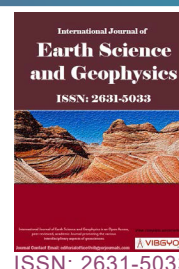




Using IPSOM Technique to Electrofacies Analysis of Yamama Formation in Faihaa Oil Field



Zuhoor J Younis Al-Aani*

Department of Oil and Gas Engineering, College of Oil and Gas Engineering, Basra University of Oil and Gas, Basra, Iraq

Abstract

Based on the analysis of well logs, Yamama Formation in Faihaa field was divided into four reservoir units (YA, YB, YC, and YD), in this study have been predicted and classification electrofacies of the Yamama Formation by using the IPSOM module of Techlog software into four facies: High porosity with high reservoir quality, Medium porosity with middle reservoir quality, low porosity with low reservoir quality, and poor porosity or cap rocks by training open well logs: Density, neutron porosity, and gamma-ray using a fuzzy classification method. The upper part of the Yamama formation represented by the YA unit is considered the best unit which contains a good reservoir quality and a good percentage from high porosity facies as compared with the rest of the formation units.

Keywords

IPSOM, Electrofacies, Yamama Formation, Faihaa Field, Techlog software

Introduction

The Yamama Formation, which was deposited during the Late Tithonian-Hauterivian sequence and is a component of the Thamama group, is regarded as one of the most significant lower cretaceous carbonate formations and the main productive reservoir in the south of Iraq [1]. According to the analysis of well logs, the Yamama Formation is composed of four main units (YA, YB, YC, and YD), which are separated by three main caps.

Study Area

Faihaa field is an anticline fold in the Zubair subzone in the southeastern part of the Mesopotamian basin. in the north-east of Block 9

north of Basra in southern Iraq, approximately 20 kilometers north of Basrah, adjacent and parallel to Iraqi and Iranian borders. Faihaa field borders with Majnon field in the north, Sindbad field borders the south, Nahr Omar field borders the west, and Iranian Hosseinieh field borders the east [2] as shown in the Figure 1.

Tectonic Setting and Stratigraphy

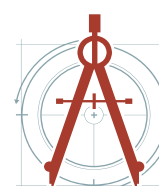
The Yamama Formation has been deposited in the Arabian plate as part of the late Tithonian-Turonian mega sequence (AP8) in a large new intra-shelf basin with a new phase from the ocean floor spreading in the southern Neo-Tethys [3]. When the Southern Neo-Tethys opened, a narrow microcontinent drifted away, a new passive margin

***Corresponding author:** Zuhoor J Younis Al-Aani, Department of Oil and Gas Engineering, College of Oil and Gas Engineering, Basra University of Oil and Gas, Basra, Iraq

Accepted: February 15, 2023; **Published:** February 17, 2023

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Al-Aani. *Int J Earth Sci Geophys* 2023, 9:065



Citation: Al-Aani ZJY (2023) Using IPSOM Technique to Electrofacies Analysis of Yamama Formation in Faihaa Oil Field. *Int J Earth Sci Geophys* 9:065

