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OTWAY BASIN SEISMIC SURVEY 1992: OPERATIONAL REPORT

by
K D Wake-Dyster, A J Owen and D M Finlayson

RECORD 1993/97

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by

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A CONTRIBUTION TO THE
NATIONAL GEOSCIENCE MAPPING ACCORD PROJECT:
EARLY DEVELOPMENT OF THE OTWAY BASIN

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

Minister for Resources: Hon. Michael Lee, MP
Secretary: Greg Taylor

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Executive Director: Harvey Jacka

ISSN: 1039-0073

ISBN: 0 642 20043 2

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EXECUTIVE SUMMARY

The Australian Geological Survey Organisation (AGSO) (formerly the Bureau of Mineral Resources, Geology and Geophysics (BMR)) conducted a deep reflection seismic profiling survey in the onshore portion of the Otway Basin in the southeastern part of South Australia and southwestern part of Victoria, from February to June 1992. The seismic survey formed part of a National Geoscience Mapping Accord (NGMA) project to study the early development of the Otway Basin.

The objective of the seismic survey was to acquire new deep reflection seismic data (20 seconds two way travel time) using explosive seismic energy sources to improve on the knowledge of early sedimentary sequences in the Otway Basin, especially at depths greater than 3 km (ie. deeper than 2 seconds on a seismic section). Explosive seismic energy sources were used in an attempt to provide a stronger seismic energy source than the seismic vibrator sources currently used in the region by seismic contractors. Eight seismic lines with a total survey line length of 474 km were planned for the seismic survey, specifically positioned to target the survey objectives. Positioning of the seismic lines was achieved through consultation with NGMA partners, industry and universities.

The seismic survey obtained 461 km of 5 to 10 fold CMP deep reflection seismic data along seven of the proposed seismic lines over a 15 week acquisition period. Line 8 was deleted from the program due to Line 2 being extended in length and budgetary constraints. In addition to the seismic survey, gravity observations were made by the Geological Survey of Victoria and AGSO at 300 m intervals along all seismic lines. All seismic lines were also flown by the AGSO geophysical aircraft to record aeromagnetic and radiometric data at a flight height of 100 m AGL.

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.

INTRODUCTION

1.1 Background

The Australian Geological Survey Organisation (AGSO) (formerly known as the Bureau of Mineral Resources, Geology & Geophysics (BMR)), as part of the Australian National Geoscience Accord (NGMA), proposed to conduct a deep seismic reflection profiling survey in the Otway Basin region of SW Victoria and SE South Australia during 1992. The objectives for conducting the seismic survey were aimed at achieving a better understanding of the sub-surface geology of the onshore Otway Basin region, thought to have considerable resource potential, including hydrocarbons, industrial gases and geothermal energy. Previous AGSO deep seismic reflection profiling surveys (using explosives as the seismic energy source) in other areas of Australia to investigate basin sequences and basin formation have provided new perspectives on basin development not always apparent in industry seismic data.

Recent industry high CMP fold and higher spatial resolution seismic data using seismic vibrators as the seismic energy source, have produced excellent seismic data in the onshore region of the Otway Basin down to 2 seconds two-way travel time (ie. to 3 km depth). The lack of resolution of seismic reflection events at greater depths was possibly attributable to the restricted capacity of the commercial seismic vibrators to provide enough seismic energy to resolve deeper seismic reflection events at greater than 2 seconds two-way travel time. A proposal was therefore prepared to use explosives as the seismic energy source, with charge sizes in the vicinity of 10 kg of ICI Powergel in an attempt to input greater seismic energy into the earth to resolve seismic reflections from sediments greater than 3 km depth. The AGSO seismic reflection acquisition system is specifically designed for seismic acquisition using an explosive seismic source in conjunction with AGSO seismic shot hole drilling rigs.

To test the feasibility of recording deeper reflection events using large explosive charges as the seismic source, AGSO conducted a short test survey during October and November 1991 (Wake-Dyster & others, 1993). The test sites were located in several areas of the Otway Basin with different technical problems for seismic acquistion, including areas with outcropping Tertiary volcanic rocks, near surface limestones and palaeo-sand dunes. The results from the test survey showed that deeper reflections could be recorded using an explosive seismic energy source. The test survey also highlighted operational problems in shot hole drilling. Difficulty in drilling shotholes in palaeo-sand dunes using air and water injection showed that for a major seismic survey, drilling using mud would be needed and that portable mud pits would be required.

1.2 Previous Geophysical Investigations

Numerous seismic reflection surveys have been conducted in the onshore part of the Otway Basin since the early 1960's. The earlier seismic surveys used explosives as the seismic energy source, with areas of surface volcanics, limestones and palaeo-sand dunes being avoided due to recording and shothole drilling problems. With the development of the 'Vibroseis' technique in the mid-1960's, experimental seismic surveys by the BMR comparing 'Vibroseis' and explosive seismic energy sources (Jones, 1966; Raitt, 1966; Schwing & Moss, 1974) were conducted to develop seismic acquisition parameters and methods to record good quality seismic data in the difficult surface condition areas. Results of the experimental surveys showed similar data quality being obtained, for the same amount of effort for both 'Vibroseis' and explosive energy sources. However using explosives as the seismic energy source required 'a high-effort technique', ie. large explosive charges of between 45 to 140 kg and larger areal patterns of geophones and shotholes. Nowadays due to environmental constraints, urbanisation and the high cost of explosives, the 'high-effort technique' would be extremely difficult to implement. Modern seismic surveys in the Otway Basin by industry seismic crews have predominantly used 'Vibroseis' seismic methods, with less impact on the environment and agricultural land, with excellent data being recorded to 2 seconds TWT.

The development of digital seismic data acquisition systems with a large dynamic range, compared to AM and FM analogue seismic recording systems, plus the full implementation of CMP recording techniques, has allowed good quality seismic data to be obtained to depths of 3 km, using smaller size seismic sources (eg. reduced shot charge sizes and medium size seismic vibrators). The use of 'Vibroseis' compared to explosives in shotholes, avoids hard drilling conditions in volcanics, lost circulation in cavernous limestones and collapsing shotholes in palaeo-sand dunes, with good quality data still recorded. The disadvantage of 'Vibroseis' has been the limited size of the seismic vibrators available to produce sufficient seismic energy to resolve reflection events below 2 seconds TWT.

1.3 Location

The 1992 AGSO seismic survey was conducted in SW Victoria and SE South Australia. The seismic lines were confined to the following 1:250000 map sheets; BALLARAT, COLAC, HAMILTON, PORTLAND, PENOLA and NARACOORTE. Topographic and cadastral maps, and air photos were used to position the seismic lines. Figure 1 shows the location of the seismic lines.

1.4 Seismic Lines

Eight seismic lines were proposed for the 1992 seismic survey. Due to funding limitations and an extension of Line BMR92.OT02, only seven of the proposed seismic lines were recorded, including Lines BMR92.OT01 through to Line BMR92.OT07. Line BMR92.OT08 was pegged and surveyed, but no shotholes were drilled. To minimise disturbance to landowners, the majority of the seismic lines were positioned along existing roads and tracks in consultation with local authorities.

1.5 Operations: Commencement, Personnel and Vehicles

The seismic survey commenced in early February 1992 with the contract surveying crew, chaining, pegging and surveying the seismic lines. Some line clearing was necessary for survey operations, and this was organised with local authorities. The shothole drilling crew commenced shothole drilling in late February, followed one week later by the recording crew. The seismic lines were recorded in order of highest priority, except for Line BMR92.OT02 which was recorded out of priority sequence to maximise resources while in that area. Line BMR92.OT01 was recorded first, with the other lines through to Line BMR92.OT07 recorded in sequential numbering order. The seismic survey started in the eastern Otway Basin region (objectives of highest priority) and moved progressively westward. The seismic program was also designed to take advantage of the drier conditions in the Otway Ranges during mid-summer and to finish the survey in an area still accessible during late autumn and early winter.

Due to the problems of urbanisation and potentially adverse wet weather conditions in the Otway Basin region, all accomodation for the seismic operations was based on commercial accomodation in motels and hotels in towns, within close proximity of the seismic lines. Hire arrangements were made with local authorities for sheds, parking, power and amenities to allow mechanical and technical workshops to be operational throughout the survey. Seismic survey operations commenced in Colac, Victoria, with accomodation in motels, and an area at the showgrounds hired for mechanics and technicians. Throughout the survey commercial accomodation problems were experienced due to fluctuating accomodation pressures from other users; however arrangements were organised so that accomodation problems did not impede progress of the survey. As the survey progressed, other towns used for accomodation were Terang, Warrnambool, Casterton, Penola, Mt Gambier and Millicent.

Details of personnel, vehicles and equipment used on the seismic survey are documented in Appendix 1. Due to commercial accomodation being used for the survey, no ablution and kitchen trailers, and camp generators were required on the survey. Similarly a reduction in temporary personnel being employed resulted in no cooks, assistant cooks and camp attendants being employed. Expenditure savings from a reduction in temporary personnel being employed were used in part to offset the additional costs of travel allowances.

1.6 Associated Geophysical Surveys:

Because all seismic lines were surveyed to produce third order standard elevation and coordinate values, gravity readings were also made along all the lines with measurements taken every 300 m. The Geological Survey of Victoria (GSV) made the gravity readings along the seismic lines in Victoria (as part of the NGMA) with the remainder read by AGSO gravity group personnel.

The seismic lines were also flown over by the AGSO airborne geophysical aircraft to record the total magnetic field and radiometrics. The flight height was 100 m AGL. All eight seismic lines were flown over in a single day from Ballarat Airport, with one refuelling stop at Mt Gambier Airport. The seismic lines were flown over on an opportunity basis, with the aircraft having just completed flying the Ballarat 1:250000 map sheet.

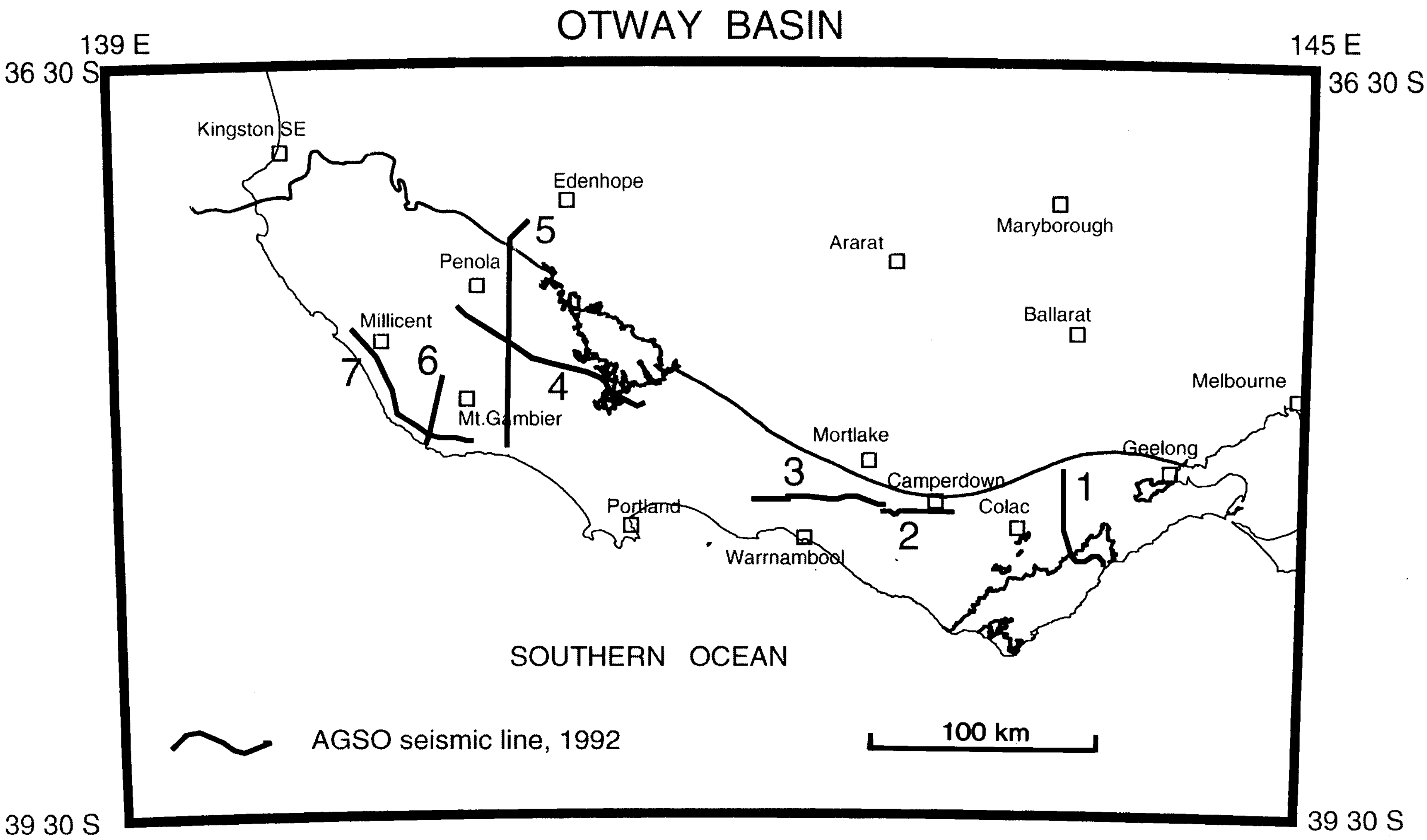

Figure 1. Location map, 1992 seismic survey lines.

1.7 Objectives and Program

Within a resource constraint scenario, eight targets for seismic reflection profiling in the onshore portion of the Otway Basin were identified after consultation with NGMA partners (Geological Survey of Victoria and South Australian Department of Mines and Energy), exploration companies and university groups. The targets were selected on the basis of the need to:

1. Improve knowledge of the nature and timing of major basin structures,
2. Provide regional tie lines,
3. Improve imaging of the deeper basin sequences.

To minimise survey costs and the problem of a very short lead time for survey preparations, all seismic lines were positioned along existing roads and tracks where possible, with the proviso that survey objectives were maintained. A total of 474 km of seismic lines was planned, with a probable 440 km being acquired with existing resources.

Brief notes on the geological rationale for each of the proposed seismic lines are contained below;

Line BMR92.OT01 - Wingeel to Lorne (62 km)

The eastern Otway Basin has a structural style which is different from that in the west. Line 1 was designed to provide a regional tie connecting a number of troughs of the Port Campbell Embayment near the northern margin of the basin, the Barwon Downs Graben, and the uplifted and exposed part of the early Cretaceous basin sequences in the Otway Ranges to the southeast of the Bambra Fault.

Line BMR92.OT02 - Ewen Hill to Lake Purrumbete (16 km)

The northwestern margins of the Port Campbell Embayment are only poorly understood. Line 2 was designed to provide a deep image of this margin across the Curdie Fault. The line also lies just to the south of Lake Bullen Merri, the location of xenolith samples used to determine geothermal gradients for SE Australia. The line also straddles a zone thought to be of fundamental importance to the development of the Otway Basin, namely the structural zone connecting the Mt. Staveley Fault Zone with the Sorell Fault offshore.

Line BMR92.OT03 - Moyne River to Terang (57 km)

There are no regional seismic tie lines across the Warrnambool Gravity High. Line 3 was designed to determine the nature of the structure across the high and provide tie-line information between the Port Campbell and Tyrendarra Embayments.

Line BMR92.OT04 - Nangwarry to Digby (85 km)

Line 4 was designed to examine the nature of the structures across the Merino High where early basin sequences crop out, and provide a tie line from the Penola Trough to the Ardonachie Trough. The line straddles the state border. The initial suggestion was for the line to continue eastwards along the Ardonachie Trough but it was felt that industry data were sufficient for that purpose.

Line BMR92.OT05 - Langkoop to Lower Glenelg River (100 km)

One objective of the survey was to provide a regional line crossing from south of the Tartwaup Fault, north to the Penola Trough and then onto basement north of the Kanawinka Fault. Line 5 was planned to achieve this purpose. Although it does not connect to the coast, the offset Line 6 achieves this goal. Line 5 follows the border where lease boundaries join and will provide a very useful tie line.

Line BMR92.OT06 - Glencoe to Kongorong Forest (33 km)

Line 6 was designed to traverse the deepest basin sequences encountered onshore and to provide a tie line from north of the Tartwaup Fault to the coast where there are adjacent offshore data. Basement has not been identified in industry data from the area. Using dynamite sources it is expected that the imaging of the deepest basin sequences can be improved.

Line BMR92.OT07 - Rendelsham to Allendale East (81 km)

Tie lines in the region of the deepest basin sequences are poor. Line 7 extends industry data from north of the Tartwaup Fault into the region where deep sequence images and the structural history can be improved.

Line BMR92.OT08 - Kingston SE to Robe (40 km)

The nature of structures in and around the Robe Trough is still only poorly understood. There are numerous small tilt blocks and their fault geometry is complex. Line 8 was a regional tie line from basement on the Padthaway High across the Robe Trough near the coast and onto the Lake Eliza High where it connects with industry lines.

At the commencement of the survey, the seismic lines were prioritised in the following sequence for acquisition, Line 1, 3, 4, 5, 6, 7, 8, 2. However, during the recording of Line 1, wet weather conditions made it unlikely that Line 2 could be recorded at the end of the survey. Line 2 was thus recorded after Line 1, and the other seismic lines were recorded in numerical sequence, although the lack of resources caused Line 8 to be deleted from the program.

