Petrophysical Properties and Reservoir Layers Of Facha Member Of Gir Formation In Dahab Oil Field, Block74A, Sirte Basin-Libya

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Abstract

Study of Petrophysical properties of the reservoir layers is an important to evaluate the reservoir reserve assessment using well logs

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data recorded of select five wells over studied reservoir for presenting this subject. The dolomite and anhydrite layers Facha member (Gir Formation) studied reservoir (Eocene Age) located in middle of the northern part of Block NC74A (Dahab oil field) , western part of Sirte Basin, has about (42 to 132) Feet thickness, with average total porosity %. The reservoir divided into eight units (A, B, C, D, E, F, G and I) according to reservoir quality and lithology. However, using Techlog software 2015 and Surfer for mapping.

The reservoir quality of these layers B, D, and F have the best reservoir quality than other layers. The results are as follows: average porosity ranging from 10.1 to up 24.7 %, water saturation ranging from 23.1 to reached to 50.5 %, net pay thickness varies due to reservoir quality from 32 to 124 feet. The Original oil in place (OOIP) is 10,968,431 Million Stock Tank Barrels (MMSTB), Initial oil in place (IOIP) is 8,705,104 (MMSTB), And Recoverable Reserves is 3,020,671 (MMSTB).

**Keywords: Facha Member; Gir Formation; Dolomite and Anhydrite Layers; Original oil in place; Initial oil in place; Million Stock Tank Barrels.*

I. ntroduction

Dahab oil Field located in the middle of the northern part of Block NC 74A, in the western part of the Sirte Basin(in the Zallah trough). about 550 km to the SE of Tripoli city, producing from the Facha member reservoir section is highly dolomitized and consists of two broad units with very different properties of the Gir Formation The Facha The member (Zueitina Oil Company report2006) .

The main aim of study is evaluate the reservoir quality of the Facha member and divided into layers based on type of lithology also on reservoir quality . Using Petrophysical analysis and to combined the

results with geological information of area study to understand more about the reservoir quality. The source rock in this study is Upper Cretaceous Sirt shale. Hon member (anhydrite rock) is the cap rock of Facha Reservoir.

The method used in this study were applied Petrophysical analysis Using Techlog 2015 software for five selected wells (C1 ,C6 ,C7,C8 and C10-NC47A) content well logs, include Gamma-ray, Neutron, Resistivity log and Sonic log and Formation tops., in order to determine the quantity of Petrophysical properties for the Facha member such as Porosity, Permeability, water saturation and net pay, and combined them with the geological information to help us to evaluate the reservoir quality in study area.

surfer 13 software has been using for generated by Maps of Porosity, Permeability and Water saturation.

