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PEDIRKA BASIN

GEOLOGICAL STUDIES

Submitted by

MESA
1994

MINES AND ENERGY
SOUTH AUSTRALIA

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PEDIRKA BASIN Z HORIZON

MAPPING PROJECT

Final Report for
Department of Mines and Energy, South Australia

14 March 1994

by

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1. INTRODUCTION

In late 1992, staff of the Oil, Gas & Coal Division of the Department of Mines & Energy, South Australia (MESA), began discussions with personnel from the National Centre for Petroleum Geology & Geophysics (NCPGG) concerning the feasibility of a project to map the top of the pre-Permian "basement" across the South Australian portions of the Pedirka and Simpson Desert Basins. This interface generates the so-called "Z horizon" event on reflection seismic data. MESA's requirement was to produce a regional map of the Z horizon by integrating well information with a large volume of seismic data collected during more than twenty years of petroleum exploration in the basins. Apart from providing a good overview of basin shape, such a map could be subjected to digital imaging techniques which have the potential to reveal subtle structural features and trends. This knowledge may result in a better understanding of basin evolution and hydrocarbon potential, and provide a basis for encouraging further petroleum exploration in the area. The idea was partially motivated by the success of the earlier regional mapping of the "C horizon" (top Cadna-owie Formation) throughout the South Australian portion of the Eromanga Basin, and the digital imaging results achieved by this project.

It was ultimately agreed that MESA would contract NCPGG to do the interpretation, which would be performed as part of the thesis projects of two Honours students, and supervised by NCPGG staff. Work commenced in July 1993, when the students spent six weeks at the MESA office, during which time they reviewed the literature, selected the seismic data to be used, and arranged for it to be reproduced. MESA supplied digital shotpoint and well log data, formation tops, checkshot information and synthetic seismograms, and access to well completion reports for the project. Interpretation continued until October, when the students stopped to write up their theses, which were submitted in late November. Digitizing of interpreted sections commenced in late September. After completing their academic obligations, the students interpreted the remaining lines, and began mistie corrections for previously digitized data. The misties were completed at the end of February.

In this process, the two students, Anthony Goodall and Glen McFadzean, interpreted all the sections, with guidance from Nick Lemon on the tectonic aspects, and help from Andy Mitchell on the geophysical aspects. Andy Mitchell generated the synthetic seismograms required, constructed and maintained the database, supervised the digitizing, and made the maps. Chris Cubitt, Martin Eldridge and Mark Brincat operated the digitizing table.

Eight horizons were picked and digitized, ranging from the pre-Permian Z horizon to the early Cretaceous C horizon, in order to examine the tectonic evolution of the basins through time. At the time of writing of this report, mistie corrections and maps have only been generated for the Z horizon, as required by MESA.

The products of this work are:

- two Honours theses, which discuss in detail the structural and stratigraphic evolution of the basins, as determined from the present work integrated with the results of the literature search.
- A digital database of times and depths to the Z horizon for over 10,000 line km of seismic data in the study area.
- Preliminary maps at scales of 1:500,000 and 1:1,000,000 derived from the database.
- This report, outlining the conduct and mechanics of the project.

In addition, uncorrected times for seven other horizons exist in digital form, and could be upgraded for mapping with modest effort.

The purpose of this report is to discuss the methodology of the project, and in particular the seismic interpretation, mistie corrections, depth conversion and mapping. The geological interpretations are contained in the two Honours theses resulting from this work.

2. DATABASE

The project area is shown in figure 1. It is roughly triangular, with the South Australian border as its northern boundary. It extends from the eastern edge of the Erinya Trough 400 km eastwards through the Pedirka Basin and the Simpson Desert Basin, and 300 km southwards across the Birdsville Track Ridge. The total area is some 85,000 square km.

Twenty-three petroleum exploration wells have been drilled in this area, of which twenty-one penetrate the pre-Permian. The wells tend to be clustered into small groups, but these groups are scattered quite widely across the region, so that no part of the study area is more than about 100 km from a well. The poorest control occurs across the middle of the area, at about latitude 27.5 degrees, and in the extreme northeast and south. Wireline logs, locations and horizon tops for these wells were provided by MESA, and were used to construct a digital well database using the GEOLOG software package. Basic data for these wells is given in table 1, and their locations are shown on figure 1.

Synthetic seismograms were available for most of the wells. Most of these were computed by Delhi Petroleum Pty Ltd or Santos Ltd to a standard format. However, synthetics had to be generated for Crater-1, Mt Crispe-1, Poolowanna-3, Tirari West-1 and Witcherrie-1, for which no synthetics could be located in the MESA archives. The new synthetics were calculated using QUIKLOG. The logs were resampled to 1 msec, and the "standard Delhi/Santos wavelet", with a 10 to 55 Hz bandpass, and phases of 0, 90, 180, and 270 degrees, was convolved with the reflectivity to yield four synthetic traces. The 0 and 180 degree wavelets correspond to SEG normal and reverse polarity zero phase wavelets.

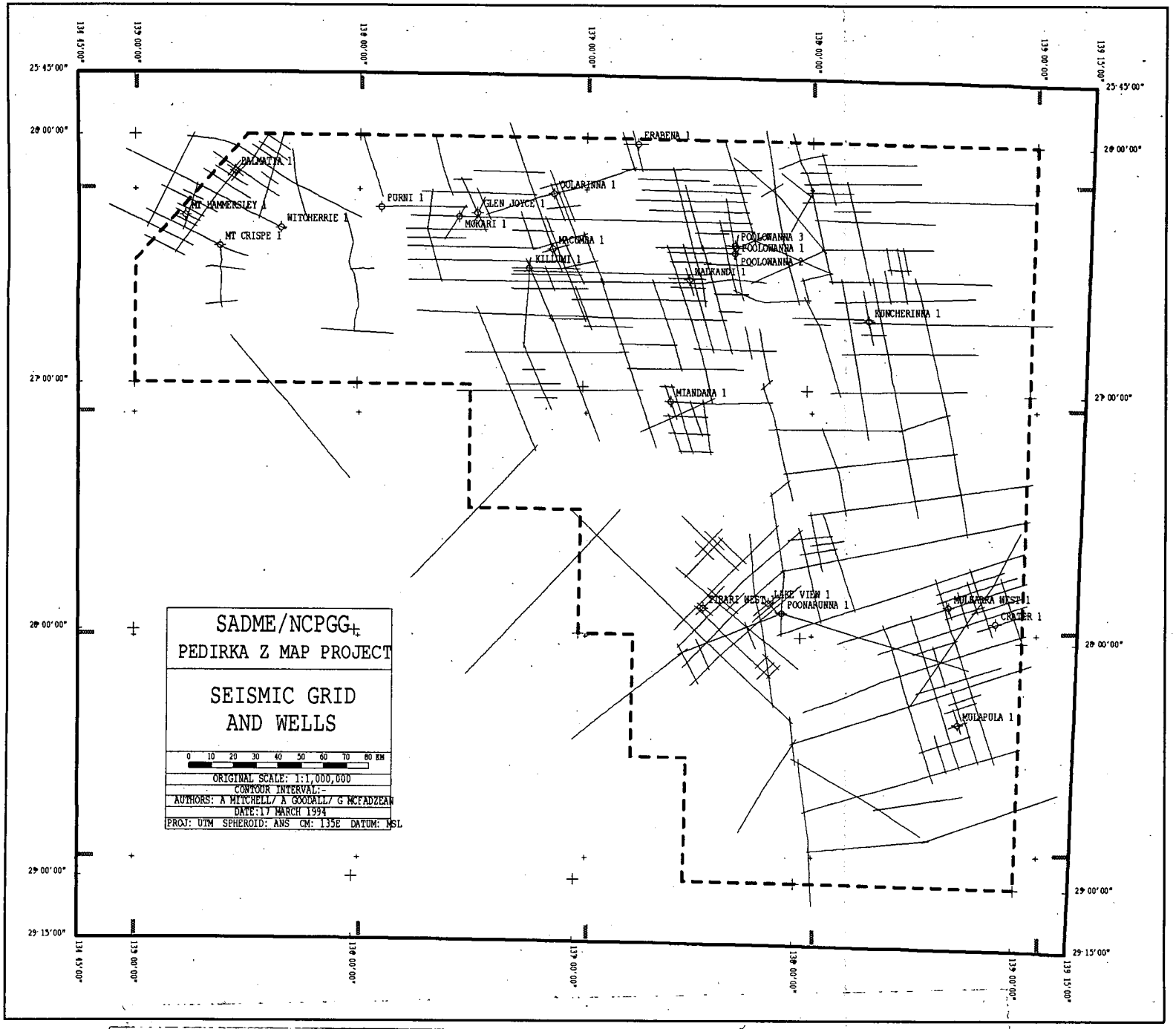


Figure 1 - Basemap of project area, showing seismic grid and wells

WELL	EASTING (M)	NORTHING (M)	SOUTH LATITUDE	EAST LONGITUDE	SURFACE ELEV (M)	KB ELEV (M)
CRATER-1	881938	6905248	27 55 23.000	138 52 48.36	45.0	51.0
DALMATIA-1	544578	7108074	26 08 45.190	135 26 45.53	165.5	169.8
ERABENA-1	722947	7120096	26 01 15.040	137 13 39.99	67.5	80.0
GLEN_JOYCE-1	651688	7089671	26 18 16.890	136 31 10.30	70.5	75.9
KILLUMI-1	674547	7065192	26 31 22.850	136 45 06.38	50.4	59.7
KUNCHERINNA-1	825033	7041399	26 42 39.470	138 15 59.96	15.5	21.0
LAKE_VIEW-1	780982	6914824	27 51 42.500	137 51 12.39	16.5	21.0
MACUMBA-1	684955	7073795	26 26 38.600	136 51 17.77	36.6	48.4
MIANDANA-1	737533	7005350	27 03 13.240	137 23 41.43	19.8	29.3
MOKARI-1	643750	7088070	26 19 11.890	136 26 24.75	67.7	74.4
MT_CRISPE-1	537553	7074956	26 26 42.400	135 22 36.00	134.1	138.1
MT_HAMMERSLEY-1	522081	7088587	26 19 20.514	135 13 16.48	174.0	178.4
MULAPULA-1	865085	6859659	28 20 18.390	138 43 24.14	59.0	64.0
MULKARRA_WEST-1	860948	6912744	27 51 40.909	138 39 53.81	28.6	32.5
OOLARINNA-1	685455	7098225	26 13 24.660	136 51 23.17	57.5	64.3
POOLOWANNA-1	766528	7074331	26 25 34.560	137 40 20.41	30.2	35.2
POOLOWANNA-2	766164	7071937	26 26 52.520	137 40 09.08	21.3	30.5
POOLOWANNA-3	766093	7075341	26 25 02.039	137 40 03.95	31.2	35.7
POONARUNNA-1	786875	6910113	27 54 10.900	137 54 51.71	3.1	5.5
PURNI-1	609483	7092101	26 17 11.810	136 05 47.79	72.9	77.7
TIRARI_WEST-1	752375	6912622	27 53 14.518	137 33 49.14	10.4	15.8
WALKANDI-1	745823	7059755	26 33 41.340	137 28 03.75	25.9	31.4
WITCHERRIE-1	564880	7082952	26 22 18.980	135 39 01.25	82.0	86.0

N.B.

1) Data supplied by DMESA.

2) Elevations are referred to mean sea level datum.

3) Eastings and northings are for UTM projection, using the Australian National Spheroid, and a central meridian of 135 degrees East longitude.

Table 1 - Basic Well Data

More than 2100 seismic lines, totalling over 15,300 km of data, were shot in the project area between 1960 and 1992, ranging from single fold analogue to 48 fold digital. Inspection of sample sections from the different surveys showed that lines shot from 1974 onwards were of acceptable quality for the project, and could be used to construct a comprehensive regional seismic grid, although a few lines of 1966 and 1967 vintage were required in the Purni-1/Witcherrie-1 area to fill gaps in the more recent coverage. In addition to the older vintage data, some more recent infill lines were also omitted from the grid in order to reduce the number of lines to be handled, and the variation in line spacing throughout the area.

The resulting seismic grid for the project comprised 306 lines, totalling almost 10,200 line km of data (Enclosure 1 and Appendix 1). The geographic coordinates for these lines were provided by MESA, and were loaded into GEOSEIS, a seismic digitizing and database package. MESA also produced dyeline copies of the selected lines, on which the interpretation was performed. So as to make the data as consistent as possible, where several versions of a line were available, the normal polarity final stack was ordered, since this was the most common type of display. Unfortunately, very few of the lines had been migrated. For some lines, only reverse polarity displays were available.

3. INTERPRETATION

The two students worked on different parts of the project area. Glen McFadzean was assigned the Pedirka Basin sector, extending across into the Poolowanna Trough. Anthony Goodall handled the Simpson Desert Basin and Birdsville Track Ridge sector. These sectors deliberately contained a large area of overlap, centred on the deepest part of the Poolowanna Trough. Glen and Anthony started the project by together interpreting the lines falling within the overlap. This area, a block one degree on each side, defined by latitudes 26 and 27 degrees south and longitudes 137 and 138 degrees east, was termed the "Joint Area". Each then tied the lines in his own area into the Joint Area interpretation. This procedure ensured that the two interpretations would fit together seamlessly in the final maps.

The following horizons were interpreted:

- Top Cadna-owie Formation (C) - yellow
- Top Westbourne Formation - brown
- Top Birkhead Formation - green
- Top Poolowanna Formation - purple
- Top Peera Peera Formation - blue
- Top Purni Formation - orange
- Top Crown Point Formation - pink
- Top pre-Permian (Z) - red

Of these events, only the C and Z horizons are present throughout the project area. The others are restricted to varying degrees by erosion, pinchout or stratigraphic changes.

Synthetic seismograms were used to identify events on sections passing through the wells, and a skeleton grid of lines connecting the wells was first interpreted. The remaining infill lines were then interpreted by tying back into the skeleton grid. The ties between the seismic and synthetics for all the wells are shown in Appendix 2.

The pre-Permian generally has a higher acoustic impedance than the rocks immediately overlying it, so on a normal polarity section, the Z horizon is usually a trough. However, the strength of the Z event is highly variable over the project area, since the pre-Permian itself and the supercropping rocks change in age and lithology from place to place. The reflection tends to be stronger where basement is high, since in these areas there is likely to be a greater age difference across the unconformity, with a consequent larger contrast in acoustic properties. The Z event can also be easily recognized where there is significant topography on it, such as occurs over the Birdsville Track Ridge, or where, although itself relatively unstructured, it clearly truncates deformed underlying sediments. In many areas, the Z horizon marks the base of coherent reflections. The most difficult situation occurs where there is little acoustic contrast across the boundary, and the bedding is parallel, so that the Z reflection is not identifiable either by its strength, or by events terminating against it. As a result of these variations in the nature of the Z horizon, the reliability of the maps produced from the interpretation is spatially highly variable. In some places, either in the vicinity of wells, where the reflection can be accurately tied to the known geology, or where the Z horizon has a characteristic signature, reliability is good, and the accuracy of the pick is limited by error in marking and digitizing the event. In other places, far removed from well control, or where there is no distinctive Z signature, there is potential for the picks to be significantly in error, possibly by hundreds of milliseconds. The fact that the picked reflection ties around loops is only partial protection against such errors, since this merely ensures that the interpretation is internally consistent, not that it is correct. Enclosure 2 is a qualitative assessment of the reliability of the Z horizon picks, based on the above discussion.

4. DIGITIZING

Once the Joint Area interpretation had firmed to a point where it was unlikely to change significantly, digitizing of sections from this area commenced, using the GEOSEIS package. Digitizing of lines from the individual areas followed as parts of these areas were interpreted. With the small CMP intervals of the later vintage data, some of the more recent sections were many metres long, requiring six or seven separate "lay-downs" on the digitizing table to complete. For some of these lines, however, compressed displays ("squash plots") were available. In these cases, the interpretation was performed on the full scale section, and the picks

were then transferred to the compressed display for digitizing, which then required only one or two lay-downs.

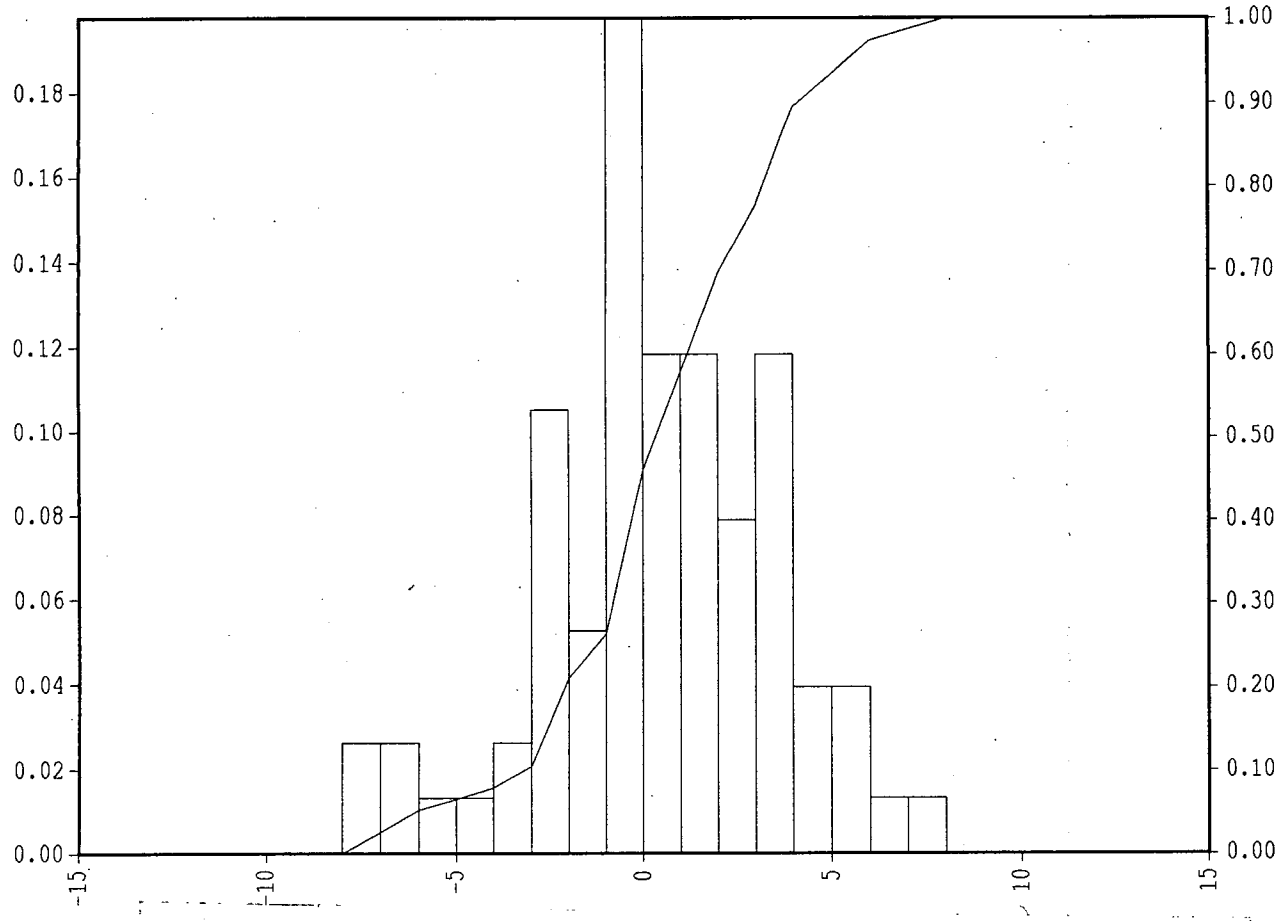
All the interpreted horizons were digitized. Because the interpreters found it easier to follow, they marked the peak overlying the Z horizon trough on normal polarity sections, but the operator digitized the trough. This procedure may have slightly increased the digitizing error for the Z horizon. On reverse polarity sections, this problem did not arise, because the Z horizon is a peak, and so was digitized on the interpreter's mark.

One of the idiosyncracies of GEOSEIS is that it does not store the actual data points digitized, but interpolates them to a regular, user-specified station increment. This is done to make inter-horizon calculations (eg isochrons) easier, since all horizons will be sampled at the same locations. A sampling interval of five stations was used for all lines of 1974 or later vintage. Since the station spacing varied from 25 to 150 metres for these lines, the sampling distances in the database varied from 125 to 750 metres. The upper limit is believed to provide adequate spatial resolution at the mapping scales likely to be used (an interval between data points of 1.5 mm on a 1:500,000 scale map), whilst at the lower limit, the data are oversampled. For the few 1960s vintage lines included, the station spacing was much larger, between 600 and 700 metres, and the sampling interval was reduced to half a station (300 to 350 metres).

One further point that should be mentioned is that although GEOSEIS can handle multi-valued horizons (ie structures such as thrust sheets or recumbent folds, where a horizon may occur at several times at a given station), it is messy, and was not practical for this project. This situation occurs in many places in the project area, because the bulk of the faulting is interpreted to be reverse or thrusted in nature. In these cases, the operator was directed to digitize the upthrown block as far as it extended, before digitizing the downthrown block. Hence, the digitized time represents the shallowest occurrence of a horizon at any given location. Except for a few large faults in the far west of the project area, the amount of overhang on reverse faults is negligible at the mapping scale.

The intrinsic accuracy of the digitization was measured by digitizing the same section twice, and plotting the distribution of the time differences between the two versions for the C and Z horizons. These histograms are shown in figure 2 (for the C horizon) and figure 3 (for the Z horizon). The figures show that for both horizons, the average difference in time is close to zero, so there is no bias between the two versions, and that the standard deviation of the differences is about 3 msec for the C horizon, and 5 msec for the Z horizon. If we can assume that the error in digitizing any point is distributed similarly to the difference between many points, each digitized twice, the histograms suggest that 90% of digitized data points are in error by less than 6 msec on the C horizon and 10 msec on the Z horizon. The difference in errors is probably due mainly to the fact that the C horizon was digitized on the interpreter's pick, while for the Z horizon the operator digitized on the (unmarked) trough beneath the picked peak.

