**Faculty of Science and Technology**

**Institute of Petroleum Technology**



**EXAMINATION: BIP210 Well logging DATE: 06.06.14**

**TIME OF EXAMINATION: 3 hours**

**EXAMINATION IN NORWEGIAN AND ENGLISH**

**We recommend you to answer in English.**

**AUTHORIZED HELP:**

* **Simple calculator (Casio FX-82, TI-30 or HP30S)**
* **Language dictionary between your mother tongue and English**

**The exam consists of total of 9 pages: 3 pages consisting of 3 exercises plus 5 pages of 4 enclosures. The enclosures must be handed in with the answers.**

**Exercise 1 – Sonic Log**

Use short answers and sketches.

1. What are the acoustic waves detected by the sonic tool? Describe each of them using sketches.
2. What is the Snell’s law and which principle is used for the sonic tool? Explain using sketches.
3. BHC tool:
   1. Describe the functioning of the Borehole Compensated tool using sketches.
   2. How is computed the slowness?
4. Newer tools: (use sketches)
   1. What are the main difference between BHC and the newer tools
   2. Then, how is computed the slowness?
5. What are the difficulties for using LWD sonic tools?
6. What is the impact of high pressure zones on the sonic log? Illustrate with sketches.  
   1. How do we calculate porosity using the sonic log?
   2. Do we need to correct the sonic porosity for sandstones? If so, explain what this correction is.
7. Use sketches to illustrate.
   1. What do we call seismic lithology?
   2. Show how the density log and sonic log can be used in seismic lithology.
8. Illustrate using sketches.
   1. Why do we need a time-depth conversion?
   2. What is a vertical seismic profile VSP?

**Exercise 2**

1. What are the main differences between natural and drilling induced fractured. Cite at least 5 examples. If possible use sketches.
2. A fractured reservoir shows natural fractures saturated in oil oriented vertically. How should be positioned the well in order to produce the maximum of oil from the fractures? Illustrate with sketches.  
   1. What is a break out? What are the differences between drilling induced fractures and break out? Use sketches.
   2. Which logging tools do we use to characterize a break out?
3. Which tools can create image logs in:
   1. WL?
   2. LWD?
   3. What is the reason of more imaging tools in LWD than in WL?
   4. Is the resolution between WL and LWD image the same?
4. What represents the color scale (dark and light colors) in:
   1. Electrical image logs?
   2. Acoustic image logs?
5. Figure 2.1 and 2.2 are electrical image logs and Figure 2.3 is an acoustic image log.
   1. Interpret the main beds (with associated lithologies), natural and/or drilling induced fractures and/or break out on each figure. Precise if the fractures are open or cemented.
   2. For each figure, plot the dip and azimuth of the identified beds and/or fractures on the tadpole graph.

Exercise 3 – Well evaluation

From the well 8/4-1 in the North Sea, the following wireline logs are given for an interval from 2375m to 2630m (Figure 3 on 2 pages):

