OIL COMPANY
OF AUSTRALIA

PEL 60
OTWAY BASIN
SOUTH AUSTRALIA

TECHNICAL COMMITTEE MEETING
29TH NOVEMBER 1998

Churinga-1 Post Audit

- Depth Prognosis
  - Windermere 27m low,
  - Base Eum. Unconf, 35m Low
- Windermere Sst - Well developed, (35m thick) 7m thicker than expected
- No shows, well Plugged and Abandoned on 15/5/98

Churinga-1 Post Audit

Implications for Prospectivity

- Lack of shows indicates insufficient charge since trap formation.
- Basal Eumeralla targets are downgraded
- Confirmed lack of intra Crayfish seal in upper section
- Timing of trap formation becomes the critical issue
- Remaining prospectivity lies in the deeper Crayfish section

PEL 60 - OTWAY BASIN S.A.

CHURINGA-1

POST AUDIT

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PEL60\Drill\Churinga\Churinga Post Audit
Sept 1998

REASONS FOR DRILLING

Churinga-1 was spudded on the 7th of May 1998. The well was drilled to test the potential of the Windermere Sandstone and mid Crayfish Group in the central portion of the onshore Robe Trough (ORT) in PEL 60 (Taylor and Doyle, 1998). The Churinga closure is a tilted fault block with no fault independent closure. The structure is covered by a seismic grid of 0.75 to 1km spacing with vintages from 1995 – 1997 (Fig 1).

Amplitude mapping of the basal Eumeralla unconformity indicated the potential for a thick Windermere Sandstone over the Churinga structure. The top seal and cross-fault seal were interpreted as the basal shales and silts of the Eumeralla Formation. Hydrocarbon charge was assumed to have originated from shale beds in the mid to lower Crayfish Group.

The prospectivity of the well was based on the recovery of oil from the mid Crayfish Group in Nunga Mia-1. Nunga Mia-1, drilled in 1996 on an intra-Crayfish fault dependent trap southwest of Churinga-1. did not test the Windermere Sandstone within closure.

RESULTS OF THE WELL

- The Windermere Sandstone was intersected at 1212.5m TVDKB, which was 27m low to prognosis (Taylor and Doyle, 1988; Fig 2).

- The secondary target (an intra Crayfish high amplitude seismic event) was intersected at 1515m TVDKB, which was close to prognosis. The seismic event corresponded to a 25m thick shale bed, as interpreted pre-drill.

- Log analysis of the Windermere Sandstone indicates an average effective porosity of 24% and a net:gross of 76%.

- The mid Crayfish Group comprised interbedded sands and shales with a gross sand to shale ratio of approximately 40%.

- No hydrocarbon shows were recorded within the well.

- TD for Churinga-1 was 1670m MDKB (1630.7m TVDKB).

- The well was plugged and abandoned on the 15^{th} of May 1998.

PRE-DRILL RISKS V ACTUAL

Closure

The pre-drill risk for closure was estimated to be 95% (Fig 1) on the basis of the 0.75km seismic grid and the good imaging of the fault, which controlled the structure. The low risk appears to have been justified by the closeness of the predicted depth of the Windermere Sandstone to the actual depth (27m low). However, apart from Nunga Mia-1/DW1, there is a lack of nearby well control to Churinga-1. The lack of a velocity survey means that it is not possible to compare the 'Time-Depth' curve of Churinga-1 with any surrounding wells to gauge the extent of any velocity gradients in the area.

Reservoir

The pre-drill risk for reservoir was 80% (Fig 1). This low risk was vindicated by the intersection of a 34.5m thick Windermere Sandstone (Fig 2). The basal Eumeralla unconformity (base of the Windermere Sandstone) may be lowered to 1261.5m TVDKB, pending the results of the sidewall core petrology and palynology. This would increase the thickness of the Windermere Sandstone to 49m (20m thicker than prognosed).

The major risk for reservoir was whether the Windermere Sandstone was developed over the Churinga structure. The unit had been intersected only once in the ORT at Nunga Mia-1/DW1 and so Churinga-1 was considered a test of the depositional model of the unit. The amplitude mapping indicated good potential for reservoir development at the Windermere level.

Even if the Windermere Sandstone had been absent, the reservoir risk was low because of the likelihood of sand development in the mid Crayfish Group directly subcropping the base Eumeralla unconformity. This unit would act as a reservoir if the Windermere had been absent. Sand development in the mid Crayfish Group was considered very low risk due to the predicted similarity (based on seismic control) between the sedimentary sequence in Nunga Mia-1/DW1 and at the Churinga-1 location. The Crayfish Group section in Nunga Mia-1/DW1 was a highly sand prone section of stacked fining upward sequences with thin shale caps.

Charge

Pre-drill, charge was considered the critical risk for Churinga-1. The charge adequacy was estimated at 30% (Fig 1). This risk was subdivided into 15% chance of gas charge and 15% chance of oil charge (Taylor and Doyle, 1998). The lack of any indications of hydrocarbons at Churinga-1 appears to support the high risk associated with adequate charge.

The primary control on charge risk was the timing of closure formation compared to the peak migration of hydrocarbons. The basal sediments of the Crayfish Group (assumed source units) were deposited very rapidly and would have generated and expelled hydrocarbons early in the depositional history of the ORT. The Churinga structure did not form until during Eumeralla deposition (approximately 100Ma) by which time peak migration is already expected to have taken place from the lower Crayfish Group units (J. Skinner, pers comm).

The Churinga structure therefore required late stage generation of hydrocarbons from within the mid Crayfish Group. Background gas readings did begin to increase in the deeper portion of the well but never rose ~~above~~ to a significant level.

The lack of any significant recoveries of hydrocarbons in the ORT (besides Nunga Mia-1) also contributed to the high risk placed on charge.

Seal

The pre-drill risk for seal was estimated at 60% (Fig 1). This risk is based on the uncertainty of the fault plane to provide an adequate seal.

