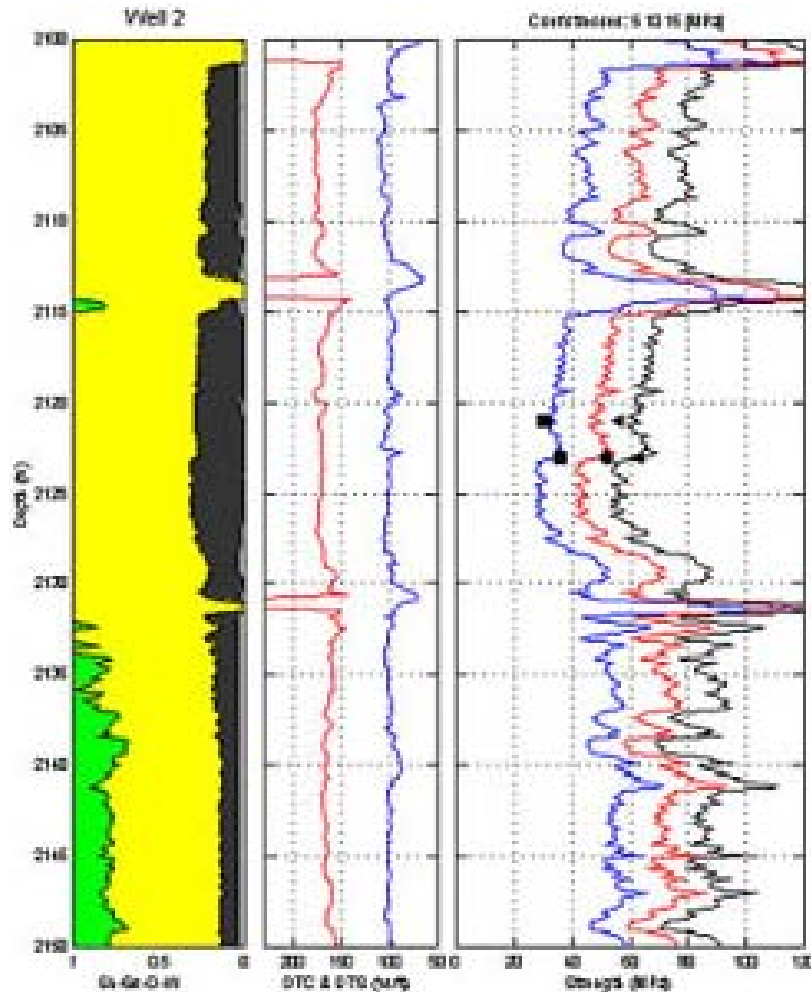


LITTLE ABOUT BASIC PETROPHYSICS



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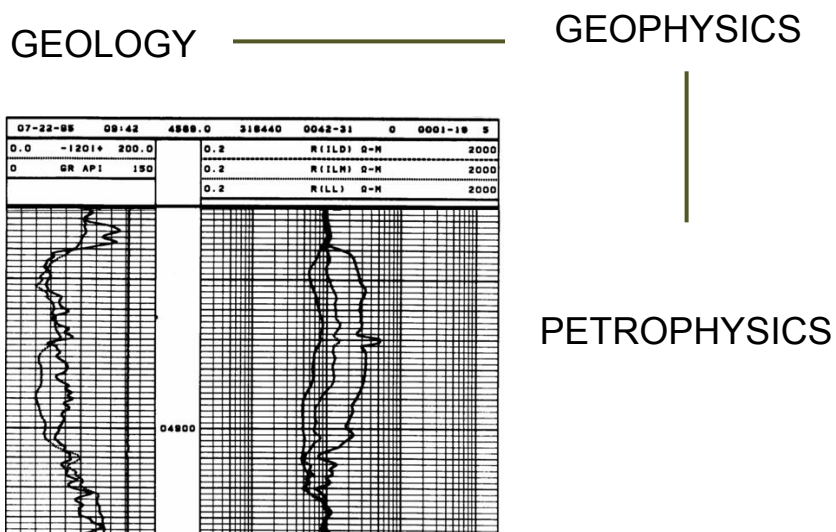
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 - VII. RESISTIVITY
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Introduction - Determination of Physical Properties of Rock.i.e. Porosity, Clay Volume, Minerals, Bed Boundaries, Hydrocarbon Saturation etc.

