3D PP and Geomechanics: Work Smarter and Faster Integrating Geoscience with Machine Learning

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ABSTRACT

In unconventional plays, given the comparatively short drilling times and the likelihood that operators have multiple active rigs, wells are drilled and data is acquired at an unprecedented rate. In the Delaware Basin, a typical well takes approximately 3–4 weeks to complete from rig acquisition to release, and given that major operators can have upwards of 25 rigs running concurrently means, on average, a new well is completed every 1–2 days at a cost of $6–9M per well.

For the exploitation of these unconventional plays, pore pressure prediction plays a critical role in the ability to predict areas of higher productivity, assuming a direct relationship to overpressure and stress. Shales in these plays have variable clay content and complex multi-mineral fractions that require a detailed petrophysical assessment reinforced with rock physics and geomechanical modelling. Therefore, performing manual, consecutive workflows for petrophysics, pore pressure, and geomechanics prediction can be impractical due to turnaround considerations and the multiple personnel required. This, together with technical challenges of complex stratigraphy, multiple facies, variable rock properties, and the interaction of pore pressure and geomechanics, calls for more consistent, sophisticated, and faster analytical tools.

A supervised deep neural network approach is introduced as an innovative tool for upscaling the valuable manually derived models for petrophysics, pore pressure, and geomechanics across all the offset wells and then into the seismic domain in a fraction of the time. Application of machine learning in this domain enables the subject matter experts, who derived the interpretations that formed the training dataset from which the machine learning algorithms were derived, to focus their time on blind testing the results from machine learning rather than wasting their time repeating manual workflows on each well delaying the integration into the holistic basin model.

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