HISTOGRAM OF YELLOW_DIFF

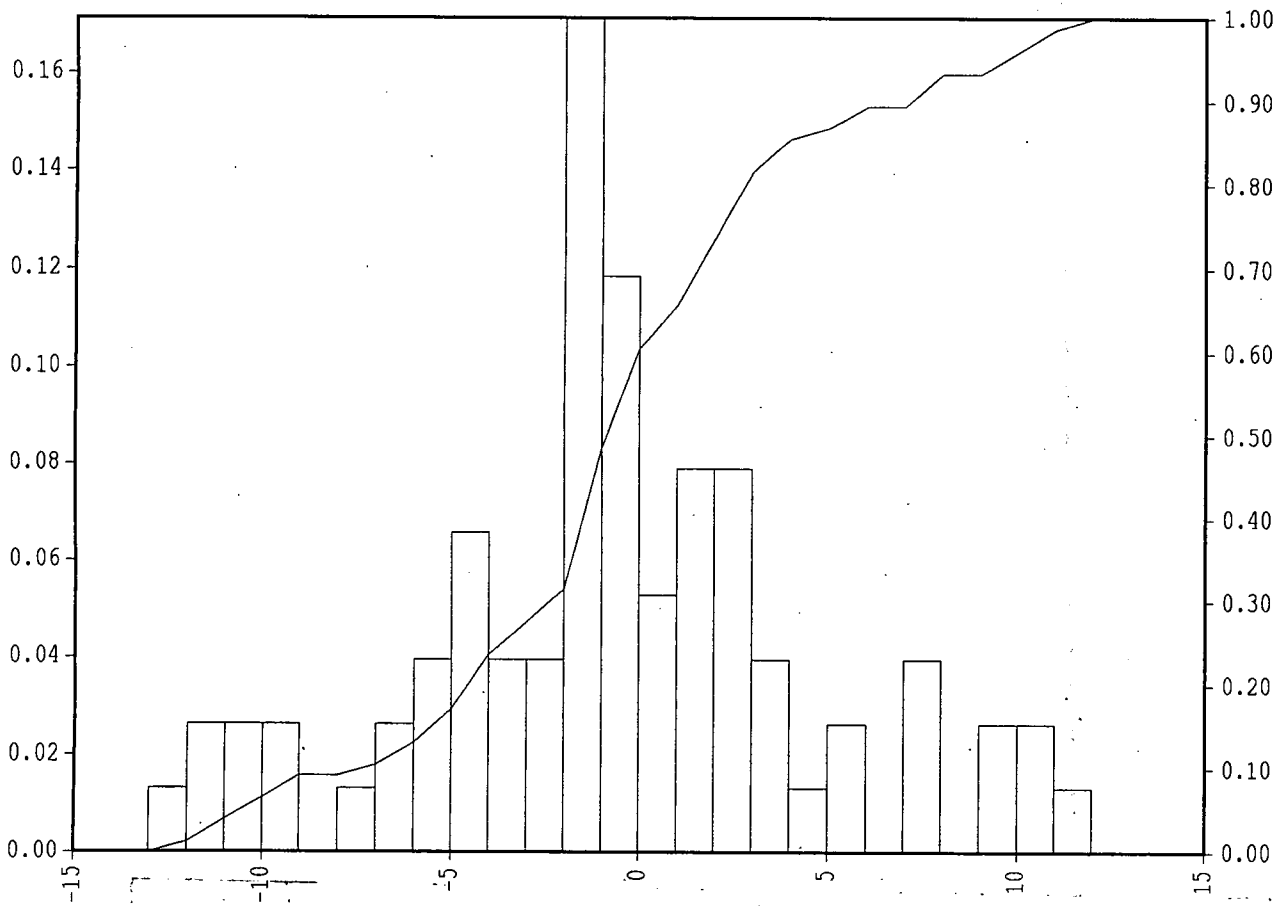


Hole name	:	88-BMY
Number of values	:	76
Minimum value	:	-8
Maximum value	:	7
Arithmetic Mean	:	-0.1052
Standard Deviation	:	3.14782
Geometric Mean	:	2.30851
Geometric Deviation	:	1.85725
Median	:	0.33333
Mode	:	-0.5

Figure 2 - Distribution of digitizing errors for C horizon

HISTOGRAM OF RED_DIFF

00013



Hole name	:	88-BMY
Number of values	:	76
Minimum value	:	-13
Maximum value	:	11
Arithmetic Mean	:	-1.1710
Standard Deviation	:	5.2647
Geometric Mean	:	3.08557
Geometric Deviation	:	2.33439
Median	:	-0.8888
Mode	:	-1.5

Figure 3 - Distribution of digitizing errors for Z horizon

5. EDITING AND MISTIE CORRECTIONS

Once most of the data had been digitized, GEOSEIS was used to compute misties between lines at their intersections. The main reasons for misties are as follows:

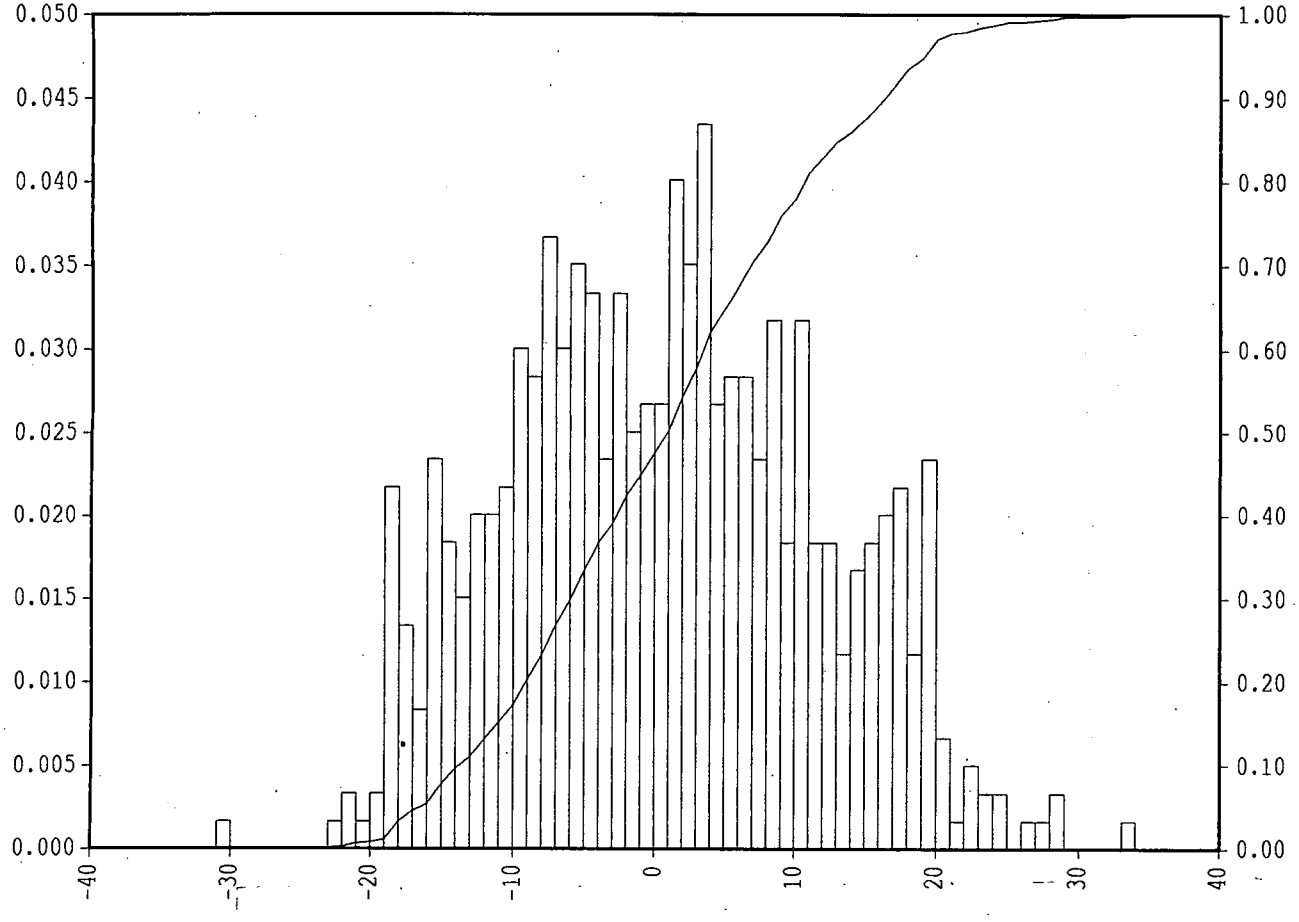
- Events on the two sections do not tie because of different acquisition and processing parameters.
- Errors in the line locations in the coordinate database, or in the position of the line intersections marked on the sections.
- Interpreter error, caused by erroneous correlation across faults, unrecognized character changes, etc.
- Digitizing error, including factors such as positioning accuracy, paper stretch, and operator error in data entry.

Examination of the first round of mistie reports showed that the last two factors were the major problem. Significant misties (of the order of 30 to 70 msec) were present in the picked horizons at many intersections, even though the events on the sections tied quite accurately. This necessitated revision of the interpretation around such intersections. Due to time constraints, only the Z horizon was considered during this editing phase. Some major misties (of the order of hundreds of msec) were quickly traced back to data entry errors and corrected.

At first sight, it seemed strange that, given the number of different surveys involved in the grid, there did not appear to be any obvious large systematic misties between vintages. It proved possible to edit the interpretations so as to reduce virtually all misties to below 20 msec. Some systematic errors may have been removed by the editing, but it seems likely that any bulk shifts between vintages are probably of the order of 20 msec or less. This becomes more reasonable when it is remembered that virtually all the data used was acquired by the one consortium (with Delhi Petroleum Pty Ltd or Santos Ltd as the operator) using the same source (vibroseis), and a fairly consistent processing stream with emphasis on accurate field and residual statics.

The distribution of misties remaining after editing of the Z horizon interpretation is shown in figure 4. The largest is 33 msec, there are two over 30 msec, four between 25 and 30 msec, and twelve between 20 and 25 msec. The mean is very close to zero, and the standard deviation is about 11 msec. Ninety-seven percent of all misties are no greater than 20 msec. In contrast, the distribution for the unedited C horizon misties (figure 5) has a few much larger values, and only about 82% of them are no greater than 20 msec. It should be borne in mind that these misties will include the intrinsic digitizing error discussed previously. The 20 msec mistie bound represents the limit of accuracy of the data in well controlled areas of high reliability. Accepting that this is the absolute limit to which we should attempt to push the resolution of the data during mapping, GEOSEIS was used to apply a final blind correction to the data to remove the remaining misties. In this process, the mistie at any intersection is partitioned equally between the lines, and along any line, the mistie correction is prorated between adjacent intersections. This is a cosmetic process to aid in map production, and was only applied to the data after several rounds of editing had

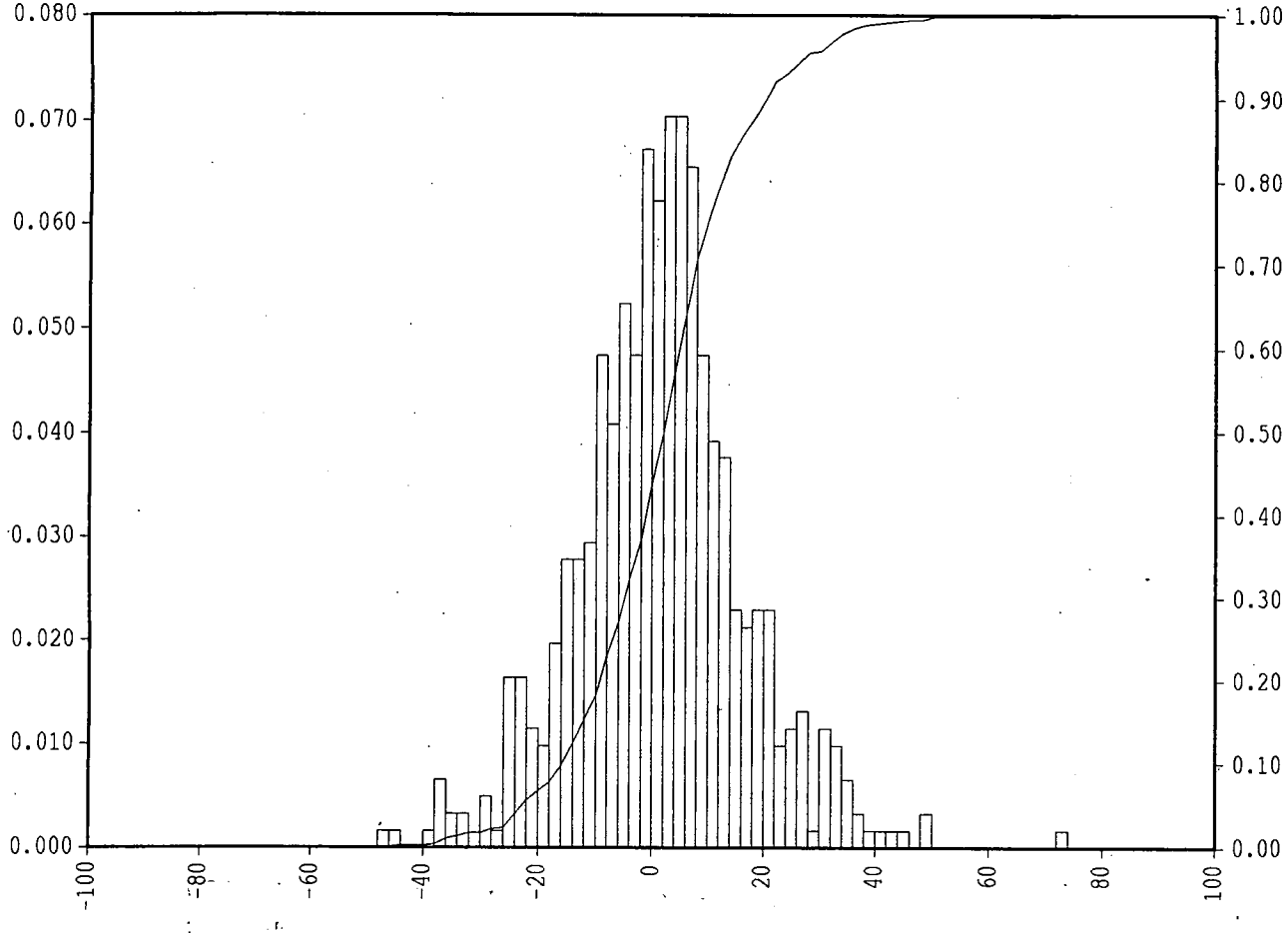
HISTOGRAM OF MISTIES ON Z HORIZON



Hole name	: MISTIES
Number of values	: 598
Minimum value	: -31
Maximum value	: 33
Arithmetic Mean	: 0.29264
Standard Deviation	: 10.9445
Geometric Mean	: 6.83467
Geometric Deviation	: 2.44357
Median	: 0.875
Mode	: 3.5

Figure 4 - Distribution of misties for Z horizon

HISTOGRAM OF MISTIES ON C HORIZON



Hole name	:	MISTIES
Number of values	:	611
Minimum value	:	-47
Maximum value	:	73
Arithmetic Mean	:	1.34534
Standard Deviation	:	14.8103
Geometric Mean	:	8.04936
Geometric Deviation	:	2.56422
Median	:	1.94737
Mode	:	3

Figure 5 - Distribution of misties for C horizon

reduced the remaining misties to the 20 msec limit. The remaining discrepancies are heavily influenced by random effects, and further work would not have significantly reduced the average level of error.

6. DEPTH CONVERSION

A simple method was sought to convert the Z horizon times to depth. Bearing in mind the sparse well control and the large area, any method used could not be expected to be very accurate, but rather should provide a reasonable first approximation. The starting point for any depth conversion method is the available well data. At each of the twenty-one wells penetrating the pre-Permian, the depth of the Z horizon was known. For each such well, the time to the mistie-corrected Z horizon was extracted from the database at the projection point of the well onto seismic lines which passed within 500 metres of the well (table 2). This resulted in between one and three estimates of the Z time at each well. Where there was more than one estimate for a well, an average was taken, weighting the closer lines more heavily. After converting to one-way time, the depth and time data for the wells was tabulated (table 3) and plotted (figure 6). The plot shows that a well-defined relationship exists between the depth and time to the Z horizon, both measured from the mean sea level datum to which all the seismic data was referred. The lack of scatter in this plot is remarkable, given the size of the area covered by the data. It implies that the average velocity through the sediments overlying the pre-Permian is essentially determined by their thickness, with relatively little lateral variation over a large area. Only one well, Mt Hammersley-1, falls significantly below the trend, indicating a faster average velocity. This can be explained by the fact that the area around this well has been uplifted and eroded (see Glen McFadzean's thesis), so that that the velocities in the remaining sediments, which are determined by the maximum burial depth, are noticably higher than those which would be predicted from their current depths.

The plot suggested that a simple empirical relationship between time and depth to the Z horizon could be found which would provide an adequate depth conversion method. A cubic regression of depth upon time was performed, with the constraint that the constant term be zero, so that the resulting curve passed through the origin (ie zero travel time at zero depth). The relationship found by the regression is:

$$D = 0. + 2891.7*T - 1680*(T**2) + 1685.6*(T**3)$$

In this equation, D represents depth in metres below msl, and T is the one-way time below msl to the Z horizon, measured in seconds. The average velocity between datum and the Z horizon is simply given by dividing the depth by the one-way time, resulting in a quadratic relationship as follows:

$$V\ average = 2891.7 - 1680*T + 1685.6*(T**2)$$

WELL	TIE LINE	STATION	EASTING (M)	NORTHING (M)	PROJ DIST (M)	Z TIME (MSEC)
CRATER 1	86-AEW	433.32	882042.	6904930.	334.6	1196.2
DALMATIA 1	86-AEB	760.60	544728.	7107948.	196.2	577.5
DALMATIA 1	86-AJE	372.11	544577.	7108072.	1.5	579.3
ERABENA 1	80-WGN	188.98	722947.	7120107.	11.1	1684.8
GLEN JOYCE 1	82-WKS	262.12	651697.	7089675.	9.9	1589.5
GLEN JOYCE 1	84-WMK	374.76	651947.	7089559.	282.6	1588.3
KILLUMI 1	76-WBA	130.86	674905.	7065335.	385.9	1728.9
KILLUMI 1	82-WLB	202.64	674547.	7065216.	24.7	1740.8
KILLUMI 1	84-WMX	1215.13	674746.	7065178.	199.4	1737.4
KUNCHERINNA 1	80-WFJ	287.83	825025.	7041398.	8.1	1945.2
LAKE VIEW 1	86-AGD	486.58	780979.	6914826.	3.3	1148.9
LAKE VIEW 1	87-BAH	337.40	781174.	6914994.	257.4	1154.4
MACUMBA 1	76-WCC	159.98	684975.	7073802.	21.7	1800.8
MACUMBA 1	76-WCD	132.86	684984.	7073692.	106.9	1793.5
MACUMBA 1	84-WMM	1881.80	684949.	7073792.	5.6	1781.8
MIANDANA 1	80-WFM	141.77	737534.	7005359.	9.4	1854.9
MIANDANA 1	80-WFN	208.03	737552.	7005357.	20.2	1854.8
MOKARI 1	74-WAA	112.02	643750.	7088070.	0.6	1634.0
MOKARI 1	84-WMJ	550.70	643718.	7088089.	37.5	1632.3
MT CRISPE 1	82-RAR	588.96	537536.	7074921.	38.8	273.2
MT CRISPE 1	86-AED	291.87	537533.	7074915.	45.9	279.0
MT HAMMERSLEY 1	85-YGS	396.90	522132.	7088673.	100.3	957.7
MULAPULA 1	86-AGQ	413.07	865482.	6859784.	416.8	1062.5
MULAPULA 1	86-AJM	314.86	865084.	6859662.	3.3	1061.8
MULKARRA WEST 1	84-TZQ	1590.09	861038.	6912469.	290.0	1037.4
MULKARRA WEST 1	88-BMP	283.95	860947.	6912744.	0.6	1029.1
OOLARINNA 1	80-WHC	164.73	685554.	7098262.	105.2	1840.1
OOLARINNA 1	84-WML	1096.72	685456.	7098223.	1.7	1836.4
POOLOWANNA 1	76-WBL	339.97	766528.	7074342.	11.4	1993.3
POOLOWANNA 1	79-WED	112.51	766570.	7074235.	104.0	1996.0
POOLOWANNA 1	87-WRA	341.00	766528.	7074331.	0.0	1991.0
POOLOWANNA 2	76-WBY	313.20	766170.	7071938.	5.1	1971.0
POOLOWANNA 2	85-WPC	711.70	766165.	7071953.	16.0	1976.0
POOLOWANNA 2	87-WRA	271.86	766168.	7071937.	3.2	1970.1
POOLOWANNA 3	76-WBY	290.81	765634.	7075266.	465.3	1957.7
POOLOWANNA 3	87-WQL	326.05	766093.	7075341.	0.2	1955.8
POONARUNNA 1	82-RBC	776.08	786855.	6910162.	53.7	1359.1
POONARUNNA 1	82-RBJ	140.51	786886.	6910148.	37.5	1360.6
POONARUNNA 1	84-TZM	468.01	786871.	6910113.	3.5	1367.3
PURNI 1	84-WMD	256.03	609482.	7092163.	62.1	1356.7
TIRARI WEST 1	87-BAN	315.47	752376.	6912620.	1.8	1424.8
TIRARI WEST 1	88-BQT	290.49	752557.	6912836.	281.7	1438.2
WALKANDI 1	80-WGE	175.15	745833.	7059757.	10.0	2069.3
WITCHERRIE 1	86-ADS	1323.63	564891.	7082977.	28.2	459.9

Table 2 - Z horizon times at well locations

WELL NAME	Z DEPTH (M KB)	Z DEPTH (M MSL)	Z OWT (SEC MSL)	CALC DEPTH (M MSL)	DEPTH ERR (M)
CRATER-1	1443.500	1392.500	0.598	1488.923	96.423
DALMATIA-1	947.000	777.220	0.285	726.697	-50.523
ERABENA-1	2433.000	2353.030	0.842	2249.967	-103.063
GLEN_JOYCE-1	2207.000	2131.100	0.795	2084.046	-47.054
KUNCHERINNA-1	2836.000	2814.970	0.973	2775.839	-39.131
LAKE_VIEW-1	1387.000	1365.970	0.574	1425.095	59.125
MACUMBA-1	2563.000	2514.570	0.895	2450.785	-63.785
MIANDANA-1	2554.000	2524.740	0.927	2579.679	54.939
MOKARI-1	2254.000	2179.630	0.817	2158.600	-21.030
MT_CRISPE-1	466.000	327.920	0.138	371.491	43.571
MT_HAMMERSLEY-1	1591.000	1412.610	0.479	1184.915	-227.695
MULAPULA-1	1367.000	1302.990	0.531	1314.168	11.178
MULKARRA_WEST-1	1270.000	1237.540	0.515	1273.885	36.345
OOLARINNA-1	2639.000	2574.690	0.918	2542.819	-31.871
POOLOWANNA-1	2902.000	2866.830	0.996	2879.000	12.170
POOLOWANNA-2	2867.000	2836.520	0.986	2833.718	-2.802
POONARUNNA-1	1630.000	1624.510	0.681	1722.478	97.968
PURNI-1	1786.000	1708.280	0.678	1713.647	5.367
TIRARI_WEST-1	1749.000	1733.160	0.713	1818.697	85.537
WALKANDI-1	3027.000	2995.640	1.035	3062.106	66.466
WITCHERRIE-1	655.000	569.050	0.230	597.921	28.871

N.B.

1) Well depths and KBs provided by SADME.

2) One way times from mistie-corrected seismic interpretation.

3) Calculated depth computed using following equation:

depth = 0 + 2891.7*T -1680*(T)**2 +1685.6*(T)**3

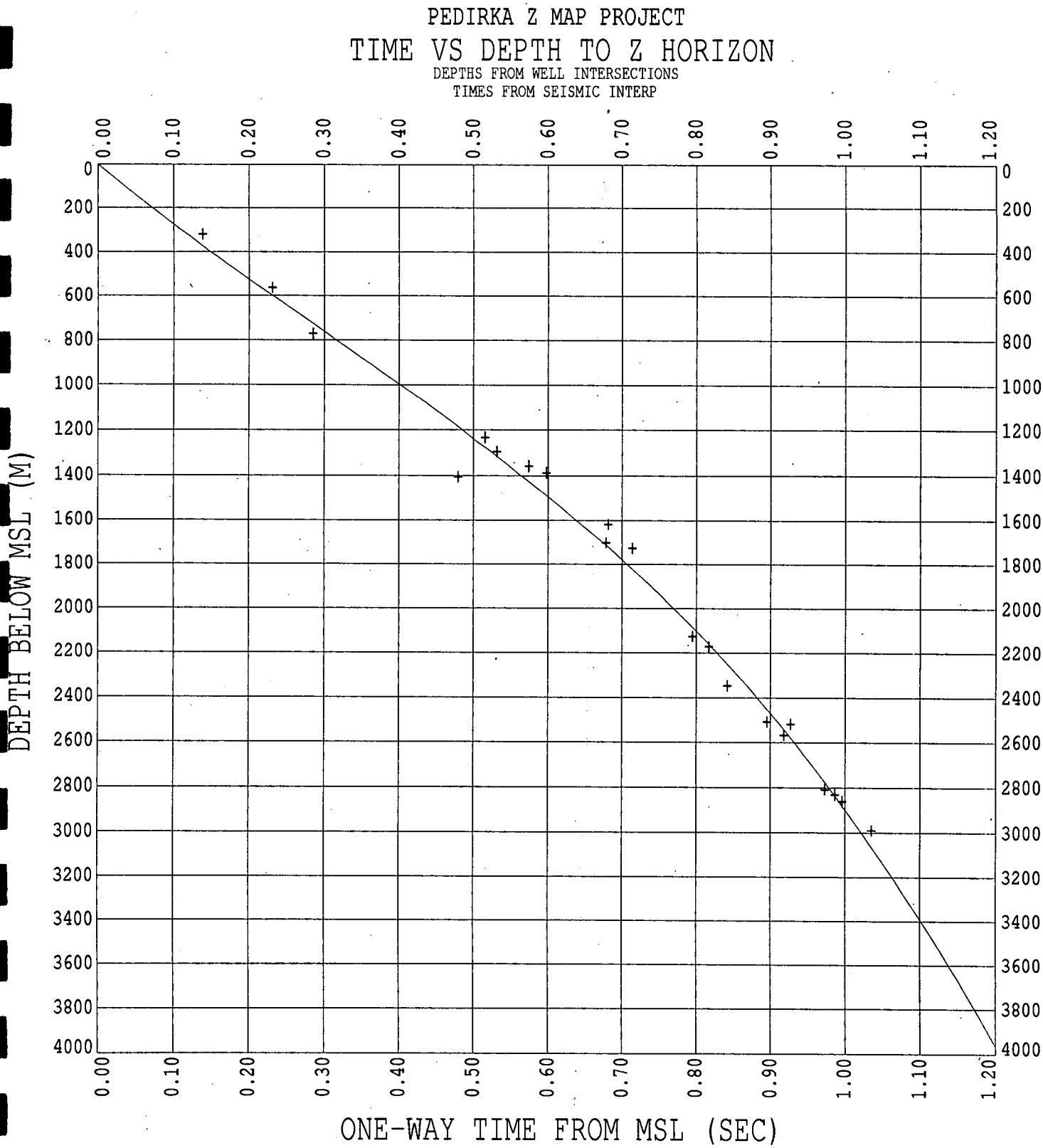
where T = one way time to Z horizon.

