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Pacific Oil & Gas Pty. Limited

McARTHUR BASIN

EP33

1991 CTEM SURVEY

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Date: March 1992

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ONSHORE

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1 INTRODUCTION

Compensated Transient Electro-magnetics is an EM technique designed to identify resistivity changes at depth. It is considered a potential tool for the identification of resistivity anomalies associated with oil or gas accumulations.

Using stratigraphic control from an adjacent well, Elliott 1, and seismic coverage, a trial CTEM survey was carried out in EP33. Two soundings were made and this report briefly describes the equipment, procedures and results.

2 1991 CTEM SURVEY EP33

Two EM soundings were made adjacent to seismic line MA91-103 immediately to the north of Elliott 1 (Plan No. PetNTcw4556). Russian "IMPULSE 3" equipment was used in conjunction with a Zonge Engineering DC power supply (Plan No. PetNTcw4557). The transmitter waveform is shown in Plan No. PetNTcw4558. This is a step change in transmitter current with a short linear ramp, similar to that used in SIROTEM equipment. The decays were stacked for 50 complete cycles, corresponding to 100 step changes in the transmitter current. The raw data is given in Table 1. Note that these values are in microvolts and that they have not been normalised for the transmitter current of 20A. Voltages above 400,000 microvolts (0.4V) were truncated by the receiver preamplifier.

The soundings were interpreted using GRENDL, a computer program for modelling layered earth structures. The final models are given in Table 2, and the models are compared to the resistivity logs for Elliott 1 in Plan No. PetNTcw4559. The full output file of the inversions are given in Appendix 1.

Time (msec)	(MA91-103E, 2150) (Corr = 0.90 msec)		(MA91-103E, 2130) (Corr = 0.90 msec)	
	emf 1 (micro V)	emf 2 (micro V)	emf 1 (micro V)	emf 2 (micro V)
2.82				
3.16				
3.55				
3.98				
4.47				
5.01				
5.62	388000	388000		
6.31	350000	346000	372000	372000
7.08	293000	293000	325000	325000
7.94	238000	238000	268000	268000
8.91	189000	189000	216000	216000
10.0	147000	147000	170000	170000
11.2	114000	114000	133000	133000
12.6	85800	85600	101000	101000
14.1	64500	64500	76700	76700
15.8	47600	47600	57200	57400
17.8	34100	34100	41500	41500
20.0	24400	24400	30000	29900
22.4	17400	17400	21400	21400
25.1	12300	12300	15200	15200
28.2	8500	8500	10500	10500
31.6	5890	5890	7360	7360
35.5	4010	4010	5040	5040
39.8	2750	2750	3440	3440
44.7	1870	1870	2320	2320
50.1	1270	1270	1570	1570
56.2	872	872	1050	1050
63.1	595	597	713	715
70.8	410	411	484	484
79.4	285	284	326	326
89.1	200	199	224	223
100	140	141	155	156
112	100	99.9	106	107
126	70.9	72.0	76.5	76.5
141	51.9	51.1	52.6	53.6
158	37.6	37.3	39.6	40.3
178	26.9	26.8	26.6	26.3
200	20.0	18.6	19.4	19.0
224	13.4	13.8	14.5	14.7
251	11.2	10.1	11.0	11.7
282	7.91	7.69	8.16	7.75
316	5.60	5.51	5.92	5.26
355	4.19	4.80	4.32	3.46
398	3.25	3.83	3.34	3.31
447	2.63	2.35	2.26	2.90

Table 1: TEM Soundings - Raw Data

Sounding 2130		Sounding 2150	
Resistivity (Ωm)	Thickness (m)	Resistivity (Ωm)	Thickness (m)
19.8	43.9	19.6	42.4
1.5	70.9	2.0	86.0
218.4	667.9	205.6	524.5
51.9	214.0	50.5	201.5
7.6	∞	9.8	∞

Table 2: TEM Model Parameters

The upper 40m of the model corresponds to dry, relatively resistive Undifferentiated Tertiary and Cretaceous sediments. The conductive layer below this corresponds to similar material in the presence of saline ground water. The base of the sediments at 120m as interpreted from the gamma log for Elliott 1, is well mapped as the base of the conductive layer (115 or 128m).

Due to the large conductivity thickness product of the conductor, units below 120m are poorly resolved. The Tindall Limestone has a high resistivity, similar to that observed in EP18 to the north. The Proterozoic sequence immediately below the unconformity at 535m is not seen as conductive, suggesting an invasion of the sequence by fresh water from the overlying Tindall Limestone. The effective depth of investigation of the soundings is around 700 to 800m, considerably less than that achieved in EP18.

KEYWORDS

Petroleum, Geophys EM, Geophys Seismic, Drill Stratigraphic, Well Logs, McArthur Basin.

LOCATION

Beetaloo	SE5306	1:250,000
Walhallow	SE5307	1:250,000

DESCRIPTION

This report describes a trial Compensated Transient Electro-Magnetic Survey carried out over the vicinity of Elliott 1, EP33, Northern Territory.

Appendix 1

TEM Inversions, GRENDL Output File

GRENDL output for sounding at MA 91-103, 2130

INPUT DATA - WHOLE FILE

```
MA91-103,502,2130
2 0
5 33 2
20 3 200 50 10
50 100 500 200
250000 2 1
0.4 0.28 900
6.11 6.88 7.74 8.71 9.8 11.0 12.4 13.9 15.6 17.6 19.8 22.2
24.9 28.0 31.4 35.3 39.6 44.5 49.9 56.0 62.9 70.6 79.2 88.9
99.8 111.8 125.8 140.8 157.8 177.8 199.8 223.8 250.8
200000
1 0 1
0.01
0 0 10 1
18600 16250 13400 10800 8500 6650 5050 3835 2865 2075 1497.5 1070 760 525
368 252 172 116 78.5 52.5 35.7 24.2 16.3 11.18 7.775 5.325 3.825 2.655
2.00 1.323 0.96 0.73 0.5675
```

```
***************
*             *
* GRENDL DATA *
*             *
***************


 TITLE = MA91-103,502,2130
 ICASE = 2
  IDAT = 0
  NLIB =      5
MDELAY =     33
 INVERT =     2
    RO =      20.00         3.000         200.0         50.00         10.00
     H =      50.00         100.0         500.0         200.0
TXAREA =  0.2500E+06
  ITYM =      2
   IRX =      1
  TRMP = 0.400      TRISE = 0.280      OFFTYM = 900.0
   TMS =      6.110         6.880         7.740         8.710         9.800         11.00         12.40         13.90
              15.60         17.60         19.80         22.20         24.90         28.00         31.40         35.30
              39.60         44.50         49.90         56.00         62.90         70.60         79.20         88.90
              99.80         111.8         125.8         140.8         157.8         177.8         199.8         223.8
              250.8

  WTMS =    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00
            0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00
            0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00
            0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00
            0.0000E+00

THE DELAY TIMES ARE PRINTED FROM THE END OF RAMP TURNOFF TO CONFORM WITH THE EM37 CONVENTION.
RXAREA =  0.2000E+06
   IWH =      1
   IWZ =      0
  IBND =      1
   BND =    0.1000E-01
  NWTS =      0
 IHOLD =      0
   ITS =     10
 IPRNT =      1
     V =    0.1860E+05    0.1625E+05    0.1340E+05    0.1080E+05    8500.         6650.         5050.         3835.
            2865.         2075.         1498.         1070.         760.0         525.0         368.0         252.0
            172.0         116.0         78.50         52.50         35.70         24.20         16.30         11.18
            7.775         5.325         3.825         2.655         2.000         1.323         0.9600        0.7300
            0.5675


*****************************
*                           *
* INITIAL MODEL AND TEM DATA *
*                           *
*****************************


TITLE = MA91-103,502,2130

THE NUMBER OF LAYERS INCLUDING BASEMENT =  5
THE NUMBER OF DELAY TIMES =  33
THE FLAG FOR THIS RUN =  2


THE INITIAL MODEL IS
```

I	RESISTIVITY	THICKNESS	DEPTH
			0.0000E+00
1	20.00	50.00	
			50.00
2	3.000	100.0	
			150.0
3	200.0	500.0	
			650.0
4	50.00	200.0	
			850.0
5	10.00		

TRANSMITTER LOOP AREA = 0.250E+06 SQUARE METRES
RECEIVER LOOP AREA = 0.200E+06 TURN METRES SQUARED
RAMP TURN OFF = 0.400 MS. RISETIME = 0.280 MS. OFFTYM = 900.0 MS.

