A Geohistory Analysis of the Cape Sorell-1 Well Drilled Offshore West Tasmania

Amoco Australia Petroleum Company
Robertson Research (Australia) Proprietary Limited

Contents

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A GEOHISTORY ANALYSIS OF THE CAPE SORELL-1 WELL, DRILLED OFFSHORE WEST TASMANIA

by

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Introduction

The Cape Sorell-1 well was submitted for biostratigraphic examination by Amoco Australia Petroleum Company. The stratigraphic results are listed in Tables I and II, and are discussed fully in the Robertson Research Report No. 1176. Palaeobathymetric data is available, but not combined within this memorandum. A basic geochemical evaluation of eight sidewall cores from the well was also carried out (R.R.S. Report No. 1170).

A geohistory diagram of the well has been constructed (Figure 1), in which stratigraphic and lithological data have been combined to produce a subsidence and sedimentation picture for the well section examined, spanning the Palaeocene to Early Miocene. An unconformity is present at the Eocene-Oligocene boundary, and one is also probably present at the top of the Early Miocene section studied.

Structural and Sedimentological Conclusions

The basement of the site of deposition subsided at a relatively rapid rate during the Palaeocene (11576' TD.-5770'), during which time sandy breccio-conglomerates, overlain by interbedded shales and sandstones, were deposited. A high rate of sedimentation maintained the site of deposition within a possibly supralittoral to brackish littoral, possibly shallow inner sublittoral environment.

During the Early Eocene (5770'-2550') the rate of subsidence is considered to have decreased, as illustrated by the less steeply dipping subsidence curves for T.D. and top shales. Sandstones, with thin, scattered shale beds were deposited sufficiently rapidly to maintain the site of deposition within a possibly supralittoral to possibly middle sublittoral range of environments.

During the Early to Middle Eocene (2550'-1360'), sandstone deposition continued and maintained the site of deposition within the middle sublittoral environment, except during the latter part (1470'-1360'), when rate of sedimentation was insufficient to maintain a constant water depth at the site of deposition, and deepening to the outer sublittoral regime took place.

The absence of Late Eocene sediments suggests either uplift and erosion of the Late Eocene sediments, or a period of non deposition owing to submarine scour. The subsidence rate has been extrapolated from the Early Eocene, but the correct rate is unknown for the Late Eocene.

During the Early Oligocene (1360'-1230'), deposition of sandstones continued, and the subsidence rate was further reduced. The sedimentation rate maintained the depth of deposition within the deep middle sublittoral.

During the Late Oligocene (1230'-990') sandstones were deposited in a deep middle sublittoral regime (1230'-1110') followed by bryozoan limestones in an outer sublittoral environment, thus testifying to a rate of basement subsidence which exceeded that of sediment accumulation.

Further subsidence took place during the Early Miocene (990'-690'), and the deposition of bryozoan limestones was sufficiently great to maintain the site of deposition within the outer sublittoral environment.

The post Early Miocene history of the site is unknown, but as the sea floor lies at 309', the 381' (690'-309') of sediment which overlies the Early Miocene is abnormally thin to accommodate the expected thickness of Middle Miocene to Recent marine sediments. This situation may be explained either by the presence of a condensed sequence, or removal of the post Early Miocene sediments by erosion.

<u>Organic Maturation Implications from the Geohistory History</u>

The geothermal gradient of the Cape Sorell-1 well has been determined by obtaining the bottom hole temperature of 87°C (190°F) log, and calculating the gradient up well to 9002' at 70°C (158°F) and 4144' at 39°C (102°F), thus providing gradients of 6.6°C and 6.4°C per 1000 ft respectively. If a surface temperature of 10°C is assumed, an overall geothermal gradient of 6.85°C per 1000 ft is concluded (for well section thickness of 11267' (11576'T.D.-309')). This geothermal gradient differs considerably from that of the Bass Basin, where a gradient of 10.67°C per 1000 ft exists (Middleton, 1982).

Intervals of 10°C have been plotted on the geohistory diagram, each interval occupying 1480', and the total thermal maturity index (TTI) is calculated at T.D. for each interval as follows:

Temperature Interval	Time (Ma)	Lopatin's temperature factor r	Interval TTI	Cumulative TTI
10-20	2.25	r^{-9}	0.0043	
20-30	2.25	r^{-8}	0.0087	0.013
30-40	2.25	r^{-7}	0.0175	0.030
40-50	2.25	r^{-6}	0.035	0.065
50-60	2.25	r^{-5}	0.070	0.135
60-70	7.0	r^{-4}	0.437	0.572
70-80	7.0	r^{-3}	0.875	1.447
80-90	18	r^{-2}	4.5	5.947

The cumulative TTI at 11576' T.D. is 5.947, which is equivalent to a vitrinite reflectance value of 0.55, using Waples (1980, Figure 5). At approximately 10250', a cumulative TTI value of 1.447 is equivalent to a vitrinite reflectance value of 0.45.

