Deltaic facies of the Hartshorne Sandstone in the Arkoma Basin, Arkansas-Oklahoma border

David W. Houseknecht, *Department of Geology, University of Missouri, Columbia, Missouri 65211*

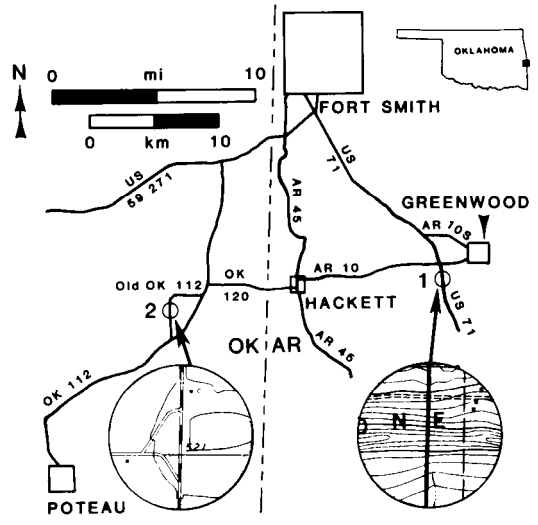

Figure 1. Highway map showing locations of two Hartshorne outcrops discussed in text. Note that Greenwood topographic map predates roadcut of locality 1.

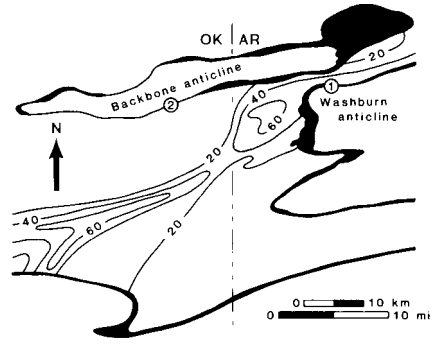

Figure 2. Sandstone isolith map of Hartshorne Sandstone illustrating field trip localities (numbered circles) relative to linear sand body. Black indicates Hartshorne outcrops; isolith contours are in meters (from Houseknecht and others, 1983).

LOCATION

Sedimentary facies deposited in channel and interchannel positions within an actively prograding, river-dominated delta are illustrated at two localities near the Arkansas-Oklahoma border south of Fort Smith, Arkansas.

Locality 1 (94°17’20"W.; 35°11'41’’N.; Greenwood, Arkansas, Quadrangle) is a distinctive, terraced roadcut on U.S. 71, approximately 12 mi (20 km) south of Fort Smith (Fig. 1). The Hartshorne Sandstone dips steeply north (nearly vertical) along the north limb of the Washburn anticline (Fig. 2).

Locality 2 (94°31’20W.; 35°10’30"N.; Spiro, Oklahoma, Quadrangle) is a roadcut on old Oklahoma 112, approximately 8 mi (12 km) west of Hackett, Arkansas (Fig. 1). The Hartshorne Sandstone dips 15° southward along the southern limb of the Backbone anticline (Fig. 2).

SIGNIFICANCE

From late Cambrian through early Pennsylvanian time, the area now occupied by the Arkoma basin was a passive continental margin dominated by carbonate sedimentation. During the Atokan, convergent tectonism along the Ouachita erogenic belt resulted in the formation of the Arkoma foreland basin, and detrital sedimentation prevailed in this basin through the Desmoinesian. Bordered by the Ozark uplift to the north and the Ouachita erogenic highlands to the south, the Arkoma basin evolved into a typical molasse environment; shallow marine and coal-bearing deltaic and fluvial facies dominate the Desmoinesian stratigraphic section (Houseknecht, 1986).

Within this foreland basin setting, the Hartshorne Sandstone was deposited in a river-dominated delta system, the seaward margin of which was modified primarily by tidal processes; this delta system migrated longitudinally westward through the basin (Houseknecht and others, 1983). The combination of fluvial domination and tidal reworking of the delta front resulted in the accumulation of elongate, linear sandstone bodies composed primarily of distributary channel facies. In addition, the development of marked lateral facies changes was dependent on proximity to the mouth of an active distributary channel.

Figure 2 shows the distribution of a Hartshorne channel deposit that trends southwestward and bifurcates near the western edge of the map. Paleocurrent data collected at both the eastern and western outcrops of that sandstone body indicate that paleoflow was westward (Houseknecht and others, 1983). The two outcrops spotted in Figure 2 and described below have been selected to illustrate the similarities and differences between facies deposited in channel (Locality 1) and interchannel (Locality 2) positions within this deltaic environment.

LOCATIONS

Locality 1

This roadcut exposes a 450-ft (137-m) section that represents a complete vertical facies sequence deposited in a channel position of a prograding delta (Fig. 3).

The lower 70 ft (20 m) (south end of outcrop) displays a generally coarsening upward sequence from shale to siltstone intercalated with shale and thin, rippled laminae of sandstone. This sequence is interpreted as prodelta to distal bar facies deposited on the aggradational slope in front of the prograding delta.

