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Record 1974/49

NGALIA BASIN SEISMIC SURVEY, NORTHERN TERRITORY, 1967-1969

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by

F.J. Moss and P. Jones

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SUMMARY

The Bureau of Mineral Resources made three seismic surveys in the Ngalia Basin, Northern Territory, during 1967 to 1969 as part of a comprehensive geological and geophysical investigation of the structure and stratigraphy of the basin. The project was aimed at delineating the configuration of the basin, within which outcrops are sparse, and providing information pertaining to its depositional and tectonic history. Investigation of the extent of Lower Palaeozoic sedimentation was considered to be important in assessment of the petroleum prospects of the basin.

Single-coverage continuous reflection profiling techniques were used on the seismic surveys, which were of eleven months total duration, to obtain seismic data mainly on four north-south traverses across the basin. Short east-west reflection traverses provided dip control, expanded spreads were surveyed for velocity control, and some refraction profiling provided supplementary information on the main reflecting horizons. Gravity was read at seismic shot-points on some traverses.

The quality of the seismic reflection results varied from good to poor; the best data were recorded in the deeper parts of the basin under the Quaternary cover, and poor data were recorded in most areas near the margins and over Palaeozoic and Proterozoic outcrops. From the sedimentary section approximately 5000 m deep at the northern margin in the Waite Creek area, good-quality reflections were recorded and they persisted under a thrust fault for a distance of 11.5 kilometres.

The seismic results confirm that the basin is asymmetric, with its axis located near the Proterozoic outcrops which delineate the northern margin. From the southern margin, sediments generally dip gently northwards at attitudes of five to ten degrees towards the synclinal axes. The maximum thickness of sediments is approximately 5000 m in both the eastern and western lobes of the basin which are partly separated by a highly complex faulted zone about longitude 131°30'. In the western part of the basin the thick sedimentary pile, fault-bounded at the northern margin, was not evident from geological mapping but had been suggested from interpretation of the magnetic results.

Numerous faults, some of which could be traced over considerable distances, were indicated by the seismic results. One fault system is apparent in the pre-Carboniferous section only, with the Mount Eclipse Sandstone draped unconformably over the eroded fault blocks. The second fault system, which is shown to have affected the entire section, occurred during the second period of diastrophism during Carboniferous or later time. The seismic results indicate that major faulting and folding of the sediments affect the entire section within the

basin; both low- and high-angle thrusting are prevalent.

Tentative identifications of the reflectors with outcropping formations suggests that the bulk of the sedimentary sequence consists of Mount Eclipse Sandstone and Vaughan Springs Quartzite. The seismic objective of determining the extent of Lower Palaeozoic sedimentation was not achieved because of inconclusive attempts to correlate seismic reflectors with Lower Palaeozoic outcrops. However, the seismic results suggest that Lower Palaeozoic rocks could be present in the deeper troughs, beneath unconformities, in both the eastern and western lobes of the basin, and that with less complex faulting in the western lobe than the eastern lobe. Lower Palaeozoic sedimentation in the Ngalia Basin could thus have been more widespread than was previously thought.

Magellan Petroleum Australia Ltd, in a search for possible petroleum prospects, has further defined structural leads established from the Bureau of Mineral Resources work and surveyed a number of seismic traverses in the western lobe of the basin. A number of buried structural closures have been indicated, particularly in the western parts of the basin, where several low-angle thrusts have been mapped with anticlines developed over the sole fault of the folded fault system.

1. INTRODUCTION

The Bureau of Mineral Resources (BMR) carried out programs of reconnaissance and experimental seismic work in the Ngalia Basin, Northern Territory during September and October 1967, May to November 1968, and September to November 1969. The surveys were part of a comprehensive geological and geophysical investigation of the Ngalia Basin by BMR, which commenced in 1967. Surface geological mapping of the basin has been completed (Wells, Evans & Nicholas, 1968; Evans & Glickson, 1969; Nicholas, 1969) and geological maps at 1:250 000 scale have been produced for the Sheet areas covering the basin. Systematic reconnaissance helicopter gravity coverage of the basin by BMR, which commenced earlier, was completed in 1967 (Flavelle, 1965; Whitworth, 1970).

Prior to 1967, the only systematic geological work in the basin consisted of a few local investigations and regional reconnaissance. The most recent and comprehensive of these were the work of Cook (1963), and Cook & Scott (1968). The Northern Territory Oil Permit (OP165) covering the entire Ngalia Basin was originally held by the Pacific American Oil Co. (P.A.O.C.) as OP81. This company made an aeromagnetic survey over a large part of the basin and seismic and gravity surveys in the central and eastern part (Hartman, 1963; Hudson & Campbell, 1965).

Since 1968, the present permit holders, Magellan Petroleum Australia Ltd (operator) and Southern Pacific Petroleum N.L., have maintained an active exploration program involving detailed seismic and gravity surveys. The most recent of these was a detailed seismic survey in 1971(Krieg, 1972).

The terrain of the survey area is generally flat; east-west sand dunes in the west and low outcropping ridges in the central and northern part provide the only significant relief. Vegetation cover is generally dense in the areas of interest, so the seismic party had access tracks and traverses graded wherever possible; in some areas of dense eucalyptus and acacia scrub, grading was not feasible. General access to the survey area is provided by a good graded road from Alice Springs to the Yuendumu Native Settlement and within the area along graded station tracks. Some surface water was available in creeks and waterholes, but water for domestic purposes and for drilling was normally obtained from bores in the survey area.