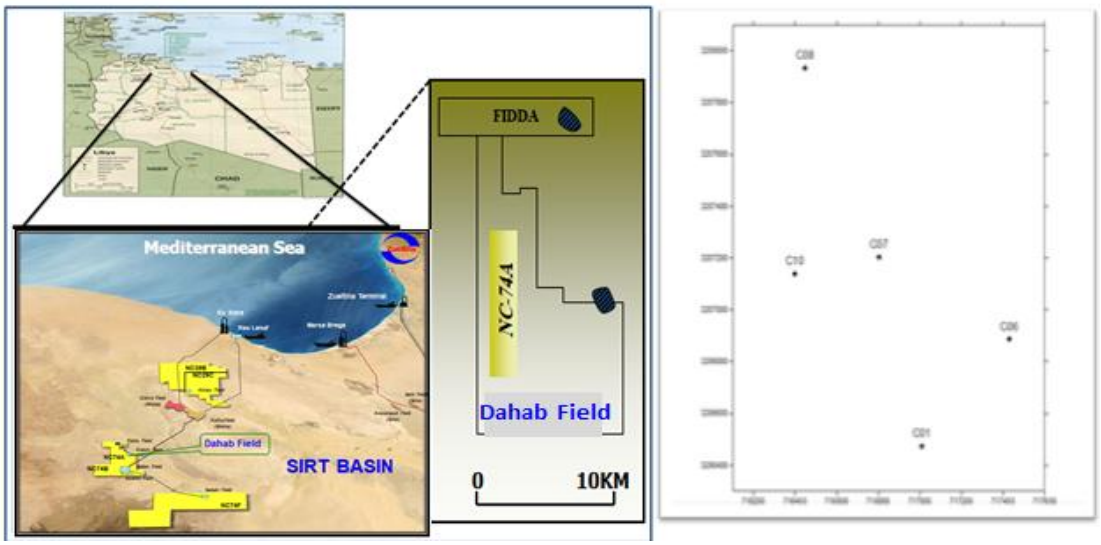


Fig1.: location map of study area,NC74A(Dahab Field)Sirt Basin

2. Geology Setting Of Sirt Basin

Sirt Basin is located onshore in Libya along the Mediterranean coastline of Northern Africa. It is bounded to the north by the deeper water of the Gulf of Sirt, to the northeast by the Cyrenaica Platform, to the southeast by the Jabal Al Dalmah Arch, to the south by the Tibisti Massif, to the southwest by the Murzuq Basin and to the west by the Hun Graben (Mohamed A. Saleem 2015) Sirt Basin is the youngest and most hydrocarbon prolific basin in the country. The area of Sirte Basin occupies about 230,000 km², with a wildcat drilling density of one new field wildcat per 145 km². Overall drilling density of the basin is 3.3 wells per 100 km², with an average field depth of 2,100 m. (Mohamed A. Saleem 2015).

The Sirt Basin formed by intracratonic rifting, in late Mesozoic and Cenozoic triple Junction continental Rift (extensional basin) along northern Africa that was initiated during the late Jurassic Period. and it began to form by tensional tectonic activities in the middle Mesozoic. By the early upper Cretaceous (Cinomanian) time, the general structural pattern of Basin was established. Tectonically, the Sirt Basin is a northwest elongated Basin made of a series of northwest-southeast trending Platforms or uplift (Horsts) and Troughs (Grabens) (Figure 2). During the Oligocene to Miocene the present-day structural elements of the Sirt Basin comprises several NNW-SSE trending troughs of grabens separated by intervening horsts. These are from west to east, Hon Graben Waddan Platform, Maradah (Al-Hagfa) trough, Defa ¬Waha Zelten Platform, Ajdabiya trough, Amal-an Nafurah platform, Maragh trough, and Cyrenaica platform The basin subsided slowly during the Cretaceous and the Tertiary, and particularly in the Eocene time when the maximum rate of Subsidence of the basin was reached (Berggren, 1974). Structure of Study Area From the structure contour map on Top Facha member in

the, and cross sections showed the structural configuration is high area in the north part is affect by Faulting after fold Anticline oriented NW-SE, and trend to lower structure towards the south. These structural boundaries (major fault) in the eastern part and other one in western part of Field, these faults create fractures in the field with different fluid contact but area study very closed the faults . Sedimentation was controlled by tectonic and eustatic influences, locally inducing high sedimentation rates, with the distribution of the various lithologies being governed by ridge-and-trough paleotopography.

The oil field studied can be subdivided into 3 paleogeographic areas

1) Northern area where peri-reef deposits prevails.
2) Central area dominated by protected middle shelf deposits;
3) Southern area of dolomitized inner platform deposits, probably intermittently emerged. Sedimentary sequences of the Sirte Basin varying from continental to near shore and marine sediments (Barr and Weggar,1972).

It can be divided into four litho- Stratigraphic sequences described below :- First sequence overlying the basement is dominated by the pre-upper Cretaceous sedimentary Sequence that existed before the basin was formed .Second sequence is the upper Cretaceous graben-fill sediments deposited following the structural development of the grabens. The grabens were the accumulation sites of marine shale deposits and eroded from the structural high areas . Third sequence is represented by the Tertiary sediments and is part of the graben-fill stage started by the early Paleocene deposits . The fourth sequence starts near beginning of the Lower Eocene. It is characterized by the slight to moderate local thickness variation within the upper Gir Formation.

