

VRIJE UNIVERSITEIT, AMSTERDAM / UNIVERSITEIT UTRECHT

MSc tentamen (examination) 2008

Petroleum Systems and Regional Geology (VU 450179)

November 03, 2008, 13.30 - 16.30hrs, room F 301

Time allocation: 3 hours

Answer 5 questions. You **must** answer questions 1 and 2.

- Answers may be in English or Dutch
 - Credit will be given for indications of understanding the basic principles and for your reasoning
 - Make as much use as you can of diagrams and illustrated examples
 - You will **not** earn more marks by answering more than 5 questions
 - When you have finished please hand in all the material that supports your interpretations
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Question 1 (35% of the marks, obligatory)

Use figures 1 to 4, which summarize the geology and petroleum prospects of the Gilbertland offshore basinal area.

Fig 1: Gilbertland area, structure and prospect map.

Fig 2: Gilbertland area, Geological column and stratigraphy

Fig 3: Gilbertland area: distribution, depth and maturity of early to middle Jurassic source rock

Fig 4: Gilbertland area: distribution, depth and maturity of late Jurassic source rock

Several structural prospects have been identified in this area, which deepens towards north and where no wells have yet been drilled. I would like you to group the prospects into families or "exploration plays" with similar characteristics. For this you should carry out the following tasks:

- Indicate in the empty column in fig 2 the main cycles and stages that the basin passes through in its evolution.
- The prospects are numbered and grouped by province. Tabulate them and indicate for each prospect the (a) basin cycle/stage in which it is most likely to occur (alternatives

or multiple levels may be possible!) (b) the age and depositional environment of the reservoir (c) using figs 3 and 4, the likely source rock horizon(s) from which it is charged (you can assume vertical migration except for on the Beagle Ridge, where horizontal migration on the basement surface is possible) (d) whether they will contain oil or gas, or only water.

- How many Petroleum Systems and “Exploration Plays” can you recognise in this area? List the plays indicating which prospects belong to each, indicating the reservoir age/lithology and characteristic trap type.

Question 2. (20% of the marks, obligatory)

Complete the events chart for the Amposta Field (offshore Spain) using the data provided. You have a cross section through the field (fig 5) and an empty events chart (fig 6).

This Mesozoic passive margin sequence was exposed in the early Tertiary prior to rifting in the Valencia Trough. You may assume that the Salsade Group source rock is mature for oil (and some gas) generation. The main reservoir consists of karstified Montsia Group limestones. OOWC = oil-water contact.

When you have completed the events chart on fig 6, answer the following questions:

- Indicate on fig 5 (i) main migration paths from the source rock and (ii) which of the faults appear to act as a seal and which appear to allow leakage.
- How many trap and potential trap types can you identify on the section? List them and indicate an example of each on fig 5.
- Suggest why some of these trap and potential trap types contain petroleum, while others do not

Question 3. (15% of the marks). List and briefly describe the types of sedimentary basins and/or basin cycles that are commonly associated with petroleum occurrence, noting the most important geodynamic or tectonic processes involved. Support the description of each with a simple sketch showing the main basin form.

Question 4. (15% of the marks). Divide the two basin cross sections on Fig. 7 into their component cycles and stages (as appropriate). Tabulate these on a separate sheet, noting (a) the cycle/stage number, (b) the age, (c) lithology and (d) associated tectonic features. Based on the lithologies shown, suggest which depositional environments you think may characterize each cycle/stage.

Question 5. (15% of the marks). Describe a known petroleum system of your choice, noting the area where it developed, the type of basin/cycle it occurs in and the main characteristics of the petroleum parameters. Indicate some of the traps and plays associated with it.

Question 6. (15% of the marks). Relate the various types of buried organic material or kerogen to the main types of source rock and the type of hydrocarbon charge (oil, oil

& gas, gas) they produce when mature. Provide examples from different petroleum provinces.

Question 7. (15% of the marks). Contrast the petroleum geology of the Mesozoic of the Middle East province with that of the Mesozoic North Sea province.

Question 8. (15% of the marks). Look at the geological cross-section of the basin provided (fig 8) and answer the following:

1. Construct a stratigraphic column for the area, dividing it into basin cycles and showing tectonic events
2. How many petroleum systems can there be on the section? Relate them to the stratigraphic column you have constructed
3. Identify 3 potential “plays” and note for each the likely source horizon, the migration paths, the reservoir and seal lithologies and the trap type.

Question 9. (15% of the marks). Which types of clastic rock types make the best reservoirs and why? Make a simple depositional environmental sketch showing their typical distribution.

Question 10. (15% of the marks). Describe some of the issues related to understanding the history of petroleum accumulation and preservation in the Palaeozoic of Oman in the Middle East province.

October 2008.