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Hot and steamy fractures in the Philippines: the characterisation and permeability evaluation of fractures of the Southern Negros Geothermal Field, Negros Oriental, Philippines

Loraine Pastoriza (1,2), Robert Holdsworth (1), Kenneth McCaffrey (1), Eddie Dempsey (1), Richard Walker (3), Jon Gluyas (1), and Jonathan Reyes (2)

(1) Department of Earth Sciences, University of Durham, Durham, United Kingdom DH1 3LE, (2) Energy Development Corporation, Ortigas, Pasig City, Philippines 1605, (3) Department of Geology, University of Leicester, Leicester, United Kingdom

Fluid flow pathway characterisation is critical to geothermal exploration and exploitation. It requires a good understanding of the structural evolution, fault distribution and fluid flow properties. A dominantly fieldwork-based approach has been used to evaluate the potential fracture permeability characteristics of a typical high-temperature geothermal reservoir in the Southern Negros Geothermal Field, Philippines. This is a liquid-dominated geothermal resource hosted in the andesitic to dacitic Quaternary Cuernos de Negros Volcano in Negros Island. Fieldwork reveals two main fracture groups based on fault rock characteristics, alteration type, relative age of deformation, and associated thermal manifestation, with the younger fractures mainly related to the development of the modern geothermal system. Palaeostress analyses of cross-cutting fault and fracture arrays reveal a progressive counter-clockwise rotation of stress axes from the (?)Pliocene up to the present-day, which is consistent with the regional tectonic models. A combined slip and dilation tendency analysis of the mapped faults indicates that NW-SE structures should be particularly promising drilling targets. Frequency versus length and aperture plots of fractures across six to eight orders of magnitude show power-law relationships with a change in scaling exponent in the region of 100 to 500m length-scales. Finally, evaluation of the topology of the fracture branches shows the dominance of Y-nodes that are mostly doubly connected suggesting good connectivity and permeability within the fracture networks. The results obtained in this study illustrate the value of methods that can be globally applied during exploration to better characterize fracture systems in geothermal reservoirs using multiscale datasets.