Preliminary results from the seismic survey in 1967 were presented by Jones (1969), and those from the 1968 survey by Smith (1968) and Tucker (1969). The results from all the seismic surveys in the period 1967 to 1969 are discussed here.

2. GEOLOGY

The geology of the central part of the Ngalia Basin is described by Wells et al. (1968). The following discussion is based mainly on that account and the description of the geology by Wells, Moss & Sabitay (1972). The generalized structure and solid geology are shown in Plate 1.

The Ngalia Basin is a east-trending intracratonic depression covering an area of about 15 600 km in the southern part of the Northern Territory between latitudes 22°00' and 23°00' south and longitudes 129° and 133°45' east. The basin is about 420 km long and up to 70 km wide.

The unmetamorphosed sedimentary section, which attains a thickness of at least 4900 m, generally lies unconformably on Precambrian crystalline basement. Upper Proterozoic quartzite and sandstone crop out along the northern and southern margins; these sediments overlie Lower Proterozoic metamorphics and granite intrusives which probably represent magnetic basement. The western margin as mapped from surface geology is uncertain because of poor outcrops.

Stratigraphy

A generalized version of the stratigraphic table is shown in Table 1. The sediments, which are predominantly arenaceous, are of Proterozoic, Cambrian, Ordovician, and Carboniferous age. Eight formations and one member which have been recognised have a maximum aggregate thickness of more than 6100 m. The base of the sequence is placed at the base of the Vaughan Springs Quartzite. Most of the formations are separated by unconformities and a complete sequence is not present in any one area. The geological succession exposed at selected places along the northern margin of the basin is shown by Wells et al. (1972).

The basin sediments are probably mostly shallow-marine deposits with the exception of Proterozoic glacial beds, some of the Palaeozoic marine beds, and the Carboniferous continental deposits. A stratigraphic correlation between the Amadeus and Ngalia Basin successions shown by Wells et al. (1972) indicates that the sequence in the Ngalia Basin is very much thinner and more incomplete than that in the Amadeus Basin. Part of the Ordovician sequence persists into the Ngalia Basin; this is important in view of the occurrence of hydrocarbons in rocks of that age in the Amadeus Basin.

TABLE 1. STRATIGRAPHY OF THE NGALIA BASIN

Age	Formation	Max thickness (m)	Lithology and environment
Carboniferous	Mount Eclipse Sandstone	2100-2500±	Sandstone and subgreywacke. Interbeds of cobble and boulder conglomerates and red micaceous siltstone, continental, fluviatile and piedmont.
	UNCONFORMITY		
Ordovician	Kerridy Sandstone	700	Sandstone and subgreywacke Siltstone interbeds. Probably fluviatile.
	UNCONFORMITY		
	Djagamara Formation	320+	Sandstone. Thick green siltstone intervals in west. Shallow marine.
	UNCONFORMITY		
Cambrian	Bloodwood Formation	200+	Siltstone and sandstone. Lower Cambrian age. Shallow marine.
	Walbiri Dolomite	430±	Dolomite, interbeds of siltstone and sandstone. Shallow marine.
	UNCONFORMITY		
	Yuendumu Sandstone	700+	Sandstone
	UNCONFORMITY		
Proterozoic	Mount Doreen Formation	340	Siltstone with dolomite. Fluvioglacial and partly marine.
	UNCONFORMITY		
	Vaughan Springs Quartzite	2400±	Silificied sandstone with basal conglomerate. Shallow marine.
	Treuer Member	1370±	Sandstone with interbedded siltstone. Shallow marine.

Structure

Deformation of the sediments is more pronounced in the northern part of the basin; there they are generally in faulted contact with Precambrian crystalline basement rocks which have been upthrust against, and in places thrust over, the sedimentary pile. By contrast, towards the south, where the outcrop geology is sparse, available information points to less deformation. At the southern margin, the basin/basement relationship if essentially the Vaughan Springs Quartzite resting unconformably on crystalling basement and dipping northwards into the basin at low or moderate angles. In the western half of the basin the picture is more complex: the quartzite is broken into large blocks which have assumed various attitudes by differential tilting.

Palaeotectonics

The numerous unconformities in the sedimentary sequences along the northern margin of the basin indicate that the area has been subjected to several periods of epeirogenic movement. The main deformation, however, resulted from two main periods of diastrophism. The first occurred after the deposition of the Ordovician sediments and caused major faulting and minor folding. During the ensuing period of erosion, the sediments were partly eroded from the tops of fault blocks. The Carboniferous continental deposits were then deposited unconformably over most of the formations in the basin. The second period of diastrophism, during the Carboniferous or later, resulted in major folding and faulting of the sediments and in places the north-to-south overthrusting of basement rocks over the sediments. The fold axes in the basin trend mainly easterly. Faults are mostly parallel to the fold axes and the displacement is generally north-side-up except where a reversal has been caused by later movements. The Ngalia Basin became an entity during this period and was separated from surrounding areas of sedimentary rocks by erosion of sediments from the basement uplifts to the north and south. The basin was stabilized after this last diastrophic event.

3. PREVIOUS GEOPHYSICS

The paucity of rock exposures in the central and southern parts of the Ngalia Basin has dictated the use of geophysical methods to define the structure of the sediments in the basin.