Look , understand and interpret the signatures of Open Hole and Cased Hole logs by using Quick look methods (Log Interpretation Charts) to evaluate the formation.

Learning Goals

- Basics of logs.
- Understand Open Hole & Cased Hole logs.
- Quick Look Interpretation of Logs.



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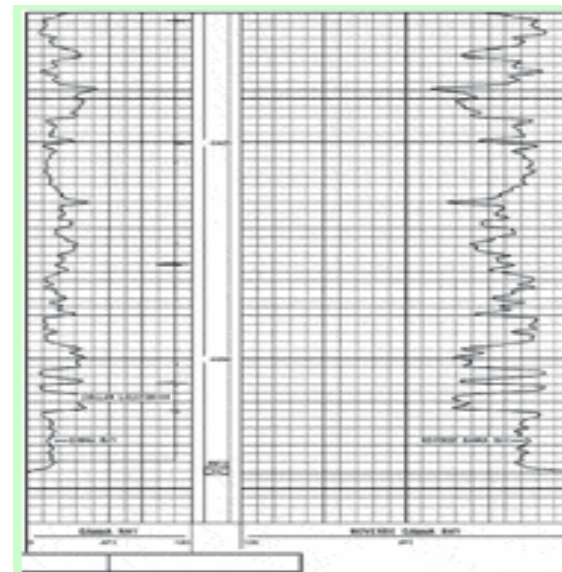
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UNDERSTANDING LOGS OPEN HOLE

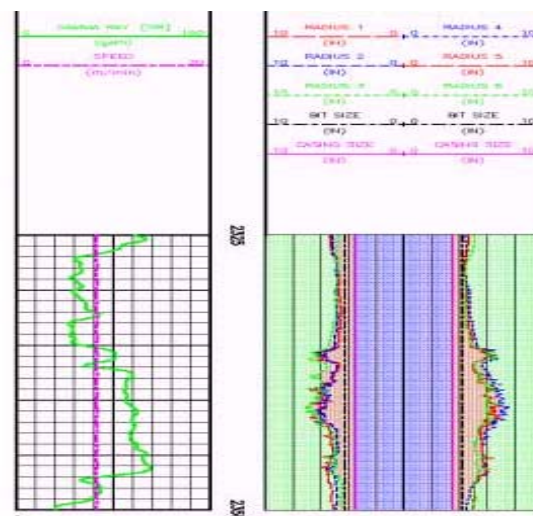
I. GAMMA RAY

Gamma Ray log known as GR log. Its measure the intensity of natural radioactivity of rocks. The intensity of GR is high in the Shale. Why?. The answer is very simple. The radioactive particles like Uranium, Potassium, Thorium are very fine grains. During deposition these particles deposit with shale because Shale is also fine grain rock. That's why the value of GR is high in Shale. GR is the best log for correlation.



II. CALIPER LOG

Caliper log use to measure the hole size. Through this log we can determine the caving size and wash outs.



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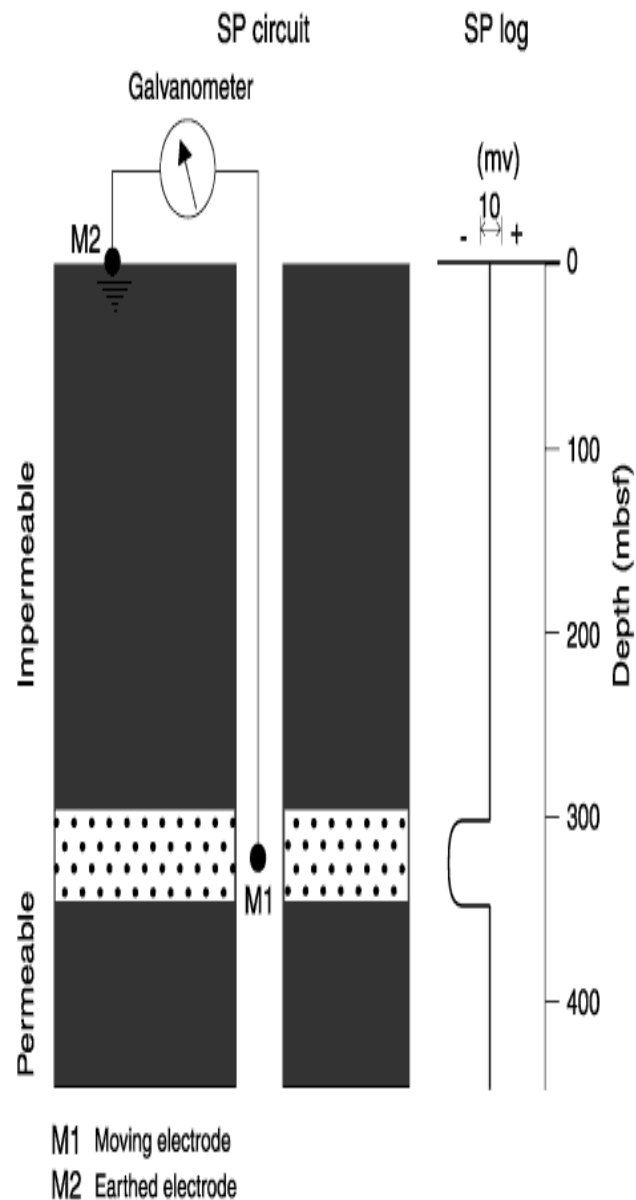
III. SP LOG

