



InfoCentre

NT Minerals and Energy

Petroleum Exploration Reports

This file contains scanned images of hardcopy reports/data submitted to the Northern Territory Government under Petroleum Legislation.

Bringing Forward Discovery

This information is made available to assist future petroleum explorers and may be distributed freely.

InfoCentre

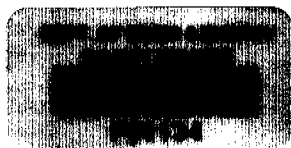
Call: +61 8 8999 6443
Click: geoscience.info@nt.gov.au
www.minerals.nt.gov.au
Visit: 3rd floor
Centrepoint Building
Smith Street Mall
Darwin
Northern Territory 0800



AN INTERPRETATION OF THE GEOLOGY AT THE UNDANDITA NO.2 WELL

J.A. Deckelman

December, 1988



INTRODUCTION

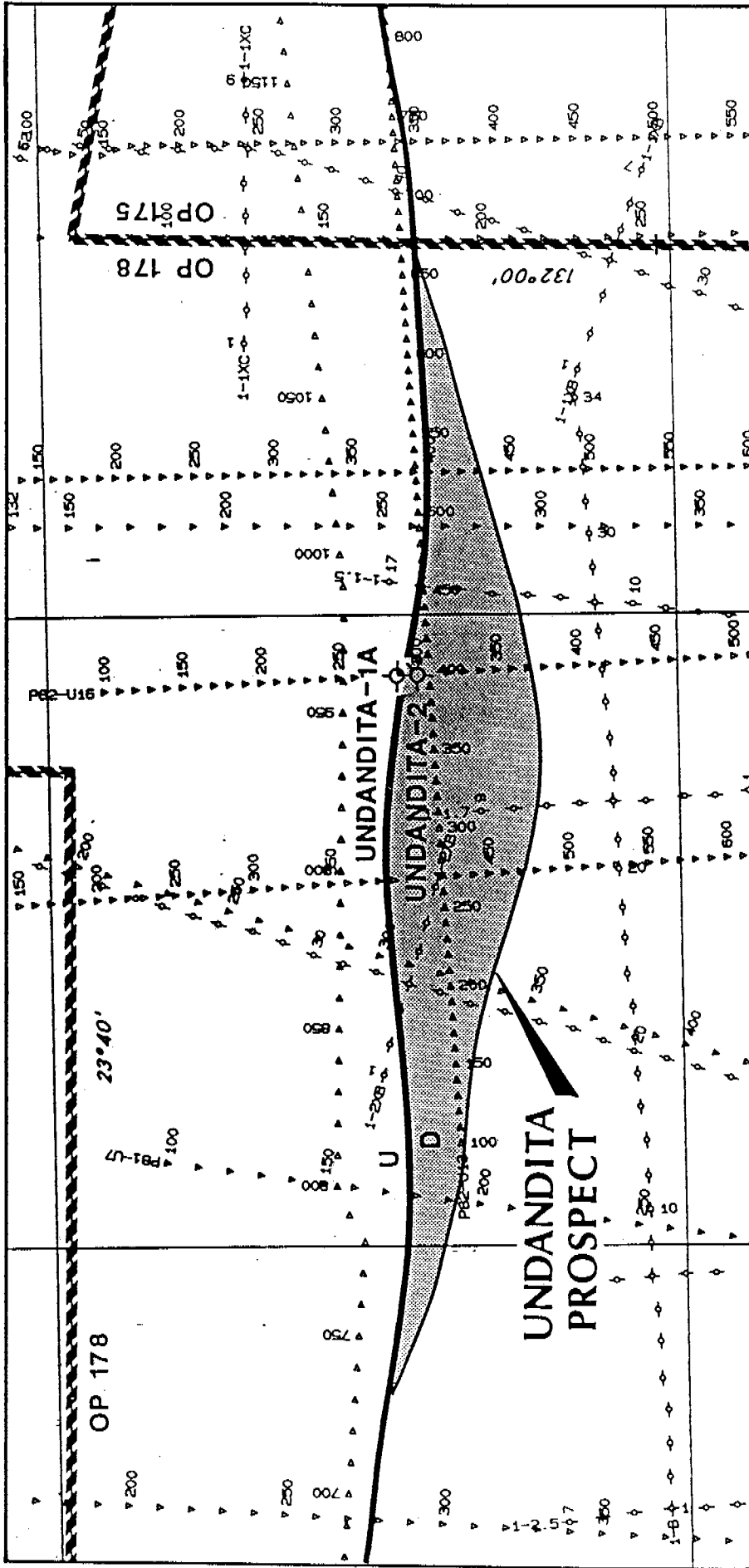
In late 1982 and early 1983, the Amadeus Joint Venture drilled the Undandita -1A well, a continuously cored hole designed to "assess the hydrocarbon potential of the Pacoota Sandstone, and secondly the Stairway Sandstone" (Gorter et al., 1983) at the Undandita prospect (Fig.1). Although the Undandita -1A well provided valuable structural and stratigraphic information, it did not penetrate either of the primary targets at this prospect (Deckelman, 1983). In order to test the reservoir potential of the Pacoota Sandstone and the Stairway Sandstone at the Undandita prospect, the Amadeus Joint Venture drilled a second well, the Undandita -2 well, in late 1988. The Undandita -2 well spudded at V.P.300 on seismic line P82-U16, 1033' (315m) south of the Undandita -1A well (Fig.1).

