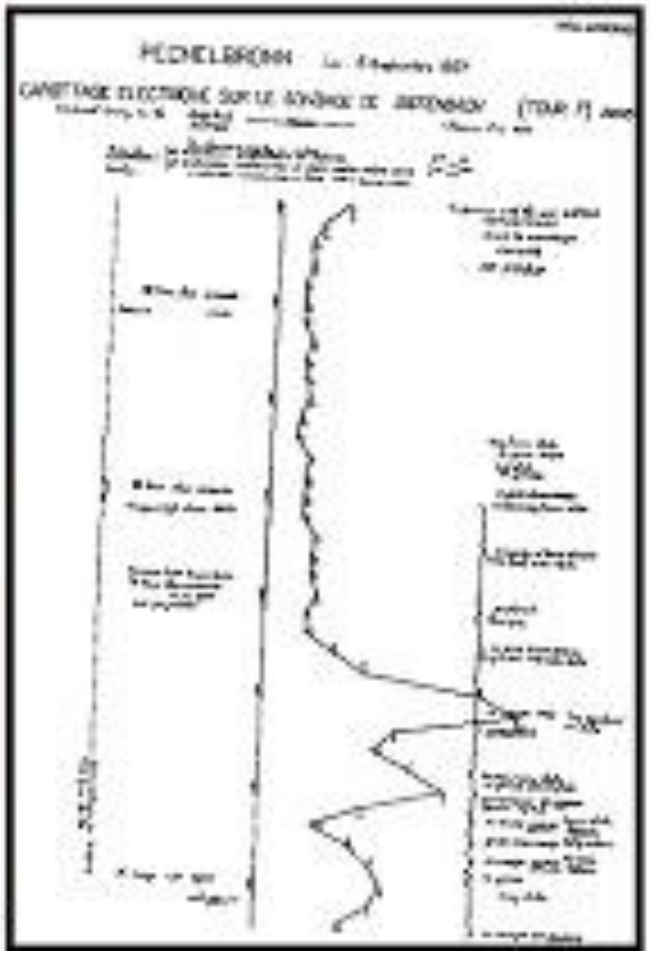

SCHLUM BERGER
ELECTRICAL CORING



# Why we run well Logs

1- Exploration and correlation and isopach mapping.
2- Define physical rock properties.(Porosity, Lithology, Permeability)
3-  Define fluid type and quantity
4- Determine depth and thickness of pay zone

# Reservoir Properties that affected by well log

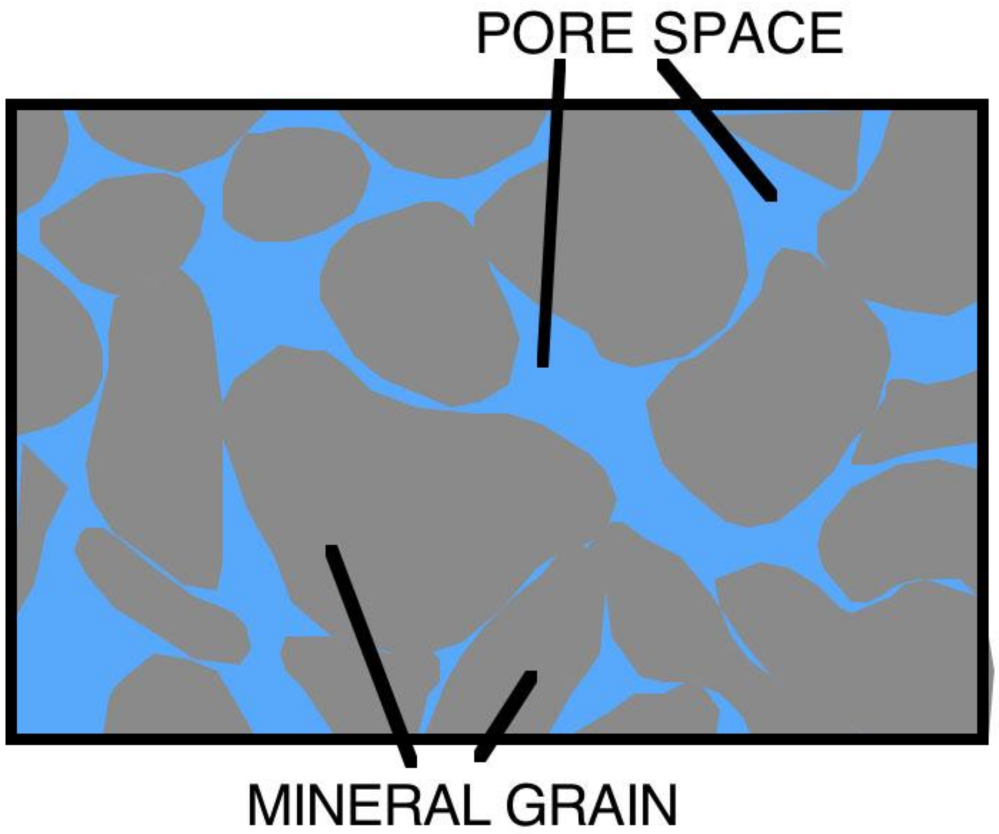
1- Porosity
2-Saturation
3-Lithology
4-Mineralogy

# Porosity

Ratio of the volume pore spaces to the total volume

$$\text{porosity}, \phi = \frac{\text{volume of pores}}{\text{total volume of rock}}$$

- Effective porosity is when pore spaces are connected
- Total porosity are connected plus non connected pore spaces

