KASDI MERBAH UNIVERSITY - OUARGLA -

FACULTY OF HYDRCARBONS AND RENEWABLE ENERGIES AND EARTHAND UNIVERSE SCIENCES

Department of Earth and Universe Sciences

FINAL DISSERTATION

With a view to obtaining a Master's degree in Geology

COMPARISON BETWEEN LOGGING RESULTS AND WELL EVALUATION RESULTS BY THE RESERVOIR CHARACTERIZATION INSTRUMENTS (RCI) TOOL

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Finally, we would like to thank all the people who participated directly or indirectly in the realization of this work.

Dedication

*I dedicate my success and this work to my beloved father, who had the first credit for my attainment of higher education, my beloved father **BOUDJEMA HADJ ALI**, may God prolong his life.*

*To the one I prefer to myself, to the one who sacrificed for me, to the light of my life and the source of my energy and happiness, my mother **MANSOURI FATIHA.***

*To my pride and honor, to the fountain of energy, happiness and positivity, to my beloved brothers and sisters: **MOUTEZ ,OUSSAMA, MARIA** and my little sweety **SIRIN**.*

*I dedicate this work to all members of the **BOUDJEMAA** family and the **MANSOURI** family. To the best grandmother, to the source of tenderness and love, to my grandmother, all love and appreciation.*

*To **Mr. AHMED MADANI**, thank you for your positive support ,May Allah keep you healthy and well.*

Inçaf

SUMMARY

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LIST OF ABBREVIATIONS

RCI: reservoir caracterization instruments

WEC: well evaluation conference

SN REPAL : national company for petroleum research and exploitation in algeria

API :american petroleum institute

GOR:gas oil rasio

C: conductivity

d: density

△p:the difference betweenFormation pressure and theEnd-of-flow pressure

△t: flow time

Pb: ball pressure

Ø: porosity

Pg: reservoir pressure

T ° :temperature

µ: viscosity

Bo:volume factor oil deformation

Vc: volume of the flow chamberChamber

°C : celsius

GR :gamarey

Sw: saturation water

Rw: water resistivity

Ph: hydrostatic pressur

K: permeability

Ri: reservoir including sandstone isometric

Ra: reservoir including anisometric sandstones

R2: reservoir 2

R3 :reservoir 3

Bo : volumetric oil forming factor

K/µ : MOBILITE EN MD/CP

INTRODUCTION

INTRODUCTION:

The Saharian platform lies to the south of alpine Algeria and forms part of the North African craton. It consists of a Precambrian basement, unconformably overlain by a thick sedimentary cover, which was subdivided in the Paleozoic into several basins separated by highlands.

The oil industry makes use of technology, employing a plethora of sophisticated instruments with varying degrees of efficacy in the assessment of hydrocarbon reservoirs.

RCI is one of the high-tech tools that enables accurate reservoir evaluation and determination of the nature of the formation fluids, viscosity, density and points of contact between the fluids, as well as measurement of reservoir pressure and permeability.

In our thesis, we have applied this study to an OMG612 production well.

The aim is to compare logging data with the results of the RCI tool. The thesis is divided into four chapters:

The first chapter presentation of the HASSI MESSAOUD study area.

The second chapter , logging and RCI tool.

The third chapter, compares the results of the logging with the results of the Reservoir Characterization Instrument (RCI).

CHAPTER I :

PRESENTATION OF THE STUDY AREA (HASSI MESSAOUD)

INTRODUCTION:

The Saharan platform lies to the south of the Alpine Algeria and is part of the North African Craton. It consists of a Precambrian basement overlain by a thick sedimentary cover, which was structurally formed during the Paleozoic into multiple basins separated by elevated zones.

The Triassic province, also known as the northeastern province of the Sahara, is situated in the northern part of the Saharan platform. Covering approximately 300,103 km^2, this province has been extensively studied and holds some of the most significant discoveries in Algeria. It is bounded by the Grand Erg Oriental basin to the east and the Tunisian border, the southern Atlas flexure to the north, and the Grand Erg Occidental to the west. To the south, it is demarcated by the presence of Triassic formations, delineated by a sinuous line extending from the eastern Béchar basin to the northern Illizi basin.

The Triassic province forms a Precambrian metamorphic basement that constitutes the Saharan platform. Here, the Paleozoic deposits, spread out over the area, have been affected by the Hercynian unconformity. Consequently, the Triassic formations, marking the onset of the Mesozoic era, exhibit unconformable deposition over the Paleozoic strata.

In the western section of this province, the hydrocarbon accumulations discovered thus far can be categorized into four primary clusters:

- The Hassi Messaoud field and its adjacent areas in the east

- The Hassi R'mel field in the west. Between these two significant fields, additional regions stand out:

- The Oued Noumer area.

- The Oued M'ya rift axis.

Ⅰ.1 CHAMP HASSI MESSAOUD:

1.1 The geographical location of Champ Hassi Messaoud is as follows:

The field of Hassi Messaoud is situated approximately 700 kilometers southeast of Algiers, 350 kilometers from the Tunisian border, and about 80 kilometers east of Ouargla. It covers an expansive area of 2000 square kilometers, with an elevation of 142 meters above sea level. The region experiences a desert climate, characterized by temperatures ranging from 0°C to 47°C on average. During autumn and spring, it is prone to frequent sandstorms, with wind speeds reaching up to 100 km/h, predominantly from the north-northeast direction.

(WEC. 2007).[4]

Considered the largest oil field in the Algerian Triassic province, Champ Hassi Messaoud boasts extensive reserves and territory, spanning nearly 2200 square kilometers. It is bordered:

- To the northwest by the Ouargla, Guellala, and Haoud-Berkaoui fields.
- To the southwest by the El-Gassi, Zotti, and El-Agreb fields.
- To the southeast by the Rourde-El-Baguel and Mesdar fields.
- To the east by the Berkine field.

The coordinates of Champ Hassi Messaoud are:

- LSA coordinates:
- East: 790,000 to 840,000
- North: 110,000 to 150,000

Geographical coordinates:

- Latitude: 34°14'38.2817" to 34°35'18.6238"
- Longitude: 05°50'48.3453" to 06°24'20.0802"

UTM coordinates:

- X: 262,038.10 to 762,187.43.
- Y: 3,792,593.43 to 3,830,188.99.

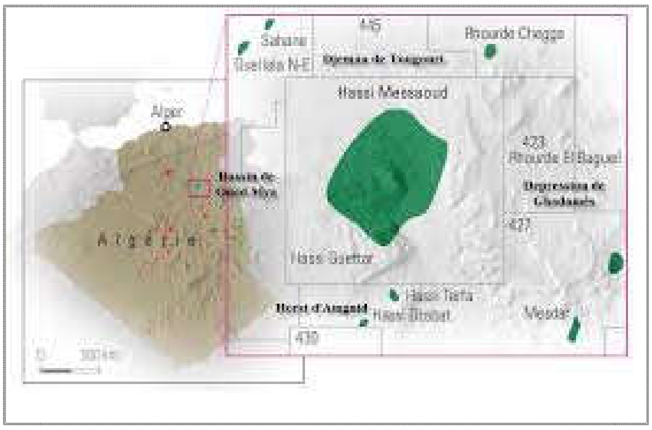


Figure 0-1 : Geographical location of the HASSI MESSAOUD field

Source : WEC. 2007[2-5]

The geological context:

The use of refraction seismic techniques, as part of the collaboration between SN REPAL and CFP (A), in 1956, unveiled a significant structural dome. This discovery was made during the initial drilling operation, designated as Md1, which led to the identification of an undersaturated oil reservoir situated within Cambrian sandstones at a depth of 3338 meters. Ownership of the venture was shared, with CFP (A) holding 51% and SN REPAL holding 49%.[4,7,8]

Located within the Hercynian unconformity, the field is distributed across four distinct Cambrian reservoir levels denoted as Ri, Ra, R2, and R3. Notably, the reservoir properties exhibit an improvement in quality from the lower to upper levels.

The detailed description of the reservoir levels within the field is as follows:

1.2 The geological setting:

The seismic refraction survey conducted by the collaborative effort between SN REPAL and CFP (A) in 1956 revealed a significant structural dome. This discovery was made during the initial drilling operation, denoted as MD1, leading to the identification of an undersaturatedoil reservoir within Cambrian sandstones at a depth of 3338 meters. Ownership of this venture was shared, with CFP (A) holding 51% and SN REPAL holding 49%.Situated within the

Hercynian unconformity, the field encompasses four distinct Cambrian reservoir levels: Ri, Ra, R2, and R3. Notably, reservoir properties exhibit an improvement from lower to upper levels.[7,8]

Here's a detailed description of the reservoir levels:

- R3: Porosity ranges from 5 to 10%, with permeability typically smaller (around 1md and sometimes negligible).
- R2: Porosity increases from 10 to 13%, while permeability remains low.
- Ra zone: This serves as the primary reservoir, with a thickness of 100m in the East and 145m in the West. It consists of poorly sorted sandstone exhibiting a wide variation in grain size, sometimes exceeding 1mm. Coarse beds are intercalated with finer beds, a few millimeters thick, displaying oblique stratification. The sandstones contain a cement matrix primarily composed of secondary quartz and clay, with an average content of up to 100%. However, silicification is highly irregular. Permeability through porous levels varies between 60 and over 100md, while porosity ranges from 4 to 20%.
- Ri: Grain sizes are uniform and typically do not exceed 1mm. These layers consist of fine to medium quartzites, primarily poorly sorted. The average porosity is low, in the range of a few tens of md, with porosity not exceeding 10 or 15%. However, extensive silicification significantly reduces this layer's potential.
- The alternating zone: This layer has undergone substantial alteration due to the Hercynian orogenic phase preceding the Triassic transgression. It comprises hardened clays interspersed with fine, isometric quartzites similar to those in Ri, over a thickness of 45m. Production from this zone within the Hassi Messaoud field is highly erratic.
- The total thickness of the productive Cambrian reservoir segment ranges from 100-120 meters, with oil saturation levels at approximately 85%. The average well flow rate ranges from 300-350 m^3/day, while individual well rates can vary between 0 and 1900 m^3/day. The oil exhibits under saturation, with a light density of 0.800 g/cm^3 and zero sulfur content.

The Hassi Messaoud field, located centrally with in the Triassic province, is the largest oil reserve in Algeria, owing to its vast expanse and reserves. The Hassi Messaoud dome

represents the culmination of a complex paleo-tectonic history, extending from the Amguid El Biod ridge, which spans over 800km. Structurally, it forms part of a broader group of formations constituting the northeastern Triassic province. Geologically, its boundaries are delineated by:

- To the west, it is bounded by the Oued M'ya depression.
- To the south, it extends into the Amguid El Biod ridge.
- To the north, it is bordered by the Djamaa-Touggourt structure.
- To the east, it is delineated by the elevated grounds of Dahar, Rhoude El Baguel, and the Berkine depression.

