



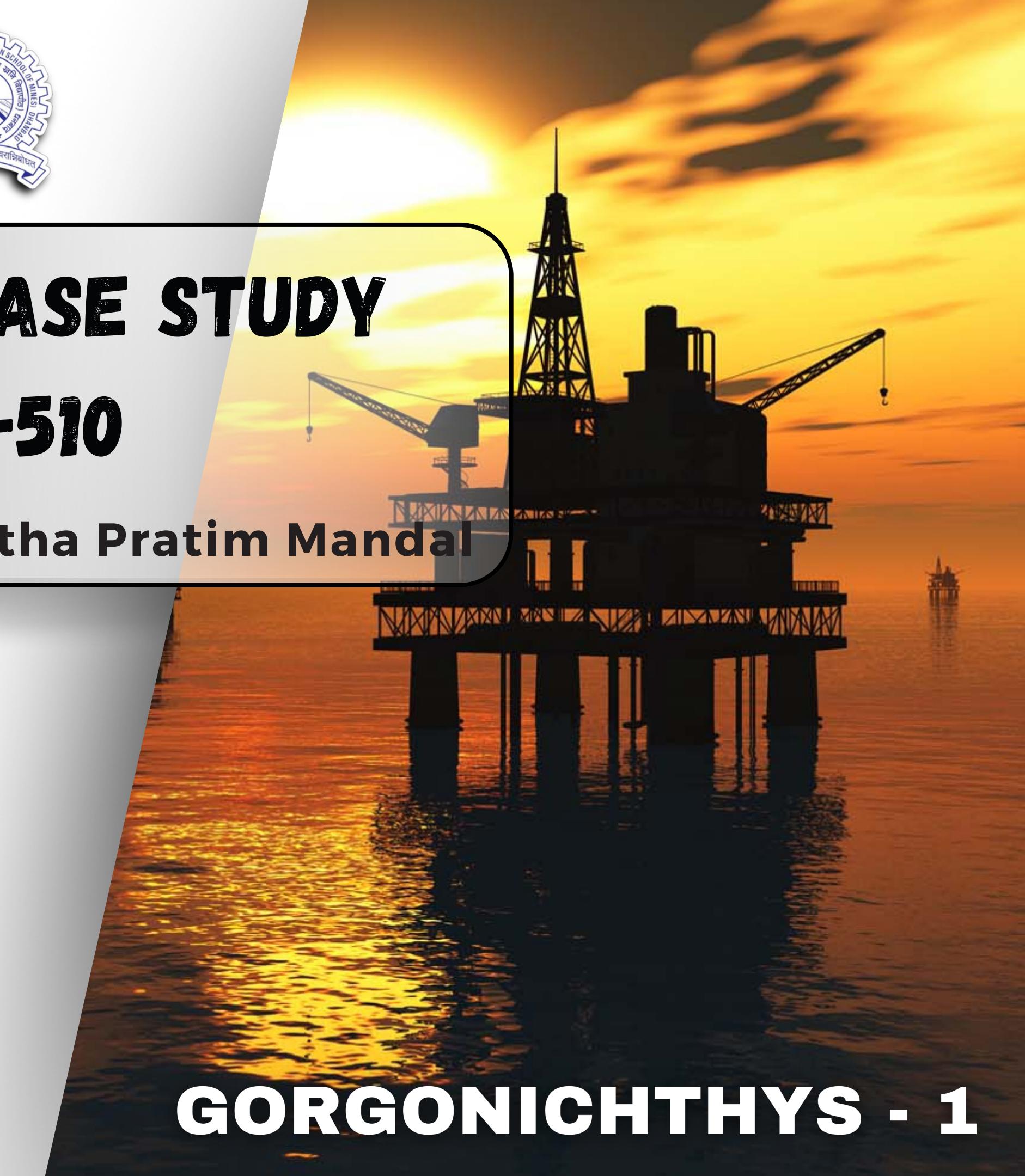
WELL LOG CASE STUDY

GPC-510

Instructor: Prof. Partha Pratim Mandal

Group - 14:

- Bapi Barman (23MC0021)**
- Pritam Kundu (23MC0060)**
- Harshit Nitharwal (21JE0392)**
- Yashovardhan Gupta (23MC0116)**

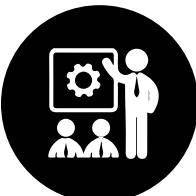


GORGONICHTHYS - 1

CONTENTS



Introduction & Study Area



Well Data



Designing A Sonic Tool



Analysis of Log Data

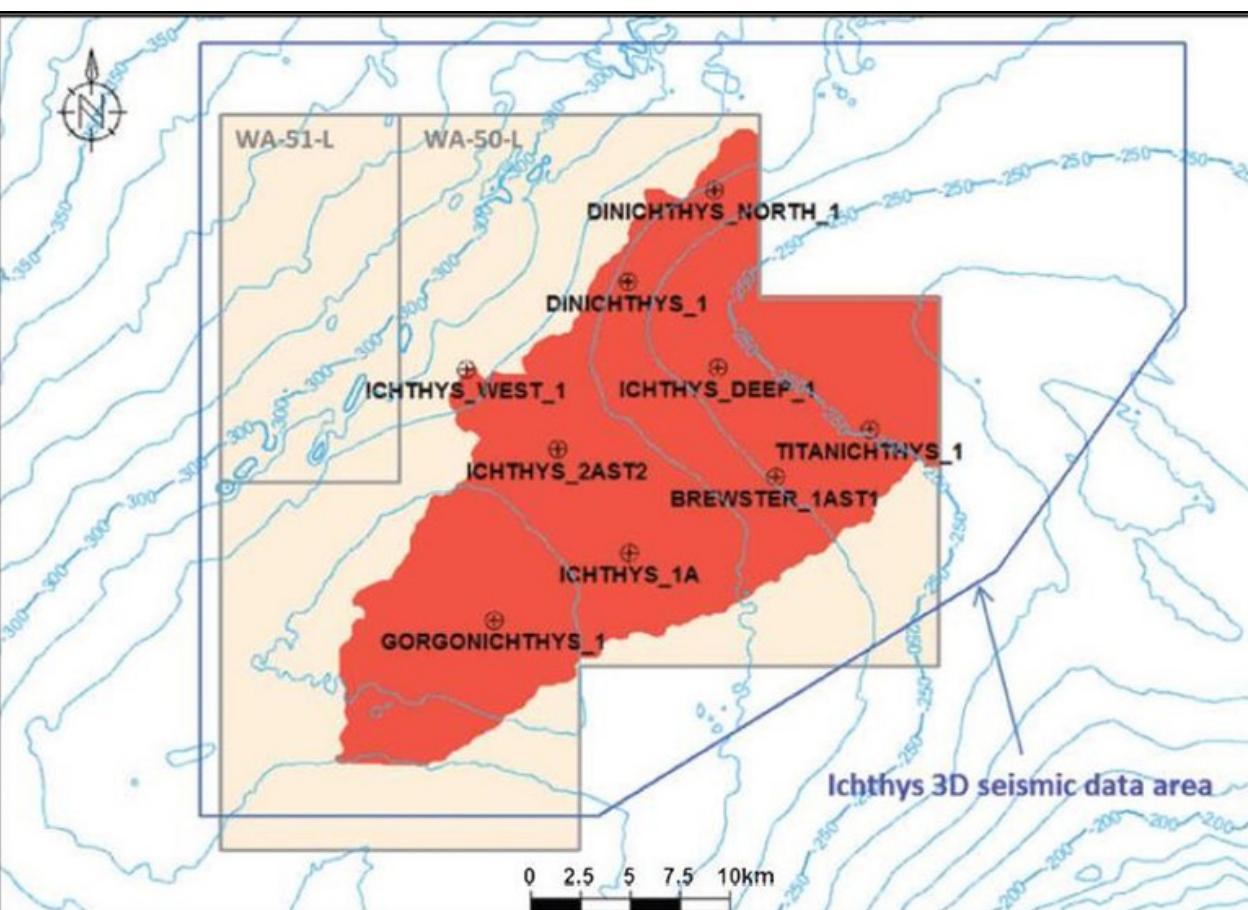


References



Introduction & Study Area

- The **G-1 Well** is situated in the north-western shelf of Australia.
- Our primary target: **Brewster Member** (3911.5 - 4218 m).