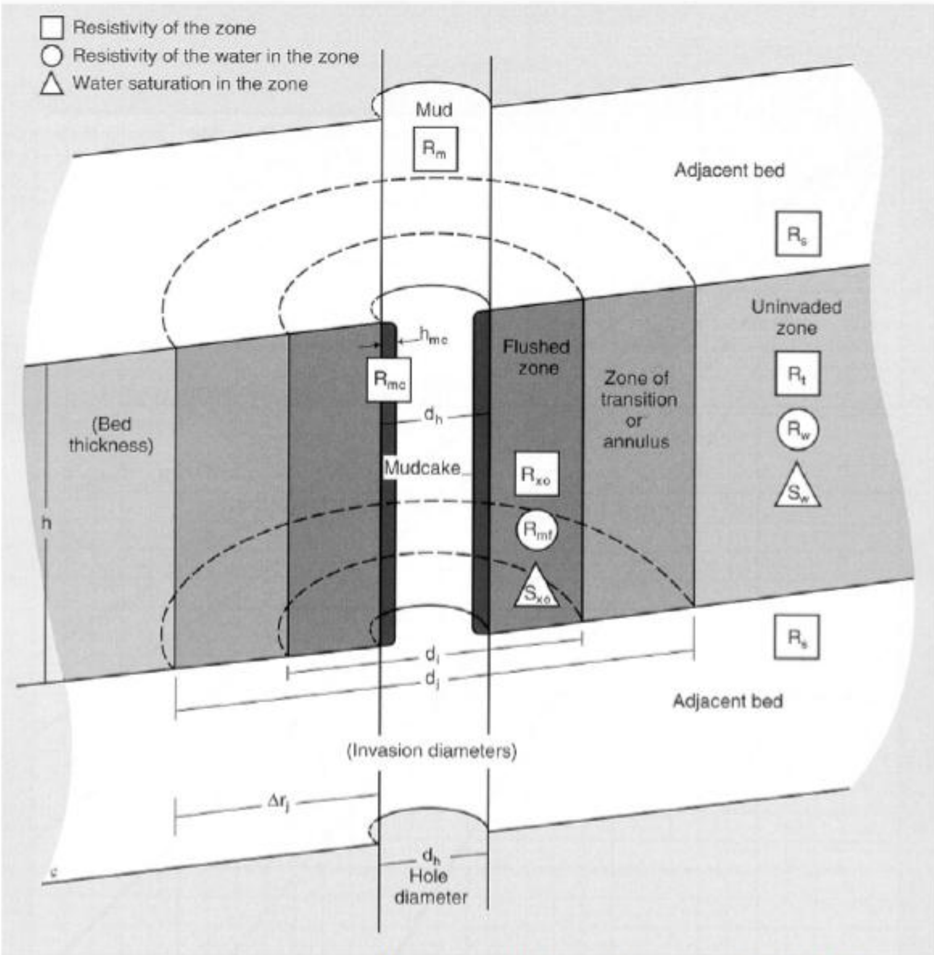


# Water Saturation

Is fraction of pore volume occupied by water. It is represented as decimal fraction or as percentage.

Hydrocarbon saturation is determined by the unity minus fraction of water saturation

# Invasion profile




Courtesy Schlumberger Wireline & Testing, ©1998 Schlumberger

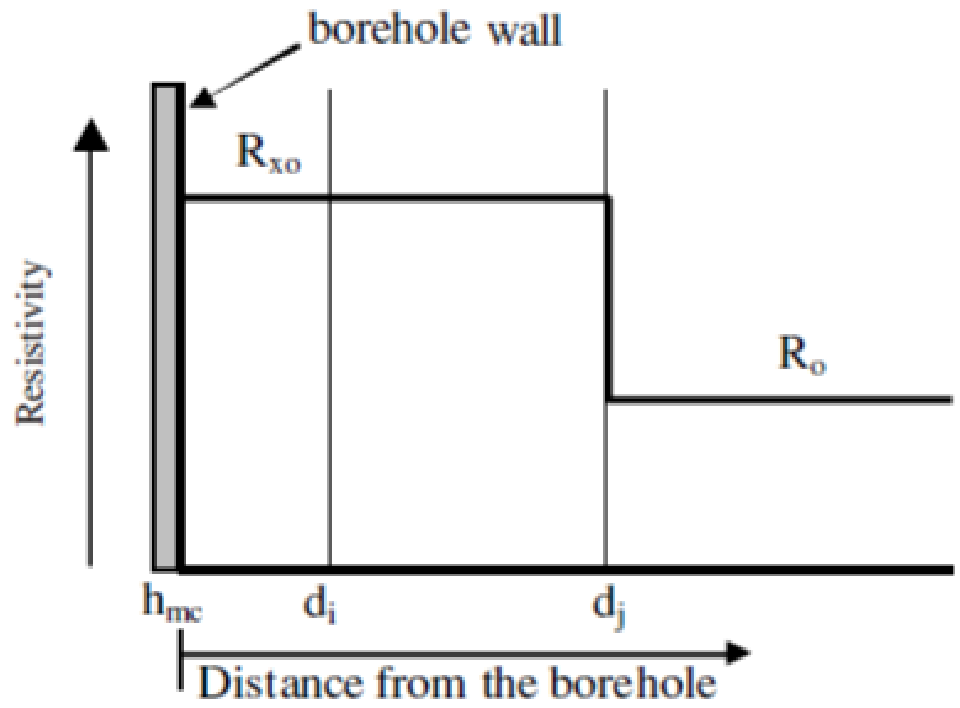
**Figure 1.1.** The borehole environment and symbols used in log interpretation.

This schematic diagram illustrates an idealized version of what happens when fluids from the borehole invade the surrounding rock. Dotted lines indicate the cylindrical nature of the invasion.

