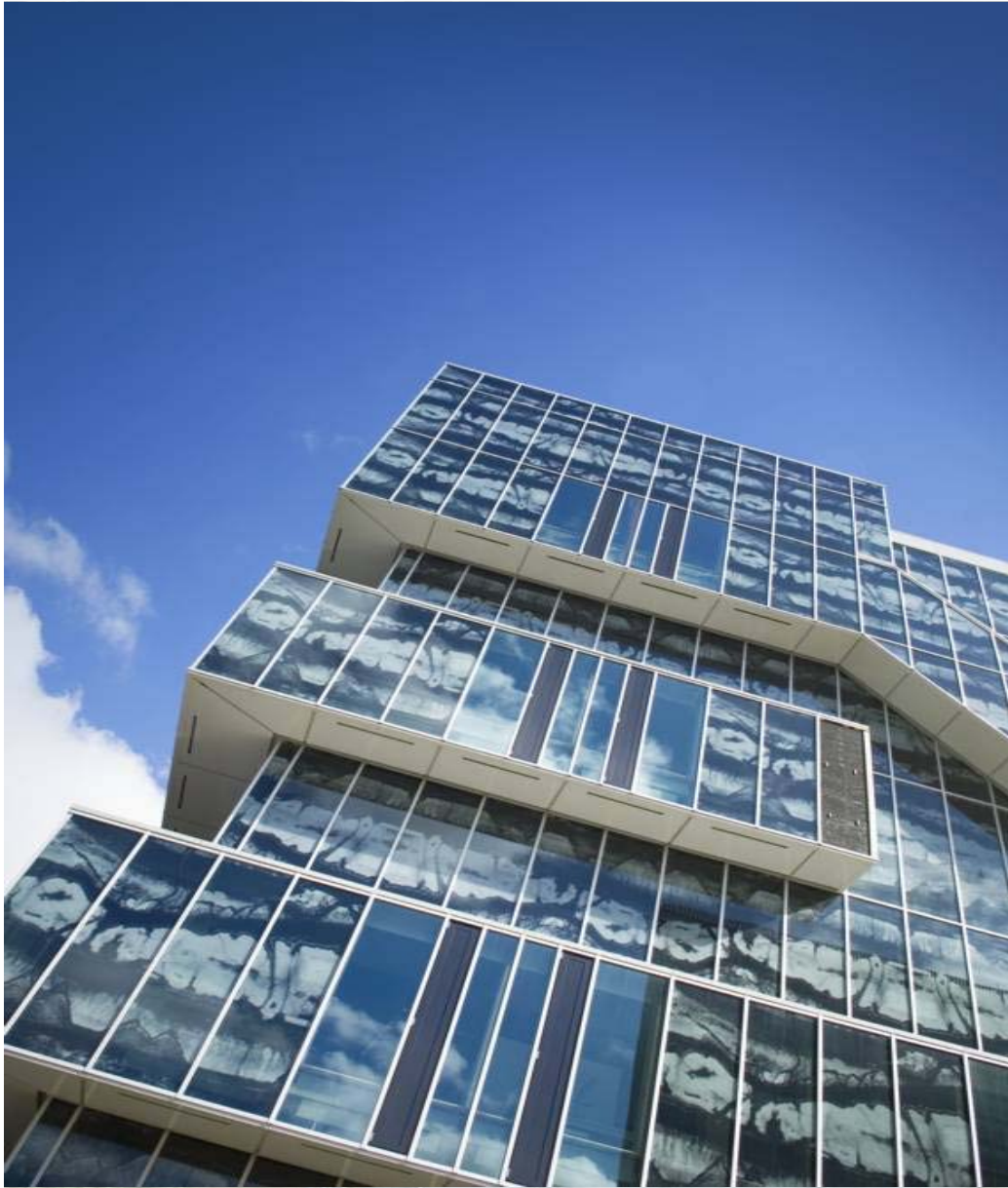


# Delft University of Technology



**Founded 1842**  
**16500 students**  
**2800 scientific staff**  
**250 PhDs/yr**  
**8 faculties**





# Department of Geoscience & Engineering

Faculty of Civil  
Engineering and  
Geosciences

# Main department characteristics

- Focus on interface between Geosciences and Engineering
- Mission: “Reveal and explain the Earth’s underground resources and support their use in an environmentally friendly manner”
- Far-reaching integration of different groups and international staff and students
- Large laboratory: triaxial press, borehole simulator, acoustic tanks, CT scanner+microscanner, shock tube, etc.
- Participation in large national and international research projects and strategic partnerships (ISES, DELPHI, IDEA League, Deltares, TNO, Shell, Statoil, etc.)

