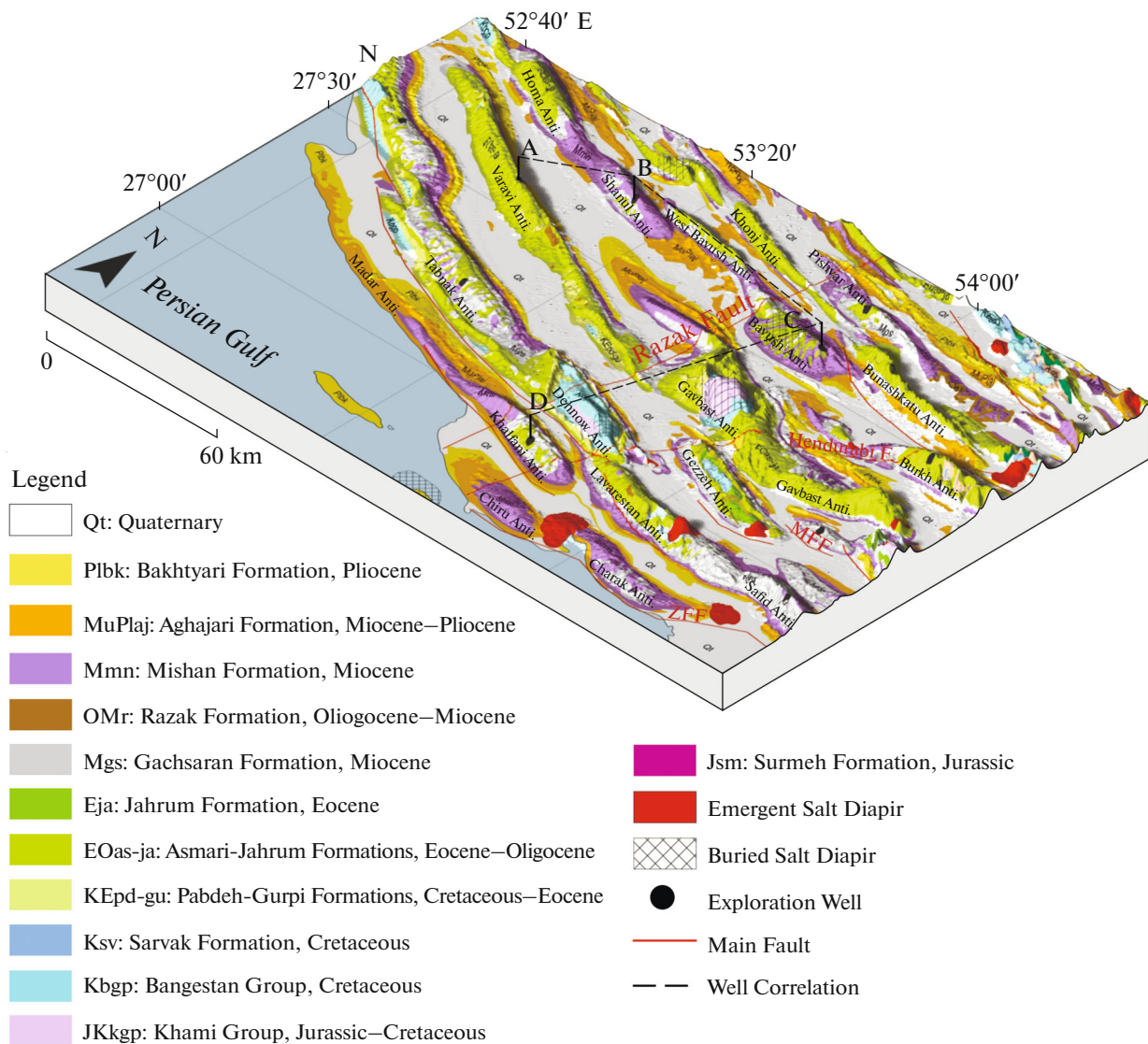
The Triassic Dashtak Formation evaporite is the main caprock of the Dehram reservoirs [38]. In the studied area, hydrocarbon traps are mainly structural and include anticlines and salt diapirs [27, 28, 38]. The Hormuz with the approximate age of Precambrian-Cambrian is the oldest outcrop in the area. The location of the anticlines around the Razak fault with geological characteristics and stratigraphy of the study area is shown (Figs. 2, 3).

Barzegar [11] showed this fault in the map based on Gemini satellite images. Although Barzegar [11] did not indicate the mechanism of the Razak fault, later according to the displacement of the fold axis, the mechanism of this fault was introduced sinistral strike-slip. This fault with the NNE-SSW trend and with a length of about 230 km starts from adjacent to Bandar-e Nakhilu and continues to the eastern plunge of the Kuh-e Toudej anticline.

So far, different researchers have studied the Razak fault and its effect on region structures. Hessiani et al., [24] with study on the strike-slip faulting importance in the Zagros fold-thrust belt, consider the Razak fault as one of the basement faults of the Zagros. This fault has caused the bending and cutting of anticlinal structures axis and sinistral displacement of the seismic zone.

Yassaghi [62] based on field observations and compilation of magnetic maps with information obtained from remote sensing studies, considered the Razak fault as a basement fault.