RAMP TURNOFF TIME WILL BE HELD CONSTANT DURING INVERSION PROCEDURE

THE INPUT DATA FOR THIS MODEL IS

I	DELAY TIME (MS)	OBSERVED APP.RES.	OBSERVED VOLTAGE (MU V)
1	6.110	3.252	0.1860E+05
2	6.880	2.980	0.1625E+05
3	7.740	2.946	0.1340E+05
4	8.710	2.963	0.1080E+05
5	9.800	3.028	8500.
6	11.00	3.098	6650.
7	12.40	3.201	5050.
8	13.90	3.315	3835.
9	15.60	3.450	2865.
10	17.60	3.623	2075.
11	19.80	3.813	1498.
12	22.20	4.046	1070.
13	24.90	4.292	760.0
14	28.00	4.611	525.0
15	31.40	4.901	368.0
16	35.30	5.264	252.0
17	39.60	5.674	172.0
18	44.50	6.136	116.0
19	49.90	6.633	78.50
20	56.00	7.207	52.50
21	62.90	7.724	35.70
22	70.60	8.293	24.20
23	79.20	8.948	16.30
24	88.90	9.519	11.18
25	99.80	10.03	7.775
26	111.8	10.71	5.325
27	125.8	10.98	3.825
28	140.8	11.63	2.655
29	157.8	11.63	2.000
30	177.8	12.57	1.323
31	199.8	12.82	0.9600
32	223.8	12.75	0.7300
33	250.8	12.48	0.5675

****
* *

```
* INVERSION OUTPUT *
*                  *
********************


NONLINEAR LEAST SQUARES
SECOND ORDER MARQUARDT WITH SINGULAR VALUE DECOMPOSITION
ITERATION LIMIT =  10


PARAMETERS ARE ORDERED THUS: RLSISTIVITIES FOLLOWED BY THICKNESSES
------------------------------------------------------------------

INITIAL STANDARD ERROR =    70.50     PERCENT
RELATIVE SINGULAR VALUE THRESHOLD (RSVT) =    0.100



ITERATION    1          ICNT =   0          RSVT =    0.100

THE NUMBER OF RELEVANT VARIABLES IS    6

CURRENT PARAMETER VALUES
     19.2        2.17        201.        50.4        10.3        42.7        111.        540.        205.

STANDARD ERROR =    14.57     PERCENT



ITERATION    2          ICNT =   0          RSVT =    0.050

THE NUMBER OF RELEVANT VARIABLES IS    6

CURRENT PARAMETER VALUES
     18.9        1.97        203.        50.7        10.4        35.6        91.7        571.        208.

STANDARD ERROR =    3.498     PERCENT



ITERATION    3          ICNT =   0          RSVT =    0.025

THE NUMBER OF RELEVANT VARIABLES IS    6

CURRENT PARAMETER VALUES
     18.9        1.88        205.        50.9        10.0        35.3        87.0        593.        210.

STANDARD ERROR =    2.878     PERCENT



ITERATION    4          ICNT =   0          RSVT =    0.013

THE NUMBER OF RELEVANT VARIABLES IS    6

CURRENT PARAMETER VALUES
     19.5        1.69        214.        51.6        8.21        41.8        78.6        653.        214.
```

STANDARD ERROR = 2.694 PERCENT

ITERATION 5 ICNT = 1 RSVT = 0.020

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.5	1.64	215.	51.7	7.98	41.7	75.7	655.	214.

STANDARD ERROR = 2.264 PERCENT

ITERATION 6 ICNT = 0 RSVT = 0.020

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.6	1.61	216.	51.8	7.84	42.3	74.2	661.	214.

STANDARD ERROR = 2.188 PERCENT

ITERATION 7 ICNT = 1 RSVT = 0.020

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.6	1.59	217.	51.8	7.74	42.8	73.1	664.	214.

STANDARD ERROR = 2.161 PERCENT

ITERATION 8 ICNT = 0 RSVT = 0.020

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.7	1.58	217.	51.8	7.67	43.2	72.2	666.	214.

STANDARD ERROR = 2.144 PERCENT

ITERATION 9 ICNT = 1 RSVT = 0.020

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.7	1.56	218.	51.8	7.63	43.6	71.5	667.	214.

STANDARD ERROR = 2.132 PERCENT

ITERATION 10 ICNT = 0 RSVT = 0.020

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.8	1.55	218.	51.9	7.60	43.9	70.9	668.	214.

STANDARD ERROR = 2.122 PERCENT

CONVERGENCE ON PREDICTED DECREASE - 10 ITERATIONS

ITERATION 10 ICNT = 0 RSVT = 0.020

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.8	1.55	218.	51.9	7.60	43.9	70.9	668.	214.

STANDARD ERROR = 2.122 PERCENT

****
* *
* FINAL MODEL AFTER INVERSION *
* *
****

MA91-103,502,2130

I	RESISTIVITY	THICKNESS	DEPTH
			0.0000E+00
1	19.75	43.86	43.86
2	1.549	70.88	114.7
3	218.4	667.9	782.6
4	51.86	214.0	996.6
5	7.603		

STANDARD ERROR = 2.12 PERCENT

NOISE TO SIGNAL RATIO = 0.316 PERCENT

****
* *

* ERROR STRUCTURE OF THE FITTED MODEL *
* FOR TEM DATA *
*
****

I	DELAY TIME (MS)	OBSERVED APP.RES.	CALCULATED APP.RES.	OBSERVED VOLTAGE (MU V)	CALCULATED VOLTAGE (MU V)	VOLTAGE ERROR WEIGHTED	WEIGHTED PERCENT SYMMETRIC ERROR	I
1	6.110	3.252	3.021	0.1860E+05	0.1955E+05	-951.2	-4.987	1
2	6.880	2.980	2.971	0.1625E+05	0.1629E+05	-37.67	-0.2316	2
3	7.740	2.946	2.965	0.1340E+05	0.1333E+05	68.55	0.5129	3
4	8.710	2.963	2.992	0.1080E+05	0.1071E+05	90.88	0.8450	4
5	9.800	3.028	3.041	8500.	8459.	40.66	0.4795	5
6	11.00	3.098	3.122	6650.	6598.	52.32	0.7898	6
7	12.40	3.201	3.221	5050.	5017.	33.17	0.6591	7
8	13.90	3.315	3.340	3835.	3802.	33.47	0.8765	8
9	15.60	3.450	3.479	2865.	2837.	28.35	0.9943	9
10	17.60	3.623	3.653	2075.	2054.	20.89	1.012	10
11	19.80	3.813	3.844	1498.	1482.	15.42	1.035	11
12	22.20	4.046	4.064	1070.	1064.	6.270	0.5877	12
13	24.90	4.292	4.305	760.0	757.0	3.041	0.4010	13
14	28.00	4.611	4.595	525.0	527.0	-2.015	-0.3831	14
15	31.40	4.901	4.900	368.0	368.1	-0.1427	-0.3877E-01	15
16	35.30	5.264	5.266	252.0	251.9	0.1431	0.5678E-01	16
17	39.60	5.674	5.648	172.0	173.1	-1.138	-0.6593	17
18	44.50	6.136	6.100	116.0	117.0	-0.9860	-0.8464	18
19	49.90	6.633	6.563	78.50	79.71	-1.209	-1.529	19
20	56.00	7.207	7.099	52.50	53.66	-1.161	-2.187	20
21	62.90	7.724	7.650	35.70	36.21	-0.5082	-1.413	21
22	70.60	8.293	8.261	24.20	24.34	-0.1391	-0.5732	22
23	79.20	8.948	8.856	16.30	16.55	-0.2507	-1.526	23
24	88.90	9.519	9.501	11.18	11.21	-0.3040E-01	-0.2716	24
25	99.80	10.03	10.09	7.775	7.701	0.7359E-01	0.9510	25
26	111.8	10.71	10.68	5.325	5.340	-0.1541E-01	-0.2890	26
27	125.8	10.98	11.19	3.825	3.718	0.1074	2.848	27
28	140.8	11.63	11.66	2.655	2.645	0.9998E-02	0.3773	28
29	157.8	11.63	12.00	2.000	1.908	0.9226E-01	4.722	29
30	177.8	12.57	12.32	1.323	1.364	-0.4120E-01	-3.066	30
31	199.8	12.82	12.49	0.9600	0.9990	-0.3903E-01	-3.985	31
32	223.8	12.75	12.62	0.7300	0.7418	-0.1178E-01	-1.601	32
33	250.8	12.48	12.65	0.5675	0.5563	0.1124E-01	2.000	33