This equation was determined by performing a cubic regression of depth below MSL upon one way time, and forcing the constant to be zero, so that the curve passes through the origin.

4) Depth error = calculated depth - true depth.

Table 3 - Times and observed and predicted depths to Z horizon at wells

Figure 6 - Observed time-depth data at wells and regression equation



The time-depth regression function is shown in figure 6, and the depth predicted from the time to the Z horizon in each well, and the error in the prediction, is given in table 3. Excluding Mt Hammersley-1, the average unsigned prediction error for the remaining twenty wells is about 48 metres, which is equivalent to a two-way time error of between 20 and 40 msec, depending on the Z horizon time. The wells in the south of the project area, which occur in the depth range between 1200 and 1600 metres on the plot, fall consistently above the regression line, indicating slower velocities than predicted. This might be expected, since the average age of the sediments overlying the pre-Permian in this area is younger than in the wells closer to the Poolowanna Trough depocentre. Hence, the depths predicted in the southern area are likely to be somewhat deeper than the true values. Conversely, in the Mt Hammersley-1/Dalmatia-1 area, the uplift effect discussed previously will cause the predicted depths to be shallower than the true depths.

The above relationship between time and depth to the Z horizon was used in GEOSEIS to compute a corresponding depth for each mistie-corrected time pick recorded in the digitized database. The validity of extrapolating this curve to shallower or deeper times is not an issue, since the wells cover virtually the entire range of times and depths present in the digitized database.

7. MAPPING

To provide a first-pass look at the results of the interpretation, time and depth maps were generated from the data using the GEOMAP package. The results are preliminary, because GEOMAP has a number of limitations which reduce the spatial resolution of the maps below that inherent in the data. These limitations are as follows:

- The program has a limit on the number of data points which can be held in memory during the gridding process. This number is much lower than the number of points in the complete data set. Even after resampling the data to an approximately regular 500 metre interval, it was necessary to divide the new data set into three overlapping areas, generate three separate grids, and then merge them to get a final grid. Apart from the clumsiness of this procedure, it leaves the way open for artifacts caused by the merging at the edges of the grids. There is some evidence of this in the resulting maps.
- The program is unable to handle faults easily, unless the area to be gridded can be divided up into a number of discrete fault block polygons, which is not possible for this data set. Hence faults are not properly represented in the contour maps, appearing as areas of steeper gradient, rather than discontinuities. The traces on the Z horizon of the major faults were digitized and are plotted on the maps to indicate their positions. Virtually all these major faults have been interpreted as reverse or thrust faults.
- There is also a limit on the number of grid cells allowed in both dimensions. This meant that the smallest grid interval which could be used whilst still allowing the entire project area to be contained in a single grid was two km. A one km grid interval was achieved by gridding the three data sets mentioned

above, and then plotting the contours for each grid within polygons having common sides on the same base map. This process was time consuming, clumsy, and resulted in discontinuities in the contours across the polygon boundaries.

- The gridding algorithm will not extrapolate into areas of poor control, leaving holes in the contours where the data density is inadequate. This becomes more of a problem as the grid interval is reduced. In order to circumvent this effect on the two km grid interval map, a four km grid, which was complete over the project area, was converted to data, and combined with the original data, which was then gridded at the two km interval. The data points from the four km grid provided control in places where the original data distribution would have caused holes to be left in the two km grid, albeit at the loss of some spatial resolution in the resulting contour maps.

Despite these problems, two time contour maps were produced at 1:500,000 and 1:1,000,000 scales and contour intervals of 25 and 50 msec respectively (Enclosures 3 and 4). These maps show the gently dipping base of the Poolowanna Trough depocentre in the northeast, the area of deformed and uplifted basement in the west, and the complex eroded topography on the Birdsville Track Ridge to the south. Whilst the Trough itself has an east-west orientation, and most of the faulting trends more or less north-south, Nick Lemon noted evidence for a northwest-southeast structural grain in these maps, similar to that found in the adjacent Cooper Basin.

Depth maps were also generated at the same two scales, with contour intervals of 50 and 100 metres (Enclosures 5 and 6). They were produced by applying the time-depth relationship to the two km time grid, thus avoiding the process of making the depth grid from the raw depth data. Since the depth conversion process is laterally invariant, the depth map is simply a relabelled version of the time map.

It is apparent that the time and depth maps do not tie accurately to the wells in many cases. This can be explained by the smoothing brought about by the use of a two km grid interval to make the maps. Variations in relief with wavelengths less than the grid interval are attenuated by the gridding process, resulting in a contour map which is much smoother than the data set from which it was constructed. In particular, local high points (where most wells are located) are lowered, whilst local lows are raised by the smoothing. This effect is well demonstrated by figure 7, which shows the original digitized time profile for the Z horizon along line 82-RBJ. This line runs eastsoutheast from Poonarunna-1 across eroded topography of the Birdsville Track Ridge. The heavy line on this plot is the profile along the line back-interpolated from the 2-km time grid. It obviously represents a heavily smoothed version of the digitized data, and shows that the contour maps provide a very subdued picture of the local relief in this area. Differences between the digitized and gridded profiles may exceed 100 msec in places. At a well located on a local high, the contour map may mistie with the digitized well by this amount. The depth maps suffer from the same problem, but additional errors will be caused by inaccuracy in the depth conversion, as discussed previously.

82-RBJ

INTERPRETER : AG
OPERATOR :
DATE MODIFIED : 11-03-94
TIME MODIFIED : 15:00
DATE PLOTTED : 11-03-94
TIME PLOTTED : 15:04
CHECKED :
APPROVED :

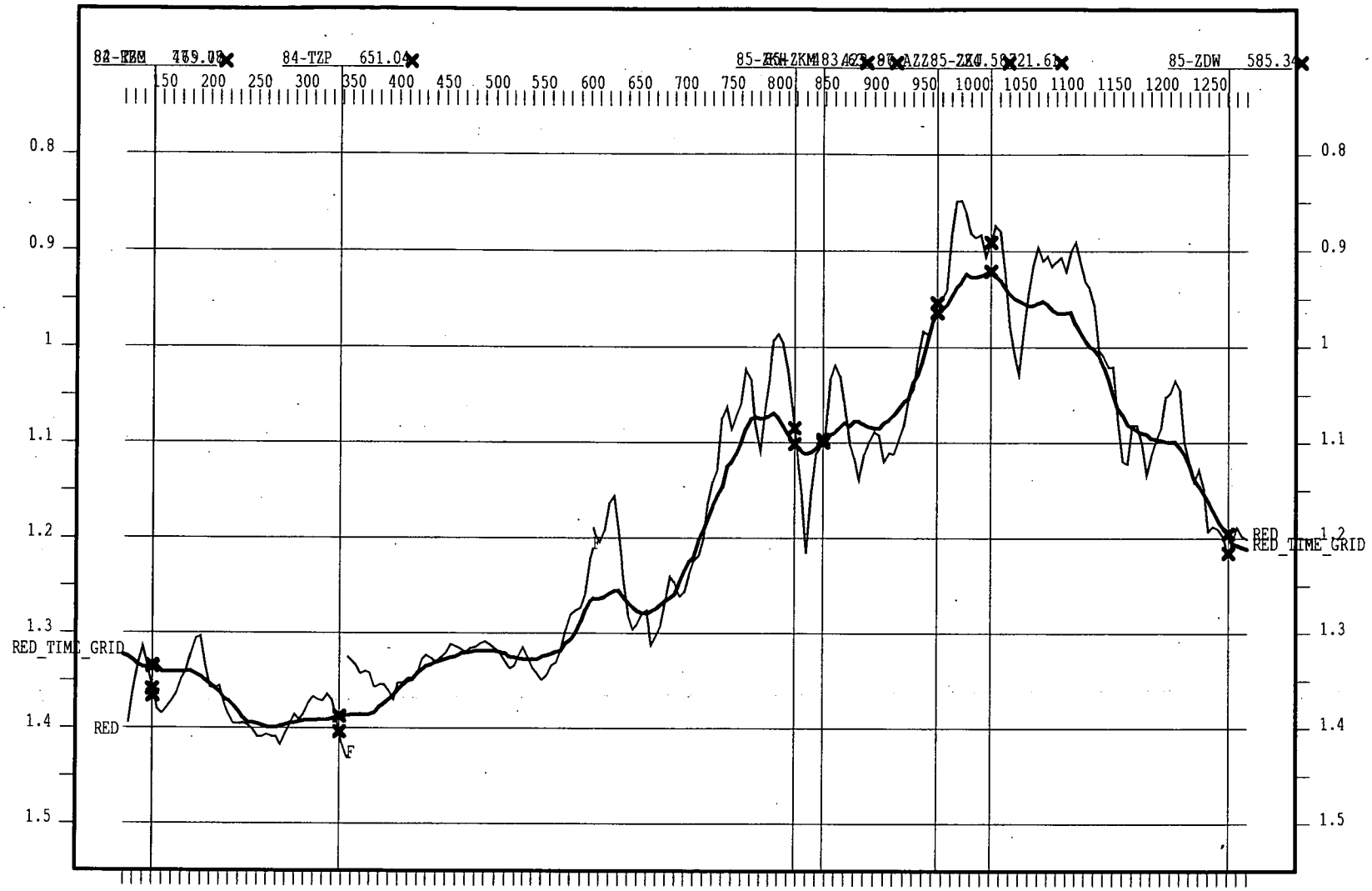


Figure 7 - Digitized and gridded time profiles for Z horizon on line 82-RBJ

00023

Hence there is much more detail in the digitized data than is shown in the maps presented here, and the dataset should be regridded with a more powerful algorithm than the one available for this work. The chief requirements will be to be able to handle larger grids and datasets, and to represent faults correctly. This was tried using the MIMIC+ package, which was able to handle the entire dataset and a one km grid interval, but has deficiencies in its extrapolation and display capabilities. Although the results are not presented here, it was obvious from the one km grid that, at this grid interval, the relatively large average spacing between adjacent seismic lines in most areas of the grid will become a problem, as the finer detail which can be captured by the smaller grid interval cannot, in many places, be sensibly extrapolated into the voids between the seismic lines. The result is a series of small anomalies strung out like beads along the seismic lines. Perhaps this effect may be reduced by feeding grid node values from a coarser grid back into the computation of the finer grid, as described above, to control the extrapolation. However, sampling theory says that the line spacing must limit the resolution achievable in computing a grid from the original data. The above experiments suggest that the limiting grid interval is probably not much below 1 km, and may be higher. There is a trade off to be made between a high resolution map which is unduly influenced by the data distribution, and a lower resolution map which does not tie the wells accurately. These issues need to be addressed before digital imaging is attempted on the gridded data, since such techniques will render any deficiencies in the grid glaringly obvious.

APPENDIX 1

Summary of seismic lines used in project

LINE	FIRST STN	LAST STN	INTERP BY	DIGITIZED BY	DATE OF DIGITIZATION
65-AB1	202	220	GM	CC	93-11-24
65-AC2	504	495	GM	CC	93-10-21
65-AD	281	258	GM	CC	93-11-25
65-AD1	282	311	GM	CC	93-11-25
65-AF1	202	147	GM	CC	93-10-25
65-AF2	257	221	GM	CC	93-10-25
65-AF3	147	94	GM	CC	93-11-23
65-AK1	950	919	GM	CC	93-11-24
66-CA	2	25	GM	CC	93-11-23
66-CB	56	26	GM	CC	93-12-09
66-CD	129	174	GM	CC	93-11-25
74-WAA	106	1000	JA	CC	93-11-23
74-WAB	1800	2000	JA	CC	93-10-04
74-WAC	100	360	AG	CC	93-10-04
74-WAD	2080	2000	AG	CC	93-10-24
74-WAE	100	210	AG	CC	93-10-17
74-WAF	2500	1970	AG	CC	93-10-21
74-WAG	1990	2400	AG	CC	93-10-20
74-WAH	2000	2540	AG	CC	93-10-17
74-WAJ	2000	2180	JA	CC	93-10-04
74-WAK	1990	2370	AG	CC	93-10-18
74-WAL	1990	2400	AG	CC	93-10-20
74-WAM	2310	2050	AG	CC	93-10-18
74-WAN	2169	2010	AG	CC	93-10-21
74-WAO	1971	2310	AG	CC	93-10-17
74-WAP	1977	2300	AG	CC	93-10-17
74-WAR	2000	2110	AG	CC	93-10-17
74-WAS	2150	2001	AG	CC	93-11-03
74-WAT	2000	2170	AG	CC	93-10-24
76-WBA	100	310	GM	CC	93-10-12
76-WBB	100	430	GM	ME	94-02-16
76-WBC	100	320	GM	CC	93-10-12
76-WBD	100	270	GM	CC	93-10-12
76-WBE	100	200	GM	CC	93-10-13
76-WBF	100	270	GM	CC	93-10-13
76-WBG	100	900	JA	CC	93-10-02
76-WBH	100	220	GM	CC	93-10-13
76-WBJ	100	600	JA	ME	94-02-03
76-WBK	100	300	JA	CC	93-10-01
76-WBL	100	380	JA	CC	93-10-01
76-WBM	100	310	JA	CC	93-10-02
76-WBN	100	430	JA	CC	93-10-04
76-WBP	290	100	JA	CC	93-10-02
76-WBQ	90	210	JA	CC	93-10-02
76-WBR	100	350	JA	CC	93-10-29
76-WBS	100	270	JA	CC	93-09-30
76-WBT	100	390	JA	CC	93-10-02
76-WBU	100	210	JA	CC	93-10-01
76-WBW	100	440	JA	CC	93-09-30
76-WBX	100	250	JA	CC	93-11-01
76-WBY	150	460	JA	CC	93-10-02
76-WCA	101	220	GM	CC	93-11-26
76-WCB	100	250	GM	CC	93-10-12
76-WCC	101	230	GM	CC	93-10-12

76-WCD	100	200	GM	CC	93-10-12
79-WDA	100	790	AG	CC	93-10-20
79-WDB	420	1310	AG	CC	93-10-21
79-WDC	100	840	AG	CC	93-10-20
79-WDD	140	750	AG	CC	93-10-20
79-WDE	100	860	AG	CC	93-10-20
79-WDF	100	580	AG	CC	93-10-20
79-WDG	100	710	AG	CC	93-10-20
79-WDH	100	750	AG	CC	93-10-20
79-WDJ	100	880	JA	CC	93-10-06
79-WDK	100	260	AG	CC	93-10-19
79-WDL	100	710	AG	CC	93-10-22
79-WDM	70	320	AG	CC	93-10-20
79-WDN	100	660	AG	CC	93-10-24
79-WDP	90	160	JA	CC	93-10-06
79-WDQ	100	420	AG	CC	93-10-24
79-WDR	105	345	AG	ME	94-01-13
79-WDS	100	470	AG	CC	93-10-24
79-WDT	80	890	JA	CC	93-10-06
79-WDU	50	900	GM	CC	93-10-13
79-WDV	70	790	GM	CC	93-11-23
79-WDW	100	840	GM	CC	93-11-30
79-WDX	100	710	GM	CC	93-11-25
79-WDZ	100	350	JA	CC	93-09-29
79-WEA	100	780	JA	CC	93-09-29
79-WEC	100	320	JA	CC	93-10-05
79-WED	100	230	JA	CC	93-11-01
79-WEE	100	500	JA	CC	93-10-06
79-WEF	100	470	JA	CC	93-10-06
79-WEG	90	680	JA	CC	93-10-07
79-WEH	100	210	JA	CC	93-10-06
79-WEJ	100	310	JA	CC	93-10-06
79-WEK	100	280	JA	CC	93-10-06
80-WFB	100	300	AG	CC	93-10-19
80-WFC	100	300	AG	CC	93-10-19
80-WFE	100	250	AG	CC	93-10-14
80-WFJ	100	430	AG	CC	93-10-11
80-WFK	100	360	AG	CC	93-10-11
80-WFL	100	370	AG	CC	93-10-17
80-WFM	100	360	AG	CC	93-10-11
80-WFN	100	340	AG	CC	93-10-11
80-WFQ	100	280	JA	CC	93-10-07
80-WFS	100	320	JA	CC	93-09-22
80-WFT	100	330	JA	CC	93-09-22
80-WFW	100	300	JA	CC	93-09-24
80-WGA	100	300	JA	CC	93-09-24
80-WGE	100	270	JA	CC	93-09-24
80-WGG	90	540	JA	CC	93-09-21
80-WGH	100	360	AG	CC	93-10-11
80-WGJ	120	340	AG	CC	93-10-11
80-WGK	100	430	JA	CC	93-09-24
80-WGN	100	250	JA	CC	93-09-24
80-WGR	110	340	JA	CC	93-09-22
80-WGS	95	350	JA	CC	93-09-22
80-WGT	100	560	JA	CC	93-09-24
80-WGZ	110	290	GM	ME	94-02-16
80-WHC	110	340	GM	CC	93-10-12
80-WHD	90	360	GM	CC	93-10-13
80-WHE	100	360	AG	CC	93-10-11
80-WHM	100	180	JA	CC	93-10-07
80-WHN	100	540	AG	CC	93-10-11
80-WHR	100	260	AG	CC	93-10-11
80-WJB	100	270	AG	CC	93-10-17
80-WJC	100	300	AG	CC	93-10-19
80-WJD	100	270	AG	CC	93-10-17
82-RAP	100	810	GM	CC	93-11-08

82-RAQ	100	470	GM	CC	93-11-05
82-RAR	100	600	GM	CC	93-11-09
82-RAS	100	420	GM	CC	93-11-08
82-RAT	100	370	GM	CC	93-11-08
82-RAW	100	720	GM	CC	93-11-09
82-RAX	100	540	GM	CC	93-11-05
82-RBC	130	790	AG	ME	94-01-14
82-RBD	520	960	AG	ME	94-01-13
82-RBE	110	270	AG	ME	94-01-13
82-RBF	110	990	AG	ME	94-02-03
82-RBG	80	970	AG	ME	94-02-02
82-RBH	100	630	AG	ME	94-01-11
82-RBJ	110	1290	AG	ME	94-01-17
82-RBK	110	1000	AG	ME	94-01-12
82-RBL	150	420	AG	ME	94-02-09
82-WKA	100	410	JA	CC	93-11-02
82-WKB	100	440	JA	CC	93-10-08
82-WKC	100	440	JA	CC	93-10-08
82-WKD	100	490	GM	CC	93-10-10
82-WKH	100	320	GM	CC	93-10-12
82-WKK	110	580	GM	CC	93-12-04
82-WKL	100	450	GM	CC	93-11-25
82-WKM	110	870	GM	ME	94-01-17
82-WKN	110	1020	GM	ME	94-02-16
82-WKP	110	870	GM	CC	93-11-26
82-WKQ	100	450	GM	CC	93-10-22
82-WKR	100	350	GM	CC	93-10-12
82-WKS	30	390	GM	CC	93-11-24
82-WKX	100	350	GM	CC	93-10-10
82-WLB	140	260	GM	CC	93-10-10
82-WLC	110	350	GM	CC	93-12-09
82-WLD	100	380	GM	CC	93-10-10
82-WLF	100	340	GM	CC	93-10-13
82-WLH	100	260	GM	CC	93-11-25
82-WLJ	100	210	GM	CC	93-11-05
82-WLM	100	310	GM	CC	93-10-10
82-WLN	100	630	JA	CC	93-11-01
82-WLQ	100	360	JA	CC	93-10-07
82-WLR	100	320	JA	CC	93-10-08
82-WLW	100	300	JA	CC	93-11-02
82-WLY	100	310	JA	CC	93-11-02
82-WLZ	100	310	JA	CC	93-11-02
82-WMB	100	270	JA	CC	93-11-01
82-WMC	100	240	JA	CC	93-11-02
84-TZH	250	2350	GM	CC	93-10-12
84-TZJ	2210	2870	AG	ME	94-02-02
84-TZK	240	1990	AG	ME	94-02-02
84-TZL	210	3870	AG	ME	94-02-03
84-TZM	210	950	AG	ME	94-01-11
84-TZN	190	3160	AG	CC	93-10-25
84-TZP	210	3280	AG	ME	94-01-18
84-TZQ	210	2560	AG	ME	94-01-17
84-TZR	210	920	AG	ME	94-02-02
84-TZS	190	3210	AG	CC	93-10-25
84-TZT	210	1500	AG	ME	94-01-12
84-TZW	210	2890	AG	ME	94-02-02
84-TZX	210	1630	AG	ME	94-01-13
84-WMD	203	1334	GM	AM	93-11-18
84-WMJ	210	720	GM	CC	93-12-06
84-WMK	210	590	GM	CC	93-12-04
84-WML	210	2200	GM	CC	93-12-06
84-WMM	210	2040	GM	CC	93-12-04
84-WMQ	210	2300	GM	CC	93-12-04
84-WMS	210	720	GM	CC	93-11-23
84-WMT	210	2720	GM	CC	93-11-24
84-WMX	190	1400	GM	CC	93-12-02

