Multiphysic Coupling Between Geothermal Water Cycle, Surface Heat Exchanger Cycle and Power Plant Cycle

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Abstract

A conversion of deep geothermal energy into electricity requires a temperature of about 150 °C and a minimum flow rate of 50m^3/h. Multiphysic coupling between three major cycles of a deep geothermal system i.e. (subsurface) geothermal water cycle, surface heat exchanger cycle and power plant cycle is crucial to study the optimization of net electricity provision and the recovery of the overall geothermal system. Use of COMSOL Multiphysics: We begin with the geothermal water cycle, a standalone 3D deep geothermal reservoir model is coupled with fractures, wells (injection well, production well) and fault zones for the study of fluid flow (porous media and subsurface flow) and heat transfer of fluid in porous medium. Hydraulically induced fractures are integrated as 2D extruded faces into reservoir geological units which are represented as elements for 3D geometries. Internal fault zones are integrated as 2D extruded faces as well. Injection well and deviated production well are integrated as 1D edges within fractures and fault zones. An interface to the surface heat exchanger cycle will be developed following by a further interface to the power plant cycle. This study is performed in the framework of Groß Schönebeck (GrSk) project in the North German Basin of Germany, at which its local geology is representative for many parts of Western and Central Europe therein represents an important pilot for geothermal technology development in Europe.

Reference

1. G. Blöcher, G. Zimmermann et al., 3D numerical modeling of hydrothermal processes during the lifetime of a deep geothermal reservoir, Geofluids, 10, 3, 406-421 (2010).
2. E. Holzbecher, LW. Wong et al., Modelling Flow through Fractures in Porous Media, COMSOL Conference 2010 Paris (2010).

Figures used in the abstract

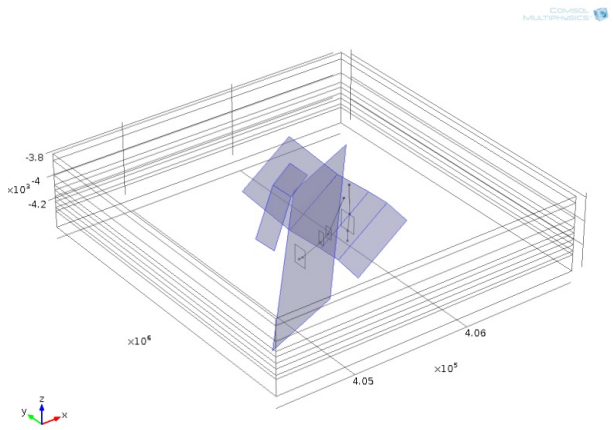

Figure 1: 3D deep geothermal reservoir built with COMSOL (1D wells, 2D fractures, 2D fault zones).

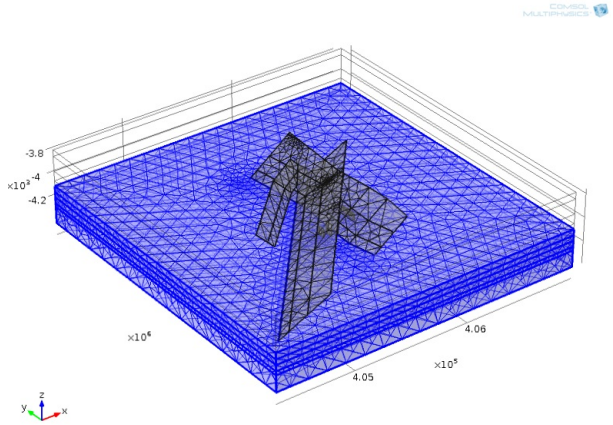

Figure 2: 3D deep geothermal reservoir with 2D mesh and 3D mesh.

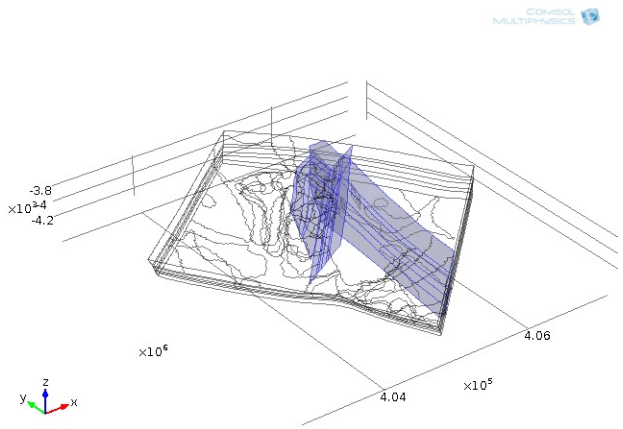

Figure 3: Imported 3D mesh into COMSOL.