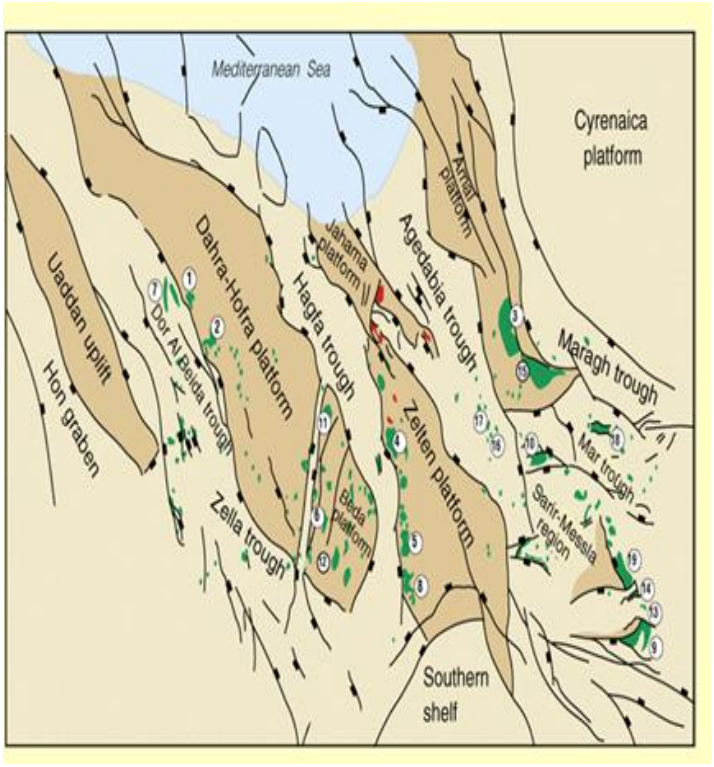


Fig 2 Major Structural elements map of Sirt(Mohamed A. Saleem 2015)

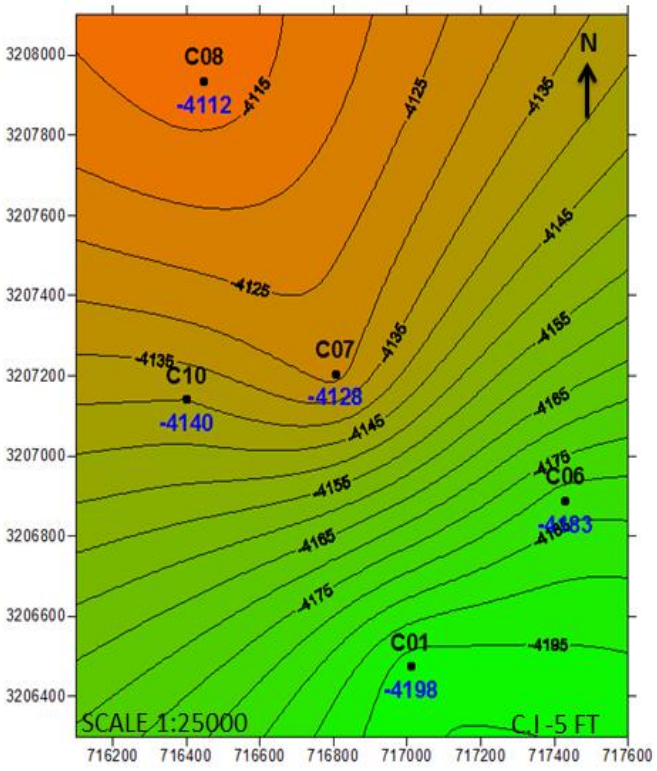


Fig.3 Structure Map On Top Facha Member Reservoir

3-Petrophysical & Reservoir Zoning

In this study The Facha member is the main reservoir rock in Dahab oil field. The member is highly dolomitized and consists of two broad units with very different properties: The upper Facha and the lower Facha. The Upper Facha is a fairly tight formation, but may be associated with some fractured network. It has been divided into various layers which have remarkable variations within their thickness and petrophysical characteristics The lower Facha consists of finely crystalline dolomite with appreciable vuggy porosity. This is a twin porosity reservoir and dominated by high permeability fracture network, vuges or solution channels. Remarkable variations exist within the

thickness and petrophysical characteristics of the layer. The permeability of some layers ranges from a few to several hundred md (Zueitina Oil company report 2018).

