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THÈME

GEOLOGICAL STUDY OF THE EXTENSION OF THE BENKAHLA AREA: THE GEOLOGICAL MODEL OF THE DEPOSIT

Defended publicly on : 10/06/2026. Before the examination committee:

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table of content

liste of figures:

list of tables:

ABSTRACT

Benkahla's reservoir is located in the depression of the Wade Myawhich is the center of the Triassic province, situated south-eastern Berkaoui's reservoir. The sedimentary structure consists of deepunderground clay Silurian.The trap is structural joint. The rock cover is provided at the regional level by the thick evaporate sequence of Triassic salifère S4 and S3 to S1 Lias levels. Clays intercalated between the Triassic reservoirs maylocally constitute blankets.The region of Benkahala is a large reservoir of Ouargla region, having been the subject of exploitation for years; recent studies show the presence of several reservoirs to the south of Benkahala's field.

Several prospecting was done with the objective of assessing the reserves The purpose of this research is to provide a three-dimensional image of the underlying geological formations, in this case the reservoir rock. Reservoirs geological model is constructed using Petrel software by integrating all available data; or data obtained by direct petrophysical methods or interpretation of the logging logs (clay volume, porosity, saturation, reservoir thickness ……).

It includes the following elements:

- The implementation of geological maps and petro-physical evaluation for TAGI reservoir.
- To build a structural model of the study area.
- Build the geological model of the area.
- Calculate amount of in place oil.

The superposition of available data shows that point for the development of the field.

KEYWORDS: BENKAHLA, Triassic, Several, model, reservoir.

Résumé

Le gisement de Benkahla se trouve dans la dépression de l'Oued M'ya au centre de la province Triasique, et au Sud-est du gisement de Berkaoui. La structure de gisement est constituée par une roche mère profonde argileuse d'âge silurien, le piège est structural mixte. La roche couverture est assurée {l'échelle régionale par l'épaisse série évaporitique du salifère S4 du Trias et les niveaux S3 à S1 du Lias. Les argiles intercalées entre les réservoirs triasiques peuvent constituer des couvertures { l'échelle locale. La région de Benkahala est un grand gisement de la région de Ouargla, ayant fait l'objet d'une exploitation depuis des années, les études récentes montrent la présence des plusieurs réservoirs vers l'Sud du gisement de Benkahala.

Plusieurs campagne de prospection ont été fait dont l'objectif de l'évaluation des ces réserves L'objectif de ce travail de recherche est de proposer une image de trois dimensions des formations géologiques sous-jacentes, en l'occurrence la roche réservoir, le modèle géologique de gisement est construit en utilisant le logiciel Pétrel par l'intégration de toutes les données disponibles; soit des données obtenus par les méthodes pétro-physiques directes ou l'interprétation diagraphique des logs(volume d'argile, porosité, saturation, épaisseur de réservoir...). Il comporte les éléments suivants :

- La réalisation des cartes géologiques et pétro-physiques pour l'évaluation du réservoir TAGI.
- Construire un modèle structural de la zone d'étude.
- Construire le modèle géologique de la zone.
- Calcul quantité des huiles en place
- La superposition des données disponibles montre que le point de développement du champ.

Mots clés:BENKAHLA, Trias, évaluation, modèle,gisement.

الملخص

يقع المكمن بن كحلة في منخفض واد مياء بحوض بركاوي الترياسي, حيث يتميز نظام المكمن التالي:

. صخرة الام المكمن بواد مياء الطينية تعود لحقبة الزمنية السيلوري -

.صخرة المكمن الحجر الرملي تعود لحقبة الزمنية الترياسي و التي تحتوي على نسبة من الطين -

صخرة غطاء للمكمن الملح التبخر تعود لحقبة الزمنية لياس 1, 3 و 4 -

.بحيث يتميز بفخ متنوع -

تحتوي منطقة بن كحلة على أكبر خزان بولاية ورقلة فهي موضع استغلال لسنوات، وتشير الدراسات الحديثة وجود العديد من الخزانات بجنوب بن كحلة . وقد تم العديد من شركات التنقيب بتقييم الاحتياطيات والغرض منه هو تقديم صورة ثلاثية الأبعاد لتكوينات الجيولوجية الأساسية لصخور الخزان ، و على أساسها تم بناء نموذج جيولوجي باستخدام برنامج بترل من خلال دمج كل البيانات المتاحة و البيانات التي تم الحصول عليها بطرق ...... مباشرة. بتروفيزيائية أو من خلال البيانات دياقرافي (حجم) طين المسامية التشبع و سمك خزان

حيث تتبعنا الخطوات الآتية:

من خلال تفسير البيانات ديا قرافي تم الحصول على الخرائط الجيولوجية و التقييم بتروفيزيائية

بناء النموذج البنيوي لمنطقة الدراسة

بناء النموذج الجيولوجي للمنطقة

حساب كمية النفط في المكامن

.تراكب البيانات المتوفرة لتبين نقاط تطوير الحقل

الكلمات المفتاحية بن كحلة ترياس، التقييم النموذج و المكمن

LISTE DES ABREVIATONS

Vsh : Clay volume.

Rw: Electrical resistivity of formation water.

TAG SI: Lower Series Sandy Clay Triassic.

ρf: Density of mud filtrate.

ρsh: Density of clay.

ρma: Density of the matrix.

NPHI: Neutron Porosity.

ΦNsh: Neutron Porosity of Clay.

Δtma: Sonic Porosity of the Matrix.

Δtf: Sonic Porosity of the Filtrate.

Δtsh: Sonic Porosity of Clay.

Hu: effective thickness.

GR: Gamma Ray.

CNL: compensated neutron log.

BHC: Borehole Compensated.

Δt: sonic porosity.

FDC: Formation Density Compensated.

Rt: Reservoir resistivity.

F: Formation factor.

SIS: Schlumberger Information Solutions.

Q: Core porosity.

K: Core permeability

TAG: Triassic Clayey Sandstone

GENERAL INTRODUCTION

General Introduction

The Benkahla deposit is located in the Oued M’ya depression in the center of the Triassic province, and to the southeast of the Berkaoui deposit. Since 1956, SFPA has begun exploration in this region. Today, this area is among the most explored regions of the Algerian Sahara, where there are 40 producing wells in the TAG reservoir, 6 injection wells, and 7 dry wells. Nevertheless, real problems are frequent in this region from a production standpoint.

The Benkahla region is a large deposit in the Ouargla region, which has been exploited for years. Recent studies show the presence of several reservoirs to the south of the Benkahla deposit. Several prospecting campaigns have been carried out with the aim of evaluating these reserves. The objective of this work is the development of a geological model of the extension of the BENKAHLA deposit. This thesis focuses on the characterization and modeling of the TAGI reservoir, and it is divided into four (03) chapters:
The first chapter aims to provide a description of the M’yaet Wadi basin in the study area of the BENKAHLA deposit; The second chapter deals with the description of the work methodology;
The third chapter is inherent to the development of the work, using the available data, including end-of-well reports, well logs, petrophysical analyzes of the reservoir, etc.
The evaluation of petrophysical parameters; porosity, water saturation, and other parameters such as clay volume and sandstone thickness with the help of the software (IP) and the modeling results with the help of the Petrel software from the BENKAHLA field. Finally, this research work will be completed with a general conclusion.

Chapter I: geology setting

Introduction

The Saharan platform, of which our study region is a part, is located to the south of the Alpine Algeria and belongs to the North African Craton. It includes a Precambrian basement on which a powerful sedimentary cover rests unconformably, structured in the Paleozoic into several basins separated by high zones. In this context, from west to east, we distinguish:

• the Tindouf and Reggane basins located on the northern and northeastern edges of the Reguibat shield. The sedimentary cover would reach 8000m in the Tindouf basin and 6500m in the Reggane basin. In this poorly explored area, the Paleozoic formations could be revealed to contain liquid and gaseous hydrocarbons;

• the Béchar basin limited to the north by the High Atlas, to the south and west by the Ougarta chain. Its sedimentary cover would reach 8000 m. The reservoirs are found in the lower Paleozoic detrital and Carboniferous reefs;

• the Ahnet-Timimoun basin is limited to the north by the Oued Namous high ground, to the west by the Ougarta chain, to the south by the Tuareg shield, and to the east by the Idjerane-M'zab ridge. The cover would average 4000 m. In the south, the Ordovician and lower Devonian reservoirs are gasified. To the north, in the Sbâa basin, oil has been discovered throughout the entire Paleozoic;

• the Mouydir and Aguemour-Oued M'ya basins are bounded to the west by the Idjerane-M'zab ridge and to the east by the Amguid-El Biod ridge. To the south, Paleozoic sediments outcrop in the Mouydir. To the North, in the Aguemour-Oued M'ya depression, filled with a powerful Paleozoic and Meso-Cenozoic series (5000m at Oued M'ya). Significant deposits have been identified in the Cambrian (Hassi Messaoud) and the Triassic (Hassi R'Mel);

• the Illizi-Ghadames syncline is bounded to the West by the Amguid-El Biod ridge and to the East by the Tihemboka dome and the Tunisian-Libyan borders. In the Ghadames basin, the sedimentary cover (over 6000 m) contains hydrocarbon deposits from the Paleozoic and Triassic periods

(SONATRACH/EXPLORATION, 1995).

I.1. Regional framework of the Oued M’ya basin

I.1.1. Geographical situation of the Oued M’ya

The Oued M’ya is a basin of the Saharan platform, corresponding to the western part of the Triassic province, covering an area of 400,000 km². The geographical boundaries serve as the best landmarks (Figure 01).

The parallels 31˚15’ and 33˚00’ respectively limit the area to the south and north, and the meridians 6˚15’ and 3˚30’ limit it to the east and west, encompassing the blocks: 438-425422-437-436-3178-420-419-418-417 and 416, belonging to district IV of Sonatrach.

The basin is bounded by the Djemaa-Touggourt structural high to the north, the Mouydir basin to the south, the Amguid-Messaoud structural high to the east, and the Allal vault to the west (Figure 01).

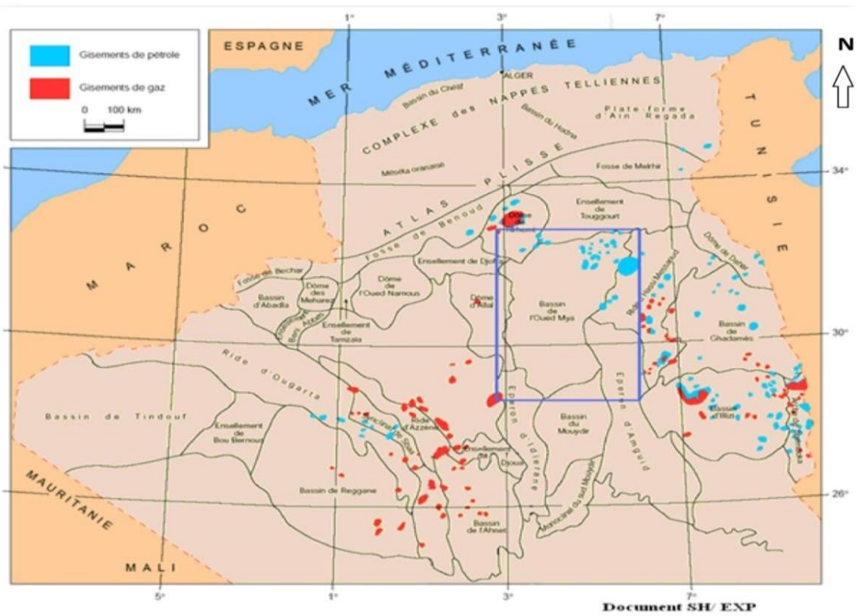


Figure 1:Geographic location of Oued Mya (SONATRACH/ EXPLOITATION, 1995).

I.1.2. Geological setting of the Oued Mya Basin

The region of Oued M’ya is merely an intracratonic sub-basin. Its northern border gradually sinks toward the Saharan flexure where the existence of a highly subsiding trough in the Mesozoic will give rise to the pericratonic chain of the Saharan Atlas (Figure 02).

The evolution of the Oued Mya region since the Cambrian involves two major stages:

1-The sedimentation of the Paleozoic, practically restricted to the Lower Paleozoic and its pre-Hercynian structuring;

2-The creation of a basin in the Triassic and its evolution during the Mesozoic and Tertiary periods.

These two main stages of regional history lead to the consideration of two sedimentary megacycles, Paleozoic and Mesozoic, classically separated by the Hercynian discordance, with the permanence of the high zones structuring the region throughout the Paleozoic.

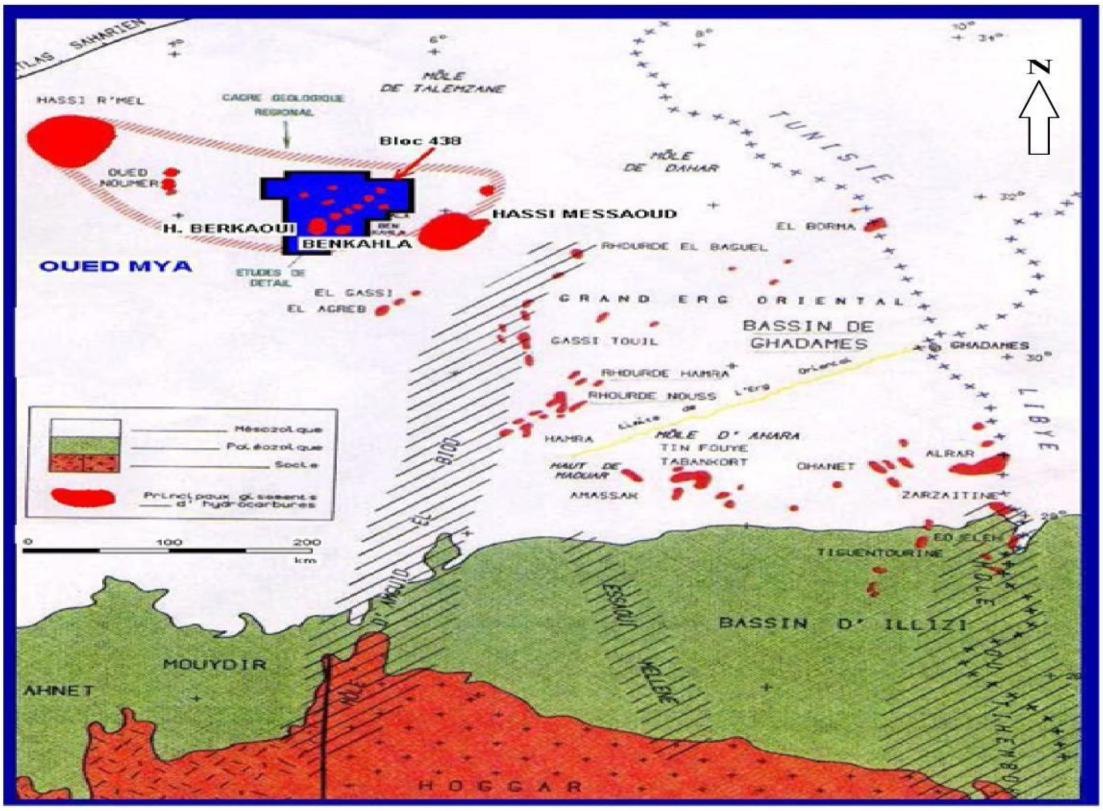


Figure 2:Geological situation of the Oued Mya basin. (SONATRAH/ PRODUCTION)

I.1.2.1. Stratigraphy

In the northern part of the platform (Oued M'ya), the typical sedimentary series, whose thickness can reach 6,000 meters (figure 03), presents Paleozoic deposits often eroded up to the Ordovician and Cambrian.

The Mesozoic, discordant on the Paleozoic, is present from the Triassic to the Cretaceous.

The Cenozoic is represented by a thin detrital series from the Miocene. (SONATRACH and SCHLUMBERGER, 2007).

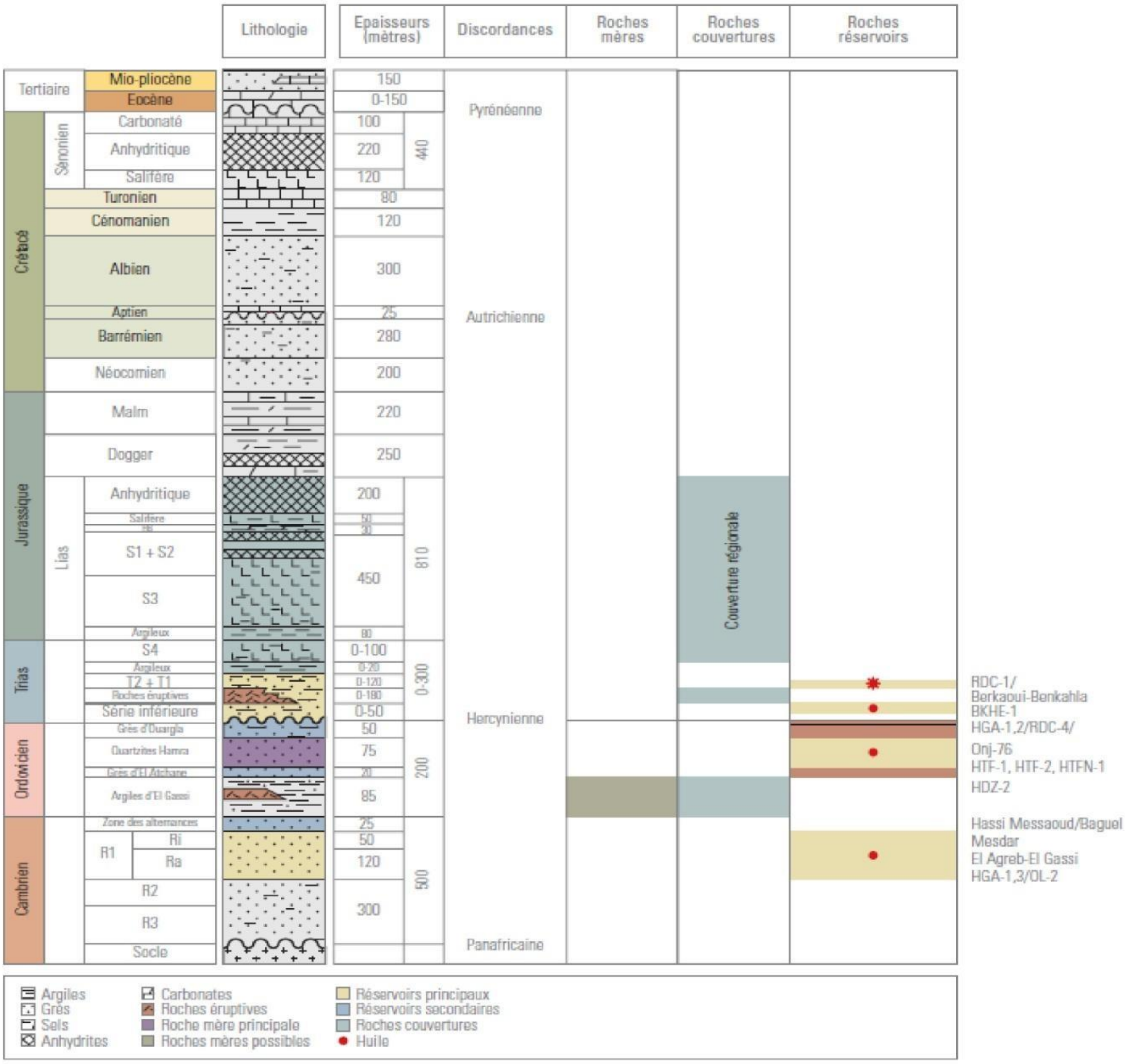


Figure 3:Typical lithostratigraphic section of the Oued Mya basins. (SONATRACH and SCHLUMBERGER, 2007).

I.1.2.2. Tectonics

I.1.2.2.A. The major stages of the structural evolution of the Saharan platform during the Paleozoic

Given the reduction in thickness, and sometimes even the complete disappearance of sedimentary units due to local discordances or lack of sedimentation, it is necessary to recall the main phases of the structural evolution of the Saharan platform during the Paleozoic. (Table 01)

I.1.2.2.A.1. The Pan-African Orogeny and the Origin of the Fracture Network of the North African Craton

Materialized by vertical movements accompanied by volcanic eruptions and uplift, leading to the erosion of the sedimentary cover. The result of this orogeny is the network of fracturing.

I.1.2.2.A.2. Distension of the Cambrian-Ordovician and establishment of the cover

Resulting in the formation of a pediplain, called Infra-Tassilian.

I.1.2.2.A.3. The compression phase Taconic (Caradoc)

After the period of extension followed by the generalized transgression of the Arenigian Lianvirian, we observe in the Caradoc a compressive movement, accompanied by regional uplifts leading to erosion. At the same time, there was a climate change that led to the establishment of an ice cap, centered in the central Sahara during the Caradoc-Asligillian age.

I.1.2.2.A.4. The melting of the ice sheet and eustatic rebounds

The melting of the ice sheet during the Late Ordovician led to a rise in sea level.

I.1.2.2.A.5. The Caledonian compression phase

It took place at the end of the Silurian with an east-west orientation.

I.1.2.2.A.6- The phase of extension of the Lower Devonian

After the distensive movements, a marine transgression is observed in the Emsian.

I.1.2.2.A.7. Tectonic movements of the Upper Middle Devonian

Materialized by the Frasnian discordance, oriented north-south.

I.1.2.2.A.8. Post-Famennian Movement.

I.1.2.2.A.9. Hercynian Movements

According to the study (A. BOUDJEMAA 1987), two Hercynian movements are highlighted:

- Early Hercynian movements

In the Tournaisian-Visean with a N40° compression direction.

- Major Hercynian movements

Having caused the complete cessation of Carboniferous sedimentation. The axis of the folds and the measurements of the striations indicate a tightening of N120°.

Table 1:The tectonic phases affecting the Saharan platform. (A. Boujemaa, 1987).

