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Formation Evaluation for Nasiriyah Oil Field Based on The Non-Conventional Techniques

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Abstract

The unconventional techniques called "the quick look techniques", have been developed to present well log data calculations, so that they may be scanned easily to identify the zones that warrant a more detailed analysis, these techniques have been generated by service companies at the well site which are among the useful, they provide the elements of information needed for making decisions quickly when time is of essence. The techniques used in this paper are:

- Apparent resistivity R_{wa} technique.
- R_{xo} /R_t method.

The above two methods had been used to evaluate Nasiriyah oil field formations (well-NS-3) to discover the hydrocarbon bearing formations. A computer program had used to represent CPI results for the two mentioned methods, the results of interpretation indicate to hydrocarbon zones in.

Key words: Nasiriyah Oil Field, quick look techniques.

Introduction

Nasiriyah structure was discovered in 1975 through a seismic investigations covered partially the southern part of Iraq by Iraqi National Oil Company (INOC).this structure had clearly appeared at that time as a longitudinal anticline[1].Five oil wells had been drilled to Sulaiy formation during the period 1978-1987.

It is considered as giant oil field in southern part of Iraq and located in Nasiriyah area.Nasiriyah oil field is located in the NW-SE oriented mesopotamian zone extending across the alluvial plains of the Euphrates-Tigris valleys. The mesopotamian zone is characterized by quaternary molasses and absence of surface relieves of folds [2].

Apparent Resistivity Rwa Technique

The R_{wa} techniques also called the quick look techniques which is useful for detections of hydrocarbon pay zones and estimation of water saturation and formation water resistivity, R_{wa} define as[3][4]:

$$R_{wa} = R_t / F \quad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where: -$R_t$is the true formation resistivity from well logs, and $F = 0.62 \, Ø^{-0.25}$which is Humble equation*.

*: Humble equation has been used in sandstone and carbonate formations, which are the main lithological column of the studied area.

Porosity had been calculated from sonic or neutron logs, in clean water bearing zones, the reading of deep resistivity tool will approximate to R_o and because:

$R_o=F.\ R_w$…….. (2)

So as:
$R_{wa} =R_t / F = R_o / F = R_w$…… (3)

It follow that, in hydrocarbon zones $R_t>R_o$ so that $Rwa>R_w$.

Simple rearrangements to Archie equation (1) and substitute of equation (3) will results in:

$S_{wa}= (R_w/ R_{wa})^{1/2}$ ……. …. (4)

The water saturation is related to as apparent due to this method is unconventional one, in practice R_{wa} may be calculated or read it directly from well logs in the section of interest, R_w also may be calculated from SP or from formation water analysis. If Rwa/ R_w calculated the hydrocarbon zones can be defined according to equation (4).

Restrictions of Apparent Resistivity Rwa Technique

The R_{wa} technique is still applicable when water resistivity R_w is unknown. However two conditions must be fulfilled [3][4]:

1- Water zones must be present in the section evaluated.

2- No abrupt salinity changes can occur over the section of interest so that the R_w can be considered as constant, therefore the (Rwa) min in water bearing zones is then selected to define Rw.

Abnormally high Rwa values can be displayed by zones other than hydrocarbon. Relatively high-resistivity shale will display a high Rwa values. Shale zones can be distinguished easily by shale indicators such as gamma ray and SP logs. Cycle skipping of the sonic log will also cause high Rwa values [3][5].

The Rxo/Rt Method

To economically establish the existence of producible hydrocarbon reservoirs (oil & gas), well logs contain key information about the formation drilled in different petrophysical measurements, among these measurements are (SP and Resistivity) [3].

This method was introduced by Dumanoir et al.[6] for well site interpretation. This technique involves computing log $(R_{xo}/R_t)$from either the R_{LL8}/R_{ILd} or the R_{SFL}/R_{ILd} ratio and recording it as a comparative curve with the SP. Separation between the properly scaled (R_{xo}/R_t)curve and the SP provide a quick- look location for the producible hydrocarbons [3].