MEAN PERCENT SYMMETRIC ERROR = 1.810
MAXIMUM PERCENT SYMMETRIC ERROR = 4.987
MAX. SYMMETRIC ERROR OCCURED AT OBSERVATION 1

****
*
* LAYER THICKNESS PARAMETER SENSITIVITY ANALYSIS *
*
****

1.00 0.137 0.971E-01 0.165E-01 0.682E-02 0.462E-03 0.187E-03 0.329E-04 0.713E-05

THE NUMBER OF EFFECTIVE PARAMETERS IS 4.059

PARAMETER SPACE EIGENVECTORS (V MATRIX)

	EP1	EP2	EP3	EP4	EP5	EP6	EP7	EP8	EP9
LOG(RES1)	0.037	-0.036	0.049	-0.079	0.114	-0.228	0.943	-0.188	0.008

LOG(RES2)	0.723	-0.298	0.261	0.375	-0.416	-0.080	0.010	0.006	0.000
LOG(RES3)	0.014	0.050	0.004	-0.119	0.062	-0.915	-0.171	0.335	0.014
LOG(RES4)	0.004	0.039	0.026	-0.033	-0.017	-0.156	-0.155	-0.552	0.802
LOG(RES5)	0.014	0.250	0.271	0.679	0.633	-0.028	-0.033	-0.009	0.003
LOG(H1)	0.053	-0.474	0.625	-0.450	0.399	0.091	-0.114	0.016	-0.001
LOG(H2)	-0.684	-0.273	0.390	0.345	-0.415	-0.106	0.050	0.002	0.000
LOG(H3)	0.066	0.711	0.538	-0.232	-0.267	-0.010	-0.028	-0.183	-0.202
LOG(H4)	0.018	0.197	0.154	-0.035	-0.077	0.245	0.203	0.717	0.561

DAMPING FACTORS (1.000 PERCENT LEVEL)

1.000	1.000	1.000	0.881	0.178	0.000	0.000	0.000	0.000

CORRELATION MATRIX

1	1.000	-0.376	-0.730	0.240	0.274	-0.968	0.397	0.004	-0.056
2	-0.376	1.000	0.748	-0.252	-0.506	0.133	0.693	0.012	0.041
3	-0.730	0.748	1.000	0.043	-0.312	0.587	0.231	-0.366	0.432
4	0.240	-0.252	0.043	1.000	0.821	-0.186	0.010	-0.942	0.914
5	0.274	-0.506	-0.312	0.821	1.000	-0.159	-0.267	-0.634	0.578
6	-0.968	0.133	0.587	-0.186	-0.159	1.000	-0.608	-0.014	0.056
7	0.397	0.693	0.231	0.010	-0.267	-0.608	1.000	-0.077	0.092
8	0.004	0.012	-0.366	-0.942	-0.634	-0.014	-0.077	1.000	-0.997
9	-0.056	0.041	0.432	0.914	0.578	0.056	0.092	-0.997	1.000

```
**************************************
*                                    *
* 'ERROR BOUNDS' FOR LAYER THICKNESS *
*                                    *
**************************************
```

LAYER RESISTIVITIES - 68 PERCENT CONFIDENCE INTERVAL (UNDAMPED)

I	RO(I)	BOUND(1)	BOUND(2)	IMPORTANCE
1	19.75	0.4903E-04	0.7956E+07	0.1019
2	1.549	0.9728	2.467	0.8913
3	218.4	UNBOUNDED		0.1179
4	51.86	UNBOUNDED		0.5613E-01
5	7.603	3.147	18.37	0.7119

LAYER THICKNESSES - 68 PERCENT CONFIDENCE INTERVAL (UNDAMPED)

I	H(I)	BOUND(1)	BOUND(2)	IMPORTANCE
1	43.86	11.14	172.7	0.8829
2	70.88	38.43	130.7	0.8903
3	667.9	UNBOUNDED		0.9186

4	214.0	UNBOUNDED	0.2527

```
**********************************************************************
*                                                                    *
* AVERAGE PREDICTED RESIDUAL ERROR (APRE) =    2.611     PERCENT *
*                                                                    *
**********************************************************************
```

GRENDL output for sounding at MA 91-103, 2150

INPUT DATA - WHOLE FILE

```
MA91-103,501,2150
2 0
5 39 2
20 3 200 50 10
50 100 500 200
250000 2 1
0.4 0.28 900
5.42 6.11 6.88 7.74 8.71 9.8 11.0 12.4 13.9 15.6 17.6 19.8 22.2
24.9 28.0 31.4 35.3 39.6 44.5 49.9 56.0 62.9 70.6 79.2 88.9
99.8 111.8 125.8 140.8 157.8 177.8 199.8 223.8 250.8 281.8
315.8 354.8 397.8 446.8
200000
1 0 1
0.01
0 0 10 1
19400 17475 14650 11900 9450 7350 5700 4285 3225 2380 1705 1220 870 615
425 294.5 200.5 137.5 93.5 63.5 43.6 29.8 20.525 14.225 9.975 7.025
4.9975 3.5725 2.575 1.8725 1.3425 0.965 0.68 0.5325 0.39 0.278 0.225
0.177 0.125
```

```
***************
*             *
* GRENDL DATA *
*             *
***************


 TITLE = MA91-103,501,2150
 ICASE = 2
  IDAT = 0
  NLIB =     5
MDELAY =    39
 INVERT =    2
    RO =     20.00        3.000        200.0        50.00        10.00
     H =     50.00        100.0        500.0        200.0
TXAREA =  0.2500E+06
  ITYM =     2
   IRX =     1
  TRMP = 0.400     TRISE = 0.280     OFFTYM = 900.0
   TMS =     5.420        6.110        6.880        7.740        8.710        9.800        11.00        12.40
             13.90        15.60        17.60        19.80        22.20        24.90        28.00        31.40
             35.30        39.60        44.50        49.90        56.00        62.90        70.60        79.20
             88.90        99.80        111.8        125.8        140.8        157.8        177.8        199.8
             223.8        250.8        281.8        315.8        354.8        397.8        446.8

  WTMS =  0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
          0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
          0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
          0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
          0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00

THE DELAY TIMES ARE PRINTED FROM THE END OF RAMP TURNOFF TO CONFORM WITH THE EM37 CONVENTION.
RXAREA =  0.2000E+06
   IWH =     1
   IWZ =     0
  IBND =     1
   BND =  0.1000E-01
  NWTS =     0
 IHOLD =     0
   ITS =    10
 IPRNT =     1
     V =  0.1940E+05   0.1748E+05   0.1465E+05   0.1190E+05   9450.        7350.        5700.        4285.
          3225.        2380.        1705.        1220.        870.0        615.0        425.0        294.5
          200.5        137.5        93.50        63.50        43.60        29.80        20.52        14.23
          9.975        7.025        4.997        3.572        2.575        1.872        1.342        0.9650
          0.6800       0.5325       0.3900       0.2780       0.2250       0.1770       0.1250


*******************************
*                             *
* INITIAL MODEL AND TEM DATA  *
*                             *
*******************************


TITLE = MA91-103,501,2150

THE NUMBER OF LAYERS INCLUDING BASEMENT =  5
THE NUMBER OF DELAY TIMES =  39
THE FLAG FOR THIS RUN =  2


THE INITIAL MODEL IS
```

I	RESISTIVITY	THICKNESS	DEPTH
			0.0000E+00
1	20.00	50.00	
			50.00
2	3.000	100.0	
			150.0
3	200.0	500.0	
			650.0
4	50.00	200.0	
			850.0
5	10.00		

TRANSMITTER LOOP AREA = 0.250E+06 SQUARE METRES
RECEIVER LOOP AREA = 0.200E+06 TURN METRES SQUARED
RAMP TURN OFF = 0.400 MS. RISETIME = 0.280 MS. OFFTYM = 900.0 MS.

