Reservoir Properties of the Lower Cretaceous Qishn and Saar Formations from Well Log Analyses of Masila Region, Yemen

Hassan S. Naji

Department of Petroleum Geology and Sedimentology,
Faculty of Earth Sciences, King Abdulaziz University,
Jeddah, Saudi Arabia
hnaji@kau.edu.sa

Abstract. In the Masila area, oil was first discovered in late 1990 with commerciality being declared in late 1991. Oil production at Masila began in July 1993. Total known oil-in-place exceeds 1.6 billion STB, with proved ultimate recoverable oil reserves approaching 900 million STB. The reserve estimates (Proved, Probable, and Possible) are in excess of one billion barrels of recoverable oil. About 90% of the reserves are found in the Lower Cretaceous Upper Qishn Clastics Member of the Qishn Formation. Production also comes from a secondary target within the Saar Formation.

The scope of this study is the evaluation of hydrocarbons in the porous zones encountered in the Lower Cretaceous formations, penetrated by the eight wells scattered in the study area. Some points of interest will be considered in such process such as the geological aspects of the techniques utilized and the presentation forms of the obtained petrophysical parameters.

The basic logging data exist in the form of spontaneous potential (SP), Caliper (CL), Deep (LLS and LLD), and Shallow (MSFL) resistivity logs, porosity tools (Density, Neutron and Sonic), Litho-Density Log (LDT) and Gamma-Ray (GR).

Different crossplots such as Rho-PhiN, Rho-DTN, M-N plots were implemented for lithology identification of the two formations in the studied wells. Such formation evaluation and the presentation forms of the petrophysical parameters have proven that the formations

have high hydrocarbon saturations in this area and containing many pay zones.

Keywords: Well log analysis; Qishn and Saar Formations; Masila.

I. Introduction

The Masila area is located in the Hadhramaut region in east central Yemen (Fig. 1 and 2). The Masila area lies between latitudes 49° 00' E and 49° 20' E and longitudes 15° 20' N and 15° 50' N. Masila area is considered one of the most important oil provinces in Yemen, which includes a considerable number of oil fields and wells. Oil was first discovered in the area in late 1990 with commerciality being declared in late 1991. Oil production began in July 1993. Total known oil in place exceeds 1.6 billion STB, with proved ultimate recoverable oil reserves approaching 900 million STB. In addition, the reserve estimates (Proved, Probable, and Possible) are in excess of one billion barrels of recoverable oil (Canadian Oxy CO., 2004).

About 90% of the reserves are found in the Lower Cretaceous Upper Qishn Clastics Member of the Qishn Formation. Oil is also found in at least seven other distinct reservoir units consisting of Lower Cretaceous and Middle to Upper Jurassic age clastics and carbonates as well as fractured Cambrian granitic basement (Canadian Oxy CO., 2004).

Well log analyses are the most important tasks for any well after drilling, to evaluate reservoir parameters like porosity, permeability, water saturation*, etc*. One of the features of modern log interpretation is the systematic usage of computer that allows a detailed level-by-level analysis of the formation to define the producing zones. Moreover, the presentation of results through cross plots, and litho-saturation models helps to give a quick conclusion about the petrophysical characteristics of the studied reservoir.

The lower Cretaceous sequence is divided, from base to top, into Saar and Qishn Formations. Moreover, the Qishn Formation is further subdivided into two units: The upper Qishn carbonate member, and: The lower Qishn member.

The objective of this paper is to study and evaluate the reservoirs of lower Cretaceous ages, and integrate a variety of the state-of-the-art

computer packages to conclude the reservoir properties. The packages include:

1. The Neuralog software, which is the most widely-used automated log scanning/ digitizing solution in the oil and gas industry.

2. The Interactive Petrophysics, which is used for well log interpretation to calculate the measurable quantities such as shale volumes, porosity, permeability, and fluid saturations, Schlumberger (1992).

Eight wells (Fig. 3), that cover the whole study area, were selected based on the different log types. The generalized stratigraphic column is shown in Fig. 4. The available well logs are listed in Table 1 and are shown in Fig. 5. These logs include: Gamma Ray (GR), Caliper (CL), Spontaneous Potential (SP), Apparent Formation Resistivity (Rwa), Shallow (MSFL), Deep (LLS and LLD) resistivities, Formation Density Compensated (FDC), Borehole Compensated Sonic (BHC), Compensated Neutron Porosity (CNL) and Litho-Density (LTD). These logs are checked and matched for depth before processing and interpretation.

Table 1. The available open hole well logs in the study area.

No.	Well Name	Available Data
1	Camaal-4	GR, SP, LLS, LLD, MSFL, DTLN, RWA, CAL, PEF, RHOB, DRHO, NPHI, DPHI, SGR
2	Harue-1	GR, LLS, LLD, MSFL, RWA, CAL, SP, PEF, RHOB, DRHO, NPHI, DPHI, SGR
3	Heijah-3	GR, LLS, LLD, MSFL, DTLN, RWA, SP, CAL, PEF, DRHO, RHOB, NPHI, DPHI, SGR
4	Heijah-5	RWA, CAL, GR, SP, LLS, LLD, MSFL, SGR, PEF, DRHO, RHOB, NHPI, DPHI
5	Hemiar-1	CAL, GR, SP, LLS, LLD, MSFL, RWA, SGR, PEF, DRHO, PEF, RHOB, NPHI, DPHI
6	South Hemiar-1	RWA, GR, SP, LLS, LLD, MSFL, CAL, DTLN, SGR, PEF, DRHO, NPHI, DPHI, RHOB
7	North Camaal-1	GR, RWA, SP, LLD, LLS, MSFL, DTLN, CAL, SGR, PEF, RHOB, DRHO, NPHI, DPHI
8	Tawila-1	GR, SP, RWA, LLS, LLD, MSFL, CAL, DTLN, SGR, DRHO, PEF, RHOB, NPHI

