Lab 2. Well logs, geological mapping, and seismic interpretation

Student No.: _____ Student Name: _____

_____ _____

Hand-in deadline: **25th April 2019** at the lab session.

Graded lab can be picked up on **2nd May 2019 at KE D306.**

GRADE: _____ / 50 = _____

PART 1: Well logs and rock properties (15 points)

Problem 1: Fill in the blanks (5 points)

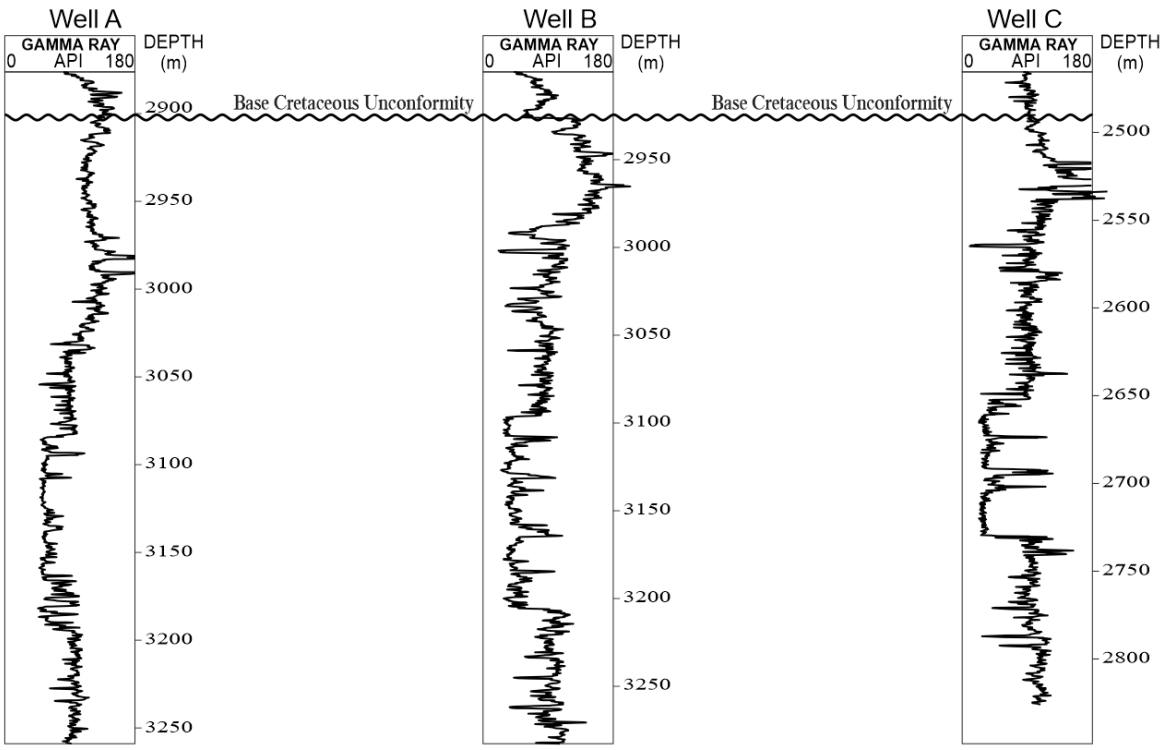
1. What rock properties is measured by gamma-ray log? _____
2. What rock properties is measured by resistivity log? _____
3. Sort lithology below by their expected gamma-ray reading value from low to high.
   Sand, Shale, Limestone _____
4. Sort lithology below by their expected permeability reading value from low to high.
   Sand, Shale, Tight limestone _____

5. Sort lithology below by their expected resistivity reading value from low to high.
Water bearing sand, Gas bearing sand, Oil bearing sand _____

Problem 2: Well correlation (10 points)

The following wells were drilled in the northern North Sea. The gamma-ray (GR) curves are displayed.