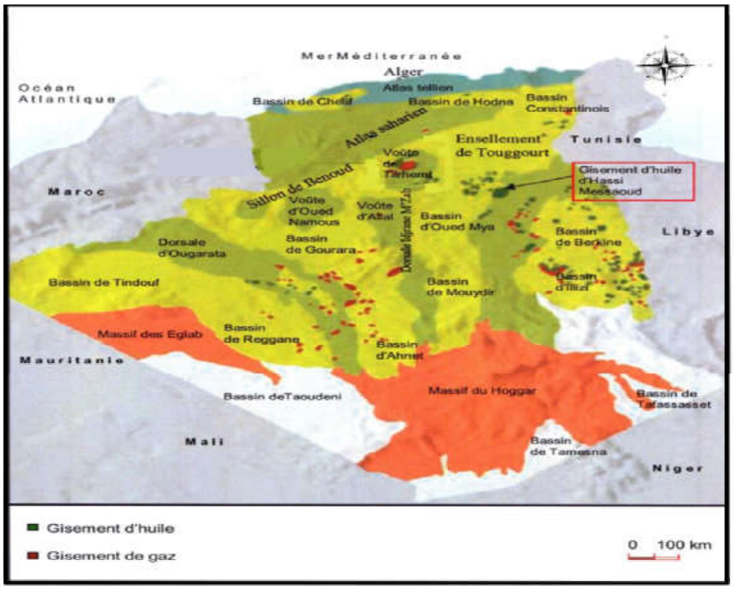


Figure 0-2 : Major hydrocarbon reservoirs in ALGERIA

Source : WEC. 2007

1.3 Historical Background of the Hassi Messaoud Field:

The discovery of the Hassi Messaoud field is credited to the efforts of two distinct companies: CFPA (Compagnie Française des PétrolesAlgérie, now TOTAL) in the northern section of the field (OM, ON) and SN.Répal in the southern area.[7-9]

In 1946, SN.Répal commenced its exploration endeavors across the Algerian Sahara. Three years later, geophysical prospecting began with gravity reconnaissance. By 1951, the first seismic survey was conducted in the Ouargla region, laying the groundwork for SN.Répal and its partner CFPA to submit their inaugural exploration permit application.[7-9]

On January 16, 1956, the Hassi Messaoud field was officially discovered by SN.Répal. This breakthrough came with the commencement of the first drilling operation, designated MD1, which was strategically located following a comprehensive refraction seismic campaign. Just a day prior, on January 15, 1956, the MD1 drilling successfully tapped into productive Cambrian oil sands at a depth of 3338 meters. This milestone marked the beginning of extensive oil exploration and development in the region.

In May 1957, CFPA solidified the existence of the field with the OM1 well, located approximately 7 kilometers northwest of the MD1 site.[7,8,10]

Over the following years, from 1959 to 1964, a total of 153 wells were brought into operational status. Following the nationalization of hydrocarbons on February 24, 1971, the pace of drilling activities escalated significantly, averaging 34 wells per year by 1977.

The field's development progressed through distinct phases, initially focusing on the exploitation of production zones via vertical drilling until 2000. Subsequently, efforts shifted towards tapping into structurally complex zones and reservoirs with lower matrix properties (upper R2) through unconventional drilling methods since 1997.

Throughout its operational history, production from the Hassi Messaoud field faced various challenges, including the occurrence of asphaltene salt deposits and gas breakthroughs, as well as the management of injection water. To address these complexities, surface installations were established, comprising two industrial complexes equipped to process all produced fluids and injection fluids.

The Hassi Messaoud field stands as a testament to the pioneering exploration efforts that have shaped Algeria's oil industry and continues to be a significant contributor to the nation's hydrocarbon production.

1.4 Stratigraphy of the Hassi Messaoud Field:

The Hassi Messaoud field presents itself as a vast structural high, with a significant portion of the Paleozoic stratigraphic sequence absent, erasing any geological history evidence for 230 million years.

Basement Crystalline Rocks:

Observed in wells Md2 at 3658m and Om81 at 3533m, described as porphyroid granite of pink color and altered at the top.

a) **Infracambrian:**

The oldest lithological unit encountered by drilling Omg47 at a depth of 4092m, consisting of red clayey sandstones.

a.1) Paleozoic:

On the basement, Paleozoic formations rest in discordance; this is the Pan-African discordance. From base to top, we distinguish:

a.2) Cambrian:

Primarily composed of heterogeneous sandstones, fine to very coarse, interspersed with layers of clayey, micaceous siltstones. Average thickness of 590m. It constitutes the main reservoir of Hassi Messaoud and has been subdivided into four distinct units (LHOMER 1966).[11]

This division is based on petrographic, petrophysical, and diagraphic criteria. From bottom to top:

• **Lithozone R3**: Average thickness of 370m.

R3 lithozone rests on the Infracambrian or directly on the basement. It consists of feldspathic and micaceous sandstones, medium to very coarse conglomeratic at the base, with abundant clayey cement, admitting passages of ferruginous sandstones and silty clay. It has no petroleum interest **due to its low matrix properties and its deep position above the water table.**

• Lithozone R2: Average thickness of 100 meters.

R2 lithozone consists of medium to coarse micaceous sandstones, poorly sorted, with abundant clayey cement and interbedded silts. Stratifications are often oblique. It is exploitable when in a high position.

• **Lithozone Ra:** Average thickness of 125 meters.

It consists of medium to coarse-grained quartzite sandstones, with clayey and siliceous cement, admitting numerous passes of centimeter to decimeter silts. Stratifications are often oblique to cross-stratified, sometimes horizontal. Tigillites are present in the upper part of the

series. The entire "Ra" has been eroded in the center of the field. According to LHOMER 1966, "Ra" is subdivided into three granulometric classes [11]:

• **Lower coarse zone or Lower Ra**: subdivided into drains 1: "D1, ID, D2" are coarse, poorly sorted sandstones with oblique stratifications.

• **Fine median zone: corresponds to the drain "D3**", composed of fine to very fine-grained materials, well-sorted with abundant Tigillites and intercalations of clayey and silty layers.

• **Upper coarse zone: corresponds to lithozone "D4",** it is almost entirely composed of the same sandstones as those of the Lower Ra.

Lithozone Ri (Cambro-Ordovician): Average thickness of 42m. The transition between the Cambrian and the Ordovician is not well-marked, hence a transition zone called "Cambro-Ordovician." It consists of fine, well-sorted, glauconitic isometric quartzitic sandstones, with clayey and siliceous cement, with abundant Tigillites. Petroleum-wise, this zone represents a secondary reservoir.

a.3)Ordovician:

Regionally, the Ordovician is composed of several lithological units, but for the Hassi Messaoud field, only four (4) lithological units are distinguished from base to top:

• **Alternating Zone: Average thickness of 20 meters**.

As the name suggests, it is a term where black silty clays alternate irregularly with fine isometric quartzite sandstones with abundance of Tigillites and some Lingulidae (Ordovician-Recent), its mineral fraction includes glauconite and siderite.

• El Gassi Clay: Average thickness of about 50 meters.

This formation consists of indurated schistose clay, green to black in color, occasionally red. This clay can be glauconitic or carbonate, showing fauna (Graptolites) indicating a marine depositional environment. This formation is mostly encountered on the peripheral zones of the field.

• El Atchane Sandstones: Average thickness varies from 12 to 25 meters.

This formation consists of fine to very fine sandstones, gray-beige to dark gray in color. This sandstone may be clayey with numerous clayey and silty interbeds.

• Hamra Quartzites: Average thickness varies from 12 to 75 meters.

These are fine quartzitic sandstones, light gray to beige in color, with rare clayey, silty, micaceous, and indurated intercalations of glauconite, anhydrite, and numerous Tigillites.

b) **Mesozoic:**

b.1) Triassic:

It rests unconformably on the Cambrian, in the center and on the Ordovician on the flanks of the structure. It is a highly varied ensemble resulting from transgression, which was lagoonal-marine in character, accompanied by volcanic flows. It is subdivided into four (4) units:

• Eruptive Triassic: Thickness varies between 0 and 92 meters.

Locally, volcanic flows are interstratified with Triassic sandstones, indicating the presence of several volcanic eruptions interspersed within the detrital facies. These flows often occurred in the Hercynian valleys.

• **Argillo-sandy Triassic: Average thickness of 35 meters**.

It constitutes the first filling of the Paleozoic relief and is subdivided into several units that differ in their lithologies and diagraphic responses. It rests, locally, on a volcanic flow filling the deep Hercynian erosion valleys:

• Upper Sandstones: fine sandstones with clayey cement.

• Lower Sandstones: consisting of fine to medium sandstones with abundant clayey cement.

• Clayey Triassic: Average thickness of 113 meters.

It consists of dolomitic or silty clays intercalated with beds of red-brown salt.

• **Saliferous Triassic: Average thickness of 340 meters.**

It acts as a covering layer and consists of massive salt beds with intercalations of anhydrite and slightly silty and dolomitic clay beds. It is composed of three (3) units:

• Saliferous Triassic "3" or "TS3": with a thickness of 202 meters.

At the base of the Saliferous Triassic, it consists of massive salt beds with intercalations of anhydrite and slightly silty and dolomitic clay.

• **Saliferous Triassic "2" or "TS2": with a thickness of 189 meters.**

It consists of massive salt beds with intercalations of anhydrite and gypsiferous clays.

• Saliferous Triassic "1" or "TS1": with a thickness of 46 meters.

It is made up of salts, with a predominance of anhydrites and dolomitic clays.

b.2) The Jurassic:

Its average thickness is 844 meters. The Jurassic is a clayey-sandy ensemble with limestone intercalations at the top (Malm) and alternating lagoon and marine facies at the base (Dogger and Lias).

• The Lias: Its average thickness is 300 meters.

The transition from the Triassic to the Liasis characterized by a zone of dolomitic marls known as the "Horizon B," which is a seismic marker. The Liasis subdivided into five (5) distinct levels interleaved over its entire thickness:

• **Dolomitic Lias "LD3": With a thickness of 31m,** it consists of gray marls with layers of gray dolomites.

• **Saliferous Lias "LS2": With a thickness of 58m,** it consists of translucent salts and layers of reddish-brown clays.

• **Dolomitic Lias "LD2": With a thickness of 55m**, it is composed of an alternation of massive dolomite beds with fine grains, grayish in color with layers of slightly dolomitic gray marls.

• **Saliferous Lias "LS1": With an average thickness of 90m**, it consists of brown clays with layers of salts and white anhydrites.

• Dolomitic Lias "LD1": With a thickness of 66m, it is composed of beds of dolomites and anhydrites with layers of clays and limestones.

• **The Dogger: Its average thickness is 320 meters**.

The Dogger is divided into two (2) formations, the lagunar Dogger at the base and the clayey Dogger at the top.

• **Lagunar Dogger:** It is represented by a lagunar series primarily composed of anhydrite and dolomite over 210m in thickness.

• **Clayey Dogger**: With a thickness of 107m, it consists of soft, silty clays with layers of fine sandstones with carbonate clayey cement.

• Le Malm:

Its average thickness is 226 meters. It is characterized by deposits of clays and marls with intercalations of limestone and dolomite beds accompanied by some traces of anhydrites.

c.1) Le Crétacé:

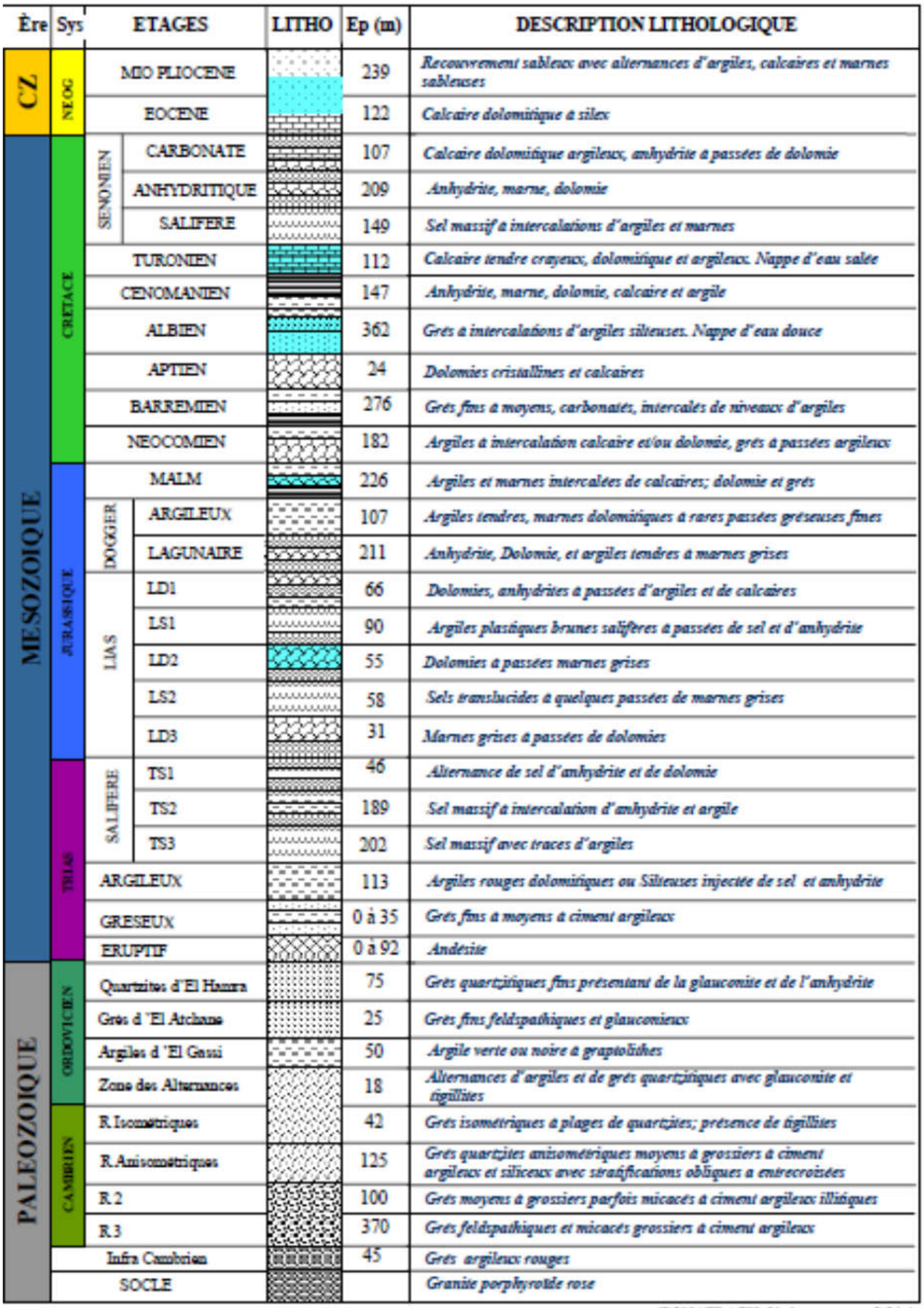
Its average thickness is 1620 meters. It is composed of seven stages, from the base to the top:

- **Le Néocomien**: Its thickness is 182 meters. It includes two levels, at the base a sandy term composed of sandstone and some clay layers, at the top a clayey term represented by clays with numerous intercalations of limestones and dolomites.
- **Le Barrémien:** Its average thickness is 280 meters. It is formed of fine to medium carbonate sandstones with layers of anhydrite, alternating with levels of sandy and dolomitic clay.
- **L'Aptien**: Its thickness is 25 meters. It is represented by two dolomitic beds flanking a clay layer. The Aptian-Barrémien boundary coincides with the limestone-dolomite barrier which represents a good seismic marker.
- **L'Albien**: Its average thickness is 350 meters. Composed of sandstone and fine sand, with intercalations of silty clay, it includes a vast aquifer.
- **Le Cénomanien**: Its average thickness is 145 meters. Alternating layers of anhydrite and reddish-brown clay, gray marls, and dolomites. The Cenomanian-Albian boundary coincides with the transition from evaporitic series to the more sandy series of the Albian.
- **Le Turonien:** Its average thickness varies from 70 to 120 meters. Alternating layers of clayey limestone, dolomitic limestone, and chalky limestone; limestone beds appear at the top. The Turonian represents the saline water aquifer.
- **Le Sénonien:** Its average thickness is 230 meters.
- **SénonienLagunaire**: With a thickness of 350 meters, it presents massive salt beds with clay intercalations at the bottom and an alternation of anhydrites, clays, and dolomites at the top.

- **SénonienCarbonaté:** With a thickness of 110 meters, it is characterized by a succession of argillaceous dolomitic limestone beds and anhydrite beds with intercalations of gypsiferous dolomites.

  Cenozoic:

- Its average thickness is 360 meters. It consists of dolomitic limestone in the Eocene and a sandy type covering in the Miocene-Pliocene.



Ère	Sys	ETAGES		LITHO	Ep (m)	DESCRIPTION LITHOLOGIQUE
CZ	NEOG	MIO PLIOCENE			239	*Recouvrement sableux avec alternances d'argiles, calcaires et marnes sableuses*
		EOCENE			122	*Calcaire dolomitique à silex*
MESOZOIQUE	CRETACE	SENONIEN	CARBONATE		107	*Calcaire dolomitique argileux, anhydrite à passées de dolomie*
			ANHYDRITIQUE		209	*Anhydrite, marne, dolomie*
			SALIFERE		149	*Sel massif à intercalations d'argiles et marnes*
		TURONIEN			112	*Calcaire tendre crayeux, dolomitique et argileux. Nappe d'eau salée*
		CENOMANIEN			147	*Anhydrite, marne, dolomie, calcaire et argile*
		ALBIEN			362	*Grès à intercalations d'argiles silteuses. Nappe d'eau douce*
		APTIEN			24	*Dolomies cristallines et calcaires*
		BARREMIEN			276	*Grès fins à moyens, carbonatés, intercalés de niveaux d'argiles*
		NEOCOMIEN			182	*Argiles à intercalation calcaire et/ou dolomie, grès à passées argileux*
	JURASSIQUE	MALM			226	*Argiles et marnes intercalées de calcaires; dolomie et grès*
		DOGGER	ARGILEUX		107	*Argiles tendres, marnes dolomitiques à rares passées gréseuses fines*
			LAGUNAIRE		211	*Anhydrite, Dolomie, et argiles tendres à marnes grises*
		LIAS	LD1		66	*Dolomies, anhydrites à passées d'argiles et de calcaires*
			LS1		90	*Argiles plastiques brunes salifères à passées de sel et d'anhydrite*
			LD2		55	*Dolomies à passées marnes grises*
			LS2		58	*Sels translucides à quelques passées de marnes grises*
			LD3		31	*Marnes grises à passées de dolomies*
	TRIAS	SALIFERE	TS1		46	*Alternance de sel d'anhydrite et de dolomie*
			TS2		189	*Sel massif à intercalation d'anhydrite et argile*
			TS3		202	*Sel massif avec traces d'argiles*
		ARGILEUX			113	*Argiles rouges dolomitiques ou Silteuses injectée de sel et anhydrite*
		GRESEUX			0 à 35	*Grès fins à moyens à ciment argileux*
		ERUPTIF			0 à 92	*Andésite*
PALEOZOIQUE	ORDOVICIEN	Quartzites d'El Hamra			75	*Grès quartzitiques fins présentant de la glauconite et de l'anhydrite*
		Grès d 'El Atchane			25	*Grès fins feldspathiques et glauconieux*
		Argiles d 'El Gassi			50	*Argile verte ou noire à graptolithes*
		Zone des Alternances			18	*Alternances d'argiles et de grès quartzitiques avec glauconite et tigillites*
	CAMBRIEN	R Isométriques			42	*Grès isométriques à plages de quartzites; présence de tigillites*
		R Anisométriques			125	*Grès quartzites anisométriques moyens à grossiers à ciment argileux et siliceux avec stratifications obliques à entrecroisées*
		R 2			100	*Grès moyens à grossiers parfois micacés à ciment argileux illitiques*
		R 3			370	*Grès feldspathiques et micacés grossiers à ciment argileux*
		Infra Cambrien			45	*Grès argileux rouges*
		SOCLE				*Granite porphyroïde rose*

(SONATRACH. légèrement modifiée)

Figure 0-3 : Stratigraphic column of the Hassi Messaoud field

1.5 petroleum potential of the study area:

The source of the hydrocarbons is represented by the following rocks:

Source rocks:

In the Ordovician we have the microconglomeratic clays, the Azzel clays, which also have levels with the characteristics of the source rock. The Frasian source rock (Devonian), the Upper Devonian, the radioactive zone of the Frasian, rich in organic carbon, with a TOC varying from 2.5% to 6.6% and an S2 of up to 40kg/t rock. According to the geochemical data, this source rock is a Type II kerogen. There are also other rocks that play the role of generators such as.

El Gassi clays:

Black, marine and organic clays, which could have made the largest contribution to the accumulation of reserves at Hassi Messaoud; this formation is 37 to 50 metres thick and is found on the periphery of the field as well as in the grabens of the Hassi Messaoud structure (MD21, MD55, ON11).

Silurian clays:

This formation is located 2km west of the field and 100km east of the field (on the field margins), where it is likely that these hydrocarbons have undergone a shorter migration within the structure. It is the source of hydrocarbons on the scale of the Saharan platform, with a thickness varying from 20 to 70m.

At present, we can say that after the migration of the hydrocarbons generated in the Palaeozoic, there was a second phase of migration at the end of the Cretaceous.

Bedrock:

The Hassi Messaoud reservoir is associated with Cambrian fissured quartzite sandstones eroded under the Hercynian unconformity and covered by the thick clay-salt cover of the Trais. The latter is considered the main reservoir with dimensions up to 2,000 km^2, an oil-impregnated surface area of 1,143 km^2 and a transition zone of about 400 km^2.

The average depth of the producing zone varies between 3400m and 3600m. The absolute height of the oil-water interface is estimated to be 3380 meters.

The reservoir has been subdivided into four strata, the petrophysical properties of which change rapidly in space.

The R3, R2 and Ri litho-zones differ in their petrophysical characteristics, with the reservoir quality improving from bottom to top due to an increase in the number of open fractures. Towards the base, these physical characteristics deteriorate, the number of fractures decreases and they are increasingly plugged by clays.

Overlying rocks :

The Ordovician reservoirs are covered by the effusion of eruptive rocks and by thick series of evaporites of Triassic or Jurassic age.

Traps:

Traps are the most favourable zones for the presence of hydrocarbon accumulations, characterised by a lower pressure and temperature than that of the source rocks and by a barrier that forces the accumulation of hydrocarbons.

(A.PERRODON.1985). There are three types of traps [12-14]:

Structural traps:

These traps are the result of tectonic movements such as anticlines or fault traps.

Stratigraphic traps:

This is the combination of two different environments, corresponding to the transition from one permeable environment to another impermeable one, such as sandstone lenses, bevels, etc. ...

Mixed traps:

These are both structural and stratigraphic, such as the HMD structure (anticline cut by the Hercynian unconformity).

In the Oued M'ya basin and northeast of Hassi Messaoud, the traps identified so far are stratigraphic and structural (mixed).

Hydrocarbon migration :

The hydrocarbon accumulations in the Hassi Messaoud field and all adjacent fields are thought to originate from two basins, Berkine and Illizi to the east and Oued M'ya to the west.

The primary migration and feeding of these reservoirs took place within the Silurian, then through the Triassic sandstone layers at the contact of the Hercynian unconformity (secondary migration).

Fluid characteristics :

Light oil.

Average surface density: do = 0.8.

The reservoir pressure is variable: Pg = 120-400 Kgf /cm

The reservoir temperature is T°=118°C

Gas/oil ratio: GOR = 219 m3/m3

The porosity is low:10-5 =◌́ %.

Permeability is highly variable

Viscosity: μ = 0.2 Cp.

Background volumetric factor: Bo = 1.7 m^3/m^3.

CHAPTER Ⅱ : LOGGING AND RCI

Ⅱ.1 CONCEPT ABOUT LOGGING AND RCI

1.1 INTRODUCTION

When a potential underground reservoir is discovered through surface geological and geophysical methods, it is necessary to study its qualities, which determine its potential yields, namely porosity, permeability, saturation rate, thickness, and the various fluids it contains (gas, oil, or water). These studies are summarized in what is called LOGGING.

Logging refers to geophysical techniques implemented within a borehole. The radius of the investigation volume is not much larger than that of the borehole. They serve to measure in situ a characteristic physical parameter of the terrain, with the best possible vertical resolution. Unlike drilling geophysical techniques, they do not allow for an increase in the investigation radius of the borehole or for making a judgment on the representativeness of the information obtained from the borehole.

