PETROPHYSICAL ANALYSIS OF MISSA KESWAL-03 WELL, UPPER INDUS BASIN, PAKISTAN

A thesis submitted to Bahria University, Islamabad in partial fulfillment of the requirement for the degree of BS in Geology

Ahmed Hassan Ghauri

Misbah Riaz

Department of Earth and Environmental Sciences

Bahria University, Islamabad, Pakistan

2022

ABSTRACT

.

The objective of this study is to find the hydrocarbon potential of Missa Keswal-03 well. Upper Indus Basin, Pakistan. In Missa Keswal-03, drilling has been done up to Khewra Sandstone of Early Cambrian age.

Missa Keswal oil field is situated around 60km from Islamabad in the eastern side of Potwar basin. On surface, it is an anticline thrusting in SW-NE direction.

Data which is used in this study are LAS files and well tops of well-03 of Missa Keswal. LAS files of this wells only contain the complete log curves of Chorgali, Sakesar and Nammal respectively.

Log used are Gamma ray log, SP log, Caliper log, Resistivity logs, Neutron-porosity log. Methodology adopted for petrophysical analysis included interpretation of log curves, calculation of volume of shale, estimation of porosities, and computation of resistivity of water by Pickett plot and hydrocarbon saturations by utilizing Archie's equation.

Two prospect zones in each of formations i.e., Chorgali Formation and Sakesar Limestone have been marked. Petrophysical analysis indicated that Chorgali and Sakesar have fair hydrocarbon potential.

ACKNOWLEDGEMENTS

All our praises to Allah Almighty, for his mercy and beneficence who help us in all difficulties and guide us, to get through this tremendous effort of compiling our age long learning into this work of thesis. Endless belief in last Holy Prophet (P.B.U.H), who reliably directed mankind to look for data or information.

We offer our heartfelt gratitude to our supervisor Mr. Saqib Mehmood, Senior Assistant Professor (E & ES), Bahria University, Islamabad campus for his dynamic assistant, friendly encouragement, and sincere advices and for trusting us to adopt our own working style.

We pay our humble regards to Dr. Said Akbar Khan, Head of Department, of Earth and Environmental Sciences, Bahria University, Islamabad for their concern and kind attention.

We must not forget our family and friends who provided emotional and financial equilibrium which led us to accomplish our goals and helps us to discover our literary capabilities.

CONTENTS

CHAPTER 3

PETROPHYSICAL INTERPRETATION

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

LLS	Shallow Lateral Log
LLD	Deep Lateral Log
MSFL	Micro-Spherically focused Log
SP	Spontaneous Potential
GR log	Gamma-ray log
Vsh	Volume of shale
Rt	Resistivity of true zone
Rw	Resistivity of water
Sh	Hydrocarbon saturation
Sw	Water saturation
SPDZ	Southern Potwar Deformed Zone
NPDZ	Northern Potwar Deformed Zone
SRPFB	Salt-range Potwar Fore Belt
SRT	Salt range Thrust
MBT	Main Boundary Thrust
MMT	Main Mantle Thrust
MKT	Main Karakoram Thrust

CHAPTER 1
INTRODUCTION

Presently, economy is being controlled by energy sectors; which ultimately affected the political and economic stability of country. Energy sector of Pakistan comprised of oil and gas, coal and electricity. Hydrocarbon and its exploitation have an ultimate relation with the development and progress of country. (Alger, 1980).

In oil exploration, our main goal is to identify the porous and permeable formation, determine its size, thickness, extent of reservoir etc. The productivity of wells in oil and gas bearing reservoir is influenced by petrophysical properties which includes porosity, permeability, saturation, and resistivity.

Petrophysical analysis is carried out to for the examination of hydrocarbon saturation of a particular oil and gas well. It is one of the critical and valuable tools which are used for the characterization of reservoir.

1.1 Introduction of the study area

Northern and southern parts of Pakistan are highly capable of producing hydrocarbons.48% of worlds known oil resources belong to the category of extra-continental downward basins; including Indus and Kohat-Potwar basins (study area) and Indus basin (Kadri, 1995).

In June 1991, Missa Keswal oil field was discovered. Later on, its generation was started in December (1992). An anticline bounding thrust having NE-SW direction of strike. In 1980, seismic work was completed, and the well drilled; which was not successful. Seven reservoir units of oil and gas which is of Cambrian, Eocene, Pliocene and Miocene eras were successfully produced when a new well was drilled later on.

Gas reserves of 27.900 BSCF and 37.650 MMSTB oil reserves have been named as proven reserves originally. At the meantime, three wells of Missa Keswal field produces 4500 barrels of oil and 7.3 MMCFD of gas in a day.

1.2 Location of the Study area

Oil field of Missa Keswal is positioned around 60km of distance in the south-east of Islamabad in the eastern part of Potwar basin (Fig 1.1). Its's latitude and longitude are 33°12'0"N and 73°22'0"E respectively.

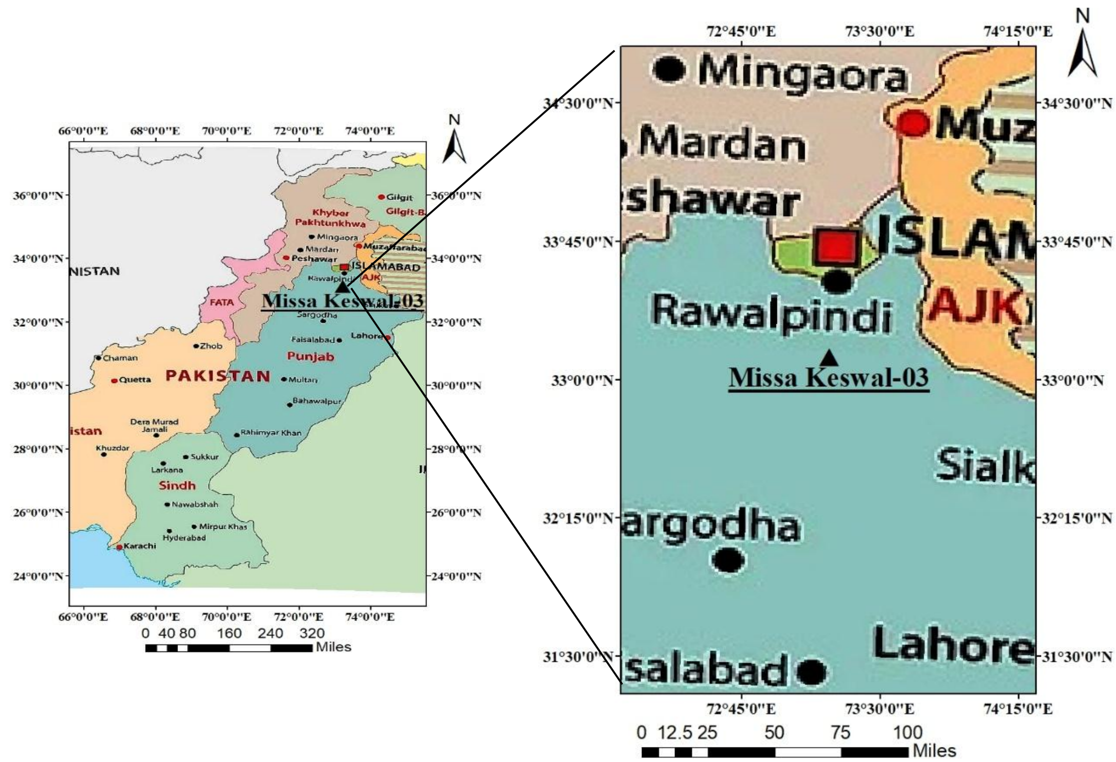

Figure 1.1 Location map of Missa Keswal (from ArcMap GIS 10.5)

1.3 Climate

Climate of study area is dry cold in winter while hot in summer. Average temperature during winter ranges from 8°C to 20°C and rises up to 42°C in summer. Average annual rainfall is 880mm.

1.4 Objectives

Main goal of this study is to;

1. Interpret the hydrocarbon potential in reservoir zones of Missa Keswal oil field.
2. Identify the lithologies of reservoir zones of Missa Keswal-03.

1.5 Data Required

Well tops and LAS files of Missa Keswal-03 are required for this study.

