

laminated sandstones as displayed in cores. The composite bedsets of the point-bar facies are significantly thicker than the bedsets of the longitudinal-bar facies. The thinly stacked nature of the longitudinal-bar composite bedsets produce an apparent random dip pattern. However, individual bedsets within the sequence show a decrease in dip upward.

Azimuth-frequency plots of cross-bed dip directions yield valuable information on the reservoir morphology. A unidirectional azimuth pattern indicates a predominant paleocurrent direction characteristic of point-bar deposition. Longitudinal-bar sandstones produce a multidirectional azimuth pattern due to stream bifurcation. However, the general paleocurrent direction can be determined from a weighted average of the azimuths. The local sandstone trend of each facies is in the direction of the paleocurrent. Azimuth-frequency plots of the overlying shale drape are 90° out of phase with the paleocurrent direction, indicating that the thicker sandstones of the trend lie in the opposite dip direction of the shale drape. Paleogeographic reconstructions based on paleocurrent and shale-drape data show that the point-bar facies has a broadly arcuate, dip-trending morphology of high sinuosity, and the longitudinal-bar facies has a gently curving, dip-trending morphology or low sinuosity.

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Atokan Clastics of Fort Worth Basin—Depositional Environments in a Foreland Basin

The sedimentary evolution of the Fort Worth basin may be explained by tectonic movement within the basin and bounding features. This tectonic activity was the primary constraint on the depositional environments and distribution of the clastic sediments from the basin's margins.

Previously, the lower Atoka Big Saline (Bend) conglomerates of the Fort Worth basin have been interpreted as a part of the larger Atokan clastic sequence derived from the Ouachita orogene. However, the distribution, progradation of depositional environments, and reservoir qualities of these sediments suggests an alternative interpretation. The Big Saline (Bend) conglomerates appear to be derived from the Muenster-Red River arch complex to the north and transported into the basin through a series of prograding, high-constructive deltas.

Seven primary deltaic facies are recognized for the Big Saline (Bend) sediments. The facies include (1) point bar; (2) distributary-mouth bar and bar finger; (3) distributary-channel fill; (4) meander-channel fill; (5) crevasse splay; (6) backswamp marsh; and (7) undifferentiated delta front and prodelta deposits.

Contemporaneous with Big Saline (Bend) deposition, clastics derived from the Ouachita orogene were deposited in the deeper, eastern part of the basin. Deposition occurred primarily in fan-delta complexes; however, deep-water sedimentation in the form of submarine-fan deposits is also recognized. This eastern influx of sediments continued after the cessation of Big Saline (Bend) deposition.

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New Method for Determining Paleocurrent Direction

A new technique has been developed for determining paleocurrent direction for siliciclastic formations. Develop-

ment of an efficient and accurate technique for determining this has been a recurring problem in both industry and university research labs for the past 20 years. The new technique measures variations in the intensity of a beam of coherent light reflected from a polished horizontal surface on an oriented core. These variations indicate the orientation of the resultant vector for the optic axes of the quartz grains in the surface. Since the optic axis of a detrital quartz grain is statistically sub-parallel to its long axis, determination of the orientation of the optic axes is equivalent to determining the orientation of the long axes. In most noneolian siliciclastic deposits, the orientation of the long axes of the sand grains are parallel with the flow direction of the depositing fluid. Paleocurrent data from oriented cores have two uses in the mature oil field. First, they would aid in development drilling by providing accurate sand-body trends. Second, since the permeability of a sandstone is greater parallel with the grains than across them, the data should be useful in designing secondary and tertiary recovery programs.

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Types and Controls of Facies-Stratigraphic Traps in Permo-Pennsylvanian Carbonates in Permian Basin—Exploration Models

Many existing and undiscovered hydrocarbon reservoirs in Permo-Pennsylvanian carbonates of the Permian basin are stratigraphic traps in various shallow-marine depositional facies. Paleoenvironmental interpretations and an understanding of the causal relations among facies occurrence, mappable paleogeologic features, and regional stratigraphy provide predictive models in the exploration for similar traps in the Permian basin.

Some of the depositional environments recognized in shallow-shelf carbonates in this area include strandline beaches, tidal channels and barrier bars, lagoonal and inner-shelf patch reefs, and shelf-marginal oolitic or bioclastic grainstone shoals and organic buildups. The areal occurrence, geometry, and reservoir-trap configurations of each of these facies and, hence, the strategy and model-approach toward their exploration, are dictated by an understanding of the interplay between several factors, including paleobathymetry, relative rates of subsidence and sedimentation, regional stratigraphy and history of transgression or regression, and complexities of diagenesis. The coincidence, or lack thereof, of preexisting structure or bottom topography and the predictability of occurrence of a given depositional facies are probability potentials dependent on the nature of regional sedimentation patterns and the types of sediments and/or organisms present during deposition.

Porosity evolution in these facies may or may not be related to and mappable together with depositional facies. Porosity formation or occlusion may occur in a spectrum of diagenetic environments from eogenetic (submarine and meteoric exposure) to mesogenetic (deep burial). Porosity types and reservoir permeabilities are dependent on original facies textures and timing of porosity formation.

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Dipmeter Interpretation of Cherry Canyon Reservoir Sandstones, Delaware Basin, New Mexico

Stratigraphic interpretation of high-resolution dipmeter logs can provide important information concerning the mor-