Magnetic

Two aeromagnetic surveys have been made in the area. In 1958 BMR made an airborne magnetic and radiometric survey of the Mount Hardy area west of Yuendumu Native

Settlement (Carter, 1960). This survey covered the northern margin of the Ngalia Basin and part of the surrounding Precambrian basement complex. P.A.O.C. (Hartman, 1963) made an airborne magnetic survey which covered nearly the whole of the Ngalia Basin. Magnetic basement contours based on the results of these surveys are shown in Plate 2.

The results indicated a wedge-like sedimentary sequence, thickening northward, overlying magnetic basement. Two deep lobes, containing sediments about 5200 m to 6100 m thick, are separated by a linear north-south ridge near longitude 131°25'E. These lobes are asymmetrical, their deepest part in each case being closest to the northern margin.

The magnetic results in the western part of the basin indicated large changes in magnetic intensity to the south, while to the north and east the magnetic gradients were much lower. Superimposed on the regional gradient to the north and east were some smaller features which were thought to represent fault blocks or horsts.

The magnetic anomaly features in the southern part of the area are alternatively broad and narrow in extent and are separated by northeast-trending lineaments. These were interpreted as represeting northeast-trending faults which cut magnetic lineament blocks that already lay in various attitudes. Analysis of the features suggest that the magnetic bodies dip northwards at 20° to 45°. Depth estimates in the area indicate a northward plunge; therefore the above dips may represent the slope of the magnetic basement. Generally in the southern part of the survey area, magnetic basement was estimated to be at shallow depth.

The abrupt transition from large magnetic basement depth estimates in the central part of the basin to shallow depth estimates in the north supports the postulate of major faulting at the northern margin of the basin.

The magnetic pattern in the eastern part of the area was relatively featureless but was bounded in the north and south by sharp anomalies. Magnetic results indicate that the eastern part of the basin is markedly narrower than the western part. Depth estimates in the eastern part were not considered to be very reliable because of the more confined area of the basin, the lack of geological control, and the lack of features on the magnetic pattern; however, a thick sedimentary pile is indicated. At the extreme eastern end of the basin the magnetic results indicate shallow magnetic basement, suggesting that the basement area is closed in this direction.

Gravity

BMR made a reconnaissance helicopter gravity survey which covered the eastern part of the Ngalia Basin in 1965 (Flavelle, 1965) and completed the reconnaissance coverage of the basin and its surroundings during a helicopter gravity survey of parts of the Northern Territory and Western Australia in 1967 (Whitworth, 1970). Gravity was measured on seismic lines surveyed by P.A.O.C. in 1964 (Hudson & Campbell, 1965) and by Magellan on the BMR seismic traverses surveyed to the end of 1968 (Hickey, 1969). The results of the detailed work from these traverses and further semi-detailed gravity lines by Magellan in 1970 (Sabitay, 1971) were integrated to produce the Bouguer anomaly map shown in Plate 3.

The reconnaissance gravity surveys outlined a large regional gravity province, the Yuendumu Regional Gravity Low, which extends across north NAPPERBY*, north of MOUNT DOREEN, south MOUNT THEO, north LAKE MACKAY, and southeast HIGHLAND ROCKS. The axis of the Yuendumu Regional Gravity Low reaches Bouguer anomaly nadirs of -100 mGal in central NAPPERBY, north MOUNT DOREEN, and west MOUNT DOREEN. It is flanked to the north by the Willowra Gravity Ridge and to the south by the Papunya Gravity Ridge, which have culminations of 0 mGal and +40 mGal respectively.

The Ngalia Basin as indicated from outcrops, lies within the Yuendumu Regional Gravity Low but it occurs on the southern gradient rather than along the axis of the low. The low would suggest that the basin could be of far greater extent than its surface expression indicates, about 160 km as compared with 80 km maximum, in which case basement rocks would have to be thrust over the sediments along the northern margin for about 80 to 100 km. Although there is both geological and geophysical evidence of thrust-faulting along the northern margin of the basin, faulting generally is thought to be of relatively high angle and the degree of overthrusting is thought to be moderate. Various alternative hypotheses have been proposed, mainly by Whitworth (1970), to explain the Yuendumu Regional Gravity Low; these include, in addition to overthrusting of the sedimentary section, large granitic intrusions, crustal warping, and lateral density variations in the basement. It would seem that no simple model can be found which will explain the magnitude of the Yuendumu Regional Gravity Low. While the presence of a thick sedimentary section must play some part, other more deep-seated causes must also contribute significantly.

The later semi-detailed gravity work throws little further light on the above questions. The crescent-shaped basin as inferred from the gravity results is in disagreement with that inferred from the magnetic results only in the eastern lobe of the basin. Gravity results here

* The names of 1:250 000 Map Sheets are written in Capital Letters in this Report.

suggest that the basement is several hundreds of metres deeper than the proposed magnetic basement. It is probable that the gravity field reflects deep intrabasement changes and the magnetic basement is related to overlying metamorphics. Studies of the residual gravity pattern greatly assisted in indicating structural leads in Magellan's work in the Ngalia Basin in 1970 (Sabitay, 1971).

Seismic

The only seismic survey in the Ngalia Basin, prior to the work by the BMR, was a reflection seismic survey in the NAPPERBY area by Geophysical Associates Pty Ltd for P.A.O.C. in 1964 (Hudson & Campbell, 1965). Gravity was measured at the seismic shot-point locations during the seismic survey. The objective of the survey was to confirm the distribution of sediments in the eastern lobe of the basin indicated by the airborne magnetic survey.

