Irving, A. 2007.
Faults, fluid flow and uncertainty.
Tectonic Studies Group Meeting, Glasgow, 3 January.

ABSTRACT
Faults affect fluid flow in hydrocarbon reservoirs on multiple length and time scales. Sampling of subsurface information is limited to spatially extensive but low resolution seismic data and sparse, high resolution well penetrations. Large (≥10m displacement) faults are usually avoided as a drilling hazard and very rarely cored, while typical seismic surveys are designed to image sub-horizontal reflectors rather than faults. This lack of knowledge must be filled by making inferences from indirect data (inverse modelling) and/or by employing some kind of conceptual model to predict fault properties from other information. In siliciclastic sediments, the type of fault rock developed depends mostly on host rock composition and, to a lesser extent, deformation conditions and temperature history. Fault permeability may be measured from small faults in core, faults in analogue outcrops or synthetic faults created in laboratory deformation experiments. Fault rock relative permeabilities may sometimes need to be modelled, depending on well/fault pattern, production mechanism and simulation parameter of interest. Observed pressure differences, 4D seismic data, well tests, analogues and history matching may all be used to calibrate fault property predictions, although a change of scale is often required between empirical models and dynamic data. A prerequisite of any method used to optimise properties is knowledge of the range of values within which a particular property (e.g. fault permeability) may occur. Within limits, fault permeability seems relatively insensitive to strain, suggesting that statistics measured from small faults can be extrapolated to similar larger features. In situ stress and sample support should also be taken into account. In addition to fault rock property uncertainties, model uncertainty occurs for 'geometrical' parameters (sedimentary architecture, structure geometry, fault geometry). Fault properties may make a significant contribution to overall uncertainty, although the choice of modelling approach is highly dependent on data quality and the problem under investigation. Further work is required:
• To better define representative ranges for fault property values (fault permeability, thickness).
• To investigate flow sensitivity to spatial variations in fault permeability and thickness.
• To integrate fault and sedimentary uncertainties for reservoir modelling.
• To evaluate different upscaling/downscaling approaches for fault permeability.
• To quantitatively calibrate fault property predictions from dynamic data.