A Comparison of SGR and Geomechanical Methodologies for Fault-Seal Risk

***Graham Yielding**, Peter Bretan, Stephen Dee, Brett Freeman, and Helen Jones. Badley Geoscience Ltd, North Beck House, North Beck Lane, Hundleby, Spilsby, Lincolnshire, PE23 5NB, United Kingdom, phone: +44-1790-753472, fax: +44-1790-753527, graham@badleys.co.uk*

Failure of fault-bound traps is typically attributed to either (a) hydrocarbon buoyancy pressure exceeding the capillary threshold pressure of the fault zone, or (b) leakage up the fault due to reactivation (or critical stress). However, it is rare for these failure mechanisms to be compared quantitatively for the same trap.

Fault-zone capillary threshold pressure can be estimated from data on fault-zone composition (via Shale Gouge Ratio) and the stress/temperature history. Calibrations of these estimates can be made by comparison with drilled fault traps and by measurements of fault-zone samples where available. Hydrocarbon-water threshold pressures are typically in the range 10-300 psi (c.70kPa – 2MPa) for fault-zone rocks.

Fault reactivation is assessed by examining resolved shear stress on the fault plane, given the fault orientation and the effective stress tensor. The proximity to failure can be expressed as the increase in pore-pressure required to induce reactivation. Required pore-pressure changes of 1450psi (10MPa) or less are considered higher risk for trap integrity (Mildren et al 2002). The most obvious pore-pressure change associated with a hydrocarbon trap is the buoyancy pressure associated with the hydrocarbon column. However, comparison of the 10MPa threshold with the capillary pressures shows that fault zones would be expected to fail by across-fault capillary leakage long before failure by reactivation.

We compare the capillary and reactivation methodologies for a number of structures and discuss the magnitude of uncertainty associated with each. In most cases, uncertainty arising from the stress field will be larger than uncertainty in fault-zone capillary properties.