



## *Paleontological reconnaissance of subsurface Pennsylvanian in southern Apache and Navajo Counties, Arizona*

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# PALEONTOLOGICAL RECONNAISSANCE OF SUBSURFACE PENNSYLVANIAN IN SOUTHERN APACHE AND NAVAJO COUNTIES, ARIZONA<sup>1</sup>

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## INTRODUCTION

The area of interest is located at the southern edge of the Colorado Plateau and north of the Mogollon Rim, within Apache and Navajo Counties, Arizona. Four wells drilled by Pan American Petroleum Corporation provide new paleontological information on Pennsylvanian strata of eastern Arizona. A correlative zone of fusulinids is defined between subsurface Pennsylvanian intervals and surface equivalents on the Mogollon Rim to the south.

Huddle and Dobrovolny (1945) provide the basic reference for surface stratigraphy of the region. In their work, they detail a section in Salt River Canyon with age determinations based upon fusulinid study by L. G. Henbest. Kottowski (1960) has summarized known stratigraphic information since that date. He mentions the lack of "Naco-like" rocks in two wells north of St. Johns, and suggests that most of the thinning in the Naco Formation is within post-Desmoinesian strata (also see Kottowski and Havenor, this guidebook). Generalized Pennsylvanian and Permian stratigraphic information for this area has been included in several reports (Havenor and Pye, 1958; Peirce, 1958; Elston, 1960).

A gradational change from shale and limestone in the south to a red-bed sequence in the north, complicates efforts to correlate and date the strata. Fossil evidence, so abundant in the Mogollon Rim area, becomes very sparse as lithologies change to the north and the rocks dip beneath the surface. The relatively unfossiliferous beds in the few wells penetrating the Pennsylvanian interval have resulted in a sketchy picture of subsurface changes northward and eastward from the Mogollon Rim.

The surface section at Salt River Canyon is composed of very fossiliferous limestone intervals assigned to the Naco Formation, and a transitional to red-bed interval above is assigned to the Supai Formation. The data presented below is from the subsurface equivalents of these formations.

## SUBSURFACE PALEONTOLOGY

Pennsylvanian fusulinids useful in age determination have been found in several wells north of the Mogollon Rim in Apache and Navajo Counties, Arizona. Four wells, all south of Holbrook, were drilled by Pan American in 1959, each penetrating the Pennsylvanian interval. In addition, data are presented from a fifth well, the Lockhart No. 1 Aztec Land and Cattle Co., located between two of the Pan American wells (Figure 1).

### Pan American 1A Aztec Land and Cattle Co.

The well is located in Sec. 5, T16N, R20E, Navajo County, Arizona. *Fusulinella?* was recorded at a depth of 3510-20', approximately seventy feet above the base of the Pennsylvanian. The two small fragments obtained show a four-layered wall and light fluting. The *Fusulinella?* specimens are interpreted to be Lower Desmoinesian

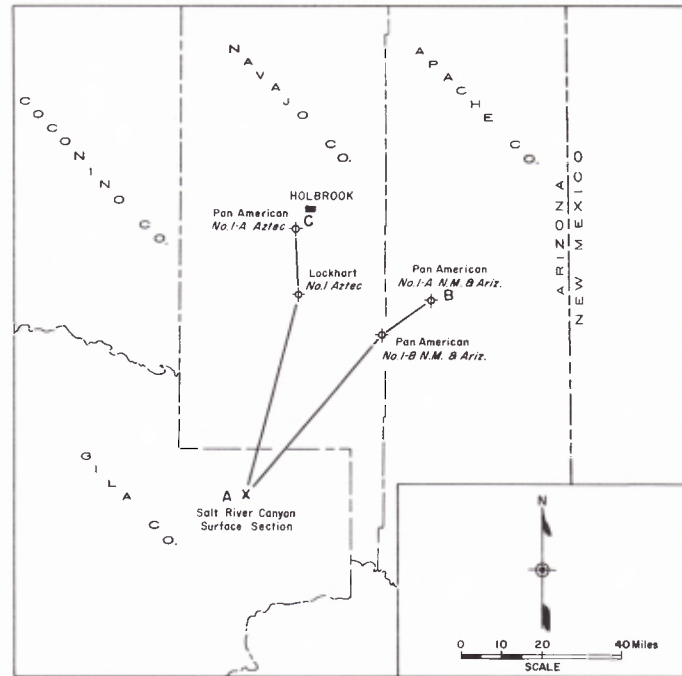


Figure 1. Index map showing location of cross sections A-B and A-C in Apache, Navajo, and Gila Counties, Arizona.

