iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** I **Month of publication:** January 2018

DOI: http://doi.org/10.22214/ijraset.2018.1130

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 6 Issue I, January 2018- Available at www.ijraset.com

Interpretation Well Logging Data in KG Basin

B.Lavanya[1]
[1]*(15A91D0803), M. Tech Petroleum Engineering, Aditya Engineering College, Surampalem-533437, East Godavari District, AP*

I. OBJECTIVE OF THE STUDY

Standard interpretation is the process of determining volume of hydrocarbons in place from wire line logs. This process requires four basic steps.

Determine the volume of shale. Shale affects the response of the various -logging devices. To interpret the response for porosity or saturation, the volume of shale must be determined.

Determine the porosity. Porosity is the fraction of the total rock available for the storage of fluids.

Determine the formation water resistivity (Rw). The resistivity of the water is used to interpret the formation resistivity for saturation.

Determine the water saturation (Sw). A resistivity model is interpreted for saturation. This model relates water saturation, porosity, water resistivity, and volume of shale.

A. Well data

# DEPT	GR	LLD	NPHI	RHOB
2094	82	0.52	0.42	2.35
2094.5	80	0.6	0.41	2.36
2095	80.5	0.51	0.4	2.34
2095.5	80	0.49	0.42	2.33
2096	85	0.7	0.46	2.3
2096.5	90	1.5	0.36	2.46
2097	95	1	0.22	2.52
2097.5	85.5	0.6	0.42	2.42
2098	90	0.55	0.422	2.4
2098.5	90	0.57	0.39	2.39
2099	82	0.52	0.42	2.4
2099.5	89	0.6	0.46	2.39
2100	92	0.85	0.38	2.42
2100.5	90	1.8	0.38	2.42
2101	96	2	0.21	2.3
2101.5	80	16	0.09	2.22
2102	89	14	0.07	2.09
2102.5	63	40	0.06	2.01
2103	65	28	0.05	2.16
2103.5	63	4	0.08	2.02
2104	81	1.7	0.16	2.1
2104.5	61	1.6	0.24	2.2
2105	54	1.3	0.22	2.18

2105.5	71	2	0.19	2.2
2106	96	2.1	0.16	2.42
2106.5	75	1.8	0.24	2.3
2107	70	2	0.21	2.43
2107.5	62	1.6	0.2	2.28
2108	61	1.7	0.2	2.28
2108.5	60	1.6	0.21	2.24
2109	60	1.8	0.19	2.25
2109.5	60	1.5	0.18	2.2
2110	84	1.4	0.19	2.18
2110.5	61	1.3	0.2	2.16
2111	70	0.8	0.22	2.15
2111.5	105	1.2	0.24	2.26
2112	71	1.1	0.21	2.18
2112.5	80	1	0.24	2.17
2113	106	1.2	0.16	2.2
2113.5	120	1	0.24	2.32
2114	70	1.5	0.32	2.36

Table-1: well data

B. Estimation of Shale Volume

The volume of shale (Vsh) is best estimated by logging measurements that respond primarily to shale, in particular, gamma ray and spontaneous potential (SP), the most common method for estimating the shale volume from gamma ray and SP logs. Other measurements can be used under special conditions to estimate shale volume, such as the resistivity in very high resistivity formations, the compensated neutron in very low porosity formations.

<u>Shale volume from gamma ray:</u>

$$v_{gr} = (Gr_{log} - Gr_{min})/(Gr_{max} - Gr_{min})$$

Where, $Gr_{log} -$ gamma ray from log

Gr_{min} –Minimum gamma ray value from the log on sand portion.

Gr_{max} – Maximum gamma ray value from the log on shale portion.

<u>Shale volume from SP:</u>

$$v_{sp} = (SSP - PSP) /(SSP)$$

Where,

PSP- pseudo static potential i.e. the SP read in the water bearing shaly sand zone.

SSP-static spontaneous potential i.e. maximum SP value in a clean sand zone.

