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Petro physical evaluation of in the one ofoil wells Abadan plain hydrocarbon basin

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Abstract

Abadan plain is considered as the one of the hydrocarbon sub basins in south of Zagros in Iranwhich from the tectonic viewpoint is known as the Arabian plate north platform terminal.Existence of basic differences in Abadan plain sediments due to the structural geologicalviewpoint with Zagros sediments area and Dezful embayment shows the petro physical studiesnecessary. So for determination of porosity, shale volume and water formation saturation fromimportant rank factors after the determination by the probes and data sending and theirprocessing as the full set logs, related data was prepared as the diagrams and then determinationand evaluation was performed by two certain and probable methods. As it is observed in SarvakFormation interval, the results showed that major lithology was carbonate andalso observed with Dolomite rocks in the depth of 3250-3575 and 3450-3475 m. From the oil reservoirviewpoint, 3125-3265 m is the best hydrocarbon depth in wells, though beside oil zone, freewater zone is present but due to the 30% water saturate sub limit can almost have more oilreservoir. But due to the very low quality, next predicts for depth less than 3125 and 3240 m tillthe Sarvak interval ending has no certainty.

Keywords: Sarvak Formation, petro physics, oil reservoir, Abadan plain, geo log.

1. Introduction

Porosity, shale volume and formation water saturate are of the most importantreservoir factors. In one hand electrical facieses modeling and its separation is one analyticaland certain method for petrophysical well mapping categorizing which have a crucial role inhydrocarbon reservoir development (Basheni 2009 and Kadkhodaie 2009). Petrophysicalevaluation which is the data interpretation and description of well logs is one of the mostimportant factors in reservoir rock features and hydrocarbon reservoir properties evaluation (Ghassem-Alaskary 2012 and Riblier 2005). In the other hand, knowing the manner of sedimentfacieses and digenetic in one basin scale and oil field will effectively help in understanding the3D spaces distribution of porosity, permeability and capillary pressure in that field. For thispurpose it is necessary that in facieses analysis by using well mapping, at first formations shouldbe divided in acceptable layers units, then the relationship between the petro physical parameterswill be obtained from determined charts and features of rock facieses as the interpretable certainor statistical form (Kim et al. 1998).

1.1 Geological setting

structural study area located of the south Zagros folded belt. Northboundary and eastern north is limited to the Zagros (Soosangerd Anticline, Abteimor Mansory) and after passing from the south of petroleum field Rag eSefid enters the Persian Gulf. Abadanplain's south boundary is Persian Gulf and Arabia (Ghazban et al. 2009). Abadan plain is a partof Mesopotamian plain which from the geological viewpoint is considered as the Arabianplatform (Fig. 1). Due to the young alluvial coverage, geological knowledge is limited to theobtained results of petroleum excavation and geophysics studies. These data show that incoverage sub sediment, Paleozoic and Mesozoic deposits will be limited (Aghanabati 2004). Existence of basic difference in Abadan plain sedimentation base of structural geology with the Zagros folded belt and Dezful embayment shows the integrated and ordered study necessity forbetter identification of area and considered area which have lots of uncertainties (Ghazban et al. 2009).The most important difference in Abadan plain with Zagros folded belt and Dezfulembayment are as follows:

-The anticlines of Abadan plain against the Zagros folded belt and Dezful embayment havesouth-north trend.

-Anticline slope in this area is smooth against the Zagros sediment area and Dezfulembayment.

-There is no anticline protrusion in this area. and Existence of anticlines in this area is the resultof basement faults.

-Against the Zagros folded belt and Dezful embayment which less depth reservoirs (AsmariFormation) have importance, in this area, deeper reservoirs (Khami and BangestanGroup) areimportant.

-Reservoirs of this area are not structural and facieses changes have an important role in oil trapcreation (Sadooni 2014).

1.1.2 Groups and formations of Abadan plain analysis

Against the Zagros folded belt and Dezful embayment which less deep reservoirs (Asmari Formation) have importance, in this area,deeper reservoirs (Khami and BangestanGroup) are important.