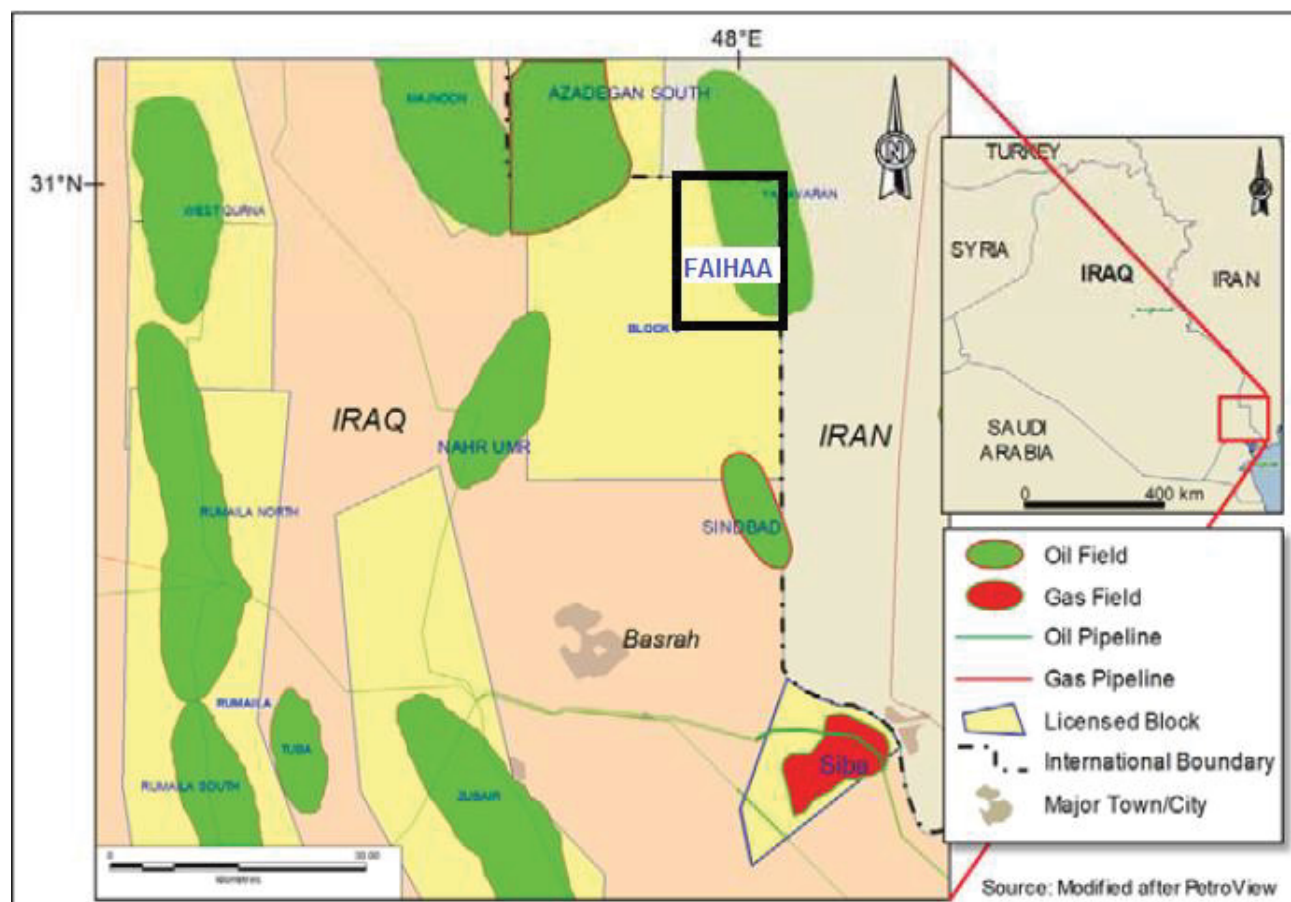


Figure 1: Location map of study area (Faihaa Field).

was formed as along the northeastern edge of the Arabian plate. The Rutbah uplift formed the Mesopotamian basin's western margin, while a carbonate ridge formed in the northeast margin along the northern passive margin of the southern Neo-Tethys. The eastern margin was possibly formed by a carbonate ridge that bordered the continental margin along the southern Neo-Tethys [4]. The Yamama Formation in southern Iraq is a carbonate heterogeneous reservoir, which formed due to overall regressive cycles, with reservoir quality significantly improving at the top of the formation. The Yamama Formation is composed primarily of limestone, with some of the shale and dolomitic limestone, which deposited in environments of oolitic shoal (inner shelf) and deep shelf that probably dominated by highs structural in carbonate ramp. The Yamama Formation covered conformability by the Ratawi Formation in the top and Sulaiy Formation in the bottom, both of each composed mainly of limestone [4]. The Yamama Formation has three depositional cycles: the top cycle has oolitic grain stone inner ramp facies that

pass down into finer-grained peloidal facies, the middle-ramp (bioclastic, coral, stromatoporoid) packstone-wackestone, and the outer ramp bases cycle has thick gray shale with chalky micrite stringers [1].

Aims of the Study

Build electrofacies model and evaluate reservoir equality of Yamama Formation at Faihaa oilfield using IPSOM in Techlog.

Materials and Methods

1. The data collected from the studied well are gamma ray, bulk density and neutron porosity logs were training within IPSOM technique to predict electrofacies in Yamama Formation.
2. Techlog software was used to evaluate reservoir equality using IPSOM technique.

Electrofacies Model using IPSOM Technique

The sedimentary units characterized and defined by wireline logs are referred to as electrofacies or logfacies [5]. Logfacies evaluation and analysis is

the most essential tool in the oil and gas industry, studying the sedimentological and depositional environment of the bearing rock, especially when wireline logs are the only data available [5].

The model of electrofacies was built using IPSOM within Techlog. The IPSOM (self-organizing maps) module depends on a neural network model developed for geological interpretation in order to identify and classify facies from well logs [6]. The

fuzzy classification method was chosen to build the electrofacies model in IPSOM after it was found to produce satisfactory results. The method starts after input and defining the variables bulk density (ρ), neutron porosity (N-PHI), and gamma ray (GR) logs that will be used for classification, as well as the number of groups or facies. Then it enters a loop in which it calculates the barycenter of each group and then finds a probability value between each node with each group and as (Figure 2, Figure

Inputs	Zonation	Input properties		Indexation	Output Statistics		Ranking Variables	
	Variable	Weight	Transformation	Norm Min	Norm Max	Unit	Color	Activate
1	Bulk Density	1	Linear	2.22838	2.7836	g/cm3		yes
2	Neutron Porosity	1	Linear	0.00974	0.3616	v/v		yes
3	Gamma Ray	1	Linear	15.39907	85.35695	gAPI		yes

Figure 2: Inputs properties of Ipsom module.