$d_h$ = hole diameter
$d_i$ = diameter of invaded zone (inner boundary of flushed zone)
$d_j$ = diameter of invaded zone (outer boundary of invaded zone)
$\Delta r_j$ = radius of invaded zone (outer boundary)
$h_{mc}$ = thickness of mud cake
$R_m$ = resistivity of the drilling mud
$R_{mc}$ = resistivity of the mud cake
$R_{mf}$ = resistivity of mud filtrate
$R_s$ = resistivity of the overlying bed (commonly assumed to be shale)
$R_t$ = resistivity of uninvaded zone (true formation resistivity)
$R_w$ = resistivity of formation water
$R_{xo}$ = resistivity of flushed zone
$S_w$ = water saturation of uninvaded zone
$S_{xo}$ = water saturation flushed zone

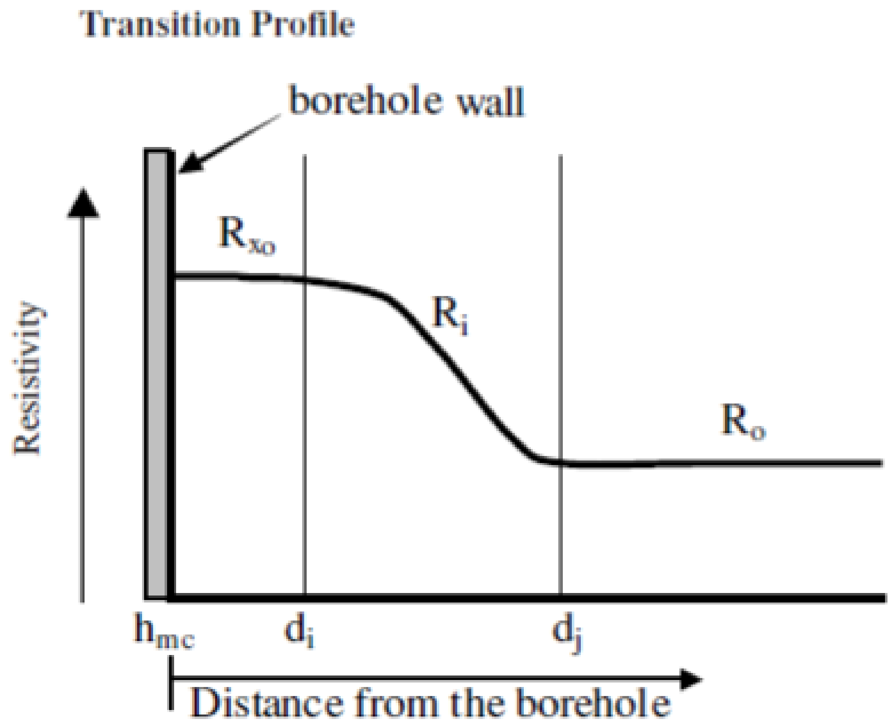
# Step invention profile

Ideal model
Invaded zone is mud filtrate only
Uninvaded zone formation water only



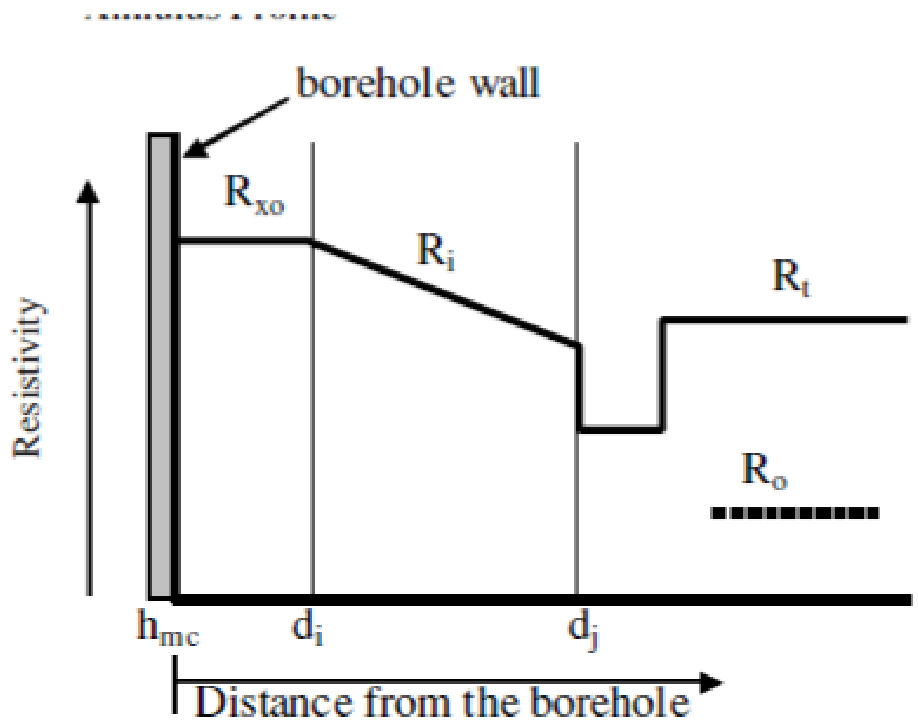
# Transitional profile

- True Formation condition model
- Invaded zone is mud filtrate and Residual fluids only
- Transition zone mud filtrate, formation fluids and residual fluids
- Uninvaded zone formation fluids