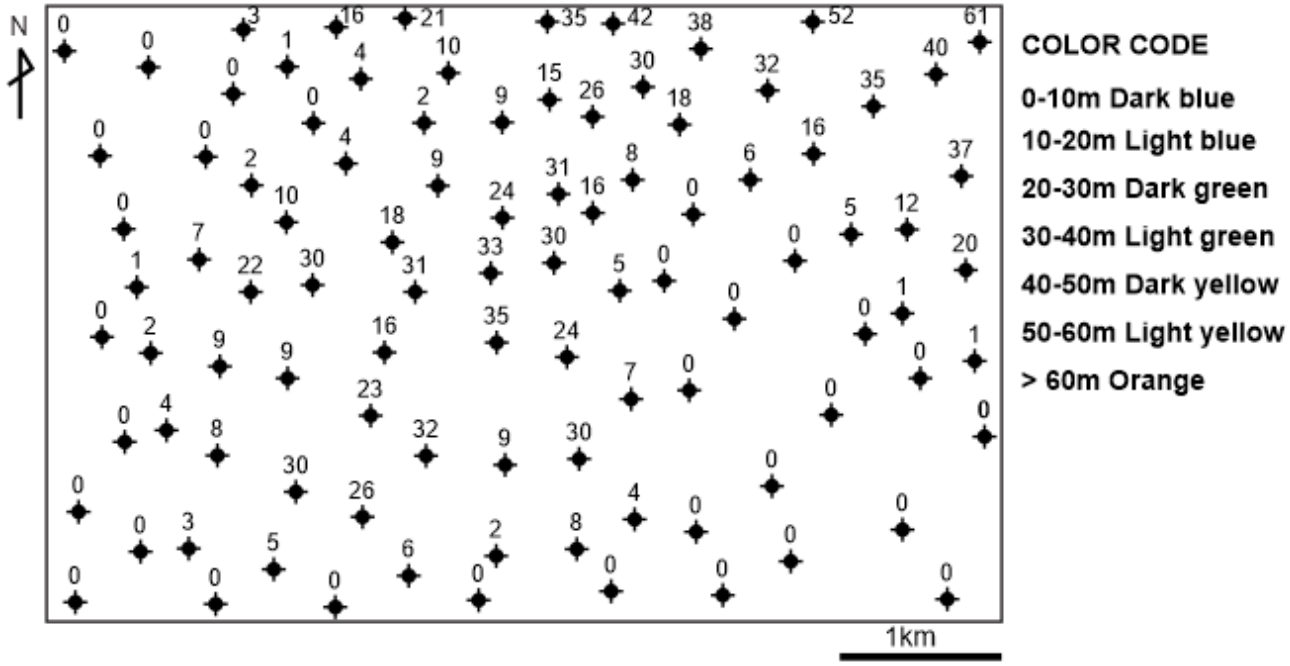
1. Draw a vertical straight line to mark the GR value of 100 API in each well. (2 point)
2. Color all of the sands for the entire three wells based on the log responses. Hint: Color should be filled between the GR curve (left) and the GR100 line (right). (2 point)
3. Correlate the logs with at least three horizons. Hint: sandy units can wedge out or be faulted. (6 point)



PART 2: Geological mapping (15 points)

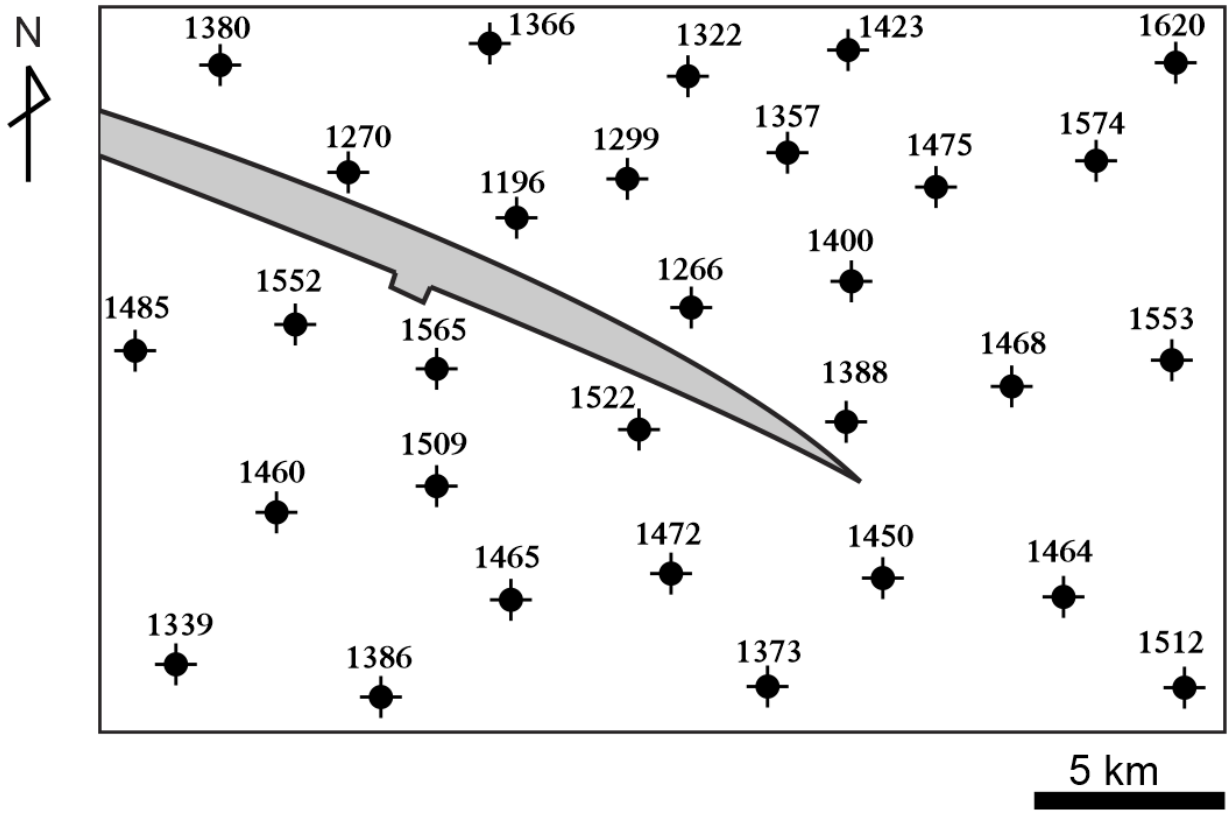
Problem 1. (6 points)