The Churinga Prospect was fault dependent at all levels and therefore required both a top seal and a cross-fault seal. The basal Eumeralla Formation was interpreted to provide both of these, at the Windermere Sandstone level. The lithology of the basal Eumeralla Formation was a homogenous silt/shale, which would provide an adequate lithological seal and quite possibly an adequate fault plane seal due to shale smear.

The lack of any hydrocarbon shows means that it is not possible to definitely rule out seal as the primary cause of failure of the well. However, had seal failure occurred, it is reasonable to expect that some residual shows may have been encountered. On balance, it is felt that the failure of Churinga-1 is probably due to the poor timing of charge rather than adequate seal.

IMPLICATIONS OF CHURINGA-1 ON FUTURE EXPLORATION IN PEL 60

The failure of Churinga-1 is mainly attributed to the lack of adequate closure prior to peak hydrocarbon migration. This suggests that early formed palaeoclosure is of prime importance in evaluating future prospects in the ORT. Alternatively, the generative potential of the source rocks may be insufficient.

In most cases, this requires the mapping of a closure deeper than the base Eumeralla level. The primary targets would be sands sealed by intra-formational shales within the mid to lower Crayfish Group. Early stage closure formation may have occurred in the deeper portion of the mid Crayfish Group due to differential subsidence or drape and compaction of the sediments over pre-existing basement highs. This closure formation would need to have commenced soon after the deposition and maturation of the lower Crayfish Group source rock units.

Seal becomes high risk for this play type due to the high sand content in the mid to upper Crayfish Group. The available well control suggests that overall, the upper and mid sections of the Crayfish Group are highly sand prone. There do not appear to be any well-defined shale units that could act as intraformational seals. In addition, the reliance of cross-fault juxtaposition of sand and shale becomes even more risky. Nunga Mia-1/DW1 and Churinga-1 however show that proportion of thicker shale interbeds increases with depth. The presence of these thicker shale interbeds would decrease the risk of seal in the deeper portion of the mid Crayfish Group.

Alternatives to this style of play are low-side fault closures against basement on the Trumpet and Lake Eliza faults. Closure formation on these two major bounding faults may have occurred relatively early in the history of the trough.

Despite these shortcomings, the recovery of oil at Nunga Mia-1 from the mid Crayfish Group does suggest hydrocarbon generation and migration capacity in the ORT.

REFERENCES

Taylor, R.J. and Doyle, J.D., 1998: Churinga-1 Well Proposal. Unpublished company report for Oil Company of Australia Ltd

OIL COMPANY OF AUSTRALIA

POST AUDIT WELL SUMMARY

CHURINGA-1

DEPTH (mTVDKB)	Stratigraphy: Formation	Fm Tops (mTVDKB) Progn.	Actual	mH/L
	Gambier Limestone			
	Nirranda Group	147	142	+5
	Wangerrip Group	167	172	-5
250		272	225	+47
500				
750	Eumeralla Formation			
1000				
1250	Windermere Sst	1185	1212.5	-27.5
		1212	1247	-35
1500	Intra Crayfish 'seismic marker'	1525	1515	+10
	T.D.	1610	1630.7	-20.7

T.D. (Driller's): 1670m MDKB / 1630.7m TVDKB
T.D. (logger's): 1662.6m MDKB / 1623.5m TVDKB

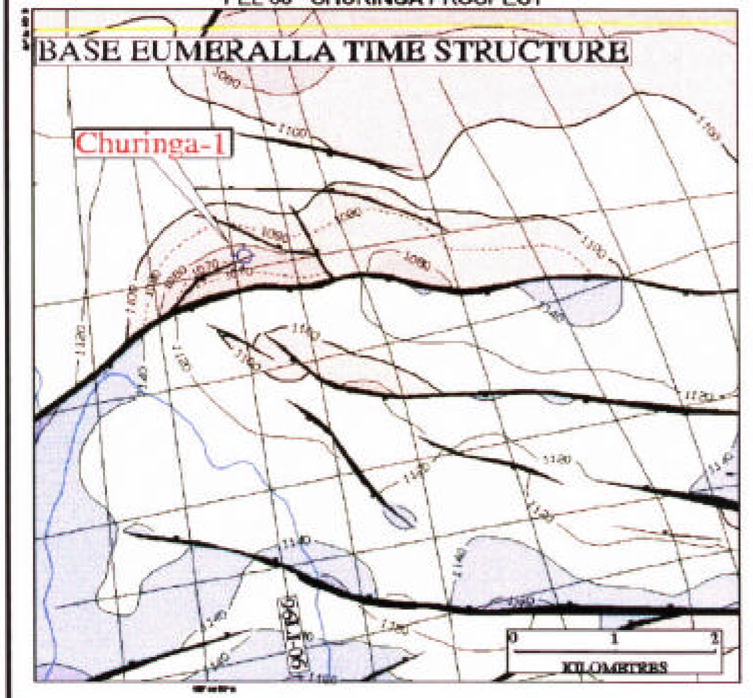
Well Summary

State:	S.A.	Well type:	Exploration
Block:		Primary target/s:	Windermere Sandstone
Permit:	PEL 60	Well status as	P & A
GL (aMSL):	5.6m	Surface Location	
KB (aMSL):	10.5m	Seismic line:	96LI-06
Spud date:	7/5/1998 (0300)	VP	200 (CDP 200)
TD date:	13/05/98 (0430)	Latitude:	37° 06' 16.53" S
Release date:	15/05/98 (0900)	Longitude:	139° 55' 11.14" E
TD (MD):	1670m MDKB	TD (TVD):	1630.7m TVDKB
Joint Venture Parties:	OCA 62.5%, Cultus Petroleum NL 25%, Todd Petroleum 12.5%		

SUMMARY

Churinga 1 was drilled to assess the potential of the Windermere Sandstone in a fault dependent closure in the central portion of the onshore Robe Trough. The secondary objective was an intraformational 'seismic marker' within the mid Crayfish Group. Churinga 1 did not encounter hydrocarbons in either target. The primary cause of failure is assumed to be a lack of closure at the time of peak hydrocarbon migration. Lack of adequate fault-plane seal is also a possible reason for failure in both targets. However, the absence of shows suggests that there is little chance of a palaeocolumn ever having developed.