Ichthys gas-condensate field

TIMESCALE	DUNIFLAGELLATE ZONE (Helby et al, 1987, Helby et al, 2004.)	STRATIGRAPHY	LITHOLOGY
			sandstone mudstone volcanics
CRETACEOUS	Hauterivian	<i>M.australis</i>	Echuca Shoals Fm. (upper)
	Valanginian	<i>M.testudinaria</i> <i>P.burugeri</i> <i>S.tabulata</i> <i>S.areolata</i>	Echuca Shoals Fm. (lower)
JURASSIC	Berriasian	<i>E.torynum</i> <i>B.reticulatum</i> <i>D.lobispinosum</i> <i>C.delicata</i> <i>K.wisemaniae</i>	UVF Mbr 3
	Tithonian	<i>P.iehiense</i> <i>D.jurassicum</i> <i>O.montgomeryi</i> <i>C.perforans</i>	BREWSTER MEMBER
	Kimmeridgian	<i>D.swanense</i> <i>W.clathrata</i>	UVF Mbr 1
	Oxfordian	<i>W.spectabilis</i>	UVF Mbr 0
			Lower Vulcan Fm.
			Upper Vulcan Fm.
			Upper sandstone Mudstone Break Lower sandstone

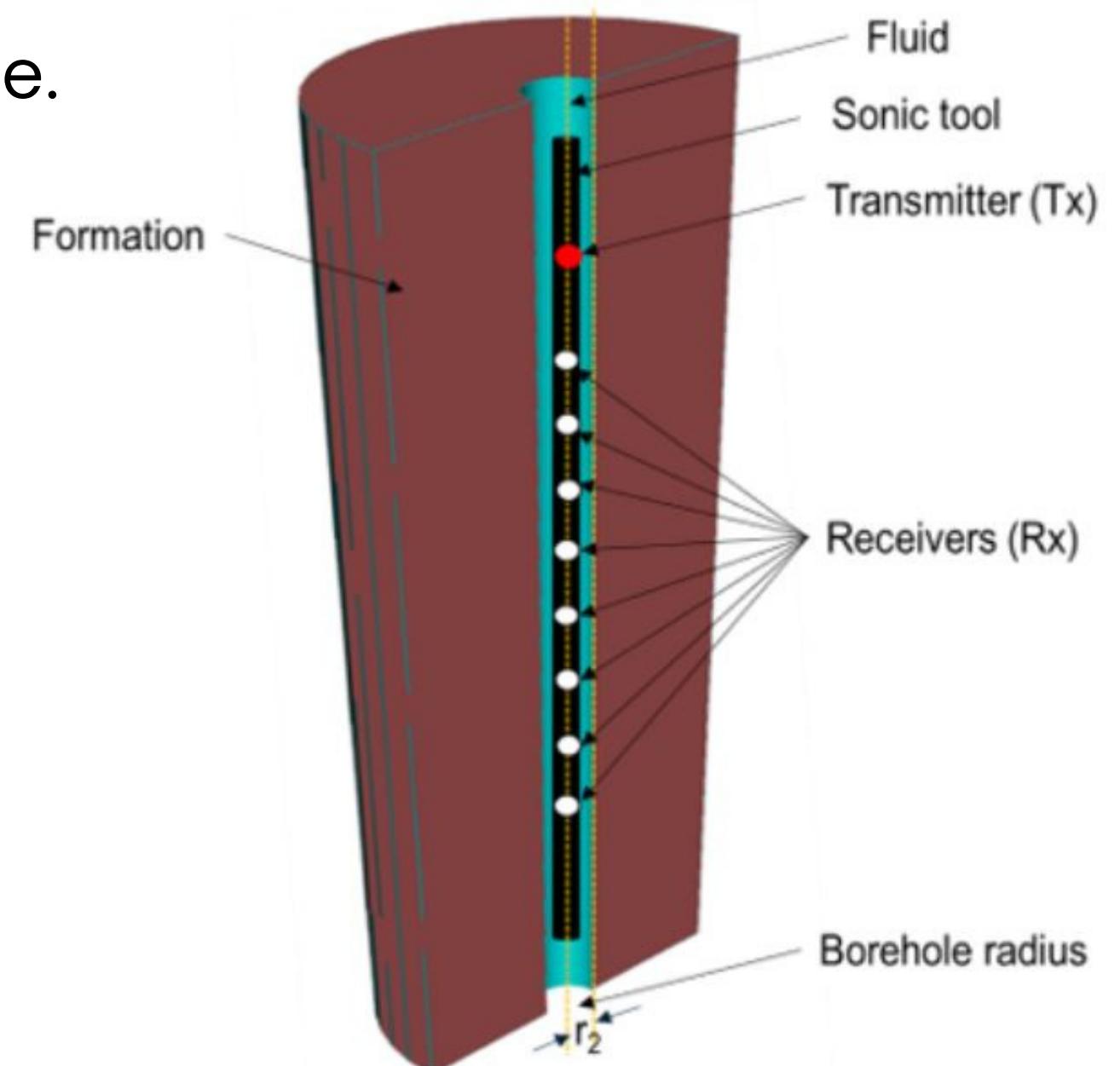
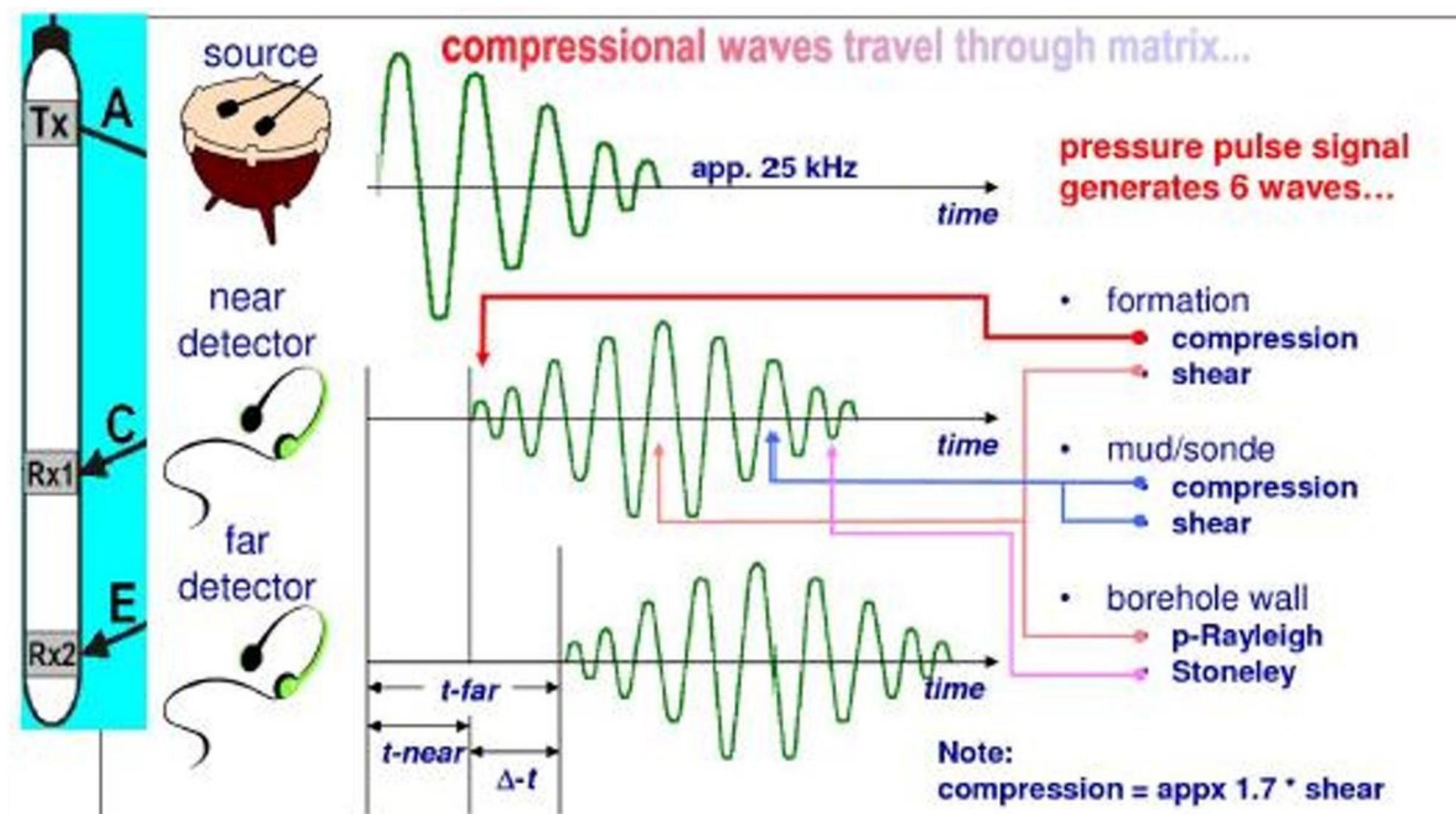
WELL DATA

COMPANY	INPEX BROWSE LTD
WELL	GORGONICHTHYS-1
PERMIT	WA-285-P
REGION	BROWSE BASIN, NORTHWEST SHELF
COORDINATES	013° 58' 41.585" S LAT 123° 07' 35.634" E LONG
SPUD DATE	23RD MAY 2000
WATER DEPTH	260.4 M LAT
REFERENCE ELEVATION	RT 26.4 M ABOVE SEALEVEL LAT
TOTAL DEPTH	4767 M MD
RIG	MODU SEDCO 703
TYPE	SEMI-SUBMERSIBLE
DEPTH	286.8 M TO 4767 M
DATE	23RD MAY - 20TH JULY 2000