3-1 Identification of Lithology from Wire Line log :

The Facha member can be divide in to two type of lithology; dolomite layer and anhydrite layer using well logging (neutron log and density log) which one of Functions uses to order identifying type of Lithology and the identification of reservoir zones from non-reservoir zones. A non-reservoir zone here refers in study area to anhydrite zone , reservoir zone here refers to dolomite bed, the technique to distinguish between dolomite and anhydrite in studied wells, (density log reading in anhydrite g/cm bed about 2.87 and in dolomite bed about 2.78 g/cm .

Table 2 **Average Sw of the Facha reservoir**

Well Name	Average Water Saturation %
C1-NC74	30
C6-NC74	35
C7-NC74	31.6
C8-NC74	36.4
C10-NC74	20.7

Table1 **Average porosity of the Facha reservoir.**

Well Name	Average porosity %
C1-NC74	22

C6-NC74	**20.9**
C7-NC74	**13.3**
C8-NC74	**21.3**
C10-NC74	**27.7**

4.Reservoir Layering Base On Petrophysics

Integrate Petrophysics result with Lithology type for divide the Facha reservoir to divide into Eight layers based on Petrophysics result and lithology :

Layer A : Top of Facha reservoir ,consists of Dolomite with thin beds of anhydrite bed, thickness of 18 ft , net pay 8 ft , porosity 34 % and water saturation 31 % .

Layer B : consists of dolomite bed with gross thickness 27 ft, net pay 23.7 ft , porosity 37.5 % and water saturation 31.6 % .

Layer C : consists of anhydrite bed only with thickness 5 ft

Layer D :consists of dolomite bed with very thin layers of anhydrite in top with thickness 35 ft , porosity about 35.8 %,and water saturation 14.5 % **.**

Layer E : this layer consists of anhydrite bed only with thickness 3 feet. **Layer F** : consists of dolomite bed with thickness 26 ft ,net pay 26 ft , porosity 25 % and water saturation 20 % . Layer G : consists of anhydrite bed only with thickness 4 ft. **Layer I** : bottom of reservoir , consists of dolomite bed with thickness 188 ft , net pay 34.5 ft , porosity 26 % and water saturation 34 % .

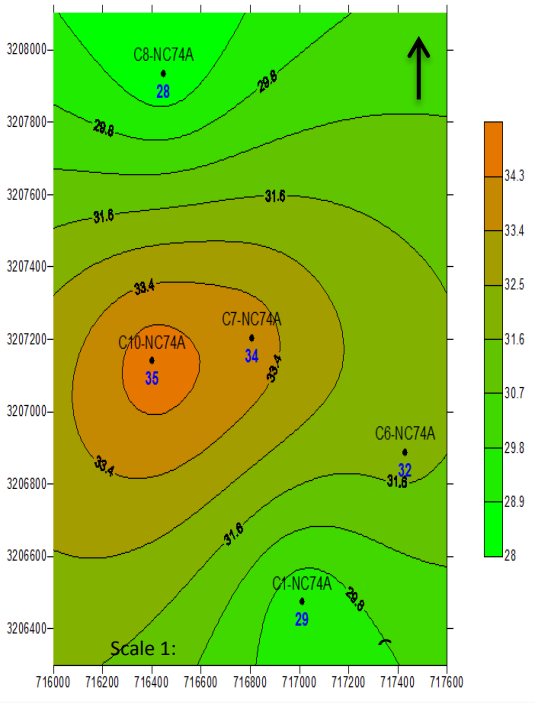
5-Layers Quality :

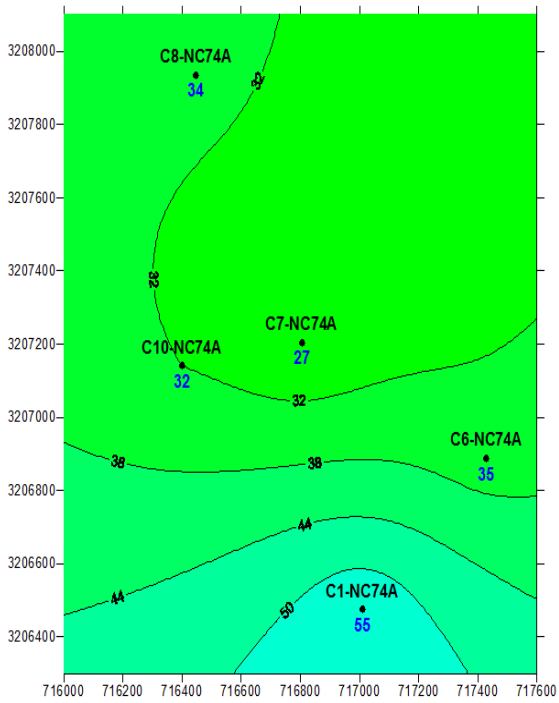
Petrophysics result for all wells show the Layers B, D and F have good reservoir quality than other layers below are description of each layer properties.