PEL 60 CHURINGA PROSPECT



Wireline Logging Summary

RUN	Tool(s)	Interval m MDKB	BHT
1	ECGR-HALS-RXOZ-TNPH-RHOZ-PEFZ-DT-HCAL	328.9 - 1662.6 ECGR run to surface	70°C
2	FMI-GR	600 - 1350	70°C
3	SWC	1642.5 - 1137	

DST/Core/Show Summary

DST #	Zone	Interval (mRT)	Pressures/Times	Recovery/Flow rate(s)/Comments

No drill stem tests were conducted on Churinga 1

	Pre-Drill	POST DRILL ADEQUACY ASSESSMENT OF TRAPPING COMPONENTS
STRUCTURE	95%	27m low at Windermere Sandstone level but 10m high at Intra Crayfish 'seismic marker'
RESERVOIR	80%	Intersected a 35m thick Windermere Sst overlying extensive sands of the mid Crayfish Group (7m thicker than prognosed)
CHARGE	30%	This risk includes either oil or gas charge. Timing of closure formation is the primary reason for failure. Risk must now be increased.
SEAL	60%	Pertains to cross-fault seal and fault-plane seal. Seal not likely cause of failure but still a considerable risk.

IMPLICATIONS / REASON FOR FAILURE

Primary cause of failure is the lack of closure at time of peak hydrocarbon migration. Seal is less likely to have failed but still a significant risk without further information. All closures at base Eumeralla level must now be increased in risk due to the lack of palaeoclosure. Closures within the mid Crayfish Group must now be considered the most prospective play types in the permit. Mid Crayfish closures however have the increased risk of adequate seal due to the highly sand prone lithology of the mid Crayfish sediments as seen at Nunga Mia 1/DW1 and Churinga 1.

10-Nov-98

Figure 1

Nunga Mia-1 to Churinga-1

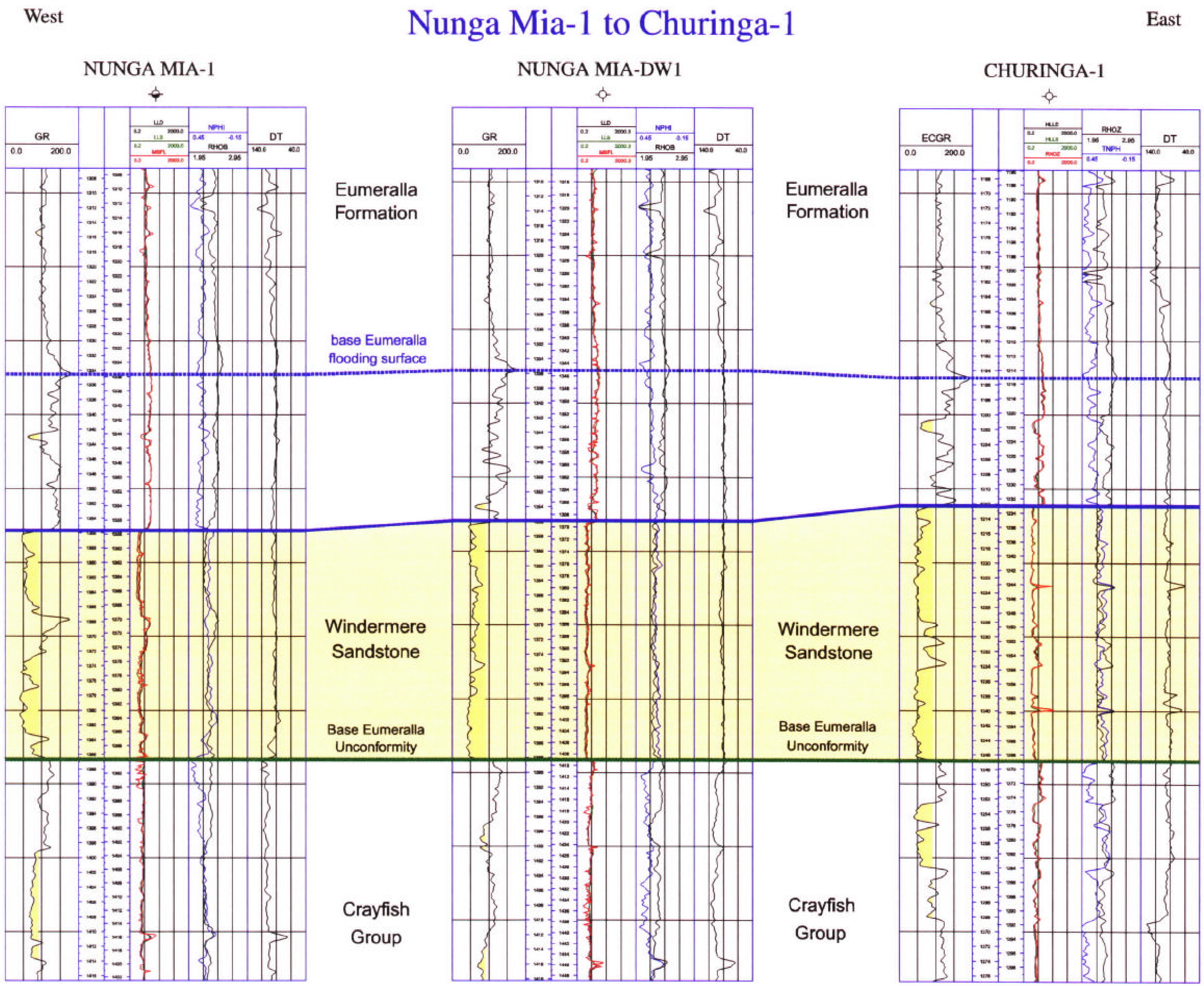


Figure 2

Prospectivity Review - Aims

- Reassessment of Prospectivity
- Identify new play types and define their critical components
- Generate new maps and sections to quantify the remaining prospectivity in the block
- Suggest future programme options

Crayfish Group Overview

- Definition of gross facies types in the Onshore Robe Trough
  - Correlation to offshore wells
  - Use of geological model and seismic facies
- Timing of thermal maturity
- Identification of most prospective section

Crayfish Group

- Crayfish Group appears to be one continuous cycle of deposition
  - No significant transgressive episodes within the overall regressive sequence
  - No substantial seismic evidence for intra-Crayfish unconformities

Note: Well penetrations to date are limited to the upper (1/3?) of the Crayfish Group

Crayfish Group Facies Distribution

It is practical to define 3 units of distinct facies associations.