The available electrical logs for all studied wells were scanned and digitized in ASCII or LAS format, using Neuralog scanning and digitizing software. Log interpretation was then accomplished using the Interactive Petrophysics program.
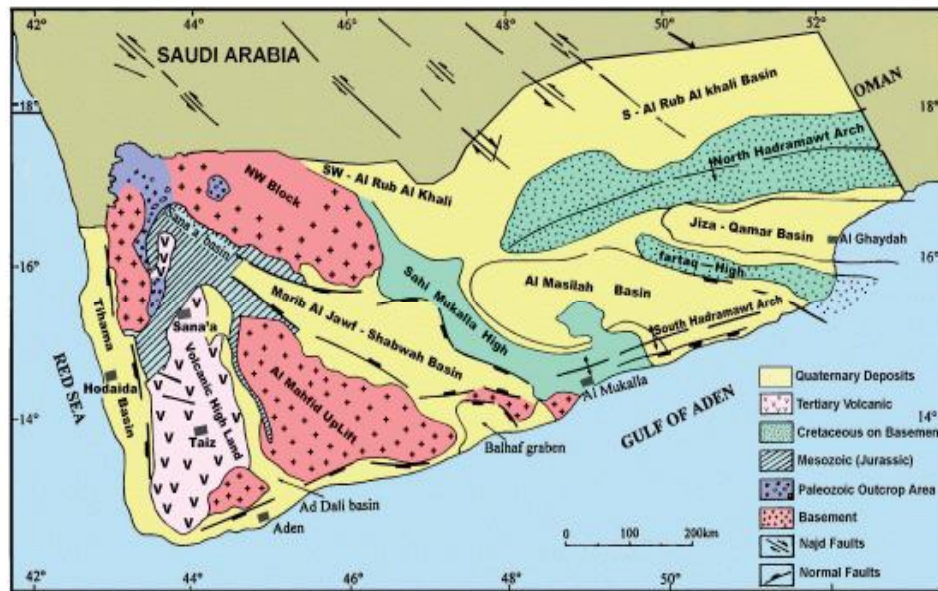
Fig. 1. Geological map of Yemen showing the principal sedimentary basins (modified from Beydoun at al., 1998 and Canadian Oxy Co. 1999).

II. Geological Setting

Cenozoic sediments dominantly outcrop in the Masila basin, where less abundant Cretaceous sandstones are the oldest outcropping sediments. The Jurassic limestone has been penetrated only in offshore wells (Haitham and Nani, 1990). The Oligocene–Miocene syn-rift sediments of the Shihr Group outcrop mostly in the coastal area (Bosence *et al.,* 1996; Watchorn *et al.,* 1998). Quaternary Volcanics occur in the eastern area of the basin (Fig. 1 & 2).

The general stratigraphic succession of the Masila basin prospective area includes different sedimentary sequences ranging in age from Pre-Cambrian to Recent. A generalized stratigraphic column of the study area is shown in Fig .4.

III. Studied Units

The Lower Cretaceous section at Masila reflects post-Pangea breakup and the creation of basins formed by rifting (Beydoun *et al.,* 1998; Redfern and Jones, 1995). Jurassic deposits form the earliest stage of the fill and reflect sedimentation in relatively deep marine settings. In

contrast, interpretations of Lower Cretaceous deposits portray fluvial sediments (Tawilah Group) in the west and marine carbonates with minor sandstones located directly east of the Masila region (Beydoun *et al.,* 1998; Golonka *et al.,* 1994) and NAP (1992).

The lowest Cretaceous succession seen in this region is believed to be the carbonates of the Saar Formation; which is succeeded by the Qishn Formation. Both the Lower Siliciclastic Member and the Upper Carbonate Member, as described by Richardson *et al.* (1995a). The remainder of the preserved Cretaceous section comprises the interbedded limestones and shales of the Fartaq Formation and the more argillaceous limestones and claystone of the Sharwayn Formation. The Qishn Carbonate Member and the Fartaq and Sharwayn Formations comprise the units that are the focus of this sequence stratigraphic review.
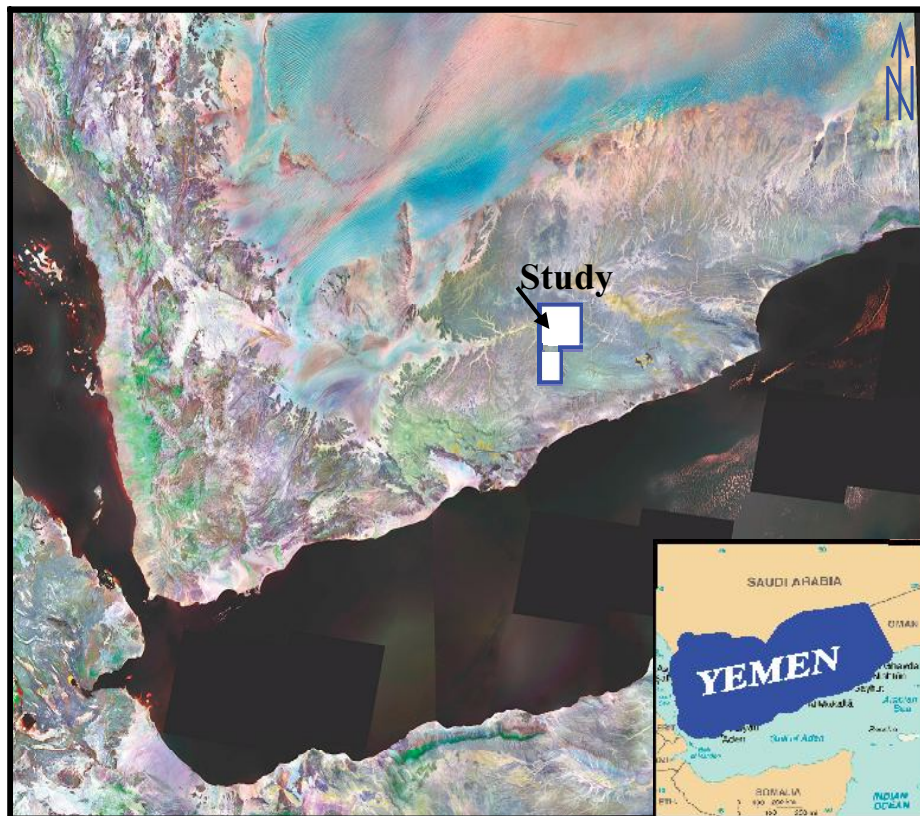

