4. 地下地質調查

4.1 鑽探

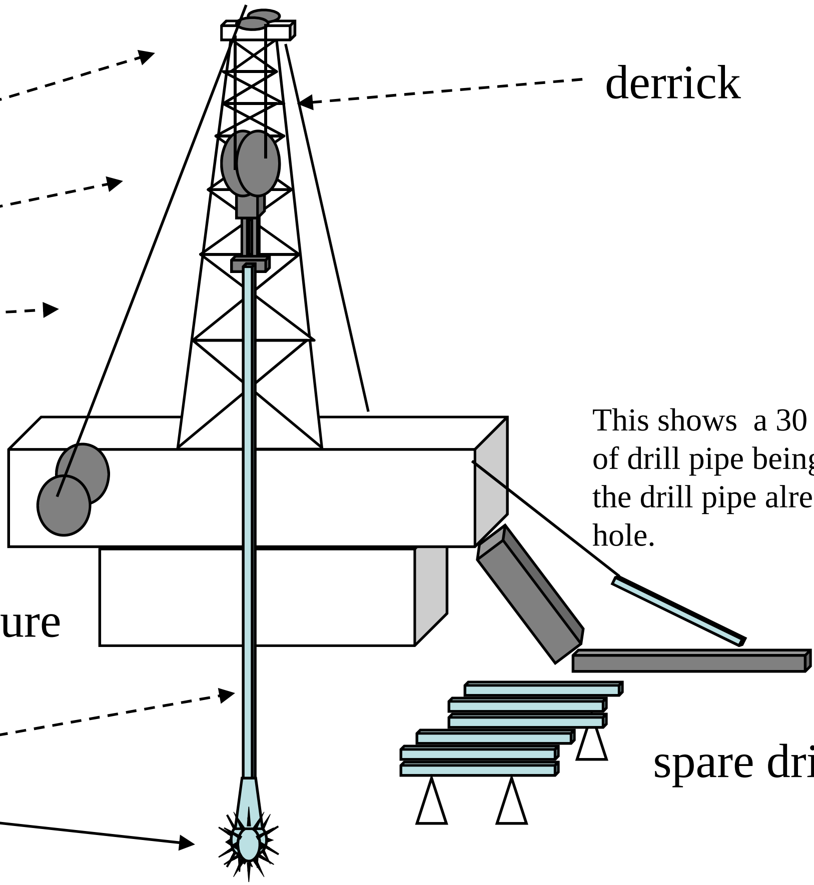
4.2 井測

4.1 鑽探

This picture shows the hoisting equipment on a rig.
This equipment is used to raise or lower the drillstring, which is picked up in 30 foot long segments, or “joints”, of drill pipe.

The hoisting equipment consists of:

a crown block,
a traveling block,
drilling line,
and a drawworks to pull the drilling line up or down.



derrick

This shows a 30 foot section of drill pipe being added to the drill pipe already in the hole.