84-WMY	100	1150	GM	CC	93-11-25
84-WNA	200	700	JA	CC	93-10-08
84-XAA	210	2180	AG	ME	94-01-11
84-XAF	120	3600	GM	CC	93-10-29
84-XAK	220	3520	GM	CC	93-11-25
84-XEZ	200	510	AG	CC	93-10-24
84-XFG	220	1260	AG	CC	93-12-10
85-WNF	200	1090	GM	CC	93-11-25
85-WNG	200	900	GM	CC	93-11-24
85-WNP	200	460	GM	CC	93-11-24
85-WNQ	200	600	GM	CC	93-11-24
85-WNS	210	1630	JA	CC	93-10-10
85-WNT	200	800	JA	CC	93-10-10
85-WNW	200	1100	JA	CC	93-09-27
85-WNX	200	1200	JA	CC	93-09-27
85-WNY	200	1140	JA	CC	93-09-27
85-WPA	200	630	JA	CC	93-09-27
85-WPC	200	790	JA	CC	93-09-27
85-WPE	200	650	JA	CC	93-10-14
85-WPG	200	500	AG	CC	93-10-14
85-WPN	210	1900	AG	ME	94-02-02
85-WPQ	210	480	GM	CC	93-10-12
85-WPR	200	890	GM	CC	93-11-25
85-WPS	200	490	GM	CC	93-10-12
85-WPT	200	840	JA	CC	93-10-08
85-WPY	210	940	AG	ME	94-02-02
85-WPZ	190	480	AG	ME	94-02-02
85-YGH	405	755	GM	CC	93-12-09
85-YGK	190	1120	GM	CC	93-11-05
85-YGN	200	1750	GM	CC	93-12-20
85-YGP	205	600	GM	CC	93-12-08
85-YGR	200	730	GM	CC	93-11-05
85-YGS	200	683	GM	CC	93-10-20
85-YGT	200	650	GM	CC	93-10-20
85-YGW	200	1080	GM	CC	93-11-08
85-YJP	190	690	GM	CC	93-12-21
85-YJQ	190	770	GM	CC	93-11-02
85-YJR	200	800	GM	CC	93-11-08
85-YRS	210	2230	AG	ME	94-01-13
85-YRT	210	1880	AG	ME	94-02-14
85-YRW	210	1960	AG	ME	94-01-11
85-YRX	210	730	AG	ME	94-02-09
85-YRY	210	1430	AG	ME	94-01-14
85-YRZ	210	2080	AG	ME	94-01-13
85-YSA	210	2300	AG	ME	94-01-14
85-ZDR	190	1200	AG	CC	93-10-29
85-ZDS	210	1060	AG	ME	94-01-12
85-ZDT	200	1270	AG	CC	93-12-06
85-ZDW	210	1780	AG	ME	94-01-13
85-ZJZ	210	590	AG	ME	94-02-02
85-ZKC	200	700	AG	CC	93-10-29
85-ZKD	200	600	AG	CC	93-10-29
85-ZKH	210	2200	AG	ME	94-01-14
85-ZKJ	210	1600	AG	ME	94-01-13
85-ZKK	210	1040	AG	ME	94-01-11
85-ZKL	200	1060	AG	CC	93-12-06
85-ZKM	210	2050	AG	ME	94-01-12
85-ZKN	210	1980	AG	ME	94-01-12
86-ADS	200	1410	GM	CC	93-12-03
86-ADT	190	1200	GM	CC	93-11-09
86-ADW	310	1000	GM	CC	93-11-25
86-ADX	220	760	GM	CC	93-12-08
86-AEA	200	460	GM	CC	93-11-08
86-AEB	190	1040	GM	CC	93-12-20
86-AEC	240	890	GM	CC	93-10-29
86-AED	200	840	GM	CC	93-11-08

86-AEF	210	1100	GM	CC	93-12-09
86-AES	210	1430	AG	CC	93-12-09
86-AET	210	1260	AG	ME	94-02-09
86-AEW	210	830	AG	ME	94-01-12
86-AEX	210	830	AG	ME	94-01-12
86-AEY	210	960	AG	ME	94-01-12
86-AEZ	210	830	AG	ME	94-01-13
86-AFA	210	670	AG	ME	94-01-12
86-AFB	210	770	AG	ME	94-01-12
86-AGD	190	690	AG	CC	93-10-25
86-AGE	210	810	AG	ME	94-02-02
86-AGG	210	460	AG	ME	94-01-13
86-AGJ	210	560	AG	ME	94-01-13
86-AGK	210	460	AG	ME	94-01-13
86-AGM	210	520	AG	ME	94-01-13
86-AGN	210	590	AG	ME	94-01-13
86-AGQ	190	520	AG	CC	93-10-25
86-AJE	200	540	GM	CC	93-12-20
86-AJH	210	550	GM	CC	93-12-09
86-AJJ	200	680	GM	CC	93-12-08
86-AJM	190	440	AG	CC	93-10-25
87-AZZ	210	750	AG	ME	94-01-12
87-BAB	230	660	AG	ME	94-01-13
87-BAC	210	610	AG	ME	94-02-02
87-BAD	210	700	AG	CC	93-12-06
87-BAH	190	510	AG	CC	93-10-25
87-BAM	270	730	AG	ME	94-02-02
87-BAN	210	670	AG	ME	94-02-02
87-BAP	250	550	AG	CC	93-10-29
87-BAQ	280	1220	AG	CC	93-10-22
87-BAR	200	700	AG	CC	93-10-21
87-BBA	210	700	AG	ME	94-01-11
87-BCC	220	780	AG	ME	94-01-12
87-BCD	210	910	AG	ME	94-01-13
87-BCE	220	720	AG	ME	94-01-11
87-BCF	220	640	AG	ME	94-01-11
87-BCK	220	740	AG	ME	94-01-12
87-WQL	200	440	JA	CC	93-09-29
87-WRA	200	520	JA	CC	93-09-29
88-BJA	190	530	AG	CC	93-10-24
88-BJB	200	520	AG	CC	93-10-24
88-BJC	190	660	AG	CC	93-10-22
88-BJD	190	870	AG	CC	93-11-02
88-BMP	200	430	AG	CC	93-12-06
88-BMY	200	600	AG	CC	93-12-06
88-BMZ	210	830	AG	ME	94-01-11
88-BQT	200	450	AG	CC	93-10-29
88-WRF	210	1650	AG	ME	94-01-13
88-WRG	210	1220	AG	CC	93-10-21
88-WRH	200	1370	AG	CC	93-10-21
88-WRJ	200	2420	AG	CC	93-10-21
88-WRK	200	3100	AG	CC	93-12-10

N.B.

1) Interpreters:

AG = Anthony Goodall
GM = Glen McFadzean
JA = Joint Area (interpretation by both AG & GM)

2) Digitizer operators:

CC = Chris Cubitt
ME = Martin Eldridge

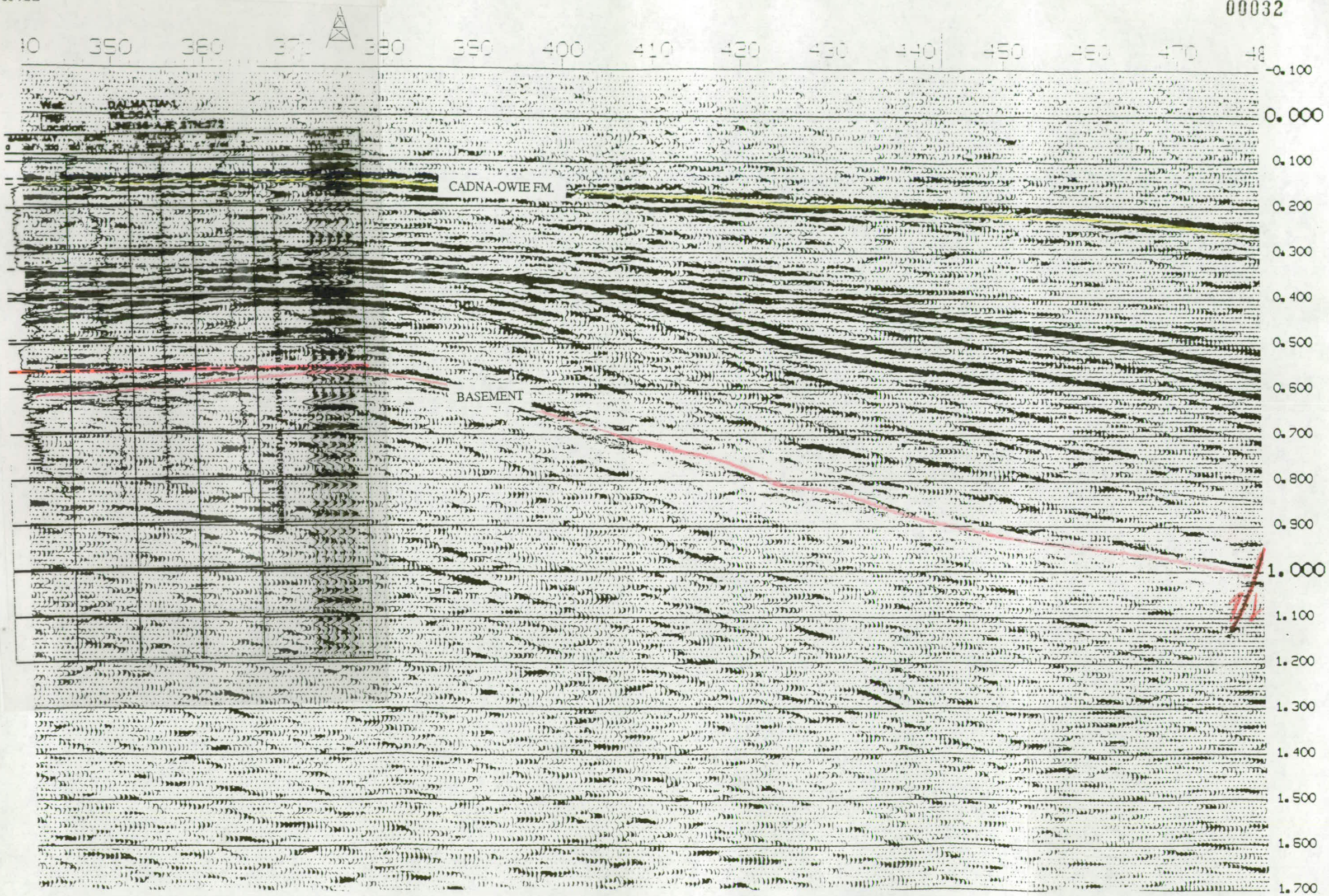
APPENDIX 2

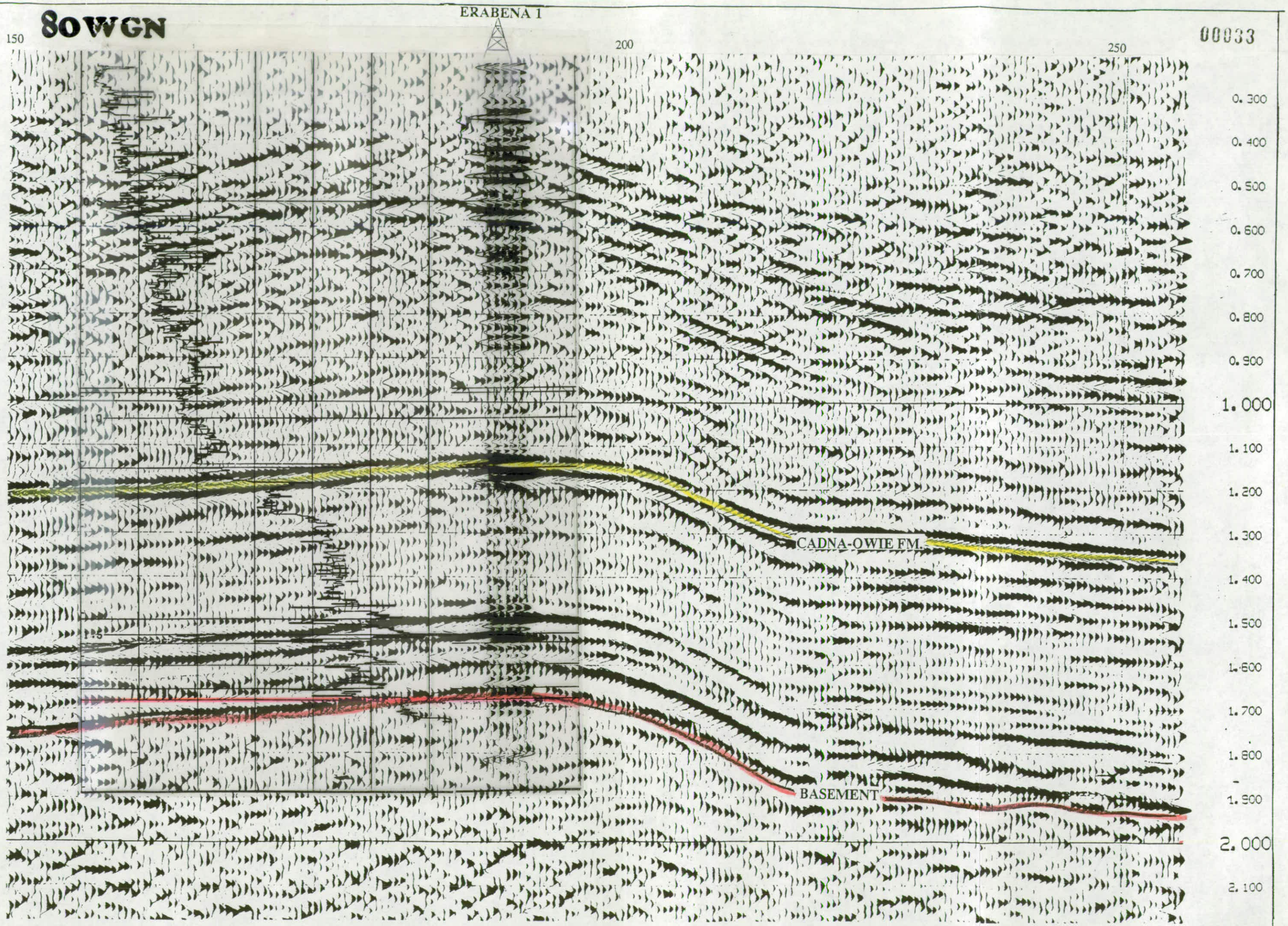
Synthetic to seismic ties for wells used in project

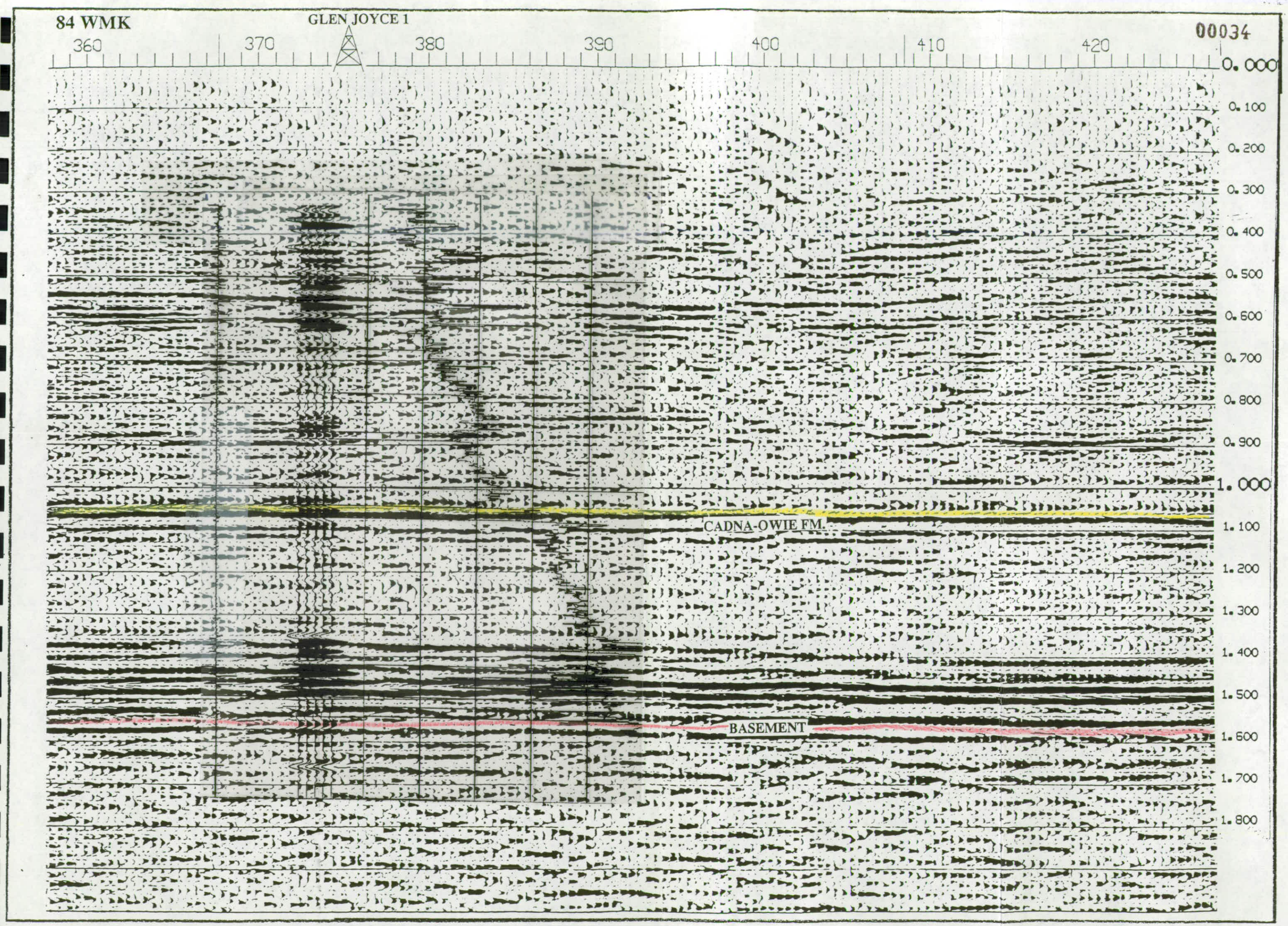
86-AJE

DALMATIA 1

00032

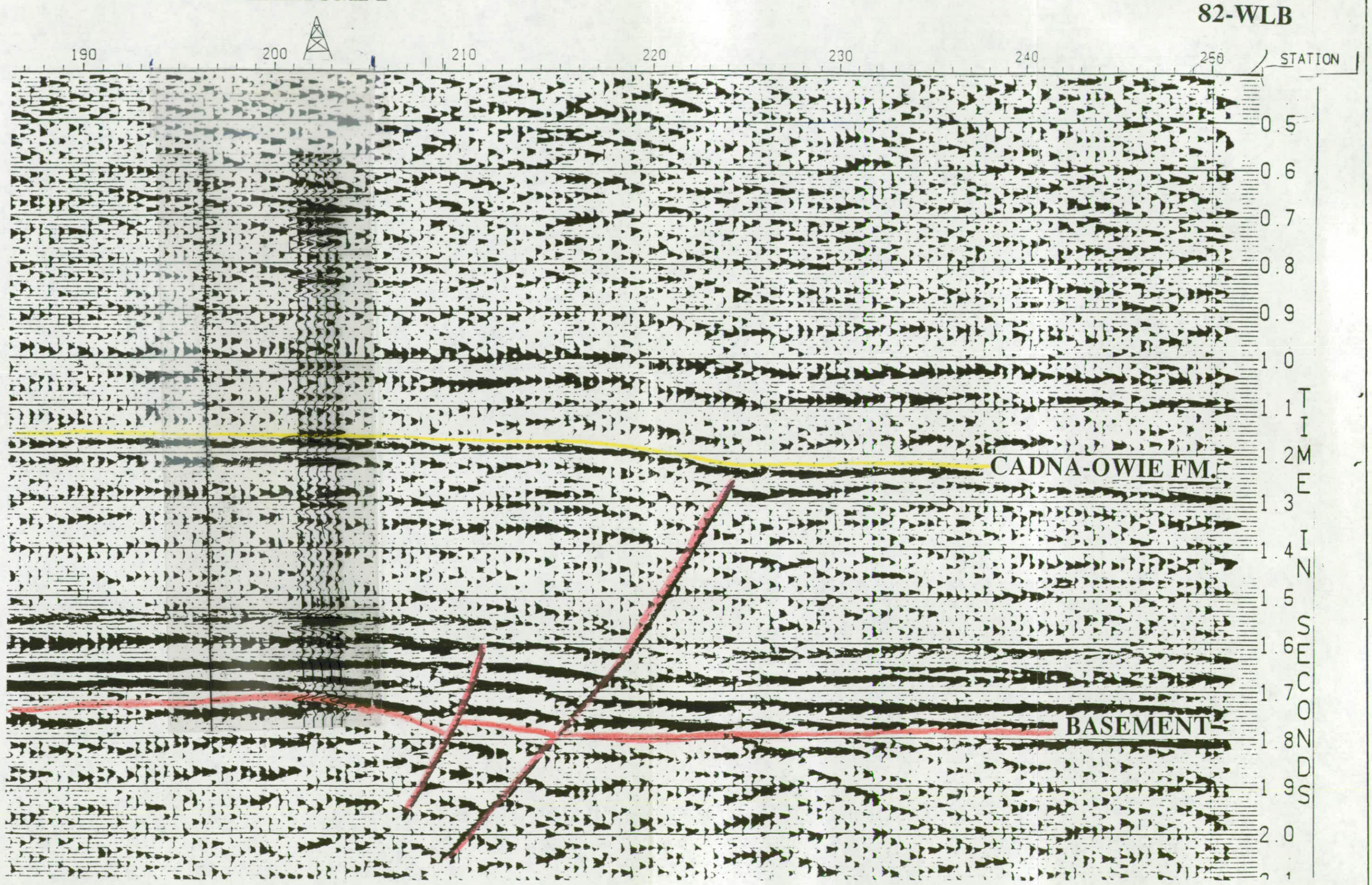


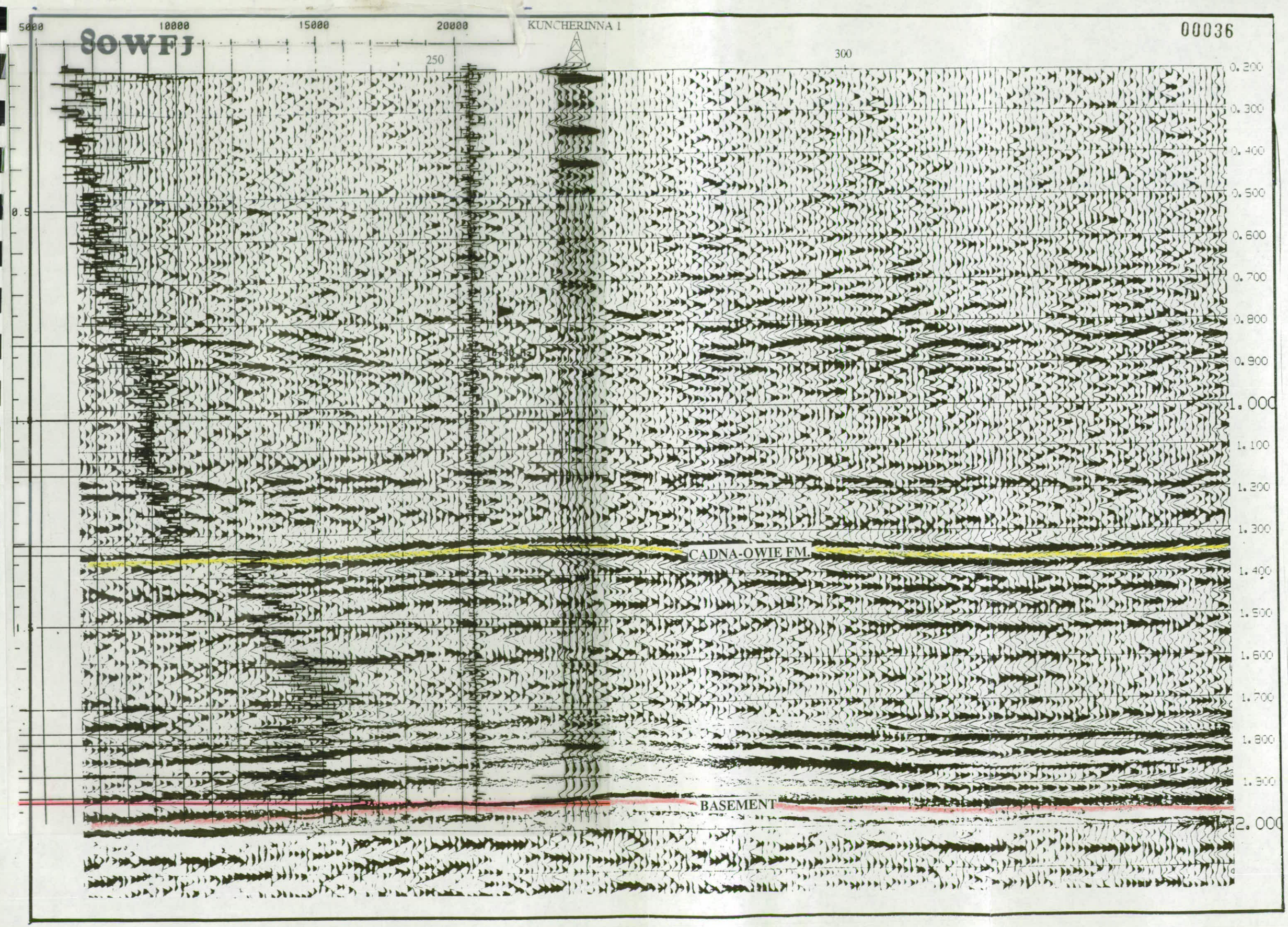

80WGN
ERABENA 1
00033
150
200
250
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
1.900
2.000
2.100
CADNA-OWIE FM.
BASEMENT