In order to assess the basement faults, the focal depth of the recorded earthquakes can be used. To study the basement being of the Razak fault in the external Fars region, earthquakes occurred from the year 1900 to 2019 up to a distance of 30 km from the fault and with a magnitude of more than 2.5 were extracted (Fig. 4).



**Fig. 2.** 3D geological map of the study area with the anticlinal structures around the Razak fault in the external Fars sub-basin. Location of the well correlation is shown in Fig. 3.

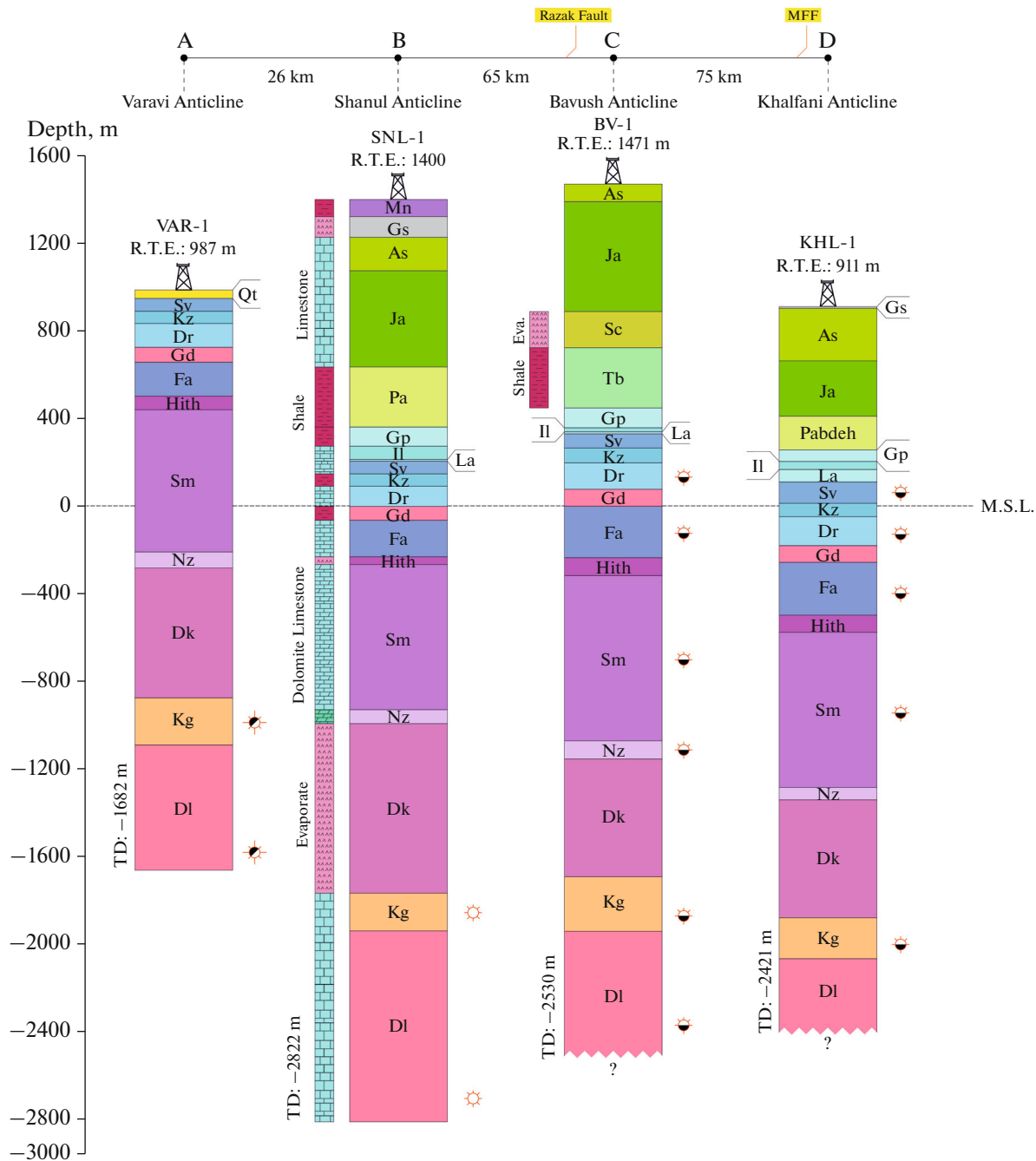
## MATERIALS AND METHODS

The isopach maps are main tools in geology that show the thickness changes of sedimentary units. For the first time, Kay [31] used the isopach maps to evaluate the structural sequence. By preparation of the isopach maps and three-dimensional modeling of sedimentary basin floor for formations, valuable information can be obtained about the tectonic changes in the studied area. These maps make it possible to assess better the hydrocarbon systems of the region. The faults control the facies contained in the sedimentary cover on the basement [24, 50, 55, 60,

63] and also the thickness of the sedimentary cover, thus, by analyzing the isopach maps, the appropriate tool can be used to investigate the role of destructive and destructive faults in the hydrocarbon capability of the region. In order to extract the sedimentary basin floor during sedimentation, it can be approached by reversing the thickness and drawing a 3D curve approach into the shape of the sedimentary basin floor [48].

