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Abstract: Significance of clay dehydration on overpressures, in the Alwyn area, Viking graben, North Sea

Using a kinetic model for smectite to illite transformation in a basin model, we evaluate the potential role of the fluid produced by the dehydration phenomenon in the overpressure generation and then we explore a way to account for diagenetic effects in the evaluation of the permeability of argillaceous sandstones during the numerical reconstruction process.

As we simulate the deposition sequences, by representing the heterogeneous sediment loading and the burial during time, we access to the evolution of past fluid migrations and thermal regimes. Clay dehydration is introduced as a mechanism providing a source term for the flow mass-balance equation. Specific surfaces in the Koseny-Carman laws used for flow are modified to account for the evolving illite content.

As an application, we consider a 80 km square area in the western margin of the Viking Graben, North Sea, from Statfjord period (219 MY) to present day. This part of the basin exhibits sandstone/shale alternances and is affected by NNW-SSE trending faults. Neighbouring oil fields, known as Alwyn, Dunbar or Hild, present different abnormal pressure developments, with overpressures as large as 20 to 35 MPa in Jurassic sandstone reservoirs. Illitisation is reported, which can be accompanied by a sharp decrease in hydraulic properties. A morphological characterisation of this illite is available and implications for the hydraulic behaviour of the porous material are simulated. Geochemical interactions, fluid speciation and stability of the mineral assemblage, are controlled at each time step and various locations using a local thermodynamic equilibrium model.