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CALCULATION OF FRACTURE DENSITY VIA IMAGE LOGS AND COMPARING THE RESULTS OF MUD LOSS, GACHSARAN OIL FIELD, SW OF IRAN

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Abstract

In this study by using image logs (FMI, OBMI and UBI) of 5 wells in different sectors of Gachsaran oil field, located in SW of Iran, the number of fractures in each zone of Asmari reservoir of study well were calculated and then the fracture density chart of each zone was drawn and well No. 387 Zone 1 and 2, shows a high fracture density (5.1). Mud loss data was also converted to charts so as to be compared with fracture density chart. Base in this study, the lowest Mud loss has been related to the well No. 384 – Zone 4, and its fracture density is very low (0.2). The result showed that there was a good correlation between 2 groups of data. According to the findings of this story, although it is only image logs that are capable of showing the exact location and attitude of fractures in reservoir, but when unavailable, other data such as mud loss data can be used to predict and approximate the fracture condition in an oil well.

Keywords: *Image log; Fracture Density; Gachsaran oil field; Mud loss; SW of Iran.*

1. Introduction

A reservoir rock is one that, in addition to high porosity to store hydrocarbons, has an appropriate permeability to drive oil fluids [1]. By this description, sandstone is commonly referred to as a good reservoir rock .However, it should be noted that more than 65 percent of the Middle Eastern hydrocarbons are located in carbonate reservoirs, and in Iran, according to the number of hydrocarbon reservoirs and regardless of the volume of hydrocarbons, about 90 percent of the large reservoirs, carbonate and 10 percent are sandy limestone. In carbonate rocks, ultimate porosity is often very low, and fracturing in these rocks is very important in increasing porosity [2], especially in permeability [3]. They are important in the carbonate reservoirs due to their high influence on the reservoir's rock properties [4-5]. Therefore, in determining the reservoir properties of carbonate rocks, fractures have a special position [6-7] and accurate determination of fractures location and determining the depths with the highest fracture rates for reservoir designation with high production potential, providing a suitable method for recycling projects, and Reconstruction, design of diversion drilling, the determination of the location of acidity and the location of the lattice operations with the completion of the well to have the highest production and also the avoidance of excessive costs in the completion of inappropriate reservoir zones has great importance [8].

In this research, by identifying zones with higher fracture density in the Asmari reservoir of the Gachsaran oil field, sections with higher production potential are introduced. Meanwhile, considering the high cost of image log, their use is limited to specific wells of a field. In the following, we have tried to find the relationship between fracture density and mud loss from studied wells, the use of these data as a substitute for estimating and predicting fractures conditions when there is no image log, are presented.

2. Geological setting

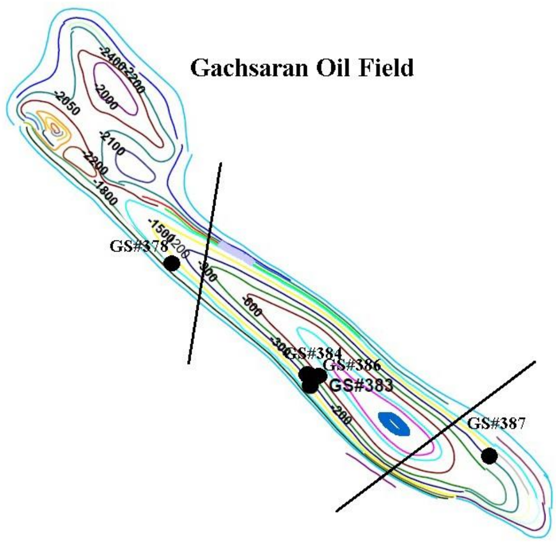

Fig.1 UGC map of Gachsaran oil field based on the upper border of the Asmari Formation and the position of the studied wells No. 378, 383, 384, 386 and 387 on it.

