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Early Characterization of the Reservoir Reduces Uncertainty

Progressively integrating characterization through the use of embedded QSI tools provides a way to drastically reduce drilling risk.

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The oil and gas industry is facing an economic downturn again, and the ability of both operators and software and service providers to confront these challenges is becoming increasingly critical. There is an urgent need for technologies that can help reduce drilling risk and increase productivity, leading to better results and higher profitability.

The integration of early quantitative seismic interpretation (QSI) into the seismic interpretation process is one of the most effective methods for reducing uncertainty. The uncertainty, which needs to be taken into account when drilling decisions are made, is a cumulative result of approximations, decisions and knowledge accumulated in the past. Therefore, adding QSI to daily interpretation work can help companies thrive, even in today's economy.

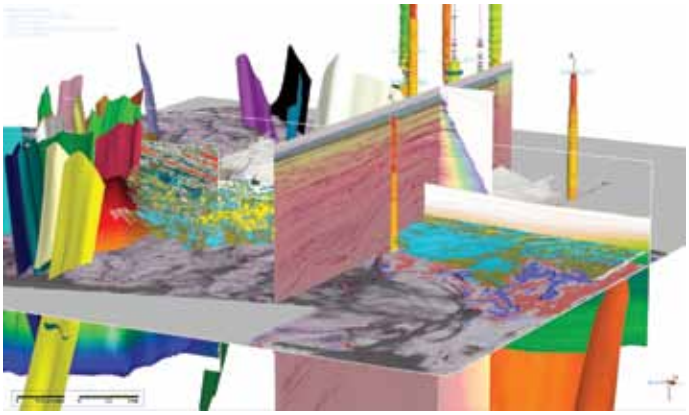
Some of these techniques still are perceived as being appropriate for only specialists. To make them available to the wider interpretation user base, efforts have been made in the industry to simplify tools but not science, with the aim of reducing risk through the integration of more knowledge. Techniques like colored inversion, amplitude-vs.-offset (AVO) inversion and neural networks are creating new opportunities to turn QSI workflows into "bread and butter" techniques for the interpreter, in a similar way that seismic attributes became an interpretation core competency.

Early leads to better

One of the challenges for optimizing hydrocarbon production or infill development in laterally heterogeneous reservoirs is to combine geological information about lithology and geophysical data acquired through reflection seismic data. Beacuse the source of information can vary (lithology logs, cuttings, and for seismic, post- and prestack attributes) and be of different resolutions, manually integrating all such available data implies tedious work for the analyst and is a task that might sometimes be considered impossible in a limited time frame. The ability to provide interpreters with all the relevant tools in an integrated environment is opening new fields of possibility. A rough estimate of lithology and fluid content can be performed in early stages to best estimate the economic viability of a prospect and rank it among others. This estimation is then iteratively refined over time to reduce uncertainty.

Scale the tools to the need

QSI methodologies need to be adapted to the different types of users. For example, QSI for rock and fluid properties, which is well suited to interpreters, should contain tools that are slightly different than configurations designed for reservoir geophysicists. The first needs to provide a way to estimate gross lithology and discriminate false hydrocarbon indicators from true ones. Colored inversion, AVO inversion and AVO modeling already are used for that purpose by many interpreters, as this type of data has long been available. The second configuration should have tools for analyzing elastic properties and preparing better inputs for reservoir modeling. It also can experiment with new technologies to allow the creation of realistic models. All of the steps are interdependent, and each one, if well controlled, limits uncertainty for the next. The impact of early characterization on appraisal wells has a strong influence on exploration and later development investments.



Early estimation of facies distribution using elastic properties and AVO analysis provides an estimation of reservoir distribution and heterogeneities. (Image courtesy of Paradigm)

Finally, when fluid flow is impacted by natural fracture systems or when fracking is involved, it is crucial to integrate QSI for the estimation of azimuthal fracture properties. The ability to integrate fracture interpretation from borehole images with the latest full-azimuth data provides a unique way to control the impact of fracture sets on well production.

The impact of rock, fluid and fractures is obviously critical to the financial return on any prospect. Progressively integrating characterization through the use of embedded QSI tools provides a way to drastically reduce drilling risk. At each step of the prospect's life cycle, it ensures the cohesion of the interpretation scheme and provides a consistent way to move between interpretation and modeling. ■