TU Delft

Written Examination
Convergence Course (ta4001)

October 31, 2003
9.00 – 12.00 hours

This exam contains the following parts:

- part: Petroleum Engineering (40 points)
- part: General Geology (20 points)
- part: Introduction to seismics (20 points)
- part: Sedimentology (20 points)

Your total score is calculated by summing up the points (maximum 100). The grade will be obtained by dividing the score by 10.

Please use separate pages for each part !

Write your name and student number on <u>each page !</u>

Good luck !!

Part: Petroleum Geology

The following questions should be answered a concisely as possible. Each question counts the same towards the final score.

1. Draw a sketch of the carbon cycle on the Earth and indicate approximately how much of the total carbon is in each part of the cycle (in %).
2. Make a flow diagram of the various stages of hydrocarbon maturation. Name and briefly describe at least two maturation indicators.
3. Describe the principal factors that lead to the accumulation of hydrocarbon reservoirs.
4. Make a schematic cross-section of a rift basin and indicate on it where possible accumulations can be found. Describe the migration paths.

Part: General Geology

1. What is the difference between a crystal, a mineral and a rock? Give three examples of each of them, and describe eventual relations between the examples you give.

2. a - Draw a cross-section of the earth across South America and Africa, and indicate in your drawing which plate tectonic processes are going on there.

   b - Describe why plate tectonics was first rejected and later accepted: state the arguments in each case.

   c - Describe what the importance is of plate tectonics for the formation of oil and gas reservoirs.

Part : Introduction to Seismics

1. a) On the next page, a raw land record is given. This data has been shot with a Vibroseis and correlated; the geophones are 1.5 meter separated. It was shot on a beach with a few meters of sand on top of some hard rock. For this record, indicate which event(s) can be interpreted as:
   - surface waves (1 point)
   - direct wave/refraction (1 point)
   - reflections (1 point)

   b) Determine in the record below the velocity of:
   - (range of) the surface waves, (2 points)
   - direct wave/refraction (2 points)

   c) For a reflected wave, try to estimate the velocity by using the NMO. Clearly indicate which reflection you are using. (2 points)

2. a) What is (zero-offset) migration? Explain your answer (2 points)

   b) Draw the zero-offset ray paths of a diffractor (1 point)

   c) Based on these ray paths, draw the corresponding zero-offset time-sections. Label the axes properly. (1 point)

   d) Based on the diffractor response above, explain what happens if the velocity for migration is taken too low. Also draw the (wrongly) migrated section. (2 points)

   e) Explain the different types of velocities: Root-mean-square (RMS) velocities and interval velocities. (2 points)

   f) How does a Vertical Seismic Profile help in determining velocities ? (2 points)

deals with the wave phenomia to decode a wave which gives a better image of the subsurface

Part: Sedimentology

1 - Deep marine sands

The morphology (shape) of deep marine sand deposits depends, among other things, on the sediment supply from the shelf and continental slope, and more specifically: from the occurrence of one or more supply sources.

1.1 Make plan view drawings of at least three morphological scenarios that are the result of different sediment supply sources.

1.2 Accurately describe the characteristics of a debris flow. Deal with: the processes of transportation and deposition, and the internal structures of a debris flow deposit.

1.3 Accurately describe the characteristics of a high-density (coarse-grained) turbidite. Deal with: the processes of transportation and deposition, and the internal structures of a high-density turbidite deposit, and summarize the main differences with a debris flow.

The theoretical models of sandy submarine fans show a symmetrical fan-shaped geometry. However, studies from sandy submarine fan reservoirs demonstrate that the shape is highly irregular, and that the spatial distribution of reservoir properties is therefore difficult to predict.

1.4 Describe three different scenarios that may **syndepositionally** condition the geometry of a sandy submarine fan at the bottom of the basin plain.

2 - Fluvial deposits

Fluvial channels are in a dynamic equilibrium with the environment through which they flow. This means that a fluvial channel migrates within the limits of their channel belt as a response to the flow dynamics. This process continues until the entire channel belt changes its position following avulsion.

2.1 What is the definition of a channel belt?

2.2 Accurately describe the process of avulsion.

2.3 A labyrinth-type fluvial reservoir is characterized by a loose, apparently random spatial distribution of fluvial channel sands embedded in a matrix of floodplain silt and clay. Can you explain this spatial distribution in terms of channel belt migration, avulsion and development of the accommodation space in the sedimentary basin.