Shale volume from resistivity

$$Vsh_{Rt} = a^{0.59+1.44a-1.29\,a\wedge 2}$$

Where,

$$a = (R_{lim} - R_t) \quad /(R_{lim} - R_{Sh})R_t R_{Sh}$$

R_{sh}- Maximum resistivity value in the shale portion.

R_{lim} – max resistivity in the entire zone

Shale volume

R_{t} – Latero log deep (LLD)value at each depth

.

$Ø_N$- Neutron value at each depth from log on TNPH curve.

$Ø_D$- Porosity value from Density log.

$Ø_{NSh}$ - Maximum value at shale portion from log on TNPH curve.

$Ø_{Dsh}$ - Maximum value at shale portion from density curve.

$$Ø_D = (\rho_b - \rho_{log})/(\rho_b - \rho_f)$$

Where,

$Ø_D$ –Porosity log from density log.

ρ_b –Bulk density of the formation.

ρ_{log} – density value at each depth from log. .

ρ_f – density of the formation fluid

Matrix Values-ρ_{ma}(sandstone) = 2.65gm/cc, ρ_{ma}(lime stone) = 2.71gm/cc, ρ_{fluid}= 1.0gm/cc.

# DEPT	VGR	VRT	VND	VCLMIN
2094	0.763636364	1.080028506	0.893754835	0.763636364
2094.5	0.727272727	1	0.873086334	0.727272727
2095	0.736363636	1.084880497	0.84599838	0.736363636
2095.5	0.727272727	1.088532752	0.889475199	0.727272727
2096	0.818181818	0.871440818	0.974289019	0.818181818
2096.5	0.909090909	0.407447396	0.780442921	0.407447396
2097	1	0.596945826	0.473965371	0.473965371
2097.5	0.827272727	1	0.90873356	0.827272727
2098	0.909090909	1.056613056	0.909015588	0.909015588
2098.5	0.909090909	1.035783067	0.833889151	0.833889151
2099	0.763636364	1.080028506	0.904453924	0.763636364
2099.5	0.890909091	1	0.993547379	0.890909091

2100	0.945454545	0.710067891	0.817500286	0.710067891
2100.5	0.909090909	0.353487141	0.817500286	0.353487141
2101	1.018181818	0.328089819	0.404081061	0.328089819
2101.5	0.727272727	0.095231062	0.113262698	0.095231062
2102	0.890909091	0.105905868	0.039828429	0.039828429
2102.5	0.418181818	0	0	0
2103	0.454545455	0.049005219	0.009190518	0.009190518
2103.5	0.418181818	0.219453129	0.047658023	0.047658023
2104	0.745454545	0.368895882	0.247243112	0.247243112
2104.5	0.381818182	0.386682584	0.451107837	0.381818182
2105	0.254545455	0.461410145	0.401211565	0.254545455
2105.5	0.563636364	0.328089819	0.337066246	0.328089819
2106	1.018181818	0.317480105	0.315717283	0.315717283
2106.5	0.636363636	0.353487141	0.472506016	0.353487141
2107	0.545454545	0.328089819	0.431898692	0.328089819
2107.5	0.4	0.386682584	0.376993107	0.376993107
2108	0.381818182	0.368895882	0.376993107	0.368895882
2108.5	0.363636364	0.386682584	0.391242154	0.363636364
2109	0.363636364	0.353487141	0.347765335	0.347765335
2109.5	0.363636364	0.407447396	0.314257927	0.314257927
2110	0.8	0.431993395	0.33278661	0.33278661
2110.5	0.381818182	0.461410145	0.351315293	0.351315293
2111	0.545454545	0.758030236	0.394792111	0.394792111
2111.5	1.181818182	0.497194286	0.463946744	0.463946744
2112	0.563636364	0.541418451	0.378403247	0.378403247
2112.5	0.727272727	0.596945826	0.444688384	0.444688384
2113	1.2	0.497194286	0.268641291	0.268641291
2113.5	1.454545455	0.596945826	0.476785651	0.476785651
2114	0.545454545	0.407447396	0.667811469	0.407447396

Table-2: Shale volume

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 6 Issue I, January 2018- Available at www.ijraset.com

