FACIES RELATIONSHIPS AND DEPOSITIONAL ENVIRONMENTS OF LOWER TUSCALOOSA FORMATION RESERVOIR SANDSTONES IN THE McCOMB AND LITTLE CREEK FIELD AREAS, SOUTHWEST MISSISSIPPI

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ABSTRACT

Excellent conventional core control and electric log (SP) signatures were used to compare stratigraphic facies relationships and depositional environments of the productive reservoir sandstones of McComb and Little Creek fields. Part of the "updip" Lower Tuscaloosa productive trend, these fields are structurally modified stratigraphic traps formed by the combination of gentle structural nosing and updip pinch out of the reservoir sandstones. Current studies confirm that this part of the trend is characterized by two major depositional facies; a lower fluvial sequence topped by nearshore marine deposits. Cumulative oil production exceeds 100 million barrels in the immediate study area.

Recognition of the depositional environments of productive sandstones in the McComb and Little Creek field areas is based on (1) sand body geometry as revealed by detailed isopach maps and cross sections; (2) vertical variations in sedimentary structure and texture based on detailed examination of 19 conventional cores; (3) the nature of boundaries with underlying and overlying sediments; (4) bedding architecture; and (5) regional stratigraphic setting.

Detailed core and electric log studies reveal that the main producing sandstone in the McComb field area ("McComb Sand") was deposited as a transgressive barrier-island complex along a coastline influenced by wave action and tides. Transgressive sands are relatively thin and lenticular in strike and dip sections (Moslow, 1984). This type of geometry is classically referred to as "sheet like". The sands pinch out updip and thicken in a downdip (seaward) direction. McComb field cross sections show the same general architecture. Isopachs of the McComb sandstone exhibit a thickening of the sandstone to the west. This pattern of sandstone thickening is consistent with regional structural maps in the McComb field area which indicate that seaward directions during deposition of the Lower Tuscaloosa Formation lay to the west and southwest.

Sedimentary structures recognized in the McComb sandstone strongly resemble those described by Moslow (1984) and Galloway and Cheng (1985) as characteristic of a transgressive barrier complex. These structures include large-scale low-angle planar laminations and cross-bedded, burrowed sequences typical of foreshore and shoreface environments as well as thinly laminated, flasered, and burrowed sequences representative of lagoonal and tidal flat sequences. Coarsening-upward sequences were identified in 10 of 14 McComb cores and probably represent shoreface and barrier facies. The remaining cores comprise generally thinner fining-upward and mixed sequences typical of washover fan, tidal-channel, and tidal-inlet sequences. Tidal inlets tend to migrate laterally along a shoreline, reworking barrier island sediments, which are re-deposited as sequences of fining upward inlet-fill. Tidal channel and/or inlet sequences in the McComb sandstone were identified in as many as three cores.

Sandstones of transgressive barriers migrate landward and commonly overlie lagoonal, marsh, and/or tidal-flat deposits comprised mostly of silts and muds. Intense bioturbation, especially that produced by burrowing, is often a feature of fine-grained and sandy tidal-flat and lagoonal sediments. The core study revealed that strongly bioturbated and flasered silty and sandy mudstones (interpreted as tidal-flat and a lagoonal facies) occur throughout the McComb field immediately below the base of the productive sandstone.

The producing sandstone in Little Creek field (Denkman sand) differs from those in McComb field with respect to depositional environment and stratigraphic position. The Denkman sand occupies a lower stratigraphic position in the "Stringer Sand" section than the McComb sand. The McComb sand is approximately 50-60 feet below the base of the Middle Marine Shale Formation, a unit clearly of marine origin on the basis of glauconite occurrence and fossil evidence. The Denkman sand is 70-80 feet below the Middle Marine Tuscaloosa Formation, closer stratigraphically to the Dantzler Formation (Lower Cretaceous), which is continental in origin.

Eisenstatt (1960) and Busch (1974) report that sandstones of the Little Creek field are the product of meander belt deposition. Their conclusion is based on the Denkman sandstone isopach map produced by Eisenstatt (1960) which illustrates the concentric and ovoid pattern of irregular shape and thickness often observed in maps of meander belt deposits. The core analysis of this study is in accord with their conclusion regarding the depositional environment of the reservoir sandstones. However, the meandering stream responsible for the deposition of the Little Creek point bars was considerably smaller than that proposed by Busch (1974). Multi-story point bar cycles are clearly evident in the Sun Oil Co., #1 Busby A (Sec. 23-4N-8E) and Sun Oil Co., Atkinson B-1 (Sec. 2-4N-8E). The Little Creek reservoir sandstones are up to 66 feet thick and composed of at least two full or partial point-bar cycles, the thickest single point bar being on the order of 30 feet. The thickness and continuity of full point bars indentified in the core indicate that the sandstones were deposited by a stream approximately the size of the modern lower Brazos River (Texas).

The results of this study, supported by petrographic grain size analysis data, show that two major depositional facies characterize producing Lower Tuscaloosa Formation sandstone reservoirs in this area; a lower fluvial sequence (Little Creek) topped by nearshore marine deposits (McComb). Detailed core data, isolith maps, and cross-sections of the McComb field area reveal that the McComb sandstone was deposited as a transgressed barrier island system at a time when sand supply was diminishing. Thus, the barrier complex marks the shore-zone of the Upper Cretaceous marine transgression in the McComb field area.

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