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THE ROLE OF PERMEABILITY IN COMPACTION, SUBSIDENCE AND OVERPRESSURE BUILT-UP

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Tight Reservoir Development - Extraction of oil from the Lower Cretaceous reservoir

The role of permeability in porosity reduction resulting in compaction and seabed subsidence and in the built-up of abnormal formation pressures is not yet fully understood.

In this study, porosity reduction (compaction) and overpressure build-up over geological time as a function of permeability is investigated by the means of forward finite-element modelling.

The geological medium is modelled as a porous, soft material fully saturated with water, 2000 m thick and 200 m wide. The material is considered permeable in all directions. The sediment column is submerged in 100 m of sea water. The fluid-solid interaction is simulated as a semi-coupled process, i.e. the mechanical part is solved explicitly, the fluid part – implicitly and the two parts are synchronized at given steps. Porosity measurements from the Ocean Drilling Program (ODP) were integrated with available density logs to obtain a porosity-depth curve from sea bed to approximately 2000m depth.

Different values for the permeability are used to study the preservation of porosity given geological time.

The preliminary results (Figure 1) indicate that for in the shallow section (depth less than approximately 1200 m), the compaction is not affected much by permeability, while at greater depths (below 1200 m), a permeability of 1 nD fits best the observed porosity-depth data. A sea floor subsidence of is approximately 6m is estimated for permeability of 1 nD is used, while the subsidence estimated with permeability of 1 μ Da is approximately 68 m.

This type of modelling can be used to understand better depletion-induced compaction and seabed subsidence in mature oil-fields.

Figure 1. Porosity as function of permeability

