Høgskolen i Telemark

EXAM

4504 Georesources and Groundwater

20.05.2009

Time:	5 hours (9-14)
Language:	English
No. of pages:	3 including front page
Helping tools:	None
Remarks:	All problems count equally
Attachments:	None

The results from the exam will be published on the web via 'Arena høgskole'. In addition you will find lists of the exam results outside the front door of the Exam office. You will then need your candidate number, so please note that number and take care of it.

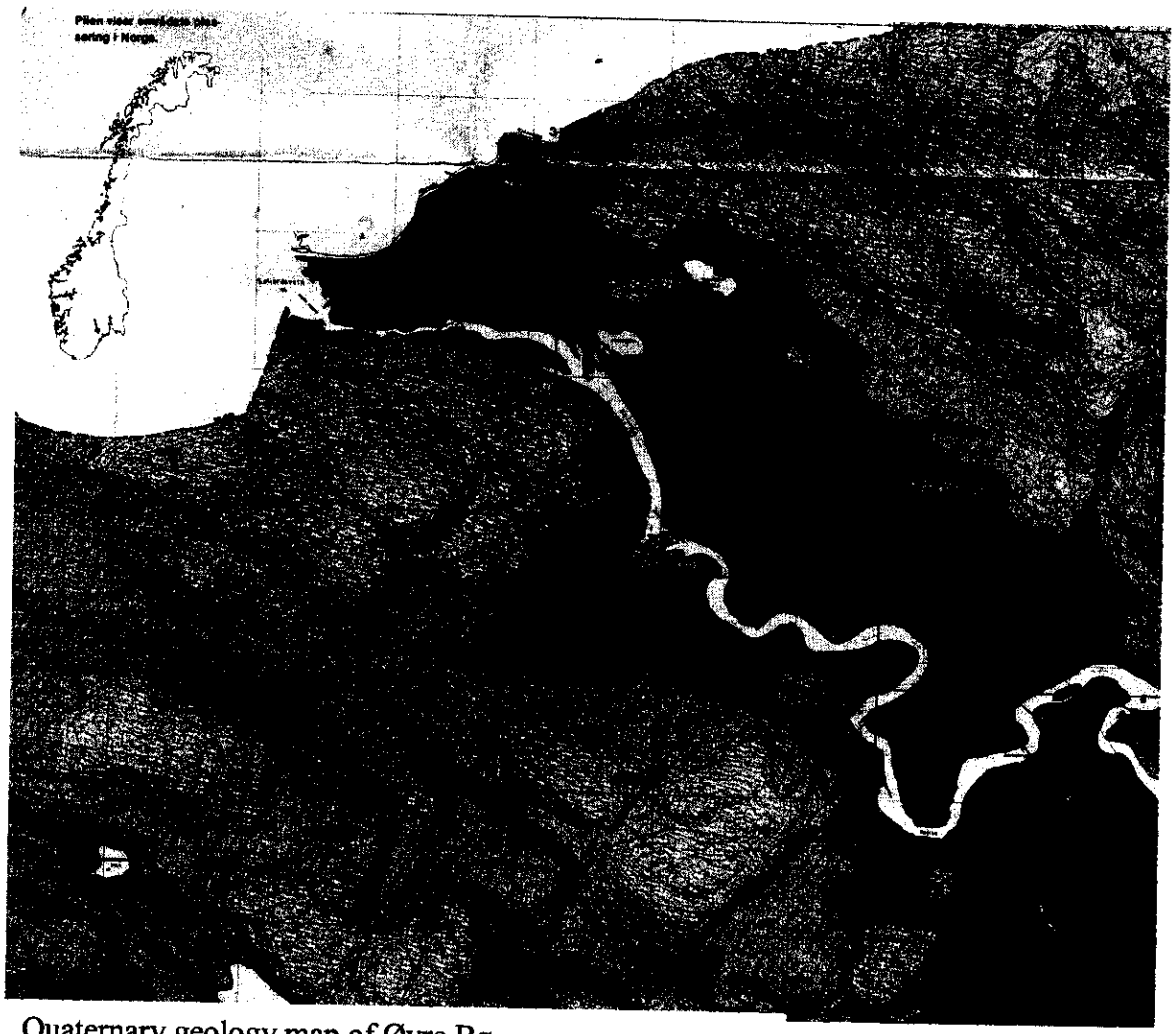
Avdeling for allmenne fag

Problem 1

a) Describe briefly the geology of Bø and Lifjell. What geological time era or period does this area represent on a bedrock map?
b) Describe the origin and the geology of the Oslo rift /Oslo graben.
c) Fjords, U-valleys, hanging valleys, Skjærgård landscapes and lake landscapes characterize Norway. When and how were these features formed?
d) Which are the three most important present-day geomorphic processes acting continually upon the landscape?

Problem 2

a) Below is a quaternary geology map of Øvre Bø. Make a figure legend to the colours of the map and explain the deglaciation history and the sedimentology of the area.
b) There are some kettle holes on the map. How are they formed?
c) Looking at the map, where would you expect to find agricultural land? State the reason for your answer.
d) Where on the map are the best possibilities for a large supply of ground-water? State the reason for your answer.
e) Discuss possible conflicts between groundwater supply and other interests in the area.



Quaternary geology map of Øvre Bø.

Problem 3

a) Define the following terms:
   i. Groundwater
   ii. Water table
   iii. Aquifer
b) Approximately how much of the world's total available (non-frozen) fresh water is ground-water, and what is the corresponding value for Norway?
c) What is the mean annual groundwater temperature in Bø, and how does the groundwater temperature vary during the year compared to the air temperature?
d) Describe briefly how heat from groundwater may be used for heating buildings.

Problem 4

a) What determines the direction of groundwater flow?
b) Formulate Darcy's law verbally, and then express the law mathematically. Define all variables included.
c) Describe three methods for determining hydraulic conductivity (K).
d) Use the information below about a groundwater resource (deposits) and calculate the discharge (Q), the specific discharge (q), and how many households that may be supplied.
   - Hydraulic conductivity K = 100 m / d
   - Gradient i = 0,03
   - Thickness M = 10 m
   - Width B = 1 m
   - Water required per day for one household: 1500 L (=1,5 m^3)

e) What is meant by average velocity of the groundwater, and will the average velocity be less or more than the specific discharge? State the reason for your answer.