An interpretation of the stratigraphy and structure at the Undandita -2 well follows. This interpretation is based on analysis of wireline logs, the lithology log, sidewall cores, and cuttings recovered from 5042' (1537m) to total depth. Cuttings recovered above 5042' (1537m) were not available for inspection at the time of writing.

STRATIGRAPHY

The Undandita -2 well penetrated an 8216.5' (2504.4 m) sequence of structurally disturbed Proterozoic, Cambro-Ordovician, and Devonian sediments beneath a 180' (54.9m) veneer of Cainozoic alluvium. Proterozoic and Cambrian sediments comprise the upper part of the well and are separated from Cambro-Ordovician and Devonian sediments below 3382' (1030.8m) by the Carmichael fault. The stratigraphic sequence penetrated at the Undandita -2 well is listed in Table 1 and shown on the gamma ray/sonic log (Enclosure 1) and the lithology log (Enclosure 2).

The Illara Sandstone, the Tempe Formation, and the Gillen Member of the Bitter Springs Formation comprise the stratigraphic sequence above the Carmichael fault at the Undandita -2 well. The Illara Sandstone, present between 180' (54.9m) and 425' (129.5m), is faulted and truncated by erosion at the base-Cainozoic unconformity. Only the lower part of the Illara Sandstone is present at this well. The Tempe Formation conformably underlies the Illara Sandstone and comprises most of the stratigraphic sequence above the Carmichael fault at the Undandita -2 well. From 425' (129.5m) to 975' (297.2m) where structural dip is moderate, its gamma-ray response correlates well with that of continuously cored strata assigned to the Tempe Formation at the Undandita -1A well (Enclosure 3).



MAGELLAN PETROLEUM AUSTRALIA LIMITED

LOCATION MAP UNDANDITA - 2

0 1 2 3 4 K.M.

