SBED

TECHNICAL BULLETIN

NEAR-WELL-BORE MODELING

OVERVIEW

SBED technology models the small-scale sedimentary details that impact large-scale reservoir performance. Unlike conventional cell-based or object-based models, SBED models simulate bedding structures observed at core scale (where cell dimensions are millimeters to centimeters). By running petrophysical simulations constrained by bedding geometry, users can derive directional permeability for a given lithofacies and identify net pay below the level of petrophysical log resolution. In addition, SBED can help determine the maximum size to which a grid cell may be upscaled without compromising the flow properties.

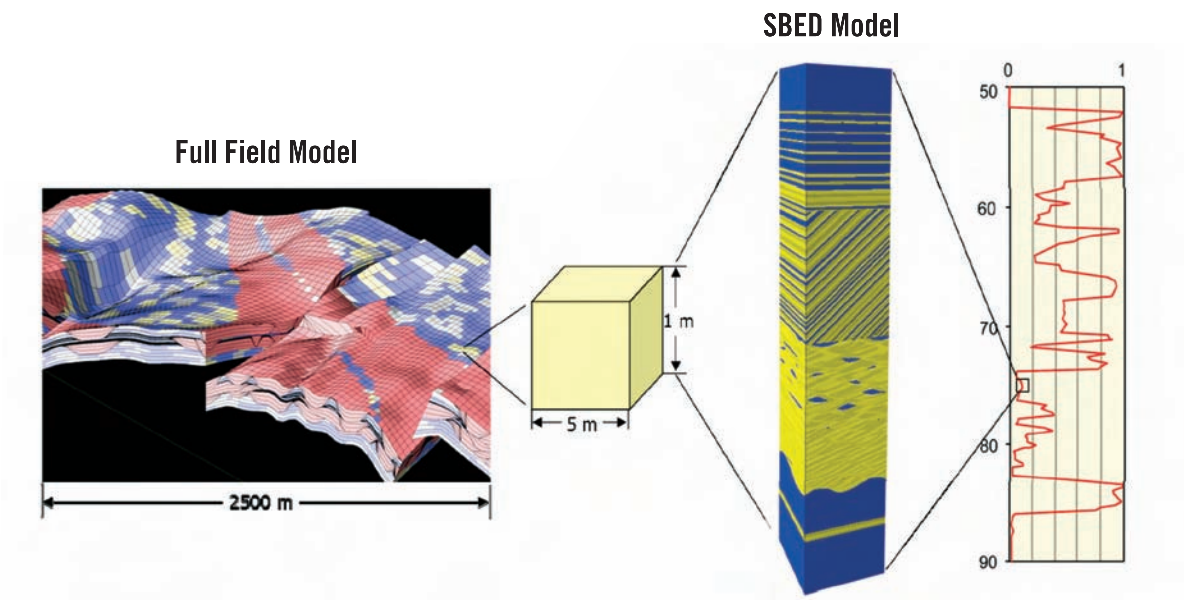

Figure 1. Scale difference between well logs, SBED models and full-field simulation grid.

Small-scale SBED models provide critical reservoir properties to reduce modeling uncertainty, evaluate reservoir potential and optimize recovery in thin-bedded and heterogeneous reservoirs. Estimating net-to-gross based solely on gamma ray cut-off values is subjective and inaccurate for determining net pay in today's low permeability reservoirs. SBED enables users to model the impact of low permeability sands in reservoirs comprised of multiple sand types.

SBED MODELING WORKFLOW

- Identify representative lithofacies intervals by evaluating core, lithology description or borehole images.
- Compile petrophysical statistics such as porosity, permeability and net-to-gross (sand/shale) ratio for each identified facies.
- For each defined interval, generate bedding structure models using built-in SBED stratigraphic templates.
- Populate bedding structure models with porosity, permeability and saturation data. Generate realizations of porosity and permeability grids.
- Stack bedding structure models to simulate a depositional facies (e.g. channel, turbidite) over the entire cored interval.
- Upscale the stacked model to calculate effective porosity, horizontal permeability, vertical permeability, relative permeability, oil/gas/water saturation and net-to-gross ratio.
- Export upscaled SBED geometry and property grids into third-party reservoir simulators to evaluate reservoir quality and associated uncertainties.