Sonic Tool : Designing & Measurement

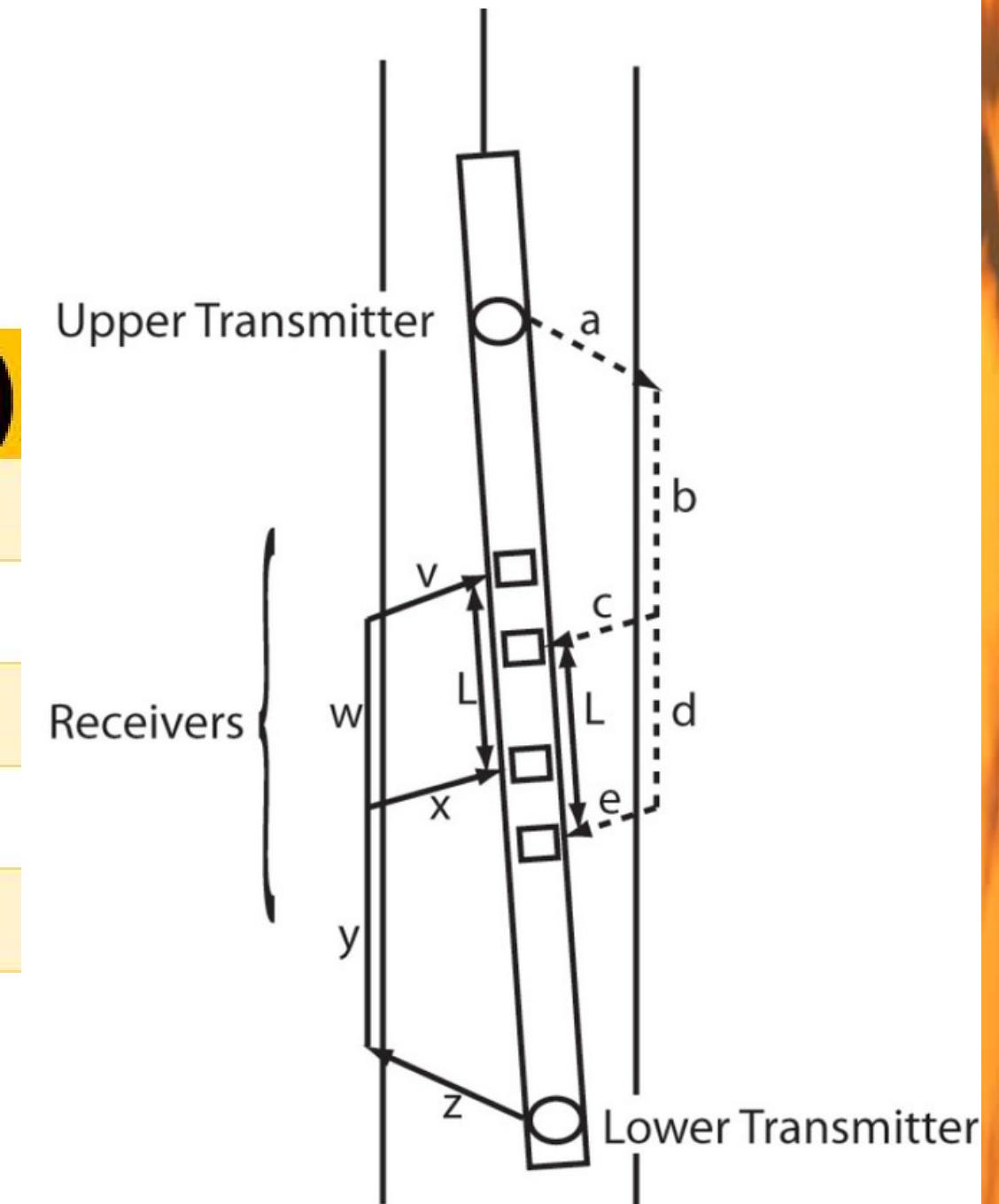
Frequency Range:

- High-frequency (10-20 KHz) sound waves assess formation properties.
- **Optimization factors:** borehole diameter and rock type.



Essential Parts & Estimated Cost of a Sonic Tool

Instrument	Estimated Cost(in USD)
Transmitter	5,000-20,000
Receiver	3,000-10,000
Logging Cable	10-50 per foot
Surface Equipment	20,000-50,000
Processing Software	Additional Licensing Fees



ANALYSIS OF LOG DATA



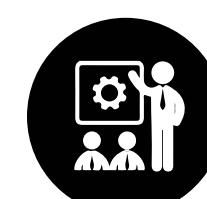
Quality Control & Marking Outliers



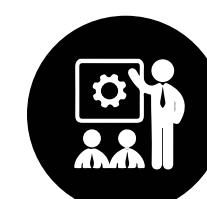
**Calculating Total Porosity & Highest
Porosity Zone Identification**



