Høgskolen i Sørøst-Norge

Exam

4324

Georesources and groundwater

09.05.2017

Tid/Time:	4 timer/hours (9-13)
Målform/Language:	Engelsk/English
Sidetal/Pages:	7 (including this page)
Hjelpemiddel/Aid:	None
Merknader/Special remarks:	A blank sheet of paper Printout of the GPR profile

Vedlegg/Number of attachment: 2

Sensuren blir offentliggjort på studentweb

The results will be published on Studentweb.

Problem 1

Flood zone mapping

a. Explain the needs for flood zone mapping.
b. Set up the different steps in a flood zone mapping procedure.
c. An important step in this procedure is hydrological modeling with the software HEC-RAS or MIKE. Explain the procedure with HEC-RAS.
d. Make a sketch of a flood zone map for a river environment with Quaternary geological deposits, buildings and infrastructure.

Problem 2

Groundwater modeling and watershed

a. How does a watershed influence on an aquifer?
b. How can you make a digital watershed?
c. How can you you represent the watershed runoff in a groundwater model?
d. Which other parameters do you need to set up groundwater model? Explain and make sketches.

Problem 3

Ground Penetrating Radar (GPR) and 2D-Resistivity

Attached is a GPR profile. The profile is from a Norwegian valley close to a river and below the marine limit where there was a fjord in Late Weichsel and Early Holocene.

Attached is also a resistance code for 2D-Resistivity.

a. Make an interpretation of the GPR profile about grain size, type of sediments and other phenomena you can observe on the profile. Make drawings on the GRP paper copy.
b. How can a 2D-Resistivity profile help with the interpretation of this GPR profile?
c. How will you do a field survey with a GPR and with 2D-Resistivity equipment?

Problem 4

Groundwater heat

a. How is the behaviour of the groundwater temperature during a year? Illustrate with a curve.

b. Look at the curve you made in question 4a. What are the properties of the curve that make it so convenient to extract heat from groundwater?

c. Make a cross section of the groundwater flow and the heat flow through an aquifer with a river boundary at the inflow side and a lake in the outflow area. Explain the cross section you have made.

d. What impact will the river probably give to the groundwater temperature during a year?

e. We calculate the potential for groundwater heat by the two formulas shown below.
What are the most important parameters for the calculated product of the groundwater heat potential?

1. **Thiems well formula:** $S_w = \frac{Q}{2\pi T} \ln\frac{R}{r} + \epsilon$ (m)

where S_w = lowering (m)

Q = pump capacity (m^3/s)

T = transmissivity (m^2/s)

R = extension of depression cone(m)

r = well radius (m)

ϵ = screen losses

Example: $T = 0.02\ m^2/s$

$R = 1000$ m

$r = 0.075$ m

$\epsilon = 0$

2. **Heat pump effect formula:** $E = C_p * Q * \Delta t$ (kW)

