

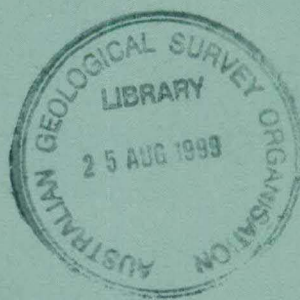
# AGCRC eastern Lachlan seismic survey 1997: operational report

D.W. Johnstone, A.J. Owen &amp; M.G. Nicoll

AGSO Record 1998/30



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AGSO RECORD 1998/30



# **AGCRC eastern Lachlan seismic survey 1997: operational report**

**D.W. JOHNSTONE, A.J. OWEN, & M.G. NICOLL**

*Petroleum & Marine Division, Australian Geological Survey Organisation, GPO Box 378, Canberra, ACT 2601*

CANBERRA 1998

# **Department of Industry, Science, & Resources**

Minister: Senator the Hon. N. Minchin

Secretary: Russell Higgins

## **Australian Geological Survey Organisation**

Executive Director: Neil Williams

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## Abstract

The Australian Geodynamics Cooperative Research Centre (AGCRC), through the Australian Geological Survey Organisation (AGSO) conducted a seismic reflection survey in various localities in the eastern Lachlan Orogen of NSW, from October to November 1997.

The objectives of the project were to obtain a better understanding of sub-surface geology at a regional and local scale and, in particular, provide more information on :

- basement control on basin development
- regional crustal thickness and major features within the basement
- stratigraphic architecture of the basins
- structural architecture of the basins
- the location of fluid flow pathways

The seismic survey acquired 105 km of 10 fold CMP (common midpoint) deep (20 second TWT) reflection seismic data along three traverses over a 6 week acquisition period. In addition to the seismic data, gravity observations were made at 300 m intervals along the lines. Drill cutting samples were also collected for analysis.

Copies of the final seismic sections for all seismic lines can be purchased through the AGSO Sales Centre, GPO Box 378, CANBERRA, ACT 2601, AUSTRALIA.

# 1. Introduction

## 1.1 Background

On behalf of the AGCRC, AGSO acquired 105 km of seismic reflection data in the Cabonne region of central New South Wales in the spring of 1997. The data form a sub-set of information in the "Eastern Lachlan Project" an Australian Geodynamics Cooperative Research Centre initiative. Gravity readings and drill cutting analysis (by CRCLEME) were also acquired to assist in geological interpretation. The AGCRC had previously (July, 1997) acquired wide angle seismic data along a north-south transect over the Molong-Wyangala Structural Zone (Leven, et. al, 1998)

The goals of the seismic reflection work are to improve the definition of the areas mineral potential and to understand the geological controls on the distribution of these resources. In particular, an attempt was made to image WNW and N dipping structures that characterise the Lachlan Transverse Zone. The survey should also provide information on the geometry of the Molong volcanic belt, the Siluro-Devonian Mumbil Shelf and Hill End Trough.

## 1.2 Location

The 1997 Eastern Lachlan Seismic Survey was conducted in various localities in the Cabonne region of central NSW. A full description of the lines is contained in the 'Environmental Management Plan: 1997 Eastern Lachlan seismic survey operations.'(unpublished), this plan is included in this report as Appendix 7. Figure 1 shows the regional setting of the three lines. Figure 2 positions the acquisition lines on the Bathurst 1:250 000 map sheet.

## 1.3 Associated Gravity Survey: (Survey 9707)

As part of the AGCRC Eastern Lachlan Seismic Survey gravity data was acquired by M. G. Nicoll along the reflection seismic lines, utilising the seismic line station pegs. The gravity survey was undertaken between 08/12/97 and 18/12/97 over eight working days. 370 new values were added to the national gravity data base.

## Equipment

Gravity meter, LaCoste & Romberg model G, meter number 252 was used for all readings. Previous usage has shown this meter to have very good drift characteristics and repeatability

- Base plate
- HP palmtop computer for recording data
- Vehicle, Toyota landcruiser stationwagon
- Three watt analogue mobile telephone
- Orange flashing safety beacon for vehicle roof
- Orange safety vest for observer
- First aid kit
- 20 litre water container
- Large water type fire extinguisher
- GPS
- Fridge
- Shovel

Flagging tape

Maps as supplied by seismic party crew chief, including surveyors report with line mud maps.

## Base station

Base station observations were taken as the first and last readings each day. Orange SRA 4619 benchmark at the Orange Railway Station platform was used for this base station.

On the last day the ends of the three seismic lines and the Orange base station were tied into the following gravity stations:

Orange	9400 2004
Blayney	9400 2003
Blayney	9320 9016

## Procedure

Observations on seismic lines were made at each shotpoint (300 metre intervals, or every sixth station) and at the permanent markers (PM's, approx 5 km intervals). The observer moved along the line until about lunchtime, then made repeat observations at the PM's. After lunch he made a repeat observation at the last station then continued along line as before.

08/12/97	line 2	stations 100 - 370	55 observations
09/12/97	line 2	stations 370 - 637	56 observations
10/12/97	line 3	stations 100 - 472	75 observations
11/12/97	line 3	stations 472 - 804	69 observations
12/12/97	line 3	stations 804 - 1030	44 observations
15/12/97	line 1	stations 100 - 352	50 observations
16/12/97	line 1	stations 358 - 636	56 observations
17/12/97	line 1,2,3	stations 636 - 740	32 observations

Total 437 observations

## Data processing (AGSO Gravimetry Group)

The survey data processing was done on a Sun workstation by Alice Murray in Canberra. The field data was downloaded from the HP palmtop computer, and transferred to the Sun computer, checked for syntax and valid characters, combined with seismic line position data, reformatted and rearranged for input to tidal gravity correction and drift adjustment programs.

**Datum:** The gravity data as supplied are based on the IGSN71 datum and ISO GAL84 scale. The gravity unit used is micrometres per second squared ( $\text{Om s}^{-2}$ ). The height data are given in metres based on the Australian Height Datum (AHD). The positions are based on the AGD66 datum. Bouguer anomalies are calculated using a density of 2.67 tonne / cubic metre ( $\text{tm}^{-3}$ )

## 2. Field operations

### 2.1 General

Three, 10 fold CMP deep seismic reflection profiles were recorded with a total line length of 105 km. The seismic lines were pegged, shot holes drilled, recorded and surveyed beginning with line 97AGSEL1 and finishing with line 97AGSEL3. Spread and recording parameters for all lines are given in Appendix 4.

Shot hole drilling for all lines was by done using five, AGSO, Mayhew drilling rigs. Explosive pre-loading and shot firing was also undertaken by AGSO staff as an in-kind contribution to the AGCRC.

Seismic recording was undertaken using AGSO's SERCEL SN368 acquisition system. Both the drilling and recording crews were based in a camp at the Orange Bowmans Club grounds on the Lower Lewis Ponds Road, Orange. To gain a drill lead, members of the drilling crew were housed in commercial accommodation at Cowra when the survey commenced.

Commencement date for the survey depended on the delivery of the vehicles, by rail, from Western Australia.

Surveying for the project was done, under contract, by Dynamic Satellite Surveys (DSS).

### 2.2 Reconnaissance

An initial reconnaissance of the survey area was made on 26<sup>th</sup> and 27<sup>th</sup> June, 1997 by Kevin Wake-Dyster, Russell Korsch, Richard Glen and David Johnstone. Three traverses were selected based on funding for approximately 100 km being available.

David Johnstone visited all property owners and others concerning access from 18<sup>th</sup> - 22<sup>nd</sup> August. Property owners, exploration companies, shire councils, railway authorities, land protection boards and park authorities were most helpful with the planning of the survey. The only permission that we were denied was access across 'Peffer Pastoral Company' land near Molong. The pastoral company farm eggs and were very concerned about the possibility of the introduction of disease.

One reason for the reconnaissance trip was to locate commercial accommodation for the crew. This proved to be very difficult because the timing coincided with the Bathurst car races and the Orange agricultural field day. It was decided that a camp would be set up for the crew and a location was found near Orange at the Orange Bowman's Club premises. A follow up reconnaissance was undertaken from 10<sup>th</sup> -13<sup>th</sup> September. This was to meet with parties not available on the first trip, and included a meeting with NSW National Parks and Wildlife officers in Dubbo.

### 2.3 Environmental management plan

As part of the planning process of the seismic survey, and to comply with State regulations for conducting seismic surveys, an environmental management plan was formulated. The 'Environmental Management Plan, 1997 Eastern Lachlan Seismic Survey Operations' is included in this report as Appendix 7.

### 2.4 Line clearing

No line clearing was required for this survey. Permission was obtained from property owners where the seismic line was to cross their land. These people are acknowledged in the appendices.

Permission to use the road verges was obtained from the relevant local councils and property owners as outlined in the 'Environmental Management Plan'. Permits were obtained from the State Rail Authority to cross lines near Molong. Telstra was also consulted about underground telephone cable locations.

### 2.5 Surveying

Pegging of all lines was done by Dynamic Satellite Survey (DSS) staff before drilling commenced. David Johnstone from AGSO accompanied the pegging crew to ensure that access problems did not occur and to follow up some earlier contacts. Surveying of the seismic lines was done by DSS after the drilling and recording was completed. Survey data was supplied on PC floppy discs and their Report 'DSS Report #97-83' lists all relevant information and included here is a copy of their 'Conclusions and Recommendations'.

'The prospect was chained manually by Bill and Damien Hedditch in early October. Survey commenced a few weeks behind drilling and recording on November 5.

Three surveyors surveyed the 105 kilometres in about a week and found the lines generally easy going. The abundance of trees on certain sections of each line made surveying slow and the Rapid Elevation Meter was required for about 5 kilometres of the total prospect.

As surveying commenced about six weeks after chaining, quite a few pegs were not found or were down and this created chaining errors, for example, a corner may have been cut by omitting a peg and therefore the chainage between the two other pegs will be shown to be short.

Most drill holes were found by the Surveyors and the ones missed were covered by road works or had been refilled such that they couldn't be seen. A listing of these drill holes can be found in the Survey Data Report.

Surveyors were given a drill description for about 75% of the drill hole locations and the others were manually found and surveyed.

The job was completed in minimal time and conforms to all the guidelines given by the client'.