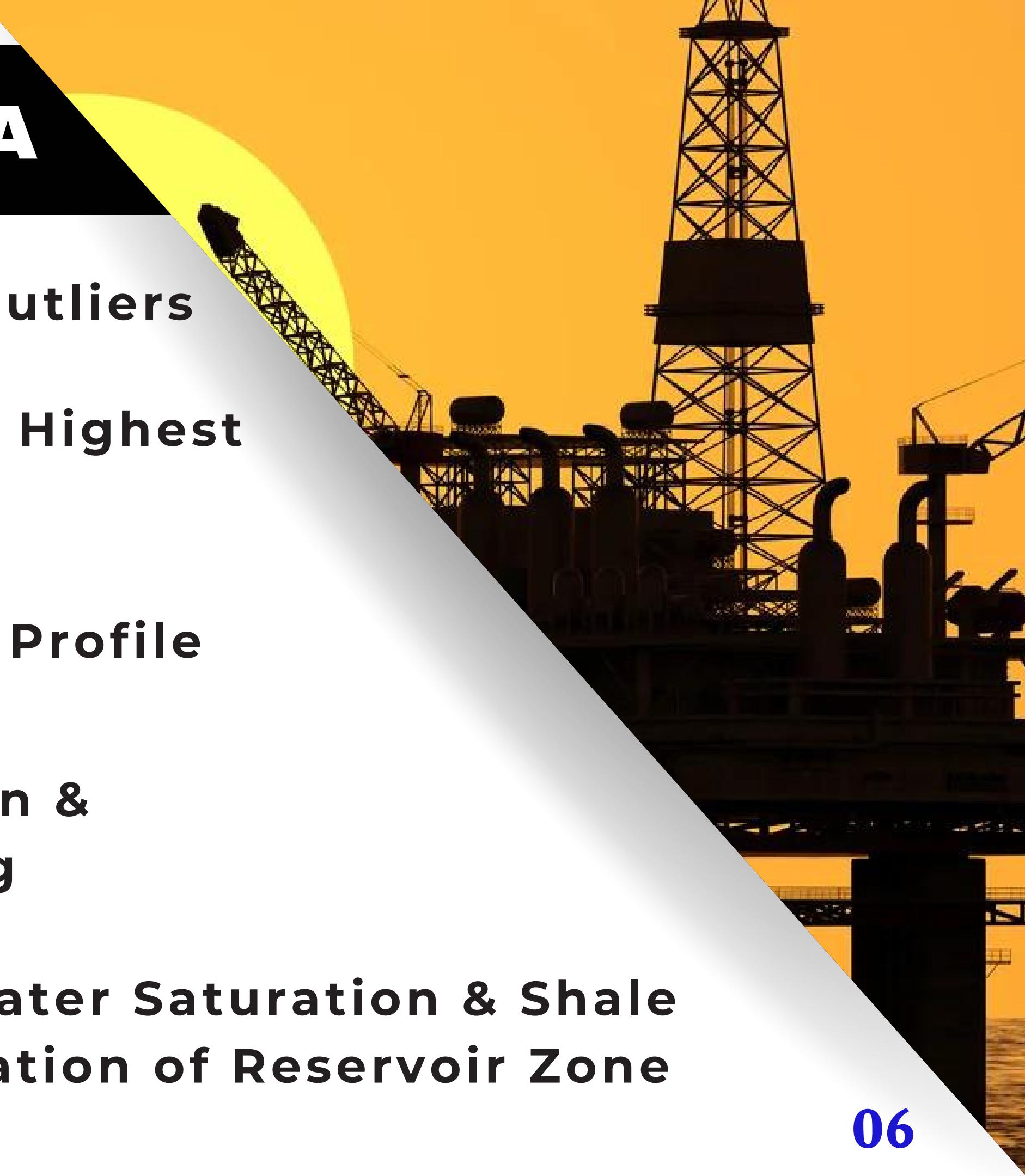
Color-coded Velocity Depth Profile



**Water Saturation Calculation &
Generation of Reservoir Flag**



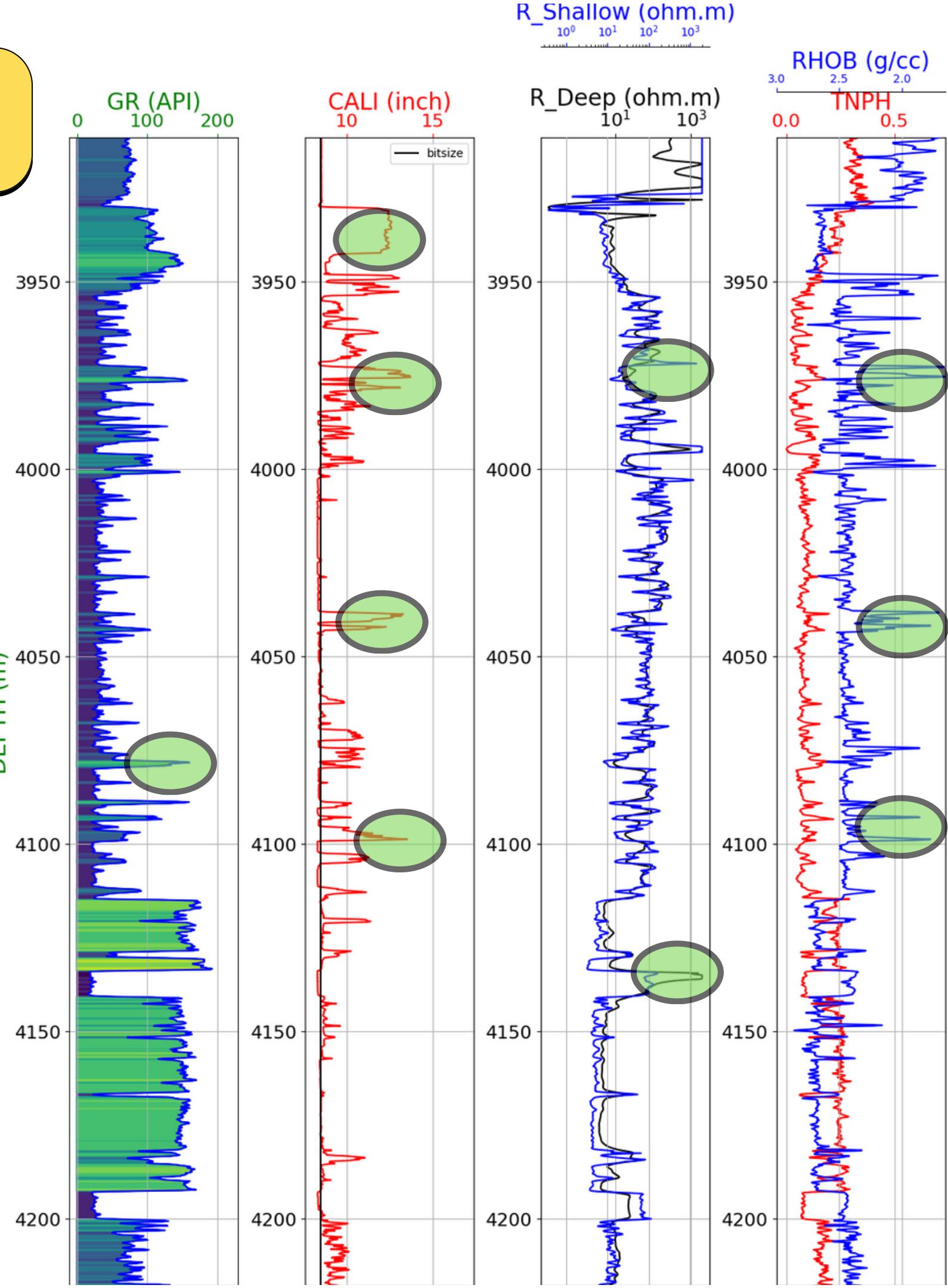
**Reporting Total Porosity, Water Saturation & Shale
Volume with Standard Deviation of Reservoir Zone**



