An Integrated Workflow for Shale Gas in the Western Canadian Sedimentary Basin: Surface Seismic to Stimulation

Close, David I.[1]; Horn, Frederik [1]; Cho, David [1]; Cameron, Greg [2]; Malapad, Maggie [3] (1) Reservoir Seismic Services, Schlumberger, Calgary, AB, Canada. (2) WesternGeco, Schlumberger, Calgary, AB, Canada. (3) Data Services, Schlumberger, Calgary, AB, Canada.

Lockstep with increased North American and global shale gas activity over the last decade have been advances in technology and operational efficiency, primarily in completion and stimulation engineering. More recently there have also been advances in geological and geophysical characterization of these 'resource plays'. Currently, there is much interest in integrated geological, petrophysical, geomechanical and geophysical workflows for shale gas characterization, with different degrees of scientific sophistication evident amongst different operator and service companies.

In this paper we present a case study from an active shale gas play in the Triassic age Montney Formation, Western Canada, which integrates surface seismic amplitude and elastic property volumes with petrophysical data, geomechanical modeling and micro-seismic monitoring results. The integration of reflection seismic data and appropriate attributes brings more geophysical rigor to a traditionally engineering dominated play type.

For the geophysicist, mapping major structures and looking for closure becomes less imperative in shale gas, where in-situ permeabilities are typically sufficiently low that there is no mobile gas. Geophysics can, however, provide significant uplift in reservoir characterization studies of shale gas. The heterogeneity in shale composition subtly alters its seismic response. Experience and modeling results suggest that stack data is minimally sensitive to the heterogeneity, and to provide maximum uplift pre-stack simultaneous AVO inversion for elastic parameters (Poisson’s ratio and/or Lame parameters Lambda-Rho and Mu-Rho) is necessary. Geophysicists can also help identify subtle structural trends using seismic attributes sensitive to discontinuities and reflector geometry.

We demonstrate the uplift of integrating 3D seismic reflection and AVO inversion data with petrophysical data from available well logs into an holistic reservoir model. This allows the geophysical interpretation to be quality-controlled by measurements at the wells. Inversion and petrophysical data can also be used to generate deterministic and stochastic reservoir models and also to extrapolate 1D Mechanical Earth Models (MEMs). Image logs, production data, and micro-seismic monitoring of hydraulic fracture propagation are discussed as means of calibrating geophysical interpretations and reservoir modeling efforts.