1.6 Methodology

This study is comprised of few steps. Logs used in this study are loaded into GVERSE software. Logs are displayed; on the basis of three parameters and readings of Resistivity logs, Porosity logs are used to interpret the zones of interest of Missa Keswal-03.

By using Pickett plot, Resistivity of water is computed. Utilization of Archie's equation gives the result of water and hydrocarbon saturation.

Two types of crossplots (DT vs NPHI and RHOB vs NPHI) are used to identify the lithologies of reservoir zones. Methodology we used to acquire our results consists of few steps which has been shown in figure 2.2.

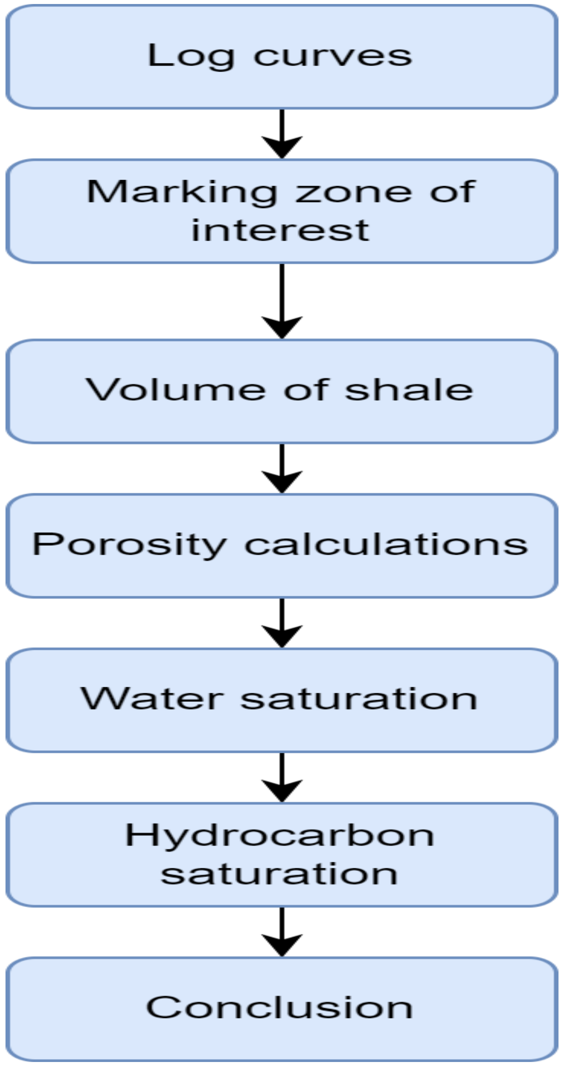

Figure 1.2 Flowchart indicating the methodological approach for analysis.

1.7 Possible Outcomes

Possible outcome is to delineate the hydrocarbon potential of Missa Keswal oil field in its different zones.

CHAPTER 2
GEOLOGY AND TECTONICS

2.1 Pakistan's Regional Tectonic Setting

Location of Pakistan is at the dynamic plate boundaries; point at which Arabian, Eurasian and Indian plates collide and create two forms of plate boundaries. One of them is the collision of continent with other mainland include the collision of Indian plate with Eurasian and as a result orogeny of Himalayas take place; while the subduction of Arabian plate under southwestern part of Pakistan lead to Chagai volcanic arc.

Other transform boundary is in the west of Pakistan having strike-slip fault between Afghan and Indian plate resulting in the formation of Charbagh transform fault (Fig 2.1).

Indian plate is thought to be Tethys ocean of late Paleozoic era, closed due to the northward collision of Indian plate. Areas covered by oceans filled with the sediments of Permian age. Australian plate, Antarctica, Indian and African plate separated from Gondwana in Jurassic time period and later on for next 50 million years, Indian plate kept moving at slow pace in northward direction till it collided with Eurasian plate (Jan, 1997).

Shift of Indian plate towards the north was the result of closing of Tethys Ocean, formation of volcanic arches etc.

Sedimentation and deposition of Upper Indus basin is the result of Indian plate northward movement to Eurasian plate. Subduction of Indian late under Eurasian resulted in the formation of Himalayas i.e., Continent-Continent collision (Jan, 1997).

Formation of many faults such as MBT, MKT, MMT, and SRT as shown in figure 2.1 are the result of thrusting mechanism.

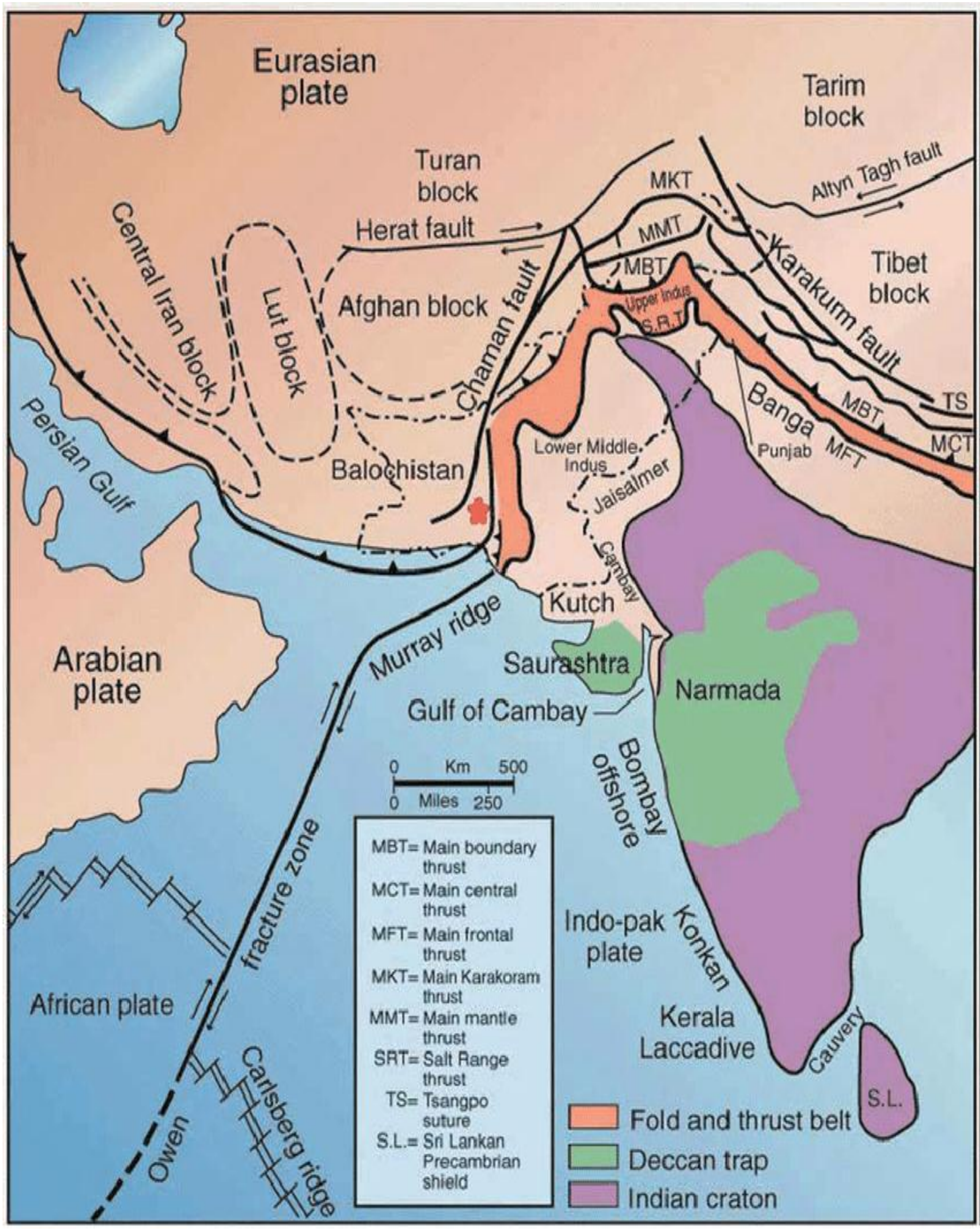

Figure 2.1 Regional tectonic setting of Pakistan (Modified from Quadri & Quadri)

2.2 Indus Basin

It is the largest sedimentary basin of Pakistan and situated along its axis to the east of Pakistan and extend NE-SW of about $1600km^2$. It is further subdivided into three basins;

1. Upper Indus
2. Central Indus
3. Southern Indus

Upper basin occupies an area of $50,000km^2$ while an area of about $250,000km^2$ covers by the lower basin. Upper and central Indus is separated by Sargodha high while Jacobabad high separates Central Indus from lower Indus basin.