FIELD OPERATIONS

2.1 General

Seven 5-10 fold CMP deep seismic reflection profiles were recorded with a total line length of 462.7 km of new seismic reflection data acquired. The seismic lines were surveyed, shothole drilled and recorded in numerical sequence from Line BMR92.OT01 through to Line BMR92.OT07. General spread and recording parameters for all seismic lines are given in Appendix 4.

Shothole drilling on Lines 1, 2 and 3 was fair to good, using mainly air and water injection. On the western end of Line 4, sand dunes were encountered requiring mud drilling. Similarly the majority of Line 5 required mud drilling in sands, with an additional problem on the southern end of Line 5 of Gambier Limestone beneath the sand dunes causing lost circulation of drilling mud fluids. Line 6 had some sand dunes at the northern end, but the remainder of the line was drilled in surface outcropping Gambier Limestone using air and water injection. The Gambier Limestone was good drilling except for the occasional bands of very hard chert, and caverns were sometimes encountered. Line 7 on the southern end also had surface outcropping Gambier Limestone requiring only air and water injection, but on the northern end from Lake Bonney to the north, palaeo-sand dunes were encountered with a shallow water table (6 m depth). Mud drilling was attempted but proved unsuitable in the palaeo-sand dunes, with the result that shallow shotholes were used with two holes per shotpoint (spaced 3 to 4 m apart) to hold the 10 kg charges, with 4 kg placed in one hole and 6 kg in the other.

Seismic recording progressed smoothly with only minor problems, until Line 7, where line continuity problems were a major delay in recording. Line continuity problems resulted from worn cable and station unit connectors and an increase in moisture (rain) into the cable connections.

During the survey weather conditions were generally good, with very little rain during the majority of the survey. Towards the end of the survey, and approaching winter, rain squalls and scuds made working conditions unpleasant, but drilling and recording could still be maintained.

2.2 Reconnaissance

A brief initial reconnaissance of the survey area was made in early October 1991 by Kevin Wake-Dyster and David Johnstone, to select sites for a proposed seismic test survey in late October 1991. Paul MacDonald of GSV provided assistance in site selection in the Colac area and Rob Langley from SADME provided assistance in site selection near Lake Bonney and south of Mt Gambier. Several of the proposed seismic lines were also examined to highlight any major access problems.

During the seismic test survey, Doug Finlayson carried out a major reconnaissance of the proposed seismic lines to highlight acquisition and environmental problems and make contact with local authorities and landowners. During the major reconnaissance the proposed line positions were finalised, highlighting problem areas for data acquisition.

During the seismic survey, final contacts with local authorities and landowners regarding line position arrangements were made by Kevin Wake-Dyster.

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. A copy of the environmental management plan is attached in Appendix 8.

In Victoria, environmental issues are managed by the Department of Conservation & Environment, with control of designated areas through regional offices. In the Colac area, at the request of the Department of Conservation & Environment, the southern end of Line 1 was rerouted from the Lorne Road, past Erskine Falls, to Big Hill Track to the north, due to the sensitive high profile environmental problems in the Lorne area. The Big Hill Track route proved to be a better alternative for the seismic operations, while still maintaining survey objectives. Also a cooperative funding arrangement with the department allowed Wickham Track in the Otway Ranges (State Forest) to be upgraded for both forestry and seismic operations.

Further west in the Portland Region of the Department of Conservation & Environment the conservation of native grasses and flora were of prime importance. Much of the Portland Region is under farming and cultivation, with very few localities left to preserve examples of original native floras of the region. Road verges and railway easements have thus become very important localities for preservation of native floras, however most of the seismic operations in the area were planned to follow existing roads and tracks. A strategy was developed with the department to allow the seismic operations to proceed with no disturbance to native floras in the road verges. An officer from the Department of Conservation & Environment was hired to traverse the planned seismic lines in conjunction with the seismic party leader to document the distribution of native flora along the route. The major concern involved the impact of shothole drilling operations on the native flora. Once the seismic line was pegged and surveyed, shotpoint positions were altered to avoid disturbance to existing colonies of native flora. The native flora of importance included kangaroo grass, native peas, pennyroyal, blue devil and native herbs. Larger species of native flora included shrubs of Blackwood and Wattle. Similarly in the northern part of the Portland Region, conservation of native flora was also important, especially in designated flora reserves. The seismic line did not pass through any major flora reserves, except a restriction was made on bulldozing near the riverbanks of the Glenelg River. Where the seismic line crossed the Glenelg River south of Casterton, the seismic line was rerouted to take advantage of forest tracks in pine plantations, resulting in only a walking trail cleared by hand for several hundred metres satisfying access and survey objectives.

In South Australia, the use of existing roads and tracks resulted in very few problems in conflict with environmental and conservation issues. Contact was made with local aboriginal groups in the planning stage of the survey to avoid any aboriginal archaeological sites, especially in the Lake Bonney and Woakwine Range areas.

2.4 Line Clearing

To minimise expenditure on seismic line clearing, seismic lines were positioned to follow existing roads and tracks. However some of the tracks required upgrading and several of the roads required slashing of grass regrowth on the road verges and table drains.

Line 1 - Due to the dry conditions at the start of the survey, slashing grass on road verges was regarded as a significant fire hazard. The northern end of Line 1 required clearing of the grass to enable better access to the road verge. Arrangements were made with the local country fire service to control burn the roadside verges instead of grass slashing. Wickham Track was upgraded with AGSO providing grading of the track.

Line 2 - Access to the road verge was acceptable with no clearing done.

Line 3 - Due to the conservation of native flora, no clearing of the road verges was performed. However at the completion of recording along the line, AGSO was requested by the Warrnambool Shire to remove all drill cuttings from the roads. A grader from the Shire was hired to perform the restoration task as requested.

Line 4 - Only a small amount of tractor slashing was required on Line 4, across a farm paddock with bracken fern overgrowth. The local landowner (Geoff Paltridge, "Sherwood") was hired to perform the slashing.

Line 5 - Approximately 5 km of tracks and road verges were slashed to allow access for vehicles along overgrown tracks along the state border. The landowner hired on Line 4 also was hired for the slashing along Line 5.

Line 6 - Several kilometres of road easement were slashed towards the southern end of Line 6. The Port MacDonnell District Council was hired to do the slashing. The same road easement also required restoration work after recording due to the drilling rigs and tankers badly cutting up the track with deep bogholes. The District Council was hired for the restoration work, to be performed when drier weather conditions prevailed.

Line 7 - No clearing was required for Line 7. A large boghole made by the drilling rigs and tankers on the northern end of the line required repair. The Millicent District Council was hired to repair the track, when drier weather conditions prevailed.

2.5 Surveying

Chaining, pegging and surveying of the seismic lines was performed under contract by Dynamic Satellite Surveys Pty. Ltd. (DSS). DSS were selected on the basis of fulfilling survey requirements at the lowest cost. DSS employed a surveying system utilising Ashtech XII Geodetic GPS receivers for coordinate determination and a Rapid Elevation Meter (REM, digital quartz barometer) for determining elevations. The DSS crew consisted of a senior GPS surveyor and two assistants. To enhance progress during the later half of the survey, DSS subcontracted pegging and chaining services to French Seismic Chaining (2 person crew), with production rates of between 16 to 20 km/day.

In comparison to other contract surveyors hired for previous AGSO seismic surveys, surveying production rates using GPS compared favourably with optical methods using total station theodolites for seismic lines with many bendpoints (ie. approx 5-6 km/day). DSS used extensive computer software for error checking the data, with very few errors in surveying occurring.

Survey data was supplied both in paper computer printouts and PC floppy disk files. A separate surveying report for the survey was supplied by DSS. DSS were contracted for the surveying at a 'Turnkey Rate' of $ 149/km with additional charges for survey plans and report.

2.6 Drilling and Explosives

2.61 Drilling

Five AGSO Mayhew 1000 drilling rigs and five water tankers were used on the seismic survey for shothole drilling. Drilling statistics for the seismic survey are shown in Appendix 1. The types of lithologies encountered in the drilling directly affected drilling and production rates. Figures 2, 4, 6, 8, 10, 12 & 14 illustrate the correlation between shothole depths, uphole weathering velocities and sometimes surface elevation. Often valleys between hills were filled with recent gravels and alluvium, resulting in difficult drilling and shallow shotholes. Figures 3, 5, 7, 9 ,11, 13 & 15 show graphs of shothole depths and depths to the top of the shot charge, illustrating the problems that often occur with collapsing holes and swelling clays, causing difficulties in loading shotholes to drilled depths.

The major drilling problems for the survey were in areas with palaeo-sand dunes, especially the northern end of Line 4, most of Line 5 and the northern parts of Lines 6 and 7. The sand dune areas on Lines 4 and 5 required drilling using drilling mud and mudpits. Mud drilling caused a rapid decrease in the production of shothole drilling, hence the decision was made to decrease the CMP fold and drill fewer shotholes to maintain a reasonable production rate without a significant loss in data quality. The mud drilling required several pallets of good quality drilling mud (Rapidgel) to be purchased from suppliers in Adelaide and freighted to Mt Gambier several times a week, supplemented with bags of cotton seed, bran, LC Stop and liquid polymer. Mud drilling on Line 7 proved ineffective, due to a shallow water table and unconsolidated sands with shelly bands. Shotholes on the northern end of Line 7 were drilled using air and water injection to depths of about nine metres, with two hole patterns per shotpoint.

Two shotholes drilled on Line 4 at SP 1366 and SP 1372 flowed water at the surface. The two shotholes were not loaded with shot charges, and considerable effort using cement and casing was required to plug the holes to stop the water flow to the surface. The local water board at Casterton were interested in the location of the artesian water flow as a future source for shallow groundwater in the area, and advised of the shothole locations.

The shothole drilling crew were warned in advance by SADME drilling inspectors, not to drill into a black sticky clay formation that could be encountered in drilling on Lines 4, 5 and 6. The black sticky clay formation provides a seal to a perched water table in that area, especially east of Penola. The black clay formation was encountered several times, with the depth to the horizon being very inconsistent over short distances. Once the black clay formation was encountered, shotholes were terminated at that depth.

Drilling water was obtained on a convenience basis either by purchasing water from local shires (using overhead standpipes) or using billabong pumps to obtain water from nearby creeks, lagoons and quarries.

Shotpoint locations for the survey were, where possible, located midway between geophone station positions to give a better distribution of receiver offsets for velocity analysis.

2.62 Explosives

ICI 'Powergel' explosives were used as the seismic energy source, mainly as 2 kg plugs with a small quantity of 0.5 kg plugs. ICI detonators with 45 m leads were used on the survey. Explosive statistics are given in Appendix 1.

Explosive stocks were held at the ICI magazine in Tocumwal, NSW. During the survey, two trips to Tocumwal to replenish detonator and 'Powergel' stocks were made using the Toyota flat-top preloader and International truck with the AGSO mobile magazine. While in the field the mobile magazine was stored either in commercially operated quarries or in security compounds of local authorities. For Lines 1 and 2, the CSR Readymix quarry at Ondit north of Colac was used, and for Line 3 and part of Line 4, the CSR Readymix quarry at Framlingham north of Warrnambool was used. Difficulty was encountered in locating a suitable storage location in the Casterton area. Eventually a quarry was located south of Casterton near the seismic line on a property owned by Mick Sullivan near the Myringa Bridge over the Glenelg River. For storage in the Penola area, a quarry owned by David Marcus, 11 km west of Penola was utilised. For recording Lines 5 and 6 the quarry at Mt Schank south of Mt Gambier was used and finally in the Millicent area an old limestone quarry, now becoming a recreational lake, was used with the permission of the Millicent District Council. A problem arose at the start of the survey where insufficient drill cuttings remained to backfill and solid tamp the shotholes. To overcome the problem a trailer was hired and used to carry quarry screenings which were used to solid tamp the shot charge. The hired trailer was replaced by a box trailer from Canberra and again used in the Mt Gambier area on Line 6, to carry crushed limestone, purchased from a quarry, which was used to backfill and solid tamp the shotholes where needed.

Several misfires were encountered on the survey and their locations are listed in Appendix 7. Overall, the 'Powergel' explosives performed well with very few faulty detonators. Depths to the top of the charge were measured for each shothole by using a 'Hip-Chain' with cotton thread tied to the top of the charge and the digital counter set to zero before lowering the shot charge assembly down the shothole. The 'Hip-Chain' measuring device proved to be easy to use with reliable depths to the charge being obtained.

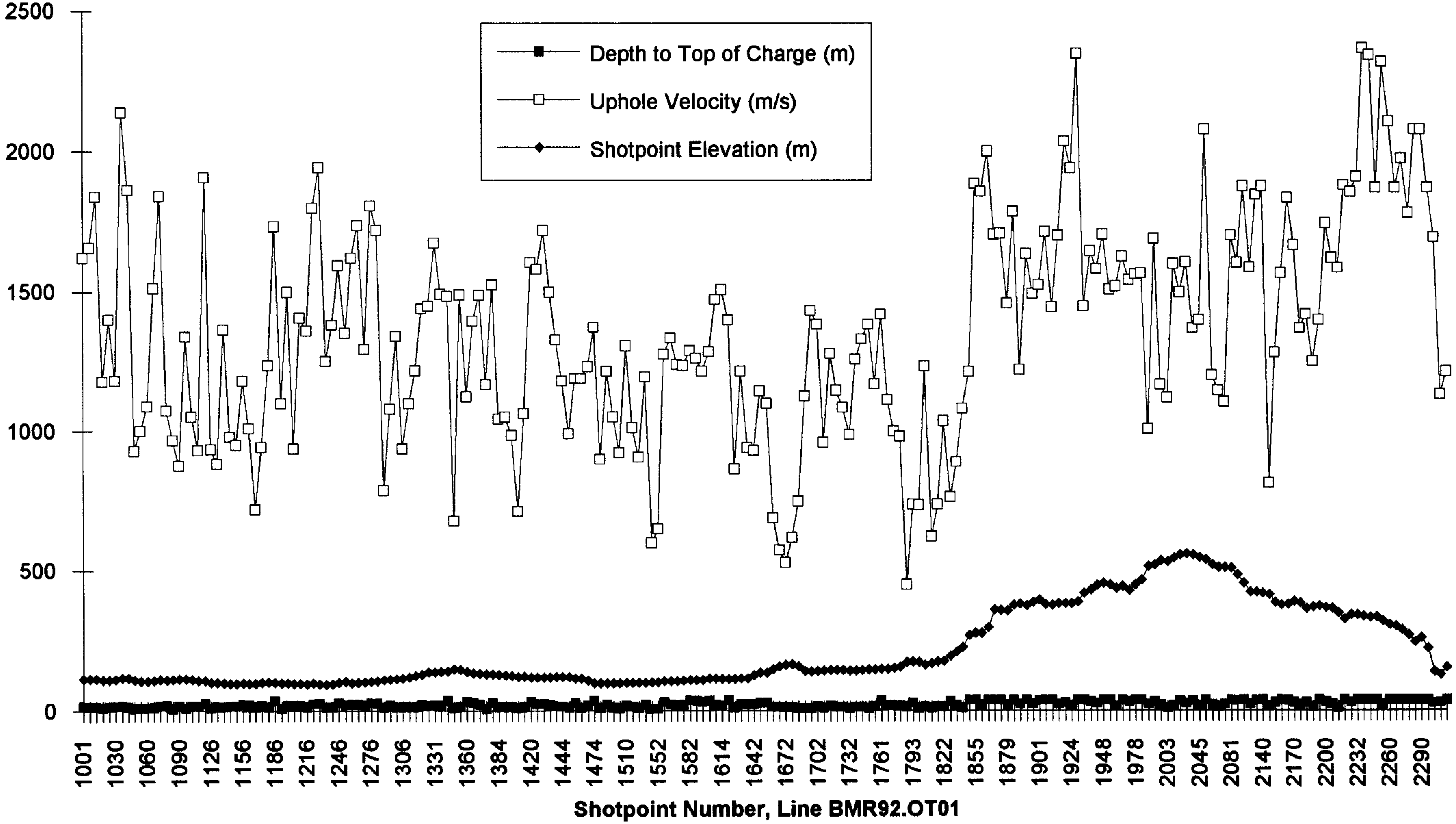

Figure 2. Plot of Depth to Top of Charge, Elevations & Uphole Velocities for seismic shots on Line BMR92.OT01