RAMP TURNOFF TIME WILL BE HELD CONSTANT DURING INVERSION PROCEDURE

THE INPUT DATA FOR THIS MODEL IS

I	DELAY TIME (MS)	OBSERVED APP.RES.	OBSERVED VOLTAGE (MU V)
1	5.420	4.036	0.1940E+05
2	6.110	3.541	0.1748E+05
3	6.880	3.411	0.1465E+05
4	7.740	3.396	0.1190E+05
5	8.710	3.431	9450.
6	9.800	3.516	7350.
7	11.00	3.590	5700.
8	12.40	3.714	4285.
9	13.90	3.851	3225.
10	15.60	4.022	2380.
11	17.60	4.240	1705.
12	19.80	4.470	1220.
13	22.20	4.733	870.0
14	24.90	5.020	615.0
15	28.00	5.374	425.0
16	31.40	5.750	294.5
17	35.30	6.190	200.5
18	39.60	6.637	137.5
19	44.50	7.128	93.50
20	49.90	7.676	63.50
21	56.00	8.191	43.60
22	62.90	8.734	29.80
23	70.60	9.276	20.52
24	79.20	9.815	14.23
25	88.90	10.28	9.975
26	99.80	10.74	7.025
27	111.8	11.18	4.997
28	125.8	11.50	3.572
29	140.8	11.87	2.575
30	157.8	12.15	1.872
31	177.8	12.45	1.342
32	199.8	12.78	0.9650
33	223.8	13.37	0.6800
34	250.8	13.03	0.5325
35	281.8	13.21	0.3900
36	315.8	13.70	0.2780
37	354.8	12.99	0.2250
38	397.8	12.61	0.1770

```
   39       446.8           13.10          0.1250


********************
*                  *
* INVERSION OUTPUT *
*                  *
********************


NONLINEAR LEAST SQUARES
SECOND ORDER MARQUARDT WITH SINGULAR VALUE DECOMPOSITION
ITERATION LIMIT =  10

PARAMETERS ARE ORDERED THUS: RESISTIVITIES FOLLOWED BY THICKNESSES
------------------------------------------------------------------

INITIAL STANDARD ERROR =    47.58     PERCENT
RELATIVE SINGULAR VALUE THRESHOLD (RSVT) =    0.100



ITERATION    1          ICNT =   0          RSVT =    0.100

THE NUMBER OF RELEVANT VARIABLES IS    7

CURRENT PARAMETER VALUES
     19.4        2.35        201.        50.1        9.92        44.0        107.        512.        201.

STANDARD ERROR =    7.978     PERCENT



ITERATION    2          ICNT =   0          RSVT =    0.050

THE NUMBER OF RELEVANT VARIABLES IS    6

CURRENT PARAMETER VALUES
     19.2        2.23        202.        50.2        9.83        39.3        95.8        521.        202.

STANDARD ERROR =    3.437     PERCENT



ITERATION    3          ICNT =   0          RSVT =    0.025

THE NUMBER OF RELEVANT VARIABLES IS    6

CURRENT PARAMETER VALUES
     19.2        2.18        202.        50.3        9.75        39.2        93.4        528.        203.

STANDARD ERROR =    3.310     PERCENT



ITERATION    4          ICNT =   1          RSVT =    0.025
```

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.2	2.16	203.	50.4	9.74	39.6	92.1	529.	203.

STANDARD ERROR = 3.291 PERCENT

ITERATION 5 ICNT = 0 RSVT = 0.025

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.3	2.13	203.	50.4	9.76	40.1	91.0	528.	203.

STANDARD ERROR = 3.275 PERCENT

ITERATION 6 ICNT = 1 RSVT = 0.025

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.3	2.11	204.	50.4	9.77	40.6	90.0	527.	202.

STANDARD ERROR = 3.260 PERCENT

ITERATION 7 ICNT = 0 RSVT = 0.025

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.4	2.09	204.	50.4	9.79	41.0	89.0	527.	202.

STANDARD ERROR = 3.245 PERCENT

ITERATION 8 ICNT = 1 RSVT = 0.025

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.4	2.07	205.	50.4	9.81	41.5	88.0	526.	202.

STANDARD ERROR = 3.231 PERCENT

ITERATION 9 ICNT = 0 RSVT = 0.025

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.5	2.05	205.	50.4	9.82	41.9	87.0	525.	202.

STANDARD ERROR = 3.217 PERCENT

ITERATION 10 ICNT = 1 RSVT = 0.025

THE NUMBER OF RELEVANT VARIABLES IS 7

CURRENT PARAMETER VALUES

19.6	2.03	206.	50.4	9.84	42.3	86.0	525.	201.

STANDARD ERROR = 3.203 PERCENT

MAXIMUM ITERATIONS REACHED

****
* *
* FINAL MODEL AFTER INVERSION *
* *
****

MA91-103,501,2150

I	RESISTIVITY	THICKNESS	DEPTH
			0.0000E+00
1	19.55	42.35	42.35
2	2.029	86.02	128.4
3	205.6	524.5	652.9
4	50.45	201.5	854.4
5	9.840		

STANDARD ERROR = 3.20 PERCENT

NOISE TO SIGNAL RATIO = 0.382 PERCENT

****
* *
* ERROR STRUCTURE OF THE FITTED MODEL *
* FOR TEM DATA *
* *
****

I	DELAY TIME (MS)	OBSERVED APP.RES.	CALCULATED APP.RES.	OBSERVED VOLTAGE (MU V)	CALCULATED VOLTAGE (MU V)	VOLTAGE ERROR WEIGHTED	WEIGHTED PERCENT SYMMETRIC ERROR	I