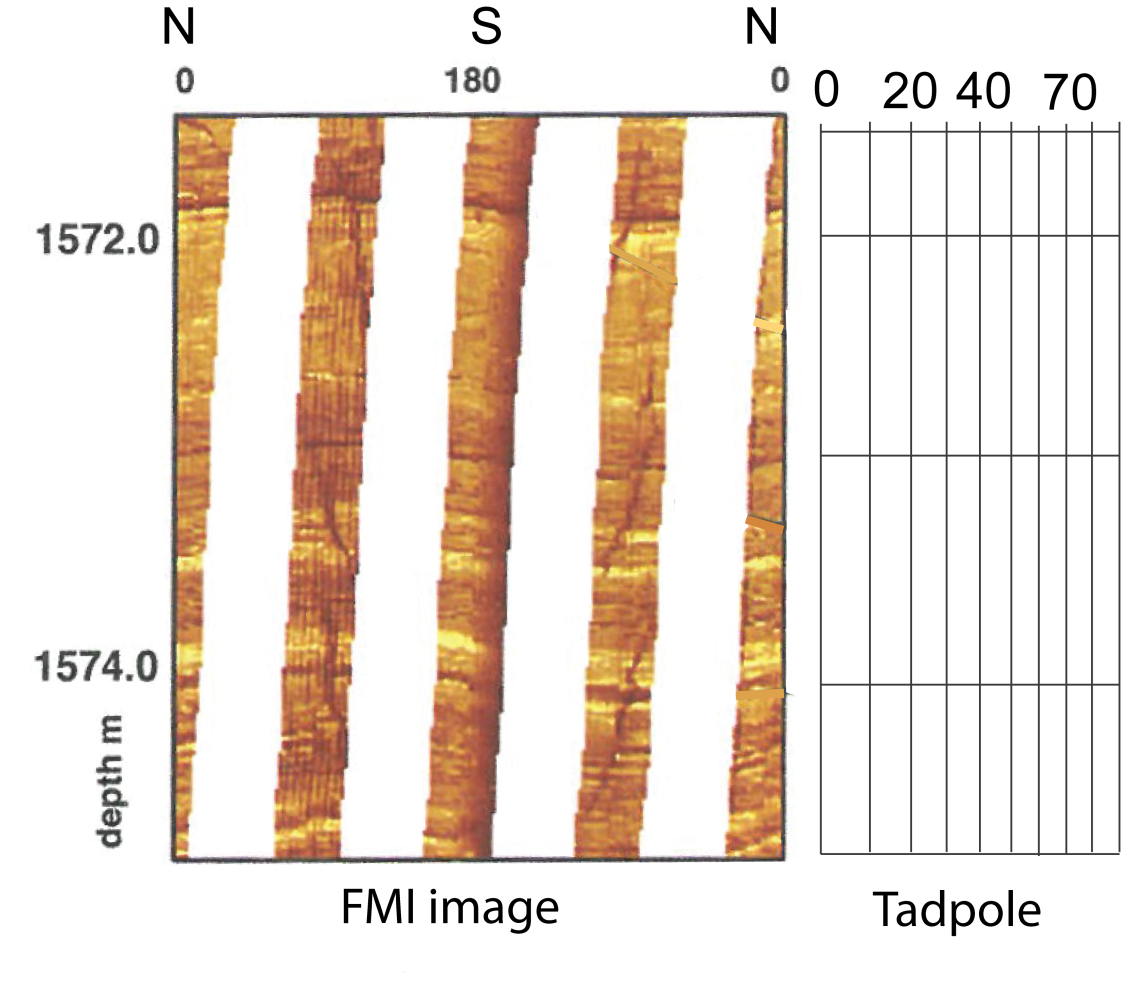
* Gamma log
* Density log
* Neutron log
* Sonic log
* Resistivity log

1. Mark the lithology in the depth track for the log interval on pages 7 and 8.
2. Between 2550 and 2575m there are two peaks A-A, explain them.
3. There is no gas in this well. Mark the oil zone for the reservoir.
4. For this oil zone:
   1. Compute the porosity using three methods.
   2. Compute the water saturation using only the porosity from the density log.
5. Is there vertical communication through the whole log interval? Why?
   1. What is the Net Sand?
   2. Mark the net sand zone on the logs

