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Integrating Outcrop Data and Modern Subsurface Logs to Define New Opportunities for Exploitation of Remaining Oil in Carbonate Reservoirs: Permian, West Texas

Even in mature stages of development, carbonate platform reservoirs typically display low recovery efficiencies. This is generally a result of the limited resolution of reservoir architecture and flow unit character provided by subsurface data sets. Permian carbonate platform reservoirs in West Texas are good examples. The San Andres/Grayburg reservoir at Fuhrman-Mascho field, at a current recovery efficiency of 33 percent of original oil in place, was originally considered a single reservoir succession. Recent integrated re-analysis using data from outcrops, cores and specialized wireline logs, however, reveals three very different component reservoirs, each characterized by distinctive facies, rock fabrics, petrophysical character, and flow unit continuity.

The topmost Grayburg reservoir is dominated by continuous, highly permeable, cycle-based siliciclastic beds that are definable on conventional logs. Because of their continuity, these beds are an excellent candidate for secondary recovery strategies. By contrast, definition of boundaries and architecture within underlying upper and lower San Andres reservoirs is not possible with conventional tools. Integration of outcrop, core, and specialized wireline log data show that reservoir quality in the upper San Andres reservoir is controlled by depositional facies. Poor quality, discontinuous tidal flat carbonates that dominate much of the field are poor candidates for flooding. Better quality subtidal rocks down structural dip represent an underexploited target, however. The lower San Andres reservoir owes its origin to diagenesis below a sequence boundary formed during major sea level fall. Although an excellent target for advanced recovery operations, this widely continuous zone may have been overlooked in many San Andres platform carbonate reservoirs.