Sequence Stratigraphy of Upper Cretaceous Alluvial Plain Facies Tuscaloosa Formation, eastern Alabama

David T. King, Jr.
Department of Geology, Auburn University
Auburn, AL 36849-5305

The Cenomanian Tuscaloosa Formation of eastern Alabama crops out in a belt, approximately 10 km wide, and dips south at approximately 3 m/km (Smith and King, 1983; Smith, 1984). The Tuscaloosa rests unconformably on Piedmont crystalline rocks and is overlain disconformably by the Santonian Eutaw Formation (King and Skotnicki, 1994). In this report, Tuscaloosa Formation is used versus the generally accepted term Tuscaloosa Group (Szabo et al., 1988), because Reinhardt and Gibson (1981), among many others, recognize that the Tuscaloosa of eastern Alabama is more nearly like the Tuscaloosa Formation of Georgia than the Tuscaloosa Group in central and western Alabama.

Tuscaloosa alluvial-plain facies in eastern Alabama arc subdivisible into a lower and an upper third-order stratigraphic sequence. Each stratigraphic sequence is further subdivisible into numerous fourth-order parasequences. Parasequence characteristics are different within and between the lower and upper stratigraphic sequences.

Tuscaloosa alluvial-plain environments in eastern Alabama were affected strongly by Cenomanian (96-92 Ma) eustatically induced, third-order sea-level (base-level) changes. In particular, it seems likely that a sharp, 75 m third-order sea-level drop, noted by Haq et al. (1988), at 94 Ma profoundly changed Tuscaloosa alluvial-plain dynamics and initiated an episode of deep channel incision and thick paleosol development that delineates the top of the lower Tuscaloosa sequence. The alluvial-plain streams next had to adjust to a sharp, 50 m rebound in sea-level and subsequent gradual sea-level oscillation over the next several 100 Kyr influencing deposition in the upper Tuscaloosa sequence. A sharp sea-level drop of 125 m at 90 Ma caused deep erosion and channel incision, and eventually lead to related thick paleosol development at the top of the Tuscaloosa.

Regional climatic and local tectonic changes further affected the regional drainage basin, and as a result numerous fourth-order parasequences, consisting of fining-upward sequences bounded by surfaces of thalweg scour and immature lateritic paleosols, occur within each sequence.

Fourth-order parasequences in the lower Tuscaloosa are characterized by 1 to 2 m thick, laterally continuous thalweg deposits of trough and planar cross-stratified, coarse arkosic sand with a significant component of subangular to subrounded, crystalline cobbles and pebbles, 0.5 to 20 cm in diamcter.. Individual parasequences are typically truncated leaving virtually no silt- or clay-size fines at the top. Complete bar deposits are typically not preserved in the lower Tuscaloosa, and the vertical profiles of parasequences do not fit neatly into current braided or meandering stream models.

Fourth-order parasequences in the lower Tuscaloosa are interpreted to represent an unusual, hybrid environment comprised of vast humid alluvial-fans and/or very broad, anastamosing alluvial braid-plains that developed on moderately sloping conditions. High capacity and competence streams of the lower Tuscaloosa first mantled, then buried preexisting crystalline piedmont topography with arkosic sediment. This burial occurred under conditions of probable excess sediment load and heavy continuous (tropical) discharge. High water-table conditions, consistent with the heavy discharge scenario, likely augmented widespread lateral scour owing to the bouyant effect of excess pore-pressure. Under these assumed dynamic conditions of scour and erosion, development of numerous deep-rooted phreatophytes is unlikely. In fact, no fossil wood has been found in the lower part of the Tuscaloosa and no tap-root traces are noted either.

Fourth-order parasequences in the upper Tuscaloosa are characterized by 1 to 4 m thick, mutually truncating thalweg deposits of trough cross-stratified, coarse arkosic sand having a significant component of pebble-sized clay clasts and round, armored clay mudballs, up to 25 cm in diameter. Individual parasequences fine upward into an overbank, silty clay layer. Truncated point-bar deposits comprise some parasequences, however nondescript, channel-bar deposits with overbank on top are more common.

Overbank fines typically show immature lateritic paleosol development (as described by Reinhardt and Sigleo, 1983). In addition, overbank layers display extensive, back-filled burrowing (due to insects ?) in some locales. In rare sites, dropstones suggest that shallow lacustrine deposits are intermingled with overbank fines. Overbank deposits are typically red or maroon, and are intercalated with rare laterally extensive gray-green silty clay layers a few centimeters thick. These reduced-color layers suggest uncommon episodes of poorly drained, stagnant conditions on the floodplain.

Fourth-order parasequences in the upper Tuscaloosa are interpreted to represent an unusual type of high-sinuosity stream deposition that arose from having very low regional slope conditions and appreciable overbank fines in the depositional system. This high-sinuosity, but anastamosing (braided) channel pattern accomodated the continued high sediment load and high continuous discharge on a broad alluvial plain. As in the lower Tuscaloosa, these were high competence and capacity streams.

References

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