

A New Upper Rotliegend Play Opportunities in the Dutch offshore

Unlocked potential

The presence of a Lower Slochteren ('Lower Leman') reservoir equivalent on the northern feather-edge of the Southern Permian Basin is expected. The recent Cygnus discovery in the UK is a very significant play-opener as it confirms the presence of a viable Slochteren sandstone play fairway. This northerly-sourced Rotliegend play fairway is expected to extend into the Dutch offshore as well.

- The northern Dutch offshore is an underexplored area
- Presence of **Rotliegend sandstones** on the northern edge of the Southern Permian Basin is proven by a TNO study (2015)
- Rotliegend reservoir potential present in the northern offshore is waiting to be unlocked

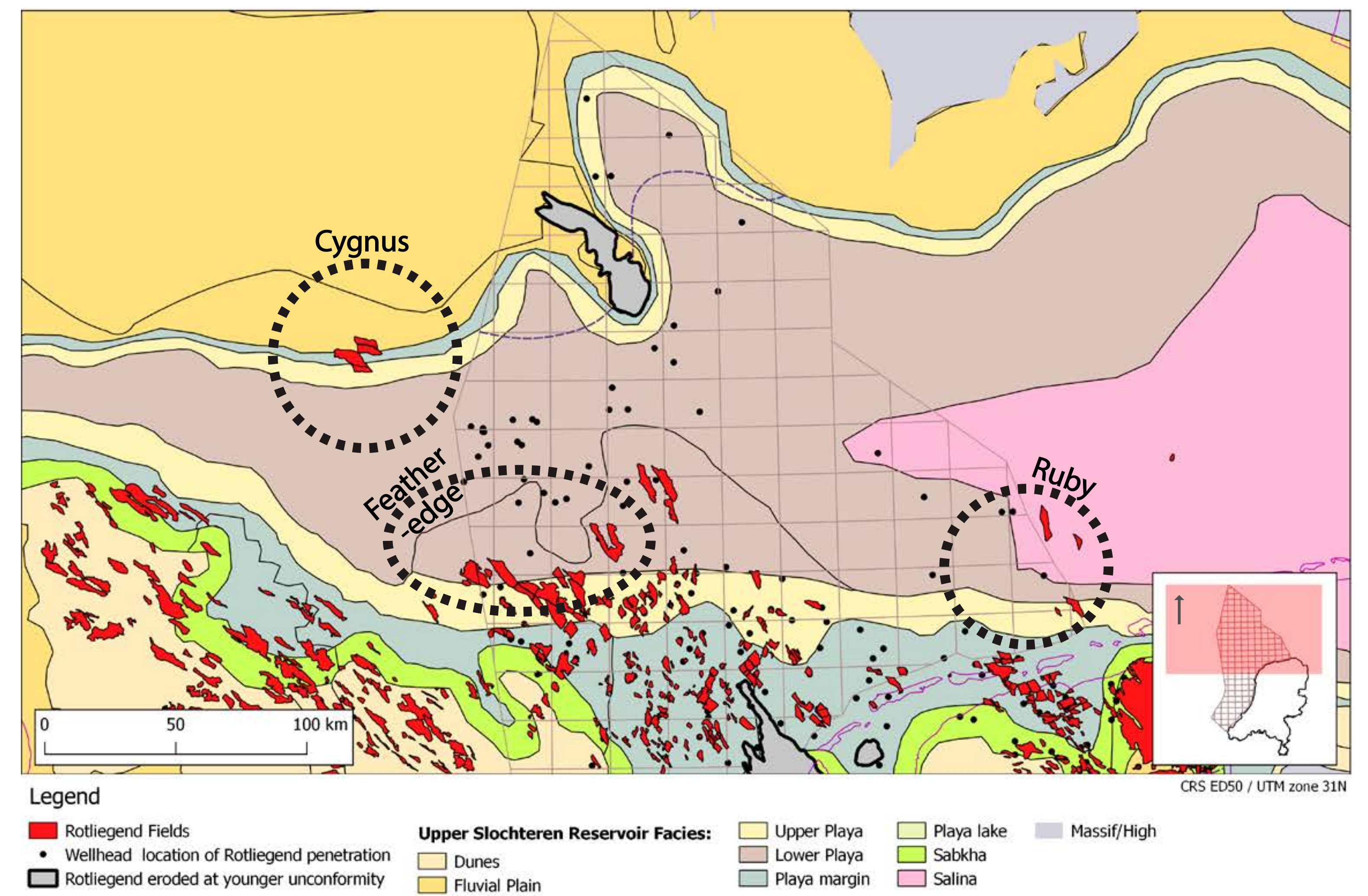


Figure 1. Facies distribution in the Upper Slochteren (modified after Doornenbal & Stevenson (SPBA), 2010).

Cygnus field

- **21 Bcm** (760 bcf) ultimate recoverable volume (forecast)
- Reservoir comprises **stacked sandstones of the Permian Leman Sandstone Formation** (Lower Slochteren Member) and **Carboniferous Ketch Formation**
- Northern-sourced play fairway at Upper Rotliegend times
- Top seal provided by shales of the Silverpit Formation
- Closure: **broad 4-way dip anticlines**

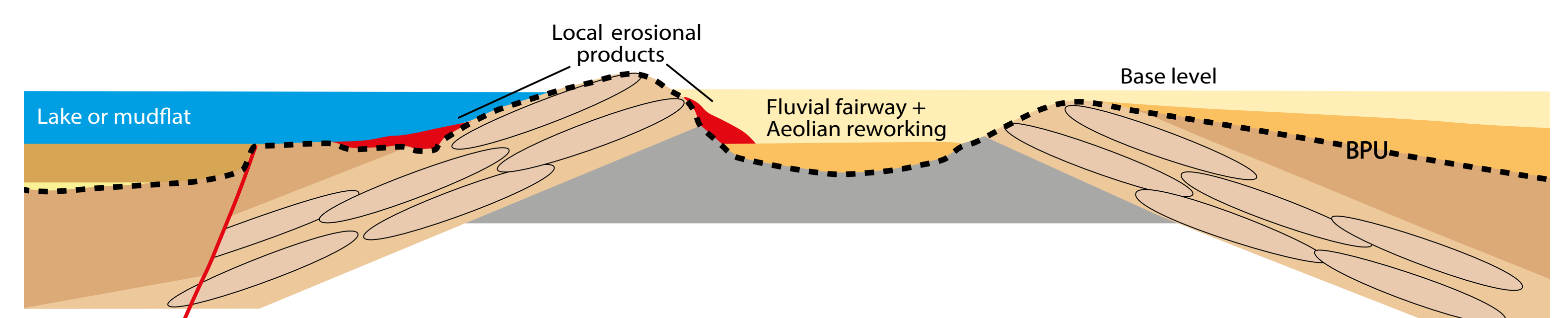


Figure 2. Cuesta model applied to the Feather-edge area (modified after Mijnlief & Pezatti, 2009).