The R_{xo}/R_t method is based on the calculation of the parameter $(E_{sp})_{QL}$ derived from the ratio R_{xo}/R_t,so [1][6] :

$(E_{sp})_{QL}= -K \log (R_{xo}/R_t)$ …… 6

Because $R_{xo}= F .R_{mf} / S_{xo}^n$ and $R_t= F. R_w / S_w^n$ then: $R_{xo}/R_t= (S_w/S_{xo})^n (R_{mf} / R_w)$

Then equation (6) becomes:

$(E_{sp})_{QL} = -K \log\{(S_w/S_{xo})^n(R_{mf} / R_w)\}$ …… 7

After re-arrange the above equation, then it will became;

$(E_{sp})_{QL}= -k\{\log(R_{mf} / R_w) + \log(S_w/S_{xo})^n\}$ ….. 8

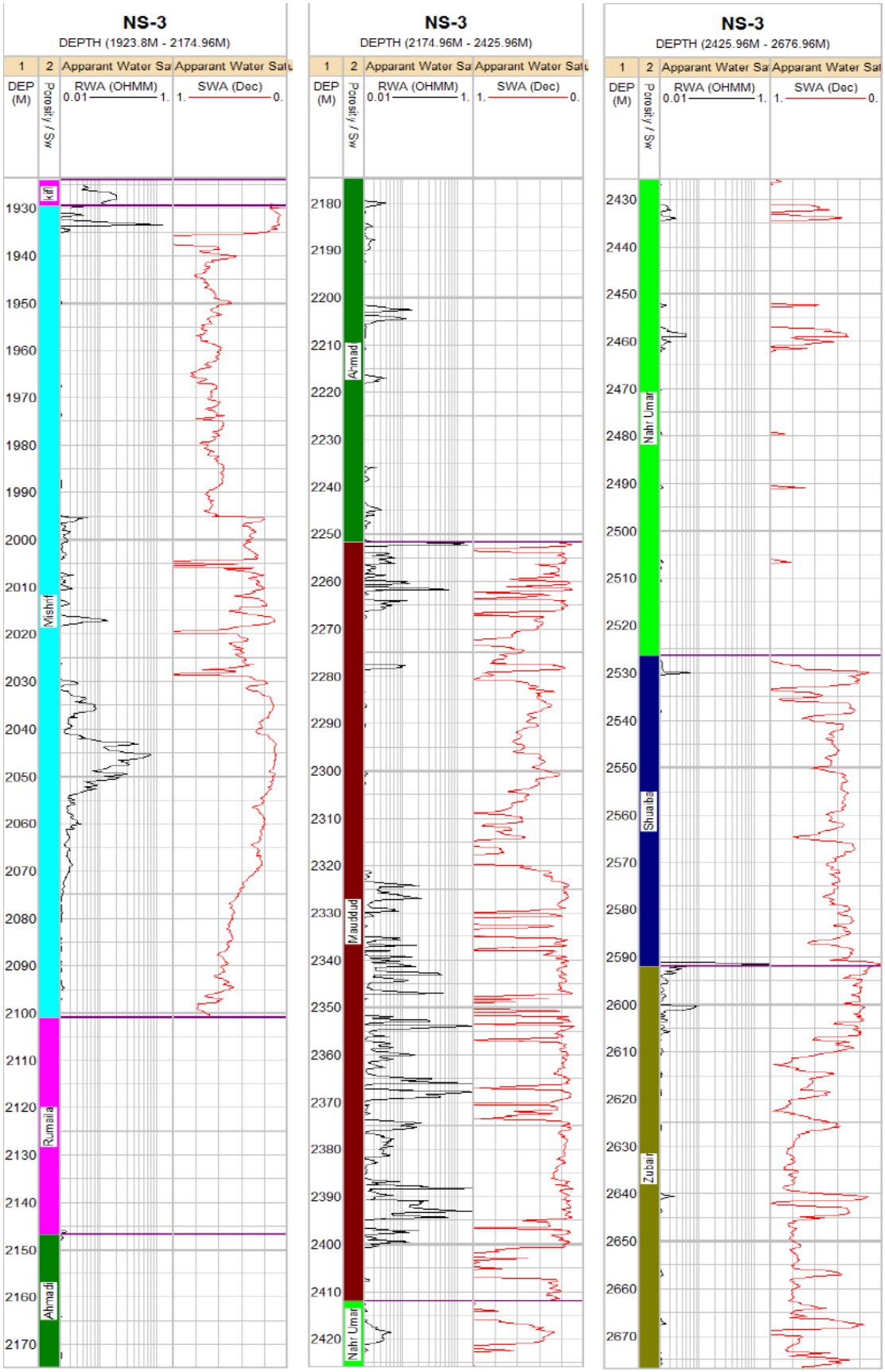

Fig. 1, S_{wa} Results from Mishrif to Zubair formations

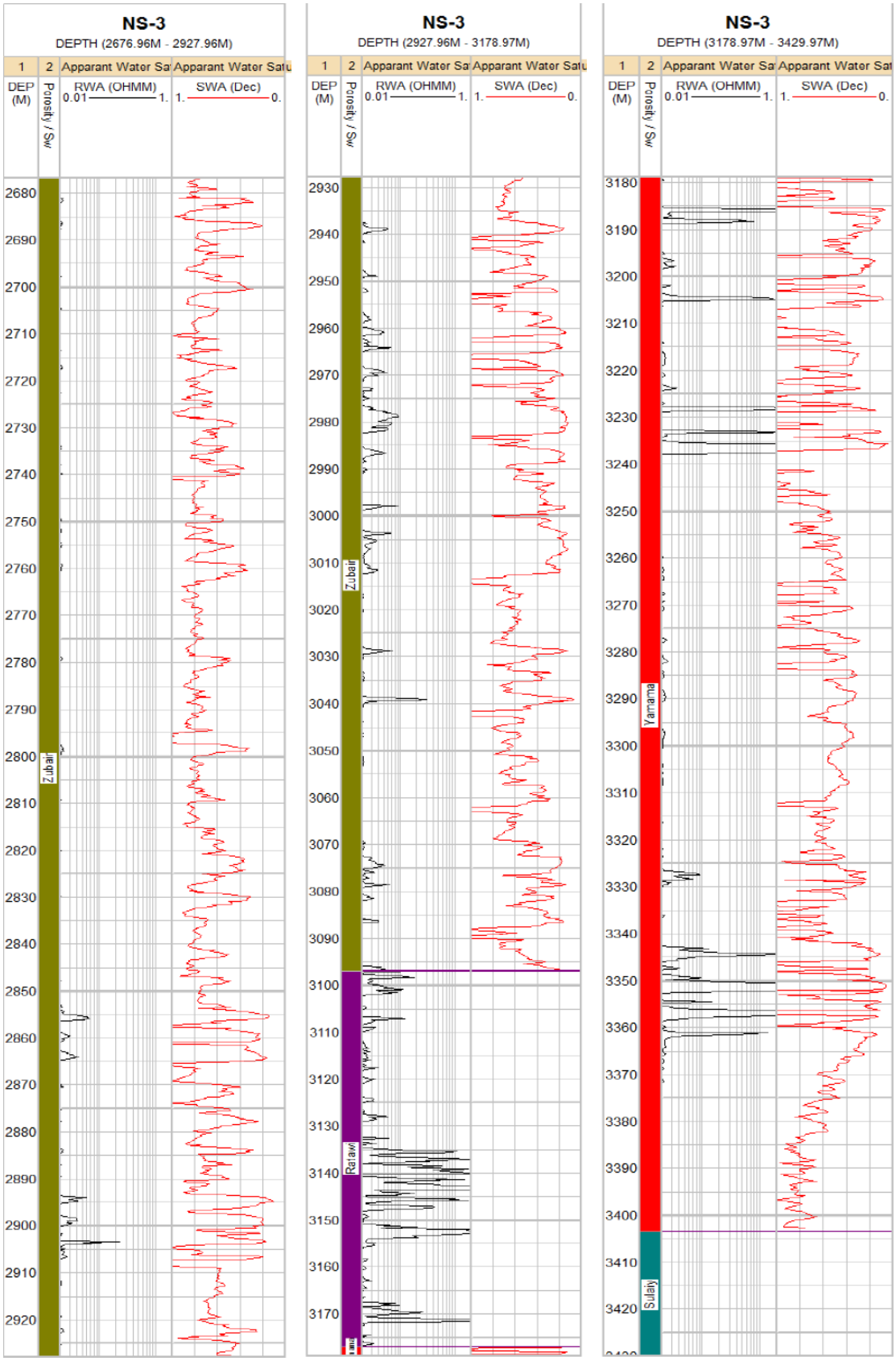

Fig. 2, S_{wa} Results from Zubair to Sulaiy formations

The calculation of (R_{xo}/R_t)does not require knowledge of porosity, formation factor, or R_w. The technique is most suitable for cases where porosity is not available or cannot be determine accurately owing to complex lithology, or when F-Ø relationships are in appropriate [7].