where C_p = specific heat capacity of water

= 1.16 $kWh/m^3\ °C$

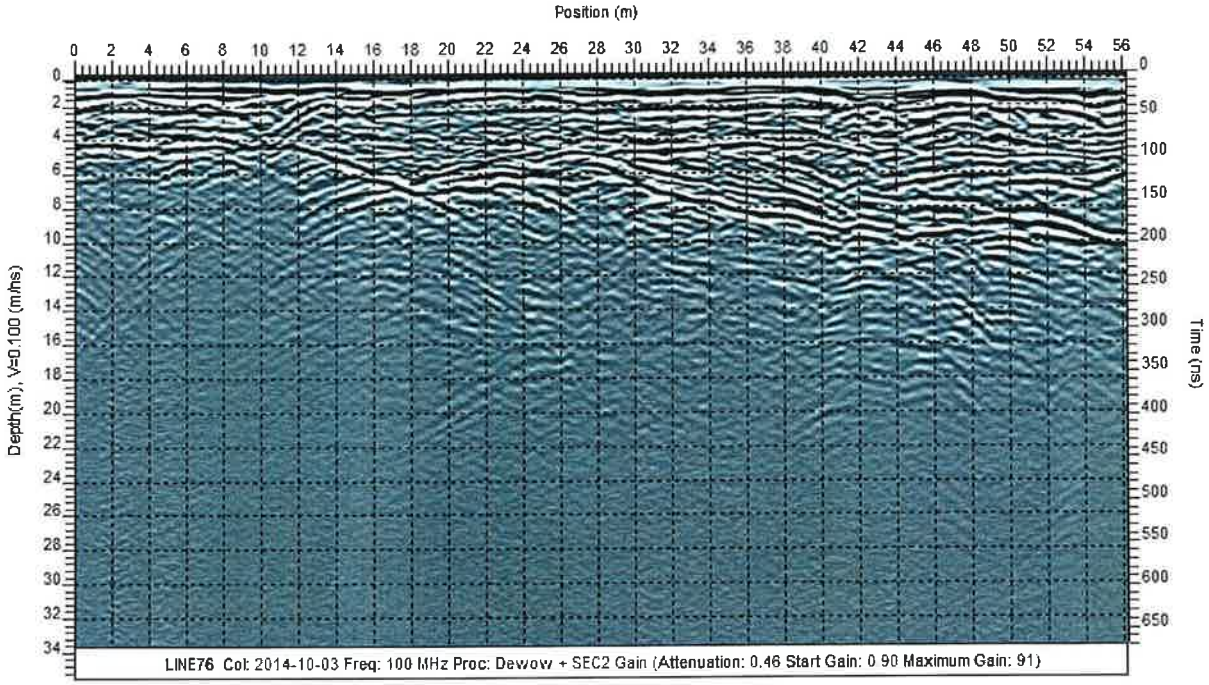
Q = pumping rate (m^3/h)