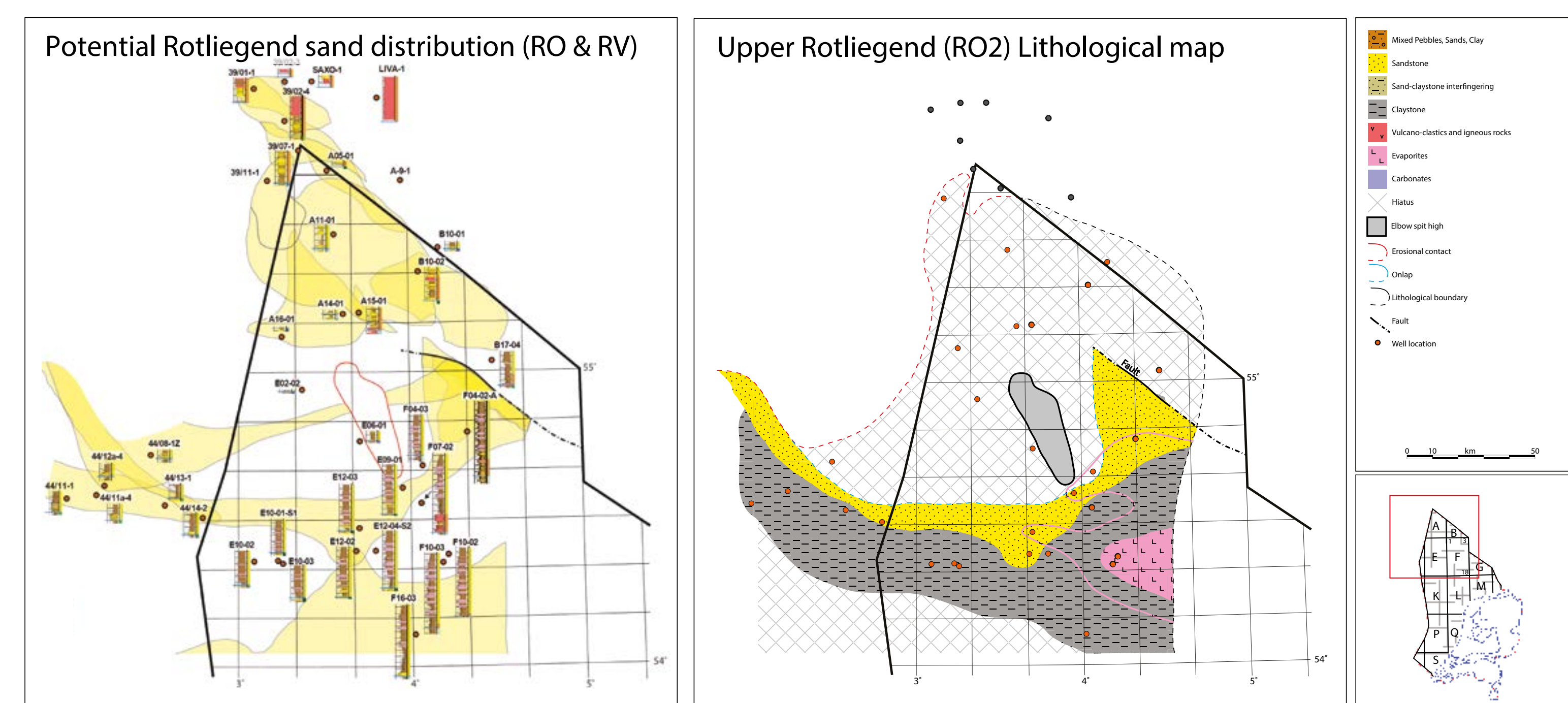


Figure 3a. Facies distribution of the basal sequence of the Lower Rotliegend Group, b. Cycle 2 (of 5) of the Upper Rotliegend Group (constrained by well data and limited 2D seismic data) (TNO, 2015).

