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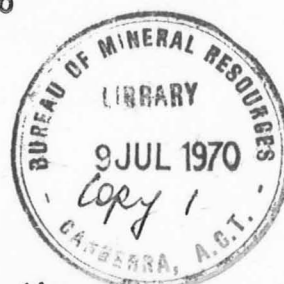
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Palynological Observations on
Amoco Towerhill No. A-1 Well,
Galilee Basin,
Queensland

by

D. Burger

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PALYNOLOGICAL OBSERVATIONS

ON AMOCO TOWERHILL No.A - 1 WELL, GALILEE BASIN, QUEENSLAND.

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RECORDS 1970/26

Contents

	<u>Page</u>
SUMMARY	
INTRODUCTION	2
AGE OF SAMPLES	3
CONCLUSIONS	9
REFERENCES	10
Table 1 : Specification of samples.	2
Table 2 : Comparison of Permian Palynological Zonations.	3

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ON AMOCO TOWERHILL NO. A-1 WELL, GALILEE BASIN, QUEENSLAND

SUMMARY

Permian, Triassic and Jurassic sediments, drilled and sampled in the Towerhill No. A-1 well by Amoco Australia Exploration Company, Sydney, were palynologically examined with emphasis on the stratigraphy of the Permian and Triassic. Palynological units P 1b-c, P 3b-4, Tr 3(a-c) are recognized and discussed in connection with the positions of the Permo-Carboniferous, Permo-Triassic and Trias-Jurassic boundaries in the lithological sequence of the Galilee Basin in Queensland.

INTRODUCTION

Towerhill No. A-1 well was drilled 60 miles northwest of Amerada Thunderbolt No. 1 in the Tangorin 1:250,000 Sheet area (lat. 21°43'06" south; long. 144°20'50" east). Drilling was carried out in November 1967 and reached a total depth of 4886 feet, entering ignimbrite basement (Haworth 1968). Samples of conventional and sidewall cores were cut by Amoco Australia Exploration Company for the purpose of palynological examination, in order to locate the boundaries of the Triassic and Permian Systems and establish the possible presence of Carboniferous sediments. Seventeen samples representing the interval between 4650 feet and 1804 feet (549.86m) were selected as most likely to produce microfossils. They were chemically processed according to standard Bureau methods and are listed together with the results of the examination, in Table 1.

TABLE 1 : SPECIFICATION OF SAMPLES

SAMPLE NUMBER (MFP)		DEPTH FEET METRES		AGE	FORMATION (Haworth 1968)	UNIT
SWC	4639	1804	549.86	JURASSIC	HUTTON	J und.
"	4640	1943	592.22	TRIASSIC	MOOLAYEMBER	Tr 3(a-c)
"	4644	2050	624.84	"	"	"
c.1	4660	2333'6"	711.24	"	"	"
SWC	4646	2550	777.24	"	CLEMATIS	barren
SWC	4651	2639	804.36	"	"	"
"	4645	2849	868.37	"	REWAN	"
"	4652	3150	960.22	"	"	"
"	4647	3250	990.70	"	"	"
"	4648	3456	1052.39	PERMIAN		P 3b-4
"	4649	3808	1150.68	"		P?
"	4661	3915'4"	1193.39	"		P 3b-4
"	4650	4190	1277.11	"		?
"	4653	4300	1310.64	"		P 1c?
c.5	4662	4441'4"	1353.72	"		P 1b-c
SWC	4654	4650	1417.32	"		"

AGE OF THE SAMPLES

The age of the microfloral assemblages is expressed in palynological units, as far as possible. Since Evans' earlier studies in the Permian of the Bowen Basin and Springsure Shelf, various attempts have been made to formulate an adequate palynological subdivision of the Permian. Evans (1967) designed a generalized scheme of palynological "Stages", in which more recent data from the Cooper, Galilee, Bowen and Sydney Basins were incorporated. These Stages are included in the discussion of various microfloras; for the sake of convenience their relation to the spore units is illustrated in Table 2.

TABLE 2 : COMPARISON OF PERMIAN PALYNOLOGICAL ZONATIONS

AGE	SPORE UNIT (Evans 1964)	STAGE (Evans 1967)
LOWER-UPPER PERMIAN	P 4 P 3b-d	5
LOWER PERMIAN	P 2a - P 3a	4
	P 1c	3
	C 2 - P 1b	2
UPPER CARBONACEOUS	C 1	1

JURASSIC

Sample MFP 4639 (depth 1804 feet) produced few spores, among which the following types were recognized:

Classopollis spp.

Podocarpidites cf. multesimus

Baculatisporites comaumensis

Cyathidites minor

Although spore recovery was poor, the presence of Classopollis is sufficient to indicate a Jurassic age for the microflora.