Lower Section:

- lacustrine shales & fluvial sands (analogy drawn from Penola Trough)
- Potential source rocks (supported by Nunga Mia oil recovery)

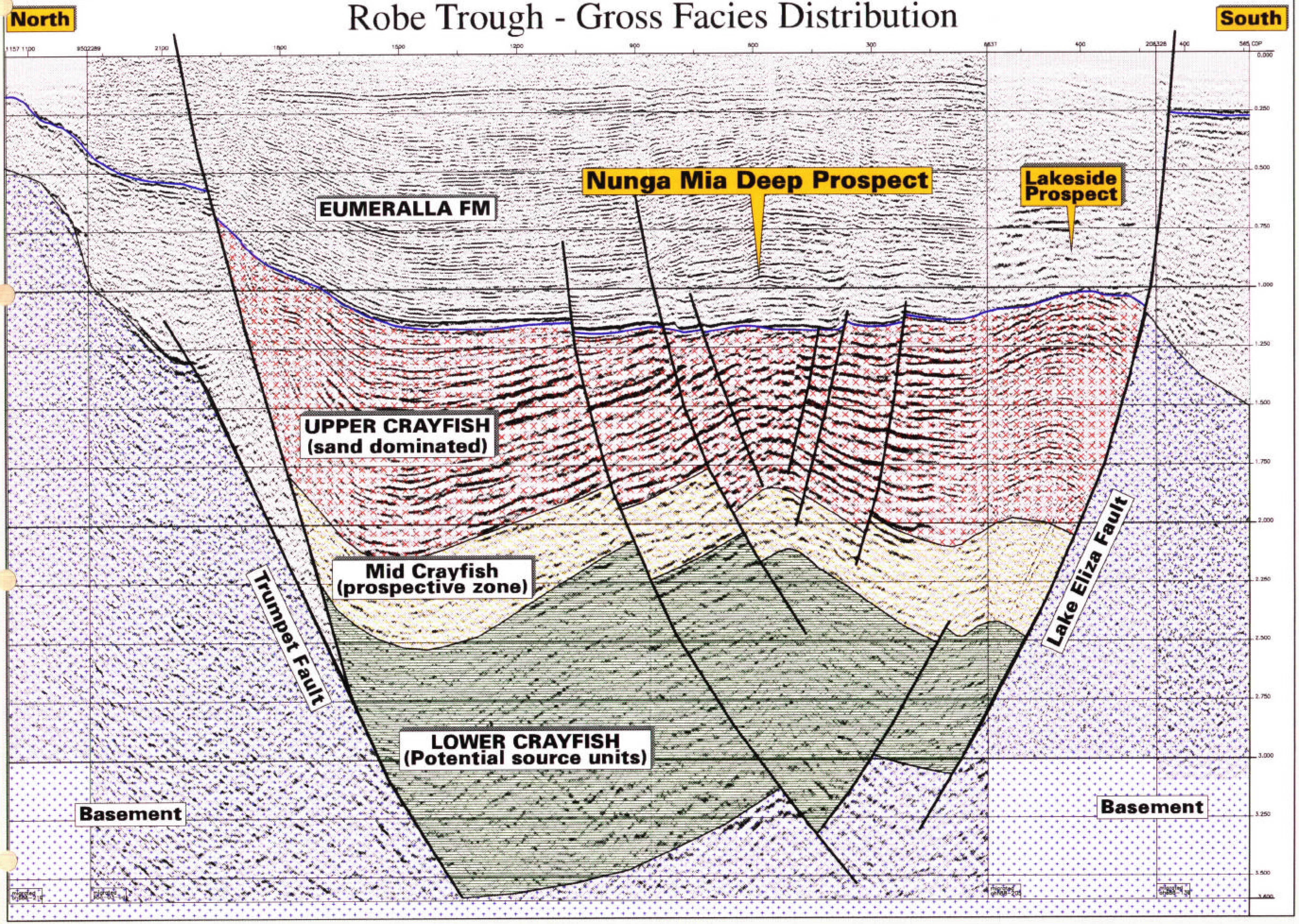
Middle Section:

- Transition zone, expected to contain thick shales (50-200m) with interbedded sands
- Evidence for this is a) increasing shale content toward the base of Nunga Mia-1& Churinga-1, b) 200m+ thick shale at base of Trumpet-1

Upper Section:

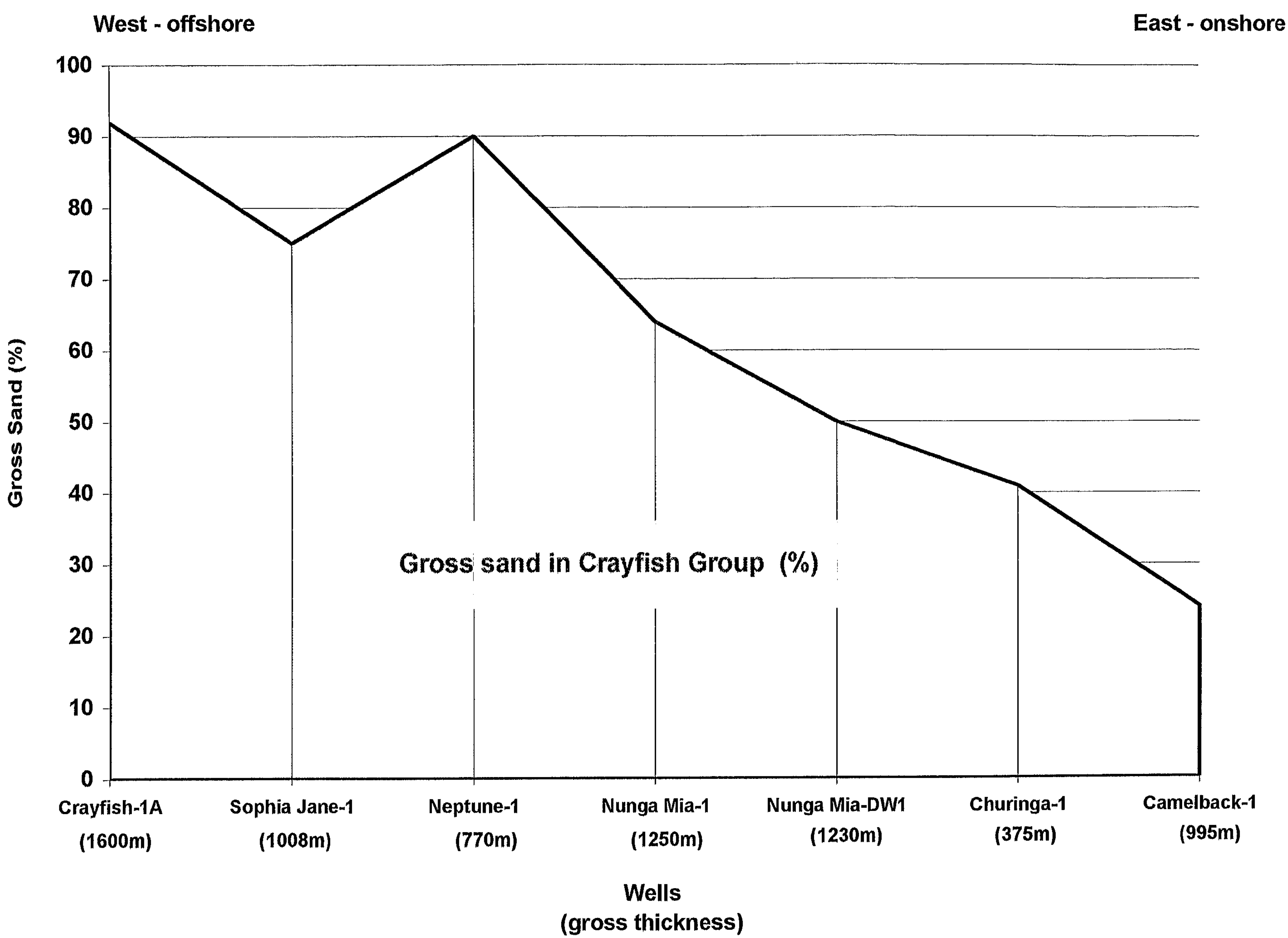
- Proven fluvial sand dominated, Sand shale ratio (45-90%)
- Lack of intraformational seals

Robe Trough - Gross Facies Distribution



1600m

R[illegible]e Trough - Crayfish Group Gross[illegible]and Percentage



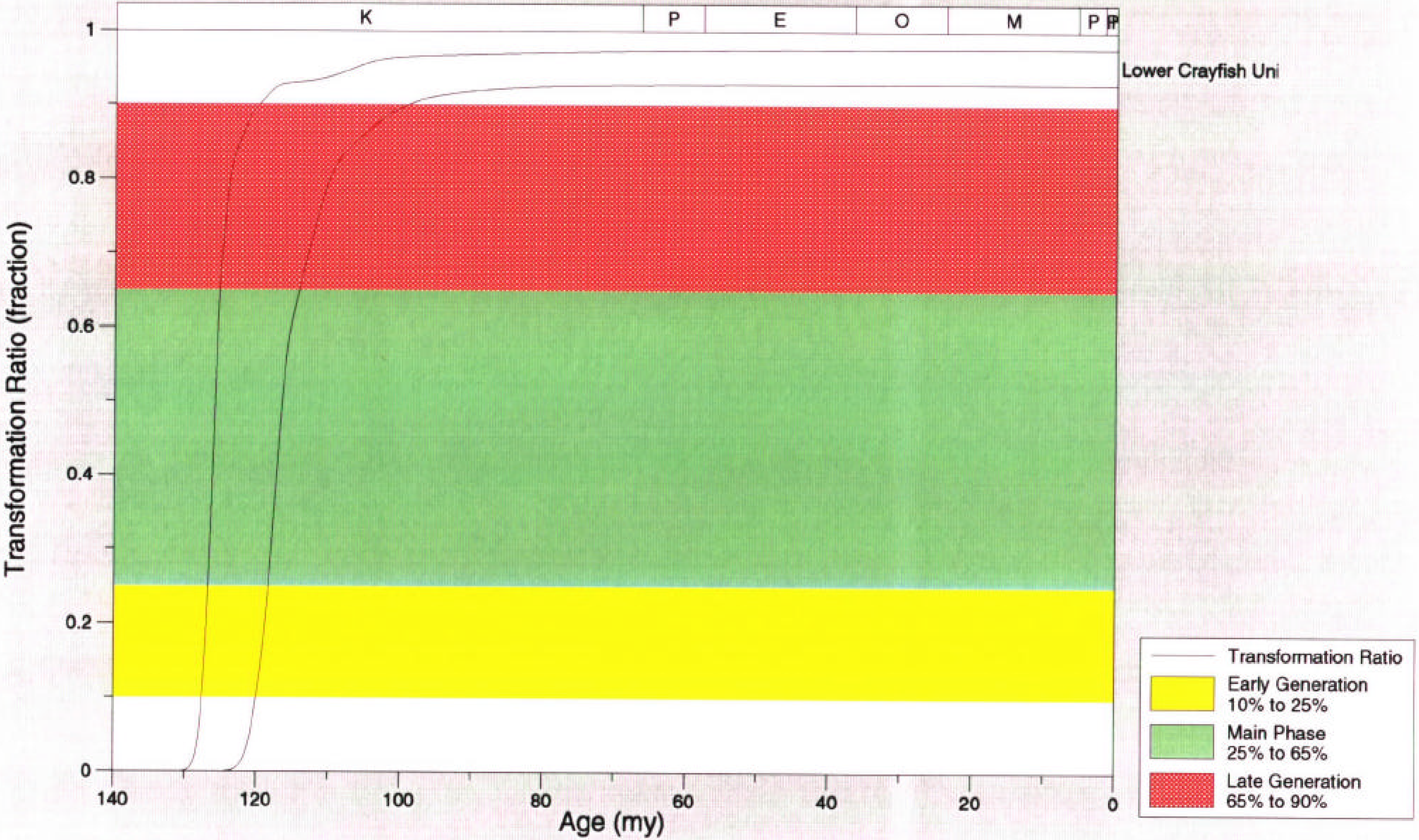
OIL SOURCE - Thermal Maturity & Timing of Oil Generation

