WELL COMPLETION REPORT
HOTSPUR-1
G.WALKER
UNPUBLISHED REPORT 1984/11

WCR
HOTSPUR-1
(Stratigraphic Well)

REF ID 352

HOTSPUR 1: WELL COMPLETION REPORT

BY:

G WALKER

UNPUBL REPORT 1984/11

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1 INTRODUCTION

Hotspur 1 was drilled as part of a program comprising two deep drill holes in the Otway Basin to investigate the Mesozoic aged Otway Group. Hotspur 1 was located in the western part of the Victorian sector of the Otway Basin adjacent to the Merino High within the Tyrrendarra Embayment (Fig 1). The other well was drilled on the Otway Ranges High (Walker 1984 c.).

A regional site investigation was carried out by D Ripper (1980) using bore hole and seismic data. Hotspur 1 is situated on seismic line 72 - 113 of the Dartmoor Seismic Survey by Shell 1972, between shot points 385 and 390. In this area the basement was shown by Ripper (op cit) to form a "high" which was within the depth capacity of the Department's deep rotary drilling rig.

The hole was spudded on 11 March 1981 and drilling was completed on 16 April 1981 at a total depth of 1349.8m. It was geophysically logged on 17 March 1981 prior to running the surface casing string and again on 30 April 1981 to T D.

Thirteen conventional cores were cut over a total interval of 33.1m with a 52% recovery. Forty three sidewall cores were also recovered. The well was cemented off at 920m and 247m depth. A string of 6" steel casing was emplaced to 247m with a slotted interval from 222.3 to 233.1m. The bore was developed as a water well, completed as an observation bore and is currently monitored by the Department. The aquifer developed was the Pebble Point Formation which presented difficulties due to inflowing fine grained sands.

This report contains a geological interpretation of the well and also a compilation of the basic data obtained.

The geological supervision during drilling was undertaken by D Ripper, formerly of the Basin Studies Section. Mr Ripper logged the conventional cores, sidewall cores, and cuttings and his core descriptions are contained in Appendixes 2 and 3. The author also examined a number of the cores and cuttings and is responsible for the geological interpretation.

Foraminiferal Zone determinations on selected samples were provided by Dr C Abele (Appendix 4) and palynological determinations by V Archer (Appendix 5). W R M Ramsay provided a petrographical description of the basement core which was written up as an unpublished report (1981/61) and is included in Appendix 6 in this report. The same core was also dated by AMDEL (Appendix 7) and a specific gravity measurement was obtained by Beach Petroleum N L (Appendix 8). Appendix 9 contains a chemical water analysis of the developed aquifer.

The well encountered basement meta sediments at 1299.0m depth overlain by 1029.0m of Otway Group Sediments and 273.0m of sediments belonging to the Sherbrook Group, Nirranda Sub-Group and Heytesbury Group covered by a thin veneer of sands (Doradong Sand).

The Otway Group was made up of a thin lower basal conglomerate Member and a thick sandstone/mudstone sequence of the Eumeralla Formation.

Interest was shown after the completion of the well by oil company personell in a reported "gas kick" at about the level of the basal Conglomerate Member of the Otway Group. However the paper trace from the gas detector on the rig has been mislaid and enquiries by the author with persons involved with the hole have been conflicting and the claim has not been substantiated.

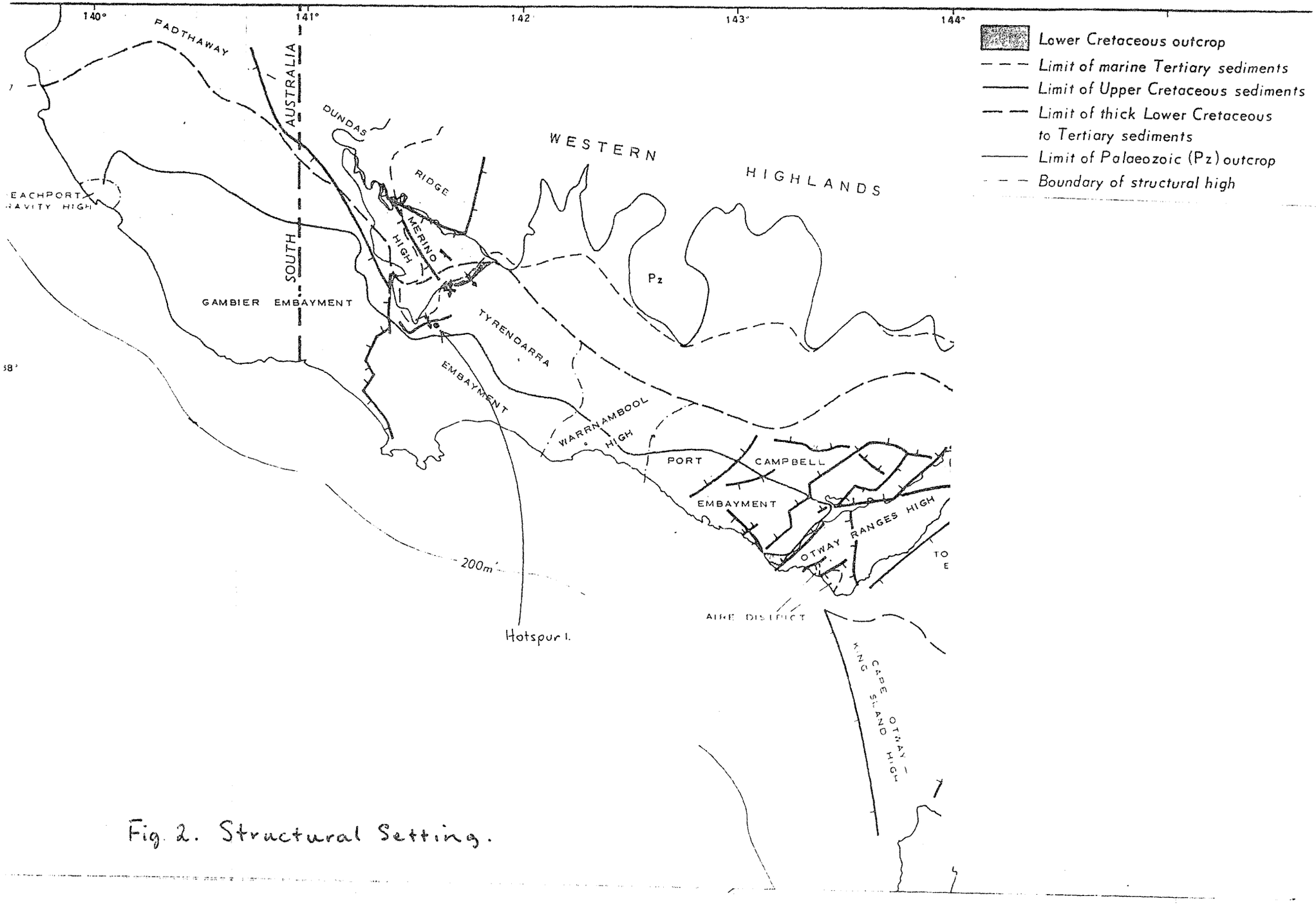
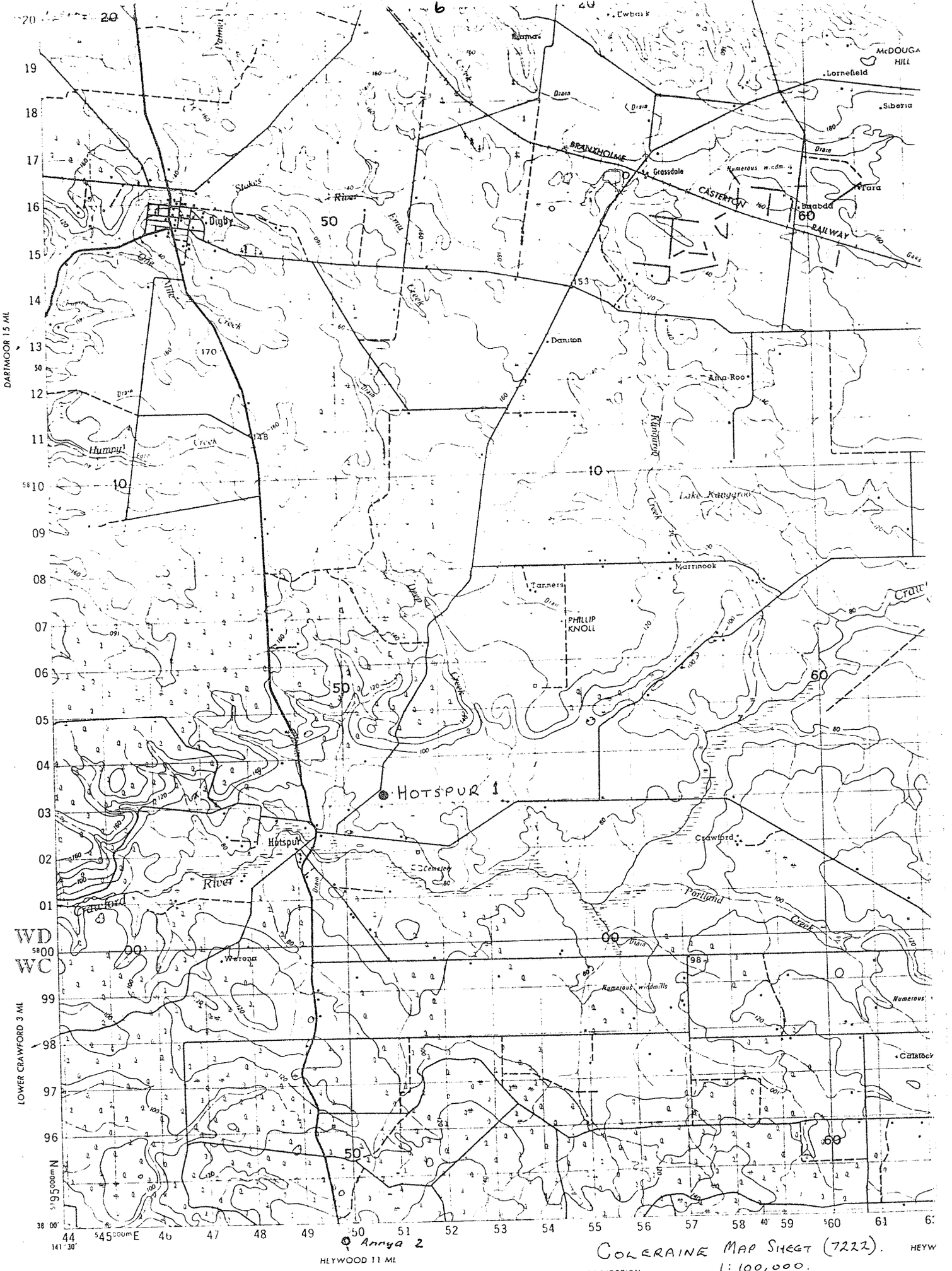


Fig. 2. Structural Setting.



COLERAINE MAP SHEET (7222).
1:100,000.

EDITION 1 - AAS
SERIES R 652

PRODUCED by the Royal Australian Survey Corps under the direction of the

TRANSVERSE MERCATOR PROJECTION
HORIZONTAL DATUM: AUSTRALIAN GEODETIC DATUM 1966

2. BASIN STUDIES SECTION - DEEP WELL SUMMARY SHEET - DM & E WELL

WELL NAME: Hotspur 1. BASIN: Otway

STATUS: Observation bore RIG: EMSCO GB 250 T CONSEC No: 21.81.1

DATE: Commenced 11 March 1981 Completed 3 June 1981 TOTAL DEPTH: 1349.8m

ELEVATION (G.L.) 89.1m LOCATION: A.M.G. sheet Zn 54 Coleraine (7222)

PARISH No 759 N 5803309 E 550706

ENGINEERING DATA: (casing, plugs, completion details)

Hole Size:			Casing:			Plugs:		
17.1/2"	to	120m	13.3/8"	to	130.2m	247.7	to	
15"	to	133.1m	6"	to	247.4m	920.0	to	945m
8.1/2"	to	819.8m						
7.7/8"	to	1344.9m						

Completion: 6" casing capped with locking cap

GEOPHYSICAL LOGS: Logged by D.M.&E. B.H.T 58°C at 1000m

G.R., Neutron	0	-	1350m
S.P., S.N., L.N., Lateral	100	-	1350m
Caliper, M.C.	0	-	1320m
Temp			
Density	0	-	1350m

CORES: Conventional

From (m)	Thick	Recov.	%
1. 228.2	5.9	0.2	
2. 318.7	2.0	1.8	
3. 418.9	1.3	1.3	
4. 518.9	1.8	1.6	
5. 609.2	1.5	1.5	
6. 709.4	3.3	3.3	
7. 819.8	3.0	2.0	
8. 917.2	2.2	1.2	
9. 1016.9	2.4	0.1	
10. 1117.2	1.6	1.5	
11. 1194.1	2.8	0.5	
12. 1286.7	4.0	1.0	
13. 1335.6	1.3	1.3	

Side Wall Cores

Depth (m)	Recov.	Depth	Recov.
1. 200		23. 798	
2. 208		24. 837	
3. 212		25. 851	
4. 216		26. 874	
5. 221		27. 955	
6. 227		28. 975	
7. 244		29. 1005	
8. 262		30. 1037	
9. 269		31. 1038	
10. 311		32. 1070	
11. 361		33. 1073	
12. 409		34. 1106	
13. 466		35. 1138	
14. 500		36. 1162	
15. 540		37. 1185	
16. 573		38. 1205	
17. 601		39. 1230	
18. 644		40. 1260	
19. 662		41. 1275	
20. 690		42. 1294	
21. 745		43. 1311	

Foraminifera Det. by Abele

9m	Zn. 11.	(Carter 1964)	(Cuttings)
15m	Zn. 11.	"	
30m	Zn. 11.	"	
75m	Zn. 11	"	
138m	Zn. 5.	"	

Palynology Det. by Archer

200.0m M. diversus Zone
208.2m " " "
212.0m Early-mid. M. diversus
221.8m " " " "
244.0m lower L. balmei Zn.
262.0m C. paradoxa-lower A. distocarinatus Zones.
269.4m C. paradoxa - C. triplex Zones
1275.0 m. D. speciosus Zone, R. reticulatus Unit.

319-321m	C striatus Subzone	(Dettman 1969	
409.5m	"	"	"
776.0m	"	"	"
917-919m	"	"	"
1138.5m	C hughesi Subzone		

by whom?

GROUNDWATER DATA: (T.D.S., screened intervals, S.L., Drawdown, Yield)

Slotted casing: 222.3 to 233.1m

STRATIGRAPHY: Formation (PRELIMINARY)	Depth(m)	R.L.	Thick	Comments
Donodong Sands	0.0			
Port Cambell Limestone	5.5			
Clifton Fm.	74.0			
Nirranda Sub-Group	102.4			
Dilwyn Fm.	144.5			
Pember Mudstone Mbr	170.0			
Pebble Pt. Fm.	209.7			
Paaratte Fm.	237.0			
Nullawarre Greensand Mbr.	251.0			
Belfast Mudstone Mbr	261.0			
Eumeralla Fm	270.0			
Basal Conglomerate	1277.5			
Basement; metasediments	1299.0			

OTHER DATA: (Velocity survey, seismic line, gas/oil show, tests)

Ramsay W.R.H. Petrological Report on basement core. Geol Surv. Unpub. Rep. 1981/61.

Fanning N. Report by AMDEL on K/Ar geochronology of rocks for 1981/82. Geol Surv. Unpub. Rept. 1982/40. (K/Ar date on core 1335.6m - 464 x 10^6y).

