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EARLY PENNSYLVANIAN CONODONT-AMMONOID BIOSTRATIGRAPHY AND THE WITTS SPRINGS PROBLEM, NORTH-CENTRAL ARKANSAS

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ABSTRACT

The Witts Springs Formation was proposed as a lithostratigraphic unit in north-central Arkansas to include the interval from a horizon equivalent to the base of the Prairie Grove Member, Hale Formation to the top of the Bloyd Formation, of the type Morrowan Series, northwestern Arkansas. The top of the Witts Springs Formation was regarded as being unconformably succeeded by the middle Pennsylvanian Atoka Formation. Recent investigation of this unit in its type area has shown that the presumed Atokan Sandstone is actually a unit confined to the Bloyd Formation. Thus, the type section of the Witts Springs in Searcy County, Arkansas only comprises the Prairie Grove and Brentwood interval. This determination is supported by the recovery of the conodonts *Idiognathoides sinuatus, Neognathodus symmetricus* and *Idiognathodus delicatus*, and the ammonoids *Arkanites, Brannerоceras* and *Gastrioceras* from a succession of calcareous units below the middle Bloyd sandstone throughout the type Witts Springs and other sections in the type region. The Witts Springs should continue to be interpreted in the sense of its original definition, although a supplementary reference section is needed for the upper Witts Springs which spans the Morrowan-Atokan boundary with removal of the Trace Creek from the Morrowan.

INTRODUCTION

The lower and middle Pennsylvanian Hale and Bloyd Formations form the type Morrowan Series of northwest Arkansas. These rocks unconformably overlie Mississippian strata and they are succeeded unconformably by the Atoka Formation of middle Pennsylvanian age.

A dramatic facies change characterized by increased sandstone development occurs eastward across northern Arkansas in the Morrowan units. Only the Cane Hill Member of the Hale Formation is continuously mappable eastward and it has been raised to formation level in north-central Arkansas (Glick and others, 1964).

The Witts Springs Formation was proposed as the stratigraphic equivalent of the Prairie Grove Member of the Hale Formation and the entire overlying Bloyd Formation (Glick and others, 1964) in recognition of the facies changes occurring in the interval. In north-central Arkansas, the Witts Springs unconformably overlies the Cane Hill Formation and is overlain by the Atoka Formation.

A sandstone, informally called the middle Bloyd sandstone, caps most of the hills in north-central Arkansas and has been mistaken for the first Atokan sandstone (Zachry and Haley, 1975). Recent studies suggest that the middle Bloyd sandstones rather than the Atoka Formation, caps the Witts Springs at its type section. This situation alters the recognition of the Witts Springs as a formation and that problem has served as the focus of this study.

CONODONT AND AMMONOID BIOSTRATIGRAPHY

Both conodonts and ammonoids were recovered from calcareous lenses within the Witts Springs at its type section and other nearby localities (Fig. 1). Although biostratigraphic data is not as complete as desirable, zonations for both these faunal groups are well known from the type Morrowan succession.

The Morrowan conodont sequence of northwestern Arkansas was refined by Lane (1977) and two Morrowan conodont zones were identified with confidence. In addition, a third may be represented at the base of the Witts Springs at its primary reference section (RS). Figure 2 lists the sample horizons and abundances of the various conodont elements recovered in this study which are illustrated in figure 3.

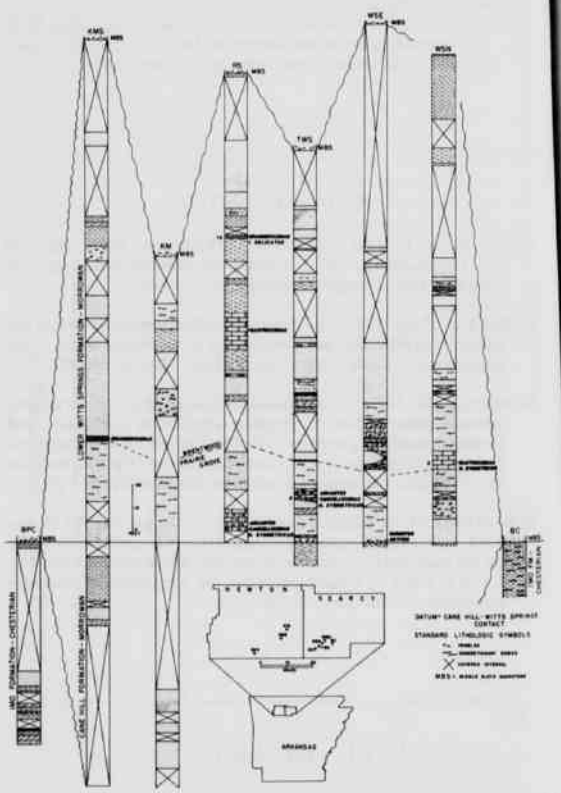

Figure 1. Stratigraphic columns illustrating measured sections and conodont and ammonoid occurrences in the Witts Springs Formation in its type area.

