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# Introduction to special section: Geophysical modeling for interpreters

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## Abstract

Interpretation of subsurface data is done with models, either conceptual or digital. Every interpreter brings to the process a knowledge set of “preconceived answers” derived from literature, illustrated examples, or personal experience. This provides a basis regarding what the “answer should look like.” These prior experiences guide and influence the interpreter in the derivation of geology and properties from the observations of the subsurface. The use of models in interpretation is also utilized when a set of assumptions makes the computation of interpretation results simpler (e.g., a flat layered earth). The simplification process can provide a framework in which classifications become easier, as in amplitude variation with offset (AVO) analysis.

Models may also be employed in the interpretation process when they are built for purpose to either help illustrate a principle or to confirm an interpretation of structure, stratigraphy, or properties. These are forward models that predict the response of the subsurface in order to match observations. When the model response looks like the observations, it becomes a possible “answer” to the interpretation.

The purpose of this special section is to help subsurface interpreters understand more about why models are important, how they are constructed for interpretation purposes, how they are used in the interpretation process, and how they impact an interpretation. The following papers include examples of the impact of modeling regarding structure, microstructure, stratigraphy, and rock properties:

**Wood et al.** use seismic forward modeling to illustrate the importance of understanding and accounting for a range of structural uncertainties during hydrocarbon exploration. The potential pitfalls when extrapolating 2D data into three dimensions are demonstrated and provide a useful reference for interpreters to appreciate the limitations of 2D data.

**Filina et al.** construct models of an integration of 3D seismic, gravity, and well data in support of a proprietary seismic reprocessing project in the western Gulf of Mexico. This integration resulted in a more robust salt model, which led to significant improvements in subsalt seismic imaging.

**Julio et al.** model flow simulations that are performed on a set of 100 en echelon fault models, which mainly vary in number of fault segments and in connectivity between the segments. The simulation results highlight the importance of integrating fault connectivity uncertainty in reservoir behavior studies.

**Lecomte et al.** review the use of ray-based methods for efficient and flexible seismic modeling to support interpretation. The authors focus on a 3D spatial prestack convolution approach extending convolution modeling to 3D PSDM images, and the latter can thus be analyzed in terms of survey- and model-dependent illumination/resolution effects.

**Adelinet et al.** use the effective medium theory (EMT) to infer porosity and fracture data from seismic impedances in part of the Fort Worth Basin, Texas. The EMT proves to be a useful tool to explain reservoir and geophysical data in terms of microstructural properties, in particular for fractured reservoirs.

**Pelham et al.** show how simple seismic modeling during the processing, AVO analysis, and inversion of seismic data is used to provide reliable, robust volumes for the interpreter. Visual quantification of the sensitivity and uncertainty of the results when compared to well results are also presented.

**Verma et al.** illustrate in four separate case studies that seismic attribute study on seismic modeling results helps significantly in testing possible interpretation hypotheses.

**Sapia et al.** describe 3D modeling of buried valley aquifers via cognitive-based procedure for interpreting airborne electromagnetic data.