- Lower Crayfish Section became over-mature before end of Crayfish deposition
- Bitumens in the upper Crayfish from Crayfish-1 & the Nunga Mia-1 Oil rec. indicate generative potential
- Lower-Mid Crayfish required to be the main source interval
- Base Eumeralla & upper Crayfish closures post-date peak migration
- Base Eumeralla should be used as a datum for estimating palaeo-closure of deeper intra-Crayfish plays

Robe Trough

Crayfish conductivit

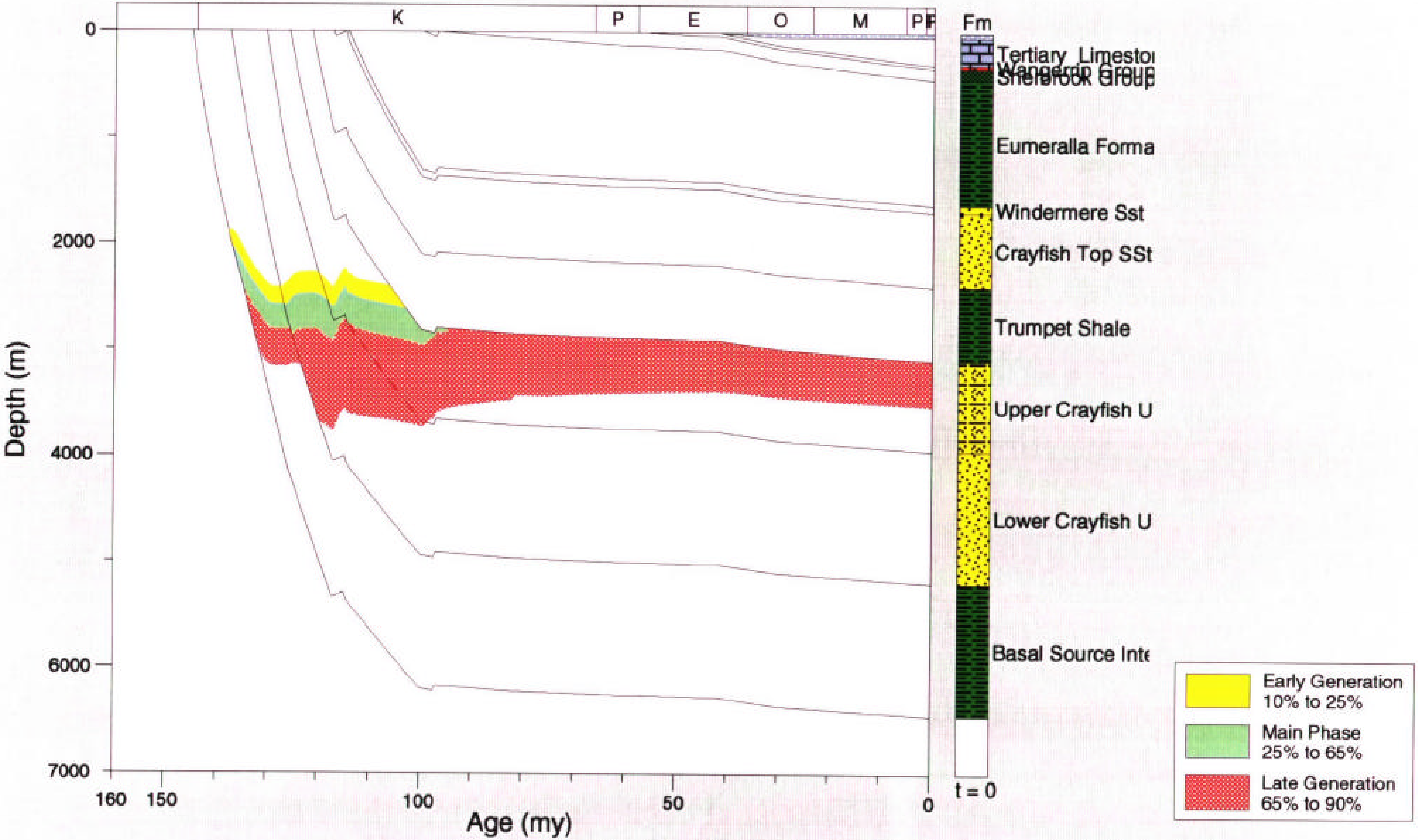
ROBE TROUGH.MOD
JES hf 70-75-65
14/10/98