The locations of the P.A.O.C. seismic lines are shown in Plate 4. No detailed experimental work was done to determine optimum shot-hole and geophone arrangements. Recordings were made using single holes 34 m deep on split-spread continuous profiles approximately 400 m long with 12 geophones per trace, 3 m apart in line. This arrangement was adequate to obtain fair-quality reflection records in most areas. In areas where record quality deteriorated, shot-hole patterns of 3 to 5 holes 15 m apart in line were used; however, the improvement in reflection quality was marginal. Drilling conditions were good except across hard outcrops. In these areas the depths of shot-holes were reduced to 6 m. All shots were recorded using fast AGC and a 20-90 Hz filter passband. Sections were processed using a 38-65 Hz filter passband. The narrow-passband filter of less than one octave led to serious lack of resolution of the reflection events. The P.A.O.C. seismic sections were reprocessed by BMR using a 25-78 Hz filter passband for integration of the results with those of the BMR surveys (Plates 43 to 48).

The results obtained were presented by P.A.O.C. as a depth contour map on a tentatively identified 'Lower Palaeozoic' horizon (Plate 49). At the time the survey took place, very little was known of the geology of the Ngalia Basin and no effort was made to correlate the horizon with surface outcrops. Thus little credence could be placed on the tentative identification of the mapped horizon. The event mapped is of consistently good quality and is continuous except where faulting is indicated. Reflection events above the mapped horizon show fair local continuity but lack distinctive character; thus correlation is difficult. Reflected events below the mapped event were discontinuous and lacking in distinctive character.

The interpretation (Plate 49) indicated a series of east-trending thrust sheets, with the overthrusting from the north, as the dominant structural feature in the basin. Normal faulting, with the downthrown block mainly to the northwest, is evident on the western part of the section from Line 2. The faults may be associated with a prominent magnetic high to the north of Line 2 and west of Line 6. Maximum depths to the 'Lower Palaeozoic' horizon were 3700 m on the northern end of Line 3 and 4000 m at the intersection of Lines 2 and 5.

Three areas of interest were defined by the seismic survey. The first, a seismic high at the intersection of Lines 2 and 6, has 300 m of east dip, closure to the west through faulting of at least 600 m, 200 m of north dip, and 100 m of south dip. The second feature, at the intersection of Lines 2 and 4 has fault closure of 600 m to the north, south, and east, and 150 m to the east. The third structure of interest was a gentle anticline on Line 2 between Lines 1 and 3. The seismic work in the eastern lobe of the basin confirmed the existence of the substantial thickness of sediments proposed from the magnetic work. While no definite identification of seismic horizons could be made this did not detract from an optimistic view of a substantial section of Palaeozoic sediments older than the Mount Eclipse Sandstone.

In 1971, Magellan carried out a major seismic survey (Krieg, 1972) primarily to further define structural leads indicated by the P.A.O.C. seismic work and the BMR seismic work that is the subject of this report. A brief discussion of the Magellan work is given in Wells et al. (1972) and the results are referred to again later in this report.

4. OBJECTIVES AND PROGRAM

Very little geological and geophysical work had been done in the basin at the time the initial BMR seismic program was planned. Geological mapping had shown the presence of a suite of Proterozoic to Upper Palaeozoic sediments, outcrops of these rocks being confined mainly to the northern and southern margins of the basin. Geophysical work had indicated that the basin was wedge-shaped in section in the western part, with its axis close to the northern margin, and that in the east it was a graben. Possible large-scale overthrust faulting at the northern margin was postulated from the reconnaissance gravity work.

Because of the almost total absence of exposures away from the margins of the basin, a program consisting of a number of north-south trans-basin seismic reflection traverses was proposed with the objective of determining the

configuration of the basin, wherever possible identifying seismic reflection horizons with outcropping formations. In particular, an investigation of the extent of Lower Palaeozoic sedimentation in the basin was considered to be important in an assessment of the petroleum prospects of the basin. The locations of all traverses are shown in Plate 4.

A. 1967 SURVEY

Objectives

The specific objectives for the survey were as follows:

- To develop an optimum recording technique to obtain reliable reflections from the sedimentary section, particularly from the Lower Palaeozoic sequence where it existed in the basin.
- To record all refractors to a probable basement refractor, in the deep concealed part of the basin. A probable basement refractor was defined as a refractor with a velocity of about 6000 m/s with little attenuation of energy over long distances.

Planned program

The program drawn up to achieve the objectives was as follows:

- Experimentation to study noise and signal characteristics, and comparison shots to determine an optimum recording technique, prior to reflection traversing.
- Reflection profiling along a north-south traverse in the centre of the basin from Lower Palaeozoic outcrops near Saltbush Bore (Plate 4) south to approximately latitude 22°31'S.
- Refraction work along latitude 22°30'S, west from the above traverse, to record all refractors possible to basement.

Actual program

Reflection Traverse A and Refraction Traverse B are shown in Plate 4.

Traverse A was surveyed from a point 9.6 km south of Saltbush Bore south to approximately latitude 22°30'S. Noise tests were made at SP1602 and SP1566, in areas of appreciably different surface conditions; geophone and hole patterns were decided from analysis of the noise tests.