The meaning of SP is Self potential or Spontaneous Potential. The mechanism of this log can be understand with a very simple experiment.

Experiment:

Take two beaker. Put water in both beakers in equal quantity then mix salt in both beakers. In one beaker the quantity of salt must be less then other. Make salt solution. Put a copper wire in these beaker and connect a Volt Meter between them you can see the ion will move from high concentration to low concentration. This is called Self Potential. Same this principle use here. The quantity of salt in formation water is different then the quantity of salt in drilling mud. Due to this contrast of salt this potential produce.

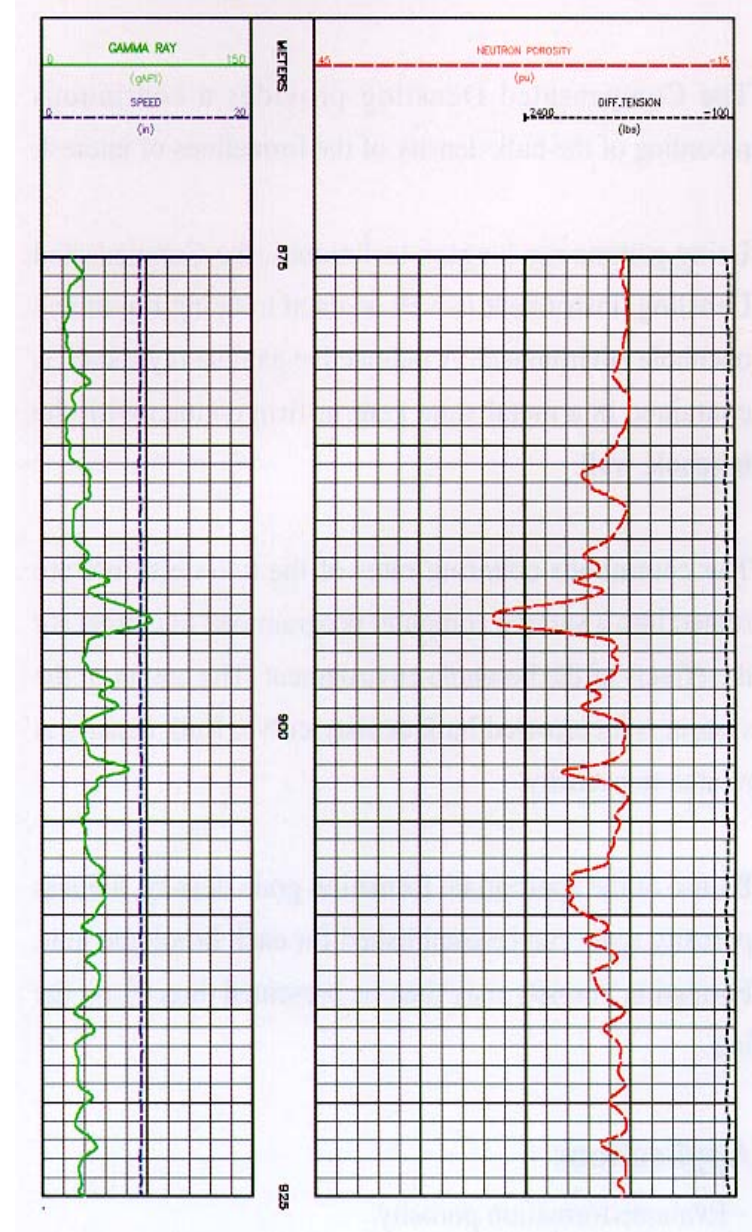
Through SP log we can determine the permeable zone and also calculate the resistivity of water.



