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Real-time simulation of geochemical processes in geothermal power plants

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The use of machine learning in geochemistry is on the rise. The MALEG project uses artificial intelligence to increase the efficiency of geothermal energy production. To improve geothermal power plants, real-time geochemical modelling of the current state within the thermal water cycle is essential. Therefore, both a digital twin of the geothermal power plant (cyber-physical system) with its sensors and actuators and a digital twin of the hydrogeochemical processes (process simulation) along the circuit are developed.

In terms of the geochemical digital twin, energy production in geothermal power plants is linked to the basic hydrochemical conditions of the fluid. Changes in pressure, temperature or pH alter the chemical equilibrium of the extracted thermal water, which can lead to uncontrolled processes such as mineral precipitation, outgassing and corrosion. To better map these processes, a digital twin has been developed and applied to several geothermal power plants to model the current hydrochemistry in real-time. These simulations are automatically calculated, transferred and evaluated. This allows the new geochemical equilibrium conditions to be directly determined and interpreted as the power plant parameters change throughout the energy production phases and at different sections along the circuit. These process simulations, in combination with the cyber-physical system, form the basis for implementing artificial intelligence to increase the efficiency of geothermal power plants.