PERIODE MAX D'ACTIVITE	DIRECTION OF THE FORCE	EFFECT ON THE FAULT SYSTEM	EFFECT ON SEDIMENTATION
PAN-AFRICAN	E-W	Shear tectonics creating faults and fractures oriented NW-SE and NE-SW	Subdivision of the Central Sahara Craton.
CAMBROORDOVICINNE	NW-SE	Normal movement	Variations in thickness are controlled

		along the N-S faults.	by faults. NW tilting of the Saharan platform. Volcanism.
TACONIQUE(Caradoc-Ashgilian)	**E-W**	Reverse movement along the resulting N-S faults.Formation of N-S structures	The Reguibat and Tuareg Uprisings.
CALEDONIAN(Silurian–Devonian)	**E-W**	Mou Reverse or detaching movement along the N-S faults	Erosion along the upper reaches of the N-S and E-W-trending areas (Tihemboka, Ahara
FRASNIEN	**NW-SE**	Normal movement along the NE-SW faults.	Lack of sedimentation and local erosion (Ahara mole). Volcanism.
VISEEN (Early Hercynian)	***N40°***	Reverse or detachment movement along the N-S faults.Beginning of the formation of the Variscan mountain range.	Erosion of Tihemboka and uplift of Ougarta.
UPPER CARBONIFEROUS TO	**N120°**	Reverse or detaching movement along	Erosion sur les axes NE-SW.

PERMIAN (Main Hercynian)		the NE-SW faults (resulting from the formation of Pangaea).	
TRIAS-LIAS RIFTING (breakup of Pangaea)	**NW-SE**	Response of the NE-SW-trending faults terminating at TAGS and S4	Control of sedimentation by faults resulting in rapid variations in thickness along NE-SW-trending faults
LOWER CRETACEOUS (Austrian)	**E-W**	Response of the N-S and NE-SW faults resulting from the differential motion of the European and African plates	Erosion of Cretaceous sediments beneath the Aptian (the Al Biod&Illizi arch), with a slight impact on the Berkine Basin
EOCENE(Pyrenean)	**N-S&NW-SE**	The beginning of northward overlap resulting from the convergence of the African Plate with the European Plate Disengagement of the South Atlas Fault.	
MIOCENE	**NW-SE&N-S**	A major compression event in the	Predominantly flysch deposits in the north.

		Atlantic region.	
POSTVILLAFRANCHIEN	**N-S**	Block tilting and reversal. Final period of compression in the Atlantic domain. Major collision event.	Uplift of the Hoggar. Tipping of the El Borma block

The current architecture denotes the result of a long evolution, as the culmination of slow deformations that have continued in a more or less continuous manner throughout the history of the basin.

The main phases of deformation that influenced the sedimentation and structuring of the basin (Boeuf, 1971; Boudjemaa, 1987) are the Hercynian phase and the Austrian phase.

The Hercynian movements correspond to a compression in the N° 120 direction, with the most significant deformation occurring along the NE-SW faults.

One of the most important features of this formation concerns the fate of the main source rocks (Silurian). They are preserved in the depressions of Berkine and Oued M'ya, and will supply hydrocarbons to the structural and stratigraphic traps that will form later. (Boudjemaa, 1987).

During the Austrian movements (terminal Aptian), we witness a compressive phase from east to west, which reverses the north-south submeridian accidents of the Oued M'ya.

This compression would be responsible for the individualization of structural traps.

I.1.2.2.B. Structural evolution of the Oued Mya basin

The main structural elements are oriented N-S and NE-SW (figure 04). (SH and Sch, 2007).

In the Cambrian: There was significant erosion that leveled the previous structures and reliefs (Boeuf et al, 1971).

The Oued M'ya center perimeter was located on the flank of a major depression that corresponds to the current location of the high zone of Hassi Messaoud (Benamrane, 1993).

The Ordovician begins with a marine transgression of the Arenigian-Llanvirnian, followed by regional uplifts (Eglab). These uplifts lead to erosion, sometimes reaching the basement (Boeuf, 1971). Toward the end of this period, a glaciation set in, with an ice cap at the level of the current Hoggar.

Following the Caledonian phase, the Oued M'ya area began to rise while remaining submerged.

In the Silurian, the final melting of this ice cap caused the sea level to rise, and a generalized transgression reached the southern Sahara where black shales with graphtolites were deposited (Boudjemaa, 1987).

At that time, the Oued M'ya center area was completely covered by this sea (Benamrane et al, 1993).

In the Devonian, following the tectonic uplift (Caledonian phase), a regression of the sea during the Geddinian was followed by a transgression.

The beginning of the Hercynian orogeny and the gradual uplift of the Hassi Messaoud area involved the movement of deposits from the center of the basin to the west, where Devonian deposits are developed.

Toward the end of the Carboniferous, the collision between Gondwana and Laurasia accentuated the uplift of the Tilghermt dome region and the structuring of Djemaa Touggourt.

The region of Oued M'ya appeared as a submerged high plateau, which prevented the deposition of the Carboniferous (Benamrane, et al, 1991). The formation of Pangaea occurred toward the end of the Hercynian orogeny, and the intense erosion of the reliefs reached the basement in some places.

At Oued M'ya, the Devonian is the youngest Paleozoic formation. In the Permo-Triassic, the region remained continental until the end of the Triassic, which

meant that the Permian sea did not reach the region.
The Oued M’ya area is characterized in the Triassic by a fluvial system established in favor of the Hercynian paleovalleys, oriented NE-SW, with sources of supply consisting of the highlands of the time, which are Hassi R'mel, Hassi Messaoud, and the Allal arch.
At the end of the Triassic, evaporitic deposits were followed by carbonates on this submerged land, then by a marine transgression in the Late Jurassic.
In the Cretaceous, a manifestation of the Alpine orogeny, as well as a marine transgression, settled over a large area followed by a regression in the Albian.
Following the widespread transgressions of the Cenomanian and Turonian, the Alpine orogenic movements shaped the current structure.
The Oued M’ya area is currently characterized by a rather complex structure inherited from the Paleozoic, materialized by structural trends with **NE-SW** orientations. (Figure 05)

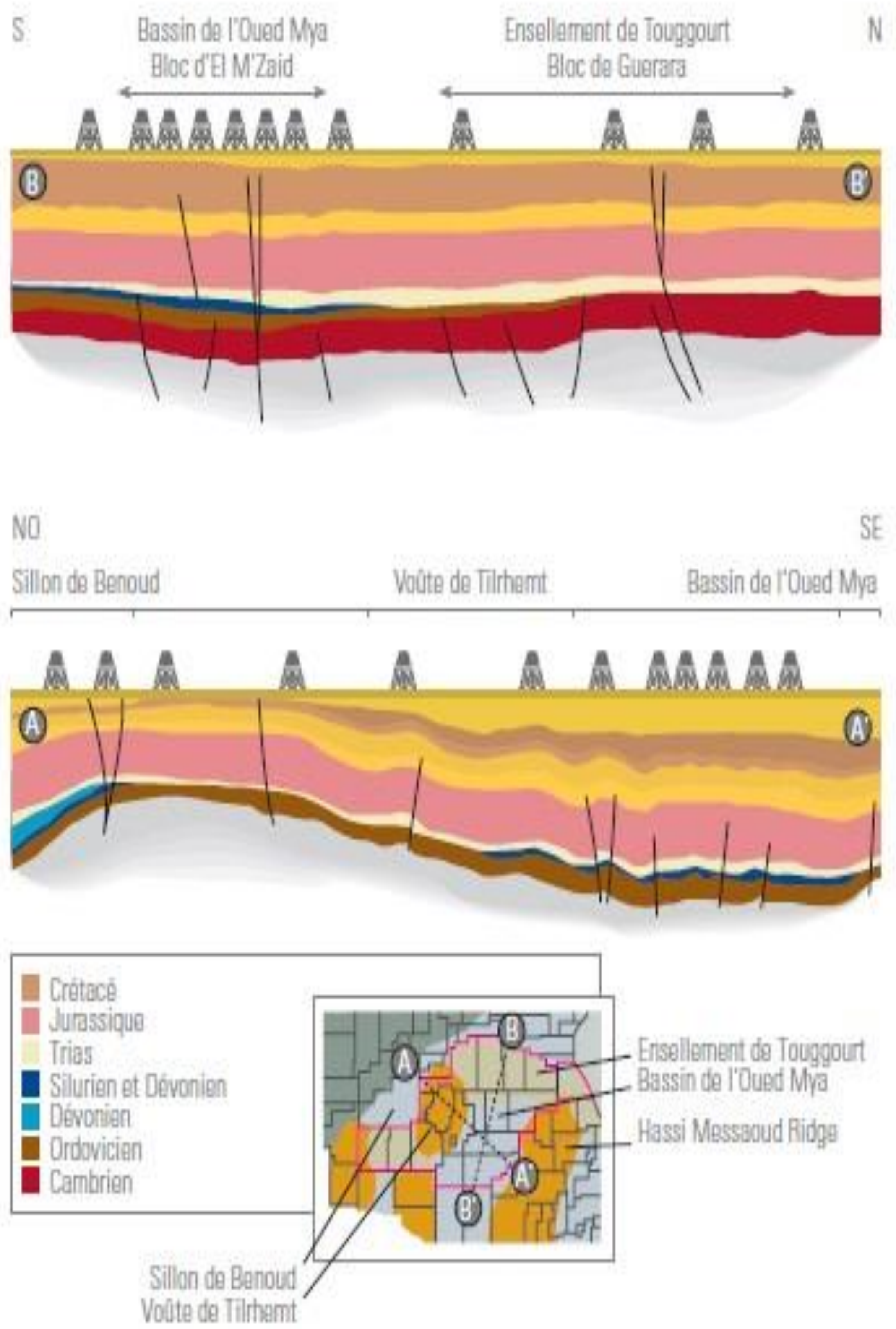


Figure 4:The N-S and NW-SE geological cross-section in the Oued Mya basin.(SONATRACH and SCHLUMBERGER, 2007).

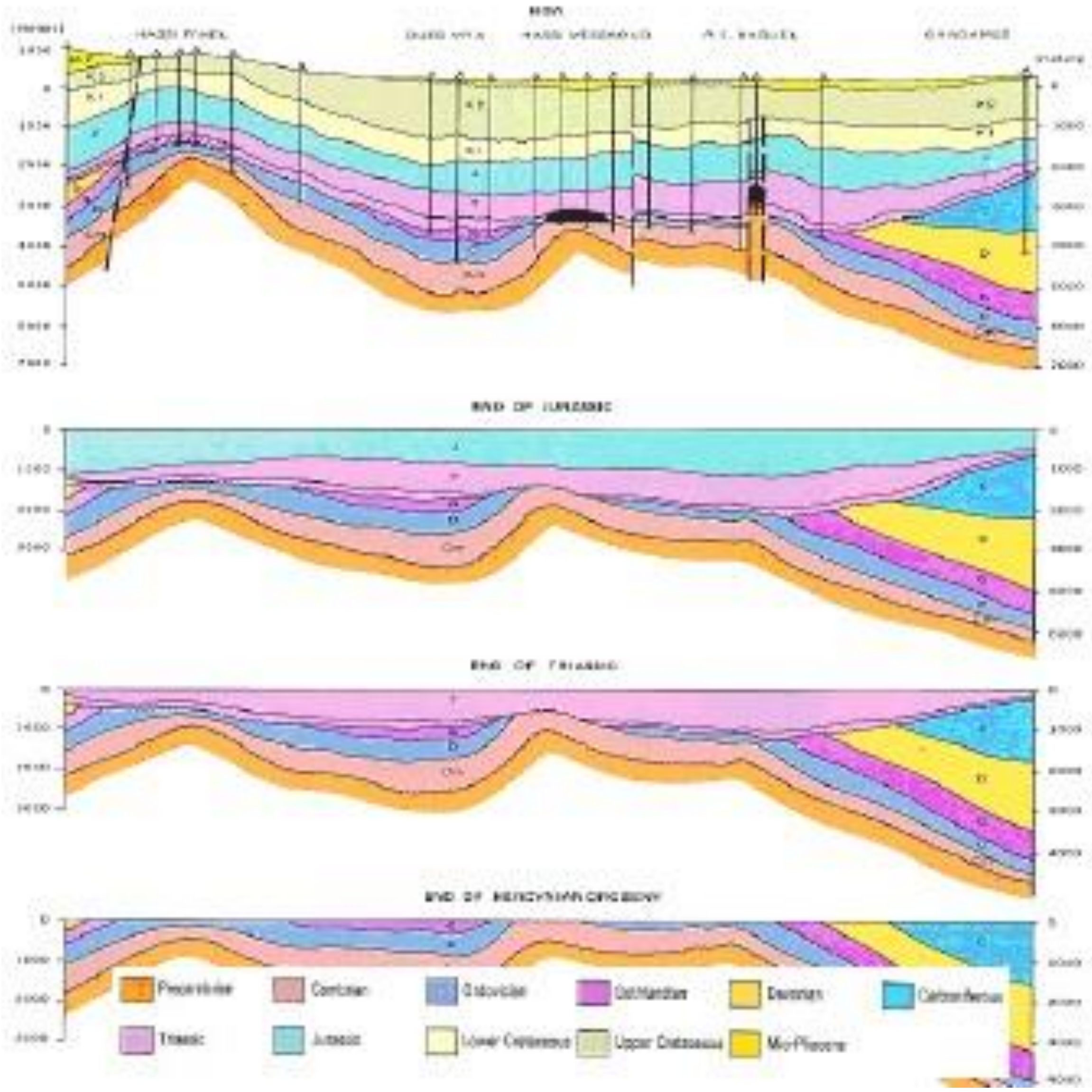


Figure 5:the different tectonic phases over geological time (according to Boujemaà, 1987).

I.1.2.3. The Petroleum Interest of the Oued Mya Basin

The major petroleum interest of the basin is related to the presence of Triassic reservoirs. However, the understanding of the petroleum results obtained to date and the guidelines for exploitation must be sought in the Paleozoic evolution of this basin.

The Oued M'ya depression is indeed characterized by the presence of a residual Paleozoic series, containing radioactive Silurian clays, very rich in organic matter and well-developed, constituting the main source rock, unfortunately eroded over vast areas of the region. This series is covered by a powerful Mesozoic series, which at its base includes the main reservoirs of the basin and their salt cover (Triassic-Liassic).

I.1.2.3.A. Source rocks

The Silurian is the main source rock level in the Oued M'ya basins, thanks to a basal level of blackish-gray radioactive clays very rich in organic matter. (SONATRACH and SCHLUMBERGER, 2007).

I.1.2.3.B. Reservoirs of the M'ya Wadi(SONATRACH and SCHLUMBERGER, 2007)

I.1.2.3.B.1.Main reservoirs

In the basin, they are composed of Triassic fluvial sandstones which include:

- the lower series unit (center of the basin and south of HassiR'mel);
- the T1 unit (north of the central part of the basin and the HassiR'mel region);
- the T2 unit (HassiR'mel region).

The quartzitic sandstones of the Hamara quartzite unit (Ordovician) are considered the main target since the recent discovery of oil in the Berkaoui structure (BKP well).

I.1.2.3.B.2. The secondary reservoirs are

- The sandstones of the Lower Devonian, the quartzitic sandstones of the Ordovician (M'kratta slab, sandstones of Oued Saret, sandstones of Ouargla, sandstones of El Atchane) and the sandstones of the Cambrian;
- The sandstones and carbonates of the Moscovian in the NW of the basin and the carbonates of the Jurassic in the NE.

I.1.2.3.C. Regional cover of Triassic reservoirs

It is composed of Triassic evaporites (S4 salt) and Lias (S3 to S1 levels). For the Paleozoic reservoirs, the cover is provided by the intercalated clay series.

I.1.2.3.D.Trapping in the basin

It is of structural, mixed, or purely stratigraphic type. The supply of reservoirs is done vertically with the help of faults and/or laterally along the drains, constituted by the reservoir levels. (SONATRACH and SCHLUMBERGER, 2007).

I.1.3. Petroleum System (SONATRACH and SCHLUMBERGER, 2007)

Triassic Reservoir

In the Oued M'ya basin, the clayey-sandy Triassic corresponds to an azoic detrital assemblage, covered by the evaporitic deposits of the salt-bearing Triassic S4, resting unconformably on formations of varying ages from the Cambrian to the Lower Devonian. The Triassic is delimited at the base by the Hercynian unconformity and at the top by the base of the dolomitic marker D2 of Hettangian age and regional extent. Palynological dating allows for the evaluation of the age of Triassic deposits from the Lower Carnian to the Rhaetian.
In the Oued M'ya basin, the Triassic is subdivided into six lithological units which are, from bottom to top: the lower series, the eruptive rocks, the T1 level (Reservoir C and B), the T2 level (Reservoir A), the lower clay, and the saline S4. The topography of the Hercynian discordance surface and the extensional tectonic regime during the Triassic rift activity are the major factors controlling the distribution of Triassic sediments. These were deposited in a semi-arid to arid climate over a large area, in the form of alluvial valley fill deposits. The lower series levels, T1 "B & C" and T2 "A," constitute the main reservoirs in the basin (Table 02, SONATRACH and SCHLUMBERGER, 2007).

Source rock

The main source rock for the Triassic reservoirs of the Oued M'ya basin is composed of radioactive Silurian clays. The Ordovician clays (El

Gassi clays and Azzel clays) constitute secondary source rocks. The supply of hydrocarbon reservoirs is achieved thru vertical migration along faults and/or lateral migration along permeable drains.

Reservoirs

Lower series

It represents the base term of the Triassic and constitutes the main reservoir in the central part of the depression (block 438). It is represented by an alternation of brown to green silty clay and white, reddish-brown to greenish-brown, fine to coarse sandstones and conglomerates. In the areas closest to the source of supply, the detrital material is coarser and contains abundant conglomerates (areas of Benkahla, Haoud Berkaoui, Gar and Echouf, Guellala), with thin intercalated clay beds. They were deposited in a braided river environment, originating from the Hassi Messaoud and Tilrhemt-Hassi R'mel areas, evolving northward toward meandering-type deposits, with a marine influence becoming apparent thru increasingly carbonated levels. The total thickness of the lower series averages between 50 to 70 meters (ranging from 0 meters to over 90 meters).

The quality of the reservoir in this unit is largely controlled by the sedimentary facies and their textural characteristics. The grain size and the rates of cement and binders are the main factors controlling permeability. The sandstones of the lower series have undergone the effects of intense diagenetic activity in the northern part of the basin.

Pressure-dissolution and the formation of feeding quartz are common there. Anhydrite, carbonate, and halite cements are also present.

The average porosities of the lower series range from 9 to 12%, and the permeabilities can exceed values of 100 mD.

Levels T1 and T2

These levels are represented by fine to coarse reddish-brown sandstones and slightly dolomitic reddish-brown silty clays. Their sedimentation, just like that

of the lower series, is characterized by an increase in subsidence and thicknesses toward the NE. It is controlled by the new relief created by the deposition of eruptive deposits and the tectonic reactivations related to Triassic rift activity.
The T1 and T2 units were deposited in a continental fluvial environment, gradually transitioning toward the NE to a fluvio-deltaic sedimentation. The diagraphic correlations show a superposition of several sequences corresponding to channel or point bar deposits. The sandstones are gray and red, micaceous, coarse at the base or with clay pebbles.
The sequences are separated by clay banks, brown-red or gray-green, of floodplain, with the presence of paleosols. The total thickness of the T1-T2 units is on average around 100 m and increases toward the north, where it can exceed 200 m.
The average porosities of reservoirs T1 and T2 are between 15% and 20%, and the average permeabilities are above 200 mD.

Table 2:Source rock, cap rock, and trap types in the Triassic.(SONATRACH and SCHLUMBERGER, 2007)

Bedrock	Radioactive Silurian clays (primary); El Gassi clays and Azzel clays (secondary)
Roche Roofing	Provided regionally by the thick evaporitic sequence of the Triassic Salifère S4 and the Lias S3 to S1 levels. The clays intercalated between the Triassic reservoirs may act as local caps. When igneous rocks are sufficiently thick and unfractured, they provide a good local cap for the lower reservoir.
Trap	Structural (low-amplitude structures), mixed (as in the Benkahla structure), or purely stratigraphic (bevel and bar point in the reservoirs of the Lower Series and T1)

I.1.4. The evaluation of block 438

It corresponds to the western part of the Algerian Triassic basin and represents the most explored area of this basin. This area is located between the two deposits of Hassi R'mel in the Northwest and Hassi Messaoud in the Southeast (Figure 06).

This block extends over approximately 400 km in longitude and 300 km in latitude, covering an area of around 120,000 km². The Paleozoic and Triassic targets are located at a significant depth ranging between 3400 m and 4000 m. Within the Triassic, the primary target is the lower series, while the T1 reservoir is a secondary target over a large part of the block.

The Lower Devonian is only present along the axis of the Oued M'ya trough, and the Ordovician targets are practically marginal and of little interest.

