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Devonian Sandstone Lithostratigraphy, Northern Arkansas

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ABSTRACT

Two areas of Devonian sandstone development may be recognized in northern Arkansas. In northwestern Arkansas, the Clifty Formation comprises a massively bedded, supermature quartz arenite of Middle Devonian age overlain by thinner bedded, phosphatic quartz arenite and chert breccia of the Sylamore Sandstone Member, Chattanooga Shale (Upper Devonian). This sequence overlies Ordovician strata (Powell or Everton) and is succeeded by the Chattanooga Shale and strata of Lower Mississippian age.

In north-central Arkansas, the Clifty Formation is absent and the Chattanooga Shale may develop sandstone at its base and top. Occasionally the Chattanooga Shale is absent and the entire interval may be Upper Devonian sandstone. These Upper Devonian sandstones are phosphatic, mature quartz arenites referred to the Sylamore Member except where they overlie the Chattanooga Shale. In these cases, the sandstone is recognized as an informal upper member of the Chattanooga. Reports of Lower Mississippian Sylamore Sandstone in north-central Arkansas are regarded as misidentification of the Bachelor Formation (Middle Kinderhookian).

INTRODUCTION

Sandstones of Devonian age are sporadically developed throughout northern Arkansas. Lithostratigraphy of these units is complex. They are thin, lithologically similar, bounded by unconformities, and unpredictable in their occurrence. They have been frequently misidentified and included with both older and younger units. Although these Devonian sandstones have been recognized in the literature for more than 60 years, little progress has been made toward understanding their character and occurrence.

LITHOSTRATIGRAPHY

Sandstones of Devonian age are referred to the Clifty Formation and the Sylamore Sandstone Member of the Chattanooga Shale. In northwestern Arkansas, these two units are adjacent, although separated by an unconformity. In north-central Arkansas, the Clifty is absent and the Chattanooga Shale may develop sandstone at its top and base. The base of the Mississippian System in northern Arkansas is represented by the Bachelor Formation. This unit is thin, usually less than 1 foot (.3 m), and is commonly a mature quartz arenite of similar character to Devonian units. This sandstone is entirely Lower Mississippian in age and has been confused with the Sylamore previously.

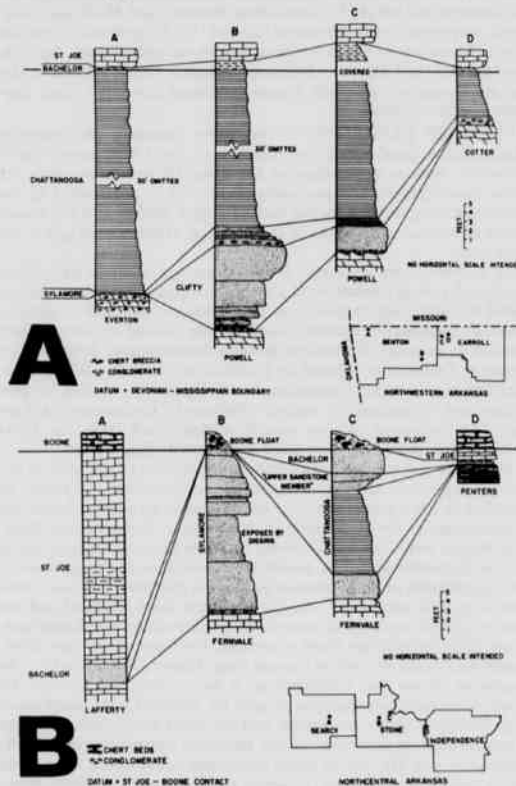
CLIFTY FORMATION - The name Clifty was originally proposed by Purdue and Miser (1916) for a localized bed of sandy, fossiliferous limestone of Middle Devonian age confined to the East Fork of Little Clifty Creek, Benton County, Arkansas. The limestone is thin (less than 4 feet) and separated by unconformities from adjacent Ordovician (Kings River) and Devonian (Sylamore) strata. Purdue and Miser (1916) and later Cronis (1930) reported typical Middle Devonian brachiopods from the basal portion of the unit.

