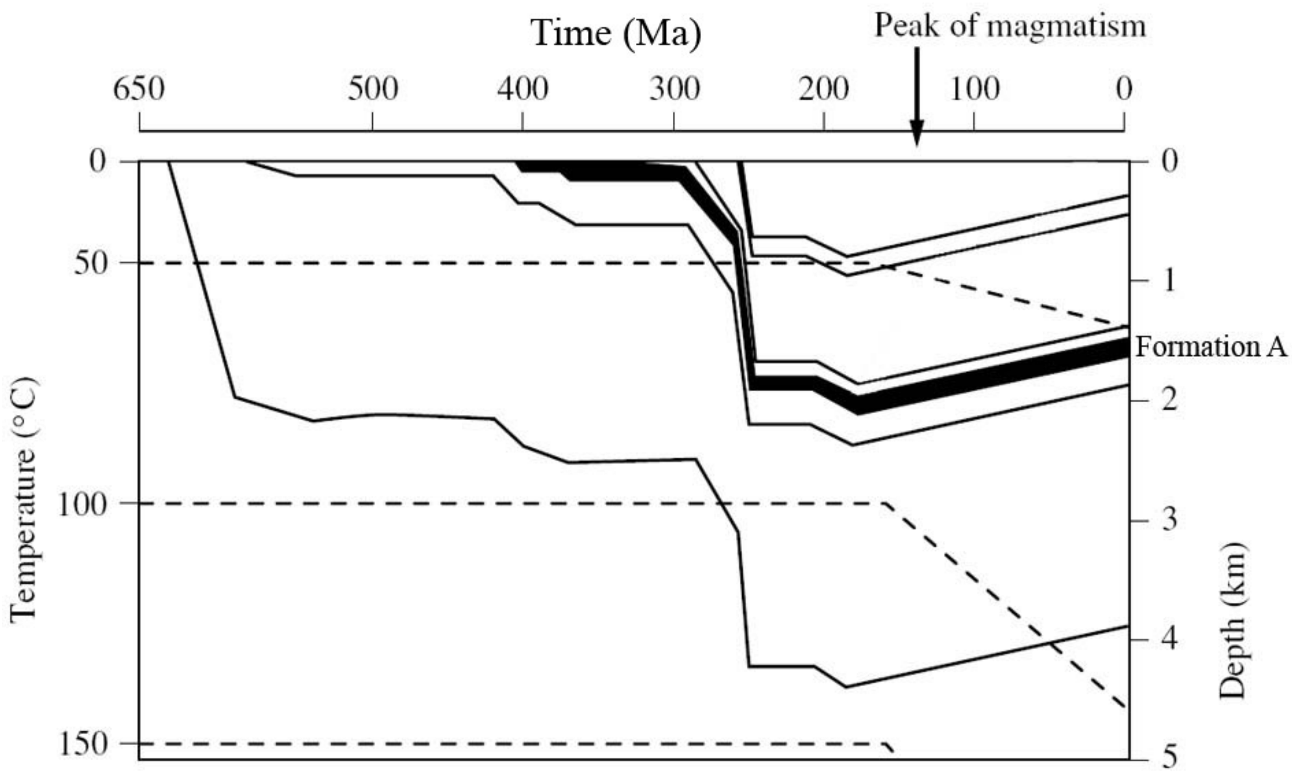
Part 2, (50*% of exam):*

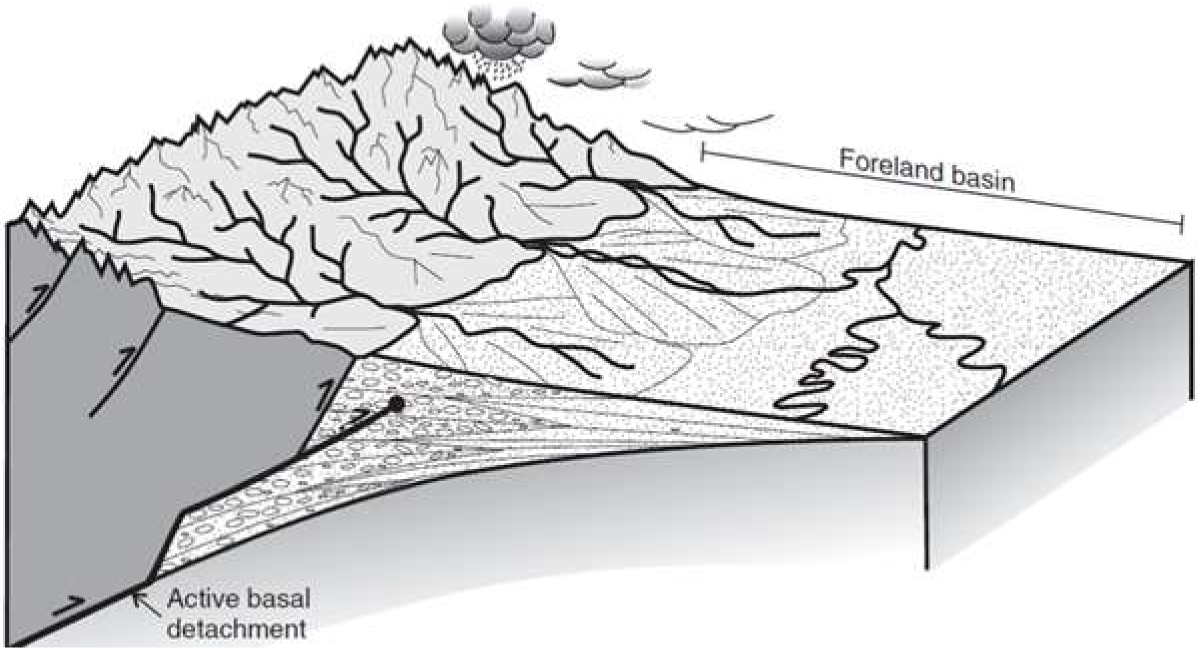
Reservoir Geology

1. In the burial curve below:
   A. What kind of geologic process can lead to steeply dipping curves like at ca. 250 Ma?
   B. What may be the reason for the different temperature gradient in the crust (dashed line) from ca. 150 Ma onwards? Give an explanation that strengthens your theory.
   C. During what geological time period(s) was Formation A deposited?
   D. Assume that Formation A is mainly composed of meandering-river sandstone of 15-20 % intergranular porosity. Explain all your assumptions for part D of the question.
      (1) What part of such a fluvial system would provide the best reservoir?
      (2) Estimate the reservoir potential for Formation A in terms of (I) rock type, (II) shape of the reservoir basin, and (III) temperature.
      (3) Provided that a suitable seal covers the reservoir, what kind of hydrocarbons would you expect in the reservoir?



