

A Workflow to Estimate Reservoir Properties of Unconventional Gas Shales: A Case Study on the Haynesville Shale

Jiang, M.¹, Spikes, K.¹

meijuan.jiang@utexas.edu

1. Jackson School of Geosciences, The University of Texas at Austin, Austin, TX

Reservoir properties, such as porosity, composition, and pore shape of gas shales are important for both exploration and production. This work presents a workflow to invert for these properties from well log sonic data for unconventional gas shales, using the Haynesville Shale as a case study. Two rock physics models, an isotropic and an anisotropic one, were combined with a grid search method. Rock physics models for unconventional gas shales must model multiple solid phases, their shapes, pore shape distributions and anisotropy because the composition and pore shapes significantly affect the elastic moduli and velocities of the rock. In the workflow, the isotropic model represents a complex medium as a single homogeneous medium by including grains and pores of different shapes and sizes; the anisotropic model treats the shale as a vertical transversely isotropic medium by introducing aligned fractures. After the relationships between the reservoir properties and elastic properties (P- and S- wave velocities) were built by rock physics models, a grid search method was used to estimate porosity, composition and pore shape. In the grid searching, P- and S- wave velocities from the rock physics models were compared with the measured log data. The modeled seismic velocities that satisfied specific criteria provided the estimated reservoir properties. The workflow was applied to the Haynesville Shale and provided simultaneous estimations of porosity, composition, and pore aspect ratio distributions at the well location. The porosity and composition estimations matched the observations from log and core data within a few percent. When we apply this workflow to seismic scale where there are continuous seismic velocities inverted from 3D seismic data, we will be able to obtain spatial distributions of these reservoir properties and, therefore, provide optimal locations for exploration and production wells.

Keywords: Shale, Rock Physics Model, Reservoir Characterization, Statistical Inversion