

CIVIL-428

Engineering geology for geo-energy

Nussbaum Christophe

Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	During the semester
Workload	90h
Weeks	14
Hours	3 weekly
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

Objective is to provide an understanding of the problems in geo-energy projects. Human induced fracturing has serious consequences in projects as conventional and unconventional hydrocarbon resources exploration, deep geothermal systems, CO₂ storage and deep geological disposal of radioactive waste.

Content

We propose the following course outline:

- Structural geology, tectonics, in-situ stress, natural seismicity
- Methods of rock stress measurement, reliability and meaning of stress measurement, natural and excavation induced stress variation, borehole breakouts
- Borehole and gallery stability, rock mass discontinuities and anisotropy, role and development of pre-existing vs tunnel induced fractures, methods to characterize the excavation/borehole damage zone
- Application to deep geothermal systems
- Human induced fault reactivation, fault slip tendency, fracture propagation, induced seismicity
- Geological storage of CO₂: well sealing integrity, caprock sealing integrity, fault sealing integrity

Keywords

structural geology, tectonics, natural and induced seismicity, stress measurements, borehole stability, hydraulic fracturing, deep geothermal systems, CO₂ sequestration

Learning Prerequisites**Required courses**

Soil mechanics, Geomechanics, Rock mechanics

Learning Outcomes

By the end of the course, the student must be able to:

- Construct a coherent geological model with the available data.
- Anticipate the rock mass and hydraulic perturbations for any subsurface projects (i.e. deep geothermal, CO₂ storage, conventional and unconventional hydrocarbon resources exploration, construction of deep geological disposal for radioactive waste).
- Design the rock mass and hydraulic perturbations for any subsurface projects (i.e. deep geothermal, CO₂ storage,

conventional and unconventional hydrocarbon resources exploration, construction of deep geological disposal for radioactive waste).

- Use correctly the acquired data in the project for building a coherent interpretation.

Transversal skills

- Access and evaluate appropriate sources of information.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Demonstrate the capacity for critical thinking

Teaching methods

Ex cathedra

Slides powerpoint with the recommended reading : "Elements of Crustal Geomechanics" François Henri Cornet, May 2015

Expected student activities

attendance at lectures, completing exercises, reading selected scientific publications and doing a personal work

Assessment methods

During the semester, written control and personal work

Resources

Bibliography

"Elements of Crustal Geomechanics", François Henri Cornet, May 2015

Ressources en bibliothèque

- [Elements of crustal geomechanics / Cornet F.H.](#)