Fig. 2. Mosaic of TM Landsat image of Yemen and location of the study area.
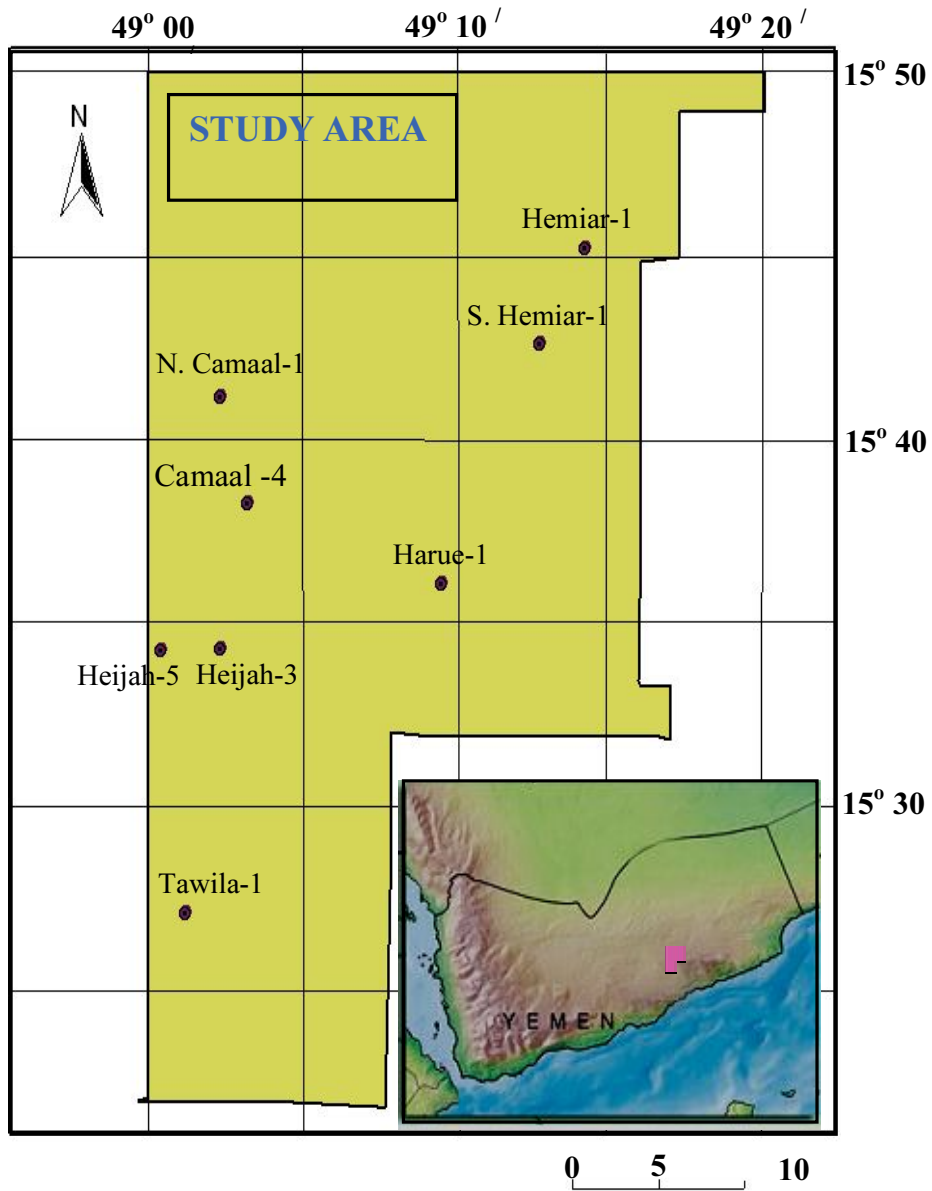
Hassan S. Naji

Fig. 3. Location Map of Wells in the study area (Canadian Oxy Co. 1999).
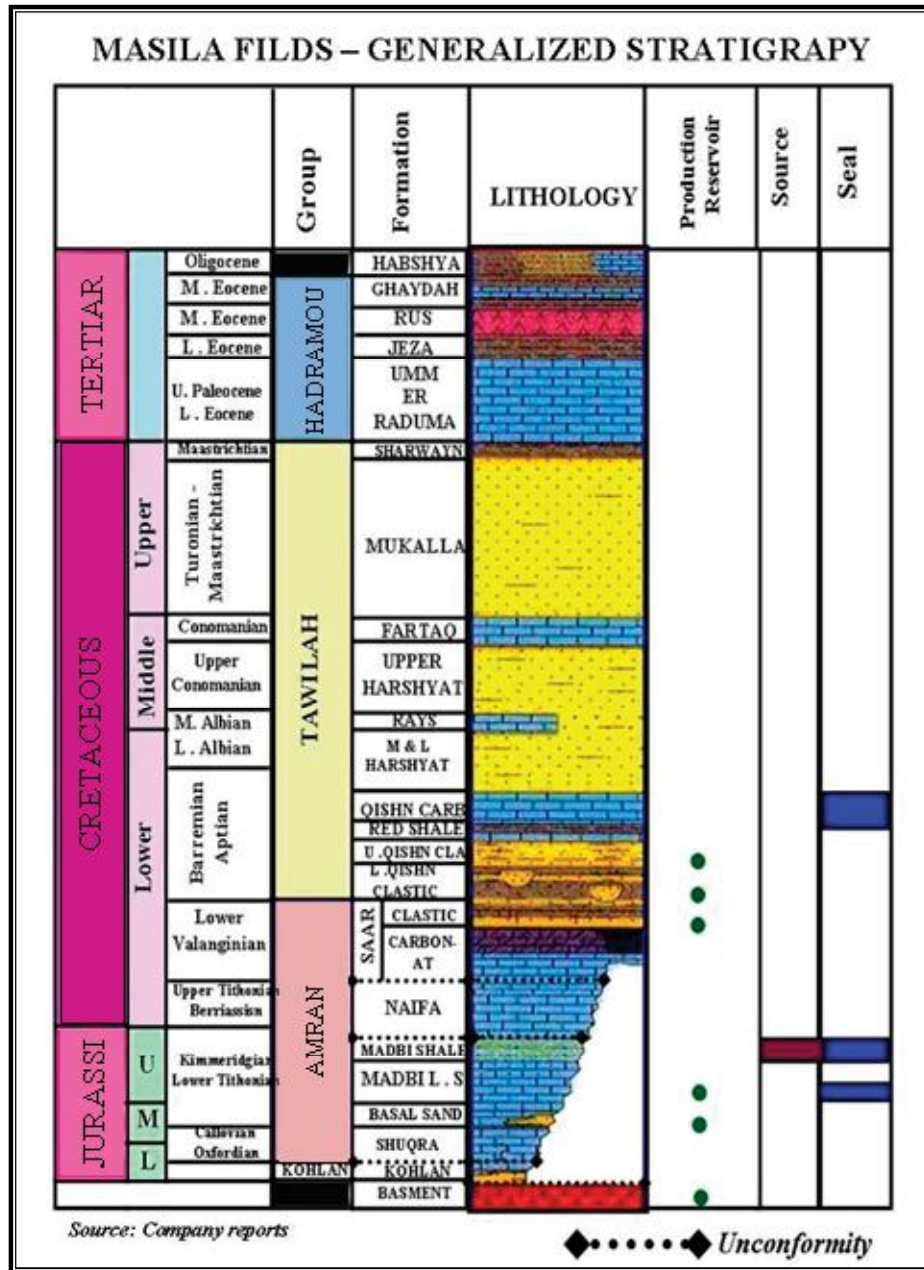
Fig. 4. Litho-Stratigraphic Column of the Study Area, Yemen.

