Flow Study without Simulation? - Using Production Mapping Technique

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Chevron Nigeria-Mid Africa Business Unit has several hundreds of production reservoirs. Giving current available resource our earth modelers and simulation engineers can only study limited reservoirs in one year for reservoir management purposes. It would require many years to build flow models for all these reservoirs. The technique of Production Mapping can be of immense value in the qualitative evaluation of reservoir flow performance while significantly reducing labor time.

In recent flow studies production water cut maps were compared with history matched models. Both simulation oil-water contact (OWC) and water saturation distribution were predicted remarkably well for the same time period using Production Mapping.

Production mapping is a time series of water cut maps. It shows moving water front (OWC) and water cut distribution through time. The maps are based on three data sources: 1) water cut recorded from production wells, 2) reservoir thickness above OWC at the year a map is plotted, and 3) water cut boundary condition along bounding fault, internal fault, and initial OWC.

Compared to complicated and time-consuming earth and reservoir simulation models, production mapping can be done in a couple of hours after data has been carefully checked. It is a quick, first order approach to “History Matching” and prediction. At well location, water cut matches measurement exactly and between wells water cut is interpolated and controlled by local geology (reservoir thickness and structural height) and current OWC. Even though water cut at a well has already reached 1.0, its local reservoir top may still be higher than current OWC at the time.

How does production mapping find possible by-passed oil? If a well is situated below current OWC and still shows water cut less than 1.0, an isolated sweet spot would be shown on a late production map. This is a case where the reservoir layers are unevenly swept by water flood. By increasing the weight from reservoir thickness in the interpolated water cut map one can start to see a colored “island” behind the water front.

Should reservoir simulation be replaced by production mapping? No, that is not our intent. However, one can use Production Mapping tool for fast reservoir dynamics screening to preview a candidate for simulation, for a first order approach when simulation is unavailable due to limited resources, and for prediction of future fluid flow in a water flood project.