1.2 DEFINITION OF LOGGING:

Logging refers to continuous recording as a function of depth of variations in a given characteristic of the formations traversed by a borehole. The recording is done from the surface using a probe lowered on the end of a cable equipped with electrical conductors. Currently, there are approximately 35 different recordings, not including auxiliary operations carried out at the end of the cable such as lateral coring, formation testing, perforations, and logging, which are performed by service companies in Algeria: SCHLUMBERGER, Baker Atlas, and HESP.

1.2.1 Presentation of a logging:

The result of logging is presented in the form of a curve in a coordinate system where depth is indicated on a vertical axis oriented downward and the measurement result (resistivity, density, drilling rate, etc.) is indicated on a horizontal axis. The presentation is crucial. The log header should display a number of essential details:

- Company Name.
- Well Number and Coordinates.
- Tool Used.
- All other logs recorded simultaneously during the same operation.
- Depth – Driller: The depth reached by the drilling.

- Depth – Logger: The maximum depth reached by the log.
- Btm log interval: The depth at which the logging operation actually begins.
- Top log interval: The depth at which the logging operation is stopped.
- Type of fluid in Hole: The type of fluid filling the borehole, including mud type with its characteristics such as density, viscosity, pH, etc.
- Source sample: Origin of the mud sample, usually taken during the last circulation.
- Rm (mud resistivity): Resistivity of the drilling mud.
- Rmf (mud filtrate resistivity): Resistivity of the filtrate.
- Rmc (mud cake resistivity): Resistivity of the mud cake.
- Time since circulation: Time elapsed after the last circulation until logging.
- Permanent datum: Reference level (very important in logging for water).
- Casing: Tubing.
- KB (Kelly Bushing): Elevation of the drilling table.

1.3 Types of logging:

There are several types of logging. In this course, only the principles of application and interpretation of logging for petroleum reservoir evaluation will be discussed, namely:

- Electrical logging.
- Nuclear logging.
- Acoustic logging.

1.4 Applications of well logging:

The study of well logging enables us to intervene in various stages of the exploration and exploitation of oil fields, particularly regarding:

- Hole conditions: (Diameter; temperature; wellbore stability...) (Installing casing, Monitoring cementation and casing integrity).
- Accurate lithology reconstruction of different formations penetrated: (Locating reservoir rocks, Identifying reservoir rock types, Addressing stratigraphic and sedimentological issues).
- Evaluation of petrophysical characteristics (Porosity, Permeability, Saturation).
- Well completion (Perforation delineation and control, Production logging).
- Correlation work between multiple wells.(SERRA O. 1985).[15,16]

1.5 Different types of well logging and their principles and applications:

GAMMA RAY LOGGING:

Tool Description:

The tool consists of a detector coupled with an electronic cartridge to measure gamma radiation generated within the formation behind the tool.

Principle:

It records the natural gamma radioactivity of formations. The only radioactive elements with significant concentrations in natural materials are potassium, uranium, and thorium.

Applications:

In sedimentary formations, significant radioactivity is recorded in:

- Clay formations containing potassium (especially illite).
- Potassium salts.
- Formations rich in organic matter may concentrate uranium.
- Detrital formations containing feldspars (potassium) or enriched in heavy minerals.

Limitations:

High GR readings in the presence of potassium in the mud. The presence of barite in the mud reduces GR readings. Vsh evaluation is not correct in the presence of radioactive sandstones.

RESISTIVITY LOGGING:

Measurement Tool:

It is a measurement device where a receiver, located at a certain distance from the source, records the formation's responses to this signal.

Principle:

An emitting source (electrode) sends a signal (electric current). A measuring device (receiver) located at a certain distance from the source records the terrain's reactions to this signal.

Applications:

- Quick interpretation for hydrocarbon detection.

- Calculation of water saturation (Sw).
- Determination of invasion diameter (di).
- Determination of formation water resistivity (Rw).

Limitations:

- Cannot be used in the case of saline mud.
- Cannot be used in formations with high resistivities.
- Layer inclination affects resistivity recordings.
- Vertical resolution, especially with thin layers.

SONIC LOGGING:

Measurement tool:

The sonic logging tool consists of one or more transmitters and receivers placed in the borehole.

Principle:

The emitted wave is calibrated in amplitude and frequency. The signal received by the receivers, compared to the emitted signal, provides an indication of the velocity of the acoustic wave in the medium, which is related to its compaction and therefore linked to porosity. The tool measures the transit time of the acoustic wave over a distance of 1 foot.

Applications:

- Formation evaluation.
- Porosity assessment.
- Lithology determination.
- Analysis of mechanical properties.
- Well stability analysis.
- Fracture identification.
- Geophysical interpretation:
- Establishment of synthetic seismograms.
- Vertical seismic profile.

NEUTRON LOGGING:

Measurement tool:

The neutron logging tool emits high-energy neutrons from a source.

Principle:

Neutrons are electrically neutral and their mass is similar to that of protons. The neutron tool responds to both primary and secondary porosity, calibrated directly in porosity.

Applications:

- Porosity determination for clayey sand formations.
- Lithology indicator.
- Gas indicator.
- Porosity determination in cased hole.

Limitations:

Lithology:

- Matrix type must be known for porosity calculation.
- Water bound in clays causes high porosity readings.

Fluid type:

Residual oil leads to underestimation of porosity since the hydrogen index of oil is lower than that of water.

DENSITY LOGGING:

Measurement tool:

The Formation Density Compensated (FDC) or Litho-Density (LDL) tool is used for lithology and porosity measurements. It records data only in open hole conditions.

Principle:

By measuring the number of gamma rays and their energy level at a given distance from the source, the formation electron density can be determined. The relationship between electron density and bulk density allows for the determination of the latter.

Applications:

The number of gamma rays reaching the detector, after collision, is inversely proportional to the density of the medium; hence, proportional to porosity.

Limitations:

The density of the matrix must be known to compute porosity (Φ). The volume of shale (Vsh) and shale density (ρsh) must be known to compute effective porosity.(SERRA O. 1979).[15,16]

Ⅱ.2 PRESENTATION OF THE RCI TOOL:

2.1 Introduction:

A reservoir tool is a device or instrument used in the fields of geology and geophysics to characterize underground reservoirs of oil, gas, or water. Its primary function is to collect data and information about the reservoir's characteristics, such as its composition, structure, porosity, permeability, pressure, etc.

These data are crucial for assessing the economic viability of reservoir exploitation and for designing effective strategies for extracting underground resources. The reservoir tool can take various forms, ranging from advanced drilling tools to geophysical measurement instruments, depending on the specific needs of exploration and exploitation of underground resources.

2.2 Definition of the Tool (RCI):

The Reservoir Characterization Instrument (RCI) is a high-technology tool designed to obtain pressures and samples from a reservoir formation at various depths. It provides a comprehensive description of the reservoir.[4]

2.3 Components of the RCI Tool:

The tool is composed of different modules assembled on a rod according to the need, ranging from the "drawdown" module to the "multi-tank" module, which we describe in the following.

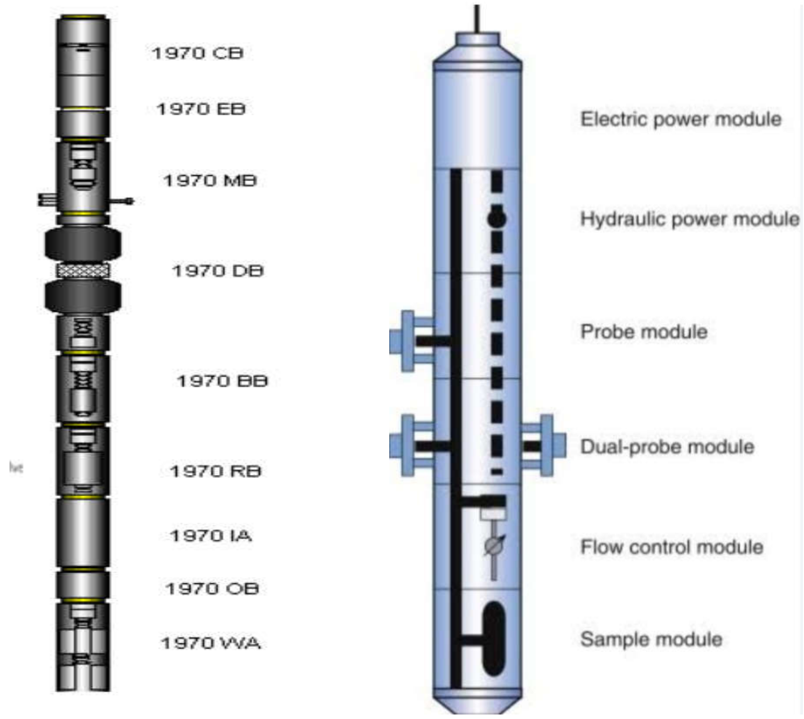


Figure 0-1 : RCI configuration (BEAKER).

• Module 1970 BB "Drawdown":

- It allows us to:
- Pump the fluid.
- Determine the flow pressure.
- Conduct the phase separation test.

• Module 1970 CB "Hydraulics Section":

- As its name suggests, it provides the necessary power to the RCI for the operation of various control circuits.

• Module 1970 EB "Electronics Control":

- It provides a link between the RCI and the surface acquisition software (ECLIPS). Each section has its own communication hardware with the electronic module for diagnostic control.

• **Module 1970 GB "Borehole Exit":**

- It facilitates communication between the reservoir and the borehole. It is used to discharge the mud filtrate pumped into the hole.

• **Module 1970 MB "Packer":**

- It contains a resistivity and capacitance R/C sensor used to determine the type of pumped fluid, providing an indication of the fluid's resistivity and permittivity.

• **Module 1970 PB "Transportable Tank Carrier":**

- These are tanks that allow for sample collection without causing changes in the fluid. These tanks are pressurized after filling to prevent the fluid from dropping below the bubble pressure during ascent to the surface. The volume of each tank is 600cc.

• Module 1970 RB "Large Volume Pump":

- It allows for the rapid pumping of a large quantity of fluid.

• **Module 1970 IA "Sample View":**

- There are two versions of the "sample view": the 1970 IA, which is an infrared spectroscopy module with 17 optical channels, and the 1970 IB, which is also an infrared spectroscopy module but with 19 optical channels. In addition to providing the fluid's fluorescence spectrum and refractive index.

• **Module 1970 OB "Auxiliary Power Section":**

- This module provides power to the other modules.

• Module 1970 WA "Multi-Tank Carrier":

- It is designed for collecting multiple samples in a single descent into the well.

2.4 Operation (pressure measurements):

The pressure measurement begins with a series of pre-test operations. The different steps of this pre-test are as follows:

- Descent of the tool into the well.
- Measurement of hydrostatic pressure.

- Opening of the "Packer" module and its placement against the well wall at a portion of the formation resulting in the creation of a seal that maintains tightness.
- Withdrawal of the probe from the "Packer," which penetrates into the formation.
- Drawing a small amount of fluid into the flow chamber to check for tightness.
- Pumping the fluid through modules 1970 BB "Drawdown," 1970 RB "large volume pump," and 1970 PB "tank carrier," finally exiting the instrument through 1970 GB "Borehole exit." This step continues until formation fluid is detected by R/C control or bubble testing.

Once the filtrate is purged, the pressure test can begin to determine:

- Reservoir pressure at various depths.
- Fluid mobility.
- Pressure gradients and fluid densities.
- Depths of fluid contacts.