A refraction probe was shot on Traverse B. Five kilometres of continuous reflection profiling was shot at the centre of Traverse B where it crossed Traverse A to assist in the correlation of reflection and refraction results. A further short refraction probe was shot, at the northern end of Traverse A, to determine the refraction velocity of outcropping Palaeozoic rocks.

An expanded spread was shot on Traverse B between SP2048 and SP2052. Velocity information obtained from the analysis of the expanded spread was incorporated with $t : \Delta t$ information from Traverse A to provide integrated vertical velocity information in the section.

B. 1968 SURVEY

Objectives

The broad objectives of the 1968 survey remained those of outlining the configuration of the basin and the extent of Lower Palaeozoic sedimentation. Other specific objectives formulated as a result of the 1967 seismic survey were as follows:

- To identify a strong reflecting and refracting horizon observed on Traverse B in 1967.
- To correlate this event along Traverse A to outcrop.
- To identify and map this strong marker elsewhere in the basin.

Planned program

The program proposed to achieve the objectives was as follows:

- Extension of Traverse A northwards as far as useful reflections could be obtained, preferably as far as the area of minimum gravity at about $22^{\circ}S$.
- Extension of Traverse A southwards to the southern margin of the basin and attempt to correlate reflectors with outcrops, if necessary using refraction methods to complete the tie.
- Refraction probing perpendicular to Traverse A near SP1610 to assist in correlating horizons by determining the depth of the main refractor marker south of a major fault evident on Traverse A near SP1601.

- Surveying a reflection traverse in the western part of the basin near Waite Creek, southwest of Vaughan Springs homestead.
- Refraction probing near Waite Creek in an effort to record the main refraction marker found on Traverse B.
- Surveying a reflection traverse in the Yuendumu/Mount Wedge area in the eastern part of the basin, where the structure of the northern margin was considered to be less complicated than in the central and western areas.
- Refraction probing in the Yuendumu/Mount Wedge area in an effort to record the main refraction marker found on Traverse B.
- Reflection and refraction work in the extreme eastern part of the basin, along Napperby Creek, south of Napperby homestead.
- East-west reflection traversing to tie between the proposed north-south reflection traverses where the results indicated that this could be warranted to provide an adequate picture of the structure in the basin.

Actual program

The order in which the program was carried out was determined mainly by the weather. Abnormally heavy rains in April and May 1968 delayed the proposed start of the survey by three weeks. As the road to Vaughan Springs was impassable, a start was made in the Napperby Creek area.

At Napperby reflection profiling was done along Traverse C in the centre of the basin; refraction work was done to provide ties to outcrops to the north and south of the reflection traverse; and Traverse D, an east-west reflection and refraction traverse, was surveyed through Traverse C at SP501 to provide dip information.

The party then moved to the Gum Creek area near Vaughan Springs to extend Traverse A northwards from SP1621 and southwards from SP1558 to the margins using reflection and refraction techniques. A refraction probe was shot on Traverse E which ran east-west through Traverse A at SP1611. A reflection profile, an offset reflection/refraction profile, and an expanded spread were also recorded on Traverse E in an effort to obtain reliable correlation between reflecting and refracting horizons. An addition was made to the program by reflection profiling on Traverse H. Since no apparently reliable tie between reflecting horizons and surface outcrop could be made on Traverse A, where the sediments were considerably disturbed by folding and

faulting, it was hoped to achieve this objective on Traverse H, as the sediments in this region appeared to be relatively undisturbed. A short refraction probe was shot on Traverse G on a dolomite ridge which ran east-west across Traverse A at SP1621. The purpose there was to measure the refraction velocity of the dolomite to determine if it could be correlated with the reflection/refraction marker recorded on Traverse B. Finally in the Gum Creek area an offset reflection/refraction profile was shot on Traverse F, perpendicular to Traverse A, through SP1553 in a further attempt to correlate reflection and refraction events.

An access road was graded from Vaughan Springs to the Waite Creek area. A reflection profile was shot on Traverse J along Waite Creek. A short reflection profile and expanded spread were also shot on Traverse K perpendicular to Traverse J at SP3508.

Reflection Traverse L was shot in a roughly southwest direction from near Mount Allan towards Central Mount Wedge. A reflection profile and an expanded spread were also shot on Traverse M through Traverse L at SP4491.

Because of the lack of time available no attempt was made to shoot reflection profiles to tie between the north-south reflection traverse. Deep refraction probes were also dropped from the program in the Waite Creek and Mount Allan areas, when refraction results obtained elsewhere indicated that they were only of marginal value.

C. 1969 SURVEY

Objectives

The objectives of the 1969 work were to clarify problems which arose from analysis of the results of the 1967 and 1968 surveys and carry out further seismic work to complete the reconnaissance seismic coverage in the basin.

Planned program

The program proposed to achieve the objectives was as follows:

- Extension of Traverse J in the Waite Creek area to the northwest to establish the extent of overthrusting at the northwestern margin of the basin.
- Reflection profiling on Traverse K west from Traverse J to investigate the westerly closure of the basin; geological investigations had suggested that the basin was narrowing and becoming shallower to the west whereas the 1968

seismic results indicated that the basin deepened with probable fault closure and with a considerable thickness of sediments under a thrust sheet of basement rocks.

- Reflection traverses to tie the P.A.O.C. traverses both to outcrop and to BMR seismic traverses.

Actual program

At Waite Creek, Traverse K was extended to the northwest over the thrust zone and Traverse N was shot at right angles to Traverse J at SP3494 to determine the true dip of the reflecting horizon. Survey progress was retarded by a fire which seriously burnt several seismic party members.

