Predicting Thin Dolomitized Gas Reservoirs by Integrating Outcrop, Core, Wireline Log and 3D Seismic Data in Permian-Triassic Sichuan Basin, China

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Abstract

This study shows how high-resolution reef- and shoal-carbonate facies can be interpreted and 5-10 m thick dolostone reservoir units can be predicted by integrating outcrop, core, wireline log and 3D seismic data in a seismic-sedimentologic workflow in Permian-Triassic Changxing and Feixianguan Formations in Longgang field, Sichuan, China. Outcrop and well data revealed the major depositional facies of the carbonate sequences, including evaporite platform, open platform, platform-margin reef or oolite shoal, slope, and basin. A high-quality 3D seismic data set provided crucial spatial coverage for study of lithology, diagenesis, geomorphology, and depositional history. Development of dolomized reservoirs was inferred to closely relate to high-frequency sequence frameworks and to exposure of platform margin during sea-level falls. To reconstruct a high-frequency sequence framework, we generated seismic-stratal slices among time-equivalent sequence boundaries and maximum-flooding surfaces. With each selected stratal slice representing a high-frequency sequence and being tied to facies analysis in sparse wells, seismic-geomorphologic patterns can be interpreted in terms of depositional facies and elements. Viewing of stratal slices in the order of geologic time revealed migration of facies along paleoshore lines, which were controlled by high-frequency sea-level cycles. A seismic-lithologic analysis was performed by using core-lab data, wireline logs, and seismic models, which correlated multiple thin-bedded dolostone reservoir units to changes in amplitude and other seismic attributes. Sweet spots and reservoir architectures (mound versus clinoform) can be predicted on the facies and attribute maps with variable reliability.