(Cherokee) in age. Exact positioning of the fusulinids within the time sequence is not attempted with this fragmentary evidence. The specimens are of value since they give assurance of pre-Missourian fusulinid-bearing strata in this well. Also observed and recorded were the following fossils:

3085-90'	Free crinoid columnal and free bryozoan
3375-80'	Free echinoid spine
3455-60'	Ostracod
3520-25'	Free bryozoan
3530-35'	Free bryozoan

The noted occurrence of free specimens suggests a marine origin for some of the shales in the sequence. Ecologic interpretations should take into account that free specimens may be cave.

### Pan American 1B Aztec Land and Cattle Co.

The second well is located in Sec. 9, T16N, R18E, Navajo County, Arizona (Figure 1). No fusulinids were observed in a preliminary examination of a single cut of the samples. Only crinoids and bryozoans were noted at 3460-70'.

### Pan American 1B New Mexico and Arizona Land Co.

This well is located in Sec. 25, T12N, R23E, Navajo County, Arizona. Virgilian fusulinids designated as *Triticites cullomensis* Dunbar and Condra were recorded at a depth of 3450-3500', approximately 600-650' above the

<sup>1</sup>Publication authorized by Pan American Petroleum Corporation

base of the Pennsylvanian. The specimens occur in limestone and are relatively abundant. Also observed and recorded were the following fossils:

3240-45'	Ostracod
3275-80'	Ostracod
3645-50'	Free echinoid spine
3650-51'	Bryozoan in shale
3665-70'	Free bryozoan
3670-75'	Echinoid spine
3680-85'	Productid fragment
3690-95'	Ostracod in purple shale

Most of the fossils listed above suggest the presence of marine shale intervals.

#### Pan American 1A New Mexico and Arizona Land Co.

The fourth well is located in Sec. 12, T13N, R25E, Apache County, Arizona. No fusulinids were observed in examination of a single sample cut from this well. The following fossils were recorded:

3240-45'	Free crinoid columnal
3250-60'	Crinoid columnal in shale, free bryozoan
3260-65'	Crinoid columnals and gastropod
3265-70'	Free crinoid columnal, echinoid spine in shale, and free bryozoan
3300-05'	Free crinoid columnal
3315-20'	Bryozoan and crinoid columnal in limestone
3320-25'	Ostracod in limestone
3325-35'	Free crinoid columnals
3355-60'	Algae in limestone, free bryozoan
3360-65'	Echinoid spine in limestone
3375-80'	Algae in limestone
3380-85'	Free crinoid columnals
3395-3400'	Algae and echinoid spine in shale
3400-05'	Free crinoid columnals
3465-70'	Free crinoid columnal
3495-3500'	Free echinoid spine and crinoid columnal
3500-05'	Ostracod in shale, free crinoid columnal
3515-20'	Free crinoid columnal and echinoid spine

The list of fossil occurrences given above does not necessarily reflect a greater abundance of these forms than faunas noted to the west. Lack of fusulinids resulted in a more detailed recording of additional faunal data for this well.

#### Lockhart No. 1 Aztec Land and Cattle Co.

This well is located in sec. 33, T14N, R20E, Navajo County, Arizona. One specimen identified here as *Triticites cullomensis* Dunbar and Condra was previously recovered by Dr. G. J. Verville from a depth of 3220-30'. This occurrence is approximately 430 feet above the base of the Pennsylvanian.

#### SURFACE PALEONTOLOGY

The surface section used for comparison with the subsurface is located in Salt River Canyon, T7N, R19E, Gila County, Arizona. The section was measured, described, and sampled by Dr. W. W. Tyrrell, Jr., in 1956.

Fusulinids were obtained from thirty-two limestone intervals in the Salt River Canyon section. Interest is concentrated on fusulinids from the Zone of *Triticites* (Missourian and Virgilian) and the Zone of *Fusulina* (Desmoinesian). The uppermost fusulinid-bearing intervals were located in beds assigned to the Supai Formation in field examination.

A collection approximately 800 feet above the base of the Pennsylvanian yielded the same Virgilian *Triticites*

species as recovered from the subsurface. Both the surface and subsurface forms are tentatively identified as *Triticites cullomensis* Dunbar and Condra. The highest recorded occurrence of Desmoinesian fossils is approximately 450 feet above the base of the Pennsylvanian.

#### PALEONTOLOGICAL CORRELATIONS

The same species of Virgilian *Triticites* was recorded from two wells and from the Salt River Canyon surface section (Figures 2 and 3). These occurrences constitute a time horizon recognizable from surface exposures 53 miles to the north and northeast. A cross section to the northeast (Figure 2) shows thinning of about 150-200 feet within the interval between the base of the Pennsylvanian and the *Triticites cullomensis* horizon. The 800 feet in the surface section is represented by 600-650' in the Pan American No. 1B New Mexico and Arizona well. Red beds inter-finger with marine carbonate units; however, the data also indicate a decrease in total sediment thickness between the time horizons. Only one of the thirty-two surface intervals bearing fusulinids was found in the Pan American No. 1B New Mexico and Arizona well.