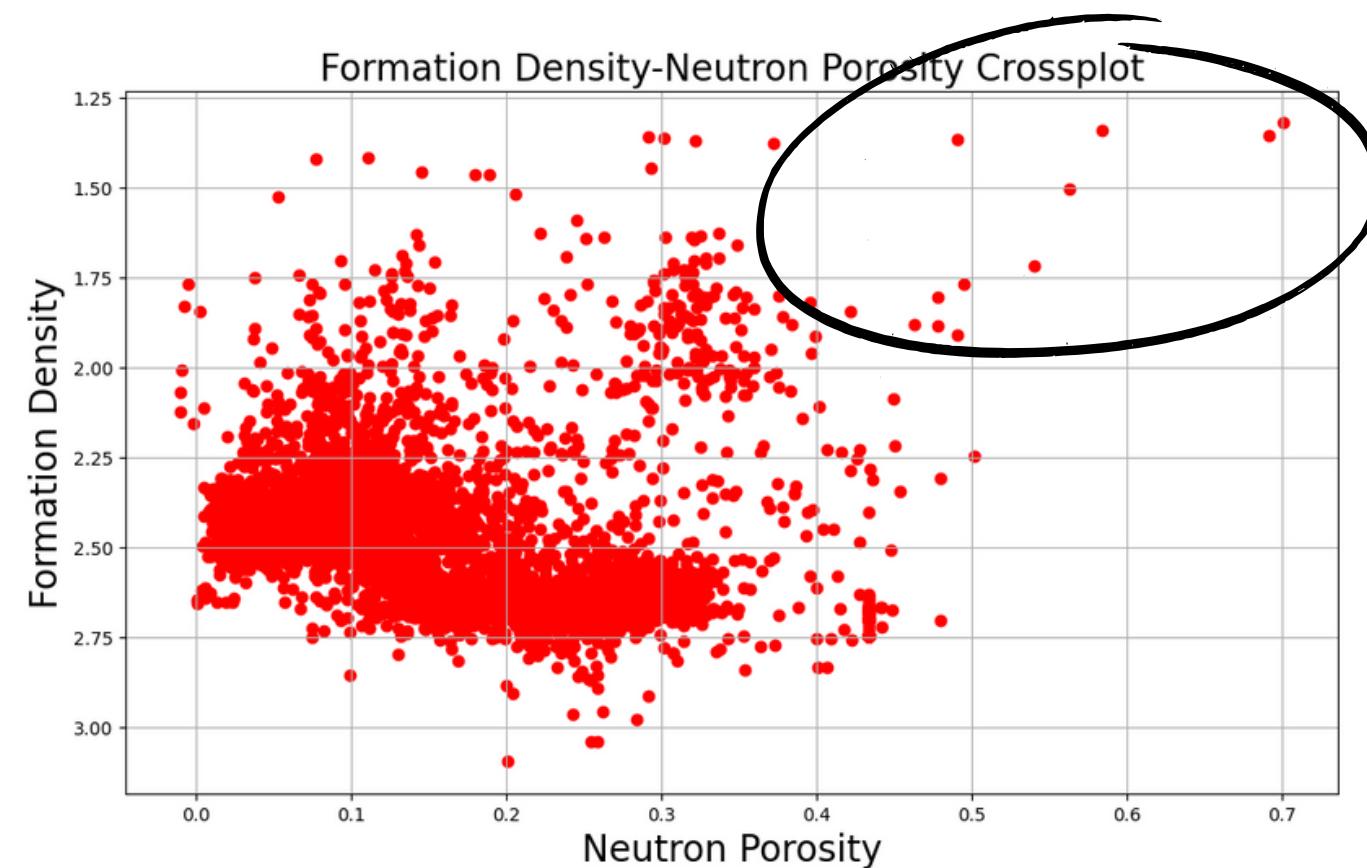
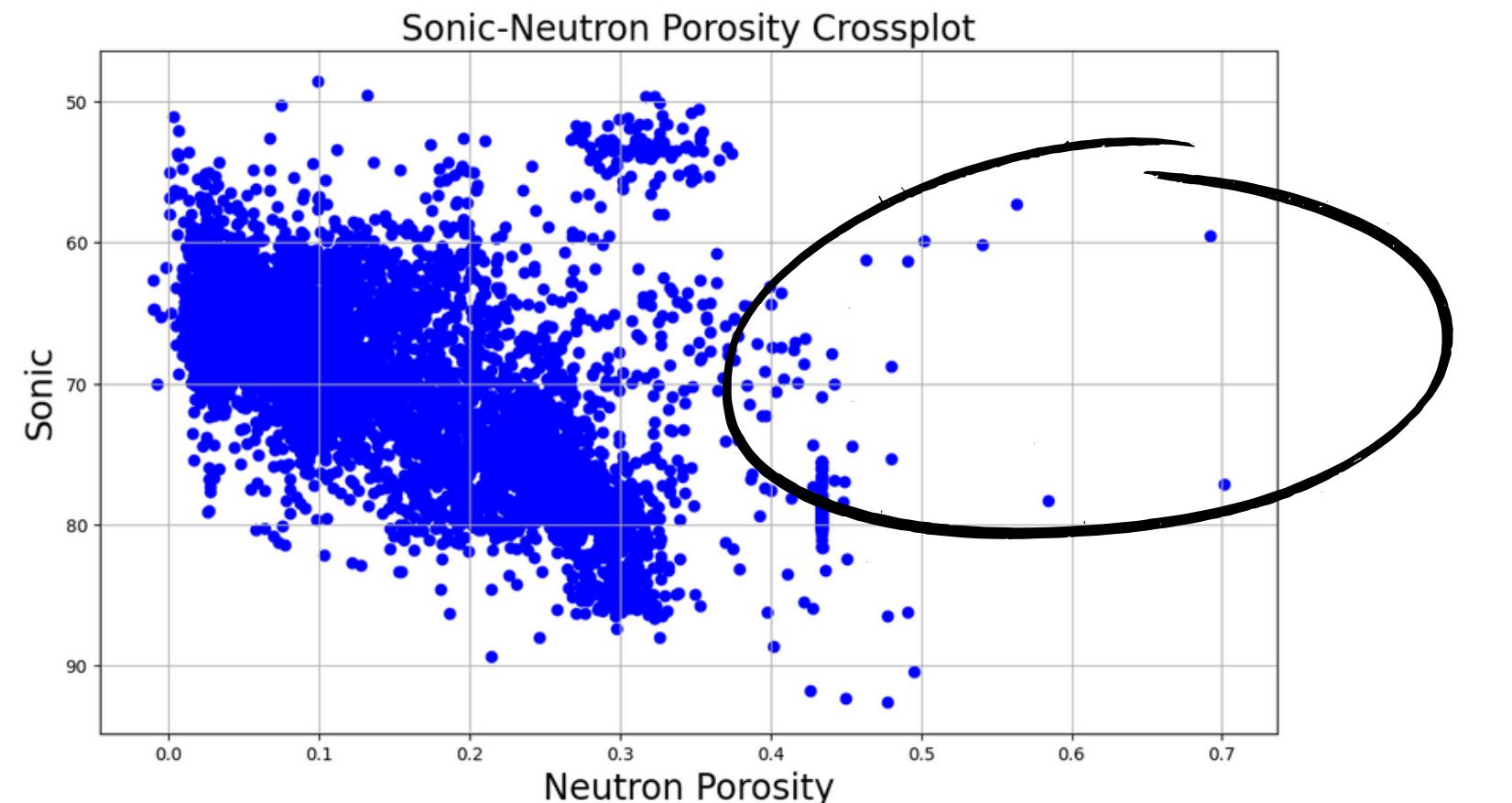
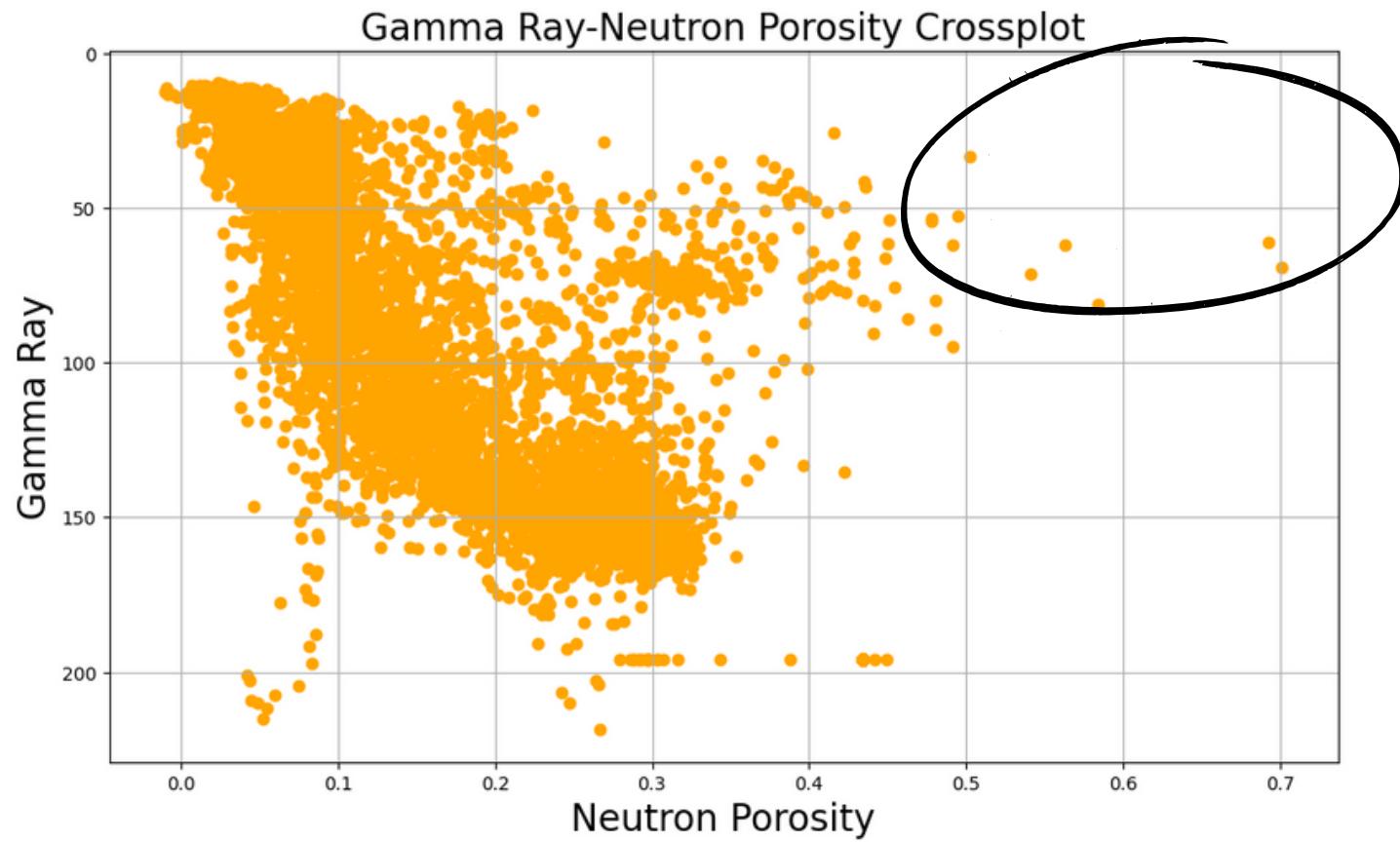
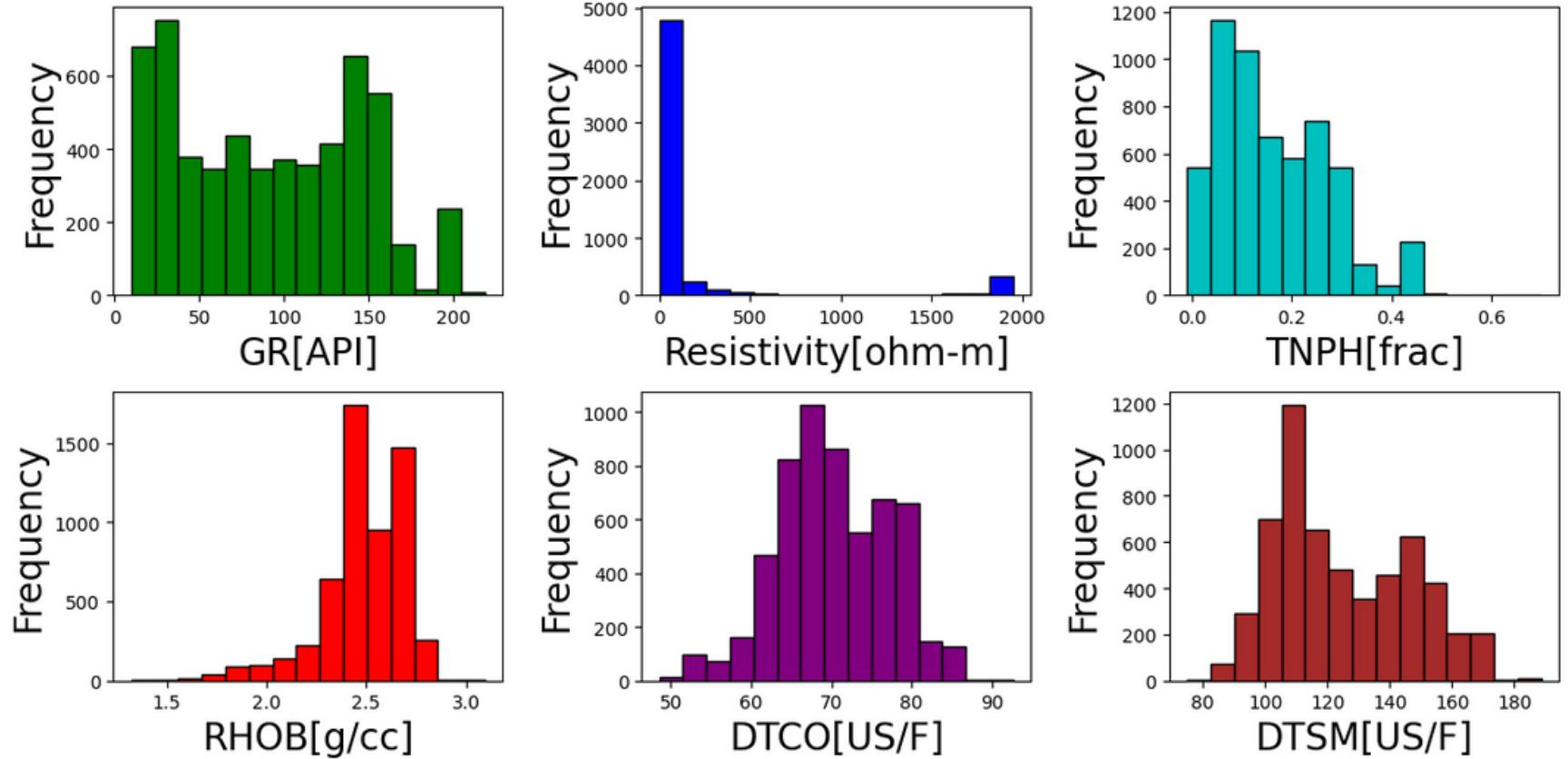
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Quality Control & Marking Outliers