Field mapping (Staley, 1962; Arrington, 1962) and detailed lithostratigraphic analysis (Hall, 1977) have documented the occurrence of supermature quartz arenite yielding Devonian conodonts and occasional brachiopods throughout the Beaver Lake area (Benton, Carroll, Madison Counties). The sand is regarded as a lateral equivalent of the type Clifty incorporating the limestone as a lens (Staley, 1962; Wise and Caplan, 1967; Hall, 1977). Previously the Clifty sandstone was included within the Sylamore Sandstone (i.e. Purdue and Miser, 1916) which also occurs throughout this area.

The Clifty Formation rests disconformably on Ordovician strata representing either the Powell Dolomite or Everton Formation. This contact is easily recognized where the underlying strata are carbonates. A basal conglomerate of carbonate clasts may be present at some localities (i.e. Beaver Dam Site, Figure 1A, section C). Where the Clifty Formation overlies Ordovician sandstones, precise placement of the boundary is difficult and requires establishment of age

relationships. The bulk of the Clifty is a white, supermature, homogeneous quartz arenite exhibiting massive planar bedding. Shaly sandstone and shale are developed in medium beds at the base of the Highway 12 section (Fig. 1A, section B). Brachiopods occur com-

Figure 1 (A) Correlation of selected measured sections through the Middle-Upper Devonian interval, northwestern Arkansas; (B) Correlation of selected measured sections through the Upper Devonian-Lower Mississippian interval, north-central Arkansas.



monly in the limestone at the type locality (Purdue and Miser, 1916). Ferruginous internal molds of brachiopods were collected by Staley (1962) from a single locality in Benton County. No other megafaunal remains are known and most exposures are unfossiliferous. The upper contact of the Clifty is a marked disconformity with the Sylamore Member, Chattanooga Shale (Upper Devonian). This boundary is drawn at the change from massively bedded, homogeneous, super-mature, quartz arenite to medium bedded, phosphatic, mature, quartz arenite. The top of the Clifty, immediately subjacent to the contact, is usually discolored and heavily burrowed. The basal Sylamore may be a conglomerate of angular chert fragments, rounded phosphate pebbles or both in an iron-stained, mature quartz arenite matrix. Maximum thickness for the Clifty is reported by Wise and Caplan (1967) as 20 feet, and it appears that the unit is confined to the area surrounding Beaver Lake, Benton and Carroll Counties, Arkansas.

A Middle Devonian age assignment for the Clifty has been based on the brachiopods *Tropidoleptus carinatus* (Conrad), *Spirifer fornaculus* Hall, *S. audaculus* Conrad and *Homalonotus dekayi* Green recovered from the basal limestone bed at the type Clifty Section (Purdue and Miser, 1916, p. 9). *Tropidoleptus carinatus* has also been recovered from the Clifty sandstone facies in association with *Protoloptostrophia periplana* (Conrad) and *Spirifer varicosus* Hall (identifications by G.A. Cooper, written communication to Staley, 1960). These brachiopods have been correlated with the Hamilton Group of New York (Cooper, *ibid*) indicating assignment to some portion of the upper Eifelian or lower Givetian Stage of the Middle Devonian. Conodonts recovered from the lower portion of the Clifty Sandstone at the Beaver Dam and Highway 12 sections are fragmental and abundant. Assemblages are dominated by bar elements and the form genera *Icriodus* and *Polygnathus*. Typical and distinctive Upper Devonian forms such as *Palmatolepis*, *Ancryodella*, and *Pelekysgnathus* are absent. Identifiable taxa include *Icriodus alternatus* Branson and Mehl, *I. symmetricus* Branson and Mehl, and scattered fragments with ornament similar to *Polygnathus cristatus* Hinde. Correlations based on these conodonts are tenuous, but it is possible that the Clifty may represent a slightly higher portion of the Middle Devonian, near the Upper Devonian boundary, than suggested by brachiopods.

SYLAMORE SANDSTONE - The name Sylamore has generally designated a basal sandstone member of the Chattanooga Shale. However, precise application of the name by various workers has been contradictory and confusing. Problems in application of the name are compounded by the lack of a type section and the occurrence of several sandstones of Devonian or Mississippian age in the type area.

