Improving Accuracy of Structural Model in Thrust Belt Using Integrated Workflow

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In thrust belt settings, the accurate determination of subsurface structures often remains a challenge. This presentation aims at showing that a strong combination of geological and geophysical studies including field work, laboratory measures, seismic imaging and geological modelling is essential to ensure the quantitative evaluation of the main structural features: fault characteristics, layer thickness variations, depth interfaces, erosion time parameters.

This method benefits from advances in structural modeling and seismic migration software and the workflow is a sequence of successive applications requiring efficient control criteria between steps. The structural model is then built step by step with various types of model grid parameterization. The consistencies between these different models must be checked using structural coherency controls.

The case study of the central part of the Gaspé belt (Northern part of Canadian Appalachians) is used to illustrate the benefits of this integrated geological-geophysical approach, especially the limitation of the geological ambiguities and the estimation of quantitative structural parameters. The present belt geometry is complicated by the fact that the Siluro-Devonian rocks were deposited on and deformed over the previously structured Cambro-Ordovician basement. Our objective is to propose and validate a new 3D structural model for the Acadian fold belt.

Firstly, depth imaging of 2D seismic lines was performed to improve the time to depth conversion and to provide more reliable seismic interpretation. Then, the geometrical consistencies of the model were ensured by applying kinematic restoration. Finally, using Kine3D, a plug-in developed by IFP, a new 3D model was built integrating both seismic and geological data. Between each step, the model description is checked using geometrical and geological consistency criteria which are used to update the structural model.

This integrated workflow is applied to obtain more realistic geometries that provide additional knowledge in order to identify new potential structural traps for hydrocarbon exploration in complex structures.