### 2.6 Drilling and explosives

#### 2.61 Drilling

Five AGSO Mayhew 1000 drill rigs were used for this survey. A total of 355 shot holes were drilled to an average depth of 18.6 metres. This gave a total of over 6,600 metres drilled.

Out of the five rigs available only four were operating at any one time because one driller, Mr Alan Porter, was unavailable due to ill health. This meant that one rig was always in camp being repaired or undergoing maintenance.

For the first two weeks of the survey only two rigs were available while the others, together with the recording



vehicles, were being transported from Western Australia. The five personnel needed for the first two weeks were accommodated in commercial lodgings in Cowra. Two days of this time were lost due to bad weather. It should be noted that some time (about one and a half days) was needed to re-drill some of these shot holes prior to their loading with explosives.

From the 16th October all personnel were camped at the Orange base and the remaining drilling operated from there.

Safety of the crew was of concern. The track used for the seismic line was mostly very narrow, hilly and winding. All care was taken to alert traffic of the works ahead. Safety signs were posted, cones deployed around the work site, fluorescent jackets worn by staff and flashing orange beacons displayed. It is a credit to the crew that no incidents were reported from this potentially dangerous work site. The drilling crew was a total of twelve staff. Drill supervisor, two loaders, four drillers, and five offsideers.

Water for the drilling operations was purchased from Orange City Council or in some cases pumped from local creeks.

Samples of the drill cuttings were collected by the drillers. Approximately 3000 regolith and bedrock samples were bagged for analysis by the Cooperative Research Centre for Landscape Evolution & Mineral Exploration (CRCLEME), Hargraves Resources and Homestake Gold.

## 2.62 Explosives

ICI 'Powergel 3000' explosives were used as the seismic energy source, mainly as 2 kg plugs. A 10 kg charge was selected as the optimum size to use, considering the acquisition target. The charge size was reduced where shot holes were shallow. An 8 kg charge was alternated with 10 kg charge on line 97AGSEL3 in order to have sufficient explosives to complete the survey with the stock on hand.

Shot holes were, in the most, pre-loaded several days before detonation and, where possible as soon as drilling completed. It was not possible to load the holes immediately for the two drilling rigs which commenced the survey, as explosives were not available. Redrilling of some collapsed holes required an additional 1.5 days work.

Shot firing was undertaken by two AGSO staff. This ensured extra safety precautions at the site. Of the 334 production shots fired 35 of them blew out after detonation. This meant that the holes had to be solid tamped again afterwards. Generally blow outs occurred at sites where the water table was shallow.

## 2.7 Seismic recording

The recording crew performed very well under some difficult circumstances. The majority of the acquisition was along roads, the crew had to contend with traffic control not only on the lines but also at intersections. Safety was of paramount concern. All steps were taken to ensure that work was carried out in a safe and proper manner.

At several locations the traverse crossed farming properties. Cattle chewing geophone cables was a constant problem. Also some damage was done by a local farmer burning off grass stubble on the road verge.

At most times there were eight field hands deploying and picking up equipment. Four 'jug buggies' were used for this work. Another two vehicles were available mainly for traffic control. The recording crew was a total of eleven staff, eight field hands, two shot firers, and one Observer.

## 2.71 Conventional SEG D

The Sercel SN368 telemetry seismic acquisition system operated in a 120 channel configuration for the survey. Four auxiliary channels were also recorded, channel 1 was the uphole geophone and channels 2 to 4 were unused. The SEG D recordings were on 0.5 inch "Blackwatch" brand magnetic tapes. The tapes were 1200 feet long and hold 24 shots at 2 ms sampling rate for 20 seconds data length. The first record on tape was a 20 second internal sine wave test to test the system and check tape quality. A 'cap' test was also performed each day prior to production to test the system. The 'cap' test was recorded on tape. A second end of file (eof) mark was always placed at the end of each tape.

A new tape was used at the beginning of each acquisition line. Field SEG D tapes numbered 97067 through to 97085 inclusive were used for this survey. Refer to appendix 6 for a listing of field tape contents.

## 2.72 Eavesdropping on the SERCEL

The eavesdropping system first trialed in 1995 during the TASGO survey was also used for this survey.

This system captures the SEG D data written to tape onto a 486 computer. The 486 computer configured with the LINUX operating system, demultiplexes the data and writes out in SEG Y format to disk. This data is then copied to 8 mm Exabyte magnetic tape. This process enables quicker data processing both in the field and at head office.

## 2.8 Communications

Communications between the seismic party and head office during operations of the survey presented no problems.

Mobile phone service was not available at the camp site. The mobile network signal was available approximately five kilometres from camp on the road to Orange. In camp an Optus satellite service was available for telephone and fax lines.

A Post Office box service for mail was organised in Orange.

While operating on the line VHF and UHF radio services were available to all working groups, with reception at base camp useable within a certain range.

## 2.9 Data Processing

### 2.91 In field 'Vista'

The 'Vista' field seismic processing system was used on the seismic survey for quality control (QC). QC consisted of reading in the SEG Y eavesdropper tapes, concatenating the separate SEG Y shot files and writing out to exabyte tape in 32bit IBM floating point format. The occasional short or missing file was de-multiplexed from the SEG D field tape on Vista and incorporated with the other data.

Uphole signals, recorded on auxiliary channel 1, were demultiplexed separately by the eavesdropper and written onto 3.5 floppy disk. These were also concatenated and analysed on the Vista and uphole time arrivals picked in the field.

Field QC also involved the checking of shot geometry from the monitor records and observers report. Reporting of loaders, drillers and shot firers logs were also cross checked for quality in the field.

## 2.92 Head office 'Disco/Focus'

Full processed sections of all seismic lines were produced in-house at AGSO, at both 20 and 4 seconds two-way travel-time (TWT). The software used in the processing stream was provided by 'Cogneseis' and was both batch mode 'Disco' and interactive mode 'Focus'. These programs were run on an IBM RISC 6000 machine using the 'Unix' operating system.

Crooked line processing was undertaken for all lines, the CMP locations for binning being calculated from geometry distribution plots and a personal computer based screen picking routine developed in house. As a rule, the deep 20 second (TWT) sections have a large binning window while the shallow 4 second (TWT) sections were binned at about 250 metres. Constant velocity analysis was undertaken on CMP stacked data, concentrating on the top three seconds. A near trace display was produced to display structure not affected by normal moveout.

A typical processing stream used for the 20 second displays is:

1. Crooked line geometry definition

2. Field SEG-Y to 'Disco' format
3. Resample to 4 milliseconds
4. Quality control display and edits
5. Crooked line binning
6. Spherical divergence and gain correction
7. Statics computation (first breaks or uphole method, differing datums)
8. CDP sort
9. 50 Hz notch filter (if required)
10. Velocity analysis (cvs)
11. Normal moveout correction
12. Pre-stack NMO mute (stretch mute)
13. Common depth-point stack
14. Bandpass filter
15. Time varying equalisation
16. Signal enhancement (digistack)
17. Post stack balance.

Profiles of total magnetic intensity and bouguer gravity were displayed on top of all seismic sections together with the elevation and refraction depth model.

## 3. Environmental audit

An audit of the survey operations was undertaken by D. Johnstone and A. Takken from 15th-18th of December, 1997. All pegs were removed from the ground and recycled. All flagging tape was collected and disposed of. An inspection was made of all shot sites, and any holes which had collapsed were filled in with gravel. Any holes that had blown out during operations were also inspected and found to be left in good condition. All padlocks and keys left in access gates were collected during the audit.

Mr John Bourke was visited at his property, 'Clear View', near Mandurama. Overall Mr Bourke was satisfied with our operations but suggested that the drill rigs were somewhat too heavy to cross his paddocks considering the soft ground conditions.

The camp site at the Bowman's Club was found to be in good condition. A few of the drain holes from the kitchen area

had collapsed a few centimetres. These holes were re-filled. The President of the Bowman's Club was happy with the condition of the camp site when we left. He said they would have a bob-cat in shortly to do some work and they would get the hole cuttings levelled off. The Cabonne Council received a complaint from Mr Philip Black, a property owner who uses the entrance to the Bowman's Club, for his own access. He complained about the pot holes on the road and damage to the entrance grid. This, not being a council road, passed the complaint on to AGSO. It is true that the grid was damaged by an AGSO vehicle, but was restored by AGSO staff immediately after the incident. The President of the Bowman's Club was satisfied with the condition of the road and grid when we vacated the camp site. He did mention that they had in mind to erect a better grid in the near future and had the materials standing by.

## 4. Preliminary results

Seismic data collected from the survey show reflections from the near surface upper crust to below the Moho. Devonian and Silurian successions of the Lachlan Orogen are, in most places, well imaged on the three seismic lines. The data quality could be regarded as fair to good. Seismic sections are displayed in Figures 3, 4 and 5 for traverses 97AGS-EL1, 2 and 3 respectively. The sections are final 4 second TWT coherency enhanced stacks. Horizontal scale is displayed in CMPs which is half (25 metres) the group interval (50 metres). Vertical scale is displayed in TWT and at an average velocity of 6000 m/s, 1 second TWT is approximately 3 kilometres.

First arrivals were picked for all traverses and both refraction velocity and depth models calculated. The velocity and depth models are displayed in Figures 6, 7 and 8 for traverses 97AGS-EL1, 2 and 3 respectively.

The geological structure of the area is quite complex, but good continuous reflections can be mapped over lateral

distances of up to two kilometres. A geological interpretation of the seismic data however, can be based mostly on reflection segments that are of smaller lateral extent. Consideration is also taken of the character of the reflections as this can indicate gross differences in rock type.

For a preliminary geological interpretation of the data, the reader is referred to Glen, 1998.

## 5. Acknowledgments

The authors acknowledge the contributions and efforts made by all members of the 1997 Eastern Lachlan seismic survey team. The co-operation and assistance from local government authorities, landowners, exploration companies are appreciated. In particular the following organisations and people should be recognised.

### Survey Design

R. Korsch, K. Wake-Dyster (AGCRC/AGSO); R. Glen (AGCRC/NSWDMR).

### Survey Crew

D. Johnstone, A. Owen (scientific officers) K. Wake-Dyster (operations manager) A. Crawford (mechanical technician) J. Whatman (technical officer) T. Cherry (drill supervisor) D. Eaton, A. Hinds, B. West, G. Gowans (drillers), D. Keast, B. Devenish, B. Payne, C. Bruce, S. Richardson (driller's offsidiers) R. Cherry, M. Cuzner, A. Takken, P. Taylor (explosive experts and field hands) S. Carswell, G. Filmer, C. Hindle, D. Mc Appion, T. Mikulic, J. Moore, B. Porters, A. Sweeney, (field hands) R. Asmus (camp attendant), S. Burns, G. Palmer (cooks). Permanent staff operated as an AGSO in-kind contribution to the AGCRC and the temporary employees were paid from funding provided by the AGCRC.