Generally, the basement faults due to their performance divide the basement into separate blocks. Each block exhibits different behavior. This change in

**Fig. 3.** Correlation of wells and stratigraphy chart in the study area along with hydrocarbon status at different depths. The position of the used wells is shown in Fig. 2.



Paleozoic					Mesozoic										Cenozoic														
Cambrian	O.	S.	D.	C.	Permian	Triassic	L. J.	M. J.	U. J.	Cretaceous					Paleogene		Neogene		Q.										
Hormoz Series	Ondovician Silurian Shale	Zakreen			Faraghan	Dl	Kg	Kk	Dk	Nz	Sm	Hith	Fa	Gd	Dr	Kz	Sv	La	Il	Gp	Sc	Tb	Pd	Ja	As	Gs	Rz	Aj	Bk

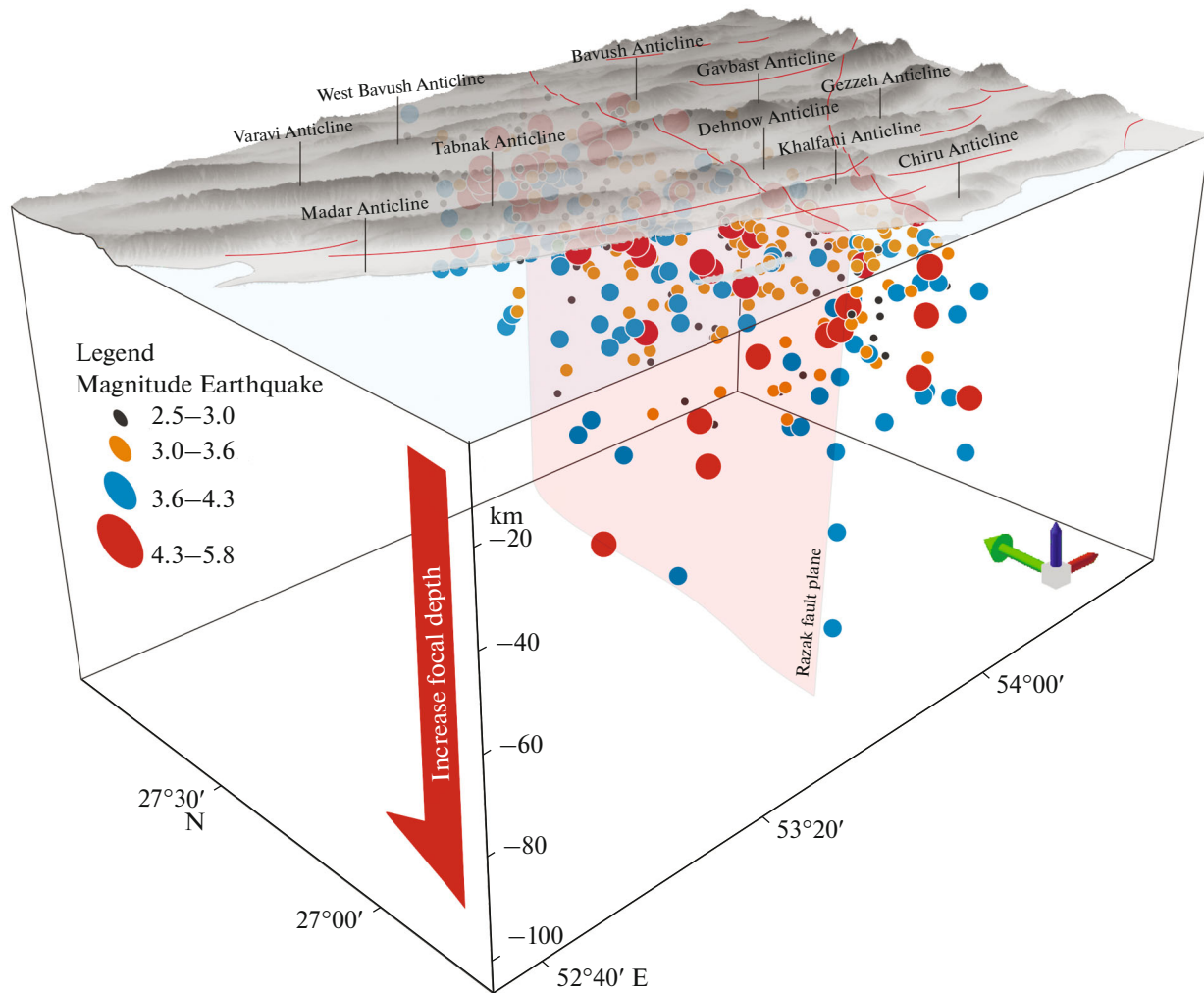
R.T.E.: Rotary table elevation TD: Total depth M.S.L.: Mean sea level MFF: Mountain frontal fault Eva.: Evaporate  
 ☀ Gas and condensate ☀ Gas ☀ Dry hole with show of oil and gas