# Key activities

- Characterize the shallow and deep subsurface with novel technologies
- Explain and model the origins and properties of subsurface formations
- Develop concepts and techniques to influence and control subsurface states and processes
- Develop methods to assess, monitor or restore the natural subsurface environment
- Design methods to responsibly use the subsurface for construction, transport and resource exploitation

Geology    Geophysics    Geo Engineering

## Education

2008 – 2010

Base Course Geothermal Energy for MSc-Students G & E.

- Elective, 30 hours, 5 – 10 students in Working Groups
- Objective: Characterization of mainly the sub-surface infra-structure

2010 - 2012

Base Course Geothermal Energy for MSc-Students G & E, PhD-Students CTG and some SET-MSc-students.

- Elective, 30 hours, ca. 15 Participants in Working Groups
- Objective: Characterization of Mainly the Sub-Surface Infra-structure Connected to Existing

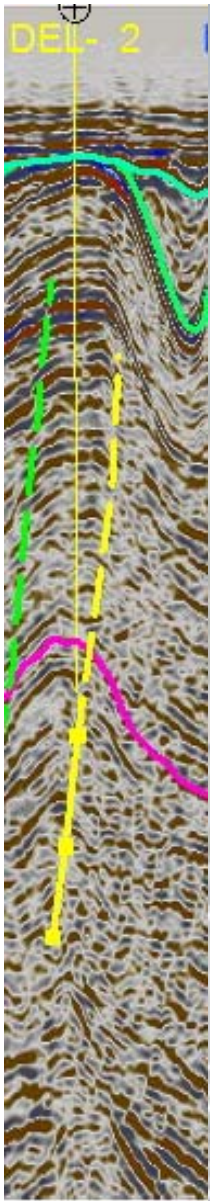
2013 - on

Extended Geothermal Energy Courses for all types of Geoscience Students, PhD-Students and Inter-Faculty MSc-students from Delft, Utrecht, Amsterdam and Industry.

- Elective, 60 hours, ca. 100 International Students in Working Groups
- *Objective: Characterization of the Surface and Sub-Surface Infra-Structure for High- and Low Enthalpy Systems*

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# EDUCATION, RESEARCH AND DEVELOPMENT

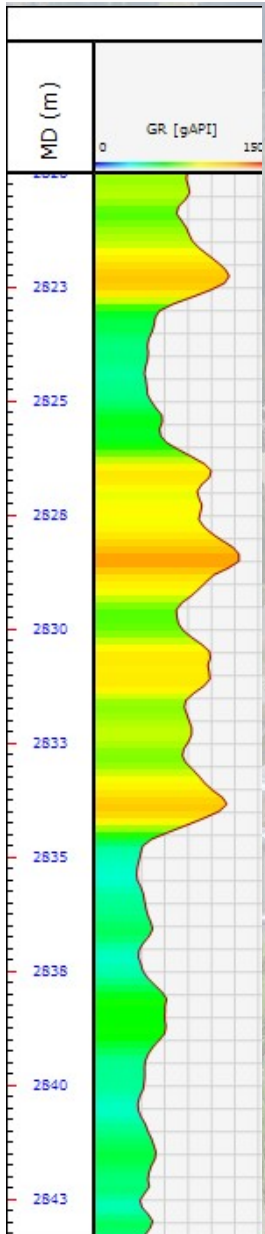
In the past 5 years:

21 BSc-students, 11 MSc-students, 2 PhD's

## Research Topics and Results

- *Well Analysis of Relevant Wells in and Around the License:*
  - Cuttings, Cores, Petrophysics, Fluid-analysis
  - Geophysics: Static model of the Rijswijk and Delft Sands, i.e. Tectonics, Fault distribution, Lateral/Vertical continuity
- *Static Reservoir Model and Sedimentary Characteristics:*
  - Determination of Depositional Environments, Sediment Petrography; Use of Analogues
  - Geostatistics and Monte Carlo/Environment based Permeability Distributions
  - Distribution of Potential Shallow and Deep Tertiary Reservoirs
- *Reservoir modelling and Engineering*
  - Dynamic Modelling between Well Pairs on Heat Production, Flow and Rock/Fluid/Gas (CO<sub>2</sub>) – Interaction versus Time
  - Reservoir Behaviour on Differential Heat and Multi-Phase Flow

