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# Stratigraphic Relationships of the Brentwood and Woolsey Members, Bloyd Formation (Type Morrowan), Northwest Arkansas

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# STRATIGRAPHIC RELATIONSHIPS OF THE BRENTWOOD AND WOOLSEY MEMBERS, BLOYD FORMATION (TYPE MORROWAN), NORTHWESTERN ARKANSAS

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**ABSTRACT**

The Brentwood Member of the Bloyd Formation conformably overlies the Prairie Grove Member, Hale Formation in the type Morrowan succession of northwestern Arkansas. At its type locality, the Brentwood is separated from the underlying Prairie Grove Member by nearly 6 m of dark shale. Away from this area, the shale thins rapidly and the Hale-Bloyd boundary may be placed with difficulty. At some localities east of type section, the boundary is thought to be erosional rather than the more typical gradational contact. The Brentwood consists of discrete carbonate bodies separated by dark shales. The carbonates consist principally of open shelf deposits, such as crinozoan biosparites and oolites. All carbonate lithologies contain varying amounts of fine to medium grained, rounded, quartz sand. Regionally, the Brentwood Member becomes more shaly to the west of its type locality and loses the quartz sand content in its carbonate lithologies. To the east, the Brentwood shales become less prominent and quartz sandstone intervals characterize the succession.

The Woolsey Member overlies the Brentwood Member and consists of light to dark, argillaceous shales with occasional sandstones, carbonates, and a thin coal. The coal is confined essentially to Washington and northern Crawford counties and never exceeds 45.7 cm. The shales are thought to be of terrestrial origin, but marine fossils and thin limestones in the lower part of typical Woolsey strata indicate a transitional change within the member rather than at its base. In contrast, the detrital fraction of the upper Brentwood carbonates seem to decrease rather than increase towards the Woolsey contact. To the west of the type area, the Woolsey gives rise to marine shales and carbonates. To the east, the Woolsey is equivalent to a thick, quartz pebble-bearing sandstone of fluvial origin. The top of the Woolsey Member is a regional unconformity with the overlying Dye Shale Member, Bloyd Formation.

## INTRODUCTION

Lower Pennsylvanian (Morrowan) strata of northwestern Arkansas may be characterized as a succession of predominantly marine shales, sandstones, and occasional limestones. In addition, a terrestrial horizon with an associated coal seam is also developed in the type Morrowan Series. The succession has been divided into the Hale and overlying Bloyd Formations. The Hale Formation has been subdivided into the Cane Hill Member (basal) and the Prairie Grove Member. The Bloyd Formation has been subdivided into four members. These are (ascending order) the Brentwood, Woolsey, Dye, and Kessler Members (Henbest, 1962; Sutherland and Grayson, 1978). This report deals with the lithostratigraphy of the Brentwood-Woolsey interval, Bloyd Formation, in its type region.

## LITHOSTRATIGRAPHY

**Brentwood Member:** Strata referred to the Brentwood Member, Bloyd Formation were originally referred to the Pentremital Limestone of the Boston Group (Owen, 1858; Simonds, 1891). Adams and Ulrich (1904) abandoned the name Pentremital Limestone in favor of the name Brentwood to designate this member of the Morrow Formation. No type section was proposed at that time, although the term Brentwood was stated to be derived from exposures near Brentwood station in northwest Arkansas (Adams and Ulrich, 1905). The name Morrow Formation was raised to group status by Purdue (1907). He proposed the Bloyd Shale to include the Brentwood Limestone Member of Adams and Ulrich (1904) and the Kessler Limestone Member of Simonds (1891). The name Bloyd was derived from exposures on Bloyd Mountain northwest Arkansas. Purdue (1907) also raised the Hale sandstone lentil of Taff (1905) to formation status. As a result, the Morrow Group included the Bloyd Shale and underlying Hale Formation with the Brentwood and Kessler Limestones as formally named members of the Bloyd Shale. No type section was designated for either the Hale Sandstone or Bloyd Shale. This use of the Hale and Bloyd remained essentially unchanged for four decades.