TRIASSIC

Sample MFP 4640 (depth 1943 feet) yielded the following spores:

Dictyophyllidites mortoni
Osmundacidites wellmanii
Alisporites parvus
A. australis
Platysaccus queenslandi type
Punctatosporites walkomi
Polypodiisporites ipsviciensis
Aratrisporites coryliseminis
A. granulatus
Lundbladispora cf. brevicula
Nathorstisporites sp. (fragment)
Ceratosporites sp.

Sample MFP 4644 (depth 2050 feet) produced a poor assemblage, in which the following species could be identified:

Ginkgocycadophytus nitidus
Annulispota folliculosa
Dictyophyllidites mortoni
Alisporites australis
A. parvus
cf. Hamiapollenites insculptus
Polypodiisporites ipsviciensis
Aratrisporites sp. (1 specimen)
Anapiculatisporites cooksonii
Foraminisporis tribulosus
Striate monosaccate form

Sample MFP 4660 (depth 2333'6") produced the following assemblage:

Alisporites spp.
Vitreisporites pallidus
Ginkgocycadophytus nitidus
Osmundacidites wellmanii
aff. Ephedripites sp.

(MFP 4660 cont.)

Aratrisporites fimbriatus

A. flexibilis

A. coryliseminis

Dictyophyllidites harrisii

Striatiti (indeterm.).

All three assemblages have in common a relative abundance of Alisporites sp. and the presence of various types of Aratrisporites (except for MFP 4644). This is characteristic of Upper Triassic microfloras and indicates Evans' spore units Tr 3a-d, known from the Clematis Sandstone and Moolayember Formation in the Eromanga, Surat and Bowen Basins (Evans 1966a). Further restriction of the age to the interval of units Tr 3 a-c is indicated by the absence of Duplexisporites gyratus, which type Evans regards to be characteristic of spore unit Tr 3d.

In view of the closeness of the Jurassic-Triassic boundary at 1848 feet and the regional (unit J 3-4) age of the overlying Hutton Sandstone (Burger, in prep.) it is very probable that part of the uppermost Triassic as well as a large part of the Lower Jurassic are not represented in the section. In fact, unconformable contact between Triassic and Jurassic is quite well-known in the Eromanga Basin area (Evans 1966b) and was also established palynologically in the section of Thunderbolt No. 1.

PERMIAN

Sample 4648 (depth 3456 feet) yielded the following spores:

Acanthotriletes sp.

Nuskoisporites gondwanensis

Leiotriletes directus

Taeniaesporites sp.

Protosacculina multistriata

Lunatisporites cf. amplus

cf. Apiculatisporites sp.

Pityosporites sp.

Striatites phaleratus

Apiculatisporites sp.

This assemblage is attributable to the Permian. Balme (1964) reports relative abundance of Striatiti and spinose azonate trilete spores in his Upper Permian Dulhuntyi Assemblage, which Evans correlates with Stage 5, including spore units P 3b - P 4 (Evans 1967). Microfloras of this type are widely known from the Queensland area, and in the upper part are very often associated with coal measures. The logs from Towerhill show that this sample is taken just above the major development of coals at 3460 feet. The only spore indication of an uppermost Permian age is the presence of a type here attributed to Taeniaesporites, that is reported from basal Triassic strata in Western Australia (Balme 1964) and in the eastern part of Australia (Evans 1966a), and may indicate the proximity of Balme's Taeniaesporites Microflora equivalent.

Sample 4649 (depth 3808 feet) produced only a few spores:

Leiotriletes sp.,
cf. Pityosporites sp.,

These types do not warrant an age determination within the Permian interval.

Sample 4661 (depth 3915'4") yielded the following spore types:

Lunatisporites
(Protohaploxylinus) amplus
Nuskoisporites gondwanensis
cf. Vesicaspora sp.
Laevigatosporites vulgaris colliensis
Apiculatisporites sp.

The presence of L. vulgaris suggests an age not older than Stage 4, while the abundance of Apiculatisporites again points to the Dulhuntyispora Assemblage equivalent (Stage 5; spore units P 3b-4). The occurrence of major coal seams in the Towerhill section just above this level also favours a P 3b-4 age for the sample.

Sample 4650 (depth 4190 feet) produced a few spores resembling Deltoidospora sp. No age determination is possible.

Sample 4653 (depth 4300 feet) produced, besides considerable amounts of microscopic plant debris, the following spores:

Nuskoisporites gondwanensis

Apiculatisporites filiformis

Granulatisporites sp.

Striatites phaleratus (fragment)

Punctatisporites gretensis

Protosacculina cf. multistriata

Lunatisporites amplius

Verrucosisporites pseudoreticulatus

Evans (1967a) restricts the vertical extension of P. gretensis to Stages 1 to 4; i.e. spore units C1 - P2, the equivalents of Balme's Nuskoisporites and Vittatina Assemblages. Balme (1964) reports the spore only from the Sakmarian and Lower Artinskian, which interval he associates with the Nuskoisporites Assemblage.

Reports of V. pseudoreticulatus from eastern Australia (spore units P 1b-P 2, Evans 1966b; mainly Stages 3 and 4, Evans 1967a) and from Western Australia (Upper Sakmarian-Artinskian, Balme 1964) appear to restrict the range of this spore to the lower Permian.