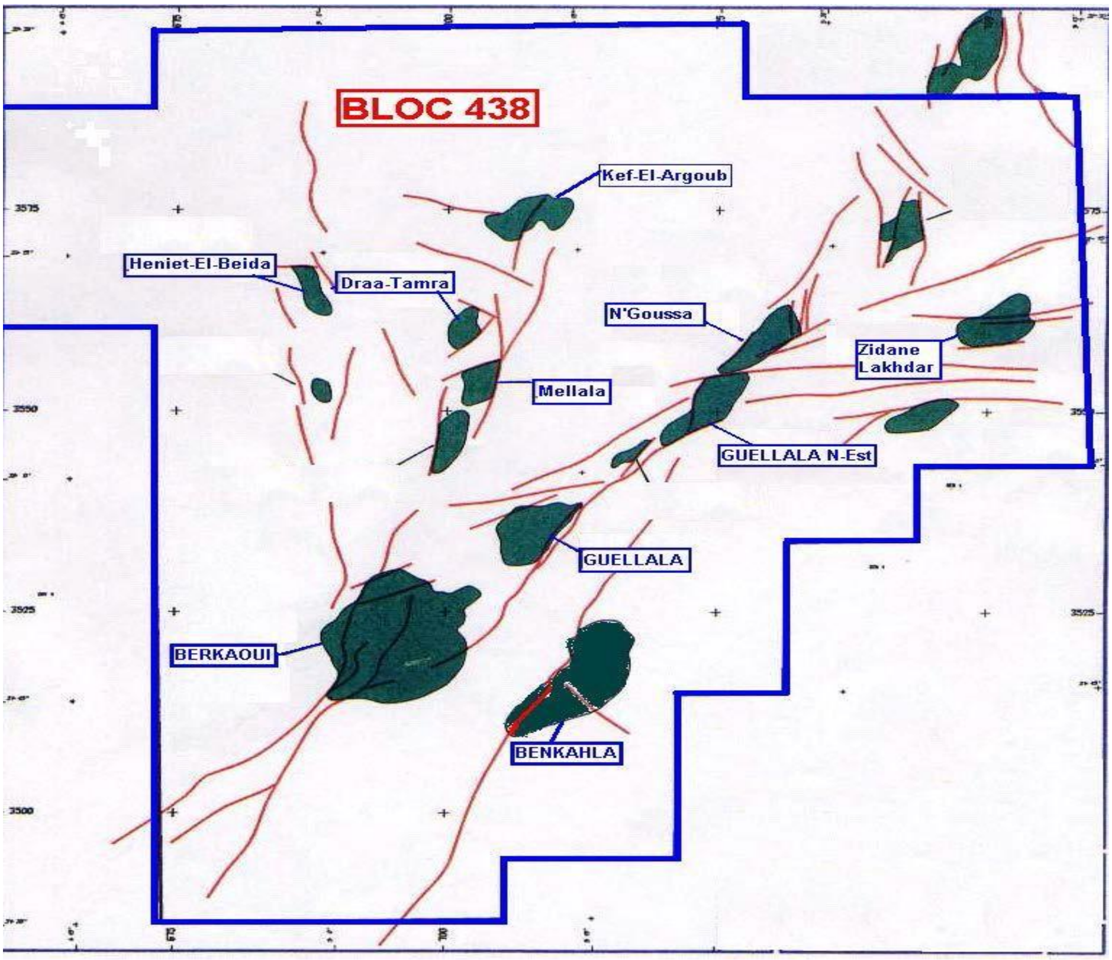


Figure 6:Map of the main accumulations of block 438BEICIP (BEICIP, 1992).

From a structural point of view, with the exception of the HaoudBerkaoui structure which presents a vertical closure of about 300 m; this area is generally weakly structured. This is combined with the presence of thick evaporitic series within the Mesozoic cover, which makes the definition of structural traps by seismic methods very difficult. The definition of these low-amplitude closures is also greatly influenced by the significant velocity variations that are partly related to the complex distribution of the saline Senonian.

The highlighted structures are organized along trends related to faults, mainly oriented north-south and northeast/southwest, the most important of which corresponds to the axis of the Oued M'ya trough (trend HaoudBerkaoui/Guellala/BoukheznaSahane). These trends are intersected by transverse trends oriented east-west, which have played a late role in displacement.

Most of the structures have been drilled and correspond to: The three deposits of HaoudBerkaoui, Guellala, and Ben Kahla developed in the lower series.

To the other accumulations developed in the block, to a multitude of peripheral fields which are in order of importance: N'Goussa, Guellalanord East, Draa Tamra, and Mokh El Kebechs.

I.2.Local framework: presentation of the Benkahla field

I.2.1. Geographical situation of the Benkahla deposit

The Benkahla deposit is located in the region formerly known as Gara krima, approximately 80 kilometers west of Hassi Messaoud, about twenty kilometers south of the Guellala deposit, and the same distance east of HaoudBerkaoui. Its area is approximately 83.5 km². (Figure 07)

The Benkahla area is located in the Ouargla province and is thus positioned between the two regions of Hassi Messaoud and Hassi R'Mel, approximately 600 km south of Algiers.

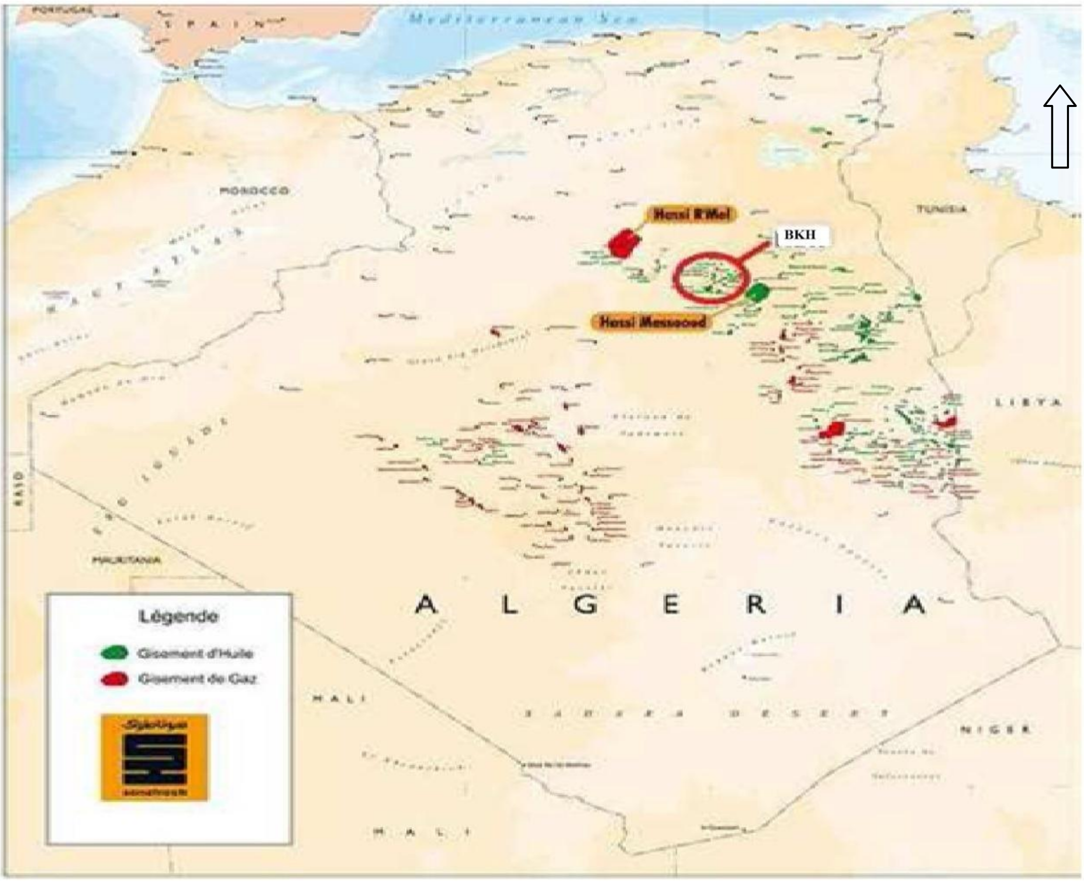


Figure 7:Geographic location of Benkahla (SONATRACH/EXPLORATION, 1995).

I.2.2. Geological Framework of the Benkahla Deposit

The Benkahla deposit is located in the Oued M'ya depression, in the center of the Triassic province, where it is bounded to the west by the HassiR'Mel field, to the northwest by the Berkaoui deposit, to the northeast by the Galalla deposit, to the east by the Hassi Messaoud field, and to the south by the El-Gassi deposit.

I.2.3. History of the Study Area

The regional directorate of HaoudBerkaoui is located in the municipality of Rouissat, 25 km from the capital of the Ouargla wilaya. The region was managed by Hassi Messaoud until 1977, the year it became autonomous. Geophysical studies conducted in the Ouargla region revealed the existence of two (02) structures called: Haoud Berkaouiet Benkahla, both located on an exploitation area of 1600 km².

The first well drilled in the Ouargla region in 1963 is OA01. It was in March 1965 that the first well, OK101, was drilled at the top of the HaoudBerkaoui structure, locating an accumulation of light oil with a density of 43 °API (d = 0.8) in the lower series of the clayey-sandy Triassic (CST) by the French company Algerian Petroleum Company (CFPA). This borehole reached the Gothlandian at 3327.8 m (the first Paleozoic horizon encountered below the Hercynian discordance). Following this drilling and the seismic interpretations, a second well, OKP24, was drilled on 31/08/1966 in the Benkahla structure, where it also encountered oil in the T.A.G. To evaluate this new structure, another well, OKS55, was drilled. The production test conducted by the CFPA yielded a flow rate of 11 m^3/h with a reservoir pressure of 520 kg/cm^2 and a GOR of 101 m^3/m^3. This successful test was promising, it persuaded the producers to install additional wells around the structure, which made it possible to highlight other peripheral deposits. To date, 38 wells are in operation, distributed across all fields, including 27 production wells and 8 water injection wells for pressure maintenance. The other wells, which number 03, are dry wells.
All quantities of oil and gas recovered are transported to the various production centers in the region. The main activities in the region are:

* The production of oil and condensate;

* The production of associated gas (sales gas and lift gas);

* Water injection.

I.2.4. Stratigraphic Column of Benkahla

From a stratigraphic point of view, the peculiarity of the Triassic province is that the Mesozoic rests in Hercynian discordance on the Paleozoic (Figure 08), which allows us to note that the Benkahla area contains three entire subsystems that are eroded:

- The Devonian;
- The Carboniferous;
- The Permian.

The stratigraphy starting from the Paleozoic is as follows:

II.1.4.1. The Paleozoic

The stratigraphic data obtained from 32 boreholes of the deposit during this period are those of the Silurian.

A. The Silurian

This stratigraphic unit, formerly called Gothlandian, was greatly affected by the Hercynian unconformity. It is composed of black clays, laminated, sometimes carbonaceous, becoming very fossiliferous at the top, with sandstone intercalations of a few meters in thickness at times.

II.1.4.2. The Mesozoic

The Mesozoic is well developed in the Triassic province.

A. The Triassic

It is composed of a clayey-sandy series of continental origin resting unconformably on the various terms of the Paleozoic and ending with a clayey-saline series of lagoon-marine origin, which constitutes an excellent cover for the sandy Triassic deposits, and is composed from bottom to top of:

*** The Lower Series**

It constitutes the main reservoir in the HaoudBerkaoui and Guellala fields, but the only reservoir in Benkahla. (Sonatrach/ EP)

This geological series composed of clays and sandstones is discordant over the Silurian (Hercynian discordance), and it is also covered by andesitic flows. Its average thickness is around 40 to 50 meters, consisting of a succession of coarse sandstones, fine to medium sandstones, very fine sandstones, and frequently dolomitic clay (J. Thouvenien, 1968).

These different constituents are generally arranged in sedimentary sequences, from the coarsest at the base to the finest at the top.

These clays are sometimes green at the top, sometimes gray. The intercalations of the clay joints are gray-green on the order of centimeters, and are finely laminated.

Sometimes, less flattened pebbles are encountered; the probable cause was a sequential halt in mud deposits. Toward the base, brown-red clays were deposited, sometimes with breccia-like sandstones and soft pebbles, with frequent pink dolomite concretions.

*** The Eruptive Series (The Andesitic Series) The Eruptive Series (The Andesitic Series)**

It is a series of volcanic outpourings intra-dispositional of the lower series or toward the end of its sedimentation. Its thickness varies from 0 to 70 meters at HaoudBerkaoui, on average from 130 to 140 meters at Guellala, and finally from 0 to 80 meters at Benkahla.

This series sometimes includes intercalations of dolomitic or silty red clays (OKP12, OKP22, and OKP24).

Its thickness increases from the south to the north of Benkahla. The presence of intra-andesitic sandstone intercalations, containing a pressure higher than that of the reservoir, seems to indicate that the eruptive forms the cover of the Benkaha deposit. A test conducted at the roof of an intra-andesitic detrital level at OKP22 allowed for the recovery of saline water at 320g/l. As for the virgin pressure, it was 477Kg/cm^2, while in the lower series it was 210Kg/cm^2.

Above the Andesite and in the southern part of Benkahla, a clay passage with cinérites is encountered, with a thickness ranging from 1 to 6 meters. However, certain drillings did not encounter the Andesitic Series. The cinérite clays being the only manifestation of volcanism (PL2) according to J-Thouveninjan 1968. These cinérite clays form a ferruginous crust (Paleosol).

*** The sandy Triassic T1**

This formation constitutes a clayey-sandy sequence, varying between 20 and 30 meters in thickness. In its upper part, there is a bed of dolomitic and breccia clay about 10 meters high. The T1 level was deposited throughout the entire region of HaoudBerkaoui and Guellala, except in Benkahla, where it is very weakly deposited.

The presence of this thin deposit south of Benkahla leads us to believe that these deposits were interrupted by a volcanic phenomenon, or that the structure was much higher at the time of sedimentation. We can subdivide T1 into two sub-layers: - A clay-dolomite sublayer at the top, with a thickness of about 8m; - A sandstone sublayer, with a thickness of 12m.

*** The Sandy Triassic T2**

At the top, there is a reddish-brown clay-silt sublayer, about ten meters thick. It is dolomitic with fissures filled with salt and anhydrite. A sandstone sublayer at the base (medium to fine grains of 8 to 10 m).

B. The Jurassic

It is composed of evaporitic deposits (lagoonal-marine), with a thickness of approximately 850m, and it is subdivided as follows:

***The Lias**

Its thickness is around 340m-350m, subdivided into two lithological zones:

-At the base: the massive salt (80m);

-At the top: the massive anhydrite (260-270m).

The Jurassic wall is taken at the base of the marl bench, known as the "B" horizon, which serves as a regional diagraphic marker.

The Dogger

It is subdivided into two series:

1. The Lagoonal Dogger

It has a thickness of 120 m, and it is composed of alternating layers of gray-green and reddish-brown clays, gray marls, and anhydrite.

2. The Clayey Dogger

This series is composed of plastic clays and hardened clays, gray marls sometimes dolomitic, and intercalations of fine sandstones.

The Malm

It is a clayey-sandy-limestone complex with a thickness of 234 meters, composed of alternating plastic clay, often silty, argilo-dolomitic limestone, and gray marls, with intercalations of sandstone.

C. The Cretaceous

***The Neocomian**

It is composed of red-brown clays and gray marls, often dolomitic with intercalations of fine sandstone and layers of dolomitic limestone, with a thickness of 181 meters.

The Barremian

It is composed of fine to very coarse sand and fine beige to brown-red sandstone, with some intercalations of silty clay layers, brown-red, and clayey limestone with a thickness of 372m.

The Aptian

It is a carbonate series, microcrystalline dolomitic, with a thickness of around 20 to 30 meters. **The Albian**

It is a set of sandstones and clays with the presence of some dolomitic intercalations, and an alternation of marl and clay at the top of the layer. It has a thickness of approximately 460m.

The Cenomanian

It has a thickness of 161m, composed at the top of alternations of white anhydrite, limestone, dolomitic marls, and gray clays, and at the base of gray clays and dolomitic marls, with layers of dolomitic limestone, gray-green clays, and brown-red clays.

The Turonian

It is a series of marine deposits 70 meters thick, carbonated, consisting of beige to white chalky limestone, with layers of clayey and dolomitic limestone at the top.

*** The Senonian**

It is subdivided into:

1. The Saliferous Senonian

It is composed of translucent massive salt with intercalations of hard crystalline anhydrite, soft gray clay, slightly dolomitic and saline, and at the base, it consists of massive anhydrite with a thickness of 220 meters.

2. The Anhydritic Senonian

It is composed of alternations of microcrystalline white anhydrite, sometimes crystalline, gray dolomite, layers of beige limestone, and brown-reddish dolomitic clay, with a thickness of 250m.

3. The Carbonate Senonian

It is affected by erosion and marked by the alpine unconformity at the top. It is a carbonate series of white fossiliferous limestone, often dolomitic and vacuolar, with layers of marl 225 meters thick.

II.6.4.3. The Cenozoic

Only the Miocene-Pliocene represents the Cenozoic terrains in the region, resting unconformably on the Mesozoic; its thickness varies from 30 to 70 m. It is composed of fine yellow sand, coarse, sub-angular to rounded, with layers of fine to medium sandstone, friable with carbonate cement, and soft white limestone, sometimes dolomitic sandstone.

ÈRE	SYST	ÉTAGES		DESCRIPTION	EPAISSEUR
CENO-ZOIQUE		MIO-PLIOCÈNE discordance alpine		Sable, grès et argile	0 à 60 m
MESOZOIQUE	CRÉTACÉ	SÉNONIEN	CARBONATÉ	Calcaire dolomitique et marne	0 à 700 m
			ANHYDRITIQUE	Anhydrite massive, calcaire, dolomie, argile et marne	
			SALIFÈRE	Sel massif, anhydrite et argile	
		TURONIEN		Calcaire crayeux	
		CÉNOMANIEN		Argile grise, anhydrite blanche, dolomie et marne	
		ALBIEN		Grès fins à moyen à intercalations d'argile brun-rouge et de sable grossier à la base	300 à 900 m
		APTIEN		Dolomie et marne	10 à 30 m
		BARRÉMIEN		Sable fin à très grossier Passées de dolomie Calcaire et marne	600 à 1300m
		NÉOCOMIEN		Grès fins à moyen Passées d'argile et d'anhydrite, lignite	
	JURASSIQUE	MALM		Argile silteuse à intercalations de dolomie, de calcaire et de marne	120 à 300 m
		DOGGER	ARGILEUX	Argile indurée	
			LAGUNAIRE	Anhydrite et dolomie Passées d'argile silteuse	
		LIAS	ANHYDRITIQUE	Anhydrite massive blanche, intercalations de dolomie et argile	700 à 900 m
			SALIFÈRE	Sel massif incolore à rosé avec intercalations d'argile plastique	
			HORIZON "B"	Marne, argile dolomitique	
			S1 + S2	Sel massif incolore à rosé avec intercalations d'argile plastique	
			S3	Sel massif incolore avec intercalations d'argile plastique	
			ARGILES SUPÉRIEURES	Argile plastique salifère	
	TRIAS	S4		Argile brun-rouge parfois salfère	100 à 250 m
		ARGILES INFÉRIEURES		Argile silteuse	
		T2		Grès fin argilo-silteux	
		T1		Grès argileux	
		ROCHES ÉRUPTIVES		Andésite altérée	
		SÉRIE INFERIEURE discordance hercynienne		Grès fin à moyen	
	GOTHLANDIEN			Argile noire grés fin à moyen	300 à 900 m

Figure 8:Typical Stratigraphic Column of Benkahla (Document Production Division/SONATRACH).

I.2.5. Structure of the Benkahla deposit

I.2.5.1. Source Rocks

The importance of the lower Paleozoic series is linked to the presence of the source rocks in the basin, the richest of which are composed of radioactive Silurian clays (Figure 11). In connection with the sedimentary condensation of the entire Silurian in this basin, these clays exhibit excellent geochemical characteristics. Their shallow burial during the Paleozoic preserved their petroleum potential, maturation, and hydrocarbon genesis, which occurred during their subsequent evolution under the influence of Mesozoic subsidence. The Silurian source rock is absent on the mounds of Hassi Messaoud and Talemzane.

In the depression of Oued M’ya, the Silurian source rock currently exhibits a favorable degree of maturation for oil generation. Its degree of maturation is higher (gas zone) to the west of Hassi R'Mel and north of the Talemzane dome, where its burial increases toward the southern Atlas trough.

The current configuration of the basin and the extension of the Silurian mother rock have been extremely favorable for the feeding of the overlying reservoirs (Triassic and locally Lower Devonian) in the depression of L’oued M’ya.

To the west, the HassiR'Mel deposit, in immediate proximity to the Silurian edge, could be supplied, given its very favorable structural configuration. (Document Production Division/SONATRACH). (Figure 09, 10)

I.2.5.2. The reservoir rocks

With the exception of a few reservoir levels located in the Lower Devonian at the heart of the M’ya valley, the Paleozoic reservoirs are limited to the Cambro-Ordovician sandstones. These reservoirs generally exhibit poor characteristics, especially in the M’Kratta slab and the Hamra Quartzites. The extension of the latter is limited to the eastern part of the basin where its thickness is much lower than on the western edge of the Berkine basin.

The most important reservoirs are those of the Cambrian present throughout the basin. However, in areas where the Cambrian is covered by the argillaceous series of the Ordovician, it is generally very deep and in an unfavorable position relative to the source rocks. On the Talemzane dome, where it is partially eroded beneath the Triassic sandstones, it is not covered.

On the contrary, on the El Agreb-Hassi Messaoud mole, the Cambrian cover can be provided by the Triassic clay facies, as the good reservoir levels have not been deposited in this area.

In the Oued M’ya depression, the Triassic reservoirs are similar, but in which the distribution of the reservoirs and their quality vary notably, as distinguished (Document Division Production/ SONATRACH). (Figure 09, 10):

The lower series:

It rests on the Paleozoic substratum, with the best facies located in the depression of Oued M’ya, presumably in connection with the paleo-mole of Hassi Messaoud. Thus, this series constitutes the main reservoir for the deposits of Benkahla, Guellala, HaoudBerkaoui, and a large part of block 438. This formation is considered the equivalent of the Lower Argillaceous-Sandy Trias (TAG) of the Berkine basin.

The T1 unit In which very interesting reservoirs are developed in the western part of the basin (reservoirs B and C). On the contrary, in the Oued M’ya trough, the reservoir levels of this unit are significantly reduced (reservoir T1) above a highly developed eruptive series in this sector, in relation to the extensional plays of the major structural trends. This unit is the equivalent of the carbonate Triassic of the Berkine basin and the intermediate Triassic reservoirs of the RhourdeNouss region.

The T2 unit In which the "A" reservoir develops, particularly important at the HassiR’Mel field, and quickly degraded elsewhere, especially by widespread saline cementation at block 438.