Gachsaran oil field is one of the most important oil fields of Iran, which is located in the southwest of Iran. This oil field has situated on Dezful Embayment. Dominant structural trends in this area are NW-SE. From tectonics view, it contains the over thrust and simple fold belts of Zagros that 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.

Gachsaran oil field is an asymmetric anticline with NW-SE trend (Fig. 1). This oil field at the Asmari horizon is 70 km in length and 11 km in width [9]. This field as a giant oil fields in Iran, consists of Asmari, Bangestan and Khami reservoirs, which were discovered in 1965 by means of seismic operation and drilling of the first well in Asmari formation. Because of tectonic activity, there are highly fractured area in this oil field, which causes upward migration of hydrocarbon [10].

3. Research method

The best methods for fracture evaluation are image logs and core. However, cores have vital limitations such as low recovery factor, being undirected, and high cost of coring [6,11]. The raw data obtained from the wellhead charts after loading in GEO FRAME-CPS3 software and performing several stages of software processing, are presented as a virtual image of the well wall. In wells drilled with a water base drill, FMI image log and in the wells where the drilling mud is based on oil, OBMI and image log UBI are used simultaneously. In this image, plate phenomena in the well wall, such as layering and fractures, are recognizable and can be compared to the direction, length, and gradient of these phenomena. In Fig. 2, for FMI image log, refers to well 387, with a scale of 1:1000 has been presented.

After plotting the image log for each of the studied wells in the Gachsaran oil field, fractures, layering and other plate phenomena were determined in it [12], and then the density of open fractures in each zone was calculated from the Asmari reservoir.

The method used in this study to calculate open fracture density is to count all open fractures in a zone or sub zone of the Asmari reservoir, and then divide the fracture number by the depth of that zone or sub zone, which is showed by 1m [13-14].

Mud loss information for wells studied in Gachsaran oil field using Excel software is presented in graphical way in different zones that comparing this chart with other information related to fractures can be about the possibility of using mud loss information to detect broken zones.