### Cuttings Sampling

R. Chan, D. Gibson (AGSO/CRCLEME) J. Graham (Hargraves Resources), H. Jefferson (Homestake Gold).

### Field Accommodation

Orange Bowmans Club, Rob Hines (President)

### Surveying Contractor

D. & K. Williams, G. Bax, B. & D. Hedditch (Dynamic Satellite Surveys).

### Environmental Issues, Access and General Support

K. Wake-Dyster, D. Johnstone (AGCRC/AGSO). Michael Thorpe (Orange City Council), S. Darlington & G. Hooper (Blayney Shire Council), K. Howell (Cabonne Shire Council), Evans Shire Council, J. Sanders (National Parks and Wildlife Service, NSW), Orange Local Aboriginal Community, Neil Thomas (State Rail Authority), D. Sligar (Central Tablelands Water), Telstra, Ken Jones (Avondale (02) 6367 5033), George & Bartley King (Manager, The Coombing Park 018 883316), John Bourke (Clear View (02) 6367 5240 5 James St. Wallerawang 02 6355 1324), Mark Robson (Hillcrest (02) 6367 3191), Jan & Perry Platt (Glen Ayr (02) 6367 3091), Ralph Christopherson (The Vale (02) 6365 9130), Craig (Manager, Belgravia (02) 6365 0658), Brian & Julie Evans (Old Redbank (02) 6366 8337), Mr & Mrs Dean (Hill St Molong (02) 6366 8803). C. Somerset (Molong Rural Lands Protection Board) F. Coleman (Hargraves Resources)

### Data Processing

D. Johnstone, A. Owen (AGCRC/AGSO).

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## Appendix 1. Operational statistics and timetable

Line pegging commenced	23/9/1997		
Line pegging completed	27/9/1997	Due to instrument breakdown	0
		CMP fold	max 10
AGSO drilling commenced 2 x Rigs	3/10/1997	Total number of production shots	334
AGSO drilling commenced 4 x Rigs	17/10/1997	Average number of prod. shots/recording day	17
AGSO drilling completed	5/11/1997	Explosives used	3168 kg
AGSO drilling crew returned to Canberra	6/11/1997	Detonators used	342
		Average charge/production shot	9.5 kg
Contract surveying commenced	4/11/1997		
Contract surveying completed	14/11/1997	<b>Drilling:</b>	
		Number of drilling rigs	4
Recording crew departed Canberra	15/10/1997	Total number of rig days worked	78.5
Recording crew commenced acquisition	20/10/1997	(including maintenance)	
Recording completed	11/11/1997	Rig days lost:	
Recording crew returned to Canberra	12/11/1997	Due to adverse weather	2
<b>Recording:</b>		<b>Shot holes:</b>	
Total number of recording days worked	20	Total number of holes drilled	355
Recording days lost:		Total metres drilled	6,610.5
Due to travel to and from Canberra	2	Average depth/shot hole	18.6m
Due to adverse weather	0		

## Appendix 2. Survey personnel

Field Party Leader/Geophysicists	D. W. Johnstone		M. Cuzner
	A. J. Owen		A. Takken
Technical Officers (Engineering):	J. Whatman		P. Taylor
	A. Crawford	Field hands:	S. Carswell
Drill Supervisor:	E. Cherry		G. Filmer
Drillers:	D. Eaton		C. Hindle
	A. Hinds		D. Mc Appion
	B. West		T. Mikulic
	G. Gowans		J. Moore
AGSO Assistant Driller:	D. Keast		B. Porters
	B. Devenish		A. Sweeney
	B. Payne	Camp attendant:	R. Asmus
	C. Bruce	Cooks:	S. Burns
	S. Richardson		G. Palmer
Shot firers/pre loaders:	R. Cherry		

## Appendix 3. Survey vehicles

<b>Camp:</b>			ZBE-748 MERCEDES LA911B	RECORDER VAN
ZKG-780 TOYOTA	L/CRUISER 4X4	S/WAGON RECON	ZKF-243 TOYOTA	RED JUG-BUGGY
ZRM-053 TOYOTA	L/CRUISER 4X4	BIONIC ARM	ZKF-245 TOYOTA	BLUE JUG-BUGGY
ZKA-069 TOYOTA	L/CRUISER 4X4	S/WAGON	ZKD246 TOYOTA	WHITE JUG-BUGGY
ZRM-015 TOYOTA	L/CRUISER 4X4	TRAY TOP UTE/	ZKD-900 TOYOTA	GREEN JUG-BUGGY
		TAILGATE	ZRM-019 TOYOTA	SHOOTING TRUCK
ZBE-687 MERCEDES LA911B		TAILGATE		
ZBE-689 MERCEDES LA911B		ELECTRONICS	<b>Drilling:</b>	
ZBE-775 MERCEDES LA911B		WORKSHOP	ZKA-066 TOYOTA	L/CRUISER
ZBE-781 MERCEDES LA911B		FUEL TANKER	ZKA-067 TOYOTA	L/CRUISER
ZBE-634 MERCEDES LA911B		WATER TANKER	ZBE-606 MACK	R685RS 8X6
ZRM-348 INTER LA911B		TRAY TOP	ZSU-471 MACK	R685RS 8X6
ZRM-017 TOYOTA	L/CRUISER 4X4	TRAY TOP	ZSU-472 MACK	R685RS 8X6
ZJD-115 TOYOTA	L/CRUISER 4X4	GXL S/WAGON	ZSU-473 MACK	R685RS 8X6
ZKA-068 TOYOTA	L/CRUISER 4X4	S/WAGON	ZSU-529 MACK	R685RS 8X6
			ZSU-863 MACK	RM6866RS 6X6
<b>Recording:</b>			ZSU-864 MACK	RM6866RS 6X6
				WATER TANKER

ZSU-865 MACK RM6866RS 6X6 WATER TANKER  
 ZSU-866 MACK RM6866RS 6X6 WATER TANKER  
 ZSU-911 MACK RM6866RS 6X6 WATER TANKER

**Pre-loading:**

ZKA-505 CANTER PRE-LOADING  
 ZRM-349 INTER ACCO 2350E EXPLOSIVES

**Trailers:**

ZXD-196 JAKAB C'VAN 4-WHEEL ABLUTIONS  
 ZXD-197 JAKAB C'VAN 4-WHEEL ABLUTIONS  
 ZTL-511 FREIGHTER C'VAN 4-WHEEL 6-TON DRILL  
 ZTL-514 FREIGHTER C'VAN 4-WHEEL 6-TON DRILL

ZTL-915 DURAVAN C'VAN 4-WHEEL KITCHEN  
 ZTL-917 DURAVAN C'VAN 4-WHEEL KITCHEN  
 ZTL-845 DURAVAN C'VAN 4-WHEEL KITCHEN-FREEZERS  
 ZTL-994 ROGERS C'VAN 4-WHEEL OFFICE  
 ZTV-016 TREG C'VAN 2-WHEEL FURPHY  
 ZTV-022 ROGERS C'VAN 4-WHEEL 4-TON CARGO  
 ZKD-329 4-WHEEL MACFARLANE  
 GENERATOR  
 ZKD-330 4-WHEEL MACFARLANE  
 GENERATOR  
 ZTL-501 2-WHEEL WELDING  
 ZXD-114 4-WHEEL COOL ROOM

## Appendix 4. Spread and recording parameters

Spread length	5950 m	Tape	9 track, 6250 bpi GCR, 0.5 inch, 8.5 inch reel, 1200 ft/Exabyte
Spread type	Split Spread		
Number of channels (max)	120	Record length	20 second
Number of station units available	153	Sample rate	2 ms
Geophone station interval	50 m	Input filters:	
CDP fold	10	Low-cut	8 Hz/18db/Oct
Number geophones/trace	16	Hi-cut	178 Hz
Geophone pattern (GSC-20D)	in-line	Pre-Amp Gain	7**2
Geophone spacing	3.3 m		
Seismic system	Sercel SN368	Playback Parameters:	
Blaster	OYO Model 1340	Low-cut	12 Hz
Camera	OYO DFM-480	Hi-cut	90 Hz
Station unit test & repair system	Prosol TRS-2	Slope	18 ms
Field processing system	Vista PC based system	Seis Monitor Gain	42 db
Sercel SN368 instrument settings:		Output Adjust	4 db
Recording mode	digital	Gain Curve	1
Tape format	SEG-D Multiplexed/PC SEG-Y	Release Time	10 ms
Number of input channels:		Compression Delay	8 ms
Data	120	Early Gain	36 db
Auxiliary	4	AGC	1
		Recovery Delay	32 ms

## Appendix 5. Line-recording parameters

Line 97AGSEL1		Last Geophone station	637
Orientation	S-N	First Shot point	102
(High SP numbers North, Trace 1 to the South)		Last Shot point	623
Length	32 km	Geophone Station interval	50 m
First Geophone station	100	Shot point interval	300 m
Last Geophone station	740		
First Shot point	100	Line 97AGSEL3	
Last shot point	740	Orientation	E-W
Geophone station interval	50 m	(High SP numbers West, Trace 1 to the East)	
Shot point interval	300 m	Length	46.5 km
Line 97AGSEL2		First Geophone station	100
Orientation	E-W	Last Geophone station	1030
(High SP numbers West, Trace 1 to the East)		First Shot point	119
Length	26.85 km	Last Shot point	1030
First Geophone station	100	Geophone Station interval	50 m
		Shot point interval (nominal)	300 m