Due to the young alluvial coverage, geological knowledge is limited to the obtained results ofhydrocarbon excavation and geophysics studies. These data show that in coverage sub sediment,first and second periods' deposits will be limited (Aghanabati 2004). In the following we pointedto two groups according:

1. Khami Group: khamiGroup includes the Sormeh, Heith, Fahlian, Gadvan and Dariyan Formations. Actually carbonate sequence relates to the Jurassic-cretaceous. Khamireservoirs manly are placed in central Zagros (Dezful, Izeh), Abadan plain andbeyond its shore. A part of the Khami reservoirs is developed sporadically in Lorestan, Fars, Bandar Abbas

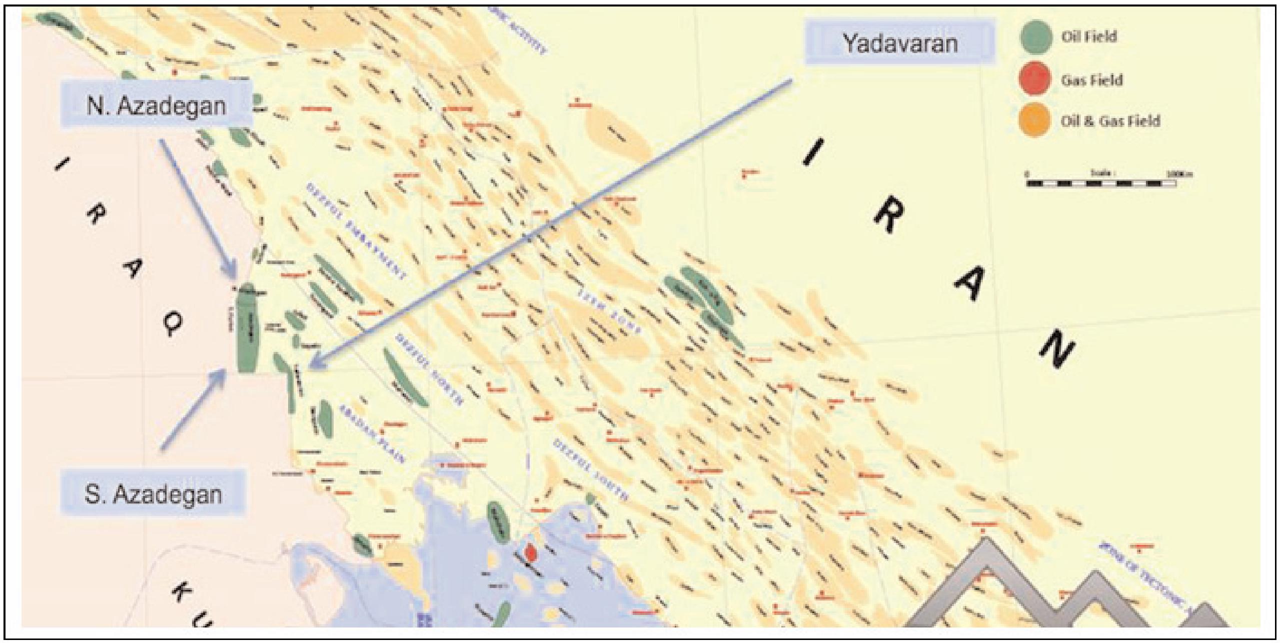

Figure 1. Case study general position of oil field and Abadan plain (SW of Iran).

province and Persian Gulf (Gazban et al. 2009).

2. Bangestan Group: this group name is adopted from the Bangestan mountain placed innorth of Behbahan city. For the first time, Bangestan limestone name referred to thelayers that were known as the medium Cretaceous, Roodist limestone, Hyporitelimestone or Lashtegan limestone before. This group is considered from old to new asthe KazhdomiFormation, Sarvak, Soorgah and Ilam. This group from bottom toward up isidentifying one sediment cycle which lasted from Albian toCampanian.

Table 1. Well tops formation in one well of studies oil field.

Formation	Top (meter)	Thickness (meter)
Mishan	1384	64
Gachsaran	1440	637
(Cap Rock)	2015	70
Asmari	2085	284
(ahwaz Sandstone)	2210	125
pabdeh	2369	257
Gurpi	2626	275
ilam	2901	121
Sarvak	3022	693
Kazhdumi	3715	260
Dariyan	3975	185
gadvan	4160	102
Total depth	4262	

2. Material and Methods

In the study oil field after determining by the probes and data sending and processing as the fullset logs, related information is prepared as the diagrams (Fig 2,3 and 4) and then for determinationand evaluation is prepared as the determine and Multimin methods (Masoudi et al. 2012 and Rabiller 2005). Generally after project creation and data and information loading, main work on dataafter preparation and data editing will be began and concludes the evaluations and results.Totally, it is common that for better results, to perform some of the editions and determination ondata, this is namely includes the data preparation and their editing and pre determination leveland environmental correction and in the following regarding to the two determine and multiminevaluation methods, evaluating process ends and in the next level, after determining the study oilfield facieses, general conclusion will be obtained.