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IV. CNL

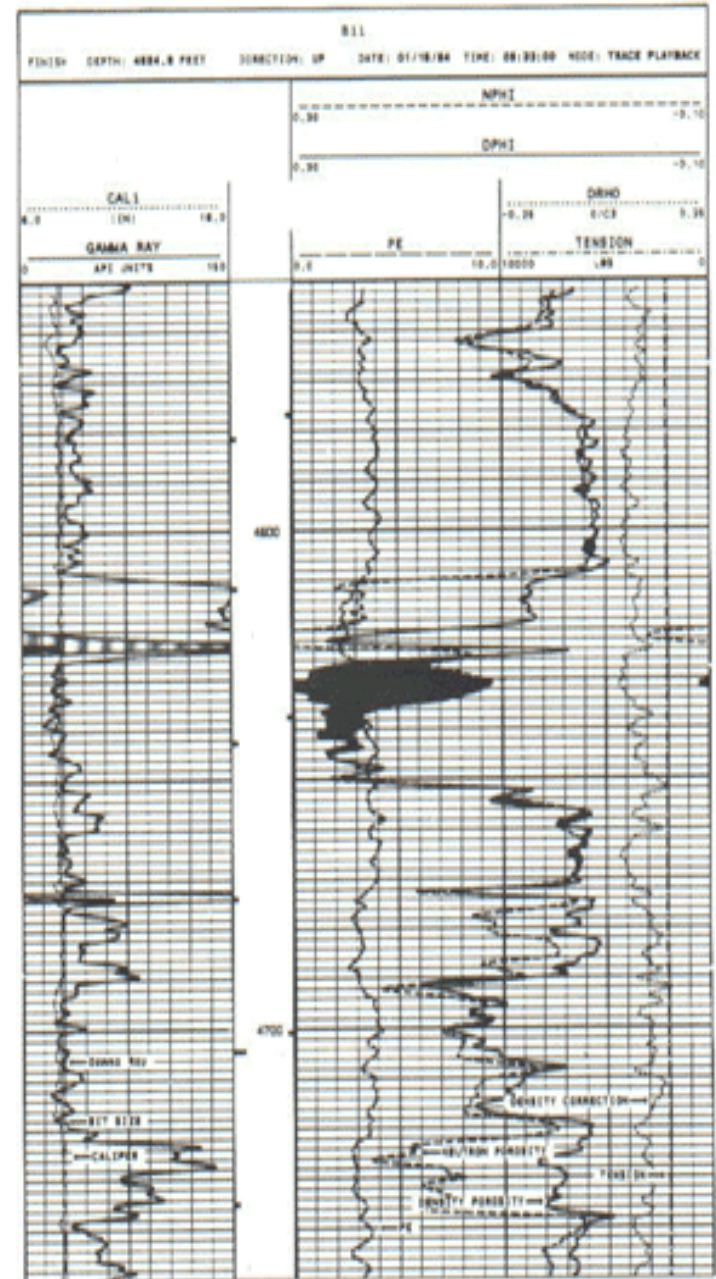
CNL stands for “Compensated Neutron Log”. CNL used to measure the porosity of rock. The mechanism of CNL is very interesting. One thing is common in Water, Oil and Gas. What is this?. The answer is “Hydrogen”. The mass of hydrogen atom and Neutron is almost same. When we bombarded the neutron in the formation , they collide with the hydrogen , if in the formation the number of Hydrogen atoms is higher (water) then it slow down the speed of neutron as the result little number of neutron will received at the receiver and opposite result will be obtain in the case of Hydrocarbon (Gas).