. This formation is considered the equivalent of the Lower Argillaceous-Sandy

Trias (TAG) of the Berkine basin.

The T1 unit

In which very interesting reservoirs are developed in the western part of the basin (reservoirs B and C). On the contrary, in the Oued M’ya trough, the reservoir levels of this unit are significantly reduced (reservoir T1) above a highly developed eruptive series in this sector, in relation to the extensional plays of the major structural trends. This unit is the equivalent of the carbonate Triassic of the Berkine basin and the intermediate Triassic reservoirs of the Rhour de Nous region.

Unit T2

In which the "A" reservoir develops, particularly important at the HassiR'Mel field, and quickly degraded elsewhere, especially by widespread saline cementation at block 438.
This unit is the equivalent of the Upper Clayey-Sandy Triassic (TAGS), which reaches its maximum development in the Rhour de Nous region..

I.2.5.3. Cap rocks

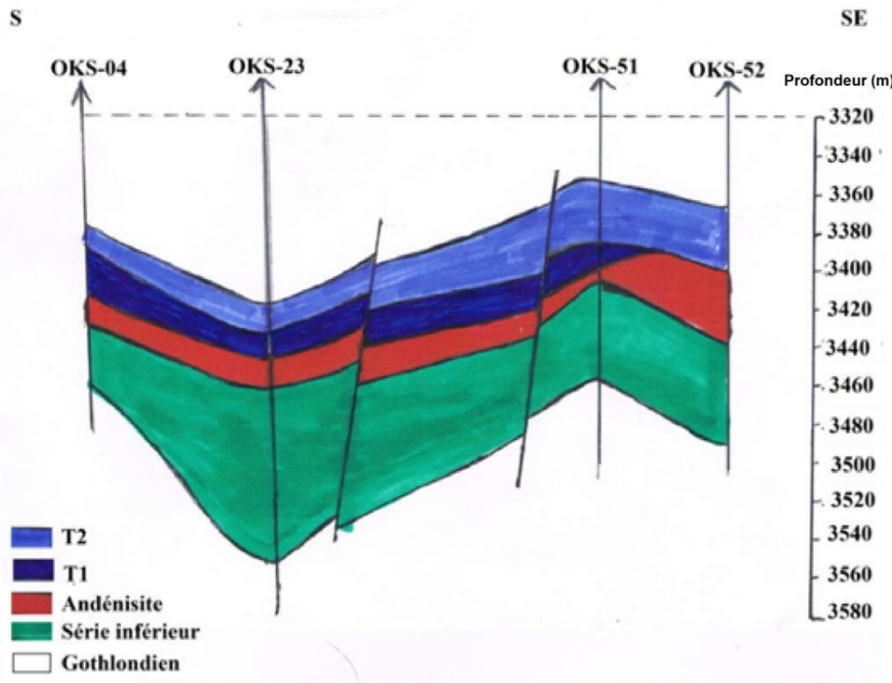
The evaporitic series deposited at the end of the Triassic across the Benkahla field constitutes an excellent regional cover over the entire Triassic basin. This cover is composed of salts and anhydrites with thicknesses exceeding one thousand meters.

In addition to this regional cover, there is a local cover specific to this reservoir. the eruptive rocks of the Triassic, which are well developed, originating from quite considerable lava flows, and playing an important role in ensuring good sealing between the lower series and the T2. (Figure 11)
The reservoir of the lower series is a litho-stratigraphic wedge trap (Production/SONATRACH).

I.2.5.4. Migration

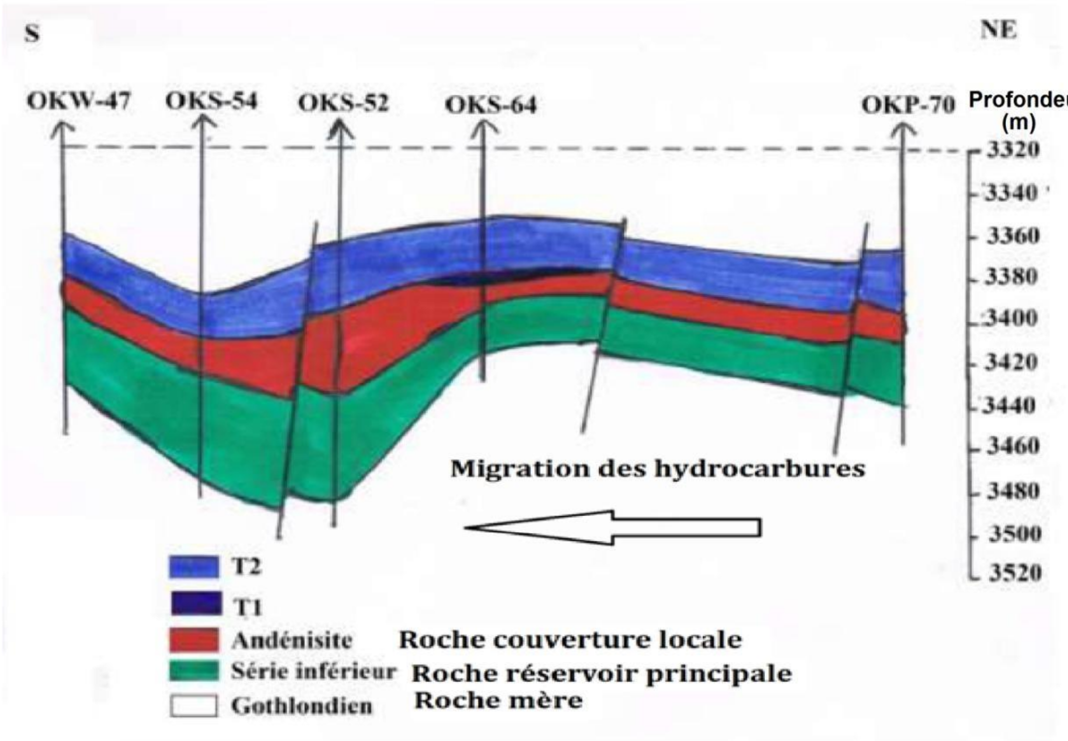
The hydrocarbons generated, especially in the northeastern part of the Oued M’ya basin, which is the most subsided, migrated toward the high areas where trapping occurred. The migration took place from the west toward Hassi Messaoud, and from the north to the south in the directions of Haoud Berkaoui, Benkahla, Guellala, and even Hassi Messaoud.

The timing between the establishment of the salt cover at the end of the Triassic, beginning of the Jurassic, and the start of hydrocarbon generation in the mid-Cretaceous implies that all the generated hydrocarbons were accumulated and trapped in this same basin in the absence of leaks. (Document Production Division/ SONATRACH).



(Echelle : H : 1/ 500 00, V : 1/ 2000 m)

Figure 9:The geological section S-SE.



(Echelle : H : 1/ 500 00, V : 1/ 2000m)

Figure 10:The geological section S-NE.

Age	Etages	Strati.	Lithologie	Epaisseur
TRIAS ARGILO GRESEUX	T-2		Altern.d'argile silteuse et de silts,passées de grés beige à cim.argilo-dolomitique	20 à25m
	T-1		Alternance d'argile et de silts passées de grés beige ciment argilo siliceux fine altercal.de grés gris-blanc.	25 à 30 m
	ERUPTIF		Andésite brun-rouge à brun sombre altérée en général au sommet. Présence de nodules de carbonates.Fines intercala-tions de joints d'argile ferrugineuse.	0 à 75 m
	SERIE INFERIEURE		Grés gris beige fin,moy à grossier.Ciment carbonaté à siliceux.Passées de films d'argile verdatre .Presence de pyr et nodules d'argile verte ou ferrugineuse.	15 à 60 m
	GOTHLANDIEN		Argile noire feuilletée pyriteuse, silt.	300 à 900m

Figure 11:Stratigraphic section of the argillaceous-sandy Triassic (Production Division/SONATRACH).

The exploration effort in the Oued M'ya basin has experienced a new surge in the last five years, culminating in several oil discoveries. Indeed, particular interest has been given to the possibility of extending Triassic deposits, notably Berkaoui and Benkahla, and to the development of the network of open fractures in the deep targets (Hamra quartzites: Ordovician). Thus, several recent discoveries have been made in the basin:

- An oil field, Benkahla East, was discovered in the lower series reservoir (Triassic) to the east of the Benkahla field (well BKHE-1, 1999);
- An oil discovery in the Ordovician Hamra quartzite reservoir, in the Berkaoui region (well BKP-1, 2002);
- An oil discovery in the Triassic T1 and lower series reservoirs to the west of the Berkaoui field (wells BKO-1 to 3, carried out between 2001 and 2005);
- Two oil discoveries, between the Berkaoui and Benkahla fields and north of Berkaoui, in the lower series reservoir (well BKRE-1, 2005), and the Hamra quartzite reservoir (well NHN-1, 2005).

The modeling and geochemical assessments in the Oued M'ya basin show that a very significant volume of hydrocarbons (approximately 3 to 4 times the total discovered to date) remains to be discovered in different types of traps (structural, mixed, stratigraphic, extension of fields, and deep targets).

Chapter II: WORKING METHOD

Introduction

The objective of this research work is to propose a three-dimensional image of the underlying geological formations, specifically the reservoir rock. We will create a geological model of the reservoir of the Benkahala field extension. To achieve this objective, many parameters will be introduced, namely permeability, porosity, useful thicknesses, oil-water contact...

The determination of the parameters used in the model design will be derived from the interpretation of well log and petrophysical data.

In the following paragraphs, we will present the different methods used in determining the model parameters. All the obtained data will be entered into the Petrel software for combination and overlay, in order to trace the geological model of the deposit. It should also be noted the use of data from 35 wells drilled in the southern area of the Benkahala deposit.

2.Methodology of Reservoir Modeling

Introduction

Geological models can be used to perform precise volume calculations or to test the effect of different deposition regimes against observed data.

- **Presentation of the software Pétrel (Schlumberger)**

  Pétrel is a software, which is a Schlumberger product that allows the user to build a reservoir model with properties to export to a simulator. Petrel is a Windows-based software for 3D visualization, mapping, and 3D reservoir modeling and simulation. It was founded in 1996 and commercially released in 1998. It became part of Schlumberger Information Solutions in January 2003.

- **The stage of reservoir modeling**

  The Pétrel software, with its various modules, can help us perform all kinds of modeling on our reservoir and allow for 3D or 2D visualization (maps, sections, etc.) of the results obtained.

The models created are:

• Structural modeling;

• Facies modeling;

• Petrophysical modeling;

• Oil-water contact modeling.

II.2.1. Creation of a new project and data loading

Of course, a minimum amount of data essential for our type of modeling (we use 35 wells in the Benkahla field) must be loaded so that we can talk about a potential Petrel project.

ϖ Data from the Benkahla field wells

To be able to model the reservoir, all the reservoir parameters must be introduced, namely: the coordinates (x, y, Zs (Z bottom), Zt (Z top), log depth, drilling depth, and Symbol) of all the wells used to construct this model, the tops and bases of the existing units in each well interpreted from the logs, the logs (data from the interpreted logs).

ϖ Fault

Seismic data is very important, but if it is not available, as was our case. We need to have the faults in 3D or have them in 2D and then transform them into 3D.

ϖ Horizons

The horizons interpreted from the seismic data must be converted into a Depth map. But due to the lack of seismic map data for the region, we used the actual tops of the formations in this modeling:

- The roof of T2
- The roof of T1
- The roof of the eruptive rock
- The roof of the lower series
- The roof of the Gothlandian

II.2.2. Structural modeling

Structural modeling is one of the most important parts of this chapter. It forms the foundation for all geological modeling.

Having been unable to access the seismic data, we only used the results of the seismic interpretation and the coordinates of the highlighted fault networks.

ϖ The fault networks were determined from the digitization of the top Triassic map resulting from the interpretation of relatively recent seismic data, namely, 2D and 3D seismic. The fault networks were determined from the digitization of the Triassic roof map based on the interpretation of relatively recent seismic data, namely, 2D and 3D seismic.

ϖ The faults identified by the seismic interpretation were not "loaded" into the Petrel project and displayed as "fault sticks," that is, faults in the form The faults identified by the seismic interpretation were not "loaded" into the Pétrel project and displayed as "fault sticks," that is, faults in the formof sticks or bars, but we generate them as vertical faults, then we manipulate them.

ϖ After that, we proceeded with the gridding, which involves creating the skeleton on which the model will rest. After that, we proceeded with the gridding, which involves creating the skeleton on which the model will rest. In this part, the faults will take shape and will be taken into consideration in the skeleton of the future model.3D Grid Concept, In simple terms, a 3D grid divides a model in place into boxes. Each box is called a grid cell and will have a single type of rock, a porosity value, a water saturation value, etc. These are referred to as the cell properties. This is a simplification of the true case, but it allows for the generation of a representation of reality that can be used in calculations, etc.

ϖ The pillar grid (Pillargridding), a very important step in the realization of the 3D geological model. Using the fault plane, a grid composed of three layers (skeleton consisting of a Top, Mid, and Bottom) is constructed, forming the skeleton of the model, which is capable of containing the different reservoir levels considered in this study.

ϖ The modeling of horizons (Make horizon):

It is the insertion of horizons into the 3D grid, five main horizons limiting the reservoir that are interpreted from the well logs were initially inserted to guide the modeling. We imposed as a constraint for the model the well tops corresponding to each unit and the associated faults. They are assumed to be vertical in the absence of seismic data. The offset is automatically determined by the software for all the faults, which fit within the known global framework at the scale of the study area. The orientation of these faults is NE-SW, as a major direction of the faults.

II.2.3. The modeling of properties

II.2.3.1. The modeling of facies

In this section, the process of constructing a basic facies model conditioned to observations and using SIS. The type of variogram, varies, and the azimuth for each facies is provided for you. These are normally designed to match geological observations at the ends (typically observed in a good section), and require little experimentation to create the desired effects. Modeling Object allows users to fill a discrete facies model with different organisms of various geometries, the facies code, and fraction. All geometric inputs that control the shape of the body (width, thickness, etc.) are defined by the user.

ϖ Creation of electro-facets

Creation of electrofacies due to a lack of geological data, we used the electrofacies calculated from the logging results, defined as follows:

- **Electro-facies:** It is the set of diagraphic characteristics that can characterize a layer and differentiate it from the surrounding formations. These facies are assigned using special equations that include the previously loaded data.

ϖ Facies upscaling

The electro-facies logging data are "upscaled" (geologically scaled, for example, one-meter benches) in the static model after being loaded onto Petrel.

ϖ Data Analysis

Facies distribution maps are created after the geostatistical analysis of the data and the selection of an appropriate estimation method.

In geostatistics, the most active research area over the past 10 years has been geostatistical simulations. Simulations are necessary for any problem involving non-linear transformations of the measured variables. The estimation method used is sequential indicator simulation for discrete variables, such as facies.

II.2.3.2. Petro-physical modeling

Deterministic modeling, When the well logs were scaled to the resolution of the 3D grid cells. The values of each cell of the well trajectory can be interpolated between the wells in the 3D grid. The result is a grid with the property values for each cell.

ϖ Scaling the property Scaling the property (Up-scaling)

The previously established structural model will be populated with the various petrophysical data. These data must first be "upscaled" and then analyzed using geostatistical methods (sequential Gaussian simulation).

ϖ Data analysis

Geostatistical analysis will determine the extrapolation model to be used for modeling. The accuracy of the resulting petrophysical model will depend on the geostatistical analysis of the corresponding data.

We will obtain, at the end of this modeling, a 3D simulation of the reservoir in terms of porosity and saturation.

The sequential Gaussian simulation is the method used for continuous variables such as GR, NPHI (neutron porosity), Core Porosity (Q), Core Permeability (K), etc.

II.2.4. The modeling of oil-water contact

• Creation of a new contact group

After constructing a Petrel3D grid and before executing the volume calculation, the different contacts should be defined in the MakeContacts process. Several series of contacts can be defined, and each set of contacts can contain a certain number of different types of contacts. All the sets of contacts will be stored in a folder called fluid contacts in the Petrel Explorer Models tab. The entire set of Contacts can be created based on a constant depth value or a surface. If a surface is used as an input for the contact, it must exist in the Petrel Explorer window. Any type of surface can be used as an input. The user has the option to use the same contact for all zones and segments, different contacts for each segment, and/or different contacts for each zone.

In this model, there are oil-water contacts. I interpret the contacts by displaying the wells (the logs) and peaks at the contact depth, thus we have written an oil-water contact file.

II.3. The estimation of possible in-place oil

The uncertainties regarding certain parameters (interface, facies extension) are such that the existence of hydrocarbons in certain areas is very problematic, but cannot be definitively excluded.

In this section, we will evaluate the hydrocarbon reserves of the Benkahla field (lower series reservoir) using the volumetric method.

The mathematical meaning of this method is expressed by the following formula:

$$\mathbf{Qrec = F \,.ho \,.\Phi \,.\, S0.\theta \,.\rho \,.\gamma}$$

Where:

Qrec: Recoverable oil reserves under surface soil conditions in tons.

F: Surface area of the oil zone in m.

h0: average effective petroleum thickness of the layer in m.

Φ: Average coefficient of open porosity of the reservoir layer in %.

So: Average oil saturation coefficient in %.

θ: Recalculation coefficient used to bring the volume of hydrocarbons to surface conditions.

ρ: Average density of the oil under surface conditions in t/m^3

γ: Recovery coefficient (recovery rate), that is, the percentage of oil that can be extracted from the reservoirs.

II.4. The decision-making factor for development

To guide the development of the Benkahla field, the established model is of paramount importance. Indeed, it provides us with information on the favorable areas for the installation of new development or injection wells. To support this orientation translated by the scenarios for the continued exploitation of the field, we find it useful to reason with the decisive parameters for locating favorable development zones such as the useful height, petrophysical parameters (essentially porosity since permeability is matrix), and oil saturation. The combination of these parameters into a factor we called the decision factor (Fd) proved to be an additional argument for the modeling work carried out.

Fd = P (Φ, Hu, So) = P(Φ) x P(Hu) x P(So) since these events are independent according to the laws of probability.

P: Probability

This factor is expressed in (%) and represents the best probability of finding areas favorable for the development of the field, thus for the installation of new production wells.

CHAPITRE III: MODELISATION DU RESERVOIR

Introduction

The 3D geological model of the structure of the Southern zone of the BKH field (Figure 15), constructed using the Petrel software, is the result of the integration of all available data and the results obtained from petrophysical interpretations and electrofacies determined from log interpretations (which provide clay volume, porosity, water saturation, reservoir thickness, and net thickness) in each well using the IP software and core analysis. Thus, their spatial distribution, the spatial distribution of these results, is carried out using geostatistical laws based on variograms.

Based on a reservoir model, The application of certain logging methods, particularly electrical, nuclear, and acoustic logging on all wells (21 wells) in the study area (figure 12).