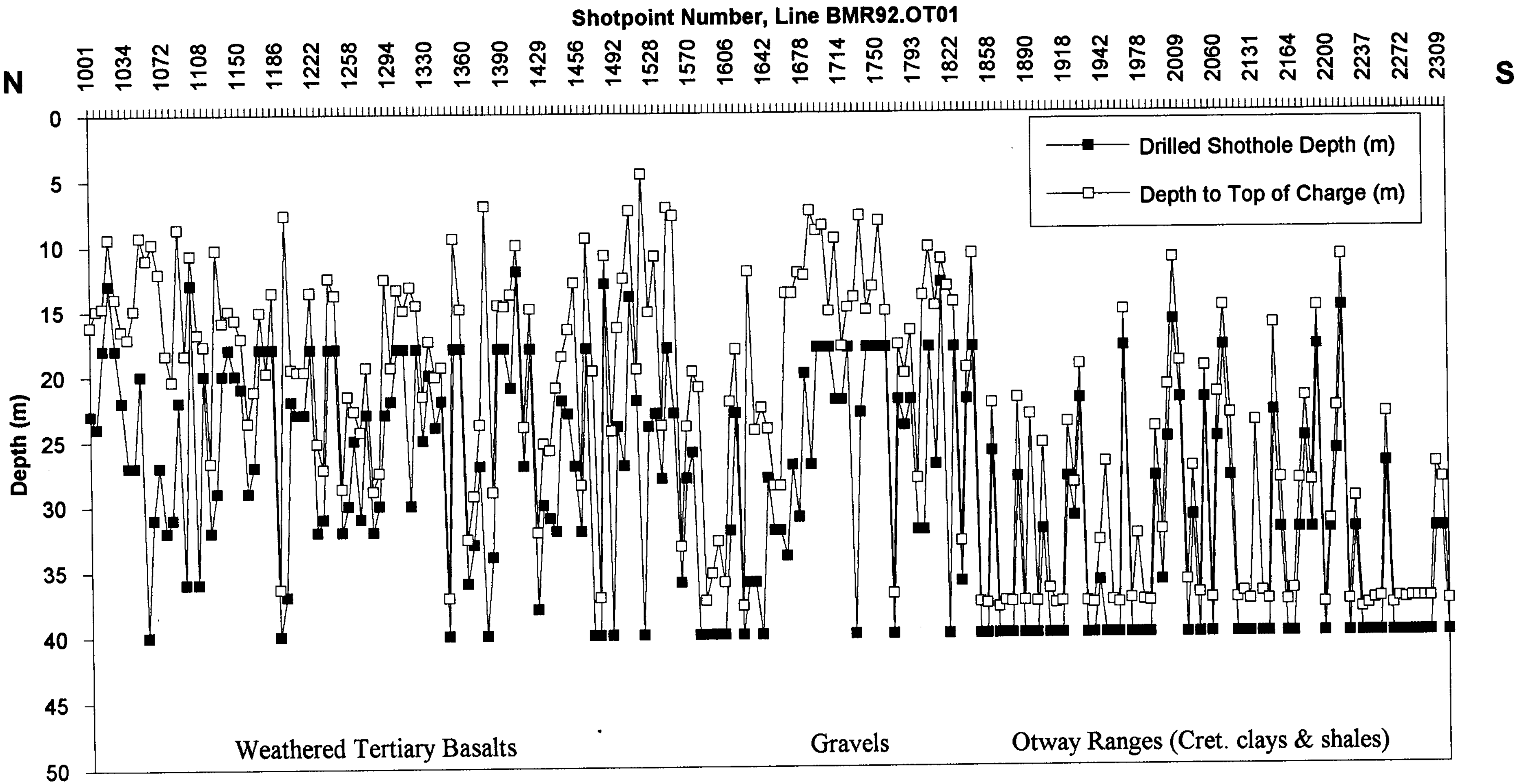

Figure 3. Plot of Depth to Top of Charge, Drilled Shothole Depth & Rock Types drilled on Line BMR92.OT01.

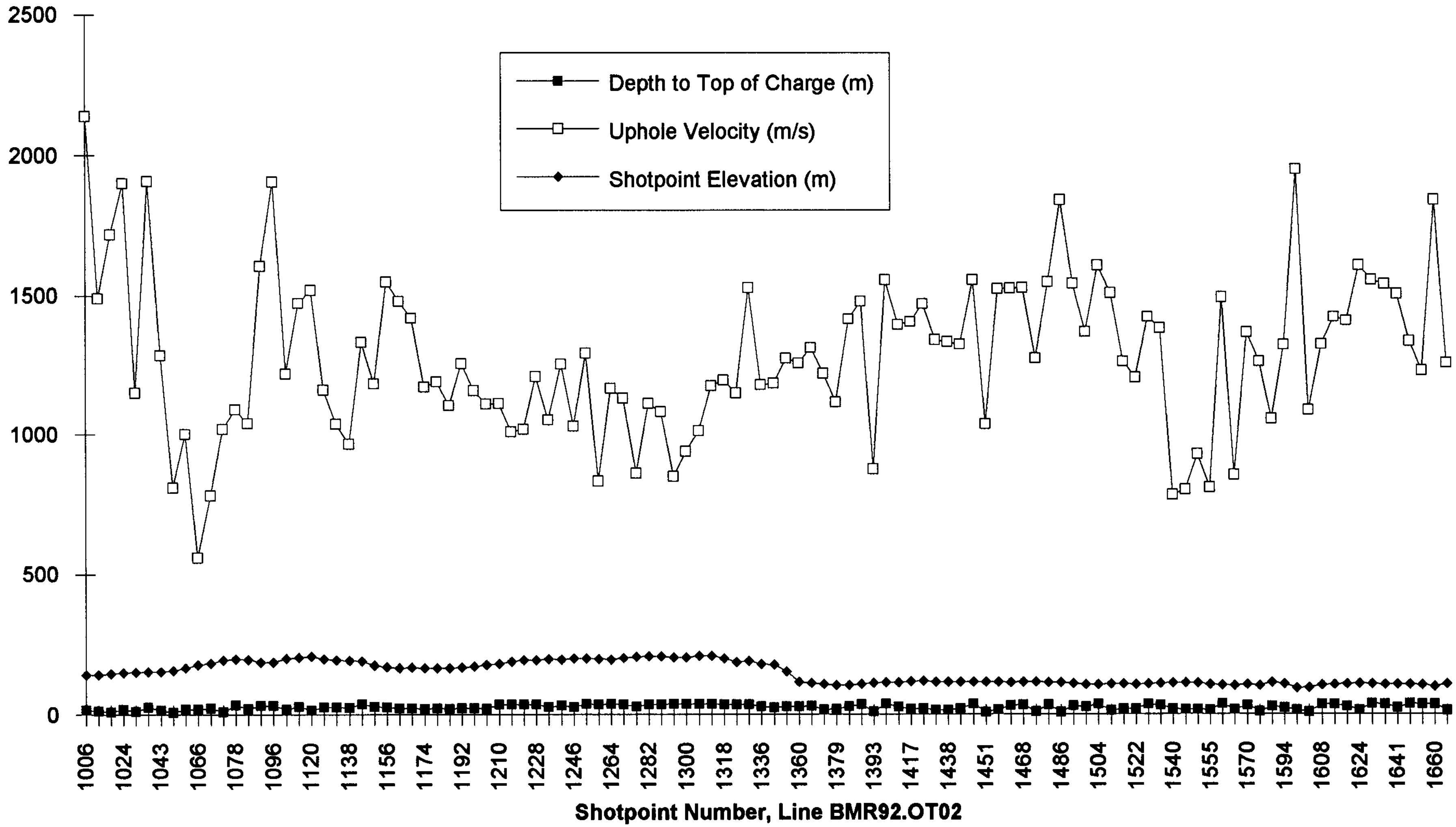

Figure 4. Plot of Depth to Top of Charge, Elevations & Uphole Velocities for seismic shots on Line BMR92.OT02

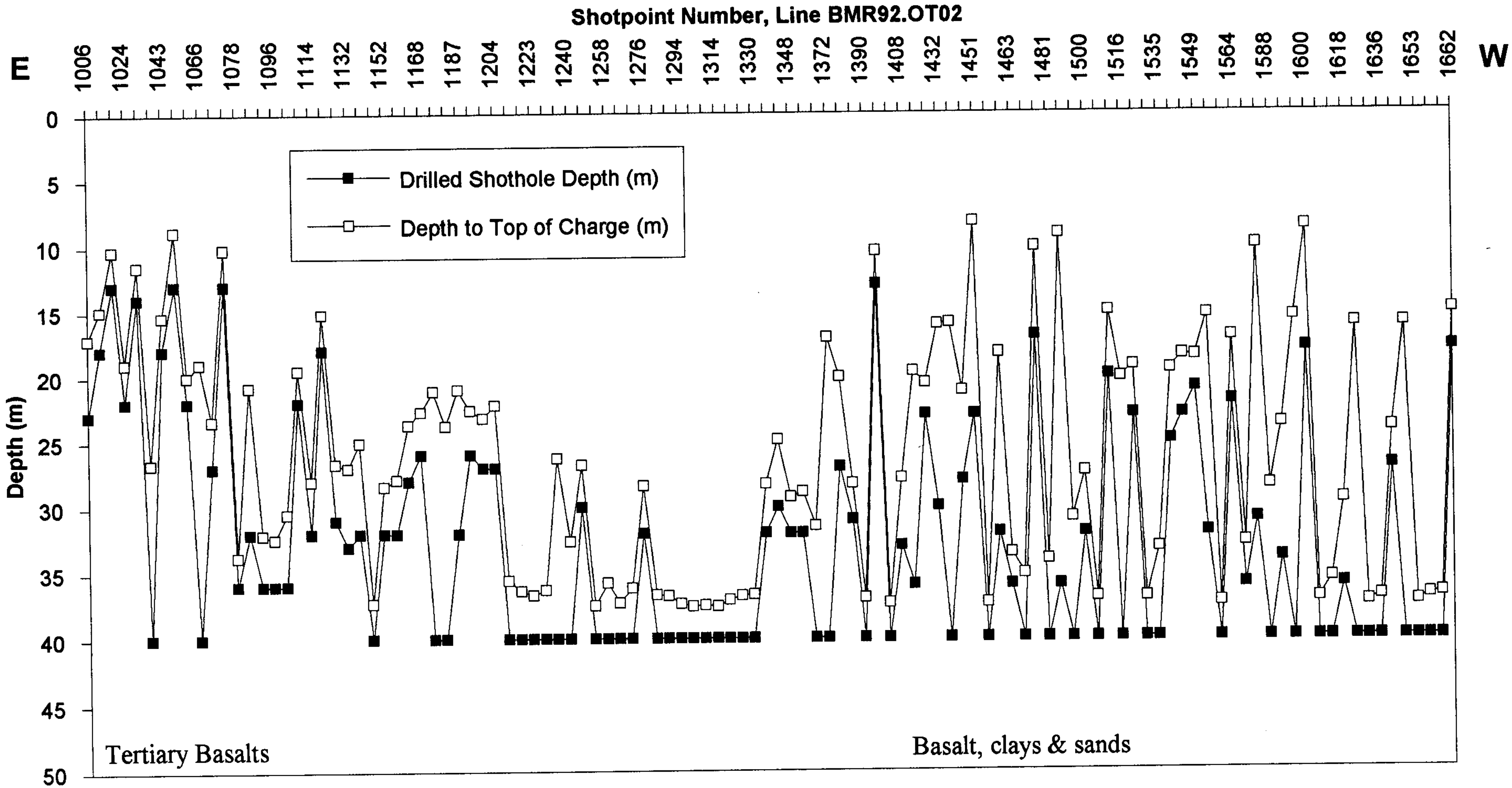

Figure 5. Plot of Depth to Top of Charge, Drilled Shothole Depth & Rock Types drilled on Line BMR92.OT02.

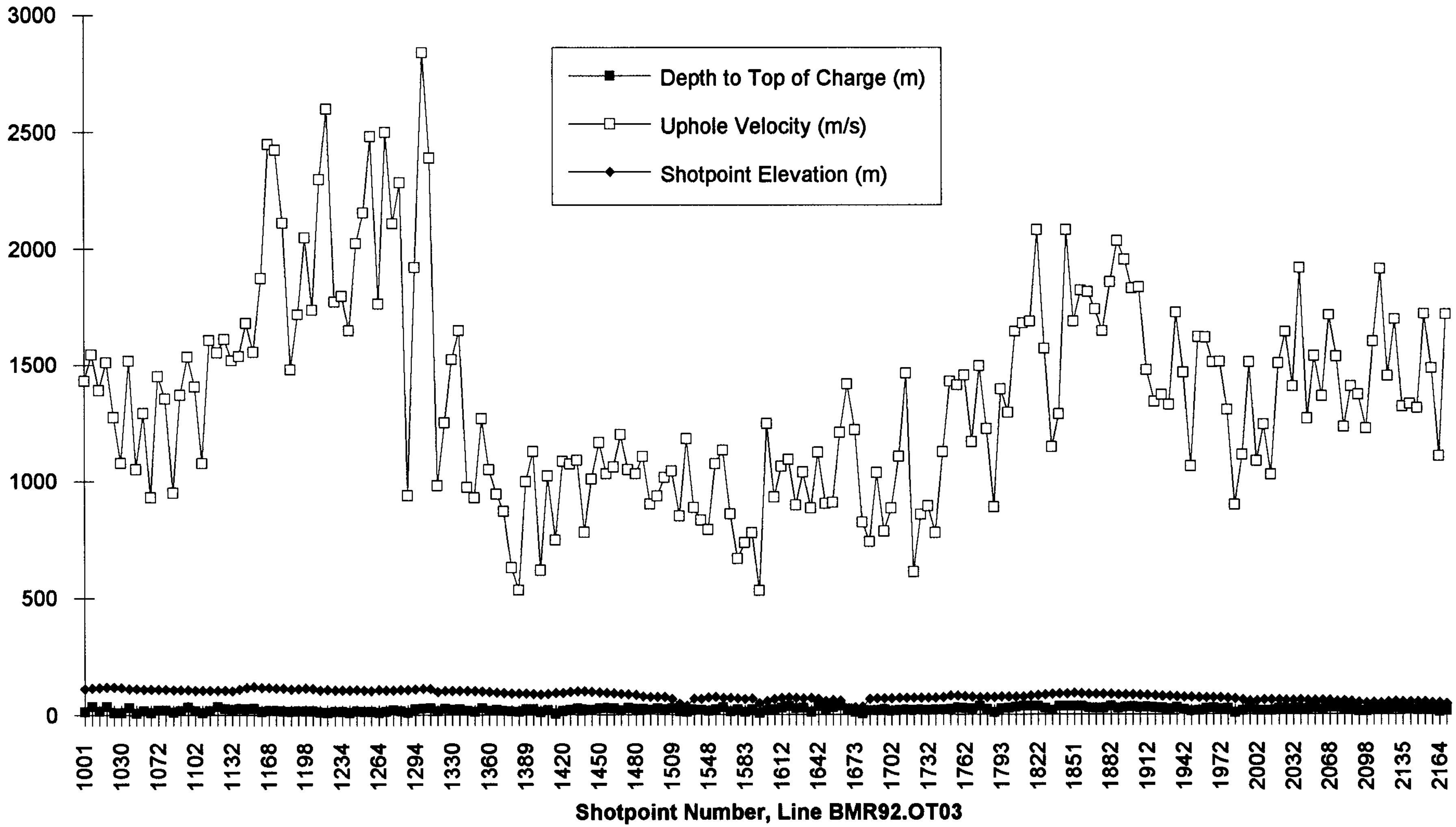

Figure 6. Plot of Depth to Top of Charge, Elevations & Uphole Velocities for seismic shots on Line BMR92.OT03

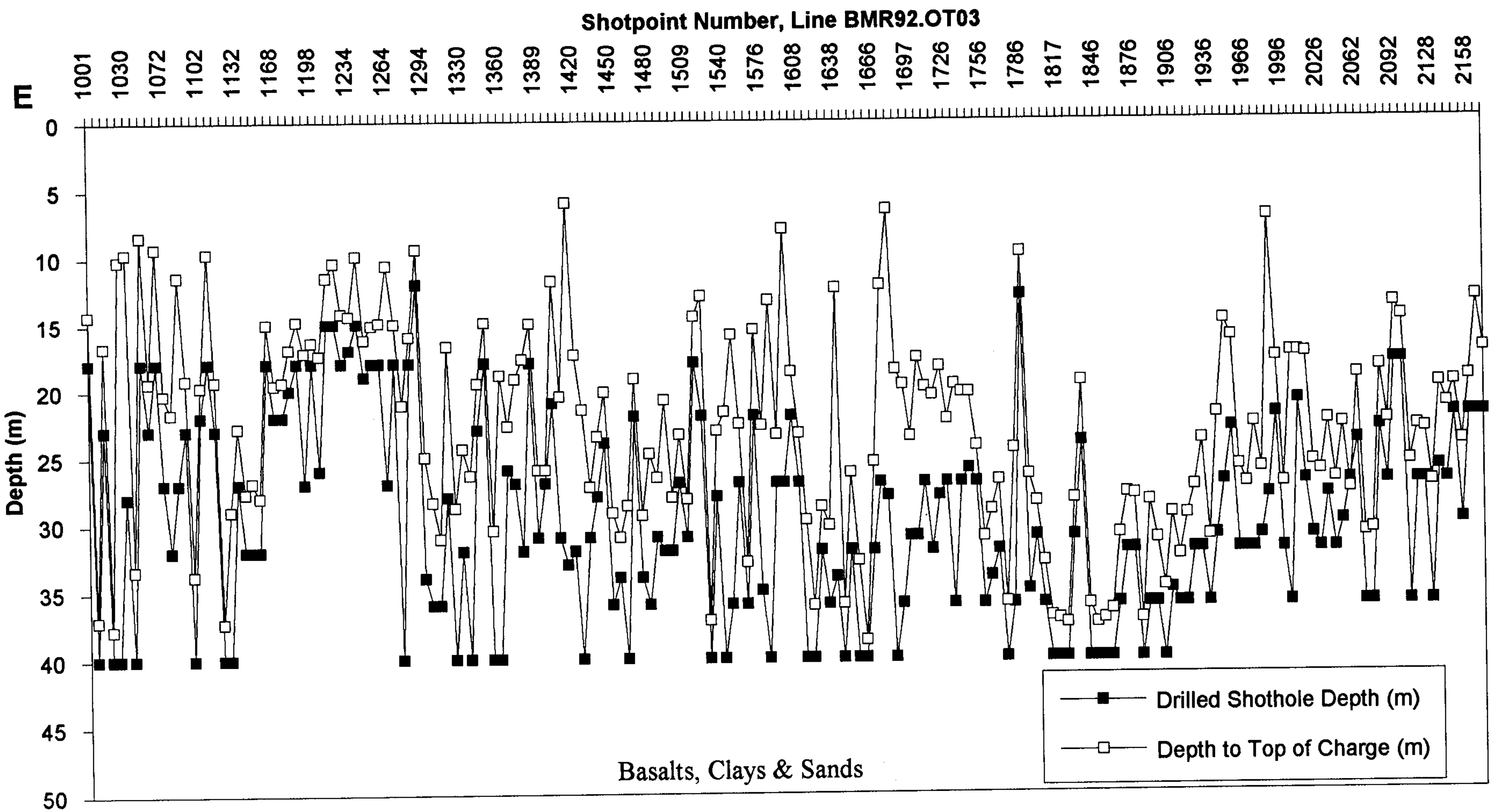

Figure 7. Plot of Depth to Top of Charge, Drilled Shothole Depth & Rock Types drilled on Line BMR92.OT03.