The values below show the thickness of a sandstone layer drilled at each wellsite. Make a thickness contour map. Note: (1) The contour interval should be 10 m (3 points). (2) Fill in color with the Color Code (2 points). (3) Name the depositional environment:_____ (1 point)



Problem 2. (9 points)

Interpolate the depth points and make a geological map at contour interval of 50 m (7 points). Pick out the closures and mark with color (2 points). Hint: Contour lines should not cross-cut the fault polygon.



PART 3: Seismic interpretation (20 points)

Background introduction

This seismic cube covers a large gas field with a very thin oil zone in the Barent Sea called Askeladd. The field was discovered in 1984 by drilling the 7120/8-1 well.

The reservoir rock is the Middle Jurassic Stø Formation sandstone, deposited in shallow marine environment.

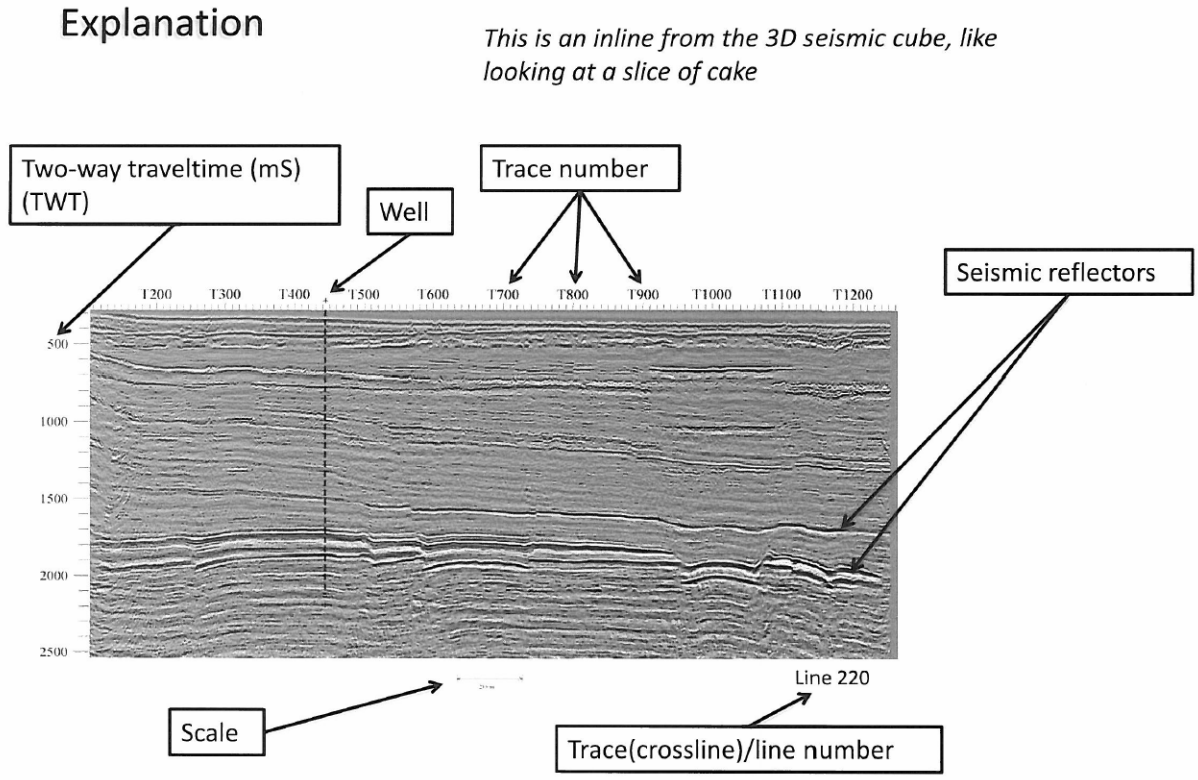
A transgression led to the deposition of the Fuglen Formation of Oxfordian age, an anoxic syn-tectonic black shale that served as the cap rock and seal overlying the reservoir. Rifting was active in the Late Jurassic-Early Cretaceous. Some of the faults were probably reactivated during later tectonic events in the Tertiary & recent times.

Large Cretaceous shales overlay these layers, before we move into Pleistocene and eventually Holocene deposits.