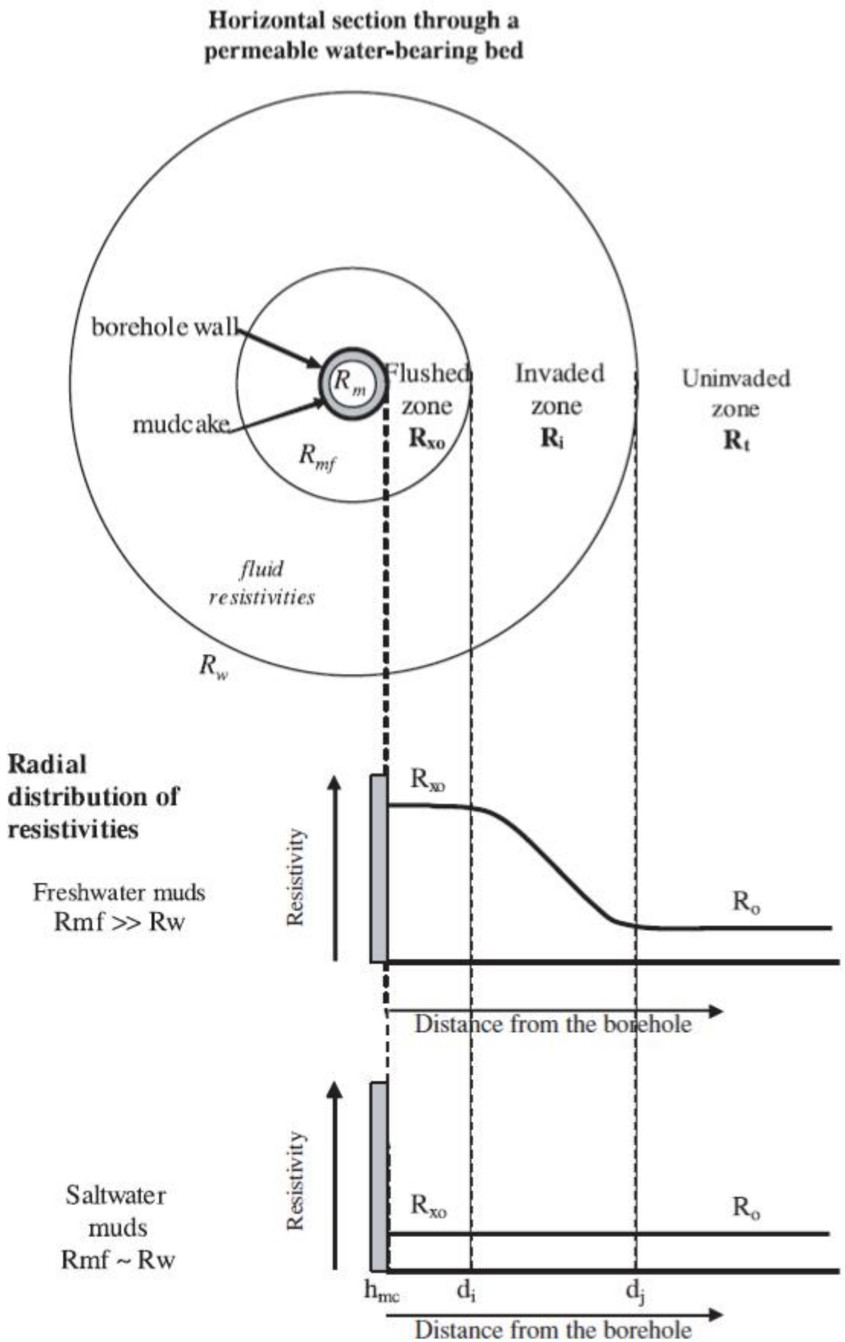


# Annulus zone profile

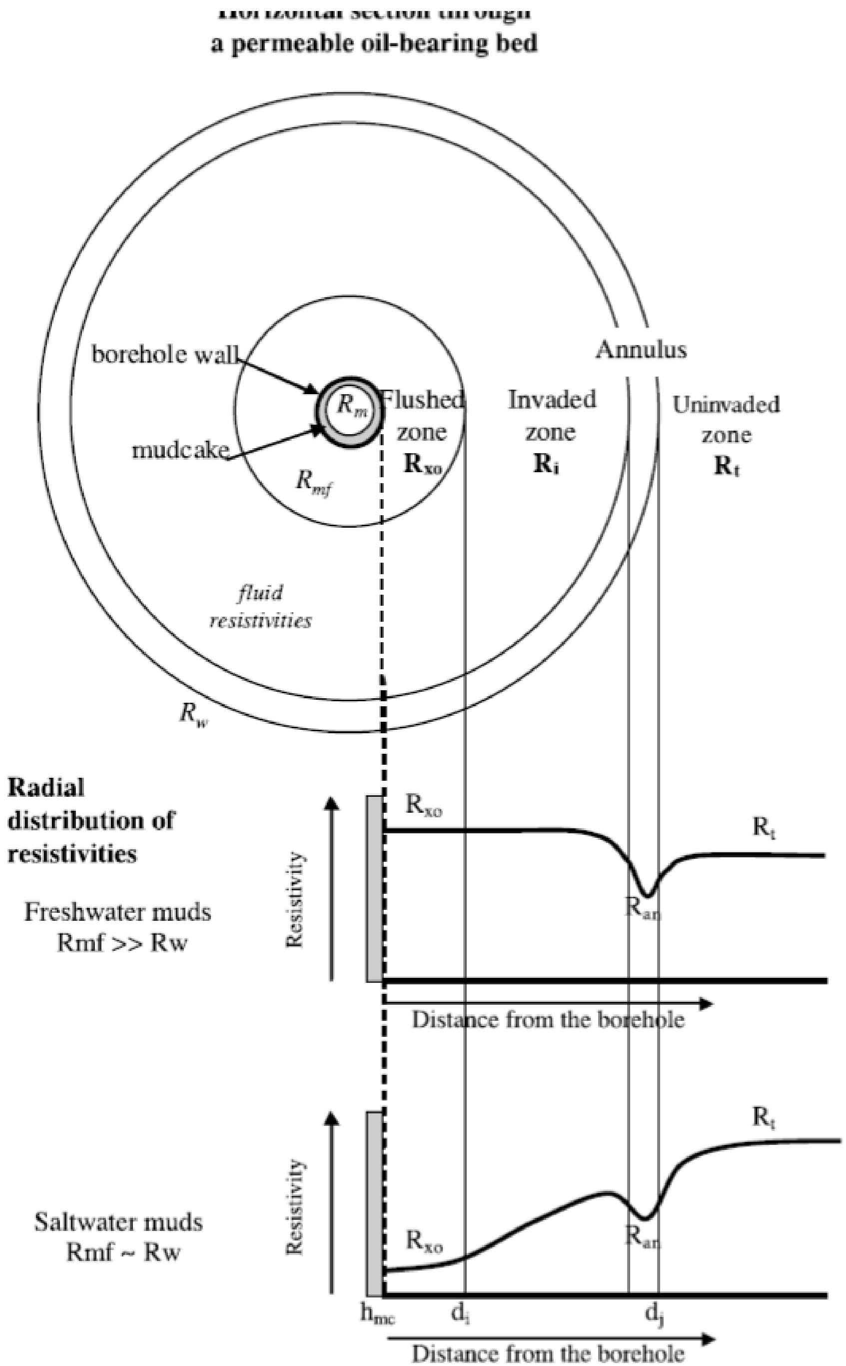
Annulus zone developed due to flushed formation fluids in this zone