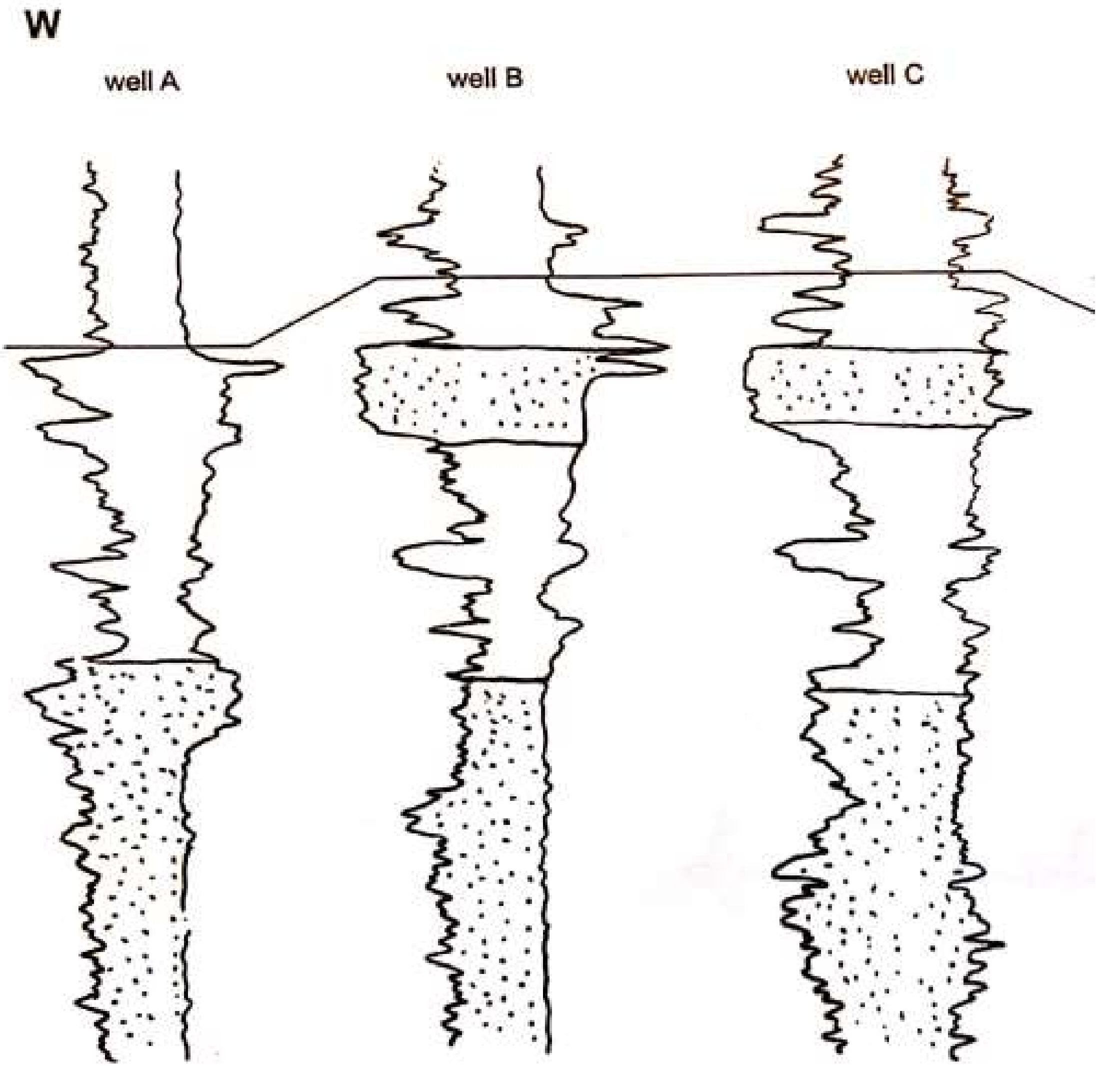
2. The figure below is a 3-dimentional cross section through a typical peripheral foreland basin.

A. What kind of faults do you see in the image? Assume that the vertical scale is exaggerate 10 times.
B. What plate-tectonic process are they related to in this example?
C. Explain the difference in sediment thickness in different parts of the basin.
D. Provided that a seal later covers the sedimentary sequence in the figure, which part of the basin is most likely to act as a petroleum reservoir (explain in terms of sediment type and depositional environment)? Why?