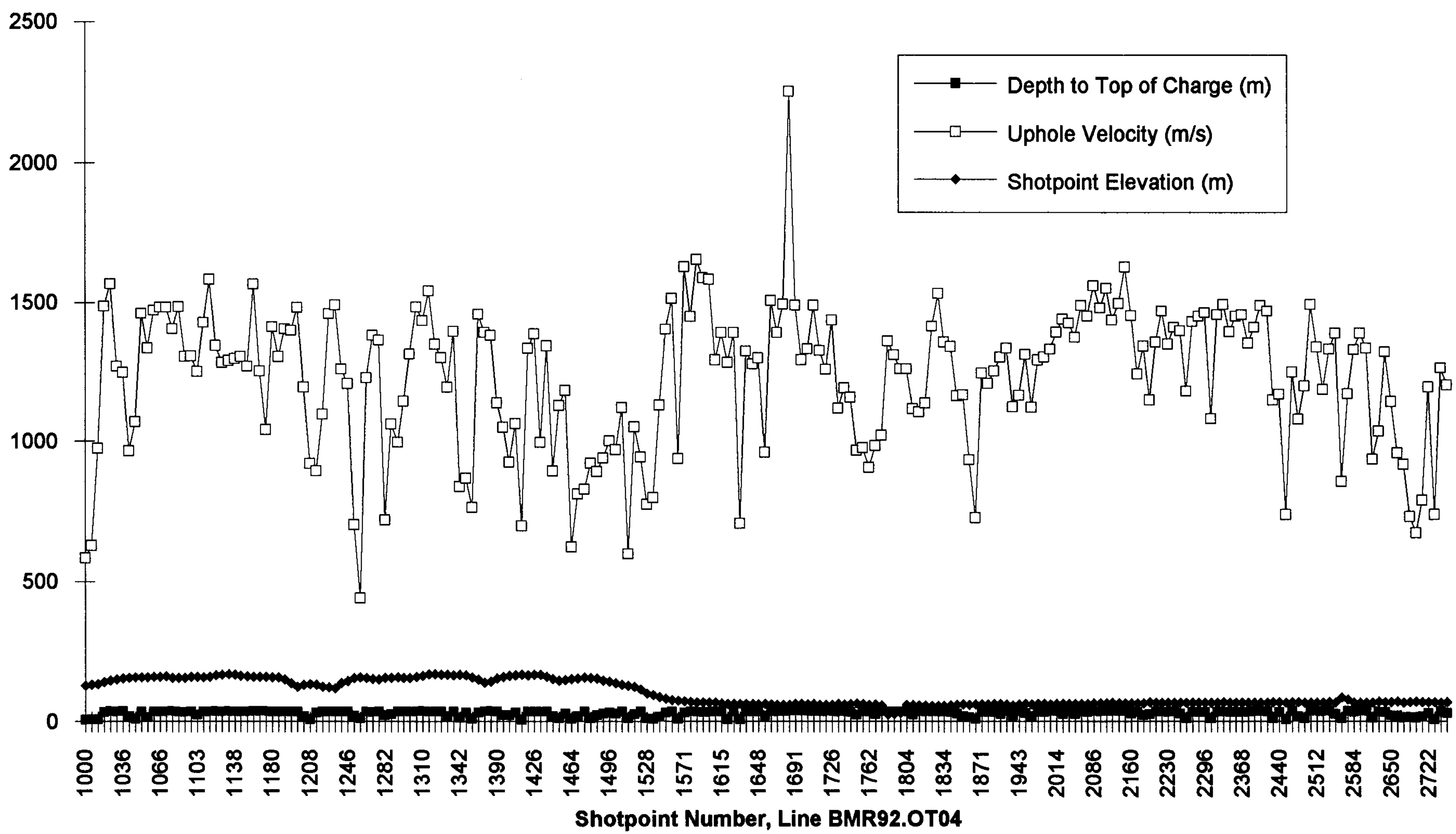

Figure 8. Plot of Depth to Top of Charge, Elevations & Uphole Velocities for seismic shots on Line BMR92.OT04

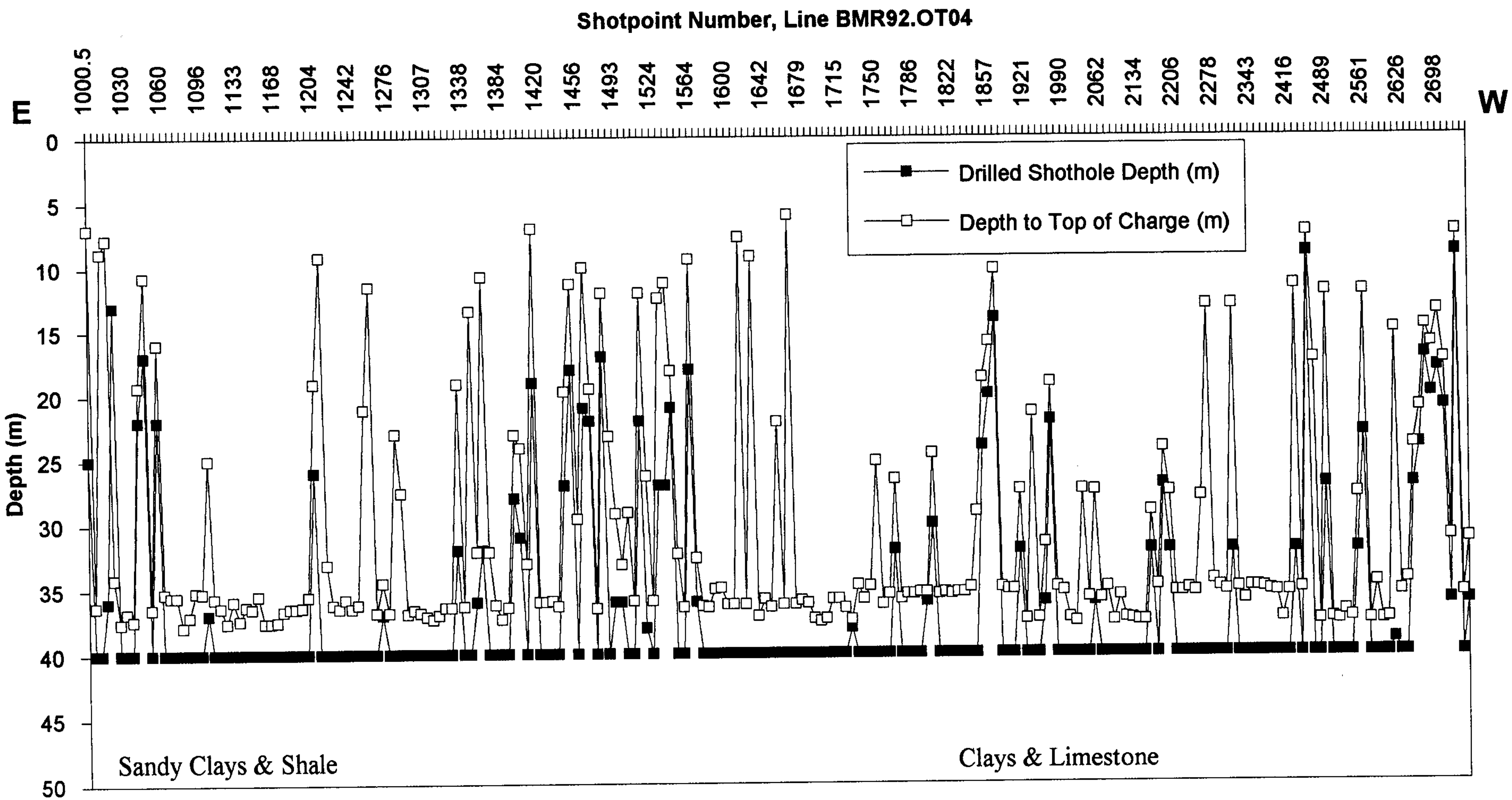

Figure 9. Plot of Depth to Top of Charge, Drilled Shothole Depth & Rock Types drilled on Line BMR92.OT04.

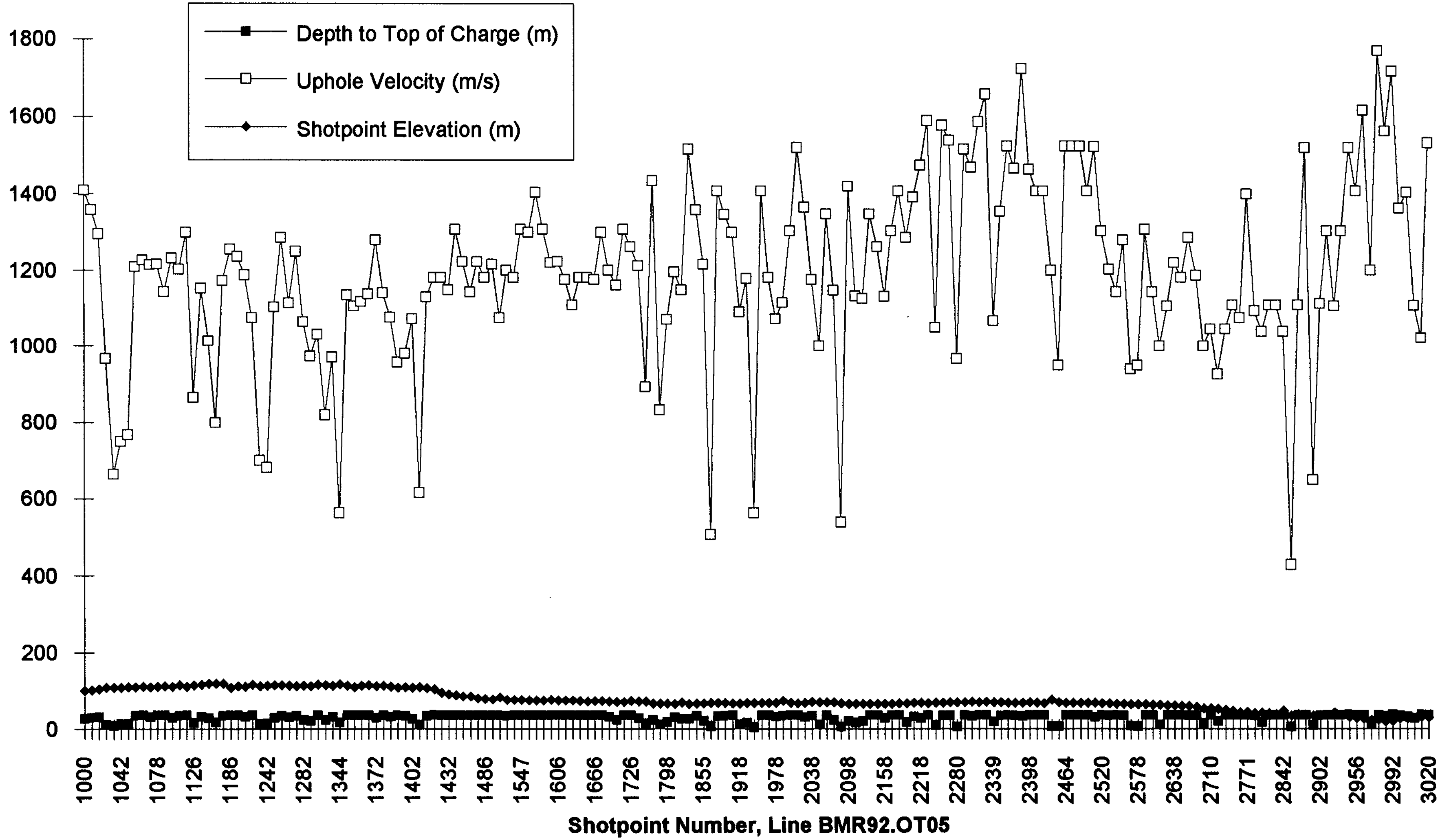

Figure 10. Plot of Depth to Top of Charge, Elevations & Uphole Velocities for seismic shots on Line BMR92.OT05

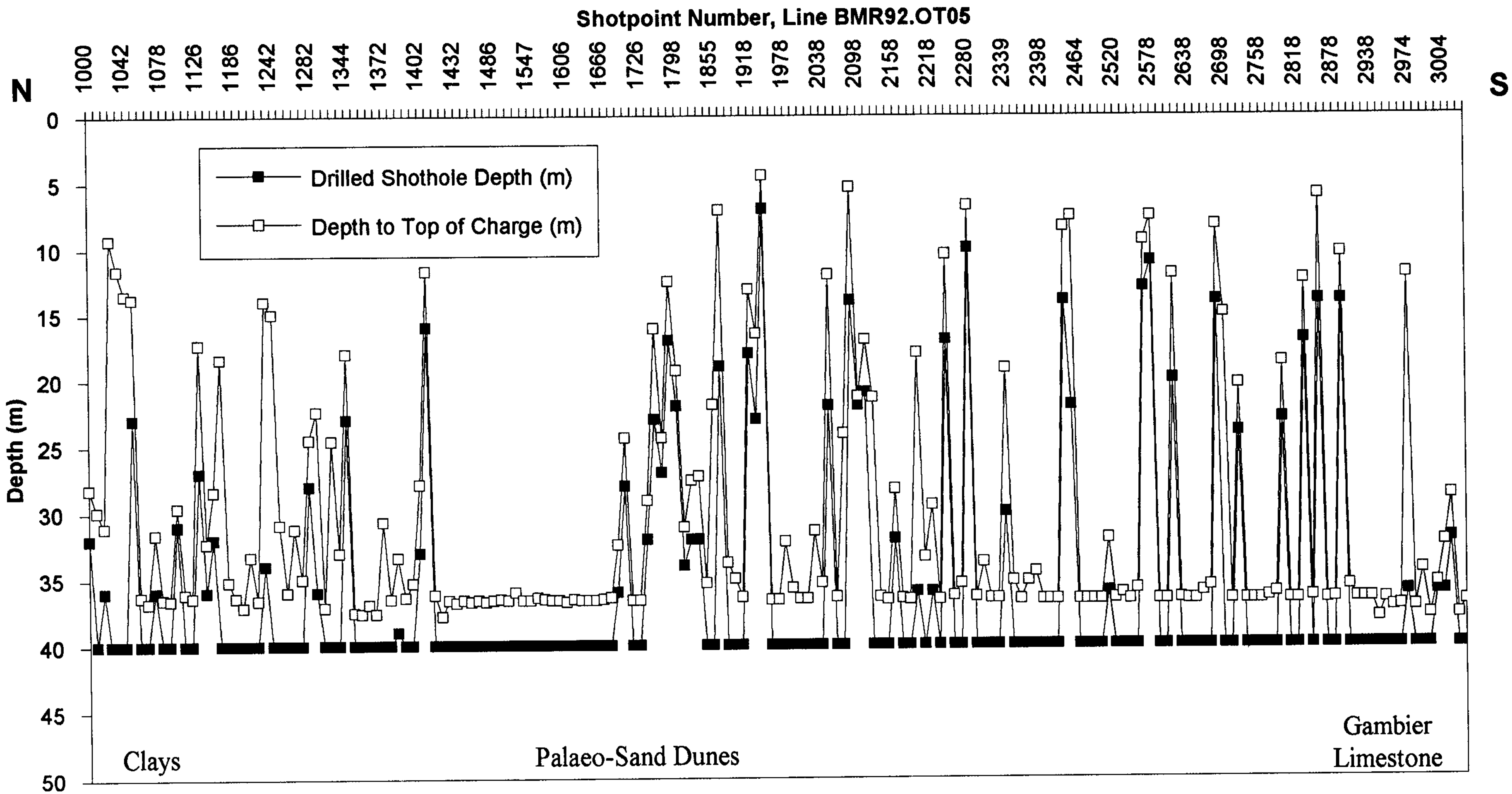

Figure 11. Plot of Depth to Top of Charge, Drilled Shothole Depth & Rock Types drilled on Line BMR92.OT05