Inputs	Zonation	Input properties	Indexation	Output Statistics	Ranking Variables
Supervised	Supervised methods	Unsupervised methods	HC method	Weighting Fact	Class number
1 no	quantitative cla...	fuzzy classificatio...	Ward	1.2	4

Figure 3: Indexation properties of Ipsom module.

Inputs	Zonation	Input properties	Indexation	Output Statistics	Ranking Variables			
	Modalities	Number of Nodes	Bulk Density mean	Bulk Density var	Neutron Porosity mean	Neutron Porosity var	Gamma Ray mean	Gamma Ray var
1	1	14	2.419817	0.001656606	0.194481	0.0008434114	30.97233	30.2508
2	2	36	2.532799	0.001062339	0.1140835	0.0004524944	29.96886	24.72947
3	3	17	2.581292	0.005994052	0.0721733	0.001261686	50.97415	40.15814
4	4	33	2.631261	0.001393095	0.05701979	0.0002368366	32.80224	30.20888

Figure 4: Out statistics of Ipsom module.

Table 1: Overview of the electrofacies description.

Facies NO.	Facies Color	Facies Name	Facies Environment	Quality	P mean	N_PHI mean	Gr mean
1		High porosity	Inner Ramp shoal	High reservoir quality	2.41	0.19	30
2		Medium porosity	Open Marine	Medium reservoir quality	2.53	0.11	29
3		Low porosity	Mid Ramp restricted marine	Low reservoir quality	2.58	0.07	50
4		Poor porosity	Outer Ramp	Cap rock	2.63	0.05	32

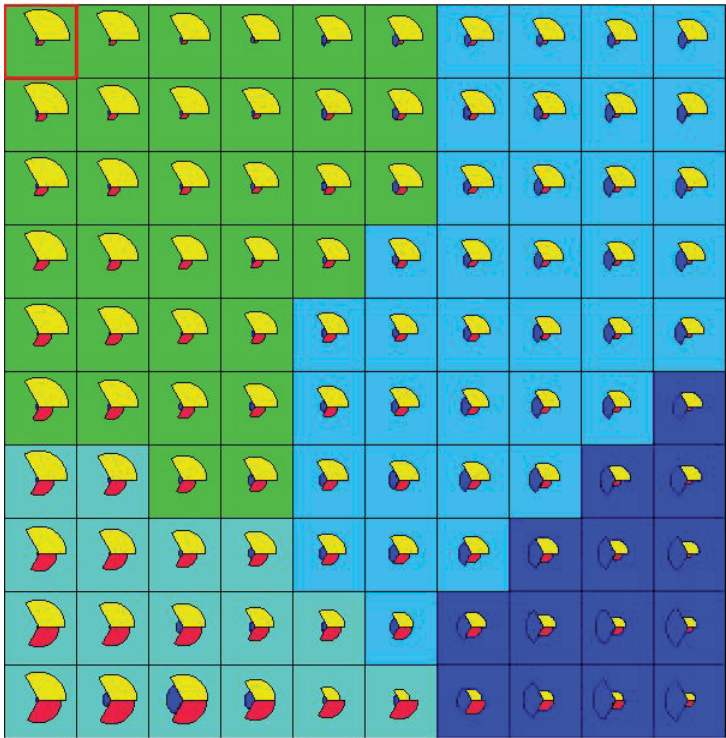


Figure 5: Clarify the processing for IPSOM module.

