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ABSTRACT

Lower Mississippian lithostratigraphic units in northern Arkansas are (ascending order) the Bachelor, St. Joe, and Boone Formations. These formations disconformably overlie Middle Ordovician to Upper Devonian strata and are overlain disconformably by Meramecan or Chesterian strata.

The Bachelor Formation is generally a thin (less than 0.3 m), persistent, orthoquartzitic sandstone with common to abundant phosphatic pebbles overlain by a green silty shale. In northwestern Arkansas, the Bachelor Formation commonly lacks sandstone. The Bachelor Formation has been confused previously with the Sylamore (Upper Devonian) and older sandstone units.

Although commonly regarded as a member of the Boone Formation, the St. Joe Limestone should be raised to formation rank in accordance with the earlier proposal of Cline (1934). The St. Joe Limestone in northwestern Arkansas can be subdivided into (ascending order) the Compton, Northview, and Pierson Members which are recognized as formations in Missouri. In the type region, northcentral Arkansas, subdivision of the St. Joe is precluded by lack of the shaly Northview Member. A marked color change from gray to red from northwestern to northcentral Arkansas is accompanied by a general increase in the allochemical constituents. The St. Joe-Boone boundary is taken to be at the first persistent chert. This contact generally coincides with a thin calcareous shale unit and a marked decrease in carbonate grain size.

INTRODUCTION

Lower Mississippian (Kinderhookian-Osagean) strata of northern Arkansas are predominantly limestone with variable development of chert. This entire sequence, which may be more than 110 m thick, traditionally is referred to the Boone Formation and the basal chert-free part is recognized as the St. Joe Member (Stroud et al. 1969). Recent investigations of Lower Mississippian strata (Thompson and Fellows 1970; McFarland 1975a,b; Shanks 1976) support earlier suggestions (Cline 1934) that this interval be subdivided further. This report presents a preliminary proposal for a more detailed lithostratigraphic framework for Lower Mississippian strata in northern Arkansas.

LITHOSTRATIGRAPHY

Lower Mississippian lithostratigraphic units in northern Arkansas are (ascending order) the Bachelor, St. Joe, and Boone Formations. The formations disconformably overlie Middle Ordovician to Upper Devonian strata and are overlain disconformably by Meramecan or Chesterian strata.

Bachelor Formation. The Bachelor Formation was proposed by Mehl (1960) for a thin (generally less than 0.3 m), quartzose sandstone at the base of the Kinderhookian Series in central Missouri. Lateral equivalents of this unit had been recognized previously in southern Missouri (Moore 1928), northeastern Oklahoma (Laudon 1939), and northern Arkansas (Purdue and Miser 1916). However, they appear to have been included within the St. Joe Limestone or confused with older units, particularly the Sylamore Sandstone (Upper Devonian). Thompson and Fellows (1970) divided the Bachelor informally into a basal quartzose sandstone overlain by a green, silty shale and applied the name to all basal Mississippian terrigenous strata in southwestern Missouri, northern Arkansas, and northeastern Oklahoma.

The Bachelor Formation has been recognized at more than 35 localities across northern Arkansas (Fig. 1A). In northwest Arkansas, the Bachelor is predominantly a green, silty shale, particularly where it overlies the Upper Devonian Chattanooga Shale. Maximum thickness of the Bachelor in this area is approximately 1.2 m, but generally it is less than 0.3 m (McFarland 1975b). In northcentral Arkansas, medium-grained, orthoquartzitic sandstone predominates Bachelor exposures, reflecting the change from Chattanooga Shale to older quartz-bearing strata (Fig. 1A). Commonly the sandstone is conglomerate bearing abundant, black, rounded phosphatic pebbles and cobbles. These pebbles are commonly oolitic in texture, and the writers interpret them to be reworked, phosphate-replaced fragments of Ordovician carbonate rocks.