DATA SOURCE, REFERENCES, COMMENTS

G.R. & Electric logs digitized by Wiltshire.

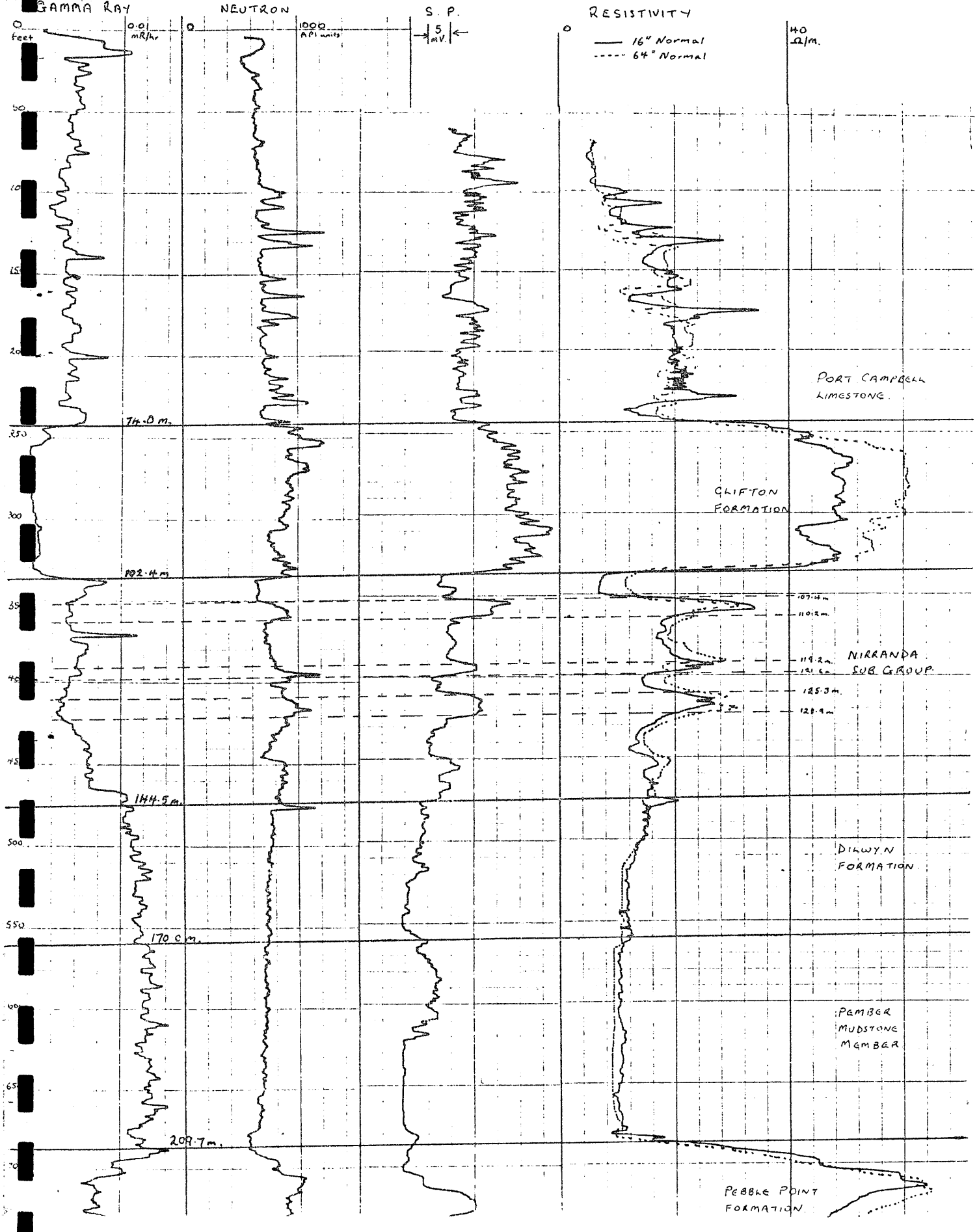
3 STRATIGRAPHY

The stratigraphic scheme used is mainly as presented in the Geology of Victoria (Abele et al 1975) except that the name Eumeralla Formation (Dellenbach & Hawkins 1964) has been resurrected. The stratigraphic breakdown is below in Table 1 and an interpreted geophysical log compilation is contained in Appendix 1.

Table 1 Hotspur 1 Stratigraphic Column

Age	Group	Formation	Member	Depth to m	Thickness m	R L m
Pliocene		Dorodong Sand		0	5.5	+89.1
Miocene	Heytesbury Group	Port Campbell Lst		5.5	68.5	+83.6
		Clifton Fm		74.0	28.4	+15.1
Oligocene	Nirranda Sub-Group			102.4	42.1	-13.3
Palaeocene/ Eocene	Wangerrip Group	Dilwyn Fm		144.5	25.5	-55.4
			Pember Mudst Mbr	170.0	39.7	-80.9
		Pebble Pt Fm		209.7	27.3	-120.6
Late Cretaceous	Sherbrook Group	Paaratte Fm		237.0	14.0	-147.9
			Nullaware G/sand Mbr	251.0	10.0	-161.9
			Belfast Mudst Mbr	261.0	9.0	-171.9
Early Cretaceous	Otway Group	Eumeralla Fm		270.0	1007.5	-180.9
		"Basal Conglomerate"		1277.5	21.5	-1188.4
Palaeozoic	Basement			1299.0		-1209.9

ig. 3. Geophysical log Compilation for Tertiary.
(Logs derived from initial logging run with Widco Equipment)



3.1 Palaeozoic Basement

The top of basement was selected at 1299.0m associated with a resistivity increase and a change in the S P and Neutron log character.

A sidewall core at 1311m, was described as a very biotitic siltstone, with some lineation of the grains, which suggests it is actually weathered? mica schist.

The basement core at 1335.6m to 1336.9m consists of fresh garnet hornfels (Ramsay in Appendix 6) which belongs to the medium grade amphibolite hornfels contact metamorphic facies (The original rock was considered to be a pelitic sandstone). This core was dated by AMDEL (Appendix 7) at 464 x 10^6y corresponding with a lower Ordovician age for the metamorphism.

The basement rock type is therefore most likely mica shist and hornfels.

A specific gravity measurement obtained by Beach Petroleum N L for the core was SG = 2.78 ± 0.05 (Appendix 8).

3. 2 Otway Group

The Otway Group consists of two units the Eumeralla Formation and a lower unit informally named here the Basal Conglomerate.

3.2.1 Basal Conglomerate

The top of this unit was selected at 1277.5m coinciding with an S P shift, an increase in resistivity and a decrease in natural

gamma ray radioactivity. The cuttings also indicate a sharp change to coarse grain size from fine grain sizes above.
Two cores were cut; a conventional core at 1286.7 to 1290.7m consisting of a lithic pebble to cobble conglomerate with the gravel consisting of angular vein type quartz and mica schist rock fragments set in a v micaceous quartzose f g sand matrix, and a sidewall core at 1294.3m of chlorite mica schist rock fragments and quartz pebbles. Lithic rock fragments were also recognised in the cuttings. The predominant lithology for the unit is a lithic conglomerate which has been derived from the Palaeozoic basement metamorphics and undergone little sediment transport. The unit can therefore best be compared with other informal units described as occurring at the base of the Otway Group in the Barrabool Hills (Coulson 1930) and in the Casterton Area (Kenley 1954) rather than as a correlative of the Pretty Hill Sandstone.

3.2.2 Eumeralla Formation

The top of the Eumeralla Formation is selected at 270.0m depth based on the geophysical logs.
Ten conventional cores and thirty two sidewall cores were cut. Lithologically the sediments consist of interbedded olive grey to greenish grey lithic fine grained sandstones, mudstones and siltstones with very minor black coal bands. The sediments are massive to bedded on a large scale with occasional finely laminated and cross bedded intervals.
Palynological results indicate a range from the R reticulatus unit of the C hughesi Subzone (Dettmann 1969) of early Aptian age (sidewall core at 1275m) to the C striatus Subzone of early Albian age (core

at 318.7 to 320.7m). The uppermost determination is 49m below the top of the Eumeralla Formation suggesting that sediments of the C paradoxa zone (late Albian) which are found nearby are thin or have been eroded off.

No subdivision of the Eumeralla Formation is considered here on the basis of lithology or palynology except that the geophysical logs indicate a tentative division into three units based on the sand/shale ratio which is shown in the interpreted log in Appendix 1. An upper unit (Unit A) from 270.0m to 450m depth consists predominantly of mudstone. A middle unit (Unit B) from 450 to 948m contains thick interbedded mudstone and sandstone units with sandstones constituting approximatily 40% from 450 to 627m and a lesser percentage to the base of the unit. The lower unit (Unit C) from 948 to 1277m is predominantly of mudstone character.

3.3 Sherbrook Group

The Sherbrook Group is represented by the Paaratte Formation in which the Nullawarre Greensand Member and the Belfast Mudstone Member are present.

The top of the Paaratte Formation is placed at 237.0m depth based on the radiometric and electric logs and a change in the cuttings from c g stained quartz grains of the overlying Pebble Pt Formation to fine grained clear quartz grains referred to as undifferentiated Paaratte Formation. Sidewall core at 244.0m consisted of brownish black mudstone with minor pale grey clean f g sandstone lenses.

The Nullawarre Greensand Member occurs between 251 and 261m corresponding with a sandy interval on the gamma ray and electric logs and an increase of glauconite in the cuttings from trace to 3%.

The Belfast Mudstone Member occurs from 261m to 270m and is based on an increase in "shale" radioactivity on the gamma ray logs and on two sidewall cores taken within this interval which are described as black glauconitic siltstone and mudstone.

3.4 Wangerrip Group

The Wangerrip Group is represented by the Pebble Point Formation and the Dilwyn Formation.

The top of the Pebble Point Formation has been selected at 209.4m based on the electric and radiometric logs and a sharp increase in coarse grained sand content in the cuttings (Fig 3).
The top of the formation is muddy and is transitional with the overlying Pember Mudstone Member of the Dilwyn Formation. The lithology of the Pebble Point Formation consists of partly stained quartz sands ranging to very coarse grain and granule size in places with oolites of chlorite and limonite set in a chloritic muddy matrix.

The top of the Dilwyn Formation placed at 144.5m corresponding to a change in S P character and an increase in "shaliness" on the gamma ray log. The cuttings indicated a sharp increase in fine grained clean quartz sand. The Dilwyn Formation consists of fine grained sand silt and mud with mudstone predominating from 170.0m where it is designated the Pember Mudstone Member. Two sidewall cores were cut in the Pember Mudstone Member at 200m described as a silty mudstone and at 208.2m described as a limonitic oolitic mudstone.

3.5 Nirranda Sub-Group

The top of the interval was placed at 102.4m coinciding with an increase in "shale" on the gamma ray log and a change in character on the electric logs. No cores were cut in this interval and the cuttings are strongly contaminated. The cuttings contain up to 20% calcareous

grey silts and olive grey marls indicating the lithology is dominantly a calcareous mud to marl. However the interval has three zones of high resistivity (107.4 - 110.2m, 119.2 - 121.6m, 125.3 - 128m) indicating limestone or sand bands. The cuttings description shows approximately 20% of fine grained partly iron stained quartz sand in the lowermost zone.

The dominant lighology in the Nirranda Sub-Group is marly corresponding with the Narrawaturk Marl with minor intervals of possibly iron stained sand corresponding with the Mepunga Formation, or limestone, interbedded in the Narrawaturk Marl.

A palaeontological determination on the cuttings at 138m gave a probable late Oligocene age (F U 5).

3.6 Heytesbury Group

The Heytesbury Group is represented by the Clifton Formation and the Port Campbell Limestone.

The top of the Clifton Formation is recognised at 74.0m from a decrease in gamma radioactivity, a change in electric log character and from cuttings which are predominantly yellow orange in colour and consist of fragmental limestone and crystallize limestone with up to 5% limonite oolites.

The Port Campbell Limestone was intersected at 5.5m depth and consists of pale orange to yellow and olive grey fragmental crystallize limestones with minor grey marly limestone with minor limonite oolites in places. The interval has a moderately high resistivity (approx 20 Ω/m^2) which is consistent in character with the Port Campbell

Limestone rather than the Gellibrand Marl (Esplan 1971).

Palaeontological determinations on a cutting sample from 9m gave an early middle Miocene age of F U 11 for the top of the Port Campbell Limestone.

3.7 Doradong Sands

Overlying the Port Campbell Limestone is a thin sequence of red brown lateritic m g to c g sands and muddy sands/sandy mud which correlates with the Doradong Sands of possible early Pliocene age. The Doradong Sands are shown to outcrop in the area on the 1:250 000 Hamilton geological map (Douglas 1970).

4 RELATIONSHIP TO NEARBY BORES

Figure 4 illustrates the positions of nearby deep drill holes. Detailed well completion reports have been prepared for Departmental drill holes Wataepoolan 2 (Holdgate 1975) and Glenaulin 2 (Holdgate 1974) and brief reports on Annya 2, Myamyn 2, Ardonachie 2, and Byambynee 2 (Walker 1984a,b). None of these holes penetrated pre-Mesozoic basement, however all reached the top of the Otway Group or were drilled some distance into the Otway Group. Beach Petroleum N L recently drilled Greenbanks 1 (Parish of Condah) on their Petroleum Exploration Permit 105 and reached basement, however their results are confidential at this stage.

The fence diagram as shown in fig 5 indicates the relationship of

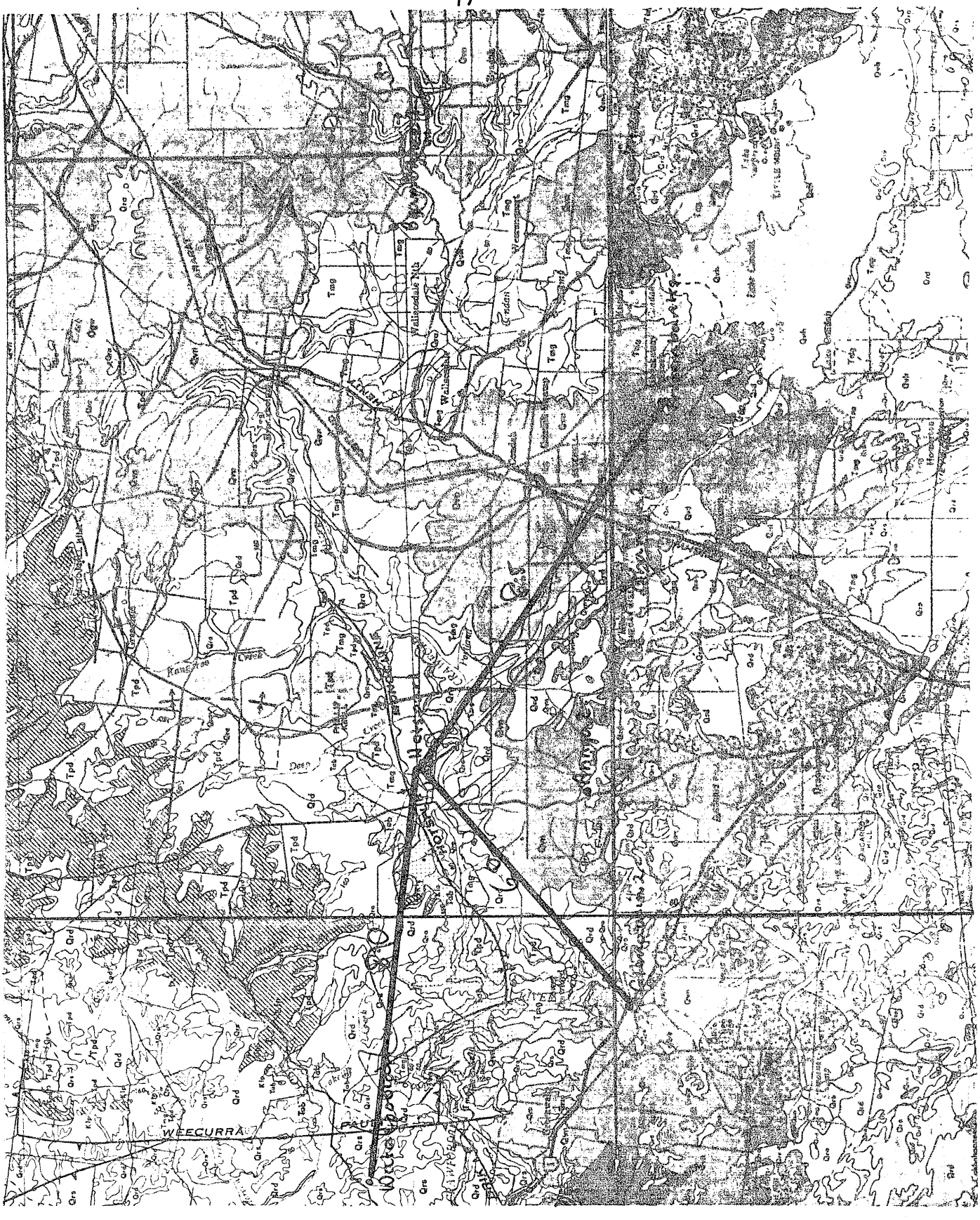


Fig 4. Location of nearby deep drill holes.

the late Cretaceous and Tertiary sequence in Hotspur 1 to three holes basinward within the Tyrrendarra Embayment.