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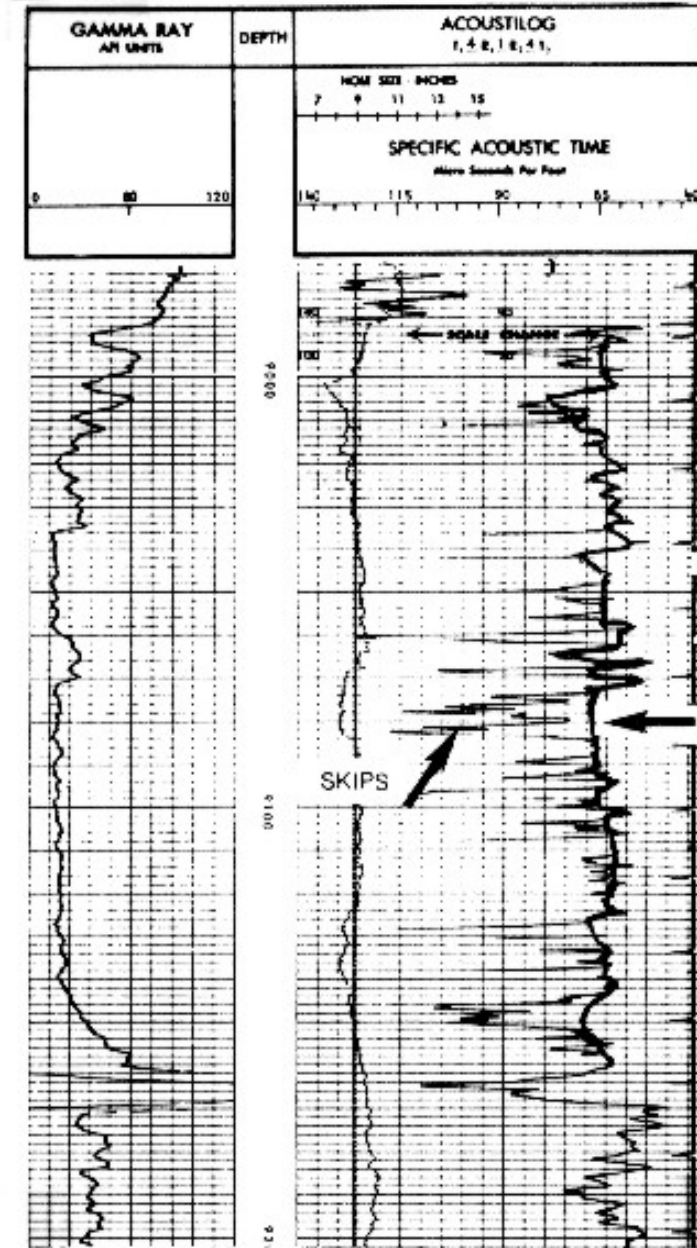
V. LDL

LDL stands for the litho density log. Through this log we can measure the density of the rock. And with the combination of LDL and CNL we calculate the porosity and Lithology.



VI. SONIC

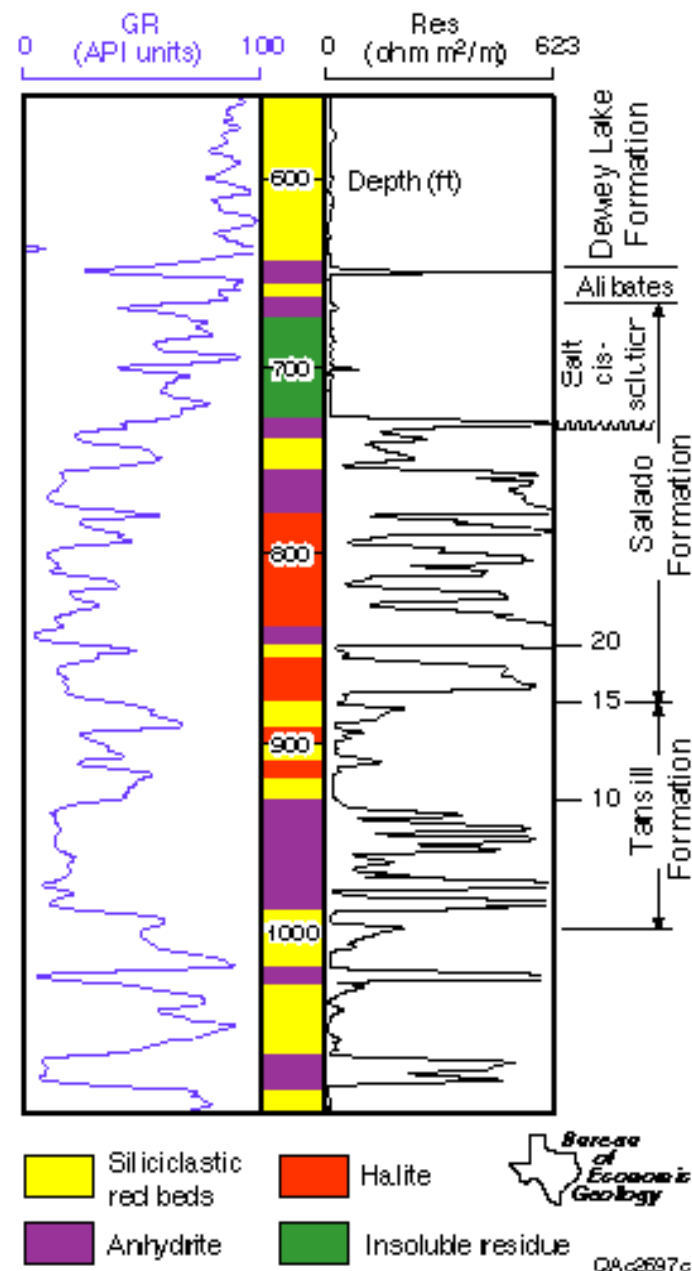
The Sonic log has a great importance in Petrophysics. Through the Sonic log we calculate the porosity of the rock. The principle of this tool is simple. Through sound wave we calculate the porosity. As much pores present in the rock the travel time will be greater and in less porous rock the travel time will be little. Because the speed of sound wave in different medium is different.