The Bachelor Formation is entirely of Mississippian age on the basis of conodonts recovered from all localities. The formation in places contains a reworked Upper Devonian assemblage. Conodonts from the Bachelor Formation can be assigned to the *Siphonodella duplicata* zone of the type Mississippian (Collinson et al. 1971). The fact that this conodont zone is well above the base of the type Mississippian indicates later initiation of Mississippian deposition in Arkansas than in the type region. The Bachelor forms an obvious disconformity with subjacent strata at most localities in northern Arkansas. However, where the Bachelor overlies the Chattanooga Shale, age relations have not been resolved completely because of the lack of fauna in the uppermost Chattanooga strata. This problem is complicated further by localities where the Bachelor may directly overlie the Sylamore Sandstone, which is reported to span the Devonian-Mississippian boundary (Freeman and Schumacher 1969).

St. Joe Limestone. The name "St. Joe" was used by Hopkins (1893) for the chert-free lower part of the Boone Formation in northern Arkansas. However, Hopkins did not formally propose or describe the unit. Girty (1915) formalized the St. Joe as a member of the Boone Formation, citing a railroad cut near St. Joe, Searcy County, Arkansas, as the presumed type section. Cline (1934) elevated the St. Joe to formational rank in Arkansas and included all its lateral equivalents and the basal shale (=Bachelor) as members. This proposal has not been widely accepted. Present usage in Arkansas recognizes the St. Joe as the basal and only member subdivision of the Boone Formation (Stroud et al. 1969).

Before 1944, the name "St. Joe" was used to designate a formation in Missouri (Branson 1944). Since that time it has been used occasionally as a group name (Clark and Beveridge 1952). However, the present lithostratigraphic framework in Missouri subdivides equivalent strata into (ascending order) the Compton, Northview, and Pierson Formations of the Chouteau Group (Howe and Koenig 1961).

In northeastern Oklahoma, "St. Joe" has been retained as a group name encompassing the equivalent Missouri formation names (Huffman et al. 1966).

The St. Joe Limestone has been recognized widely throughout

northern Arkansas; it is distinguished as a mappable unit on the Geologic Map of Arkansas (1929). In northwestern Arkansas, the St. Joe Limestone is generally a light gray, mud-supported, crinozoan-bryozoan calcilutite. Allochemical constituents average 34%, decreasing from an average of 44% in the basal rocks to 29% at the top of the St. Joe (McFarland 1975b). Thickness in this area ranges from 4.9 to 13.0 m (Fig. 1B). The St. Joe carbonate succession is interrupted by a thin, persistent, green, calcareous siltstone in the lower half of the section. This siltstone can be traced continuously into the Northview Formation of Missouri (Thompson and Fellows 1970). The carbonate section above the Bachelor Formation and below the Northview is a continuation of the Compton Formation from Missouri into northwestern Arkansas. The section between the Northview and Boone correlates with the Pierson Formation of Missouri. Lithologically, the Compton and Pierson intervals cannot be distinguished except by reference to the intervening Northview terrigenous rocks (McFarland 1975b).

The name "St. Joe" has priority over all equivalent Missouri lithostratigraphic names for the carbonate succession above the Bachelor and below the Boone in northern Arkansas. The writers advocate adoption of Cline's (1934) proposal for recognition of the St. Joe as a formation separate from the Boone. In northwestern