Parameters picking: One of the methods which are important in volume determination of somepetro-

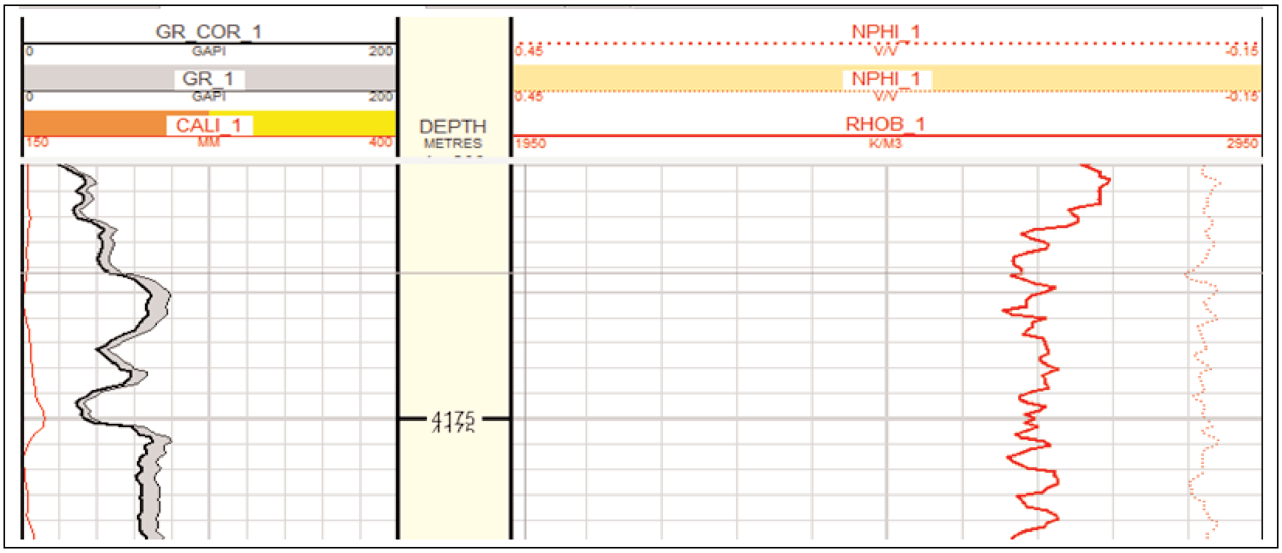

Figure 2. Correction level and gamma correction output diagram in well.

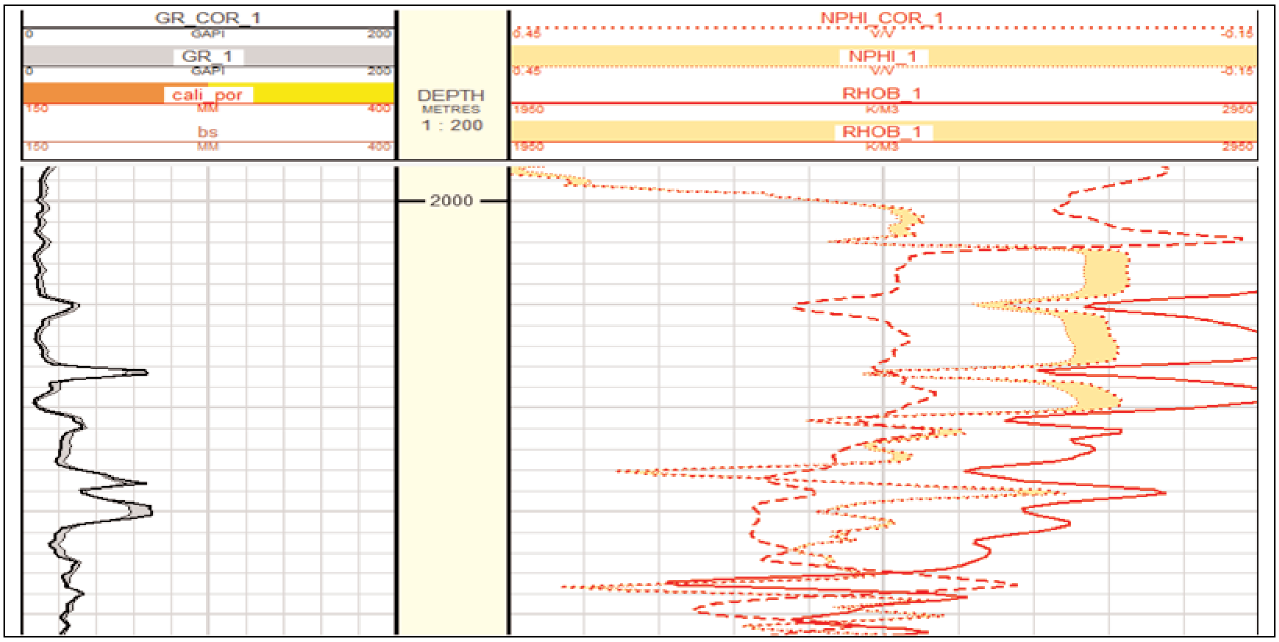

Figure 3. Environment correction Neutron log.