$\Delta t = t_{in} - t_{out}$

= temperature difference between input and output of the heat pump

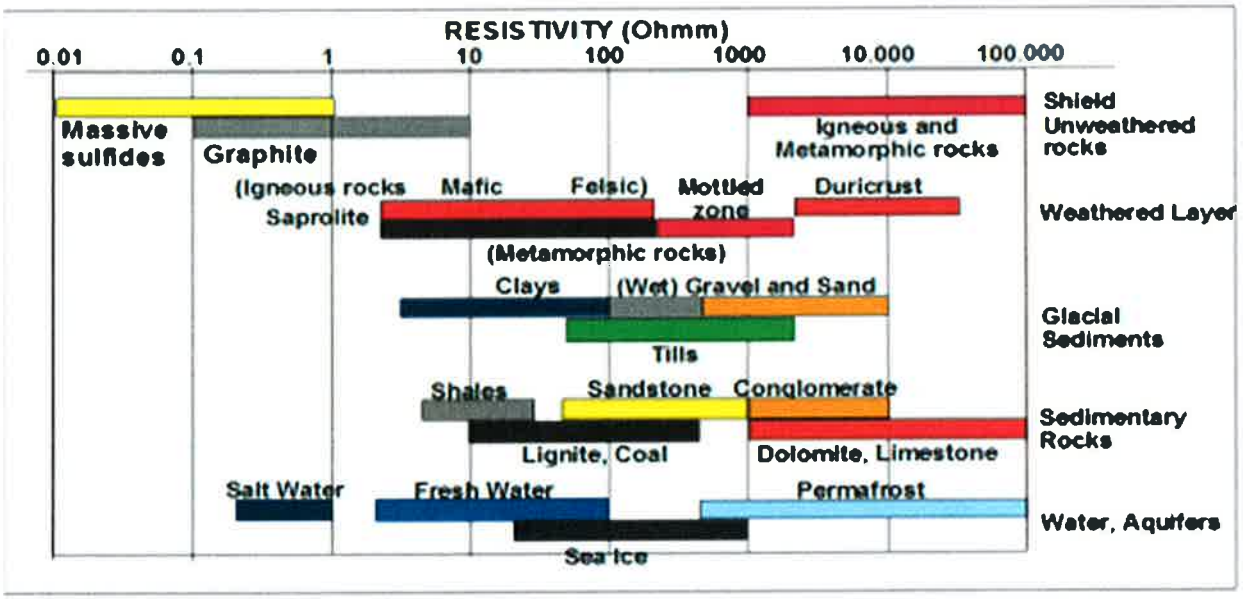
Attachment 1

GPR profile

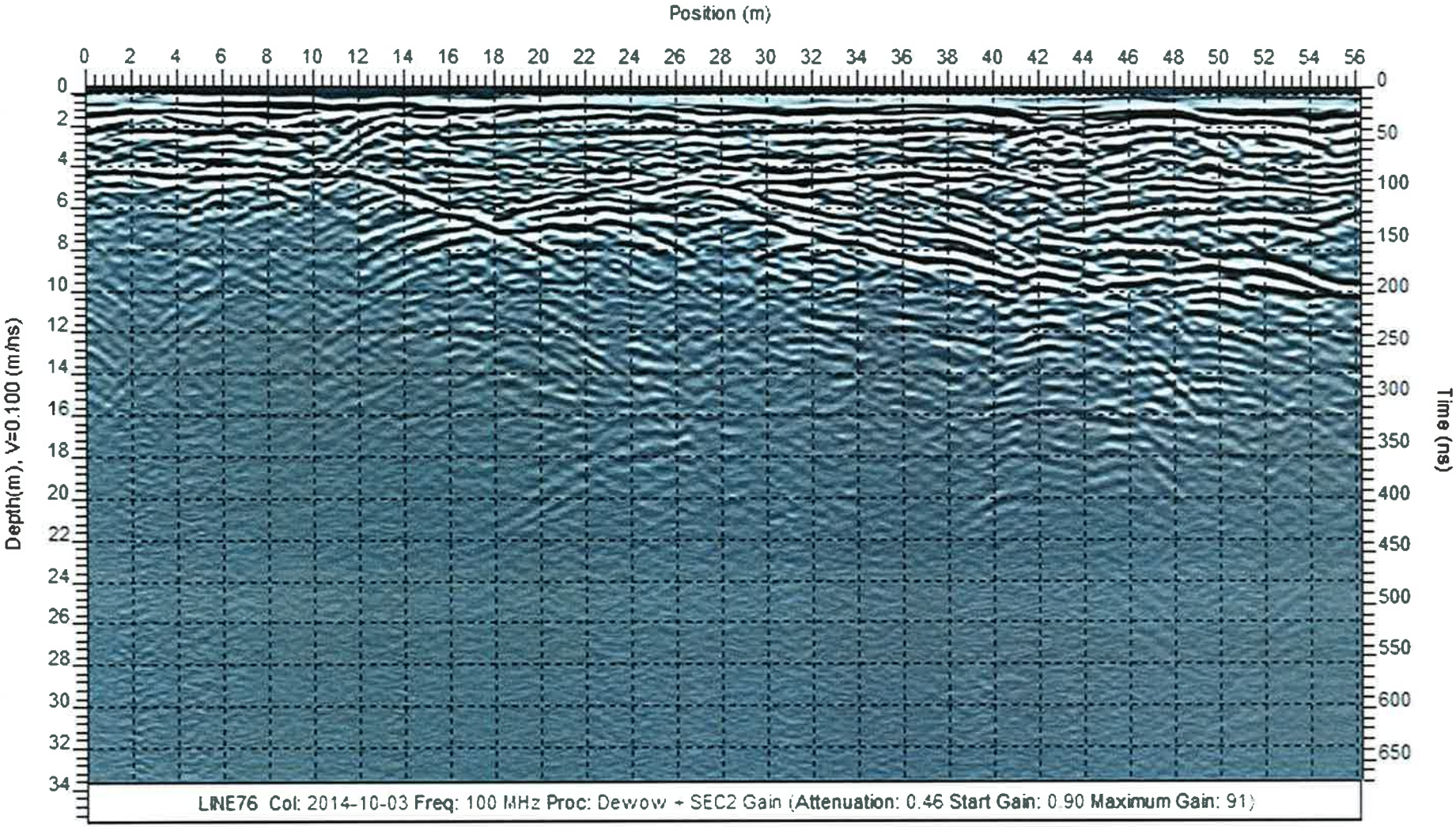


Attachment 2

Typical resistivities in water and geological materials



(after Palacky, 1987)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Depth(m), V=0.100 (m/ns)
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Time (ns)
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LINE76 Col: 2014-10-03 Freq: 100 MHz Proc: Dewow + SEC2 Gain (Attenuation: 0.46 Start Gain: 0.90 Maximum Gain: 91)