**Legend**

**Formation name**

Aj: Aghajari	Gs: Gachsaran	Nz: Neyriz	La: Laffan	Fa: Fahlian	Kz: Kazhdumi	Dl: Dalan	Kg: Kangan	Sc: Sachun	Dk: Dashtak
As: Asmari	Gp: Gurpi	Pb: Pabdeh	Tb: Tarbur	Sm: Surmeh	Kk: Khanehkat	Gd: Gadvan	Ja: Jahrum	Dk: Dashtak	Rz: Razak
Bk: Bakhtyari	Il: Ilam	Qt: Quaternary	Mn: Mishan	Dr: Darian	Sv: Sarvak				





**Fig. 4.** 3D earthquake focal depth and magnitude map of Razak fault in the external Fars (from the year 1900 to November 2019), (data from the Iranian Seismological Center (IRSC) and the United States Geological Survey (USGS)).

behavior of basement blocks creates many uplifts and depocenters that should be affected the distribution of hydrocarbons in the region. For instance, by placing the basin in the deeper part, it is much more likely to form source rocks with appropriate organic matter richness. Also in areas where along with synsedimentary the uplift happens, the potential for the formation of source rocks is reduced. This effect is post-depositional and can control burial depth for source rocks. Also, the distribution of reservoir rock and cap rock will be controlled by basement faults.

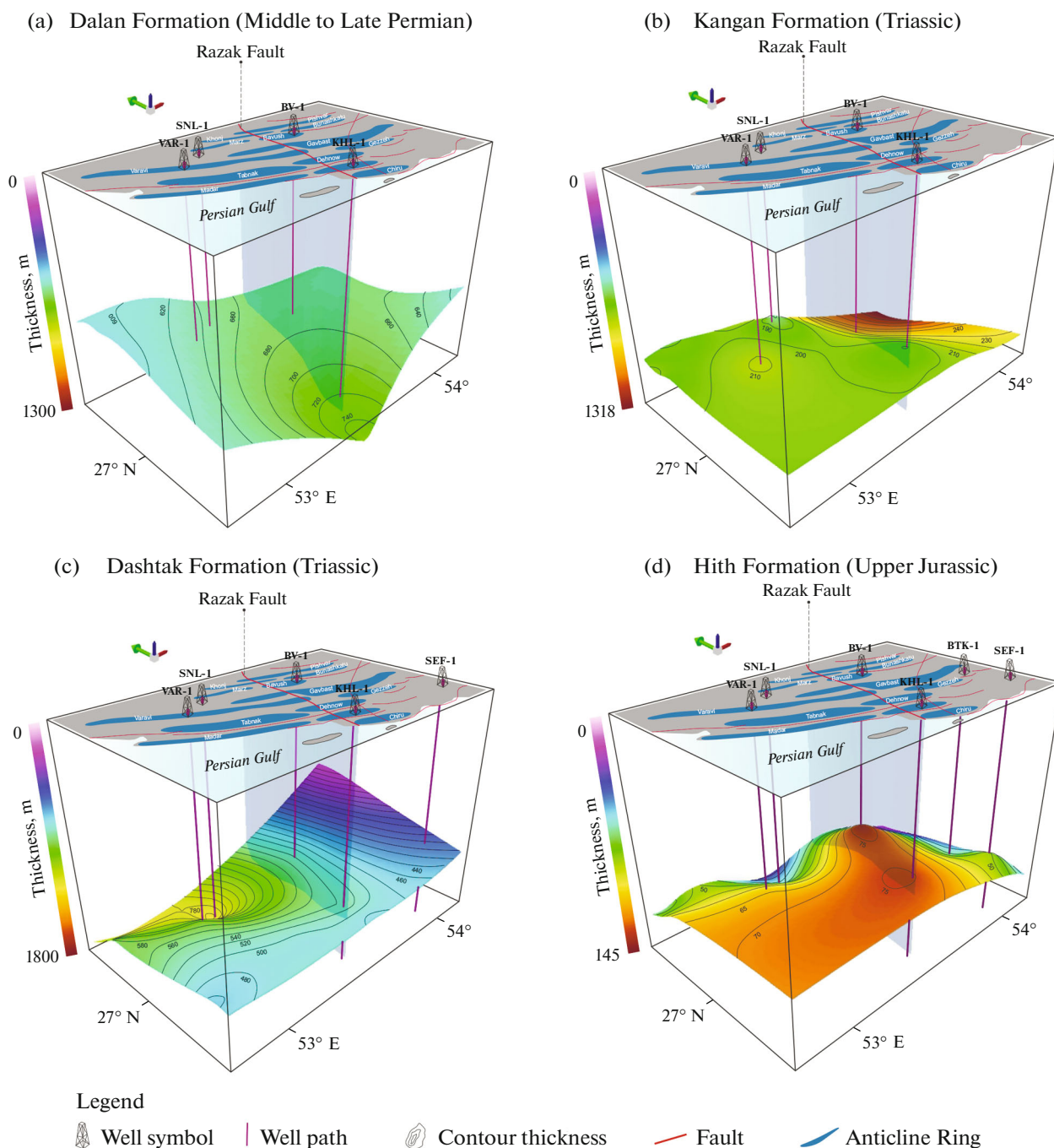
In an analysis of the isopach maps, it is assumed that high thickness sediment represents the deep part of the basin and the low thickness of sediment represents the shallow part of the basin during deposition [48, 63]. Also, sudden changes in the thickness of the sedimentary cover is depends on subsidence resulting from extension along the strike-slip fault [49, 50, 52]. Recent studies have indicated many tectonic subsidences which were related with displacement along the