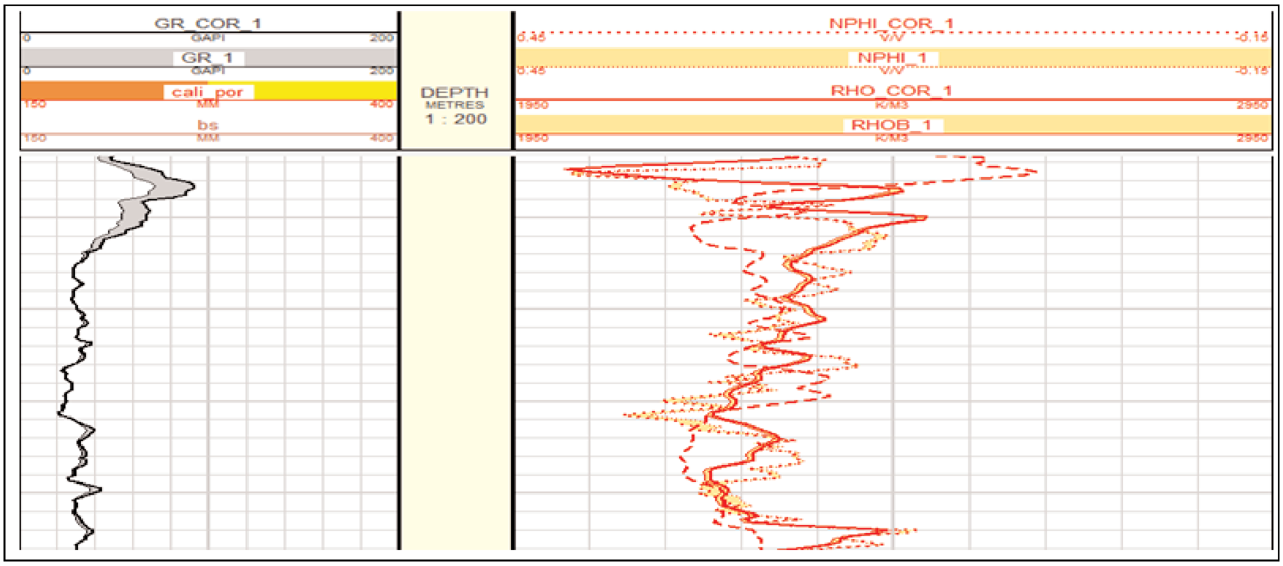

Figure 4. Environment correction Density log.

physical parameters is the cross plots drawing and their estimation (Buryakovsky 2012). Inthis project, this part is one of the most important working parts. The purpose of cross plots isthat instead of drawing the logs rather than depth, they will be drawn rather than each other,therefore in this part some of the parameters are constant and apparent matrix properties will beevaluate like the minerals (Tiab 2012).

RHOMA-UMA plot: At first for well in reservoir, we draw the diagram and related parameterswill be picked.

In reservoir Sarvak Formation well limited part, the whole data will be around Calcite and thisindicated that reservoir major part in each Sarvak Formation reservoir interval and the density is2.7g/cm^3 and u equals 15.5 B/cm^3. Regarding to the third dimension of figure which was coloredwe will notice that GCR & GR value is more blue and indicating the Shale

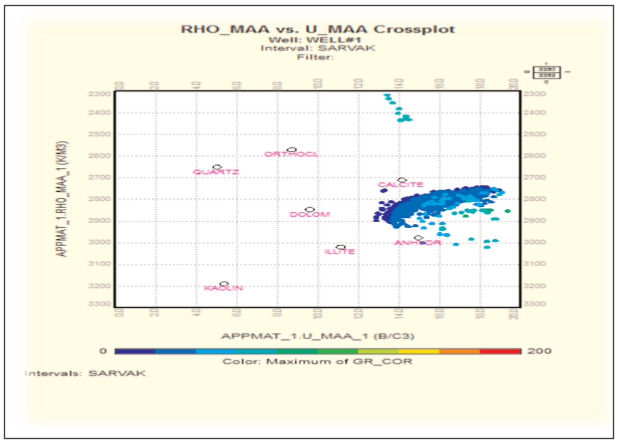

Figure 5. U-density cross sectional diagram for well.