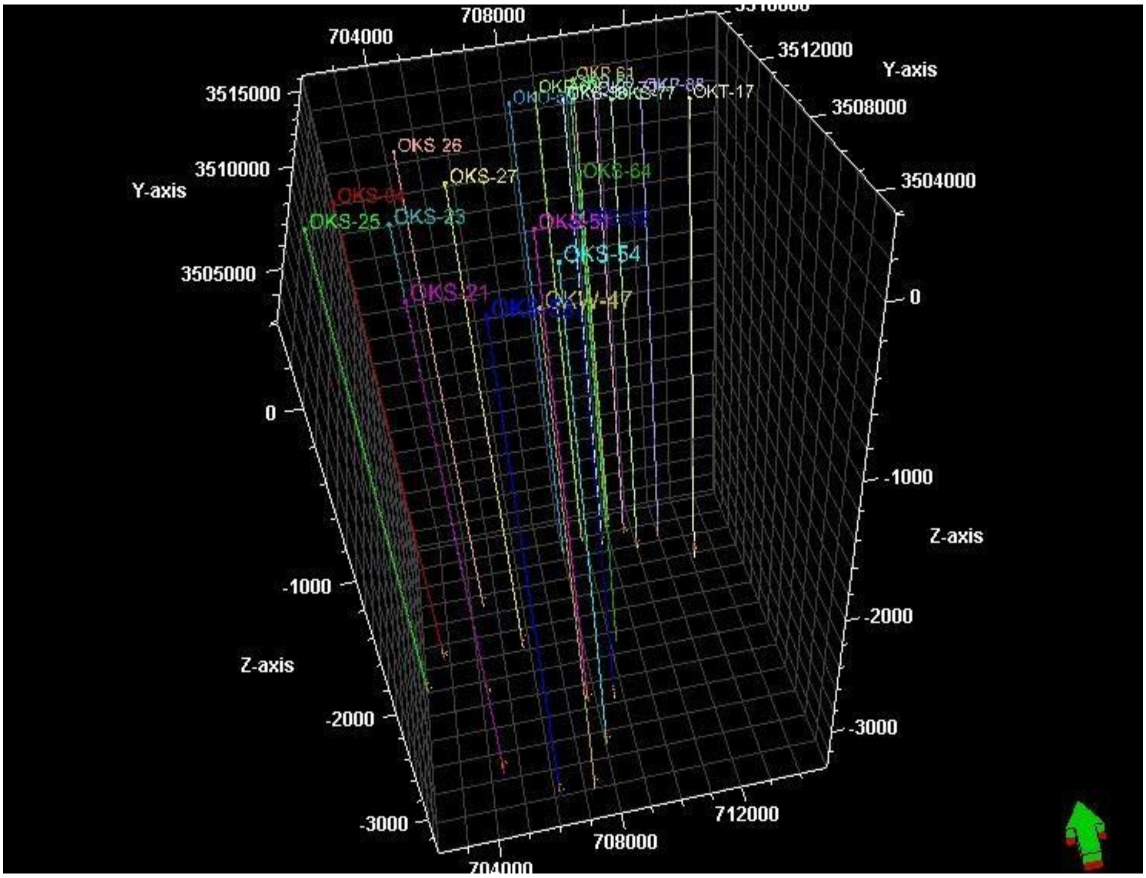


Figure 12:Plan de position des puits en3D

(Nassira Mebrouki et al, 2026)

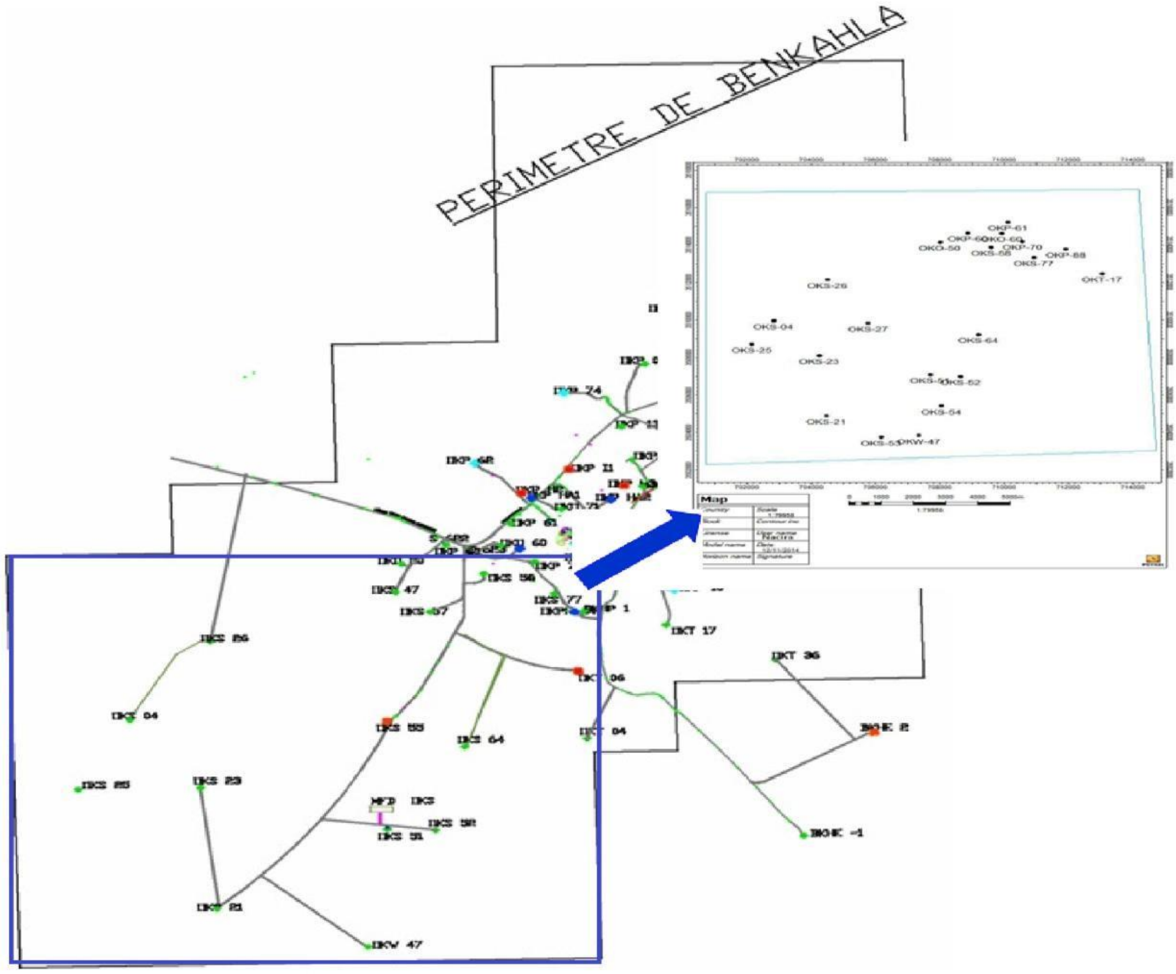


Figure 13:Well position plans(Nassira Mebrouki et al, 2026)

III. 1. Interpretation of Well Logging Results

Objective of the well survey of the Benkahla deposit Main objective TAGSérie Inférieure.

- **The Isobath Map at the top of the lower series**

The analysis of the Isobath map at the top of the lower series (figure 14) shows an anticline structure near the wells: OKS-77, OKS-21, and OKS-64. The reservoir deepens toward the southeast and northwest flanks. The depth of the roof of the lower series in the studied area varies between -3136 and -3300 m.

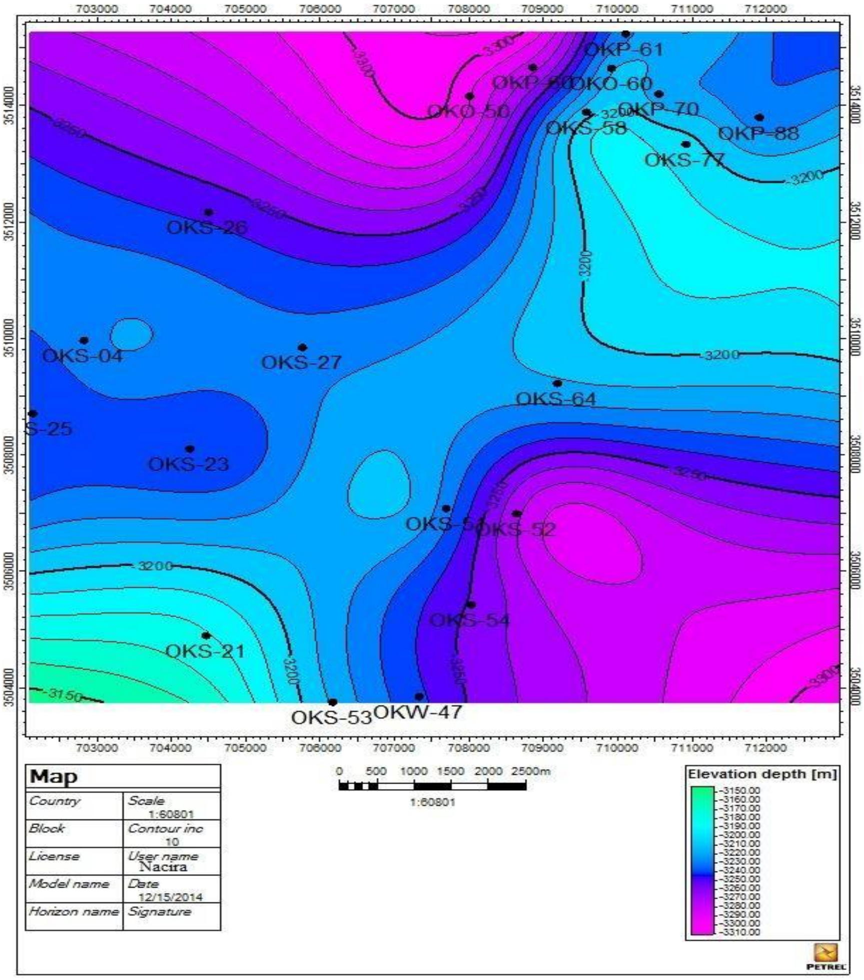


Figure 14:Isobath map at the top of the lower series

(Nassira Mebrouki et al, 2026)

- **The iso-packs card of the lower series**

The analysis of the Iso-paque map of the lower series (figure 15) shows a clear distribution of thicknesses that are less significant in the center of the field. These increase toward the south and northeast, where the thickness reaches its maximum at well OKS-51 (54 m). A large part of the deposit reveals a dominant thickness of around 35 to 45 m.

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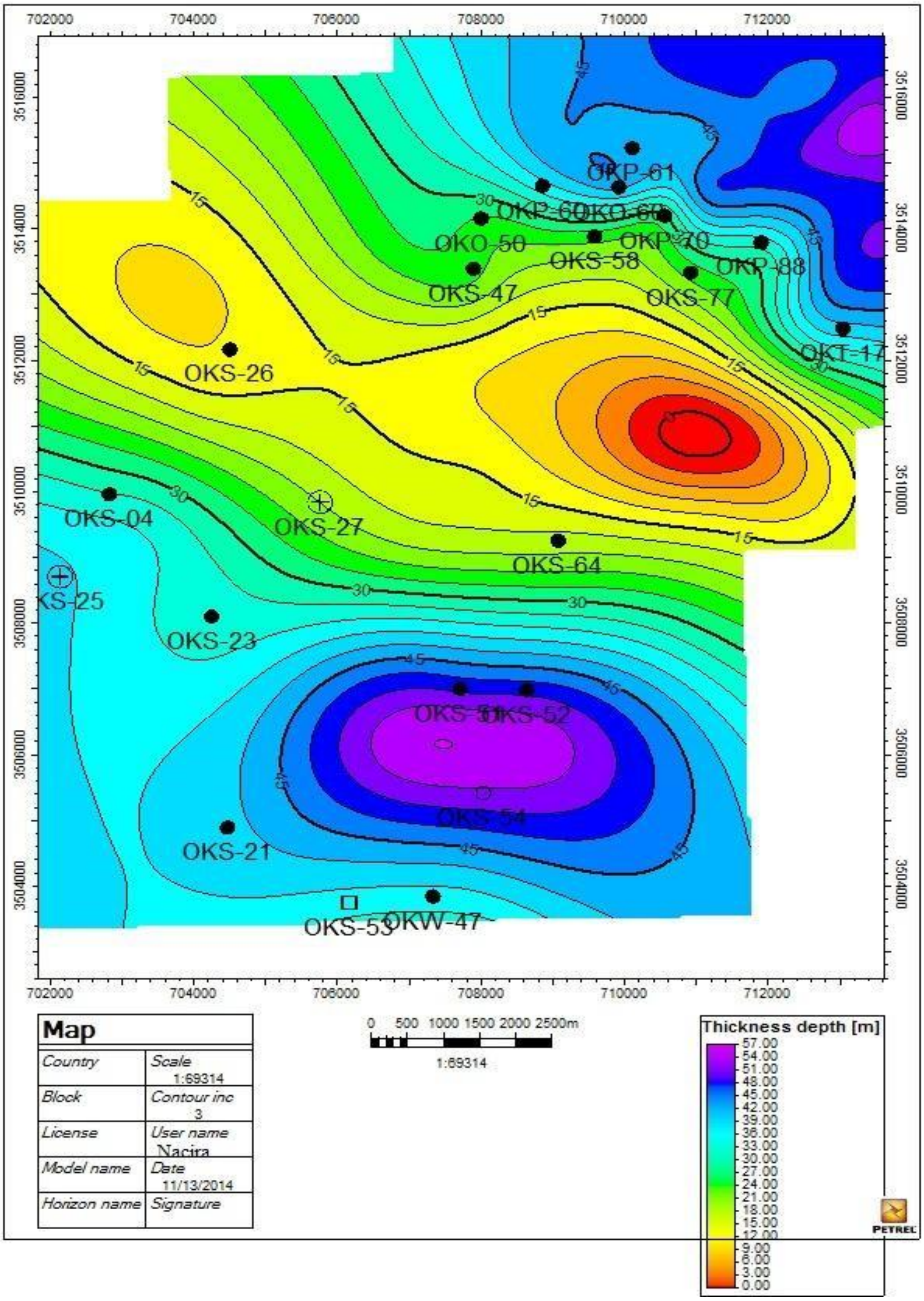

Figure 15:isopaque map of the Lower Series.

(Nassira Mebrouki et al, 2026)

• Thickness of the productive reservoir (net pay):

This map (Figure 16) shows us that there is a variation in the productive thickness of the lower series, which decreases toward the southeast and southwest. A large part of the well in the BKH field has a useful thickness that varies between 08 and 20 m.

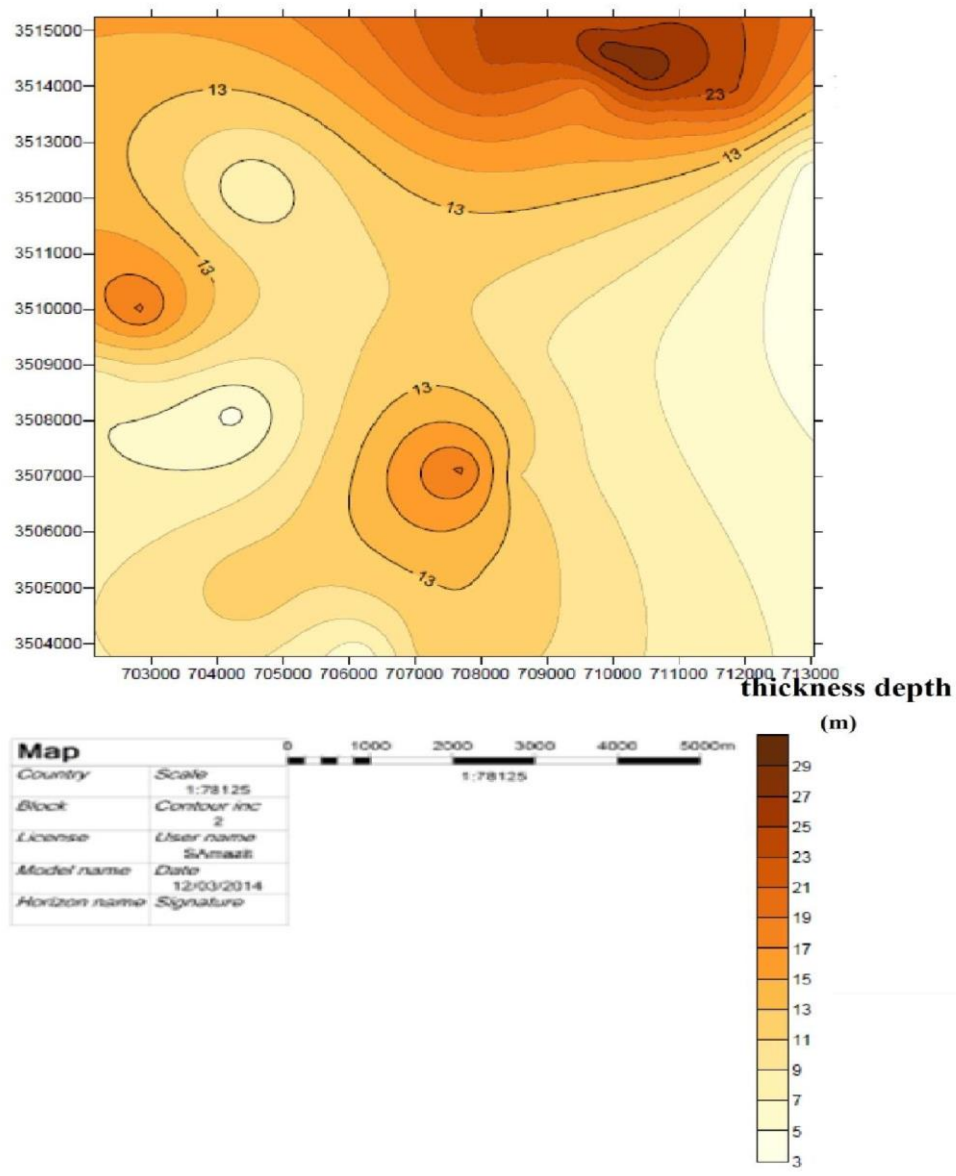

Figure 16:The useful iso-thickness map of the Lower Series.

(Nassira Mebrouki et al, 2026)

• **Volume of clay (Clay content of the reservoir)**
This map (Figure 17) shows us that there is a variation in the clay volume of the Lower series that increases toward the southeast, and a large part of the well in the BKH field has a clay volume that varies between 4 and 12 m.

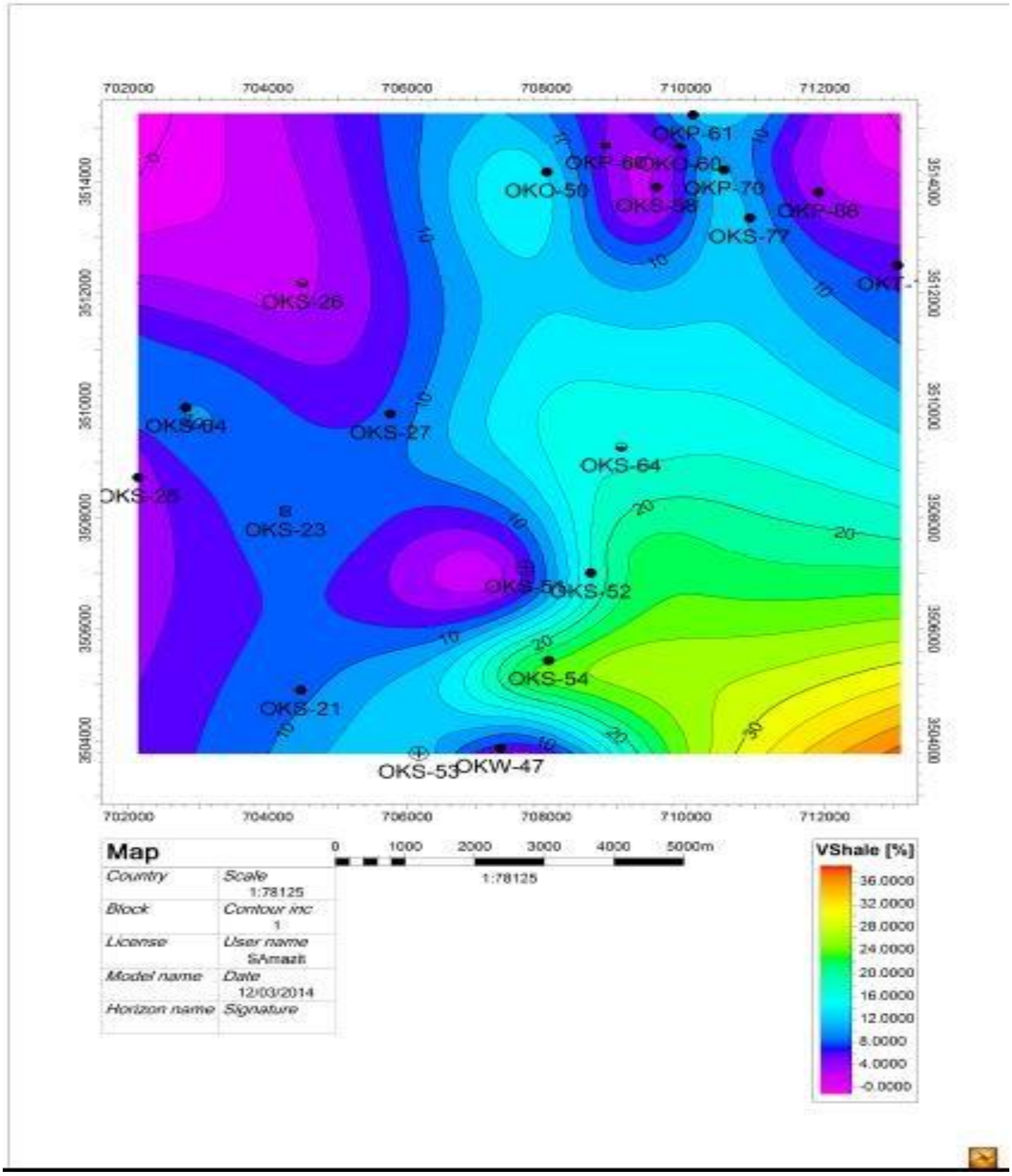

Figure 17: Carte of clay volume

(Nassira Mebrouki et al, 2026)

- **Porosity**

According to this map (Figure 18), low porosity values are observed in the west, which increase toward the east and south, where it reaches its maximum value at the OKS-77 well (19.4%).

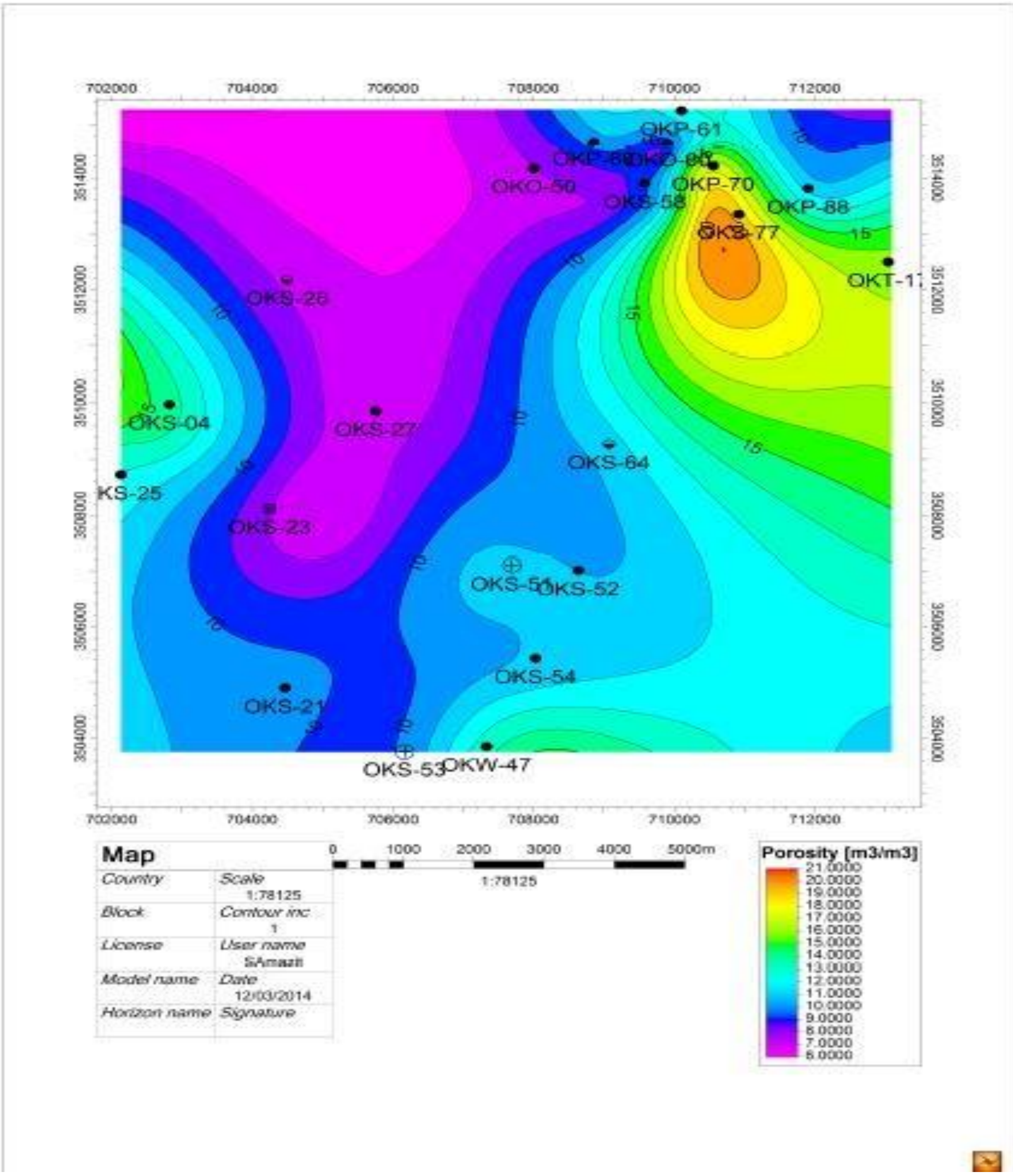

Figure 18: Iso-porosity map

(Nassira Mebrouki et al, 2026)

- **Oil Saturation:**

The analysis of this map (Figure 19) indicates an average increase in oil saturation from the center toward the southeast; for example, well OKS-64 (69.8%), and is higher toward the north, for example, well OKT-17 (88.31%).

