M.Sc. Track
Petroleum Engineering & Geosciences

3-9-2017
Challenging industry (and study)
Geothermal Energy

Produce energy (heat) from subsurface for heating; reduce need for fossil or other fuels

Principles same as for producing hydrocarbons from subsurface

Initiated at TU Delft by student project

Plans to build doublet on campus to supply heat and as research facility
Geological storage of CO$_2$

Depleted oil and gas field

Use of CO$_2$ to enhance oil and gas production

Deep saline formations (onshore) offshore

Use of CO$_2$ to enhance coal bed methane production
Outline

1. The end-goals
2. Structure of Master programme
   1. Shared Topics
   2. Specialization: PE
   3. Specialization: RE
3. Advice for a smooth transition
4. Other relevant organizations
   1. MV
   2. SPE
   3. AAPG
Outline

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Aims of the MSc in Petroleum Engineering & Geosciences

• Educate well-rounded geo-engineers
• Prepare students to integrate both geosciences and engineering
• Apply these skills in the *specific* area of petroleum engineering, giving a solid foundation for a career in the petroleum industry
• Also applies to other activities dealing with fluids in the subsurface: geothermal energy, CO2 sequestration, groundwater
Managing the earth’s resources for today and the future

• Find new reservoirs
  • Hydrocarbons
  • Geothermal
  • Water
• Improve production from existing reservoirs
• Develop new techniques to produce challenging reservoirs
• Store unwanted fluids permanently and safely underground
What’s Distinctive About Petroleum Engineering and Geosciences?

- Plenty of responsibility early in your career
- Opportunities to live and work all around the world
- Opportunities to work outdoors, if desired
- Apply latest technology in challenging situations
- New opportunities arising in emerging areas of geothermal and groundwater applications
- Work requires ability to cope with and manage huge technical (geological) uncertainties – unique in industry
- Work requires interdisciplinary skills
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MSc Organization 1st year

M.Sc. Track:

Petroleum Engineering and Geosciences

Specializations:

Petroleum Engineering

Reservoir Geology

35 ECTS

22 ECTS

22 ECTS
MSc Characteristics

- Reservoir Geology and Petroleum Engineering form together the M.Sc. Track “Petroleum Engineering & Geosciences”
- These two specializations have much of the coursework in common with about 25% specialized courses; they are essentially two different flavors of the same idea
- Graduates from both specializations are ideally suited to work in asset teams in major E&P companies

- **Reservoir Geology** students receive additional in-depth courses such as geological modeling, structural geology, sedimentology and field work

- **Petroleum Engineering** students additional receive in-depth courses on reservoir simulation, optimization and production engineering
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Geology, Geophysics and Petrophysics
Properties of Reservoir Fluids

**CONVENTIONAL HYDROCARBONS**

**UNCONVENTIONAL**

- Gas hydrate
- Heavy oil
- Tar Sands

- Water molecule ‘cage’
- Gas molecule (e.g. methane)
- Propane, iso-butane, natural gas....
- Methane + neo-hexane, methane + cycloheptane....
Reservoir Engineering

Field Scale
- Top of Structure
- Seal
- Gas
- Oil
- Water

Microscopic Scale
- Sandstone Grains
- Oil in Pore Spaces

Reservoir Scale
- Block of Sandstone

Reservoir Engineering
Capstone Design Course (2\textsuperscript{nd} year): “Field Development Project”
2nd year: M.Sc. Graduation thesis
In-depth and interdisciplinary

Aim: The graduate student learns to apply the skills and knowledge gained in the preceding study in a research project he/she has to carry out independently.

-University or Company (with TUD supervisor)

-Applied or Fundamental

-Theoretical or Field work (or field data)

Usually, MSc research is part of an ongoing research project.
MSc Electives

- Need not be in AES, but must be technical courses at the MSc level
  - no language courses
- Must have some relevance to your career track
- Must be approved in advance by the MSc coordinator for your given specialization
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Reservoir Geology Specialisation
What is Reservoir Geology?

What? → Prediction of subsurface (Static Modelling)

- properties (porosity and permeability) based on rock type
- geometries of reservoir bodies
- connectivity
- fractures and faults
- source rocks and the seal

How?

- advanced structural and sedimentary geology knowledge
- modeling skills to predict geometries (stochastic and process-based)
- field experience working with reservoir rocks
- uncertainty quantification
- state-of-the-art software
Reservoir Geology - disciplines

- Numerical modelling
- Production, Exploration Geology
- Modern sedimentary systems
- Remote sensing (Seismic, EM, Gravimetry)
- Well data (core, wireline)
- Ancient analogues
- Tectonics, fractures and faults

Geological reservoir model
Reservoir Geology – scales!

