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Fracture Reactivation Analysis and its Applications to Taiwan Geothermal Exploration

En-Chao Yeh[1], Ting-Hui Wang[1&2], Yu-Ching Chang[3], Ya-Chu Tseng[1], Chao-Yan Lin[3], Lun-Tao Tong[3], Chi-Hsuan Chen[2]

[1] Institute of Earth Sciences, National Taiwan Normal University, Taipei, Taiwan
[2] Geological Survey and Mining Management Agency, MOEA, Taipei, Taiwan
[3] Material and Chemical Research Laboratories, Industrial Technology Research Institute, Hsinchu, Taiwan

Due to on-going extreme climate change and global NetZero policy, the exploitation of geothermal energy is one of essential ways to compromise environment protection and economic development at the same time. For generating electricity from geothermal power plant conventionally, high-temperature heat source, abundant geothermal fluid, and fluid conduits are required. Therefore, reactivation analysis of fractures is one of keys for making the success of geothermal development. For conducting fracture reactivation analysis, two significant elements are vital. One is in-situ stress state and the other is 3D fracture map. 3D stress state with principal orientations and magnitudes is needed to complete reactivation analyses, such as fault instability, dilation tendency and slip tendency. The developed technique in this work can reconstruct the effective stress field based on current scheme of regional stress inversion from focal mechanisms via the concept of principal fault plane. 3D fracture with attitude is elementary information to understand fracture distribution pattern. The 3D fracture map regionally can be created by examining the high resolution digital elevation model with statistic evaluation. 2D fracture density map can also be developed. With in-situ stress information, reactivation tendency with different types on each fracture can be further estimated. Based on tendency distribution of focal mechanism slips, thresholds of different tendency types can be defined. Accumulating the points on each grid among different tendency types over its own threshold, the score of each grid can be summed up and contoured. The potential map of fracture tendency can thus be constructed. When potential map of fracture tendency further merges with other layers, such as temperature map, and resistivity map, the hotspot of geothermal resources can be easily identified. Based on what we are working, the technique of fracture reactivation analysis can be established and applied to site characterization of geothermal potential in Taiwan.

Keywords: fracture, reactivation analysis, in-situ stress, geothermal exploration