fault systems [10, 54, 57]. Using isopach maps, it is possible to identify the geological history of a region, which includes subsidence and uplift of blocks surrounded by deep faults [49, 50, 60, 62]. In this study, the isopach maps of different formations were prepared by using subsurface data from the National Iranian Oil Company, such as the report of wells drilled in the Fars region (more than 60 wells), geological reports, and outcrops of formations. Also, in the areas without sampling, Kriging spatial interpolation (using ArcGIS software v. 10.4) was used to estimate the thickness and provide continuous maps.

## RESULTS

### *The Dalan Formation*

The thickness of the Dalan Formation varies from 600 to 740 m in the study area. This formation has a maximum thickness in the Khalfani, Chiru, and Dehnow anticlines (Fig. 5a). The basin is located in



**Fig. 5.** Isopach maps along with 3D modeling of sedimentary basin floor during sedimentation of formations (Upper Permian–Upper Jurassic). (a) Dalan Formation; (b) Kangan Formation; (c) Dashtak Formation; (d) Hith Formation.

the deeper part during the deposition of the Dalan Formation in the Chiru and Khalfani anticlines. According to the isopach maps, probably the Razak fault had limited activity during the sedimentation of the Dalan Formation.

### The Kangan Formation

The thickness of the Kangan Formation varies from 180 to 290 m in the study area. This formation has the

maximum thickness in the Pishvar, Bonashkatu, and Bavush anticlines and has the minimum thickness in the Khalfani and Marz (Western Bavush) anticlines (Fig. 5b). the basin during deposition of the Kangan Formation is located in a shallower part compared to other anticlines and the western part of the Razak fault has uplifted. Considering the isopach maps and the parallelism of curves with the Razak fault, this fault has been active during the deposition of the Kangan Formation.

### *The Dashtak Formation*

The thickness of the Dashtak Formation varies from 200 to 780 m in the study area. This formation in the Shanul and Marz anticlines has the maximum thickness and in the Pishvar and Bonashkatu anticlines has the minimum thickness (Fig. 5c). According to the isopach maps and the parallelism of curves with the Razak fault, this fault has been active during the deposition of the Dashtak Formation.

### *The Hith Formation*

The Hith Formation lithology is Gypsum and Anhydrite with frequentation of Dolomite. According to the evaporation lithology of the Hith, formation is expected for the analysis of the isopach maps to be different. In the other words contrary to previous interpretations, the high thickness of the Hith Formation represents a shallow basin, and areas, where this formation doesn't exist, are considered deep areas. The thickness of the Hith formation varies from 40 to 75 m in the study area. This formation has the maximum thickness in the Bavush, Gavbast, Khalfani, Dehnow, Chiru, and Tabnak anticlines and has the least thickness in the Khonj and Marz anticlines (Fig. 5d).

According to the thickness of the Hith Formation, it shows that the compression force has caused the uplift in the area. The Hith Formation in the Bavush anticline is located in the shallow part of the basin and this formation in the Shanul anticline is located in the deeper part.

### *The Fahlian Formation*

The Fahlian Formation has thickness variations from 170 to 260 m in the study area and its thickness increases from the southeast to the west. The maximum thickness of this formation 240 m average thickness is in the Gezzeh, Bonashkatu, east of Gavbast and Chiru anticlines, and the minimum thickness of 190 m average thickness is located in the Khonj, Marz, Varavi, Tabnak, and Madar anticlines (Fig. 6a).

According to the thickness variations of the Fahlian Formation on the ground of the Razak fault and the parallelism of isopach curve lines with this fault, it appears that the Razak fault has been active during deposition of the Fahlian Formation. This formation in the Shanul anticline is located in the shallow part of the basin and in the Bavush and Khalfani anticlines has been in the deep part.

### *The Gadvan Formation*

The Gadvan Formation has thickness variations from 50 to 75 m in the study area and its thickness has increased from the southeast to the west. The maximum thickness of this formation is about 75 m in the Bavush and Khalfani anticlines and the minimum

thickness with 60 m average value is in the Gezzeh, east of Gavbast and Chiro anticlines (Fig. 6b). In the isopach map of the Gadvan Formation due to the lack of sudden variation in the thickness around the Razak fault, so the fault has been inactive during the deposition of the Gadvan formation (The thickness of the Gadvan Formation in the Pishvar, Khonj, Bavush, Gavbast, Varavi, Dehnow, Tabnak, and Bonashkatu anticlines are close to each other).

### *The Darian Formation*

The Darian Formation has thickness variations from 100 to 200 m in the study area which its thickness decreases from the southwest to the northeast (Fig. 6c). The maximum thickness of this formation with an average value of 150 m is in the Chiru, Gezzeh, east of Gavbast, Bonashkatu, Pishvar, and Khalfani anticlines and the least thickness with an average value of 110 m is in the Marz (Western Bavush), Khonj, Varavi, Tabnak, and Madar anticlines. According to the isopach map of the Darian Formation, the southwest part of the basin compared to the northeast part has located in the deeper part during the deposition of the Darian Formation. Due to the lack of sudden variation of the thickness around the Razak fault and also the lack of parallelism of isopach curve lines with fault, probably the Razak fault has been inactive during the deposition of the Darian Formation.