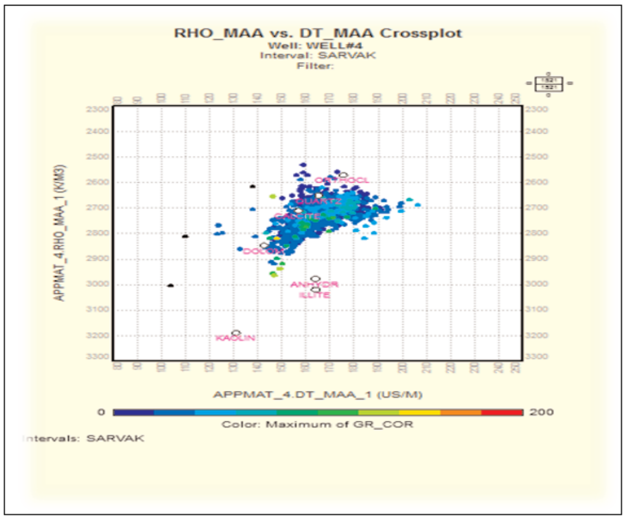

Figure 6. Sound-density cross plot for well.

very low value in thereservoir (Sfidari et al. 2012).

Sound-density cross plot: This diagram includes the density on sound and its main performancewill be the identification of occurred range between the minerals and lithology (Fig 6).

Data distribution in well follows from triangle pattern placed between calcite, anhydrite andshale. In other word data distribution range in well is located between 2.65 g/cm^3,2.8 g/cm^{3}and 2.7 g/cm^3 densities.

M.N plot: M.N plot is performed for intervals lithology interpretation which has specialcomplexities. This cross plot use from three porosity diagrams for each lithology related with theM and N quantity Sadegi 2009).M and N are the lithology slopes respectively in Sonic/Density and Density/Neutron diagrams. For this purpose it is independent from porosity and provides a cross plot for identifyinglithology. In other words, each point on cross plot can be drawn in several triangles for differentminerals (Fig. 7). Therefore for each point we obtain several lithology by combining differentminerals (Schlumberger 2000).

Boork obtained relationships are as follows:

$$M = (\Delta t_f - \Delta t_t)/(p_f - p_t)$$

$$N = (\phi_{nf} - \phi_{nt})/(p_f - p_t)$$

It should be noted that these parameters are different from presented parameters in Archi formulaand only is similar from the name viewpoint. In one hand dependency of porosity parameter israther dependents from fluids and effects on rock matrix and this will lead to determination ofmore accurate lithology (lee et al. 2002 and 2009).

Regarding to the obtained diagrams for Sarvak receivers formation we noticed that in Sarvak Formation well, is limestone dolomite, anhydrite and shale.

Neutron-density cross diagram (N-D): This diagram has major application in determination oflithology type and porosity value as the graphs. Regarding to the three parallel lines located ondata which indi-

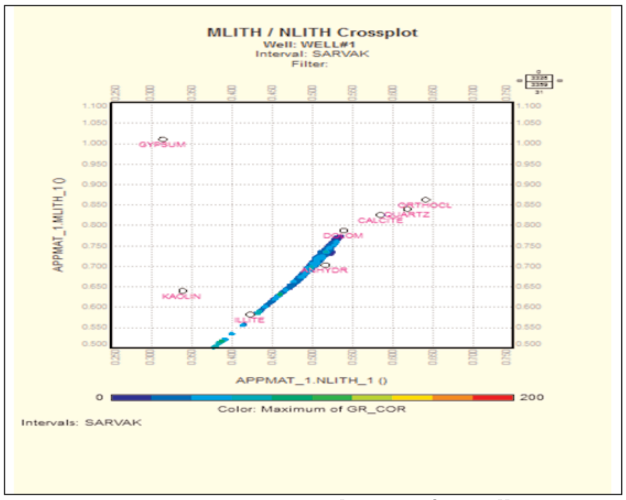

Figure 7. Cross m-n diagram for well.

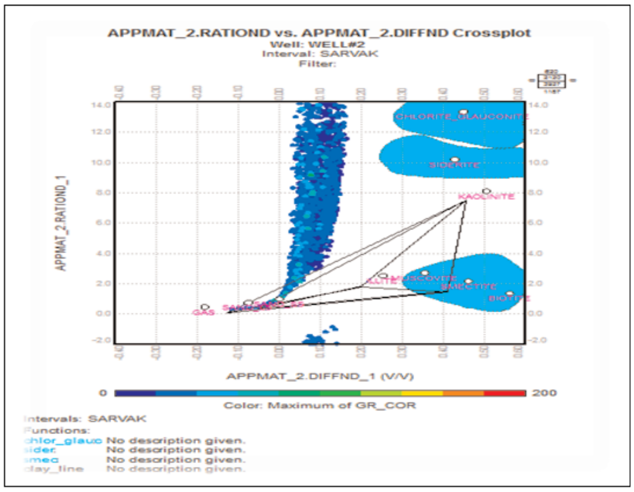

Figure 8. Relative porosity cross diagram with neutron density in well.