These results compare well with those measured and listed in Appendix I (RRS Report 1170, Table 1), and support the conclusion given therein as "early mature to just mature for liquid hydrocarbon generation for suitable oil-prone kerogen".

As the above calculations are calculated to the Early Miocene, the effects of the Late Eocene unconformity, and maturity effects since the Early Miocene have been ignored. If, however, the Late Eocene unconformity was produced by uplift in the order of 1000 ft then the thermal maturity would have been little affected at this low geothermal gradient. Similarly, if the well site had been uplifted and then subsided to the present site of deposition, the effect of such uplift, within 1000' margin, would have placed the vitrinite reflectance value at T.D. for the Recent, at between 5.50 and 0.6.

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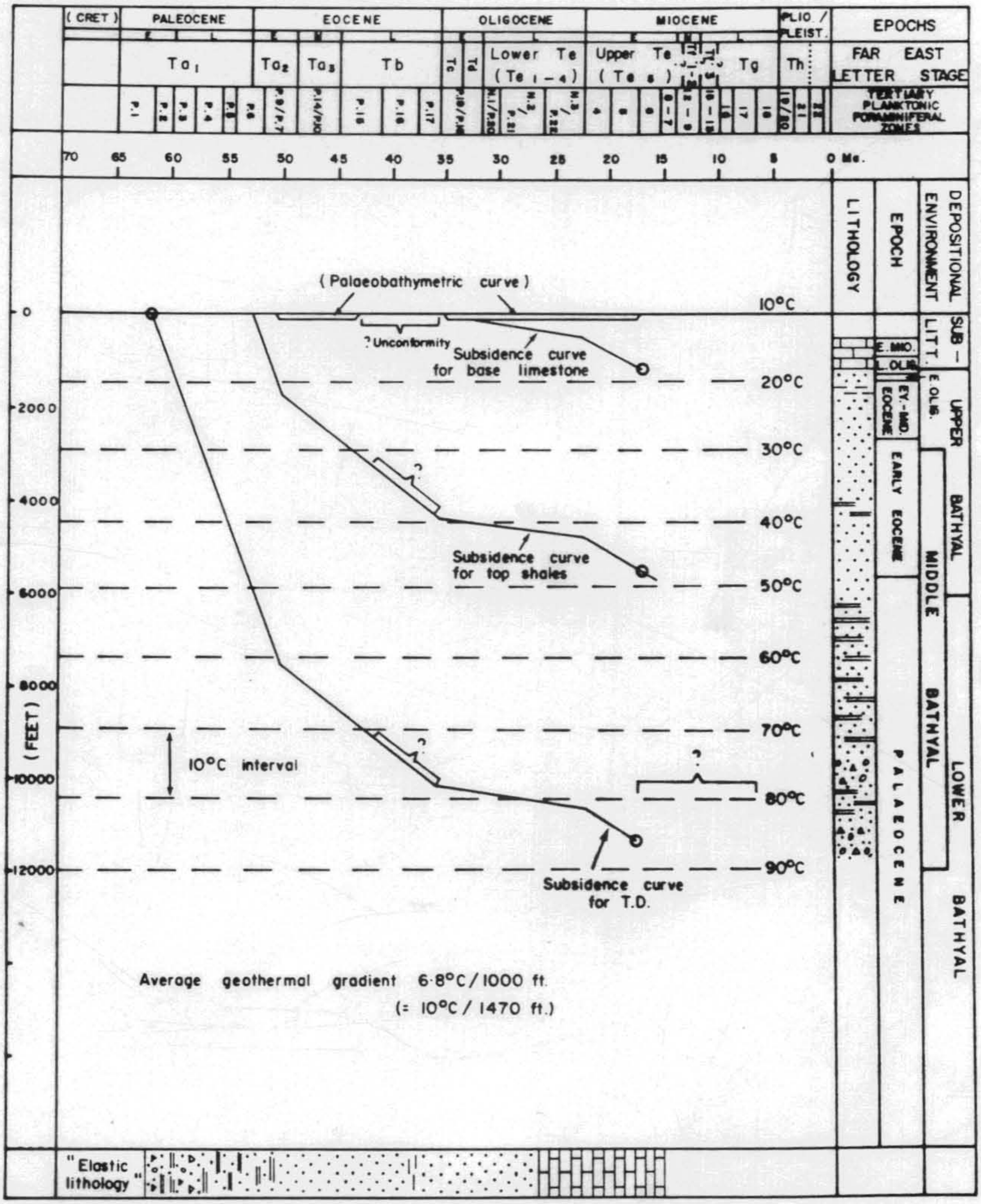