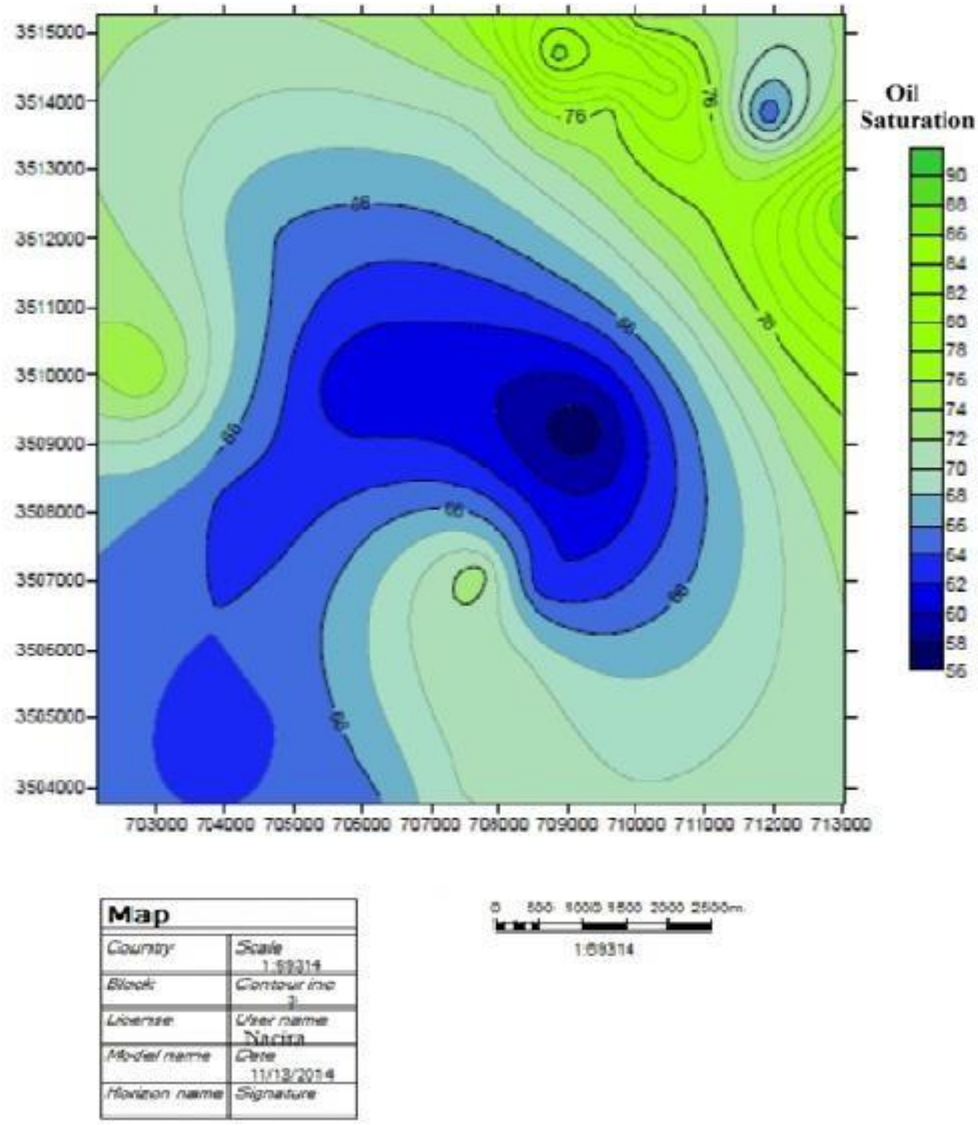

Figure 19:Oil Iso-Saturation Map

(Nassira Mebrouki et al, 2026)

The water iso-saturation map (Sw):

This map (Figure 20) shows us that there is a variation in the Sw values of the lower series, which presents a high value of 43% in the OKS-64 well, but on average around 30% over a large part of the field.

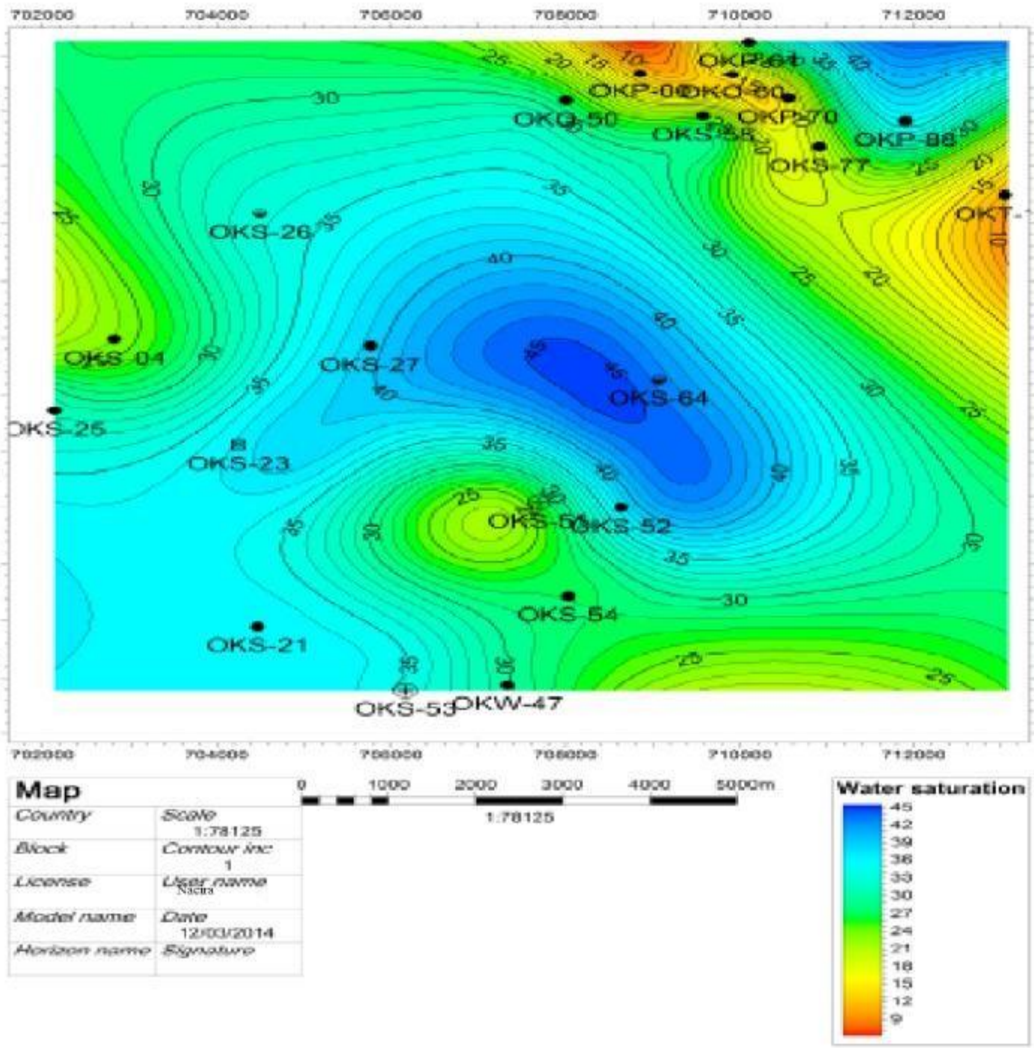

Figure 20: The water iso-saturation map

(Nassira Mebrouki et al, 2026)

III.2. Log-Log Correlation between Wells

Introduction

To better characterize the facies and detail the architecture of the lower series reservoir, in order to recognize the petrophysical properties at each level, a division into units (layers) was carried out. This division is based on the observation of various sedimentary discontinuities, as well as on regional and local boundaries marked by discontinuities, especially significant abrupt granulometric changes, or following an apparent erosive surface to overcome the difficulties posed by the absence of regional discontinuities.

The variable grain size of the sequences and their geometric organization within the formation of the lower series allow for the distinction of sequences organized in a fining-upward manner. Indeed, according to the Gamma Ray curves, these sequences are bell-shaped and rarely cylindrical according to WANT and WALKER.

Given the great complexity of the deposition system in the basin, it is not easy to follow the sequences in terms of correlation; moreover, the existence of faults further complicates the evolution of the paleo-deposits.

III.2.1. Different correlations carried out in the Benkahla field

III.2.1.a. Correlation by lithology

The lithological correlations carried out in the field have made it possible to locate the variations of the formations throughout the argillaceous-sandy Triassic. During the execution of this

corrélation, on a estimé la discordance hercynienne comme repère. Plusieurs constatations ont été faites :

-An uniformity of the lower series throughout the entire field, and the thickness ranges between 43 and 48m.

-A variability of eruptive deposits throughout the field, the amplitude of these volcanic flows is controlled by their position relative to existing faults.

III.2.1.b. Correlation by lithofacies

The characterization of the typical sequence being comparable to a virtual sequence of deposits in a braided river environment. Systematic vertical slicing tests of the lower series have been highlighted. In this context, macroscopic descriptions encompassing 3 surveys were essential, as well as the logging results aimed at refining the segmentation.

In general, 5 sequence units were distinguished, as well as the changing lithological character from one sequence to another. This characteristic commonly pertains to the nature of the examined sequence in terms of texture or grain size.

For comparison, it is sometimes their thickness and the clay/sandstone ratio or rate and the change in cement; where a different diagenesis has been accentuated compared to one another. Grain size is, of course, a predominant factor, but it remains consistent with the growth of the formation. This classification takes into account the succession of facies, but does not rule out the possibility that this succession may be incomplete (due to intensive erosion).

III.2.1.C. Correlation by Logging

This correlation extends from the wells OKO60, OKP70, and OKP88 of the Benkahla field (done at the D.P Berkaoui level). Indeed, the division into depositional units was carried out based on an interpretation of the logs and sedimentological studies of the cores. This correlation allows us to draw the following conclusions:

The sandstone boundaries may be correlated. We observe the development of several sandstone lenses, probably cut transversely, which confirms the general direction of sedimentation and flows.

In conclusion, it can be said that the difficulty encountered in correlating the different units lies in the complexity of the channel deposits in the fluvial environment, particularly in braid systems, which promotes a nearly permanent intermingling of accretion zones, hence the current problems. The internal architecture of the deposits in the lower series is very complex. The study of the cores shows extremely rapid variations in lithology: silty clay, clayey sandstone, carbonate sandstone, etc.

To study the different units, if they are genetically independent, it was necessary to resort to the use of sonic logging.

III.2.1.d. Correlation by Electro facies

The boundaries concerning the lower series wall of all the surveys are easily recognizable by the simple signature of the Gamma Ray: radioactive peak, corresponding to a reading of 120 API, and above, with which the SONIC curve maintains values with the characteristic appearance in the face of grayish clays, layered throughout the reservoir, at the level of the lower series wall / Silurian roof, is well specified for all observed wells. The upper limit at the top of the lower series corresponds to the majority of the clayey silts, reddish and greenish clay spots.

We notice floodplain deposits where a facies has formed in an arid climate. The curves are sawtooth-shaped of the GR.

In our research work, we used two logging methods: Gamma ray and sonic. The main applications are:

-Correlation between units;

-Correlation between petrophysical parameters;

-Determination of bed thicknesses.

III.2.2. Interpretation of the east-west correlation of the argillaceous-sandy Triassic

Based on this study conducted between the wells OKO-60, OKO-70, and OKP-88, it is observed that the thickness of the lower series from east to west is relatively opaque, where this profile shows the main deposition axis of the lower series. (Figure 21)

-Unit I

It is observed that the thickness of the sandstone is relatively variable, decreasing from west to east. It is 7m at the OKO60 well, 8m at the OKO70 well, and 2m at the OKO88 well, which shows that the NE-SW faults influence the thickness of the sandstone.

-Unit II

According to this correlation, we notice that the thickness is relatively constant, and it is 1m in the wells OKO60, OKP70, and OKP88, which indicates that there is a Silurian paleorelief to the south.

-Unit III

It is observed that the thickness is variable, increasing from west to east. It is 5m in well OKO60, 5m in well OKP70, and 7m at well OKP88.

-Unit IV It is observed that the thickness varies in all the wells, being 8m at well OKO60, 8m at well OKP70, and 10m at well OKP88, which shows that the NE-SW faults influence the thickness of the sandstone.

Unit V

We notice that the thickness varies from west to east, being 9m in well OKO60, 7m in well OKP70, and 8m in well OKP88, which indicates that there is a Silurian paleorelief to the south.

W **E**

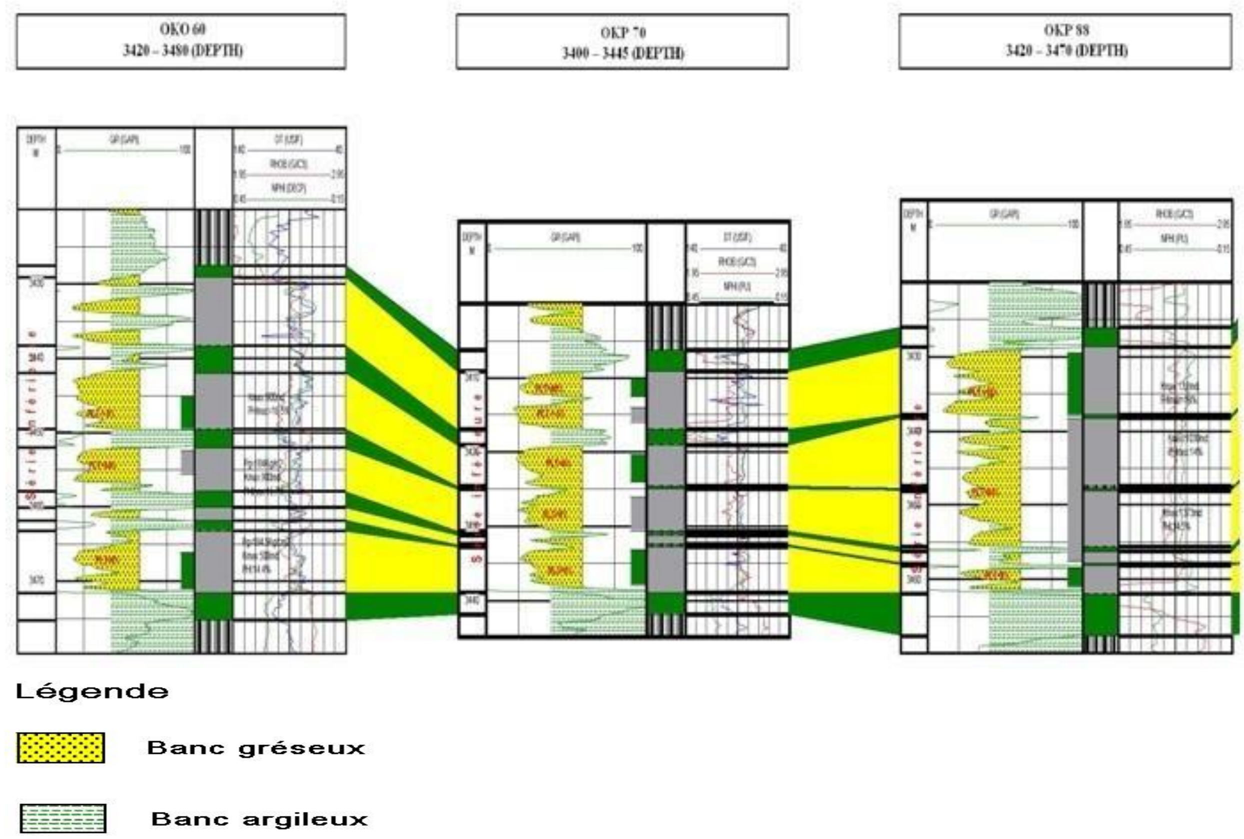

Figure 21: East-West correlation of the argillaceous-sandy Triassic (Document DP / SH)

Conclusion

By analyzing this correlation, it can be said that in the Benkahla region, the maximum sedimentation is found in the eastern part of the region. This is due to the Silurian paleorelief which is uplifted to the south, and NE-SW faults have played a role in the distribution of the thicknesses of the different terms.

III.3. Reservoir Modeling

The geological model and the mental images of the subsurface are constructed by structural modeling (seismic data), facies (geological data), and petrophysical data (logs and core analysis).

III.3.1. The interpretation of structural modeling

The results of the structural modeling carried out from the 2D interpretation allow us to visualize the faults obtained in 3D (Figure 22). Thus, we confirm that the Benkahla field is compartmentalized.

Structural analysis shows two fault networks, oriented NE-SW and NW-SE. However, the NE-SW direction is predominant, and it is in the form of horsts and grabens. (Figure 22)