## Appendix 6. Field tape index

### SEISMIC FIELD TAPE INDEX SEG D

Tape No.	Line	Shot points	Recording Dates	Record Mode	Survey
97067	97AGSEL1	100-213	20/10/97-21/10/97	6250bpi GCR	Eastern Lachlan 1997
97068	97AGSEL1	222-341	21/10/97-23/10/97	6250bpi GCR	Eastern Lachlan 1997
97069	97AGSEL1	346-463	23/10/97-25/10/97	6250bpi GCR	Eastern Lachlan 1997
97070	97AGSEL1	467-592	25/10/97-27/10/97	6250bpi GCR	Eastern Lachlan 1997
97071	97AGSEL1	596-724	28/10/97-28/10/97	6250bpi GCR	Eastern Lachlan 1997
97072	97AGSEL1	730-740	28/10/97-28/10/97	6250bpi GCR	Eastern Lachlan 1997
97073	97AGSEL2	102-222	29/10/97-29/10/97	6250bpi GCR	Eastern Lachlan 1997
97074	97AGSEL2	222-346	29/10/97-30/10/97	6250bpi GCR	Eastern Lachlan 1997
97075	97AGSEL2	352-480	30/10/97-31/10/97	6250bpi GCR	Eastern Lachlan 1997
97076	97AGSEL2	484-554	31/10/97-1/11/97	6250bpi GCR	Eastern Lachlan 1997
97077	97AGSEL3	119-236	3/11/97-1/11/97	6250bpi GCR	Eastern Lachlan 1997
97078	97AGSEL3	244-364	4/11/97-5/11/97	6250bpi GCR	Eastern Lachlan 1997
97079	97AGSEL3	364-502	5/11/97-5/11/97	6250bpi GCR	Eastern Lachlan 1997
97080	97AGSEL3	502-556	6/11/97-6/11/97	6250bpi GCR	Eastern Lachlan 1997
97081	97AGSEL3	605-735	7/11/97-7/11/97	6250bpi GCR	Eastern Lachlan 1997
97082	97AGSEL3	741-867	8/11/97-8/11/97	6250bpi GCR	Eastern Lachlan 1997
97083	97AGSEL3	875-1000	10/11/97-10/11/97	6250bpi GCR	Eastern Lachlan 1997
97084	97AGSEL3	1006-1030	10/11/97-10/11/97	6250bpi GCR	Eastern Lachlan 1997
97085	97AGSEL2	623-572	11/11/97-11/11/97	6250bpi GCR	Eastern Lachlan 1997

### SEISMIC FIELD TAPE INDEX SEG Y

Tape No.	FFID Range	Record Mode	Survey
97EL1	1286-1402	UNIX 'TAR' (Exabyte)	EASTERN LACHLAN LINE 97AGSEL1
97EL2	1405-1487, 1652-1661	UNIX 'TAR' (Exabyte)	EASTERN LACHLAN LINE 97AGSEL2
97EL3	1490-1649	UNIX 'TAR' (Exabyte)	EASTERN LACHLAN LINE 97AGSEL3

## Appendix 7. Environmental management plan

### 1. Introduction

The Australian Geodynamics Cooperative Research Centre (AGCRC) is developing a four-dimensional geodynamic framework of Australia to help the minerals and energy industries discover new deposits. The Eastern Lachlan Seismic Survey is being funded by the AGCRC. The Australian Geological Survey Organisation (AGSO) is responsible for the data acquisition and processing of the seismic reflection data. Interpretation of data will be done by the AGCRC.

The project involves, in part, the gathering of approximately 103 km of seismic reflection data in the Eastern Lachlan area of central west New South Wales (Fig. 1). The seismic data will form part of a data set aimed at achieving a better understanding and knowledge of sub-surface geology at a regional and local scale. In particular, these data will provide more information on:

- basement controls on basin development

- regional crustal thickness and major features within basement
- stratigraphic architecture of the basins
- structural architecture of the basins
- timing and location of fluid flow pathways

This document outlines procedures aimed at minimising, and wherever possible avoiding environmental impacts associated with seismic activities within the Eastern Lachlan area. The approach is based upon the concept of integrated management, that is, environmental management is integrated with operational activities and is not regarded as a separate entity.

The substance of this plan is guided by :

- 'Code for Environmental Management', Australian Minerals Industry, December 1996.
- 'Code of Environmental Practice', APPEA 1996.
- 'Environmental Assessment Guidelines, Cultural Heritage and Flora and Fauna', NPWS, NSW.



## 2. Objectives

All phases of the seismic acquisition operation within the Eastern Lachlan area shall be undertaken in such a manner as to meet the following objectives:

- avoid known sites of scientific, natural, Aboriginal or other significance;
- avoid, wherever possible, the disturbance of the natural environment. In particular minimise the impact on surface soil, vegetation, wildlife, drainage and aesthetics;
- avoid pollution of land, water and air by physical and chemical effluent;
- promote site restoration following disturbance.
- remove any risk to health and safety of personnel and public;
- comply with all legislation, government regulations and Aboriginal Land Council codes.

## 3. Cooperative partners

The proposed 1997 seismic project in the Eastern Lachlan area will be conducted under the AGCRC which provides a mechanism for co-operative research between Commonwealth, Industry and University geoscience institutions.

## 4. Timing of the seismic survey

It is proposed that topographic surveying and pegging for the seismic work commence on 22/9/1997. It is expected that AGSO shot hole drilling will commence in early October and that seismic recording will commence shortly thereafter. The duration of the survey is expected to be about 4 weeks.

## 5. Code of environmental practice

It is in the interests of all concerned that the work practices of the AGSO seismic acquisition does not impinge any more than is necessary on the environment of the region. APPEA (1996) have developed their own codes of environmental practice for seismic operations. AMI have issued a code for environmental management. Both of these documents have been consulted in the process of drawing up this document. Notwithstanding the rationale for various seismic surveys, these guidelines generally reinforce the sound management practices already applied by AGSO seismic crews. It should however be stressed that AGSO is involved in a research program rather than exploration and some parts of the voluntary guidelines may be inappropriate.

AGSO has many years experience working in rural and semi-urban areas of Australia. In recent years the AGSO seismic crew has successfully minimised the impact of operations in environmentally sensitive areas of the Bowen Basin, semi-urban areas of south eastern Queensland, rich agricultural areas of central New South Wales, forested areas of New South Wales and Queensland, as well as arid areas of the Canning Basin in north west Western Australia, the Kalgoorlie region (including strictly controlled conservation areas), the Nullarbor Plain, sensitive heritage areas of central Australia and most recently the Mt Isa region of north west Queensland and various localities in Tasmania. AGSO has a good record with communities throughout Australia.

AGSO management is well aware of the potential damage that seismic operations can inflict on the environment. Experience over many years, however, indicates that impacts of AGSO seismic operations is minimised by careful field management, reducing ground disturbance by vehicles, and keeping line clearing to a minimum.

## 6. The planning and consultative process

All relevant landholders and local council authorities will be contacted well in advance of any operations. These people will be informed of the type and timing of the seismic work and how it may affect them or their property.

Exploration companies active in the operations area will also be contacted in advance and any peculiarities of their exploration/mining lease conditions outlined so that AGSO operations will not impinge on their work.

It is in the interests of the co-operative partners to ensure that there is an appropriate consultation process in place prior to AGSO field operations. Appendices 1 and 2 contain details of authorities and individuals relevant to each line.

## 7. Environmental assessments

**7.1 Flora and fauna.** No clearing of native flora is required for the seismic survey to allow access for seismic survey vehicles. The seismic lines will follow existing roads in most parts, with some farmland pastures being crossed. No tracks will be constructed across creeks and rivers, with existing bridges and access routes being used to circumnavigate areas where vehicle access is not possible. The seismic survey will utilise the table-drain portion of the road where existing native flora is minimal due to disturbance by normal grading of the road. No roadside vegetation will be removed in drilling shotholes and deploying seismic data acquisition equipment.

All care will be taken to avoid disturbing fauna, especially on the road verges where lizards, snakes and frogs may live in fallen logs and native grasses, and could be accidentally run over by vehicles.

Below are extracts from the NPWS flora and fauna register which highlight the different types of flora and fauna which exists in the locality of the seismic lines planned for the seismic survey.

**Flora.** These data have been extracted from the Atlas of NSW Wildlife, a NSW NPWS database.

Extracted 19/09/1997.

These data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions.

**Legal status:** This identifies the legal status of the species within NSW, under the Threatened Species Conservation Act (1995).

V Vulnerable (Schedule 2)

E1 Endangered (Schedule 1 - part 1)

E2 Endangered (Schedule 1 - part 4)

P Protected

U Unprotected

Family name	Scientific name	Legal status	Sightings
Asteraceae	<i>Microseris lanceolata</i>	U	2
Lamiaceae	<i>Prostanthera nivea</i>	U	1
Orchidaceae	<i>Pterostylis woolfsii</i>	U	1
Rhamnaceae	<i>Discaria pubescens</i>	U	5
Sapindaceae	<i>Dodonaea viscosa</i>	U	1
Rhamnaceae	<i>Discaria pubescens</i>	U	1
Rutaceae	<i>Zieria obcordata</i>	E1	6

**Fauna.** These data have been extracted from the Atlas of NSW Wildlife, a NSW NPWS database.

Extracted 19/09/1997.

These data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions.