1	5.420	4.036	3.546	0.1940E+05	0.2131E+05	-1910.	-9.383	1
2	6.110	3.541	3.467	0.1748E+05	0.1775E+05	-278.8	-1.583	2
3	6.880	3.411	3.439	0.1465E+05	0.1454E+05	105.3	0.7215	3
4	7.740	3.396	3.453	0.1190E+05	0.1173E+05	174.2	1.475	4
5	8.710	3.431	3.492	9450.	9294.	156.0	1.665	5
6	9.800	3.516	3.565	7350.	7242.	107.7	1.477	6
7	11.00	3.590	3.658	5700.	5589.	111.0	1.967	7
8	12.40	3.714	3.779	4285.	4202.	83.28	1.963	8
9	13.90	3.851	3.916	3225.	3162.	62.98	1.972	9
10	15.60	4.022	4.082	2380.	2337.	43.00	1.823	10
11	17.60	4.240	4.280	1705.	1685.	20.23	1.193	11
12	19.80	4.470	4.510	1220.	1206.	14.01	1.155	12
13	22.20	4.733	4.754	870.0	864.9	5.136	0.5921	13
14	24.90	5.020	5.042	615.0	611.4	3.586	0.5848	14
15	28.00	5.374	5.359	425.0	426.6	-1.642	-0.3855	15
16	31.40	5.750	5.721	294.5	296.6	-2.113	-0.7149	16
17	35.30	6.190	6.111	200.5	204.2	-3.683	-1.820	17
18	39.60	6.637	6.553	137.5	140.1	-2.551	-1.838	18
19	44.50	7.128	7.017	93.50	95.66	-2.162	-2.286	19
20	49.90	7.676	7.532	63.50	65.27	-1.772	-2.752	20
21	56.00	8.191	8.053	43.60	44.66	-1.055	-2.392	21
22	62.90	8.734	8.633	29.80	30.31	-0.5119	-1.703	22
23	70.60	9.276	9.186	20.52	20.82	-0.2953	-1.428	23
24	79.20	9.815	9.777	14.23	14.31	-0.8239E-01	-0.5776	24
25	88.90	10.28	10.30	9.975	9.942	0.3262E-01	0.3275	25
26	99.80	10.74	10.85	7.025	6.920	0.1049	1.504	26
27	111.8	11.18	11.29	4.997	4.921	0.7677E-01	1.548	27
28	125.8	11.50	11.73	3.572	3.466	0.1062	3.017	28
29	140.8	11.87	12.05	2.575	2.517	0.5821E-01	2.286	29
30	157.8	12.15	12.36	1.872	1.827	0.4567E-01	2.469	30
31	177.8	12.45	12.57	1.342	1.324	0.1874E-01	1.406	31
32	199.8	12.78	12.74	0.9650	0.9697	-0.4682E-02	-0.4840	32
33	223.8	13.37	12.84	0.6800	0.7230	-0.4301E-01	-6.131	33
34	250.8	13.03	12.95	0.5325	0.5376	-0.5144E-02	-0.9614	34
35	281.8	13.21	13.01	0.3900	0.3990	-0.9047E-02	-2.293	35
36	315.8	13.70	13.07	0.2780	0.2983	-0.2028E-01	-7.037	36
37	354.8	12.99	13.08	0.2250	0.2227	0.2268E-02	1.013	37
38	397.8	12.61	13.13	0.1770	0.1665	0.1050E-01	6.116	38
39	446.8	13.10	13.18	0.1250	0.1240	0.1042E-02	0.8367	39

MEAN PERCENT SYMMETRIC ERROR = 2.808
MAXIMUM PERCENT SYMMETRIC ERROR = 9.383
MAX. SYMMETRIC ERROR OCCURED AT OBSERVATION 1

****
*
* LAYER THICKNESS PARAMETER SENSITIVITY ANALYSIS *
*
****

1.00 0.186 0.114 0.331E-01 0.103E-01 0.530E-03 0.141E-03 0.418E-04 0.981E-05

THE NUMBER OF EFFECTIVE PARAMETERS IS 4.519

PARAMETER SPACE EIGENVECTORS (V MATRIX)

	EP1	EP2	EP3	EP4	EP5	EP6	EP7	EP8	EP9
LOG(RES1)	0.041	-0.021	0.069	-0.042	0.144	-0.031	0.744	-0.639	0.085
LOG(RES2)	0.738	-0.187	0.384	0.070	-0.514	-0.065	0.017	-0.002	0.001
LOG(RES3)	0.016	0.038	-0.021	-0.069	0.101	-0.860	0.289	0.391	-0.088

LOG(RES4)	0.008	0.056	0.004	-0.064	0.008	-0.270	-0.367	-0.506	-0.727
LOG(RES5)	0.045	0.624	0.286	0.709	0.151	-0.019	-0.003	-0.002	-0.001
LOG(H1)	0.051	-0.198	0.698	-0.241	0.620	0.070	-0.122	0.094	-0.013
LOG(H2)	-0.664	-0.083	0.517	0.015	-0.522	-0.085	0.059	-0.029	0.004
LOG(H3)	0.086	0.690	0.098	-0.625	-0.137	-0.053	-0.125	-0.104	0.263
LOG(H4)	0.026	0.221	0.039	-0.181	-0.079	0.409	0.440	0.402	-0.622

DAMPING FACTORS (1.000 PERCENT LEVEL)

1.000	1.000	1.000	0.992	0.528	0.000	0.000	0.000	0.000

CORRELATION MATRIX

1	1.000	0.580	-0.865	-0.342	0.098	-0.998	0.967	0.538	-0.577
2	0.580	1.000	-0.286	-0.355	-0.029	-0.628	0.762	0.392	-0.400
3	-0.865	-0.286	1.000	0.553	0.057	0.849	-0.745	-0.747	0.784
4	-0.342	-0.355	0.553	1.000	0.726	0.353	-0.340	-0.965	0.948
5	0.098	-0.029	0.057	0.726	1.000	-0.092	0.086	-0.573	0.529
6	-0.998	-0.628	0.849	0.353	-0.092	1.000	-0.980	-0.544	0.582
7	0.967	0.762	-0.745	-0.340	0.086	-0.980	1.000	0.505	-0.539
8	0.538	0.392	-0.747	-0.965	-0.573	-0.544	0.505	1.000	-0.998
9	-0.577	-0.400	0.784	0.948	0.529	0.582	-0.539	-0.998	1.000

****
*
* 'ERROR BOUNDS' FOR LAYER THICKNESS *
*
****

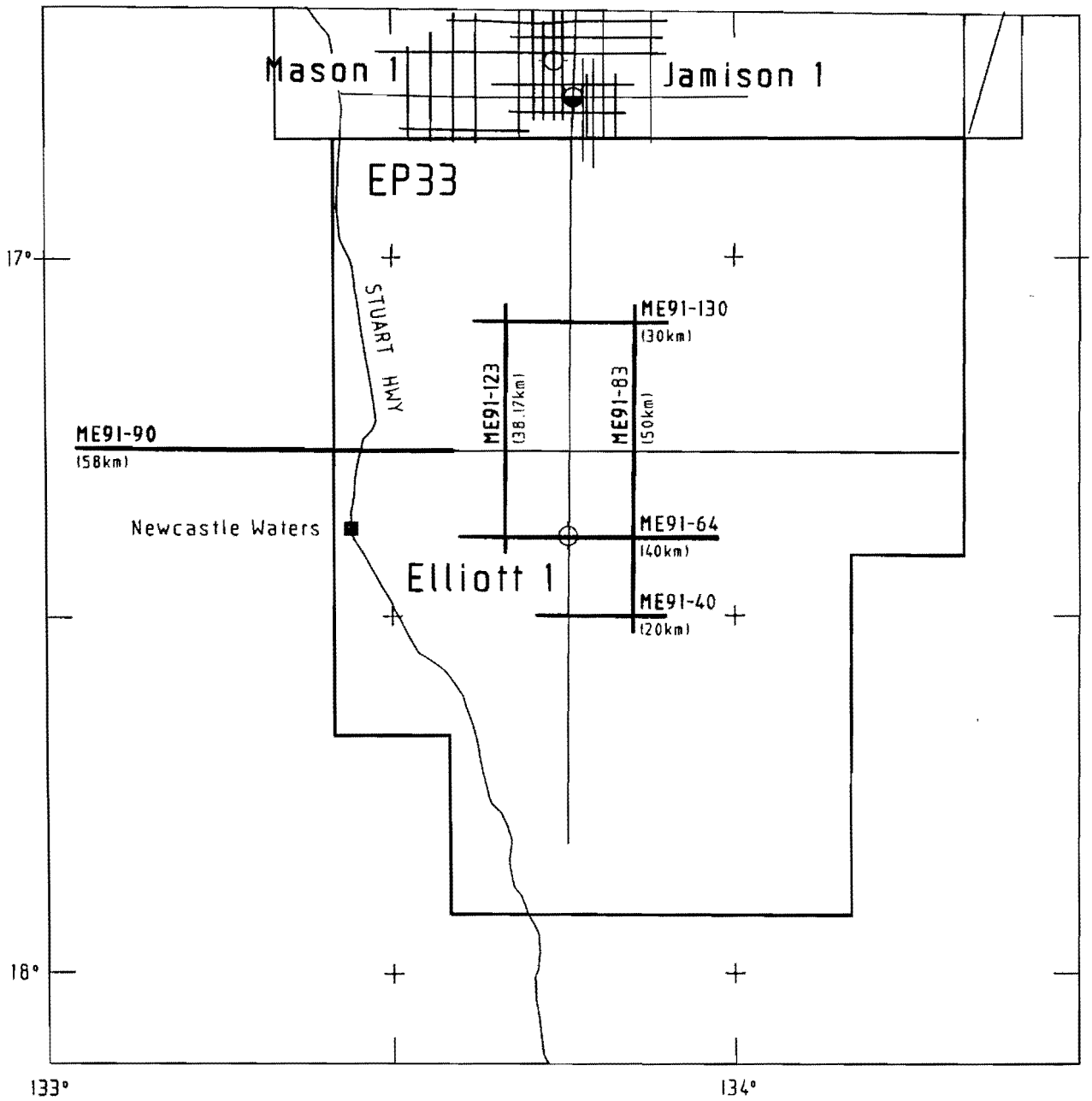
LAYER RESISTIVITIES - 68 PERCENT CONFIDENCE INTERVAL (UNDAMPED)