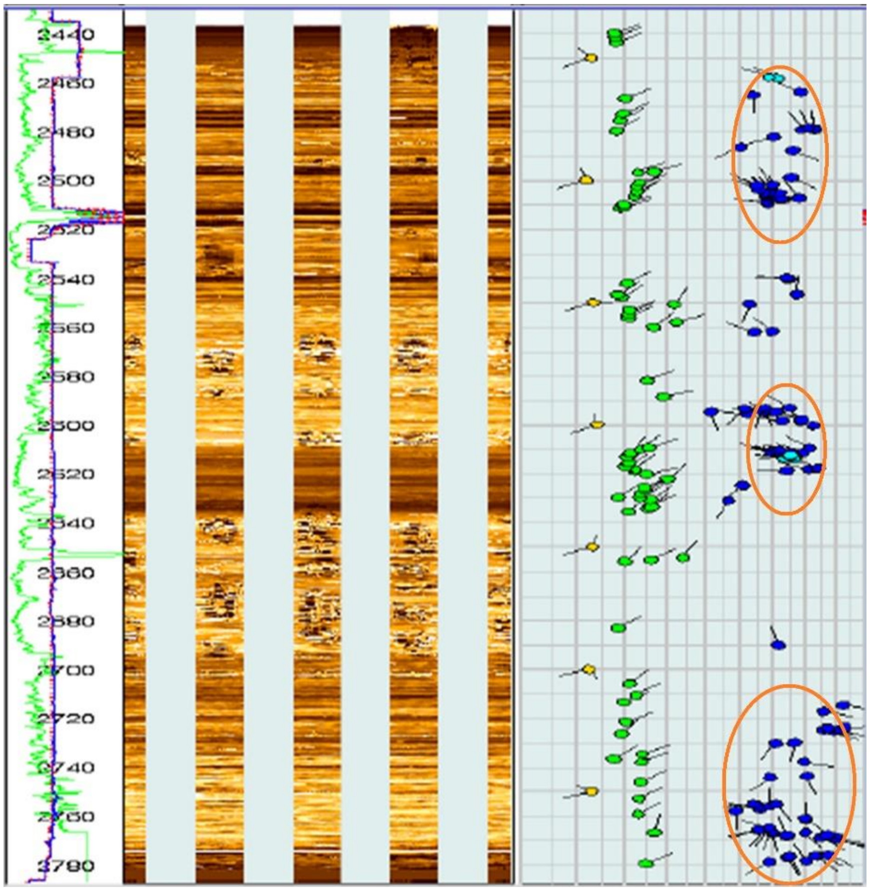

Fig. 2. The schematic representation of all the identified complications in well 378 base on FMI

4. Results and discussion

In this study FMI, OBMI and UBI image logs in wells No. 378, 383, 384, 386 and 387 were analyzed in order to identify and describe different types of fractures. The open fracture density of the oil-containing zones, the ratio of the number of open zone fractures to the drilled distance in that zone in meters was calculated in well 378, according to which zone 2, 4 and zone 7 have a fracture density of 2.7, 3.1 And 3.3 respectively that it is indicating of a high fracture density in both zones (Fig. 3). Meanwhile, as shown in Fig. 2, the depth distances from 2460 to 2510m, 2595 to 2620m, 2720 to 2780m, were described as reservoir zones with maximum fracture rates and with high production potential in well 378.

In well 383, zone 2 and zone 4, have 1.1 and 1.3 fracture potential, respectively .The fractures are roughly uniformly distributed at all depths of each zone (Fig 3). Open fracture density in zone 2 and zone 4 of wells 384 are 0.4 and 0.2, respectively, which indicates the very low fracture density in both zones and the very low production potential in this well (Fig. 3).

Based on the calculations performed in the well 386, zone 1 of this well has a fracture density of 2.1, zone 4 with a fracture density of 2.2 and zone 7 with a fracture density of 3.1. Meanwhile, in zone 5, due to the lack of log UBI information only fractures that were found in log OBMI have been seen that have a fracture density of 1.8 (Fig. 3). As can be seen, this well has a relatively high fracture density in total. In this well, the depth intervals of 2450 to 2485 meters, 2550 to 2580 meters and 2680 to 2730 meters are described as reservoir zones with maximum fracture rate and with high production potential.

The open fracture density in the well 387 shows a high fracture of this well in all depths, so that zone 1 and zone 2 each have approximately a fracture density of 5.1, sub zone 4 with a fracture density of 3.2 and zone 7 has a fracture density of 4.2, and this well has a very high production potential (Fig. 3). Comparison of Figures 3 (Fractal Density Chart) and 4 (Mud loss Chart) shows a good correlation between fracture density and Mud loss.

The lowest Mud loss has been related to the well 384 (Fig. 4), and its fracture density is very low. Wells 378, 383, 386 having a fairly high fracture average in all depth distances, show a good correlation with the Mud loss. The well 387 has the highest fracture density among all studied wells, which is due to the under balanced drilling, the mud loss has been prohibited.

As you can see, the above shows that when number of fractures in a well increases, the greater the amount of mud can escape through them, and they can enter into the structure, which, in addition to damage to the structure, can cause problems and also for drilling operations, so that it can cause the drill string to be stuck in the space around the drill by decreasing or not circulating and preventing further drilling operations. The amount of mud loss in a particular zone of the reservoir can be a criterion for proving the presence of fractures and thus indicating reservoir zones with potential production.

