SPWLA 6th Topical Conference Abu Dhabi, February 15 – 18th, 2010.

Day 2 Workshop Discussion, RRT – Log Domain to Reservoir Scale
Discussion Leader: ILhan Sener, ADCO Reservoir Engineering Discipline Expert

Questions Raised and Discussed:

- What is important from the reservoir engineer's point of view?
  - Reservoir engineers are interested in how fluids / gas flow through the rock, their dynamic behaviour and what physical characteristics affect the dynamic behaviour.
  - RE needs to have Ø,{k}, representative set of saturation functions (drainage, imbibition, relative k, scanning curves), flow units, net and gross thickness to populate the dynamic model
- "Few people ask what the reservoir engineer needs, the others are trying to sell something."
- What is "rock typing"? When to start incorporating dynamic data into rock typing?
- Static versus Dynamic RTs.
  - Definitions?
  - What does a dynamic rock type include?
  - Any relationships between Static and Dynamic RTs – what is it?
- Upscaling SRTs into DRTs.
  - What is it?
    - It is "retaining the effects of heterogeneity, not necessarily the heterogeneity, itself."
  - Vertical lumping (layer grouping)
    - optimum layer grouping
    - preserving high- and low-perm streaks
  - Areal component
    - simulation grid size selection
    - physical property and parameter upscaling (porosity, permeability, saturations)
    - no straight forward way for upscaling SRTs into DRTs – million $ question
- Integration between disciplines should be a given high priority throughout the study
- Feedback from dynamic to static modeling during HM:
  - Ideally, transfer HM changes to geological model, repopulate, then do upscaling again, instead of keeping the HM changes in the dynamic model as modifiers
  - Workflow different for Green Field vs. Brown Field
- Sector Models:
  - Reservoir engineers are not building true sector models from the static models. Most of them take the full filed model and just fine grid it in the area of interest.
  - A true sector model should have the properties extracted from the geological model directly.
- Need to include dynamic data into rock typing process as early as possible to form an opinion on geological framework. Include dynamic performance into reservoir evaluation, from there go to static model description.
  - Saves time and iterations
  - Small sector models to study effects and uncertainties early in the study
- Why build a fine scale geological model?
  - Prefer that geological and reservoir models are at the same scale which needs to be defined governed by the objective of the study → fit-for-purpose modeling
  - More efficient
  - This would require "upfront upscaling" and eliminate the need for upscaling later.

- Other disciplines (notable petrophysicists) are pushing the envelope, but this is not recognized or felt by the reservoir engineer. Not enough communication, inter discipline communication. Education (except in this conference !!)
- Experimental design technique. What is of interest is the forecast to make the right investment decision, not the history match. Look at equally probable outcomes.
- Scale of heterogeneity? Effect of heterogeneity on dynamic model cell size?
  - Facies change – How rapid? (In basins slow change but near shoal rapid change.) Impacts heterogeneity in model.
  - If heterogeneity can be represented using a quantity (from 1 to 10) distributed in 3D, it may be possible to use it to decide on the irregular "pebi grid" cell size in the dynamic model.
  - Lower the heterogeneity index (more homogeneous), larger the grid cell. Higher the index (more heterogeneous), smaller the cell.
  - Other physical features like reservoir or compartment boundaries, faults, well trajectories should also influence the irregular pebi grid cell size.
- What is the Representative Element Volume?
  - Connected to the heterogeneity index
- Wettability as an additional parameter in the simulator (as a function of height above FWL):
  - Vendors were urged to start thinking about including the wettability as input
  - The simulator would then internally make necessary cap pressure and relative permeability changes or assignments depending on height above the FWL, even for the same physical rock type.
  - Simulators are currently "tricked" to handle wettability changes using scanning curves.
- Number of SRTs vs. number of DRTs -- how many DRTs are manageable? (Figure1):
  - Static model may start with several SRTs in the geological model. After lumping and upscaling, user can arrive at a much smaller set of DRTs.
  - What is important is the dynamic behaviour of the DRT which is controlled by its constituent SRTs and their spatial distribution inside the dynamic model cell.
  - If have more than 20 DRT in the simulation model, it will slow down processing and the reservoir engineer has too many variables to manage / change → inefficient.

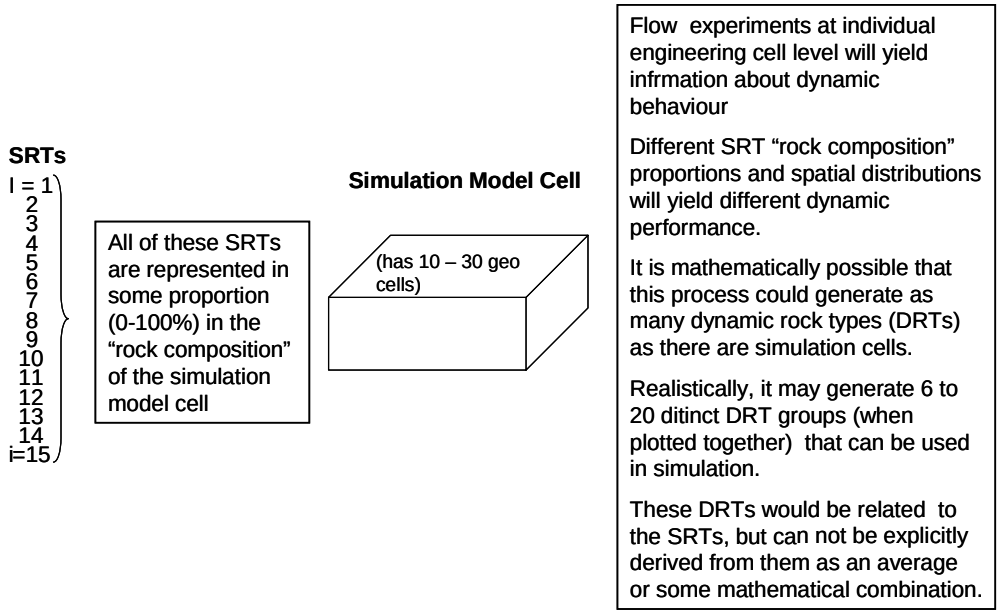

Figure 1. One Way of Converting SRTs into DRTs.

- Some suggested that the geomodelers only reliably deliver a static model with rock type distributed containing Ø,{k}, and initial Swi. Leave it to the reservoir engineer to address the dynamic properties.
- Vendor tools for upscaling RT:
  - Kelkar announced last year that it was getting ready to release a commercial software to consistently perform rock type upscaling (Using a mixing law? Not sure).
  - No further announcement after that.
- Reservoir engineer, working together with the petrophysicist, can/should look for and develop relationships between Ø, {k}, Pc, Corey exponents, Swir, Sorw, Sorg. After upscaling the properties, relative permeabilities and cap pressures can be assigned to simulation cells based on these relationships.