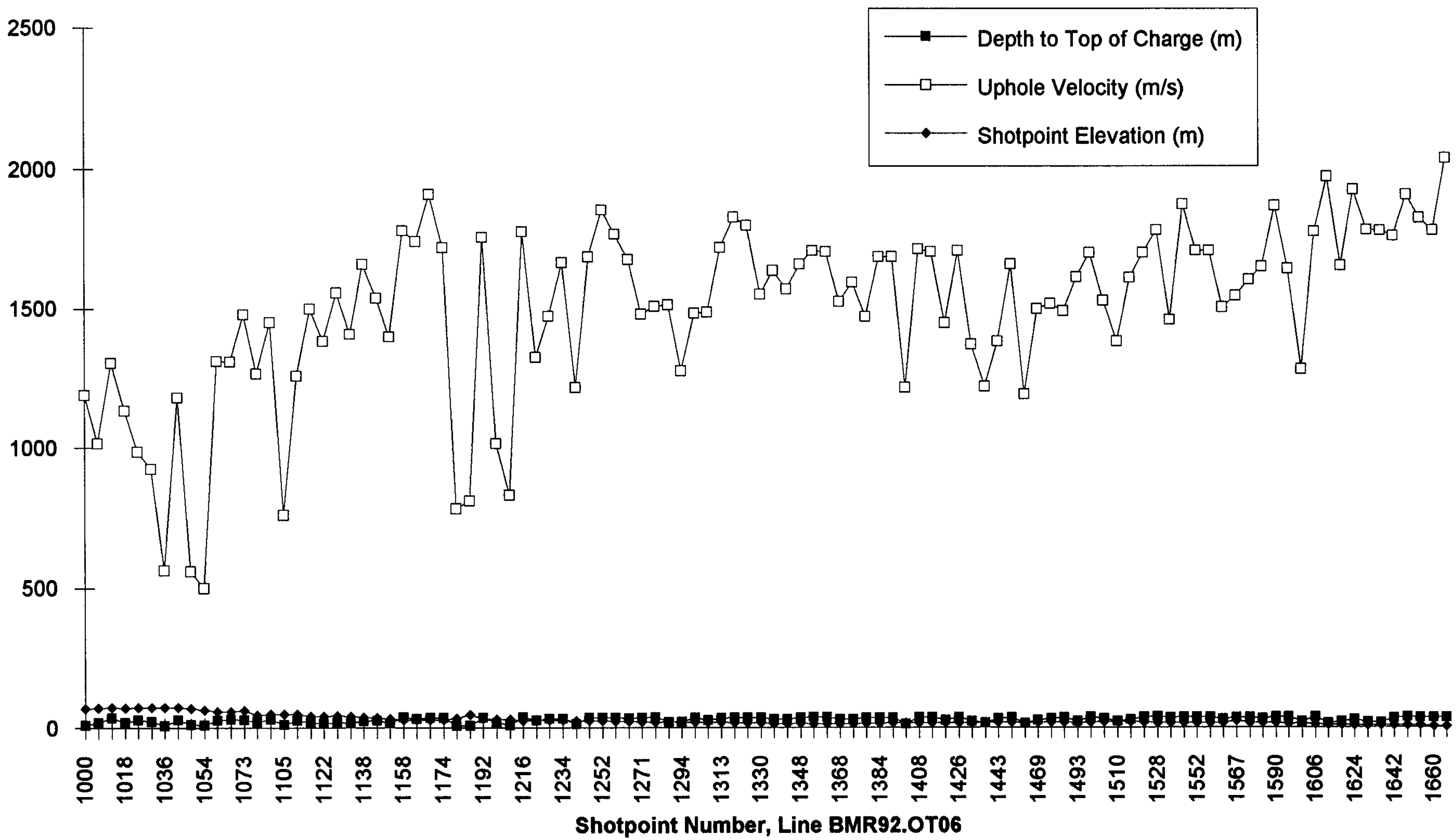

Figure 12. Plot of Depth to Top of Charge, Elevations & Uphole Velocities for seismic shots on Line BMR92.OT06

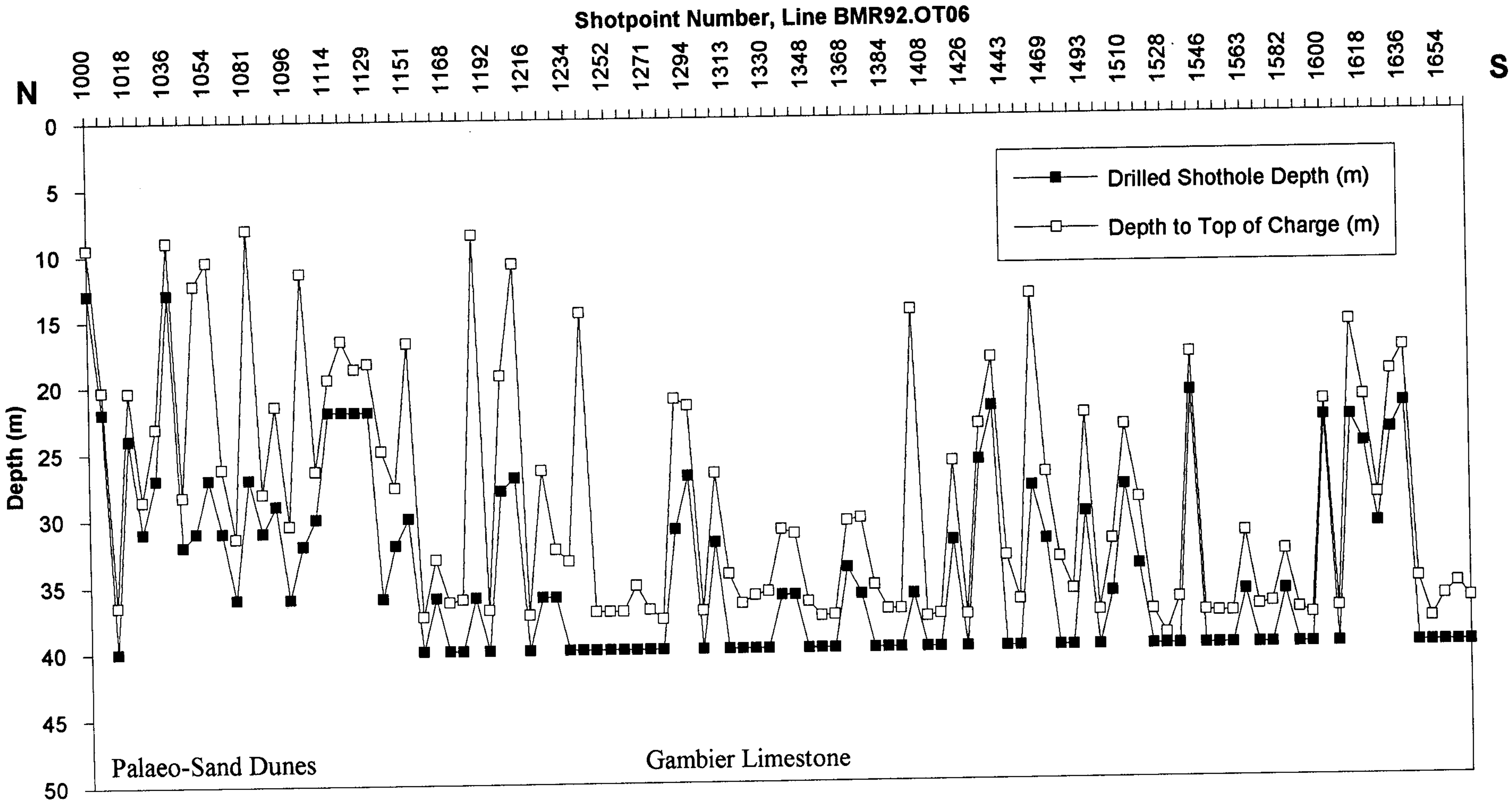

Figure 13. Plot to Depth to Top of Charge, Drilled Shothole Depth & Rock Types drilled on Line BMR92.OT06.

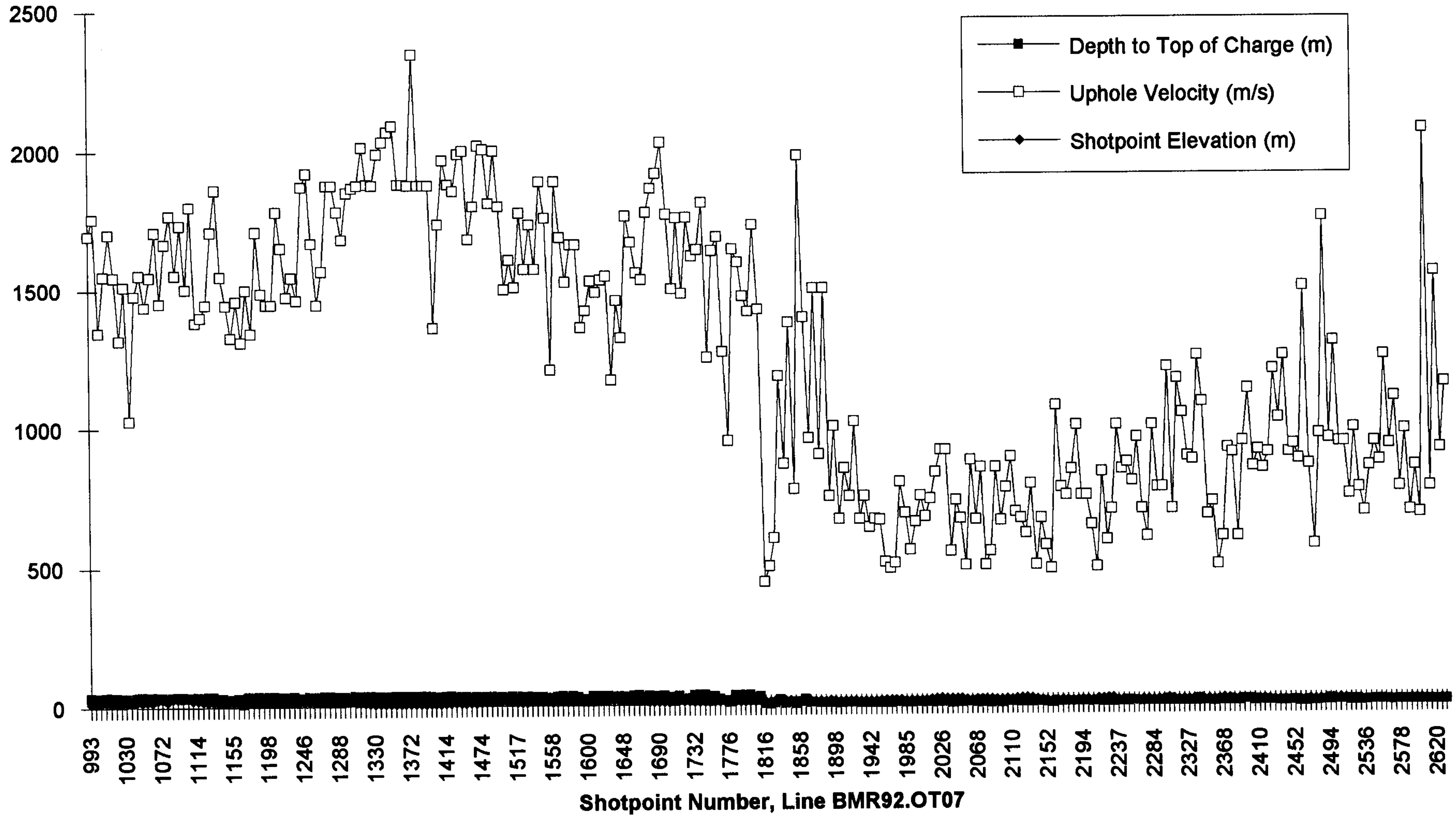

Figure 14. Plot of Depth to Top of Charge, Elevations & Uphole Velocities for seismic shots on Line BMR92.OT07

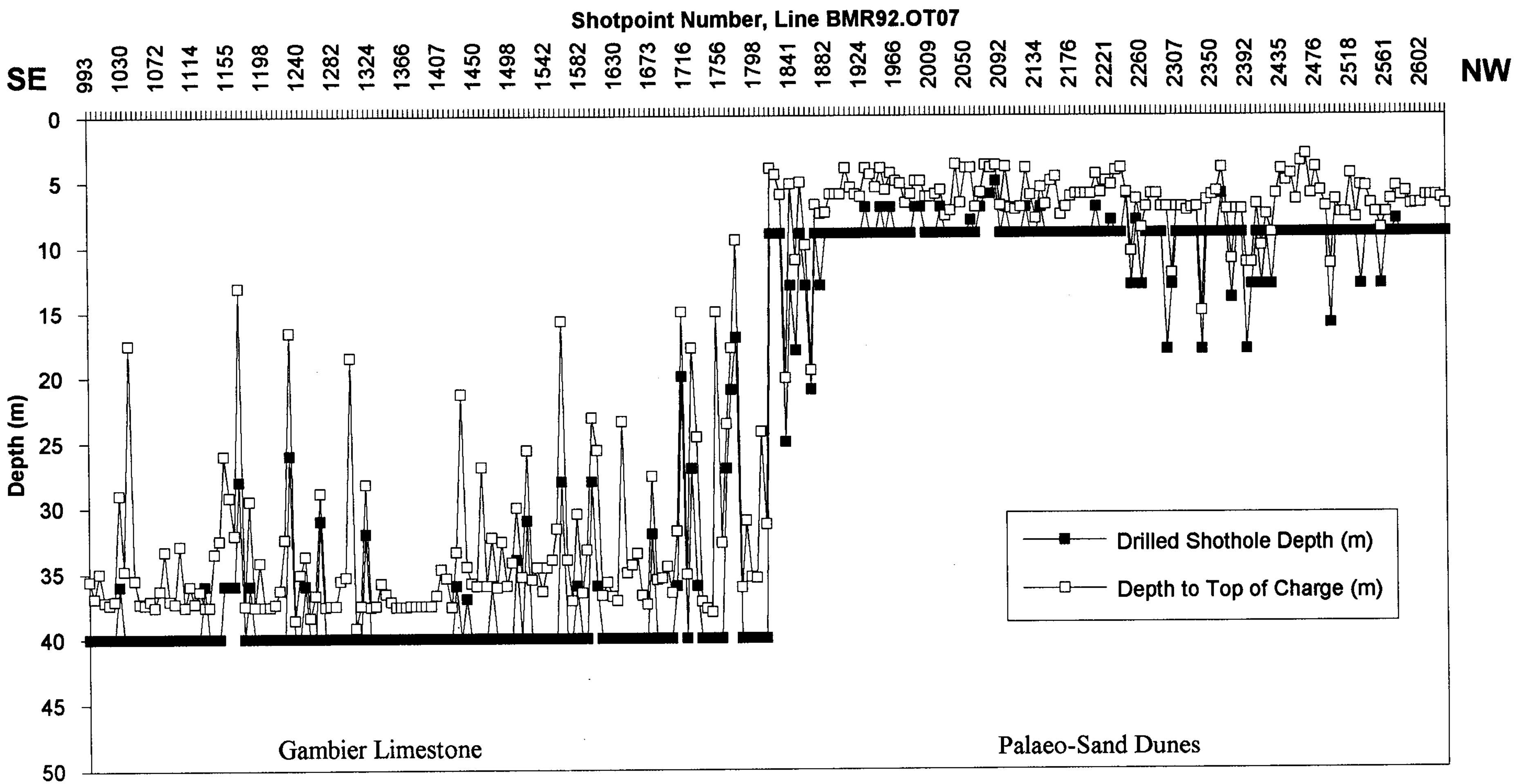

Figure 15. Plot of Depth to Top of Charge, Drilled Shothole Depth & Rock Types drilled on Line BMR92.OT07.

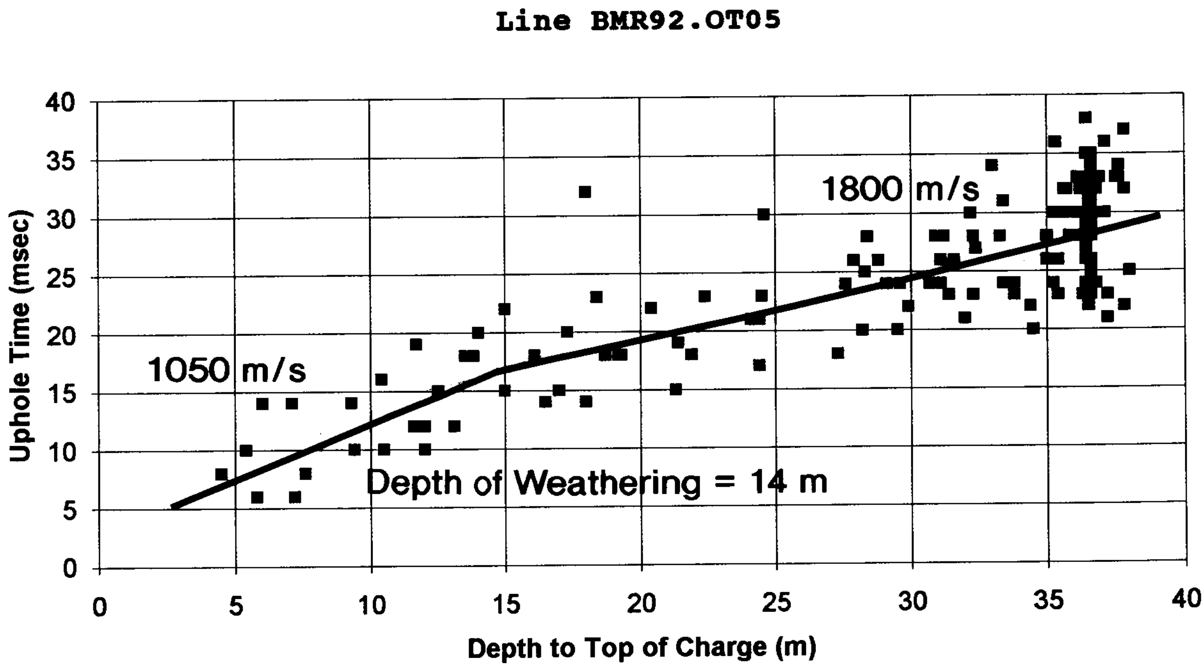

Figure 16. Plot of Shot Uphole Time vs Depth to Top of Charge for all shots on Line BMR92.OT05. The plot can be used to compute an average depth of weathering for the whole line (pseudo uphole shoot).