# Water-bearing bed

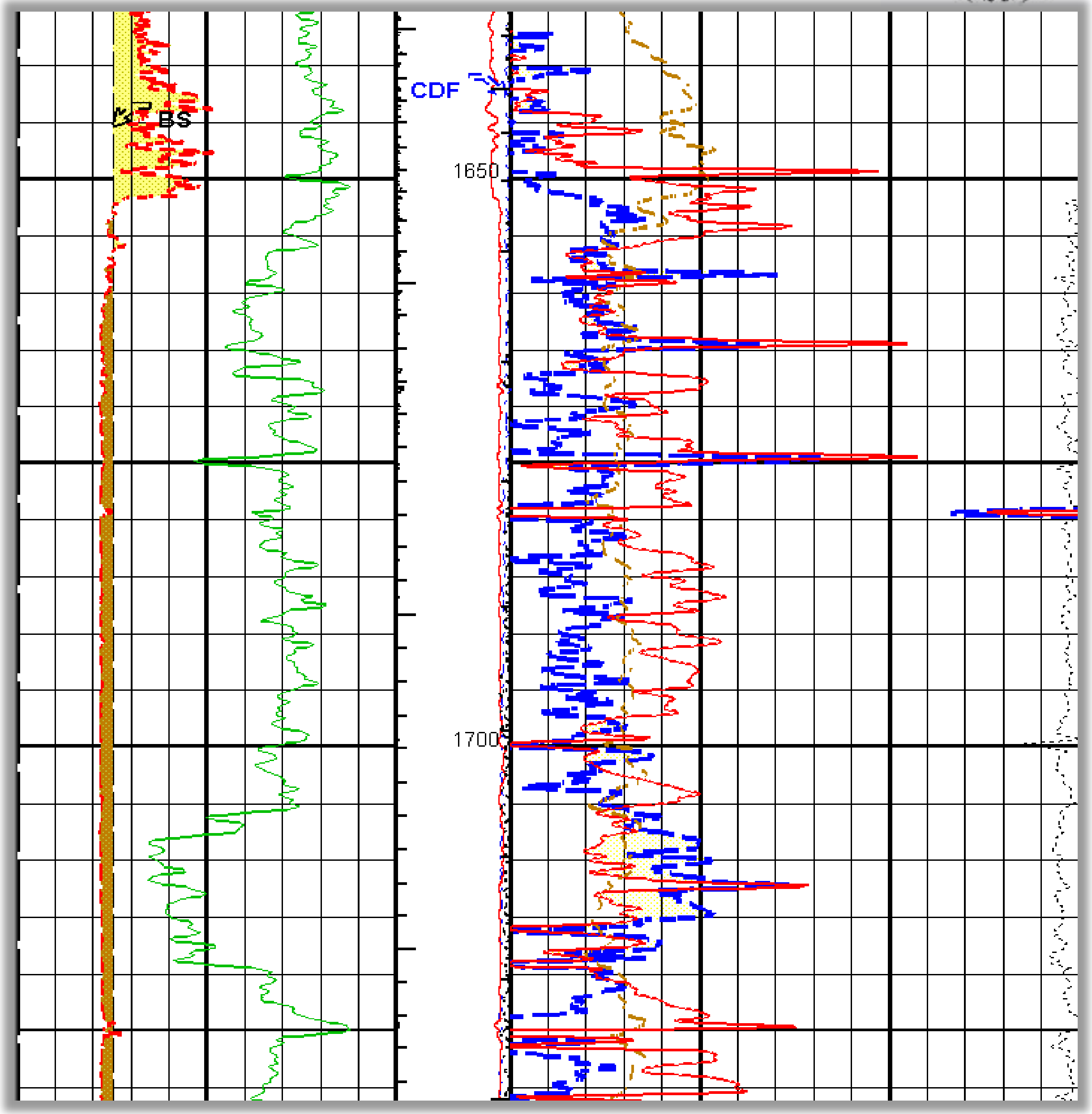


# Oil Bearing bed



# Caliber

- Measure Hole diameter
- Used in borehole correction
- Shaded with Bit Size BS log