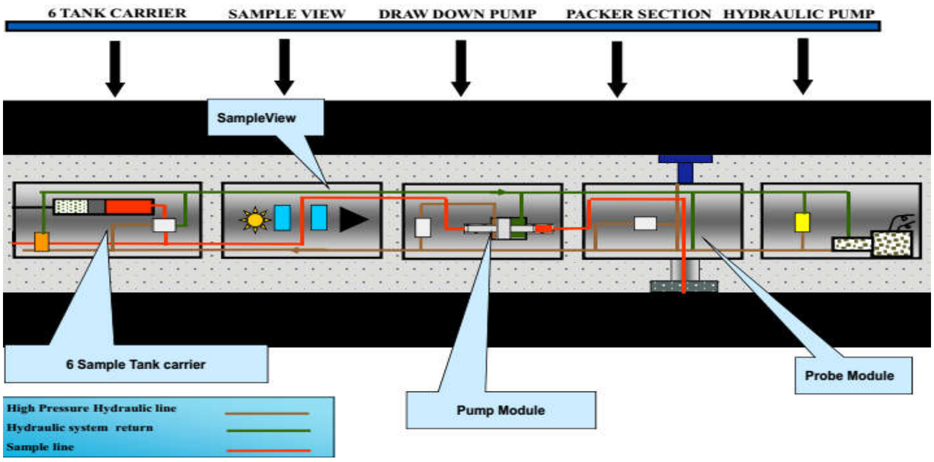


Figure 0-2: Parts diagram in the RCI tool (Beaker)

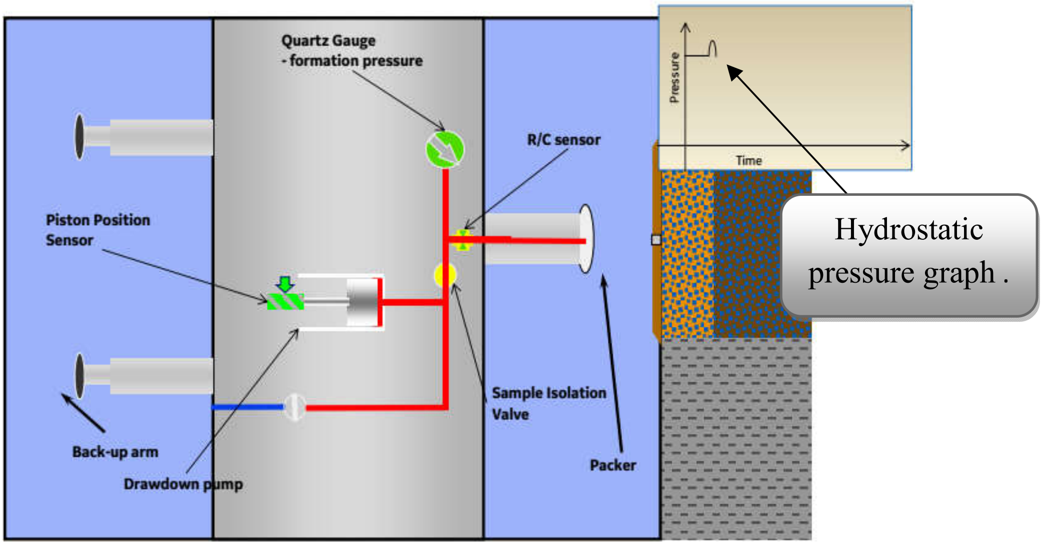


Figure 0-3 : The tool is lowered into the shaft.(BEAKER).

2.4.1 Determining reservoir pressure:

The flow test is the process of decreasing fluid pressure by increasing volume. In this context, the pump piston is pulled backward, creating a large volume in the flow chamber. Until this volume is filled, a pressure difference is created, and the fluid flows from the formation (high pressure) into the flow chamber.

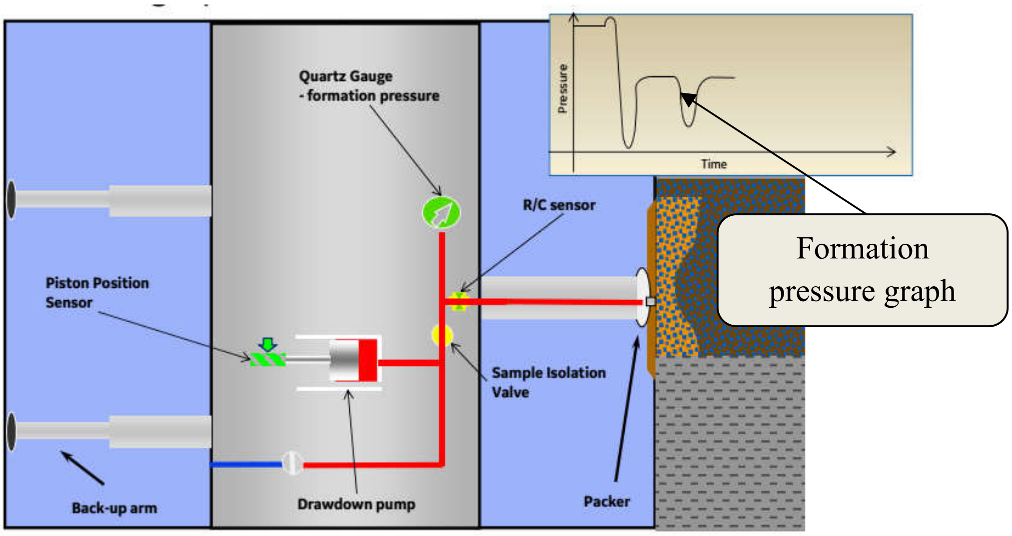


Figure 0-4: The tool is lowered into the shaft.(Beaker)

The pressure recorded before the placement of the 'packer' module is the hydrostatic pressure in the well. When the 'packer' module is placed against the wall of the hole facing the formation under study, it results in compression of the fluid.

This is followed by a pressure drop when the piston of the chamber is pulled, indicating the decompression of the fluid until the end of its flow. The pressure then begins to increase again (pressure buildup) until stabilizing at the formation pressure.

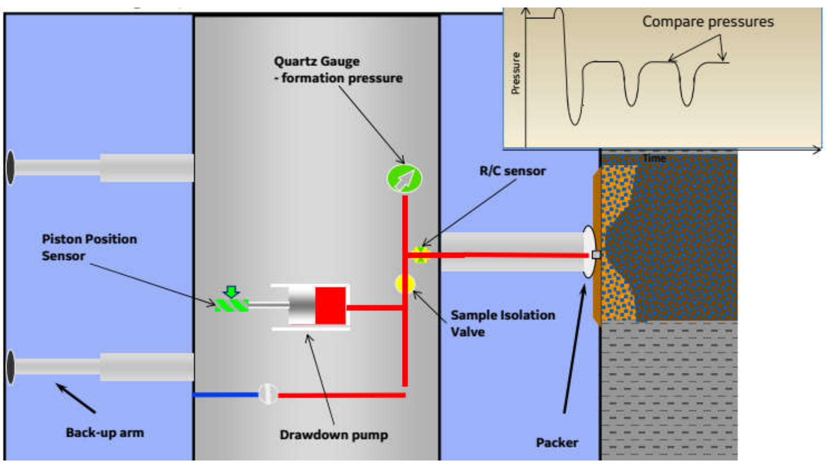


Figure 0-5 : Test pattern (draw dawn) and recording of training pressure.

Removing the 'packer' results in a sudden rise in pressure to the hydrostatic pressure.

The fluid mobility K/μ can be estimated by two methods:

1. From the 'buildup' portion of the flow test curve as shown in the figure.

The mobility is then written as:

$K/\mu = C .q / (rp . \Delta p)$ with $q = Vc / \Delta t$

Where: C is the correction factor

q: the flow rate.

Vc: the volume of the flow chamber.

K: permeability.

μ: viscosity.

rp: probe diameter.

Δt: flow time.

Δp: the difference between the formation pressure and the end of flow pressure.

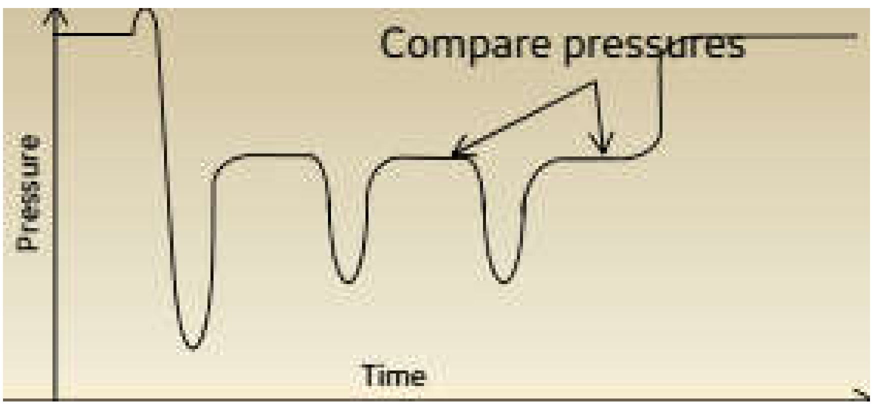


Figure 0-6: Formation pressure versus time curve.

(BEAKER) [5]

Based on the analysis of the flow rate of the formation as a function of pressure (FRA), which is based on Darcy's law, where mobility represents the slope of the line.

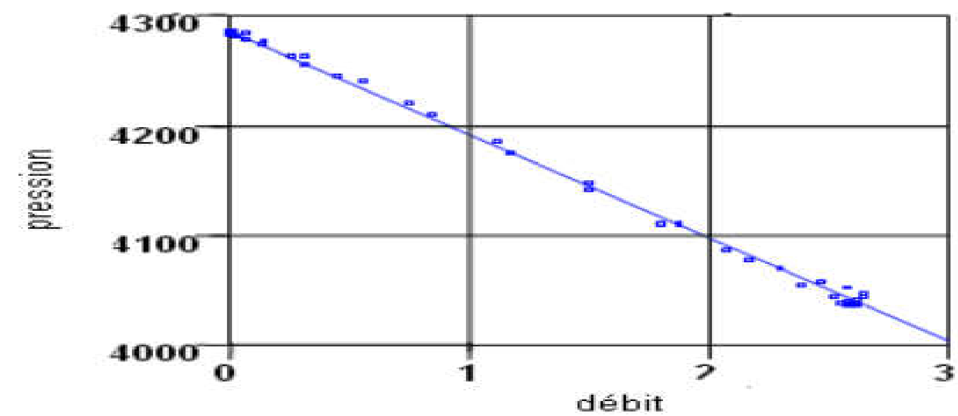


Figure 0-7: Example of a curve showing the flow rate of the formation as a function of pressure

(BEAKER)[2,3,5]

2.5 Data exploitation:

Gradient Determination**:**

The recorded formation pressures are plotted against true vertical depth. The slopes of the lines correspond to the fluid gradients. Densities in (g/cc) are obtained by dividing the calculated gradient in (psi/m) by the constant (0.703). The table below provides the densitiesof various types of fluids.

Figure 0-7: TAB Densities of different types of fluids (SONATRACH)

Type de fluide	Densité (g/cc)
Gaz	0.1 – 0.35
Condensât	0.5 – 0.65
Huile	0.67 - 0.8
Eau	1 – 1.2

2.5.1 Determination of the depths of contacts between fluids**:**

The intersection points of the lines on the formation pressure versus true vertical depth plot correspond to the depths of contacts between fluids.

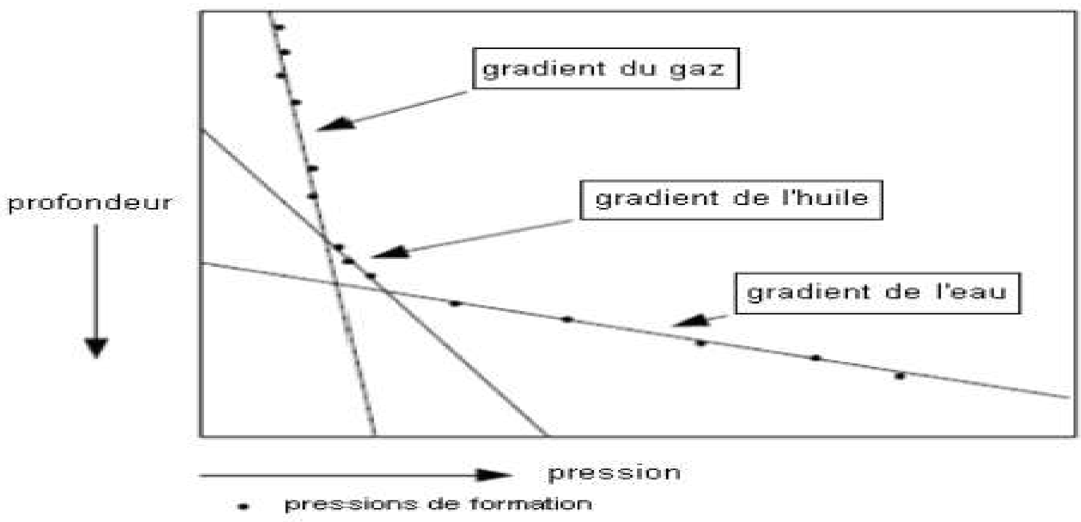


Figure 0-8: Example of formation pressure curve as a function of depth.