III. 1. Saar Formation

This deposit overlies conformably the underlying Naifa Formation. In general, the Saar Formation is composed mainly of limestone, with some mudstone and sandstone. Oil companies classified the formation into lower Saar carbonate and upper Saar clastic.

III. 2. Qishn Formation

III. 2. 1. Nomenclature and Thickness

The term 'Clastic Member' is proposed for the syn-rift, fluvial and shallow marine sandstones and mudstones and subordinate carbonates (usually limestones) of the Barremian age. In east-central Yemen, the Qishn Formation is the lowermost clastic unit of the Tawila Group in the west and the lowermost carbonate unit of the Mahra Group in the east. The proposed type well is Sunah-I well from 1675m to 1935.5m below KB. The lithology of the unit consists of subequal amounts of sandstones and mudstones, the latter being more common in the lower part of the unit in thicker well sections.

III. 2. 2. Unit Boundaries

The upper boundary of the Qishn Formation is marked by the mudstones of the 'Shale Member' (Fig. 4). The boundary is marked y a downhole decrease in gamma ray values and increase in sonic velocity. The lower boundary may coincide with sandstones and mudstones of the proposed 'Furt Formation', older carbonates or with basement. This boundary, with the 'Furt Formation', is marked by an overall downhole decrease in sonic velocity. The sands of the 'Furt Formation' exhibit a higher gamma ray value. The boundary is also marked by a downhole change from carbonate stringers, which are predominantly limestone in the Qishn Formation 'Clastic Member', to dolomite in the 'Furt Formation'.

III. 2. 3. Subdivision, Distribution and Depositional Environments

The Qishn Formation, in general, is divided into two members, Lower Qishn Clastic and Upper Qishn Carbonate. In Masila Block 14, the ~198 m (650 ft) thick Qishn Clastics Member is further subdivided into two units (Fig. 4 and 8). The 128 m (419 ft) thick unit forms the lower Qishn Clastics and the 70 m (231 ft) thick unit forms the upper Qishn Clastics (Fig. 8).

The lower Qishn Clastics Member was deposited during the Middle to Late Barremian over a duration of 7 to 10 My. The lower two thirds of the upper Qishn Clastics Member were deposited in the Late Barremian to Early Aptian. The upper third was deposited during the Early to Middle Aptian. This could be interpreted as follows: after the marine transgression that resulted in the deposition of the Saar Formation, the sea level falls and resulted in the erosion of the Valanginian deposits. In the Hauterivian to Barremian time (Late early Cretaceous), the braided plain to fluvial and shallow marine sediments, deposited in the Say'un-Al Masila basin (mainly basal Lower Qishn Clastic Member). This basal unit is followed by the deposits of the shale and carbonate shallow marine sediments accumulated in the Barremian–Aptian time (upper shale and carbonate members of the Qishn Formation).

The distribution and thickness of the 'Clastic Member' have been recognized in 12 of the Simon Petroleum Technology (1994) study wells. The thickness varies from 761 m in the A1 Furt-I well to 20m in the Hami-lX well. The 'Clastic Member' can be distinguished east of the Kharwah-I well and west at approximately 50°E. To the west of the Kharwah-1 well, the section cannot be differentiated due to the well's proximal location and the subsequent dominance of clastic material throughout the Qishn Formation.

The Regional correlation of the 'Clastic Member' is a lateral equivalent of the 'Lower Carbonate Member', the latter being deposited in deeper marine conditions away from areas of the sediment source (Fig. 4). The Environment of deposition of this unit is an alluvial fan/braid-plain to meander plain fluvio-deltaic sandstones, common shallow marine sandstones and mudstones. These pass laterally into the shallow to locally deeper marine lime mudstones and carbonates of the 'Lower Carbonate Member' of the Qishn Formation.

Fully marine and brackish strata, throughout the lower Qishn Clastics Member, bear indicators of tides. Double mud and carbonaceous drapes, tidal bundles, evidence of salinity variations, mud flats and tidal inlets indicate significant macrotidal and prevailing tides. Evidence of storms is extremely rare in fully marine strata. Marine conditions, dominated by carbonates, prevailed to the east and non-marine clastics to the west. The Say'un–al Masila Basin had a funnel shape, tapering westwards from several hundred kilometers wide to approximately 60 km

wide. To the east, it was connected to the open Tethys Ocean (paleo-Indian ocean) on the early-rifted Gondwanaland continent. The tapering and constricting configuration of the Say'un–al Masila rift basin facing the paleo-Indian ocean would have been the ideal setting for the development and amplification of tides.

III. 2. 4. Oil Potentialities

The Lower Qishn Clastic Member represents the main reservoir rock in the Masila area. From this point of view, oil companies classified the Qishn formation into the following units: Lower Qishn Clastic, and Upper Qishn Carbonate. The Upper Qishn consists mainly of carbonate rock with red shale beds at the base. These red shale beds are considered to be the main seismic markers at the Masila area (Cheng, 1999).

The Upper Qishn Carbonate Member consists of laminated to burrowed lime mudstone and wackestone interbedded with terrigenous mudstone and black fissile shales. These sediments were deposited in deep water under alternating open and closed marine conditions.

IV. Methodology

IV. 1. Scanning/Digitizing of Well Logs

It is very important to change well logs from analog format to digital format; *e.g.* ASCII or LAS format. This formatted data is stored on a PC computer, and then used with certain packages such as "Neurascanner" and "Neuralog". The Neuralog software is the most widely-used automated log scanning/digitizing solution in the oil and gas industry. It was introduced by Neuralog, Inc. (2002).