- BS > Caliber:
  Bad calibration
  Mudcacke
  Bit wearing out

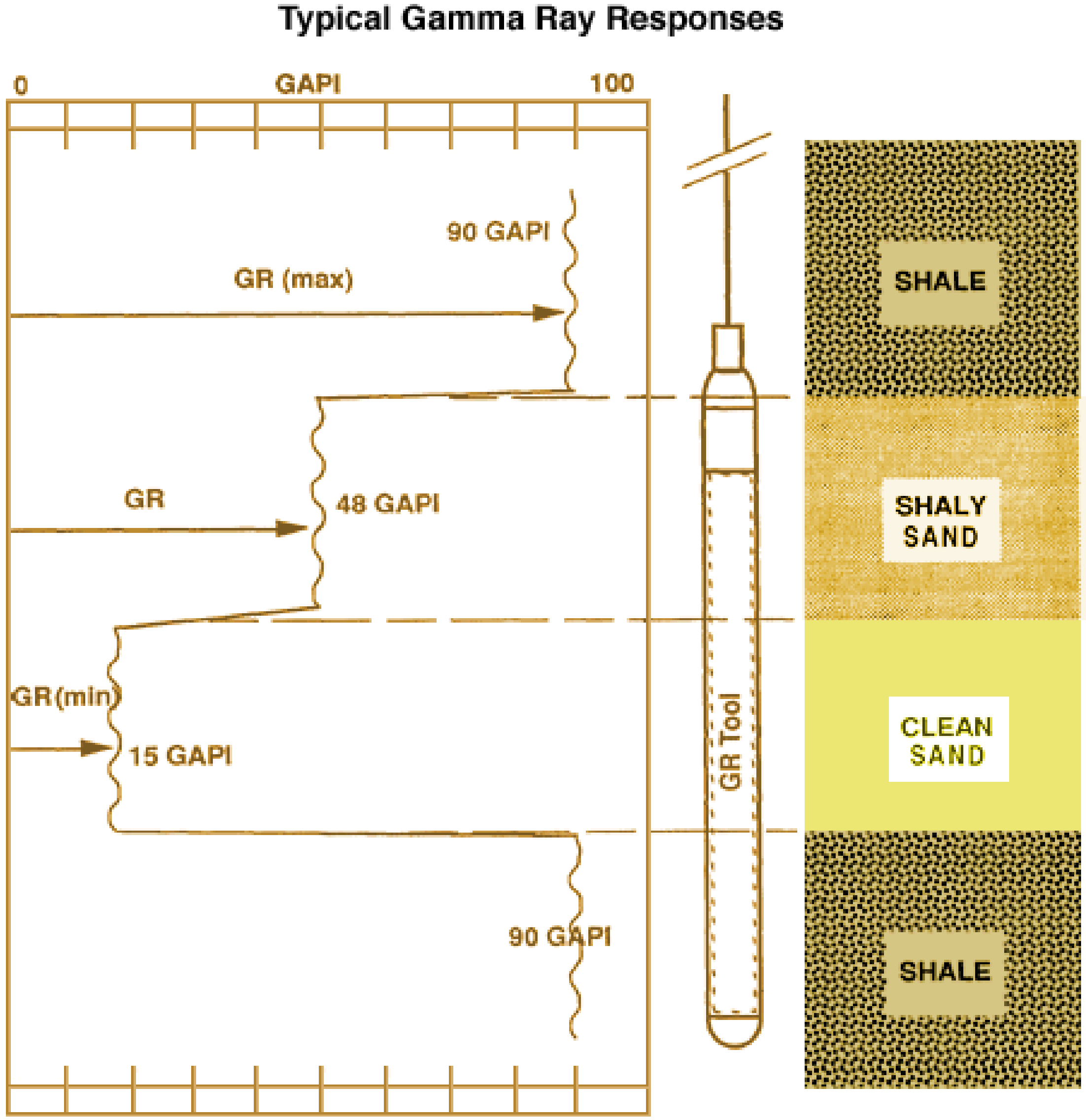
- BS< Caliber:
  Bad calibration
  Washout

# Introduction to Gamma Ray

The Gamma Ray log is a measurement of the formation's natural radioactivity.

Gamma ray emission is produced by three radioactive series found in the Earth's crust.