(BEAKER)[5]

2.5.2 Multiple flow:

One of the other advantages of RCI compared to a conventional tool is that the volume and flow rate of the flow are controlled from the surface. This allows us to perform multiple flow tests without having to remove the tool and break the seal between the "packer" module and the formation. The final pressure of the "Buildup" portion, in the formation pressure versus time curve, can be controlled to identify any overload effects due to mud.(BEAKER, 2008).

2.6 Sampling:

RCI is also designed to address issues associated with obtaining a good quality sample. The two main problems affecting sample quality are:

- Contamination with mud filtrate, which affects laboratory analyses. To address this, it must be ensured that contamination is minimized (5%) before collecting the formation sample.

- Alterations of fluid properties due to pressure drop. To address this, the sample pressure must be maintained above the bubble pressure to prevent gas and asphalt from coming out of solution.

2.6.1 Sampling process:

The diagram below illustrates a simplified scheme of the RCI, showing most of the valves for sampling after the mud filtrate has been purged. The sampling process is similar to pressure measurements, except for opening the valves for tank filling. Certain tests must be conducted beforehand to ensure the integrity of the sample.

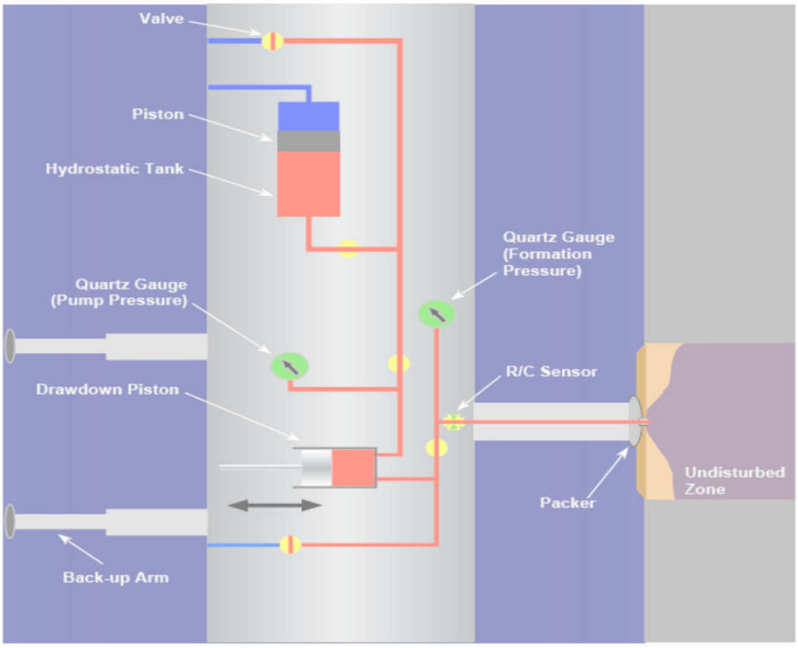


Figure 0-9: Sampling process. (BEAKER)[5]

2.6.2 Tests conducted before sampling:

a) Mobility Test:

This test determines the fluid's ease of movement through the formations; mobility is estimated from the graph of formation pressure versus time in the pressure test section.

b) Mud Filtrate Removal:

This operation involves removing the mud filtrate by pumping it out of the formation.

c) Fluid Description:

Using the R/C dielectric sensor during the pumping operation, which measures resistivity and permittivity over time, allows us to distinguish the type of fluid being pumped. The graph shows an example of the R/C sensor response during a pumping operation; a very low resistivity is observed until 5600 s, which is due to the presence of water, followed by an increase in resistivity indicating a fluid change and the presence of hydrocarbons.

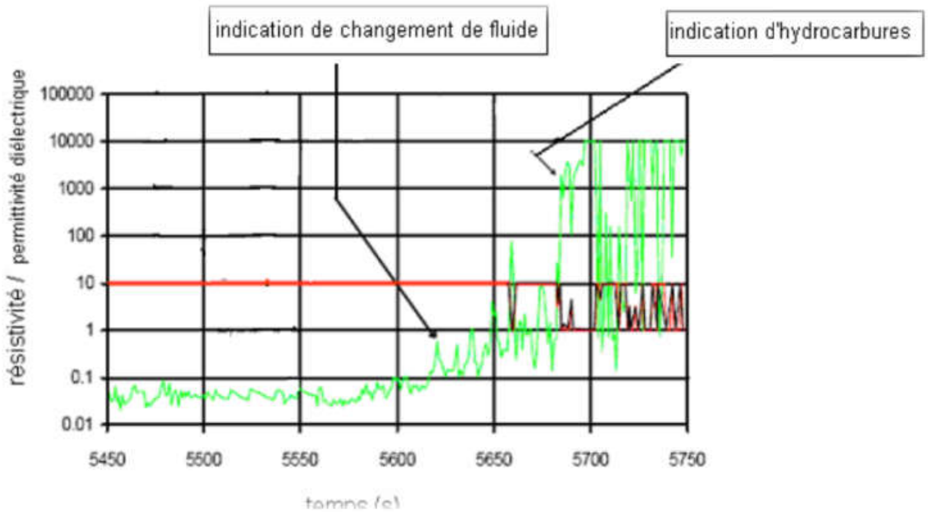


*Figure 0-10: Example of R/C sensor response during a pumping operation**(BEAKER)**[5]*

Type de fluide	Résistivité (ohm.m)	Permittivité (F/m)
Gaz	5000 – 10000	1 - 1.4
Mixture (huile/gaz)	5000 – 10000	1.4 - 1.9
Huile	5000 – 10000	1.9 - 2.4
Mixture (huile/eau)	50 - 5000	2.4 - 50
Eau douce	1 - 50	70 - 80
Eau salée	< 1	50 - 80

Figure 0-11: The resistivity and permittivity of different fluids (BEAKER)[5]

There is a situation where the R/C [Resistivity/Conductivity] cannot distinguish between fluids, which is the case of oil mud and formation oil. In this case, a phase separation test or bubble pressure test is necessary (Pb test).

Bubble pressure Pb measurement: This measurement is carried out in order to differentiate between the oil mud filtrate and the formation oil and to know the bubble pressure in real time, and thus avoid phase separation when the samples are brought up to the surface, by pressurizing the sampling bottles. The bubble pressure corresponds to the pressure of the first point from which the pressure line as a function of volume deviates from the smallest slope.

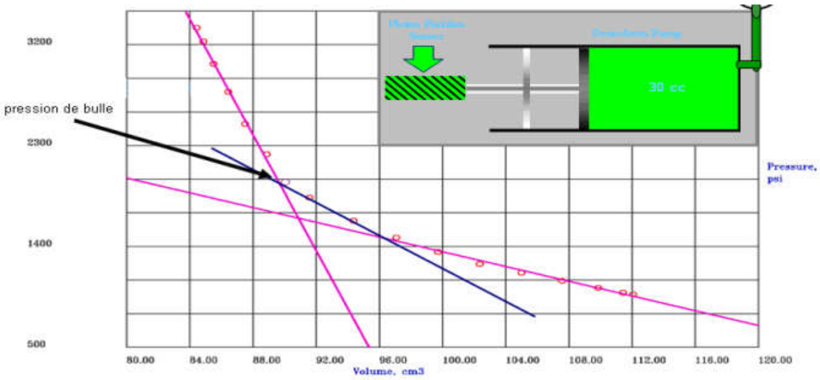


Figure 0-12: Example of a bubble test. (BEAKER)[5]

2.7 Fluid characterization

2.7.1 Sample Collection:

The RCI can collect up to four samples simultaneously. Its four tanks can be pressurized to reduce the possibility of phase separation during the ascent to the surface. The pressurization value is determined during the expansion test.

Fluid Characterization:

The 'sample view' module is an integral part of RCI services. Its main purpose is to control the fluid pumped in real-time to complete fluid characterization. There are two versions of the 'sample view' module, 'sample view IA' and 'sample view IB.'

2.7.2 Sample view IA and IB:

It is a fluid analyzer that uses absorbance spectroscopy, with optical channels in the visible and infrared domains. Some are used as indicators of oil quality. Others indicate the presence of water and hydrocarbons.

Here's the translation:

a) - Principle:

A light source emits rays that pass through a first optical window before passing through the fluid to be analyzed, and then exit through a second window. The intensity of light is reduced for certain wavelengths more than others. Through this, we obtain an absorption spectrum of this fluid. (BEAKER 2008) [5]

b) - Fluid Identification:

The spectrum provided by the 'sample view' is used to identify:

• The type of fluid flowing through the tool.

• Its API density.

• Its viscosity.

• The level of its minimum contamination.

It also allows:

• Methane detection.

• Determination of the oil/gas ratio (GOR).

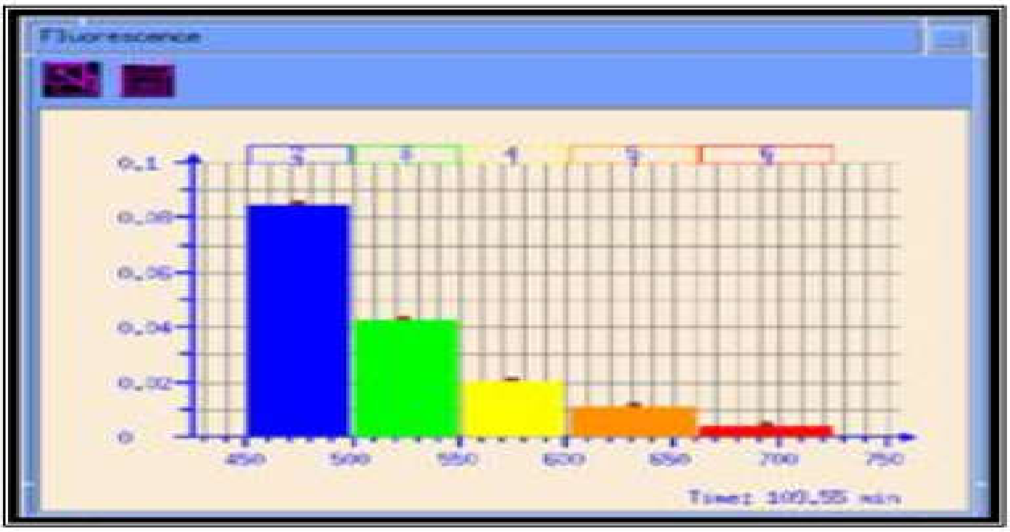


Figure 0-14:Exemple of spectrum fluids before stability (during the time of absorption of formation fluids

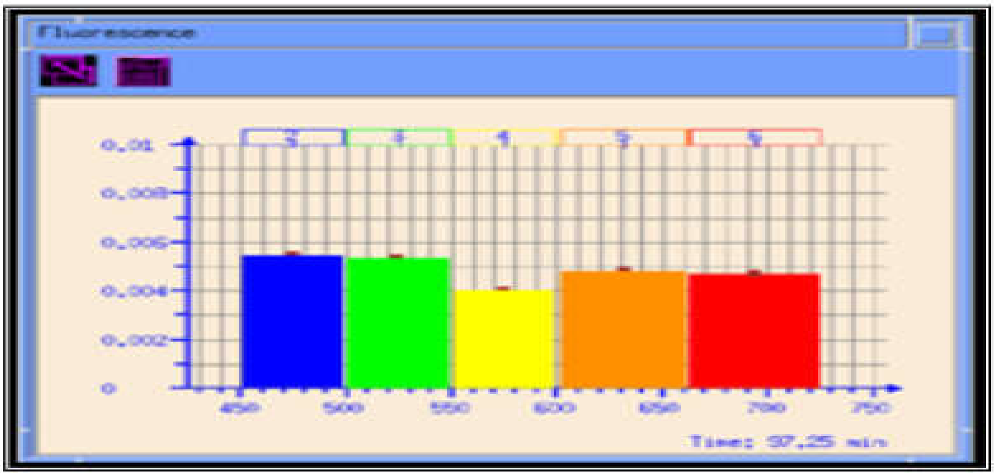


Figure 0-13: Exemple of spectrum fluids after stability (during the time of absorption of formation fluids

CHAPTERⅢ: Comparing the results of logging with RCI

1. Introduction:

Petrophysical evaluation through loggings is conducted in the oil and gas industry to obtain crucial information about the characteristics of geological formations penetrated by a drilling well.