LOWER WITTS SPRINGS FORMATION

Location	KMS	RS			TWS		WSN		FWC
Sample	10	1	10	15	6	29	8	18	
Conodont Elements									
Adetognathus lautus	1	2	2	7	1	2	6		6
Idiognathoides sinuatus		1		15		1	1	1	6
Streptognathodus expansus				1					
Neognathodus symmetricus		2			1		5		1
Neognathodus bassleri				1					
Idiognathoides noduliferus				2			1		
Idiognathodus delicatus				1					
Bar Types			1	6				2	3

Figure 2. Conodont occurrences and abundance from samples of the Witts Springs Formation, north central Arkansas. Section locations and sample horizons shown on Figure 1.

Idiognathoides sinuatus Zone — The zonal name bearer (Fig. 3) was recovered from the base of section RS in association with the ammonoids *Arkanites* and *Cancelloceras* (Fig. 1). Isolated, impoverished assemblages with this form are difficult to date since it ranges into the Atokan Series. *Arkanites* and *Cancelloceras* normally occur with the conodont Neognathodus symmetricus which succeeds *I. sinuatus* as a zonal index in the type Morrowan sequence (Manger and Saunders, 1980). Thus, the base of section RS may fall in the *N. symmetricus* zone.

Neognathodus symmetricus Zone — This zone succeeds *Idiognathoides sinuatus* in the upper Prairie Grove and lower Brentwood at their type sections and therefore spans the Hale-Bloyd boundary (Lane, 1977). It ranges from the appearance of *Neognathodus symmetricus* to the first occurrence of *Neognathodus bassleri* (Lane, 1977). The lower part of this zone is typically coincident with the appearance of the *Arkanites relictus-Cancelloceras huntsvillense* ammonoid assemblage and that association was encountered at the type section of the Witts Springs (TWS, Fig. 1).

Idiognathodus delicatus Zone — This zone is defined by the overlapping ranges of *Neognathodus bassleri* and *Idiognathodus delicatus*. The upper part of the *Branneroceras branneri-Gastrioceras fittsi* ammonoid Zone correlates with the interval of this conodont zone. At the type Morrowan area, these zones occur in the upper Brentwood Member and elsewhere in strata thought to be marine equivalents of the Woolsey Member of the Bloyd Formation. This ammonoid and conodont association was found at section RS within the Witts Springs area (Fig. 1).

Ammonoid biostratigraphy of the Morrowan series has been discussed in detail by Saunders and others (1977) and Manger and Saunders (1980). Two ammonoid zones were identified with assurrance while the zonal name bearers of two older zones were found together at the base of section WSE, but appear to be reworked.

Retites-Quinnites occurrence — Single specimens of *Retites semiretia* and *henbesti* were found at the base of section WSE (Fig. 1). These taxa are the respective zonal name bearers of the basal two Morrowan ammonoid zones (Manger and Saunders, 1980). Both specimens are discolored, abraded and appear reworked. Unfortunately, no conodonts were recovered from the horizon.