Scientific name	Common name	Legal status	Sighting
<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog	P	2
<i>Christinus marmoratus</i>	Marbled Gecko	P	1
<i>Underwoodisaurus millii</i>	Thick-tailed Gecko	P	2
<i>Christinus marmoratus</i>	Marbled Gecko	P	1
<i>Ctenotus robustus</i>	Striped Skink	P	1
<i>Trachydosaurus rugosus</i>	Shingleback	P	1
<i>Epthianura albifrons</i>	White-fronted Chat	P	1
<i>Epthianura aurifrons</i>	Orange Chat	P	1
<i>Epthianura tricolor</i>	Crimson Chat	P	1
<i>Ornithorhynchus anatinus</i>	Platypus	P	2
<i>Morelia spilota variegata</i>	Carpet Python	P	1
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	V	1
<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog	P	1
<i>Physignathus lesueurii</i>	Eastern Water Dragon	P	1
<i>Eulamprus quoyii</i>	Eastern Water Skink	P	1
<i>Platalea flavipes</i>	Yellow-billed Spoonbill	P	1
<i>Aquila audax</i>	Wedge-tailed Eagle	P	1
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	P	1
<i>Cacatua roseicapilla</i>	Galah	P	1
<i>Platycercus elegans</i>	Crimson Rosella	P	1
<i>Ninox novaeseelandiae</i>	Southern Boobook	P	1
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	P	1
<i>Merops ornatus</i>	Rainbow Bee-eater	P	1
<i>Cormobates leucophaeus</i>	White-throated Treecreeper	P	1
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	P	1
<i>Acanthiza nana</i>	Yellow Thornbill	P	1
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	P	1
<i>Lichenostomus leucotis</i>	White-eared Honeyeater	P	1
<i>Philemon corniculatus</i>	Noisy Friarbird	P	1
<i>Eopsaltria australis</i>	Eastern Yellow Robin	P	1
<i>Petroica multicolor</i>	Scarlet Robin	P	1
<i>Rhipidura fuliginosa</i>	Grey Fantail	P	1
<i>Strepera graculina</i>	Pied Currawong	P	1
<i>Corvus coronoides</i>	Australian Raven	P	1

#### MOLONG SHEET AREA

Site number	Location	AMGE	AMGN	Date recorded	Recorder	Site type
44-1-0007	Garra	664303	6335389	28-Apr-85	D. Bell	Carved, Scarred tree
44-1-0009	Yuranigh's Grave	675799	6334676			Burial, Carved tree, open campsite
44-1-0026	Bimbi Burial	675560	6335440	30-May-96	B. Allen	Burial
44-3-0088	Copper Hill	673800	6338600	1-Jan-91	W. Bluff	Scarred tree

#### BLAYNEY SHEET AREA

Site number	Location	AMGE	AMGN	Date recorded	Recorder	Site Type
44-5-0070	Dirty Creek	694500	6280570	28-Feb-96	Mark Rawson	Scarred tree
51-5-0048	DR-OS-2	694790	6268810	9-Oct-95	J. Kelton	Open camp site

<i>Corcorax melanorhamphos</i>	White-winged Chough	P	1
<i>Neochmia temporalis</i>	Red-browed Finch	P	1
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	P	1
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	P	2
<i>Acrobates pygmaeus</i>	Feathertail Glider	P	1
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	P	1
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	P	1
<i>Macropus rufogriseus</i>	Red-necked Wallaby	P	1
<i>Wallabia bicolor</i>	Swamp Wallaby	P	1
<i>Vespadelus vulturnus</i>	Little Forest Eptesicus	P	1
<i>Oryctolagus cuniculus</i>	Rabbit	U	1
<i>Canis familiaris</i>	Dingo and Dog (feral)	U	1
<i>Vulpes vulpes</i>	Fox	U	1
<i>Capra hircus</i>	Goat (feral)	U	1
<i>Sus scrofa</i>	Pig (feral)	U	1
<i>Ctenotus robustus</i>	Striped Skink	P	1
<i>Aquila audax</i>	Wedge-tailed Eagle	P	1
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	P	1
<i>Acanthiza nana</i>	Yellow Thornbill	P	1
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	P	1
<i>Lichenostomus leucotis</i>	White-eared Honeyeater	P	1
<i>Ornithorhynchus anatinus</i>	Platypus	P	1
<i>Dasyurus maculatus</i>	Tiger Quoll	V	1
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	P	1

#### 7.2 Cultural heritage

**Aboriginal site search.** At the request of AGSO, NPWS conducted a search of the NSW Aboriginal Sites Register to highlight the position of documented Aboriginal Sites which would be needed to be avoided by the seismic survey. The search of the register covered the 5 search areas where the proposed seismic lines would be positioned, and included 3 search areas for the Orange map sheet, one search area for the Blayney map sheet and one search area for the Molong map sheet.

The searches revealed nil recorded sites in the 3 search areas of the Orange map sheet, 3 recorded sites for the search area of the Blayney map sheet and 4 recorded sites for the search area of the Molong map sheet. Below are listed the results of the register search.

51-5-0050 DR-OS-1

694950 6268920 9-Oct-95

J. Kelton

Open camp site

The above aboriginal sites were plotted on maps, with none of the sites coinciding with the seismic line positions. AGSO understands the records are of "known" sites only and that other unknown sites may exist. Although the seismic line positions are mainly along existing road verges which have been extensively reworked through time, AGSO will ensure that sites found during the conduct of the survey will be avoided and documented for the NSW Aboriginal Site Register.

## 8. Minimising the environmental impact

In this section we identify activities carried out during field operations that will minimise damage to vegetation and the land surface and promote their restoration.

**8.1 Access tracks.** Where possible access to the area of operations shall be made from existing tracks and roads. AGSO and Contractors' vehicles and personnel shall be restricted to the table drain area on either side of the designated tracks or roads to be used for the seismic line.

**8.2 Seismic lines.** During seismic profiling operations AGSO prefers to work along existing roads/tracks if they are relatively straight and allow for the passage of large vehicles. Vehicles for the survey are listed in Appendix 3.

**8.2.1 Location.** Seismic lines have been located so as to minimise their impact on the environment.

Sites of natural, historical, Aboriginal and non-Aboriginal heritage significance known, or discovered in the course of exploration will be avoided and left undisturbed. Most sites of significance will be identified during the reconnaissance stage.

**8.2.2 Line preparation.** There is no line clearing planned for this survey.

**8.3 Operation.** All off-line activity will be minimised and limited to the approved corridor.

Operations will be minimised during periods of prolonged wet weather in order to minimise degradation of seismic lines.

All personnel will be responsible for ensuring that no littering occurs on or around seismic lines and camp sites.

**8.4 Camp sites.** At various stages of the data gathering process in excess of thirty people as well as a number of vehicles will be involved in the seismic operation. It will thus be necessary to establish a centralised camp site at a key location either on private land or public reserve. The proposed campsite for this survey is about 10 km east of Orange in a public reserve (used by the Orange Field Archery Club) on the road to Ophir and "Gowan" property.

**8.4.1 Location.** Camp sites will be chosen to minimise the environmental impact. Sites will be located on local government sanctioned camping areas.

Campsites will not be located near sites of known Aboriginal heritage significance. Such sites will not be visited nor disturbed.

**8.4.2 Preparation.** Where campsite preparation is necessary the area to be cleared shall be kept to a minimum. All established trees will be left standing. The campsite east of Orange requires no clearing of vegetation or soil.

Domestic waste will be disposed of in local government approved refuse tips.

Sewerage and sullage water will be disposed of in an approved manner. Septic toilets are located at the proposed campsite east of Orange.

**8.4.3 Operation.** All waste will be disposed of in a safe, efficient and environmentally conscious manner.

Adequate and properly maintained fire fighting equipment will be available in all vehicles, and the camp area. All fires and ignition sources will be managed in order to prevent bushfires.

Fuel storage, refuelling facilities and mechanical workshops will be placed in specific areas to limit the area contaminated by spillage of fuels, oils and grease and ease restoration procedures.

All vehicles will be parked within designated parking areas whilst within the campsite.

**8.4.4 Restoration.** Litter, rubbish and other wastes shall be removed from campsites and disposed of appropriately prior to the abandonment of the site.

**8.5 Explosives.** The seismic source for AGSO reflection profiling is an explosive charge located at the bottom of a drill hole 15-40 m deep. It is in the nature of seismic work that the energy released from the source is designed to penetrate downwards, not up to the ground surface, hence the requirement to load the explosive to a depth with a considerable thickness of overburden. The shot hole is backfilled with cuttings taken from the hole.

Detonating wire and debris will be removed once the charges have been detonated.

Handling, transport, storage and use of explosives is controlled by Commonwealth, State and Territory regulations.

**8.6 Surveying.** The seismic lines have to be surveyed and the position of geophone markers and shot holes known in three dimensions. Station pegs for identification will be timber stakes. These will be removed at the completion of operations. Permanent markers, constructed of steel (star pickets) will be placed at approximately 5 km intervals along the line and at bend points. These will remain in the ground but positioned so as not to interfere with normal land use operations.

## 9. Environmental audit

At the termination of AGSO seismic work, sites will be inspected by the AGSO Party Leader. A report will be lodged with the senior management of AGSO regarding any possible environmental consequences of the AGSO profiling.

## 10. References

- Australian Petroleum Production & Exploration Association (APPEA), Code of environmental practice, 1996.
- Australian Minerals Industry, Code for Environmental Management, 1996.

## Addendum 1. Seismic line description

### 1. Map sheet areas

1:250 000 scale: Bathurst

### 2. Traverse description

#### Seismic line 97AGSEL1

This north south seismic line will extend from a point 1.5 km south of 'Avondale' property. The line is 32 km in length and its northern end is at 'Willow Creek East'. The line mainly follows roads but does cross the properties of 'Avondale', 'Coombing Park', 'Clear View', 'Hillcrest' and 'Glen Ayr'.

#### Seismic line 97AGSEL2

This is a east west line approximately 26 km long. It begins at the start of 'Banjo Paterson Way' 4 km north west of Orange post office on the 'Ophir' road. The western end of



the line is at Gowan. The line follows the road mainly but it does follow a fence line on the property of 'The Vale'.

*Seismic line 97AGSEL3*

This is also a east west line approx. 45 km long. It's western end is about 18 km due west of Molong while it's eastern limit is at Mullion Creek. This line follows roads and railway easement in most parts. It will cross the properties of 'Old Redbank' and 'Belgravia'.

**3. Landowners and interested parties**

Department of Mineral Resources, NSW.