PE905876

This is an enclosure indicator page.
The enclosure PE905876 is enclosed within the container PE905875 at this location in this document.

The enclosure PE905876 has the following characteristics:

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CONTAINER_BARCODE	= PE905875
NAME	= Fence Diagram for Hotspur-1
BASIN	= OTWAY BASIN
PERMIT	= PEP/105
TYPE	= BOREHOLE
SUBTYPE	= DIAGRAM
DESCRIPTION	= Fence Diagram to Basinwards of Hotspur-1 (from WCR) for Hotspur-1
REMARKS	= this report has no well number, it is a straigraphic well ; the bore was developed as a water well and completed as an observation bore
DATE_CREATED	=
DATE_RECEIVED	=
W_NO	=
WELL_NAME	= HOTSPUR-1
CONTRACTOR	=
CLIENT_OP_CO	= GEOLOGICAL SURVEY OF VICTORIA

(Inserted by DNRE - Vic Govt Mines Dept)

REFERENCES

Ripper D.T.	1980	Drill Site for Mesozoic Stratigraphic. Hole in the Branxholme Area: Tyrrendarra. Embayment of the Otway Basin, Victoria. Unpubl. Rept. Geol. Surv. Vict. 1980/99
Coulson	1930	Notes on the Gurassic rocks of the Barrabool Hills, near Geelong, Victoria. Proc. R. Soc. Vict., 43.
Kenley	1954	The Occurrence of Cretaceous sediments in southwestern Victoria. Proc. R. Soc. Vict., 66.
Abele et. Al	1975	In Geology of Victoria, Douglas & Ferguson Eds., Geol. Soc. Aust. Special Publication No. 5.
Dellenbach & Hawkins	1964	A Petrological study of sediments from Frome Broken Hill Port Campbell No. 1 and No. 2 wells, Otway Basin, Victoria. Rec. Bur. Miner, Resour. Geol. Geophys. Aust., 1965/41. (Unpubl.)
Holdgate	1974	Glenaulin 2 Well Completion Report Geol. Surv. Report 1974/10.
Holdgate	1975	Wataepoolan No. 2 Water Bore Well Completion Report. Geol. Surv. Unpubl. Rept. 1975/3

Walker G.M. 1984 c. Krambruck 13 Well Completion Report Geol. Surv. Vict. Unpub. Rept. 1984/12

Walker G.M. 1984 a. Data on deep drilling by DME within the Coleraine 1:100000 map sheet. Geol. Surv. Vict. Unpub. Rept. 1984/37.

b. Data on deep drilling by DME within the Portland 1:100 000 map sheet. Geol. Surv. Vict. Unpub. Rept. 1984/38.

Esplan 1971 In Wopfner and Douglas (Eds.). The Otway Basin of southeastern Australia. Spec. Bull. Geol. Surv. S. Aust. & Vict.

APPENDIX 1:

PE604682

This is an enclosure indicator page.
The enclosure PE604682 is enclosed within the container PE905875 at this location in this document.

The enclosure PE604682 has the following characteristics:

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CONTAINER_BARCODE	= PE905875
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BASIN	= OTWAY BASIN
PERMIT	= PEP/105
TYPE	= BOREHOLE
SUBTYPE	= WELL_LOG
DESCRIPTION	= Interpreted Geophysical Log (from appendix 1 of WCR) for Hotspur-1
REMARKS	= this report has no well number, it is a straigraphic well ; the bore was developed as a water well and completed as an observation bore
DATE_CREATED	=
DATE_RECEIVED	=
W_NO	=
WELL_NAME	= HOTSPUR-1
CONTRACTOR	=
CLIENT_OP_CO	= GEOLOGICAL SURVEY OF VICTORIA

(Inserted by DNRE - Vic Govt Mines Dept)

APPENDIX 2:

APPENDIX 2. CORE DESCRIPTIONS by D. Ripper

HOTSPUR 1. CORES

Core	1	228.16	-	234.1	Rec.	0.06 m
	2	318.68	-	320.71		1.6 m
	3	418.9	-	420.2		1.28 m
	4	578.93	-	520.7		1.6 m
	5	619.18	-	621.18		1.64 m
	6	719.43	-	722.75		3.12 m
	7	819.77	-	821.78		1.9 m
	8	917.18	-	919.4		1.14 m
	9	1016.91	-	1019.33		0.2 m
	10	1117.23	-	1118.85		1.52 m
	11	1194.13	-	1196.93		0.43 m
	12	1286.7	-	1290.7		0.65 m
	13	1335.59	-	1336.92		1.33 m

HOTSPUR 1 CORES

CORE 1.

Core 228.16 - 234.10m Rec. 0.06m

Very hard well cemented ? massive. Dusky yellow brown (10 YR 2/2) muddy sst. - medium to granule grained with a slight polished dusky brown cement that is slightly calcareous, probably 1-2% limonite oolites slightly polished and without quartz centres.

Quartz - medium to granule grained (avg. co.), off white to pale yellow brown, probably 3% are coloured grains, most grains are slightly coated/stained with the lim. mst. cement. The grains are ang. to srd. occ. rounded and with a strong tendency to be polished, grain surfaces can have a polished or dull finish and are commonly smoothly undulating with rounded and polished etch marks, pitting, solution cavities.

Occasional grains are reworked lithics altered to clays.
Occasional trace of dissem. pyrite. Limonite probably makes up 5% of the core (oolites and lim. in the cement and coating grains).
Fair poros./perm. and slightly calc.

CORE 2.

318.68 - 320.71 Rec. 1.6m

General: 1.05m very thin to lam. (wavy lams), in parts very carbonac, very fine sdy slst./slty very fine sst., slst. and slightly clayey very fine slst. 0.55m thin to medium bedded, slight coaly muddy very fine slst., slst. with fine grains of lithics.

0-0.12m very fine silty mst. and muddy fine slst. lt. olive grey (5Y 5/2), mod. waxy trace when scratched. Lenses 1 x 0.2cm, blebs black coal (spongy type). Traces of waxy brittle chloritic mst. due to rootlets? The slst./mst. has carbonac. fragments throughout. Principally off white with occasional grains of darker olive grey lithics and mica chlorite. No clear bedding found.

0.12-0.24m olive grey (5Y 4/1), coarser grained muddy and fine sdy slst., muddy fine slst.
The muddy slst. with fine sized grains scours the top of the interval 0.12m and is moderately coaly with some pyrite crystals, pebbles of chloritic mst., fine grains of lithics, waxy chlorite.
The mdy fine slst, is carbonac. with wispy traces and coaly chunks/lenses occasionally with pyrite crystals at their base - dull black colours. ? X bedding 10° dip.

0.24-0.29m very thin bedded mdy. very fine, light olive grey 5Y 5/2, muddy very fine slst. to slty mst. with very irreg. lenses/ lams of coaly matter. The mst/slst. is coarser grained at the base with waxy grains of lithics, chlorite, chloritic mst. occasional quartz grains. Dips around 10°.

0.29-0.49m thin to very thin bedded muddy slst., slty very fine sst. to fine sdy slst. with lams of carbonac. muddy slst. Dips around 10 - 12°, some truncated X beds; carbonac. lams seem to have chlorite mica flakes as well.
The slst. has musc., chlorite, biotite, carb. fragments-flakes. The siltstone comprises 90% quartz, 10% above, plus occasional lithics & orange brown granular aggregates.

0.49-0.51m slty whitish very fine sst. with spongy black coaly lenses.

0.51-0.57m very fine slst. probably slightly muddy with 2% lithics or chloritic mst. grains.

0.57-0.65m light olive grey - olive grey (5Y 6/1 5Y 4/1), thin and laminated muddy very fine slst., fine and coarse slst, with 3-5% carbonac laminae often associated with lams of very fine slty mst. Lenses/laminae/flakes of yellow brown and brown cuticular matter. Grains of paler green waxy chlorite.

Slst - 95% quartz like grains, probably 5% lithics, orange brown granular aggregates ? musc. chlorite/bt.

Some load casting/slumping. Lams dip at 4-8° possible bioturbation, very fine slst lams are often white and clean, occasional X bed.

0.65-0.98m Interval with more freq. carbonac lams more ripple marks/ X bedding - coarser grained becoming a very fine 'sdy' slst. (ie a slst with 35% very fine grains, (5 - 7% lithics and chloritic mica). Good poros./perm.

0.85-0.98m less lams, carb. material and with mst. blebs and lenses to 1-2mm thick, nodular appearance to the outer surface of the core, mainly slty very fine sst. (to fine sst.) with carbonac. frags. (spongy). Up to 10% darker green grey lithics, chlorite, paler green grey waxy chlorite, light olive brown 5Y 5/6. Grains - ? quartz, occasional orange brown granular aggregates.

Yellow brown striated pipe like inclusion 0.75mm diam, 0.05mm

0.98-1.21m The interval is less carbonac, than the above, and has fewer laminations, less obviously X bedded. Finer grained clayey very fine slst., slst. with very fine grains, commonly finely laminated with carbonac. flakes, occasional vertical root trace infilled with brittle waxy mst. Occasional good parting, shallow dips around 5°. The silts are freq 95% white quartz, little cement, 5% Carb material, bt./chlorite and some chloritic mud blebs. Fair porosity/perm.

1.21-1.39m Thin bedded coarse slst. with up to 20% very fine to fine grains - mainly quartz with some chlorite, lithics and carb. fragments. Interbeds, ripple marked/X beds of finer grained more clayey slst. with traces of carb. material, micacious, probably chlorite/bt, occ. iron oxide 'grains'. Some prominent carb. lams and horizontal (3°-5°) dip at the top - lams with carb. material are clayey/muddy, with micro-lenses of mud, fine grains of chloritic probably waxy mst, very fine - fine quartz grains. Occasional int. (to 2cm) of slty very fine - fine sst. (Otway type sst) with up to 10% dark green grey lithics, traces of bt/chlorite, pale orange brown granular aggregates, coal fragments, waxy chlorite grains.

Quartz grains are white transl/transp., angular occasionally sub angular, (off white grains may be feldspars), uneven dimpled grain surfaces.
Good poros/perm.

1.39m to top, fine slst with bt./chlorite muscovite flakes, carbonac. fragments and occasional lenses, traces of pale orange brown 'FeO' grains. Slst may be coarser and finer (mdy.) in parts. The slst. is not well std. and has scattered 20% coarser grains.

Vertical rootlets (to 2mm diam) infilled with brittle waxy mud and carb. material are quite common - irregular X sections. Some laminations - probably X beds.

CORE 3.

418.9 - 420.22 Rec. 1.28m

General: 57cm slst. and muddy slst. very thin - lam., shallow dips 3 - 5%. 71cm fine sst. - thin bedded (? med), some X bedding. Rare Carbonac. lams and lenses. The mst. has ints. of the slst./muddy slst. Sst. - (dry) is greyish yellow green 5GY 7/2, greenish grey 5GY 6/1 to dusky yellow green 5GY 5/2. Mst. - (dry) lt grey N7 & greyish yellow green 5GY 7/2.

0-0.04m Dark greenish grey to greyish olive green (5GY 4/1 to 5GY 3/2) very fine sandy slst. - different from general Otway slst.

15% green grey lithics - finer grained and more angular than usual.

½% pale orange brown aggregates ? Fe oxides.

1-2% accessories, chlorite mica, soft waxy chlorite, probable carbonac. fragments occasional carbonac. lams.

80% Quartz & felds - fine slst. to v. fn. grained, 40% off white pale greenish appearance, 60% white transp/ transl, angular.

Occasional blebs of chloritic mst.

In general the slst. has little cement. Good poro/perm.

0.04m-0.11m slightly sandy very fine slst., olive grey 5Y 4/1 with carb flecks, chloritic mica flakes. 5% scattered very much coarser quartz and waxy chlorite grains (green). Rootlets trace vertically into the overlying mst. interval, 2-3mm wide and infilled with carbonac. sst. Occasional carbonac. coal lense 3 x 0.2cm. Irregular pale green patches stand out against the olive grey.

0.11-0.34m lams to very thin beds of very very fine slst., thin int. of slst., slty chlorite mst. with occasional intervals of fine carbonac. wispy lenses (dips around 3°). The thin slst. ints. show occasional carbonac. lams, some X beds and are almost pure quartz - lithics 5%.
3mm wide wedge shaped roolet infilled with slty chloritic very fine sst., some crystalline pyrite in these vertical rootlets. Parting on lams is good.

0.34-0.36m fine sst. - ? 35% lithics sub angular to angular,
½% pale orange brown aggregates,
1% chlorite mica, carb. fragments,
10% Quartz silt cement,
52% Quartz & felds - white - pale green, transl./transp./ang. Good poros./perm.
0.36- 0.40m olive grey slst. with carbonac. lams.
0.40-0.70m core takes on a greenish colour. Slst. - very fine slty sst. and the occasional thin int. of slty fine sst. X beds at the base, thin bedded with rootlet traces vertical and oblique, frequent chlorite mica flakes often associated with lams of slty chloritic mst. Little carbonac. material, suggestion of bioturbation.
0.70-0.78m finer grained in general and with more

.78m - top similar to 0.4 - 0.7m, thin bedded slty fine sst. and sdy slst. with occasional int. to 6cm, of lams of chloritic finer grained slst and slty mst. (These lams are very undulating/irregular/non planar, overall impression of bedding dips 3-5°). The bedding is expressed by discontinuous disrupted/bands of slst./sst. with increased cement. The core is more of an olive grey due to decrease in % green grey lithics to 10% and increase in white silica cement.

Occasional rootlet trace 3mm diam (Vertical).

At 1.18m the core is blotchy with large irregular patches of greyish yellow green to dusky yellow green (5GY 7/2 - 5GY 5/2) chloritic mst. The mst. may have been pulled apart here, squeezed, load casted and altered by rootlets and vegetation. Rare carbonac. fragments to 2mm. Porosity/permeability is governed by the degree of cementing, generally poor - good in the ints., . 34-.36m, .38-.73m, .86-1.05m.