IV. 2. Well Log Interpretation

In this work, the well log evaluation has been achieved using the Interactive Petrophysics[TM] (IP) program. Interactive Petrophysics is a PC-based software application for reservoir property analysis. It is ideal for both the geologist willing to quality check log data, and to the experienced Petrophysics carrying out multi-zone, multi-well petrophysical field analysis. The studied wells are shown in Fig. 3 and a sample of these logs is shown in Fig 5.
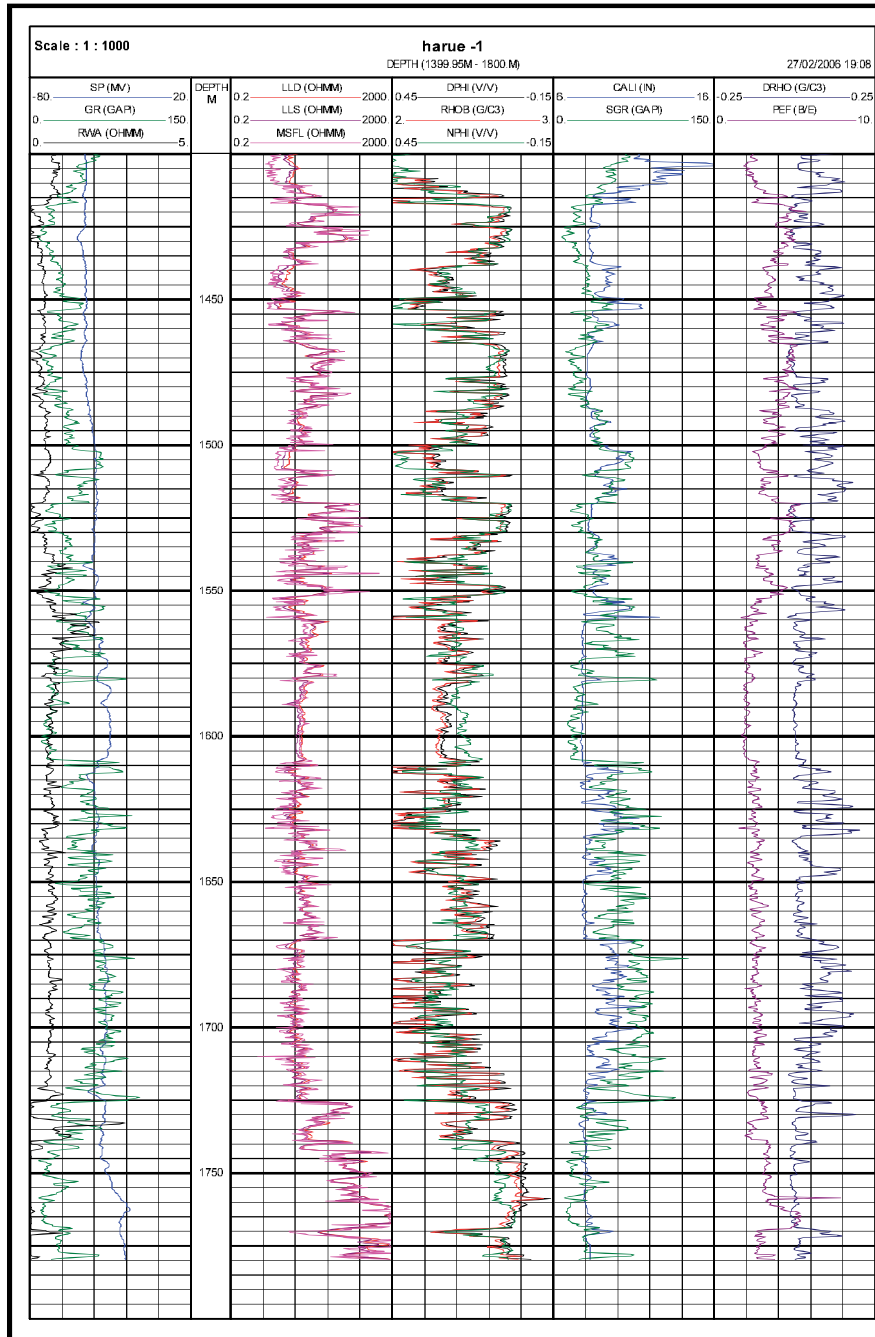
Fig. 5. The well log plot output from the Interactive Petrophysics software for harue-1 well.

The program uses deterministic and probabilistic models to calculate porosity, water saturation, shale volumes and other reservoir properties within the user-defined zones. We can pick parameters and crossplot endpoints directly on the sereen, significantly minimizing keyboard entry. As parameters are selected from the log plots and interactive crossplots, the analysis results update instantly.

V. Reservoir Properties

In this study, the evaluation of hydrocarbons, in the porous media is considered. Lower Cretaceous Qishn and Saar Formations, is considered. Reservoir parameters such as porosity, permeability, water saturation, and lithology indicators are calculated.

V. 1. Formation Water Resistivity (Rw)

The calculation of water resistivity (Rw) is necessary for an accurate determination of fluid saturations. The SP log is used to create a continuous Rw curve; which is useful for estimating Rw values over a number of zones.

V. 2. Porosity (ϕ)

Porosity is very important for calculating fluid saturations. The common porosity derived logs are Sonic, Density and Neutron. The density in the Formation Density Compensated Log (FDC) measures the bulk density (ρb) in gm/cc. The Neutron in the Compensated Neutron Porosity Log (CNL) measures the neutron porosity (ϕN) in reference to the "Apparent Limestone Porosity Index". The Sonic in Borehole Compensated Log (BHC) measures the interval transit time (ΔT) in μ sec/ft. Equations, built in the Inactive Petrophysics software, are used to calculate porosity values for all studied wells. Porosity values of the Lower Qishn clastics range between 19-24.9 %, while porosity of the Saar Formation ranges between 6- 19.7%.

V. 3. Fluid Saturations

The determination of fluid saturations is very important to complete the deduced petrophysical parameters. Such determination means principally the differentiation between the various types of fluid components (water and hydrocarbons). The hydrocarbons, in turn, need the separation between the movable and residual types. The hydrocarbon saturations are calculated

depending on water saturation (S_w). The hydrocarbon saturation can be calculated by the following relation:

$$S_h = 1 - S_w$$

The calculated water saturation for the Lower Qishn clastic in the study area ranges between 30-38 %. Whereas, for the Saar Formation, it ranges between 53-80%, see Table 2.

