The role of fractures in flow through sandstones

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Abstract

The potential hydraulic behaviour of the fracture network in a major Triassic Sandstone aquifer in the UK has been evaluated. The properties of the fracture network were determined using results from detailed scan-line surveys at 10 sites, television and geophysical borehole logging, and packer testing. Six sets of discontinuities common to all sites were identified and statistically characterised (dip, strike, orientation, density, size, and estimated transmissivity). A discrete fracture network model was then used stochastically to investigate the properties of the network. In general, the network is poorly connected: it is estimated that 9% of the discontinuities intersecting boreholes are transmissive. The hydraulic behaviour of the network is generally dominated by one sub-horizontal bedding-plane fracture set, although when present, a relatively infrequent north-south striking, sub-vertical set modifies the bulk flow properties significantly. Ignoring this latter set, the network minimum representative volume is about 35×35×35m. The upscaled permeability is anisotropic, being typically 23 times greater in the horizontal than in the vertical. Tortuosity in the north-south direction is around 1.6.

Location of study area
Stereoplot (a) and density (b) of scanline data from all survey sites (upper hemisphere, equal angle projection)

Histogram of trace lengths. Shaded bars indicate fracture traces censored by the edge of the outcrop.
The mean (solid line), and upper and lower quartiles (dashed lines) of the components of the hydraulic conductivity tensor for the fracture network as a function of size of the cube of rock investigated.

Publication