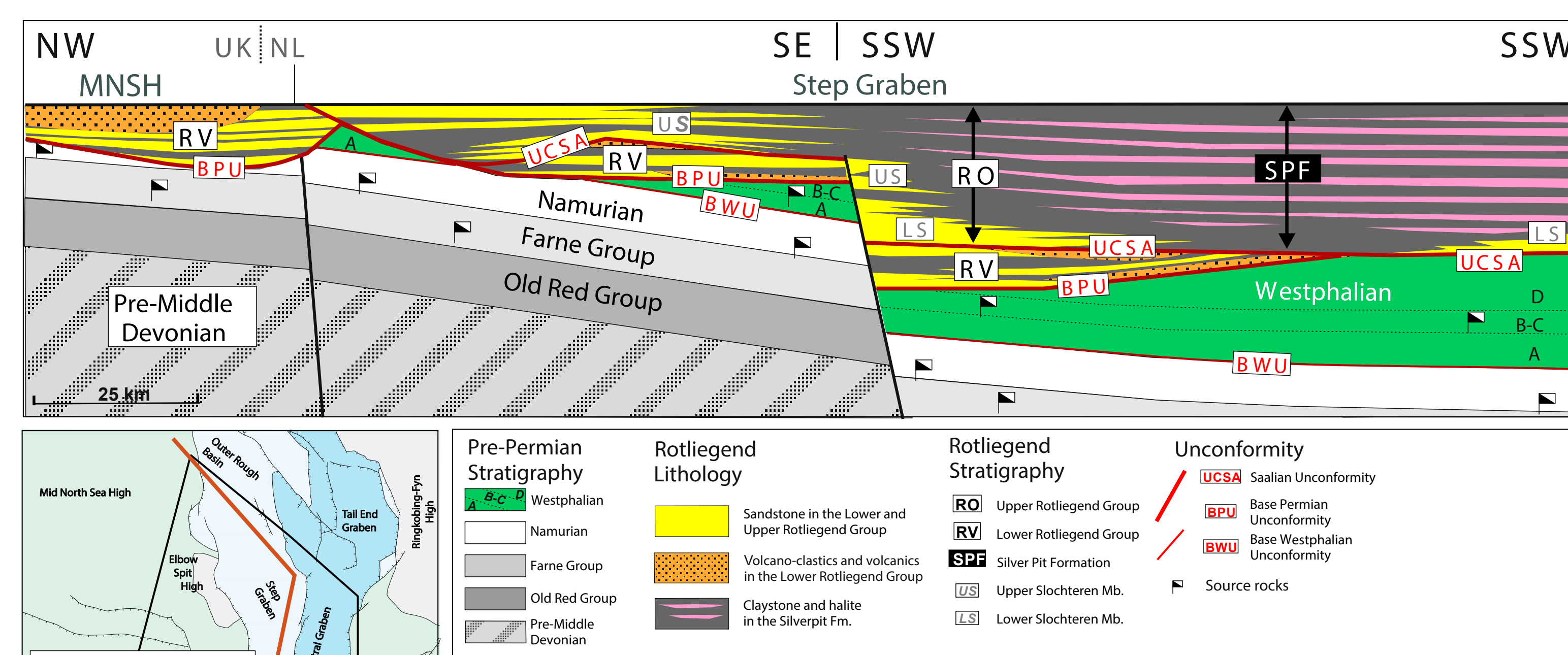


Figure 4. NE-SW trending cross section through the Step Graben and Elbow Spit High.

Reservoir

The presence of reservoir sands depends on the transport of sand from the north into local depressions. A varied landscape of depressions and asymmetrical highs ('cuestas') was created as a result of differential erosion after the Variscan orogeny. This **cuesta-type landscape** is interpreted to have controlled the distribution of the Lower Leman Sandstone, this is a **proven concept** elsewhere in the Dutch and UK offshore:

- Feather-edge area (Mijnlief & Pezatti, 2009)
- Ruby area (Corcoran, 2014)
- Cygnus area (Catto et al., 2018)

Tectonostratigraphic setting

A tectonostratigraphic review has been carried out (TNO, 2015) with the following conclusions:

- Sand-prone Lower Rotliegend strata are proven to be present in the north-eastern part of the study area (fig. 3.)
- Sand-prone Upper Rotliegend reservoir facies are present along the northern margin of the paleo Silver Pit Lake, in an E-W trending belt across the northern Dutch offshore area. This belt likely has migrated northward through time due to the infill of the Southern Permian Basin (fig. 4.)

Prospectivity

Petroleum system modelling has been carried out and provided better insights into the thermal maturity and timing of hydrocarbon generation and expulsion. Combination of the distribution of thermally mature source rock and the presence of Permian-aged reservoir rock has allowed identification of prospective areas, which require further analysis to define and mature a prospect portfolio.