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The Development of a Coupled Wellbore-Reservoir Simulator for Geothermal Application

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Boreholes under dynamic conditions are a highly non-linear and complexly coupled thermo-hydraulic system. Multiple parameters, for instance, temperature, pressure, specific heat, enthalpy, viscosity, flow regime, heat transfer, degassing, steam quality and salinity are inter connected. Production and injection often entail several engineering challenges and operational problems, within the boreholes but also up and down stream (reservoir - power plant - reservoir), which can be very diverse in their character. Finding solutions or working on process optimization prerequisite a profound understanding and a reliable numerical tool to quantify the processes. In this context, we developed a wellbore simulator implicitly solving transient fully-coupled non-isothermal two-phase pipe flow. Since the hydraulic and thermal connection to the reservoir is a crucial and critical point at the same time, we overcome the "reservoir-mimicking"boundaries (e.g. inflow performance relationships, productivity index, etc.) by integrating a real reservoir. Since the development of the tool is an ongoing process in this work we present the current state of the tool and it's most important capabilities, such as non-isothermal compressible two-phase pipe flow and the integration into a real reservoir. Future development efforts will concentrate mainly on the coupling to an appropriate module for the quantification of the aqueous chemistry and reactive multicomponent transport.

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