84 WMK
GLEN JOYCE 1
00034
360
370
380
390
400
410
420
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
CADNA-OWIE FM.
BASEMENT

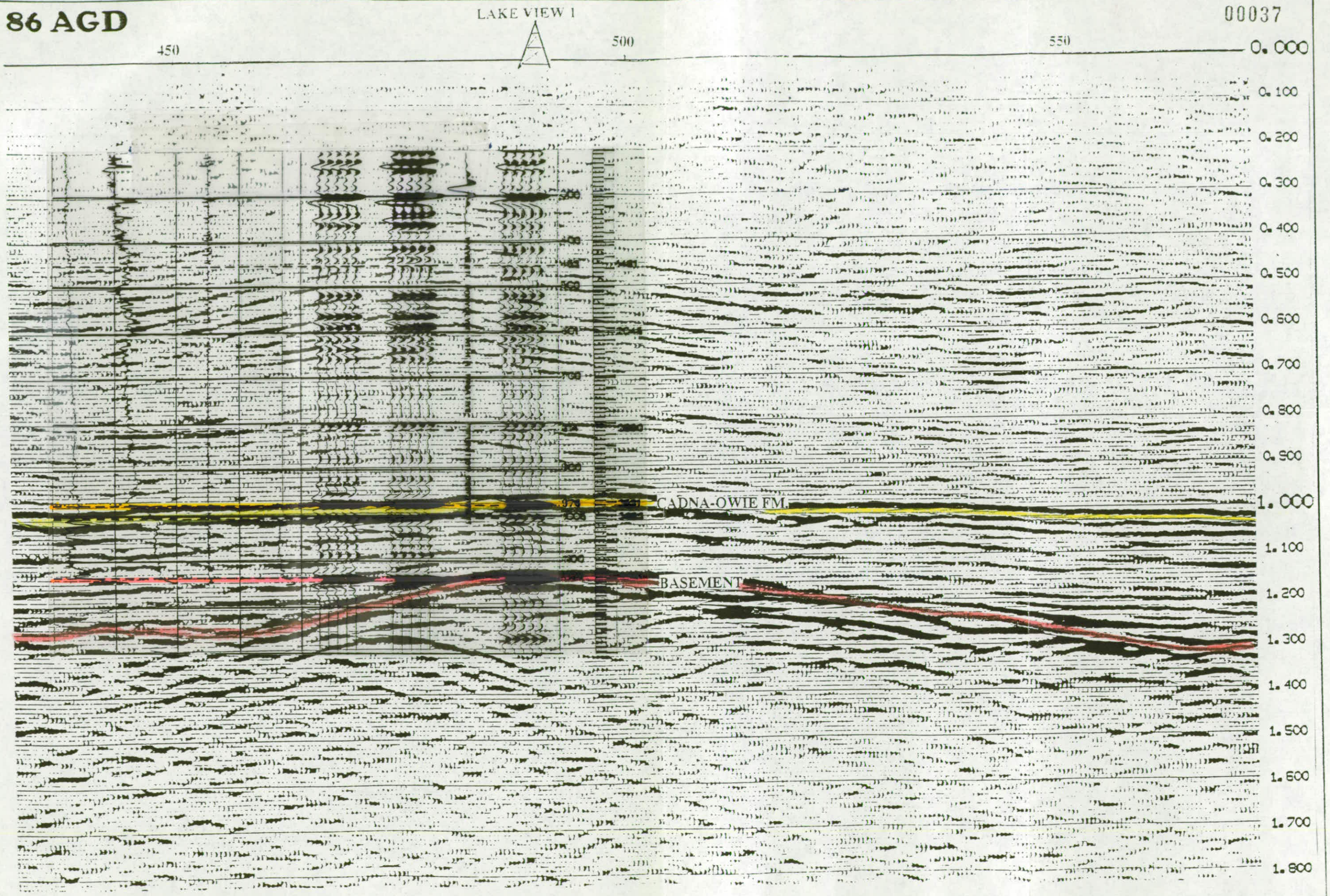
KILLUMI 1

82-WLB




5000
10000
15000
20000
KUNCHERINNA 1
00036
250
300
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
1.900
2.000
0.5
1.0
1.5
CADNA-OWIE FM.
BASEMENT

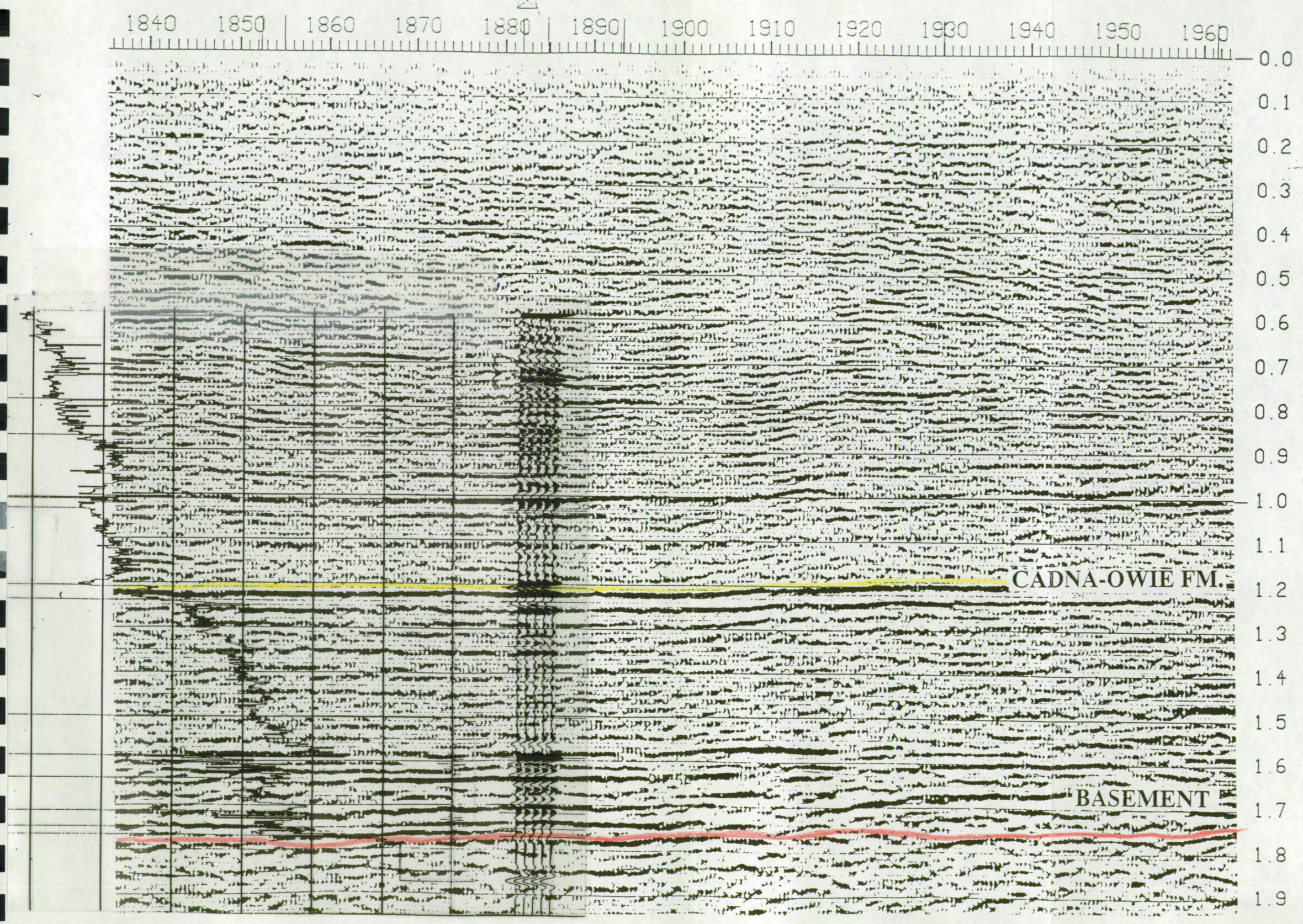
86 AGD

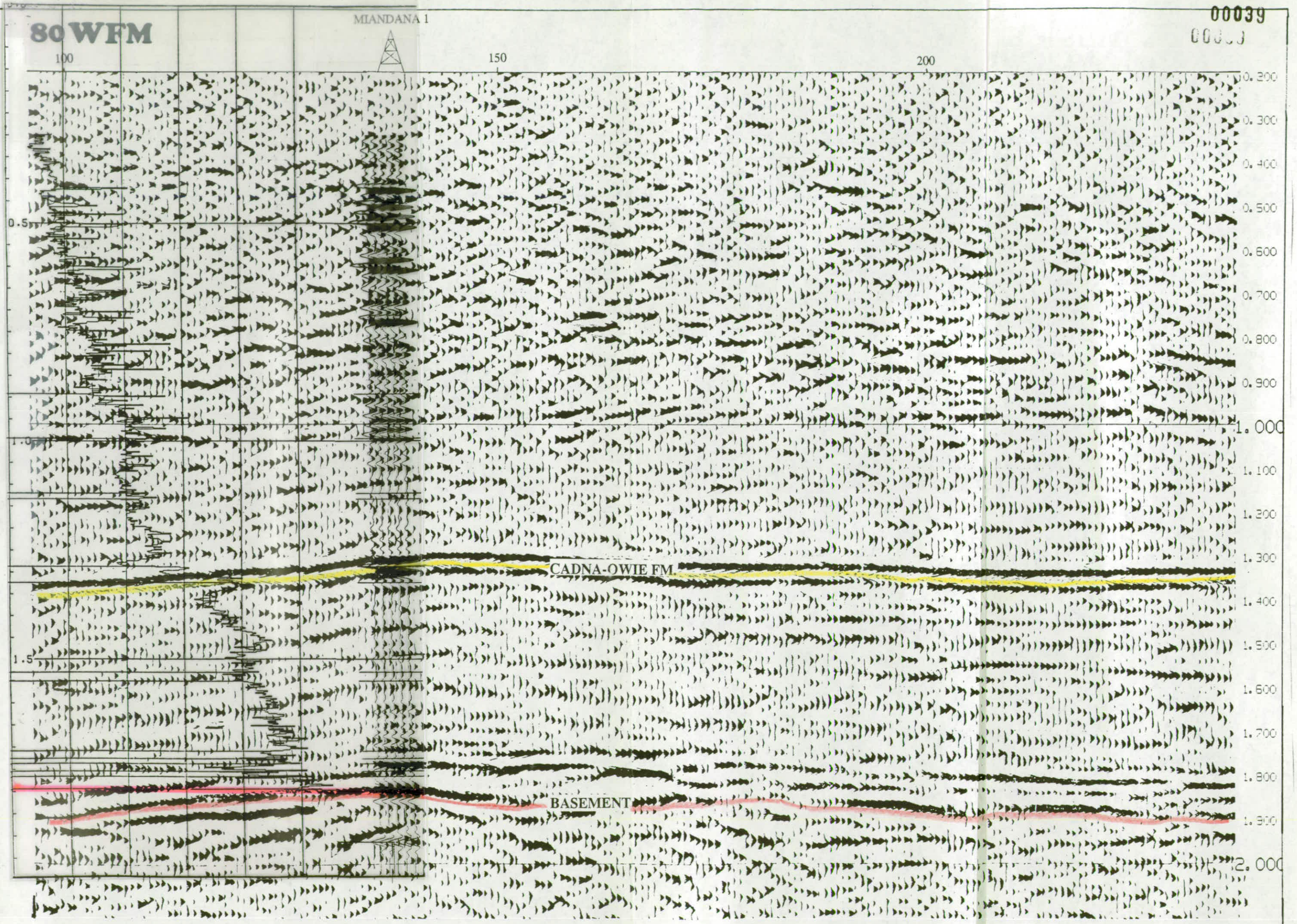

LAKE VIEW 1
00037
450
500
550
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
CADNA-OWIE FM.
BASEMENT

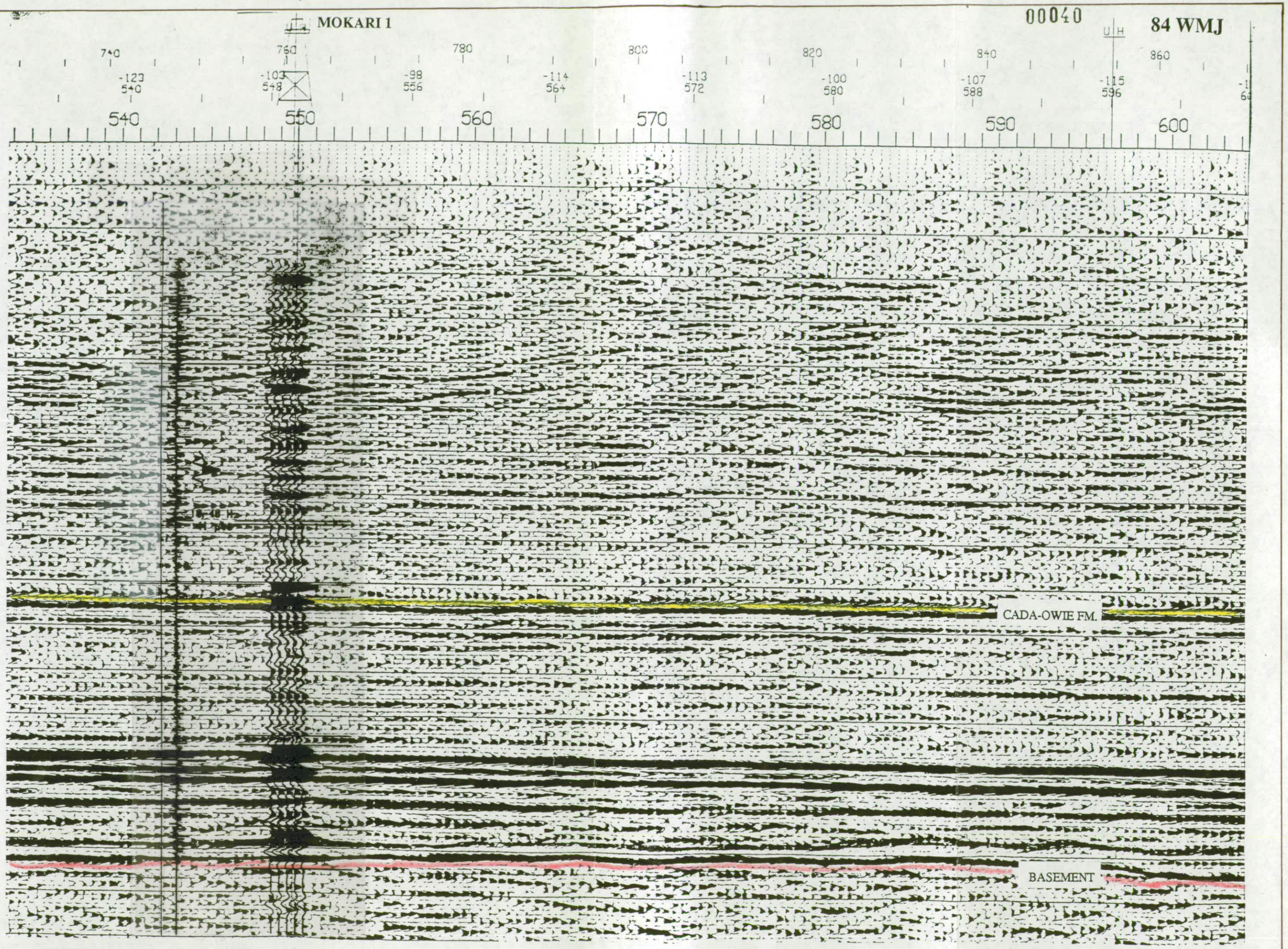
MACUMBA 1

84-WMM

00038

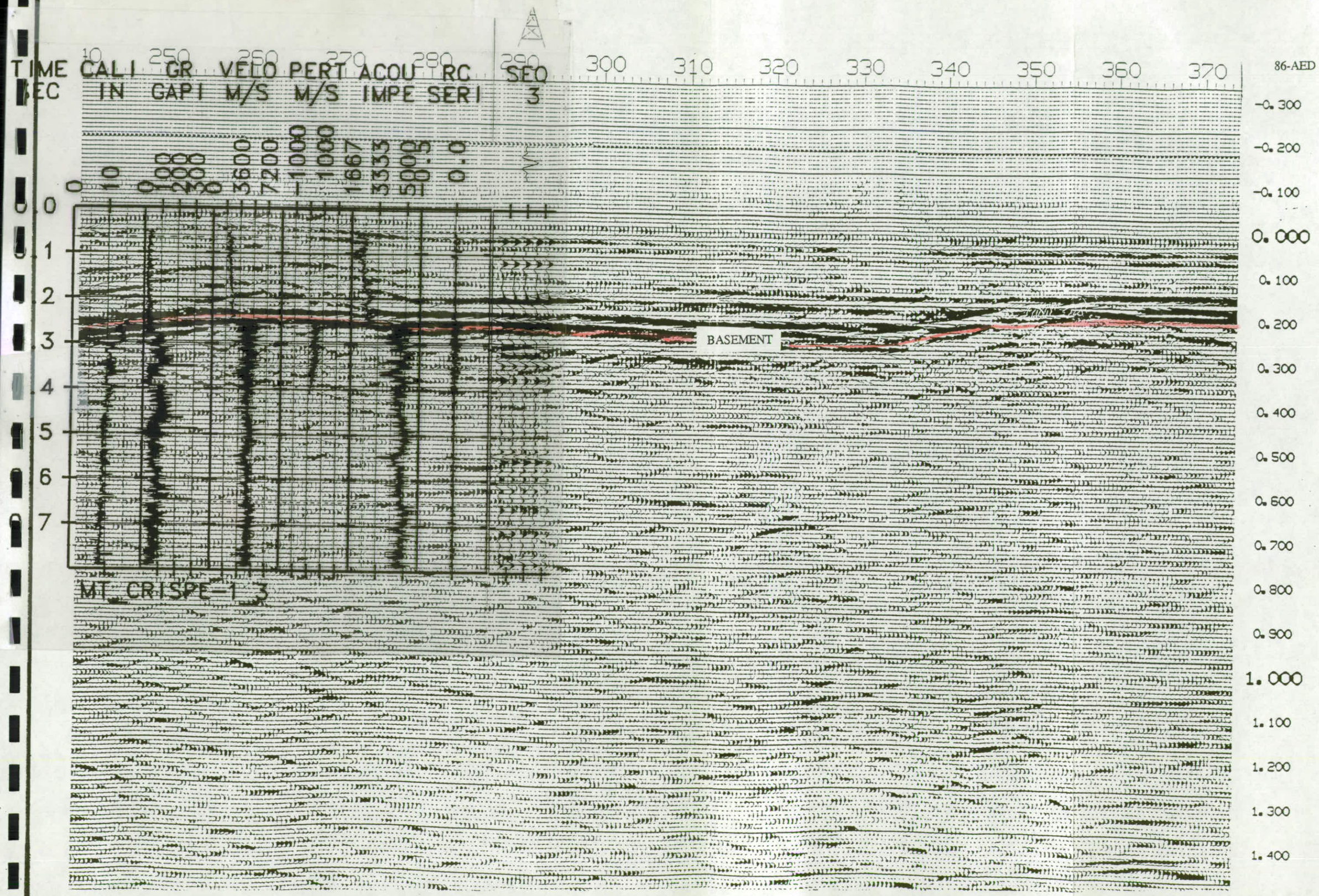



80WFM
MIANDANA 1
00039
100
150
200
0.5
1.0
1.5
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
1.900
2.000
CADNA-OWIE FM
BASEMENT


MOKARI 1
00040
84 WMJ
U H
740
760
780
800
820
840
860
-123
540
-103
548
-98
556
-114
564
-113
572
-100
580
-107
588
-115
596
540
550
560
570
580
590
600
CADA-OWIE FM.
BASEMENT