CORE 4.

518.93 - 520.70m Rec. 1.6m

General: .40m sst., thin - med. bedded, dips 5°.

1.2m mst. prone to angular fracturing, occasional slst. lense/interbeds probably medium to thick bedded. Occasionally the muddy slst. beds are broken up and suggest non uniform deposition or pull aparts.

0-0.38m dark greenish grey slty. fine sst. with very thin ints. and discontinuous lams of chloritic mst. and muddy slst. Some X bedding. Dips usually 5 - 6°. Composition of the sst. is similar to the core at 618m

very fine slst. - mst. parting is good at 4-6°.

0.965 - 1.145m sst. - thin to medium bedded and X bedded, fine grained with 20% lithics 15% cement clay silt, 3% accessories chlorite, phyllite type blebs, pinkish orange grains ? FeO, rare carbonac. fragments, 62% quartz, very good poros./perm. possible 10% of total % is silt).

1cm band of clayey (chloritic) very fine sdy slst. in this sst. interval. The slst. base is concave down.

1.145 - 1.365m very thin bedded slty mst. with interlams, very very fine slst. Dips at 10°, 5cm of fine sst. and slst. (in the middle of this interval) with lenses/blebs of slty mst. The upper mst. has short carb. laminae and chloritic mica, shows some evidence of slumping.

1.365 - 1.5m sst. with slty mst. and muddy slst, pebbles at the base (sub angular to sub. rd. very irregular shapes often elongate).

Sst. - thin to medium bedded and probably X bedded and with some heavy mineral rich bands.

20% dark green grey lithics.

15% white slty grains - cement.

2.5% accessories, pale orange brown grains, magnetic black heavy minerals (vitreous) bt./chlorite vitreous coal fragments.

10-15% silt quartz.

45-53% fine quartz white and pale green, as before.

Good poros./perm.

Wispy discontinuous carbonac. lams at the top.

1.5m - Top -. muddy fine slst. and very fine slst. - very thin bedded to laminated, X bedded, very shallow environment.

Frequent carbonac. flakes - very short laminae, prominent in

Very little carbonac. matter, quite chloritic (mica) pinkish grains transl./transp., may be garnet - rather soft and easily fractured.
Good Poros/Perm.
Near vertical rootlets/burrows replaced by brittle waxy mst. (1.3mm diam) - often with odd shaped X sections.

0.38-1.13m olive grey 5Y 4/1 slightly slty chloritic and muddy, very fine slst, with occasional irregular shaped (prob. slumped) muddy slst. patches and wispy short white slst. 'lenses'/ lines. In part the core appears fractured and recemented - probably due to rootlets and organism activity, carbonac material is often associated with rootlets. Some large scattered carb fragments with possible leaves 2.5cm wide x full width of core - sub horizontal, probably 5° dips (2-3% carb material), old soil horizon.
Concoidal fracture when dry, very shallow deposit.
Very little poros./perm., non calc.

1.13m to top, dark greenish grey 5GY 4/1, probably bioturbated chloritic muddy slst., slst. and fine sdy slst. and slty mst. Occasional fine slty sst. int. irregular shaped near vertical rootlet channels (to 3mm) infilled with brittle waxy chlorite.
The core appearance has been disturbed/altered by micro organisms - roots etc. Beds when present give dips of 20°. Generally bioturbated. Sandy silt at the top has lithics 10% and 5% chloritic mica. Definite % increase in quartz - fine and silt size. The silt has moderate poros/perm.

CORE 5.

619.18-621.18m Rec. 1.64m

1.02m fine sst.

0.62m very fine slst. and mst.

Generally - medium to thick (45cm) intervals of fine to medium 'Otway Group' sst. with medium interbeds of laminated to very thinly bedded clayey very very fine slst. and minor amounts of coarser slst. General bedding is shallow with good dips of 5° some evidence of ripples and X bedding with possible load casting. Dips of 12 - 13° conchoidal planes some scouring.

No obvious carbonac. laminations.

0-0.035m Olive grey to dark greenish grey 5Y 4/1 to 5GY 4/1, very fine silty chloritic mst. with very fine flecks of organic material, grading into muddy very very fine slst. Thin and very thin bedded and laminated. The colour banding is due to the differentiation between the darker "mst." and lighter 'slst'. Irregular cracks are infilled with mud.

Slight X bedding, burrowing, load casts.

Occasional units with scattered green grey very fine lithics and less so quartz in the very fine slst. beds.

Overlain by a black-greenish black band of heavy min. rich fine - medium 'Otway' sst. Black grains are magnetic, vitreous reflection; 2% orange brown 'FeO' grains.

0.035-0.485m Dark greenish grey (5GY 4/1) sst. - fine grained and with a clay/silt matrix.

25 - 30% darkish green grey lithics and some chlorite ang-s.ang.

10% cement slst/clay white to off white.

2% accessories - orange brown iron oxide grains., bt, chlorite, micas, coal fragments, soft waxy chlorite.
62 - 58% quartz or felds - white to pale green grey, fine grained, ang. to s. ang. transl./transp., uneven dimpled surfaces (possible 15-20% of % total could be silt quartz), good poros./perm., non calc.

0.485-0.57m similar to 0 - 0.035, banded - laminated silty chloritic slightly carbonac. mst., waxy trace, with interlams. very very fine slst. Lams as thin as 0.5mm, some evidence of slumping.

The slst is generally well std. with the occasional less std. interval with chlorite flakes, med. green grey very fine lithic grains.
Again the base of the O'lying sst. is prone to enrichment in heavy minerals.
Dips of 5° or less.
0.57 - 0.67m fine sst as for 0.035 - 0.485m.
0.67 - 0.725m 95% thin beds, very very fine slty chloritic. mst. with finely dissem. carbonac. matter and 5% very thin lams of very very fine slst. Dips 4-5°: increasing to 8° at the base.
0.725 - 0.79m fine sst.
0.79 - 0.965m thin beds,very fine muddy slst silty mst. with lams of very fine slst. Some ints. of X bedded very fine sandy slst. with muddy slst. lenses. Dips to 10°. Occasional thin bed 1.5cm of very fine sandy slst. and slst., with probable bioturbation (burrow channels).

Dips are shallow 5-10° but often at 90° to each other due to X bedding.

CORE 6.

719.43-722.75 Rec. 3.12m core

Moderate hard, slightly friable in parts, dark greenish grey 5GY 4/1.

Base - 0.6m. sandy/muddy chloritic slst, slst, muddy slst, < (75%), 10% fine - very fine sst. at times muddy or silty, and chloritic mst.(15%). Thin to very thin bedded with occasional discontinuous carbonac. laminae. The bedding planes are conchoidal suggestive of ripple marks, scouring, probable biaturbation, some fine X bedding and graded beds.

The chloritic mst. is frequently discontinuous (burrowings?)

Dip directions are constantly changing (X bedding at work) with dips of 20° & 14°. The fine sst. is well std. and with little silica cement.

55-35% green grey grains - moderately hard lithics, sub angular.

38-58% quartz - pale green and white ang. to s. ang., fine grained, transl. Occasionally transp., uneven dimpled surfaces, very poor sphericity. 2% coaly fragments black polished hexag, heavy minerals, muscovite/chlorite, occasional orange brown grains.

5% white silica cement. Good - very good poros/perm.

The silt is more quartzose (than the fine sst.) having only 10-15% green grey grains, more chlorite mica, fragments of coal, occasional black shiny heavy mins, some white silica cement/blebs. Soft green grey waxy chlorite grains - pale green grey and dark green. Possible biotite, blebs of soft off white? Kaolin. Grain size is quite variable from very very fine - co. The chloritic mst. is often slightly silty with larger quartz or green grey lithic grains.

Carbonac material tends to be softish, honeycombed and sub vitreous.

0.6-0.9m Interbeds to 8cm of silty fine and very fine sst. (25%), fine sst (75%) with 10-15% white silica cement; slight conchoidal carbonac. laminae/lenses (discontinuous) dip at 8° with dips in varying directions - X bedding, chloritic mud tends to be associated with carb laminae.

The silty very fine sst. has 45% - 55% green grey lithics/ chlorite, 10% very fine silica silt cement, 43-33% quartz, 2% col grains, carbonac. matter, kaolin, pale green waxy chlorite, bt./chlorite.

O/lying fine sst. truncates silty very fine sst. bed with a s. rd. chloritic mst. granule at boundary.

sst. - 40-55% green grey lithics.

10-15% white silica cement.

2% accessories (including orange grains, carb., soft waxy chlorite).

48 - 28% quartz - pale green grey, white, (as for description above).

Good-very good poros./perm. Top of this interval dips at 22° and has thin beds of coarse-granule grains of chloritic mst., s.rd. with a pale pink kaolin cement.

0.9-0.96m ill std. very coarse to boulder/cobble cgl-with a slty fine sst. (Otway Gp) cement.

Very coarse grains to cobbles - 30% reworked elongate to S.rd. (occ. s.ang) chloritic mst., occasional light brownish grey (5YR 6/1) carbonaceous fine slst. Pale orange pink Kaolin (30%) and a cobble (6cm x 1.5cm) of kaolin with 40% coarse-very coarse grains of chloritic mst. - srd. mainly. These grains are occasionally fractured and infilled with the kaolin, rare quartz? and secondary pyrite.

crystals mainly associated with the chloritic mst., coal fragments.
One kaolin pebble has very fine carbonac. laminae (discont.)

Possible dips of 25°, on poor imbricate bedding.
Upper surface of cgl. is irregular without a sharp boundary (no unconf).

0.96-3.1m very fine to fine sst. and silty sst., thin to medium bedded (with beds up to ? 20cm) with intervals (particularly 2.9 to 3.0m) of carbonac. laminae and discontinuous carb. lenses/laminae. General bedding is likely to be sub horizontal 5° with other dips on ? X bedding or ripples at 22°

Sst. - 10-15% white silica cement.
30-40% green grey lithics chlorite.
2% accessories (fine carb. fragments, waxy chlorite, coloured grains, musc, chlorite,? kaolin blebs.

Quartz 58-43% (probably a little high - silt is probably 15% in all). Very fine - fine, ang. to s.ang., white to pale greenish, transl./transp. low spher., uneven dimpled surface.

Rare framboidal pyrite, occasional calcareous concretionary blebs/patches that are slightly harder than the core and may have more chloritic cement. Fair poros/perm.

3.10-3.12m very fine sdy slst. - laminated of carbonac chloritic slty mst. X bedded with max. dips of 11°. (Probably ripple marking as the beds are conchoidal downwards).

CORE 7.

819.77-821.78 Rec. 2.0m

0 - 0.3m claystone/mst. (dark greenish grey 5GY 4/1) to muddy very very fine slst. - the core is slightly grainy. Bedding is medium - thick.

0.30-0.38m silty very fine sst. to sdy slst. - lt. olive grey to olive grey (5Y 6/1 - 5Y 4/1) thin - very thin bedded with occasional claystone lams/lenses.
The bedding is irregular with some X bedding.
Sst. - 78% quartz - white, clean, transl./transp, angular to sub angular. 15% palè green gray grains of lithics chlorite.
15% pale green grey grains of lithics chlorite.
5% mud clay.
2% traces of carbonac. fragments, bt./chlorite, cuticular fragments.

0.38-0.58m Interbeds of clayey slst, silty fine sst., lenses of slst, the bedding has variable parting and is of shallow dip 3-4° (max. 5°) some probable load casting, small scale X bedded, squeeze features, scouring.

General suggestions of bioturbation - vertical burrows up to 2mm diam. 5.5cm long (good). Occasional flat carbonac. fragments.

0.58-0.86m predominantly a slty very fine sst. with discontinuous slightly clayier wisps suggesting thin bedding. Good poros/perm. 79-74% quartz - A/A 10-15% green grey grains lithics chlorite.

10% white silica very fine silt cement.
1%? very small fragments of carbonac. material, chlorite/bt.
Possibly near vertical burrow or rootlet, infilled with white powdery silica, other near vertical burrows.
Occasionaly more silty interbed to 1cm thick.

0.86-1.06m erratically bedded interval of muddy slst. slst. sdy slst.
Thin beds, lams and lenses. Truncation of bedding (small scale X beds) burrowing 1.5mm across and ellipsoidal in cross section (1.5mm).

1.06-1.30m laminated interval of muddy slst.
Generally sub horizontal - horizontal dipping (3°) with occasional X beds to 22° dip.
Load casting, occasional burrow, probable quiet deposition with ripple marks, occasional moderately hard calcareous concretion to 4cm x 3cm x 1cm (olive grey to olive black 5Y 4/1 to 5Y 2/1).

1.30-1.315m Interval truncated abruptly at top by 1.5cm of carbonac. fine sst. with a silic. powdery silt cement.
Very good porosity/perm. 15-5% cement, occasional col. grain. 20% green grey grains, some 'quartz' grains are felds, up to 1% black vit. heavy minerals, occasionally with crystal planes. The sst. has scoured the u/lyng unit.

1.315-1.40m muddy carb very fine slst with lams of slst. and muddy slst.
At base - green chloritic mst. granules and pebbles - s.ang. and srd. Also occur within the mst. (reworked ? occ rd.)
Some scouring at top occasional thin elongated carb fragments 2mm x 30mm.

1.40-1.73m slightly silty very fine sst. with white powdered silica cement and waxy (irregular) discontinuous laminations of coarse carbonac 5% matter (honey combed/spongy, very finely ribbed).

The core is moderately friable, broken and with fairly good poros/perm.

74 - 79% quartz as before.

10 - 15% green grey lithics/chlorite.

5% Carb matter.

10% cement.

1% Col grains.

1.73m - Top, thin bedded slst. with wispy carb. lams. and occasional muddier lams - irregular dipping at 12°. Rhythmic thin beds broken by coarser slst. lams/lenses or finer slst. intervals. Occasional chloritic mdst. patches, blebs. Accessories, chlorite, carb. fragments, orange 'FeO' grains, cuticular matter (3 x 1mm), waxy chlorite grains. Carb. lams comprising fragments 12 x 3 to 2 x 0.5mm of carb. material. Non calc. except for the concretion.

CORE 8.

Core 917.18 - 919.40m Rec 1.14m

Thin bedded and laminated (65%) muddy or sdy slst. and 30% very fine silty or muddy sst., 5% muddy very very fine slst. - and usually in 2 - 3mm leands. The core has consistent, very thin broken bands or laminations of carbonaceous material. Mainly light olive grey 5Y 6/1 and olive grey 5Y 4/1.

Base 0 - 0.12m ill defined bedding im muddy slightly sandy slst some evidence of bioturbation.

0.83-0.92m similar to 0.2 to 0.35m, ill defined bedding with load casting/squeezing.

0.92-1.05m slst. with well defined slightly wavy laminations to very thin beds. Some small scale X bedding with good dips of 8-11° and fair parting on carbonac. rich lams (fine leaf fragments only).

1.05-1.08m similar to 0.5 - 0.68m, microfaulting, scouring load casting.

1.08m Top, v. fine silt. sst. with occasional muddy slst. wavy v. thin bed/lam., vertical burrow? to 1.2mm diam.
The core shows some poor to medium poros./perm. in the silty very fine sst., less so in the silty portions.
It is moderately hard and non calc.
The very fine sst. is a typical 'Otway Group' type.

CORE 9.

1016.91-1019.33m Rec 0.2m
All broken fragments.
CHIPS

(1) 55% slst. - very very fine with disseminated specks of biotite/chlorite and organic matter. Trace infilled with fram. pyrite. These chips are usually cracked.