Keogh et al 2007
Static reservoir model
Getting your hands dirty
RG: fluvial sandstone reservoir analogue

Obligatory for RG specialization
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Well engineering
Production Stimulation

- When permeability is low
- At the same pressure drop
- Monitoring of fracture opening
Numerical Reservoir simulation
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Some Advice for Making a smooth Transition

- First quarter is relatively light for first four weeks: use them!
  - Spend the first four weeks strengthening background in geology and/or math if needed
- Don’t delay on preparing for exams
- Some courses are required for the Field Development Project at start of year 2; delay could postpone graduation
  - in Q1, required courses include AES1300, AES1310, AES1920 (properties of hydrocarbons, rock-fluid physics, geostatistics)
Convergence Process for those of Diverse Backgrounds

• If you are weak or rusty in geology, spend the first four weeks attaining some background
  • Reference books on geology
  • MOOC by Prof. Bertotti (more information to come on this)
• Unless you are confident in your knowledge of well-log interpretation and seismic interpretation, take the convergence courses on these subjects (AES1760, AES3520)
  • Students find these challenging; but persevere!
  • They are essential to later courses
  • You can count 1 ECTS credit for each against electives requirement
Convergence Process for those of Diverse Backgrounds

• If you are weak or rusty in **math**, build up your background (see list of topics in email sent out)
  • textbooks and notes from your own BSc
  • reference books on convergence course web site
• Students report that the amount of computer programming in our MSc is challenging
  • Treat the required course in **Matlab** seriously!
• **Ask for help** during the course if you are struggling. You will need these skills to thrive in our program
Web site with information on convergence process


- The web site has detailed advice on getting needed background in a variety of different subjects.
More information will be forthcoming

• To reach you all by email, we will use the student list for AES1300 (Properties of Reservoir Fluids), which you all must take in Q1
• Sign up for this course on Brightspace immediately: http://brightspace.tudelft.nl
  • click on the "catalog" button at the top.
  • type AESM2006 into the box that appears
  • Click on box for the class
  • On page that opens, click "log in to enroll"
  • help page: https://brightspace-support.tudelft.nl/
• Important announcements will be coming out with a few days; enroll immediately
Take responsibility for your own program and progress

• Information on program, regulations, where to go for help:
  
  http://studenten.tudelft.nl/en/ceg/

• Check the rules and regulations yourself, *before* you contact the study advisor or MSc coordinator
http://studenten.tudelft.nl/en/ceg/
"study guide"
“TER rules and guidelines”
Regulations: TER, Rules and Guidelines

Academic year 2016-2017
Bachelor

For the regulations of the BSc CE programmes; see the Dutch page.

BSc Applied Earth Sciences
- Teaching and examination regulations BSc AES (TER)
- Implementation Regulations BSc AES (IR)
- Rules and Guidelines Board of Examiners BSc AES (BoE BSc AES)

Masters
MSc Civil Engineering
- Teaching and examination regulations MSc CE and AES (TER)
- Implementation Regulations MSc CE (IR)
- Rules and guidelines board of Examiners MSc CE and AES (BoE MSc CE/AES)

MSc Applied Earth Sciences
- Teaching and examination regulations MSc CE and AES (TER)
- Implementation Regulations MSc AES (IR)
- Rules and guidelines Board of Examiners MSc CE and AES (BoE MSc CE/AES)
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• Class schedules

  http://huidigeroosters.tudelft.nl/
Web Roosters 2016-2017

Activiteitengroep roosters:

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- BIK-Afstuderen
- BIK-GQ/NO GO
- BIK-Inh. momenten
- BIK-PD
- Collegezaal 3M
- Computertentamen
- Tentamen BK

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<td>Werkdagen (maandag t/m vrijdag)</td>
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Rooster weergave

Grafisch Individueel

Rooster bekijken

- Voor individuele roosters zie alternatieve roosterinterface 'My Timetable' https://mytimetable.tudelft.nl/
- Voor tentamens is uitsluitend de zaal in ORIKIS leidend (1 week voorafgaand aan het tentamen)
- Bouwlande studenten: kijk hier
Some Advice for Making the Most of the Next Two Years

• Get involved with student organizations
  • Society of Petroleum Engineers
  • American Association of Petroleum Geologists
  • Mijnbouwkundige Vereeniging
• Be careful about properly enrolling for exams when they come up
• Start thinking about your MSc thesis topic; talk with instructors you like, or in courses you find interesting, about their research
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WELCOME!
Questions?

Study Advisor, Pascal de Smidt: P.deSmidt@tudelft.nl
J.E.A.Storms@tudelft.nl (RG specialization): w.r.rossen@tudelft.nl (PE specialization)

MV: mv@tudelft.nl
SPE student chapter: SPEDelft@tudelft.nl
AAPG student chapter: aapg-GSE-CITG@tudelft.nl
A question for continuing students of TU Delft

What should incoming students know about

• Living in The Netherlands?
• Living in Delft?
• Studying at TU Delft?
• Studying Applied Earth Sciences at TU Delft?
Two questions for students new to TU Delft

• What has been most surprising about The Netherlands and Delft since you arrived?
• Any additional questions ... ?
## Courses

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<th>Course Title</th>
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