cates the lithology type (Sedigi 2009 and Tang et al. 2008). Reservoir is limestone with some dolomite part (Fig. 9). Because medium line and under line is dolomite and limestoneline. From one hand lines which are crossed parallel from these lime and dolomite lines,indicates the porosity in Sarvak reservoir regarding to the porosity diagram is determined-between 5-15%. From the quality viewpoint we can identify the Reservoir as the medium tillgood ones.

Density-gamma-well diameter cross diagram: Regarding to the gamma value is 3API for calcite, 5 API for dolomite and 20API for quartz. We can conclude that data major volume is located incalcite and dolomite range and this is a confirmation on Sarvak reservoir (Fig. 10).

Neutron-gamma-well diameter cross diagram: Regarding to four well, PEF changes are locatedin colors between green with 4-6 range. We can select the 3.9-4.1 for calcite and 4.5-5.1 fordolomite. We should state that PEF value for anhydrite is near the dolomite but regarding to thisvalue that is determined in Sarvak reservoir determination, almost and certainly there is noanhydrite (Fig. 11).

Sound-gamma-well diameter cross diagram: Regarding to the presented cross plots, changesvalue is from 152-260 micro sec which regarding to this value sound value for calcite is 160.7?s/m and for dolomite 152.5 ?s/m. Abundant percent of data are dolomite and calcite. Finally weshould say that read value from sound log for shale equals the 262.46 ?s/m and by an overview,Sarvak reservoir has very low shale volume (Fig 12).

3. Results and discussion

Shale volume determination: for determining the

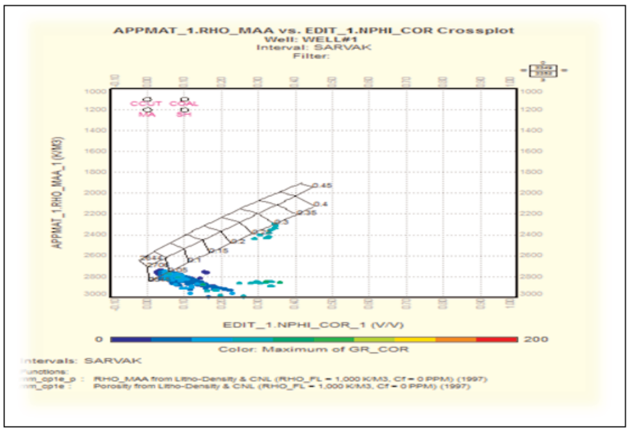

Figure 9. lithology type determination and porosity diagram N-D in well.

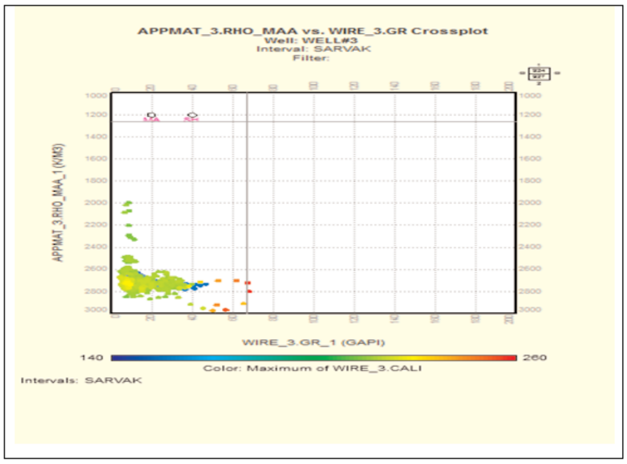

Figure 10. rho-gr-cali cross diagram in well

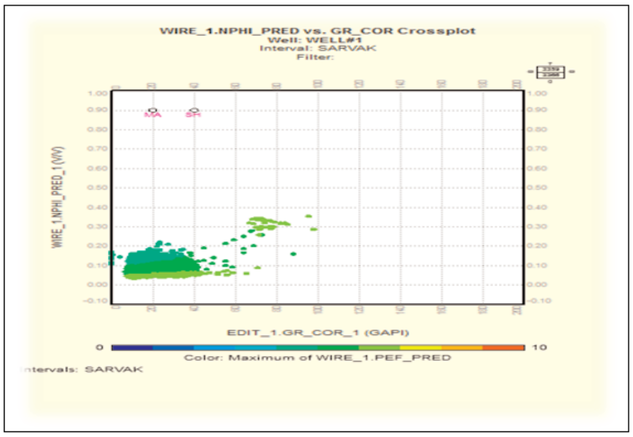

Figure 11. nphi-gr-pee cross plot.