A cross section to the north (Figure 3) shows a decrease in sediment thickness within the same time interval. *Triticites cullomensis* Dunbar and Condra found 800 feet above the base of the Pennsylvanian in the Salt River Canyon section was found 430 feet above the base in the Lockhart No. 1 Aztec well 53 miles to the north. Again, only one of the thirty-two surface intervals bearing fusulinids was found in the Lockhart No. 1 Aztec well. The same horizon was not found in the two Pan American wells north and northwest of the Lockhart well.

The extensive sequence of Missourian and Virgilian fusulinids found below the *Triticites cullomensis* horizon on the surface was not observed in any of the four wells drilled by Pan American Petroleum Corporation.

Fusulinid-bearing Lower Desmoinesian (Cherokee) strata appear to extend farther to the north than to the northeast. Their extent to the west has already been defined in surface exposures at Fossil Creek (Kottlowski, 1960). Fossiliferous marine shale and limestone of probable Desmoinesian age extend northeastward to the Pan American No. 1A New Mexico and Arizona Land Co. well in Apache County.

Fusulinid data suggest that significant thinning of Pennsylvanian sediments must be recognized in addition to the previously described interfingering of red-bed clastics with Naco subsurface equivalents.

#### CONCLUSIONS

1. A time horizon is available for paleontological correlations between the Mogollon Rim and subsurface sections to the north in Apache and Navajo Counties, Arizona.
2. The interval between the *Triticites cullomensis* horizon and the base of the Pennsylvanian thins significantly to the north and northeast of the Salt River surface exposures.
3. Of the thirty-two fusulinid-bearing intervals recognized on the surface, only one interval was recognized in each of three new wells to the north and northeast of the Mogollon Rim.
4. Reconnaissance investigation suggests that Desmoinesian fusulinid-bearing intervals appear to extend farther west and north from the Salt River section than to the northeast.
5. Fossiliferous marine shale of probable Desmoinesian age is present in the subsurface of western Apache County, Arizona.

