New Approaches to Interpretation and Validation of Structures in 3-D

By

F. Jaffri[1], C. Whitefield[1], P. Griffiths[2], A. Gibbs[2] and J. Brown[1]
[1]Midland Valley Services Inc., Boerne, Texas, USA
[2]Midland Valley Exploration Ltd, Glasgow, UK

In assessing the success of production and exploration drilling worldwide, a critical factor is the structural model. The most common reason for wells to miss their target or fail in their technical objectives is a problem in this structural model. The expected improvement in the structural models derived from the use of better quality seismic data has not generally happened because of the difficulty of accessing suitable structural technology. Therefore, if we are to optimize our commercial successes, we must seek accessible technologies and strategies that reduce the risk of technical failure.

We believe that by combining the best practices of seismic interpretation and structural validation into a common process, the structure model will be improved, and the technical risk associated with the model will be reduced.

We illustrate how application of this methodology to a currently active exploration region, offshore west Africa, has already helped in imaging strike-slip faults, extensional faults, and their associated tip structures, branch lines, splays and transfer faults together with the footwall and hangingwall deformation related to these features. In addition, we show how the approach helped in imaging structures in areas of poor quality seismic data.

The new approach involves combining the use of standard seismic interpretation and structural modeling software and techniques. The fault network is initially picked and validated by dynamically transferring the data between the interpretation package and the structure modeling package. The interpreted faults are then examined in the structural modeling package to check for fault linkages. These validated fault geometries are transferred back to the interpretation package to be used as added control in horizon picking.

With a conditioned fault network established, the horizon markers are picked on a fault block by fault block basis. Both kinematic (move-on-fault) and non-kinematic (jigsaw fitting) restoration techniques are available to test the validity of horizon-fault geometries.

This technique rapidly results in the selection of the optimum picking strategy and eliminates unfruitful strategies and structural models early in the project. The application of this approach has demonstrated a reduction in interpretation time from receipt of processed seismic data to completed volume model. Moreover, the completed model is validated, and a numerical estimate of technical risk can be applied to the model due to the developed understanding of the sensitivities attached to the structural architecture.

By combining the best structural practice and the latest software engineering advances with experience-based workflow techniques, we have developed a powerful new approach to improve the structure model. Developed workflows provide a step-by-step guide through the decision making process and the application of the techniques to a number of different structural regimes. We believe the workflows combined with automated and semi automated structural restoration, will both speed up the analysis, and help overcome the challenge of disseminating this approach throughout the geological community.