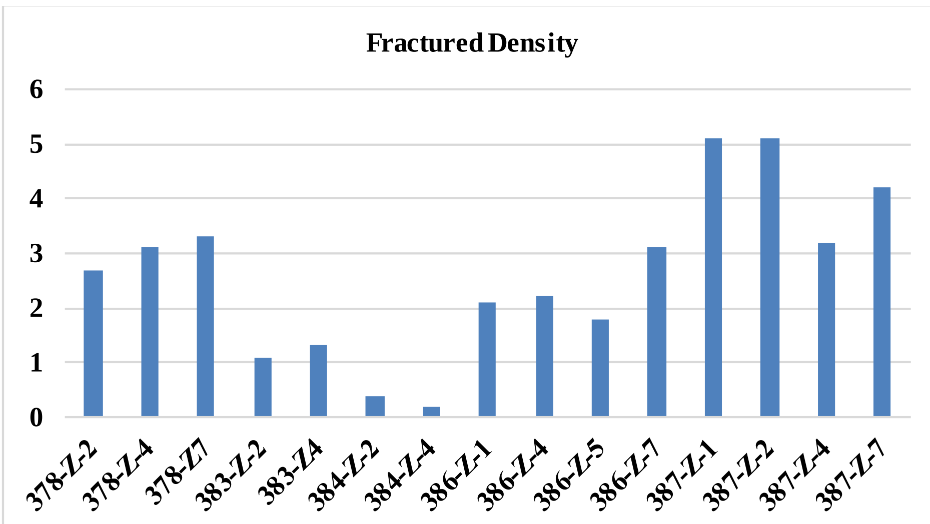

Fig. 3. Relative frequency of open fractures in different zones of Asmari structure in investigated wells base in fracture number vs. meter

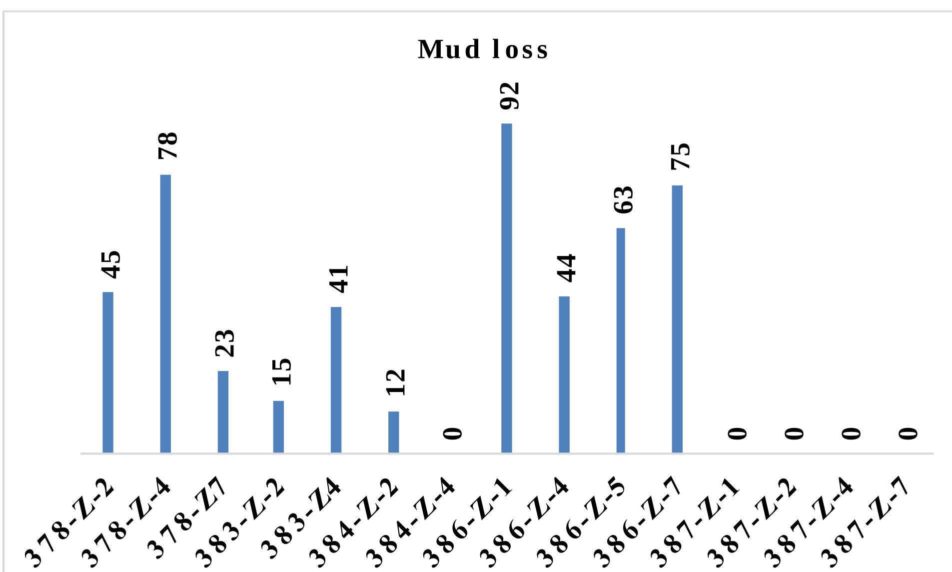

Figure 4. Mud loss average in different zones of Asmari structure from wells studied with barrel units per each hour.

5. Conclusion

Due to the fact that the Asmari reservoir characteristics are various in different parts of the Gachsaran oil field, this field is based on the characteristics of the lithology, porosity and permeability, reservoir pressure history, the amount of mud loss from each section and other reservoir properties are divided into the 3 East, Middle and West parts. This research showed that the image log is a good tool for determining the precise location and position of fractures, as well as calculating the density of fractures in order to determine the reservoir zones with high production potential. At the same time, the results of this research proved that, in the absence of image log, mud loss data can be obtained to predict and estimate the relative position of fractures can be benefit.

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