Henbest (1953) designated a type section for the Brentwood Limestone on the east side of both U.S. Highway 71 and the west fork of the White River, approximately a half mile south of Mill Creek. This section is located in the center of the N. Sec. 16, T. 14 N., R. 30 W., Washington County, Arkansas. Henbest (1962) designated a type section for the Bloyd Shale on the southwest part of Bloyd Mountain extending from the center of the E. Sec. 3 to the center, north side of sec. 4, T. 14 N., R. 30 W., Washington County, Arkansas.

The Brentwood Member, in its type region, may be described as a succession of quartz-bearing limestones and shales that accumulated under shallow-shelf conditions. The member ranges in thickness from 9 to 24 m in outcrop and thickens to 31 m or more in the subsurface to the south and southwest. The discrete limestone intervals average less than 1.5 m. A single section may contain from two to five carbonate units separated by dark-gray to black, fissile shale. The shale is generally non-silty and non-calcareous. The limestones are bioclastic grainstones and packstones which may contain calcareous sandstone lenses which display low angle, trough cross stratification.

The basal contact of the Brentwood, as defined by Henbest (1953), is conformable with the underlying Prairie Grove Member, Hale Formation. The boundary is drawn below the first shale bed, 0.5 m or more in thickness, above the Prairie Grove Member. The Prairie Grove varies in lithology from sandy carbonates to calcareous sandstones, but is essentially shale free throughout northwest Arkansas. The contact is distinctive at the type section of the Brentwood, where

the basal shale averages 5.5 to 6 m in thickness. Placement of the Brentwood-Prairie Grove contact becomes confused away from central Washington County due to thinning of the basal shale (Fig. 1A). The nature of the contact remains transitional to the west of the type area. At many localities, more than one shale horizon may be present in proximity to the boundary. These shales average less than the 0.6 m minimum thickness defined by Henbest (1953). Since the Prairie Grove Member is mapped as a shale-free unit, the Prairie Grove-Brentwood contact is drawn below the first occurrence of shale above the last Prairie Grove lithology regardless of the thickness of that shale.

East of the type area, the basal shale thins rapidly, becoming absent throughout a large portion of northwest and northcentral Arkansas. In areas where the basal shale cannot be used as a marker, the Prairie Grove-Brentwood contact is drawn between the last massive, persistent, bluff-forming calcareous sand of the Prairie Grove and the dark calcarenites of the basal Brentwood Member. Upper Prairie Grove sands typically exhibit a characteristic honeycomb weathering pattern that is related to cementation. Pockets of calcareous cement are scattered throughout the unit that is elsewhere cemented by iron oxide. Upon exposure, these pockets are solutioned more rapidly than the iron oxide cemented areas resulting in the pitted appearance of the weathered surfaces. The contact tends to be erosional and sharp, rather than gradational, in areas where the basal shale is absent. The erosional nature is suggested by truncation of upper Prairie Grove beds by carbonates of the basal Brentwood Member. The *Neognathodus symmetricus* Zone spans the contact indicating little time significance to the hiatus (Lane, 1977).

The Brentwood Limestone forms a broad belt trending northeast-southwest through Washington, Crawford, Madison, Newton, Carroll, and Boone counties, Arkansas (Fig. 1B). South of this area, the unit gently dips into the subsurface; it is truncated to the north. Different nomenclature is utilized for most of the Morrow interval, including the Brentwood, to the east and west of the type region due to pronounced facies changes. In northcentral Arkansas, the sand content of the Prairie Grove Member, Hale Formation and the whole of the Bloyd Formation increases to such an extent that they are combined as the Witts Springs Sandstone (Glick et al., 1964). Brentwood equivalents are included with the Braggs Member of the Sausbee Formation in eastern Oklahoma (Sutherland and Henry, 1977).

