Understanding Lithologic Significance of Amplitude Envelope and Acoustic Impedance Within Oligocene and Miocene Strata, South Texas Gulf Coast

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Distinguishing between sand- and shale-rich sediments is key to delineating economically viable prospects within a sedimentary basin. Researchers have noted that high seismic amplitudes indicate sand-prone sediments, and, as such, could be used to search for sand-rich zones. Whereas this observation may be correct to some extent, amplitude anomalies depend on a variety of geologic variables such as depositional environments, geo-pressure, fluid content, source of sediment supply, burial depth, age, diagenesis, etc. In this study, we integrated seismic attribute, acoustic impedance, sequence stratigraphic and wireline-log analyses to investigate the significance of high amplitudes within selected Oligocene and Miocene intervals along the South Texas Gulf Coast. We calibrated gamma-ray and resistivity logs to 3-D seismic data using synthetic seismograms to associate lithology with seismic data and then generate acoustic impedance (AI) logs and instantaneous amplitude envelope (amplitude) volume. We identified and tied different depositional systems tracts to the seismic data. By cross-plotting logs and amplitude traces, we attempted to establish a relationship between amplitudes and lithology, as well as a relationship between amplitude and AI that could be used to predict lithology in each of the different systems tracts. Our seismic analysis of various systems tracts from three different subbasins show that correlation between high amplitudes and lithology depends on individual systems tracts and basin location. High amplitudes and high AI in a transgressive systems tract in one subbasin were indicative of sand-prone zones, whereas the same attributes were indicative of shales in the transgressive systems tract of another subbasin. Similar observations were recorded in the highstand and lowstand systems tracts. However, if several systems tracts are combined into one zone for seismic analyses no direct correlation is observed between amplitude and lithology. Therefore, seismic analyses of amplitudes should be performed within individual systems tracts when relating amplitudes to lithology.