

Enhanced Permeability Prediction in Wave-Dominated Shoreface Rocks of the Spring Canyon Member, Utah, U.S.A

Les Dabek¹, Rex Knepp², and J. Michael Boyles³

¹Geomodeling Technology Corp., Calgary, AB, Canada.

²Geomodeling Corporation, Houston, TX.

³Shell Canada Ltd., Calgary, AB, Canada.

Generating geologically realistic static models based upon detailed sedimentology and stratigraphic principles results in more predictive dynamic models that result in more predictive dynamic simulations. Modeling of fine-scale bedding structures can enhance prediction of horizontal and, more importantly, vertical permeability. Variations in mud geometries, presence of bioturbation, and ranges in permeability within lithofacies at the lamina scale can have a significant impact on permeability (K_x , K_y and K_z). Accurately understanding these subtle changes in permeability is an important concern for operators working IOR and EOR projects, such as steam-assisted gravity drainage and CO₂ sequestration.

Conventional object-based and process-oriented stochastic methods were used to model a wave-dominated shoreface outcrop of the Spring Canyon Member (Upper Cretaceous), Blackhawk Formation, Utah. This outcrop was chosen because it demonstrates how detailed static models provide flow based upscaled results that can be used in a full field model. Outcrop sedimentologic studies, modern and ancient analogs, probe permeameter and gamma-ray measurements provided input for both conventional object-based and process-oriented stochastic models. Multiple realizations were generated to adequately quantify parameter variability.

This study documents the impact on effective directional permeability imposed by variation in parameters like permeability, bedform geometry, bioturbation, and degree of heterogeneity within bedforms. The simulation models underwent flow-based upscaling to calculate the effective directional permeabilities for each uncertainty realization.

An important aspect of the study is to document how seemingly small modeling decisions can result in models that look geologically reasonable, however, have dynamic properties that are not realistic.