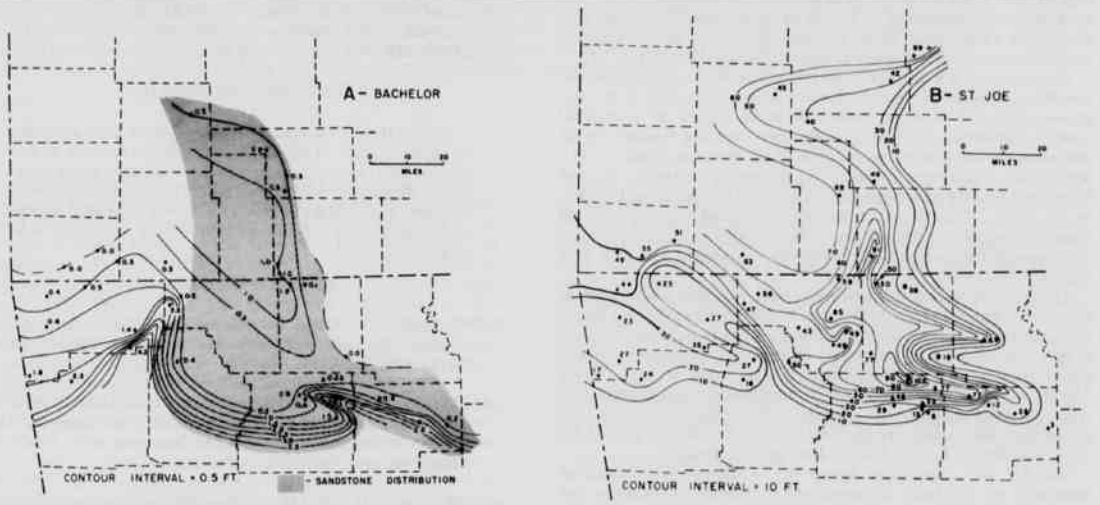

Figure 1. Isopachous maps of the Bachelor (A) and St. Joe (B) Formations, northern Arkansas and southwestern Missouri (data from Thompson and Fellows 1970, McFarland 1975b, and Shanks 1976).

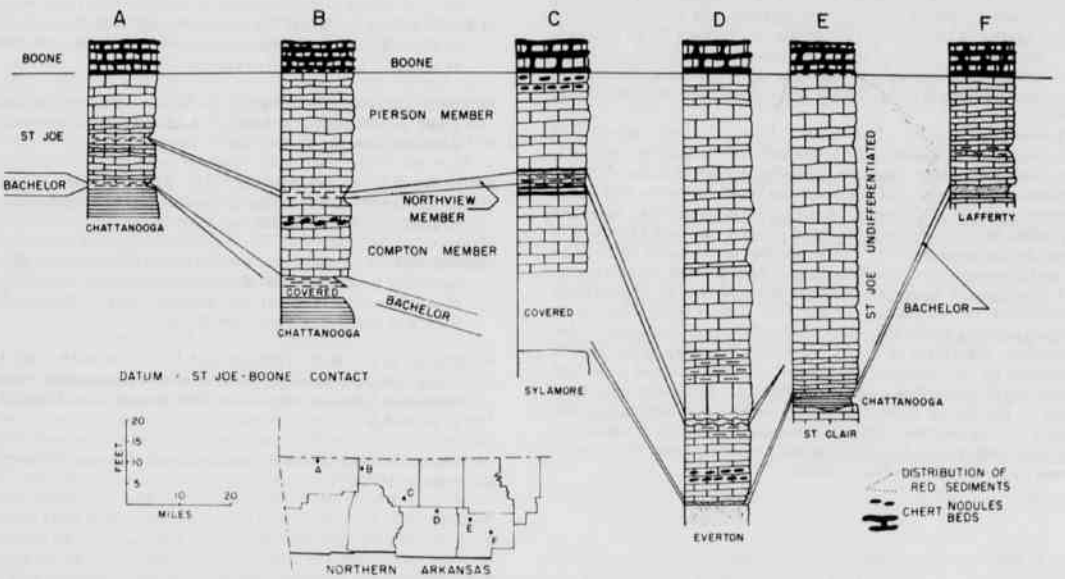

Figure 2. Correlation of selected sections of lower Mississippian strata in northern Arkansas (data from Thompson and Fellows 1970, McFarland 1975b, and Shanks 1976).

Arkansas, the St. Joe should be subdivided further by recognition of the Compton, Northview, and Pierson Formations of Missouri as members in Arkansas (McFarland 1975a; Fig. 2).