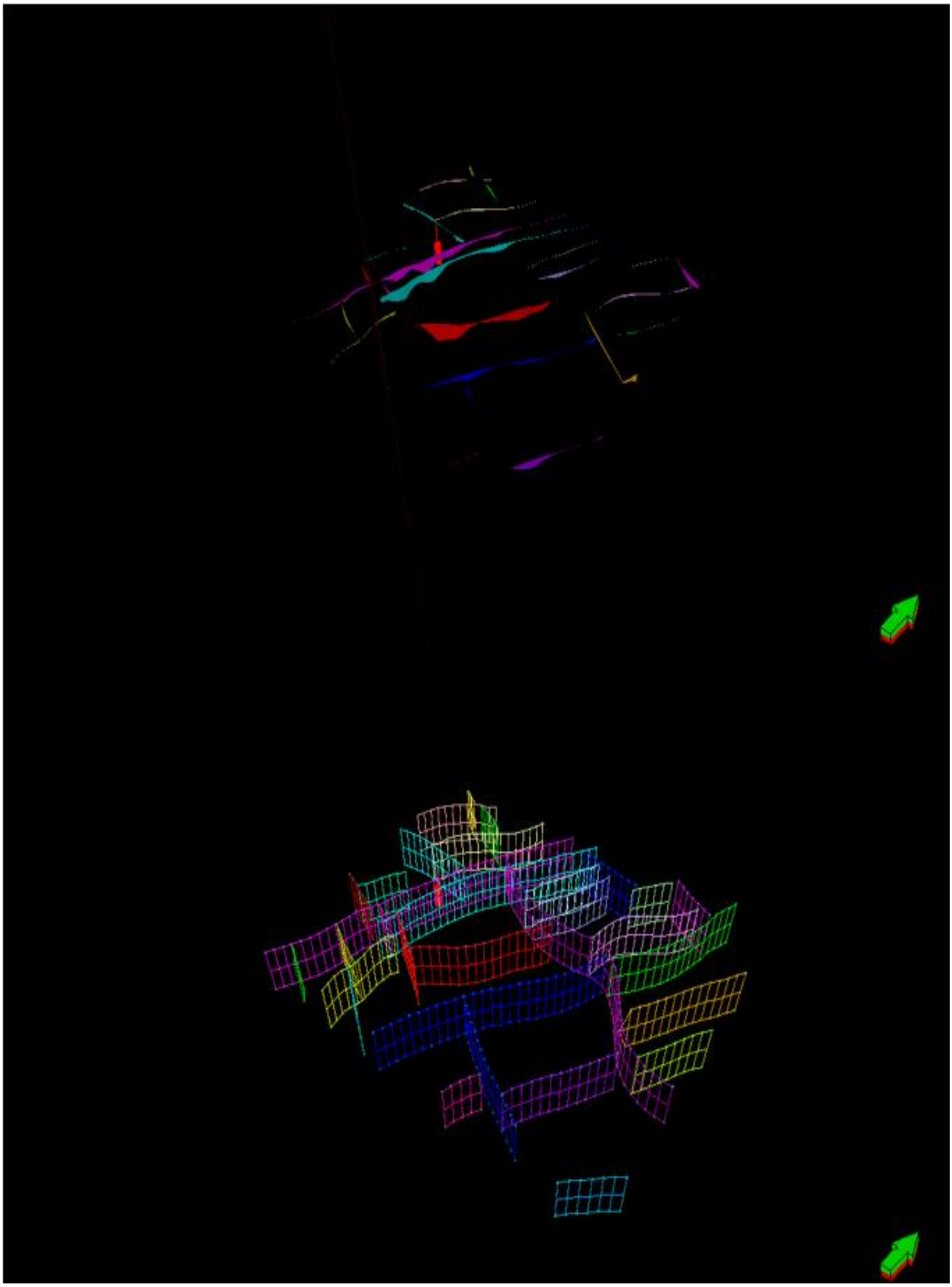

Figure 22: 3D Model of the Faults

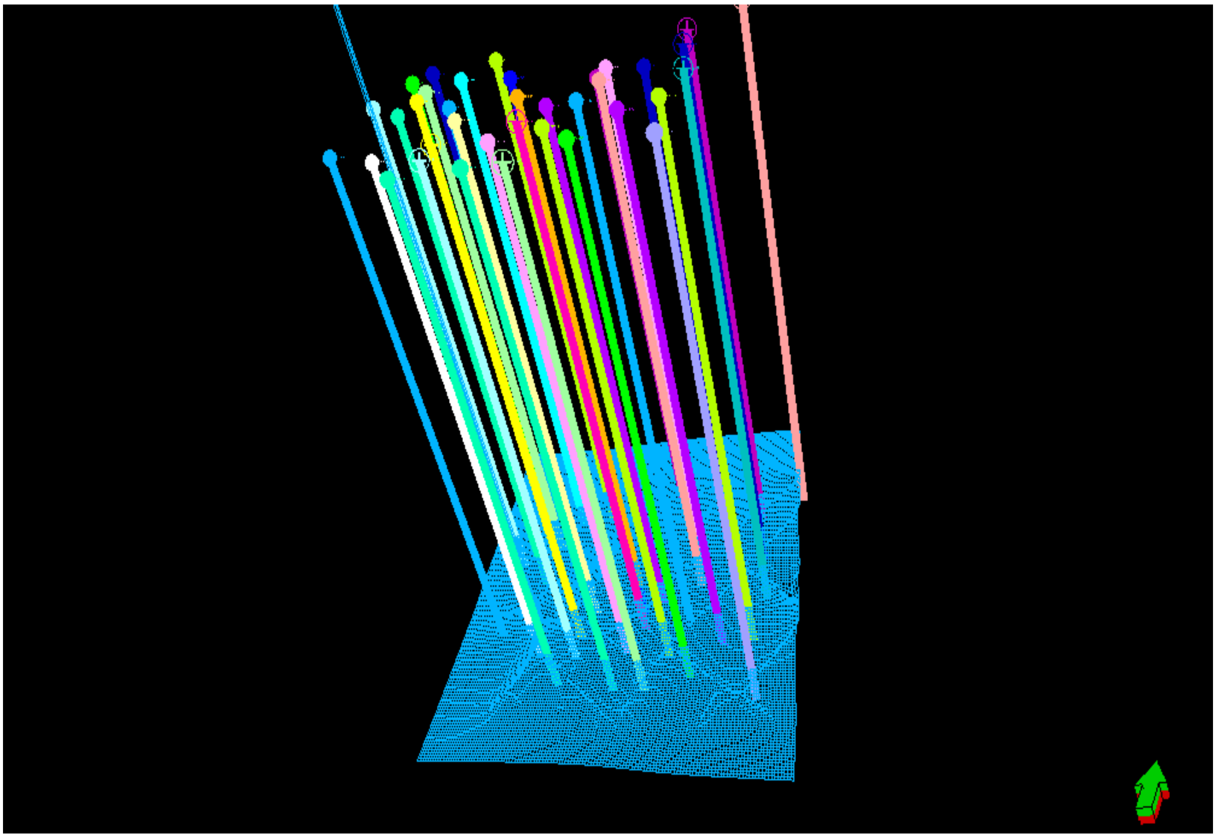

Figure 23: 3D mesh (50*50m) of the clayey sandstone Triassic in the study area.

III.3.2. The interpretation of property modeling

III.3.2. 1. The interpretation of facies modeling

Reservoir facies distribution maps (Figure 27) are established after the geostatistical analysis of the data and the selection of an appropriate estimation method.

The estimation method used is sequential indicator simulation for discrete variables such as facies.

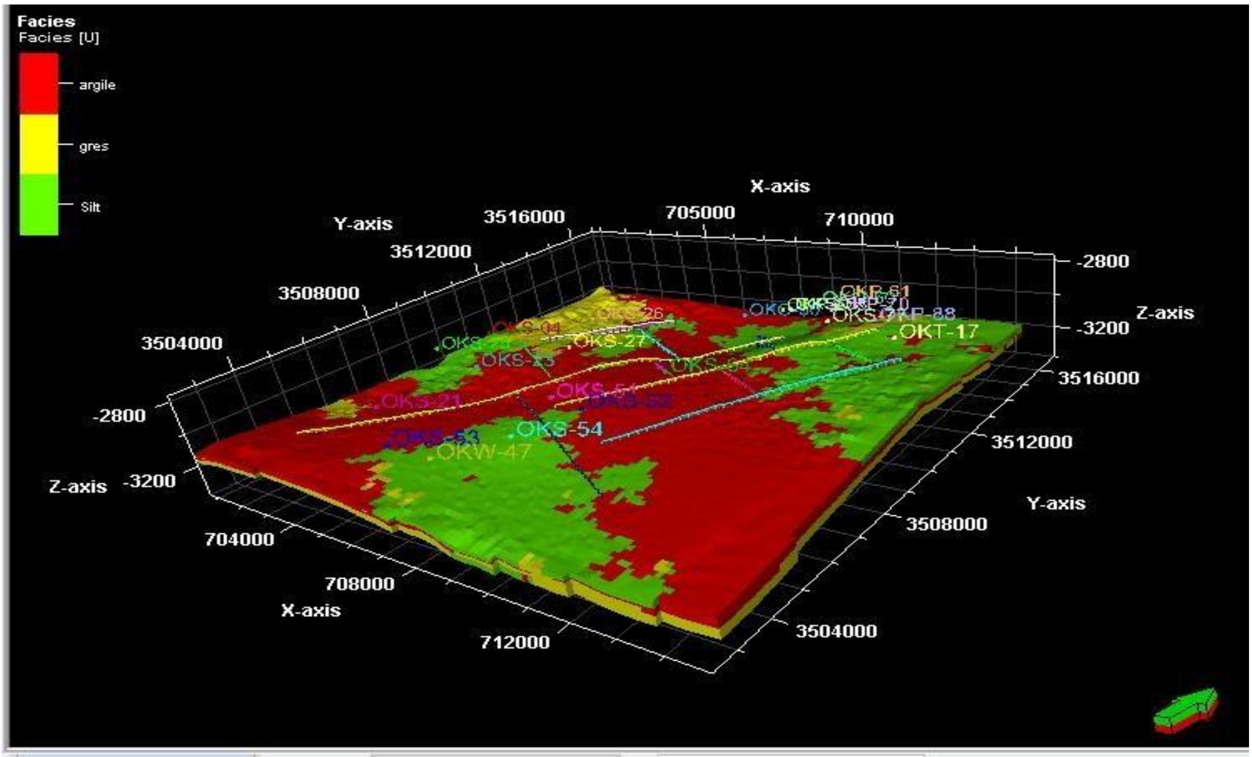

Figure 24: Facies model of the clayey sandstone Triassic in the study reservoir.

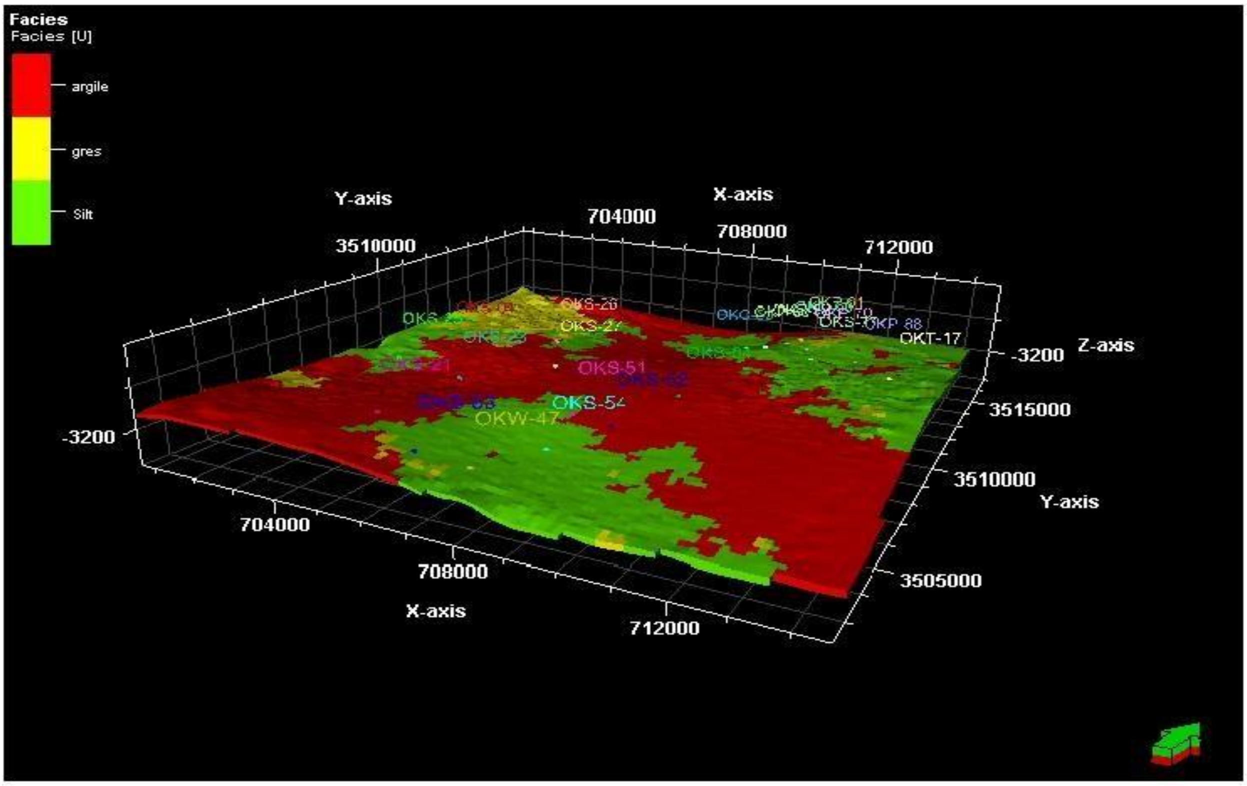

Figure 25: Facies distribution model at T2

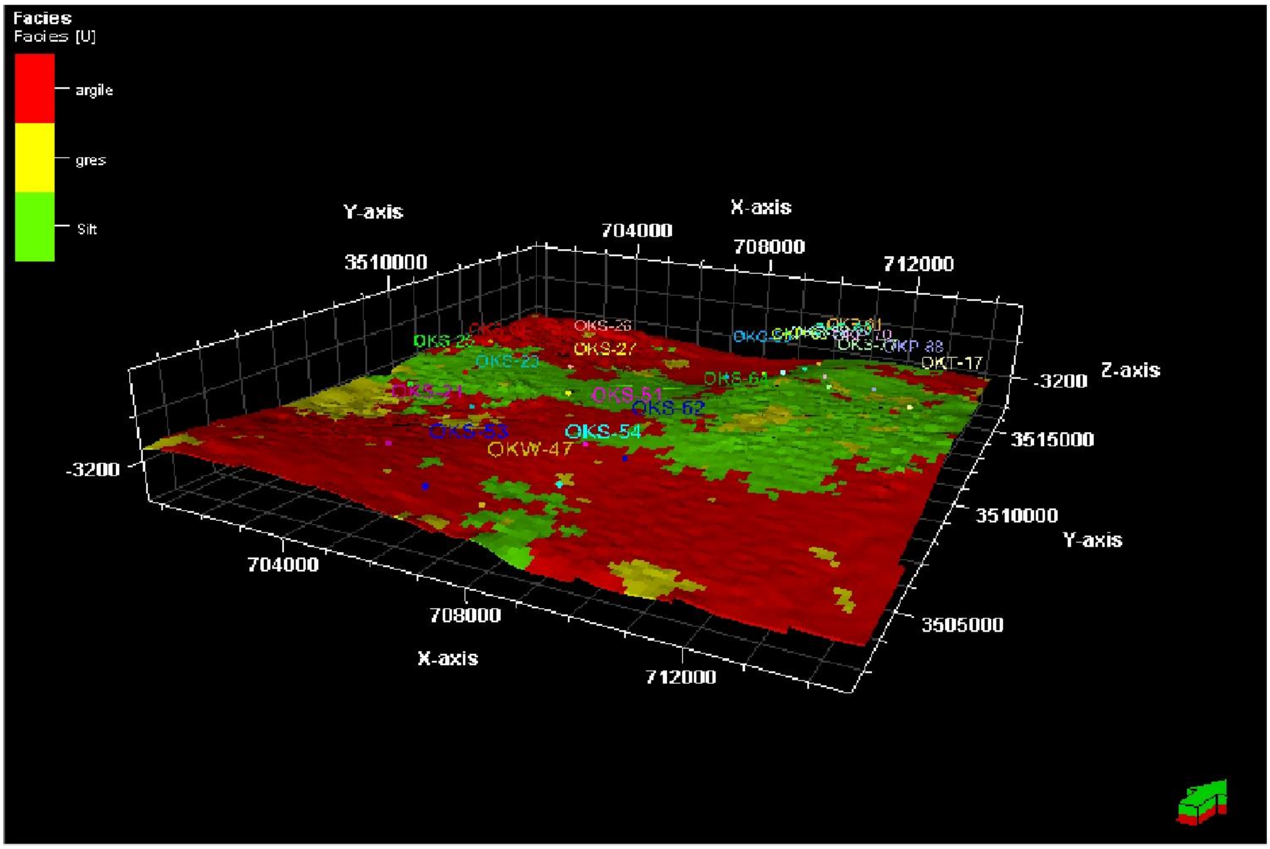

Figure 26: Facies distribution model at T1

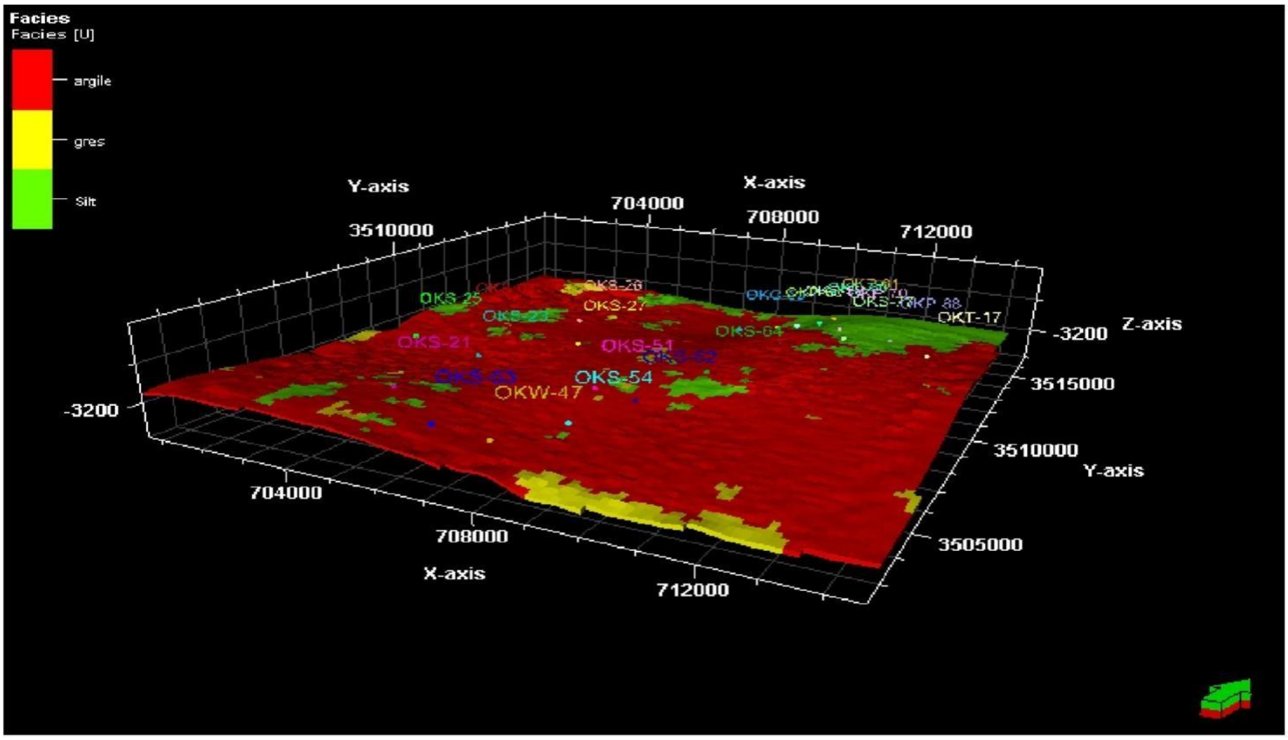

Figure 27: Facies distribution model of Andesite.

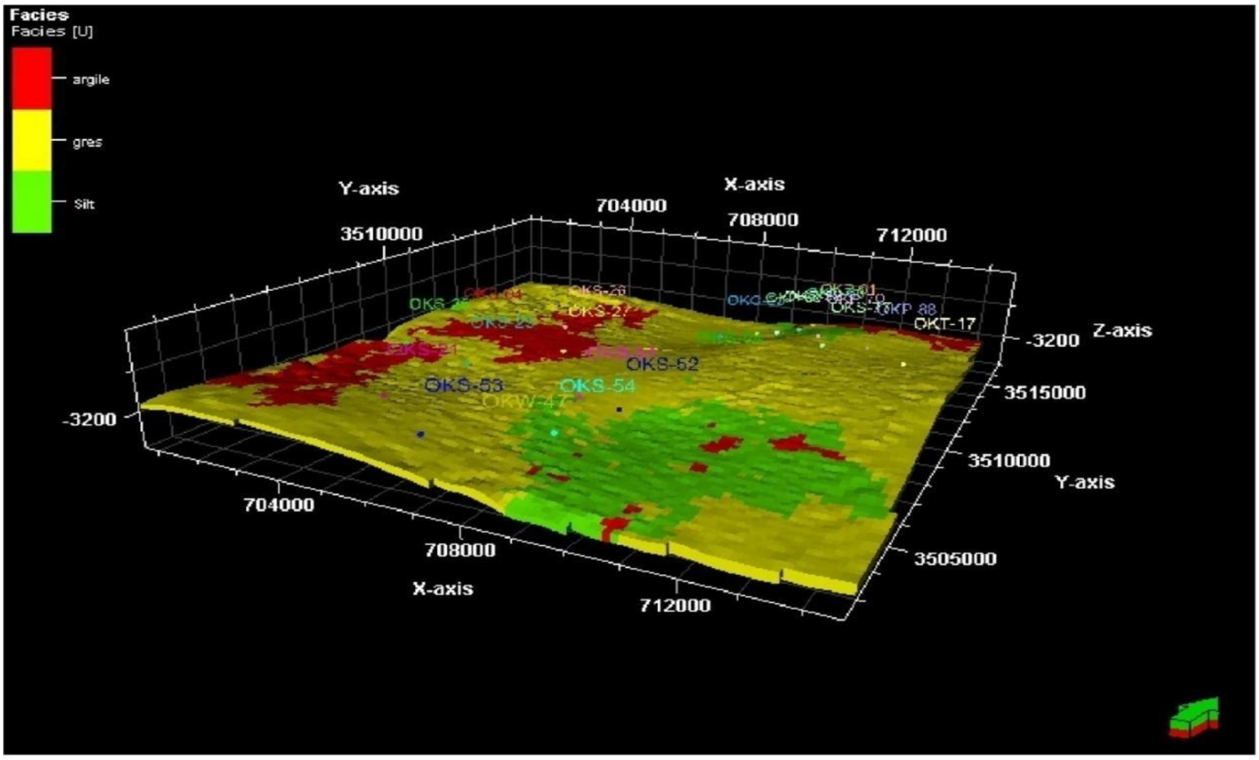

Figure 28: Facies distribution model in the Lower Series.

From the modeling of the facies of the different reservoirs of the argillaceous sandstone Triassic, it was found that:

- The T2 reservoir presents clays and silts with very weakly developed sandstone bodies (Figure 28);
- The T1 reservoir, which is a formation consisting of a lateral distribution of clay and silt, with very weak sandstone bodies (Figure 29);
- The Andesite reservoir presents clays with silts and very weakly developed sandstone bodies (it is a local cover rock of the Benkahla area) (Figure 30);
- The lower series, which is the main target in all wells, consists of clay and strongly developed sandstone bodies, and it is discordant on the Silurian clay. Its average thickness is around 40 to 50 m. (Figure 31).

III.3.2.2. The interpretation of petrophysical modeling

The objective of this research is to highlight the evolution of petrophysical characteristics (Porosity, permeability, saturation…). This is essential for evaluating their capacities and for a better understanding of fluid flow phenomena, which will enable optimal exploitation of the reservoir in question. The models of the different petrophysical properties (porosity and permeability) were created based on petrophysical interpretation using IP and core analysis. For the simulation, the SGS (Sequential Gaussian Simulation) algorithm and the spherical variogram were used.