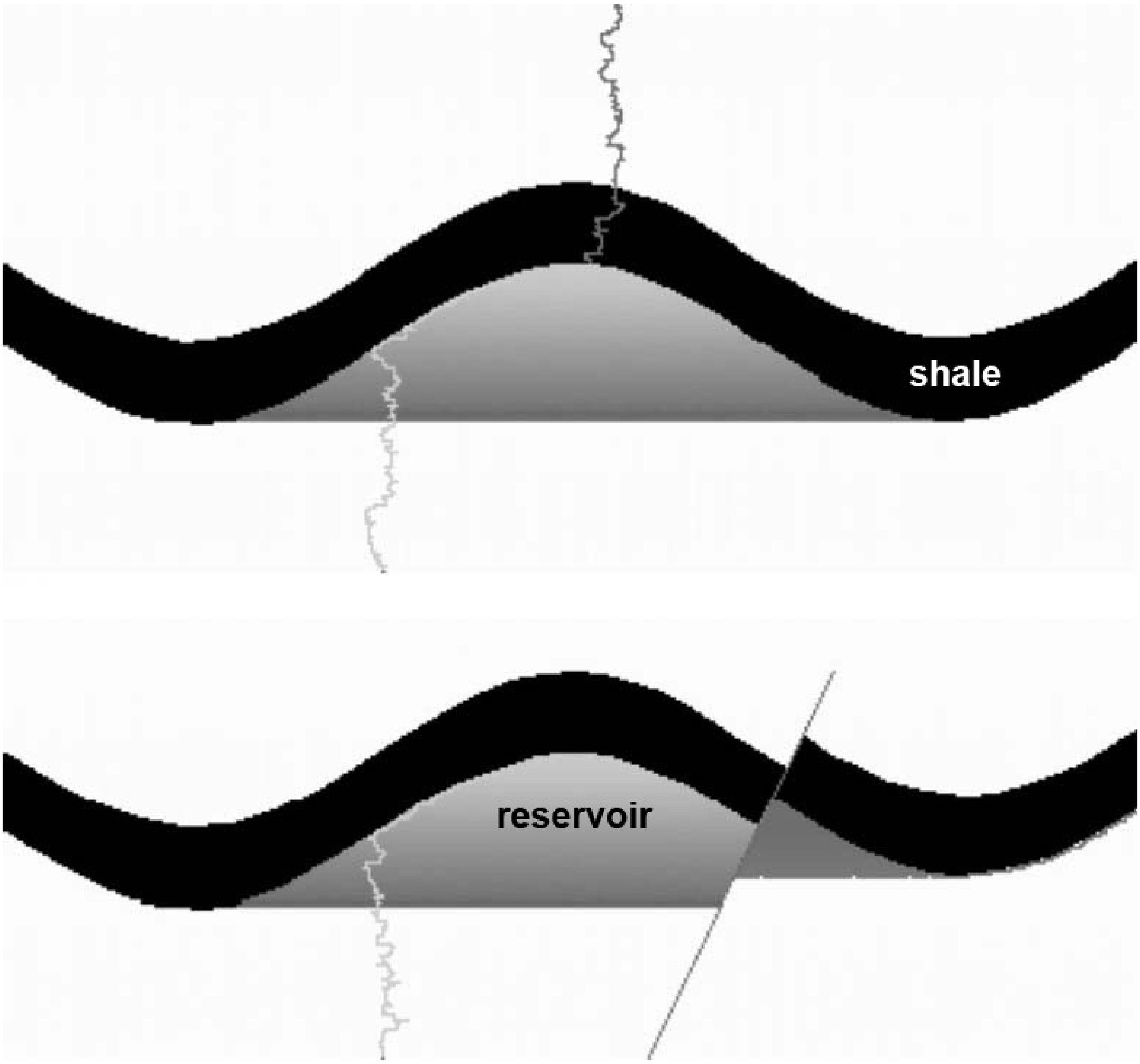
3. The three wells below are from a siliciclastic sediment basin, with a couple of kilometres between each well. **Fluvial deposits** are dotted and **shallow marine deposits** are the blank areas. For each well, the left well log is a **gamma-ray** log and the right one is a **sonic** log. The black line connecting all the wells is a marker bed that has been defined as a time horizon by microfossil dating.

    A. Correlate the wells lithostratigraphically (i. e., tie units of similar lithology that may be interlinked in the three wells) by drawing lines between the wells digitally (remember to upload the figure with your lines!). All correlations do not need to involve all 3 wells.
    B. What could the explanation be for the fluvial sand in the upper part being present in wells B and C, but not in well A?



4. The two images show a carbonate reservoir with a folded cap of shale. The shale is impermeable, but some fractures formed at the fold axes during folding in both cases. In the lower case, later extension has caused a highly permeable fault at the right fold limb.

   A. The erratic curves are the petroleum-migration paths for the two cases. In the upper case, petroleum migrates through the fractures, but not in the lower case. Explain why.
   B. Which (one or two) of the two cases have the potential to fill up with petroleum? Specify the likely lower petroleum contact(s). Either describe the position of the contact(s) in words or mark it / them digitally in the figure (remember to upload the figure with your markings!).