# EDUCATION, RESEARCH AND DEVELOPMENT



- *Reservoir modelling and Engineering (continue)*
  - Temperature and Flow Behaviour in the Production and Injection Well
  - Well Interference between the Well Pairs within the Licence
  - Shallow Well Interference (PhD)
  - Geochemistry and Scaling (Effects on Composites vs. Steel), Injectivity and Productivity
- *Drilling*
  - Well Development: Steel versus Composite
  - Implementation of Fibre Optics and P,V,T-equipment for On-Line Monitoring within the License area
- *Energy Balance, Distribution and Life Time Cycles*
  - Exergy Analysis of the Sub-Surface and Surface Infrastructure for Various Scenarios
  - Cascade Energy Production for Deeper Reservoirs
  - Dry Exploration Wells, Abandoned Reservoirs, Deep Fracturing

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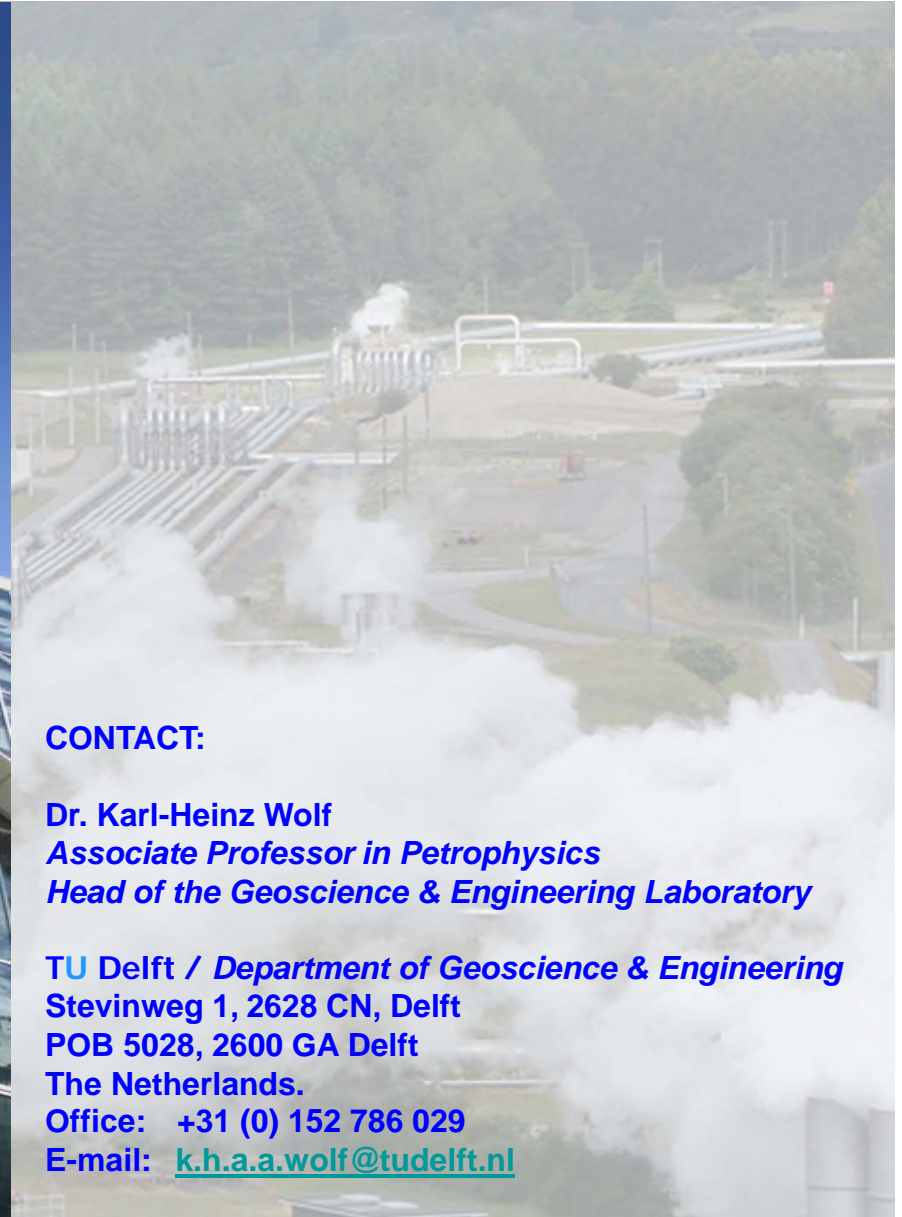
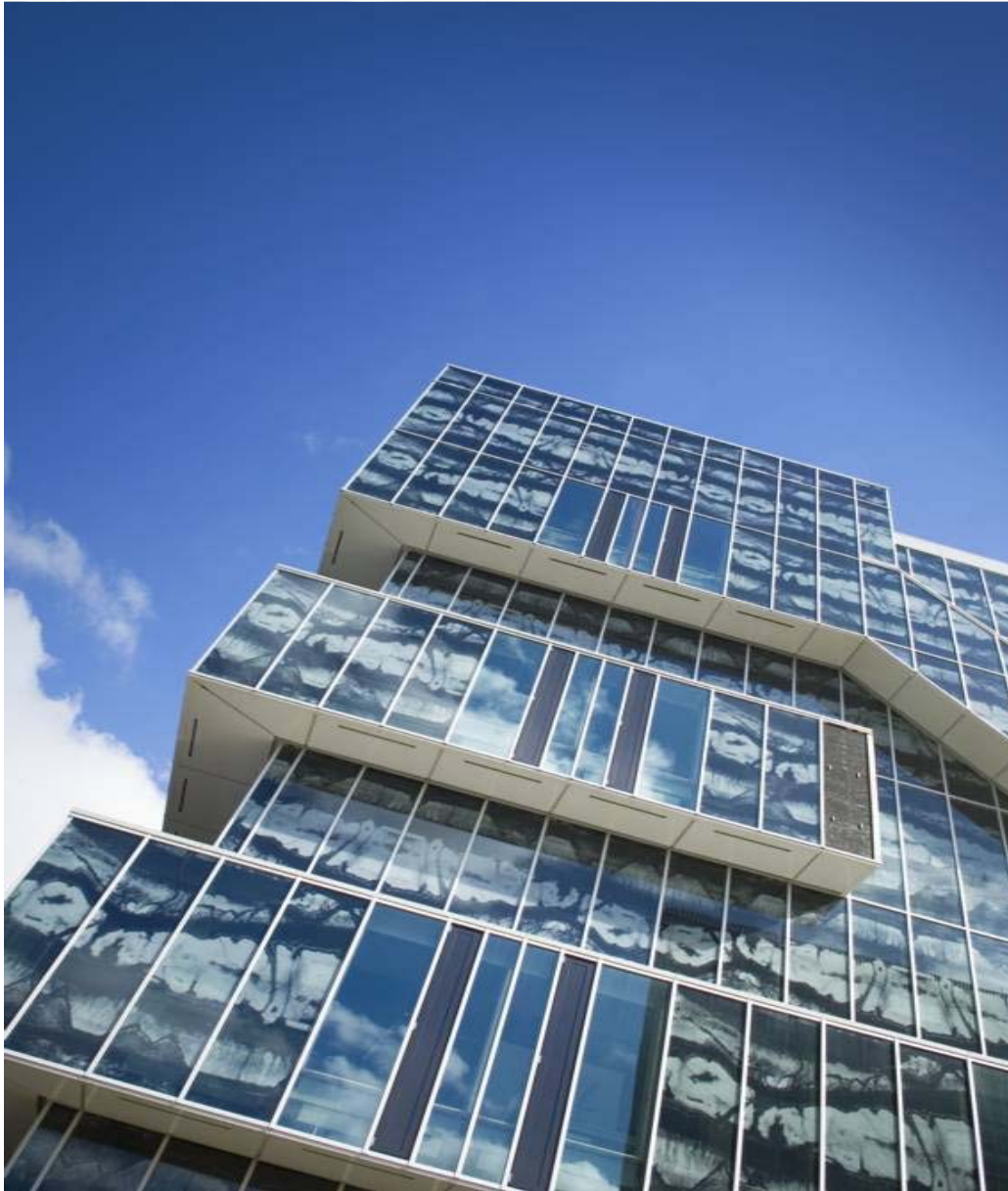
# Research & education ambitions on TU Delft geothermal system (geothermal laboratory)

- Long-term permanent monitoring: downhole (glass fibre?) & tophole (P, V, T, hardness, tracers) online, real time display
  - *Extended pump testing for dynamic modelling*
  - *Production- characteristics, history matching*
  - *Interference as function of time*
  - *Breakthrough time prediction*
- Borehole logging
  - *New techniques*
  - *Experiment facilities*
  - *Callibration of tools for composite casing*
- Code of practice: make a 'standard' for execution of geothermal projects
  - *Drilling techniques*
  - *Production testing*
  - *Logging, monitoring & sampling using composites*
  - *Commissioning practices*
- Composite casings
  - *Project cost reduction*
  - *Lighter drilling rigs, less impact*

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**CONTACT:**

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