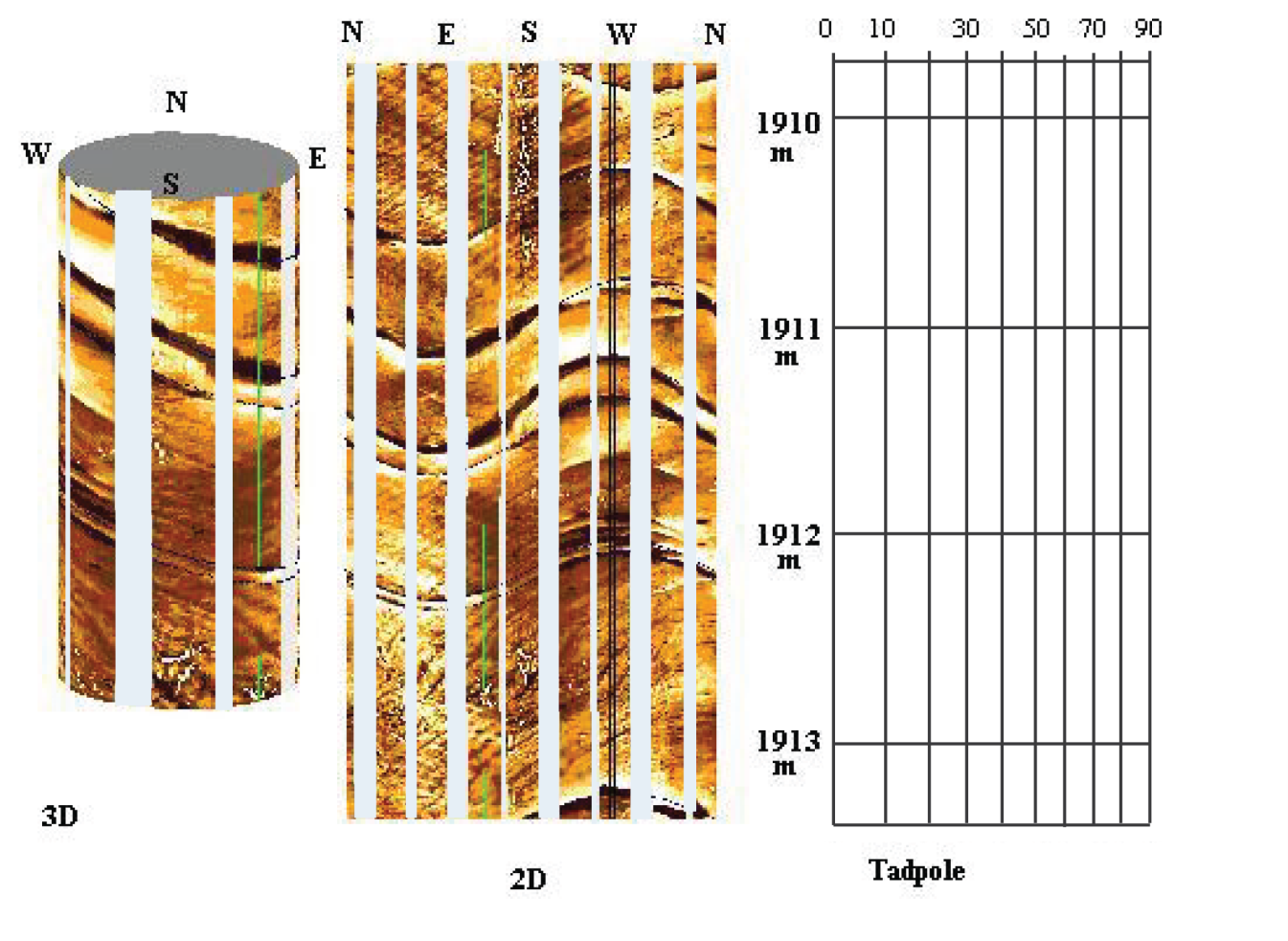
**4 ENCLOSURES of 5 pages**

**The 4 enclosures (5 pages) must be handed in with the answers**

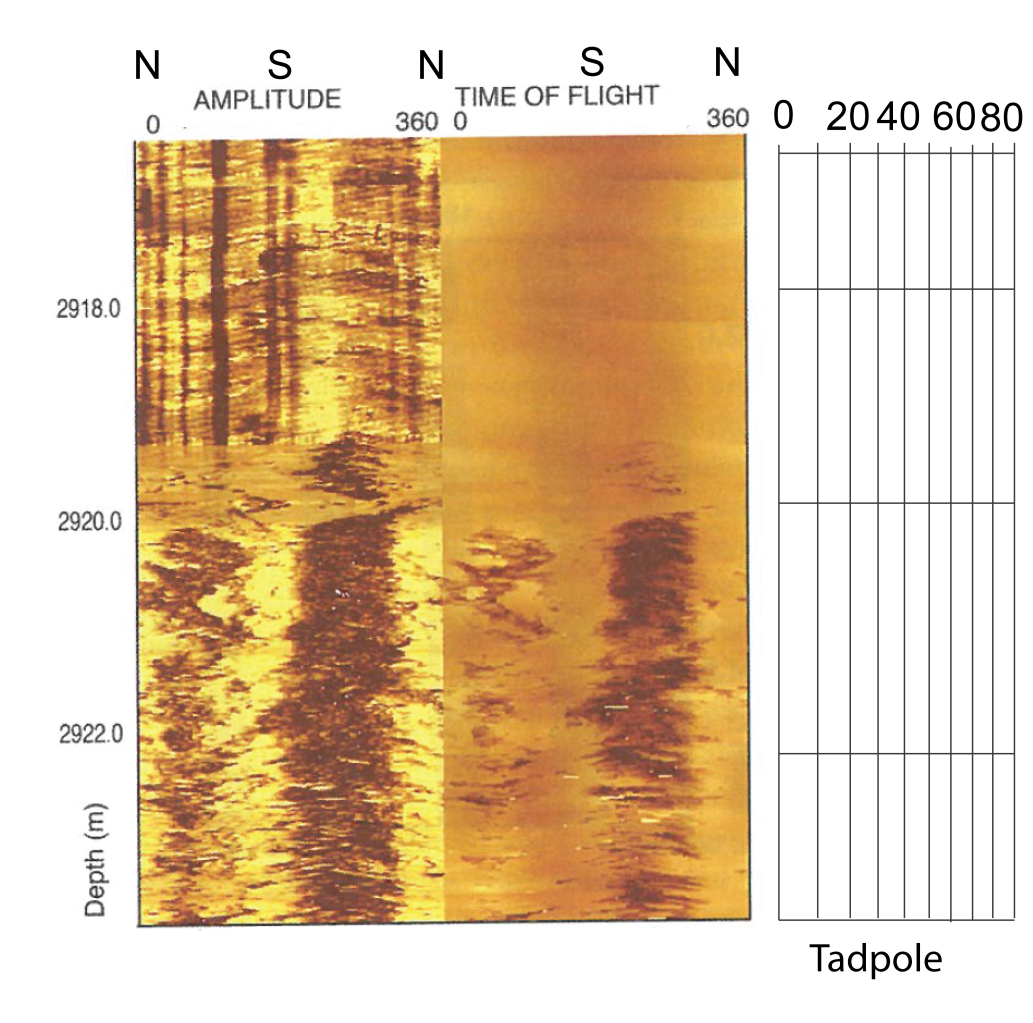