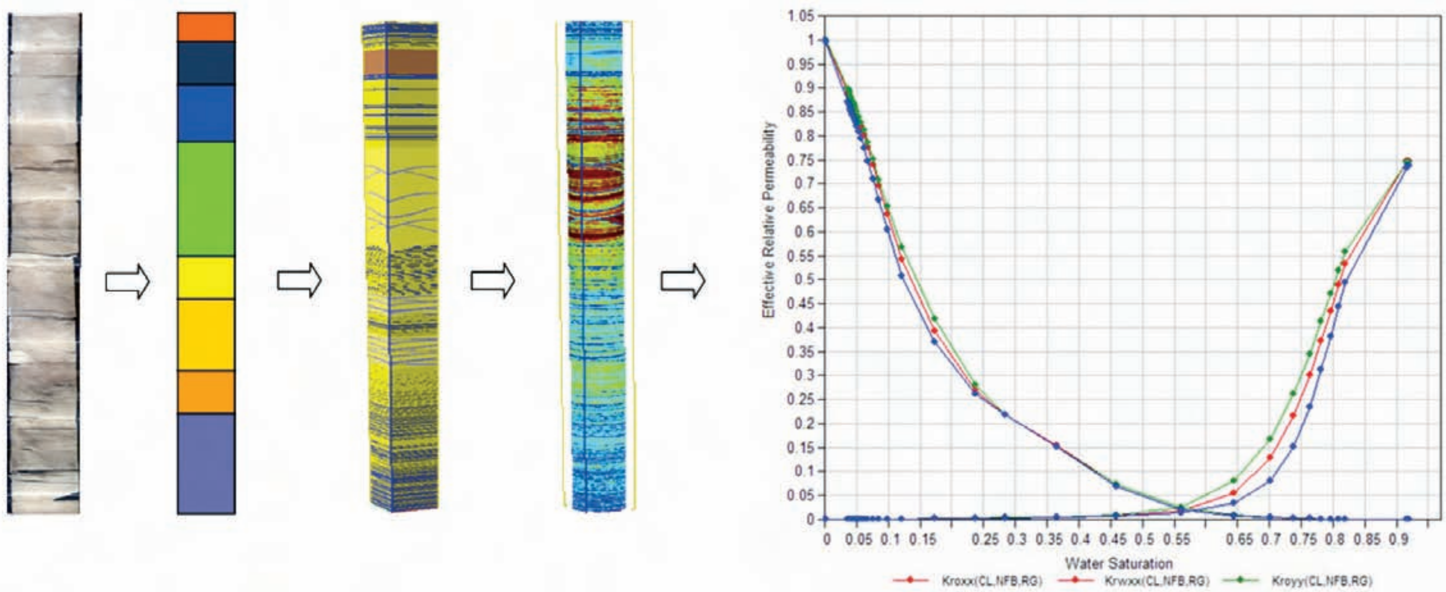

Figure 2. SBED modeling workflow.

REALISTIC BEDDING STRUCTURE MODELS

SBED generates geological models by mimicking the processes involved in the formation of sedimentary bedding, such as bedform migration, erosion and deposition. Formulated in a stochastic framework, the modeling algorithms generate accurate 3D geological models and simulate petrophysical properties that are constrained by bedding geometry.

Figure 3. SBED models mimic sedimentary bedding structures that are seen in core and outcrop.

DIGITAL ROCK LIBRARY

- Access more than 100 built-in stratigraphic templates to quickly and accurately model a wide variety of depositional environments, including estuarine, shoreface and submarine fan environments.
- Customize models using the template library to solve any geologic problem.
- Edit bedding geometry, bedform orientation and boundary conditions to represent core and outcrop observations.
- Input lithological and petrophysical parameters such as sand/shale ratio, porosity and permeability.