V. 4. Determination of Lithology

The crossplot technique, combining the different well log parameters, is applied for the identification of lithology and for defining the mineralogical associations of each lithotype. A number of crossplots (ρb *vs* Φ_N, GR vs ρb, and ρb vs ΔT) for both Qishn and Saar formations are given in Fig. 6a – 6f. It is concluded that, the lithology of Lower Qishn clastic member is composed mainly of clastic (sands) with dolomite and limestone. While the Upper Qishn carbonate member is composed mainly of carbonate rocks (limestone and dolomite) with shale and low content of clastics (sands). The lithology of the Saar Formation is composed mainly of carbonate (limestone and dolomite) with shale and low content clastics (sands).
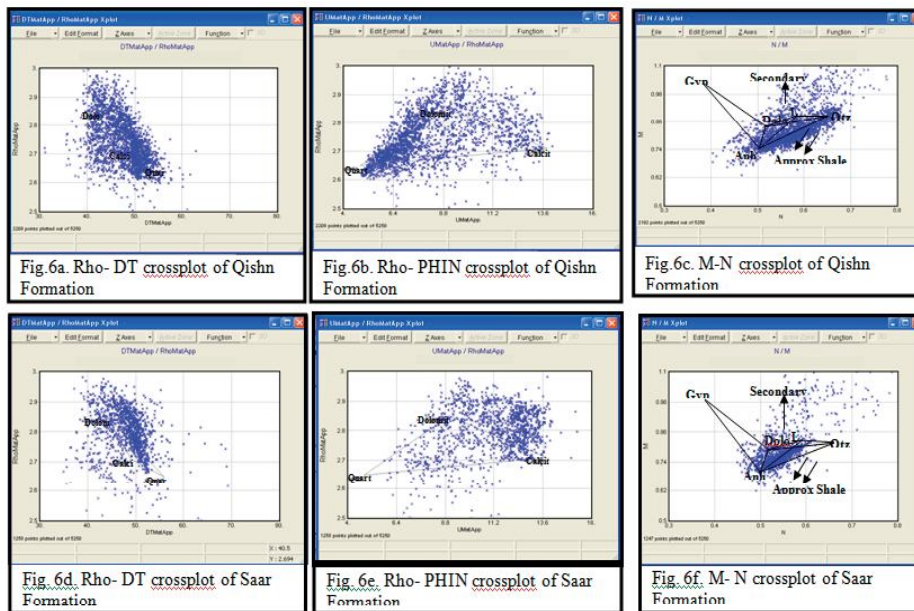

| Fig.6a. Rho- DT crossplot of Qishn Formation | Fig.6b. Rho- PHIN crossplot of Qishn Formation | Fig.6c. M-N crossplot of Qishn Formation |
| Fig. 6d. Rho- DT crossplot of Saar Formation | Fig. 6e. Rho- PHIN crossplot of Saar Formation | Fig. 6f. M- N crossplot of Saar Formation |

Fig. 6. Lithology and facis identification crossplot.

Hassan S. Naji

Table 2. Total porosity (PHT), effective porosity (PHE), water resistivity (Rw), water saturation (Sw) and hydrocarbon saturation of Saar Fm. and Qishn units in the study wells.

Parameters	Formation	Heijah-5	Heijah-3	N.Camaal-1	Camaal-4	Harue-1	S. Hemiar-1	Hemiar-1	Tawila-1
Total porosity (PHT)	Upper Qishn Carb.	17.7%	20.7%	18.2%	20.7%	14.3%	14.6%	14.9%	16.4%
	Lower Qishn clastic	20.9%	24.9%	19.7%	21.7%	21.6%	22.8%	22.7%	20.8%
	Saar Formation	19.7%	16.3%	19.4%	10.6%	5.23%	11%	10.4%	9.2%
Effect porosity (PHE)	Upper Qishn Carb.	12.2%	14.3%	16.1%	18.9%	10.6%	13.9%	10.8%	14.5%
	Lower Qishn clastic	17.5%	23.7%	18.2%	21.4%	16.8%	22.1%	18.8%	20.4%
	Saar Formation	2.88%	9.3%	18.2%	8%	5.21%	6.7%	5.7%	8.6%
Water Resistivity (Rw)	Upper Qishn Carb.	0.62	0.55	0.77	1.90	0.50	0.61	0.89	0.91
	Lower Qishn clastic	2.03	1.89	2.60	2.50	1.29	1.58	2.50	1.67
	Saar Formation	0.312	0.22	0.64	0.48	0.61	0.95	0.41	0.64
Water Saturation (Sw)	Upper Qishn Carb.	60.6%	65.1%	54.3%	48.2%	62.3%	57.9%	58.9%	55.7%
	Lower Qishn clastic	31.6%	32.6%	28.8%	30.9%	31.8%	31.4%	29.9%	37.2%
	Saar Formation	75.4%	80.2%	69.6%	67.5%	75.6%	61.3%	67.00%	53.3%
Hydrocarbon Saturation (Sh)	Upper Qishn Carb.	39.4%	34.9%	45.7%	51.8%	37.7%	42.1%	41.1%	44.3%
	Lower Qishn clastic	68.4%	67.4%	71.2%	69.1%	68.16%	68.6%	70.1%	62.8%
	Saar Formation	24.6%	19.8	30.4%	32.5%	24.4%	38.7%	33%	46.7%

Fig. 7(a). Lithology of Heigah-3 well output from Interactive Petrophysics software.
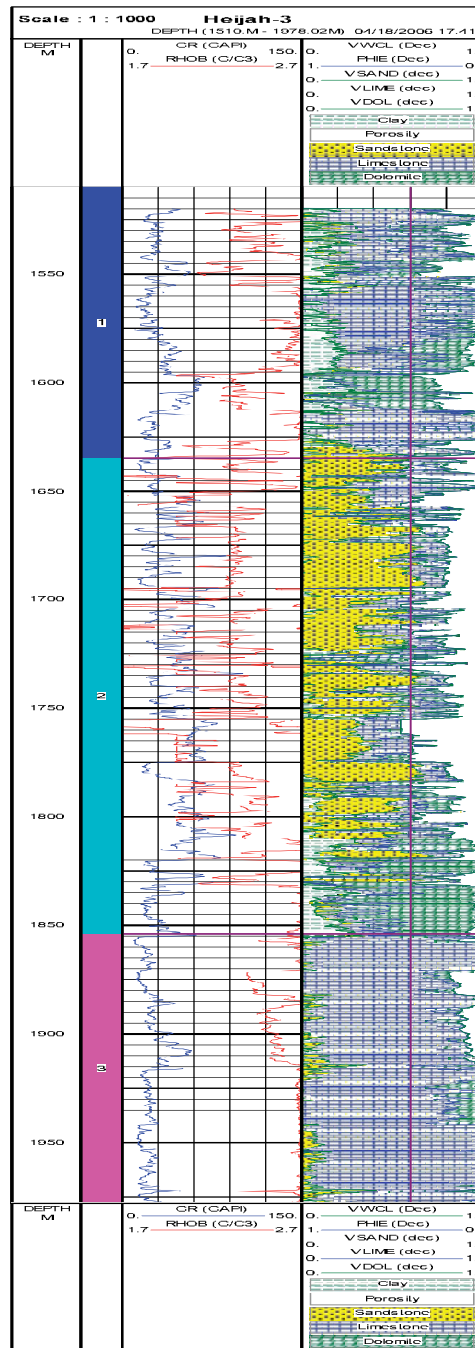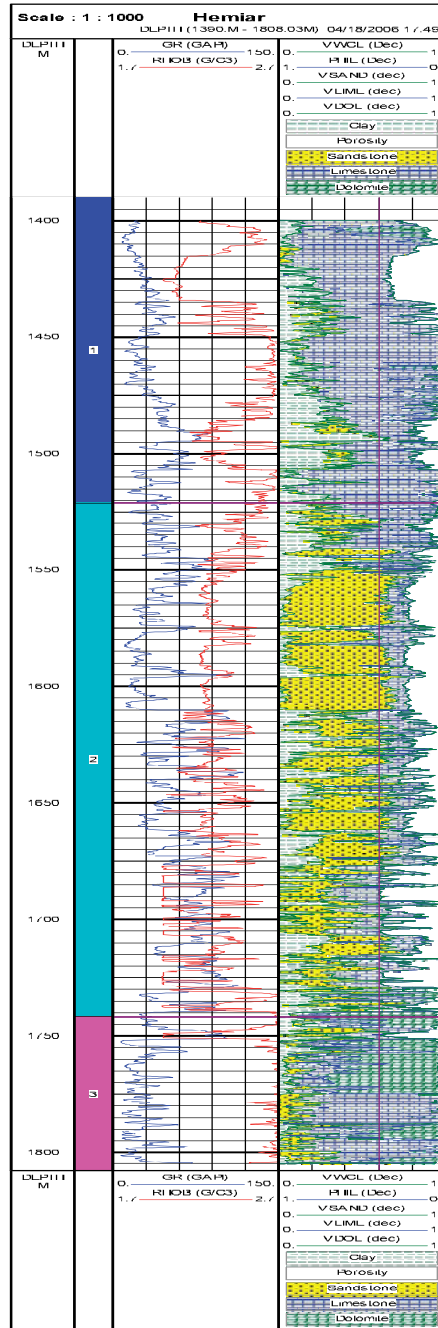
Hassan S. Naji