Layer B :

Petrophysics result show ,the average porosity 10.9 % to 37%

The water saturation show the central part low values of water reached to 30% and increasing to south part reached up to 59% . net pay thickness range from last than 10 feet up to 30 feet .





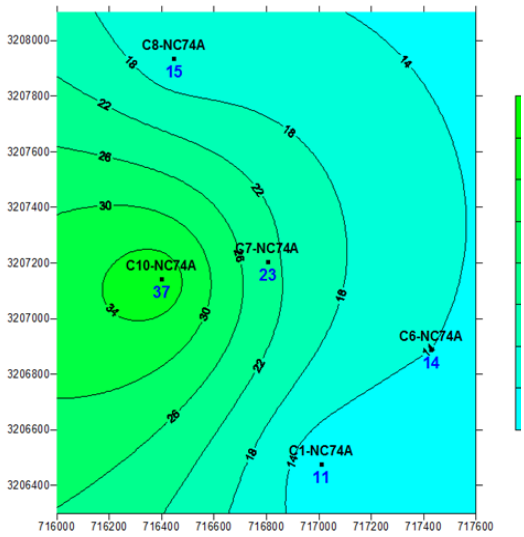


Fig 6 Porosity Map of Layer B

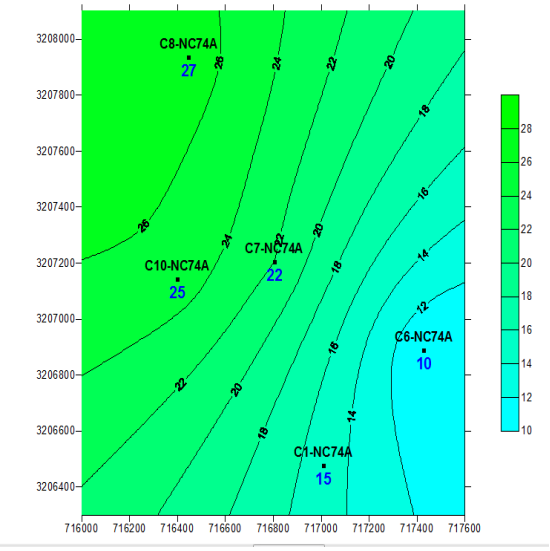


Figure 7 Net pay Map of Lay

Layer D :

The layer D is location between layer C and Layer .consists of dolomite bed with thin layers of anhydrite in top , thickness average 31 feet, the average porosity 19 % ,and water saturation 28 % and net pay thickness 19.7 feet figure (5.10)