Orange City Council

Blayney Shire Council

Cabonne Shire Council

Evans Shire Council

National Parks and Wildlife Service, NSW

Orange Local Aboriginal Community

State Rail Authority

Central Tablelands Water

Telstra

Landowners:

- Ken Jones  
Avondale  
(02) 6367 5033
- George King (Manager)  
The Coombing Park  
(018 883316)
- John Bourke  
Clear View  
(02) 6367 5240  
(or 5 James St. Wallerawang; 02 6355 1324)

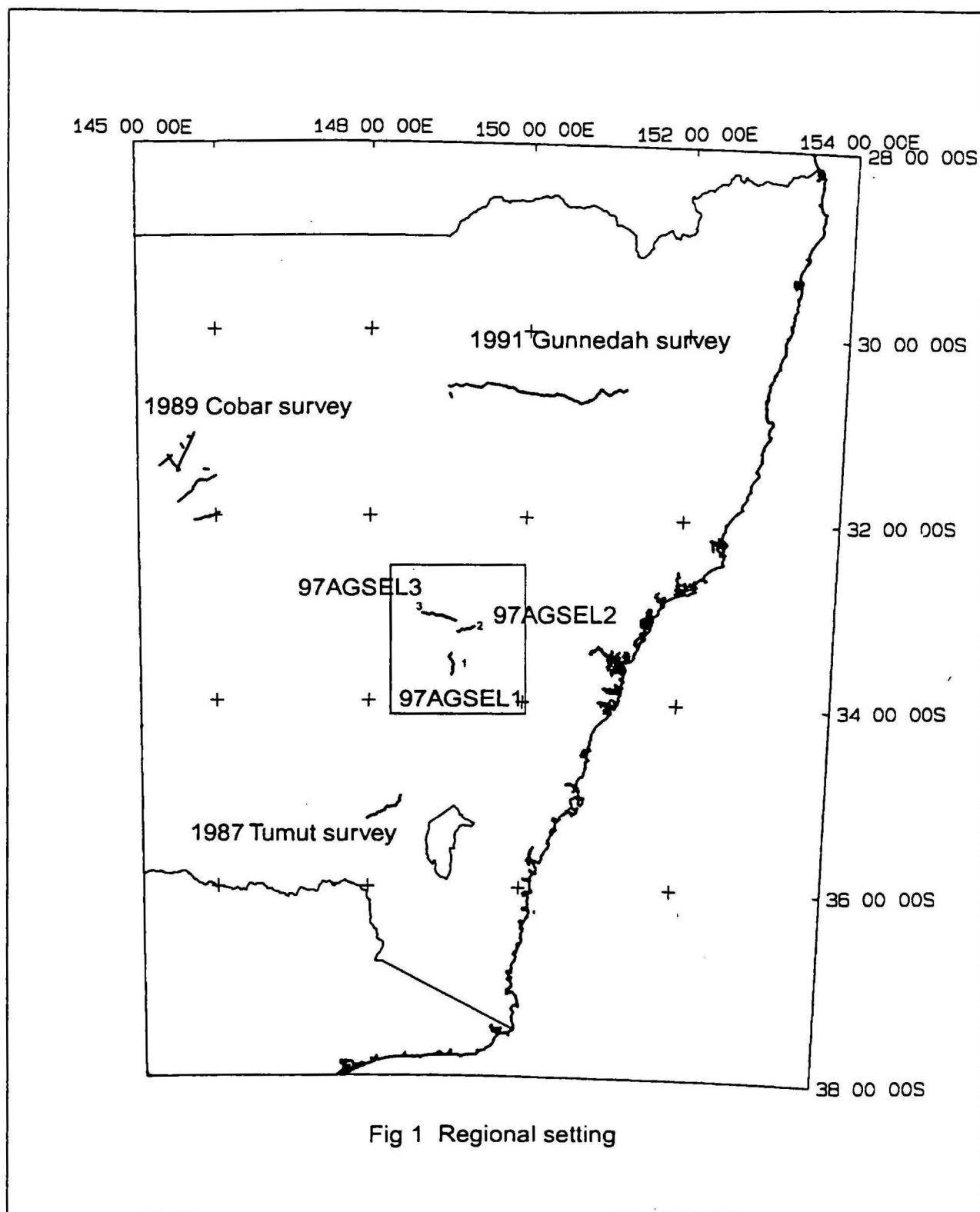
- Mark Robson  
Hillcrest  
(02) 6367 3191
- Jan & Perry Platt  
Glen Ayr  
(02) 6367 3091
- Ralph Christopherson  
The Vale  
(02) 6365 9130
- Craig (Manager)  
Belgravia  
(02) 6365 0658
- Brian & Julie Evans  
Old Redbank  
(02) 6366 8337
- Mr & Mrs Dean  
Hill St, Molong  
(02) 6366 8803
- Hargraves Resources
- Homestake Gold of Australia

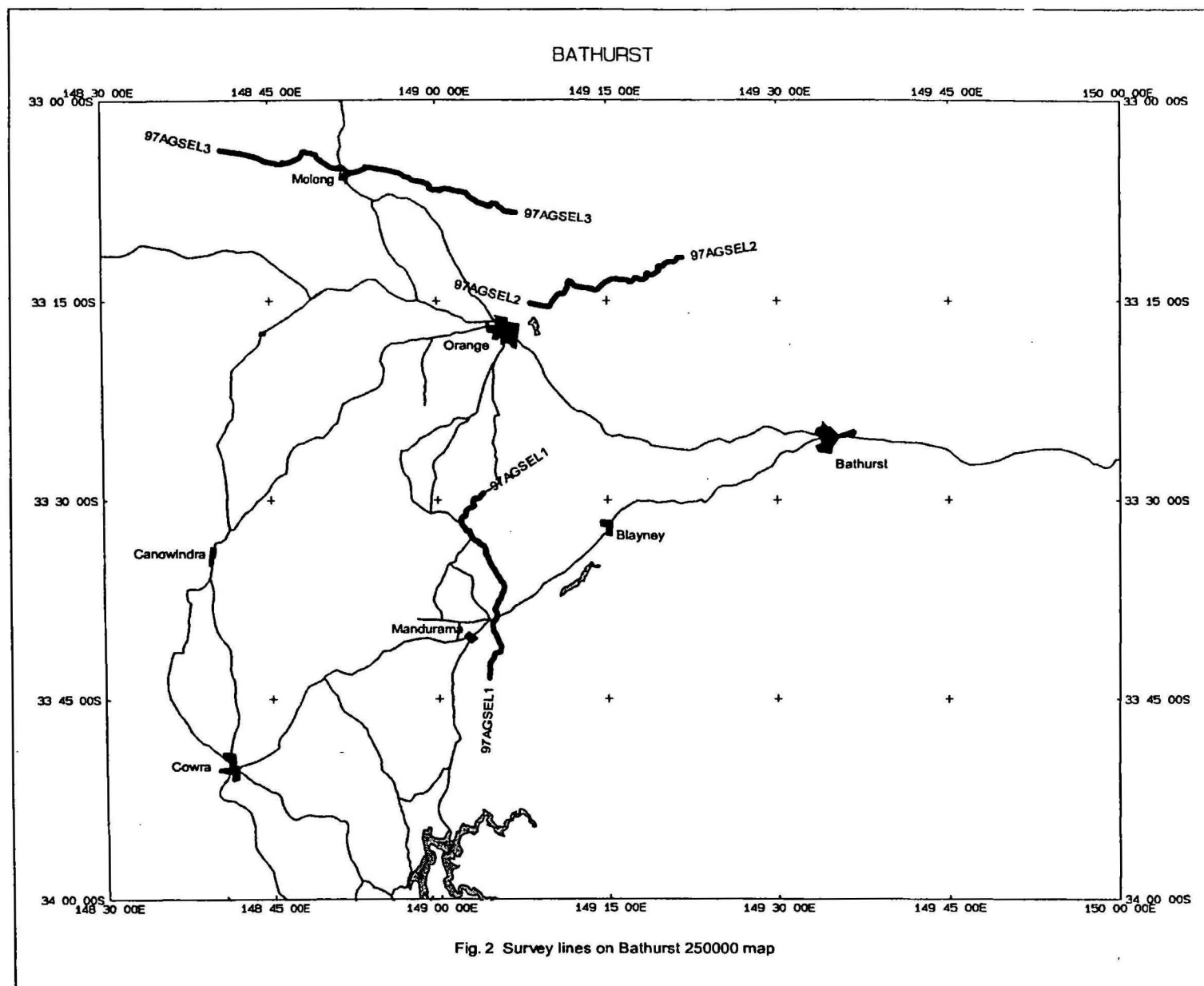
***Addendum 2. AGSO vehicles involved in seismic operations***