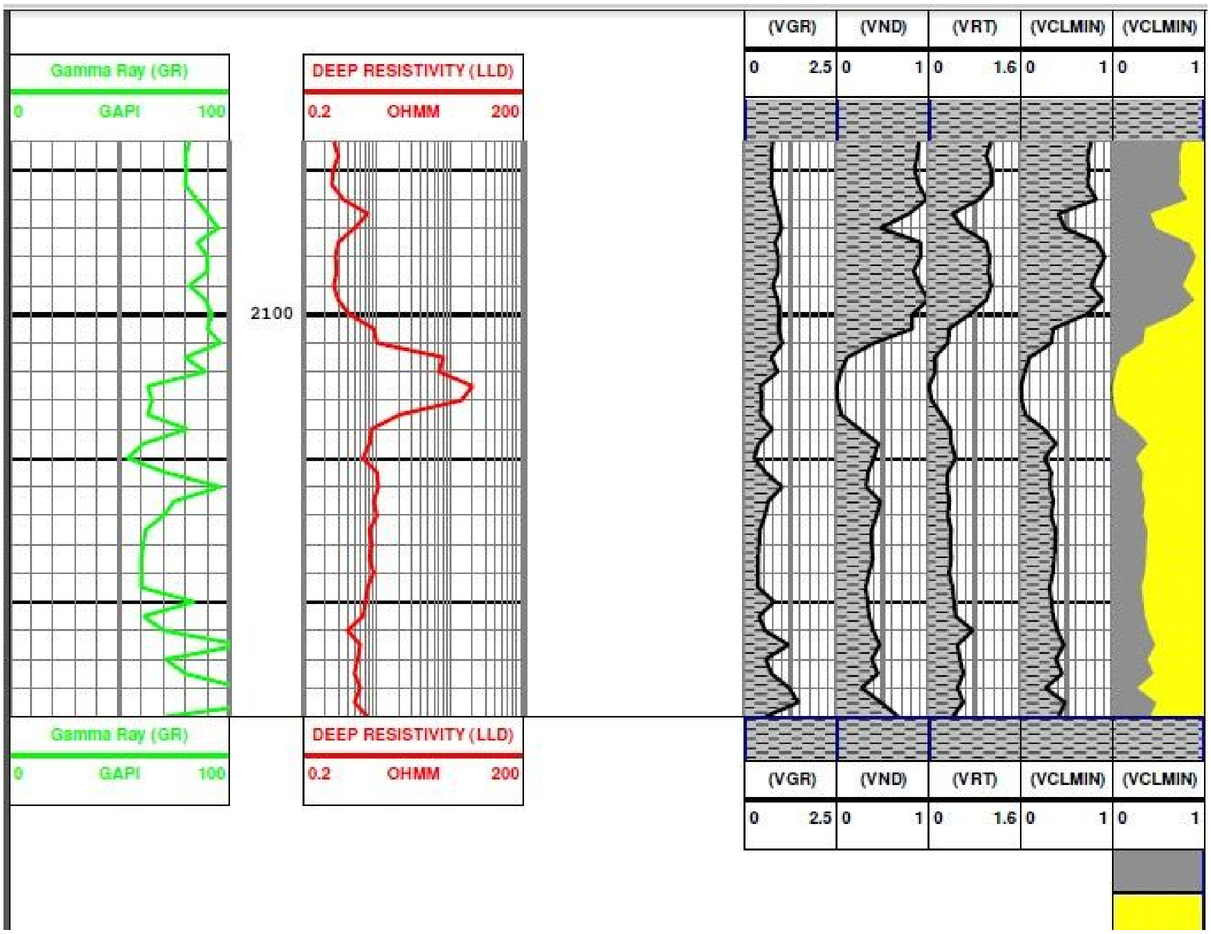

Figure1: Volume of shale

C. Porosity Estimation

Any logging device primarily affected by the presence of porosity can be used to estimate porosity. Best results are generally produced by the density, compensated neutron, and sonic logs. Multiple porosity measuring devices are recorded, the multiple measurements can frequently be used together to determine porosity and lithology.