The remainder of the field season was spent mainly in reflection traversing in the Gum Creek area tying P.A.O.C. reflection traverses to the BMR traverses. Traverse O was surveyed to tie Traverse H to P.A.O.C. Line 2 and Traverse F was extended eastwards to join Traverse O. An expanded spread was shot on Traverse F between SP2786 and SP2792 and the velocity information obtained was incorporated with the results of the $t : \Delta t$ analysis of reflection results on Traverse O.

The results from two deep seismic reflection sounding shots from Traverse O, SP6016 (Lat. 22°24.0'S, Long. 131°14.2'E), recorded into geophone spreads laid mutually at right angles, are discussed by Brown (1970).

5. DATA RECORDING AND PROCESSING

Recording techniques

All data were recorded in analogue form by direct magnetic recording in 1967 and on FM magnetic tape in 1968 and 1969. Throughout the survey stringent quality control of the seismic recordings was exercised, and tests of the recording equipment were conducted regularly. Details of operations are given in Appendix 2.

Field experimentation. As part of the initial experimentation an uphole survey and a noise test were recorded at Traverse A, SP1602. From the uphole survey, shot into a normal reflection split-spread, it was found that the best shooting depth was between 30 and 36 m (Plate 5). Analysis of the noise test, shown in Plate 7, indicated that a spatial filter with 12 geophones per trace, approximately 4 m apart in line along the traverse, together with an 18-Hz low-cut filter would attenuate most of the prominent noise interference events. Shot-hole pattern comparison tests were made at SP1603 (Plate 6). Further

noise tests were made on Traverse A at SP1566 and on Traverses C, E, and L (Plates 9 to 13) during the survey to check optimum filtering requirements. Similarly a number of uphole surveys were recorded to check the best shooting depth and to provide near-surface velocity information in selected areas. Geophone pattern comparisons were made on Traverse E (Plate 14) and shot-hole and geophone pattern comparison tests were made on Traverse L (Plate 15).

Production reflection recording. Reflection profiles on Traverses A, B, C, and D were shot using 24 geophones per trace in two rows of 12 with geophones 3.8 m apart in line and rows 6.1 m apart; i.e. a spatial filter with k_c = 10.4 cycles/1000 m was applied. Analysis of the results of the relevant noise tests indicated that this number of detectors and arrangement would attenuate sufficiently most of the random and organized noise which would otherwise affect the reflection recordings.

The number of holes drilled for each shot was determined by the number of drill rigs available, the rate of drilling, and the rate of recording while maintaining the number as large as possible for noise cancellation. The major part of Traverse A, between SP1559 and SP1621, was shot mainly using single holes because of the small drilling capacity available to the party initially in 1967. Some spreads were shot using 3- or 5-hole shot-patterns, approximately 15 m apart in line and offset 15 m from the traverse. A comparison of shallow and deep hole-patterns on Traverse A at SP1603 (Plate 6) indicated that the deep patterns of about 36 m were best. Three- and 5-hole shot-patterns were used later in the survey whenever drilling conditions permitted. Most holes for reflection shooting were drilled to about 36 m.

Traverse E was shot between SP2348 and SP2352 using the geophone pattern as for Traverses A, B, C, and D and single holes. It was found that low-velocity organized noise of velocity 1800 to 2100 m/s was recorded on the reflection section. Analysis of this noise event indicated that it could be attenuated by using a spatial filter with a wave-number cut-off of about k_c = 5.9 cycles/1000 m. SP2351 and SP2352 were reshot into split spreads using 24 geophones per trace, 6.1 m apart in line, k_c = 3.5 cycles/1000 m. The records obtained indicated that the troublesome noise was sufficiently attenuated. Comparison of the records of the shots using the two geophone patterns on Traverse E at SP2352 is shown in Plate 14. This extended geophone pattern was used for further profiling on Traverse E between SP2353 and SP2359 and on Traverse J, K, and N. Three-hole shot-patterns were used on these traverses.

Traverses F, H, L, M, and O were shot with 24 geophones per trace, 3.8 m apart in line with k_c = 5.2 cycles/1000 m. Single holes were shot on Traverse H, but 3-hole shot-patterns were used on the other traverses.

Production refraction recording. All refraction work was shot with spread lengths of about 2 km. Charges varied from about 4 kg to 540 kg as the shot-to-geophone distance was increased from 0 to about 19 km. Shot-holes were of depths from 20 to 40 m.

In the refraction probe method employed, two shot-points were located in fixed positions at the ends of traverses and the geophone spread was moved successively between the two points. The offset distance was constantly varied and a range of refractors was recorded in both the forward and reversed directions.

Refraction probes were shot on Traverse A between SP1617 and SP1621, Traverse B between SP2032 and SP 2068, Traverse C between SP479 and SP487 and between SP515 and SP523, Traverse D between SP1040 and SP1060, Traverse E between SP2338 and SP2362, and Traverse G between SP100 and SP104. On Traverses B, C, D, and E the refraction spread was moved successively over a spread of 4 reflection shot-points intervals, with a common geophone station for adjacent spreads.

Offset reflection/refraction recording. Offset reflection/refraction probes were shot on Traverse E between SP2342 and SP2358 and on Traverse F between SP2742 and SP2758, in the same manner as the refraction probes cited previously, the only difference being that groups of reflection geophones were used in place of refraction geophones. In this way both refraction first breaks and reflection events were obtained with the aim of recording the transition of reflection events into refraction and measuring the refraction velocities associated with the reflections.