- Potassium (K40)
- Uranium
- Thorium

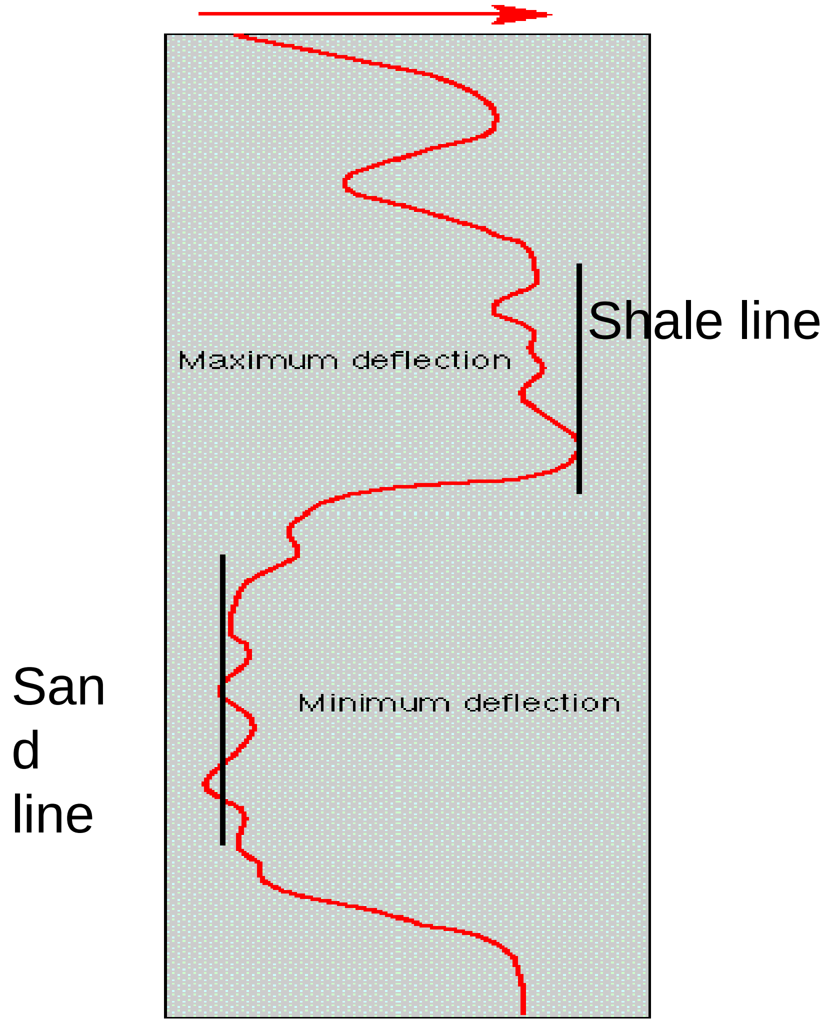


# Applications

- Correlation
- Bed boundaries
- Shale volume

# Shale Volume

$$V_{shale} = \frac{GR - GR_{clean}}{GR_{shale} - GR_{clean}}$$

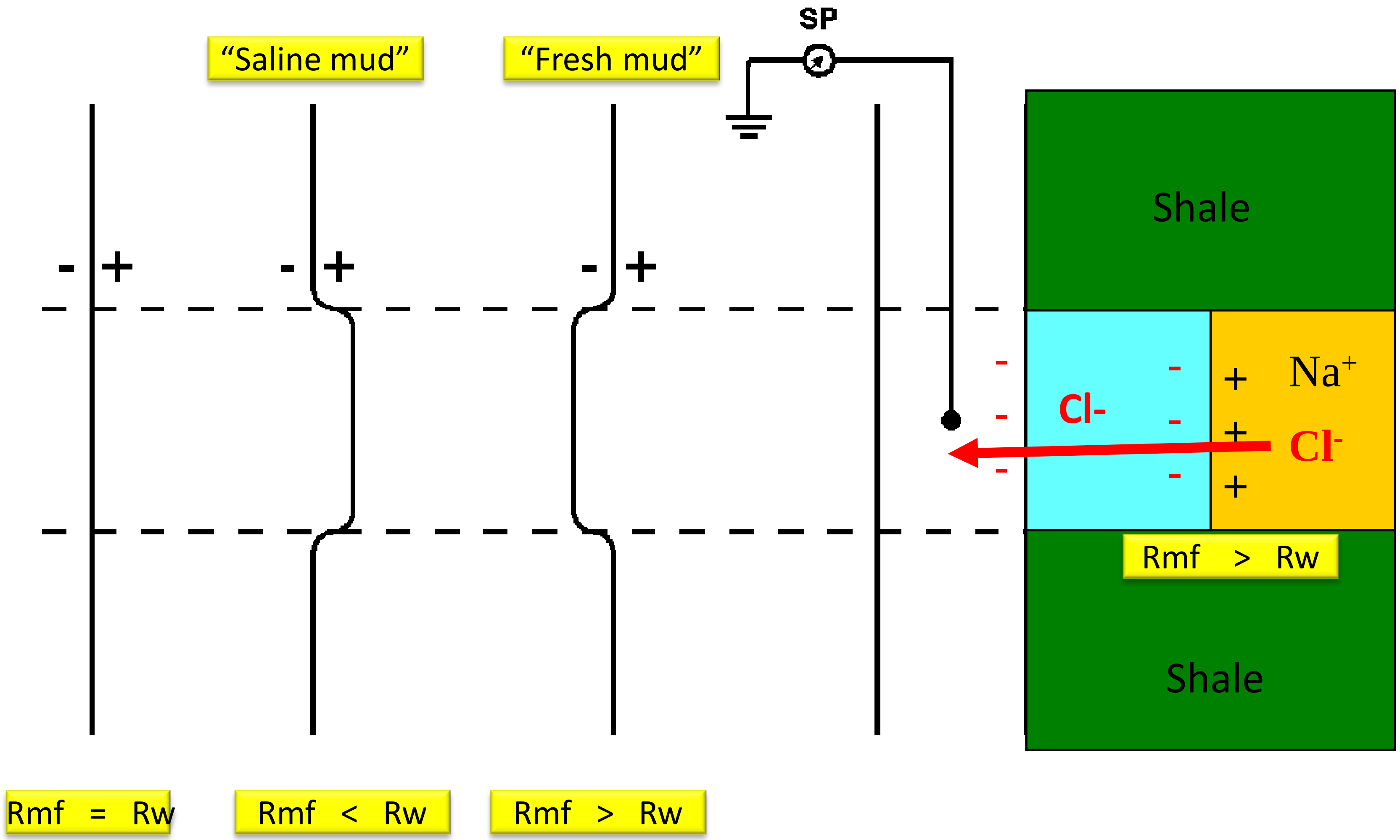


# Gamma Ray LQC

- Should read High in shale and Low in clean zones
- Should deflect at same depth as other tools
- Mirror the Neutron
- Track the SP (Rw < Rmf)

- Consistently high GR could be due to:
  - Bad Calibration
  - Activated formation (multiple passes with source tools)
  - Activated detector
    - GR detector in close proximity of nuclear source
- Consistently low GR could be due to:
  - Bad Calibration
  - Cracked crystal