(2) 45% Fine slst. and sdy slst. - very fine quartz grains, 0.75mm, larger carb. frags, 10% of grains are green grey lithics with some soft waxy chlorite; traces of bt./chlorite mica. Occasional

mst. angular inclusion. Chip with carbonaceous lams.

(3) One chip of vein mineral - dark yellowish orange, very calc. hardness 5, white scratch.

It is possible that these pieces may not be insitu., largest pieces 2 x 2 x 1cm or 4 x 2 x 0.5cm.

CORE 10.

1117.23-1118.85m Rec 1.52m

age - 0.29m, - easily scratched core, sdy slst. to fine silty sst. - light olive grey to olive grey (5Y 6/1 wet - 5Y 4/1); thin to medium bedded with occasional more prominent coaly lams that dip to 9° and are rarely continuous.

Some evidence for slight X bedding.

slst. - sst. 55-45% white soft cement, grains - very fine slst.
15% green grey grains, chlorite ? lithics feldspar.
28-38% quartz - white clear, ang-s.ang, in range 0.05 -0.01mm transl./transp, low sphericity.
2% other - carb. fragments, ? biotite, chlorite, mica, pale green grey waxy chlorite.

At base blebs (to 2mm) of pale green grey chloritic waxy mst. - probably infilling burrows - ovoid shaped or elongated roughly paralell to bedding. Bioturbation, carb material to 8mm on long axis. Top of this interval has drill chatter marks.
Very slightly calc. low poros/perm.

0.29-0.43m Core has roughened exterior (drill chatter) coarsening in grain size - probably a silty fine sst. -

- with less cement than above 30% and an increase in fine quartz to 50% along with some slst. (10%) and 10% green grey grains; carb fragments etc. (bt. chlorite) occasional carbonac. mst. claystone bands.
This sst. is a typical Otway Group sst.
Interval is marked by the presense of thin slightly darker coloured very thin beds to bands of carb/lithitic claystone with occasional waxy chlorite.
Claystone infilled burrows paralell to probable bedding (bioturbation again). This sst. is quite calcareous - fine calcite grains in the cement. The the top of the inverval more carb. and clayey bands dip at 3° (good).

0.43m to top — Thin bedded and with laminations (occ. wispy)/interbeds. 16cm of slty claystone, 73cm slst. 20cm very very fine silty sst. Very irregular bedding with possible pull aparts and squeeze type structs, minor X beds, load casts, common around 1m. Pale brown to medium brown patch 4cm x 2cm of fine sdy. slst. with small blebs and arched lenses of white slightly waxy non calc. material. The slst. is calc. One arched lense at top of patch comprises soft non calc. material transp and crystalline. The shape is similar to a ½ bivalve shell 3cm long. Occasional int to 2cm of muddy slst. with claystone blebs - bioturbation. This part of the core is quite carbonac. with leaf fragments on bedding planes.
Occasional vertical traces of rootlets.
Some load casts displace the underlying sands 2cm upwards.
This upper portion of the core is non calc. poor poros./perm.

CORE 11.

1194.13-1196.93 Rec 0.43m

8cm of coal.

Base 0 - 8cm - 7.5cm of brownish black (5YR) lignite - slightly silty or grainy, low density, hard, with 5mm lams, augen lenses, lenses of black vitreous coal. The lams are discontinuous, split etc, spherical conchoidal fracture with parallel fractures (cracking). The lignite leaves a waxy trace when scratched. ? leaf impressions - 23mm wide, 0.8mm thick with parallel main ribbing.

Vitreous coal lams are probably all associated with this leaf-frond, occasional patches of very closely fractured vit. coal - referred to in earlier SWC's as honey combed/spongy carbonac. matter. Moderate soft. Occasional en echelon short very thin (0.1mm) cracks infilled with soft white granular material - non calc. Trace of framboidal/ dissem. pyrite on top of leaf impression. Trace resin, biotite/ chlorite/muscovite beneath one vit. coal leaf. The leaves are sub horizontal to horizontal parallel to bedding above.

8 - 43 (Top) Thin bedded and laminated slst. 90% and fine sst. 10% with occasional lam, of vit. black coal. Shallow dips 3-4°. Thin beds are wavy and show some scouring, occasional X bedding in sands, bed surfaces are non planer - irregular and the bedding sequence indicates frequent lithofacies changes with slight increases/ decreases in mud/sand etc. Rare vertical carbonac. matter.

Slst. - fine grained olive grey (5Y 4/1 wet), carbonac. 1%, chloritic 1%-2%, biotitic and with cuticular material. Occasional white very fine blebs - grainy non calc. (seen in the sw cores) occasional quartz to 0.1mm.

Trace pyritic slst. Carb. matter mainly less than 1mm on long axis. Occasional brittle pale green grey waxy chlorite lense - vertical.

Sst. - very fine grained slight off white (dry), (light olive grey to olive grey 5Y 6/1 (wet) - 5Y 4/1) grains 0.05 - 0.1mm, 40-35% soft white silty matrix, 10-20% pale green grains - lithics, chloritic grains etc., 39-42% quartz clean, white trans./transp., ang. - s.ang., uneven surfaces - dimpled, accessories, mica biotite chlorite, carbonac. fragments, orange grains, waxy pink ? kaolin. Very poor poros./perm.

CORE 12.

1286.70 to 1290.68m Rec. 0.5m of larger pieces of core (2 - 18cm long) and an additional 15cm of broken pieces.
Probably a medium bedded pebble and cobble conglomerate with medium - thin beds of silty biotitic very fine to fine sst with about 5% medium quartz grains. This biotitic sst is similar to the hornfels, - no garnets, finer and less biotite. The sst has biotite rich lams. No chloritic mica or waxy chlorite seen. This bed dips at 55° to the horizontal and is truncated at the top by a cgl bed (pebs 1 to 3-4cm) whose base dips at 25°, cementing material in the overlying cgl. is a slightly coarser grained biotitic silty sst. often medium grained and with coarser biotite and occasional grain of pale green waxy chlorite.

Pebbles/cobbles are mainly subangular occasional elongate/flat and sub round to round 2-5% is white quartz pebbles, cracked.

40-45% biotitic silty sst - similar to the cement, fine-medium grained and with varying amounts of pale-med green fine

chloritic mica. Randomly orientated with the long axis not always parallel to the base of this bed.

15-20% biotitic silty very fine sst. similar to the underlying bed.

43-30% cement as noted above.

No sign of garnet from the underlying metamorphics.

Underlying the biotitic silty fine - very fine sst. bed is a pebble to cobble cgl.

5-10% quartz pebbles - mainly cracked.

35% fine - medium biotitic silty sst.

15% slst with medium sized 'grains' of biotite and occasional garnet.

10% very fine-fine biotitic silty sst.

35-40% cement silty medium sst. with fairly coarse biotite, some chlorite mica.

(NOTE: The 'biotite' throughout is a dark greenish brown and may be dark chlorite not bt.)

The cgls. have scoured the underlying beds occasionally with deep sharp scours. At least one probable fine - very fine biotitic silty sst. int. has some medium green chlorite, and a 0.5mm quartz vein or very clean lam.

Traces of waxy chlorite (pale green).

Garnets are not common only 2 seen.

Occasional broken pebble of white - off white very fine - fine sst. no bt./chlorite, hard.

Quartz pebbles 2 x 3cm ? originally from a thick quartz vein but now part of the broken up cgls.

Quartz grains are white clean, transp./transl., angular/subangular, low sphericity finely uneven surface.

Fair porosity/permeability, non calc. except for the occ. calcite vein.

Note by G. Walker - some of the pebbles described here as biotitic f.g. sandstone are rock fragments of mica schist.

CORE 13.

1335.6 - 1336.9m Rec 1.2m

Biotite hornfels - (black when wet) with garnets. Very hard to hard, generally grains are silt sized with probably 5% being medium to coarse grained.

Scattered hard pale transparent grains to 0.4mm are garnets and make up 1-3% of the core (common).

The biotite may make up 10-25% of the core - usually occurs as books with random orientation.

Quartz is transparent and the grains are usually silt sized and appear shattered/fractured/angular.

The core has thin 1.5mm quartz veins at 50° to the vertical and tends to split along very fine 0.3mm more sinuous and less planer calcite veins at 85° to the vertical.

The quartz vein has rare dissem pyrite and is oblique at 30° to the core. This basement is a source of garnets for the Pretty Hill sst.

Parts of the core appear to have less biotite and garnets. Darker patches are more biotitic, usually sub-spherical 1-1.5cm. One fracture plane is a pale green - due to chlorite with the calcite.

There is faint biotite banding at 60-65° to the vertical suggesting thin to very thin bedding with biotitic laminations.

NOTE: the SWC at 1311m is a biotite hornfels.

APPENDIX 3:

APPENDIX 3. SIDE WALL CORE DESCRIPTIONS.

HOTSPUR 1 - SIDE WALL CORES

1.	200.0
2.	208.2
3.	212.0
4.	216.5
5.	221.8
6.	227.5
7.	244.0
8.	262.0
9.	269.4
10.	311.4
11.	361.0
12.	409.5
13.	466.1
14.	500.2
15.	540.0
16.	573.0
17.	601.0
18.	644.0
19.	662.5
20.	690.5
21.	745.5
22.	776.0
23.	798.7
24.	837.4
25.	851.3
26.	874.3
27.	955.7
28.	975.0
29.	1005.5
30.	1037.5
31.	1038.5
32.	1070.5
33.	1073.0
34.	1106.5
35.	1138.5
36.	1162.5
37.	1185.0
38.	1205.0
39.	1230.0
40.	1260.3
41.	1275.0
42.	1294.3
43.	1311.0

HOTSPUR 1 Sidewall Core Descriptions

1. 200m Rec, 30mm

Olive grey 5Y 4/1, soft but firm, no bedding seen.

Silty mst. (90%), 10% silt grains (scattered), finely micaceous, occ. pale green waxy chlorite glauc?/grains, occ. carbonaceous fragments generally flattened, occ. bleb or lens of soft (darker green) clean slst/very fine sst., (transp. occ. transl. grains). Traces of mica, chlorite. Occ. irreg. shaped rather nobbly aggregates of very fine soft non calc white grains - occ. assoc. with branching pipe like features with darker centre (0.5mm diam in all). Aggregates of framboidal pyrite (quite common). The clean silty patches suggest bioturbation, along with sinuous framboidal traces.

Conchoidal fractures, probably associated with impact.

Poor poros/perm., slight H_2S odour on addition of 10% Hcl.

Appears non calc.

Rare soft/rotten arenaceous cyclammina with framboidal pyrite inside the test.

2. 208.2m Rec 39mm

Hard to very hard, no bedding seen (possibly 8° dip on resin lams.)

Black, brownish black and olive black (N1, 5YR 2/1, 5Y 2/1)

Mudstone - hard waxy chloritic with 30% limonite type oolites, occ. chloritic and scattered qtz (2%)grains (C-V.Co) and fragments of angular reddish brown (resin) grains. The chloritic mst. is waxy to scratch and has anastomosing very thin white veins - non calc. The veins are very finely granular/silty.

On breaking core the mst. is quite angular and could be pebbly.

Qtz grains occ. up to granule size.

Traces very fine pyrite/arsenopyrite occ. assoc. with the lim. nods., lenses of red brown resin to very thin resin laminations.

Oolites soft and generally without qtz centres. occ. med-co. srd.,

Qtz - grains seem to be ang.-s.ang. off white to pale brown coloured, prob. transl. Grain surfaces are usually mud cement coated and difficult to clean. The surfaces (very few observed) are uneven with occ. pitting on granules, sli. grainy finish. Occ. white calc grains.

3. 212m Rec. 27mm

Mod. hard. black N1. No Bedding.

Sdy & slty mst. to muddy silty sst. - black firm chloritic mst. silty mst. & muddy slst. in parts with 10% oolites - dark green brown limonitic and dark green chloritic type, dull polished surfaces, usually sub spherical to elongate,

0.2 to 1.5mm diam. soft.

20% mst. is firm waxy to scratch, sli., slickensided on breaking - seems slightly spongy when pressed. Occ patches of mst. but generally infills matrix.

10% slst.

60% sst. - ill std. fine to granule/pebble grained. Insitu the grains are pale brown coloured, subangular, transluscent and with solution troughs/etching on the larger grains. Grain surfaces are all smooth but uneven, dimpled:

Approx. 35% granule/pebble, 35% co. v.co. 30% fn. - med.

Patch of xtal. pyrite assoc with the qtz.

Trace of chloritic mica.

Fine angular dark red brown grains (resin?) are common - mainly fractured?

Good poros./perm. Prob. Calc.

Washed grains:

Off white rarely stained.coated/coloured. Surfaces are mainly uneven dimpled 30% occ. etched/deeply grooved (Co. grain size). The grains are more dimpled more uneven tending to etched/grooved

Few grains are coated by the mud cement or chlorite. (base of pits/grooves). Translucent tending to opaque, sub angular to occ. angular edges, very low sphericity.
Of sample from scrapings 15% med., 80% Co., 5% V.co.
Very similar in general appearance to 216m, darker in colour muddier and less obviously colitic - oolites are less weathered or more chloritic. Trace of chloritic mica. Oolites seem to have chloritic centres and often limonitic outsides, or are wholly chloritic.
White grains (finely granular) are calc.

4. 216.5m Rec. 16mm
Mod hd. no bedding prob. sli. friable.
Brownish black/greenish black 5YR 2/1 - 5G 2/1
Muddy sst. - sli. std., similar to 221.8m but with brittle chloritic mst. cement (30%), limonitic with 5-10% polished lim. nods. oolites and limonitic flat broad 'plates' occ. elongate and sausage like.
The sst. is mainly co. grained in the range medium to granule/pebble.

V. co. 10%
gran./pebb. 2 - 5%
med. 15%
Co. 65 - 70%
Grains are lim. stained and the pebbles are etched, unwashed grains show mod. polish and grain surfaces are smoothly uneven and dimpled grains are ang.-s.ang. or srd.
One clast pale-med. yellow limonite is finely striated a ? replacement.

Poor poros./perm. mod. calc.
Washed sample grains -
5% coloured (mainly finer fraction)

95% Occ. white (not stained as in 221.8 above), occ. with slight coating of limonite remaining. Transl, with up to 40% being fairly transparent, angular to s.ang.
Occ. s.rd. with uneven (not smooth) grain surfaces that are optically dimpled.
Co.-V.co. grains show some etching and infilling with chloritic mud. Very low sphericity 10-15% may be fn.- v. fn qtz. poss, silt.
Trace of chlorite mica.
These grains are different to 221.8m.
Limonite oolites are rare in the washings (no qtz centres). Some fn grained? chlorite, dark black green oolites.
Trace bright orange grains.

5. 221.8m Rec. 34mm
Friable, mud invasion, no bedding.
Dusky yellow brown to dusky brown 10YR 2/2 - 5YR 2/2
Muddy sst. - med. to very Co. with 10%-15% polished limonite coated qtz. grains (oolite in shape), with 25% mst./clay cement - dark yellowish brown 10YR 4/2. Probably 15% of qtz is very Co, s.ang-s.rd., polished and coated with limonite, All unwashed qtz. grains appear to be stained/limonite coated.
20% med. grained, 65% Co. grained, sli. calcareous.
Grains - 98% stained and coloured pale brown, stain is limonite and dark mdy. limonite, translucent to transp., sub angular to sub round (occ. angular) with polished undulating (pressure solution) surfaces - smooth, very rarely pitted or etched, occ. dusted with pale green grey chlorite.
Generally low sphericity.
Subspherical limonite oolites have qtz. grains as centres.
The mst has a mod. v. fn. silt component.
Occ. soft white granular aggregates.
Occ. calcite grains.