Two largest reservoirs are separated in Upper Indus basin i.e., Kohat and Potwar; separated by Indus River.

2.3 Regional Tectonics of Potwar Sub-Basin

It is the part of Upper Indus Basin. North and South of basin comprised of MBT and SRT i.e., two major faults of Pakistan.

Jhelum fault is in the east while Indus River marks its boundary with Potwar sub-basin in west. KalaBagh fault is in the southwest of basin.

It is further sub-divided into three zones;

1. Northern Folded Zone (NFZ)
2. Potwar Plateau
3. Salt Range

NFZ separated from Potwar Plateau by Khair-e-Murat fault (Ali H. Kazmi, 2008). Faults, folds, oroclines, syntaxes are present in Potwar sub-basin which is the result of compressional regime.

Sedimentary fold belt and Ophiolitic fold belt resulted from Himalayas collision are also present in this region.

Many minor thrust and normal faults are present here (Jan, 1997). Northern Potwar (NPDZ) and Southern Potwar (SPDZ) separated by Soan syncline i.e., two major deformed zones are also present in this region as shown in figure 2.2. NPDZ is extensively distorted as compared to SPDZ due to the presence of many structures. NPDZ is a part of Neogene deformation. It is extended from MBT to Soan syncline in southward direction.

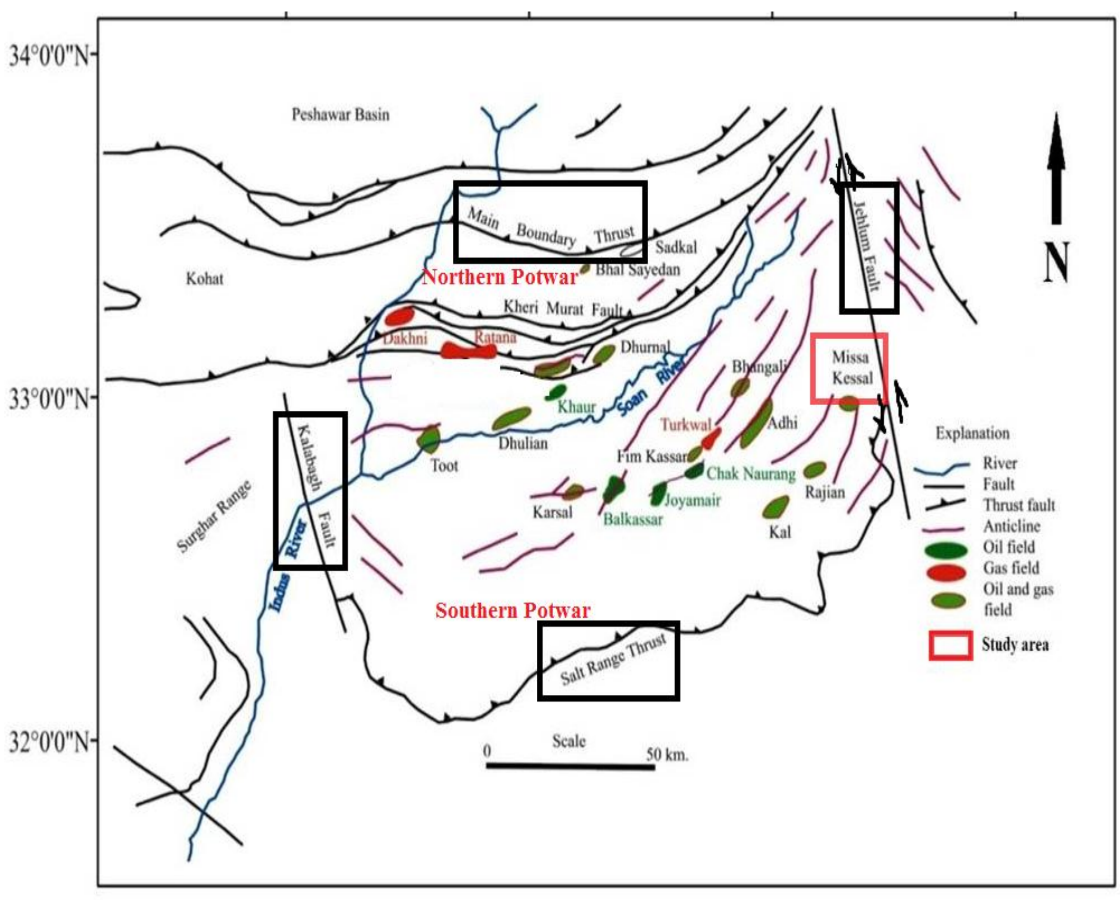

Figure 2.2 Generalized tectonics of Potwar sub-basin (Wandrey et al., 2004)

2.4 Generalized Stratigraphy of Potwar Sub Basin

Age of formations ranges from Precambrian to Quaternary sedimentary rocks as shown in figure 2.3. Lithologies encountered mainly are sandstone, siltstone, limestone, with small quantity of marl and gypsum. Exposed sediments (in Salt range) of Quaternary and Permian age filled the Potwar basin. (I.B, 1995).

It also consists of thick evaporate deposits; these deposits were overlain by Cambrian and Eocene age thin deposits; after that there is the deposition of the Miocene to Pliocene thick molasses on it. Oldest formation is infra-Cambrian Salt range formation contain halite with marl, shale and dolomite (Aamir, 2006).

One of the good producers of oil is Jhelum group (Fig 2.3). Sandy carbonates and near-shore sandstone found in Jutana. Baghanwala have sandstone and interbeds of shale; and it is of Cambrian age. An unconformity is marked at the top of Baghanwala which continues till Permian age.

2.5 Borehole Stratigraphy

2.5.1 Chinji Formation

The term "Chinji zone" is used by Pilgrim in 1913. Lithologies found in this formation are red clays and grey sandstones (Shah, 2009). Depositional environment is continental outwash.

2.5.2 Nagri Formation

The term "Nagri formation" is introduced by Lewis in 1931. Its type locality is Attock District's Nagri Village. Lithologies encountered are clays, sandstones (Shah, 2009).

2.5.3 Kamlial Formation

Pascoe in 1963, used it for the first time as “Kamlial beds”. Depositional environment is Fluvial. Lithologies found included Conglomerates, sandstone having shale intercalations (Shah, 2009).

2.5.4 Murree Formation

The term “Murree beds” used by Pilgrim in 1910. Environment of deposition is alluvial. Lithologies included Clay, sandstone with subordinate intraformational conglomerates (Shah, 2009).

2.5.5 Chorgali Formation

This formation belongs to Eocene age. Its type locality is Khair-e-Murat range (Shah, 2009). Lithologies included Limestone, Sandstone, Dolomite, Shales. Fossils found are forams, ostracods and mollusks.

2.5.6 Sakesar Limestone

This term first used by Gee in 1935. Fossils encountered are Echinoids, Mollusks, and Forams. Lithologies included Limestone, marl, chert (Shah, 2009).

2.5.7 Patala Formation

This term first used by Stratigraphy committee of Pakistan in 1977. Lithologies included Shale, marl, limestone. It is a proven source rock.

2.5.8 Lockhart Formation

This term first used by Davies in 1930. Depositional Environment is shallow marine. Lithologies encountered are Limestone, shale and marl. Fossils observed are forams, corals, mollusks and algae. It is a good reservoir.

2.5.9 Hangu Formation

This term first introduced in 1973. Lithologies encountered are Sandstone, shale, limestone. Fossils observed are Gastropods, Forams, and bivalves. It is a reservoir rock (I.B, 1995).

2.5.10 Wargal Formation

This formation belongs to Permian age. Lithologies included Limestone exposed at Nammal Gorge. Environment of deposition is Shallow marine (Shah, 2009).

2.5.11 Amb Formation

This formation belongs to Permian age. Its type locality is Khair-e-Murat range (Shah, 2009). Lithologies included Massive sandy limestone, clay, shales. Depositional environment is Shallow marine (Shah, 2009).