**Woolsey Member:** The Woolsey Member overlies the Brentwood Member in northwest Arkansas. It was named by Henbest (1953) for exposures near Woolsey Station, Arkansas. Until that time, informally it had been referred to as the coal-bearing shale. D. D. Owen (1858) was the first to describe this unit, but no type locality was defined. Simonds (1891) included the coal-bearing shale in his description of the Boston Group. Later, it was included in the Morrow Formation of Adams and Ulrich (1904), and finally the Bloyd Shale by Purdue (1907). The coal bed associated with the Woolsey Member was named the Baldwin Coal by Croneis (1930) for exposures at Baldwin Station, Washington County. Henbest (1962) defined the type section of the Woolsey as the south and west side of Bloyd Mountain from the center, E ½ Sec. 3 to the center, north side, Sec. 4, T. 14 N., R. 30 W., Washington County, Arkansas.

The Woolsey Member is essentially restricted to a northeast-southwest belt through Washington and Crawford counties, Arkansas (Fig. 1C). It dips into the subsurface to the south, and it is truncated to the north and east. Woolsey equivalents are incorporated into the Brewer Bend Limestone Member of the Sausbee Formation in northeastern Oklahoma (Sutherland and Henry, 1977).

Following deposition of the Brentwood Member, the Morrowan seas regressed to the southwest trailed by near-shore fresh water marsh environments. The majority of the sediments, which compose the Woolsey, were deposited in these marsh environments. Dark-gray, fissile shale comprises the thicker intervals of the succession. Plant impressions are found sporadically on the shale partings. In addition, thin intervals of siltstones are interbedded with Woolsey shales. The siltstones are generally thin bedded and display ripple bed forms. The coal seam, where present, varies from 2.5 to 45.7 cm in thickness (Fig. 1C). It occurs in a variety of positions with respect to the marine caprock at the base of the overlying Dye Shale Member. No systematic, predictable occurrence of the coal seam has been recognized. The Woolsey ranges from 3.2 to 31 m in outcrop, and thickens to 33 m or more in the subsurface (Fig. 1C). The thickening of the shale sequence in a down slope direction during the time of deposition suggests the possibility of a marine component to the basal Woolsey to the south.

The contact between the Brentwood and Woolsey members, Bloyd Formation, as defined by Henbest (1953), is unconformable. Placement of the contact in outcrop is confused by the similarity of marine and terrestrial shales. Stratigraphic practice has been to place the contact at the highest carbonate horizon found in the Brentwood. At many localities, a conglomerate is preserved at this horizon indicating both an unconformable contact and a change to non-marine deposition. At other localities, a thick shale sequence, probably grading from marine to non-marine, occurs above the highest limestone of the Brentwood. The Brentwood Woolsey contact in a depositional sense must fall within this interval, but it is placed at the top of the last limestone because of mappability and difficulty with determination of environmental change.

East of the Washington-Madison County Line, the Woolsey interval is represented by an unnamed middle Bloyd sandstone. This sandstone unconformably overlies the Brentwood Member throughout much of northwest and northcentral Arkansas. The sands, which compose the middle Bloyd sandstone, were deposited under largely fluvial conditions coeval with the Woolsey marshes during the regression of the Morrowan seas. Marine transgression, represented by the basal conglomerate of the Dye Shale, terminated Woolsey deposition throughout northern Arkansas.

## CONCLUSIONS

The contact between the Brentwood Member and the underlying Prairie Grove Member, Hale Formation is conformable and drawn below the first occurrence of shale 0.6 m or more in thickness above the Prairie Grove. Placement of this contact becomes confused away from central Washington County due to variations in thickness of the basal shale. Stratigraphic practice has been to map the Prairie Grove Member as a shale-free unit. As a result, the first occurrence of shale regardless of its thickness is commonly used to mark the Prairie Grove-Brentwood contact. In areas where the shale cannot be used as a marker, the Prairie Grove-Brentwood contact is drawn between the last massive, calcareous sand exhibiting a honeycombed weathering pattern (Prairie Grove) and the first dark calcarenite (Brentwood Member).

The Woolsey Member is a succession of terrestrial siltstones and shales which unconformably overlie the Brentwood Member. Stratigraphic practice has been to place the Brentwood-Woolsey contact at the highest carbonate horizon found in the Brentwood. The difficulty in distinguishing between marine and terrestrial shales in the field makes this a practical contact, although the actual depositional change may occur within the shales above the highest carbonates. The Woolsey Member is a lateral equivalent of an unnamed Middle Bloyd sandstone which unconformably overlies the Brentwood Limestone throughout most of northwest and northcentral Arkansas east of the Washington-Madison County Line.