D. Porosity From Density

$$\emptyset_D = (\rho_b - \rho_{log})/(\rho_b - \rho_f)$$

Where,

$\emptyset_D$ –Porosity log from density log.

ρ_b –Bulk density of the formation.

ρ_{log} – density value at each depth from log.

ρ_f – density of the formation fluid .

$$\emptyset_S = (\Delta t_{log} - \Delta t_{ma})/(\Delta t_f - \Delta t_{ma})$$

Where,

$\emptyset_S$ – porosity from sonic

Δt_{log} – travel time from log

Δt_f – travel time in fluid

Δt_{ma} – travel time in matrix

Travel time Values: Δtma= 55µs/ft for sandstone
Δtma= 47µs/ft for limestone
Δt fluid = 189µs/ft for water.

E. Determination hydrocarbon saturation and movable hydrocarbons

1) Finally calculate the hydrocarbon saturation by the relation;

$$S_H + S_W = 1$$
$$S_H = 1 - S_W$$

The relation is valid if the formation is saturated with only hydrocarbons and water.

2) movable hydrocarbons $= \emptyset s_{xo} - \emptyset s_w$

Where
SXOflushed zone water saturation S_H hydrocarbon saturation.
The values of R_t, $\emptyset_D$,$\emptyset_N$,$\emptyset_e$,S_{xo}, S_W against the hydrocarbon zone are tabulated in the following table:

DEPT	PHID	PHINC	PHIDC	PHIE	SWI	SXO	PHISXO	PHISWI
2094	0.18	0.07	0.08	0.07	0.80	0.96	0.07	0.06
2094.5	0.18	0.08	0.07	0.07	0.81	0.96	0.07	0.06
2095	0.19	0.06	0.09	0.08	0.81	0.96	0.08	0.06
2095.5	0.19	0.09	0.09	0.09	0.80	0.96	0.09	0.07
2096	0.21	0.08	0.10	0.09	0.72	0.94	0.09	0.07
2096.5	0.12	0.17	0.06	0.08	1.06	1.01	0.08	0.09
2097	0.08	0.00	0.01	0.01	1.32	1.06	0.01	0.01
2097.5	0.14	0.04	0.02	0.03	0.82	0.96	0.03	0.02
2098	0.15	0.00	0.02	0.02	0.79	0.95	0.02	0.02
2098.5	0.16	0.01	0.04	0.03	0.81	0.96	0.03	0.03
2099	0.15	0.07	0.05	0.05	0.83	0.96	0.05	0.04
2099.5	0.16	0.05	0.03	0.04	0.77	0.95	0.04	0.03
2100	0.14	0.05	0.04	0.04	0.87	0.97	0.04	0.04

2100.5	0.14	0.22	0.09	0.12	0.96	0.99	0.12	0.11
2101	0.21	0.06	0.17	0.14	0.87	0.97	0.14	0.12
2101.5	0.26	0.05	0.25	0.20	0.36	0.82	0.17	0.07
2102	0.34	0.05	0.33	0.27	0.29	0.78	0.21	0.08
2102.5	0.39	0.06	0.39	0.32	0.15	0.68	0.22	0.05
2103	0.30	0.05	0.30	0.24	0.24	0.75	0.18	0.06
2103.5	0.38	0.06	0.38	0.30	0.47	0.86	0.26	0.14
2104	0.33	0.05	0.30	0.24	0.70	0.93	0.23	0.17
2104.5	0.27	0.06	0.22	0.19	0.74	0.94	0.17	0.14
2105	0.28	0.10	0.25	0.22	0.83	0.96	0.21	0.18
2105.5	0.27	0.04	0.23	0.19	0.74	0.94	0.17	0.14
2106	0.14	0.01	0.10	0.08	1.21	1.04	0.08	0.09
2106.5	0.21	0.08	0.16	0.14	0.86	0.97	0.14	0.12
2107	0.13	0.06	0.09	0.08	1.17	1.03	0.08	0.09
2107.5	0.22	0.03	0.17	0.14	0.87	0.97	0.14	0.12
2108	0.22	0.03	0.17	0.14	0.87	0.97	0.14	0.12
2108.5	0.25	0.04	0.20	0.16	0.82	0.96	0.16	0.13
2109	0.24	0.03	0.19	0.16	0.82	0.96	0.15	0.13
2109.5	0.27	0.04	0.23	0.19	0.82	0.96	0.18	0.15
2110	0.28	0.04	0.24	0.19	0.79	0.96	0.18	0.15
2110.5	0.30	0.04	0.25	0.20	0.77	0.95	0.19	0.16
2111	0.30	0.04	0.25	0.20	0.83	0.96	0.19	0.17
2111.5	0.24	0.03	0.17	0.14	0.83	0.96	0.13	0.12
2112	0.28	0.04	0.23	0.19	0.82	0.96	0.18	0.15
2112.5	0.29	0.04	0.23	0.19	0.78	0.95	0.18	0.14