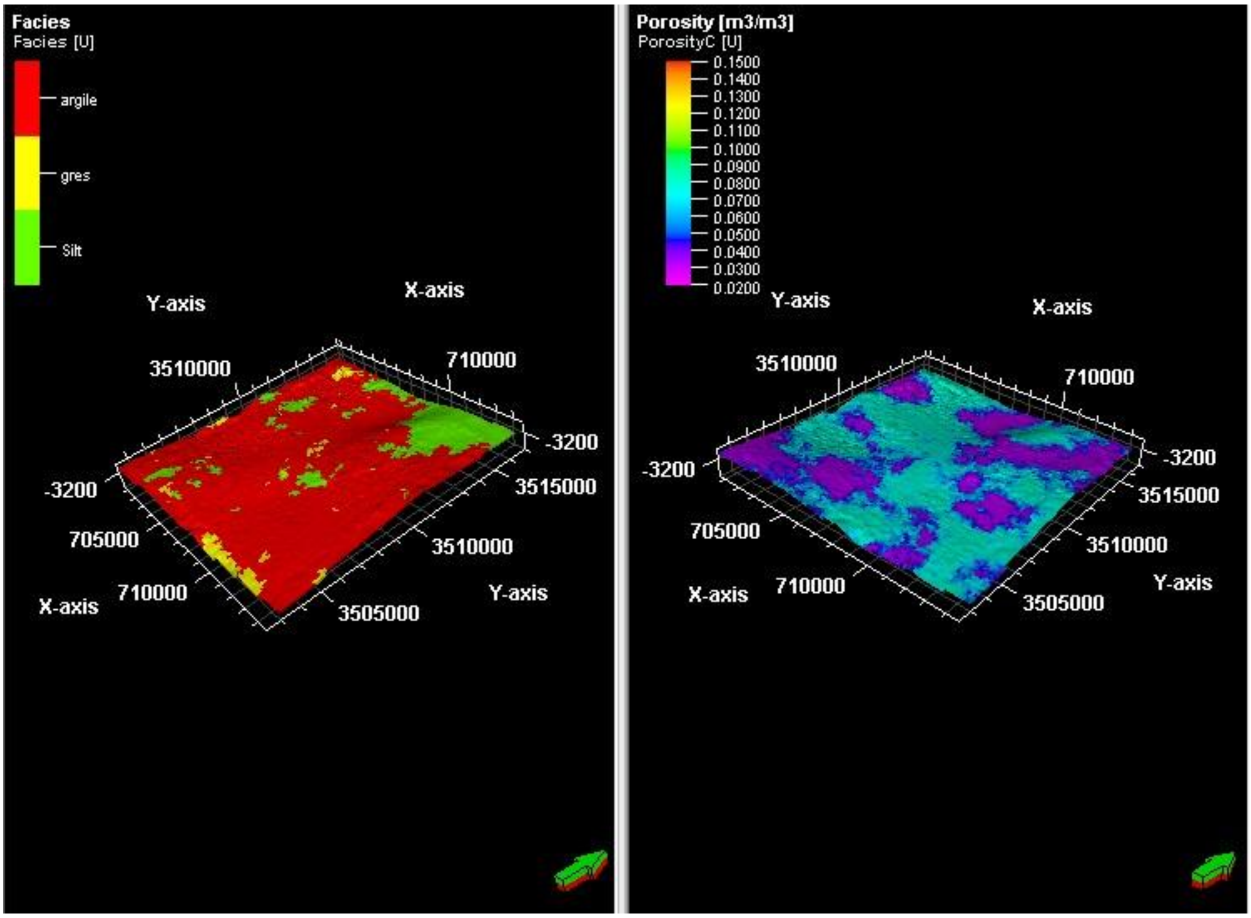

Figure 29:Facies distribution model and core porosity at L'Andésite.

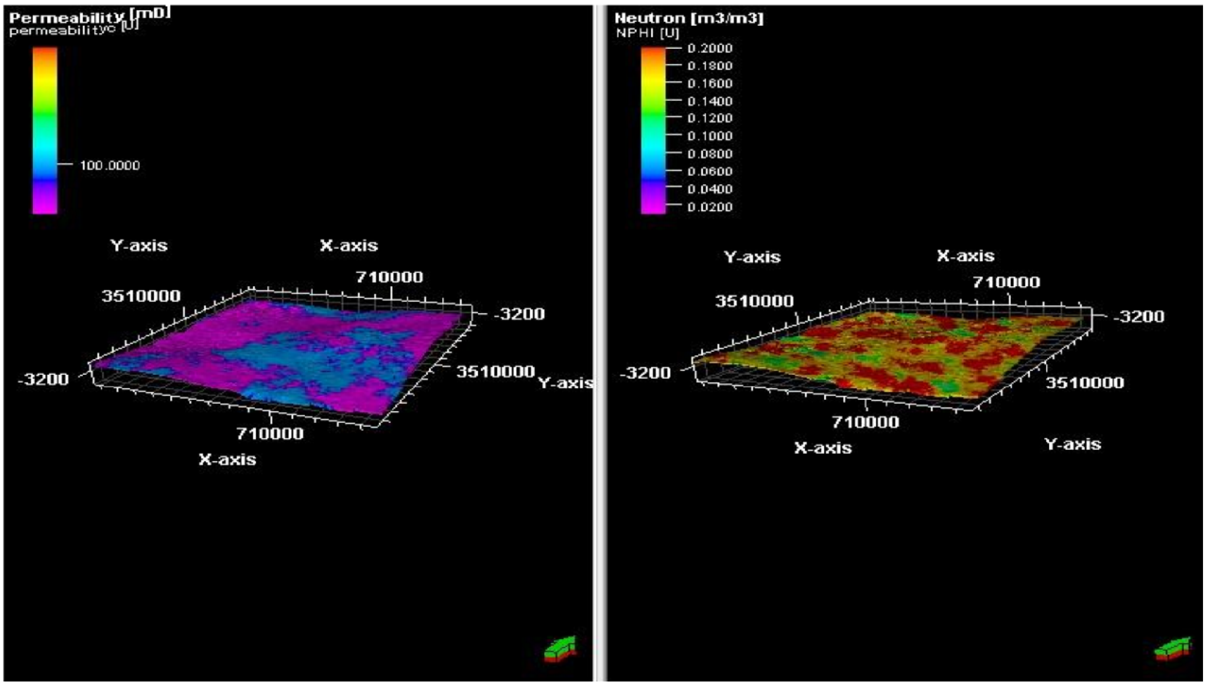

Figure 30:Porosity distribution model (NPHI) and core permeability in Andesite.

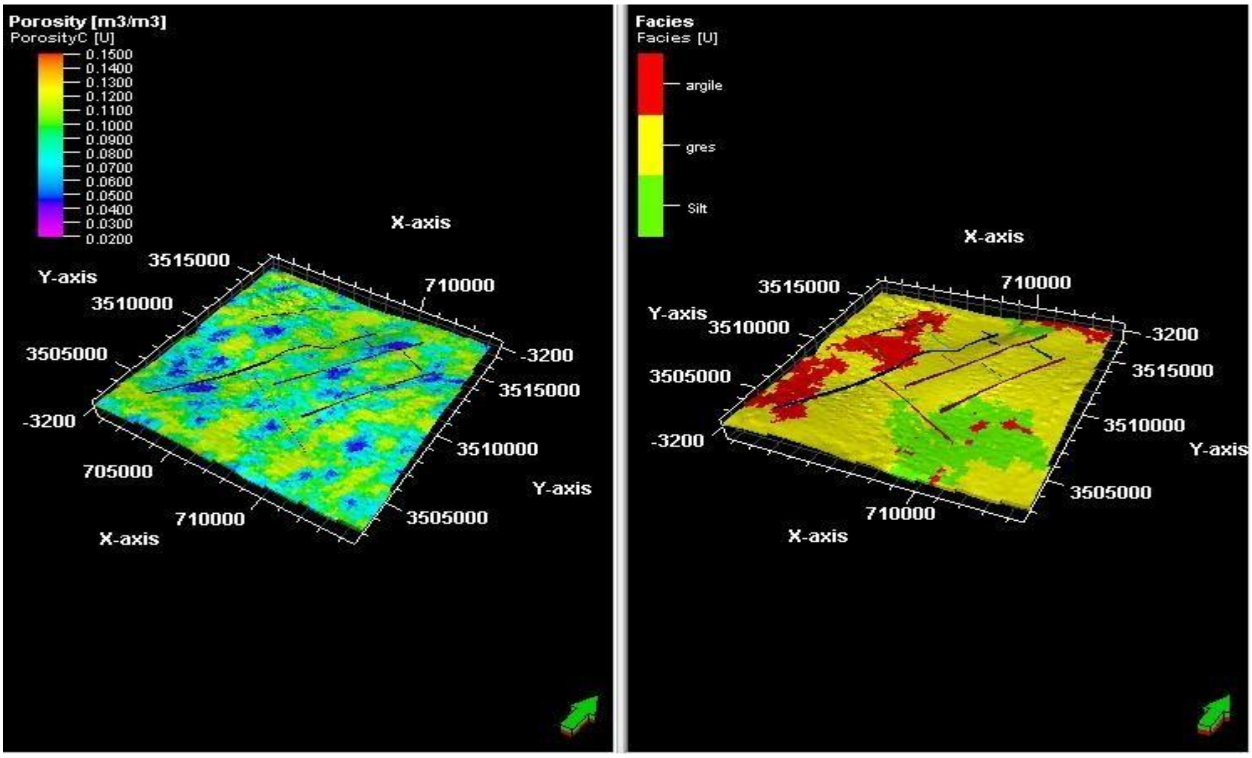

Figure 31: Model of facies distribution and core porosity in the lower series.

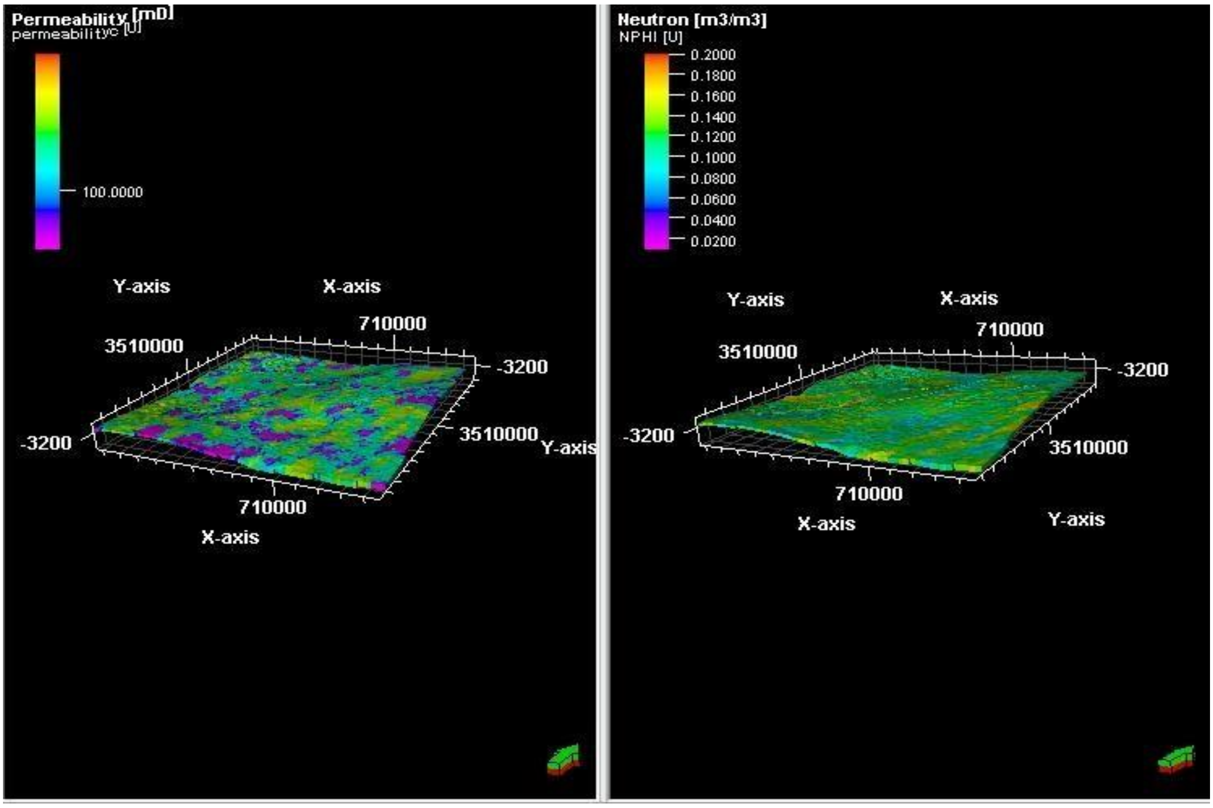

Figure 32: Porosity distribution model (NPHI) and core permeability in the lower series

Based on the modeling of petrophysical properties in the various reservoirs of the clayey sandstone Triassic; it was found that:

- **Andesite** exhibits low core porosity and permeability, which is a formation composed of clays. On the other hand, log diagraphy porosity is very good
- **Lower series:** it exhibits characteristics of core porosity (Figure 34), very good log diagraphy porosity averaging 12%, and also good core permeability, averaging 300mD, over a large part of the field. Despite the relatively high clay content, the southwestern part exhibits good permeability, generally due to the development of a large network of fractures.

III.3.3. The interpretation of the oil-water contact modeling:

The analysis of the Isobath map at the top of the oil-water contactshows an anticlinal structure near the wells: OKS-27 and OKS-23. The reservoir deepens toward the southeast and northwest flanks. The depth of the oil-water contact roof in the studied area varies between -3170 and -3300 m.

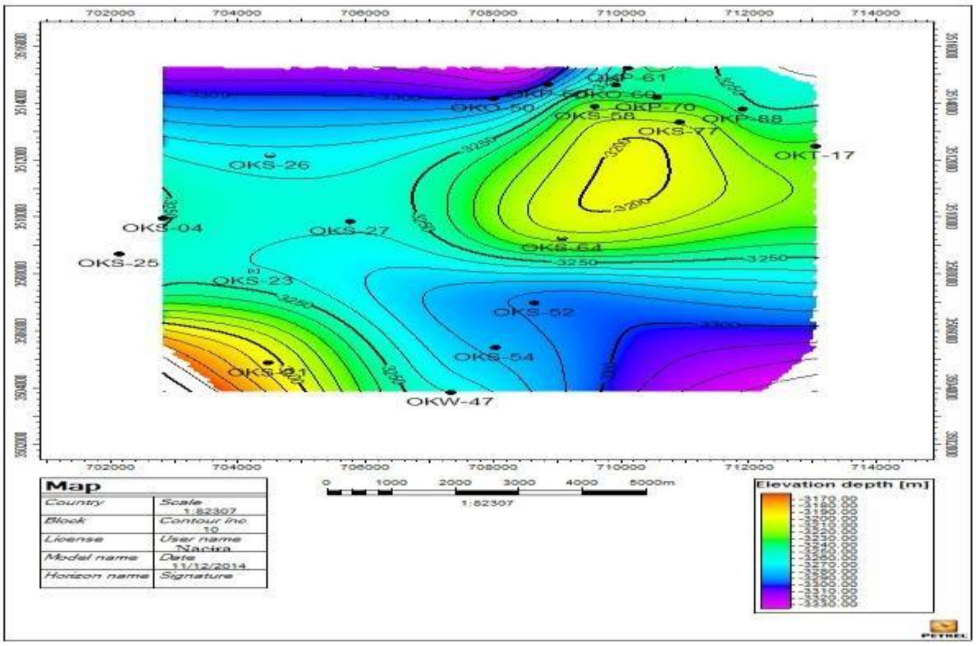

Figure 33: Oil-water contact map

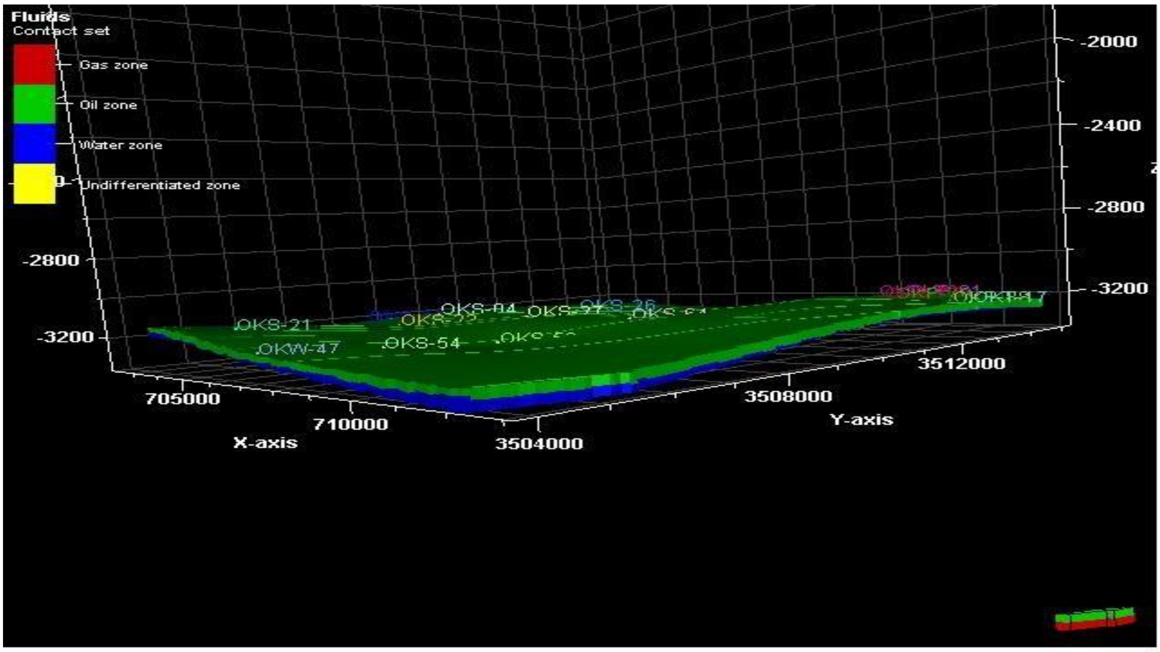

Figure 34: Oil-Water Contact Model

III.4. The estimation of possible in-place oil

This method is used for the evaluation of in-place oil reserves in fields that have been sufficiently studied and explored. The advantage of this method is that it can be used for any production regime and at any stage of exploitation.

$$\mathbf{Q_{rec}=F\ .h_o\ .\Phi\ .\ S_0.\theta.\ \rho\ .\gamma}$$

$\mathbf{Q_{rec}}$=91145831,3*15,2466667*0,116861905*0,71568095*1.5*0.807*15.
85

Qrec =2229965767=22.29.10^8 tonnes d'huile

The present research work can be completed later, despite the lack of access to seismic and geological data, but we can build a geological model (static model). The lower series reservoir is the main objective, the diagraphic and petrophysical interpretation, as well as the brief description of the cores, confirm that the lower series reservoir remains completely in the oil part, above the oil/water contact, with an average reservoir pressure of 442 kg/cm. The interpretation of the logs shows us that the main reservoir in the lower series has a total thickness of 35 to 57 m, of which approximately 6 to 20 m is useful for oil. The top exhibits average porosities and average SW. On the other hand, the basal part has very good porosities and high SW. This is due to the very low resistivity values recorded at the base of the reservoir.

Structural analysis shows two fault networks, oriented NE-SW and NW-SE. However, the NE-SW direction is predominant, and it is in the form of horsts and grabens.

Geological cross-sections have been carried out on the structure of the area, showing that the thickness of the lower series is less significant in the center, with an increase toward the south. Indicating a bevel, presented as a limit of the reservoir's extension in the southern part of the structure.

Geological, structural, and diagraphic studies have made it possible to differentiate and delineate the various Triassic reservoirs and to develop maps and models of the spatial distribution of facies and petrophysical parameters. This will allow us to locate the most favorable areas for the establishment of new drillings. The development decision factor, The spatial decision factor map indicates that the most favorable areas (1, 2, and 3) with the current data are located in the center of the southern part of the field, to the northeast of it, and in the eastern center of the studied region.

GENERALE CONCLUSION

General conclusion

The Benkahla deposit, located in the Oued Mya depression, in the center of the Algerian Triassic province, represents the most explored area of this basin. This area is located between the two deposits of Hassi R'mel to the northwest and Hassi Messaoud to the east.

The major petroleum interest of the deposit is related to the presence of Triassic reservoirs. The Paleozoic and Triassic targets are located at a significant depth, between 3400 m and 4000 m. Within the Triassic, the primary target consists of the lower series.

The main source rock for the Triassic reservoirs of the Benkahla deposit is composed of radioactive Silurian clays.

The regional cover of the Triassic reservoirs is composed of the Triassic evaporites (saliferous S4) and the Lias (levels S3 to S1). The trapping in the basin is of structural, mixed, or purely stratigraphic type. To establish a model, we use the Petrel software. This software already allows, at this stage of the static model analysis, to visualize in 3D the petrophysical characterization of the reservoirs. It is a comprehensive software used at all stages of exploration, development, up to the final phase of operation, after production and field closure.

Pour pouvoir modélisé le gisement, il faut introduire tous les paramétrés de reservoirs, namely: The coordinates (x, y, Zs (Z ground), Zt (Z table), log depth, drilling depth, and Symbol) of all the wells (21 wells) used to construct this model. The roofs and walls of the existing units in each well interpreted from the logs, the logs (interpreted log data).

The lower series reservoir is the main target. The interpretation of the logs, petrophysical analysis, and the brief description of the cores confirm that the lower series reservoir remains entirely in the oil zone, above the oil/water contact, with an average reservoir pressure of 442 kg/cm.

The interpretation of the logs shows us that the main reservoir of the lower series has a total thickness of 35 to 57 m, of which approximately 6 to 20 m are useful for oil. The top exhibits average porosities (07%) and average SW (21%). On the other hand, the basal part has very good porosities (12%) and high SW (33%). This is due to the very low resistivity values recorded at the base of the reservoir.

Structural analysis shows two fault networks, oriented NE-SW and NW-SE. However, the NE-SW direction is predominant, and it is in the form of horsts and grabens.

Geological cross-sections conducted on the structure of the area show that the thickness of the lower series is less significant in the center, with an increase toward the south, indicating a bevel, presented as a limit of the reservoir's extension in the southern part of the structure.

Geological, structural, and diagraphic studies have allowed for the differentiation and delineation of the various Triassic reservoirs and the development of maps and models for the spatial distribution of facies and petrophysical parameters. This will allow us to locate the most favorable areas for the establishment of new drillings, thus implanting new exploration wells to the south and east of the field to determine the water-oil contact.

The development decision factor, The spatial decision factor map indicates that the most favorable areas with the current data are located in the center of the southern part of the field, to the northeast of it, and in the eastern center of the studied region.

We can proceed with the construction of a dynamic model using a geological model, in addition to the production profile.

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