Hekkingen Formation (Hauterivian age) serves as the main source rock for the hydrocarbons. The following well picks are given:

1. Holocene (Sea bottom)
2. Top Upper Paleocene
3. Top Cretaceous
4. Top Cenomanian
5. Top Barremian
6. Top Hauterivian
7. Base Cretaceous
8. Top Oxfordian

Explanation of seismic profile:



Exercise - Base map (4 points)

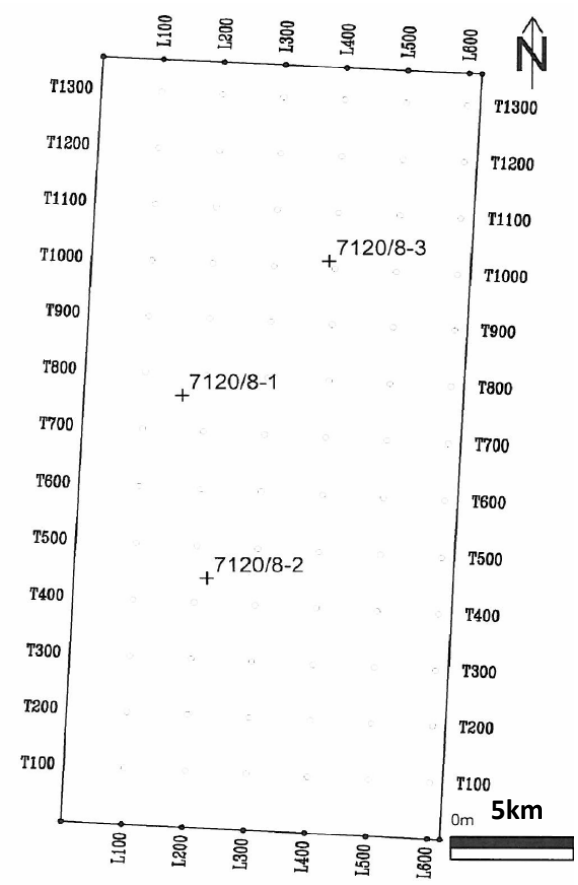
This is a grid map of our 3D seismic cube. It shows the extent of the survey, the location of the wells drilled, and inlines and traces {or crosslines), labelled LXXX and TXXX respectively.

Inlines: The direction of the original seismic lines

Crosslines: Perpendicular to inlines

1) Please mark where the inlines and crosslines (traces) you were given are located on the map (2 points)

2) Label the name of the wells displayed in two of the seismic sections in the text boxes (2 points)



Exercise- Interpreting (16 points)

For the interpretation of the four seismic sections, start with the line and trace with a well in it.

Using these two as a starting points, do the following:

1) Interpret and correlate 3 seismic horizons throughout the four seismic sections. A horizon is created from a well pick of your choice. (3 points)

a) Start with Line 220, where you have the well tops marked. Interpret around all seismic sections, correlate, and end up at Trace 1010, where a well is drilled, but no well picks are marked.

b) Mark the TWT of the horizons in the well drilled in Trace 1010.

A good advice would be to choose and interpret the following horizons: #5 - Top Barremian, #6 Top Hauterivian and #8 -Top Oxfordian.

2) Try to interpret the major faults you can see (focus on the reservoir/seal interval) (2 point). Don't worry about correlation, just draw the faults, and use arrows to show the moving directions of fault blocks. (3 points)

3) A seismic line shows us two-way time on the vertical scale, while a well log typically shows us depth measured in meter. When we try to input well data in seismic, we have challenge. Why is it often difficult to correlate well data with seismic data? (2 point)

Hint: Two way travel time will depend on density and acoustic velocity in our rocks. Are physical properties always constant?

4) A time depth table is usually created for each well located in the seismic. You are given the time depth table for well 7120/8-2. We approximate by saying this time depth table is also valid for the second well in our seismic (a good approximation). (8 points)

a) Note down the TWT for your three chosen well picks from BOTH wells in the seismic (the one where the picks are given, and the one where you are to correlate) (2 point)

b) Use the time depth table given, and find out the measured depth for your three chosen well picks from both wells (don't worry about accuracy) (2 point)