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VII. RESISTIVITY LOG

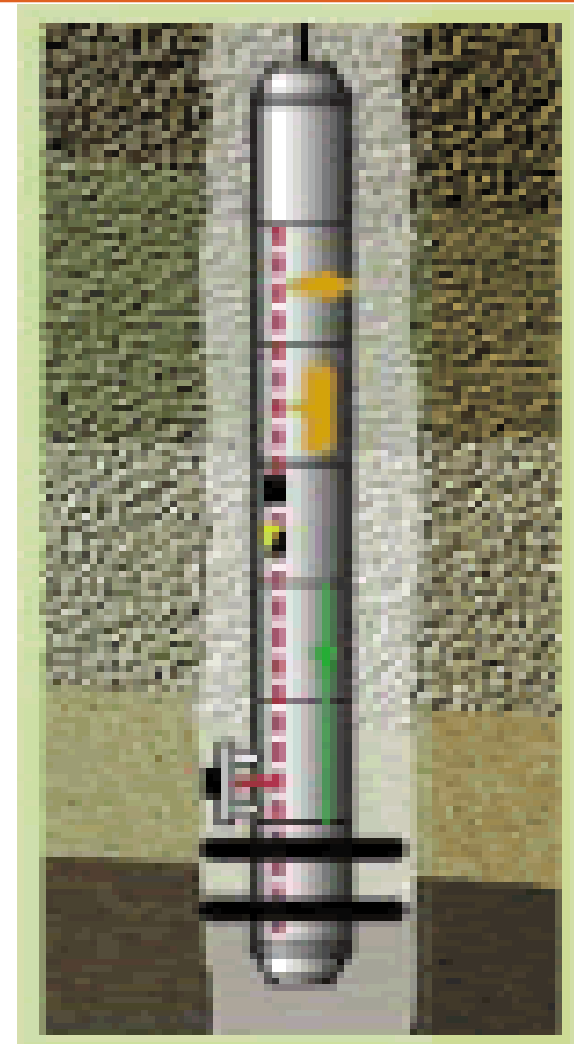
Through this tool we obtain the resistivity of formation. The resistivity of hydrocarbon is higher than the resistivity of formation water.



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VIII. MDT

MDT stands for Modular Dynamic Formation Tester. Through this log we can obtain the Formation Pressure and Formation Fluid Sample. Through these pressure points we can establish the gas water contact, oil water contact, oil gas contact etc.