**ENCLOSURE 1 – FIGURE 2.1**

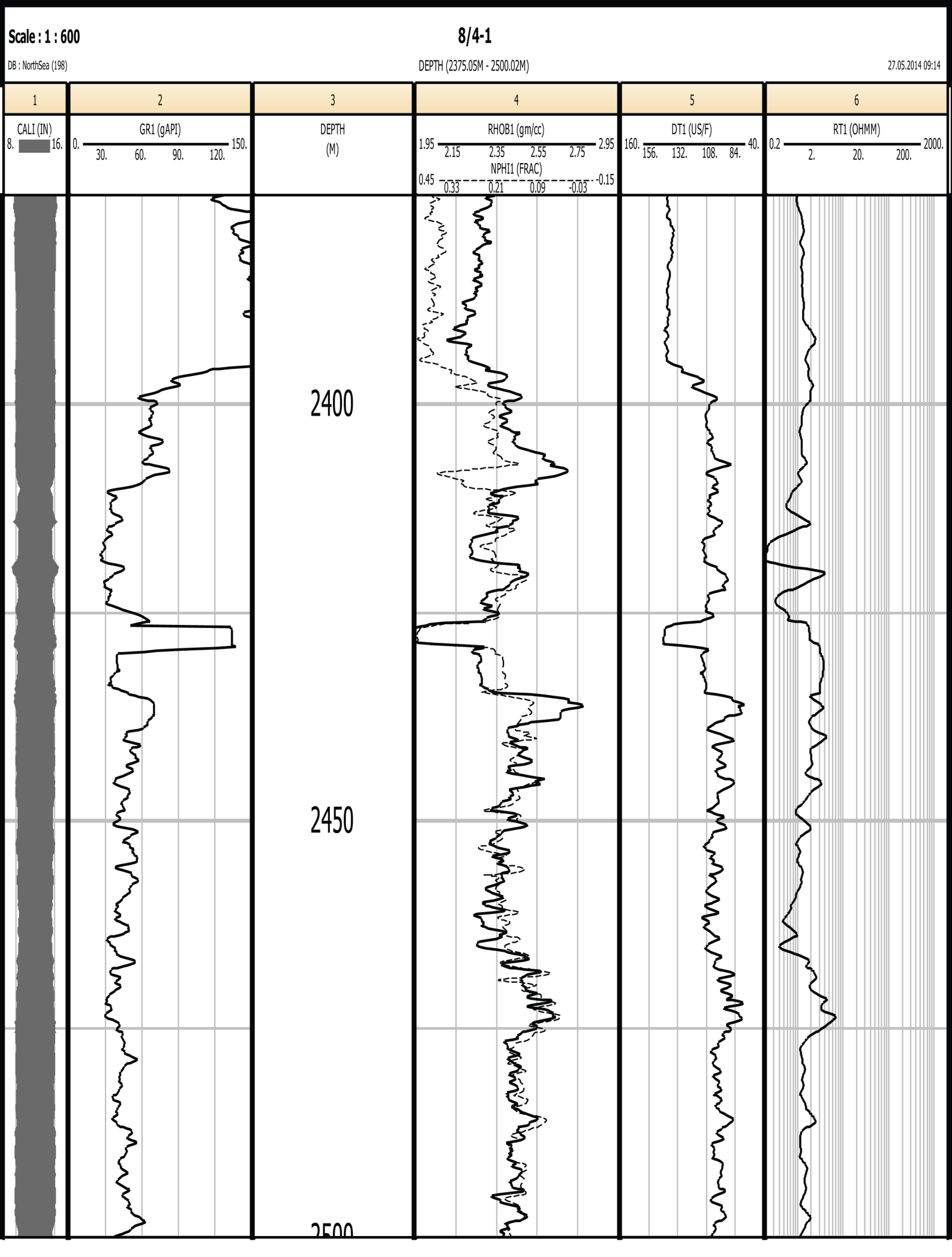
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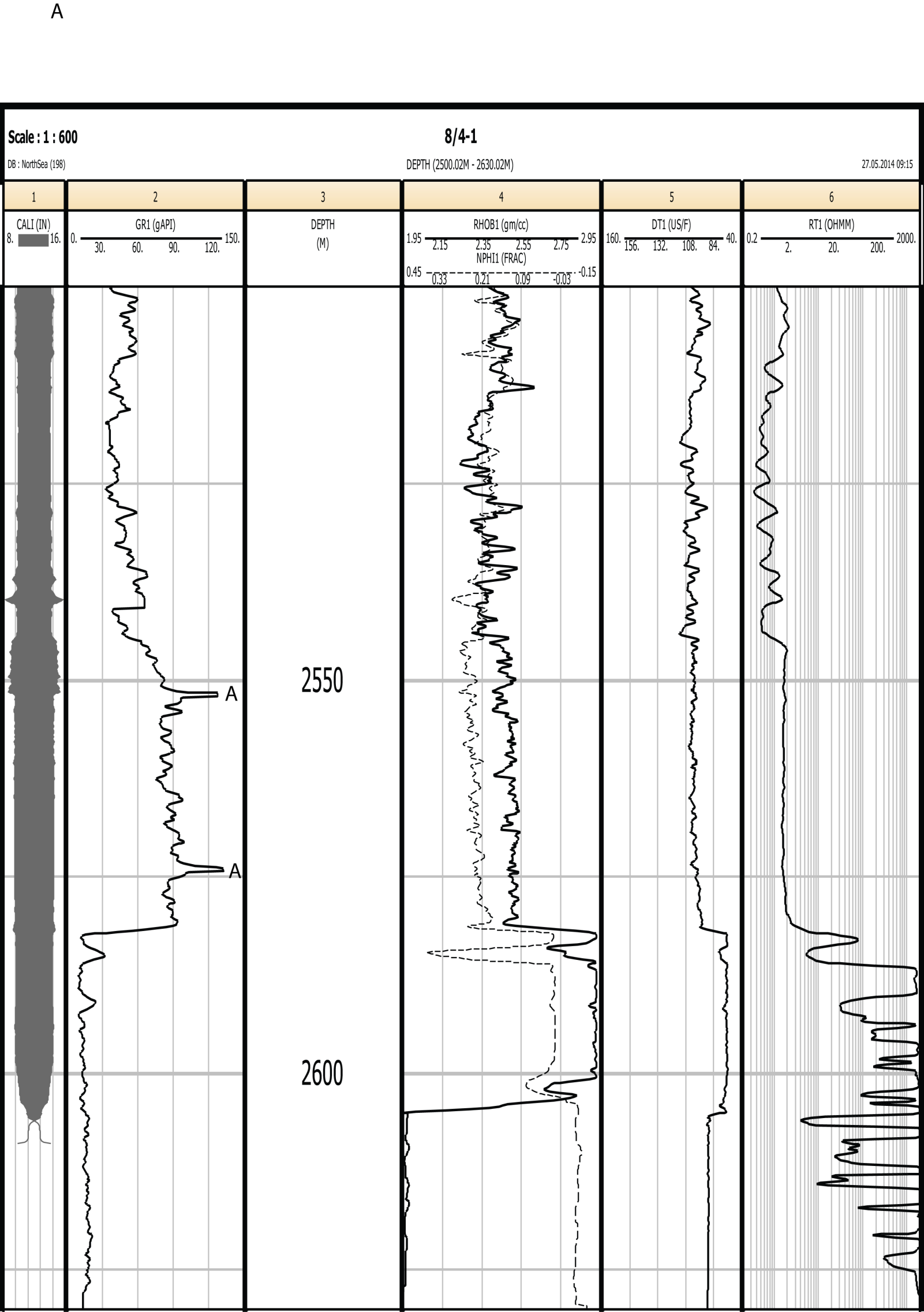
**FIGURE 2.2**



**ENCLOSURE 2 – FIGURE 2.4**

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**ENCLOSURE 3 – FIGURE 3**



**ENCLOSURE 4**