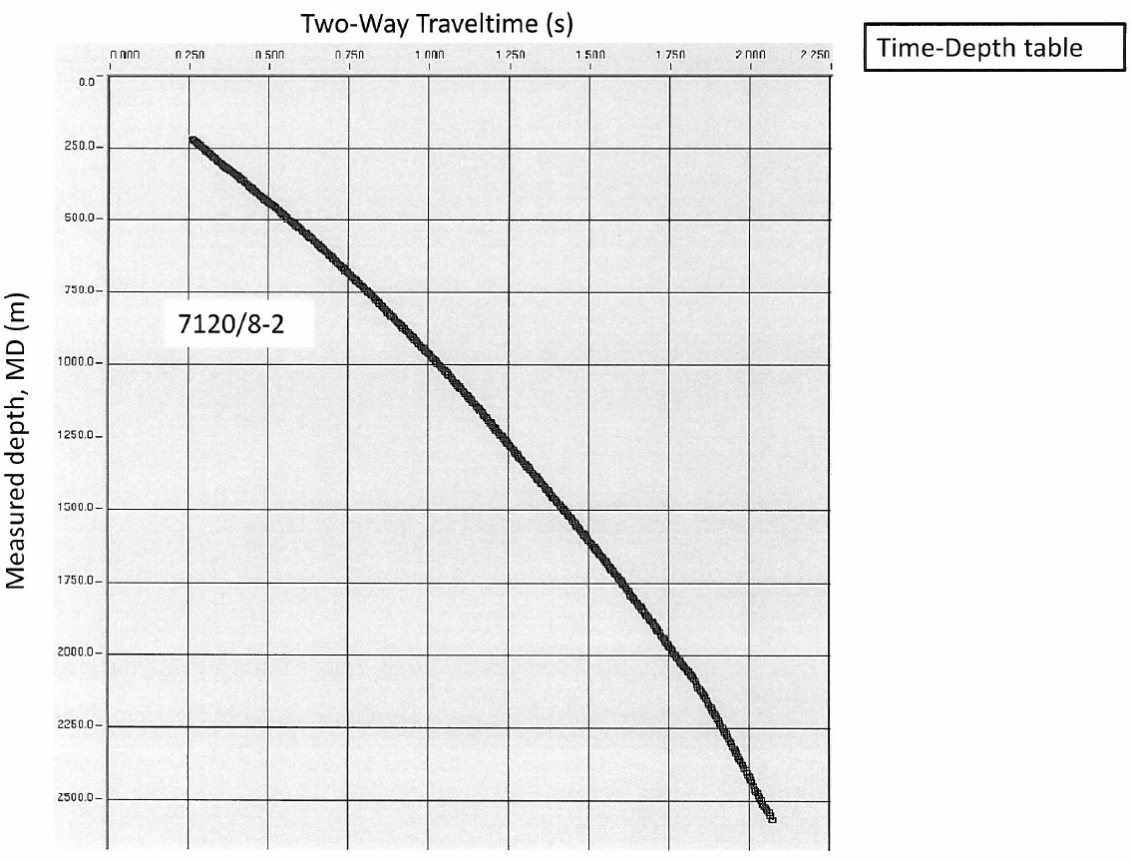
c) Lastly, take a quick look at the two logs (GR and Res) given for well 7120/8-2.

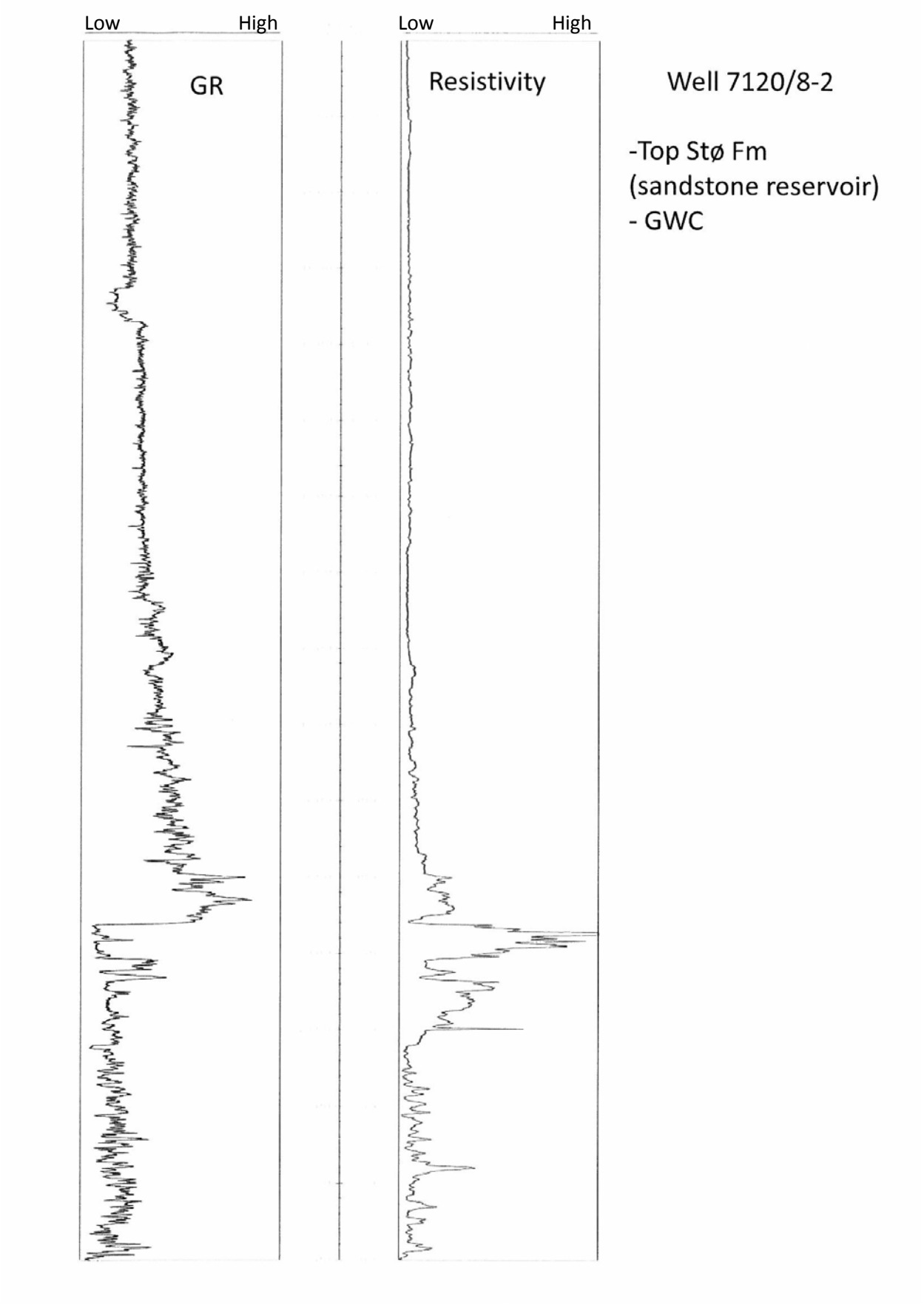
(1) Mark the top of the Stø Fm sandstone (our reservoir) (1 point)