The main advantage of this method is to[7] (provide a means for locating hydrocarbons), because the proven presence of hydrocarbons does not necessarily mean commercial production, this method is an appropriate companion to techniques that only indicate hydrocarbon presence, such as the previous method.

But the measured Esp is (Esp) log can be approximated by the term {-k log (Rmf / Rw)}; therefore:

$$(Esp)QL= (Esp)log – k \log(Sw/Sxo)n \quad \dots 9$$

In water bearing zones or in the zones with no movable hydrocarbons Sw= Sxo ,then (Esp)QL= (Esp)log and the separation will be negligible ,otherwise in movable hydrocarbon zones the (Esp)QL will separate from (Esp)log and (Esp)QL< (Esp)log this is due to (Sxo>Sw) and log(Sw/Sxo) < 0, the results are shown in the figures (3) and (4) respectively.

Finally it is more important to know that the Rxo / Rt method is applicable to fresh mud, (Rxo>Rt) in formations where invasion falls within the limits demanded by the (Rxo/Rt) computation [7].

Evaluation of the Unconventional Methods

The results of these methods indicate to presence of hydrocarbons in Maudud, Nahar Umar and Zubair formations respectively in addition to the conventional reservoirs (Mishrif and Yammama), table (1) show the results of these methods in Nasiriyah oil field which are contiguity to the results of DST and flow test.

Table (1) Hydrocarbon zones by nonconventional methods

	FM.	R_{wa}method		SP(QL)	
		Top	Bottom	Top	Bottom
1	Mishrif	2006.8	2026	2007.4	2019.5
		2029	2085	2026	2074
2	Maudud	2265.1	2268.4		
				2281	2289
				2296	2304
		2321	2323	2319	2322
3	NahrUmr	2416.1	2422.4	2414.3	2422.8
				2505	2517
4	Zubair			2937.8	2940.5
				2984	2988.7
5	Yammama	3185.7	3218.2	3184.2	3221.5
		3227.5	3238	3248.4	3268
		3342	3363	3280	3285
				3326	3333
				3358	3363

Conclusions

The detected oil zones in this study are compared with the results of conventional interpretation with actual Archies' parameters (a, m and n),DST, flow test and daily drilling reports ,from which we can be sure that most zones that interpreted as oil are correct because of convergence between the different interpretation methods and the provided reports data.

