Study Guidelines GEOCAP 1.04 course

"GEOTHERMAL RESERVOIR AND PRODUCTION ENGINEERING KNOWLEDGE AND SKILLS"

The concept: of this 2-week course is to teach the basics of reservoir and production engineering for geothermal reservoirs. To this end a combination of lectures, exercises, assignments and background reading is provided.

The main components of the course are:

- Basics of geothermal systems and reservoir engineering and reservoir geo-mechanics
- Flow measurements and production testing
- Well testing procedures for reservoir characterization
- Numerical geothermal reservoir modelling

The target group of the course are Master Students, PhD students and Industrial professionals. Participants should have basic knowledge about reservoir geology, flow mechanics, and mathematical modeling. Examples of sufficient prior educational background include students with a BSc degree in Petroleum Engineering, Geophysics, Mining, Geology, Chemical Engineering, Mechanical Engineering, Physics.

In more detail, this has been worked out in the following schedule:

Start with an introduction to the Course. Then, start the content:

1 **"Introduction to geothermal systems and basics of volcanology"**
   a. Main components of hydrothermal systems
   b. Tectonic setting
   c. Volcanoes
   d. Eruptive processes in the field
   e. Petrography and geochemistry of magmas: Reservoir rock properties
   f. Geophysics: Examples from resistivity studies
   g. Geothermal systems: Conceptual model from East Java
   h. Porosity and Permeability
   i. Exercise: Rock observation and description; microscope observation of thin sections; perform an evaluation May a rock act as a reservoir?

2 **"Main components of hydrothermal system"**
   Here, the focus is at magmatic and igneous systems.
   a. Types of hydrothermal system
   b. Rock properties (porosity, permeability, compressibility)
   c. Conceptual model
   d. Key questions about reservoir

e. Exercise: look at reservoir rocks

3 "Geothermal Production Engineering"

a. Fundamentals of Dynamic Reservoir Engineering
b. Wellbore modelling for steam well
c. Wellbore modelling for two-phase flow
d. Stimulation: Lifting; well discharge; acidizing)
e. Exercise

4 "Reservoir Geomechanics"

a. Fundamentals (stress, strain, elasticity, failure, equilibrium eqs)
b. Subsurface stresses
c. Rock failure in wellbores
d. Application examples
e. Exercises

5 **"Logging; Flow measurements; Production testing"**

a. Flow measurements in Steam wells
b. Flow measurements in Two-phase wells
c. Exercise
d. Objective of downhole measurements
e. Types of downhole measurements
f. Data analysis to identify reservoir characteristics and key parameters
g. Exercise

6 "Well testing"

a. Transient testing introduction
b. Well testing basics
    i. Models
    ii. Wellbore storage, skin
    iii. Analysis methods
    iv. Pressure derivative analysis
c. Geothermal well testing
    i. Fluid properties
    ii. Temperature transients
    iii. Heterogeneous reservoirs
d. Exercise using Sapphire
    i. Falloff test
    ii. Buildup test
    iii. Interference test
    iv. Temperature test

7 Day 8/9/10

Modelling / Knowledge and Skills Geothermal Reservoir Modelling

a. Lectures
    i. Principle and methodologies
    ii. Lumped model – distributed parameter model
    iii. Conceptual development model
    iv. Development of computer model
    v. Data preparation for modelling

vi. Modelling process
vii. Natural state modelling
viii. Chemical modelling (show PHREEQC or TOUGHREACT)
ix. History matching
x. Performance forecasting

b. Case study with TOUGH2
   i. Setup model in natural state
   ii. Forecasting
   iii. History matching