Master course: Dynamics of Sedimentary Systems, -- April 20nd 2011, Convener: **G. Postma**

BBL 001 -- Available time 13.00 – 16.00

Examination questions

1.
Recall the numerical model for the infill of an (alluvial) basin based on the diffusion equation. Sediment input occurs at the left hand side (where horizontal coordinate $x = 0$). At the right end ($x = L$, with L equal to basin length) the sediment elevation is kept at zero at all times.

a) What are the two main principles that together make up the **linear** diffusion equation?
b) Consider the case of a constant sediment input, a constant diffusivity, and no subsidence. What will the steady-state surface look like and **why** does it look like this?
c) Explain how we can obtain an estimate of the time needed to reach steady state—without actually running the model.

2.
Starting from the steady state discussed in the previous exercise we now suddenly reduce the sediment input to 75% of its original value.

a) Sketch how the surface develops with time in response to the reduction in input and explain your drawing.
b) How does the sediment elevation at $x = 0$ compare to that before the reduction? Try to be as exact as possible.

3.
Extensive fieldwork in the Cretaceous foreland basin in the central part of the US revealed important periods with gravel front progradation. How will the gravel front react to
a. increasing subsidence rate?
b. increasing sediment flux?
c. increasing discharge?
d. increasing ratio of T/T_{eq}, where T is the period of change and T_{eq} is the equilibrium time of the fluvial system

4.
A dedicated team of scientists has constructed a laboratory set-up that allows the simulation of debris flows. Density of the flowing material and slope of channel and outflow plane are known precisely. Furthermore, their experimental set-up allows the scientists to monitor aspects of the material while flowing. The sediment flow is observed to behave as a "Bingham plastic". Describe at least two ways in which the *strength* of the flowing material could be determined.

5.

Some years ago, Shell exploration was interested in analogue models of the river-delta-shelf system, where the influence of sea-level change, tectonics and climate on delta and shelf evolution could be studied. The interest resulted in research that was carried out at Utrecht University in the mid and late nineties.

In one of the practicals, you have studied, by means of lacquer peels, some of the experimental results yourself. Through analogue modelling, the effect of both syn-depositional faulting and sea-level change was studied, while sediment supply was kept constant. The experiment set-up was done to provide Shell with a sequence stratigraphic analogue for the IMO-river oil field in the Niger delta. The following questions need to be answered:

a. What is the scaling approach that is used in order to justify correlation with real world proto-types?
b. What type of stratigraphical information was most of interest?
c. What systems tracts were predominantly preserved on the footwall?
d. How can one best correlate footwall and hanging wall sequences according to the experiments: by correlation of maximum flooding surfaces or by correlation of unconformities?

6.
The Dutch coast is characterized by varying influences of waves and tides, and has different morphologies.

Describe:

1) the reasons for these differences in wave and tidal influence,
2) the different coastal morphologies, and
3) the way in which (combinations of) different factors and processes did create and maintain these morphologies.

7.
A Jurassic overall transgressive succession is exposed in the cliffs of Cap Gris Nez and Audresselles (Boulonnais). The corresponding log (from Wignall 1996) is given in the figure on a separate page.

A. Indicate the various sub environments as you recognized them in the field in the sedimentary log and give the indicative sedimentary features (facies) on which your interpretations are based (type of cross bedding, fossil content, ichno facies etc.)
B. Why is no foreshore (beach) preserved in the Grés de Chatillon?
C. Indicate possible ravine surfaces, sequence boundaries and marine starvation surfaces (condensed sequences) in the column.
D. Decribe the evolution of this succession.

8.
All classifications have strengths and weaknesses. You have studied the classification for deltas from Postma (1990). Summarize strength and weaknesses of his classification scheme.

9.
Give your favorite question related to dynamics of sedimentary systems and provide the answer.