Robe Trough

Crayfish conductivit

ROBE TROUGH.MOD
JES hf 70-75-65
14/10/98



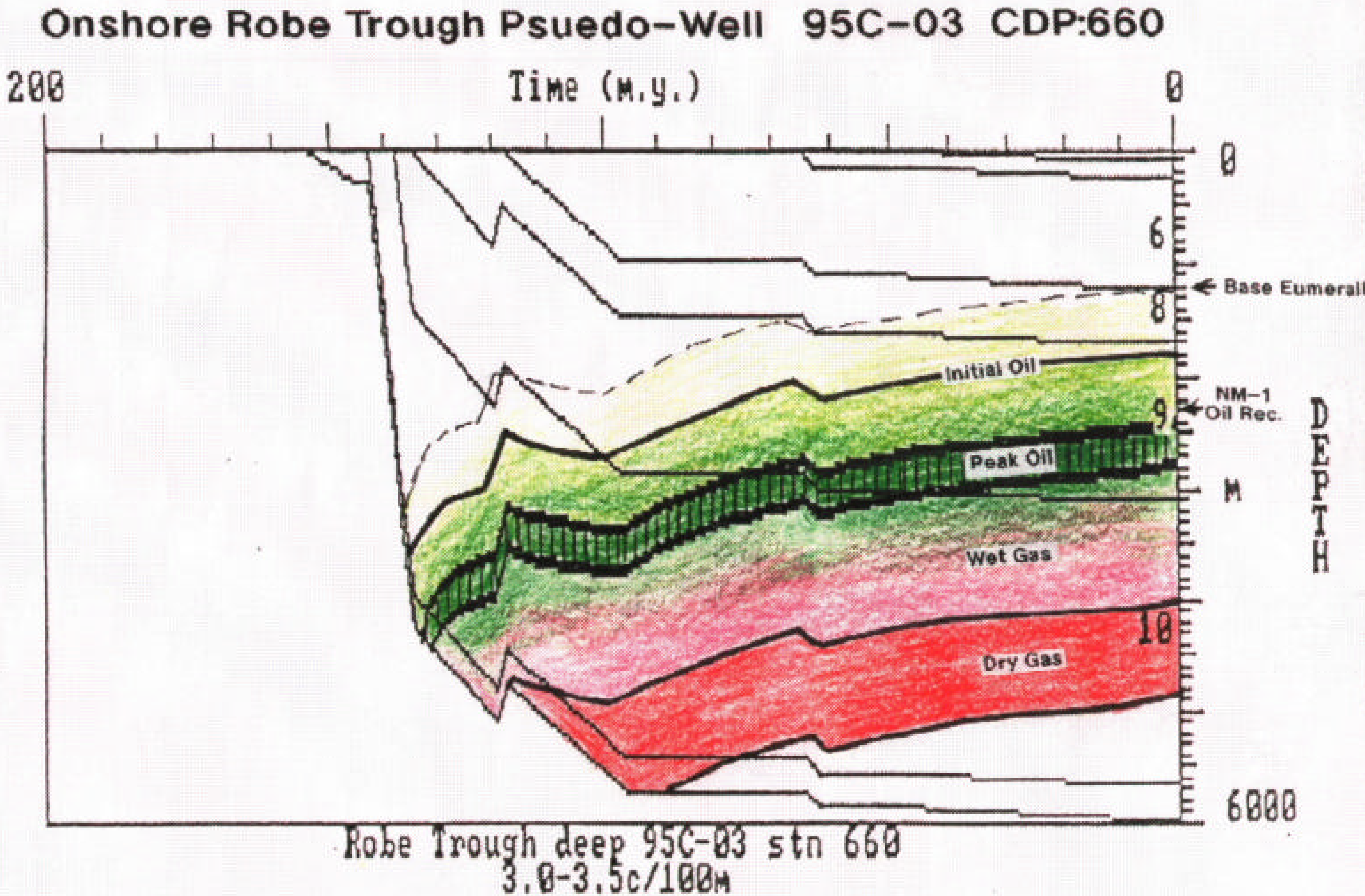
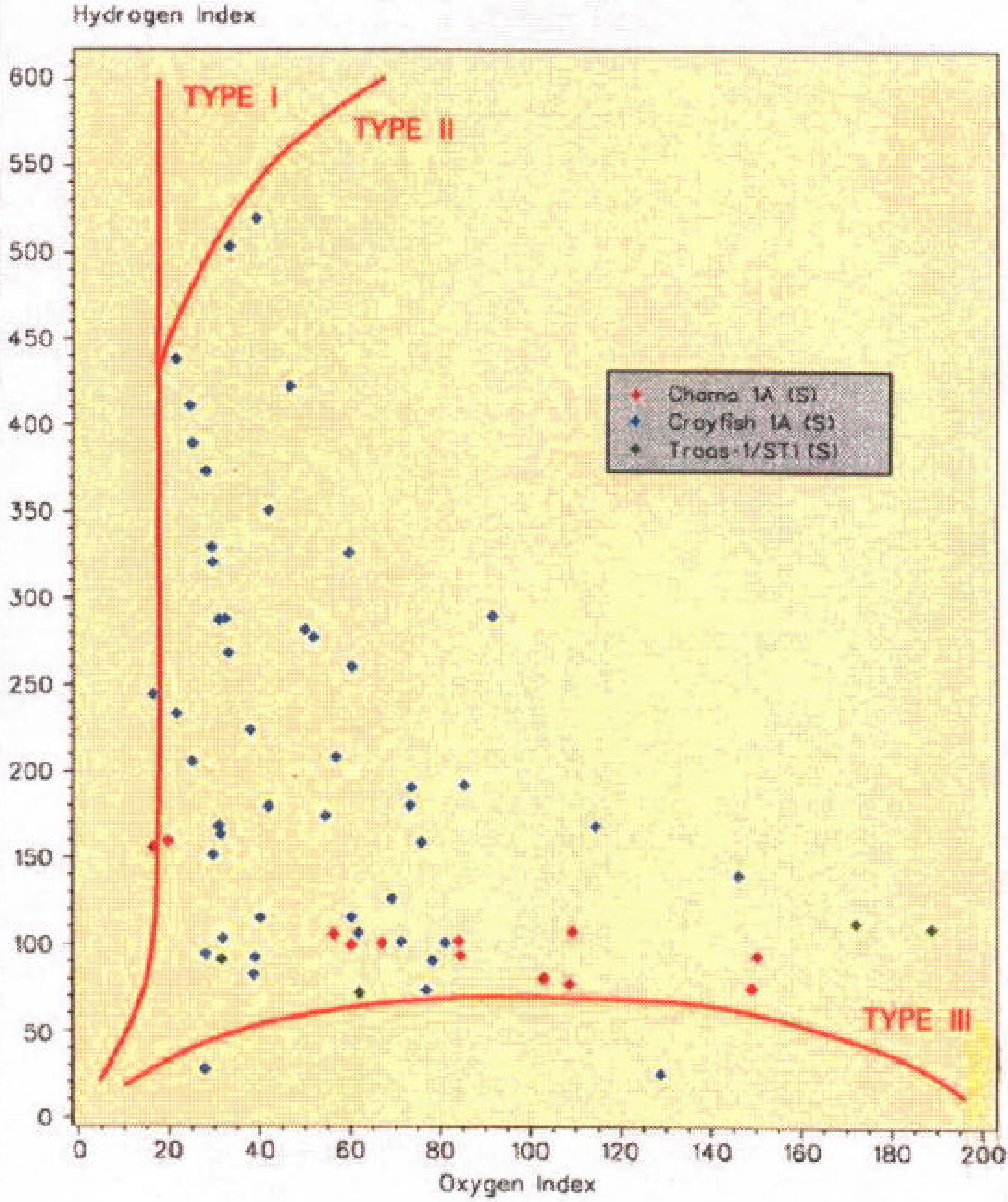