The geophone patterns consisted of 24 geophones per trace in 3 rows of 8, with geophones 6.1 m apart in line. No common geophone station was recorded on adjacent spreads.

Expanded spread recording. Expanded spreads were recorded, in the manner proposed by Musgrave (1962), for vertical velocity information using $t^2 : x^2$ analysis on Traverse B centred on SP2050, Traverse E centred on SP2350, Traverse F centred on SP2789, Traverse K centred on SP3800, and Traverse M centred on SP5002.

Processing techniques

Analogue processing of all magnetic tapes was undertaken in the BMR playback centre in Canberra. The tapes from the reflection coverage and expanded spread on Traverse K were digitally processed under contract by Geophysical Service International (GSI) in Sydney.

Analogue processing. Elevation and weathering corrections were calculated mainly from up-hole time analysis and occasionally from an analysis of first-arrival times. These correction methods are discussed by Vale (1960). Generally the static corrections calculated as above were seen to be fair from examination of the corrected record sections. Residual static corrections were applied in some areas where the normal static corrections were obviously not sufficient. The playback filter passband of 25 to 78 Hz was found to yield the highest signal-to-noise ratio for the analogue processed data and was used generally in the display of the reflection data.

Uncorrected record sections only were produced for the refraction and offset reflection/refraction profiles. The normal playback filter passband was 0 to 72 Hz for the refraction sections and 25 to 78 Hz for the offset reflection/refraction profiles.

Digital processing. Expanded spreads were processed digitally using the VELSPRED program (Pettifer, 1972). The principal events on the reflection cross-sections were migrated digitally, but the migrated sections added little new information to the interpretation of the reflection data and they are not included.

Reflection data on Traverse K from SP3780 to SP3796 and from the expanded spread centred on SP3800 were the only data processed digitally by GSI. The sampling interval on transcription was two milliseconds and the anti-alias filter was 168 Hz. All subsequent processing was done using four-millisecond sampling.

The expanded spread centred on SP3800 was used in a Moveout Scan to provide velocity information. In this process a 24-trace record was gathered from the expanded spread shots at SP3800, SP3801, SP3798, and SP3803 to give a range of offsets from approximately 410 m to 3570 m, at approximately 137-m intervals. Since these are not common-depth-point traces, dips on all major events were measured from the analogue sections on Traverse K at SP3800 and appropriate time-varying static corrections were made to the gathered traces to compensate for this dip. Time-varying deconvolution and time-varying bandpass filtering were applied before the Moveout Scan. A 22-point deconvolution operator was used over two design gates, 0.4 s to 1.8 s for the near trace and 1.5 s to 2.9 s for the far trace. The filter passband was 15 to 50 Hz to 1.3 s changing to 15 to 40 Hz from 1.7 s.

Static corrections as supplied by BMR were applied to the reflection records from Traverse K. Time-varying deconvolution with a 24-point deconvolution operator over a design gate of 0.3 to 2.9 s was used, and playbacks were

made applying the normal moveout correction derived from the Moveout Scan. Examination of the playbacks showed small residual errors in static corrections. Residual smoothing statics were considered to be necessary prior to applying a Migration Stack process. The major reflectors were picked and timed, and the times along each reflector were smoothed by taking a running 7-point average. These averaged residual statics were then applied. They varied from +6 to -8 ms, being mostly between +3 and -3 ms. A 10 to 60 Hz digital bandpass filter was applied to prevent high- or low-frequency noise from affecting the time migration processing. The reflection data were migrated by the GSI Migration Stack process using an aperture of 204 traces, with 102 traces on each side of the output trace and a velocity function which varied from approximately 5270 m/s at 0 s reflection time, 5220 m/s at 1.55 s reflection time, 5330 m/s at 1.95 s reflection time to 5880 m/s at 3.0 s reflection time.

6. RESULTS AND INTERPRETATION

The locations of seismic traverses surveyed in the Gum Creek, Waite Creek, Napperby Creek, and Mount Allan areas of the Ngalia Basin are shown in Plate 4. The main traverses lie roughly north-south, and short cross-traverses east-west. The cross-traverses were not extended generally to tie between the main traverses. Ties between the Gum Creek and Mount Allan traverses were made, however, through the P.A.O.C. lines in the central part of the basin. The locations of the P.A.O.C. lines are also shown as fainter lines in Plate 4.

Velocity information from $t:\Delta t$ analysis on the reflection traverses and from the expanded spreads were used to produce composite graphs of average velocity and reflection time against depth for the Ngalia Basin seismic reflection results (Plate 16). Approximate depths to reflecting horizons indicated by the seismic cross-sections may be obtained by reference to the graphs. The average velocity curve is considered reasonable for the section in the central part of the basin, but average velocities higher than those indicated are found where the section is thinner. A composite graph of interval velocity was considered to be meaningless and was not included.

Gum Creek

Traverse A, reflection profiling. 48 km of continuous split-spread reflection profiles were shot on Traverse A (Plate 17). The reflection results were generally of fair to good quality and showed the existence of a thick sedimentary section. The seismic reflection

results also indicated that the Ngalia Basin had undergone major and minor faulting with associated folding.