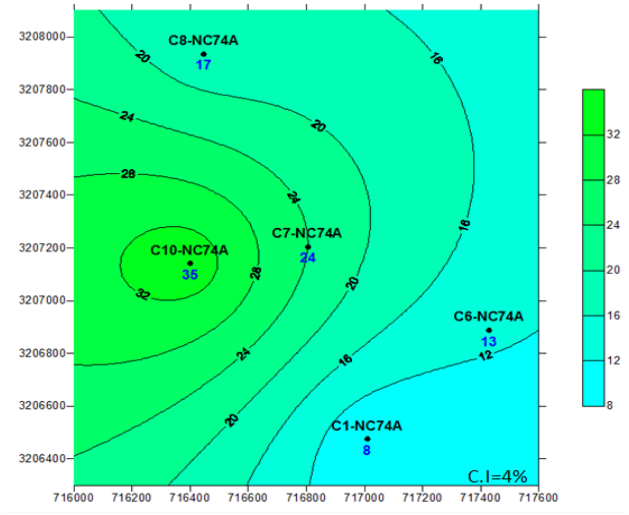


Fig 8 Porosity Map Of Layer D

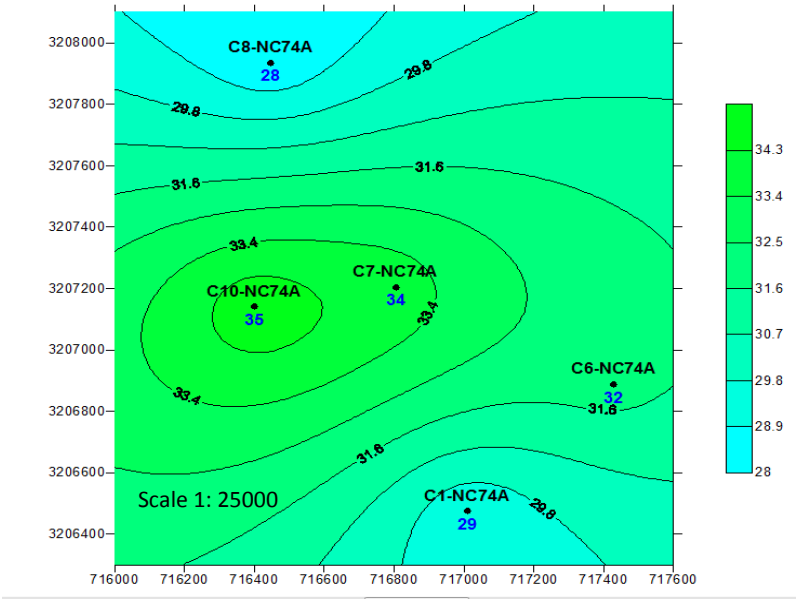


Fig 9 Thickness Map of Layer D

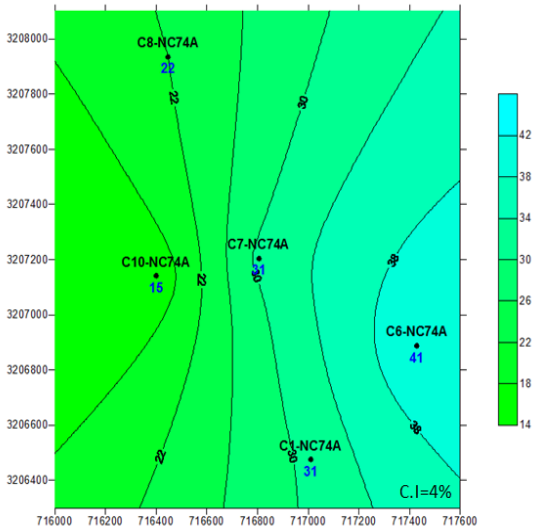


Fig 10 Water Saturation Map Of Layer D

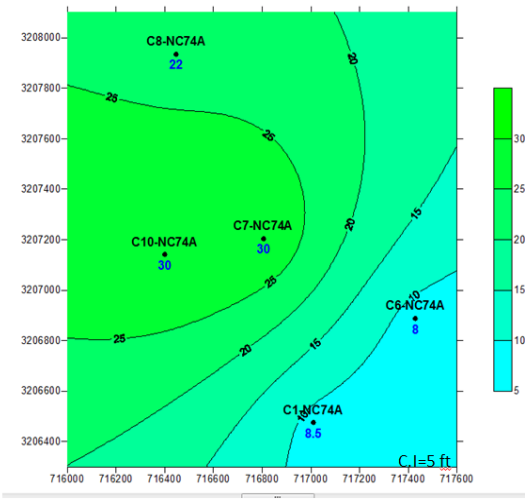


Fig 11 Net Pay Thickness Map Of Layer D

Layer F : The layer F consists of dolomite bed, with thickness 29 feet , porosity 17.4 %,and water saturation 35 % and net pay thickness 20.8 feet. figures (5.14)