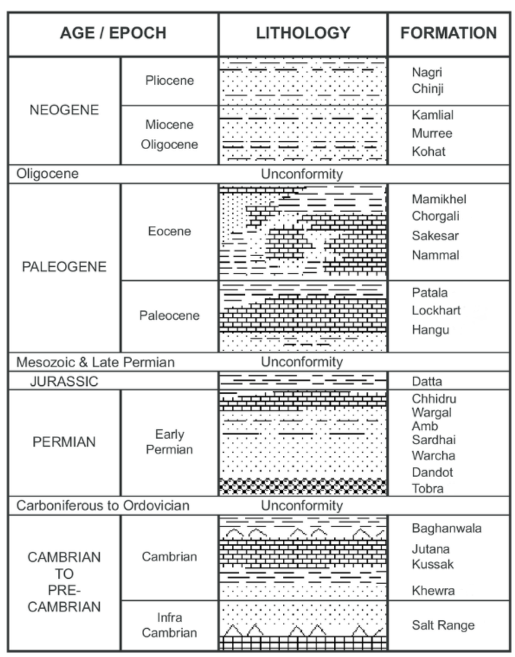

Figure 2.3 Generalized Stratigraphy of Upper Indus basin ((modified from OGDC 1996; Wandrey et al., 2004).

Stratigraphic successions encountered in Well-03 of Missa Keswal shown in table 2.1

Table 2.1 Stratigraphic succession encountered in Missa Keswal-03

Formation	Age	Formation Top (m)	Thickness (m)
Chinji	Miocene	0	935.00
Kamlial		935.00	190.00
Murree		1125.00	745.00
Chorgali	Eocene	1870.00	44.00
Sakesar		1914.00	69.00
Nammal		1983.00	13.00
Patala	Paleocene	1996.00	8.00
Lockhart		2004.00	13.00
Hangu		2017.00	6.00
Dandot	Early Permian	2023.00	10.00
Tobra		2033.00	6.00
Baghanwala	Middle Cambrian	2039.00	18.00
Jutana		2057.00	24.00
Kussak		2081.00	62.00
Khewra sandstone	Early Cambrian	2143.00	107.00

2.6 Petroleum System

The SRPFB comes under the category of continental down warp basin. Molasses deposits of about 3047m overburdened the ad created a burial depth and provided Geothermal Gradient for Hydrocarbon formation especially oils.

Sources depicted that a total of 2^{o}C/100 m of geothermal gradient has potential of producing oils at depth of 2750-5200m (Haider et.al, 2000). It has several features that support the criterion for hydrocarbon accumulation.

2.6.1 Source rock

Grey shale of Paleocene age Patala formation is considered to be proven source rock. It acts as source rock for both Chorgali Formation and Sakesar limestone.

2.6.2 Reservoir rock

Chorgali of Eocene and Sakesar of Paleocene are oil bearing zones (Shah, 2009).

2.6.3 Traps and seals

Miocene age Murree formation consists of clays and shales act as seal for Chorgali Formation while the shales of Chorgali can act as seal for Sakesar Limestone as well.

Development of traps is time taken and directly related with conditions of burial and paramount hydrocarbon production.

2.6.4 Petroleum Play

Cap Rock	Murree Formation	**Miocene**
Reservoir Rock	Chorgali formation	**Eocene**
	Sakesar Limestone	
Source Rock	Patala Formation	**Paleocene**

CHAPTER 3
PETROPHYSICAL INTERPRETATION

Petrophysical analysis of borehole is performed in order to delineate the zone of interest. Different log curves which are produced by wire line logging is used to perform this analysis.

A zone of interest is marked by following these parameters;

1. GR value should be low and caliper log should be stable.
2. There must be a clear separation between the log curves of MSFL and LLD.
3. A neutron-density crossover.

Other parameter included volume of shale, porosities, water and hydrocarbon saturation.

3.1 Quality check of logs

Log data of Missa Keswal-03 is of good quality and readable. Complete information of logs; which is required to interpret the hydrocarbon zones started from Chorgali Formation up to Nammal; that's why we started to mark our zones from Chorgali Formation. Value of GR-log log is low and caliper log is on-gauged on most of the depths.

3.2 Uninterpreted Log Trends

In track 01, GR log, SP log, Caliper log and bit size are located. Curves of GR log shows undulations and peaks while Caliper log on most of the depths remained on-gauged (Fig 3.1).

In track 02, Resistivity logs such as LLD, LLS, and MSFL (MLL) are presented on logarithmic scale. All of these three logs showed irregular values throughout the borehole.

In track 03, porosity logs i.e., neutron, sonic, average are plotted as shown in figure 3.1. Average porosity is calculated by using sonic and neutron log (sonic log is used as density correction here).

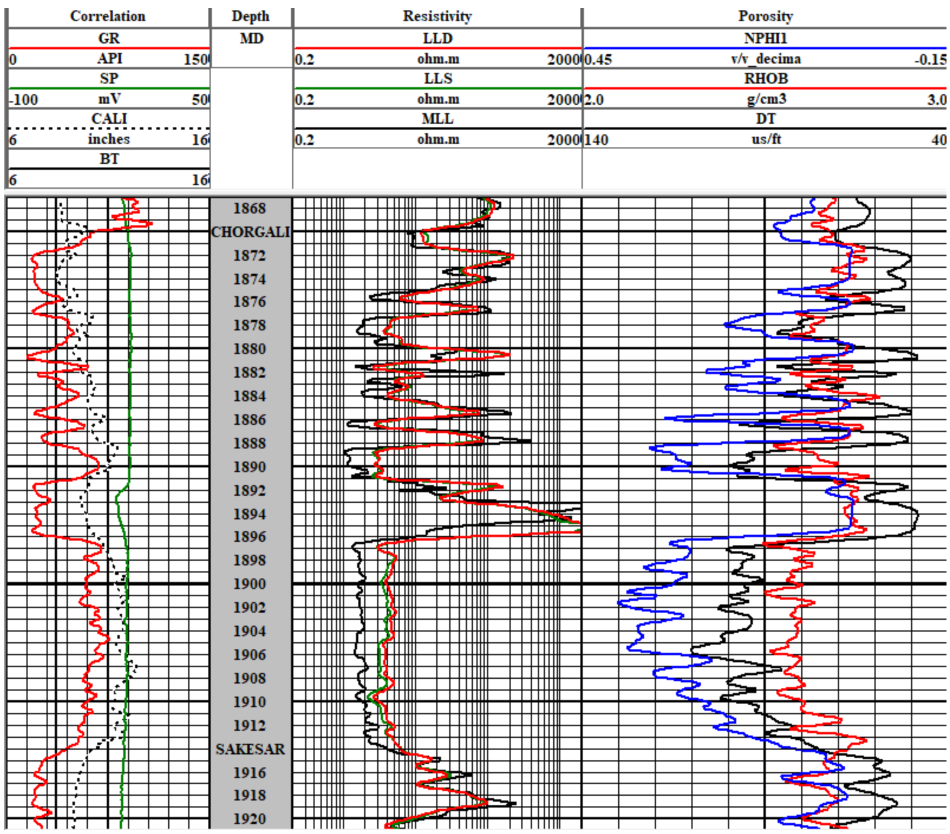

Figure 3.1 Uninterpreted log trend of well-03 of Missa Keswal

3.3 Zones of interest of Missa Keswal-03

By using GR value, conditions of MSFL, LLS, LLD and crossover between neutron density 2 zones of Chorgali formation and 2 zones from Sakesar Limestone has been marked respectively.

Zones with maximum thickness will be targeted as zone of interest; as it will be more viable economically. However, there can be a good quality reservoir present in zone of less thickness, in that scenario; zone with minimum thickness can also be our target.

3.3.1 Zones of Chorgali

Zone	**Formation**	**Starting depth (m)**	**Ending depth (m)**	**Thickness (m)**
1	Chorgali	1873.15	1876.04	2.89
2	Chorgali	1879.85	1880.91	1.06

3.3.2 Zones of Sakesar Limestone

Zone	**Formation**	**Starting depth (m)**	**Ending depth (m)**	**Thickness (m)**
1	Sakesar	1923.56	1925.23	1.67
2	Sakesar	1925.99	1927.52	1.53

3.4 Petrophysical Analysis

Chorgali and Sakesar formations are evaluated for the hydrocarbon potential. Following steps will be utilized in analysis;

3.4.1 Volume of shale

GR log is used to calculate the volume of shale. High value of GR indicate the dirty lithology i.e. shale and Lithologies having radioactive elements; on the other hand, low value of GR depicted the clean lithology.

