Combining Geology and Prestack Seismic for Structural Model Building in the Gaspé Belt (Québec, Canada)

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Abstract

The challenge of seismic exploration in foothill settings is to optimize the image, frequently of poor quality, of the deep structural objectives underneath series showing velocity variations and generating seismic energy perturbation.

This presentation aims to show that a strong combination of geological studies including field work, and structural modelling, and of advanced pre-stack seismic techniques like pre-stack seismic interpretation, traveltime inversion and depth migration, can improve the understanding of the geological structure and reduce the uncertainty when building the depth structural models.

The case study of the Gaspé belt in the Québec part of the Northern Appalachians is used to illustrate the geological benefits of this combined geological-geophysical approach. Its present geometry is complicated by the fact that the Siluro-Devonian rocks (Acadian fold belt) were deposited on and deformed over the previously structured Cambro-Ordovician basement (Taconian fold belt).

Due to the flexibility and efficiency of the IFP inversion software, various types of seismic events, e.g. reflection and first arrival travel times, can be inverted to compute velocity models. The blocky and smooth model parameterization can be selected depending of the encountered structural complexities. These traveltime inversions require a reliable horizon picking in seismic pre-stack domain and are constrained by geology to limit the ambiguities of depth seismic imaging in complex subsurface.

The computed structural depth model will then be used for a more realistic delineation of the main folds and faults and of the relationships between the two thrust belts.