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John M. Glenn
University of Arkansas, Fayetteville

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Stratigraphy and Sedimentary Structures of a Middle Boyd Fluvial Sandstone Washington and Madison Counties, Arkansas

JOHN M. GLENN
Department of Geology, University of Arkansas, Fayetteville, Arkansas 72701

ABSTRACT

A prominent quartz-pebble-bearing sandstone unit crops out at stream level along the East Fork of the White River in Madison County. Detailed geologic mapping indicates that the unit is stratigraphically positioned between the Brentwood and Dye Shale Members of the Boyd Formation and is not the Greenland Member of the Winslow Formation as previously supposed. Sedimentary textures and structures of the unit indicate that it was deposited by competent, unidirectional currents flowing in a southerly direction. These currents were related to a broad braided stream system.

INTRODUCTION

A prominent quartz-pebble-bearing sandstone unit crops out near stream level along the East Fork of the White River and along Lollars Branch in eastern Madison County, Arkansas (Fig. 1). This unit generally has been assumed to be the Greenland Member of the Winslow Formation. Detailed mapping of the Greenland Sandstone from the type area near Greenland and Brentwood, Arkansas, into the valley of the East Fork of the White River near Delaney indicates that the...
Greenland Sandstone of the East Fork lies 130-150 ft stratigraphically above the quartz-bearing sandstone formerly considered to be Greenland.

The quartz-pebble-bearing sandstone overlies the Brentwood Member and is overlain by the Dye Shale Member of the Boyd Formation (Fig. 2). It is characterized by coarse-grained and near-strand coastal plain. Cross-stratification and bed-form types, paleocurrent data, and textural aspects of the rock indicate that the basal part of the unit was deposited by competent, unidirectional currents flowing in a southerly direction. These currents were confined loosely to broad channels on a near-strand coastal plain.

**BED FORMS AND STRATIFICATION**

Exposures of primary sedimentary structures are unusually good and varied in the pebble-bearing sandstone. Recent studies by other workers indicate that certain suites of sedimentary structures are characteristic of certain depositional conditions and environments. For sedimentary structures to be useful in environmental interpretations, it is necessary to recognize certain stratification types and to have an understanding of the flow phenomena and bed forms that produce them.

Stratification is the product of bed forms, and bed forms are related to flow regime. Flow regime is the generalized, integrated result of all variables such as velocity, depth, and slope.

In controlled experiments with flumes transporting sand, a sequence of bed forms is noted as flow is increased. Ripples are the bed form first developed after initiation of sand-size particle movement and belong to the lower flow regime. With increasing flow, the sequence progresses to include dune and plane bed types of bed forms (Harms and Fahnstock, 1965).

**STRATIFICATION TYPES**

**Tabular Sets.** Tabular sets are volumetrically the most important in the lower third of the pebble-bearing sandstone. These sets have basically planar upper and lower surfaces and contain high-angle foreset cross-laminations. They range in thickness from a few inches to 6 ft or more and generally are a few tens of feet long. Most tabular sets have non-erosional bounding surfaces that converge upstream. Downcurrent, some grade into ripple laminations. Foreset cross-bedded sand laminae are formed when particles avalanche down the slip face of a transverse bar or dune. This occurs most commonly in high-energy alluvial systems and forms point-bar deposits (McGowen and Groat, 1971).

**Conglomerate Beds.** Conglomerate beds 3-14 in. thick are present near the base of the sandstone. They are bounded above and below by tabular sets. Such deposits are formed at highest energy levels where finer material is bypassing the depositional site, concentrating the quartz and clay pebbles.

**Ripple-Laminated Sets.** Ripple-laminated sand units generally overlie the tabular sets and form as much as half of the volume of the sandstone. These sets are interpreted as having been deposited in the lower flow regime as current velocity decreased after deposition of the underlying foresets.

**Clay Drapes.** Clay drapes mantle other stratification types and are deposited by the settling of suspended material as flow slackens. Clay drapes are associated most commonly with ripple-laminated sets. Less commonly they cap foreset cross-strata.

**Disturbed Beds.** Two kinds of disturbed beds were noted. Heave structures are present where water or gas was injected into overlying units. They are in the lower part of the sandstone.
Some large foreset beds also are disturbed. The upper part of each lamination is overturned in a downstream direction. As the foreset units above and below are not deformed, this might be the result of forces applied to the upper part of the foreset cross-strata by flowing water during the initial part of a new high-energy depositional event.

Fossils. Plant fossils are common in the pebble-bearing sandstone. Fragments of coal also are present in the lower part. Marine fossils, mostly abraded crinoid stems, are found in places in the sandstone.

The vertical sequence of units within the basal part of the pebble-bearing sandstone consists of (1) quartz-pebble conglomerate beds, (2) thick beds characterized by tabular foreset cross-stratification, (3) thin beds characterized by ripple bed forms, and (4) thin beds of shale deposited as drapes over the ripple forms (Fig 3).

The sandstone of the pebble-bearing unit is moderately well sorted; standard deviations range from 0.50 to 2.0 phi units. Paleocurrent directions, determined by measuring the direction of dip of prominent foreset strata, were southerly. This finding is supported by data obtained by Sandlin (1968, p. 78) east of Delaney.

CONCLUSIONS

The stratification types found in the basal part of the pebble-bearing sandstone indicate that this part of the unit was deposited in a near-strand, fluvial environment. Individual sequences record periods of extremely competent flow (quartz-pebble conglomerate), succeeded by periods of waning flow (tabular foresets and ripple bed forms). Cessation or near cessation of flow followed, as indicated by clay drapes over ripple bed forms. Most of the sediment now contained in the unit is in large, tabular foreset beds. These were deposited on dunes and transverse bars by competent, unidirectional currents that flowed in a southerly direction. Periods of waxing (flood) and waning flow produced the successive sequences of stratification types.

LITERATURE CITED


