Modelling Siliciclastic Stratigraphic Traps in Parallic Sedimentary Sequences: Integrating Stratigraphic Forward Modelling Results in a Basin Modelling Workflow

Pantelis Karamitopoulos[1], Hanneke Verweij[1], Rader Abdul Fattah[1], Susanne Nelskamp[1], and Rory Dalman[1]

[1] TNO, Petroleum Geosciences, Utrecht, the Netherlands

ABSTRACT

The distribution of depositional facies in parallic and lacustrine siliciclastic sedimentary sequences plays a major role when assessing potential migration pathways and seal leakage of hydrocarbons. The trapping mechanism in these settings has been customarily described in terms of depositional pinch-outs attributed to the lateral shift and abandonment of active depocenters under the combined influence of climatic and base level forcing. Quantifying the geometry characteristics of such stratigraphic traps and their stratigraphic variability by using solely field data comprises a difficult task due to data resolution limitations and the shredded nature of the stratigraphic record.

Stratigraphic forward modelling provides an attractive alternative to quantify the spatial distribution of facies at the time of deposition and to quantify stratigraphic variability while preserving quantitative coherence with basin-scale geological constraints (e.g. paleotopography, base level fluctuation and altering climatic regime). The simulated parallic siliciclastic sedimentary sequences generated under different stratigraphic forward modelling scenarios and the associated stratigraphic variability provide the geological input for reliable burial history reconstructions with the stratigraphic layers refined at the architectural element scale.

This work establishes a framework that permits the integration of stratigraphic information derived from a forward stratigraphic model (e.g. SimClast) into a regional basin model with assigned petroleum system elements. We will demonstrate an example from the southern North Sea to show the effect of refined stratigraphy when assessing charging and migration pathways in parallic siliciclastic sedimentary sequences. Our results highlight the significance of stratigraphic modelling as an additional source of information for tackling geological uncertainties associated with the spatial distribution of depositional facies in the basin modelling workflow.