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Fracture Characterization and Modelling in the Kraka Field

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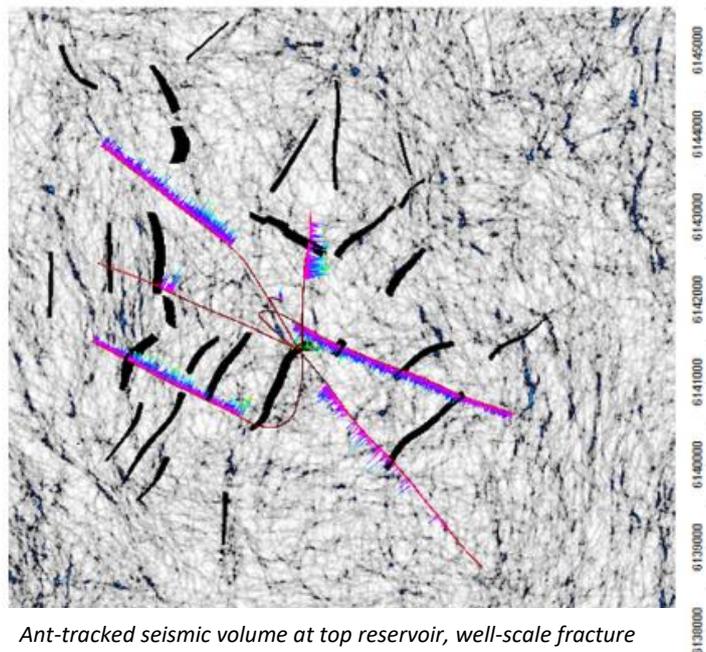
The Kraka Field is an anticlinal structure induced by halokinesis, located in the Danish Central Graben. It is produced through depletion of the naturally fractured Ekofisk Formation of Danian age, which is a widespread chalk reservoir offshore Denmark.

The Kraka fracture pattern has been mapped through borehole images, core- and seismic data prior to upscaling and fracture modelling. Two main fracture trends were identified in the Ekofisk Formation. The first is a NNE/NE trending regional fracture set, which has consistent orientation across the Kraka structure. This trend is parallel or near-parallel to the main fault system, mapped through 3D seismic interpretation, which aligns with the local maximum horizontal stress. The second set consists of fractures trending parallel or perpendicular to contours of the Kraka dome. This fracture set is therefore thought to have formed during halokinesis, and it is expected to follow the strain evolution of the Kraka chalk. Both sets occur as fracture swarms and as isolated features.

High resolution lineations mapped on two ant-tracked cubes (generated through RGB-image processing of the 3D seismic volume and through a variance cube, respectively) shows a good correlation with the well-scale fracture trends and with the structural framework in Kraka. Moreover, an additional structural trend related to the domal structure was identified in the lineations: shallow dipping faults (<30°) dipping away from the contours of the dome. These faults are likely related to an E-W compressional event, which occurred during inversion phases in the Late Cretaceous evolution of the Central Graben.

Localized variations in the fault pattern occur due to re-activation of older, Mesozoic structures.

The Kraka fracture pattern established during the reservoir characterization of the field was successfully reproduced in terms of main orientations in an industry-standard discrete fracture network model (DFN). Resultant fracture parameters (e.g. apertures and length), are however associated with a larger degree of uncertainty. This demonstrates the need for geomechanically based DFNs, to achieve an improved understanding of the fracture distribution in the chalk reservoir.



Ant-tracked seismic volume at top reservoir, well-scale fracture densities (purple) and structural framework (black).