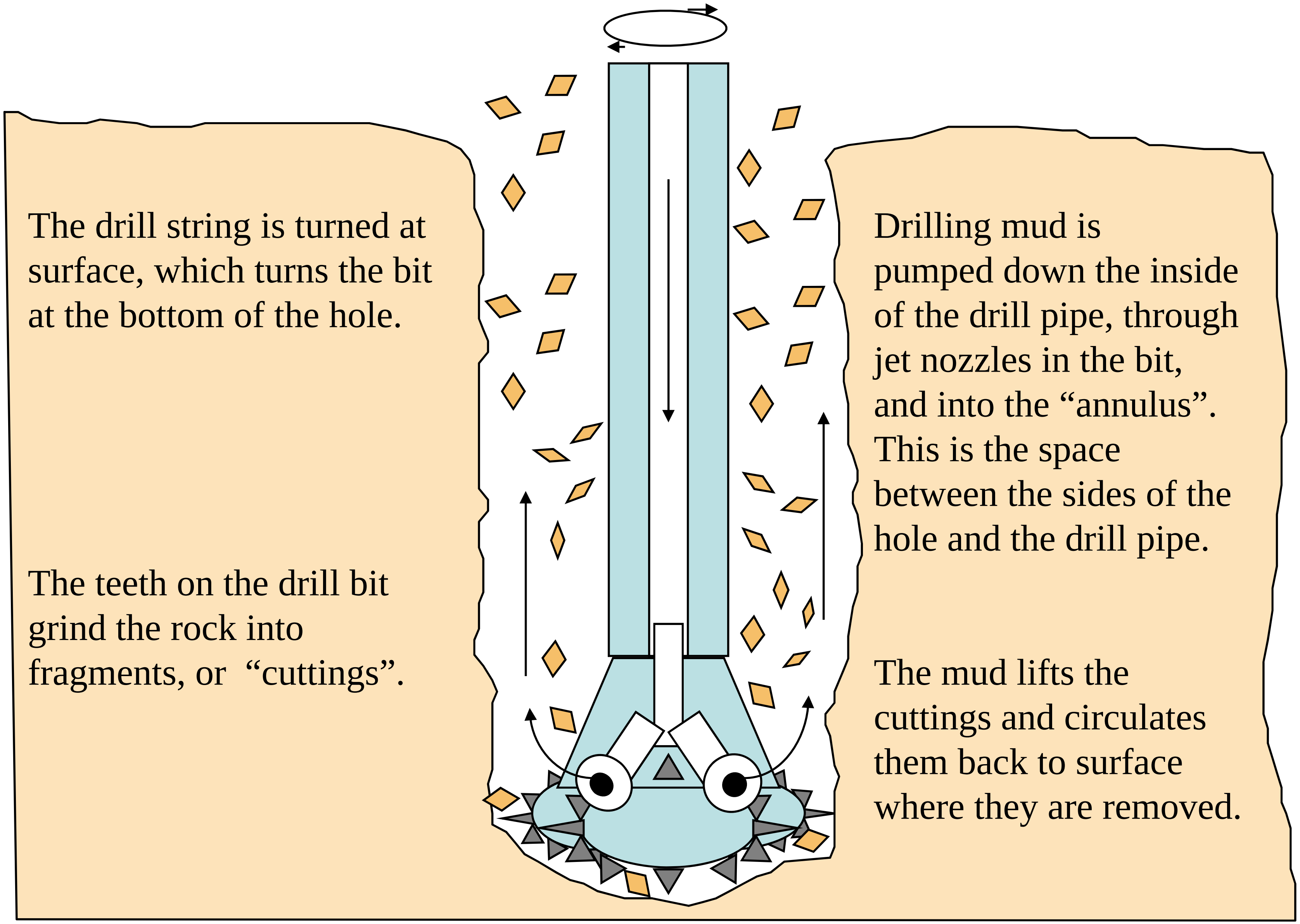
substructure

Drill string

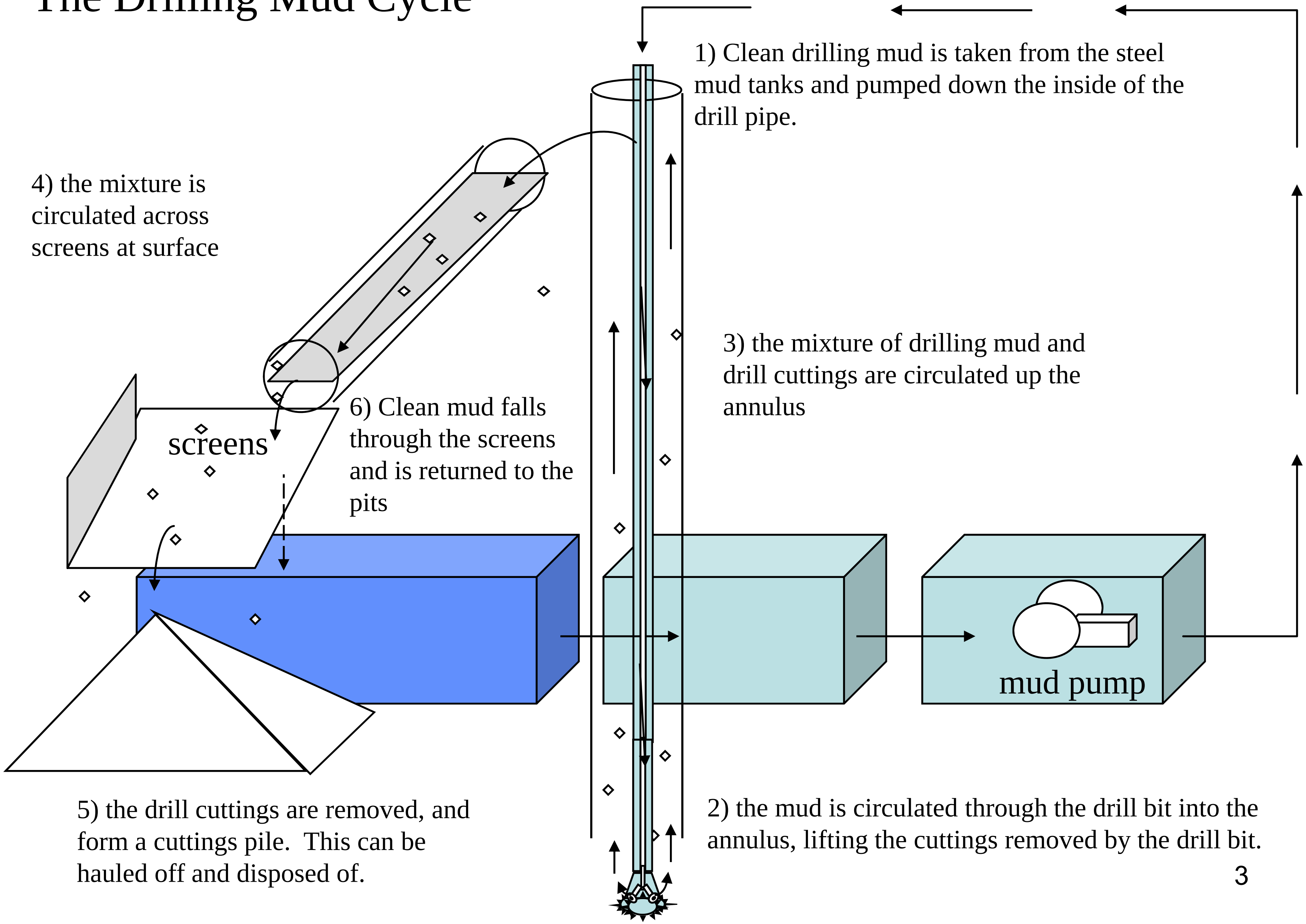
Drill bit

spare drill pipe

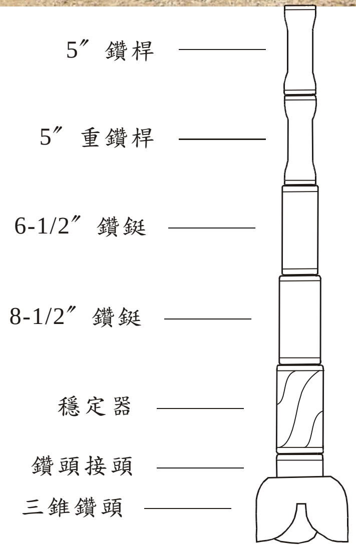
Here's a picture of the drill bit drilling the rock.

