Evaluation of oil reservoir of Hartha Formation in Y and J field, North Iraq.

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Abstract

Afield development plan (FDP) of the Y and J oil fields for cretaceous reservoir (Harth Formation) evaluation and the production of hydrocarbons in the near future in two Y and J oil fields.

Open hole logs namely (Gamma ray, Resistivity, Sonic, Caliper and Density) logs were used to determine petrophysical parameters. The parameters determined are; volume of shale, porosity, water saturation, irreducible water saturation and bulk volume of water. The thickness of the reservoir varies between (40 and 120) m. Determining the porosity depending on the porosity of the log (16-28)% and core Average porosity (18-37)% values vary between; generally decreasing with depth. Average porosity 33.3%.test is flow crude oil 1000 bll /d.in J field basically water saturation calculation5-16%. And oil saturation (90-80) % and the oil were carried out at a rate of 1000 barrels / day in the complete test of well Y. The amount of the original oil storage OOIP (1039 * 10^6) standard cubic meters.

This study provides an insight into reservoir quality prediction in the study area and other carbonate reservoirs undergone different the development of Hartha reservoir in south Mosul north Iraq as a new reservoirs in the study as Tertiary reservoir producing as old degassing stations enabling facilities from the 1950s are being" surface facility", This study's aimed at making available petrophysical data the computer processed interpretation(CPI) for Hartha reservoir.

1. Introduction

Y and J oil field consider one of the biggest and important oil fields in south Nineveh Governments North Iraq.

This study focus on showing the distribution of porosity, permeability and water saturation in these units. To evaluating the oil reservoir by evaluating the geological formation containing hydrocarbons. Also Identify areas with good hydrocarbon productivity for the purpose of start oil production from them and attempting to improve petrophysical properties in areas with low levels through various oil operations. The wells that are included in this study are (A, B, C, D) Y and J oil fields which penetrate Hartha Upper Cretaceous Reservoir

In the current study, the name of the studied fields and four wells have been coded as Y and J fields and (A, B, C and D) wells respectively Fig-1. due to confidentiality. These fields were discovered at the beginning of the last century by the German team conducting a surface survey during the [1]. There cretaceous reservoir not produce oil until now.

The largest part of the Y Field is located in the western part of the Tigris river, about 60 km south of Mosul city, while J field is located about 50 km southern part of Mosul city. The Y field consists of two domes separated by an NW-SE saddle axis, while the J field consists of one dome northwestern Y field. The dome in the southeast is wider and more developed than the dome in the northwest, the latter being narrow and inconspicuous, and the dome in the southeast is 45 meters higher than the dome in the northwest. The first cretaceous well Y-1, drilled in 1982, penetrated into the Cretaceous reservoirs, while the J-1 well was drilled in 1933[2]. Final Well Reports wells, A, B, C, and D.

According to the tectonic divisions of [3]. And Iraqi−Soviet team, the study area is located within the central faulting zone, and in the unstable shelf corresponding to the Arabian−Nubian craton [4], [5]. The studied boundary of formation study Figure (1) and within this study's aimed at making available petrophysical data the computer

processed interpretation (CPI) for upper cretaceous "Hartha reservoir".

2. Materials and Methods

Collect all information regarding Hartha reservoir formation, its literature review, logs, definitions of petrophysical properties and articles which help us to build a create a scientific view of our research

1-The data the Ministry of Oil in coordination with Petroleum Technology Department has provide us with each oil well.

2-The analysis of petrophysical properties using data from the available open hole geophysical logs and estimate the porosity and permeability.

3-The wireline log data (recorded in LAS format) of the studied wells were loaded into Interactive Petro physics (IP) and Tech-log software consequently the data had passed through environmental corrections

4- Petrel software was used to evaluate the lithology , petrophysical properties and determination of water and hydrocarbon saturations

3. Aims of Study

The main objectives of formation evaluations based on Well logs and core analysis data which:

- Petrophysical properties to determine. Lithology, porosity, saturation "oil and water", from well logging data analysis.