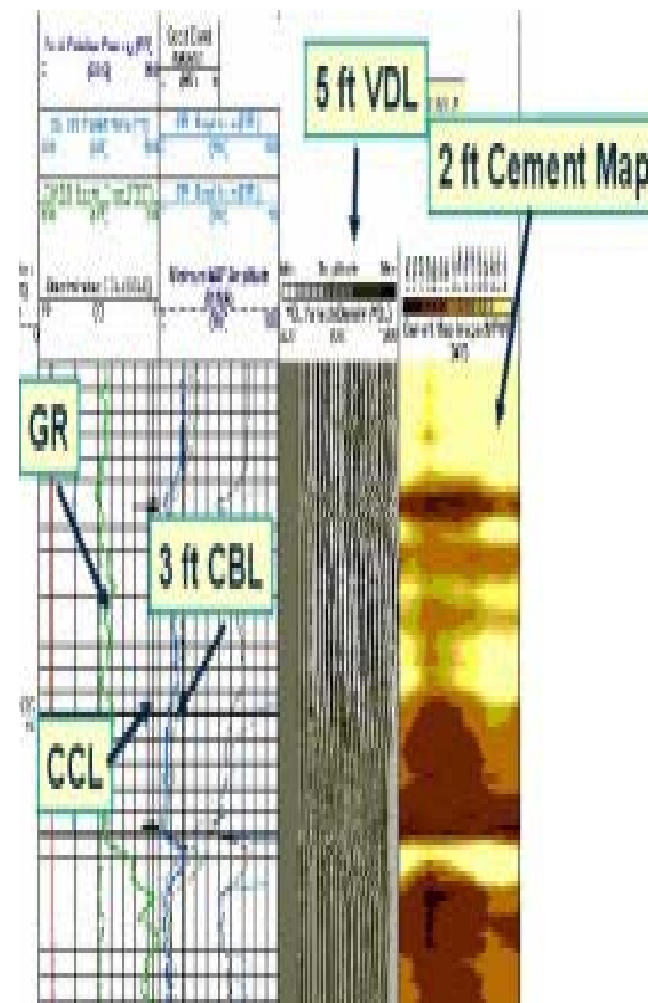


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CASED HOLE

VII. CBL-VDL

CBL (Cement Bond Log), VDL (Variable Density Log) used to check the bond of cement between casing and formation. This is also a sonic log.



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GUIDELINES FOR INTERPRETATION OF WIRELINE LOGS

A) GAMMA RAY LOG:

In Shale the value of GR is high and in Carbonates and Clean Sands the value of GR is low. During Interpretation first we have to select the clean zone. The clean zone define as where the value of GR is low.

B)SP LOG

Then we have to see the SP deflection. If the zone is permeable then there should be the deflection of SP curve.

C)LDL & CNL

The LDL and CNL are the excellent signature to indicate the hydrocarbon bearing zones. In the hydrocarbon bearing zone there should be a cross-over between LDL & CNL. The Signature of LDL moves towards Left side and signature of CNL moves towards right side.

Using Density and Neutron Interpretation chart we calculate the porosity and lithology of rock.

D)RESISTIVITY LOG

According to its name, it calculate the resisitivity of rock. The resisitivity of Hydrocarbon is higher then the resiitivity of formation water. The resisitivity of fresh water is also high.

The formation resistivity depends on the formation fluid and porosity. If the rock has low porosity or rock is compact then resisitivity of formation is high, this can be confirm from sonic log. And in the presence of hydrocarbon the resistivity is high.

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E)SONIC

Sonic Log is a porosity log. In the porous zones the travel time of sound wave is greater. While in compact zone the sound wave travel faster, therefore travel time is less.

Where the hole size is large due to caving the density tool cannot read the actual density of rock because density tool is Pad Tool. In these zones the porosity and lithology calculated by using of Sonic Log.

F)MDT

Modular Dynamic Formation Tester is use to determined the formation pressure and to get the True Formation Fluid Sample. By plotting the pressure points against depth we calculate the Gas-Water, Oil-water, gas-Oil contacts.

G)DETERMINATION OF VOLUME OF CLAY

Volume of clay calculated by using the Gamma Ray log.

FORMULA : $Gr - Gr \text{ (Minimum)}$

$$\frac{Gr \text{ (Max)} - Gr \text{ (Min)}}{}$$

H)DETERMINATION OF WATER SATURATION

water saturation can be calculated through different equations but in quick look method we use Archie's equation.

Archie Equation: $a \times \frac{Rw}{(\emptyset)^m Rt}$

Where : $a = 1$, \emptyset = porosity, $m = 2$, Rw = Resistivity of water,
 Rt = True Resistivity

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SUMMARY

- The study of physical properties of rock is called **Petrophysics.**
- Petrophysical analysis performed on the data obtained through the wireline logs.
- Basically there are two types of wireline logs. 1) Open Hole and 2) Cased Hole.
- Determination of clay volume and water saturation.