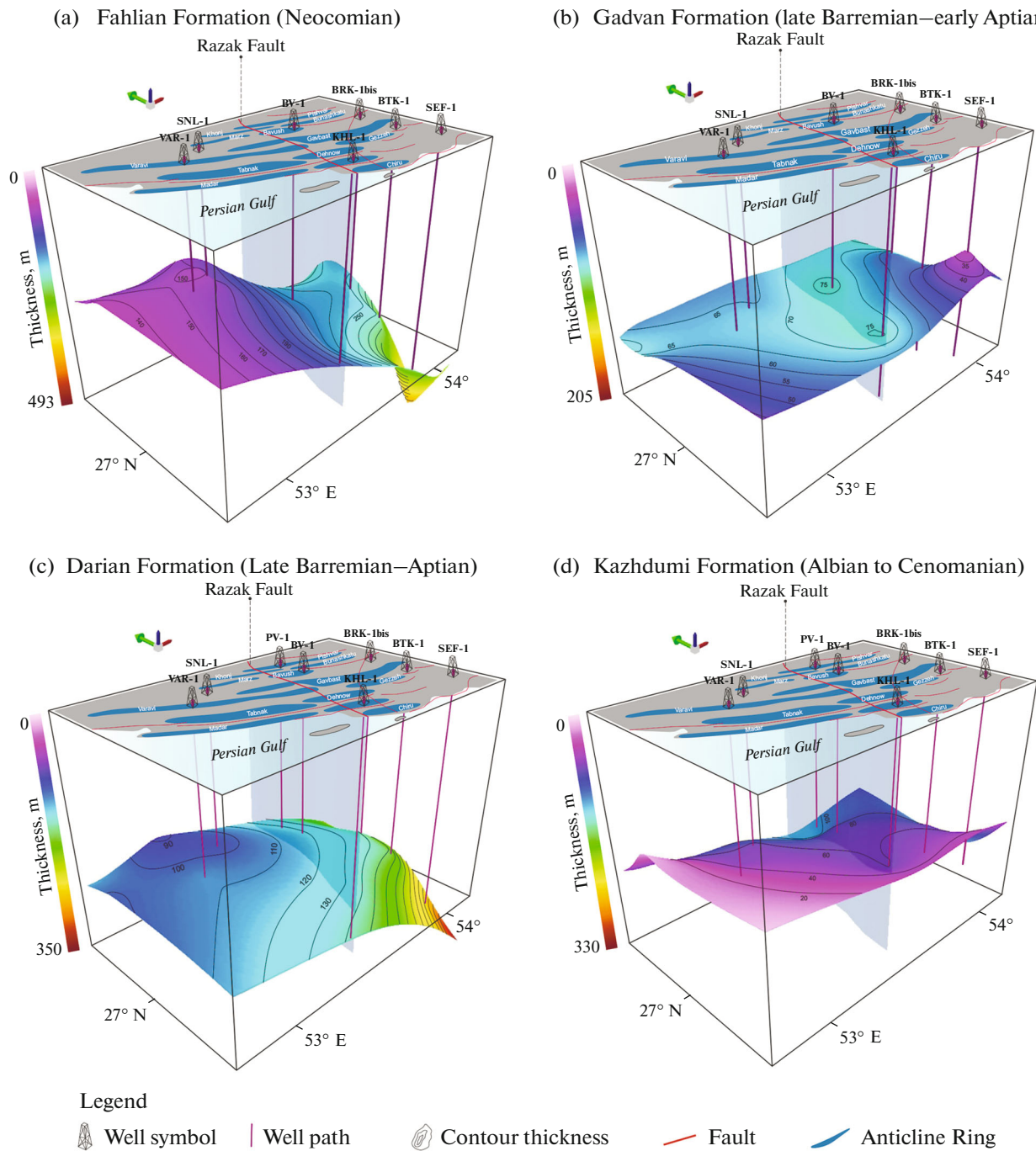
### *The Kazhdumi Formation*

The Kazhdumi formation has thickness variations from 40 to 110 m in the study area which increases from the south to the north. The maximum thickness of this formation is about 107 m in the Pishvar anticline and its minimum thickness is about 55 m in the Varavi anticline. According to the isopach map of the Kazhdumi Formation and the lack of sudden variation of the thickness around the Razak fault, the Razak fault has been inactive during the deposition of the Kazhdumi Formation (Fig. 6d).

### *The Laffan Formation*

The thickness of the Laffan formation varies from 5 to 57 m in the study area. This formation has the maximum thickness in the Khalfani, Chiru, and Dehnow anticlines and the minimum thickness in the Pishvar, Khonj, Varavi, Bavush, and Bonashkatu anticlines. Due to the thickness variations, probably the southern part of the basin compared to the northern part has located in the deeper part during the deposition of the Laffan Formation. According to the isopach map of the Laffan Formation and the lack of sudden variation of the thickness around the Razak fault, it does not seem this fault has been active during deposition (Fig. 7a).