2.7 Seismic Recording

The Sercel SN368 telemetry seismic acquisition system operated in a 120 channel configuration for the survey. 154 station units were available for use, however up to 10 of the station units could be in for repair at any one time. The small rollalong capacity of the station units however did not adversely affect acquisition productivity, with 120 channel recording maintained without either closing up on or falling behind the shothole drilling crew.

While recording Line 3, one station unit could not be located. After extensive searching and enquiries with local authorities, it was concluded that the station unit was stolen either from the rear of a jug buggy or removed from the recording line during the night. The loss of a station unit brought the system total to 153 station units. A seismic cable was also removed from the same area, and similarly the surveyors lost a surveying chain when left out on the ground overnight. With commercial accomodation for the crew in towns, fire fighting knapsacks, picks and shovels were also targets for theft with several removed from vehicles. Several more seismic cables were also stolen from the survey line along Line 6 while left out overnight. All losses and thefts were reported to local police authorities with no recovery of equipment. Replacement cost for all equipment stolen, including the station unit, would be in the order of $10,000.

The Sercel SN368 recording system performed reasonably well until the commencement of recording along Line 7. Difficulties were found in forming the line and holding continuity for any length of time. Also tape errors were becoming an increasing problem, either due to the line continuity dropping out during acquisition, tape drive problems or faulty tapes. The problem of line continuity was related to an increase in moisture in cable connections combined with aging of the cable and station unit connectors. Moisture in the cable connections was due to an increase in rainfall as the survey entered late autumn and early winter, with pin and socket areas of the connectors being very difficult to keep dry before making connections. New recording tapes (Memorex, Quantum HD) were also examined and found to contain excessive amounts of tape sliver debris and powder acetate. To overcome the tape debris problem, the remaining recording tapes were pre-tested and partly cleaned using the tape diagnostic facility on the 'Vista' field seismic processing system. The tape drive on the Sercel was also extensively checked with no faults being located. To solve the line continuity problems, the seismic cable connectors and station unit connectors requiring replacement were given maintenance priority on return to headquarters in Canberra, at the completion of the survey.

Since the purchase of the Sercel SN368 seismic acquisition in early 1986, faulty station units were sent to Seismic Supply International Pty. Ltd. for repair. In recent years the repair turn-a-round time and cost of repair was becoming excessive for normal operations of the system. In late 1991 a Prosol TRS-2, PC based test and repair system for Sercel SN348/368 station units was purchased to allow in-house repair and maintenance of station units. At the same time a comprehensive station unit spares kit was purchased from Sercel, together with a large quantity of capacitors which were beginning to fail in the units. The Prosol TRS-2 was used on the survey to test and repair station units. At the end of the survey all station units were recalibrated using the TRS-2 and all cable connectors replaced. The TRS-2 has allowed all station units to be now repaired by AGSO, with considerable long term savings in repair and maintenance of the station units.

Recording statistics for the survey are shown in Appendix 1. An average acquisition rate of 33 km/week was obtained, a production rate marginally better than previous BMR/AGSO seismic surveys, considering a reduced geophone station interval (60 m to 50

m) and the increase to 120 channel recording with reduced rollalong capabilities.

2.8 Safety Issues

The Otway Basin seismic survey lines followed many existing roads and tracks, some having reasonable amounts of traffic flow along them. A major problem existed in maintaining a safe working environment along the roads without risking injury to members of the seismic crew, or damage to vehicles. For the survey, safety signs were purchased to warn other road users of the nature of the work along the roads. To increase the visibility of personnel and vehicles, orange reflective jackets of open weave cotton were worn by personnel, and rotating flashing yellow/orange warning beacons were mounted on vehicles. Local shires/district councils and police were notified of our activities to allow work along the roads with the minimum of inconvenience to other road users.

Although the use of safety signs and other safety equipment help prevent accidents, one jug buggy managed to reverse into a private vehicle on the seismic line, and one drilling rig demolished a roadside letterbox. The damage to the vehicles was minor, with the owner of the privately owned vehicle being compensated for damage, and the letterbox being replaced by a new one built by the drilling mechanics.

Towards the end of the survey, a freak accident happened when a drill pipe suspended alongside the drilling mast by a steel rope and drill pipe lifting jaw, released while the rig was being moved (with mast erect) several metres forward. The falling drill pipe hit the drilling offsider (Bob Lewis) on the head and shoulder, causing concussion. Fortunately the hard hat he was wearing took most of the impact. Bob Lewis was later X-rayed for fractures and spinal damage, fortunately with results showing no sustained injuries.

The drilling of shotholes can sometimes cause damage to buried underground cables, and seismic energy sources can cause damage to buildings (cracking of walls). A Telecom optic fibre cable was drilled through south of Glencoe causing the wrath of Telecom to fall upon the shothole drilling activities. Along the majority of seismic lines the usual practice is to contact Telecom and 'dial before you dig'. However on the start of Line 6, contact was not not made with Telecom to locate the underground cables. The cable positions were well sign posted, however a diversion of the optic fibre cable very close to the road was not recognised, with the result that a shothole was drilled through the cable. For future surveys, the presence of newly installed optic fibre cables will become an increasing problem for both Vibroseis and dynamite seismic surveys. The new age digital optic fibre cables are less tolerant of ground vibrations than normal telephone cables, and will require greater distance restrictions for use of seismic sources (Telecom guidelines suggest for a 10 kg charge a distance of greater than 20 m in a horizontal direction for buried coaxial or optic cables, with ground vibration restricted to 50 mm/s).

Two claims for damage to buildings (cracking) were lodged with AGSO head office at the end of the survey. One building was a church in the town of Kongorong and the other a house on farmland near Kongorong.

2.9 Communications

To improve communications between the field based seismic survey party and head office in Canberra, two transportable mobile telephones (3 watt output) were purchased for the Otway Basin seismic survey. One mobile phone was a slimline NEC C3, purchased so that on return to Canberra the unit could be also used for conference purposes, etc, while not being used on seismic surveys. The other unit purchased was a Motorola 3000T with an Intercel 900 Cellular Interface to enable a facsimile machine to be connected to the mobile telephone. The Motorola unit is more bulky and heavier than the NEC C3, but cheaper in price and of more robust construction. Most of the Otway Basin area is covered by Telecom Mobilenet cells, making the survey area ideal for using relatively inexpensive new age technology for communication. External 3 db gain antennae with magnetic bases were also purchased to allow roof mounting of antennae with quick placement and removal, to allow use in a vehicle or accomodation housing. The external antennae enabled use of the mobile telephones in fringe areas, especially in the Casterton and Millicent areas.

One mobile telephone was located in the seismic survey office van with the facsimile machine, for use by the party clerk during the survey. The other mobile telephone was used by the Party Leader, with the telephone vehicle-based during the day and accomodation-based during the evening. The mobile phones proved valuable for solving urgent problems that arose during the survey, with direct communications with Canberra while doing survey operations. The mobile telephones provided the following advantages:

- direct communication link between the seismic survey and head office
- direct communication link between the party leader and party clerk
- direct communication link between the party leader, landowners and local authorities
- time saving in not having to locate public telephones
- facsimile facility direct to seismic survey operations without using Australia Post

3.0 Data Processing

The 'Vista' field seismic processing system was used on the seismic survey for quality control analysis and to produce 'Brute Stacks'. The system also proved useful as a tape diagnostic facility, to test the integrity of recording tapes prior to being used for data acquisition. Field tapes were demultiplexed in the field, however, due to tape header information not being transferred to the demultiplexed tapes, the demultiplexed tapes were only used by the 'Vista' system to process the seismic data. The field tapes were demultiplexed again on the Vax based DISCO system in Canberra as field tapes were freighted back to head office. Some shot records which proved difficult to demultiplex on the Vax based system, were later recovered from the 'Vista' demultiplexed tapes. Field processing of the seismic data allowed preliminary 'Brute Stack' seismic sections to be produced to highlight any shot/spread geometry errors and provide a close approximation of velocity functions required for Normal Moveout corrections. Accomodation for the field processing system was arranged jointly with the accomodation of the field geophysicist, allowing security for the system and data, and easy access for the field geophysicist.

On return to Canberra, the seismic data were fully processed using the Vax and Convex based DISCO processing systems. Demultiplexing and conversion from 9 track tapes to IBM 3480 cartridge format (main tape format supported on the Convex) were performed using DISCO modules on a small Vax based system. Mainstream processing of the data was then performed using DISCO on the Convex super mini-computer.

Copies of the final seismic sections are available for purchase through the AGSO Sales Centre, GPO Box 378, Canberra, ACT, 2601.

TABLE 1

Processing sequence for the seismic sections using the BMR/AGSO Disco processing system.

1. Demultiplex field tapes (SEGD to SEGY Disco internal format).
2. Crooked geometry definition.
3. Quality control displays and trace editing.
4. Spherical divergence correction.
5. Statics computation by the uphole method.
6. CDP sort and brute stack.
7. Velocity analysis with statics applied.
8. Normal Moveout correction.
9. Pre-Stack NMO mute (50% stretch).
10. Time varying equalisation (gate length 500ms).
11. Common Depth Point Stack.
12. Bandpass Filtering.
13. Time varying equalisation (gate length 1000ms).
14. Signal enhancement (Digistack)
15. Display section with gravity and aeromagnetic data.

PRELIMINARY RESULTS

Seismic reflection data collected from the Otway Basin 1992 seismic survey do show some reflections at Moho and mid-crustal depths. The deeper sedimentary sequences of the Otway Basin were imaged on some of the seismic lines but not clearly on others.

The seismic data will be interpreted in cooperation with NGMA partners and universities along a number of corridors and integrated with structural element maps of the region. From the interpretation, models will be developed to better describe the early development of the Otway Basin and associated basement structures.

ACKNOWLEDGEMENTS

The authors acknowledge the contributions and efforts made by all members of the 1992 seismic party. The cooperation and assistance from local government authorities, landowners, petroleum exploration companies (Gas & Fuel Corporation of Victoria, SAGASCO and AGL) and State Government environmental and forestry authorities, in all areas of the survey was gratefully appreciated.

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SCHWING, E.H. AND MOSS, F.J., 1974. Experimental seismic survey using explosives for comparison with a "Vibroseis" survey in the Otway and Sydney basins, 1965 & 1966. Bureau of Mineral Resources, Australia, Record 1974/157.

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APPENDIX 1

Operational Statistics

Contract surveying commenced	01-02-1992
Drilling crew departed Canberra	24-02-1992
Recording crew departed Canberra	02-03-1992
Drilling commenced	26-02-1992
Recording commenced	04-03-1992
Part of drilling crew returned to Canberra	11-06-1992
Drilling crew departed for Gippsland seismic survey	09-06-1992
Recording crew departed for Gippsland seismic survey	09-06-1992

Total line kilometres	462.7 km
Number of traverses recorded	7

Recording:

Total number of recording days worked	66
Recording days lost:	
Due to travel to and from Canberra	4
Due to townshifts	4
Due to adverse wet weather	2.5
Due to instrument breakdown	0
Due to Public Holidays	5
Due to windy weather and heat (Total Fireban)	1.5

Reflection:

CMP fold	5 -10 (ave 8-10)
Total number of shots	1306
Average number of production shots/recording day	22
Average surface coverage/recording day	7.0 km
Explosives used	12613 kg
Detonators used	1432
Average charge/production shot	9.7 kg

Drilling:

Number of drilling rigs	5
Total number of rig days worked	320
Rig days lost:	
Due to townshifts	15
Due to adverse weather	5
Due to equipment breakdowns & maintenance	34
Reflection shotholes;	
Total number of shotholes	1425
Total metres drilled	41652 m
Ave depth/shothole	29 m
Average number of holes/rig/day	4.5

OTWAY BASIN SEISMIC SURVEY 1992 - OPERATIONAL STATISTICS

DRILLING

Line	Explosives					Drilling (m)					
	0.5kg	2.0kg	Total kg	Dets(45m)		Hole Depth	DBC	% waste	Holes	Drilling Days	Ave Depth
1	0	2138	2138	218		6337	5513	13	218	9	25
2	0	1108	1108	112		3668	3208	13	112	6	29
3	450	1394	1844	190		5616	4753	15	188	6	25
4	1190	988	2178	223		8121	7375	9	222	16	33
5	380	1516	1896	195		6774	6294	7	189	12	33
6	100	922	1022	105		3594	3339	7	105	3.5	32
7	655	1772	2427	389		7542	7270	4	391	11.5	19
Total	2775	9838	12613	1432		41652	37752	10	1425	64	26

RECORDING

Line	Shots	Days	Shots/Day	Line km	km/day
1	218	9.5	23	65.90	6.94
2	112	4	28	33.10	8.28
3	188	6.5	29	58.30	8.97
4	222	11	20	87.65	7.97
5	189	17	11	101.00	5.94
6	105	4.5	23	34.80	7.73
7	272	13.5	20	81.95	6.07
Total	1306	66		462.70	
Average			22.09		7.01

APPENDIX 2

Seismic Survey Personnel

Australian Geological Survey Organisation:

Project Leader:	D.M. Finlayson	
Seismic Field Party Leader:	K.D. Wake-Dyster	
Drilling Supervisor:	E.H. Cherry	
Party Clerk:	S. Nancarrow (Jan-April)	
	D. Robson (April-June)	
Geophysicists:	A. Owen	
	D.W. Johnstone (Line 1 only)	
Technical Officers (Engineering):	J. Whatman	
	M. Timms	
Drillers:	D. Eaton	
	A. Porter	
	A. Hindes	
	J. Gebbett	(Contract)
	F. Ceichan	(Contract)
Assistant Drillers:	K. Popple	
	J. Schejnin	(Contract)
	R. Lewis	(Contract)
	M. Ramsay	(Contract)
Mechanics:	J. Keyte	
	A. Crawford	
Field Assistants: (Explosives)	R.D.E. Cherry	
	S. Pardalis	(Contract)
	A.C. Takken	

Temporary Personnel:

Drilling Assistants	4
Field Hands	11

Contract Surveying:

Dynamic Satellite Surveys Pty. Ltd.

Surveyor	P. Robinson
Survey Assistants	2

APPENDIX 3

Seismic Survey Vehicles

Recording:

Recording truck	Mercedes 911 4tonne 4X4	ZBE-748
Workshop truck	Mercedes 911 5tonne 4X4	ZBE-775
Cable truck	Mercedes 911 4tonne 4X4	ZBE-633
Computer truck	International 1830C 8tonne	ZBE-964
Geophone carrier	Toyota Landcruiser 4X4 T/Top	ZJE-052
Geophone carrier	Toyota Landcruiser 4X4 T/Top	ZJE-053
Geophone carrier	Toyota Landcruiser 4X4 T/Top	ZJE-057
Geophone carrier	Toyota Landcruiser 4X4 T/Top	ZJE-058
Shooting truck	Toyota Landcruiser 4X4 T/Top	ZJE-054
Supply truck	Toyota Landcruiser 4X4 T/Top	ZJE-028
Personnel carrier	Toyota troop carrier, 4X4	ZJE-225
Personnel carrier	Toyota troop carrier, 4X4	ZJE-025
Reconnaissance vehicle	Toyota Landcruiser 4X4 S/W	ZJE-004
Workshop Spares	4 wheel trailer	ZTV-022

Drilling:

Drilling rig	Mayhew 1000/Mack R600, 8X6	ZBE-606
Drilling rig	Mayhew 1000/Mack R600, 8X6	ZSU-471
Drilling rig	Mayhew 1000/Mack R600, 8X6	ZSU-472
Drilling rig	Mayhew 1000/Mack R600, 8X6	ZSU-473
Drilling rig	Mayhew 1000/Mack R600, 8X6	ZSU-529
Drill water tanker	Mack R875, 6X6, 8645 litres	ZSU-863
Drill water tanker	Mack R875, 6X6, 8645 litres	ZSU-864
Drill water tanker	Mack R875, 6X6, 8645 litres	ZSU-865
Drill water tanker	Mack R875, 6X6, 8645 litres	ZSU-866
Drill water tanker	Mack R875, 6X6, 8645 litres	ZSU-911
Workshop	Mercedes 911 4tonne 4X4	ZBE-647
Explosives truck	International 1830C 8tonne	ZBE-966
Preloading truck	Toyota Landcruiser, 4X4, T/Top	ZJE-055
Stores truck	Toyota Landcruiser, 4X4, T/Top	ZJE-056
Personnel carrier	Toyota troop carrier, 4X4	ZJE-011
Personnel carrier	Toyota troop carrier, 4X4	ZJE-013
Drilling spares	4 wheel trailer	ZTL-511
Workshop	4 wheel trailer	ZTV-023
Office	4 wheel trailer	ZTL-996
Welding	2 wheel trailer	ZTL-501