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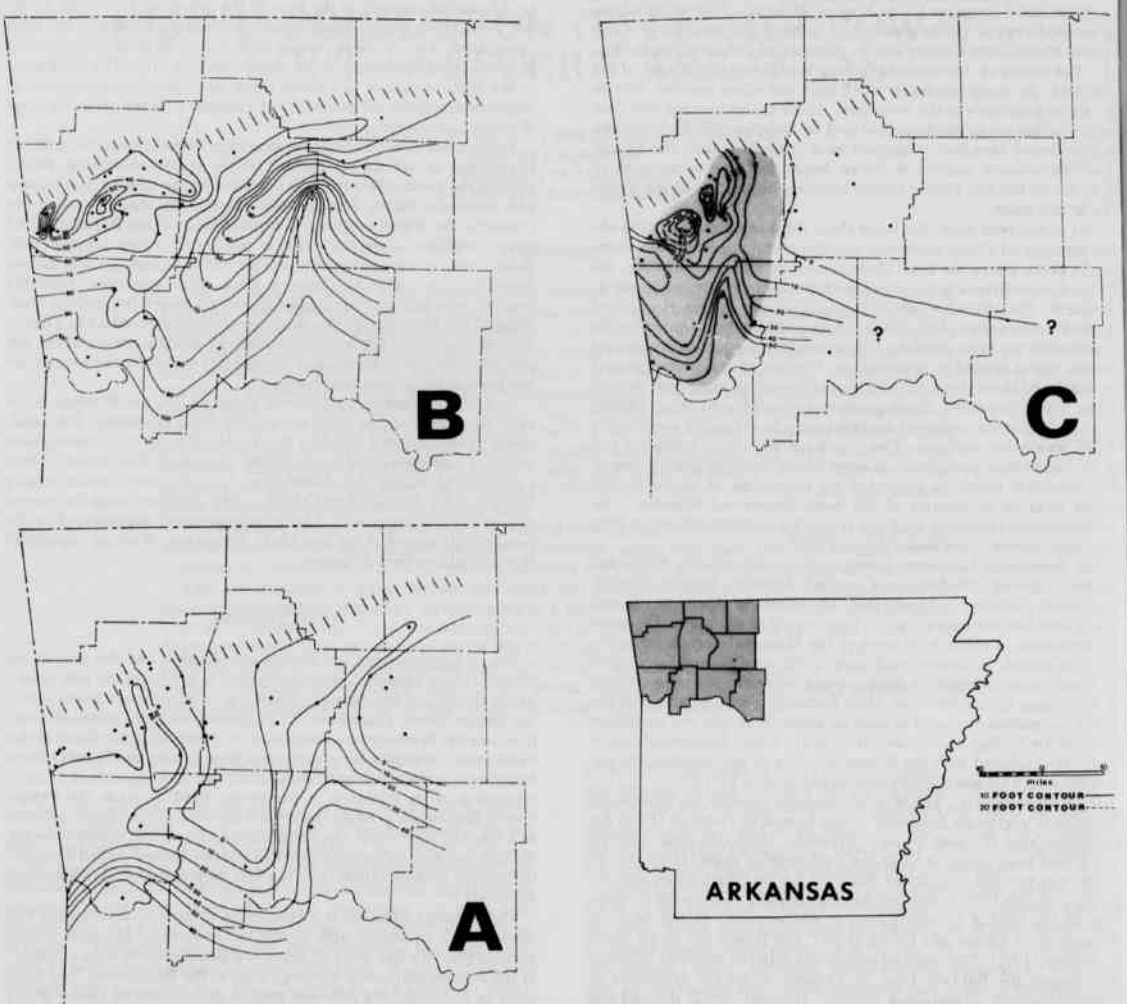


Figure 1. Regional Distribution of Brentwood-Woolsey strata, northwest Arkansas. A—isopachous maps of basal Bloyd Shale; B—isopachous map of total Brentwood Member including basal shale; C—isopachous map of total Woolsey Member with coal distribution shown by stipple pattern.

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