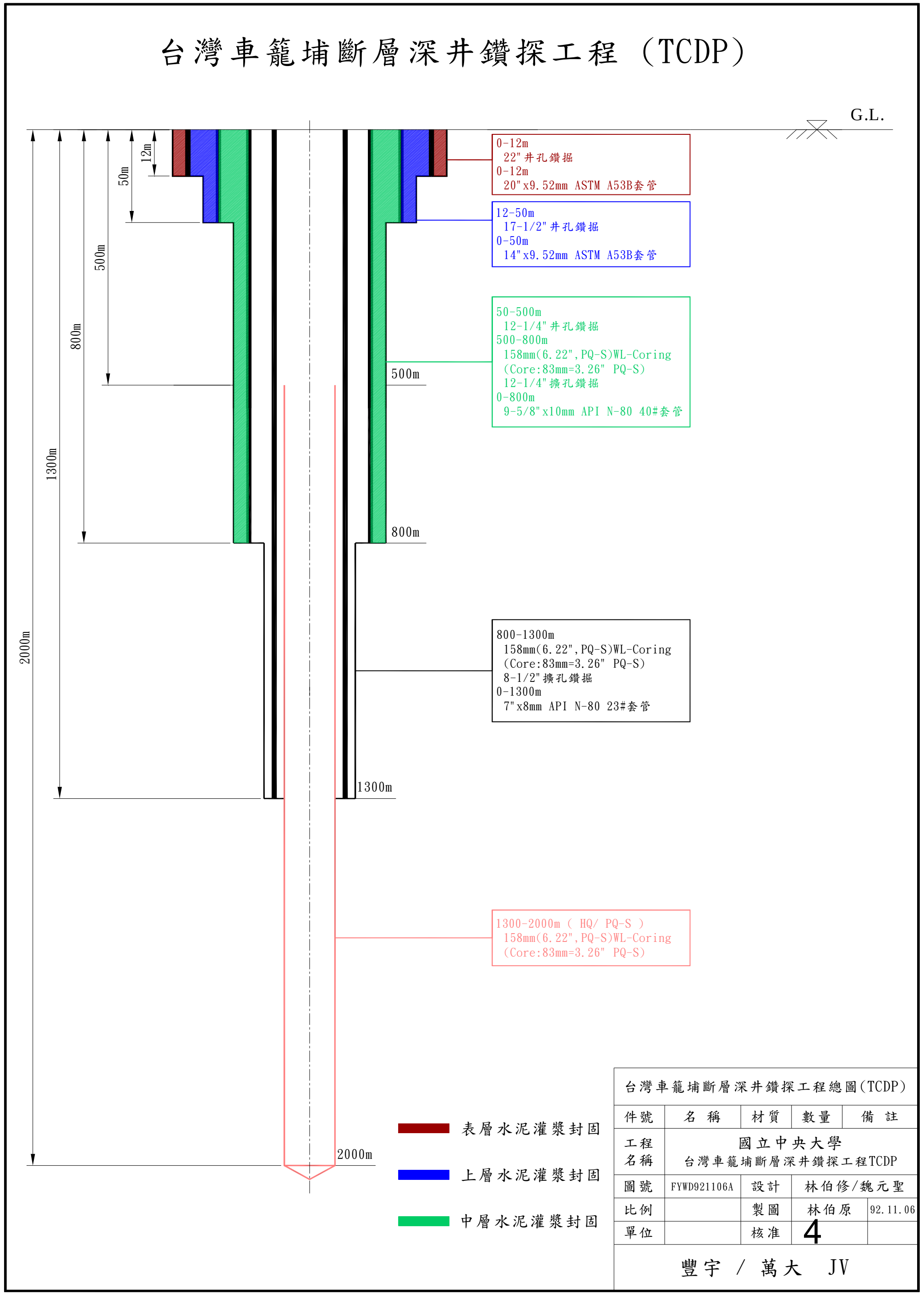


The Drilling Mud Cycle




TCDP
Taiwan Chelungpu-fault Drilling Project

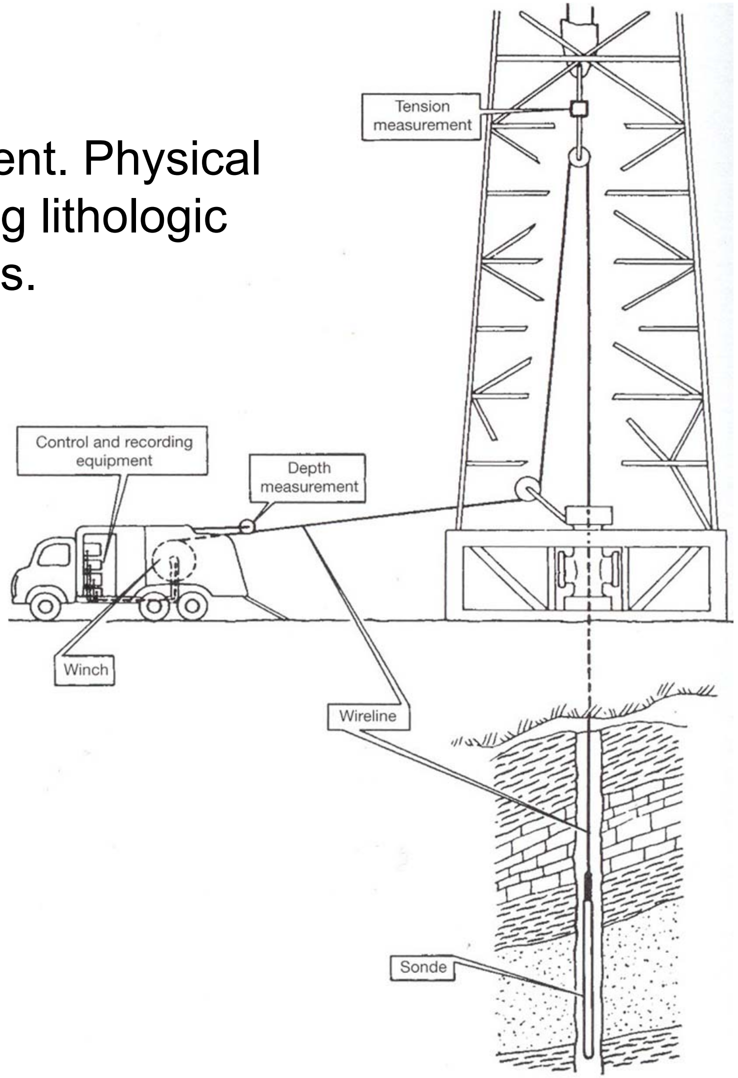

5″ 鑽桿
5″ 重鑽桿
6-1/2″ 鑽鋌
8-1/2″ 鑽鋌
穩定器
鑽頭接頭
三錐鑽頭


台灣車籠埔斷層深井鑽探工程（TCDP）
G.L.
12m
50m
500m
800m
1300m
2000m
0-12m
22"井孔鑽掘
0-12m
20"x9.52mm ASTM A53B套管
12-50m
17-1/2"井孔鑽掘
0-50m
14"x9.52mm ASTM A53B套管
50-500m
12-1/4"井孔鑽掘
500-800m
158mm(6.22",PQ-S)WL-Coring
(Core:83mm=3.26" PQ-S)
12-1/4"擴孔鑽掘
0-800m
9-5/8"x10mm API N-80 40#套管
500m
800m
800-1300m
158mm(6.22",PQ-S)WL-Coring
(Core:83mm=3.26" PQ-S)
8-1/2"擴孔鑽掘
0-1300m
7"x8mm API N-80 23#套管
1300m
1300-2000m (HQ/ PQ-S)
158mm(6.22",PQ-S)WL-Coring
(Core:83mm=3.26" PQ-S)
2000m
表層水泥灌漿封固
上層水泥灌漿封固
中層水泥灌漿封固
台灣車籠埔斷層深井鑽探工程總圖(TCDP)
件號
名 稱
材質
數量
備 註
工程名稱
國立中央大學
台灣車籠埔斷層深井鑽探工程TCDP
圖號
FYWD921106A
設計
林伯修/魏元聖
比例
製圖
林伯原
92.11.06
單位
核准
豐宇 / 萬大 JV

Drilling activities on TCDP drill site (2004-2005)

4.2 井測