- Distributing petrophysical properties of Hartha reservoir in tow studied fields and showing the difference in distribution and its control on the reservoir

- New Upper Cretaceous Hartha reservoir was constructed using Petrel TM; Schlumberger's reservoir modelling software and management operating strategy and economic decisions Uncertainty and risk management of well planning of studied fields.

- 3D geological model for Hartha reservoir in Y and J oil field to be built using petrel software. 2- Distributing petrophysical properties of Hartha reservoir in tow

studied fields and showing the difference in distribution and its control on the reservoir.

4. Geological Setting

Y and J oil field is located within the unstable shelf in the Subzone, according to the tectonic subdivision of Iraq two fields structures are represented by an elongated anticline that have approximately a NW- SE axis.

The upper boundary of the Hartha Formation in the study wells in the Y and J fields is clearly visible, which was distinguished by the high to low reading the gamma ray with the concentration of glauconitic mineral, and facies change basinal (Shiranish Formation) consisting of Marly Limestone to the shallow environment (Hartha Formation) consisting of dolomitic limestone, As for the lower boundary it is represented by a gradual transition from the shallow environment to the semi-basin environment consisting of the Sadi Formation (Santonian) which consists of Oligosteginal limestones. Figures (1), Table (1).

Fig. (1): Stratigraphic column of Hartha Formation in the study area

Table (1): Tops of units of Hartha Formation in the studied wells.

Wells	A			B			C			D		
	RTKB- 269 m		Th. (m)	RTKB- 281 m		Th. (m)	RTKB- 316 m		Th. (m)	RTKB- 259 m		Th. (m)
Formation	TOP (m.)			TOP (m.)			TOP (m.)			TOP (m.)		
	RTKB	MSL		RTKB	MSL		RTKB	MSL		RTKB	MSL	
Shiranish	501	-232	266	474	-192	276	421	-105	246	611	-352	194
Hartha	767	-498	89	750	-469	96	667	-351	140	805	-546	141
Har-1	767	-498	6	750	-469	10	667	-351	10	805	-546	10
Har-2	773	-504	23	760	-479	24	677	-361	35	815	-556	39
Har-3	796	-527	29	784	-503	26	712	-396	35	854	-595	36
Har-4	825	-556	22	810	-529	19	747	-431	43	890	-631	40
Har-5	847	-578	9	829	-548	17	790	-474	17	930	-671	16
Sadi	856	-587	25.3+	846	-565	4+	807	-491	73	946	-687	34
T.D.	881.3	-612.3		850	-569		976	-660		980	-721	
Spudded-in on	9/6/1982			20-4-1982			6/5/1983			14-3-1986		
Well Completed on	14-7-1982			25-5-1982			19-6-1983			24-4-1986		
Location	SE flank of Y field			NW Plunge of Y Field			Near to the crest of J Field			On the North part of J Field		

5. <u>Computer processing interpretation (CPI) and Reservoir units</u>

CPI was performed using Tech-log software version 3.5 for log interpretation to estimate the petrophysical properties of Hartha Reservioir. Depending on well log data, Gama Ray log (GR), Density Log (RHOB), Neutron Log (NPHI), Sonic Log (Δt), Caliper Log, Resistivity Log (Rxo, Ri, Rt). foure wells (A,B,C, and D)in Y and J oil field.

The property modeling is used for filling the cells of the grid of a 3D model with discrete (facies modeling) or continuous (petrophysical modeling) properties. The objective of the property modeling is to enable the distribution of properties between the available wells while preserving the realistic reservoir heterogeneity and matching the well data.

Reservoir rock typing is the most important part of all reservoir modelling. For integrated reservoir rock typing, static and dynamic properties need to be combined, but sometimes these two are incompatible [6].   with which water saturation, porosity and shale volume content were calculated, as shown in Figure {(2) A, B,C and D}, Figures (2) to (5).

According to the CPI results combined with facies associations interpretation, Formation evaluation plays critical role in resources assessment and is important in selection the best locations for wells as well as the best interval for perforation during the development phase of the oil fields [7].[8].

