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Characterizing the Fractured Geometry and Connectivity in the Chingshui Geothermal Field of Taiwan by Tracer Test

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Geothermal energy is regarded as an important green energy in terms of its characteristics of base load power and small land occupy. The Chingshui geothermal field was built geothermal power plant which is located in southwest Yilan plain, Taiwan. It is predominantly composed of slate, which is poor permeable formation. A total of 21 wells with depths ranging from few hundreds to over three thousand meters were drilled and finally constructed a 3-MW geothermal power plant. It operated 12.5 years and shut down in 1993 due to pressure drop and quick scaling in the wells. After re-evaluated by new data of geology, geophysics, geochemistry and well testing, a new power plant was constructed and operated in 2021. However, to recharge fluid for maintaining pressure in reservoir for long term operation, the reinjection residual thermal water is an important technique. To understand reinjection efficiency and fluid circulation in fractures between wells, the trace test is a relatively simple and usable method, In this research, use 2,6-NDS chemicals as tracer to conduct a test, which injected in well IC-09, and collected the samples in shallow wells, the R1, R3 and R5, deep wells of IC-19 and IC-21, and outcrop regularly. Then those fluid samples were analyzed by the HPLC to construct a breakthrough curve for every well and outcrop. Meanwhile, use qualitative analysis to understand relationships between peaks in breakthrough curves and possible fracture connectivity; and quantitative analysis to understand the sweep volume, flow geometry and heterogeneity. Finally, we combined all results to build up a fracture distribution conceptual model. This model provides detailed fractured connectivity between wells and more information for the future deploy of reinjection wells in the Chinghsui geothermal field.