Log traces are a reflection of lithology and fluid content. Physical meanings of log curves may be obtained by matching lithologic log (obtained from cuttings and cores) and log curves.



Logs and their applications

ELECTRIC LOGS	Lithology	Hydrocarbons	Porosity	Pressure prediction	Structural and sedimentary dip	OTHER
Spontaneous potential	✓					Calculation of R_w, and bed shaliness, Qualitative identification of permeability
Resistivity	✓	✓		✓		Calculation of R_{xo}, R_t, and hence S_w
RADIOACTIVE LOGS						
Gamma	✓					Calculation of bed shaliness and organic content
Neutron		✓ (Gas effect)	✓			Lithology identification by cross-plots
Density		✓ (Gas effect)	✓			Lithology identification by cross-plots
SONIC	✓	✓	✓	✓		Calibration of formations with seismic data
DIPMETER					✓	

FIGURE 3.41 Summary of the main types of wireline logs and their major applications.

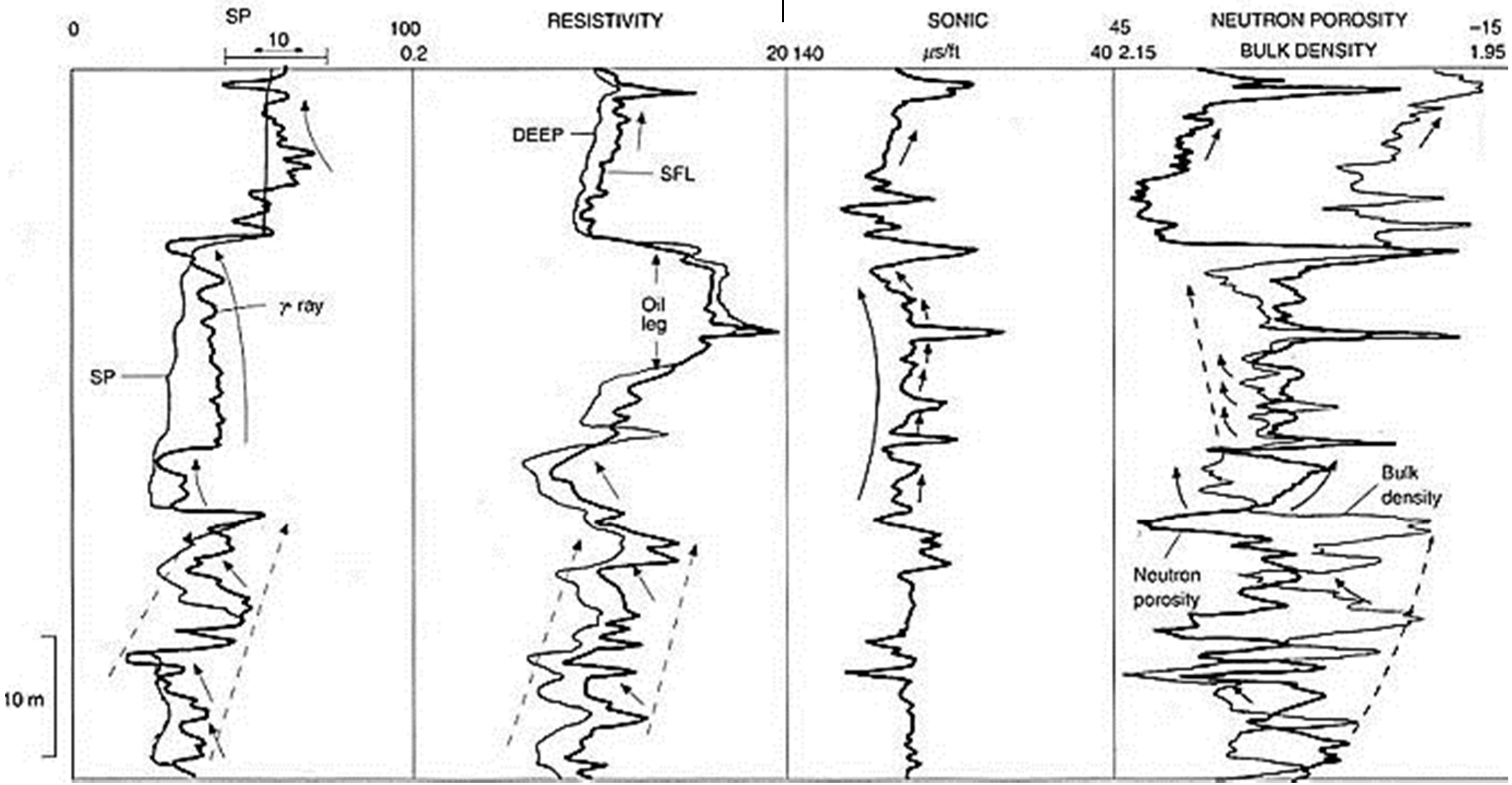
Selley (1998)

