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Thermo-Hydro-Mechanical-Chemical Coupled Modeling of Geothermal Doublet Systems in Limestones

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Limestone aquifers in Southern Germany have been used within the last decade very successfully for geothermal heating and – to a lesser extent – for power generation. As an example the region around Munich has been extensively explored. While the extent of usage of this reservoir is increasing there is also an increased interest in better understanding of the reservoir properties and its change in the course of operation. For instance, the observed production and injection pressures are partly hard to explain. They may be related to mechanical or chemical processes, or both. Based on extensive data of outcrop studies and drillings, a data-base for the relevant physical properties of the respective limestones has been complied. The data include thermal conductivity, density, specific heat capacity, permeability, as well as mechanical properties like thermal expansion coefficient and elasticity modules. By using the hydro-thermo-chemical simulator FEFLOW together with an extension for thermo- and hydro-mechanical coupling the relevant processes are studied and compared with observed data. Conclusions for an optimized operation of geothermal systems in limestones are given and discussed.