APPENDIX 4

Spread and Recording Parameters

Spread length	5950 m
Spread Type	Split Spread
Number of channels (max)	120
Number of station units available	154
Geophone station interval	50 m
CDP fold	5-10
Number geophones/trace	16
Geophone pattern (GSC-20D)	in-line
Geophone spacing	3 m
Seismic System	Sercel SN368
Blaster	OYO Model 1340
Camera	OYO DFM-480
Station Unit Test & Repair System	Prosol TRS-2
Field Processing System	Vista PC based system
Sercel SN368 instrument settings:	
Recording mode	digital
Tape format	SEG-D Multipexed
Number of input channels:	
Data	120
Auxiliary	4
Tape: 9 track, 6250bpi GCR, 0.5inch, 8.5inch reel, 1200ft	
Record length	20 second
Sample rate	2 ms
Input filters;	
Low-cut	8 Hz/18db/Oct
Hi-cut	178 Hz
Pre-Amp Gain	7**2
Playback Parameters;	
Low-cut	12 Hz
Hi-cut	90 Hz
Slope	18 ms
Seis Monitor Gain	42 db
Output Adjust	4 db
Gain Curve	1
Release Time	10 ms
Compression Delay	8 ms
Early Gain	0 db
AGC	1
Recovery Delay	32 ms

APPENDIX 5

Line recording spread parameters

Seismic Line Intersections:

BMR92.OT04	SP 2369 + 17 m	-	BMR92.OT05	SP 2220 + 11 m
BMR92.OT06	SP 1634 + 3 m	-	BMR92.OT07	SP 1395 + 30 m

Line BMR92.OT01

Orientation (High SP numbers South, Trace 1 to the North)	N-S
Length	65.9 km
First Geophone station	1000
Last Geophone station	2318
First Shotpoint	1001
Last shotpoint	2315
Geophone station interval	50 m
Shotpoint interval	300 m

Line BMR92.OT02

Orientation (High SP numbers West, Trace 1 to the East)	E-W
Length	33.1 km
First Geophone station	1000
Last Geophone station	1662
First Shotpoint	1006
Last Shotpoint	1662
Geophone Station interval	50 m
Shotpoint interval	300 m

Line BMR92.OT03

Orientation (High SP numbers West, Trace 1 to the East)	E-W
Length	58.3 km
First Geophone station	1000
Last Geophone station	2166
First Shotpoint	1001
Last Shotpoint	2166
Geophone Station interval	50 m
Shotpoint interval (nominal)	300 m

Line BMR92.OT04

Orientation (High SP numbers West, Trace 1 to the East)	E-W
Length	87.65 km
First Geophone station	1000
Last Geophone station	2753
First Shotpoint	1000
Last Shotpoint	2753
Geophone Station interval	50 m
Shotpoint interval (nominal)	300 m

Line BMR92.OT05

Orientation (High SP numbers South, Trace 1 to the North)	N-S
Length	101 km
First Geophone station	1000
Last Geophone station	3020
First Shotpoint	1000
Last Shotpoint	3020
Geophone Station interval	50 m
Shotpoint interval (nominal)	300 m

Line BMR92.OT06

Orientation (High SP numbers South, Trace 1 to the North)	N-S
Length	34.8 km
First Geophone station	1000
Last Geophone station	1696
First Shotpoint	1000
Last Shotpoint	1662
Geophone interval	50 m
Shotpoint interval	300 m

Line BMR92.OT07

Orientation (High SP numbers West, Trace 1 to the East)	E-W
Length	81.95 km
First Geophone station	0993
Last Geophone station	2632
First Shotpoint	0993
Last Shotpoint	2632
Geophone interval	50 m
Shotpoint interval	300 m

APPENDIX 6

SEISMIC FIELD TAPE INDEX

Tape No.	Line	Shotpoints	Recording Dates	Record Mode	Survey
92001	BMR92.OT01	1001 - 1072	04/03/92-04/03/92	6250 bpi GCR	OTWAY BASIN
92002	BMR92.OT01	1078 - 1210	05/03/92-05/03/92	6250 bpi GCR	OTWAY BASIN
92003	BMR92.OT01	1216 - 1342	06/03/92-06/03/92	6250 bpi GCR	OTWAY BASIN
92004	BMR92.OT01	1348 - 1468	10/03/92-10/03/92	6250 bpi GCR	OTWAY BASIN
92005	BMR92.OT01	1474 - 1624	10/03/92-11/03/92	6250 bpi GCR	OTWAY BASIN
92006	BMR92.OT01	1629 - 1756	11/03/92-12/03/92	6250 bpi GCR	OTWAY BASIN
92007	BMR92.OT01	1761 - 1822	12/03/92-13/03/92	6250 bpi GCR	OTWAY BASIN
92008	BMR92.OT01	1829 - 1937	16/03/92-16/03/92	6250 bpi GCR	OTWAY BASIN
92009	BMR92.OT01	1942 - 2081	16/03/92-17/03/92	6250 bpi GCR	OTWAY BASIN
92010	BMR92.OT01	2097 - 2218	17/03/92-17/03/92	6250 bpi GCR	OTWAY BASIN
92011	BMR92.OT01	2224 - 2315	18/03/92-18/03/92	6250 bpi GCR	OTWAY BASIN
92012	BMR92.OT02	1006 - 1138	19/03/92-20/03/92	6250 bpi GCR	OTWAY BASIN
92013	BMR92.OT02	1143 - 1223	20/03/92-20/03/92	6250 bpi GCR	OTWAY BASIN
92014	BMR92.OT02	1228 - 1360	23/03/92-23/03/92	6250 bpi GCR	OTWAY BASIN
92015	BMR92.OT02	1366 - 1383	23/03/92-23/03/92	6250 bpi GCR	OTWAY BASIN
92016	BMR92.OT02	1390 - 1516	24/03/92-24/03/92	6250 bpi GCR	OTWAY BASIN
92017	BMR92.OT02	1522 - 1598	24/03/92-24/03/92	6250 bpi GCR	OTWAY BASIN
92018	BMR92.OT02	1600 - 1662	25/03/92-25/03/92	6250 bpi GCR	OTWAY BASIN
92019	BMR92.OT03	1001 - 1024	25/03/92-25/03/92	6250 bpi GCR	OTWAY BASIN
92020	BMR92.OT03	1030 - 1162	27/03/92-27/03/92	6250 bpi GCR	OTWAY BASIN
92021	BMR92.OT03	1168 - 1198	27/03/92-27/03/92	6250 bpi GCR	OTWAY BASIN
92022	BMR92.OT03	1210 - 1348	30/03/92-30/03/92	6250 bpi GCR	OTWAY BASIN
92023	BMR92.OT03	1353 - 1480	30/03/92-31/03/92	6250 bpi GCR	OTWAY BASIN
92024	BMR92.OT03	1487 - 1600	31/03/92-31/03/92	6250 bpi GCR	OTWAY BASIN
92025	BMR92.OT03	1608 - 1738	01/04/92-01/04/92	6250 bpi GCR	OTWAY BASIN
92026	BMR92.OT03	1743 - 1822	01/04/92-01/04/92	6250 bpi GCR	OTWAY BASIN
92027	BMR92.OT03	1828 - 1851	02/04/92-02/04/92	6250 bpi GCR	OTWAY BASIN
92028	BMR92.OT03	1858 - 1990	02/04/92-02/04/92	6250 bpi GCR	OTWAY BASIN
92029	BMR92.OT03	1996 - 2026	02/04/92-02/04/92	6250 bpi GCR	OTWAY BASIN
92030	BMR92.OT03	2032 - 2166	03/04/92-03/04/92	6250 bpi GCR	OTWAY BASIN
92031	BMR92.OT04	1000 - 1114	07/04/92-07/04/92	6250 bpi GCR	OTWAY BASIN
92032	BMR92.OT04	1120 - 1157	07/04/92-07/04/92	6250 bpi GCR	OTWAY BASIN
92033	BMR92.OT04	1162 - 1265	08/04/92-08/04/92	6250 bpi GCR	OTWAY BASIN
92034	BMR92.OT04	1272 - 1338	08/04/92-08/04/92	6250 bpi GCR	OTWAY BASIN
92035	BMR92.OT04	1342 - 1453	09/04/92-09/04/92	6250 bpi GCR	OTWAY BASIN
92036	BMR92.OT04	1456 - 1571	09/04/92-09/04/92	6250 bpi GCR	OTWAY BASIN
92037	BMR92.OT04	1576 - 1697	10/04/92-10/04/92	6250 bpi GCR	OTWAY BASIN
92038	BMR92.OT04	1703 - 1834	14/04/92-14/04/92	6250 bpi GCR	OTWAY BASIN
92039	BMR92.OT04	1841 - 1852	14/04/92-16/04/92	6250 bpi GCR	OTWAY BASIN
92040	BMR92.OT04	1857 - 2014	16/04/92-16/04/92	6250 bpi GCR	OTWAY BASIN
92041	BMR92.OT04	2026 - 2206	21/04/92-22/04/92	6250 bpi GCR	OTWAY BASIN

Tape No.	Line	Shotpoints	Recording Dates	Record Mode	Survey
92042	BMR92.OT04	2218 - 2368	22/04/92-22/04/92	6250 bpi GCR	OTWAY BASIN
92043	BMR92.OT04	2381 - 2548	23/04/92-23/04/92	6250 bpi GCR	OTWAY BASIN
92044	BMR92.OT04	2561 - 2572	24/04/92-24/04/92	6250 bpi GCR	OTWAY BASIN
92045	BMR92.OT04	2584 - 2753	28/04/92-28/04/92	6250 bpi GCR	OTWAY BASIN
92046	BMR92.OT05	1000 - 1186	29/04/92-29/04/92	6250 bpi GCR	OTWAY BASIN
92047	BMR92.OT05	1198 - 1390	30/04/92-30/04/92	6250 bpi GCR	OTWAY BASIN
92048	BMR92.OT05	1396 - 1475	30/04/92-01/05/92	6250 bpi GCR	OTWAY BASIN
92049	BMR92.OT05	1486 - 1738	04/05/92-05/05/92	6250 bpi GCR	OTWAY BASIN
92050	BMR92.OT05	1762 - 2002	05/05/92-06/05/92	6250 bpi GCR	OTWAY BASIN
92051	BMR92.OT05	2013 - 2207	07/05/92-07/05/92	6250 bpi GCR	OTWAY BASIN
92052	BMR92.OT05	2218 - 2314	08/05/92-08/05/92	6250 bpi GCR	OTWAY BASIN
92053	BMR92.OT05	2327 - 2339	11/05/92-12/05/92	6250 bpi GCR	OTWAY BASIN
92054	BMR92.OT05	2350 - 2542	12/05/92-12/05/92	6250 bpi GCR	OTWAY BASIN
92055	BMR92.OT05	2554 - 2771	13/05/92-13/05/92	6250 bpi GCR	OTWAY BASIN
92056	BMR92.OT05	2782 - 2986	14/05/92-14/05/92	6250 bpi GCR	OTWAY BASIN
92057	BMR92.OT05	2992 - 3020	14/05/92-14/05/92	6250 bpi GCR	OTWAY BASIN
92058	BMR92.OT06	1000 - 1122	19/05/92-19/05/92	6250 bpi GCR	OTWAY BASIN
92059	BMR92.OT06	1126 - 1265	20/05/92-20/05/92	6250 bpi GCR	OTWAY BASIN
92060	BMR92.OT06	1271 - 1408	20/05/92-21/05/92	6250 bpi GCR	OTWAY BASIN
92061	BMR92.OT06	1414 - 1559	21/05/92-22/05/92	6250 bpi GCR	OTWAY BASIN
92062	BMR92.OT06	1563 - 1662	22/05/92-22/05/92	6250 bpi GCR	OTWAY BASIN
92063	BMR92.OT07	0993 - 1036	25/05/92-26/05/92	6250 bpi GCR	OTWAY BASIN
92064	BMR92.OT07	1042 - 1096	26/05/92-26/05/92	6250 bpi GCR	OTWAY BASIN
92065	BMR92.OT07	Test Files	26/05/92-26/05/92	6250 bpi GCR	OTWAY BASIN
92066	BMR92.OT07	1103 - 1193	26/05/92-26/05/92	6250 bpi GCR	OTWAY BASIN
92067	BMR92.OT07	1198 - 1275	27/05/92-27/05/92	6250 bpi GCR	OTWAY BASIN
92068	BMR92.OT07	1282 - 1316	28/05/92-28/05/92	6250 bpi GCR	OTWAY BASIN
92069	BMR92.OT07	1318 - 1318	28/05/92-28/05/92	6250 bpi GCR	OTWAY BASIN
92070	BMR92.OT07	1324 - 1426	28/05/92-29/05/92	6250 bpi GCR	OTWAY BASIN
92071	BMR92.OT07	1445 - 1542	29/05/92-30/05/92	6250 bpi GCR	OTWAY BASIN
92072	BMR92.OT07	1546 - 1678	01/06/92-01/06/92	6250 bpi GCR	OTWAY BASIN
92073	BMR92.OT07	1684 - 1709	01/06/92-01/06/92	6250 bpi GCR	OTWAY BASIN
92074	BMR92.OT07	1716 - 1736	01/06/92-02/06/92	6250 bpi GCR	OTWAY BASIN
92075	BMR92.OT07	1747 - 1768	02/06/92-02/06/92	6250 bpi GCR	OTWAY BASIN
92076	BMR92.OT07	1776 - 1876	02/06/92-02/06/92	6250 bpi GCR	OTWAY BASIN
92077	BMR92.OT07	1882 - 1894	03/06/92-03/06/92	6250 bpi GCR	OTWAY BASIN
92078	BMR92.OT07	1898 - 1942	03/06/92-03/06/92	6250 bpi GCR	OTWAY BASIN
92079	BMR92.OT07	1948 - 2014	03/06/92-04/06/92	6250 bpi GCR	OTWAY BASIN
92080	BMR92.OT07	2020 - 2146	04/06/92-04/06/92	6250 bpi GCR	OTWAY BASIN
92081	BMR92.OT07	2152 - 2221	05/06/92-05/06/92	6250 bpi GCR	OTWAY BASIN
92082	BMR92.OT07	2224 - 2296	05/06/92-05/06/92	6250 bpi GCR	OTWAY BASIN
92083	BMR92.OT07	2302 - 2302	06/06/92-06/06/92	6250 bpi GCR	OTWAY BASIN
92084	BMR92.OT07	2307 - 2320	06/06/92-06/06/92	6250 bpi GCR	OTWAY BASIN
92085	BMR92.OT07	2327 - 2458	06/06/92-07/06/92	6250 bpi GCR	OTWAY BASIN
92086	BMR92.OT07	2465 - 2596	07/06/92-08/06/92	6250 bpi GCR	OTWAY BASIN
92087	BMR92.OT07	2602 - 2632	08/06/92-08/06/92	6250 bpi GCR	OTWAY BASIN

APPENDIX 7

Shot Misfires and Unexploded Charge Locations

(DTC - Depth to Top of Charge)

Line BMR92.OT1

		Lat	Long
1408	Failed to detonate, DTC 24.0 m, 10 kg	-38.26496	143.83621
1492	Det wire missing, DTC 16.4 m, 10 kg	-38.30101	143.83590
1515	Charge too shallow, DTC 4.6 m, 10 kg	-38.31127	143.83397

Line BMR92.OT2

		Lat	Long
1105	Det wire missing, DTC 30.5 m, 10 kg	-38.27390	143.14704
1649	Failed to detonate, DTC 16.1 m, 10 kg	-38.29392	142.86006

Line BMR92.OT3

		Lat	Long
1528	Det wire missing, DTC 37.2 m, 10 kg	-38.26447	142.58607

Line BMR92.OT4

		Lat	Long
1000	Charge too shallow, DTC 7.0 m, 10 kg	-37.84384	141.62705
1666	Failed to detonate, DTC 6.0 m, 4 kg	-37.74684	141.31227

Line BMR92.OT05

		Lat	Long
2686	Failed to detonate, DTC 8.3 m, 10 kg	-37.84401	140.96824
2830	Det wire missing, DTC 12.4 m, 10 kg	-37.90888	140.96724
2969	Not fired, caves, DTC 37.1 m, 10 kg	-37.97114	140.96591

Line BMR92.OT06

		Lat	Long
1540	Failed to detonate, DTC 18.1 m, 10 kg	-37.94070	140.57087

Line BMR92.OT07

		Lat	Long
1228	Abandoned, drilled too close to Sewage Main, DTC 16.6 m, 10 kg	-37.98841	140.66292

APPENDIX 8

ENVIRONMENTAL MANAGEMENT PLAN: BMR SEISMIC SURVEY, OTWAY BASIN, FEB-MAY 1992

D. M. Finlayson
Bureau of Mineral Resources, Geology & Geophysics, Canberra

INTRODUCTION

As part of the Australian National Geoscience Mapping Accord, the Bureau of Mineral Resources, Geology & Geophysics (BMR) proposes to conduct seismic reflection profiling in the Otway Basin region of SW Victoria and SE South Australia during 1992. This research work follows on from a seismic test survey and line reconnaissance conducted in the region during October-November 1991. The research is aimed at achieving a better understanding of the sub-surface geology of a region thought to have considerable resource potential, including hydrocarbons, industrial gases, and geothermal energy. Experience in other parts of Australia has shown that BMR seismic reflection profiling techniques for investigating basin sequences and the underlying basement provide new perspectives on basin development not always apparent in industry seismic data.