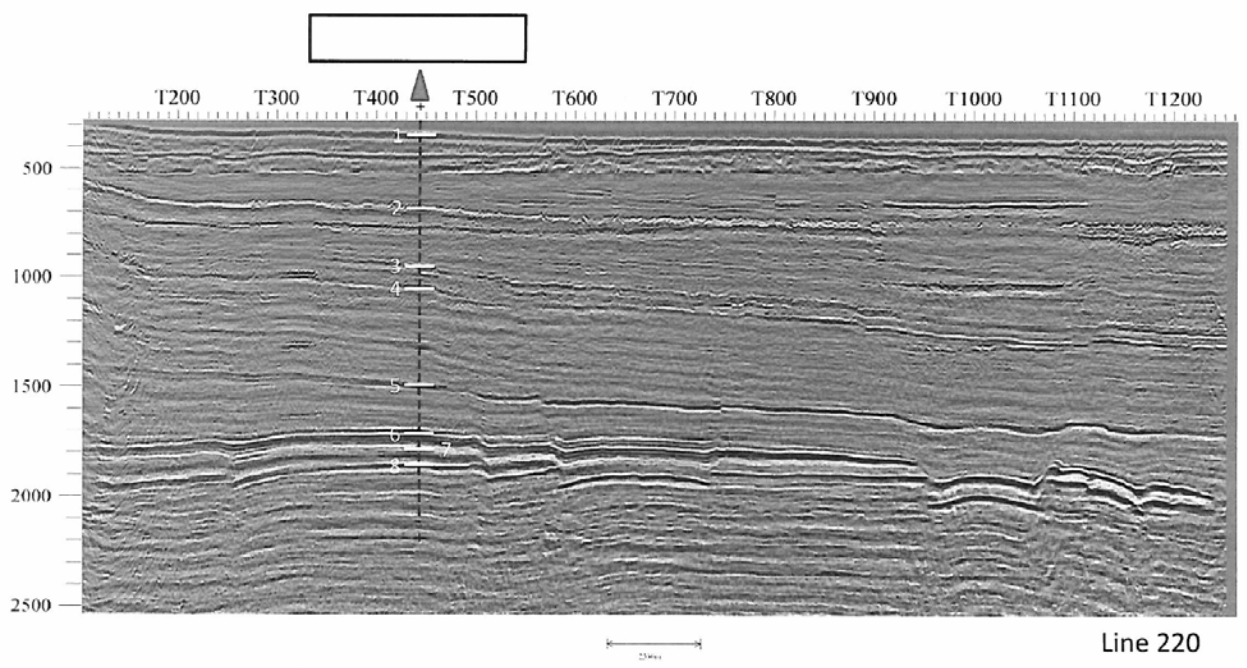
(2) Mark the GWC (Gas Water Contact) in the reservoir (1 point)

(3) The shales overlaying our reservoir have very high GR readings. Can you state a possible reason? (2 point)