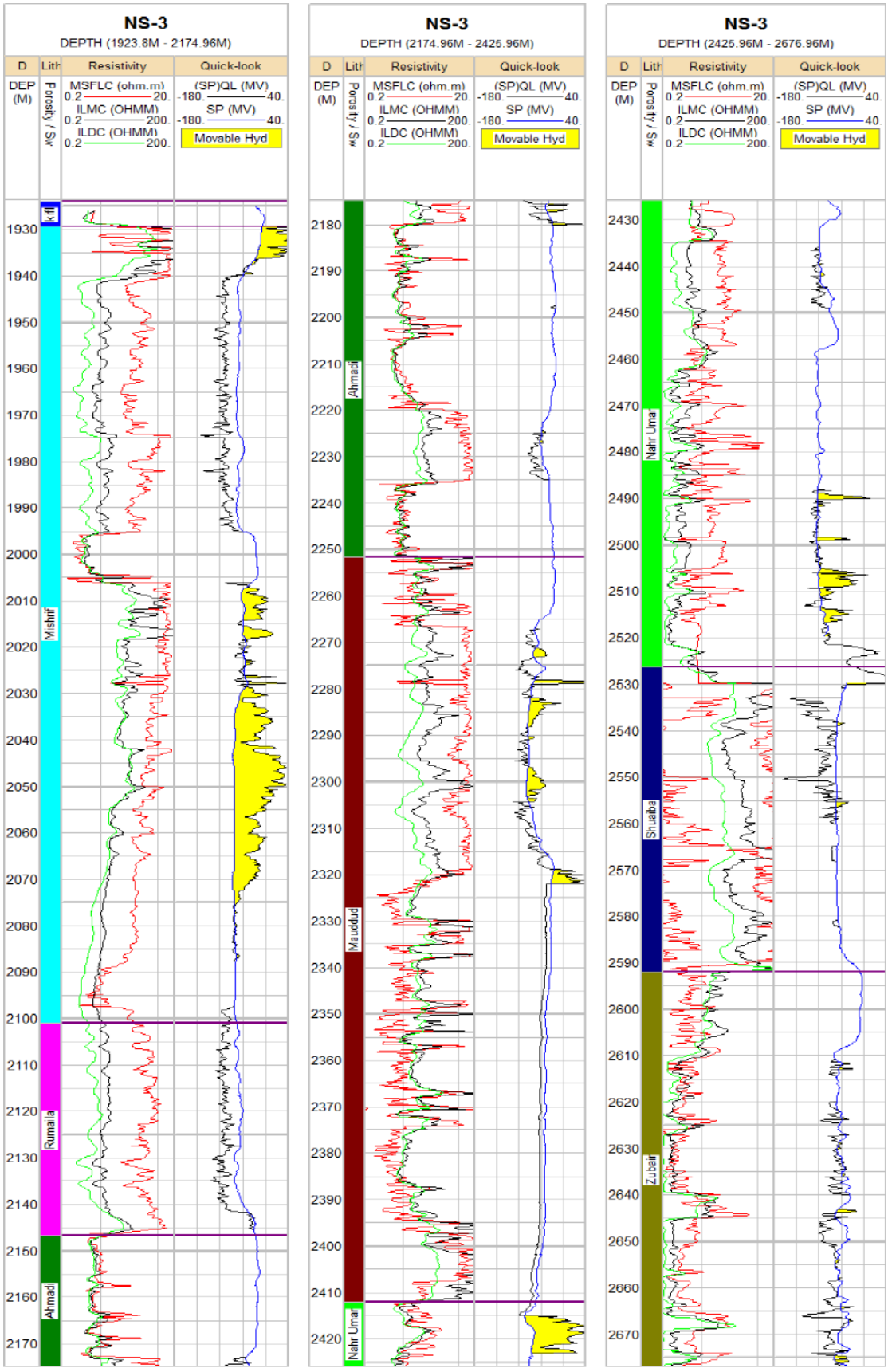

Fig. 3, R_{xo}/R_t method results from Mishrif to Zubair formations

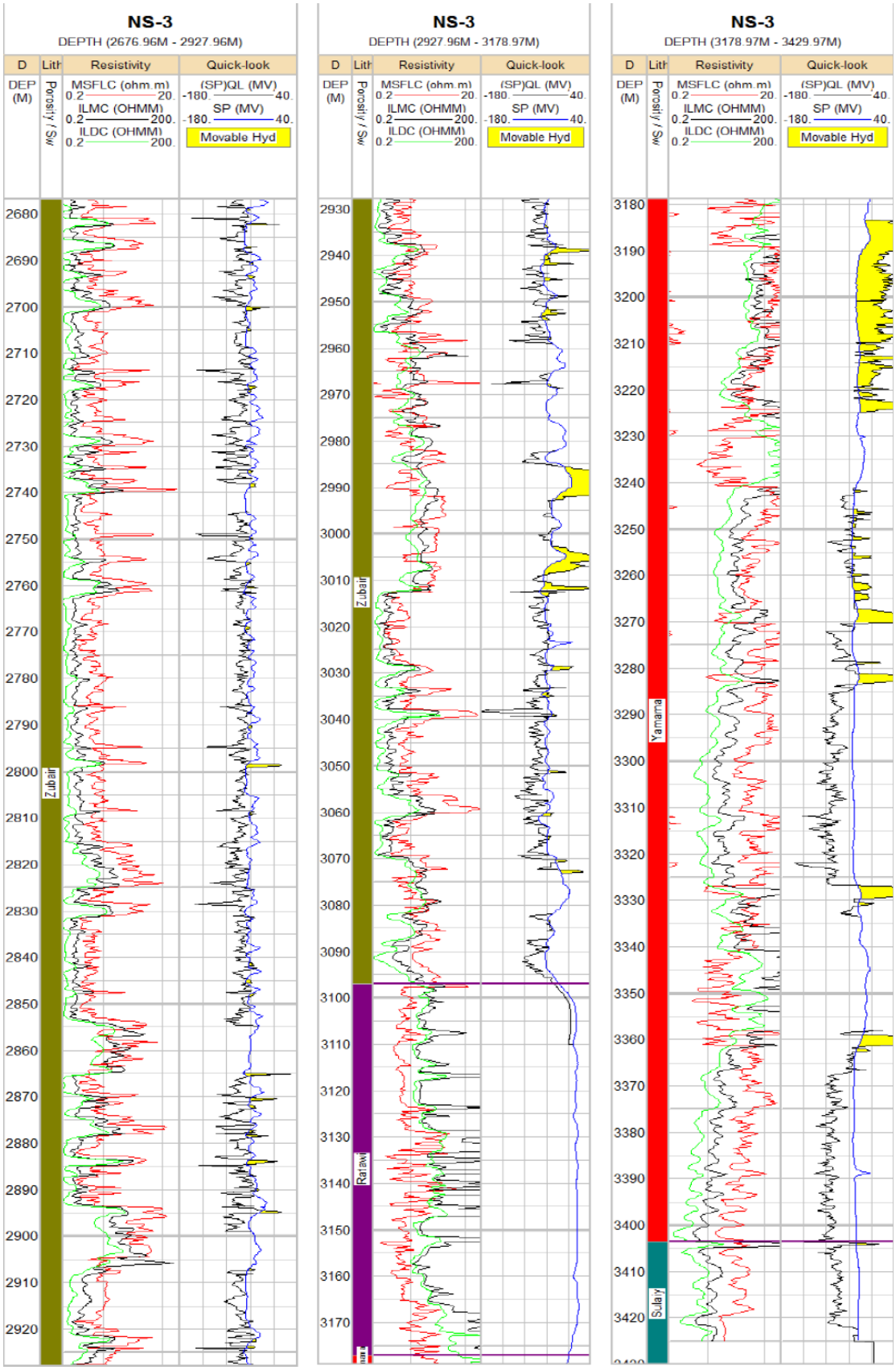

Fig.4, R_{xo}/R_t method results from Zubair to Sulaiy formations

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