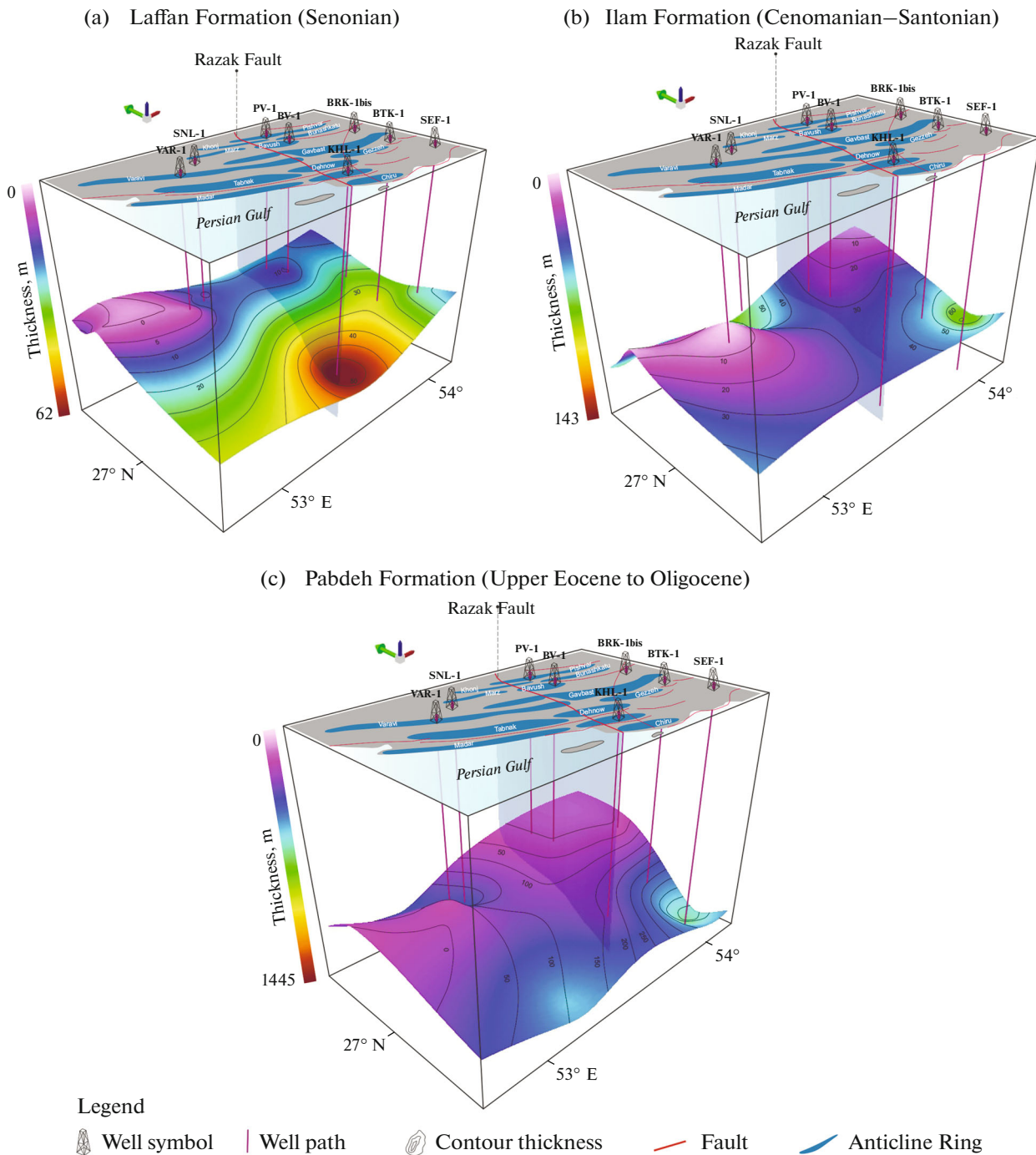


**Fig. 6.** Isopach maps along with 3D modeling of sedimentary basin floor during sedimentation of formations (Upper Permian–Upper Jurassic). (a) Fahlian Formation; (b) Gadvan Formation; (c) Darian Formation; (d) Kazhdumi Formation.

*The Ilam Formation*

The thickness of the Ilam Formation varies from 10 to 60 m in the study area. This formation has the minimum thickness in the northeast and southwest and the maximum thickness in the northwest and southeast (Fig. 7b). The Pishvar, Bonashkatu, Bavush, west of Varavi, Tabnak, and Madar anticlines have been

uplifted under the effect of compression force and the Marz, Khonj, Gezzeh, Khalfani and Chiru anticlines have been subsiding affected by tension force. According to the isopach map and sudden variation of the Ilam formation thickness around the Razak fault along with the parallelism of isopach curve lines with fault, so, the activity of the Razak fault has been sinistral strike-slip during the deposition of the Ilam Formation.



**Fig. 7.** Isopach maps along with 3D modeling of sedimentary basin floor during sedimentation of formations (Upper Permian–Upper Jurassic). (a) Laffan Formation; (b) Ilam Formation; (c) Pabdeh Formation.