MOUNT CRISPE 1

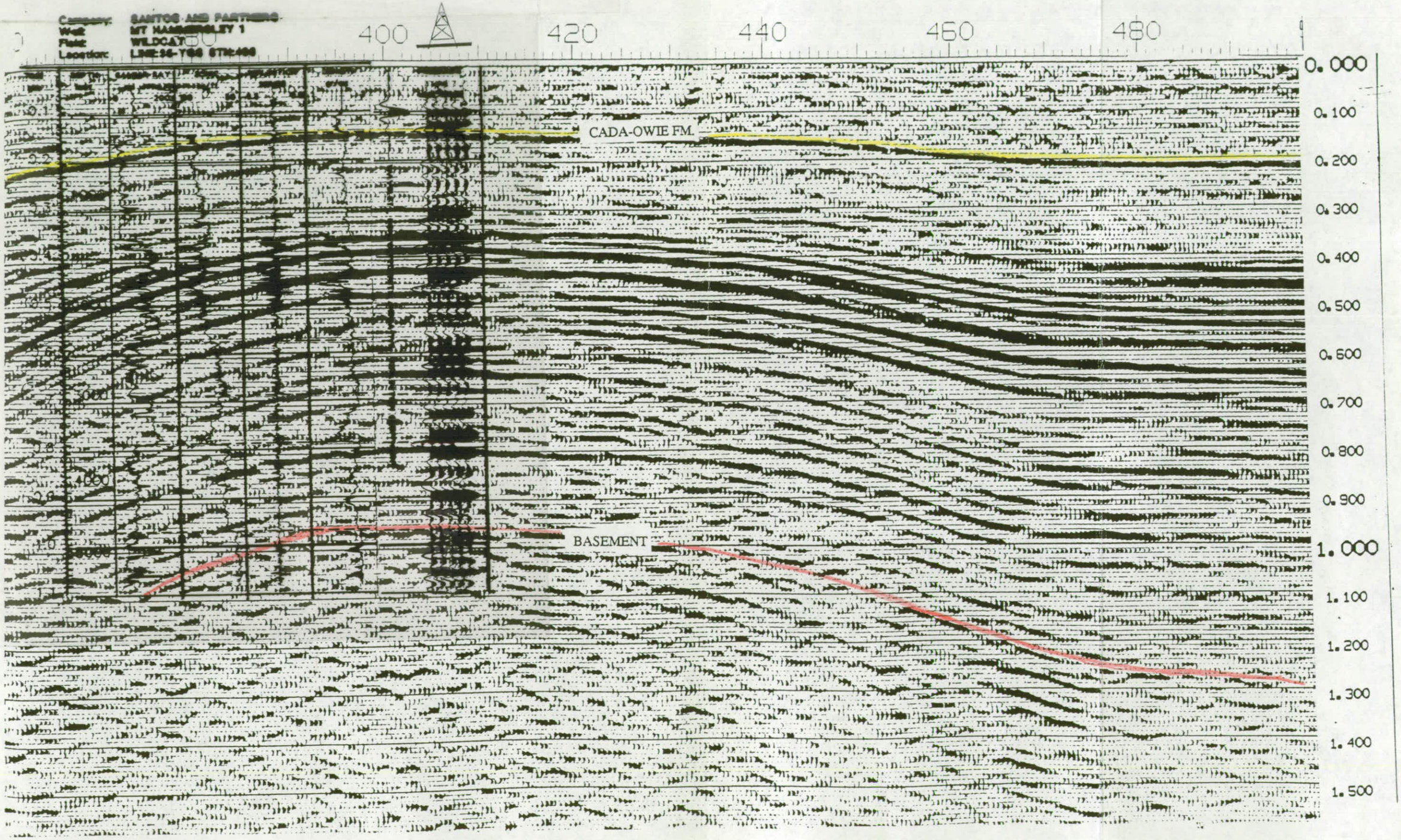
00041



85-YGS

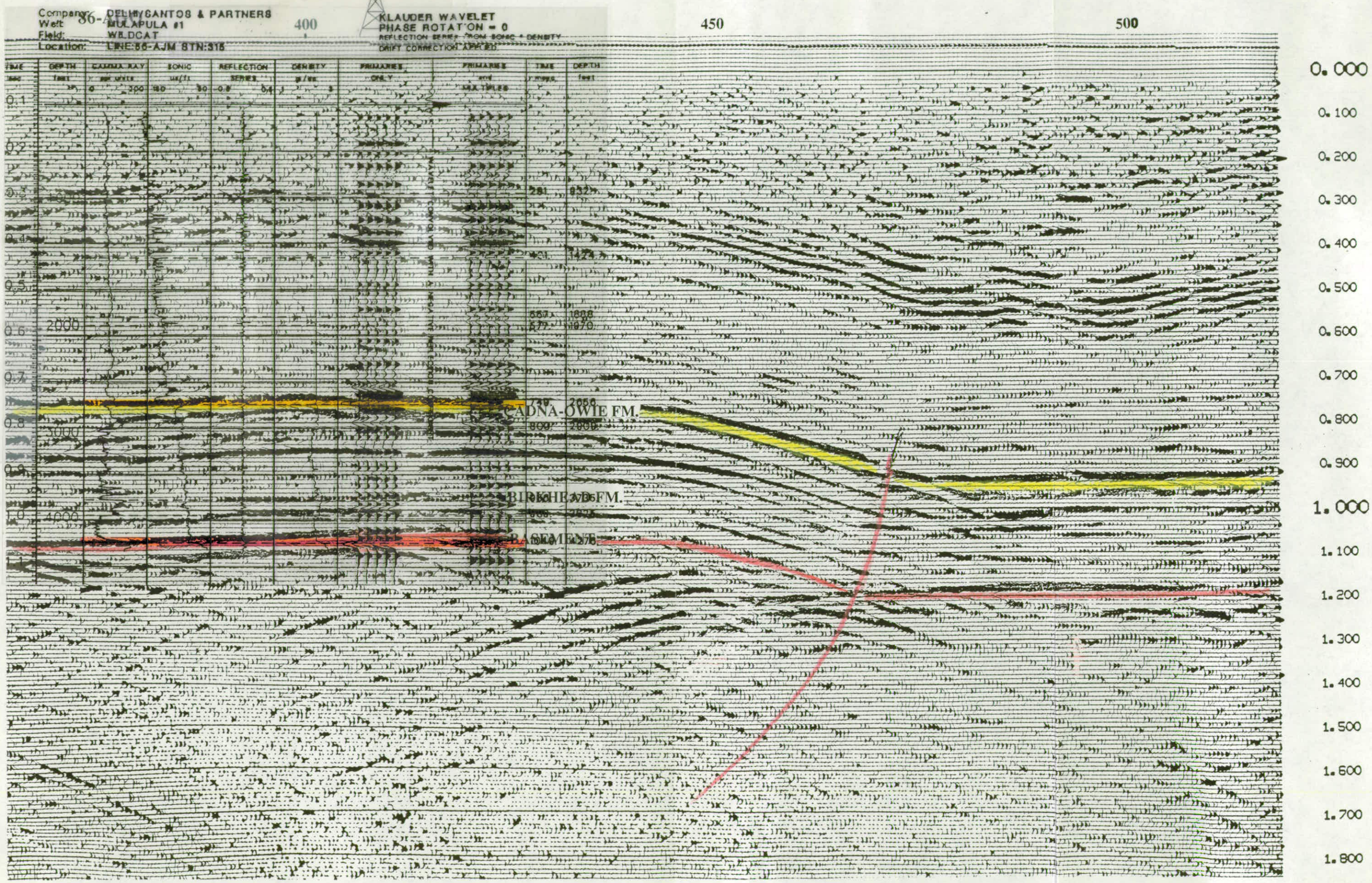
00042

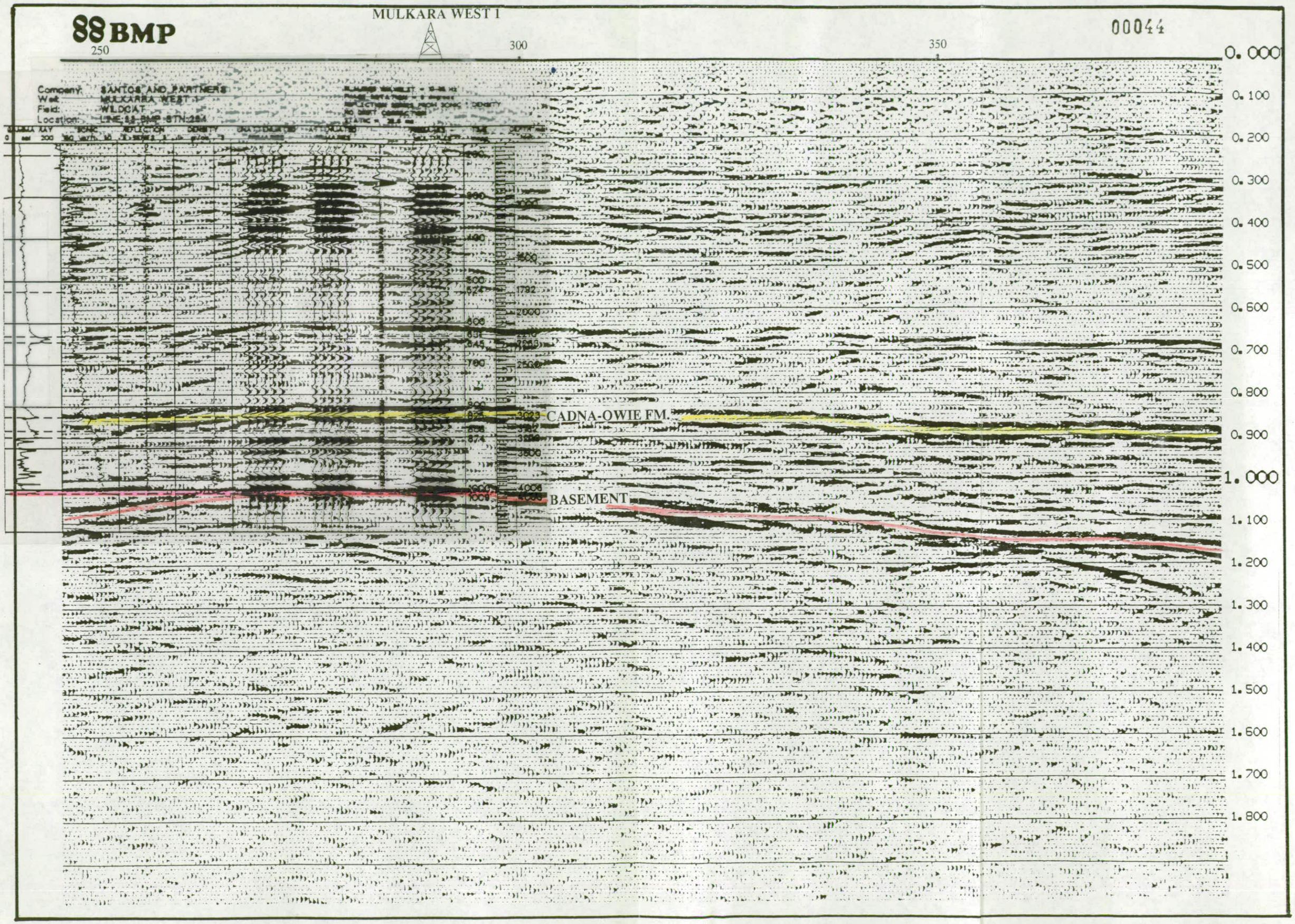
MOUNT HAMMERSLEY 4

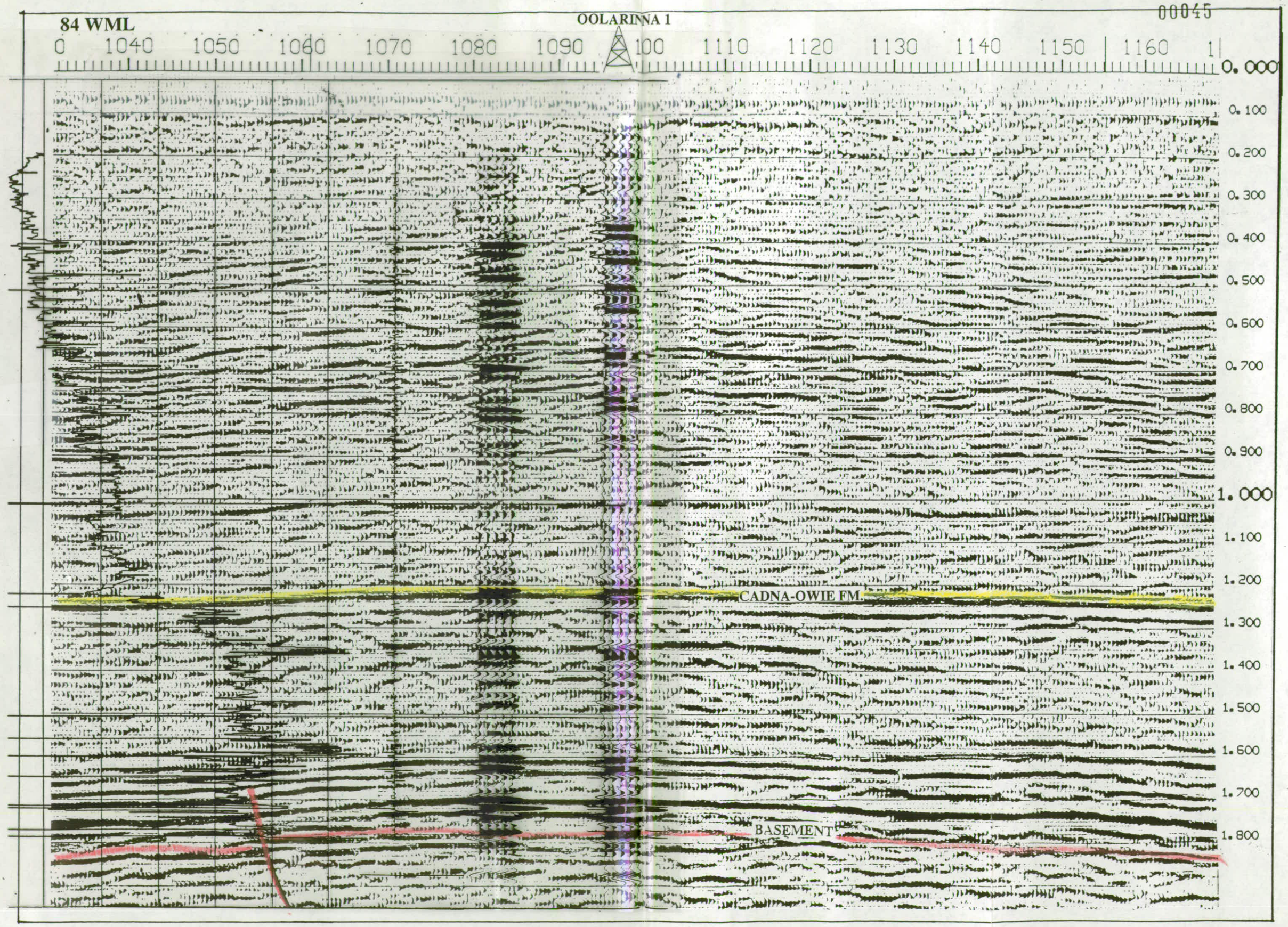


MULAPULA-1

00043

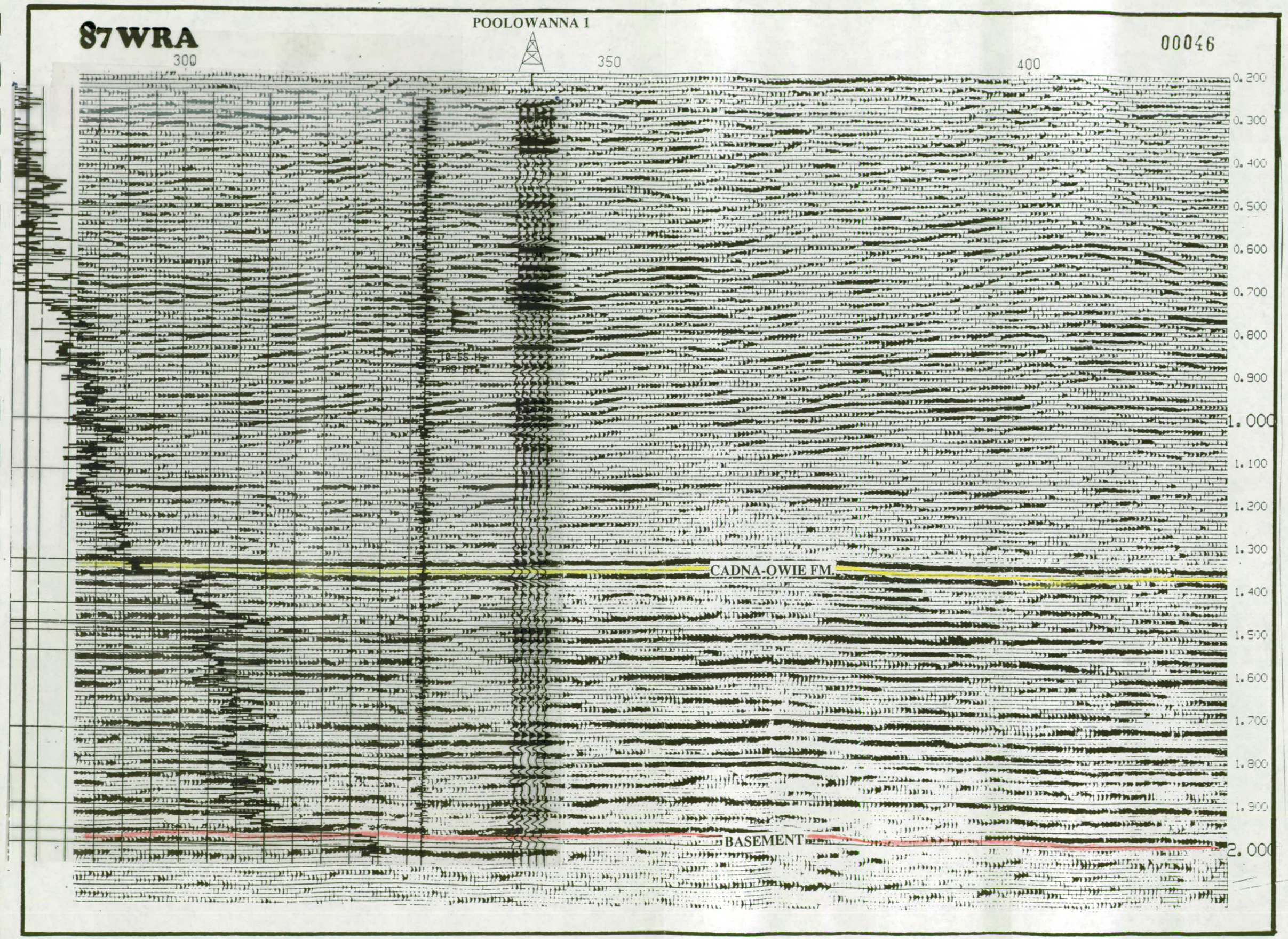



88 BMP
MULKARA WEST 1
00044
250
300
350
Company: SANTOS AND PARTNERS
Well: MULKARA WEST 1
Field: WILDCAT
Location: LINE 88 BMP STN 284
CADNA-OWIE FM.
BASEMENT
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800


84 WML
OOLARINNA 1
00045
0
1040
1050
1060
1070
1080
1090
100
1110
1120
1130
1140
1150
1160
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
CADNA-OWIE FM.
BASEMENT

87WRA

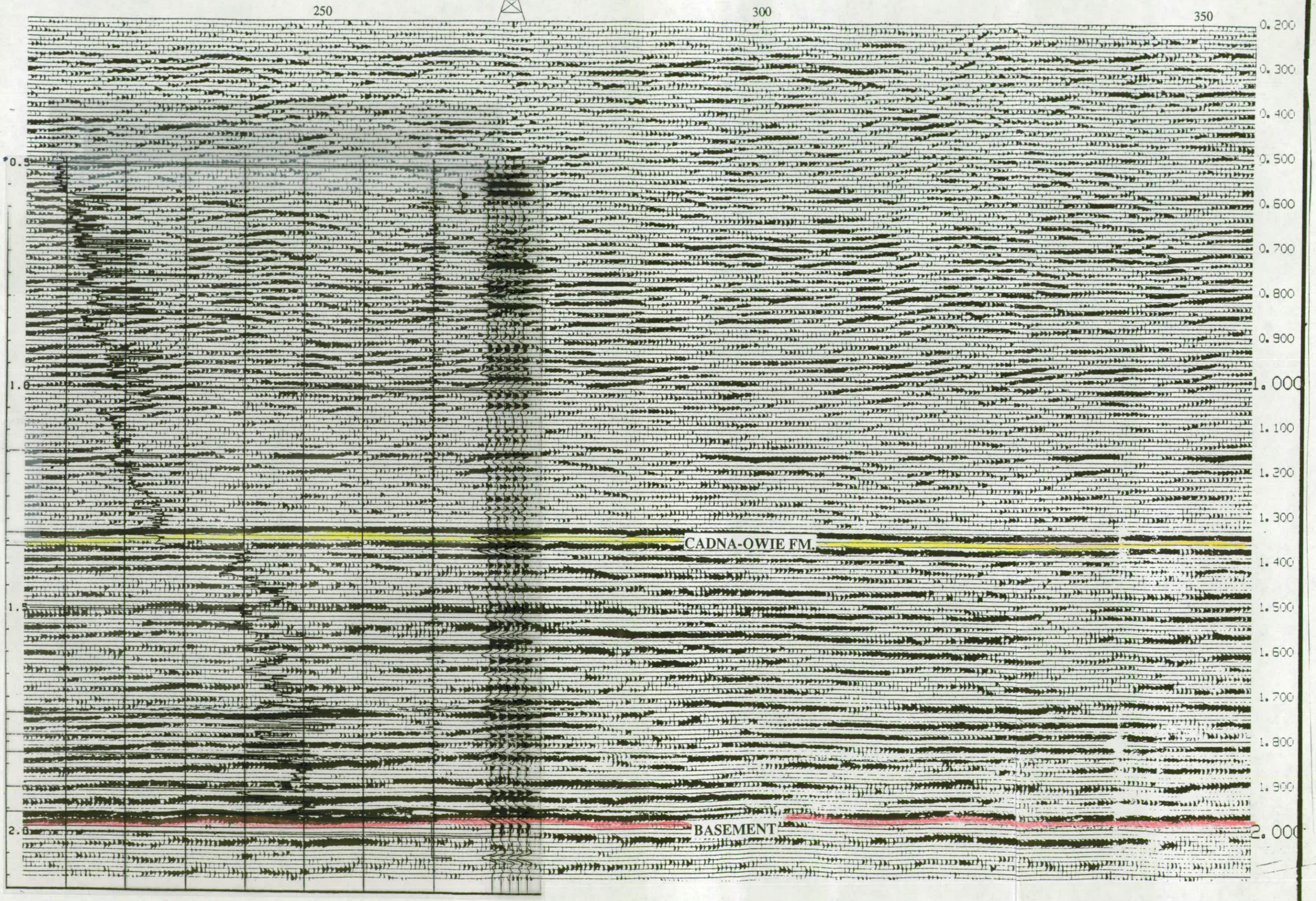
00046


POOLOWANNA 1
300
350
400
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
1.900
2.000
CADNA-OWIE FM.
BASEMENT

