A PROBABILISTIC FAULT SEAL AND FAULT BREACHING ASSESSMENT OF A NORWEGIAN SHELF PROSPECT; CONSIDERING VARIANCE IN PALEO AND PRESENT STRESSES, FAULT GEOMETRY, AND LITHOLOGY

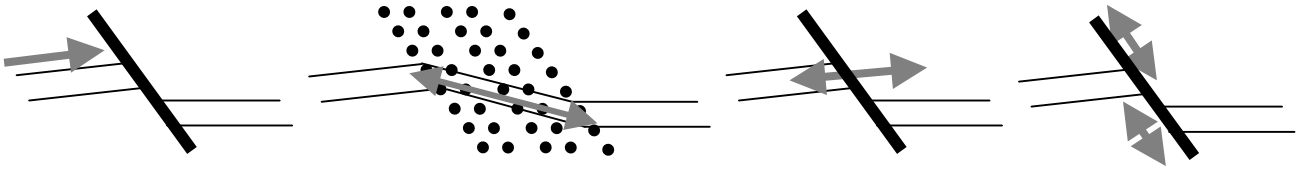
Titus Murray*, Claudia Guargena‡,
*Consultant 35 Market St Randwick Sydney NSW Australia
‡ Enterprise Oil Norge Ltd Stavanger Norway.
Corresponding Author titusmurray@optusnet.com.au

Conventional fault seal analysis techniques use geometries and parameters which often have considerable uncertainty and measurement error. It has been found that variance in the parameters can lead to great problems constructing deterministic fault juxtaposition, seal and leakage models in 3D.

Within existing fields one is interested in the smaller faults at or near seismic resolution which influence development. During exploration, lithology and trap bounding fault geometries are often highly uncertain due to lack of well/velocity constraint**.** These uncertainties are particularly problematic when fault displacement and lithological thickness are of similar magnitudes

This paper describes an assessment of a Norwegian Shelf exploration prospect. The prospect consists of multiple closures, reservoirs and fault segments. Risks for charge, top seal and reservoir could be derived from regional experience but fault seal risk was felt to be prospect specific.

To quantify the risks associated with faults; sealing, not sealing or breaching a generalized fault displacement and damage-zone model was developed. The model considered the salient features; events and process that could discriminate these fault seal behaviors.



Using a probabilistic approach, assessments of the effects of variance in displacement, lithology and present/past stress states were used to assess the hydraulic performance of the fault. Distributions for the simulations were either elicited or calculated during a multidisciplinary workshop.

Interpretation uncertainty was assessed using structural restoration. This showed the seismic restoration to have low heave uncertainty. The role of past and present pore pressure and in situ stress were less well understood. This may have been due to the glacial ice loading that the prospect has been subjected to over the last 100,000 thousand years. A range of stress tensor and pore pressures for scenarios related to glacial loading and unloading were considered.

A Monte Carlo simulation of the generalized fault displacement model was used to calculate the probability of fault sealing.

This was then used within a risk based reserves model encapsulating the multiple closures and reservoirs. This rigorous quantification of risk greatly helped during the prospect evaluation.