6. 227.5 m Rec. ?30mm

Friable, mod. yellowish brown to dark yellowish brown 10YR 5/4 - 10YR 4/2.

Mud invasion in this sst. core.

Sandstone - sli. std., medium grained to granule (Co.-V.co.) with the qtz. grains being pale brown coloured, ang. - rd., mainly s.rd.-s.ang.

Grains are slightly coated with brown ? organic matter.

Traces of carbonac. fragments and possible limonite, grey chloritic mud.

Qtz - slightly off white only 20% of grains are stained.coated or coloured, coating is dark brown - probably limonite.

15% fine - very fine to medium, 5 - 10% granule, 3 - 5% grit and 70 - 77% Co and V.Co. grained.

Grains are ang.-s.rd. mainly s.ang., transl. or transp.

Grain surfaces are dull with undulations, occ pitting/etching/ grooves with coating of limonite. Some grains show mild polish on corners (mainly co.-v.co).

One elongate pebbly grain 7.5mm x 3mm (well stained).

Generally low sphericity. Occ. chlorite coating/dusting.

Traces of polished lim. nods., and up to 10% qtz. silt occ. lim. nod./spherule to 0.125mm, limonite at times coats the grains.

Black grains prob. heavy mins. or tourmaline - not coal.

7. 244m Rec 37mm

Soft but firm, no bedding seen.

Brownish black 5Y 2/1.

70% mst. - grains waxy scratch, with 2% glauc/chlorite (med green), 5% - 30% qtz. - fn. - med grained, 1% carbonaceous fragments. - very poor spongy type (honey combed). Trace chlorite mica; muscovite is mod. common. Trace framboidal pyrite in sands and mud .

30% lenses/blebs/patches of whitish clean very fn. sst.-slst., carbonac. and chloritic (waxy).
Clean sst. patches/blebs/lenses are suggestive of bioturturbation.
Qtz. - in the lenses very poor 0.075 - 0.15mm, clean white angular occ. s.ang, transl. to transparent with occ. grain of waxy chlorite. Grain surfaces appear to be dimpled. - occ. conch. fractured.
Mod poros./perm. non calc.

8. 262m Rec. 37mm
Firm to mod hard, no bedding, black N1
Sandy slst. - dark grey, black with glauconitic oolites/nodules 10-15% (dark green - darker green than chloritic 'nodules' in 269.4) and with finely dissem? coaly (spongy) black fragments, books of chloritic mica, muscovite.
Qtz. 25 - 35% mainly fine - med. angular, clean tansp./transl. Trace of brown cuticular material. Trace of framboidal pyrite associated with glauc. and qtz grains. Traces orange grains - 'iron oxides'? Glauc. nods. - fairly angular, occ s.rd. and frequently with uneven surfaces.
Occ. more muddy or more sandy patches.
Poor poros./perm, non calc.
Qtz. - ang. - s.rd., clean (occ. coated with glauc./chlor. mud) white transp. or transl., surfaces are slightly conchoidal, uneven, dimpled occ. fractured. Mainly fn. - med. rarely co. - etched very uneven surface.
Some ribbed carb. fragments. Different qtz. type to 262m. No fossils seen.

9. 269.4m Rec 35mm

Mod. hard to friable

Greenish black and brownish black (5GY 2/1 + 5YR 2/1)

No bedding seen.

50% mst. + 45% slst. - mainly an oolitic nodular mudstone, with scattered qtz.

5% - 10% grains to 1 - 1.2mm. and fn. blotchy prob. weath. slst. cement.

The mst. oolites/nodules/fragments are s. round, occ with an angular interface, usually 0.5 - 1mm diam. up to 2mm. Dark green grey, waxy prob. chloritic, slightly polished, and set in a cement of blotchy pale yellow to green-brown finely granular slst. Scratch marks suggest some carbonac. presence (blackish/brown streaks) in the slst, and fine black fragments can be seen.

Occasional larger mst. fragments 3 x 6mm.

Clearly a reworked weathered mixed source, Otway Gr product along with ? upper Creta qtz. grains and occ. prob. Otway Gp. slst. grits to pebbles.

Poor poros/perm the slst in mod calc.

Could be considered to be a micro cgl with chloritic mst & qtz grains held together with fn. slst cement.

Grains -

? Dolo. slst. - 6mm x 7mm very well rounded, clearly reworked greyish brown, 5 YR 3/2, v. calc.

granule of same material & very co. grain (fractured).

Qtz. - 20% granule., 10% Co., 70% v Co.

Chloritic mud adheres to grains, mainly s.ang. transl., white to off white with 5% being pale yellow brown, grains freq. etched/grooved/pitted, surfaces are uneven and irregular. dimples rarely smooth or polished.

Pitting infilled with chloritic mud and silt with a trace of medium brown material poss. organic.

10. 311.4m Rec. 30-35mm

Friable - soft, no bedding

Olive black to greenish black 5Y 2/1 - 5GY 2/1.

A lot of drilling mud invasion.

Sst - fine - medium grained, friable and with 5%-10% very fine silt to clay matrix/cement.

35 - 40% qtz. ang. - s.ang rarely s.rd. clear, or stained, not coated, white transp. and transl, grain surface relatively smooth (but microscopically uneven) slight conchoidal, commonly as a result of fracturing.

50-45% lithics - olive grey and dark grey to black, pale yellow green.

Angular to s.rd. dimpled surface sli. grainy appearance, may include waxy chlorite grains, lithics vary in hardness and are hard to rel. soft (weathered).

1 - 3% orange granular aggregates/grains iron oxide.

5 - 10% cementing material very fine slst/clay.

0 - 7% Other - very fine grains, tourmaline? poss. carb. fragments, micaceous chlorite, soft white very fn granular aggregates.

Non Calc.

High poros/perm.

Occ. pyrite cemented sst. nodule to 4mm diam., very hard.

11. 361m Rec 43mm

Thin bedded with the occ. carbonac lam dips 13°, medium grey to medium dark grey (N5 - N4)

82% clayey very fine slst. - slight waxy trace, scattered (dissem) carb. fragments up to ½ - 1%, occ. chlorite mica, poss. very fine muscovite, occ. pale orange iron oxide 'grains'.

Carbonac. matter forms boundary between the above and claystones.

This material is irregular to slightly laminar and with framboidal pyrite.

Scattered off white blebs.

Waxy olive green chlorite 'grains' common.

Poor poros./perm., non calc.

18% claystone - waxy to scratch, very sli. grainy, very finely dissem carb. material often present as fine needles. Probable chlorite/ muscovite, occ.

orange iron oxide 'grain'.

Poor poros./perm., non calc.

12. 409.5m Rec 43mm

Thin bedded with dip 13 - 14° (fair only).

Mod hard to hard.

Medium grey N5 with touch of olive grey 5Y 4/1.

95% claystone - waxy scratch, v. sli slty & with the occ. qtz. grain to .1mm.

Scattered coaly (spongy) fragments, occ. thin coaly lense, finely dissem. muscovite, chlorite flakes and waxy chloritic grains.

5% slst. - fine grained, rather similar to above with increased coaly fragments, larger chloritic mica flakes. Occ. grey white rather wispy v. thin slst. lense. Qtz. grains - ang. s. ang. clean, white transl - transp, in range 0.1 to 0.05mm.

Carbonac. layer separates the claystone from the slst. - the carbonac. material is faintly ribbed, uneven.

sli. por./perm., non calc.

13. 466.1m Rec 41mm

Thin bedded with occ. coal lams. dip 20°, good parting.

Olive grey 5Y 4/1.

Mod hard.

Approx. 40% clayey very fine slst./silty claystone & 60% sli. clayey slst.

Silty claystone or clayey very fn. slst. - waxy scratch, small amount of very finely dissem. organic (coaly) material, trace biotite chlorite mica, iron oxide, mod. por./per., non calc.

Sli. clayey slst. - grain size 0.075 - 0.05mm with larger fragments of honey combed coaly material, irreg. aggregates of orange iron oxide.

10% Grains may be green grey lithics.

Qtz. - ang. to s.ang. clear, white, transl. or transp., uneven surfaces mainly present as fragments, uncommon on bedding planes, except in coal lams. occ. lense to 0.3mm thick.

High poros/perm., non calc.

14. 500.2m Rec 26mm

No bedding Seen.

Dark greenish grey 5GY 4/1.

Mod Hard.

Sli Clayey slst. - fn. grained (finer than above), 3% chlorite/ biotite and occ. musc. also with occ. pale orange 'iron oxide' grains. Scattered larger fragments of black coal ? (1%) and small grains of waxy (1%) ? chlorite.

Coal - irreg. dimpled surf., ofen ribbed, occ. vitreous, occ. 'chloritic' clay patch in the slst. aggregate, often irreg. shaped angular profile.

Coal frag. 7mm x 5mm x 3mm

Mod. poros/perm. non/calc., sli H_2S odour on addition of 10% HCl.

(One nodule of ferrug. fn. - med sst. - not insitu).

15. 540m Rec. 39mm

Dark Greenish Grey 5GY 4/1,

Mod. hard no bedding.

Fine sandy slst., up to 20% is pale green grey lithics or waxy soft chlorite. Fragments of organic matter, 'grains' of orange iron oxide, flakes of chloritic mica.

Generally well std. and without a waxy trace some clay cement infilling grain matrix (20-30% ?).

Grains - Qtz. (+ feldspar) white angular - s.ang, transluscent occ.

Fair poros./perm. non calc.

Occ. Carb. fragements show ribbed crosssections, some medium brown cuticular matter. Definite increase in pale orange 'grains' - aggregates.

Rare lense of waxy dark green grey chlorite.

16. 573m Rec 42mm

Thin bedded occ. lam., dipping 3° (some x bedding present in the slst.) fair parting, mod. hard.

60% silty claystone - waxy when scratched, dark greenish grey 5G 4/1 & with finely dissem. carbonac frags. chlorite mica, muscovite, rootlet traces or vert. carb. frag., or poss. burrow vertical to bedding 1mm diam with poss. some framboidal pyrite.

40% clayey fine slst. - dark greenish grey 5GY 4/1.

Sli. waxy when scratched, laminated with interbeds of more clayey slst. to slty claystone.

In parts the slst. is very clean and well std. with occ. pale gn./ gr. waxy chlorite grains; traces of possible iron oxide grains.

Qtz. - 0.05 - 0.075mm, ang. - s.ang. clean white transl./transp.

Evidence for some bioturbation in slst, burrows in the claystone. to 0.08mm diam., usually near vertical to bedding but occ. oblique.

Note; Carb frags less evident on the slst. partings than before.

Fair poros./perm. in the slst., poor in the claystone, non calc.

17. 601m Rec 40mm

Thin bedded with some laminations. Mod hard. Cleaner silty lams dip at 15° (good)

Dark greenish grey 5G 4/1 - 5GY 4/1.

Clayey slst. 65% - med. grained sli. std. (co & fine fraction) & 20% clean slst. (pale gn. gr.) with 20% slty claystone (darker grey), fine scattered carb. frags, with occ. mica chlorite/bt. & waxy grey gn. chlorite, traces of orange 'iron oxide', brownish black rootlet like? lenses. The core has laminations/bands of cleaner (less fines) slst. with fair to good parting & with bt./ chlorite flakes paralelling bedding, occ. larger carb. fragment that show ill defined undulating ribbing.

Slst./clayey slst. - 10% of grains prob. lithics & up to 5% may be soft chlorite; brownish cuticular matter is common.
The core has a more waxy trace when scratched, hence, the clayey slst. nomenclature. Fair poros. & perm. in the silty portion, less so in the clayey slst. & slty claystone portions, non calc.
Qtz. ang. - s.ang. white clean, transp/transl.

18. 644m Rec 38mm
Mod hard, occ. carb. lense (leaves?) dips 15°
Dark greenish grey (5G 4/1 - 5GY 4/1).
Mst./claystone - sli. grainy with occ. black carb. frags. & more common brownish woody fragments. Occ. chlorite mica flakes. Some cuticular material. Freq. v. small leaf frags. central rib 6mm wide poss. paralell veins.
Occ. v. closely ribbed leaves, waxy trace.
Poor poros./perm., non calc.

19. 662.5m Rec. 35mm
Soft to mod hard, no bedding, Mod. fractured main core.
Medium bluish grey to dark greenish grey (5 B 5/1 - 5G 4/1).
Claystone/mst. - sli. grainy & with waxy scratch; finely dissem. carb. frags/flecks, traces of cuticular material, waxy gn. grey chlorite, traces of org. 'iron oxide', mica chlorite occ. organic rich, sli. waxy 'planes' rare white v. fn. granular aggregates. Minor drilling mud invasion along fractures. Occ. small conchoidal slickenslide.
Rare shiny ? slickensided flattened cylindrical shapes may be fossil traces. Poor poros./perm. poss. sli. calc., H_2S odour.

20. 690.5m Rec 39mm
Mod. hard, no bedding, dips on carb. frag. 8 - 10°

Claystone - mst., waxy scratch, sli. granular - trace of finely dissem. carbonac. material. Flakes of chloritic mica. (tends to crack on drying).
Freq. white granular aggregates to 0.15mm non calc.
Framboidal pyrite replacing carbonac. rootlet ? - lense.
Larger carb. frags. are finely ribbed.
Poor poros. & perm., non calc.

21. 745.5m Rec 38mm
Mod firm to hard, possible dips at 13° on carb. lam.
Approx. medium dark grey with touch of green N4.
98% claystone/mst, very slightly slty (v.v. fn.), waxy scratch, - with ½% of very finely dissem. carbonac. material, occ. irreg. carb. lense with accompanying framboidal pyrite (prob. rootlets).
Occ. slickensided surf. 2% areas of clayey/sandy v.v. fine slst.
Traces of brown cuticle material.
Poor poros. & perm., non calc.

22 776m Rec 38mm
Firm, possible bedding on coal lam. dipping 20°, medium bluish grey to dark greenish grey 5B 5/1 - 5G 4/1. Slst. (grains 0.075mm) with occ. wavy carbonac lams occ. bifurcating Claystone/mst. patches around periphery of core & occ. between the coal lenses (undulating mst. surf)
Grains 85% qtz/felds. 15% lithics and olive grey grains.
Carbonac. material 1%, Traces of pale orange 'iron oxide' blebs/grains.
Qtz. - clear-transp.-transl., s.ang. to ang. not coated.
Traces of chloritic mica & musc. & freq. med brown cuticular matter.
Occ. black coal lense to 0.1mm thick.
Trace of pale to med. gn. grey waxy grains - chlorite (secondary weath. volcs).
Larger black carb frags are closely ribbed.
Fair to poor poros & perm., non calc.

23. 798.7m Rec - chips only.

(1) 85% claystone/mst. Occ. finely dissem. carb. material

(2) 15% slst. - chloritic mica, frags. or carb. material occ. qtz. grain to 0.25mm - s.rd. clear transp., mod. dimpled surf.

24. 837.4m Rec 42mm

Dark greenish grey to olive grey 5GY 4/1 - 5Y 4/1

Mod hard and with no bedding seen.

Claystone mst. - waxy scratch, very very sli. silty and with a trace of v. finely dissem. carbonac. material and poss. mica chlorite. One limonite coated semi spherical cast to 0.2mm.

Poor poros. & perm., non calc.

25. 851.3m Rec 43mm

Mod. hard, dark yellowish grey 5GY 4/1

Sli. mdy. fine slst. (sli. waxy to scratch) with some evidence of X bed. or slumping (infilled scour?) dipping at 60°. Some fine flame - type structs. 1% - ½% - finely dissem. carbonac./organic matter, traces of lithics, cuticular matter, bt./chlorite, waxy chlorite, rare iron oxide. Occ. qtz. grain to 0.1mm.