AUTHOR: J.A. DECKELMAN
 DATE: DEC. 29, 1988
 DRAFTED BY: GWH
 REPLACES MAP DATED: —

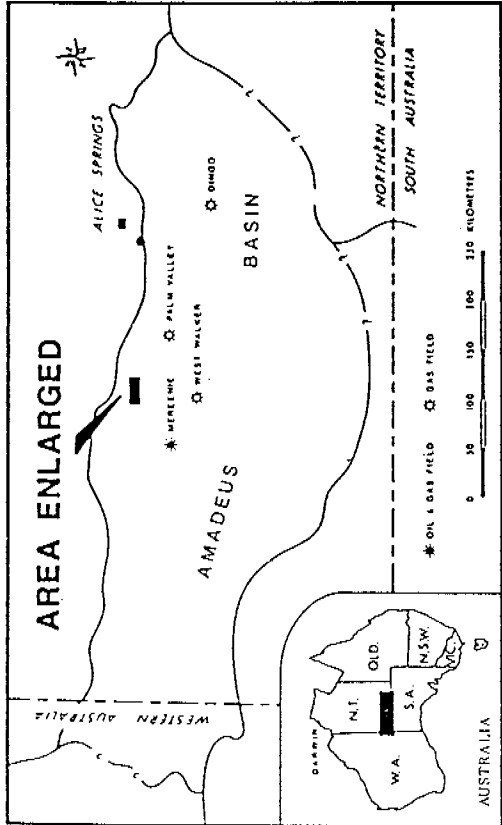


FIGURE 1

Interval	Interval Top		Penetrated Thickness	Stratigraphic Thickness
	K.B. Depth	Elevation (a.s.l.)		
Cainozoic	6.9 m.	764.0 m.	48.0 m.	48.0 m.
Alluvium	22.6 ft.	2507.3 ft.	157.4 ft.	157.4 ft.
Illara Sandstone/ Unconformity	54.9 m. 180.0 ft.	716.0 m. 2349.9 ft.	9.1 m. 30.0 ft.	- -
Fault Zone	64.0 m. 210.0 ft.	706.8 m. 2319.9 ft.	45.7 m. 150.0 ft.	- -
Illara Sandstone	109.7 m. 360.0 ft.	661.1 m. 2169.9 ft.	19.8 m. 65.0 ft.	- -
Tempe Formation	129.5 m. 425.0 ft.	641.3 m. 2104.9 ft.	167.6 m. 550.0 ft.	- -
Bitter Springs Fm Gillen Mbr/Fault	297.2 m. 975.0 ft.	473.7 m. 1554.9 ft.	143.3 m. 470.0 ft.	- -
Tempe Fm / Fault -	440.4 m. 1445.0 ft.	330.4 m. 1084.9 ft.	147.2 m. 483.0 ft.	- -
Fault Zone	587.7 m. 1928.0 ft.	183.2 m. 601.9 ft.	20.4 m. 67.0 ft.	- -
Tempe Fm / Fault	608.1 m. 1995.0 ft.	162.8 m. 534.9 ft.	422.8 m. 1387.0 ft.	- -
Mereenie Sandstone /Fault	1030.8 m. 3382.0 ft.	-260.0 m. -852.1 ft.	374.3 m. 1228.0 ft.	- -
Mereenie Sandstone Gosses Bluff unit	1405.1 m. 4610.0 ft.	-634.3 m. -2080.1 ft.	62.2 m. 204.0 ft.	47.4 m. 155.5 ft.
Carmichael Sandstone	1467.3 m. 4814.0 ft.	-696.5 m. -2284.1 ft.	58.8 m. 193.0 ft.	44.8 m. 146.9 ft.
Stokes Siltstone	1526.2 m. 5007.0 ft.	-755.3 m. -2477.1 ft.	66.1 m. 217.0 ft.	50.2 m. 164.7 ft.
Stairway Sandstone /Unconformity	1592.3 m. 5224.0 ft.	-821.5 m. -2694.1 ft.	255.7 m. 839.0 ft.	86.6 m. 284.2 ft.
Pacoota Sandstone P1/Unconformity	1848.0 m. 6063.0 ft.	-1077.2 m. -3533.1 ft.	172.8 m. 567.0 ft.	58.6 m. 192.3 ft.
Pacoota Sandstone P2 Unit	2020.8 m. 6630.0 ft.	-1250.0 m. -4100.1 ft.	61.0 m. 200.0 ft.	20.8 m. 68.1 ft.
Pacoota Sandstone P3A Unit	2081.8 m. 6830.0 ft.	-1311.0 m. -4300.1 ft.	24.4 m. 80.0 ft.	8.3 m. 27.3 ft.
Pacoota Sandstone P3B Unit	2106.2 m. 6910.0 ft.	-1335.4 m. -4380.1 ft.	55.8 m. 183.0 ft.	19.0 m. 62.4 ft.
Pacoota Sandstone P4 Unit	2162.0 m. 7093.0 ft.	-1391.1 m. -4563.1 ft.	106.4 m. 349.0 ft.	36.3 m. 119.2 ft.
Goyder Formation	2268.3 m. 7442.0 ft.	-1497.5 m. -4912.1 ft.	290.9 m. 954.5 ft.	99.2 m. 325.4 ft.
Total Depth (Logger)	2559.3 m. 8396.5 ft.	-1788.4 m. -5866.6 ft.		- -

TABLE 1. DEPTH, ELEVATION, AND PENETRATED THICKNESS OF STRATIGRAPHIC HORIZONS AND FAULT ZONES AT THE UNDANDITA-02 WELL. STRATIGRAPHIC THICKNESS IS INDICATED WHERE IT COULD BE DETERMINED ACCURATELY.

The lithology of the interval as inferred from cuttings descriptions (Enclosure 2) and wireline-log response (Enclosure 1) matches closely with the Tempe Formation at the surface and in the subsurface (Bradshaw, 1987, Enclosure 5). A prominent carbonate unit penetrated in the Tempe Formation at the Undandita -1A well also is present at the Undandita -2 well (Enclosure 3).

The Tempe Formation lies in fault contact with a melange of Bitter Springs Formation evaporitic sediments at 975' (297.2m) and, where the unit is repeated by folding (Enclosure 3), at 1445' (440.4m). The interval from 975' (297.2m) to 1445' (440.4m) contains an abundance of gypsum and anhydrite, minerals which are characteristic of the Bitter Springs Formation Gillen Member.

