Geological Modeling of the Fractured Reservoir in Tuchang Geothermal Field

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Abstract

This study integrates the results of geology, geophysics, and geochemistry surveys in the Tuchang-Jentse area in northeastern Taiwan to construct a three-dimensional geological model of fractured reservoirs in the Tuchang geothermal field. The completed geological model will be used in subsequent geothermal simulations to assist with the production evaluation and development planning of the Tuchang geothermal power station.

In contrast to petroleum reservoirs, which are usually composed of sandstone or carbonate rocks, geothermal reservoirs are often situated within metamorphic or volcanic geological environments. The permeability of the matrix in these rocks is considerably lower than that of the fractures, making fractured reservoirs the primary focus for geothermal field. Fractured reservoirs are characterized by dual porosity and dual permeability. This study employs a hybrid modeling approach, integrating discrete fracture models and dual-porosity, dual-permeability models. The attributes of faults and fractures are quantified as fracture density and incorporated into grids to derive a hybrid fractured reservoir model. Tuchang fractured reservoir model reveal that reservoir can be divided into a shallow hydrothermal zone at depths of 200m to 600m and a deep hydrothermal zone at a depth of 1,800m. It is speculated that the hydrothermal fluids in the deeper zone originate from the Jentse geothermal area and are transported northward to the Tuchang area via faults. The completed model of the Tuchang fractured geothermal reservoir will facilitate further geothermal simulations to clarify the subsurface water recharge patterns and thermal flow transmission models in the Tuchang area. Helping to evaluate geothermal potential, production well capacity, and optimization of reinjection strategies.

Keyword: Geothermal geological modeling, Fractured reservoir, Dual ϕ -Dual k model

宜蘭土場地熱區裂隙型儲集層地質建模

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摘要

本研究整合台灣東北部宜蘭土場-仁澤區域之地表地質調查、地球物理與地球化學研究成果，建立土場地熱區裂隙型儲集層三維地質模型，提供後續地熱模擬工作使用，以協助土場地熱區之生產評估與開發規劃。

有別於以砂岩或碳酸鹽為主之油氣儲集層，具地熱開發潛力的場址多屬於變質岩或火成岩地質環境，其基岩之滲透率遠低於裂隙之滲透率，因此地熱區儲集層以裂隙型儲集層為主。裂隙型儲集層具有雙孔隙率雙滲透率（雙孔雙滲）之特性。本研究採用混合模型的方法整合離散式裂隙模型以及雙孔雙滲模型兩種裂隙建模方法。將斷層及裂隙屬性化為裂隙密度後填入網格模型，將兩種模型疊合以得到混合型裂隙儲集層模型。

建模成果顯示土場地熱儲集層可分為地下垂深 200m~600m 處之淺部熱液帶與垂深 1,800m 處之深部熱液帶。深部熱液帶之熱液推測源於仁澤地熱區深部經由斷層向北傳輸至土場地熱區。本研究完成之土場裂隙型地熱儲集層模型將提供後續地熱模擬工作，以釐清土場地熱區之地下水流補注模式及深部熱流傳輸模型，以進行後續地熱資源量評估、生產井生產能力評估及回注策略最佳化。

關鍵字： 地熱地質模型、裂隙型儲集層、雙孔雙滲模型。