### *The Pabdeh Formation*

The thickness of the Pabdeh Formation varies from 0 to 300 m in the range of the study area. This formation has the least thickness in the northeast and southwest and has the maximum thickness in the northwest and southeast parts of the study area (Fig. 7c). The Pishvar, Bonashkatu, Bavush, Tabnak, Varavi, and Madar anticlines have been uplifted under the effect of

compression force and the Khonj, Shanul, Khalfani, Gezzeh and Chiru anticlines have been subsided affected by tension force. According to the isopach map and sudden variation of the Pabdeh Formation thickness around the Razak fault and also the parallelism of the isopach curve with fault, so, the activity of the Razak fault has been sinistral strike-slip during deposition of the Pabdeh Formation.

## DISCUSSION OF RESULTS

The 3D modelings done around the Razak fault indicates the activity of this fault in controlling the paleo-sedimentary basin. In addition, based on the 3D model of earthquakes in this region, it can be concluded that the Razak fault is currently active and plays a role in the structural change of the region. Also, the changes in the appearance of the anticlines and the thickness of the Hormuz salt on the sides of the Razak fault were previously reported by Najafi et al. [44], Jahani et al. [30], and Ginés et al. [22] which confirms the different behavior on the sides of the Razak fault. This issue can also be seen in the 3D models prepared in this study. So, we see many changes in the shape of the old sedimentary basin on the sides of the Razak fault.

Therefore, in response to the question, has the operation of the Razak fault affected the sedimentation in the region? It should be answered positively. Razak fault had a lot of activity in the Triassic and Jurassic times, and in the Cretaceous time, this activity was limited and stopped at some periods. As the studied area is very important in terms of hydrocarbons. Therefore, the effect of the Razak fault on hydrocarbon systems was also considered in this research. generally, tectonic activities at the end of each stage of sedimentation cause changes in the sea water level, which controls sedimentation. Also, some sediments are exposed to erosion and the sedimentation environment is constantly changing because of it. Sometimes, the depositional environment becomes energetic and sometimes in reverse, which will have a direct impact on the quality of hydrocarbon systems e.g. [49, 50, 60, 62].

Based on the 3D modeling done, the performance of the Razak fault has increased the hydrocarbon potential of the Dalan and Kangan formations (Dehram horizon) and on the other hand, it has had a destructive effect on the Sarvak and Ilam formations (Bangestan horizon). Even though the detailed evaluation of these effects requires multiple seismic and stratigraphic data, we truly believe that this study provides appropriate documentation to investigate the structural evolution of the sedimentary basin.

## CONCLUSIONS

(1) The Razak fault has been inactive during the deposition of the Dalan Formation (Middle to Late Permian) in the Coastal and Sub-Coastal Fars region.

(2) The Razak fault has been active during the deposition of the Kangan Formation (Lower Triassic). The activity of this fault has caused the uplift of the basin in the western part of the fault. The uplift of the basin in the Marz (West Bavush), Varavi, Tabnak, Dehnow, Khalfani, Chiru, and Madar anticlines caused the Silurian shales located in the suitable depth that this condition increases the reservoir potential of Deheram

Group in these anticlines. In addition, the subsidence in the northeastern part of the study area in the Bonashkatu, Pishvar, Bavush, Gavbast, and Gezzeh anticlines can increase the burial depth in the Silurian shales and can reduce the porosity in the Dehram Group.

(3) The Razak fault has been active during the deposition of the Dashtak Formation (Middle to Late Triassic). The thickness of the Dashtak Formation was reduced in the Pishvar, and Bonashkatu anticlines and the eastern part of the Gavbast anticline in the northeastern part of the study area. the reduction in thickness and change in the facies from Dashtak Formation with the evaporate lithology to Khanekat Formation with the dolomite lithology leads to the loss of cap rock ability of Dashtak Formation for Dehram reservoirs. Therefore, drilling of the anticlines of Pishavar, Bonashkatu, and the eastern part of the Gavbast Mountain with the aim of exploring the hydrocarbons in the Dehram Group will be of less priority.

(4) The Razak fault has been active during the sedimentation of the Hith Formation (Upper Jurassic). According to the thickness increase of the Hith Formation in the Bavush, Gavbast, Varavi, Dehnow, Tabnak, Madar, and Chiru anticlines, the region has experienced a huge uplift so the evaporation conditions provided for the deposition of the Hith Formation. This uplift can be important for the Dehram Group.

(5) The Razak fault has been inactive during sedimentation of the Gadvan, Darian, and Kazhdumi formations (Lower Cretaceous) in the Coastal and Sub-Coastal Fars region. Due to the beginning low depth of the basin in the synsedimentary of Kazhdumi formation and the continuation of uplift at the synsedimentary of Ilam and Gurpi formations, the Kazhdumi Formation cannot be source rock due to the placing in a low-depth environment. Therefore, the Bangestan Group also will lack reservoir potential in this region.

(6) According to the uplift in this area, the activity of the Gavbandi High has begun in the late Permian.

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## CONFLICT OF INTEREST

The authors of this work declare that they have no conflicts of interest.

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