Figure 1. Geohistory diagram for Cape Sorell-1

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TABLE I

BIOSTRATIGRAPHIC SUMMARY

Interval (Feet)	Floral Zone	Calcareous Nannofossil Zone	Age
690		*H. ampliaperta*	EARLY MIOCENE
690- 720		*S. belemnos*	
720- 990	*Proteacidites tuberculatus* and ?younger	*T. carinatus*	
990- 1230		*S. ciperoensis* - *S. predistentus*	LATE OLIGOCENE
1230- 1350		*H. reticulata*	EARLY OLIGOCENE
		---------- ? UNCONFORMITY ----------	
1350- 1410		*D. sublodoensis*	MIDDLE-EARLY EOCENE
1410- 2550	Lower *Nothofagidites asperus*		
2550- 2580			
2580-?4050	*Proteacidites asperopolus*		EARLY EOCENE
?4050- 5770	*Malvacipollis diversus*	*D. lodoensis* - *D. mohleri*	
5770- 7170	*Lygistepollenites balmei*		
7170- 7590	*Lygistepollenites balmei* -		PALAEOCENE
7590-10270	*Tricolpites longus*	?*D. mohleri* and older	
10270-11576TD	*Tricolpites longus*		

TABLE II

DEPOSITIONAL ENVIRONMENT SUMMARY

Depth (Feet)	Microfaunal Assemblage Subzones	Microfaunal Assemblage Zones	Local Pollen Assemblage Zones	Depositional Environment
690- 720	Sphaeroidina	Globocassidulina/ "Planktonic"	CS-1-I	Outer sublittoral
720- 1110	Guttulina/ Clavulina/ Bryozoa			
1110- 1140	Triloculina			Deep middle sublittoral
1140- 1350			CS-1-II	
1350-1410	Pullenia			Shallow outer sublittoral
1410- 1470			CS-1-III	
1470- 1950		Lenticulina/ Eponides		Middle sublittoral
1950- 2460		Eponides/ "Planktonic"		Deep middle sublittoral
2460- 2490	Lenticulina/ Ammodiscus	Cyclammina/ Ceratobulimina		?Middle sublittoral
2490- 2970			CS-1-IV	
2970- 3510	"Poor Fauna"/ Cyclammina			?Inner sublittoral
3510- 4020	Lenticulina/ Amphicoryna			?Middle sublittoral

TABLE II (cont'd.)

Depth (Feet)	Microfaunal Assemblage Subzones	Microfaunal Assemblage Zones	Local Pollen Assemblage Zones	Depositional Environment
4020- 4050		"Barren" I		?Brackish littoral - ?Inner sublittoral
4050- 4200				
4200- 5040		"Arenaceous"/ Cyclammina	CS-1-V	
5040- 5310		"Barren" II		?Supra- littoral
5310- 5770		Cyclammina/ Ammodiscus		Brackish littoral- Shallow inner sublittoral
5770- 6450				
6450- 6950	"Arenaceous"	"Poor Fauna"	CS-1-VI	Brackish littoral
6950- 7430	Cyclammina			
7430- 7610		"Barren" III		?Supra- littoral
7610- 7910			CS-1-VII	
7910- 9250		"Poor Fauna"/ "Arenaceous"		Brackish littoral
9250- 9320				
9320-10230		"Barren" IV	CS-1-VIII	?Supra- littoral
10230-10270		Trochammina		Brackish littoral- ?Shallow inner sublittoral
10270-11170				
11170-11576 TD		"Barren"/ "Poor Fauna"	CS-1-IX	Supra- littoral

APPENDIX I

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THERMAL MATURITY AND KEROGEN COMPOSITION DATA

COMPANY: AMOCO AUSTRALIA WELL: CAPE SORELL-1 LOCATION: TASMANIA

DEPTH (FEET)	VR (%)	SCI	KEROGEN COMPOSITION			
			VITRINITE	INERTINITE	AMORPHOUS	LIPTINITE
10180	NDP	4 / 5½-6	Modetate	Common	-	Minor
10437	0.46(8)	3½-4 / 5	Common	Moderate	-	Minor
10608	0.47(10)	NDP	Rich	Lean	-	Minor
10771	0.54(1)	NDP	Moderate	Moderate	-	Moderate
10892	NDP	NDP	-	Rich	-	-
10974	NDP	?4½-5	-	Rich	-	Minor

Trace	if	observed
Minor	if	<0.5%
Lean	if	5-20%
Moderate	if	20-50%
Common	if	50±80%
Rich	if	80/90+→100%

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