Combined 2-day course content, NFR Workshop Al Khobar. October 2026. Integrated fracture reservoir characterization and modelling and multi-phase flow, upscaling and the construction of fractured reservoir models

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Key foundation as data are for a study

- ✔ Fracture observations and description. How do rock deform? Mohr circles.
- ✔ Mechanical stratigraphy.Fracture nomenclatures.
- ✔ Understanding fracture development. Fracture chronology, Fracture corridors.
- ✔ Fault geometry, fault segmentation, Fault damage zones.

Fracture characterisation – Developing conceptual fracture concepts

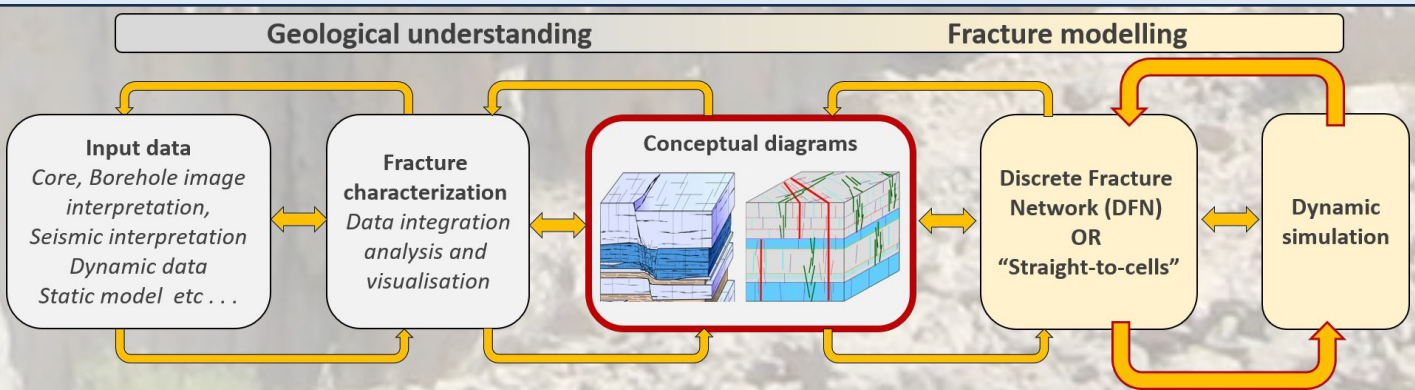
- ✔ Integration of static and dynamic data at all scales. Pressure transient analysis.
- ✔ Fracture porosity, Fracture permeability, Sampling bias.
- ✔ Extrapolating fracture model/concept away from well data.
- ✔ Use of subsurface and outcrop analogues. Use of seismic attribute
- ✔ Capturing ranges of uncertainty in a series of conceptual diagrams.

Fracture modelling – fracture model upscaling.

- ✔ Creating fracture models including learning's from previous topics and integrating all data.
- ✔ Developing a fracture modelling strategy and fracture model upscaling strategy
- ✔ Straight to cell approach and geology driven deterministic models
- ✔ **DFN** (Discrete Fracture Network) and **DFM** (Discrete Fracture and Matrix) modelling
- ✔ Calibration of the models using dynamic data

Multi-Phase Flow, Upscaling, and the construction of fractured Reservoir models

- ✔ Flow physics & heterogeneity: combined effects of viscous, gravitational and capillary driven flow that manifest differently in the rock matrix, material interfaces and fractures;
- ✔ Stress variation and fracture aperture at depth: What keeps fractures open at a subsurface depth of 4-km and a hydrostatic fluid pressure? - fracture surface roughness, rock bridges, dissolution / precipitation, pore pressure and stress shielding in heterogeneous rock sequences.
- ✔ Flow dynamics: inertia and flow structure effects that cannot be captured by constitutive relationships (like cubic law extensions and transfer functions) but distinguish multi phase fracture flow from flow in porous media;
- ✔ Upscaled ensemble relative permeability: moving beyond dual continua models to rate-dependent and direction-dependent replacements of saturation functions;
- ✔ •Alternative modelling and simulation methods and workflows for process optimisation.
- ✔ Presented modelling results are contrasted with dual-continuum and other conventional approaches, highlighting respective assumptions, strengths, and consequences for field-scale application and performance optimisation.



The course will follow the logic of an integrated fracture characterization and modelling workflow