Integration of Sedimentary Petrology and Elastic Rock Properties for Quantitative Interpretation: An Example from the Gulf of Mexico

Sourav Saha[1], Ritu Sarker[1], Neal Auchter[2], Irene Espejo[2], Stephan Gelinsky[2], Olga Rodina[2], Aysen Ozkan[2], Camilo Goyeneche[2], Michael Ehiwario[3], Afolabi Babalola[2]
[1]Shell Research Ltd; [2]Shell International Exploration and Production; [3]Shell Exploration & Production Company

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Recent discoveries in the Central and Western US Gulf of Mexico contain oil in Paleogene reservoirs. Reservoirs are heterogeneous and complex, featuring flow units of varying porosity and permeability, posing challenges for optimum reservoir development. An integrated approach to classify the reservoir rocks combining petrology, petrophysics and quantitative interpretation (QI) techniques to identify dominant sandstones and shales from core, and calibrated log responses, is presented here. A thin section-based rock types scheme (petrofacies) was translated into a log-based e-facies to build a predictive rock property framework and aid the interpretation of an elastic seismic inversion. Core descriptions suggest an unconfined depositional environment including lobe axis, off-axis and various lobe fringe facies assemblages for the main reservoirs. Representative thin sections were used for sandstone classification in terms of texture, sedimentary structures and diagenesis. Mudstones were classified based on the overall texture, presence of framework grains, and some additional attributes. A total of thirteen (13) petrofacies classes were established; those petrofacies showed a good correlation with both core porosity and permeability measurements. The petrofacies-specific porosity-permeability relationships could be used for facies-based reservoir modelling. Prior to e-facies determination, the measured logs were decompacted to remove a systematic depth dependency and were corrected to brine reference condition. These baseline logs were then

used in a principal component-based facies classification, where the petrofacies were used as a guide to yield a robust e-facies scheme based on log behaviour. This scheme was tested in zones where no petrofacies information was available and found to be robust. To reduce overlap between the initial 13 petrofacies, a simplified 5 e-facies scheme was established, with those 5 e-facies showing decent separation in the acoustic and shear impedance domain. The 5 e-facies end-members comprised two different sandstone facies, one shaley sandstone, one calcite cemented sandstone and a mudstone facies. This scheme was carried forward to generate a rock physics scheme which aided in building a low frequency model for the AVO inversion and supported interpretation of the inversion data. The newly derived e-facies scheme helped with the definition of geologic reservoir flow units, allowing for improved reservoir characterization.

AAPG Datapages/Search and Discovery Article # 91200 © 2020 AAPG Annual Convention & Exhibition Online, Sept. 29- Oct. 1.