The overlying 70 ft (20 m) displays two interbedded subfacies. One comprises ripple-bedded sandstone beds that are 1 to 2 ft (30 to 60 cm) thick and intercalated with shale "drapes" that are 1 to 2 cm thick. Both asymmetrical and symmetrical ripples are present, although the former are more abundant; interference ripple-crest patterns are common on exposed bedding planes. The other subfacies comprises sandstone that displays trough cross-bedding in sets 1 to 3 ft (30 cm to 1 m) thick and 15 to 30 ft (5 to 10 m) wide, with unidirectional westward paleoflow indicated. This subfacies typically has an erosional base and commonly contains shale and siderite rip-up clasts. These two subfacies together represent distributary mouth bar deposits. The cross-bedded sand was probably deposited by fluvial currents during periods of high discharge, and the ripple-bedded sand with shale drapes was deposited by tidal and subordinate wave processes during periods of low discharge.

The thickest individual facies exposed in the roadcut comprises sandstone displaying ubiquitous trough cross-bedding. Beds range from 4 in to 6 ft (10 cm to 2 m) in thickness, and cross-beds indicate unidirectional westward paleoflow. At the top, this facies fines upward via a decrease in the thickness of sandstone beds and the appearance and upward increase in thickness of shale interbeds. These facies were deposited in a distributary channel within a prograding delta lobe, with the fining upward sequence representing channel abandonment. The channel geometries are the primary reason for the linear map pattern illustrated in Figure 2.

The upper 130 ft (40 m) of section consists predominantly of silty shale with locally abundant laminae of rippled sandstone, macerated plant debris, horizontal burrows, pelecypod fossils, and rooted horizons. Two coalbeds are also present. Together, these facies represent deposition in interdistributary bays, marshes, and swamps on the delta plain.

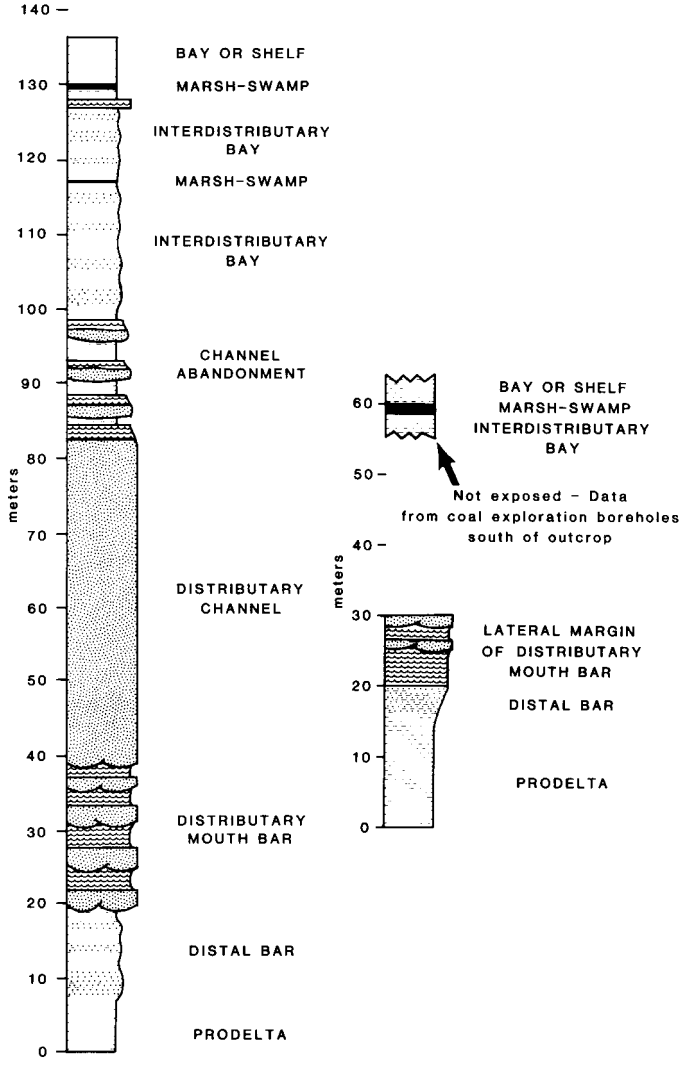

Figure 3. Measured sections for locality 1 (left) and locality 2 (right). Symbols explained in text.

Locality 2

This roadcut exposes 100 ft (30 m) of section deposited in an interchannel position of the same delta whose facies were examined at Locality 1 (Fig. 2).

The entire outcrop is a coarsening upward sequence, grading from shale into ripple-bedded siltstone into ripple-bedded sandstone (Fig. 3). Two sandstone beds near the top of the section display small-scale trough cross-bedding. This facies sequence was deposited in prodelta, distal bar, and distributary mouth bar subenvironments. The overall lack of sand compared to equivalent facies at Locality 1 is the result of deposition in an interchannel position that was well removed from active input of sand from a distributary channel (Fig. 2).

Even though shales and coalbeds of the delta plain are not exposed at this locality, data from coal exploration boreholes just south of this outcrop have been added to Figure 3 to facilitate comparison with Locality 1. The major coal bed is located about 92 ft (28 m) above the top of the coarsening upward sequence exposed in the roadcut, and most of the intervening section is shale. Thus, the total vertical facies sequence, from prodelta to delta-plain coal bed, is about 200 ft (60 m) in the interchannel position compared to 425 ft (130 m) in the channel position (Fig. 3).

REFERENCES CITED

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