Mathematical equation used to determine shale volume is;

$$\mathbf{Vsh = GR (log) - GR (min) / GR (max) - GR (min)}$$

Where;

GR (log) = value of GR at certain depth

GR (min) = low value of GR

GR (max) = high value of GR

We used GVERSE software to calculate the volume of shale.

3.4.2 Effective porosity

Sonic Porosity log is used to determine the value of effective porosity. It is the measurement of total empty spaces of porous material which is capable of transmitting fluid.

Following formula is used to determine the porosity;

$$\mathbf{\Phi e = \varphi avg * (1 - Vsh)}$$

Where

Φe = effective porosity

Φavg = average porosity

GVERSE is used to compute effective porosity.

3.4.3 Average porosity

By using neutron and sonic log (density correction), average porosity computed. The ratio between empty spaces and bulk volume of rock.

Following formula is used to determine the porosity;

$$\mathbf{A\Phi = S\varphi + N\varphi / 2}$$

Where

AΦ = Average porosity

NΦ = neutron porosity

SΦ = sonic porosity

GVERSE is used to compute the average porosity.

3.4.4 Resistivity of water

In order to determine the fluid saturation, we must know the value of true resistivity of water.

Three methods are basically used;

1. Directly from equation
2. SP method (This method is more accurate and reliable)
3. Pickett plot method

Here we used Pickett plot which we constructed from GVERSE software.

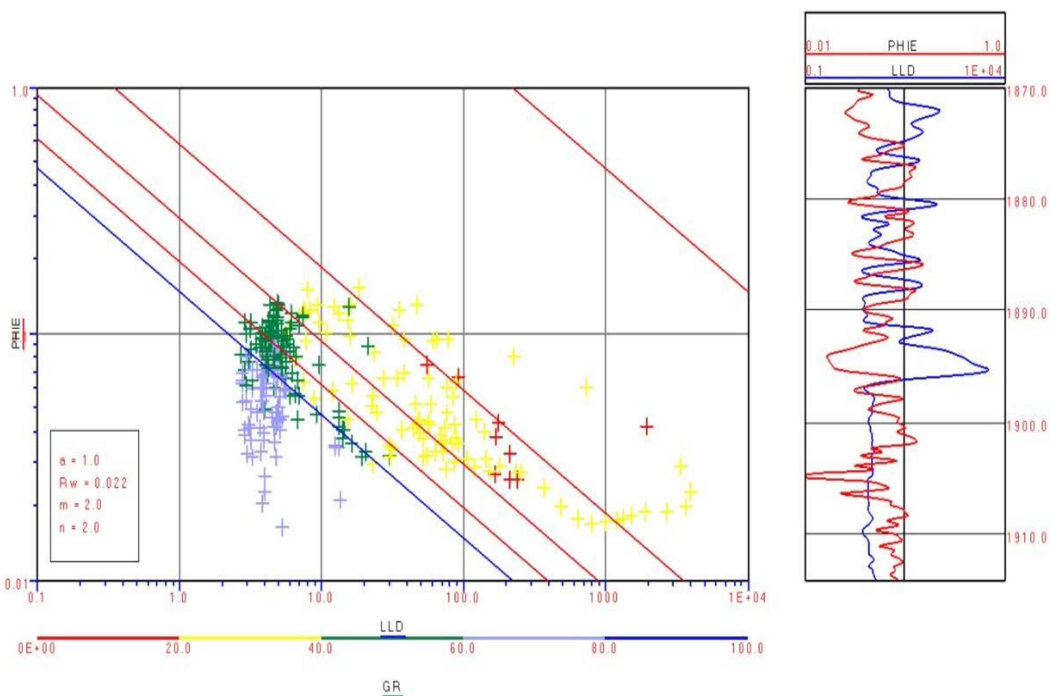

Figure 3.2 Pickett plot of Chorgali formation

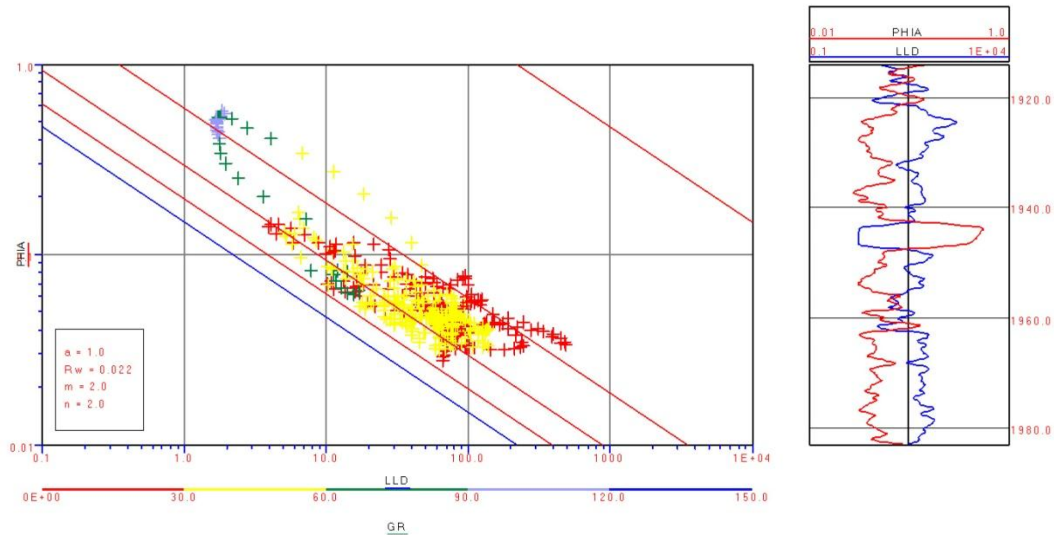

Figure 3.3 Pickett plot of Sakesar limestone

3.4.5 Water Saturation

Water present in pore spaces called water saturation (Sw). It helps to determine the presence of hydrocarbons in reservoir.

If Sw is low, it indicated the high quantity of hydrocarbon while the high value of Sw depicted the very less presence of hydrocarbon in reservoir.

Different methods including Archie's equation, Indonesian equation etc. are used; here we used Archie's equation;

$$\mathbf{Sw} = \sqrt{\left[\mathbf{Rw}\frac{\mathbf{1}}{\mathbf{Rt}}\right]} * (\mathbf{1} - \emptyset\mathbf{e}^{\mathbf{2}})$$

Where;

Rt = True resistivity

Rw = Resistivity of water

Φe = effective porosity

3.4.6 Hydrocarbon Saturation

Hydrocarbon filled in pore spaces called hydrocarbon saturation (Sh). It helps to determine the presence of hydrocarbons in reservoir.