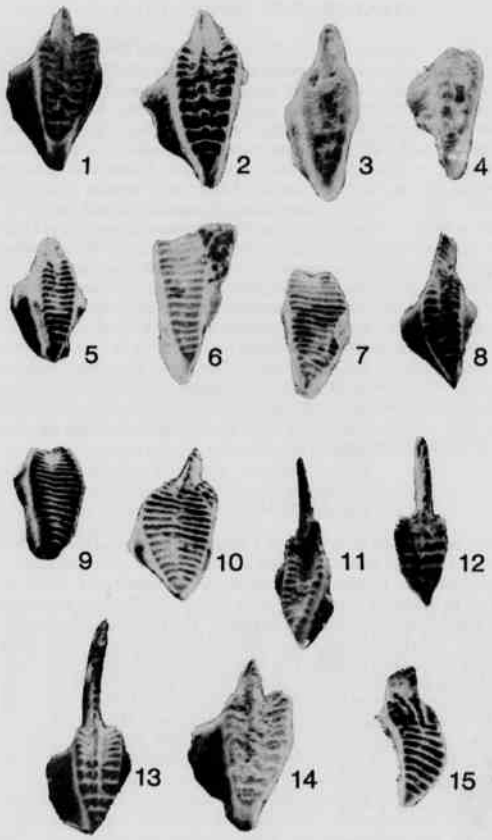

Figure 3. Conodonts from the Witts Springs Formation. Figured specimens 1-4 are from the Falling Water Creek Section. Figured specimens 5-15 are from the Witts Springs Reference Section. All illustrations are SEM photographs and are X45. 1-3: *Neognathodus symmetricus* (Lane); 4-9: *Idiognathoides sinuatus* (Harris and Hollingsworth); 10: *Streptognathodus expansus* (Igo and Koike); II: *Adetognathus lautus* (Gunnell); 12: *Neognathodus bassleri* (Harris and Hollingsworth); 13,14: *Neognathodus symmetricus* (Lane); 15: *Idiognathodus delicatus* (Gunnell).

Branneroceras branneri Zone — *Branneroceras branneri* was found at sections KMS and RS (Fig. 1). This distinctive form is a world-wide marker for the base of the Westphalian Series which also corresponds to the appearance of *Gastrioceras*. That form was found at section RS and WSN (Fig. 1). Both taxa appear at the top of the Brentwood Member at its type section and range through the marine equivalents of the Woolsey Member. The ammonoid association usually occurs with conodonts of the *Neognathodus bassleri* and succeeding *Idiognathodus delicatus* zone. At section WSN, *Gastrioceras* occurs with *N. symmetricus;* this association is not known in the type Morrowan region, and the *N. symmetricus* may be reworked.

STRATIGRAPHIC IMPLICATIONS

The interval equivalent to portions of the Prairie Grove at the type Witts Springs appears to be essentially the same lithology as it is in Washington County, except for being much thinner. The *Arkanites-Cancelloceras* ammonoid zone was found with the *Neognathodus symmetricus* conodont zone at the base of the Witts Springs at the localities RS and TWS. This zone occupies the middle of the Prairie Grove Member of the Hale Formation, and lack of lower Prairie Grove age equivalents may be due to increased duration of erosion at the Cane Hill-Witts Springs contact. Reworking of ammonoids and conodonts at section WSE in the base of the Witts Springs supports this idea.

The interval equivalent to the Brentwood within the Witts Springs changes dramatically in appearance and thickness compared to the Brentwood at its type section. The Brentwood interval is nearly three times thicker in central Arkansas and changes from quartz-bearing limestone and shale to an alternation of sandstone and shale.

Conodonts and ammonoids indicate that the Witts Springs in its type area is equivalent to the Upper Prairie Grove and Brentwood interval of the type Morrowan succession. No conodonts or ammonoids suggestive of Morrowan intervals higher than the Brentwood were found in the type region of the Witts Springs Formation beneath the presumed middle Bloyd sandstone.

CONCLUSIONS

There seems to be little value in a lithostratigraphic unit equivalent only to the Prairie Grove-Brentwood interval. This situation would leave strata above the middle Bloyd sandstone unnamed and would be difficult to recognize with the absence of the middle Bloyd sandstone in the eastern portion of northern Arkansas. Therefore, the Witts Springs should be interpreted along the lines originally intended rather than relations at the type section. The base of the formation is easily seen as a change from thin bedded shale-siltstone succession of the Cane Hill to the massive, conglomeratic, basal sandstone of the Witts Springs. The Morrowan sequence above the middle Bloyd sandstone is totally shale east of Madison County because the Kessler disappears. The loss of the Kessler causes the Morrowan-Atokan boundary to be a shale-on-shale contact. Therefore, the first massive sandstone of the Atoka should be chosen to represent the upper contact of the Witts Springs because of its mappability, although this proposal requires extensive study. By this definition, the Witts Springs Formation spans the Morrowan-Atokan boundary since the Trace Creek shale has been removed to the Atoka Formation (Sutherland and Manger, 1983).

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