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Faults in reservoir models – unwanted surprises and new methods for avoiding them

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Standard reservoir modelling techniques routinely incorporate faults as simple offsets along grid splits. The impact of faults on reservoir fluid flow is thereby captured by the combined effect of stratigraphic displacement and transmissibility modifiers attached to the cell surfaces bordering the grid split. These transmissibility modifiers can be derived either from specialised tools calculating expected transmissibility from combining information on reservoir lithology with fault throw, or by *ad hoc* history matching of the simulation model. However, this approach disregards the fact that fault impact in reservoirs is commonly not limited to a single, clear-cut fault plane but affects a volume of host rock thereby creating a complex 3D architecture. By failing to incorporate the presence of often extensive fault damage zones and fault core architectures into the reservoir model

- actual 3D flow inside and through fault zones is not captured
- in-place volumes are overestimated
- fault sealing (including capillary seals) is highly simplified
- communication along faults can not be forecast
- model uncertainty cannot be properly evaluated as fault features critical for reservoir behaviour are not included in the model
- hazardous areas for drilling can not be reliably predicted

The Fault Facies project addresses this problem by a concerted research effort involving structural geologists, mathematicians, modellers, programmers and reservoir engineers. The project has developed a practical methodology that allows volumetric gridding of fault zones on reservoir scale models and populating the resulting fault envelopes with realistic fault architectural elements and petrophysical properties. Models are built using a standard reservoir modelling tool (Irap RMS™) employing a customised gridding algorithm in HAVANA. Architecture and petrophysical properties of the fault zones are modelled by adapting facies model tools developed for object based modelling of sedimentary facies and employing volumetric strain as a conditioning parameter for the resulting fault zone architecture and petrophysical properties. The new method is fully integrated with existing modelling workflows and can be added onto existing models with no need to build new models from scratch.

Although still under development the Fault Facies method offers a practical solution to evaluation of fault impact on reservoir fluid flow in realistic detail.