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## Synthetic Seismogram Analysis of Unayzah Reservoirs in Saudi Arabia

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The quality of Permo-Carboniferous Unayzah reservoirs in Saudi Arabia can vary significantly depending on the depositional environment. Reservoir facies vary laterally from braid plain, to meandering fluvial, to lacustrine sands and silts, to dune, interdune, and sheet sands, with the dune facies usually having the best reservoir quality. Porosity-permeability relationships can also vary significantly depending on facies. A proper understanding of the seismic response is necessary to detect reservoirs, delineate the lateral extent of reservoirs, and to identify reservoir sweet spots. Both pre-stack and post-stack synthetic seismograms are presented to illustrate the variety of seismic responses that are expected due to variations in porosity, thickness, lithology, and fluid type.

Synthetic models indicate that a simple, yet effective technique for optimizing Unayzah well locations is to look for bright amplitudes immediately below the Base Khuff seismic event. The presence of gas, higher porosity sands, and greater reservoir thickness all result in larger reflection amplitudes. However, modeling shows that there is no observable AVO response which will discriminate fluid type within the reservoir. Variations in AVO are observed, but these are due to changes in lithology, not fluid saturation. Due to the large impact of porosity on acoustic impedance, a high porosity wet sand can cause a brighter reflection than a low porosity gas sand. In general, impedance contrasts within the Unayzah are small, resulting in weak reflection amplitudes even for gas filled reservoir rock. Because of the weak impedance contrasts, multiples and sidelobes of adjacent reflections are sometimes larger than primary reflections, making interpretation of seismic attributes difficult.

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