Waxy chlorite forms occ. fine lenses, the organic matter is at times wavy. Mod. poros. & perm., weakly calc. in parts only.

26. 874.3m Rec 35mm

Hard - mod. hard. Olive Black 5Y 2/1.

Claystn./mst. to v.v. fine slst. - waxy when scratched, trace of v. finely dissem. organic matter, chlorite flakes, rare pale orange brown iron oxide.

The core shows conchoidal slickenslides prob. from impact. Irreg. polished lumpy structures (slickened) may be due to impact or poss. a sed. feature

Fracture planes cut across longitudinal axes of core.
Some poros. & perm., non calc., no bedding seen.

27. 955.7m Rec 33mm
Soft. White to light grey (N9 - N7).
Slst - very soft & weathered with up to 45% white cement/matrix (clay or silica?). 20% silt sized grains are lithics - dull grey green. Qtz. - white, transl./transp. ang. with dimpled surfs. 0.1 - 0.075mm diam. occ. grain to fn. size (1mm).
The slst. is sli. carbonac. (v. fn. fragments) & with a trace of chlorite/bt. & soft waxy chlorite, traces of 'off white' grains.
Rare pale orange grain - iron oxide.
Poor poros. & perm., non calc. to v. weakly calc.
Various chip not insitu.
One ferrug. nodule to 4mm.

28. 975m Rec 38mm
Greenish grey to dark greenish grey 5G 6/1 - 5G 4/1
Fine sdy. slst - with fine carbonac. frags. & traces of brown cuticular matter and occ. flakes of chlorite & muscovite.
Larger 'qtz.' grains may account for 40-45% of the slst. the remainder is fine qtz. matrix/cement.
'Qtz.' - poss. 5% is grey lithics; qtz. clean, grainsize 0.075mm transl. occ. transp. ang. - s.ang. rarely s.rd., dimpled uneven surf. Generally well std. but with varying amounts of more clayey matrix/cement.
Traces of pale green waxy chlorite.
No waxy trace when scratched.
No bedding.
Fair poros. & perm., non calc.

29. 1005.5m Rec 27mm

Dark greenish grey 5GY 4/1

Hard to mod hard, no bedding seen.

Claystone to clayey v.v. fine slst. - traces (½%) finely dissem. carbonac. meterial & flakes of chlorite/bt., sli. granular texture, prone to conchoidal fracturing (poss due to impact). Very slight mud invasion presumably along cracks.

Scattered grains of off white material - very fine qtz.

Poor poros. & perm. very weakly calc.

30. 1037.5m Rec 20-22cm

55% olive black 5Y 2/1 45% light grey N7.

2 pieces of core with chips

Laminations of mdy slst. cleaner slst. & occ mst. patches, tending to a slty very fine sst., with black, sli waxy distinct carbonac. lams. - (2% - 4%) dips 10°, fair parting only.

Traces of mica flakes, soft waxy grey green chlorite, biotite/chlorite carb. material - thin wide fragments 3 x 6 mm & o.1mm thick.

The slst. is poorly std. and prob. has 30-40% claystone cement.

The black carbonac. frags. are finely ribbed (at 0.2mm intervals)

Pale green grey 'lithics' may account for 25% of slst. grains.

Qtz - ang. - s.ang. transl./occ. transp. clean, uneven surf. prob a fair proportion of 'carb' matter is brown cuticular material.

Off white grains - prob. very fine silica.

Rhythmic depositn. with rapid changes in environment mud/silt/mud silt etc.

Poor poros. & perm., non calc.

31. 1038.5m Rec - chips only ??? insitu.

(1) 43%, dark yellowish brown 10YR 6/2.

sli. sdy. slst. - hard & with a thin band of organic material, micaceous,

well cemented, trace framboidal pyrite & xtal. pyrite, chlorite.
Qtz - clear, transp./transl. ang. - s.ang, uneven surf.
Sli. calcareous - cementing material
Poor poros. & perm.
Unable to determine of this chip is insitu.

(2) 41%, very fn. slst. with rippling, waxy lenses of organic material/ chlorite, frequent off white grainy aggregates 0.05mm & less.
Patches of pale green grey claystone; finely dissem. carbonac. material.

(3) 8%, Greyish black (N2) mst., (waxy scratch) with cuticular material, carbonac. frags & the occ leaf? impression (ribbed).

(4) 2%, Co. grained slst (50% Qtz) to v. fn. sst. with very fn. qtz. cement, trace dark green waxy chlorite, trace iron oxide & carb frags.
Qtz. - 0.1mm. ang - s.rd. transl./transp. prob. uneven surf. poss.
30% as lithics.

(5) 2%, coarse slst. with pyrite, chlorite mica, carb. frags.

(6) 2%, slst. - with waxy rippling chlorite flakes or carb. flakes; occ. pink 'grains' (poss. orange).

32. 1070.5m Rec - Chips only ? insitu.
Barrel buckled & chipped prob. due to pyrite accumulations.

(1) 8mm nodule of 80% pyrite xtals with 20% silt sized qtz. grains and a small 'fragment' of black brown coaly organic matter.
The nodule is v. hard & well cemented with the pyrite.
Qtz. grains, clear clean white transp./transl. angular to sub ang. dimpled surfaces.

(2) Chips of sli. carbonac fine slst. The carbonac. frags are finely disseminated.

(3) Chips of carb. & chloritic (mica) coarser slst. prob. insitu (med dark grey to dark greenish grey N4 - 5GY 4/1).

33. 1073m Rec. 35mm

Laminated with dips 3 - 5° Good parting

Medium grey to medium dark grey N5 - N4, hard.

80% lam. sli. muddy v.v. fn. slst. with 20% interlaminations of slst.

½% very thin discrete lenses/flakes of carbonac. matter up to 3.0mm long. Rare carbonac. frags/blebs. Traces of brown cuticular material & muscovite; 1% chlorite/bt. Rare pale orange 'grain' of iron oxide.

Soft brown waxy lense of organic matter 0.2mm

Mod. waxy trace in the mdy. v.v. fn slst.

Qtz. grains white transl./transp. ang - s.ang. no coating, & with mod. uneven surfs.

Trace soft waxy pale green chlorite.

The slst. lams. are mod. srd. & with silica cement.

Fair poros. & perm. non calc.

34. 1106.5m Rec. 31mm

Colour as for 1138.5m

Hard claystone/mst. to v.v. fn. slst. - trace of finely dissem. carbonac. material & chlorite flakes.

Waxy trace when scratched. Occ nodules of more muddy or clayey lithol. to 0.5mm - generally sub round but occ. elongate & flattened prob. a deposit feature.

Trace framboidal pyrite & brownish cuticular material.

Prob. med - co. claystone balls, the pyrite is associated with them. No evidence for them being fossil casts, Copralites, or burrow infilling.

If horizontal then dips would be in the order of 15° - 20°.
Poor but definite por. & perm. weekly calc.
No bedding seen other than the 'nodules'.

35. 1138.5m Rec 33mm
Hard, dark greenish grey to dark greenish grey (5G 4/1 to GY 4/1).
Muddy v. fn. slst - with v. fine fragments of carbonac. matter, flakes of ? biotite & chlorite; waxy trace when scratched.
No bedding seen but poor alignment of ? biotite/chlorite suggests possible dips in order of 10°.
Occ. white grain aggregates ? very fine silica.
Trace of muscovite, trace of pale orange iron oxide.
Fair porosites/perm., non calc.
Note the finely disseminated chlorite & carbonac. material suggests deposition a long way from source.

36. 1162.5m Rec 35mm
Brownish black 5 YR 2/1.
Mod. hard to firm.
The core is quite fractured with some slickensiding.
No bedding seen. - lams. from the carb. material dip. ? 5°.
Mst. - 1% wavy lenses/flakes (freq. very thin) of carb. material, possible biotite & cuticular material. Waxy trace on scratching.
Definite impact fracturing & slicks. in the mst.

Non calc., poor poros. & perm.
Possibility of some drilling mud invasion along occasional facture planes.

37. 1185m Rec 18mm
Shattered core, 18mm. of med. to Dk. grey (N5 - N4), Mod. hard, sli
(0 - k%) carb. mdy. v. fn. slst. waxy when scratched sli. biotitic

brittle when fracturing. The core has frequent fractures. (Possibly due to impact).
Weakly calc, very poor poros. & perm.

38. 1205m Rec 40mm
Mod. hard, olive grey 5GY 4/1 with possible bedding on a mst. band dipping 25 - 28° (poor definitn. & not supported by the bt. & chlorite)
Muddy slst. to silty mst. - with flakes (tr - 1%) of bt. & chlorite & occ. black carbonac. fragments to 0.1mm. Occ. fn. qtz. grains - transl. to transp., clear, white, sub ang. and with uneven rough (closely dimpled/pitted) surf.
Generally similar to 1230m.
Occ. insig. band (to 1mm) of brownish black soft mst. sli. waxy (rather like a root infill but too planer) & mod. fractured.
The core is sli. calcareous & with poor poros. & perm.
Trace of med. green soft waxy chlorite & iron oxide.

39. 1230.0m Rec 23mm (Good Core)
Mod. hard, Med bluish grey to dark greenish grey (5B 5/1 to 5G 4/1).
85% slst. - (30 - 40% of grains 0.03mm, the remainder are much finer).
1% flecks of carbonac. meterial & flakes of bt./chlorite possible musc.
15% silty mst. with bt./chlorite flakes & very thin int. of carbonac/ coaly material. The mst./mdy. slst interval has much less carb. matter than the slst.
The core is prob. thin bedded & the thin carbonac. int. suggests shallow dips 3 - 5° at the most. This is supported by faint banding of v. thin - lenses of mst. & mdy slst.

Traces of iron oxides.
Slight porosity/perm. non calc.

40. 1260.3m Rec 10mm prob. insitu.

Mod. hard, large 'chips' - fragments only, no bedding.

Med. grey to med. dark grey N5 - N4.

Slst. - Lt grey with flakes of chlorite & bt. well std. Occ flakes of blk. carb. material - trace to 1%; - carb. frags. mainly 0.025mm the slst is sli. muddy in part with mud in the matrix. Trace of pale green waxy chlorite & framboidal pyrite. Sli. porosity & perm., non calc.

Smaller chips may not be insitu these include:-

silty mst. - sli. greenish grey, & with less bt./chlorite & carb. flecks than above.

Slst - sli. coarser grained than above with bt./chlorite & carbonaceous material, waxy pale to med. green chlorite.

slst. - dark yellowish brown (10 YR 4/2), mod calcareous & sli. carbonac. (not a dolomite).

41. 1275m Rec ? 20mm

Core is fractured/crumbly poss. infiltrated with some drilling mud. Some slickensiding.

Silty mst. - brittle-waxy when scratched. Soft to mod. hd. & hd. (depending on fracturing) sli. blotchy, sli carb. dusky yellowish brown to brownish black (10 yr 2/2 - 5 yr 2/1).

The mst is sli. grainy or silty or traces of v. fn. aggregates of black vitreous coal. 1 - 3% carbonac. clasts, & muscovite, or flakes of ? chlorite.

Prob thin bedded with carb. layers dipping around 10°.

Poor porosity & perm., non calc.

42. 1294.3m Rec 17mm

Mod hd. med. bluish grey 5B 5/1 to dark greenish grey 5 G 4/1. Slst - 50% with up to 5 - 10% thick books of chlorite (Similar to 1311m)

with fractured and split weathered qtz. 50% pebbles ? 1 - 2cm diam.
The lithology could well be a pebble silt conglomerate.
The chlorite "books" could well be sub parallel.

Beds of applegreen chlorite.
Split/fractured qtz - ang. clear, transp. fn. - co. grained Chlorite flake 4 x 2mm x 0.3mm thick.

Moderate porosity & perm. in the slst. non calc.

43. 1311m Rec. 10mm
Chips of very ? biotitic slst. to v. fn. sst. with occasional qtz. grains to 0.5mm. 70% med. grey qtz. N5, 30% grey black (wet) N2 olive green/black (dry)
? Biotite may be plagioclase/amphibole, some lineation in the xtals
? Hornfels. One chip with a trace of ? insitu pale green chloritic mud. Spots/blebs of white Kaolinitic material. One chip, Dk greenish grey (5 G 4/1) Chloritic mst. - waxy trace. Insitu ?? prob. contamination with a fern like frond impression.
Stem thickness 0.7mm fronds 1.4mm long.
Trace of med grey waxy shale and slst. biotite/chlorite flakes.

Biotite V. fn. sst. is mod. hd. - hd.
Chloritic mst. is firm and easily scratched.

FINES
Qtz - sub ang. to ang. clear./transp. occ. fractured giving transl. appearance clean with no adhering matrix or coating.
95% v fn to silt sized, 5% med/coarse sized.
Books of bt. are plentiful ? 30% in all.
Occ. chip pale green chloritic mud and white opaque grains (Silica/ Kaolin?).

Qtz chips granular and with no discernable cement - silica. Prob. v. little porosity & no permeability.

Note the qtz. grains are still distinct

APPENDIX 4:

APPENDIX H FORAMINIFERAL ZONE DETERMINATIONS.

HOTSPUR 1 by Dr C Abele

9 m
cuttings

June '83

Orbulina (incl. bilobata)
Praeorbulina glomerosa
Globigerinoides trilobus

Globigerina woodi
" praebulloides
" foliata
" angustiumbilicata
" juvenilis

Globoquadrina dehiscens
Globorotalia praemenardii
" peripheroronda

early Mid Mio
11 = suturalis (universa) Z

HOTSPUR 1

15 m
cuttings

June '83

Orbulina (incl bilobata)
Praeorbulina glomerosa
Globigerinoides sicanus
" transitorini
" trilobus
Globigerina woodi
praebulloides
foliata
angustiumbilicata
juvenilis
Cassigerinella chipolensis

Globoquadrina dehiscens
Globorotalia praemenardii
" praescitula
" peripheroronda

Heterolepa victoriensis

early Mid Mio
11 = suturalis (universa) Z

HOTSPUR 1

30 m
cuttings

June '83

Orbulina
Praeorbulina glomerosa
Globigerinoides sicanus
" transitorius
" trilobus
" subquadratus
Globigerina woodi
praebulloides
angustiumbilicata
juvenilis
Catapsydrax chipolensis

Globoquadrina dehiscens
Globorotalia praescitula

Heterolepa victoriensis

early Mid Mio
11 = suturalis (universa) Z

PLE NO.		HOTSPUR 1	Geological Survey of Victoria MICROPALAEONTOLOGICAL LABORATORY
'72- 75 m		Rock Type	
al	cuttings	Geological Information	
y		Collected by	
tic			

—	Signature	Date
Inspected		
Washed	W	Oct '83
Polished		
Sectioned		
Slides G	C	

al Description of Fauna

Orbulina
Praeorbulina glomerosa
Globigerinoides sicanus
transitorius
trilobus
subquadratus
Globigerina woodi
praebulloides
[illegible]

Globoquadrina dehiscens
Globorotalia bella

Occurrence	For.	Ostr.	Bryoz.	Echin.	Moll.	Other.
Abundant						
Common						
Rare						

Preservation

Lithology

Age early Mid Mio
11 = sutural[is] (universa) Z

Determined by: Date

169/54

PLE NO.		HOTSPUR 1	Geological Survey of Victoria MICROPALAEONTOLOGICAL LABORATORY
	138 m	Rock Type	
ial	cuttings	Geological Information	
ity		Collected by	
ati			

—	Signature	Date
Inspected		
Washed	W	Oct '83
Polished		
Sectioned		
Slides G	C	

ral Description of Fauna

fauna is largely similar to 75 m s'ple;
however, it includes fairly common Guembelitria samwelli and Bolivinopsis cubensis indicating Oligocene, not Miocene;
contamination of reworking?