Fig. 7(b). Lithology of Hemiar well output from Interactive Petrophysics software.

Fig. 7(c). Lithology of Heigah-5 well output from Interactive Petrophysics software.
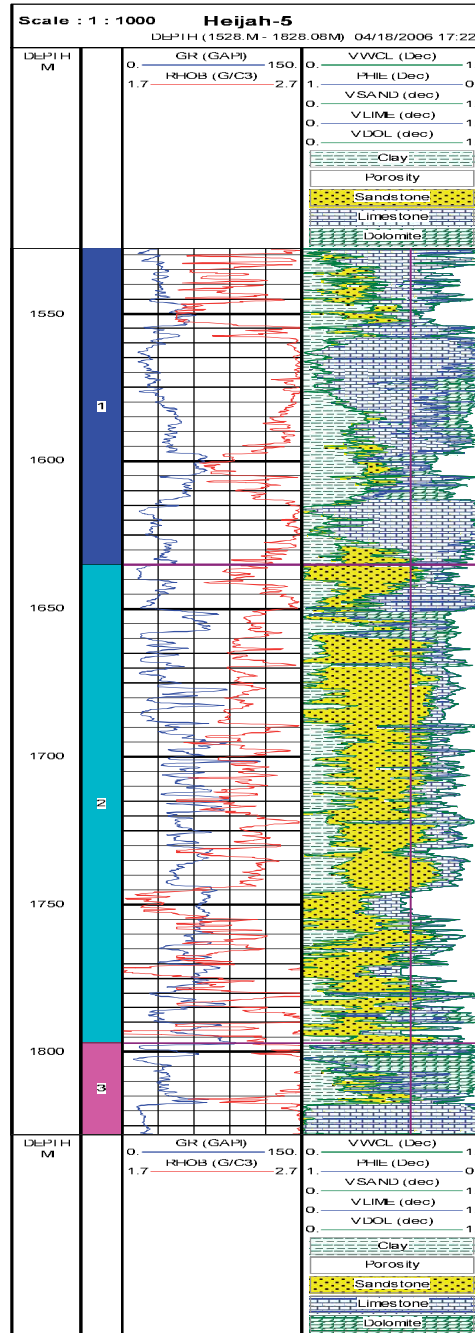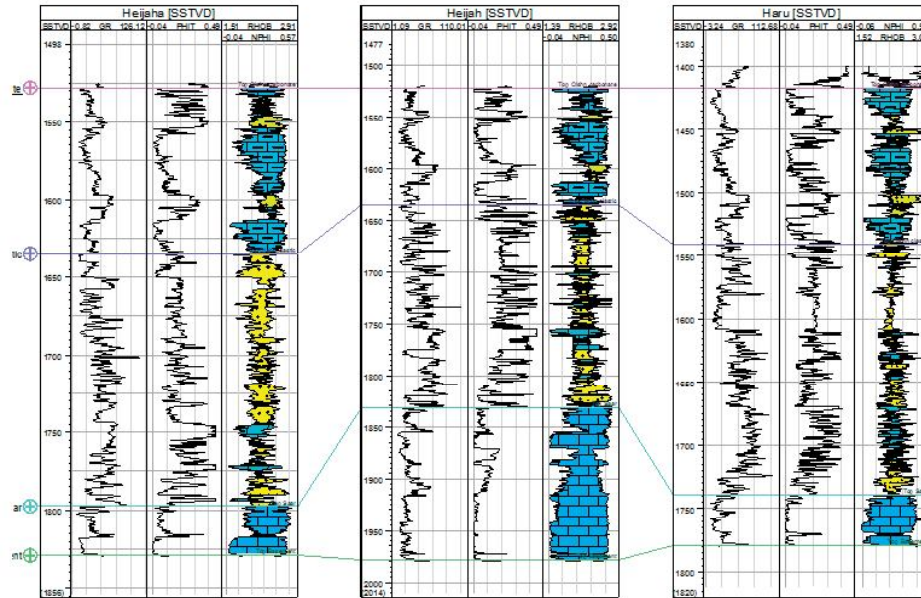
Hassan S. Naji

Fig. 8. Lithology of Heijaha-5, Heijaha-3 and Harue-1 wells output from Interactive Petrophysics software.

VI. Conclusions

1. The integrated interpretation of the open hole log data helps determine reservoir parameters in an efficient and concise way.

2. Crossplots amongst the implied petrophysical parameters facilitate lithology identification. Through this technique, it was concluded that the Qishn Formation is composed mainly of sandstone with limestone and dolomite. Whereas the Saar Formation is composed mainly of limestone and dolomite with shale and low content of sandstone.

3. The range of porosity of the Lower Qishn clastic in study area is between 19-24.9%, while the porosity of Saar Formation lies in the range 6-19.7%.

4. The range of water saturation of the Lower Qishn clastic in study area is between 30-38%, while for Saar Formation, it ranges between 53-80 %.

5. The lithology of the Lower Qishn member is composed mainly of clastics (sands) with dolomite and limestone. While the Upper Qishn member is composed mainly of carbonate rocks (Limestone and dolomite) with shale and low content of clastics (sands).