shale volume there is different methods in software. One of the best methods which usually used for shale volume is the shalevolume determination by the gamma method:

$$vsh=(CGR_{log}-CGR_{max})/(CGR_{min}-CGR_{max}) \quad (3)$$

Which in this formula $CGR_{log}$is read value from log and CGR_{min} and CGR_{max} respectively isthe minimum and maximum which for clean formation and maximum valuefor shale is determined.

Porosity determination: in porosity determination we should attend to some points. At first datatypes in one hand have the log type, so is the basic role in determination. This point that data arecomplete or full set. Selecting the considered method is permitted and only the determinationsequence is our main procedure. As we know that, porosity from the appearance viewpoint istwo first and second types and their summation will obtain the total porosity. From one handregarding to the basis of one reservoir is fixed on porosity which has the ability of fluidtransportation easily (Hearst et al. 2000). Therefore determination main procedure is secondporosity determination and at first for first porosity determination we should use from sonicmethod and secondly for porosity determination we should use from neutron-density method. First step (porosity determination from sound log): sound speed in formation relates to the rockmatrix components and porosity distribution in them. The sound passing time in four minerals is:

Quartz 55, Dolomite 43.5, Calcite 47.5 and Anhydrite 50.Porosity formula determination by the sound log is the following (Wiley formula):

$$\varphi_{sonic}=(\Delta t_{log}-\Delta t_{ma})/(\Delta t_{f}-\Delta t_{ma}) \quad (5)$$

Which Δt_{log} is read value from sound log in each point Δt_{ma} is the passed time in rock and Δt_{f} is the passed time in porous liquid. And sound passing time in reservoir fluids for oil is 189, gas250 and water is 185. Second step (porosity determination by the neutron-density (chart lookup):

As we know that neutron-density logs, contains the first and second porosity. values forsome minerals are as follows:

Water saturation determination: saturation of a formation is a fraction of occupied pores by thefluid (shlomberzhr 2000).This value is stated as the percent, considered fluids in petrophysicsare water (s_w), oil (s_o) and gas (s_g) which summation of all parameters is 1. Thereforewith water saturation value determination we can compute the presented hydrocarbon information:

$$s_w^n+s_o+s_g=1 \text{ or } 100\% \quad (6)$$

Saturation is a parameter that is determined by using from resistance logs data (Izadi et al. 2013).We should note that all of the water saturation determination is based on the obtained formulafrom Archi experimental results. Archi without the attention to the clay minerals and conductorfocused his studies on the clean rock or clean sand. Archi formula (1942) is stated as thefollowing:

$$s_w=(aR_w) / (\phi^m R_t) \quad (7)$$

Which in this formula: s_w^n is water saturation, R_w is formation water residence in formation,R_tis formation real resistance, ϕ is porosity, ais winding coefficient usually 1, m is thecementation rate (1 for sand-

Table 2. Neutron- density values for some minerals.

minerals	Density(g/cm^3)	Neutron
Quartz	2.65	-0.02
Dolomite	2.85	-005
Calcite	2.71	0
Anhydrite	2.98	-0.02

stone and 2 for limestone), n is the saturation which changes from1.8 till 2.5. Usually for simplicity 2 will be considered.

Finally we should state that sometimes which clean rock is presented in formation, Archiformula is not valid so part of the shale water saturation is considered beside main shale whichthis will be problematic in estimation and model creation of oil volume, so other methodsare presented which is determined shale water saturation (Chen et al. 2012). In the presentstudy for water saturation determination we use from three Archi, Dual Water and Indonesiamethods so we can see which one is better (Fig. 13).

3.1 Comparison the model of water saturation in cross-plot

Lithology determination: One of the main applications of data mapping is identify anddetermining lithology (Fertle 1987).In fact, the identification of lithology is an important step in the evaluation properties ofreservoir, and will help to isolated reservoir from non-reservoir area (Mishra 2005). To calculate lithology at first calculated a series of parameters and variables into a well Then, depending on the type and number of constituent minerals in the interval zone, zone orinterval method used to draw the lithology model (Moline 1995).

Water resistance formation: Formation water resistivity is a function of salinity andtemperature and it can be measured by producing water or estimated 100% Porosity at saturationof water with cross plot porosity of Resistance (Perez 2003). This parameter that sometimescalled fossil water is water that not contaminated by drilling mud and fills the empty spaces inthe intact rock formations. Calculated this parameter and knowing it to calculate water saturationon resistivity graphical is essential. One of the important logs to calculated resistivity is (SP) log (Tiba 2012).