The Otway Basin region poses particular technical problems for those wishing to acquire seismic reflection data. Much of the region has a surface cover of Tertiary volcanic rocks, and in other places there are extensive near-surface limestones and palaeo-sand dunes. These all present specific difficulties for setting recording parameters. These problems were addressed during the Oct-Nov 1991 BMR test survey and the subsequent analysis of the data. The test sites were located along existing roads and tracks in the following areas:

1. Mount Hesse	-North of Colac, Vic.
2. Condah	-Blanxholme-Condah area, Vic.
3. Penola	-Vic. side of the State border southeast of Penola.
4. Allendale	-Southwest of Mount Gambier
5. Millicent	-Near Lake Bonney, S.A

An Environmental Factors document was prepared for the seismic test work; this will be referred to as the 1991 Environmental Management Plan. Prior to the test work this plan was submitted through the S.A. Department of Mines & Energy and the Geological Survey of Victoria to the appropriate State environmental management authorities for approval.

The 1992 Environmental Management Plan formulated in this paper addresses matters relating to the conduct of BMR seismic work in the Otway Basin region during February-June 1992. Figure 1 shows the general location of the eight proposed seismic lines in relation to the major sub-surface geological features of the region. Many of the matters addressed in this documnent are the same as those addressed prior to the 1991 test work but the location of the seismic work is more extensive. Hence, during Oct-Nov 1991, a detailed reconnaissance of the proposed seismic lines was conducted to examine matters concerning access to seismic lines, land ownership, possible environmental degradation, etc. This reconnaissance resulted in all proposed lines being traversed and a photographic record and notes being compiled of conditions along each line. These compilations provide a basis for judging the impact of proposed BMR seismic work on the local environment along the lines.

CO-OPERATIVE PARTNERS

The onshore Otway Basin spans two states, Victoria and South Australia, and offshore the continental shelf beyond a coastal belt comes under the jurisdiction of the Commonwealth Government. The proposed 1992 seismic project in the Otway Basin will be conducted under the Australian National Geoscience Mapping Accord which provides a mechanism for co-operative research between State and Commonwealth geoscience institutions, universities and industry.

The partners in the Otway Basin seismic project are:

1. Bureau of Mineral Resources, Geology & Geophysics (BMR)
2. South Australian Department of Mines & Energy (SADME)
3. Geological Survey of Victoria (GSV)

The co-operative partners in this project are jointly responsible for the preparation of this document drafted by Dr. D. M. Finlayson, Project Leader, Otway Basin Project, BMR.

TIME SCHEDULE FOR SEISMIC TESTS

It is proposed that topographic surveying and pegging for the seismic work commence on or about 28 January, 1992. It is expected that BMR shothole drilling will commence on or about 26 February and that BMR seismic recording will commence about 4 March. The duration of the survey is expected to be about 15 weeks, taking thesurvey into early June.

CODE OF ENVIRONMENTAL PRACTICE

It is proposed to conduct the seismic survey in areas of South Australia and Victoria which have important agricultural industries, infrastructure, population centres, and areas set aside by special legislation. It is in the interests of all concerned that the work practices of the BMR seismic crew do not impinge any more than is necessary on the environment of the region. The South Australian Department of Mines and Energy (SADME) has prepared a Code of Environmental Practice (Stone, 1990) for resource companies working under lease agreements with the State Government. This code sets out guidelines aimed at reducing or avoiding any adverse environmental impact resulting from seismic exploration operations conducted under the S.A. Petroleum Act Regulations. However, it should be noted that BMR research is not conducted as an exploration program for hydrocarbons; rather, the research is conducted as part of an Australia-wide program into the fundamental geological and geophysical features of continental Australia, the Australian National Geoscience Mapping Accord between State and Commonwealth Governments.

Notwithstanding the rationale for various seismic surveys, the SADME guidelines generally reinforce the sound management practices already applied by BMR seismic parties. The project co-operative partners are jointly responsible for this 1992 Environmental Management Plan which addresses matters which would normally be contained in an industry Declaration of Environmental Factors and a Code of Environmental Practice. In most cases BMR seeks to operate along existing roads, tracks, and fencelines. This not only reduces the line preparation to a minimum, it also reduces BMR operating costs and disruption to landholders.

This 1992 Environmental Management Plan addresses the following matters:

1. The planning and consultative process.
2. Minimising impact of seismic operations on vegetation and the land surface.
3. Consultation with land owners.
4. Consultation with aboriginal persons.
5. Consultation with Local Councils and other public instrumentalities.
6. Guidelines for employees and contractors.
7. Environmentally sensitive locations.
8. Environmental queries
9. Environmental audit

This 1992 Environmental Management Plan also addresses particular aspects of field work done by, or on behalf of, BMR. Project management will use Part 2 of the Code of Environmental Practice prepared by the South Australian Department of Mines and Energy (Stone, 1990) setting out guidelines for every member of staff or contractor operating in the field with respect to the following matters:

1. Access tracks.
2. Line preparation.
3. Operations along the seismic line.
4. Fire prevention.
5. Use of explosives.
6. Operations in swamp regions.
7. Recording line restoration.
8. Shothole restoration.
9. Aquifer management.

The co-operating partners are also aware of other guidelines prepared by and for resource industry operators and their staff, e.g. "Environmental Planning Techniques" (Buckley, 1988), "Clearance of Native Vegetation" (SADME, 1991), Code of Environmental Practice (SANTOS, 1991). These other guidelines have been consulted in the process of drawing up this document.

THE PLANNING AND CONSULTATIVE PROCESS

BMR seismic field operations are the responsibility of the Commonwealth Government and any actions by BMR officers are circumscribed by the necessity to avoid damage to property, annoyance to persons who may feel aggrieved/threatened by work done in the viscinity of their homes or landholdings, and damage to the natural environment, wildlife, etc. Hence BMR officers take the responsiblity for the planning process and its smooth management. Should a dispute arise from BMR field operations, the aggrieved party should resolve it with the BMR Field Party Leader in the first instance, but, if this fails, then with the Commonwealth by writing to:

Associate Director (Petroleum
& Marine Geoscience),
Bureau of Mineral Resources,
Geology & Geophysics,
P.O. Box 378,
Canberra A.C.T. 2601

BMR has been assisted in the planning process by officers from SADME and the Geological Survey of Victoria who have provided advice on all aspects of operations which might impinge adversely on persons, property, or the environment, or be subject to State regulation.

It is in the interests of the co-operative partners to ensure that there is an appropriate consultation process in place prior to BMR field operations.

MINIMISING IMPACT OF SEISMIC OPERATIONS ON VEGETATION AND THE LAND SURFACE

In this section we seek to identify those aspects of BMR operations which potentially pose a threat to vegetation and the land surface. Only with a clear understanding of the nature of BMR operations can judgements be made about whether or not any real environmental risk exists. It is important to emphasize that just about every part the country being traversed by the seismic lines has been considerably modified from its natural state by agricultural and forest industries and urban infrastructure. So when environmental impact is discussed, it is done so with respect to a landscape highly modified from natural bushland.

Seismic line clearing and vehicle access

The seismic reflection method of investigating sub-surface structures involves profiling along lines which are relatively straight over a distance of 5-8 km (Appendix 9). For BMR purposes the lines do not have to be as straight as industry profiling (although desirable). BMR prefers to work along existing roads/tracks and fencelines. There is no requirement for the ground surface to be "prepared" such as for industry Vibroseis work. The only requirement is that there must be access for BMR vehicles. These vehicles range in size from Toyota Landcruisers to drilling rigs mounted on Mack prime movers (all-up weight about 16 tonnes); they must be able to get to the recording line. All the larger vehicles are fitted with appropriate tyres to ensure minimum damage to the land surface and the even distribution of their load.

It should be emphasised here that BMR has many years experience working in rural and semi-urban areas of Australia. In recent years the BMR seismic crew has worked harmoniously in environmentally sensitive areas of the Bowen Basin, semi-urban areas of SE Queensland, rich agricultural areas of central NSW, forested areas of NSW and Queensland, as well as arid areas of the Canning Basin in NW Western Australia, the Kalgoorlie region (including strictly controlled conservation areas), the Nullarbor Plain, and sensitive heritage areas of central Australia. BMR has a good record with many communities throughout Australia.

In agricultural and semi-urban lands it is often not necessary to do any line preparation to enable vehicle access. Verges on roads, tracks and fencelines are often more than adequate. However, grass may have to be cut and minor scrub clearing done. This is usually done by contract, often by a local council or landowner. In open agricultural grazing land there is no requirement for ground preparation.

For the 1992 seismic survey it is anticipated that most preparation will only be this minimum line clearing. However, on Lines 1 and 4 there will be some upgrading of access. This is being arranged with officers of the Victorian Department of Conservation & Environment.

Surveying

The topography and positions of the seismic lines have to be surveyed; a private consulting company will be responsible for this work along the eight seismic lines. In general terms surveyors are required to peg geophone stations at 40-60 m intervals and shotpoints at 240-360 m intervals. Surveyors therefore require access to the test sites for 4WD vehicles (e.g. Toyota Landcruiser, etc). This work will be done 2-3 weeks in advance of the shothole drilling along seismic lines.

Shothole drilling

Shot holes are drilled by BMR crews using Mayhew 1000 rigs mounted on Mack prime movers. A tanker vehicle accompanies each drilling rig. Holes are 12 cm diameter and are commonly drilled to 15-40 m. Drill chips are used to backfill the hole once explosives are loaded so that very little debris remains on completion of shot loading. Experience during the 1991 test survey indicates that drillhole cuttings commonly turn to a mud when flushed from the hole with water and that road gravel may have to be used to tamp shots in some areas.

Use of explosives

The seismic source for BMR reflection profiling is an explosive charge located at the bottom of a drillhole 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. Also the hole is backfilled with material taken from the hole.

The charge size usually varies between 6 and 20 kg of explosive (ICI Powergel, 2 kg sticks or equivalent). Shots are fired electrically from the seismic recording cab. On detonation there is little ground movement around the shothole; there is no air blast and no cratering on the surface. All electrical cable is removed from the shothole site after detonation.

All handling, transport, storage, and use of explosives is tightly controlled by State and Commonwealth regulation. Appropriate BMR vehicles are designed for explosive transport and storage. All BMR staff handling explosives have licenses recognised in the States in which they operate. Bulk explosives are stored at appropriate licensed magazines in the areas of seismic operation.

Environmental risk

BMR management is well aware of the potential damage that seismic operations can inflict on the environment. Experience over many years, however, indicates that any effects of BMR seismic operations are minimised by careful field management, reducing ground disturbance by vehicles, and keeping line clearing to a minimum. It is expected that the risk to vegetation and the land surface along the eight proposed seismic lines will be very small. The risk to wildlife and grazing stock is considered to be no more than that associate with normal vehicle movement along existing roads and tracks.

CONSULTATION WITH LAND OWNERS

Land owners can be divided into two catagories, local councils and public instrumentalities (forestry commissions, water boards, etc.), and private land owners. Sometimes the latter may be community groups or companies.

The BMR project officers have prepared a general information pamphlet for landowners regarding access for the field crew. This pamphlet is distributed whenever discussions are held with land owners and other interested persons.

Consultation with local councils and public instrumentalities is achieved by approaching their chief officers who usually delegate negotiations to the local government engineer or works manager. When seismic work is proposed along public roads/tracks then an assessment has to be made about possible damage to rural infrastructure. Experience over many years has shown that most local government officials are very co-operative and actively help the planning process. The general rule is "the earlier contact is made the better".

The names and addresses of private land owners are usually available through local government offices. If there is a requirement for the seismic line to pass through private land then the owner/manager is contacted by letter and then by personal contact via the BMR Field Party Leader. BMR experience has shown that it is important to develop a personal rapport with owners/managers wherever possible (along the proposed seismic lines many owners have already been contacted). Subsequent contacts by phone and possibly other staff are then made much easier. Any problems regarding access, fencing, stock, etc. are ironed out as early as possible.

CONSULTATION WITH ABORIGINAL PERSONS

SADME and the GSV are well aware of the sensitivities of aboriginal groups regarding possible seismic operations in areas of local significance. BMR takes advice from the State departments on these matters. Most of the proposed seismic lines are on public access land along rural roads and tracks.

SADME and GSV have identified any necessary contact with aboriginal groups or persons who may have an interest along the proposed seismic lines. In Victoria the Victorian Archeological Survey, Department of Conservation and Environment provides an advisory service. In southeast S.A., advice is obtained through the following group:

The SE Aboriginal Heritage Committee,
Coonnearce Association Group,
P.O. Box 82,
Kingston SE S.A. 5275

or their contact person

Mr. Lindsay Wilson,
17 Plunket Ave.,
Millicent S.A. 5280
(Ph. 087 333 603)

CONSULTATION WITH LOCAL COUNCILS AND OTHER PUBLIC INSTRUMENTALITIES

Seismic operations are necessarily a very public activity and sometimes attract the curiosity of local residents, community groups, etc. At all times BMR takes the attitude that public information should be freely available. There are occassions when traffic flow may be impeded on public roads because of BMR operations. Also the use of explosives sometimes engenders apprehension in local residents. The public have a right to know what it is all about.

Because BMR seismic operations occur in the public domain it is important to notify public instrumentalities of the project aims and "modus operandi". This often involves police and local fire officers who may be concerned regarding the use of explosives or potential bushfire hazards. If there is a requirement for traffic control on public roads then police are informed. If there are bushfire hazards in areas of grassland or forests then the BMR crew is subject to direction from local emergency services officers, just like any other member of the public. The Country Fire Service in S.A. distribute "Your Guide to Bushfire Regulations" which will be used as a basis for seismic crew management.

Contacts with local government officers is always necessary when recording is being conducted along public roads. This has been discussed in the paragraph above when considering access and land ownership. Local officers concerned with groundwater management also have to be consulted with respect to drilling and shot firing. In the southeast region of S.A. the appropriate officers are the Regional Geologist, Department of Mines & Energy, 290 Commercial St. West, Mount Gambier (Ph. 087 253530 and the Drilling Inspector, Department of Mines & Energy, Cedar Ave., Naracoorte (Ph. 087 621511). In Victoria, advice on groundwater is recieved from the Investigations Branch (Mr. Barry Mann), Rural Water Commission, 590 Orrong Rd., Armadale Vic. 3143 (Ph. 03 508 2713; Fax. 03 508 2264).

GUIDELINES FOR EMPLOYEES AND CONTRACTORS

All BMR employees and contractors have been made aware of the SADME Code of Environmental Practice Part 2 (Stone, 1990). There is no need to reproduce this code here. Sufficient to state that BMR seeks to adhere to the letter and spirit of the code. As mentioned earlier the topics covered by the code are:

1. Access tracks.
2. Line preparation.
3. Operations along the seismic line.
4. Fire prevention.
5. Use of explosives.
6. Operations in swamp regions.
7. Recording line restoration.
8. Shothole restoration.
9. Aquifer management.
10. Campsites.

ENVIRONMENTALLY SENSITIVE LOCATIONS

For the southeastern area of South Australia SADME have prepared information on environmentally sensitive areas on a series of 1:100 000 maps, together with an inventory of local information on the nature of the sensitive areas, persons to be contacted, etc. This enables the easy identification of sensitive areas which can then be avoided.

The proposed seismic lines in South Australia have been matched against the SADME environmental inventory and no clashes have been identified. All seismic lines in South Australia are along the verges of existing roads and tracks, or on private properties whose owners have been consulted. Only at the southern end of Line 8 does proposed seismic work reach the boundary of a conservation park in S.A., the Little Dip Conservation Park.

After the reconnaissance of the seismic lines, the author of this 1992 Environmental Management Plan does not consider the proposed BMR seismic work poses a threat to any environmentally sensitive area in South Australia. Any temporary disturbance to vegetation will most likely be regenerated in the following year. Any disturbance to the ground surface will either be cleared up by the BMR seismic crew or be tidied up during routine local government maintenance by arrangement with district council works managers.

The routes of seismic lines in Victoria have been open for discussion by GSV officers. Two areas where routes pass through environmentally sensitivive areas are the Wickhams Track - Erskine Falls Road part of Line 1, and the Glenelg River crossing on Line 4. For both these areas BMR has sought and received the local co-operation of officers of the Victorian Department of Conservation and Environment. The problems are easily solved by sensible management practices which, in the long term, will result in a nil effect on the present-day environmental situation. Line 5 along the State border with S.A. finishes at the northern boundary to the Lower Glenelg National Park. The BMR work on this line poses no threat to the park.

As with the proposed work in S.A., the author of this 1992 Environmental Management Plan does not consider the proposed BMR seismic work poses a threat to any environmentally sensitive areas of Victoria.

ENVIRONMENTAL QUERIES

During the reconnaissance for the proposed 1992 BMR seismic survey the author of this 1992 Environmental Management Plan gained first-hand knowledge of the routes of the proposed seismic lines. It is suggested that, if there are specific environmental concerns about particular locations on any of the lines, these concerns could be discussed in some detail with the author who can be contacted directly at the address below:

Dr. D. M. Finlayson,
Bureau of Mineral Resources,
Geology & Geophysics,
P.O. Box 378,
Canberra A.C.T. 2601

Phone - 06 249 9761; Fax. - 06 249 1954

ENVIRONMENTAL AUDIT

At the termination of BMR seismic test work, sites will be inspected by either the BMR Project Leader and/or GSV or SADME staff. A report will be lodged with the senior management of BMR, GSV, and SADME regarding any possible environmental consequences of the BMR profiling.