Sh = 1-Sw

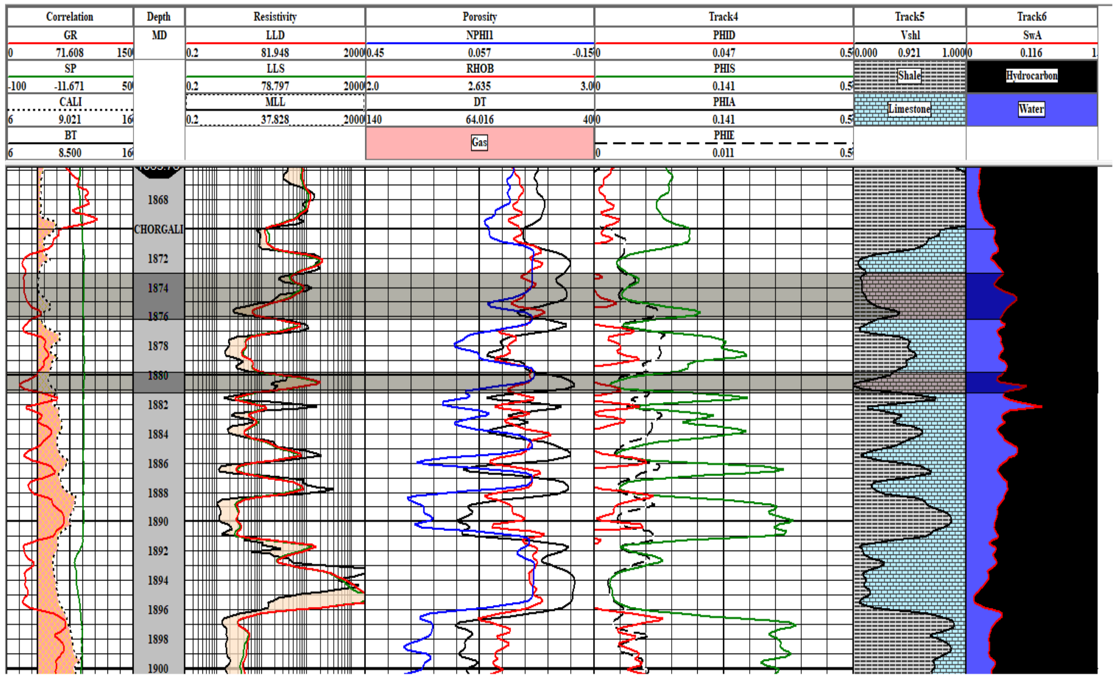

Figure 3.4. Petrophysics of Chorgali Formation

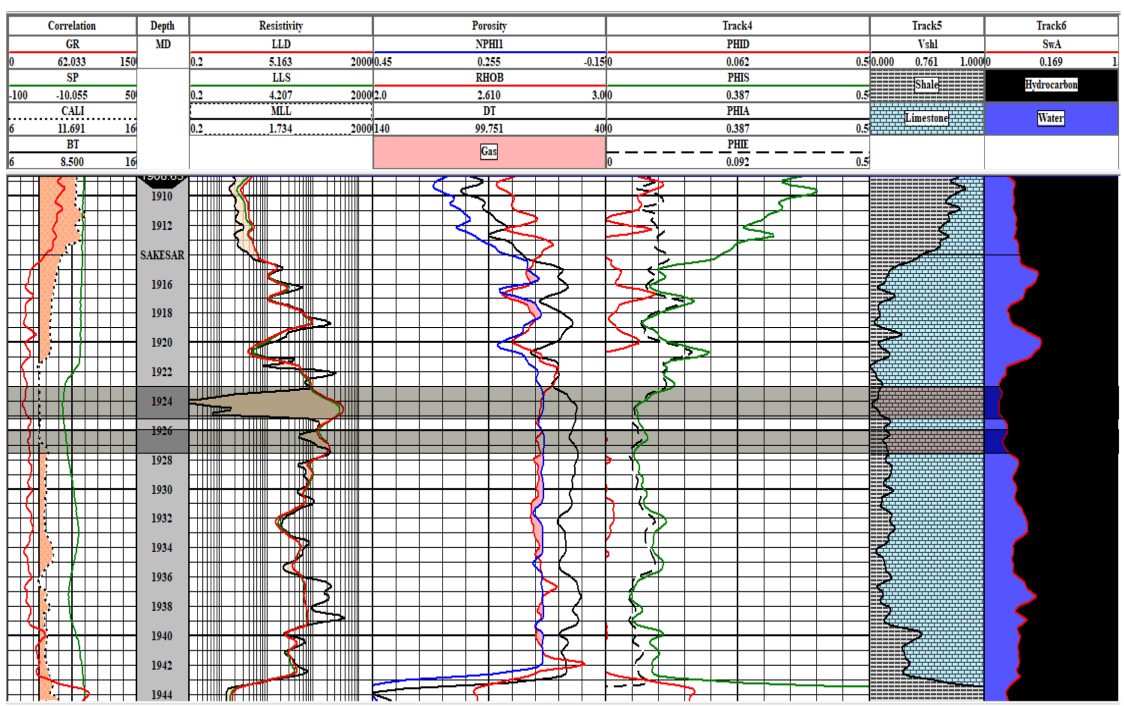

Figure 3.5 Petrophysics of Sakesar limestone

3.5 Identification of Lithologies

Second objective of this study is to Identify the lithologies of reservoir zones of Missa Keswal-03. Two types of crossplots are constructed to identify the lithologies.

1. Crossplots between NPHI and RHOB
2. Crossplots between DT and NPHI

.

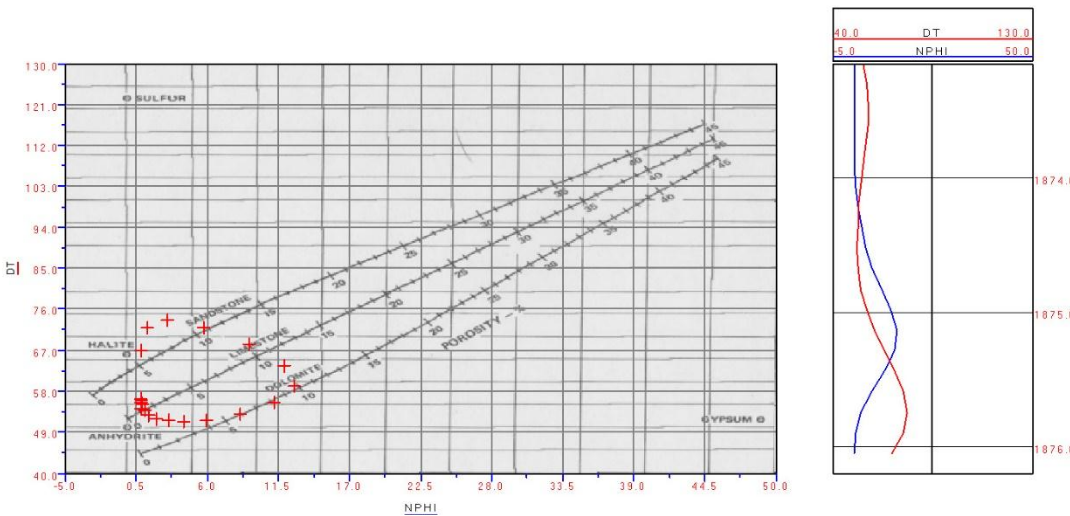

Figure 3.6 Crossplot between DT and NPHI for zone 1 of Chorgali Formation

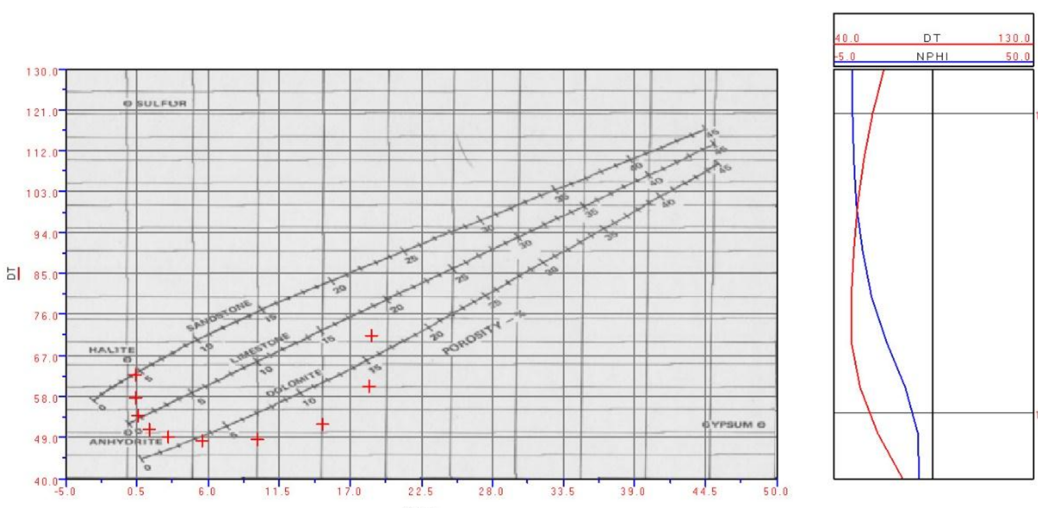

Figure 3.7 Crossplot between DT and NPHI for zone 2 of Chorgali Formation

Crossplots of RHOB vs NPHI and DT vs NPHI determine that lithology of Chorgali formation is Limestone, dolomite. Appearance of dolomite characterize that Chorgali comprised of dirty limestone.