It seems therefore that typical Carboniferous elements are absent and the above microflora can be attributed to the lower Permian, in accordance with identical assemblages that Balme (1957) described from Lake Phillipson Bore (South Australia). Expressed in Evans' spore units this means an age within the P 1b-P 2a interval, equivalent to uppermost Stage 2, Stage 3 and lowermost Stage 4 (Evans 1967a). The common presence of Striatiti and near-absence of monosaccate pollen grains may indicate some level high within this interval, i.e. unit P 1c or higher, which Evans (1966b) noticed from the Cooper and Galilee Basins.

P 1c - P 2 (mainly Stages 3 and 4) microfloras are well-known in the eastern Australian region. Stage 3 is widely spread in Queensland, northern New South Wales and in the Mt. Toondina region, South Australia. Stage 4 has been recognized in Queensland in the Bowen Basin and also the Cooper Basin, nor further north than Chandos No. 1, northwest of

Quilpie (Evans 1966b). In the Bowen Basin (Dennison Trough) Evans repeatedly noticed P 3b - P 4 (Stage 5) microfloras directly succeeding units P 1b-c (Evans 1964; 1966bc), a break caused by the unconformity between the Colinlea Sandstone and the Reids Dome Beds. In Lake Galilee No. 1, units P 3b - P 4 are directly overlying P 1b. In Thunderbolt No. 1 the higher (Stage 5) Permian includes a suite of sediments of about 500 feet thick. Near the base of this interval unit P 1c (Stage 3) fossils were recovered, while approximately 80 feet higher units P 3b - P 4 were already recognized (Evans in AMERADA Petroleum Corp. of Australia Ltd. 1967). Haworth (1968) account for a similar sedimentary sequence of the same order of thickness in the Towerhill section between 3918 feet and 3444 feet. Here, fossils recovered throughout the interval appear to be dateable as Stage 5. The next dating further down (Stage 3; unit P 1c) is at 4300 feet. Thus, there is no record of the presence of Stage 4 in this well; in fact, Evans (1964; 1966 bc) showed that regionally a break in the sedimentary sequence is connected with Stage 4. Therefore, a break in the sequence is connected with Stage 4. Therefore, a break in the sequence of Towerhill No. A-1 is here accepted, which in analogy with the Thunderbolt and Galilee sections probably includes units P 2a - P 3a.

Sample 4662 (4441'4") produced a poor microflora, in which the following elements were encountered:

Calamospora diversiformis

Calamospora sp.

Nuskoisporites gondwanensis (fragments)

Granulatisporites trisinus

Neoraistrickia cf. ramosa

Sample 4654 (4650 feet) yielded only a very few spores. The following types could be recognized:

cf. Nuskoisporites sp. (fragment)

Calamospora sp.

Neoraistrickia cf. ramosa

None of these spores are known from older than lower Permian strata in Australia. The absence of *Striatiti* points to a lowermost Permian age, while Carboniferous spores described from Balme's Nuskiosporites Assemblage equivalent in Queensland (Evans 1967a) were not encountered. However, monosaccate forms were reported in pre-Permian *Rhacopteris* microfloras, both in Queensland (Evans 1964; 1967a) and in the Sydney Basin (Evans 1967b). Although meagre, the evidence seems to point to a lower Permian (spore units P 1b-c) age for microfloras MFP 4662 and 4654.

CONCLUSIONS

Breaks in the spore succession, indicating unconformities in the sedimentary sequence, were noticed between the lower and higher Permian and between the Upper Triassic and Jurassic. This agrees with the general sedimentary and microfossil history in the area. The Jurassic/Triassic boundary lies between 1804 and 1943 feet and the sedimentary hiatus in the Permian between 3915 and 4300 feet, most probably at the depth of 3918 feet, selected by Haworth (1968).

Spore indications concerning the position of the Permian/Triassic boundary are vague. As Stage 5 microfossils were extracted from 3456 feet, this boundary should be sought at a higher level, although with all probability not much higher, as the higher Permian coal measures from many localities in Queensland ^{yield} upper Stage 5 microfloras.

According to the (meagre) evidence there is no Carboniferous present in the Towerhill section above 4650 feet. The "speckled red sandstone" (approx. 3600 feet) and the "green splintery shale" (approx. 3920 feet) in Thunderbolt No. 1, as well as the identical horizons at respectively 4056 feet and 4334 feet in Towerhill No. A-1 appear to produce P 1b-c microfloras. Although the question of the Carboniferous/Permian boundary in Australia is subject to controversy, Evans considers that, on the basis of comparative studies in eastern Australia (summarized in Evans 1967a), spore units C2 - P 1b (Stage 2) belong to the Permian. This means that the Carboniferous/Permian boundary lies some distance below 4650 feet, at the location of Towerhill No. A-1 and may not have been penetrated at all.

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