- Bits size = 8.5 inch (from Well Completion Report).
- Well Completion Reports are in .PDS format accessed using PDSView, an application by **Schlumberger**.
- Bad Hole is classified when difference in bit size and caliper log data is ~ 2 inches or more



Histogram Plots & Pair Plotsof Brewster Member Formation



2 Calculating Total Porosity & Highest Porosity Zone Identification

- Primarily we detect the gas-bearing zones by comparison of different Logs.
- Then we calculate density-porosity using given formula -

$$\varphi = \frac{\rho_{ma} - \rho_b}{\rho_{ma} - \rho_{fl}}$$

Where,

ρ_{ma} = the density of the rock matrix

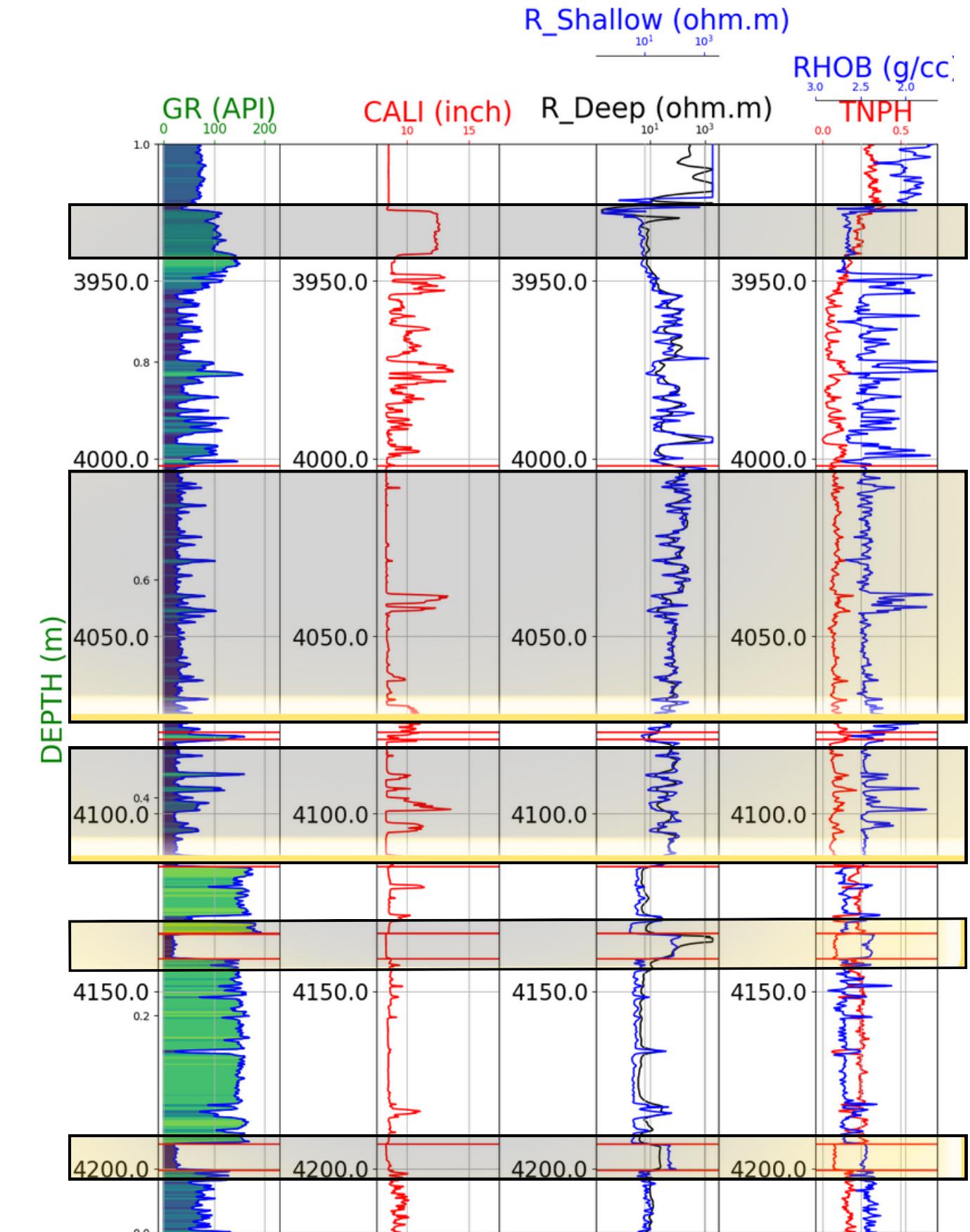
ρ_b = the bulk density of formation [from log]