Hartha reservoir is divided into five units named Har - (1, 2, 3, 4 and 5). The deep Laterolog (LLD) provided an effective sign of hydrocarbon availability in the drilled intervals of the Hartha reservoir but the fluid flow tests are confirmed a heavy oil and bitumen with low API degree production in the Hartha reservoir. These results conclude that the rock properties of the Hartha reservoir have a good reservoir quality including porosity, permeability and pore space saturation while the fluid behavior do not encourage the production rate.

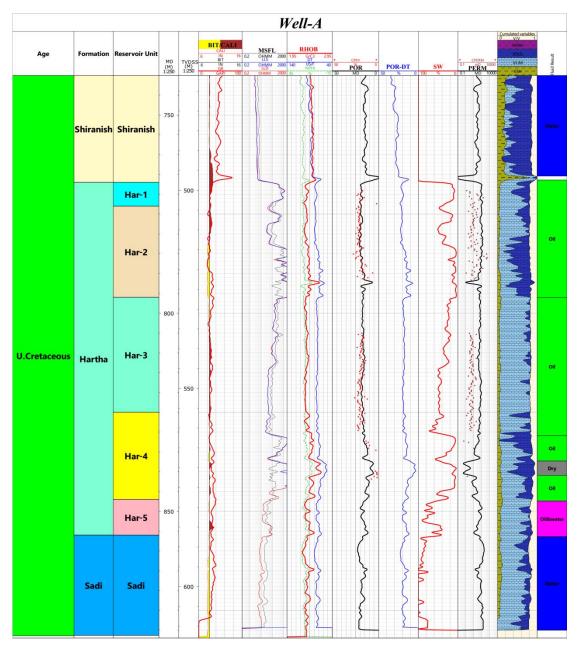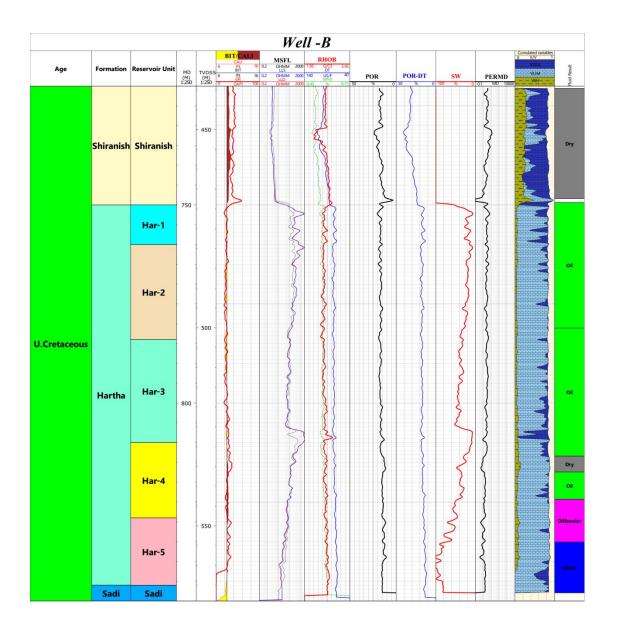**Fig. (2A): Composite wireline log data and CPI of well -A**

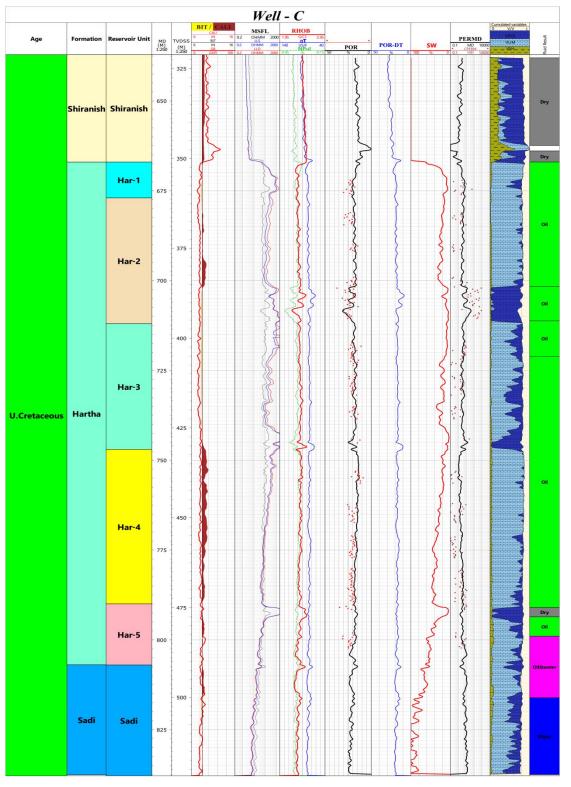**Fig. (2B): Composite wireline log data and CPI of well -B**