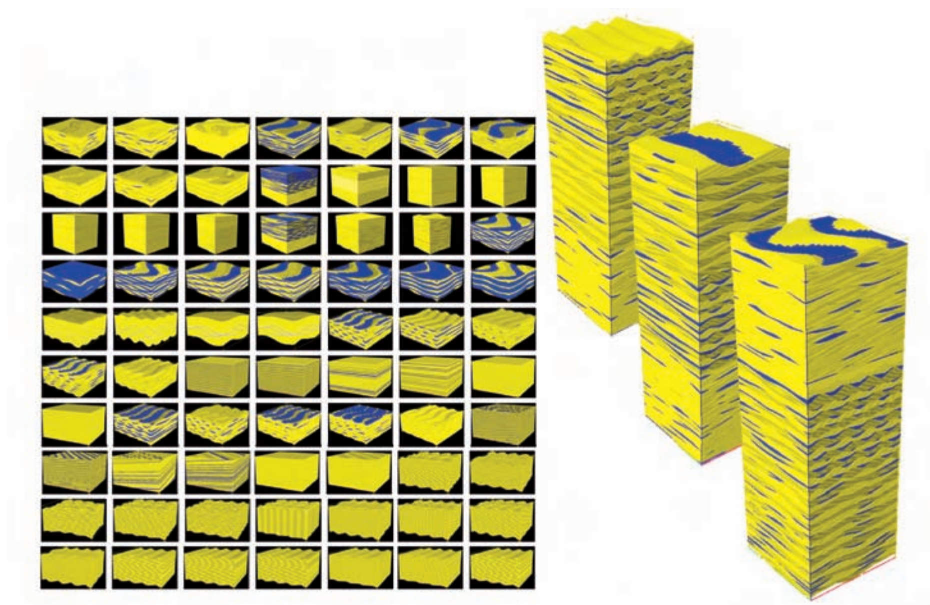

Figure 4. SBED stratigraphic templates can be stacked to model depositional environments observed in outcrop and core.

IMPROVED PROPERTY MODELING

- Input porosity, permeability and water saturation data from core plug and well log analysis.
- Plot the relationship between vertical permeability (k_v) and horizontal permeability (k_h) in SBED models.
- Derive accurate facies-dependent effective porosity and permeability (k_v/k_h) distributions to reduce uncertainty.
- Simulate multiple geological scenarios to understand how sedimentary structures impact fluid flow.
- Generate effective property values for input to larger-scale reservoir property models.

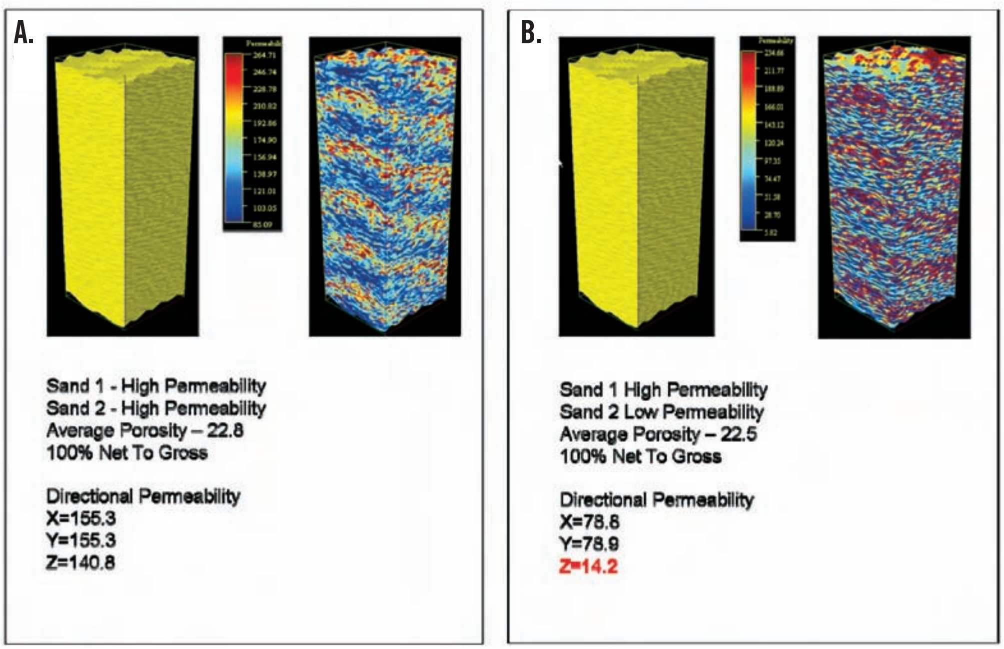

Figure 5. Comparison of permeability values for two scenarios with 100% net-to-gross: (A) interval of two high permeability sands, (B) interval containing high and low permeability sand. Scenario (B) generates permeability values that are much lower than scenario (A) and illustrates the effect of low permeability sand on flow characteristics.

SBED can have a dramatic impact on reserve estimation in reservoirs such as thinly bedded sands or shale-dominated, basin-centered gas plays by revealing net pay below the level of petrophysical log resolution.

SBED offers petrophysical characterization that is superior to simple net-to-gross estimation by providing flow-based reservoir modeling that accurately reflects sedimentary depositional processes.

Geomodeling™

www.geomodeling.com

SBED is revolutionary software for small-scale (centimeter- to meter-scale) geological heterogeneity modeling and upscaling. The software provides detailed 3D geological models for input to reservoir simulators and generates petrophysical models that honor sedimentary processes. As a plug-in to reservoir interpretation workflows, SBED enables asset teams to identify thin bed potential, understand its impact on recoverable reserves, and choose optimal depletion strategies.

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