2113	0.27	0.04	0.24	0.19	0.92	0.98	0.19	0.18
2113.5	0.20	0.02	0.13	0.11	0.93	0.99	0.11	0.10
2114	0.18	0.13	0.12	0.12	0.91	0.98	0.12	0.11

Table-3: porosity and saturation

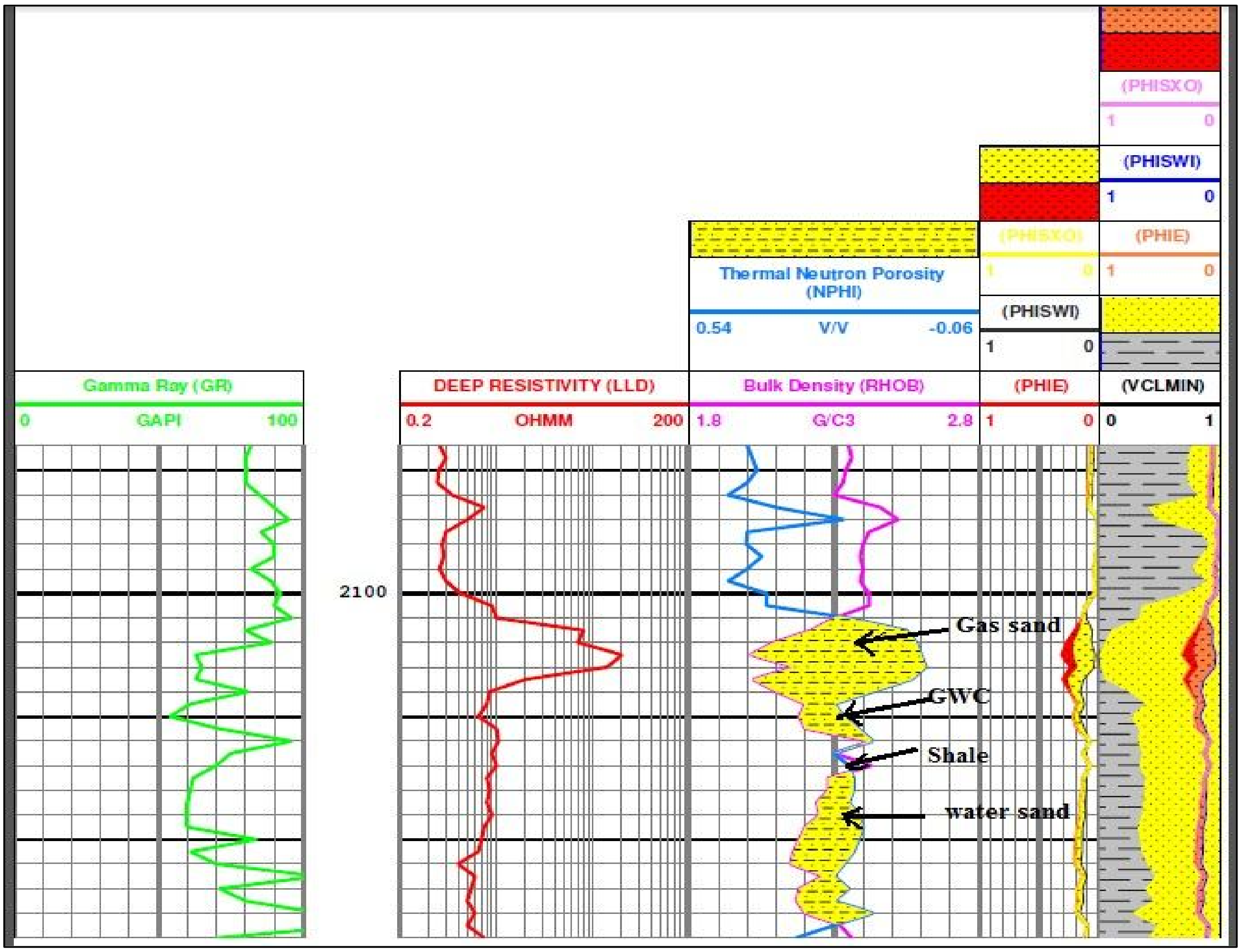

Fig-2: paralogInference: The sand pack (2101-2114m) is characterized by the resistivity 2-40 ohm-m and gamma ray of 60-65 API. The effective porosity and Sw value are 20-28% and 20-30% respectively. At 2102-2103 the resistivity showing maximum value so this have some hydrocarbons. This sand pack is interpreted as gas bearing with GWC at 2103m. The clean sand pack (2108-2112m) having resistivity 1.2-1.8 ohm-m and gamma ray of 50-60 API. The effective porosity and water saturation are ranging from 22-28% and 90-95% respectively. This is interpreted as water bearing.

II. CONCLUSION

Well logging plays an essential role in petroleum exploration and exploitation. It is used to identify the pay zones of gas or oil in the reservoir formations. It gives continuous downhole record and detailed picture of both gradual and abrupt changes in physical properties of subsurface lithology Logging has a central role in the successful development of a hydrocarbon reservoir. Its measurements occupy a position of central importance in the life of a well, between two milestones: the surface seismic survey, which has influenced the decision for the well location, and the production testing Logging is able to adequately reveal the whole of the drilled sequence and has the added advantage that it measures, in situ, rock properties which cannot be measured in a laboratory from either core samples or cuttings. From this data, it is possible to obtain good estimates of the reservoir size and the hydrocarbons in place. According