Evaluating Seal Integrity Using Dynamic Poisson's Ratio and Young's Modulus

Zakiyah Alkhadrawi, Maitham Alabbad
SAUDI ARAMCO

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Abstract

The presence of effective top, base, and lateral seals is essential for trapping hydrocarbons in stratigraphic traps. Evaluating seal integrity and effectiveness in areas of limited core coverage requires the integration of conventional and unconventional evaluation techniques. Workflows developed for assessing unconventional reservoir brittleness and fracking behavior can be effectively used to evaluate the seal integrity of potential traps. Based on a suite of wireline logs consisting of density, compressional sonic, and shear sonic, Poisson's Ratio and Young's Modulus were computed to study the elastic properties of the seal. Poisson's Ratio (PR) and Young's Modulus (YM) relationships were used to define brittle and ductile intervals within the potential seal section. Moreover, correlating calculated wellbore curves enabled the prediction of seal integrity in the surrounding areas. Even with limited well control, having one well representing an effective seal and another well of breaching seal, a clear change in elastic behavior is observed when cross plotting PR and YM. Depending on the thickness of the sealing interval, the effectiveness of the seal can be predicted from calculated elastic impedance using seismic parameters. This can be done on 3D volume or 2D lines. The established relationships were correlated to depositional facies to enhance the predictability. Seal effectiveness is a function of depositional facies and mineral composition of the seal. To enhance the prediction of the seal layer, the integration of elastic properties and depositional models is required. This technique was applied to assess the seal effectiveness in wells with no core coverage. In addition, the application of this technique to evaluate seal integrity helps to mitigate one of the critical risk elements in hydrocarbon play analysis.