The St. Joe Limestone can be traced continuously from northwestern Arkansas into its type region in northcentral Arkansas (Fig. 2). In the type region, the St. Joe is generally a red, unsorted, grain-supported crinozoan-bryozoan calcarenite. Allochemical constituents average 69%, although mud-supported lithologic types are present, most commonly in the upper 3 m of the secton (Shanks 1976). The fact that the terrigenous rocks of the Northview Member do not reach the type region precludes subdivision into members (Fig. 2). Thickness of the St. Joe in northcentral Arkansas is variable, ranging from a minimum of 0.6 m to more than 30 m (Fig. 1B). Maximum thicknesses form a series of lobate ridges oriented northwest-southeast extending across northern Arkansas (Fig. 1B).

The red color is a distinctive feature of the St. Joe in northcentral Arkansas. The color is an indication of the oxidation state of the iron oxide associated with the carbonate rocks and is not a surficial feature. However, the origin of the iron and the reasons for its oxidation are not known. In addition, there does not appear to be a significant difference in iron concentration between St. Joe Limestone units of northwestern and northcentral Arkansas (Wagner et al. 1975). Correlation of measured sections demonstrates an interfingering of gray and red carbonate rocks (Fig. 2). Allochemical constituents increase from northwestern Arkansas into the type region (Shanks 1976).

Although the St. Joe Limestone has been regarded traditionally as chert-free, detailed study (McFarland 1975b, Shanks 1976) has shown that this is not the case. Thin, discontinuous beds and nodular zones of red, varicolored, and gray chert are present in both the lower and upper parts of the St. Joe Limestone (=Compton and Pierson Members or equivalent horizons) in northwestern and northcentral Arkansas (McFarland 1975b, Shanks 1976). Color and lack of both persistence and abundance of chert seem to be reliable criteria for differentiating St. Joe and Boone chert-bearing horizons.

The St. Joe Limestone spans the Kinderhookian-Osagean boundary on the basis of associated conodonts (Thompson and Fellows 1970). Deposition of the St. Joe followed that of the Bachelor without apparent break (Thompson and Fellows 1970). The Kinderhookian-Osagean boundary is approximately 0.3 m above the Northview-Pierson Member contact in northwestern Arkansas (McFarland 1975b). In northcentral Arkansas, this boundary is in the lower quarter of the section (Thompson and Fellows 1970). Initiation of "Boone-type" chert formation, which provides a basis for lithostratigraphic recognition, appears to be markedly diachronous in southern Missouri and northern Arkansas (Thompson and Fellows 1970).

Boone Formation. The name "Boone" was introduced simultaneously by Banner (1891), Simonds (1891), and Penrose (1891) for a cherty-limestone sequence typically exposed in Boone County, Arkansas. This formation is one of the most distinctive and easily mapped units in the Boston Mountains. Unfortunately, complete exposures are few and only the basal contact has been examined in detail for the present study. The St. Joe-Boone contact is taken to be at the first persistent chert. This chert is dark colored, usually gray, and develops an irregular, anastomosing pattern of replacement (McFarland 1975b, Shanks 1976). This "Boone-type" chert is in marked contrast to the thin, nonpersistent chert in the upper St. Joe Limestone. Placement of the St. Joe-Boone boundary at this level is supported by the common presence of a thin calcareous shale unit separating St. Joe and Boone carbonate rocks. The lowest carbonate rocks of the Boone Formation are extremely microcrystalline and usually contain less than 10% allochemical constituents in contrast to approximately twice the allochemical percentage and blocky spar shown by the St. Joe Limestone (Shanks 1976).

CONCLUSIONS

Lower Mississippian lithostratigraphic units in northern Arkansas are the Bachelor, St. Joe, and Boone Formations. Although commonly regarded as a member of the Boone Formation, the St. Joe Limestone should be raised to formation rank as proposed by Cline (1934). The basal terrigenous unit included in the St. Joe by Cline (1934) is the Bachelor Formation of Missouri. In northwestern Arkansas, the St. Joe Limestone should be subdivided further into the (ascending order) Compton, Northview, and Pierson Members. In northcentral Arkansas, the St. Joe is undifferentiated because of the absence of the Northview Member. The contact of the St. Joe Limestone and overlying Boone Formation is drawn at the first persistent chert. This boundary coincides with the presence of a thin calcareous shale unit and a marked decrease in carbonate grain size.

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