See Appendix 3, main report

***Addendum 3. Personnel***

See Appendix 2, main report





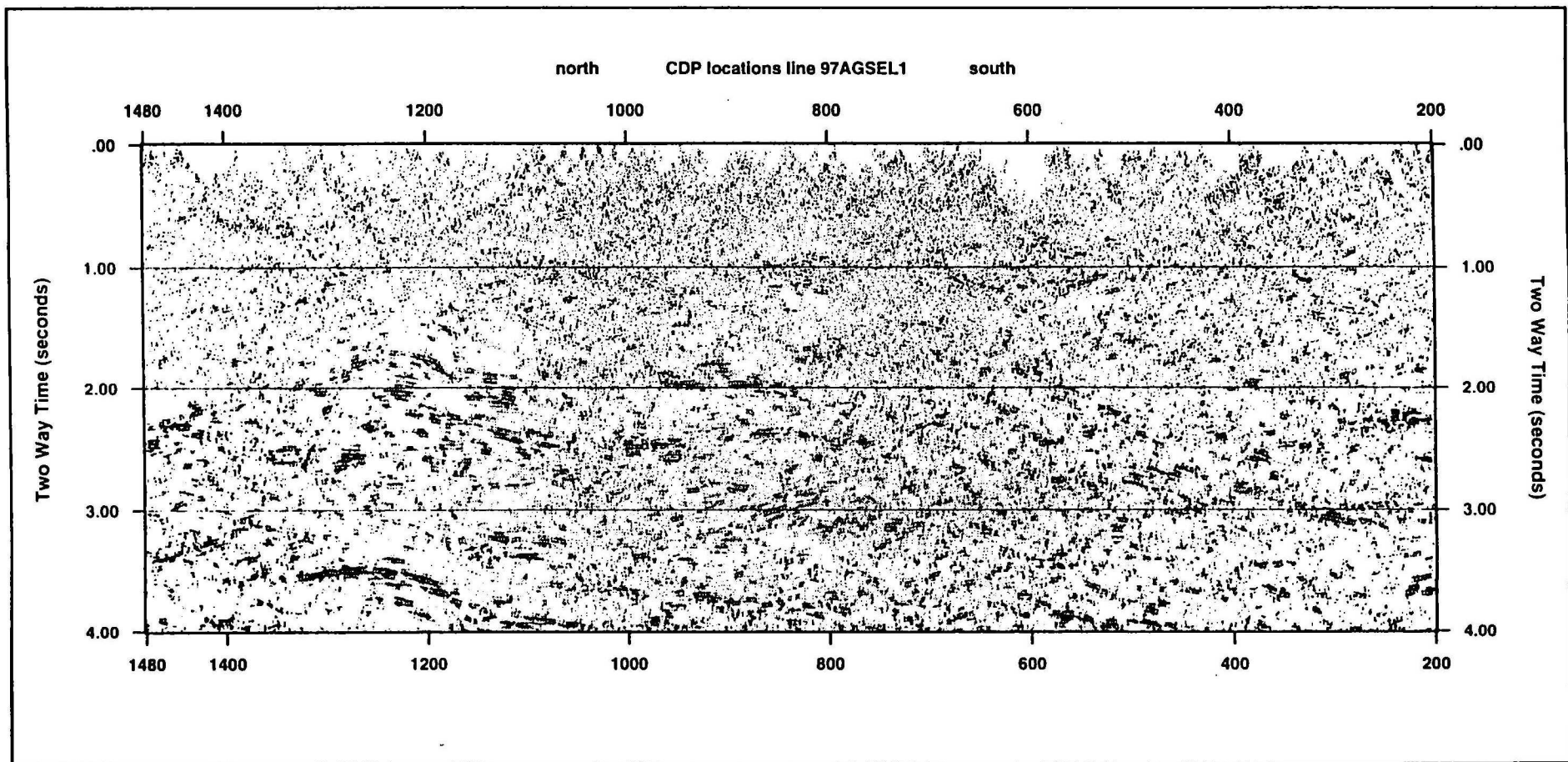


Fig 3 Final stack line 97AGSEL1 4 secs TWT



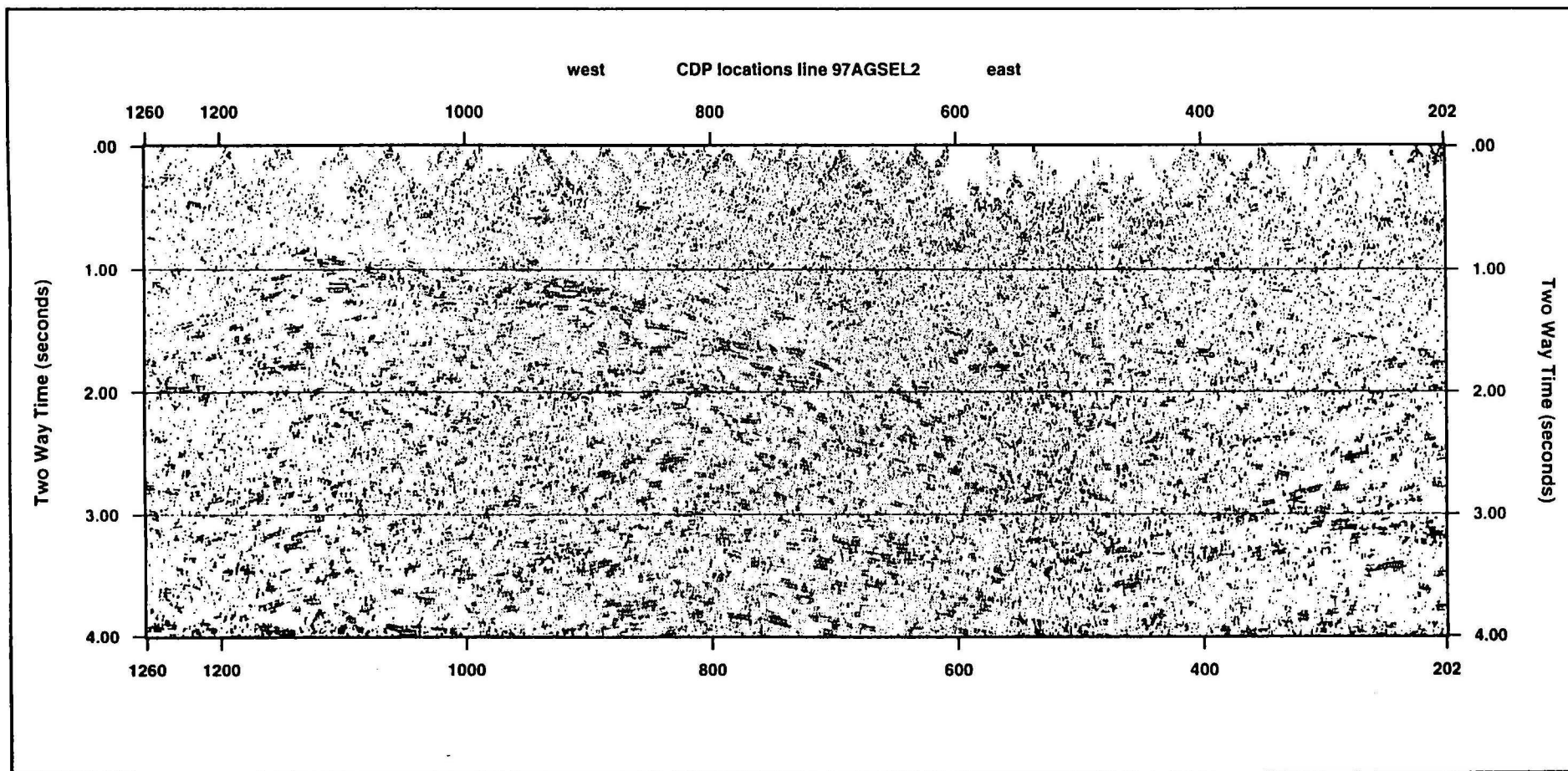


Fig 4 Final stack line 97AGSEL2 4 secs TWT