I	RO(I)	BOUND(1)	BOUND(2)	IMPORTANCE
1	19.55	UNBOUNDED		0.1199
2	2.029	1.179	3.491	0.8971
3	205.6	UNBOUNDED		0.9828E-01
4	50.45	UNBOUNDED		0.8500E-01
5	9.840	7.720	12.54	0.9874

LAYER THICKNESSES - 68 PERCENT CONFIDENCE INTERVAL (UNDAMPED)

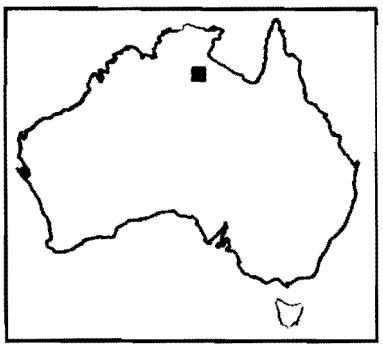
I	H(I)	BOUND(1)	BOUND(2)	IMPORTANCE
1	42.35	0.3063E-01	0.5853E+05	0.8322
2	86.02	7.433	995.5	0.8899
3	524.5	UNBOUNDED		0.9388
4	201.5	UNBOUNDED		0.2916

```
**********************************************************************
*                                                                    *
* AVERAGE PREDICTED RESIDUAL ERROR (APRE) =    3.860     PERCENT     *
*                                                                    *
**********************************************************************
```