4. Conclusion

Determined petrophysical parameters in Sarvak Formation in this field show the vastheterogeneous and discontinuous in productive and reservoirs properties, so it is suggested thatbefore selecting the final intervals for lattice work operation, to use from the estimators andmethods for confirming the reservoirs

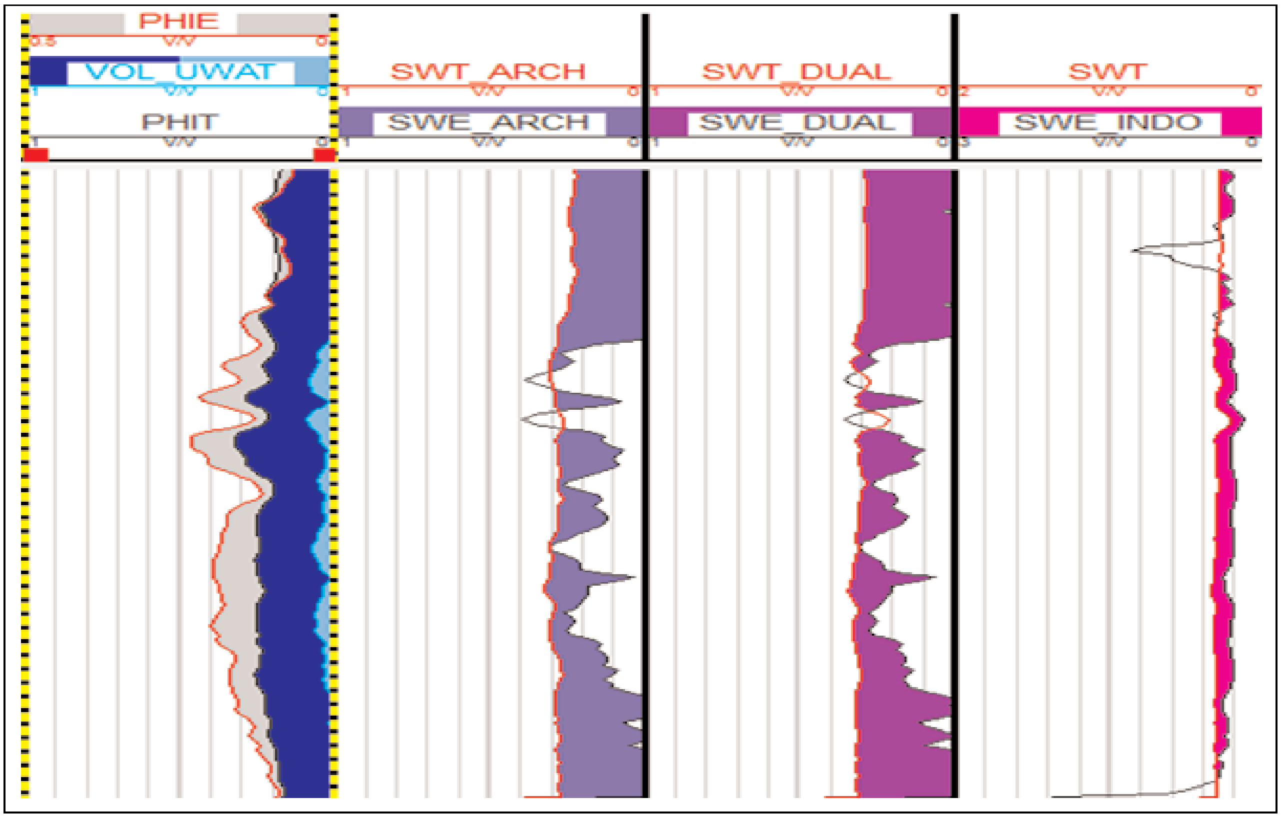

Figure 13. Comparison three methods of Indonesia, Archie and dual water for well water saturation

evaluation which in heterogeneous reservoirs (orsegmenting that area to the homogenized parts) more accurate evaluations will be performed.As it is observed in Sarvak Formation interval, major lithology was carbonate and observed in 3250-3575 and 3450-3475 m.And sometimes between the Dolomite rock layers. From the oilzone viewpoint, 3125-3265 m is the best oildepth in wells, though beside oil reservoir,free water is present but due to the 30% sub limit can almost have morehydrocarbon zone. But due to the very low quality, next predicts for depth less than 3125 and 3240 m till the Sarvak interval ending with low quality and unknown lithology, there is nointerpretable description.

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