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Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Danish Hydrocarbon Research and Technology Centre
Technology Conference 2017

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Flow properties of chalk reservoirs can significantly evolve through time due to rock deformation caused by pressure depletion, involving challenges during hydrocarbon production and enhanced oil recovery. The present study aims at identifying the relationships between petrophysical and mechanical compartments in chalk reservoirs, and recognizing which compartments are likely to deform appreciably due to production-related increase in effective vertical stress.

Based exclusively on subsurface data, we use visual inspection of cores, well correlation, and X-ray diffraction (XRD) and well log analyses to provide information on the rock fabric and stratigraphy. Mechanical properties values of chalk are derived from iso-frame conceptual models and triaxial test results, and fluid pressure data are used to estimate effective vertical stress at reservoir conditions. Well correlation indicates that the Kraka reservoir consists of petrophysical and mechanical units that vary vertically and laterally. While chalk porosity is mainly controlled by the amount of non-calcite residue, mechanical behaviour of chalk likely results from the degree of lithification.

Changes in estimated effective vertical stress due to pressure depletion over a 25 years production history led to brittle deformation of high porous chalk compartments initiated between 1991 and 1997. Such partitioning in flow and mechanical behaviour across a reservoir needs to be assessed in order to enhance our ability to predict the evolution of the network of flow conduits and baffles over a field's lifetime and, thus, optimise hydrocarbon sweep efficiency.

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