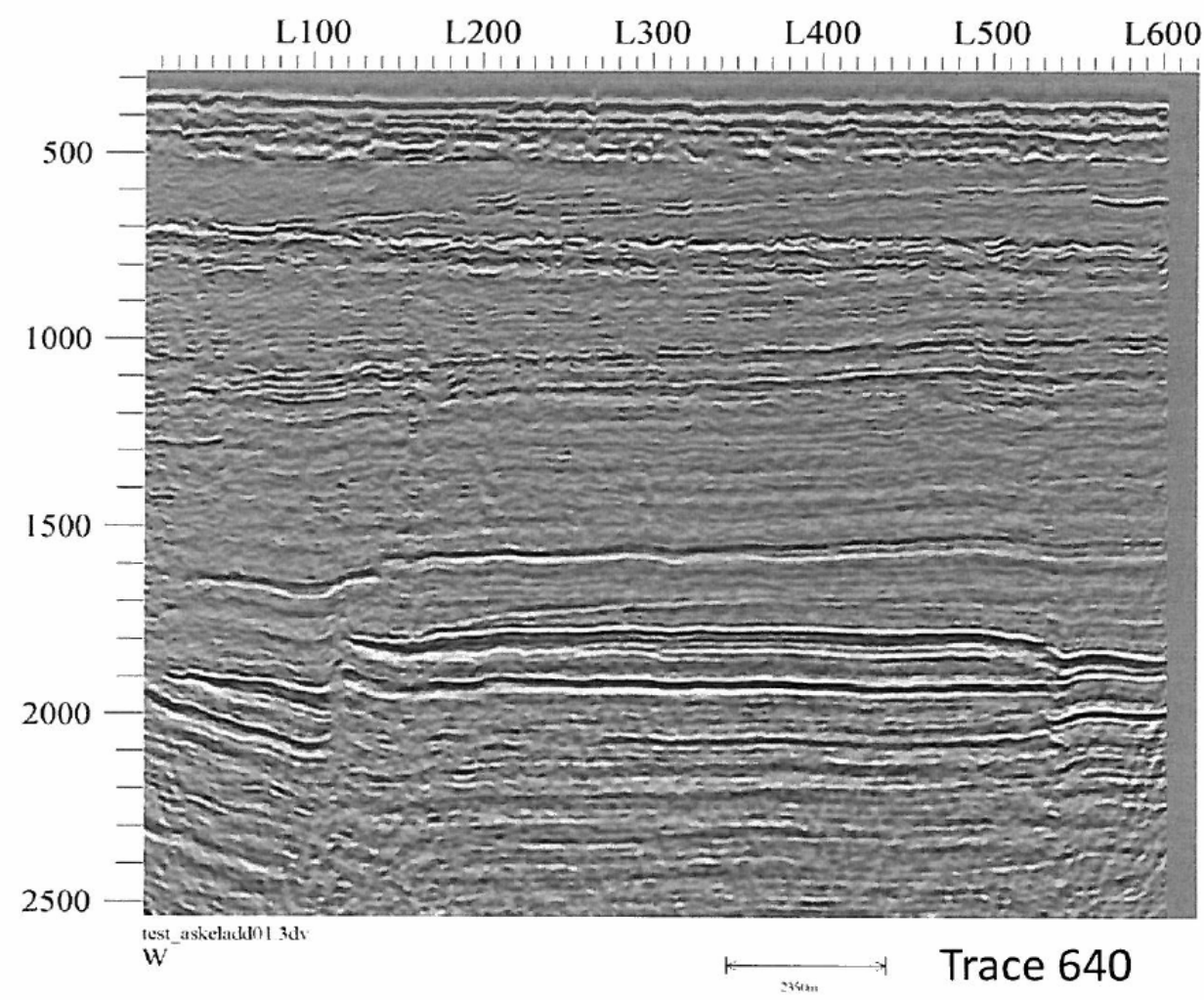
PS: Do not worry about depth, the scale in this log is very blurry, just do it qualitatively


Two-Way Traveltime (s)
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
Measured depth, MD (m)
0.0
250.0
500.0
750.0
1000.0
1250.0
1500.0
1750.0
2000.0
2250.0
2500.0
7120/8-2
Time-Depth table

