The Utility of Outcrop Analogues in the Exploration and Development of Deep-Water Reservoirs

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Technological advances in seismic acquisition and processing have allowed the observation of sedimentary bodies in the subsurface with increasing resolution, and in turn revolutionized the way we view deep-marine depositional systems. An inherent limitation to seismic studies, however, is the difficulty in resolving deposits at the scale of many hydrocarbon reservoirs. As a result, a common approach to better understanding the facies and reservoir-scale architecture of seismically imaged deep-water strata is to assess analogous deposits in outcrop. The utility of this approach is demonstrated using a subsurface dataset from the Austrian Molasse Basin of central Europe, and comparable deposits from the Cretaceous Magallanes Basin in South America.

A recently acquired 3D seismic volume that covers almost 2000 km2 reveals that sediment (and reservoir) distribution in the gas-pone Puchkirchen Formation of Austria was controlled by a large channel complex that was active along the axis of the foreland basin. Large-scale depositional elements of the channel system are seismically mappable, however, individual reservoirs are typically too small (< 10 m thick) to be observed within the resolution of seismic data. Information from wells provides important information about reservoir properties and vertical facies shifts; however, it cannot typically provide information about the 3D geometry of a reservoir. Tying observations at the bed scale (from core) and depositional setting scale (from seismic) is crucial for optimizing exploration and development in the basin. In order to make this link between scales, as well as improve our understanding of reservoir architecture and performance, outcrops characterized by similar facies that were deposited under the influence of similar sedimentary processes are analyzed.

The Cretaceous Cerro Toro Formation of the Magallanes Basin in southern Chile represents an excellent outcrop analogue to the Puchkirchen Formation. In both study areas, sedimentation took place within large channel belts that were present along the axes of foreland basins, channel fills are comparably dominated by conglomerate and sandstone, and sedimentary body geometry is also similar. The outcrop analogue provides insight into reservoir architecture and heterogeneity in the Puchkirchen Formation at a scale not imagable in seismic data. Through the incorporation of 3D seismic, well, and outcrop data, a better understanding of sediment distribution in the Molasse Basin is achieved. The knowledge gained is demonstrated to be applicable to future exploration and development of reservoirs in the region.