87 WRA

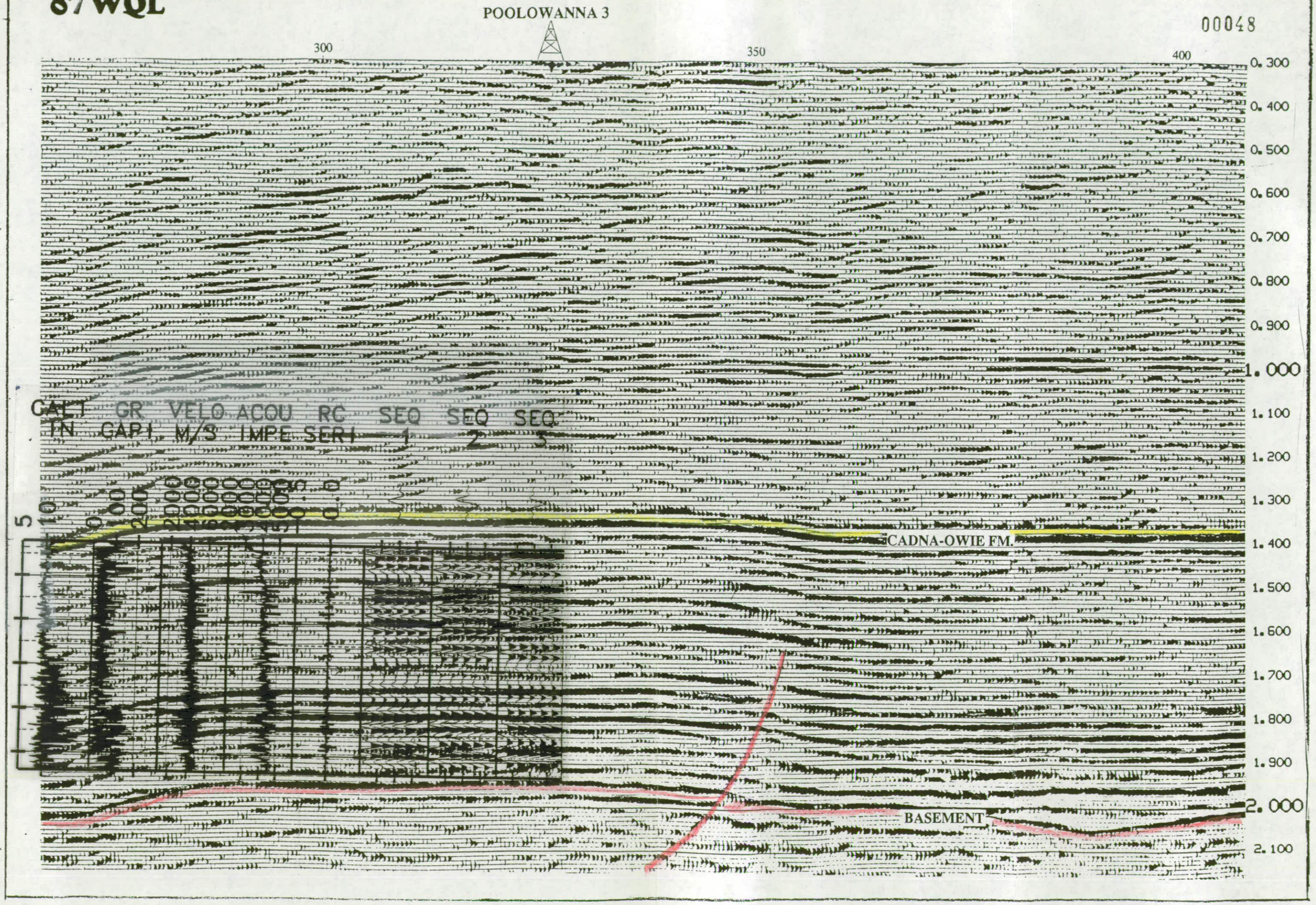
POOLOWANNA 2

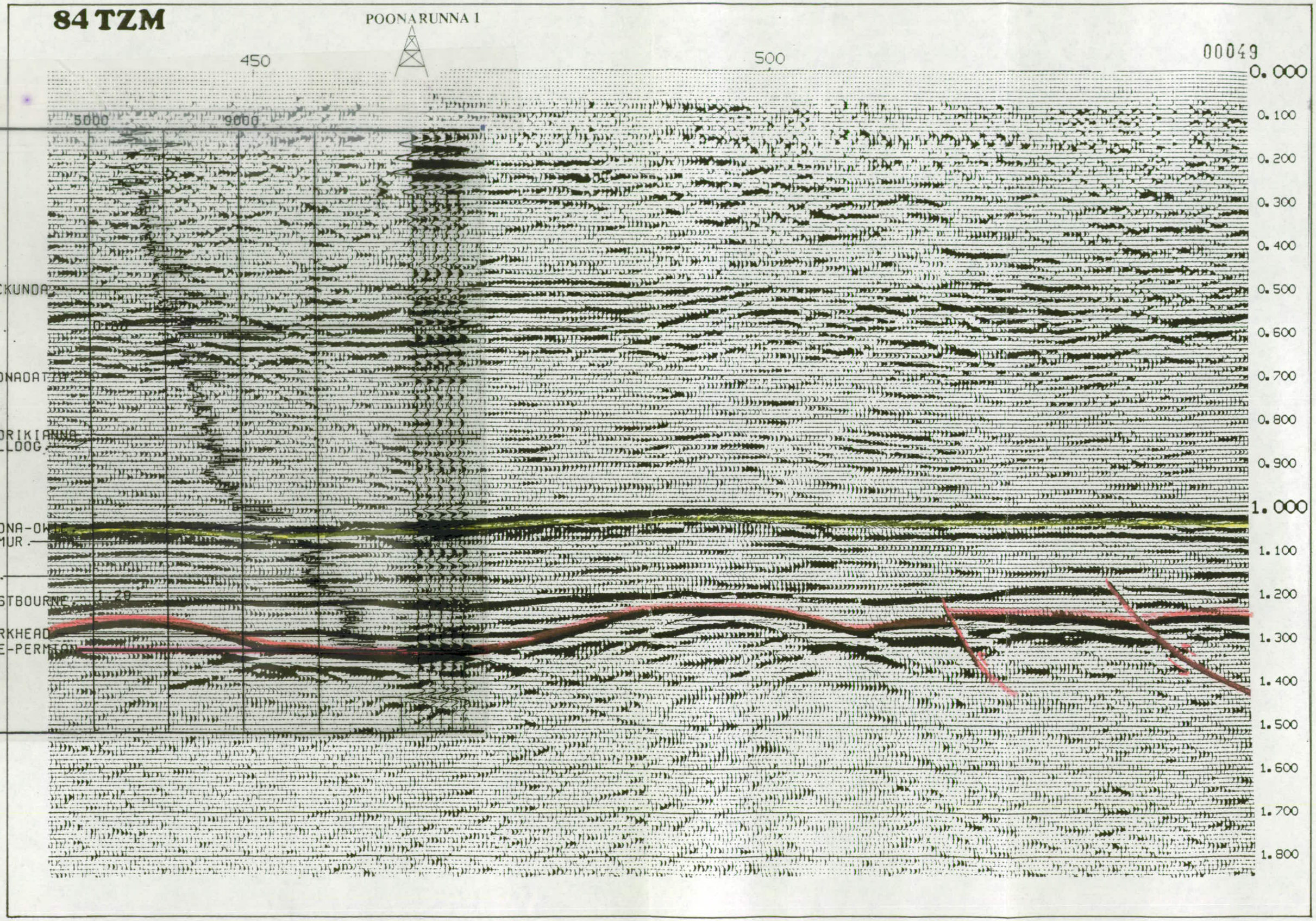
00047

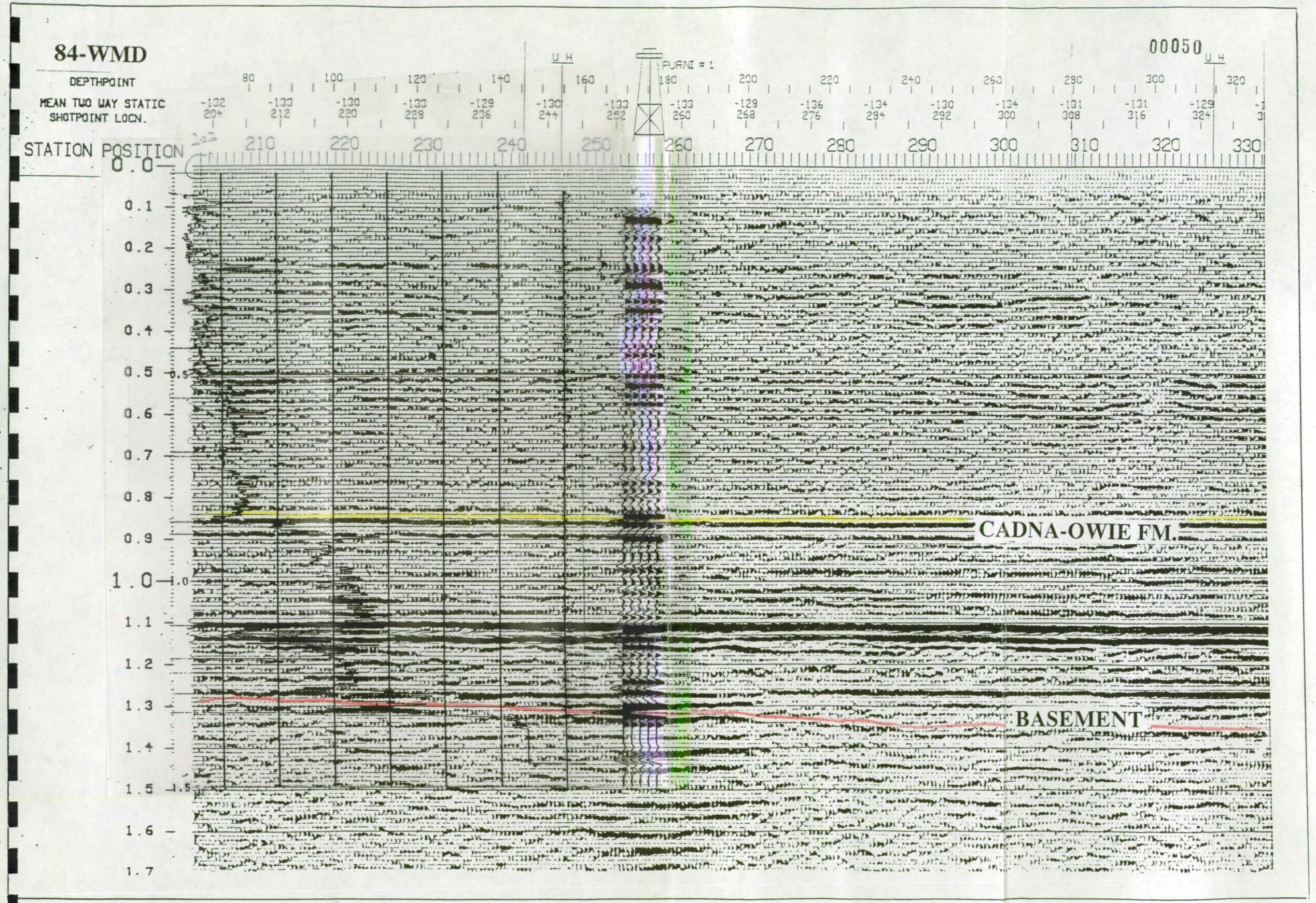


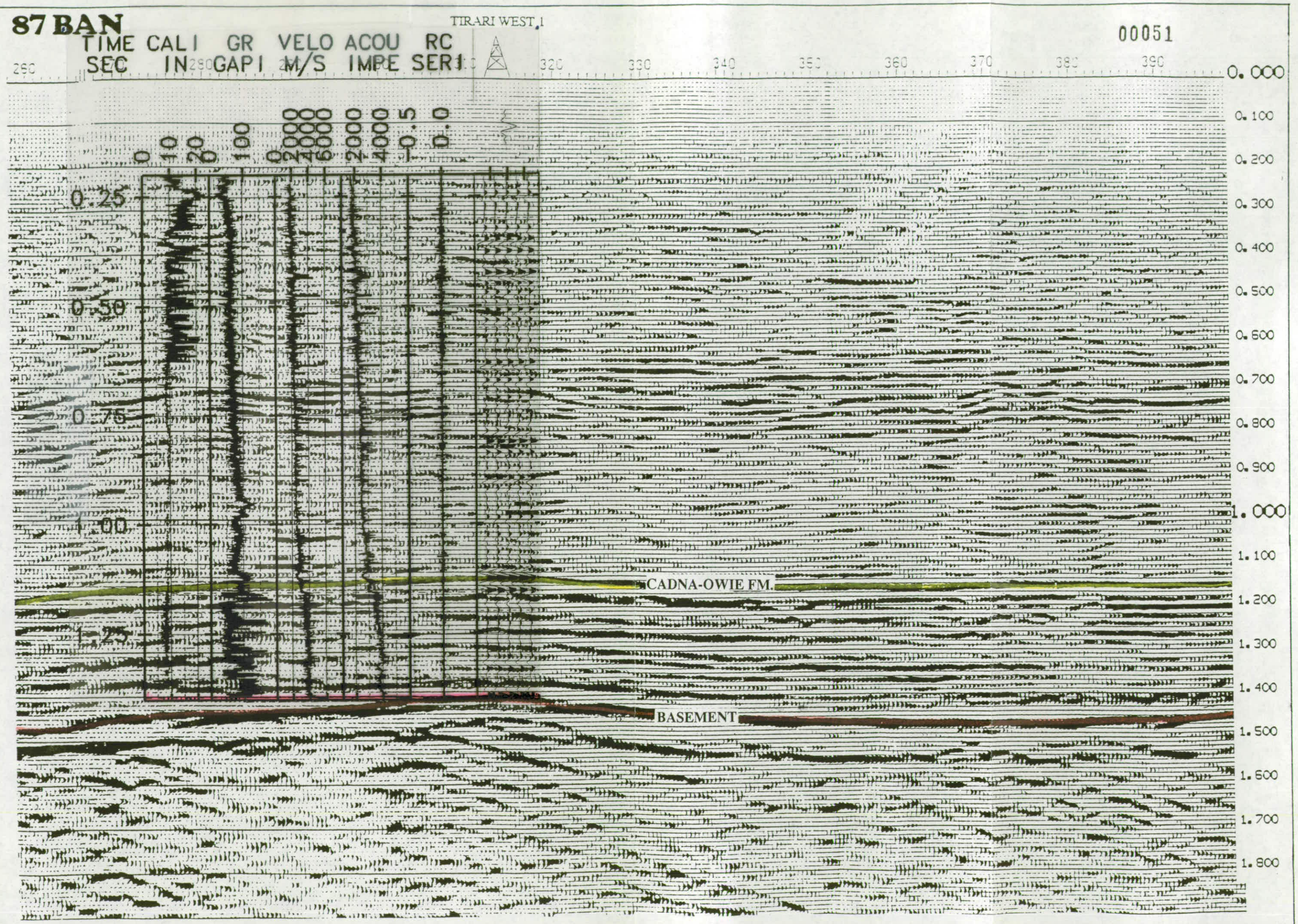
87WQL

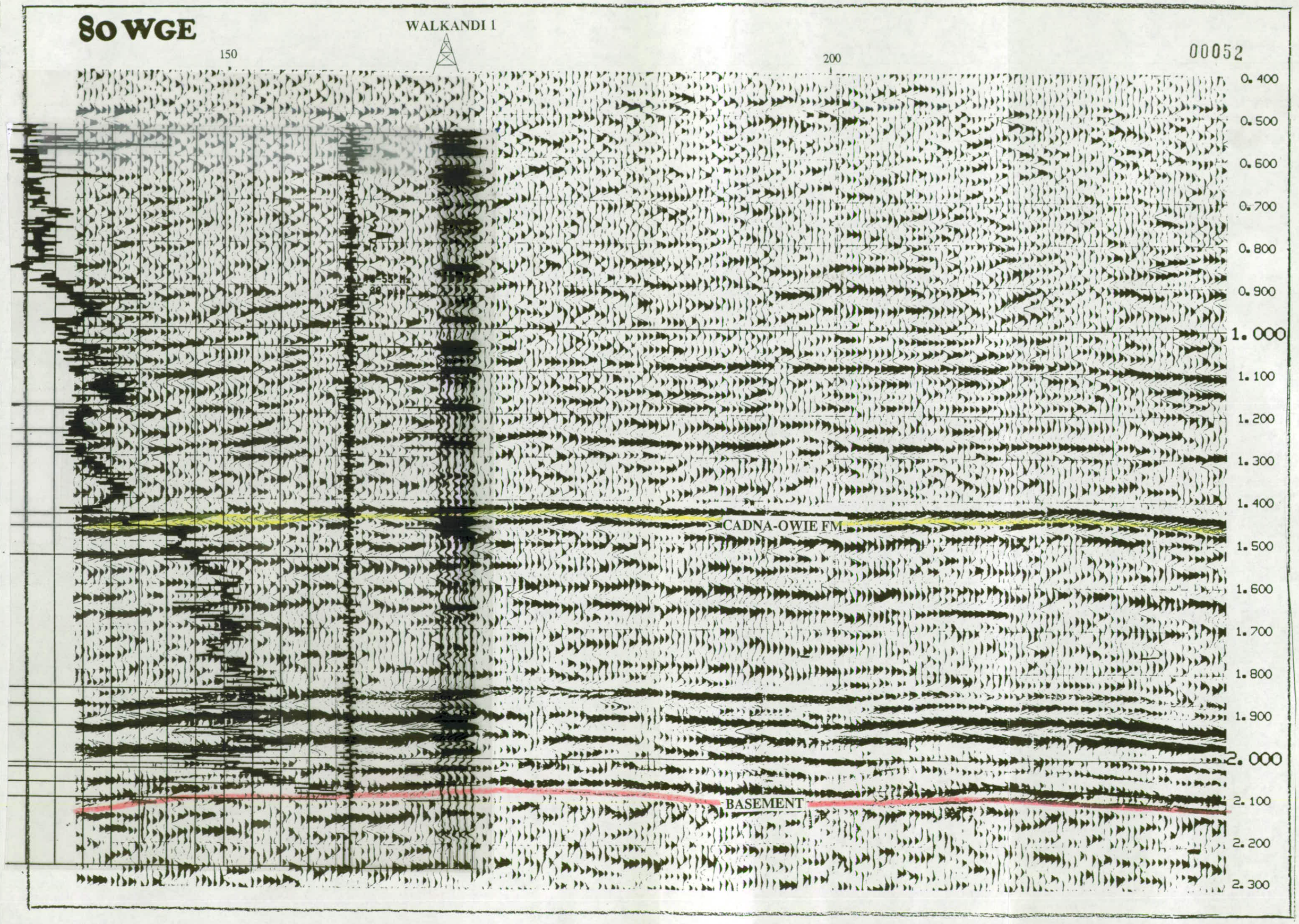
00048

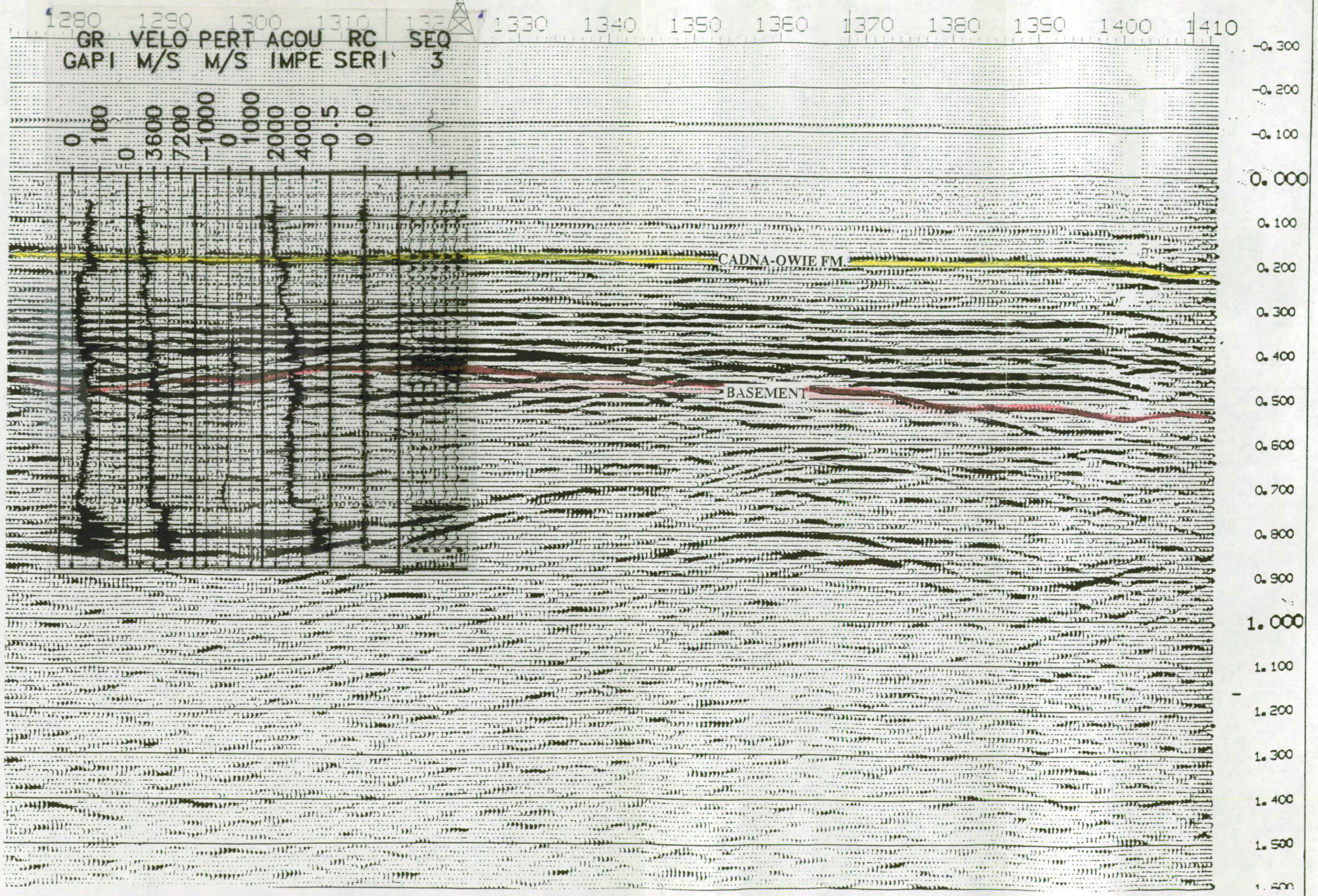

POOLOWANNA 3
300
350
400
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
1.900
2.000
2.100
CALI GR VELO ACOU RC SEQ SEQ SEQ
TN GAPI M/S IMPE SERI 1 2 3
5
10
CADNA-OWIE FM.
BASEMENT

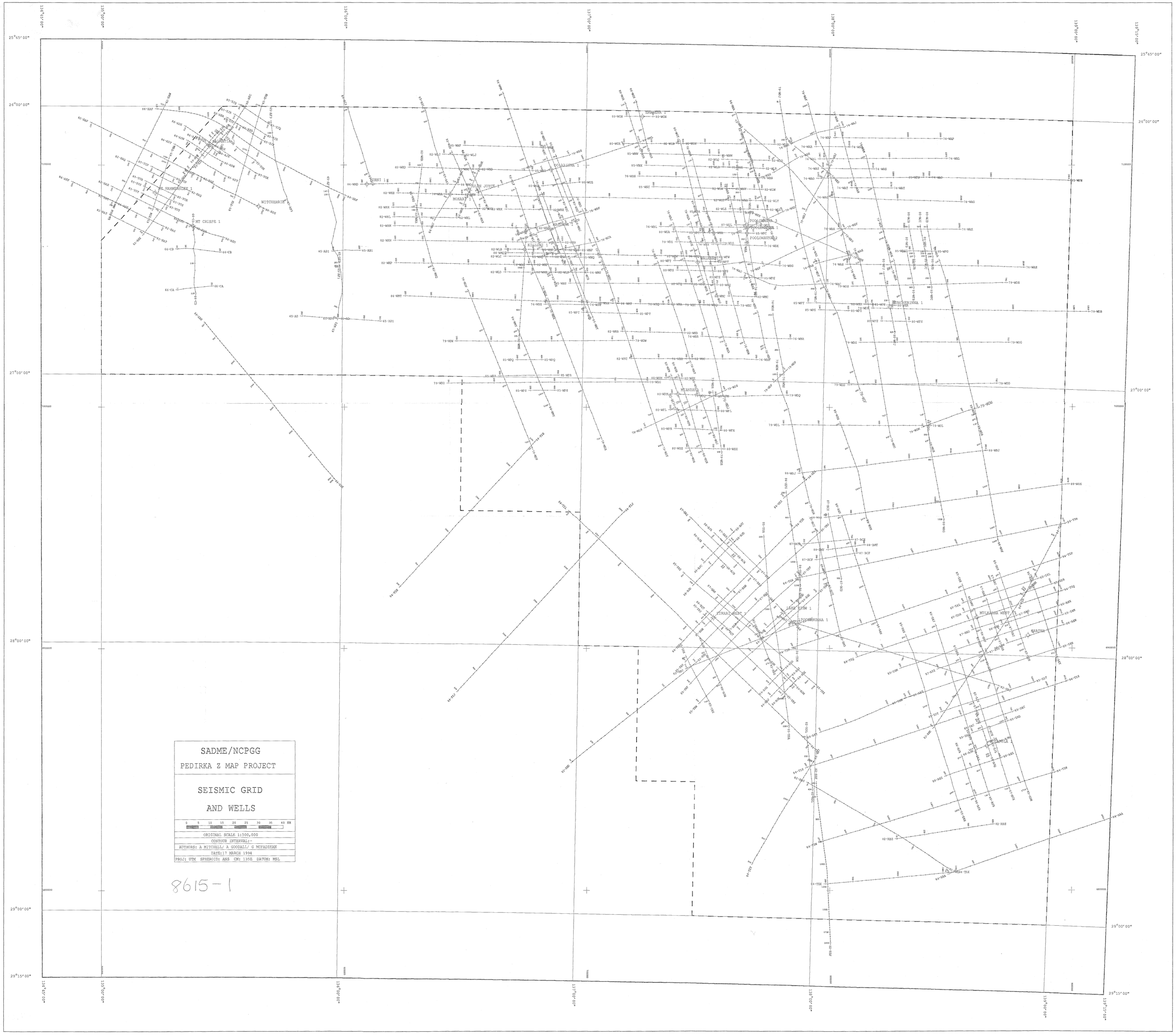

84 TZM
POONARUNNA 1
450
500
00049
5000
9000
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
MACKUNDA
COORIKIANNA
BULLOOG
CADNA-OWIE
NAMUR
WESTBOURNE
BIRKHEAD
PRE-PERMIAN