Occurrence	For.	Ostr.	Bryoz.	Echin.	Moll.	Other.
Abundant						
Common						
Rare						

Preservation

Lithology

Age probly Late Oligo
5 = euapertura Z

Determined by: Date

8469/54

APPENDIX 5:

Appendix 5

Palynological Report on samples from the Green Banks 1 and Hotspur 1 wells.

Samples from the Beach Petroleum well Green Banks 1 and the DM&E Well Hotspur 1 were examined for palynological dating at the request of Beach Petroleum.

The wells are located in the onshore portion of the Otway Basin, approximately north-east of Heywood, Victoria.

The zonation scheme used is that of Dettmann 1969 in "Palynological Zonation of Lower Cretaceous Sediments of the Otway Basin, Victoria", S.D.A. Report R 1817 (Unpublished).

Samples have been assigned to Subzones, and where possible, to Units, on the basis of the above Zonation Scheme.

A species list for each sample is included in Attachment A.

Vivienne Archer
PALYNOLOGIST

9/6/83

Report on Samples from the Green Banks 1 and Hotspur 1 wells

Results

GREEN BANKS 1

TYPE	DEPTH (M)	LITHOLOGY	CONFIDENCE RATING	SPORE-POLLEN ZONE	AGE
SWC	454.0	Carb. silty clay	0	T. longus Zone	Maastrichtian
"	569.5	"	2	C.paradoxa Zone : D.filosus unit	Middle Albian
"	755	"	1	"	"
"	812.0	"	1	"	"
"	1155.0	"	1	C.hughesi Subzone	Late Neocomian - Aptia
"	1195.5	"	2	"	"
"	1207	Coal	1	"	"

HOTSPUR 1

Core	319 - 321	Sandy mudstone	1	C.striatus Subzone	Early Albian
SWC	409.5	"	2	"	"
"	776.0	"	2	"	"
Core	917-919	"	1	"	"
SWC	1138.5	"	1	C.hughesi Subzone : Rouseisporites reticulatus unit	Early Aptian

CONFIDENCE RATING

0 = Excellent confidence ; assemblage with zone species of spores, pollen and microplankton.

1 = Good confidence ; assemblage with zone species of spores and pollen or microplankton.

2 = Poor confidence ; assemblage with non-diagnostic spores, pollen and/or microplankton.

ITTACHMENT A	WELL	GREEN BANKS 1							HOTSPUR 1				
	DEPTH (M)	454.0	569.0	755.5	812.0	1155.0	1195.0	1207.5	319-321	409.5	776	917-919	11
equitriradites spinulosus													
. verrucosus						X			X				
lisporites grandis		X	X	X	X	X	X	X	X		X	X	
similis				X	X	X	X	X	X				
mosipollis cruciformis		X											
raucariacites australis		X							X				
rcellites reticulatus				X									
aculatisporites comaumensis			X					X	X	X	X		
almeisporites holodictyus				X									
. tridictyus				X									
iretisporites spectabilis			X	X					X				
eaupreaidites verrucosus		C											
maro zonosporites amplus		X											
. ohaiensis		X											
ratosporites equ'is			X		X	X	X		X			X	X
icatricosisporites australiensis			X	X	X	X			X	X	X		X
. ludbrooki						X	X						X
. pseudotripartitus									X				
assopollis classoides			X	X	X	X	X	X	X	X	X		X
oksonites Variabilis								Cf.					X
ptospora paradoxa				X	X								
Sp. A Dettman 1963					X								
ybelosporites striatus			X						X			X	
stylosus									R/W		Cf.	R/W	
athidites asper				X	X	X	X			X			
australis			X	X	X	X	X	X	X		X	X	X

	WELL	GREEN BANKS 1							HOTSPUR 1				
	DEPTH (M)	454.0	569.0	755.5	812.0	1155.0	1195.0	1207.5	319-321	409.5	776	917-919	1138.
minor		X			X				X	X	X	X	
losporites hughesi						X							
tyotosporites complex							X						
filosus												X	
speciosus			X			X	X						
wynites granulatus		X											
tuberculatus		X											
minisporis asymmetricus				X	X				X	X	X		
lailyi			X				X						
vonthagqiensis							X		X		X		X
potriletes parviretus			X										
pierina edwardsii		X											
rudata		X											
pyrapollenites wahooensis		X											
gkocycadophytus nitidus			X		X	X		X					
cheniidites cercinidites		X			X			X	X	X			
ragacidites haloragoides									C				
harrisii		X	C										
osporites elliottii		X											
spollenites anguloclavatus		X											
osporites puncta s		X				X						X	X
isporites scaberis			X				X	X				X	X
isporites lunaris							X						
igatisporites ovatus					X				X		X		
olepidites major					X								X
errucatus					X	X	X						

WELL	GREENBANKS 1							HOTSPUR 1				
DEPTH (M)	454.0	569.0	755.5	812.0	1155.0	1195.0	1207.5	319-321	409.5	776.0	917-919	113
opodiacidites asperatus								X				
opodiumsporites austroclavatidites	X	X		x		x	x		x	x	x	
facetus						X						
odosus						X	X	X				
reticulumsporites												
istepollenites balmei	X											
florinii	X											
rocachyridites antarcticus		X				X	X		X			
raistrickia truncatus				X	X	X						
hofagidites heterus				C								
enectus	X											
amentifera sentosa	X											
undacidites wellmanii				X			X				X	X
visaccites catastus								Cf.	Cf.			Cf
iporopollenites polyoratus	X											
monolites densus	X											
llocladidites mawsonii								X				
reticulosaccatus	X											
osisporites parvispinosus									X			
notensis					X	X						X
locarpidites spp.	X	X	X		X	X	X	X	X	X	X	
losporites microsaccatus	X	X	X	X	X			X				
tracidites adenanthoides	X											
amolosexinus	X											
angulatus	X											
crassus	Cf.											

	WELL	GREENBANKS 1						HOTSPUR 1				
	DEPTH (M) 454.0	569.0	755.5	812.0	1155.0	1195.0	1207.5	319-321	409.5	776.0	917-919	113
latrobensis	X											
palisadus	X											
reticoloscabratus	X											
draplanus brossus	X											
iculatisporites pudens						X						X
seisporites radiatus			X	X								
reticulatus			X						X			X
simplex								X		X		
zosporis parvus			X			X						
reticulatus		X	X			X						X
plicepollice meridianus	X											
reisporites antiquasporites		X	X	X	X	X		X	X	X		
(Tripunctisporis) sp.	X											
racolporites verrucosus	Cf.											
colpites confessus	X											
gillii	X											
longus	X											
waiparaensis	X											
colporites lillei	X											
lobosporites trioreticulosus		X						X				
poropollenites sectilis	X											
gaepollenites dampieri				X	X					X		
trilobatus				X								
losporites triquetrus				X								

WELL	GREENBANKS 1							HOTSPUR 1				
DEPTH (M)	454.0	569.0	755.5	812.0	1155.0	1195.0	1207.5	319-321	409.5	776.0	917-919	1138.
OPLANKTON												
dinium conoratum	X											
hodinium hirsutum	X											

Cavings/contamination

= Reworking

APPENDIX 6:

APPENDIX 6.

PETROGRAPHICAL REPORT ON A BASEMENT CORE SAMPLE FROM THE HOTSPUR 1 DRILL HOLE, OTWAY BASIN

by W R H RAMSAY

UNPUBLISHED REPORT 1981/61

PETROGRAPHICAL REPORT ON A BASEMENT CORE SAMPLE FROM THE HOTSPUR 1 DRILL HOLE, OTWAY BASIN

Introduction

Deep drilling in the Otway Basin has recovered basement rock samples at a down-hole depth of 1335.59 - 1336.90 m (1245 m below sea level).

Location

The drill hole, Hotspur 1 (S1-S1-1), is located on the Coleraine map sheet, 7222, 1:100 000 approximately 1.5 km north-east of Hotspur. The collar grid reference is 508, 035.

Rock Type

In hand specimen the core fragment is a dark to very dark grey, finely crystalline, homogeneous, hornfelsed rock. A faint but distinct pinkish hue indicates the possible presence of biotite. A thin white veinlet cuts one side of the core.

Petrography

In thin section the core sample comprises granoblastic textured grains of quartz and minor cordierite together with prominent tabular to prismatic laths of red-brown biotite having a marked sieve texture and what appear to be pleochroic haloes. Thin randomly orientated small but numerous laths of muscovite are scattered along the grain boundaries in the granoblastic matrix. Prominent equidimensional porphyroblasts of garnet (? almandine) with internal sieve textured cores containing quartz inclusions are scattered through the section.

Fine grained accessories include tourmaline, apatite, sphene, opaque oxide, and possible minor zircon. Retrograde alteration of some of the biotites to a chlorite (penine) occurs.

Discussion

The rock represents medium to medium-high grade contact metamorphism of an original pelitic sediment. The presence of the indicator minerals quartz-biotite-muscovite-cordierite suggest that the rock has reached the medium grade amphibolite hornfels facies. Of note is the presence of almandine garnet which reflects the additional component MnO. Moreover the coexistence of cordierite + almandine reflects higher temperatures than normal for rocks of the amphibolite hornfels facies. Likely pressure-temperature conditions are in the region of 1 k bar - 550°C to 2 k bar - 600°C. The occurrence of such a sample is likely to be in the close proximity of an intrusive pluton.

APPENDIX 7:

APPENDIX 7. by AMDEL.

GEOCHRONOLOGY REPORT AND DATA

Sample No. VAD 88; TSC35538

Location: Hotspur 1 Bore, 1335.6-1335.9 m

ANALYTICAL DATA:

K-Ar

Constants: ^{40}K = 0.01167 atom%; λ_β = 4.962 x $10^{-10}y^{-1}$; λ_ε = 0.5811 x $10^{-10}y^{-1}$

Sample	%K	$^{40}Ar^*$(x 10^{-10} moles/g)	$^{40}Ar^*/^{40}Ar$ total	Age (x 10^6y)
Biotite	6.75 6.75	61.813	0.986	464

Rb-Sr

Constants: $^{85}Rb/^{87}Rb$ = 2.600; ^{87}Rb λ = 1.42 x $10^{-11}y^{-1}$; $^{88}Sr/^{86}Sr$ = 8.3752

Sample	Rb/Sr	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$

Age (x 10^6y): (1) ± (Assumed initial $^{87}Sr/^{86}Sr$ = 0.700)

(2) ± (Assumed initial $^{87}Sr/^{86}Sr$ = 0.710)

(3) ± (Initial $^{87}Sr/^{86}Sr$ from isochron =

PETROGRAPHY:

Rock Name:
Garnet biotite quartz hornfels

Hand Specimen:
A medium-grained gey coloured rock with no apparent fabric. The rock is essentially quartzo-feldspathic with some biotite. A recrystallised metamorphic texture is evident.

Thin Section:
This rock has an inequigranular granoblastic texture. Coarser-grained porphyroblasts of garnet (average 0.6 mm in diameter) and biotite (0.2 to 0.6 mm in length) are set in an equigranular matrix of quartz and muscovite (average 0.1 mm in diameter).

Quartz is the dominant mineral in this thin section, occurring as equant grains with polygonal grain boundaries and slightly undulose extinction. Muscovite occurs

with the quartz in the finer-grained matrix. It is present as thin elongate flakes in a rough parallel alignment which suggests a foliation.

Biotite is the major coarser-grained mineral, with its elongate flakes also having a rough parallel alignment coincident with the muscovite foliation. The biotite is commonly poikilitic with ragged grain boundaries and has numerous pleochroic haloes around zircon inclusions.

Garnet occurs as equant porphyroblasts which have irregular outlines. The garnet cores have abundant inclusions of felsic minerals, most likely quartz, and some opaques. Garnet rims tend to be free of inclusions.

Accessory minerals present include opaques, apatite, zircon and possibly xenotime.

The rock is a slightly foliated garnet biotite quartz hornfels. Despite its poikilitic nature the biotite is the most suitable material for K-Ar geochronology.

INTERPRETATION:

The poikilitic nature of the biotite separated implies a somewhat complicated metamorphic history. The calculated age however, is in good general agreement with other K-Ar ages determined on minerals from the Coleraine area (Richards and Singleton, 1981).

APPENDIX 8:

APPENDIX B. (from Beach Petroleum N.L.)

SPECIFIC GRAVITY ANALYSIS

Objective: To determine the presence of any density variation in the basement rock underlying PEP.107.

Procedure:

(i) Samples were obtained from the two wells in which basement had been penetrated and cored.

(ii) Specific gravities of the samples were calculated using the dry weight - wet weight method.

Results:

(i) Hotspur No. 1

S.G. = 2.78 ± 0.05

(ii) Moyne Falls No. 1

Sample 1. S.G. = 2.60
Sample 2. S.G. = 2.63 ± 0.05

Note: Top basement is 3080 ft. and the cored interval 3288-3308 ft. Therefore, the samples used for S.G. analysis represents the least weathered part of the Moyne Falls No. 1 basement available.

APPENDIX 9:

Re-issued Feb. 1981

DEPARTMENT OF MINERALS AND ENERGY

CHEMICAL BRANCH

5 PARLIAMENT PLACE MELB. VIC. 3002

Form No. 701

APPENDIX 9.

RM:MH
An JO,BS, 18/8
D R 27.7.81

BORE WATER ANALYSIS

Phone 651-9111 Ext. 1245
Telex: Minerg AA 36595

REPORT ON SAMPLE NO. 1959/81

21 September 1981

759/1

Bore 21/81/1

Sample: Bore Water

From Parish of Hotspur

Date Sampled - 2/6/81

Sender: C DeFina
Drilling Engineer
Dept. of MINERALS & ENERGY

Depth -

Aquifer level -

Static level -

Drawdown -

Aquifer type -

Yield -

Test type -

Bore cased to -

Position -

Owner/Address As above

Label No. -

Remarks Bailer sample D/S Sample 19

RESULTS: Total solids in solution by Summation		mg/litre (ppm) 906	me/litre
Chloride	(Cl)	283	7.98
Carbonate	(CO_3)	Nil	-
Bicarbonate	(HCO_3)	293	4.80
Sulphate	(SO_4)	30	0.62
Nitrate	(NO_3)	Nil	-
Calcium	(Ca)	63	3.14
Magnesium	(Mg)	20	1.65
Sodium	(Na)	201	8.74
Potassium	(K)	6	0.15
Iron-Total	(Fe)	2	-
Iron-Soluble	(Fe)	<0.1	-
Silicate	(SiO_3)	10	
Total hardness (as $CaCO_3$)		240	
pH		7.9	
Electrical Conductivity at 25°C		1400	microsiemen/cm

CHIEF CHEMIST

ENCLOSURE:

PE604467

This is an enclosure indicator page.
The enclosure PE604467 is enclosed within the container PE905875 at this location in this document.

The enclosure PE604467 has the following characteristics:

ITEM_BARCODE	= PE604467
CONTAINER_BARCODE	= PE905875
NAME	= Composite Well Log
BASIN	= OTWAY BASIN
PERMIT	= PEP/105
TYPE	= BOREHOLE
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Composite Log (enclosure from WCR) for Hotspur-1
REMARKS	= this report has no well number, it is a straigraphic well ; the bore was developed as a water well and completed as an observation bore
DATE_CREATED	=
DATE_RECEIVED	=
W_NO	=
WELL_NAME	= HOTSPUR-1
CONTRACTOR	=
CLIENT_OP_CO	= GEOLOGICAL SURVEY OF VICTORIA

(Inserted by DNRE - Vic Govt Mines Dept)