Integrating Information from Multiple Sources to Generate Geologically-Realistic Models: The Multiple-Point Statistics/Facies Distribution Modeling Workflow

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Building geologically realistic reservoir models that honor well data, seismic-derived information, and production history, remains a major challenge. Conventional variogram-based modeling techniques typically fail to capture complex geological structures while object-based techniques are severely limited by the amount of conditioning data. This talk presents two new reservoir facies modeling tools developed at Chevron that improve both model quality and efficiency relative to traditional geostatistical techniques: Multiple-Point Statistics (MPS) simulation and Facies Distribution Modeling (FDM).

MPS simulation is an innovative depositional facies modeling technique that uses conceptual geological models as training images to integrate geological information into reservoir models. Replacing the variogram with a training image allows MPS to capture complex spatial relationships between multiple facies, and model non-linear shapes such as sinuous channels. In addition, because MPS is not an object-based, but still a pixel-based algorithm, MPS can account for very large numbers of wells, seismic data, facies proportion maps and curves, variable azimuth maps, and interpreted geobodies, reducing dramatically uncertainty in facies spatial distribution.

Facies Distribution Modeling (FDM) is a new technique to generate facies probability cubes from user-digitized facies depocenter maps and cross-sections, well data, and vertical proportion curves. Multiple sources of information (well logs, cores, seismic, and dynamic data) can be used to generate FDM probability cubes. These cubes can be weighted and merged to be used as soft constraints in geostatistical modeling. Such constraints are critical, especially in sparse well environments, to ensure that the spatial distribution of the simulated facies is consistent with the depositional facies interpretation of the field.

A workflow combining MPS and FDM has been successfully used for the last three years to model more than thirty prominent Chevron assets in both clastic and deepwater environments. Some examples of those MPS/FDM modeling projects are presented in this talk.