6. The lithology of the Saar Formation is composed mainly of carbonate (limestone and dolomite) with shale and low content of clastics (sands).

7. The hydrocarbon saturation of the Qishn Formation is higher in value if compared with that in the Saar Formation.

Abbreviations and Terminology

GR	Gamma Ray	CL	Caliper
SP	Spontaneous Potential	Rwa	Apparent formation
MSFL	Micro-spherically Focused Log	LLS	Laterolog Shallow
FDC	Formation Density Compensated	LLD	Laterolog Deep
CNL	Compensated Neutron Log	BHC	Borehole Compensated
LDT	Litho-Density Tool	φ_N	Neutron Porosity
ρ_b	Bulk Density, gm/cc	R_W	Formation Water Resistivity
ΔT	Interval Transit Time, $\frac{\mu sec}{ft}$	φ	Formation Porosity
S_W	Water Saturation	S_H	Hydrocarbon Saturation
KB	Kelly Bushing		

VII. References

Bosence, D.W., Nichols, G., Al-Subbary, A.K., Al-Thour, K.A. and Reeder, M. (1996) Synrift continental to marine depositional sequences, Tertiary, *Gulf of Aden, Yemen. J. Sediment. Res.* **66** (4): 766–777. Bull. V.Sll.No.S, P.1306-1329.

Beydoun, Z.R., A.L. As-Saruri, Mustafa, El-Nakhal, Hamed, Al-Ganad, I.N., Baraba, R.S., Nani, A.S.O. and Al-Aawah, M.H. (1998) International lexicon of stratigraphy, Volume III, Republic of Yemen, Second Edition: *International Union of Geological Sciences and Ministry of Oil and Mineral Resources, Republic of Yemen Publication* **34**, 245 p.

Cheng, M.L., Leal, M.A. and Me Naughton, D. (1999) *Productivity Prediction from Well Logs in Variable Grain Size Reservoir Cretaceous Qishn Formation.* Republic of Yemen. Society of professional well log Analysis, Calgary, Canada, Houston Texas U.S.A.

Canadian Oxy Company (1999) (*unpublished report*) Yemen.

Canadian Oxy Company (2003) (*unpublished report*) Yemen.

Canadian Oxy Company (2004) (*unpublished* report) Yemen.

Golonka. J., M. I. Ross and C. R. Scotese (1994) Phanerozoic paleogeographic and paleoclimatic modeling maps, In A. F. Embry, B. Beauchamp, and D. J. Glass, eds., *Pangea: Global Environments and Resources:* Canadian Society of Petroleum Geologists, Memoir **17:** 1-48.

Haitham, F.M. and **Nani, A.S.O.** (1990) The Gulf of Aden rift: hydrocarbon potential of the *Arabian sector. J. Pet. Geol*. **13** (2).

NRP (1992) *Natural Resource Project;* Satellite Mapping. A Technical Report. Prepared by the cooperation between the Director of the NRP, Yemen Republic and the Robertson Group, United Kingdom, 350p.

Redfern, P. and **Jones. J.A.** (1995) The interior basins of Yemen-analysis of basin structure and stratigraphy in a regional plate tectonic context. *Basin Research*, **7**: 337-356.

Richardson, S.M., Bott, W.F., Smith, B.A., Hollar, W.D. and **Birmingham, P.M.** (1995a) A new hydrocarbon 'play' area offshore Socotra island, Republic of Yemen. *Journal of Petroleum Geology* **18**: 5-28.

Schlumberger (1992) Looking for Yemen's hidden treasure. *Middle East Well Evalution Review* **12**, 12-29.

Simon Petroleum Technology (1994) (unpublished report), Yemen.

Watchorn, F., Nichols, G.J. and **Bosence, D.W.J.** (1998). Rift-related sedimentation and stratigraphy, southern Yemen (Gulf of Aden). In: Purser, B., Bosence, D. (Eds.), *Sedimentation and Tectonics in the Rift Basins Red Sea– Gulf of Aden.* Chapman & Hall, London, pp: 165-189.

تقييم خاصية الخزان من واقع سجلات الآبار لحقل المسيلة التابع للكريتاوي المبكر باليمن

حسن سليمان ناجي

قسم البترول والترسبات، كلية علوم الأرض، جامعة الملك عبد العزيز، جـــــدة – المملكة العربية السعودية

المستخلص. تم إكتشاف الزيت بمنطقة المسيلة باليمن ســنة ١٩٩٠ وتم ضخة التجريبي سنة ١٩٩٢. وبدأ الإنتاج الفعلي ســنة ١٩٩٣. ويبلغ إجمالي الزيت المعروف ١,٦ مليـــون برميل كمـــا تقـــدر الإحتياطيات المكتشفة بحوالي ٩٠٠ مليون برميـل بينمـــا تقـــدر الإحتياطيات المحتملة بما يزيد عن ١ بليون برميل. وتوجد حوالي ٩٠٪ من هذه الإحتياطيات بالعضو الفتاتي.

ويعالج هذا البحث خـــصائص الخـــران مـــن حيـــث تقيـــيم الهيدروكربونات في المنـــاطق المـــسامية الموجـــودة بمتكونـــات الكريتاوي السفلي والتي تم اختراقها بثمانية آبار عميقـــة موزعـــة لتغطي المنطقة المدروسة. كما تمت معالجة عدة نقاط مهمة أثنـــاء تقييم هذه المتكونات مثل المفاهيم الجيولوجية للتقنيات المـــستخدمة لتقييم المتكون وعرض وشرح قيم المعاملات البتروفيزيائية.

تشمل بيانات سجلات الآبار كل من سجل قياس الجهـــد (SP) وسجل قياس (CL) وسجلات قياس المقاومة (LLS, LLD, MSFL) والسجلات المستخدمة لقياس المـــسامية (مثـــل ســـجلات الكثافـــة والنيوترون والصوت) وسجل قيـــاس الكثافـــة الـــصخرية (PEF) وسجل قياس أشعة جاما.

وتم استخدام عدة علاقات وأشكال بيانية للمعاملات الناتجـــة لتحديد وتعريف المحتوى الصخري وأنواع الـــصخور الموجــودة لمتكوني الكشن والسار بالآبار المدروسة. وقد برهن هـــذا التقيـــيم للمتكون وكذا تقييم الخصائص الصخرية المشتقة مـــن المعـــاملات البتروفيزيائية على أن هذان المتكونان (الكشن والسار) لهما تـــشبع مرتفع بالهيدروكربونات بالمنطقة المدروسة ويحوزان على العديـــد من النطق المنتجة للزيت.