In northwestern Arkansas, the Chattanooga Shale is well developed and a basal sandstone of Upper Devonian age has been recognized at more than 20 localities. The sandstone is a thin to medium bedded, phosphatic, mature quartz arenite usually exhibiting chert breccia at its base. The breccia marks a disconformity developed on strata of Ordovician (Powell or Everton) or Devonian (Clifty) age. The entire unit is thin (maximum 2 feet, Figure 1A, section B), persistent and of predictably uniform lithology in northwestern Arkansas. The Sylamore can be readily distinguished from the Clifty Formation in this area as discussed in the preceding section.

Devonian strata have been removed by erosion in the area of potential exposures throughout most of north-central Arkansas. In addition, a basal sandstone does not appear to be present below the Chattanooga in the subsurface to the south of this area (i.e. Pope, Van Buren, and Conway Counties). In Stone County, the type region for the Sylamore Member, sandstone development is unpredictable and distribution of the Chattanooga Shale is sporadic. At some localities (Figure 2, section B), the Chattanooga Shale is absent and the entire interval may be sandstone of Upper Devonian age. Elsewhere, where the Chattanooga Shale is present, the Upper Devonian Sandstones may occur at both its top and base (Figure 1B, section C). The sandstone above the Chattanooga is unconformably overlain by Lower Mississippian sandstone (Figure 1B, section C). At many localities, Devonian strata are absent, and the basal Mississippian system is represented by sandstone of the Bachelor Formation (Figure 1B, sections A and D). All of these sandstone occurrences have been called Sylamore previously (Freeman and Schumacher, 1969). How-

ever, we regard the Sylamore as a basal sandstone member of the Chattanooga Shale and wholly Upper Devonian in age based on the occurrence of conodonts such as *Palmatolepis* and *Ancryodella*. Where the entire record of the Upper Devonian is sandstone, we feel application of the name Sylamore is appropriate. Upper Devonian sandstone above the Chattanooga Shale has only been identified at one locality (Figure 1B, section C). A suggestion by Freeman and Schumacher (1969, section 7) of two sandstones spanning the Middle-Upper Devonian boundary is not supported by our study (Figure 1B, section B). More study is required to delineate the distribution of Upper Devonian sandstones at the top of the Chattanooga Shale. At present, the upper sandstone is regarded as an informal member of the Chattanooga Shale. Sandstones of Mississippian age are referred to the Bachelor Formation (Manger and Shanks, 1977). We regard reports of Mississippian Sylamore Sandstone as misidentification of the Bachelor Formation (Freeman and Schumacher, 1969, p. 2329).

CONCLUSIONS

Two areas of Devonian sandstone development may be recognized in northern Arkansas. In northwestern Arkansas, the Sylamore Sandstone occurs as a thin basal member of the Chattanooga Shale and it is Upper Devonian in age based on conodonts. At some localities in vicinity of Beaver Lake, Benton and Carroll Counties, the Sylamore rests unconformably on a thicker Middle Devonian sandstone referred to the Clifty Formation. The Clifty rests on Ordovician strata and its contact with the Sylamore may be distinguished by a chert breccia, marked increase in phosphatic content, decrease in maturity, and change from massive to medium bedding. In northwestern Arkansas, the Chattanooga Shale is well developed and provides a useful marker horizon for interpreting sandstone lithostratigraphy. Differentiation of the Bachelor Formation, basal Mississippian, is not a problem in this area.

In north-central Arkansas, Devonian sandstone occurrence is unpredictable and the distribution of the Chattanooga Shale is sporadic. This is the type region for the Sylamore Sandstone, but application of the name is problematic and previous usage of the name has been confusing. At most localities, an Upper Devonian sandstone occurs at the base of the Chattanooga or comprises the entire Devonian section. The name Sylamore is most appropriately applied to these occurrences. Rarely, there is an Upper Devonian sandstone at the top of the Chattanooga. In north-central Arkansas, the base of the Mississippian System is a sandstone referred to the Bachelor Formation. Previous reports of Mississippian Sylamore Sandstone are misidentifications of this unit.

The northwestern and north-central regions are separated by an area of no Devonian strata in surface exposures and no Devonian sandstone in the subsurface. It is possible that the sands of these two regions represent contemporaneous accumulation from two separate sources during the Upper Devonian.

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