A stratigraphically thin but nearly complete sequence of Cambrian to Devonian sediments was penetrated below the Carmichael fault at the Undandita -2 well. The Mereenie Sandstone forms the top of this sequence and lies conformably above the Carmichael Sandstone. The Carmichael Sandstone and the lower part of the Mereenie Sandstone, the Gosses Bluff unit in particular, correlate well with strata assigned to these units at the Tyler -1 well.

The Carmichael Sandstone conformably overlies the Stokes Siltstone at the Undandita -2 well. Cuttings descriptions and wireline logs indicate that the Stokes Siltstone is composed primarily of sandstone and dolomitic siltstone. It does not contain a basal carbonate unit at this well. The absence of the basal carbonate unit may be a result of local facies change or onlap.

A discordance in structural dip above and below the base of the Stokes Siltstone and an abrupt change in wireline-log character at 5224' (1592.3m) suggest that the contact of the Stokes Siltstone with the Stairway Sandstone is unconformable. Cuttings descriptions (Enclosure 2) and gamma-ray and sonic-log data (Enclosure 1) show that the Stairway Sandstone is composed dominantly of quartz arenite or orthoquartzite and little or no mudrock. The middle unit of the Stairway Sandstone was not recognised at the Undandita -2 well.

The P1 unit of the Pacoota Sandstone was encountered directly below the Stairway Sandstone. The Horn Valley Siltstone, likely to be present just south of the Undandita -2 well, was not penetrated at this well. The absence of the Horn Valley Siltstone and the presence of a horizon having the texture and appearance of loam at the base of the Stairway Sandstone (6063' (1864m)) suggest that the Stairway Sandstone unconformably overlies the Pacoota Sandstone. Each of the five units of the Pacoota Sandstone are present at the Undandita -2 well. Marine units of the Pacoota Sandstone are highly oxidized, implying that they periodically were exposed subaerially after deposition.

The Pacoota Sandstone conformably overlies the Goyder Formation at the Undandita -2 well. The lithology of the Goyder Formation as inferred from wireline-log response and cuttings is typical of the unit in the north-central part of the basin. The PEF/NPHI/RHOB log indicates that beds of carbonate are present in the Goyder Formation at least as high as 7770' (2368.3m). The Undandita -2 well penetrated the upper 325.4' (99.2m) of the formation prior to reaching total depth at 8396.5' (2559.3m).

The thickness of Cambro-Ordovician section at the Undandita -2 well is considerably less than it is in adjacent areas to the north and south. This thinning is related to the stratigraphic convergence of component units of the Cambro-Ordovician sequence and local erosion at the base-Stokes Siltstone and base-Stairway Sandstone unconformities. Both mechanisms are likely to be related to salt-induced growth of the Undandita trend.

STRUCTURE

Stratigraphic relations and available CYBERDIP data suggest that the Undandita -2 well penetrated an evaporite-cored, faulted and overturned anticline. This structure is the subsurface eastward extension of the Deering Creek anticline, an overturned anticline exposed at the surface 19 km (12 miles) to the west (Deckelman, 1984). Of the several faults which intersect the structure (Enclosure 3), vertical and horizontal displacement is greatest on the fault which intersects the well at 3382' (1030.8m). It is this fault, here referred to as the Carmichael fault, which divides the section into upper and lower plates.

Sediments of the upper plate are interpreted to be dipping moderately to the south above approximately 1200' (366m) and subvertical or overturned to the north below 1200' (366m). The presence of subvertical or overturned beds is inferred from the repetition of the Tempe Formation carbonate unit with depth (Enclosure 3), the extremely large penetrated thickness of the Tempe Formation, and the known geology of the area. The lack of reliable CYBERDIP data above 3290' (1002.8m) is consistent with, but not indicative of, steeply dipping and folded strata.

Fault zones were recognised in the upper plate in the intervals from 210' (64m) to 360' (109.7m), 975' (297.2m) to 1445' (440.4m), and 1928' (587.7m) to 1995' (608.1m). These intervals are interpreted to be the zones in which the Undandita -2 well intersected north-dipping thrust faults which sole in the Bitter Springs Formation (Enclosure 3). Displacement along these faults is likely to be relatively minor. Faults identified in core of the Tempe Formation at the Undandita -1A well (Deckelman, 1983) may be south-dipping antithetic thrust faults associated with the north-dipping thrust faults intersected at

the Undandita -2 well (Enclosure 3). The fault zone from 975' (297.2m) to 1445' (440.4m) at the Undandita -2 well contains a melange of Bitter Springs Formation evaporitic sediments. These sediments may have been emplaced diapirically, at the time of thrust faulting (which occurred subsequent to salt-induced growth of the structure), or both.

