

Improved assessment of the basin hydrogeologic framework by combining hydrodynamic and petroleum dynamic analysis methods, Dutch case studies



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ABSTRACT

The development of an extensive integrated pressure database in combination with integrated approaches to characterize and interpret current basin hydrodynamic systems in onshore and offshore Netherlands have resulted in knowledge and understanding of spatial variations in hydrodynamic and pressure conditions in relation to its geological framework and burial history (Verweij et al., 2012).

The spatial distribution of gas and oil accumulations in the Netherlands on- and offshore has provided insight into the location and lateral extension of the main reservoirs and the sealing capacity of caprocks, intraformational seals and faults. Petroleum system studies included, amongst other things, assessment of fluid migration and gas leakage paths by using seismic and petroleum geologic methods. Petroleum accumulations may not be totally closed, isolated, and sealed compartments. Gas frequently leaks from reservoirs through caprock seals over geological history. Current or past leakage paths are the direct link between deeper petroleum accumulations and gas accumulated at shallower depths along the migration path. Direct and indirect indicators of such leakage systems include seismic chimneys, pockmarks, and gas shows.

Hydrodynamic conditions are known to affect the sealing capacity of caprocks, intraformational seals, and faults to a greater or lesser extent, and consequently influence the holding capacity of hydrocarbons of structural, stratigraphic and combination traps and the creation of gas leakage systems. Significant influences on the sealing capacity of low-permeability stratigraphic units occur where large groundwater potential gradients prevail over these units.

This paper shows an integrated approach to improve the assessment of the basin hydrogeologic framework (long term integrity of low permeable stratigraphic units/aquitards and fault zones; hydraulic continuity of reservoirs/aquifers) by integrating the knowledge and understanding of the hydrodynamic and pressure systems in the Dutch sedimentary basins with results of petroleum system studies. The approach will be illustrated with case study examples from onshore and offshore Netherlands.