2. Petrophysical evaluation based on loggings:

Case of Well (OMG612):

Table Analysis:

The table below shows the results of various variable values recorded in well (OMG612), where changes can be observed in different reservoir levels. High values for water saturation (Sw) are observed primarily in the two drain levels (ZPG and R2), indicating a water zone. However, these percentages remain low in the rest of the upper levels of the well at the drain levels (D2, ID, DI), suggesting an oil reservoir. This is clearly reflected in the density values at these well levels.

Tableau 1 : Petrophysical values recorded by well logging (OMG612)

Zones	Flag Name	Top (m)	Bottom (m)	Gross (m)	Net (m)	Av_Shale Volume (m3/m3)	Av_Porosity (m3/m3)	Av_Water Saturation (m3/m3)
D2	ROCK	3406.000	3431.000	25.000	24.860	0.218	0.071	0.146
	RES	3406.000	3431.000	25.000	23.946	0.210	0.073	0.138
	PAY	3406.000	3431.000	25.000	21.355	0.203	0.076	0.111
ID	ROCK	3431.000	3454.000	23.000	22.866	0.268	0.070	0.250
	RES	3431.000	3454.000	23.000	19.971	0.236	0.074	0.246
	PAY	3431.000	3454.000	23.000	14.484	0.217	0.079	0.186
DI	ROCK	3454.000	3485.000	31.000	30.854	0.261	0.074	0.373
	RES	3454.000	3485.000	31.000	28.263	0.233	0.077	0.371
	PAY	3454.000	3485.000	31.000	14.021	0.225	0.078	0.256
ZPG	ROCK	3485.000	3491.000	6.000	5.917	0.357	0.058	0.875
	RES	3485.000	3491.000	6.000	4.420	0.253	0.067	0.854
	PAY	3485.000	3491.000	6.000	0.305	0.126	0.059	0.348
R2	ROCK	3491.000	3575.000	84.000	83.973	0.295	0.083	0.991
	RES	3491.000	3575.000	84.000	69.648	0.259	0.086	0.990
	PAY	3491.000	3575.000	84.000	0.000			

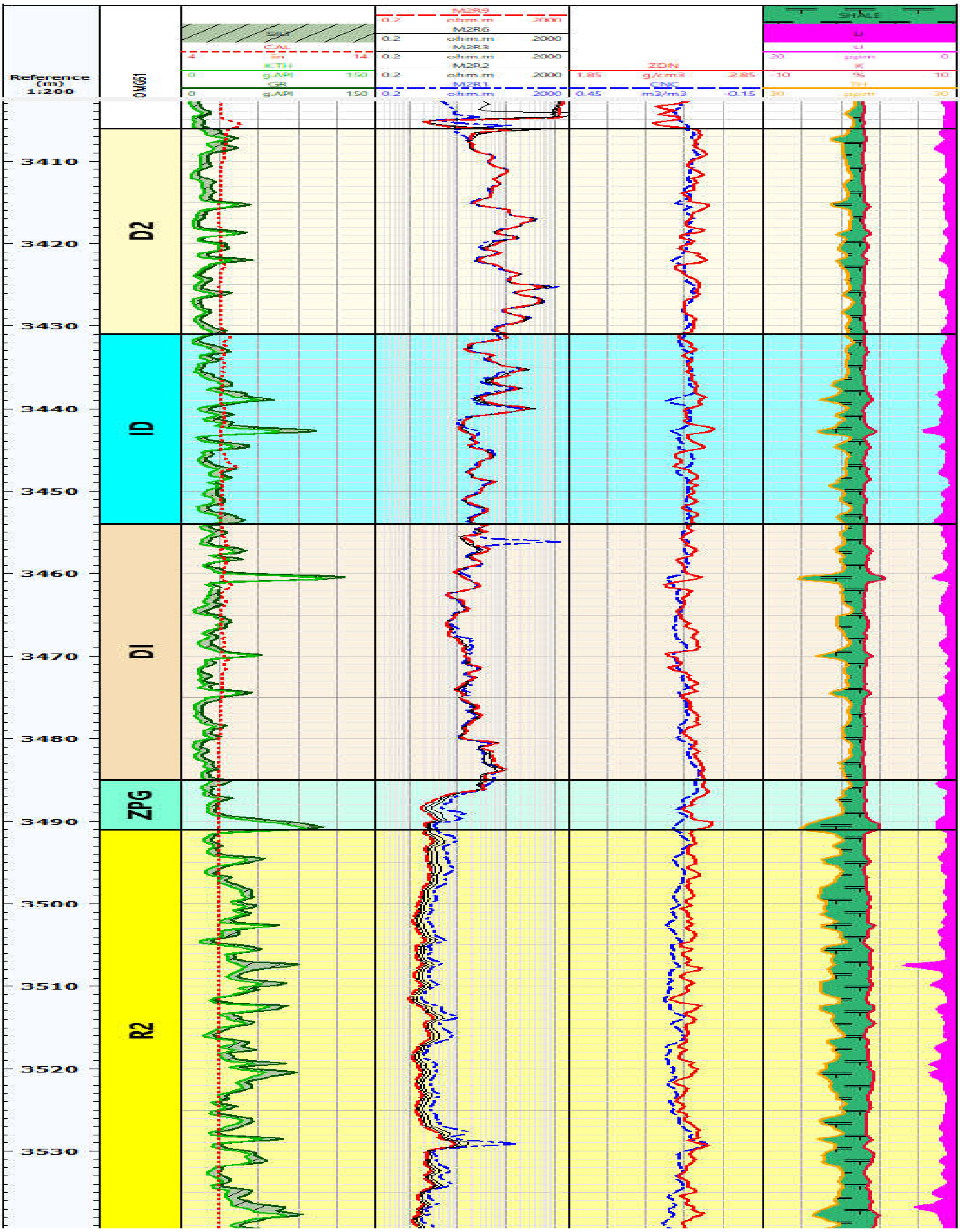


Tableau 2: Raw well logging (OMG 612), HASSI MESSAOUD field (DP SONATRACH)[1-3]

This interpretation is linked to the following petrophysical parameters: Gamma-ray , caliper , sonic ,resistivity , neutron... to get the pressure and oil water contact point .

Results at different well depths (OMG612), a change in rw and sw observed at depth 3478, with a clear percentage.

This is shown by the density value recorded at this well level, as well as by observing changes in other petrophysical parameters.

The results are linked to the pressure of the geological formation. By plotting formation pressure as a function of depth, we can identify the type of fluid and therefore the contacts between the different formation fluids.

The slopes of the lines define the nature of the fluid (gradients), so the determination of contacts is reflected by the change in slope of the pressure lines.

The depth of contact is obtained by projecting the point of intersection of the two lines with different slopes.

Once the logging results have been recorded, we move on to the results of the RCI tool (pressure measurement and sampling).

3.TANK EVALUATION WITH RCI:

From the software 'TECH LOG', we have the results of interpretation:

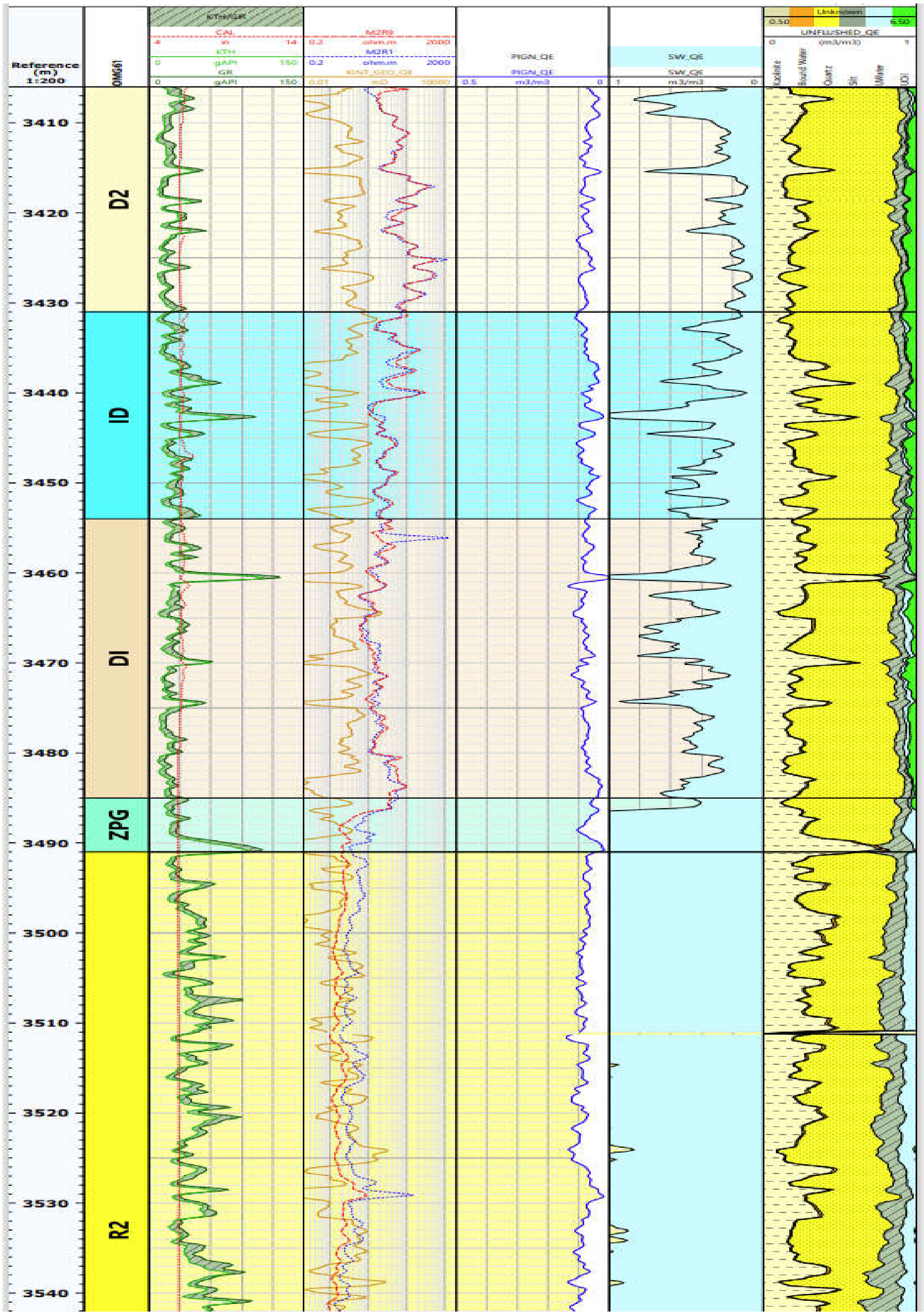


Tableau 3: ELAN Results of graphical well interpretation (OMG612) ,CHAMP HASSI MESSAOUD (.DP SONATRACH)[1-3].