Well-log suites

Permeable zone indicators

Resistivity indicators

Porosity indicators

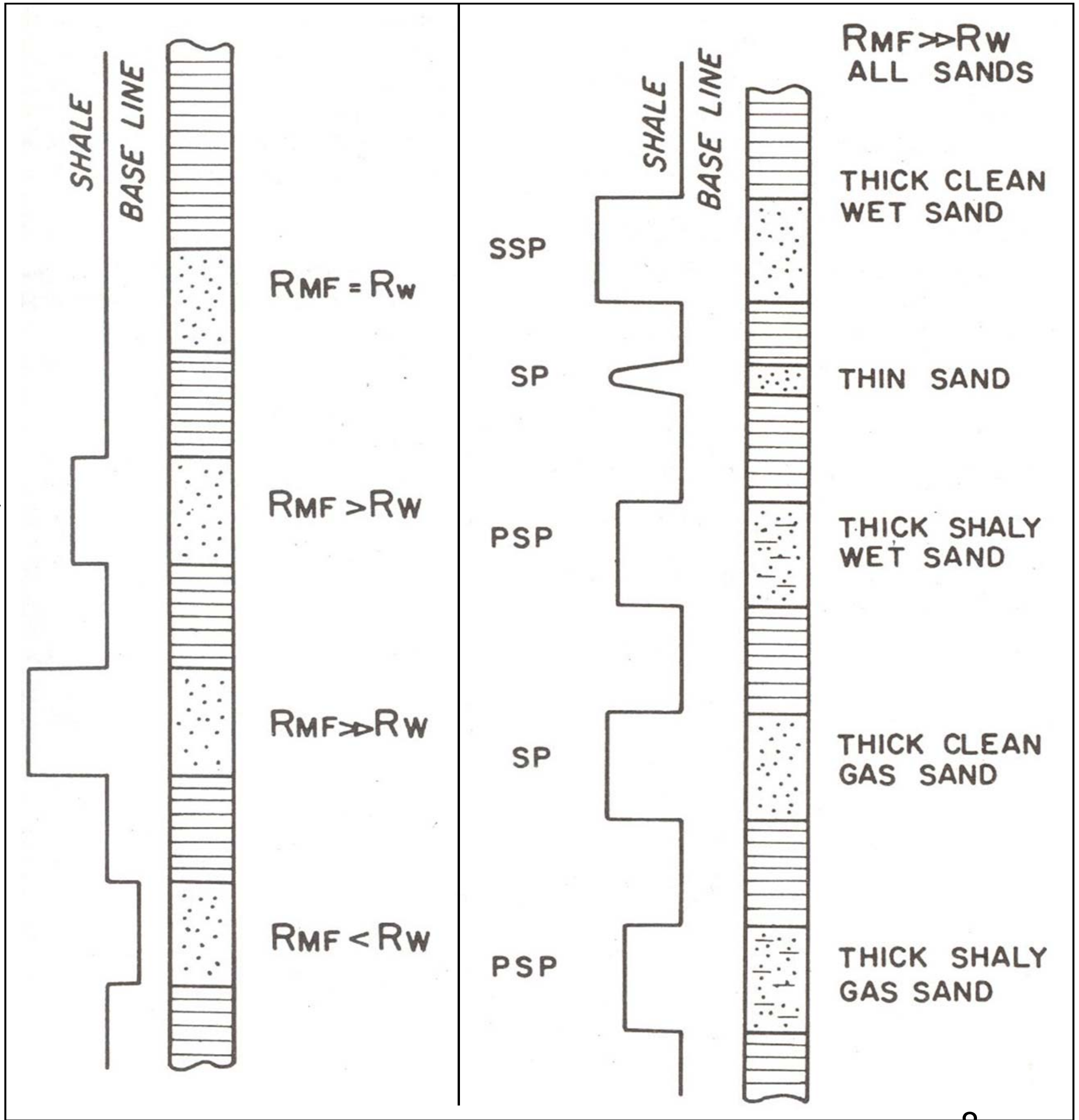


Emery (1996)

Permeable zone indicators (1)

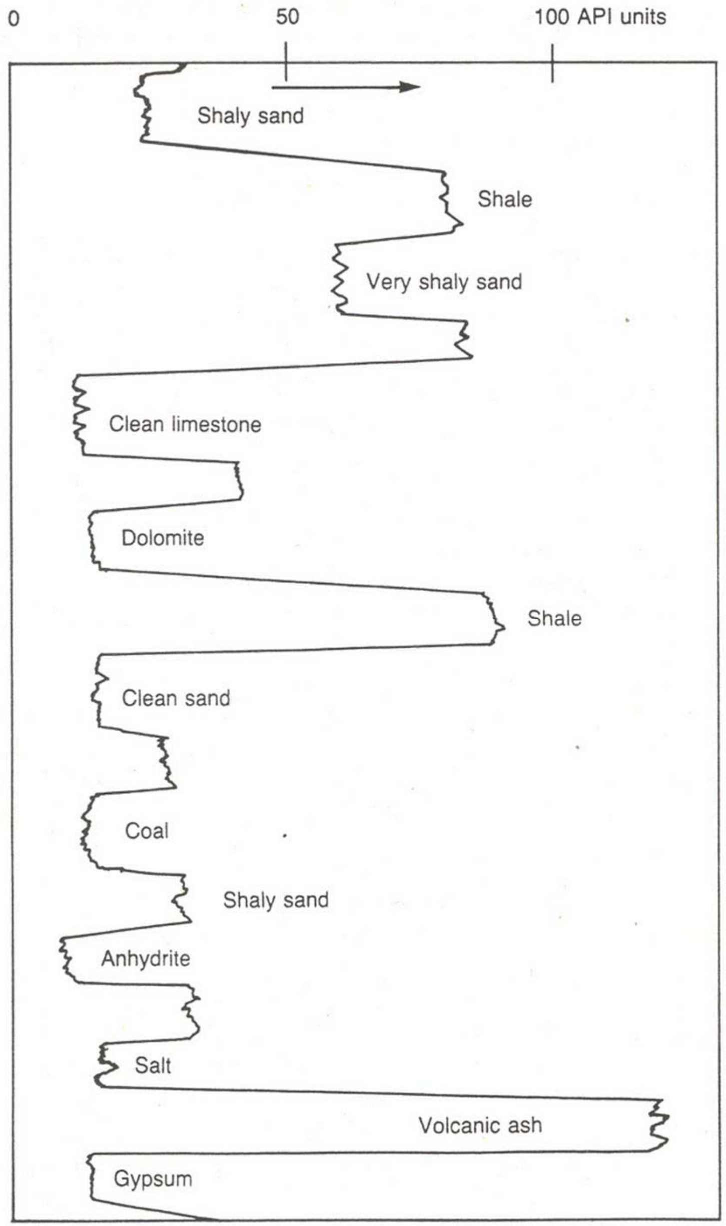
Spontaneous Potential (SP) Logs
This log measures the electrical current that occurs naturally in boreholes as a result of salinity differences between the formation water (R_w) and the borehole mud filtrate (R_{mf}). These logs are used as indicators of permeable beds (including determining permeable sands and impermeable shales) or for locating bed boundaries. The SP log was one of the first tools to be used to distinguish shale from sand in clastic sequences (zero matches pure shale while high SP values match sand).

