Fractures Point the Way to Extraction of Underground Resources

Fractures and fracture networks are critical to fluid flow and contaminant movement through rock masses, especially those at significant depths below the surface of the Earth. Rock fractures may be naturally occurring, or may be engineered to produce a desired network structure for particular applications.

Engineering applications dependent on fractures and fracture networks include:

• hot dry rock enhanced geothermal energy systems in which artificial reservoirs must be created by fracture stimulation to enable the geothermal fluid flow
• underground repositories for the safe storage and disposal of hazardous wastes for which potential contaminant transport through surrounding natural fractures must be quantified
• underground water transport through aquifers
• movement of oil and gas in hydrocarbon reservoirs
• extraction of natural gas from unconventional reservoirs.

Problem
The mapping of fracture networks at engineering scale is next to impossible due to the paucity of data on fractures at depth.

Solution
University of Adelaide researchers have pioneered the innovative use of stochastic rock fracture modelling. Stochastic rock fracture modelling can make use of sparse data gathered from direct or indirect observations of the rock mass. The information can be obtained from drill cores, borehole imaging, geophysical surveys or seismic monitoring during fracture stimulation.

The essence of the stochastic modelling approach is to treat locations, size, orientation and other properties of the fractures as random variables with inferred probability distributions. An initial fracture model is constructed by Monte Carlo simulation; and the model is then refined using various methods to take into account available data, producing a more realistic fracture model.

Benefit
This research provides more realistic models of rock fractures, thereby enabling more accurate design of enhanced geothermal systems, better reservoir characterisation for oil and gas operations, and better quantified risk assessment in environmental applications.

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