20.0 0 20.0 40.0 60.0 80.0 Km

1 : 1,000,000

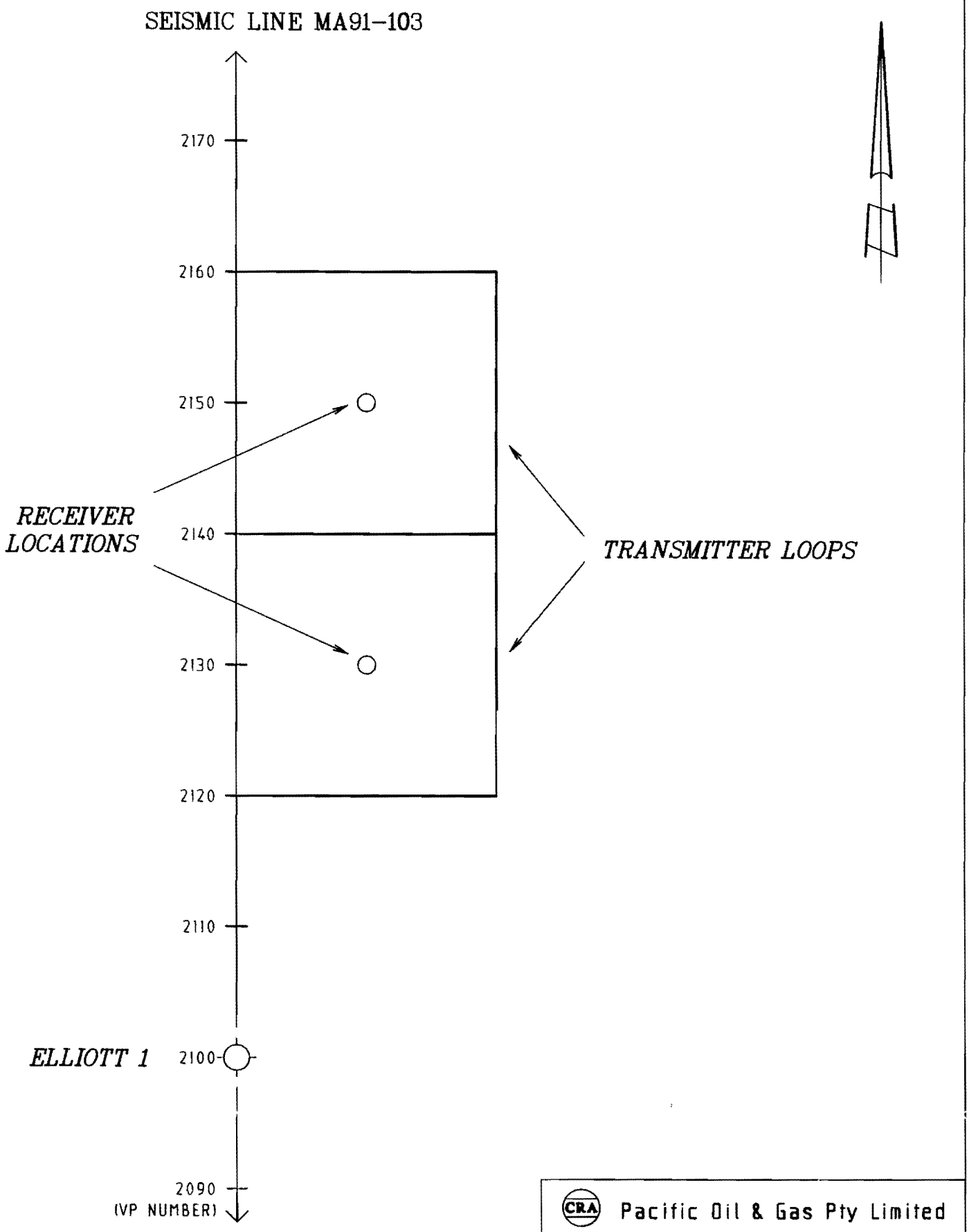


Pacific Oil & Gas Pty Limited

McARTHUR BASIN

EP33 PERMIT, SEISMIC AND WELL LOCATIONS

REF.	SD53,SE53	CHECKED	R.L.
SCALE	1:1000000	DRAFTING	C.H.
AUTHOR	I.M.C.	REPORT	304554
DATE	MARCH 92	PLAN No.	PetNTcw4555

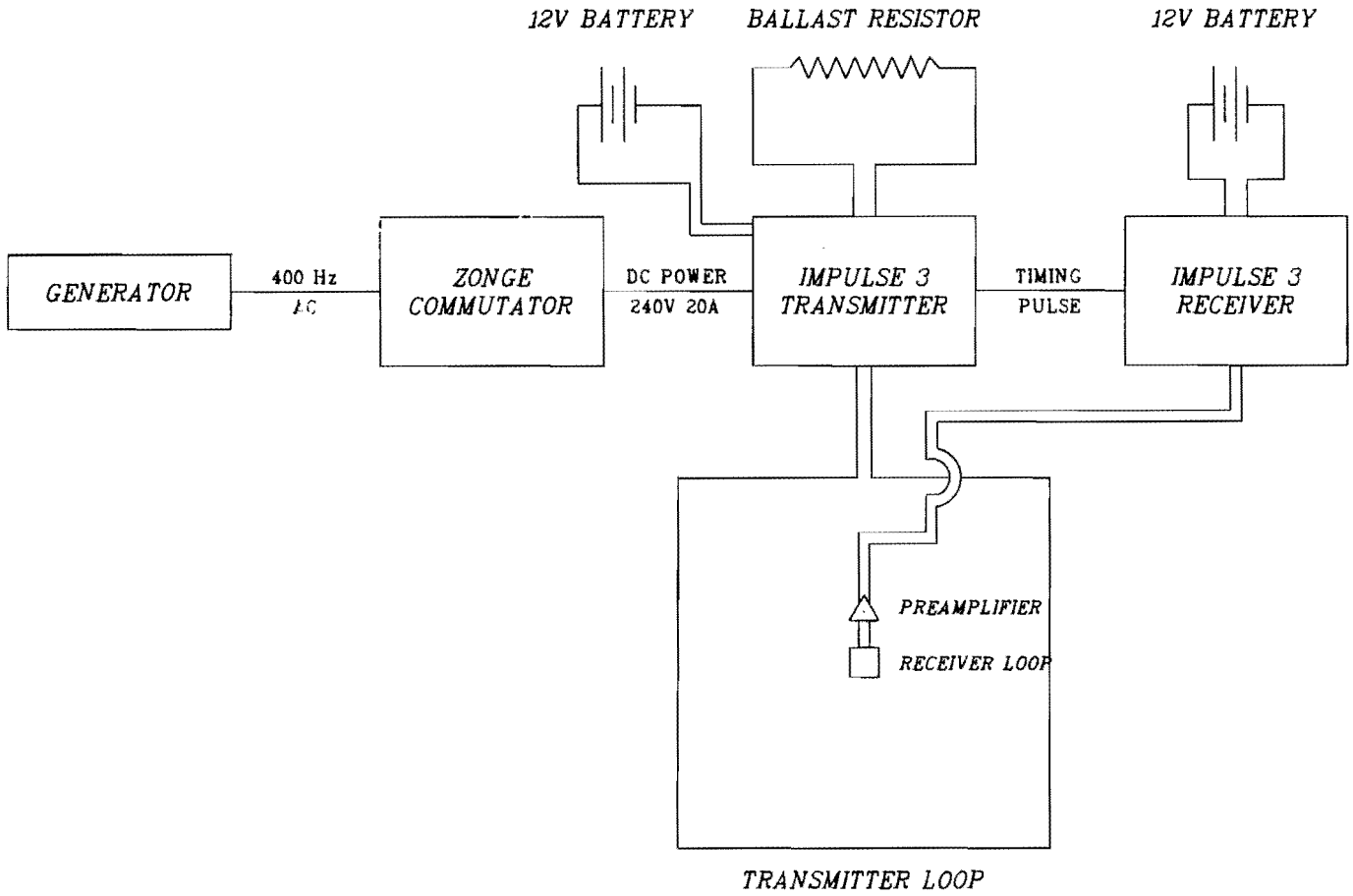


Pacific Oil & Gas Pty Limited

McARTHUR BASIN PROJECT

EP33
1991 CTEM SURVEY
LOCATION PLAN

REF.	.	DRAFTING	C.H.
SCALE	1:10 000	CHECKED	R.L.
AUTHOR	R.L.	REPORT	304554
DATE	MAR. 1992	PLAN No.	PetNTcw4556

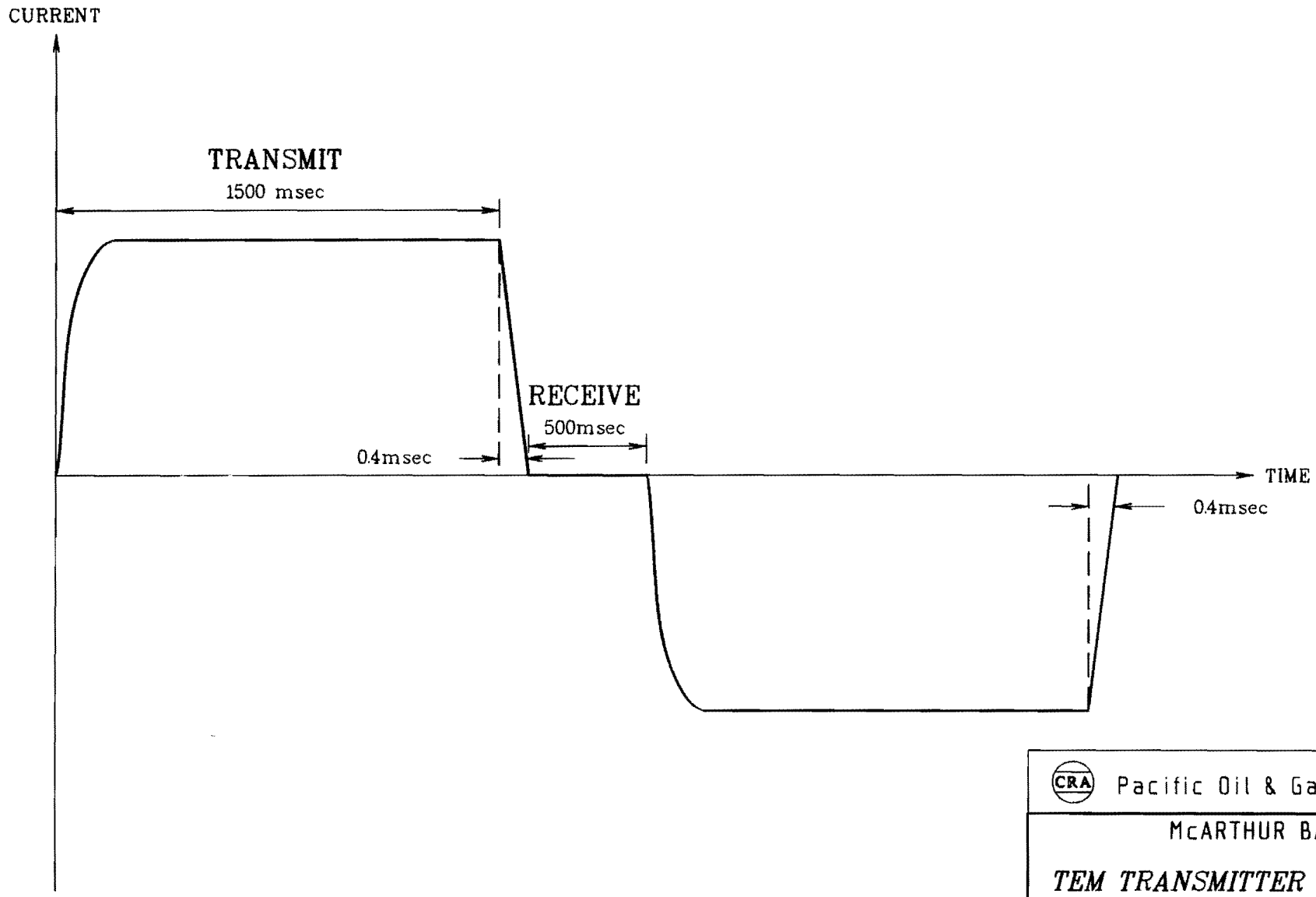


CRA Pacific Oil & Gas Pty Limited

McARTHUR BASIN

EQUIPMENT CONFIGURATION 1991 CTEM SURVEY

REF.	.	DRAFTING	C.H.
SCALE	NTS	CHECKED	R.L.
AUTHOR	R.L.	REPORT	304554
DATE	MAR 1992	PLAN No.	PetNTcw4557