ρ_{fl} = the density of pore fluid

Φ = total porosity

Fluid density = 0.8 g/cc

- The applied gas correction factor is $\times 0.8$



- Then we compute Total Porosity by the following relation,

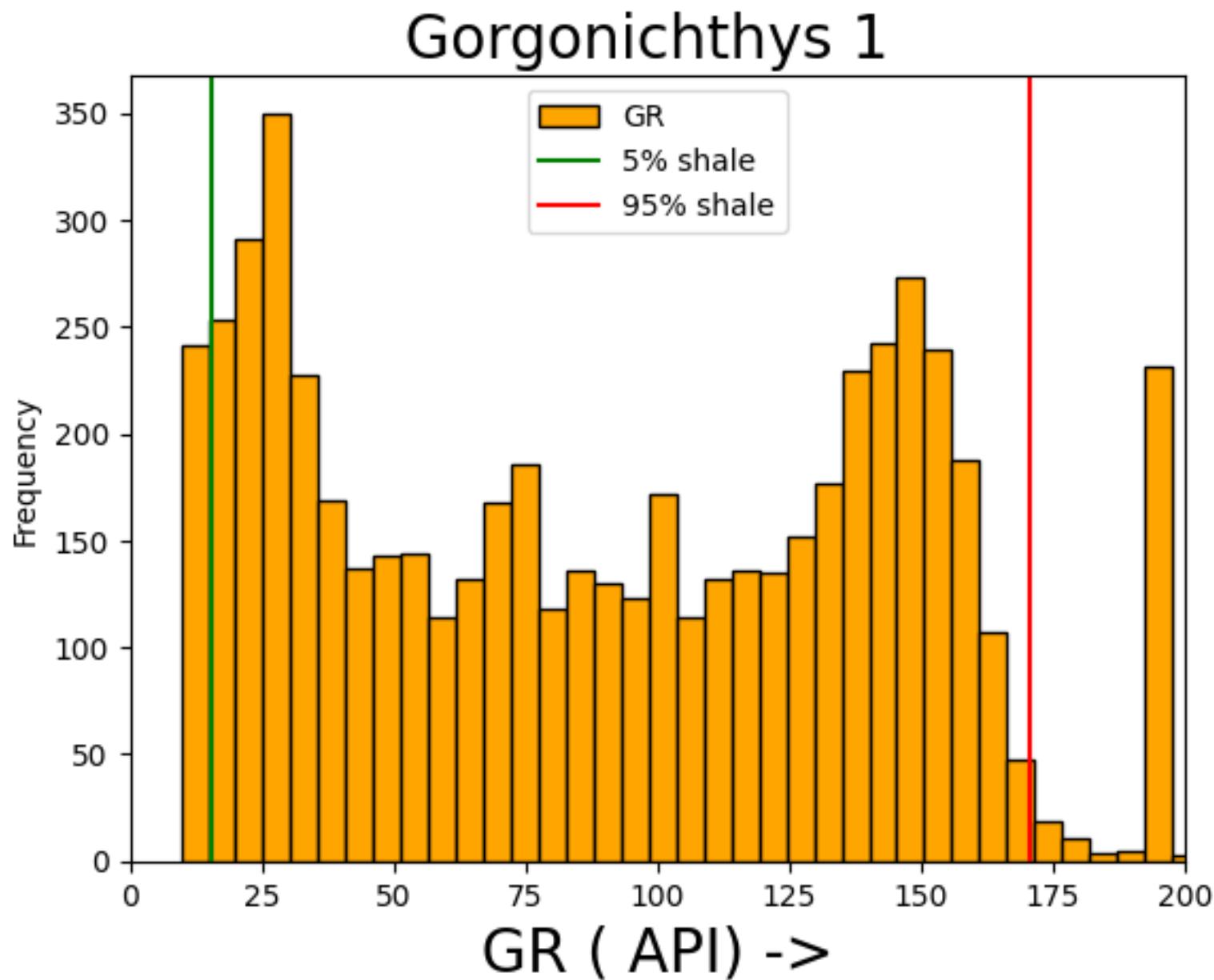
For Oil Bearing zone

$$\Phi_{N-D} = \frac{\Phi_N + \Phi_D}{2}$$

For Gas Bearing zone

$$\Phi_{N-D} = \sqrt{\frac{\Phi_N^2 + \Phi_D^2}{2}}$$

- Volume of Shale (V_{sh}) calculation,



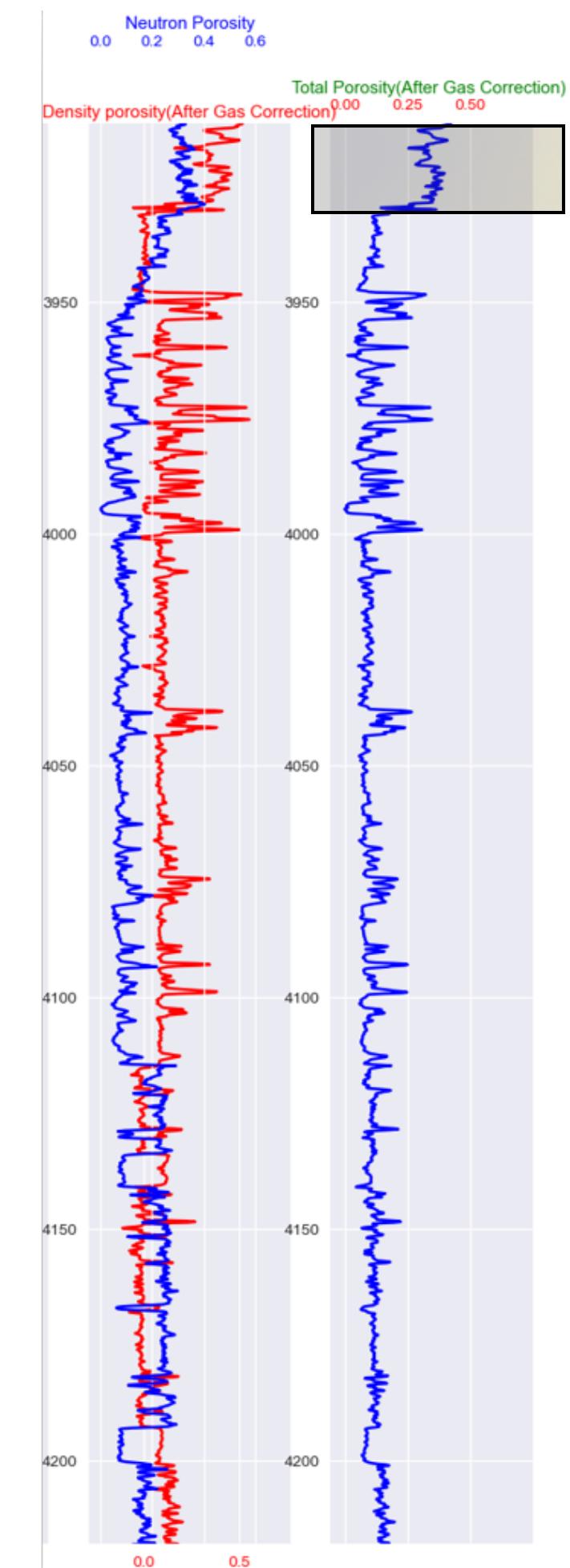
- Gamma Ray index of the formation

$$I_{GR} = \frac{GR - GR_{min}}{GR_{max} - GR_{min}}$$

- Corrected Volume of Shale

$$V_{shc} = 0.33(2^{2*I_{GR}-1})$$

The maximum GR value = 170.79
The minimum GR value = 15.39



3

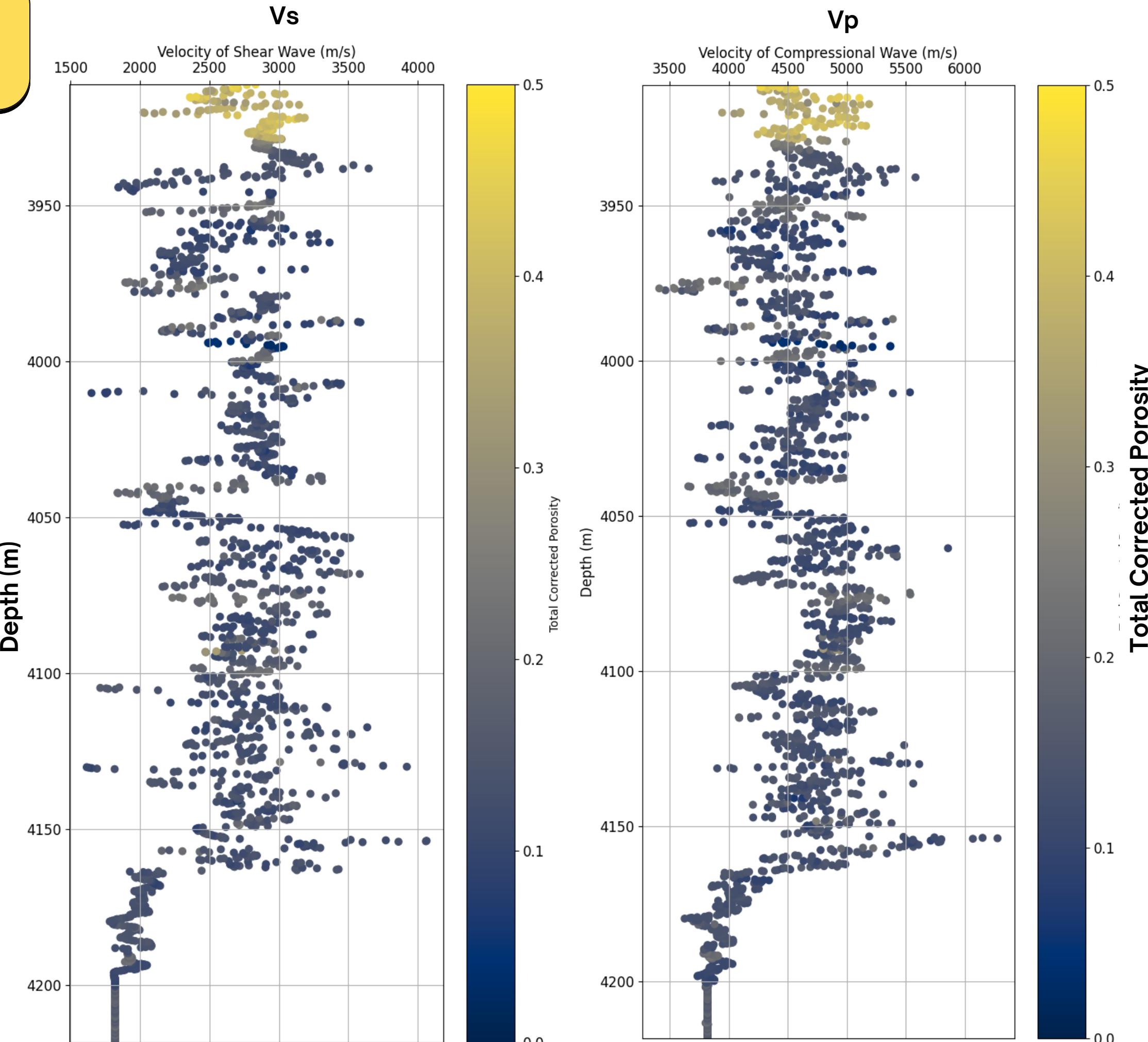
Colour-coded Velocity Depth Profile

The significance of Velocity Depth Profile :

- Lithology identification
- Stratigraphic correlation
- Fluid detection

$$v_p = \frac{304800}{\Delta t_p}$$

$$v_s = \frac{304800}{\Delta t_s}$$



4

Water Saturation Calculation & Generation of Reservoir Flag

- Archie's equation :