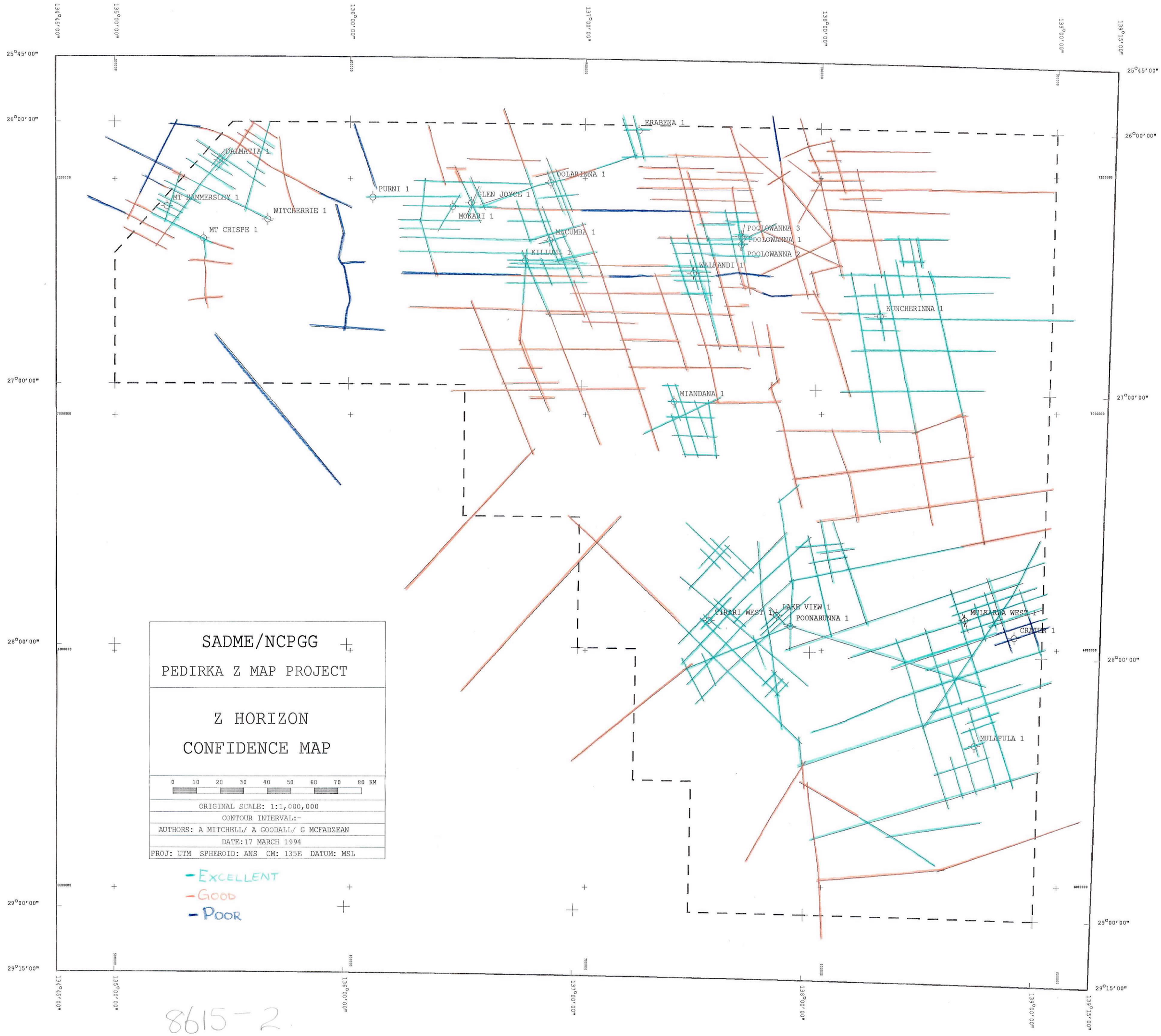

84-WMD
00050
DEPTHPOINT
MEAN TWO WAY STATIC
SHOTPOINT LOCN.
STATION POSITION
U H
PURNI = 1
CADNA-OWIE FM.
BASEMENT


87 BAN
TIRARI WEST 1
00051
TIME CALI GR VELO ACOU RC
SEC IN GAPI M/S IMPE SERI
CADNA-OWIE FM.
BASEMENT

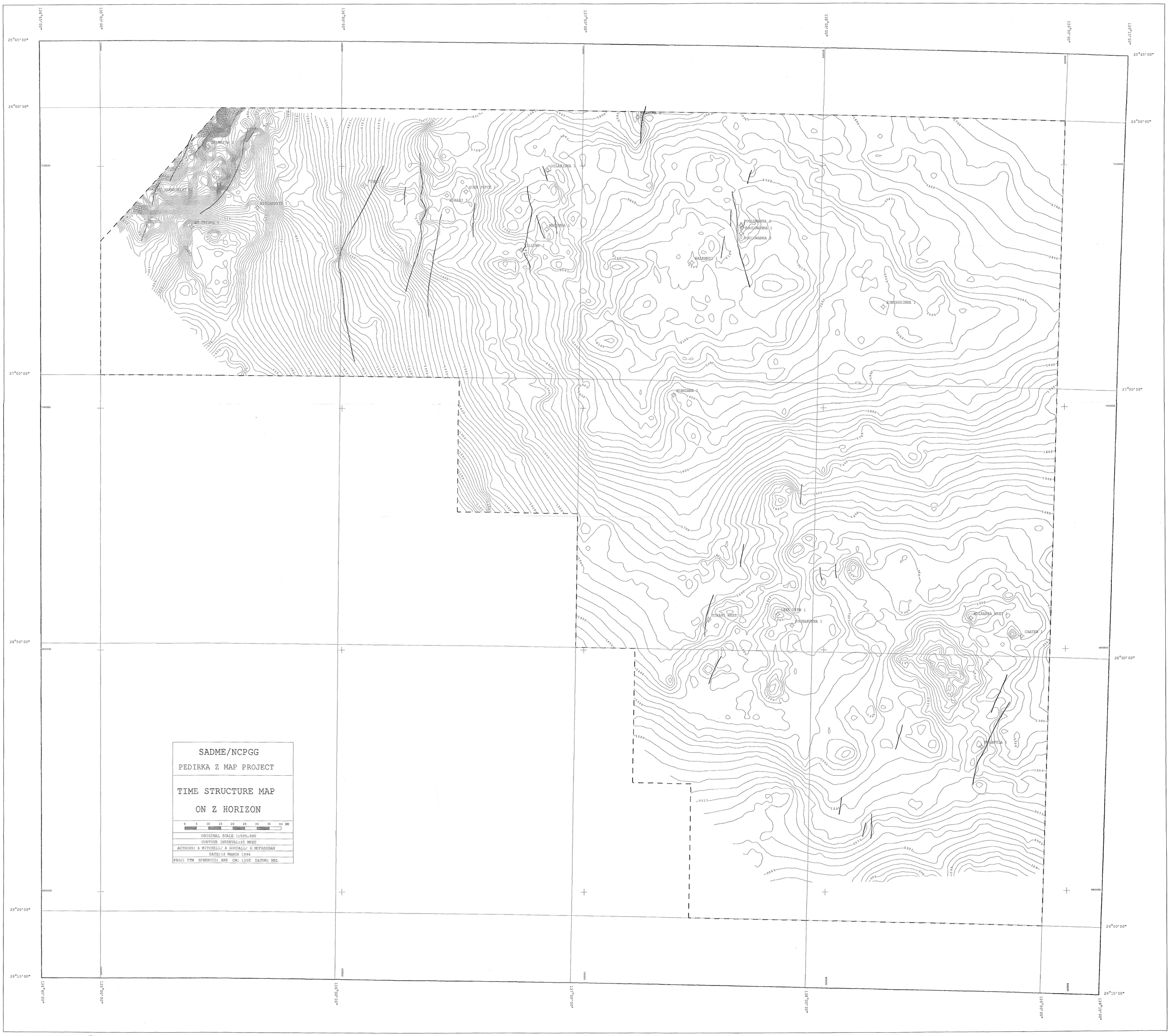

80 WGE
WALKANDI 1
150
200
00052
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
1.900
2.000
2.100
2.200
2.300
CADNA-OWIE FM.
BASEMENT


1280 1290 1300 1310 1320 1330 1340 1350 1360 1370 1380 1390 1400 1410
GR VELO PERT ACOU RC SEQ
GAPI M/S M/S IMPE SERI 3
0 100
0 3600
7200
1000
0 1000
2000
4000
0.5
0.0
CADNA-OWIE FM.
BASEMENT
-0.300
-0.200
-0.100
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500


SADME/NCPGG
PEDIRKA Z MAP PROJECT
SEISMIC GRID
AND WELLS
0 5 10 15 20 25 30 35 40 KM
ORIGINAL SCALE 1:500,000
CONTOUR INTERVAL:-
AUTHORS: A MITCHELL/ A GOODALL/ G MCFADZEAN
DATE:17 MARCH 1994
PROJ: UTM SPHEROID: ANS CM: 135E DATUM: MSL
8615-1
MT CRISPE 1
MT HAMMERSLEY 1
WITCHERRIE 1
MOKARI 1
KIRARI 1
DOLARINNA 1
MIANDANG 1
FOOLOWANNA 1
MINCHERINNA 1
KIRARI WEST 1
LAKE VIEW 1
MULKARRA WEST 1
CRATER
MULKARRA 1


134°45'00"
135°00'00"
136°00'00"
137°00'00"
138°00'00"
139°00'00"
139°15'00"
25°45'00"
26°00'00"
27°00'00"
28°00'00"
29°00'00"
29°15'00"
DALMATIA 1
MT HAMMERSLEY 1
WITCHERRIE 1
MT CRISPE 1
PURNI 1
GLEN JOYCE 1
MOKARI 1
COLARINNA 1
MACUMBA 1
KILLUMI 1
ERABENA 1
POOLOWANNA 3
POOLOWANNA 1
POOLOWANNA 2
WALKANDI 1
KUNCHERINNA 1
MIANDANA 1
TIRARI WEST 1
LAKE VIEW 1
POONARUNNA 1
MULKARRA WEST 1
CRATER 1
MULAPULA 1
SADME/NCPGG
PEDIRKA Z MAP PROJECT
Z HORIZON
CONFIDENCE MAP
0 10 20 30 40 50 60 70 80 KM
ORIGINAL SCALE: 1:1,000,000
CONTOUR INTERVAL:-
AUTHORS: A MITCHELL/ A GOODALL/ G MCFADZEAN
DATE:17 MARCH 1994
PROJ: UTM SPHEROID: ANS CM: 135E DATUM: MSL
- EXCELLENT
- GOOD
- POOR

8615-2



SADME/NCPGG

PEDIRKA Z MAP PROJECT

TIME STRUCTURE MAP
ON Z HORIZON

0 5 10 15 20 25 30 35 40 KM

ORIGINAL SCALE 1:500,000

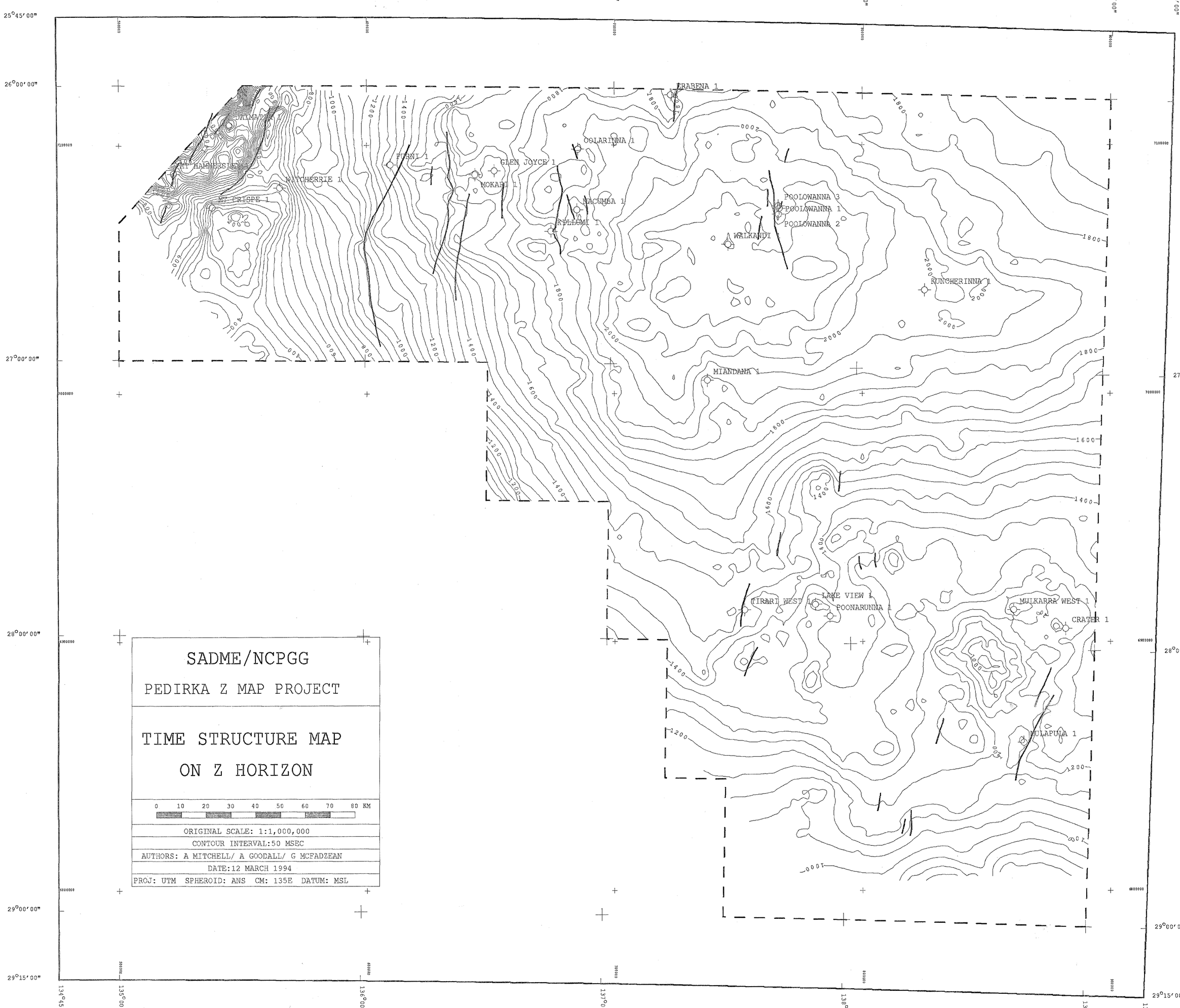
CONTOUR INTERVAL:25 MSEC

AUTHORS: A MITCHELL/ A GOODALL/ G MCFADZEAN

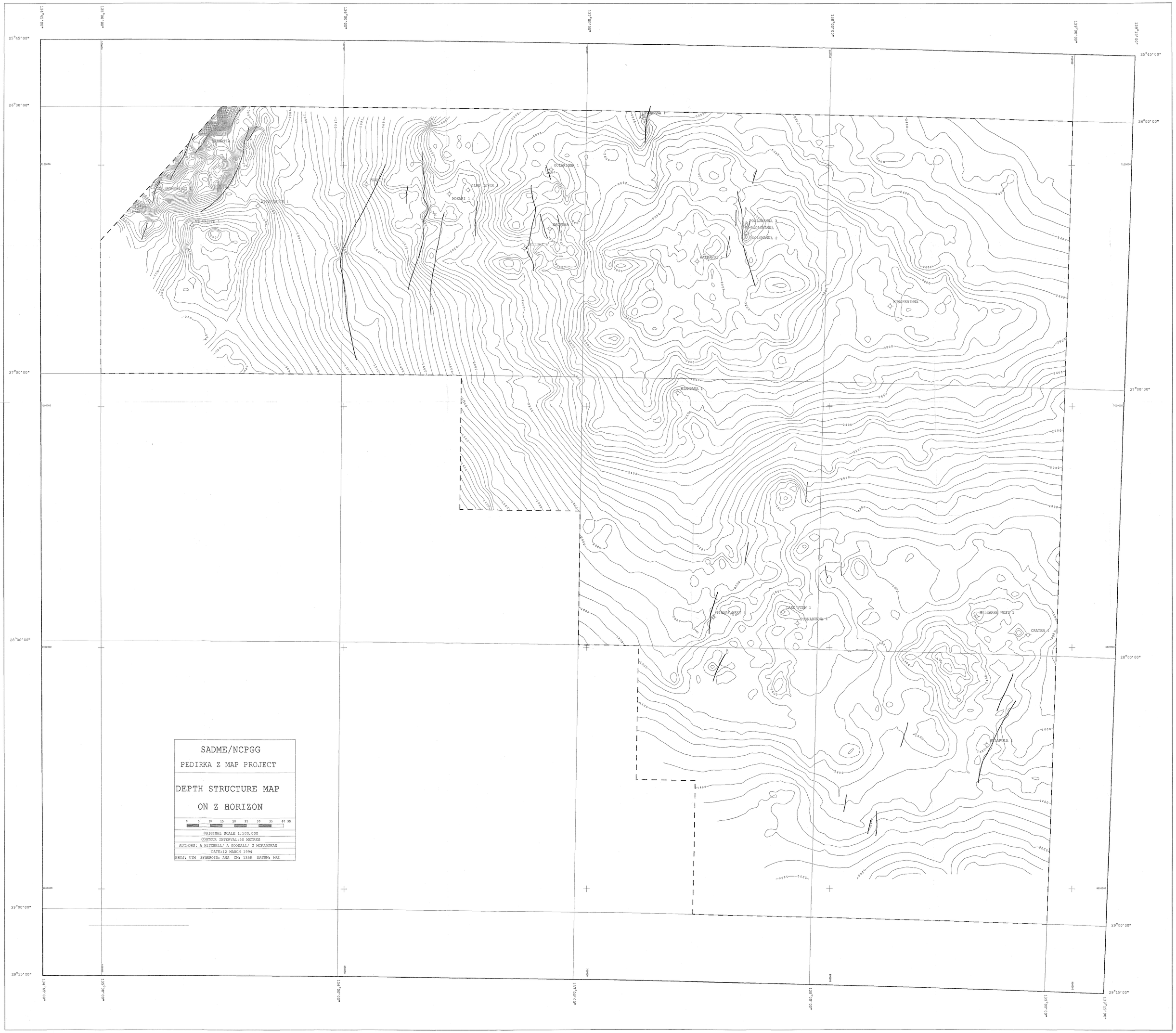
DATE:12 MARCH 1994

PROJ: UTM SPHEROID: ANS CM: 135E DATUM: MSL

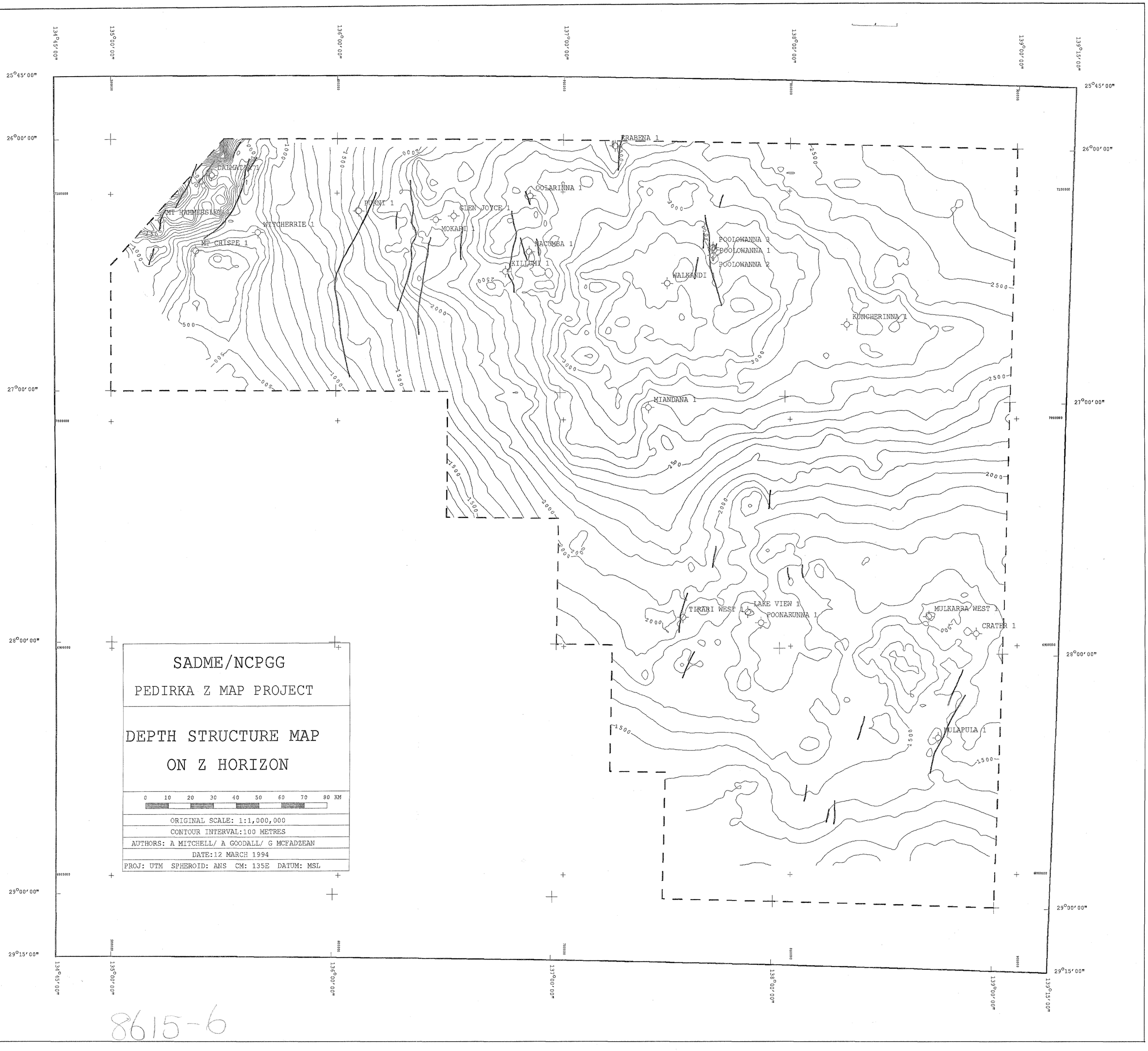
8615-3


134°45'00"
135°00'00"
136°00'00"
137°00'00"
138°00'00"
139°00'00"
139°15'00"
25°45'00"
26°00'00"
27°00'00"
28°00'00"
29°00'00"
29°15'00"
JARMATA 1
MT HAMMERSLEY
WATCHERRIE 1
MT CRISPE 1
FIRNI 1
GLEN JOYCE 1
MOKARI 1
OOLARINNA 1
NACUMBA 1
KPLLUMI 1
TRABENA 1
POOLOWANNA 3
POOLOWANNA 1
POOLOWANNA 2
WALKANDI 1
RUNCHERINNA 1
MIANDANA 1
TIRARI WEST 1
LAKE VIEW 1
POONARUNNA 1
MULKARRA WEST 1
CRATER 1
MULAPULA 1
SADME/NCPGG
PEDIRKA Z MAP PROJECT
TIME STRUCTURE MAP
ON Z HORIZON
0 10 20 30 40 50 60 70 80 KM
ORIGINAL SCALE: 1:1,000,000
CONTOUR INTERVAL:50 MSEC
AUTHORS: A MITCHELL/ A GOODALL/ G MCFADZEAN
DATE:12 MARCH 1994
PROJ: UTM SPHEROID: ANS CM: 135E DATUM: MSL

8615-4


SADME/NCPGG
PEDIRKA Z MAP PROJECT
DEPTH STRUCTURE MAP
ON Z HORIZON
0 5 10 15 20 25 30 35 40 KM
ORIGINAL SCALE 1:500,000
CONTOUR INTERVAL:50 METRES
AUTHORS: A MITCHELL/ A GOODALL/ G MCFADZEAN
DATE:12 MARCH 1994
PROJ: UTM SPHEROID: ANS CM: 135E DATUM: MSL
134°45'00"
135°00'00"
136°00'00"
137°00'00"
138°00'00"
139°00'00"
139°15'00"
25°45'00"
26°00'00"
27°00'00"
28°00'00"
29°00'00"
29°15'00"
ERMINTA 1
MT HANGERLOW
MT CHISHOLM 1
WINCHARRUP 1
BURNTY 1
GLEN JOYCE 1
MOKARI 1
OCTARINNA 1
MACUMBA 1
WILLIPA 1
POOLOWANNA 3
POOLOWANNA
POOLOWANNA 2
WACKANDY 1
MINNDANA 1
MUNCHERINNA 1
TINARI WEST 1
LAKE WISH 1
BOONARUNDA 1
MULKARRA WEST 1
CRATER 1
PEPAPULA 1

8615-5


SADME/NCPGG
PEDIRKA Z MAP PROJECT
DEPTH STRUCTURE MAP
ON Z HORIZON
0 10 20 30 40 50 60 70 80 KM
ORIGINAL SCALE: 1:1,000,000
CONTOUR INTERVAL:100 METRES
AUTHORS: A MITCHELL/ A GOODALL/ G MCFADZEAN
DATE:12 MARCH 1994
PROJ: UTM SPHEROID: ANS CM: 135E DATUM: MSL
134°45'00"
135°00'00"
136°00'00"
137°00'00"
138°00'00"
139°00'00"
139°15'00"
25°45'00"
26°00'00"
27°00'00"
28°00'00"
29°00'00"
29°15'00"
DALMATIA 1
MT HAMMERSLEY
MT CRISPE 1
WITCHERRIE 1
PURNI 1
GLEN JOYCE 1
MOKARI 1
OOLARINNA 1
NACUMBA 1
KILLUMI 1
ERABENA 1
POOLOWANNA 3
POOLOWANNA 1
POOLOWANNA 2
WALKANDI
KUNGERRINNA 1
MIANDANA 1
TIRARI WEST 1
LAKE VIEW 1
POONARUNNA 1
MULKARRA WEST 1
CRATER 1
MULAPULA 1
500
1000
1500
2000
2500
3000

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