Geophysical Research Abstracts, Vol. 8, 00702, 2006
SRef-ID:


# How can we collect information on fault zone architecture to improve estimates of bulk fault zone flow properties?

**Z. K. Shipton** (1), R.J. Lunn (2) and A.M. Bright (3)

(1) Department of Geographical and Earth Sciences, Gregory Building, University of Glasgow, Glasgow, UK, (2) Department of Civil Engineering, University of Strathclyde, Glasgow (3) Department of Geology, Trinity College, Dublin, Ireland (z.shipton@ges.gla.ac.uk)

The prediction of bulk fault zone properties for subsurface faults is presently conducted in a deterministic way. Fault zone properties are predicted from a limited number of input parameters such as fault throw and protolith, using a variety of algorithms. For example the oil industry commonly uses the Shale Gouge Ratio to predict the shale percentage of the fault gouge. These techniques are limited to specific fault development mechanisms, ignore other crucial parameters (such as stress history, post-fault cementation etc) and underestimate the amount of complexity in fault systems. Alternative approaches use detailed outcrop maps of the fault architecture as surface analogues for buried faults. These are coupled with known petrophysical properties of fault architectural components to calculate bulk permeabilities. These bulk properties are then mapped onto fault surfaces in models of subsurface flow. However, this approach does not capture the potential for spatial variability of fault architectures between faults with the same throw.

We present results of groundwater flow simulations through outcrop maps collected from the Big Hole Fault, a well-documented fault damage zone cutting the Navajo Sandstone, central Utah. Similar to other faults in high porosity sandstone, the fault is composed of tight deformation bands, and slip-surfaces that can be either open or tight. We show that for open slip surfaces, fault leakage over long timescales is primarily governed by the existence of tortuous connected pathways between the permeable host rock and the open slip surfaces. By contrast, where slip surfaces are tightly sealed, leakage is primarily governed by sections surrounded by poorly connected deforma-

tion bands and no fault core. The key to prediction of leakage in both cases, therefore, is not the traditional approach of bulk permeability estimation based on the density of individual architectural components, but a statistical characterisation of the likelihood and frequency of connected pathways. Detailed outcrop data from the Big Hole fault shows that the fault core thickness is highly variable, but that this variability can be characterised in a statistical way. We propose the compilation of a large database of fault architectures for individual lithologies, from which appropriate statistical properties for risk estimation can be drawn.