Who Should Make the Optimum Upscaling Decisions, A Geologist or An Engineer?

Benmadi Milad and Roger Slatt

University of Oklahoma

Abstract

Upscaling is the process of changing a fine grid to a coarse grid while preserving the original geology and its properties (Schlumberger, 2014). Many petroleum fields produce oil and gas from large volume reservoirs. A modeling technique is commonly applied to many of these fields to understand internal architecture of the reservoir and the fluid flow behavior of the reservoir simulation. High heterogeneity reservoirs require high resolution geological models which are usually constructed on a fine scale with an immense number of cells.

The necessity of upscaling is due to the limitations of computing hardware, computing speed and the time required to process the reservoir simulation. Therefore, in order to test the fluid flow behavior of the reservoir, model upscaling is required to convert the fine scale model to a coarser scale. Reducing the number of cells while preserving the fundamental integrity of the model allows for the delivery of simulation results within a reasonable run time.

However, the upscaling process presents several challenges. The main challenge is to avoid upscale elimination of the potentially favorable vertical and lateral reservoir heterogeneity, which will avoid false results of reservoir simulation. Optimal upscaling approaches must: 1) honor reservoir heterogeneity, 2) retain thin beds of reservoir, and 3) predict the possible reservoir heterogeneity in areas where no data is available.

To conduct optimum upscaling, project engineers need to understand the realities of reservoir heterogeneities that originate from the nature of depositional environments. In order to test the fluid flow behavior of the reservoir on such a fine scale model, both geologists and engineers are confronted with long computational times leading to the point of impracticality. Frameworks for reservoir projects have a relatively brief time period; thus, they should collaborate closely to conduct optimum upscaling to deliver correct fluid flow behavior through simulation.

The Hunton Group of Oklahoma provides the data for this study. Integration among geology, petrophysics, geophysics, geomechanics, and fluid dynamics is truly essential for addressing upscaling. Petrel Software will be used for this study to develop 3D geological models for the Hunton reservoir with sufficient detail to represent vertical and lateral reservoir heterogeneities. This study will integrate natural fractures from core, borehole image logs and outcrop(s) to examine their impacts on the flow simulation before and after upscaling. Also, geostatistical analyses will be utilized to predict all possibilities of the reservoir heterogeneities, such as permeability and porosity, in sparse areas. Specific workflows are presented to examine the optimum upscaling characterized in this study.