Magnitude of SP depends on the contrast between R_{mf} and R_w



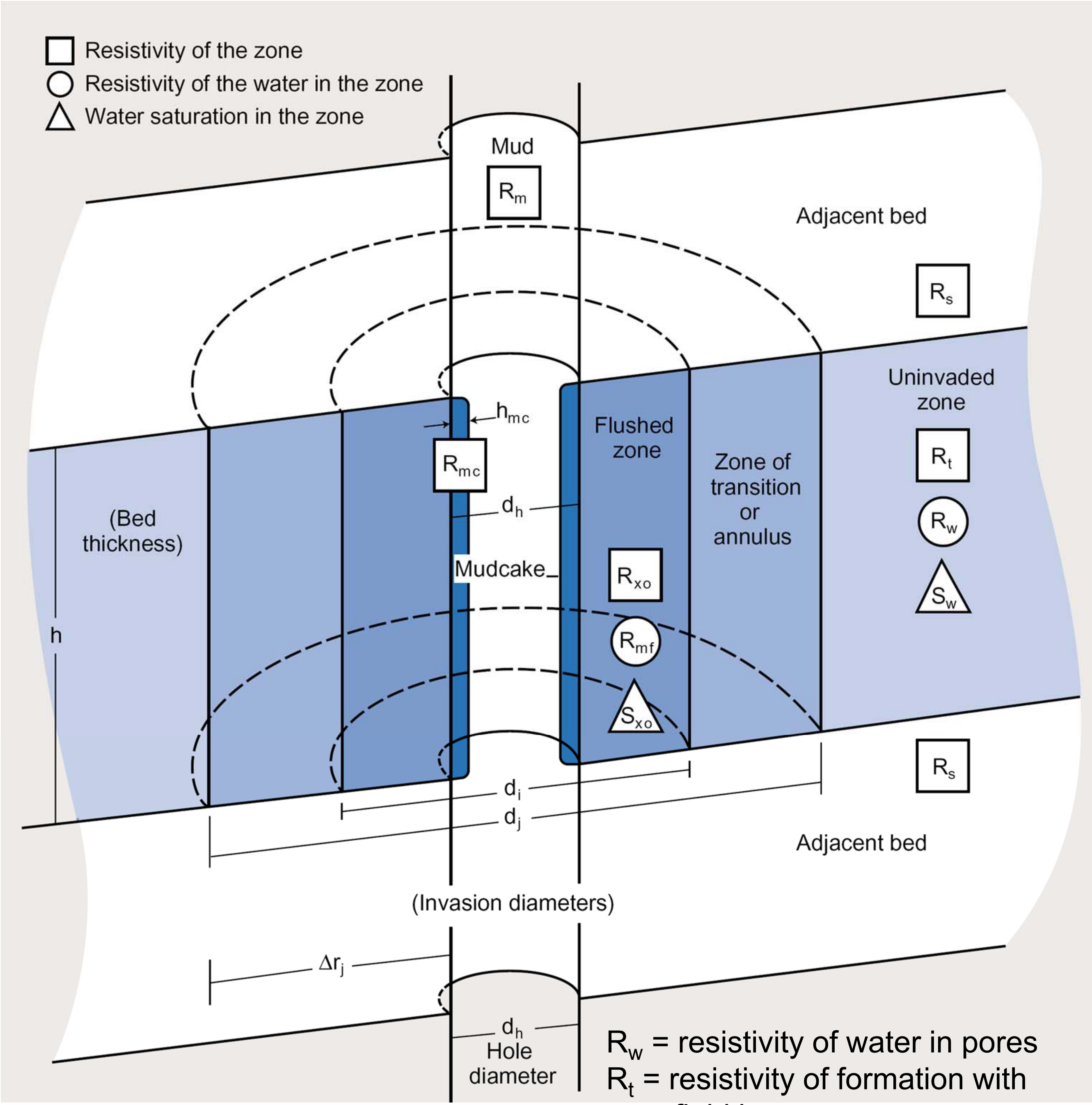
Asquith (1982)

Permeable zone indicators (2)



Gamma Ray Logs

This log records the radioactivity of a formation. Shales (or clay-minerals) commonly have a relatively high gamma radioactive response (containing U, Th, K), and consequently gamma ray logs are taken as good measures for grain size (and subsequently inferred depositional energy). Thus coarse-grain sand, which contains little mud, will have low gamma ray value, while a fine mud will have a high gamma ray value. The values range of gamma ray is measured in API (American Petroleum Institute) units and range from very few units (in anhydrite) to over 200 API units in shales.