# SP – Liquid Junction Potential

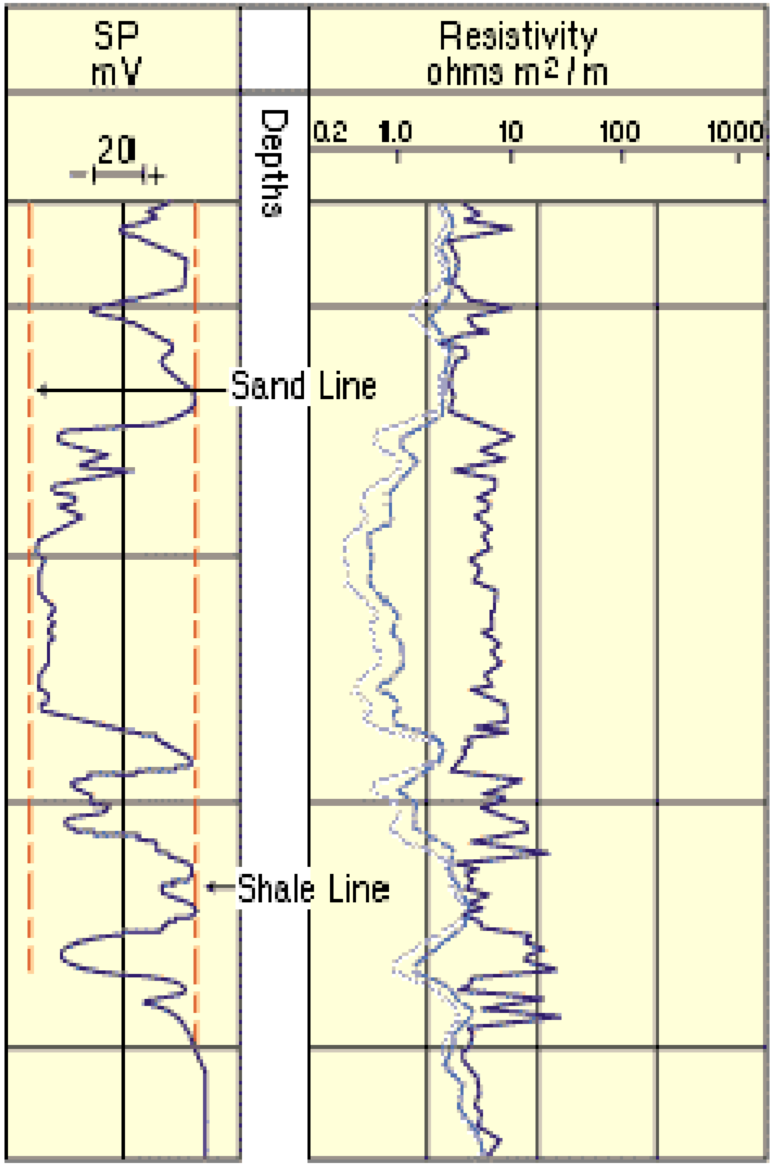


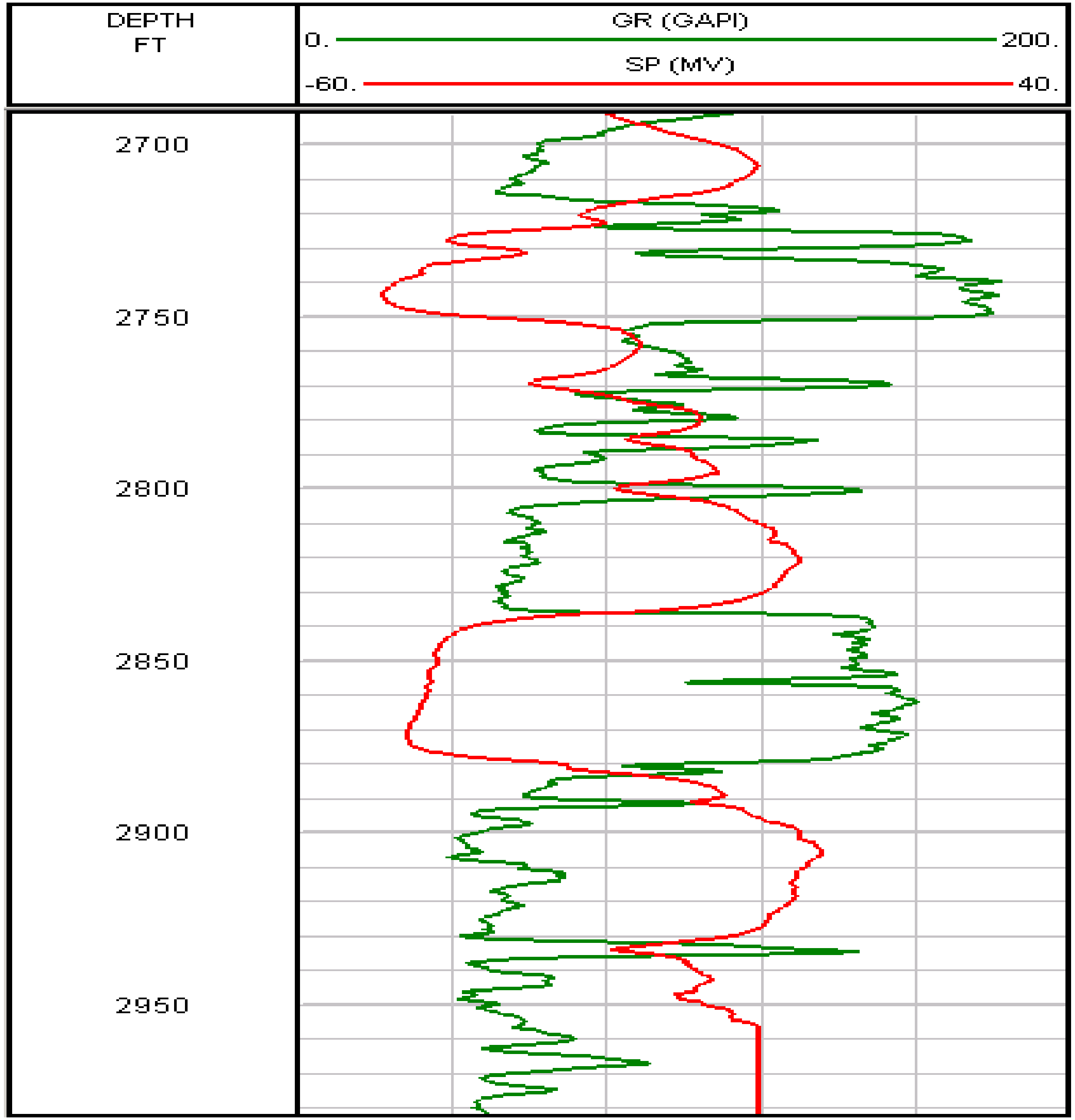
# Applications

– Define bed boundaries.

– Give an indication of shaliness (maximum deflection is clean sand; minimum is shale).

– Determine Rw in both salt and fresh muds.




DEPTH
FT
GR (GAPI)
0.
200.
SP (MV)
-60.
40.
2700
2750
2800
2850
2900
2950