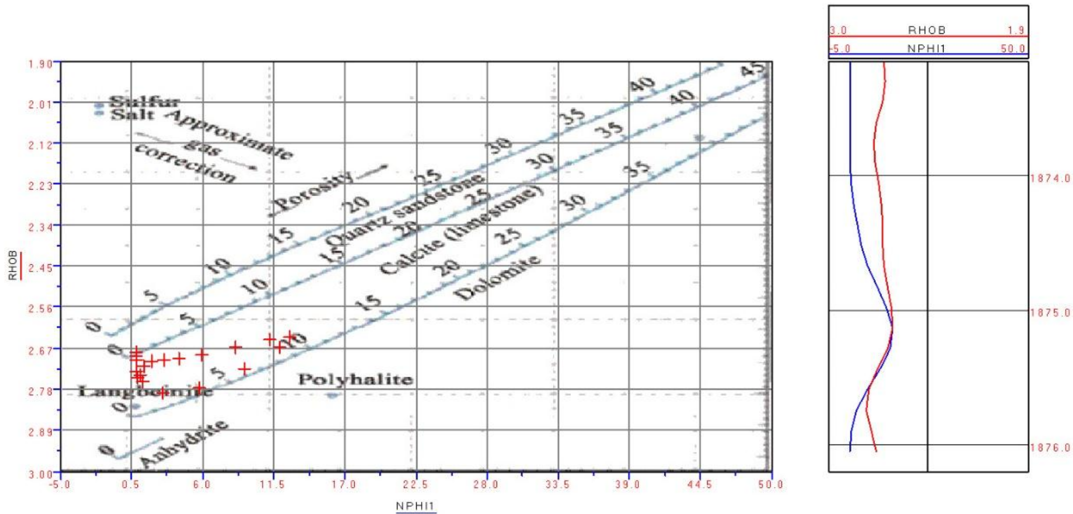

Figure 3.8 Crossplot between RHOB and NPHI of zone 1 for Chorgali Formation

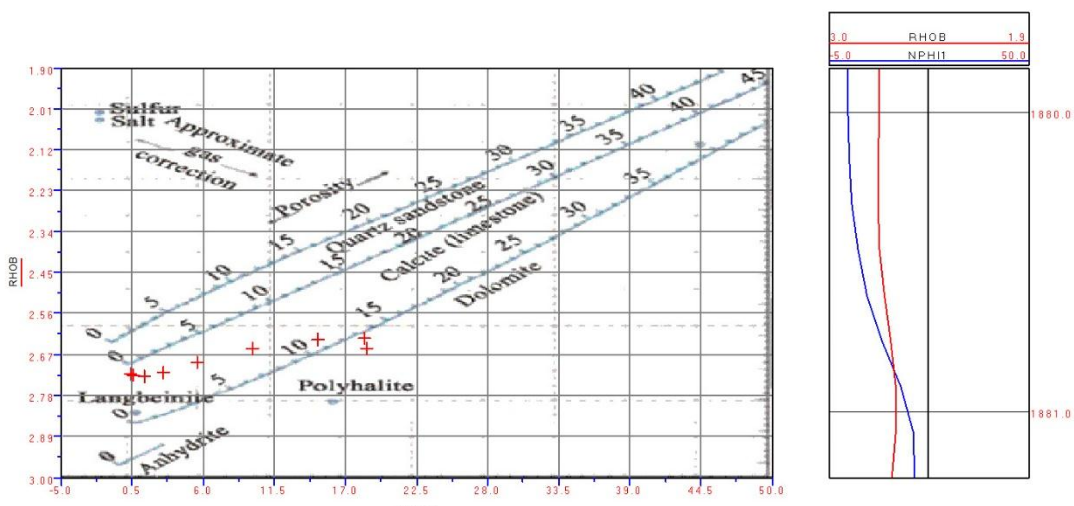

Figure 3.9 Crossplot between RHOB and NPHI of zone 2 for Chorgali Formation

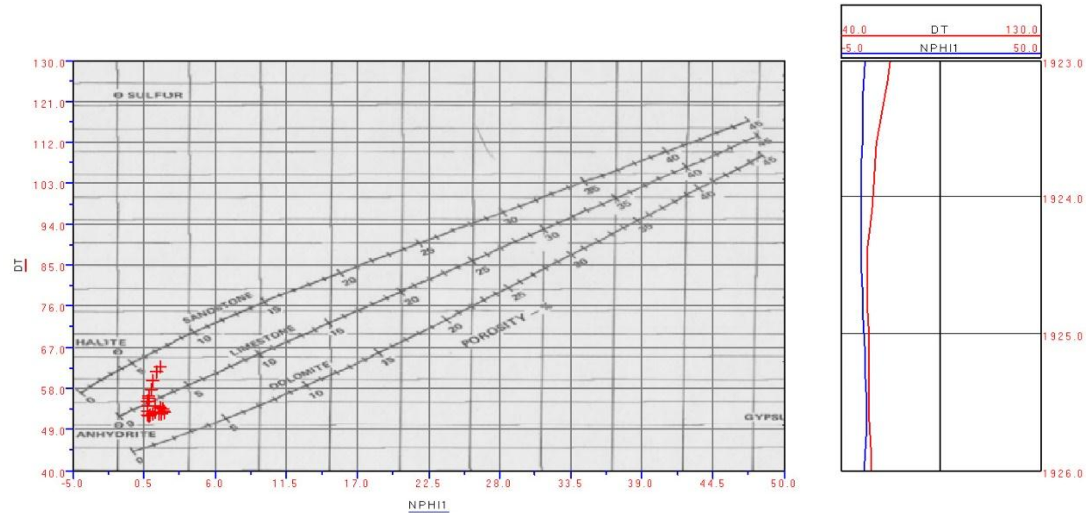

Figure 3.10 Crossplot between DT and NPHI for zone 1 of Sakesar Limestone

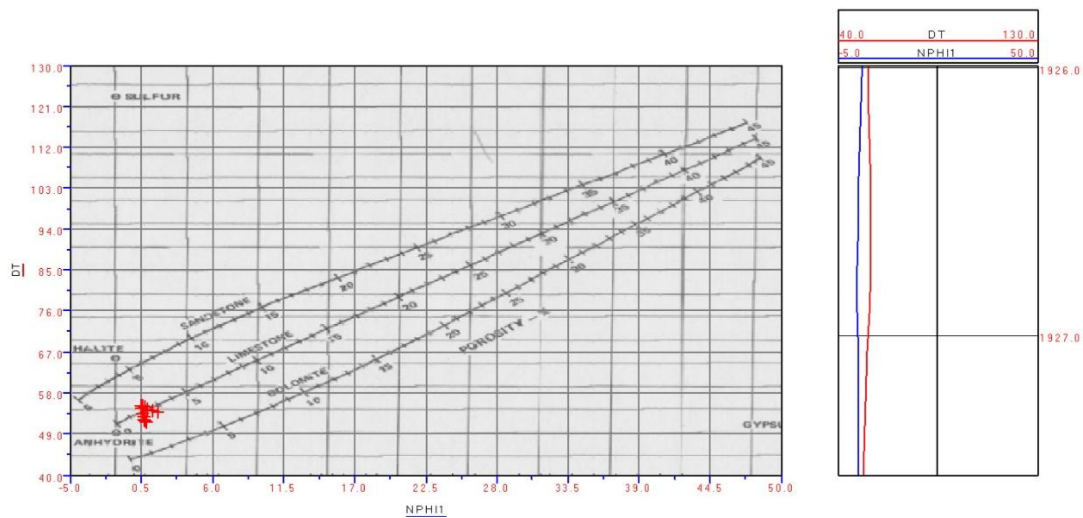

Figure 3.11 Crossplot between DT and NPHI for zone 2 of Sakesar Limestone

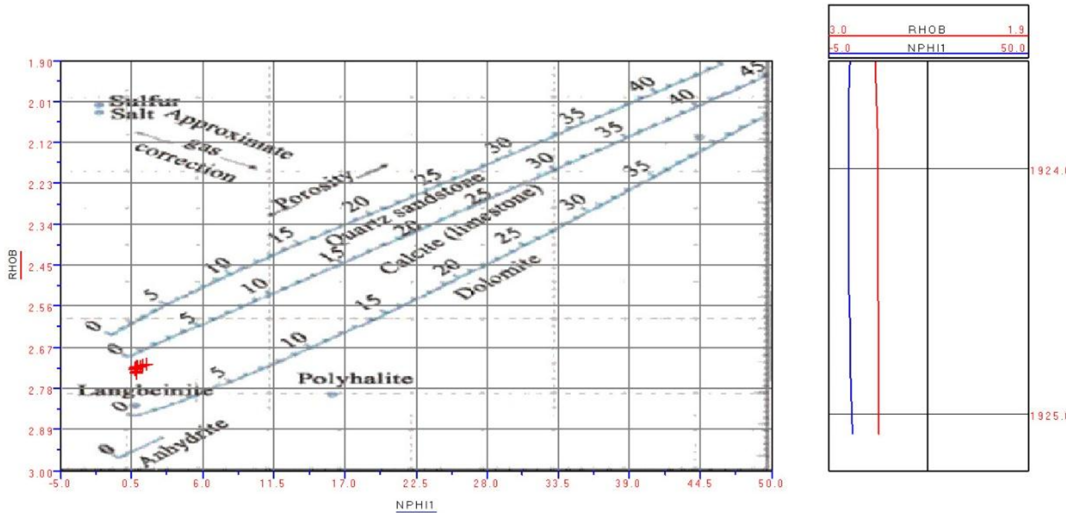

Figure 3.12 Crossplot between RHOB and NPHI of zone 1 for Sakesar Limestone

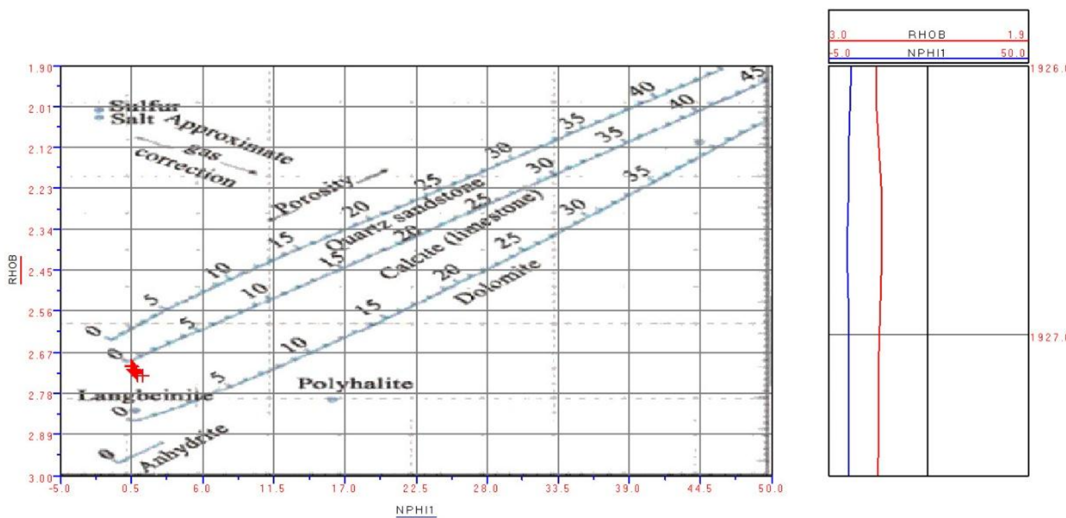

Figure 3.13 Crossplot between RHOB and NPHI of zone 2 for Sakesar Limestone

Crossplots of RHOB vs NPHI and DT vs NPHI determine that lithology of Sakesar Limestone is limestone. Value is clustered at one place and it shows how much compacted the rock is.

CONCLUSIONS

Four potential zones of interest (Chorgali Formation and Sakesar Limestone) were found and marked by using Petrophysical analysis.

Zone 1 of Chorgali Formation has average porosity of 6 % and have 70% hydrocarbon potential; while zone 2 of Chorgali formation have 5% shale volume and have 68.9% hydrocarbon potential.

Zone 1 of Sakesar Limestone has average porosity of 4% and have 84% hydrocarbon potential; while zone 2 of Sakesar Limestone have 3.2% shale volume and have 78% hydrocarbon potential.

In Missa Keswal-03, both formations act as reservoir as both depicted low volume of shale, having enough effective porosity.

In Chorgali Formation, we encountered with dirty limestone while in Sakesar Limestone, (pure)limestone has been observed.

According to Petrophysical Analysis, both formations of Eocene age (Chorgali Formation and Sakesar Limestone) have fair hydrocarbon potential and act as reservoir.

Based on crossplots between RHOB-NPHI and DT-NPHI ; lithology is identified as limestone.

REFERENCES

Aamir. (2006). Interpretation &visualization of thrust sheets in a triangle zone in Eastern Potwar.

Alger, R.P., 1980. Geological use of wireline logs in Developments in Petroleum Geology-2, G.D. Hobson, Applied Science Publication and London.

Ali H. Kazmi, I.A. (2008). Dept & National Centre of Excellence in Geology.

B, K. (1995). Scientific Research. In Petroleum Geology of Pakistan. Jan, K. (1997). Geology and Tectonics of Pakistan.

Gee, E.R. 1945. The Age of the Saline Series of the Punjab and of Kohat. Nat. Acad. Sci. India Proc., Sec. B, 14(6), 269-310.