Lower plate strata dip south-southeastward at an angle of 35° - 45° above the base of the Stokes Siltstone and southeastward at an angle of approximately 70° below the base of the Stokes Siltstone. These strata form the base of the southern flank of the overturned anticline (Enclosure 3). Faulting was not recognised in strata of the lower plate.

SUMMARY

Geology

- The Undandita -2 well penetrated the crest and southern flank of an evaporite-cored, faulted and overturned anticline (Enclosure 3). This anticline is the eastward subsurface extension of the Deering Creek anticline, a structure which is exposed at the surface 19 km (12 miles) to the west (Deckelman, 1984). Rupture of the southern flank of the structure in response to compressive forces from the north resulted in southward displacement of Proterozoic and Cambrian strata over Cambro-Ordovician and younger strata and, perhaps, accelerated migration of Bitter Springs evaporites. Displacement of strata took place primarily along the Carmichael fault which was intersected at 3382' (1030.8m).

The stratigraphic sequence above the Carmichael fault consists of the Illara Sandstone, the Tempe Formation, and the Gillen Member of the Bitter Springs Formation. Sediments below the Carmichael fault comprise a thin but nearly complete sequence of strata extending from the Goyder Formation to the Mereenie Sandstone. Thinning of the subthrust sequence is likely to be related to stratigraphic convergence which occurred in response to salt-induced growth of the structure, and erosion at local base-Stokes Siltstone and base-Stairway Sandstone unconformities. The Horn Valley Siltstone, not recognised at the Undandita -2 well, is likely to be absent due to erosion at the base-Stairway unconformity.

Exploration

The Undandita -2 well was a valid test of the Undandita prospect. It penetrated the Stairway Sandstone and the Pacoota Sandstone, both of the primary exploration targets, at or near the subthrust crest of the structure. The well encountered shows of gas below 5625' (1714.5m), but the low porosity and permeability of the Stairway Sandstone and the Pacoota Sandstone

prevented the gas from flowing. Neutron porosity values rarely greater than 3% and sonic velocities of up to 20,000 ft/sec (6096 m/sec) attest to the poor reservoir quality of these units. If intergranular porosity had been greater, the Undandita -2 well may have been an exploration success.

IMPLICATIONS AND RECOMMENDATIONS

The results of the Undandita -2 well, in conjunction with those of the Tyler -1 well, considerably decrease the exploration potential of the Ordovician sequence near the north-central margin of the Amadeus Basin. Despite the presence of adequate structure, source rock, and seal, the reservoir quality of the Stairway and Pacoota sandstones, except at extremely shallow depths and in areas of intense fracturing, is likely to be extremely poor in this area. Intergranular porosity in these units has been destroyed by pressure solution of quartz grains which occurred in response to increased sedimentary loading during deposition of the Pertnjara Group.

It is recommended that future exploration for hydrocarbons in Ordovician reservoirs be conducted in the southern part of O.P.175 and O.P.178. In this area, intergranular porosity is likely to be relatively high (Deckelman, 1987, p.125) and the Horn Valley Siltstone is likely to be oil prone (Jackson et al., 1984).

ACKNOWLEDGEMENTS

The author gratefully acknowledges the assistance provided by Laurence Roe, Martin Berry, Nick Milne, and Gordon Hoffer throughout the compilation of this report.

REFERENCES

Bradshaw, J., 1987, The depositional, diagenetic and structural history of the Chandler Formation and related units, Amadeus Basin, central Australia: Unpublished Ph.D. dissertation, The University of New South Wales, Kensington, New South Wales, 387p.

Deckelman, J.A., 1983, Evaluation of Undandita -1A: Unpublished report for Magellan Petroleum Australia Limited, 2p.

Deckelman, J.A., 1984, Surface geology - Undandita and Harajica seismic survey areas - Sheets 1 and 2: Unpublished geologic map and geologic sections for Magellan Petroleum Australia Limited, 2 sheets.

Deckelman, J.A., 1987, A collection of data from surface exposures of the Pacoota Sandstone, north-central and northwestern Amadeus Basin: Unpublished report for Magellan Petroleum Australia Limited, 148p.

Jackson, K.S., McKirdy, D.M., and Deckelman, J.A., 1984, Hydrocarbon generation in the Amadeus Basin, central Australia: Journal of the Australian Petroleum Exploration Association, v.24, p. 42-65.

Gorter, J.D., Fenton, G.G., Marsden, G.R., and Schroder, R.I., 1983, Undandita No. 1A well completion report: Unpublished report for Pancontinental Petroleum Limited, 53p.