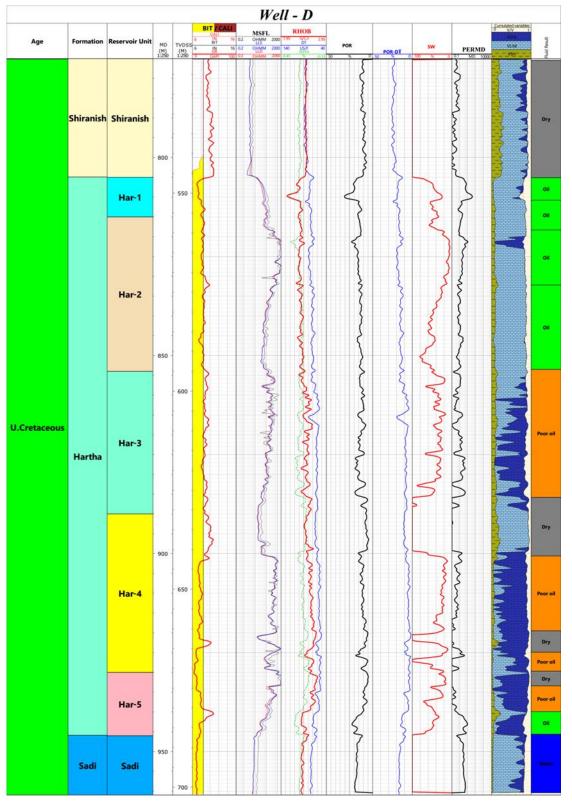**Fig. (2C): Composite wireline log data and CPI of well -C**

Fig. (2D): Composite wireline log data and CPI of well -D

- **Har -1 Reservoir unit**

The unit (Har-1) is located at the upper most part of Hartha reservoir. Although it is composed of an outer ramp facies association, the average weighted effective porosity of the wells studied for Y and J fields ranged between (17-23) %, and this ratio is considered good and ideal for the reservoir. And most of the porosity is of the secondary porosity type represented by cavern and vuggy, As for the water saturation in The first and second units is medium - good in wells Y-(A,B) and (J-C) and somewhat worse at well (J-D). Figures (4) and (5).

- **Har- 2 Reservoir unit**

The unit (Har-2) is characterized by Inner ramp association, which is characterized unit is good at wells Y- (A, B), at a rate of (18-24) %, and somewhat decreases towards the J field at the wells J- (C, D), at a rate of (13) %. Figures (4) and (5).

- **Har -3 Reservoir unit**

The reservoir quality of unit (Har-3) is the third unit in Y field it is good (18-23) % and worsens in J field to become (14-17)% ,These properties are related to Shoal facies association, which forms the main facies component in unit A3 in all studied wells. Figures (4) and (5).

- **Har -4 Reservoir unit**

The unit (Har-4) is characterized by Middle ramp association , effect porosity It becomes medium at Y- (A,B) at a rate of (15-19) %and good in J-C at a rate of (25%) and is somewhat lower in J-D, where it is (14%) unlike the previous units ,water saturation in this unit is very good in the two wells (Y-B) (J-C), medium in well (Y-A), and very bad at well (J-D). Figures (4) and (5).