Pacific Oil & Gas Pty Limited

McARTHUR BASIN

TEM TRANSMITTER WAVEFORM
1991 CTEM SURVEY

REF.	.	DRAFTING	C.H.
SCALE	.	CHECKED	R.L.
AUTHOR	R.L.	REPORT	304554
DATE	MAR 1992	PLAN No.	PetNTcw4558

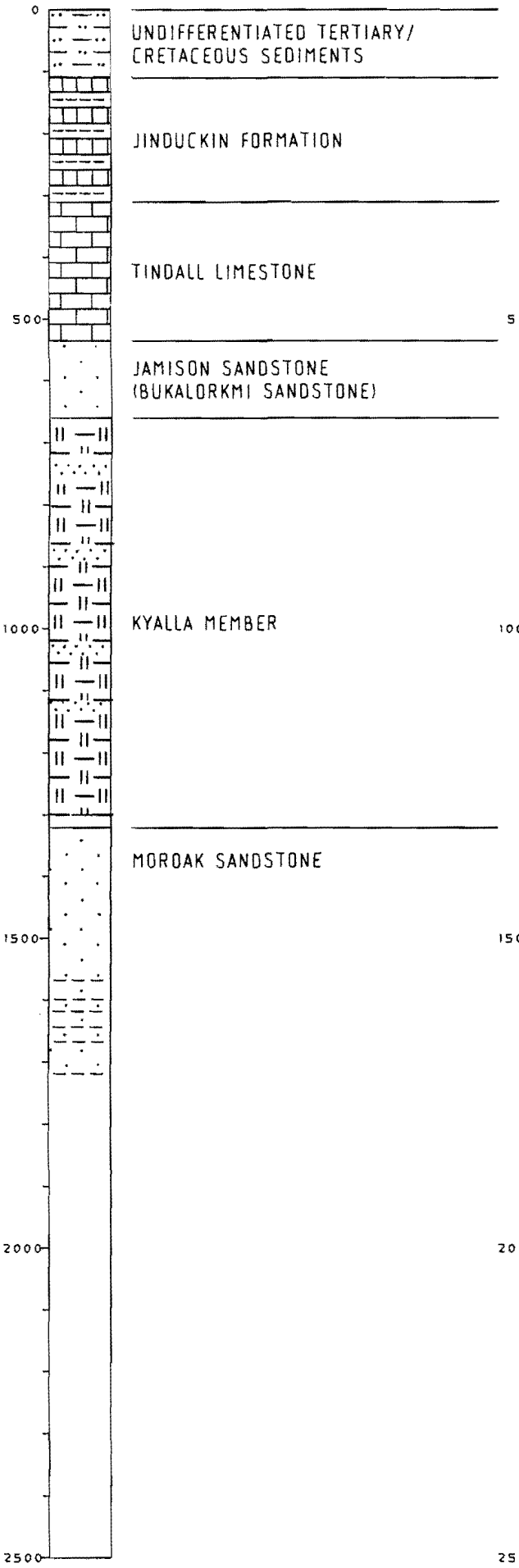
PACIFIC

ELLIOTT 1

Date: 22 Nov 1991

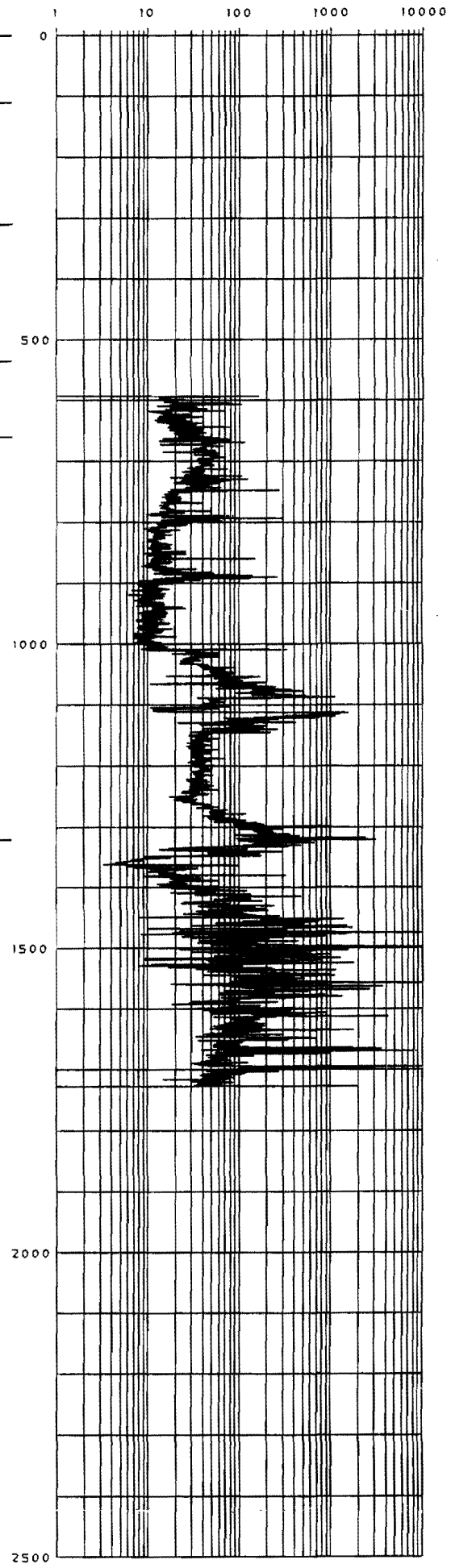
Drawing no.

Lithology



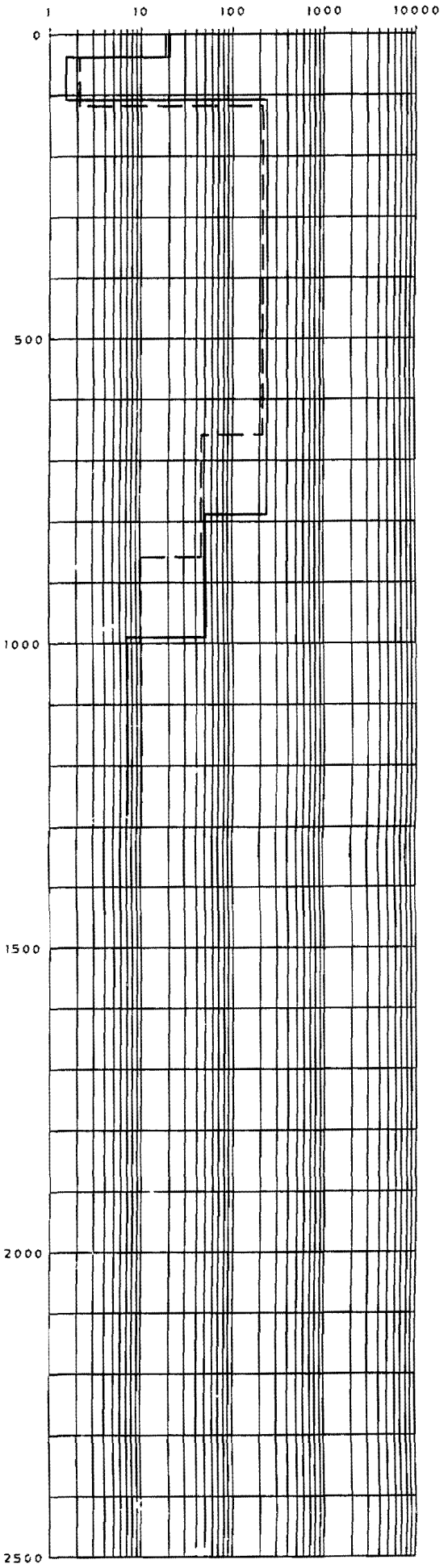
ELLIOTT 1 AT MA91-103, VP2100
(VP AT 25m INTERVALS)

Resistivity (FEI) (ohm-m)



INTERPRETATION OF TEM SOUNDINGS
AT MA91-103, VP'S2130 AND 2150

Resistivity (ohm-m) 2130 2150



CRA Pacific Oil & Gas Pty Limited

McARTHUR BASIN

EP33 1991 CTEM SURVEY COMPARISON OF ELLIOTT 1 RESISTIVITY LOG AND TEM INTERPRETATIONS

REF.	.	DRAFTING	C.H.
SCALE	1:10,000	CHECKED	R.L.
AUTHOR	R.L.	REPORT	304554
DATE	APRIL 1992	PLAN No.	PetNTcw4559