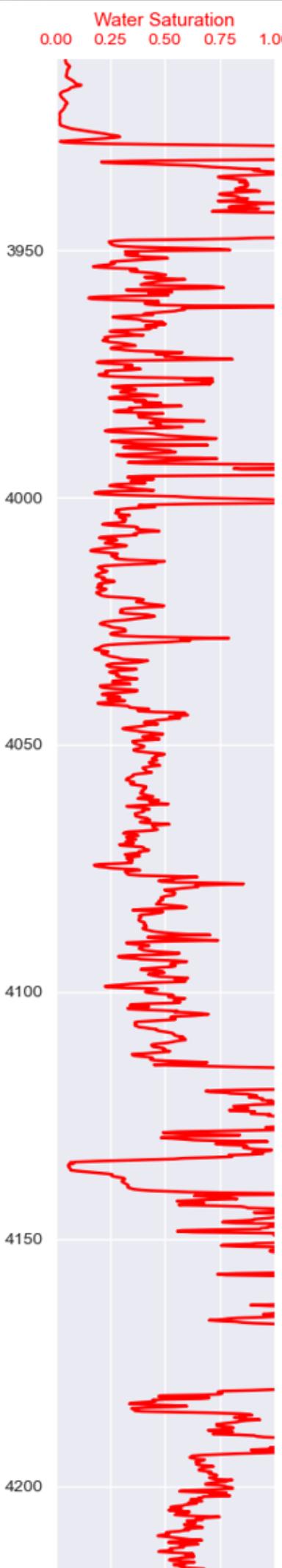
$$S_w = \frac{n}{\phi^m} \cdot \frac{a}{R_t} \cdot \frac{R_w}{R_t}$$

Diagram illustrating the components of Archie's equation:

- Saturation Exponent (n)
- Intercept (a)
- Measured Porosity (ϕ)
- Cementation Exponent (m)
- Resistivity (Rt)
- Water Resistivity (Rw)

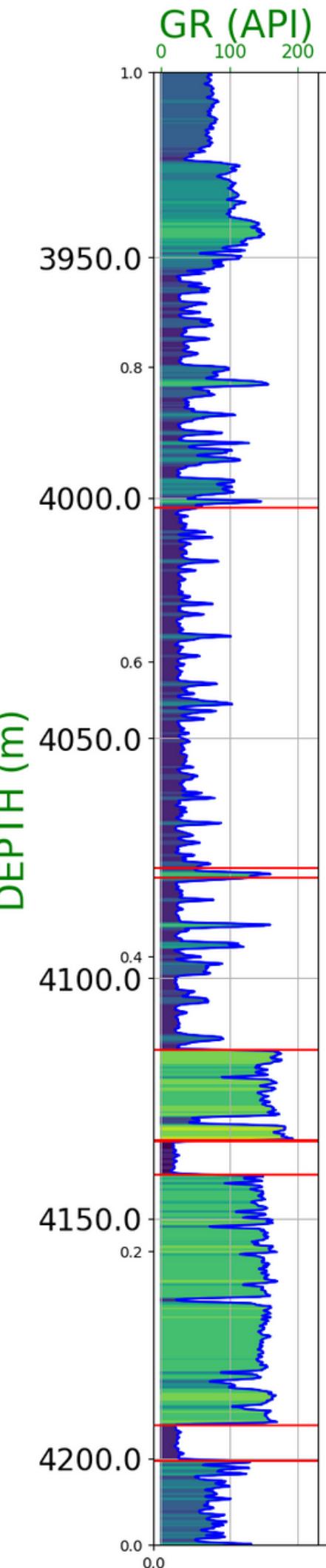
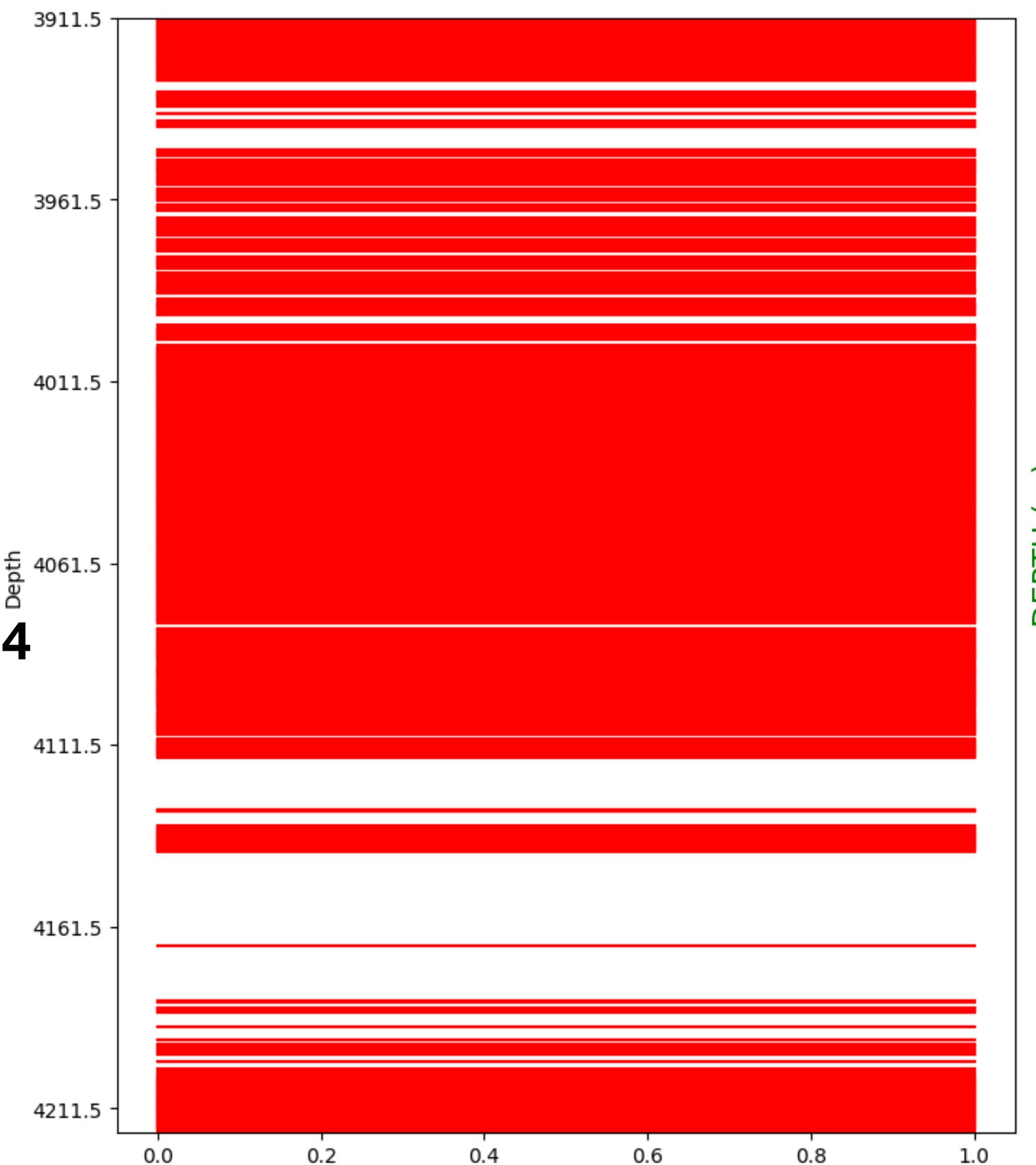
Water Saturation Variation with Depth from Archie's Equation

- Here tortuosity factor = 1
 Cementation exponent = 1.8
 Saturation exponent = 2



Generation of Reservoir Flag

For :
The volume of shale, $V_{sh} \leq 0.4$
Water saturation, $S_w \leq 0.65$



5.a

Reporting Total Porosity, Water Saturation & Shale Volume

	Depth	Volume of Shale	Water Saturation	Total Porosity
0	4719.675	0.366	0.49	0.064
1	4719.523	0.372	0.499	0.093
2	4718.304	0.379	0.597	0.113
3	4718.304	0.399	0.583	0.124
4	4717.389	0.312	0.462	0.059
.....
2740	3909.669	0.226	0.057	0.392
2741	3909.517	0.232	0.056	0.396
2742	3909.364	0.218	0.053	0.406
2743	3909.212	0.232	0.057	0.391
2744	3909.09	0.232	0.057	0.391

5.b

Standard Deviation Of Parameters Of Reservoir Zone

	Depth	Volume of Shale	Water Saturation	Total Porosity
Count	2745	2745	2745	2745
Mean	4309.136	0.132	0.382	0.130
Std	260.753	0.120	0.170	0.081
Min	3909.06	-0.016	0.019	-0.006
25%	4048.963	0.029	0.243	0.083
50%	4408.322	0.095	0.406	0.103
75%	4548.530	0.224	0.513	0.144
Max	4719.675	0.399	0.699	0.709

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- Richard M. Bateman - Openhole Log Analysis and Formation Evaluation-Society of Petroleum Engineers (2012)
- Fundamentals of Well Log Interpretation - O'Serra
- Arsalan, S. I., Ichizawa, K., & Furuya, K. (2017). Visualisation of geomorphological features and interpretation of the depositional system of the Brewster Member, Ichthys Field. The APPEA Journal, 57(1), 288-300
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- Webpage: <https://www.arab-oil-naturalgas.com/oil-well-logging-books/>



**THANK YOU
FOR
LISTENING**