- **Har -5 Reservoir unit**

The unit(Har-5) is characterized by outer ramp facies association ,It is good effect porosity at (Y-A) and (J-C), up to (21%), and somewhat decreases at well (A-B) to (14%), and worsens significantly at well (J-D) to become 6%, As for water saturation is good at the area of the two wells J- (C,D) and medium at the two wells Y- (A,B). Figures (3) and (4).
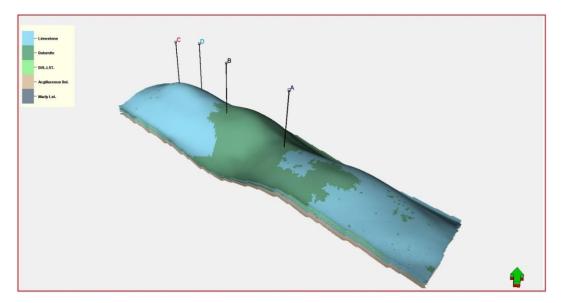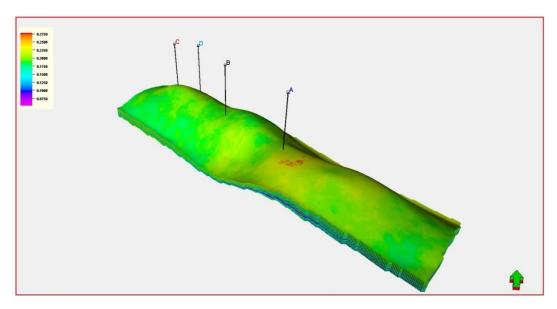
Fig. (3): Facies distribution modeling in Y and J fields

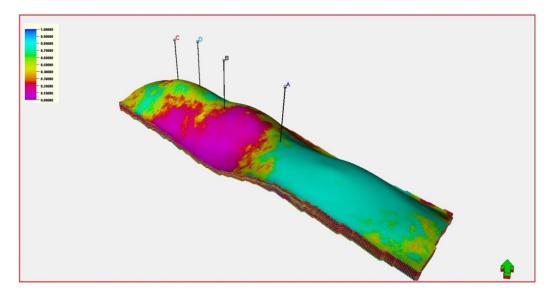**Fig. (4): Porosity distribution modeling in Y and J fields**

Fig. (5): Water saturation distribution modeling in Y and J fields

6. <u>Volume and Original-Oil-in-Place Calculations</u>

The most common wireline logs in rock typing analysis, such as RHOB, DT, and NPHI, usually classify the reservoir rocks according to the responses they have received from the fluid content or the physical properties of the rock [6], The interested zone for drilling new production wells in along structure axis of Y and J fields, near wells A, B and C, Figure (6).

The oil reserves of the Cretaceous Hartha reservoir in Y and J fields were calculated. In respect to oil /water contact level, the oil reserves are calculated to be (6535.31) bbl.
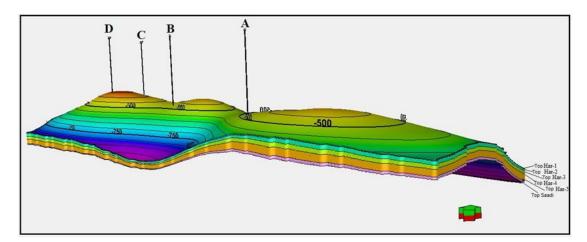

Fig. (6): The structure of the Upper Hartha Formation in Y and J oil fields

8. Conclusions:

Based on the analysis of petrophysical parameters, it is established that in of Y and J of Hartha reservoir formations is displaying medium to very good hydrocarbon saturation, so these are reflected as likely to be economically cretaceous Hartha reservoirs.

- The Y field consists of two domes NW-SE axis separated by saddle, while the J field consists of one dome northwestern Y field.
- The Upper Hartha is evaluated as a good quality reservoir in along the axis and shoulder of structure and it exhibits rapid variations in latterly to dolomite s within the location of wells A and B and C).
- The first, second reservoir units are medium - good in wells A and B and C) and somewhat worse at well (D).
- The third unit becomes very good in wells (A and B) and (C) and gets somewhat worse at well (D).
- The fourth unit is very good in the two wells (B, C), medium in well (A), and very bad at well (D).
- The fifth unit is good at the area of the two wells (C, D) and medium at the two wells (A, B).
- The oil column in well C J field is the best petrophysical properties the best producing well
- Volume and Original-Oil-in-Place, the oil reserves are calculated to be (6535.31) bbl.
- The interested zone for drilling new production wells in along axis of Y and J fields, near wells A, B and C.

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