Finding the Limit with REVs – Multi-scale Modelling in Practice

Concept

The idea revolves around the use of multi-scale modelling to capture small-scale detail in larger scale models without recourse to multi-million cell models.

To make it work, scales have to be identified at which a Representative Elementary Volume (‘REV’) can be defined. The REVs effectively capture the reservoir heterogeneity and need to be recurring features.

Application at outcrop

The concept is applied to a well-studied Permian aeolian outcrop on the Moray Firth.

Grainflow and wind-ripple elements approach an REV at difference scales, and the two combine to generate a ‘dune’ REV at a much larger scale.

Field-scale application

The field is a deep-marine clastic reservoir dominated by thin beds: stratigraphic thickness is several hundred metres but average bed thickness is only ca.10cm. Kv is very low (but not zero) and log data does not resolve the thin beds.

The field is produced by waterflood, so knowledge of effective perms and rel perms is required to predict sweep.

Element selection made from core with reference to mini-permeameter data.

The fine-scale elements carry an average NTG value based on mm-scale staining observations; the elements are then used as the building blocks for the REV models at the next scale up.

Generalisation at the small-scale by REV pseudo-isation

THE LIMIT – can generalise the thin beds but not the thicker units as no REV satisfactorily found. EITHER – there are no repeatable large scale patterns, OR the next REV scale up is beyond the scale of the question (the well spacing).

Either way, fine scale detail still required in some units.

Conclusion – not everything can be upscaled; there is a limit.

Nordahl & Ringrose, 2007

REV models for calculating effective properties

Tuning rel perms to match performance of the REV and element-scale models

Hierarchical arrangement of the representative elementary volumes