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Combining Structural Interpretation, Rock Physics and Advanced Prestack Full Waveform Inversion to Map Reservoir Properties: Application to Deep Water Gulf of Mexico

The goal of Seismic Reservoir Description (SRD) is to map seismic attributes to reservoir properties such as lithological units, porosity, saturation and clay content. Recalling that the basic physics of seismic wave propagation in elastic isotropic media is governed by three parameters (compressional and shear velocities and density), the problem of seismic reservoir characterization is non-unique. Thus, one must account for all available prior information and analyze the uncertainty associated with the SRD process. This can be achieved if we (1). Identify the rock physics relations that relate seismic attribute to sedimentary properties. (2). Identify the uncertainty associated with these relations. (3). Derive high resolution, accurate seismic attributes and (4). Use all available geological information to constrain the SRD procedure.

To that end we have developed a new, integrated approach that utilize high quality seismic data attributes generated by prestack full waveform inversion, rock physics modeling and Bayesian classification techniques to generate reservoir properties maps. We use structural interpretation and horizon mapping to delineate the reservoir zone. Inversion results generate pseudo-logs of V_p , V_s and density within the pay zone with accuracy of about 10%, 15% and 8% respectively. We are able to delineate layers with thickness of 12.5 m. and produce detailed reservoir properties maps. We can also evaluate the uncertainty associated with each lithological units estimate. This unique combination of geology, rock physics and advanced seismic inversion expertise enabled us to provide detailed reservoir description.