Kadri, I.B, 1995, Petroleum Geology of Pakistan, Pakistan Petroleum Limited. Karachi, p. 275.

Kazmi A.H. &Jan M.Q.1997, Geology &Tectonics of Pakistan, Graphic Publishers, Karachi, Pakistan. p. 232-249.

Khan, M.N., 1998, Introduction to wireline log interpretation

Lisa, J. (2015). Proceedings of the Pakistan Academy of Science. (pp. 159-168). Shah, S.I (2009). Stratigraphy of Pakistan.

Reservoir. Proceedings of the SPE-PAPG Conference, Islamabad, Pakistan 1998, p. 90-99.

QUADRI, V.N. and QUADRI, S.M.G.J., 1996. Exploration anatomy of success in oil and gas exploration in Pakistan, 1915–94. Oil and Gas Journal, 94, 1–20

WANDREY, C.J., LAW, B.E. and SHAH, H.A., 2004. Patala-Nammal composite total petroleum system, Kohat-Potwar geological province, Pakistan. United States Geological Survey Bulletin Open File Report 2208-B, pp. 1–18.

Petrophysical Analysis of Missa Keswal-3

ORIGINALITY REPORT

8%	5%	2%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Higher Education Commission Pakistan Student Paper	3%
2	www.coursehero.com Internet Source	1%
3	Karol Parchem, Anna Piekarska, Agnieszka Bartoszek. "Enzymatic activities behind degradation of glucosinolates", Elsevier BV, 2020 Publication	1%
4	Submitted to Cranfield University Student Paper	<1%
5	www.degruyter.com Internet Source	<1%
6	Submitted to Curtin University of Technology Student Paper	<1%
7	eprints.kfupm.edu.sa Internet Source	<1%
8	www.mit.edu.et Internet Source	<1%

9	ameriburn.org Internet Source	<1%
10	Submitted to Asian Institute of Technology Student Paper	<1%
11	Submitted to Middlesex University Student Paper	<1%
12	Muhammad Ahmed, Sarosh Hashmat Lodi, Muhammad Masood Rafi. "Probabilistic Seismic Hazard Analysis Based Zoning Map of Pakistan", Journal of Earthquake Engineering, 2019 Publication	<1%
13	P.F. Angert. "Preflush analysis of the Glenn Pool Surfactant Flood Expansion Project", Proceedings of SPE Annual Technical Conference and Exhibition SPE, 09/1985 Publication	<1%
14	fdocuments.in Internet Source	<1%
15	hdl.handle.net Internet Source	<1%
16	etd.lib.metu.edu.tr Internet Source	<1%
17	pdfcoffee.com Internet Source	<1%

18	Anna Mercuri, Assunta Florenzano. "The Long-Term Perspective of Human Impact on Landscape for Environmental Change (LoTEC) and Sustainability: From Botany to the Interdisciplinary Approach", Sustainability, 2019 Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		