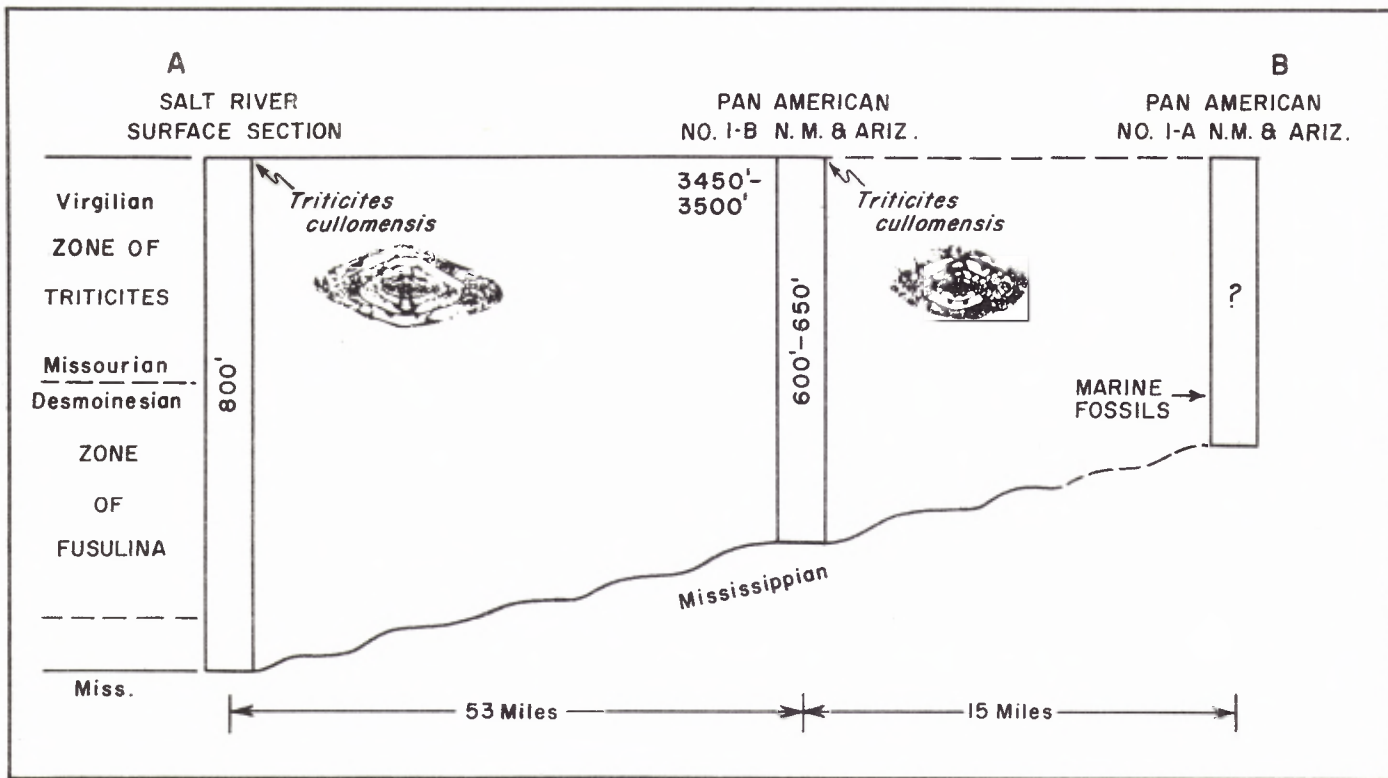


Figure 2. Cross section A-B showing occurrence of *Triticites cullomensis* Dunbar & Condra, northeast from Salt River Canyon surface section.

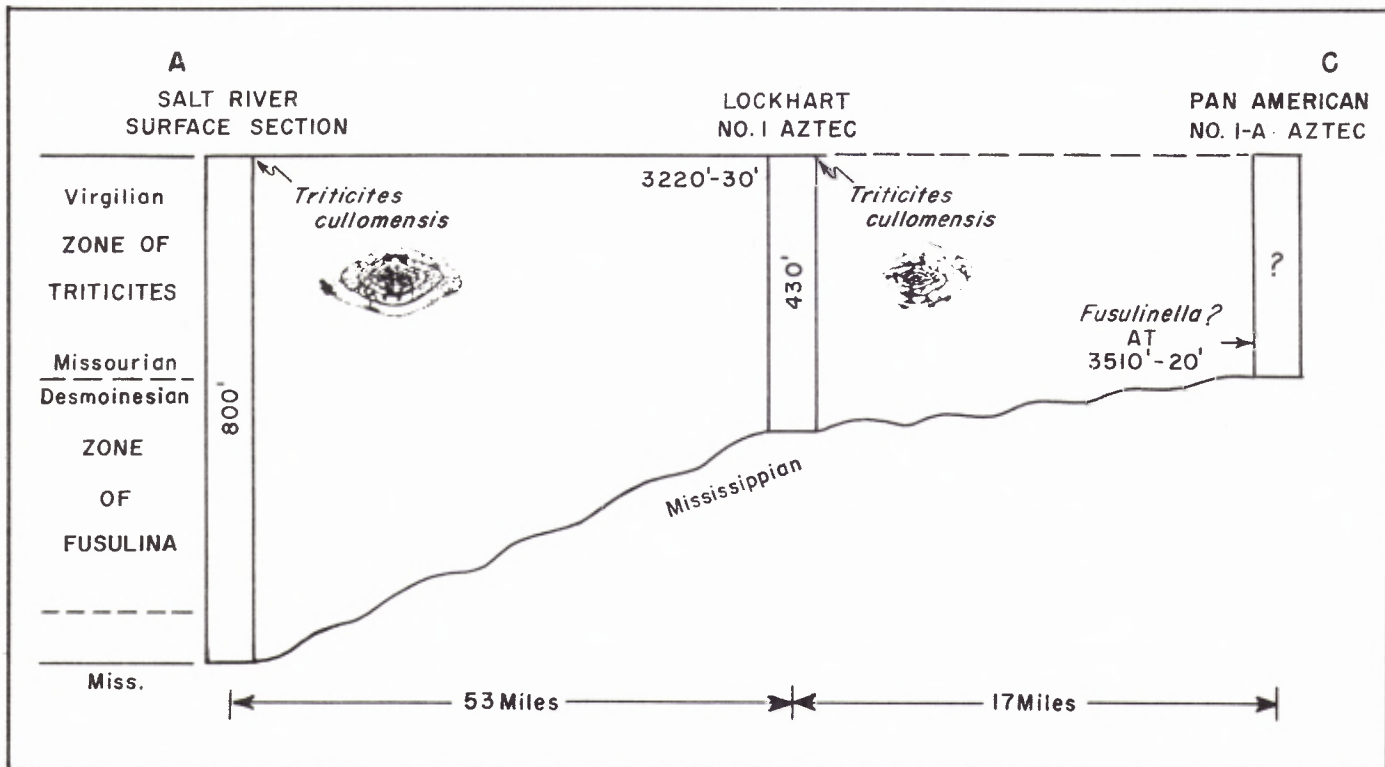


Figure 3. Cross section A-C showing occurrence of *Triticites cullomensis* Dunbar & Condra, north-northeast from Salt River Canyon surface section. Drafted by J. L. Wilhite. Fusulinid photographs by R. J. Harrill and W. F. Howard.

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