Rock Physics and AVO Mapping of Lithofacies and Pore Fluid Probabilities: Niger Delta

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Abstract

We successfully integrated statistical rock physics and AVO (Amplitude versus Offset) analysis in identification and mapping of different lithofacies (seismic scale sedimentary units) and pore fluid of reservoirs in "AIB-EX" Oil Field, Niger Delta. Statistical crossplots of Gamma Ray (GR) log versus P-wave velocity, Relative Impedance (RI) versus GR log and histogram plot of frequency against GR log were used as probabilities plots in bi-variate domains and GR, P-wave velocity, and Resistivity in tri-variate domain. Rock physics parameters (P-wave velocity, S-wave velocity and density) were modeled through multivariate regression analysis, and AVO attributes (Intercept versus Poisson's Reflectivity) were obtained using Statistical Packages and Microsoft Excel. The bi-variate crossplots of GR log versus P-wave velocity identified and differentiated the lithofacies (sand, shaly-sand, sandy-shale, and shale) by colour coding using gamma ray index (IGR) serialization. RI versus GR showed that the proper statistical distribution of the reservoirs to be either sandy or shaly based on the signature of gamma ray against the relative impedance on the curve. Additionally, the lithofacies and fluid discrimination of the three reservoirs were carried out in the Poisson's ratio, and impedance spaces, lambda-mu-rho, and AVO domains. It was also observed that the Poisson's ratio of clean gas sand occurs within 0.19 - 0.20. The crossplots of intercept versus Poisson's reflectivity yielded a good result in that it precisely discriminated the reservoirs in terms of lithofacies and pore fluid.