

TOUGH

Short Course



AGENDA

October 1~3, 2018

**Energy Geosciences Division
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Instructors
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Monday, October 1, 2018

Morning Session

9:00 am *Welcome, Introduction , Safety*

9:15 am *Introduction*

- Modeling and Course objectives
- TOUGH history and applications

9:45 am *Computer Setup & Coffee Break*

10:00 am *Review of Multiphase Flow*

- Phases, components, phase transitions, governing equations, fluid and porous-medium properties, equation of state, non-isothermal and other processes

11:00 am *Break*

11:10 am *Continue: Review of Multiphase Flow*

12:00 pm *Working Lunch – Discussion of TOUGH in General*

Afternoon Session

1:00 pm *Numerical Methods in TOUGH*

- Integral finite difference method, space and time discretization, Newton-Raphson iterations, linear equation solvers, weighting schemes

2:00 pm *TOUGH Overview*

- Capabilities, code architecture, basic input and output concepts

2:30 pm *Break*

2:45 am *Building a TOUGH Model*

- Material properties (Problem 1a)
- Mesh generation (Problem 1b)

5:00 pm *Fractured Rocks*

5:30 pm *Adjourn*

6:00 pm *Working Dinner*

Tuesday, October 2, 2018

Morning Session

9:00 am *Continue – Building a TOUGH Model*

- Initial and boundary conditions (Problem 1c)
- Computational parameters (Problem 1d)
- Explore (e.g., Problem_OneElement, EOS 9 for problem 1, and comparison with EOS3)
(Coffee break between)

11:30 am *Overview of TOUGH3 Features*

12:00 pm *Working Lunch – Discussion of Participants' Applications*

Afternoon Session

1:00 pm *Phase Change in a Non-isothermal Two-Phase, Two-Component System*

- Hands-on computer exercise (Problem PC)
- Primary variables, initialization, variable switching

2:45 pm *Break*

3:00 pm *Model Tracer Tests in a Geothermal Reservoir*

- Introduction to EOS1 for modeling geothermal reservoir
- Hands-on computer exercise
- Problem variation

5:30 pm *Adjourn*

Wednesday, October 3, 2018

Morning Session

9:00 am Injection of CO₂ in a Saline Aquifer

- Introduction to CO₂ sequestration related EOS
 - Introduction to ECO2N
 - Hands-on computer exercise (Problem ECO2N)
 - Non-isothermal simulation
 - Variable injection rate
 - Permeability reduction due to salt precipitation
 - Post-injection period: pressure recovery and phase redistribution
 - Effect of relative permeability functions
 - Introduction to hysteresis
 - Hands-on computer exercises, including quick-and-dirty plotting with Excel
- (Coffee break between)

12:00 pm Working Lunch – General Discussion and Questions