to the measurements of well logging there are three kinds of data: electrical, nuclear and acoustic. Electrical logging is used to analyze oil saturation and water saturation of the formation. Nuclear logging is used to analyze the porosity and permeability. Acoustic logging provides information about porosity and also indicates whether a liquid or gas phase occupies the pore spaces. Logging techniques in cased holes can provide much of the data needed to monitor primary production and also to gauge the applicability of water flooding and to monitor its progress when activated. In producing wells, logging can provide measurements of flow rates, fluid type, pressure, residual oil saturation. From these measurements, dynamic well behaviour can be better understood and remedial work can be planned and secondary or tertiary recovery proposals can be evaluated and monitored. Thus no hydrocarbon can be produced without the intervention of logs.

REFERENCES

[1] GEORGE ASQUITH WITH CHARLES GIBSON., Basic well log analysis for geologists.
[2] RICHARD M.BATEMAN, Cased hole log analysis and reservoir performance monitoring.
[3] JAMES J.SMOLEN, Cased hole and production log evaluation
[4] RICHARD M.BATEMAN, Open hole log analysis and formation evaluation.
[5] TOBY DARLING , Well logging and formation evaluation.
[6] OBERTO SERRA , Well logging and reservoir evaluation.
[7] MALCOLM RIDER, the geological interpretation of well logs.
[8] SCHLUMBERGER, log interpretation principles & applications, 1989.
[9] HALLIBURTON, open hole measurement physics and applications manual.
[10] Dr. PAUL GLOVER, petrophysics.
[11] O'SERRA, Fundamentals of well log interpretation.
[12] SCHLUMBERGER, Introduction to production logging.