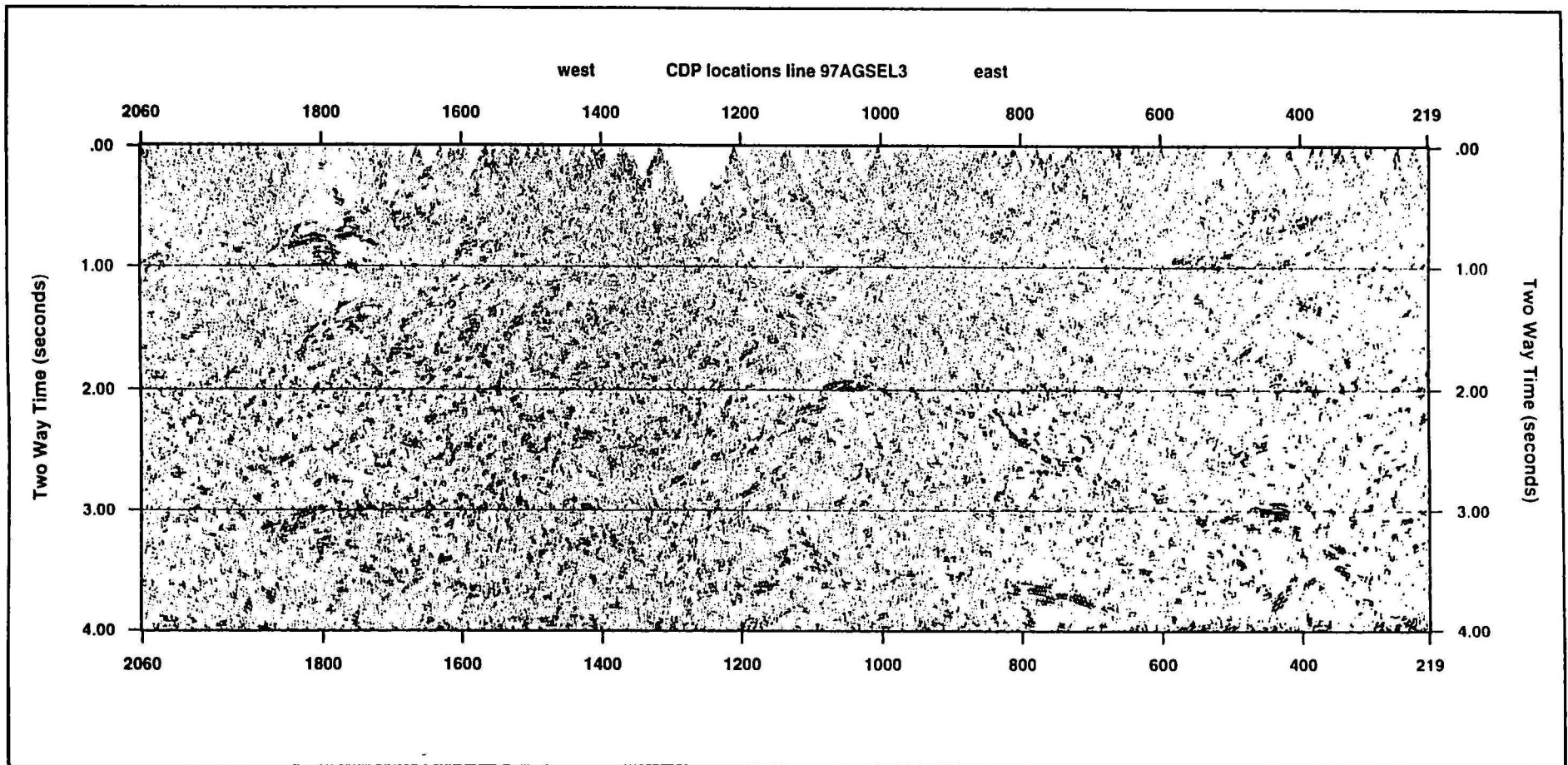


Fig 5 Final stack line 97AGSEL3 4 secs TWT

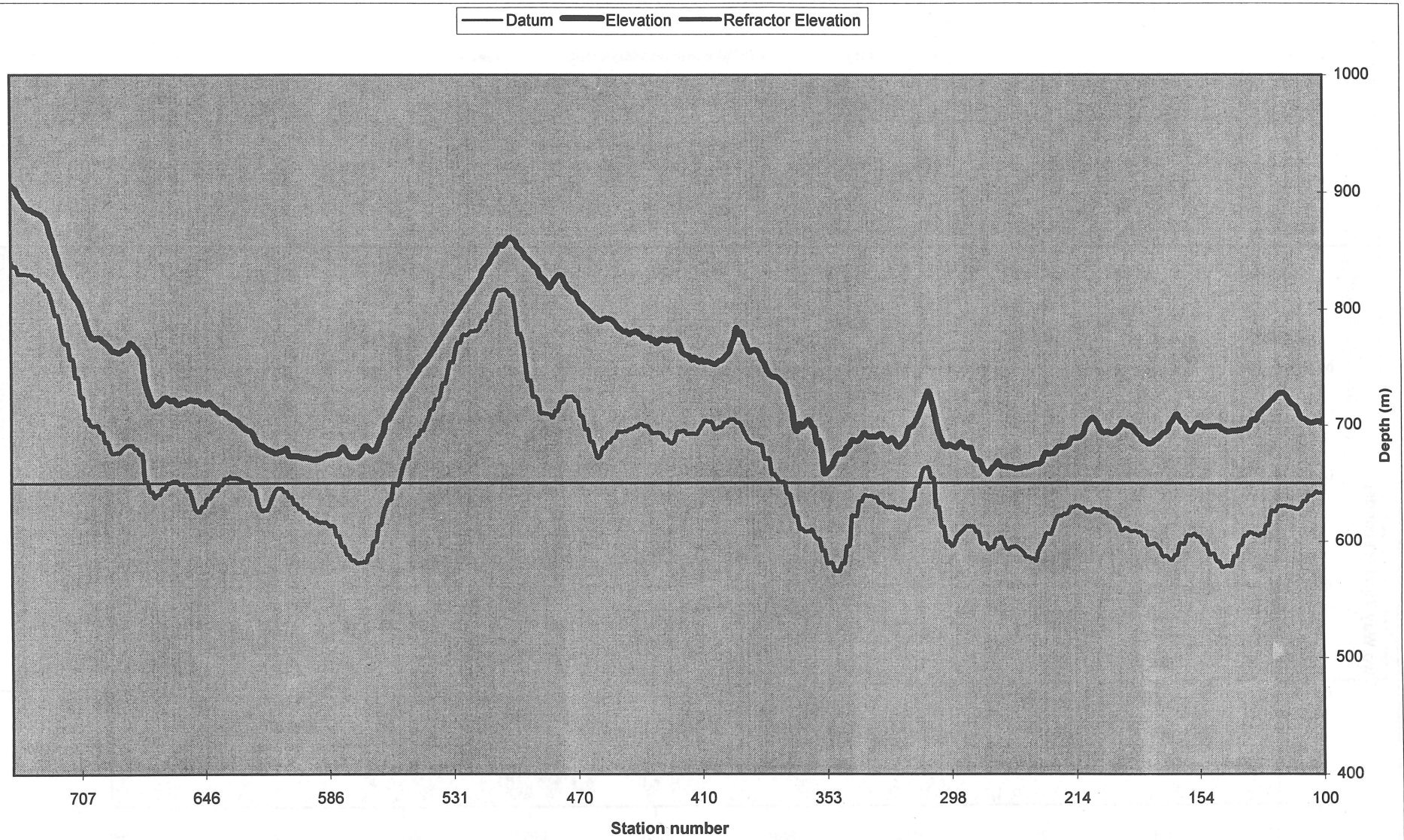
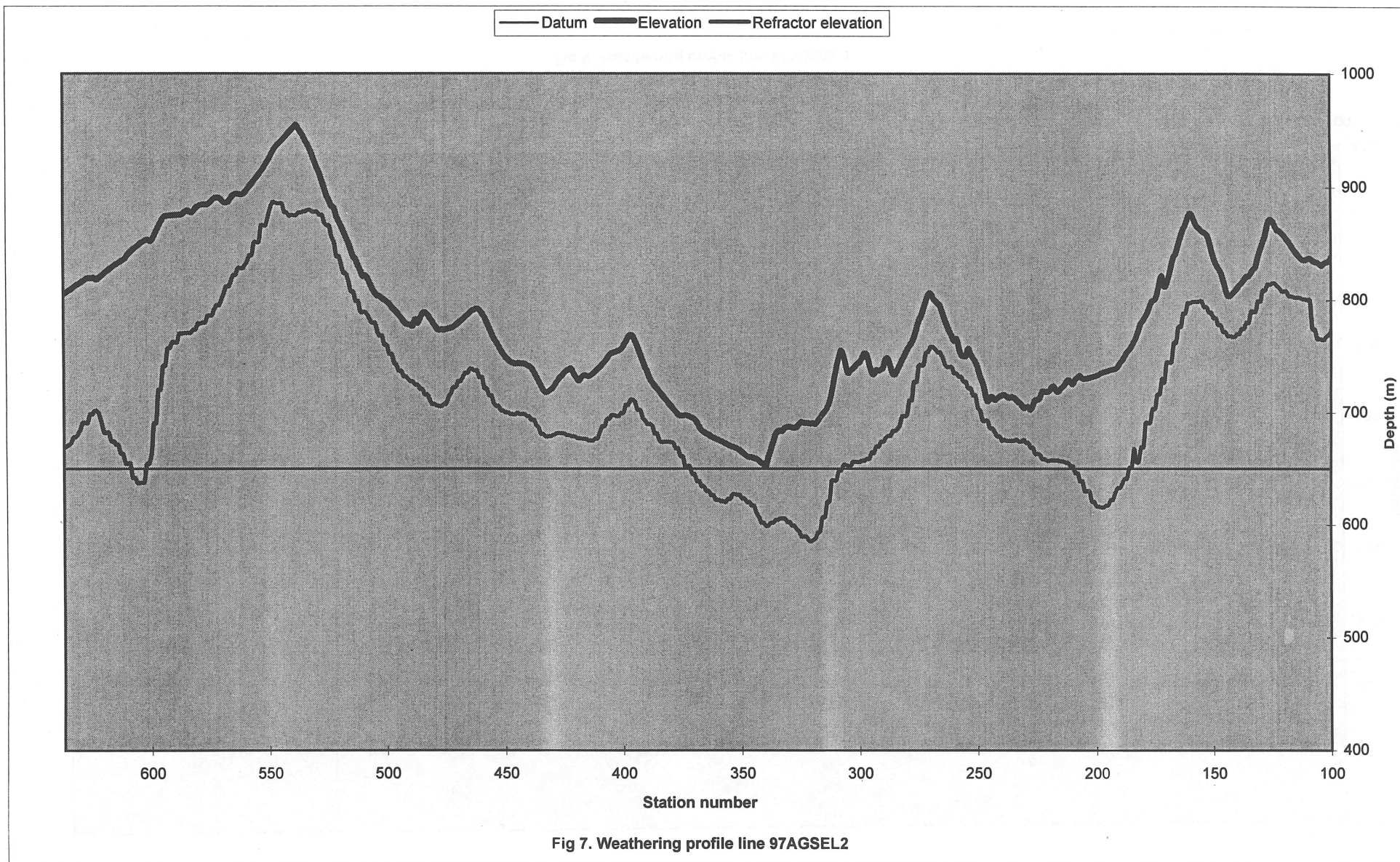


Fig 6. Weathering profile line 97AGSEL1







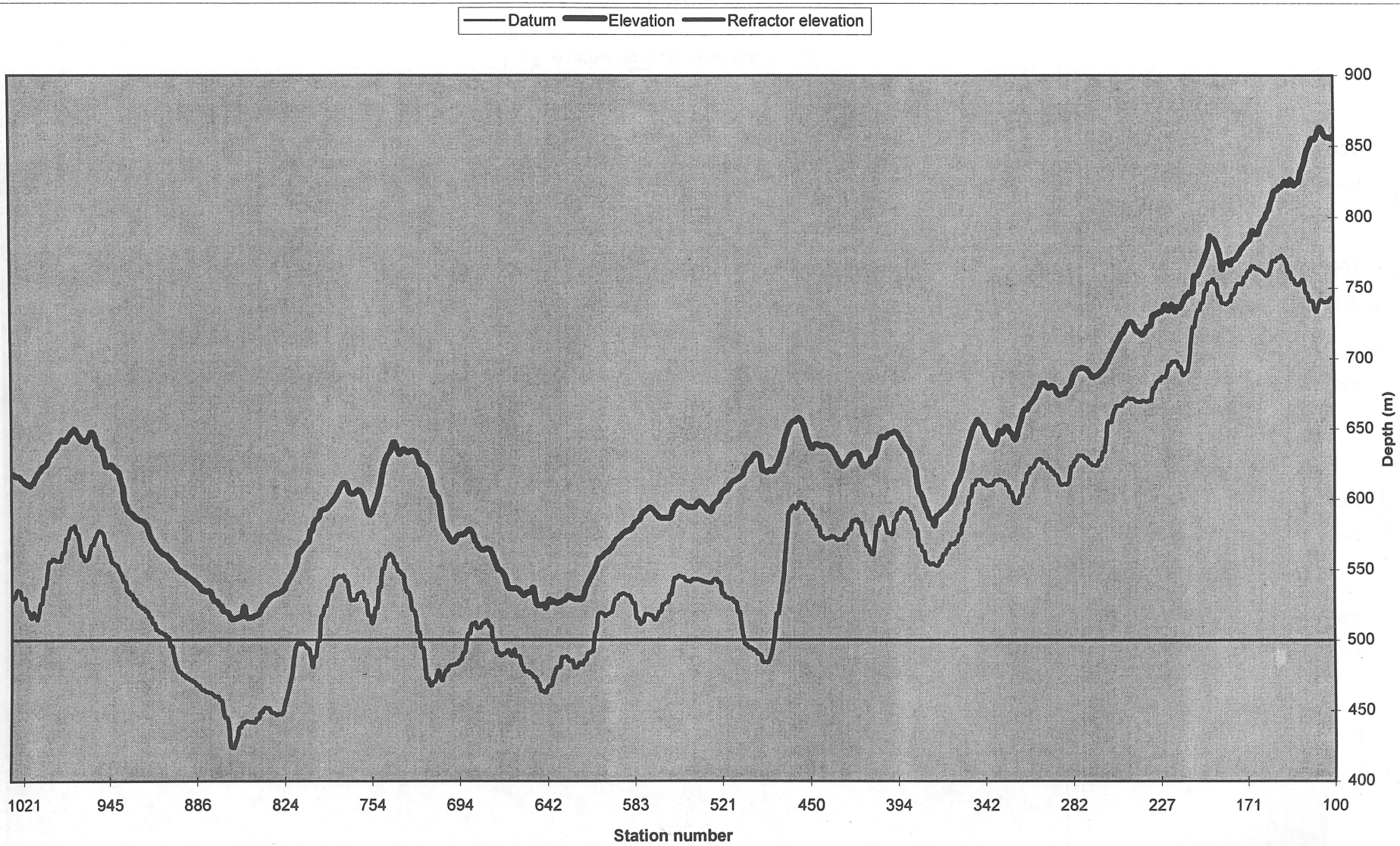


Fig 8. Weathering profile line 97AGSEL3