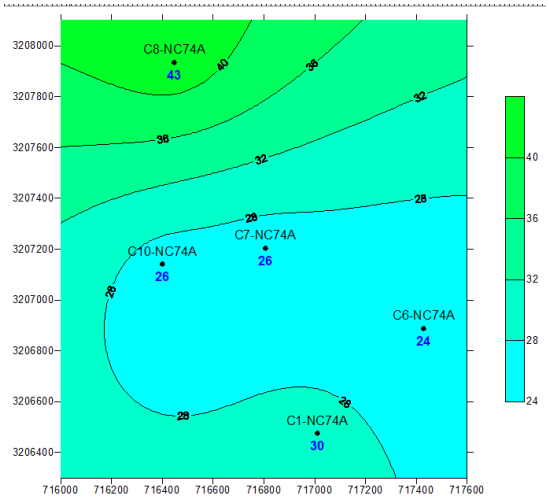


Fig12 Show Thickness Map Of Layer F

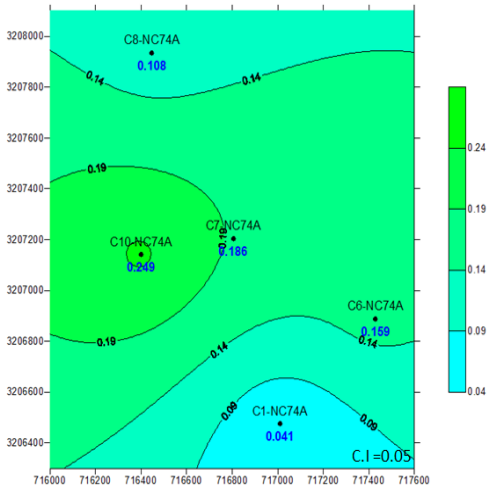


Fig13 Show Porosity Map Of Layer F

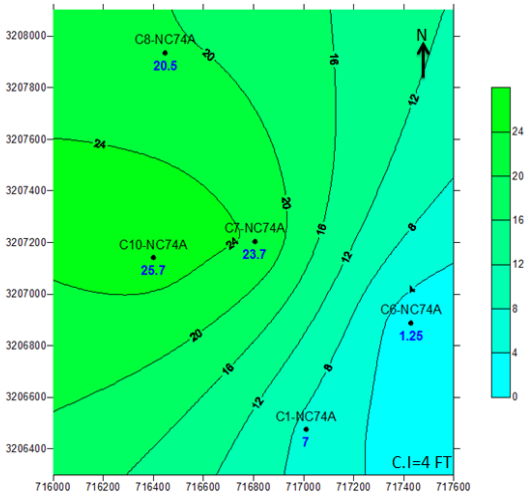


Fig14 water saturation map of Layer F

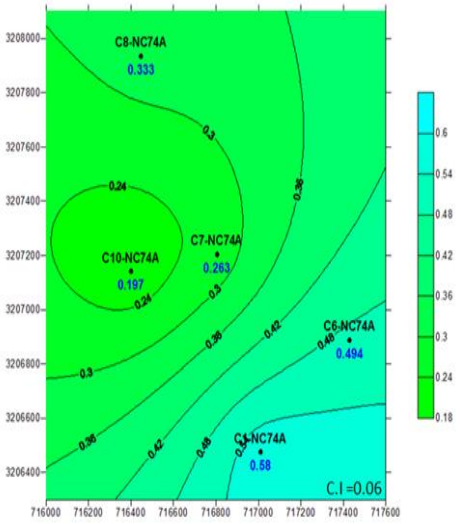


Fig15 Net Pay Thickness Map Of Layer F

Conclusions

the Petrophysics result base on the wire line log data only for five wells can be divide The reservoir into eight layers based on reservoir quality and lithology (Layer A , B ,Layer C, Layer D, Layer E, Layer F,

layer G and Layer I) we recognized the result of the reservoir quality of these layers indicate the layer B, Layer D and Layer F the best reservoir quality than other layers . Average porosity ranging from 10.1to up 24.7%. water saturation ranging from 23.1 % to reached to 50.5 %. Net pay thickness is varying in net pay thickness due to reservoir quality from 32 feet to 14.

Recommendation:

Core data analysis study for one well or two wells to correlate with Petrophysical analysis as it give correct physical properties Create geology model by combined or integrate the Petrophysical properties result and sedimentation and the depositional environment with other data to understand more reservoir quality.

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