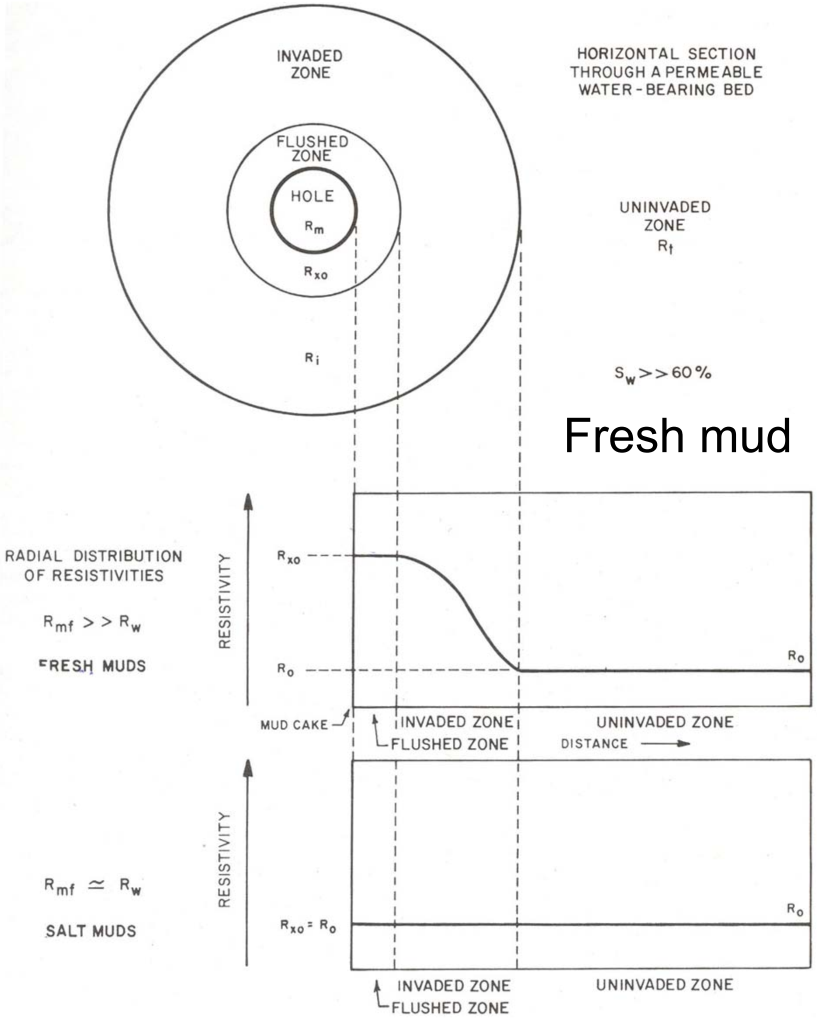
Schlumberger (1989)

Resistivity indicators

Resistivity Logs

This log measures the bulk resistivity (the reciprocal of conductivity) of the formation. Resistivity is defined as the degree to which a substance resists the flow of electric current. Resistivity is a function of porosity and pore fluid in a rock. Porous rock containing conductive fluid (such as saline water) will have low resistivity. A non-porous rock or hydrocarbon-bearing formation has high resistivity. This log is very useful for determining the type of fluids in formations and is frequently used as an indicator of formation lithology.