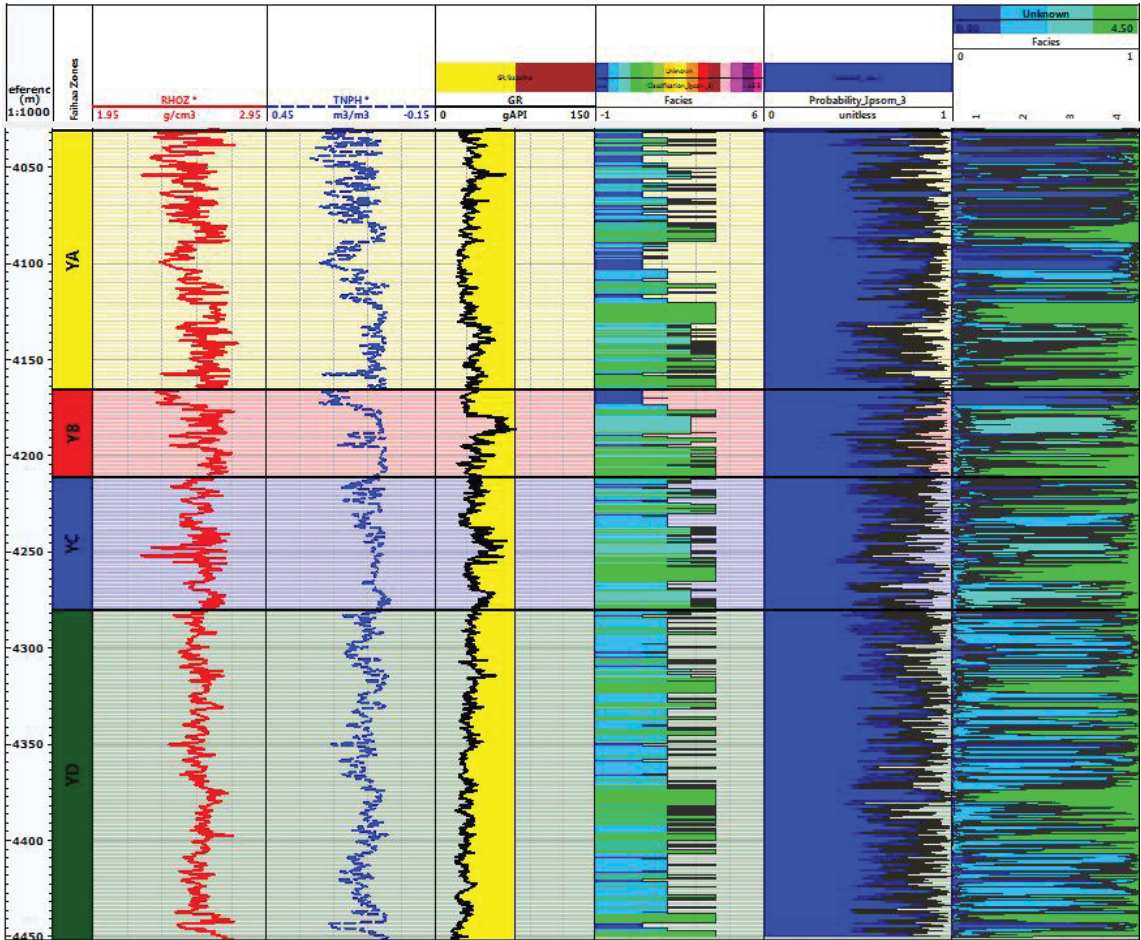


Figure 6: Electro-facies model for Yamama Formation by IPSOM technique.

3, Figure 4 and Figure 5) which clarify the input of variables with indexation variables of IPSOM module and statistics of groups. Table 1 interprets the depositional environment of facies from 1-4.

Results

The Yamama formation consists of facies unevenly, Figure 6 clarify facies distribution thought the Yamama units, each one of these units is characterized by different facies which were summarized below:

- 1. YA unit:** The upper part of this unit consists mainly of shoal deposits (Facies 1) with porosity PHI is greater than 15 and GR is less than 30, while lower part consists mainly of outer ramp deposits (Facies 4) alternating with thin beds from restricted marine deposits (Facies 3).
- 2. YB unit:** Outer ramp deposits (Facies 4) dominated unit when porosity PHI is less than 0.05 and GR is greater than 30 with thin beds from restricted marine deposits (Facies 3) and the upper part from this unit consists from of shoal deposits (Facies 1).
- 3. YC unit:** It consists mainly from restricted marine deposits (Facies 3), when PHI from (0.06-0.09) and GR is greater than 40 with beds from Outer ramp deposits (Facies 4), thin beds of shoal deposits (Facies 1) and open marine deposits (facies 2) in top of unit.
- 4. YD unit:** Open marine deposits (Facies 2) dominated unit when porosity PHI from (0.1-0.15) and GR is less than 30 with beds from Outer ramp deposits (Facies 4) and very thin from shoal deposits facies.

Conclusions

The upper unit of the formation represented by YA is considered the best unit with high reservoir quality which contains a high percentage of high porosity facies (facies 1), while the middle part of the formation YB & YC has a low reservoir quality because it contains a high percentage of low porosity (facies 3) with few from high porosity facies within the high part from YB unit, and the lower part of the formation which represents by YD unit which has a middle reservoir quality with containing a high percentage of middle porosity (facies 2). Caprock, represented by poor porosity facies (facies 4) spread throughout all parts of the formation, especially in the lower part of each unit.

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