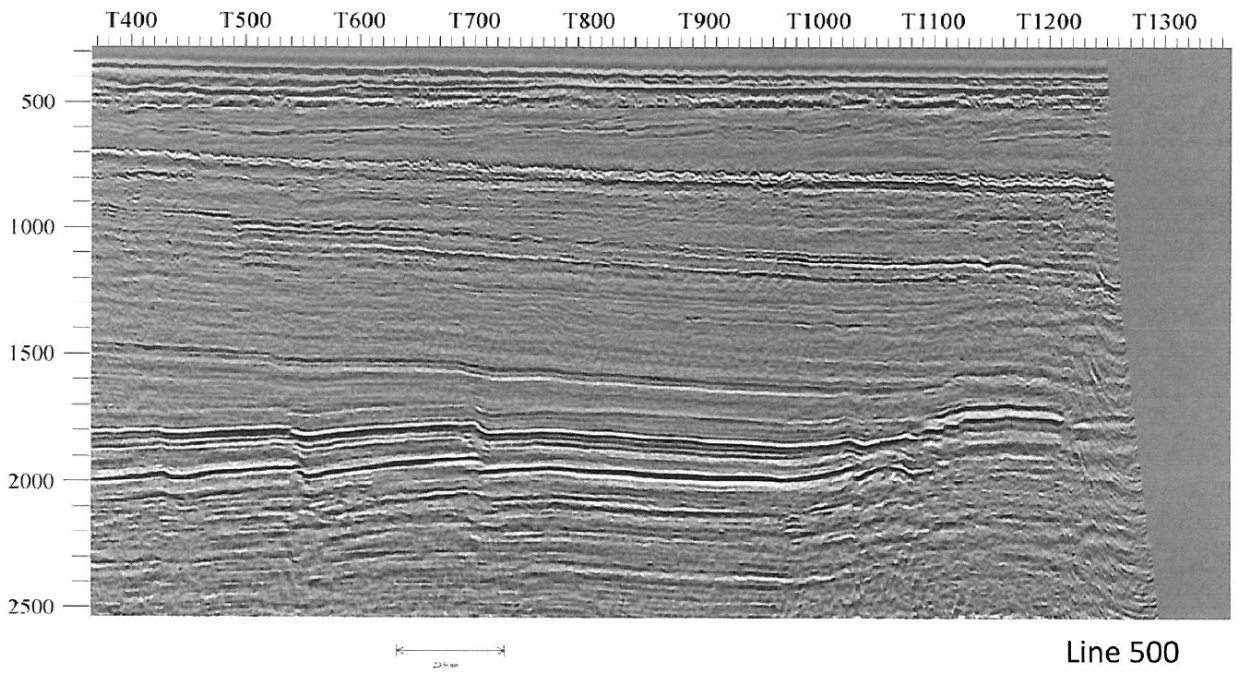

Low
High
GR
Low
High
Resistivity
Well 7120/8-2
-Top Stø Fm
(sandstone reservoir)
- GWC

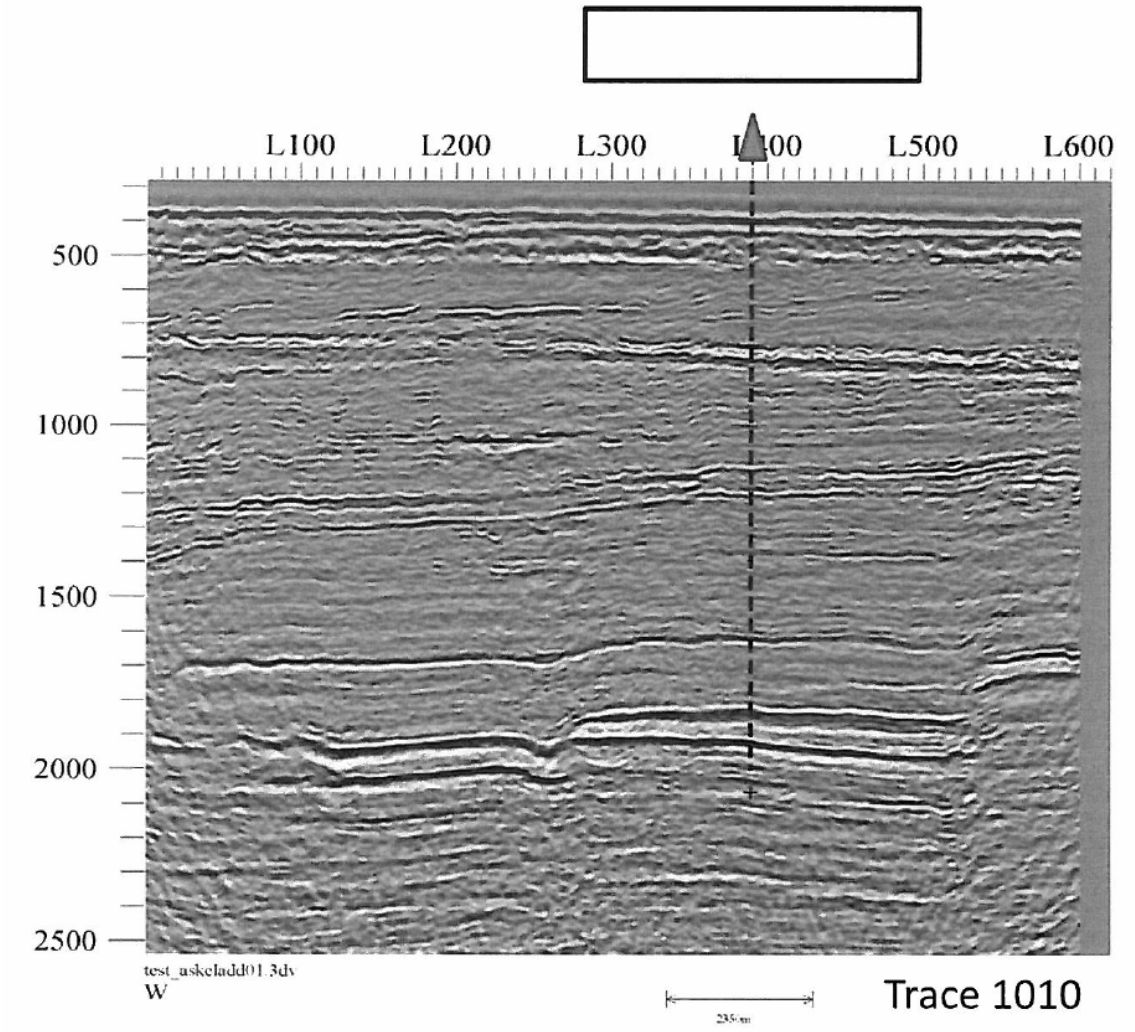


Line 220



Trace 640


T400
T500
T600
T700
T800
T900
T1000
T1100
T1200
T1300
500
1000
1500
2000
2500
Line 500


L100
L200
L300
L500
L600
500
1000
1500
2000
2500
test_askeladd01.3dv
W
Trace 1010