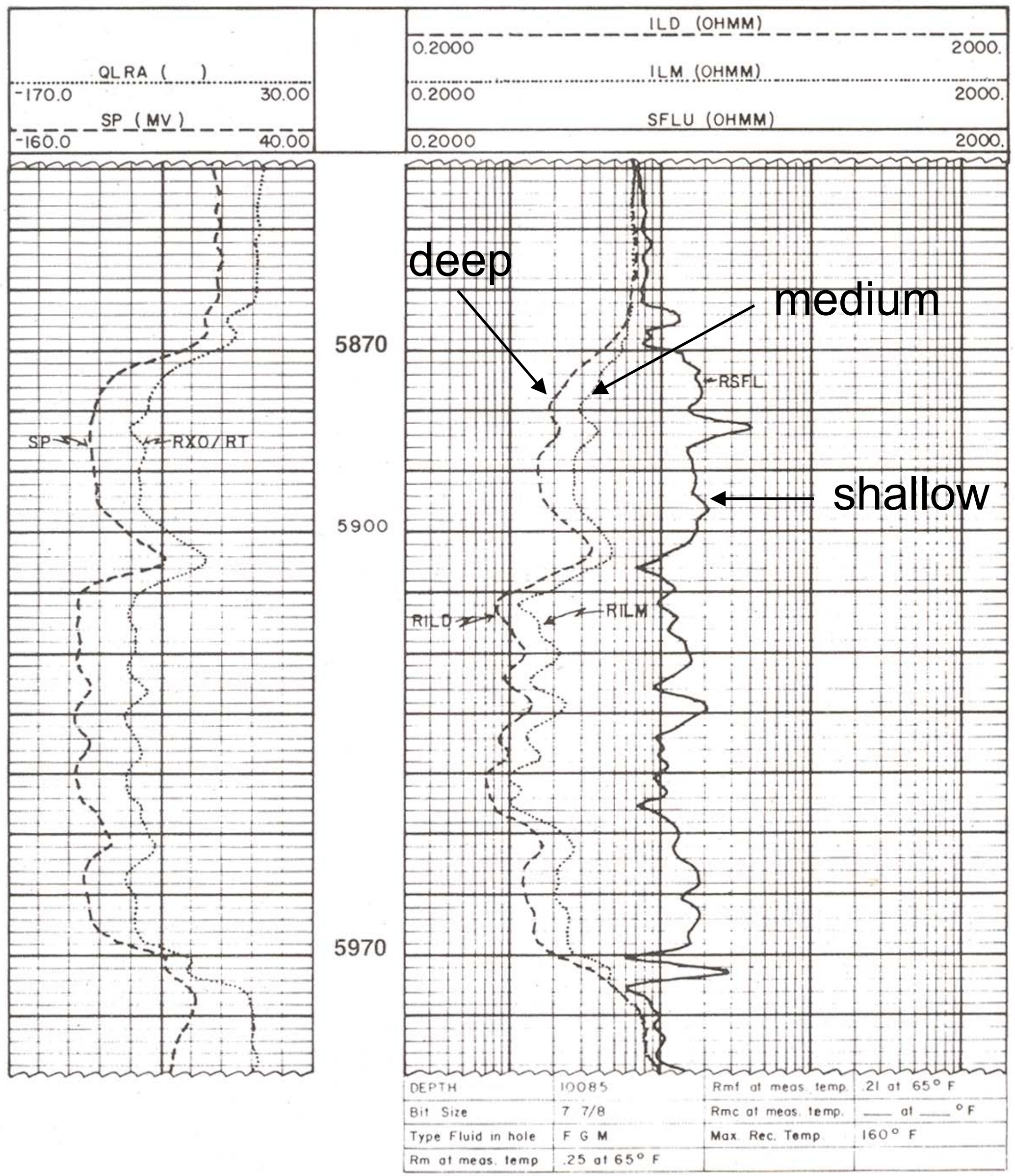
Horizontal section



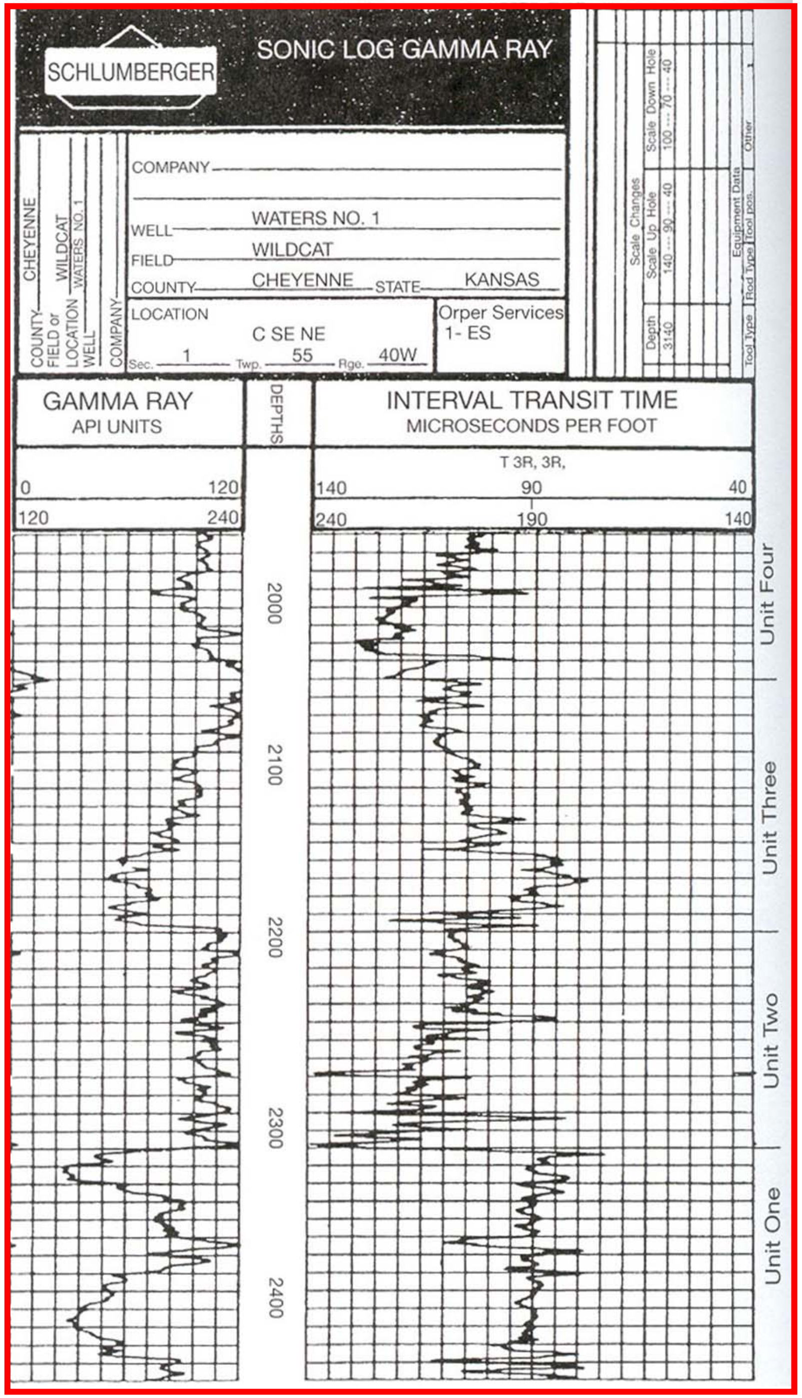
Salt mud

Asquith (1982)

Resistivity logs



Fresh mud filtrate



Porosity indicators (1)

Sonic (acoustic) Logs

This log measures of the speed of sound in the formation, and is related to both the porosity and lithology of the rock being measured. Thus, if the lithology of a formation is know, this log can be used to determine its porosity. Shales have lower velocity (higher transit time) than sandstone of same porosity, making this log a good indicator of grain size. Sonic log values (in µs/ft) for some rock types are: sandstone 51-56, limestone 47.5, dolomite 43.5, anhydrite 50, halite 67, coal low velocity.

Porosity indicators (2)

Neutron Logs
This log measures the porosity of a formation, indicating in its response the quantity of hydrogen present in the formation. The log is calibrated to limestone. The linear limestone porosity units are calibrated using the API Neutron pit in 19% porosity, water-filled limestone is defined as 1000 API units. This log is useful in measuring lithology (usually in combination with Density Log).

Density Logs
This log is a measure of the formation bulk density and is mostly used as a porosity measure. Different lithologies can also be determined using Density log based on returned density value. For example, pure quartz will have a bulk density (g/cm-3) up to 2.65, coal 1.2-1.8, halite 2.05, limestone up to 2.75, dolomite up to 2.87, anhydrite 2.98. Density is mostly commonly used in conjunction with Neutron logs to determine lithology of formation (density-neutron suites such as Schlumberger FDC-CNL suite).