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MALEG - Machine learning for enhancing geothermal energy production

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To improve the efficiency of geothermal energy production the reinjection temperature has to be reduced. Yet in most cases, the geothermal fluid composition is counteracting this temperature reduction. Whilst pressure relief or cooling, highly mineralised geothermal fluids tend to rise uncontrolled mineral precipitation (scaling). This is a strict limiting factor for the efficient and continuous operation of geothermal power plants. The complex and site-specific hydrochemistry of the fluids complicates the prediction and quantification of scalings using deterministic geochemical models. In the MALEG project, geochemical models are complemented by artificial intelligence, which is trained with hydrochemical data provided by on-site experiments.

For this purpose, a demonstrator is built resembling a hardware twin of the geothermal power plant, which is capable of representing the thermodynamic processes in the system. The demonstrator will be connected to the power plant via a bypass to conduct hydrochemical precipitation experiments. Continuous monitoring of fluid and solid samples accompanies the experiments to evaluate potential mineral precipitation. These precipitation processes are dependent on the chemical milieu of the fluid. Changing system parameters such as pressure, temperature, pH, or ion concentration enable the formation of scaling. The application of the demonstrator and the corresponding hydrochemical experiments are planned for three geothermal systems involving different reservoir conditions. The collected and analysed data will set up a diverse hydrochemical database, which will be used to develop the AI-based prediction tool “MALEG”. In addition, a digital twin consisting of deterministic geochemical models will validate the predictions of “MALEG”. Thus, the impact of changes in the fluid chemistry can be predicted more accurately. Evaluating scaling formation will allow optimisation of geothermal power plant operating parameters for improving efficiency, the introduction of cascade utilisation, integration of mineral extraction processes, or cost reduction of routine hydrochemical monitoring.