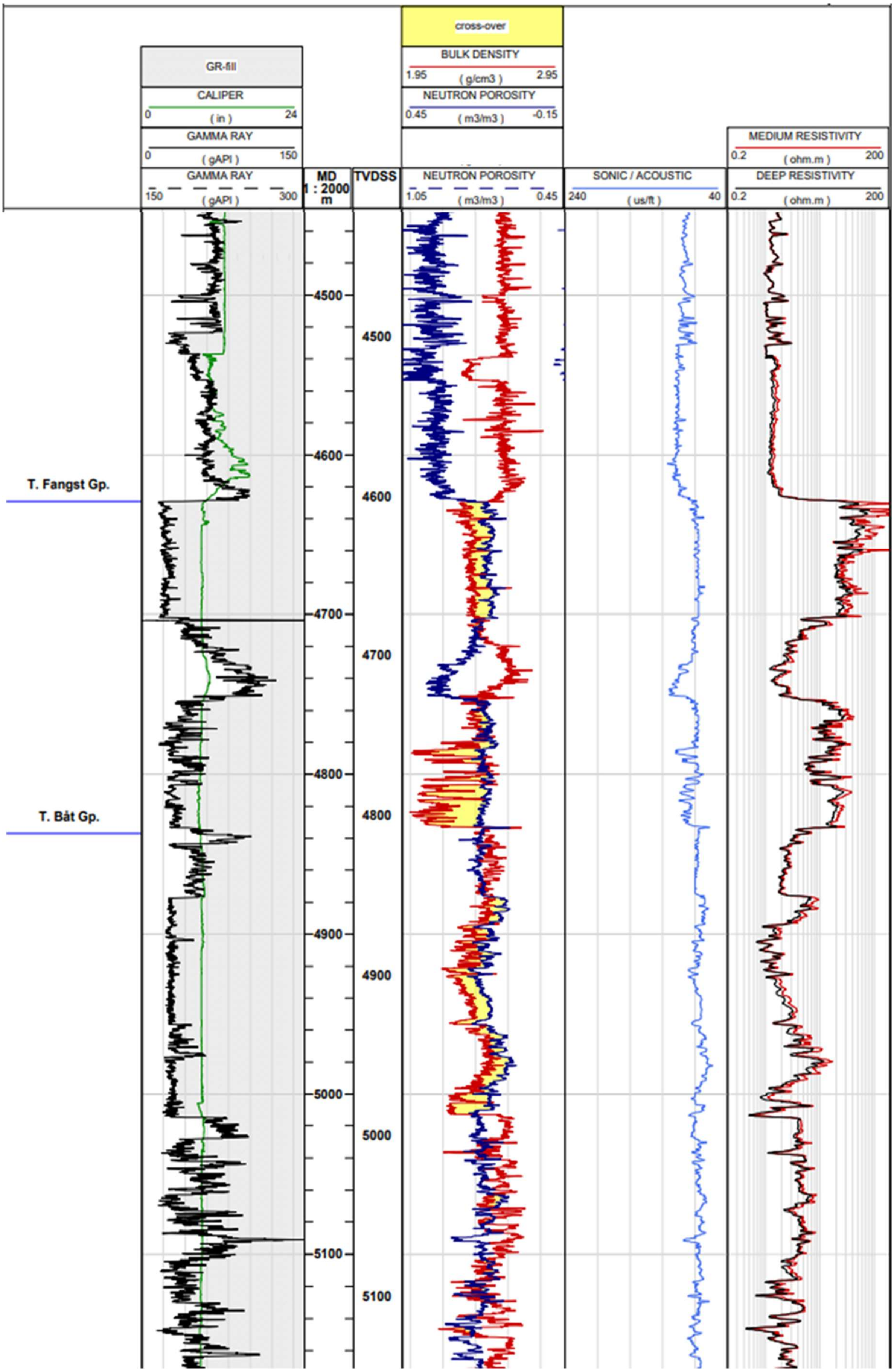
5. Define each of the elements of the HCPV-formula and briefly explain how to find all the information needed to calculate the HCPV.

$$(HCPV) = GRV \times N/G \times \varphi \times S_{hc}$$

6. The exploration well on the next page is from a field with a water depth of 370 m, where gas is produced from a sandstone reservoir.
   Based on the well-logs:
   a) At which depth will you expect to find the gas-water contact. Why?
   b) Calculate the porosity of the gas-filled Fangst Group (the top is marked with a blue horizontal line), based on the density log.

- Density Logs
  - $\phi_{den} = \frac{\rho_{ma} - \rho_b}{\rho_{ma} - \rho_f}$
    - ρ_f: *fluid density*

	ρ matrix (gr/cm³)
Sandstone	2.648
Limestone	2.710
Shale	2.565
Gas	0.256
Oil	0.871


cross-over
GR-fill
CALIPER
0 (in) 24
GAMMA RAY
0 (gAPI) 150
GAMMA RAY
150 (gAPI) 300
MD
1 : 2000
m
TVDSS
BULK DENSITY
1.95 (g/cm3) 2.95
NEUTRON POROSITY
0.45 (m3/m3) -0.15
NEUTRON POROSITY
1.05 (m3/m3) 0.45
SONIC / ACOUSTIC
240 (us/ft) 40
MEDIUM RESISTIVITY
0.2 (ohm.m) 200
DEEP RESISTIVITY
0.2 (ohm.m) 200
T. Fangst Gp.
T. Båt Gp.
4500
4600
4700
4800
4900
5000
5100