The SW values (saturation oil and saturation water) show that the oil level stops at the beginning of drain ZPG and that the water level starts at this level.

The results of the RCI are presented in the table. The average of the petrophysical characteristics of each drain presented in the table brings out 5 zones (D2, ID, DI, ZPG, R2), the different intervals are represented by straight lines with the same slope for D2, ID, DI indicating the presence of the same fluid. On the other hand, the ZPG interval and R2, the line showing pressure

as a function of depth is characterized by a less pronounced slope than the previous ones,

reflecting a denser fluid, i.e. water. The water level can be positioned at a depth of 3487 m.

3.1 Interpretation of results:

From the measurements recorded by the RCI formation pressure measurement tool, we conclude that the lowest oil level in this well is located at 3487m. so the perforation interval

perforation interval should be between (3470m and 3482m) taking into account the margin

protection margin against rising water where we have to put a cement plug.

the average petrophysical characteristics of each drain shown in the following table

Tableau 4 : Pressure test measurements in the OMG612 well (DP SONATRACH)

Depth (m)	Pression hydrostatique avant (m)	Pression de formation (m)	Pression hydrostatique après (m)	Mobilité (MD)	Remarquees	
3475.5	6759	6572	6761	7	Good test	Echanitllon d'huile
3477.3	6762	6575	6764	3.1	Good test	
3481	6770	6578	6770	6	Good test	
3483	6774	6580	6775	5	Good test	
3493	6791	6594	6792	2.8	Good test	
3496	6796	6599	6798	2	Good test	
3502	6807	****	6809	****	No seal	
3504.5	6812	6614	6813	3	Good test	
3511.6	6824	6626	6826	10	Good test	Echantillon d'eau
3516	6831	6633	6833	3	Good test	

The pressure points were selected on the basis of good mobility in order to plot the gradient and extract the location of the water body.

The density was calculated using the following method:

The density tan 〖α=m/(psi)〗 =m/(kg/(m 2))=m3/kg

So we have chosen two points on the curve:

1/a=1000/100 ×0.703 =density of fluid .

The results are shown in the figure below:

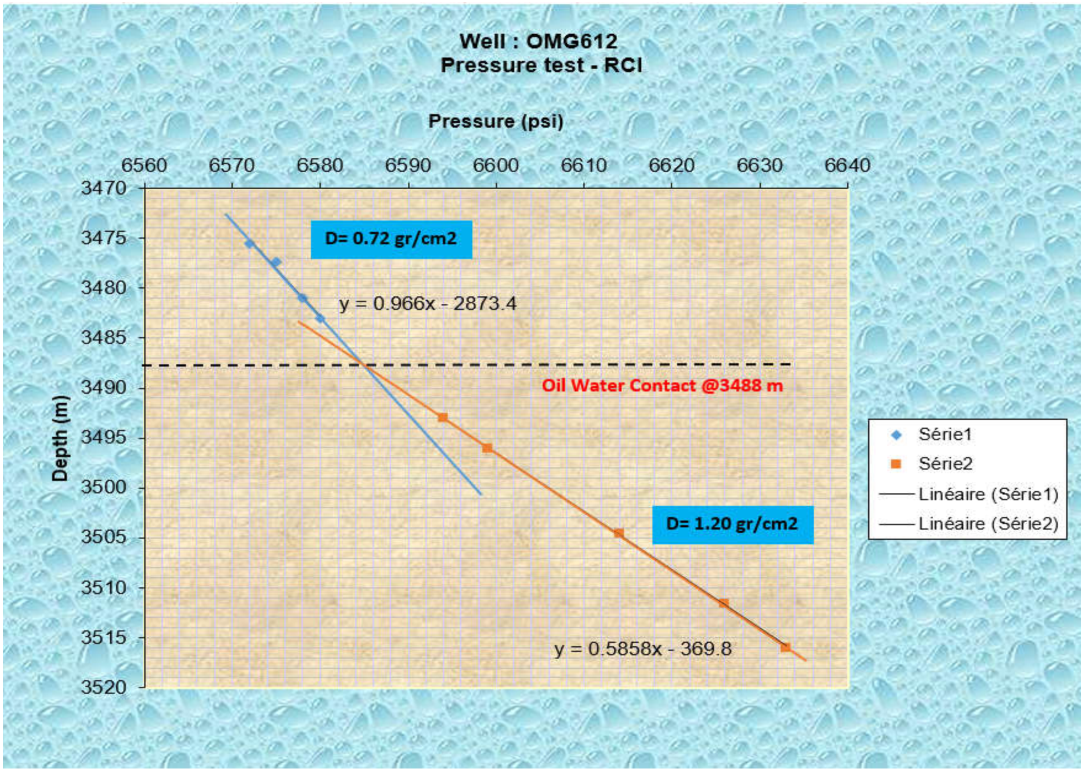


Figure 0-1: Diagram of formation pressures in well reservoir intervals (OMG612) with Oil/Water contact point determination.

After recording the pressures in order to extract the fluid contact point and identify the water reservoir, after plotting the graph and calculating the densities of the fluids, we find that the water-oil contact point is located at the point with the depth 3488m.where the water plan.

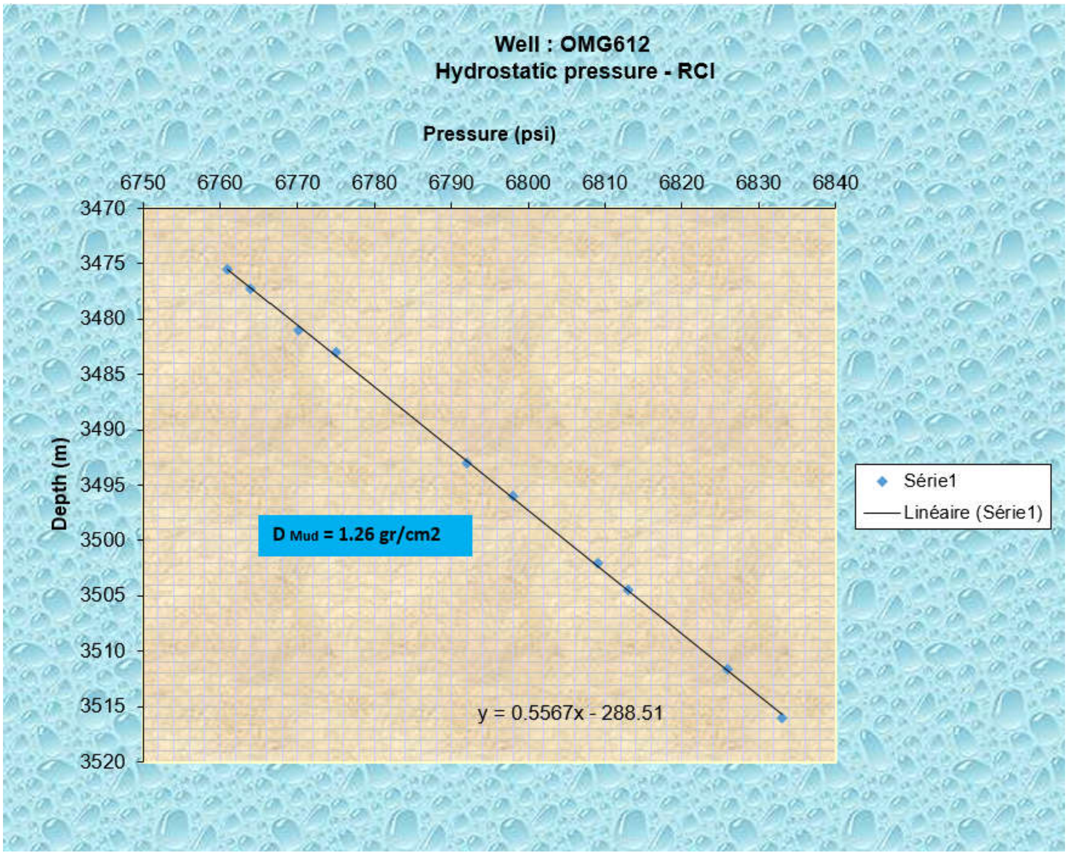


Figure 0-2: water plan

4. Conclusion:

based on the results of logging and RCI data from OMG612 wells,Calculate density values for fluids and extract the oil-water contact . We find that the water basin starts at the point of contact with depth3488m .-liquid contact can be easily resolved.

It's solved. The water level is set to avoid holes and cement plugs are installed.

it is recommended to stop before any water level meters

GENERAL CONCLUSION

General conclusion:

Reservoir formation evaluation is critical for designing the completion method and development plan for a well.

Petrophysical evaluation, using advanced logging tools and powerful software, provides valuable insights into the rock properties. However, these tools cannot directly measure real-time formation pressures.

Formation testing tools, such as the Reservoir Characterization Instrument (RCI), address this limitation by offering several key capabilities:

- Measure formation pressures in real time at multiple depths within the reservoir.
- In real time, determine the nature of fluids (oil, water, gas) and their physical properties like density and viscosity.
- Acquire formation fluid samples and measure their bubble point pressure. This involves capturing a sample and pressurizing it in a chamber to observe its behavior.
- Based on the pressure data, calculate fluid density gradients and identify the types of fluids present, as well as any contact zones between them.
- Record formation pressures from multiple consecutive tests, providing a more comprehensive understanding of the reservoir pressure profile.

In the context of this well, where the production zone is located in the upper section and the lower section is a water zone, the RCI tool can be used to:

- Precisely define the oil-water contact (OWC) - the boundary between the oil and water zones.
- Optimize the placement of the well completion interval within the oil zone.

This revision incorporates the following improvements:

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ABSTRACT:

This stady represents a good evaluation and description of the well (OMG 612) for the tank in HASSI MESSAOUD field. This study is at the level of this field using the stock description tool (RCI) and classic registration methods to determine the composition pressure geological and extraction of petrochemical values (porous, permeability, viscosity) at the level of well with the aim of comparing the results. The consequent results leads to the conclusion that the RCI tool can be a solution to study, assess wells and identify petroffordvaluesand know the connection points between fluid and locate the water tank.

Key words: the RCI tool, classic registration methods, wells, Hassi Messaoud.

الملخص :

تمثل هذه الدراسة تقييماً ووصفاً جيداً للبئر (OMG 612) لمكمن حقل حاسي مسعود. وقد تم إجراء هذه الدراسة في هذا الحقل باستخدام أداة وصف المخزون (RCI) وطرق التسجيل التقليدية لتحديد تركيبة الضغط الجيولوجي واستخراج القيم البتروكيميائية (المسامية والنفاذية واللزوجة) على مستوى البئر من أجل مقارنة النتائج.

تؤدي النتائج المتناسقة إلى استنتاج أن أداة RCI يمكن أن تكون حلاً لدراسة وتقييم الآبار وتحديد القيم البترولية وتحديد نقاط الاتصال بين السوائل وتحديد موقع خزان المياه.

الكلمات المفتاحية : أداة RCI، طرق التسجيل التقليدية، الآبار، حاسي مسعود.

RESUME :

Cette étude représente une bonne évaluation et description du puits (OMG 612) pour le réservoir du champ HASSI MESSAOUD. Cette étude se situe au niveau de ce champ en utilisant l'outil de description de stock (RCI) et les méthodes d'enregistrement classiques pour déterminer la composition de la pression géologique et l'extraction des valeurs pétrochimiques (porosité, perméabilité, viscosité) au niveau du puits dans le but de comparer les résultats.

Les résultats conséquents permettent de conclure que l'outil RCI peut être une solution pour étudier, évaluer les puits et identifier les valeurs pétroffordes et connaître les points de connexion entre les fluides et localiser le réservoir d'eau.

Mots clés : outil RCI, méthodes d'enregistrement classiques, puits, Hassi Messaoud.