Onshore Robe Trough Psuedo-Well 95C-03 CDP:660
200
Time (M.Y.)
0
0
6
8
9
10
6000
M
DEPTH
Base Eumeralla
NM-1
Oil Rec.
Initial Oil
Peak Oil
Wet Gas
Dry Gas
Robe Trough deep 95C-03 stn 660
3.0-3.5c/100M

FIGURE 14

OTWAY BASIN

HYDROGEN INDEX VS OXYGEN INDEX
CRAYFISH GROUP



No: 12830.0295

Play Types

- mid-Crayfish fault dependent closures
  - expected better intra-formational shale development
  - early trap formation
  - eg. Nunga Mia-Deep, Stockdale
- mid-Crayfish lowside fault closures
  - eg. Lakeside
- upper-Crayfish 4-way dip closures
  - eg. Lakeside west

PEL 60 Prospectivity review - 1998
Prospects and Leads Inventory and Reserves Estimates

Prospects	Target	Depth Subsea		Max Pool Area (km²)	Closure Height		Gross Reservoir Thick (m)	Geometric Correction	N/G	Porosity (%)	Sh (oil - %)	Sh (gas - %)	Bo	Bg	OOIP (MMstb)	OGIP (BCF)	Oil Reserves 30% recovery factor (MMstb)	Gas Reserves 75% recovery factor (PJ)	Proposed Total Depth (mSS)
		(ms)	(m)		(ms)	(m)													
Nunga Mia 'deep'	IC-D	1780	2450	11.78	120	310	310	0.40	0.50	0.16	0.70	0.70	0.90	201.8	463	688.0	139	467.2	3500
Camelback updip	IC-E	1020	1140	3.38	80	120	120	0.45	0.25	0.16	0.70	0.70	0.90	115.8	29	20.9	9	16.7	1500
Lakeside L	IC-B	1100	1260	2.45	100	160	160	0.45	0.50	0.16	0.70	0.70	0.90	115.8	56	40.4	17	30.3	2500
Lakeside D	IC-C	1560	2000	21.05	120	240	240	0.45	0.50	0.16	0.70	0.70	0.90	175.8	721	790.4	216	592.8	2500
Stockdale	IC-D	1520	1950	12.06	180	310	310	0.45	0.50	0.16	0.70	0.70	0.90	175.8	533	584.9	160	438.7	2500

HIP and reserves for 100m column height

Prospects	Target	Depth Subsea		Pool Area for 100m column (km²)	Closure Height		Gross Reservoir Thick (m)	G.C.	N/G	Porosity (%)	Sh (oil - %)	Sh (gas - %)	Bo	Bg	OOIP (MMstb)	OGIP (BCF)	Oil Reserves 30% recovery factor (MMstb)	Gas Reserves 75% recovery factor (PJ)	Proposed Total Depth (mSS)
		(ms)	(m)		(ms)	(m)													
Nunga Mia 'deep'	IC-D	1780	2450	0.74	120	310	100	0.40	0.50	0.16	0.70	0.70	0.90	201.8	9.4	11.8	2.8	8.9	3500
Camelback updip	IC-E	1020	1140	2.49	80	120	100	0.45	0.25	0.16	0.70	0.70	0.90	115.8	17.8	12.8	5.3	9.6	1500
Lakeside L	IC-B	1100	1260	1.02	100	160	100	0.45	0.50	0.16	0.70	0.70	0.90	115.8	14.6	10.5	4.4	7.9	2500
Lakeside D	IC-C	1560	2000	1.95	120	240	100	0.45	0.50	0.16	0.70	0.70	0.90	175.8	27.8	30.5	8.3	22.9	2500
Stockdale	IC-D	1520	1950	1.15	180	310	100	0.45	0.50	0.16	0.70	0.70	0.90	175.8	16.4	18.0	4.9	13.6	2500

PEL 60 Prospect Risking

Generic PEL 60 Prospect		Chance of Adequacy
• Structure:	Low risk	70-80%
• Reservoir:	Low Risk	90-100%
• Source:	Moderate Risk	50-80%
• Charge:	Moderate-High Risk	30-70%
• Seal:	High Risk	10-40%

Average Overall Chance of Adequacy: 6%