AAPG International Conference
Barcelona, Spain
September 21-24, 2003

Simon D Harris[1], N. Odling[1], A. Z. Vaszi[1], R. J. Knipe[1] (1) University of Leeds, Leeds, United Kingdom

A Three-Dimensional Stochastic Model of Fluid Flow Through Fault Damage Zones

Major fault zones are surrounded by damage zones composed of minor faults that, in siliclastic rocks, often form significant barriers to fluid flow. Information on fault damage zone architecture is usually available only as 2D maps, or as 1D line samples or well logs. The accurate determination of the 3D fault population characteristics is crucial for flow prediction.

Techniques for modelling spatial clustering of small faults, observed in core, outcrop and seismic-scale data, have been developed and the flow properties for the resulting 3D fault damage zone and main slip zone can be analysed using both geometric algorithms and numerical techniques. We have introduced a new methodology which both derives the minimum fault rock thickness along flow paths traversing the fault zone and predicts areas of reduced fault zone connectivity for host and fault rocks of varying permeabilities. A new 3D discrete fracture flow model (DFFM) has also been developed for upscaling complex 3D fault zones and we have been able to demonstrate accurate conditioning of the results of the geometric algorithms against the DFFM model.

Sensitivity studies are being carried out on a variety of input parameters to the 3D fault zone model. For example, the influence of variations in both the fault zone parameters (comprising fault orientations, size-frequency distributions and spatial clustering) and the fault properties (comprising thickness, offset, permeability from shale gouge ratio and dependent on lithology and fault zone development) can be measured and the uncertainty in the predictions of the upscaled properties thereby quantified.