The seismic cross-section shown in Plate 17 indicates major faulting south of SP1621. Between SP1620 and SP1600, two strong reflections, between 0.65 to 0.85 s and 0.85 to 1.20 s respectively, and several weaker discontinuous shallow events were recorded. To the south, between SP1600 and SP1547, only one strong continuous event was recorded together with indications of some impersistent shallow events and a deeper fairly strong continuous event between SP1588 and SP1544. This deep event was recorded at 1.6 s reflection time at SP1588 and at 0.74 s reflection time at SP1544.

Traverse B(at SP2050) intersects Traverse A at SP1579. In this area, the main strong reflection at a time of about 1.2 s may be correlated directly with the principal reflection/refraction events recorded on Traverse B. Extrapolation of the horizon south from SP1547 indicated that it should be close to the surface in the vicinity of SP1539. Consequently stratigraphic holes BMR Mount Doreen No. 8 and 8B were drilled near SP1540 in an attempt to identify the reflecting horizon. Information on stratigraphic drilling on the seismic traverses is given in Appendix 4. Dolomite, tentatively identified as from the Mount Doreen Formation (Evans & Nicholas, 1970) was entered at a depth of 210 m. It is considered that the main strong reflecting horizon south of SP1600 can be correlated with the dolomite in the Mount Doreen Formation. Generally the reflections indicate north dip with some minor dip reversals on the regional gradient.

The deeper of the two strong reflection events, recorded between SP1620 and SP1600, shows evidence of faulting between SP1613 and SP1605. These faults appear to be downthrown to the north by approximately 200 m. Although the apparent faults are evident only on the deep event they appear to have had some influence on the younger sediments in the form of downwarping of the shallower events towards the north. Further major faulting is apparent in the section in the vicinity of SP1620, where the quality of reflections in the south deteriorates abruptly and reflections are subject to interference by diffraction events probably from the fault. A major high-angle thrust is evident about SP1600. It is possible that minor thrusting, north of the major fault, in the shallow part of the section brings the deeper part of the Mount Eclipse Sandstone formation to the surface. Correlation of the two strong reflectors on Traverse A, along Traverses E and H to surface outcrop, suggested that the shallower reflector could be identified with the Mount Doreen Formation and the deeper event could be identified with the Vaughan Springs Quartzite (discussed in detail later).

The two main reflecting horizons evident in the section to the south of SP1600 appear to deepen northwards towards SP1600 with the section between the two main horizons thinning considerably to SP1588, where the two horizons may not be distinguished. In this part of the section from SP1600 southwards minor faulting is evident about SP1593 and about SP1568. At the southern end of the traverse faulting, with a downthrown block to the south, is indicated from the gravity results south of SP1540.

Shallow fair-quality reflection events, which are evident intermittently along the entire length of Traverse A, appear to indicate that structure within the Mount Eclipse Sandstone is similar to that indicated in the deeper parts of the section.

Traverse A, refraction probe. A short refraction probe shot between SP1617 and SP1621 indicated a refraction velocity of 4420 m/s for the Mount Eclipse Sandstone outcropping in the area. Other refraction work at both the northern and southern ends of Traverse A gave inconclusive results.

Traverse B, refraction probe. A large-scale refraction probe was shot on Traverse B between SP2032 and SP2068 (Plate 18), with shots at these two shot-points, and the geophone spread was moved successively along the traverse. Three refractors were recorded, with velocities of about 3900, 4430, and 6030 m/s, and depths were calculated using vertical velocity information obtained from t:Δt analysis. The results of the refraction probe are shown in Table 2.

TABLE 2. REFRACTION DATA FROM TRAVERSE B

Refractor velocity (m/s)	Average overburden velocity (m/s)	Depth at SP2032 (m)	Depth at SP2068 (m)
3900	3000	100	40
4430	3700	450	330
6030	4300	2400	1950

The depths indicated are only approximate and are included to indicate the order of depth estimated. This is particularly so in the case of the 6030 m/s refractor from which the energy return was very low and not generally possible to pick as first breaks. Corrections applied to the phases picked to deduce first-break times were only approximate in some cases.

Traverse B, reflection profiling. 5.5 km of continuous split-spread reflection profiling was shot at the centre of Traverse B (Plate 19), where it crossed Traverse A at SP1579. One strong, mainly horizontal, reflection was recorded along the traverse at a time of about 1.2 s. The depth to the main reflecting horizon was estimated to be about 2800 m - somewhat deeper than that estimated for the 6030 m/s refraction. There is evidence of other shallower, higher-frequency, reflection events but these are not continuous over any appreciable distance.

Traverse B, expanded spread. The expanded spread was centred on SP2050 (Plate 20) at the intersection point of Traverses A and B. Reflection quality varied from poor to fair, and six events considered to be primary events were picked at reflection times from 0.503 s to 1.427 s. Information from the expanded spread is summarized in Table 3.

TABLE 3. VELOCITY DATA FROM TRAVERSE B

Reflection time (s)	Average velocity (m/s)	Interval velocity (m/s)	Depth (m)	Tentative identification
		3900		
0.503	3900		990	Mount Eclipse Sandstone
		4770		
0.612	4000		1250	" " "
		4000		
0.687	4100		1400	" " "
		5069		
0.788	4170		1656	?
		5812		
1.205	4772		2868	Mount Doreen Formation
		5693		
1.427	4950		3500	Vaughan Springs Quartzite

The calculations of average velocities from the expanded spread section were in substantial agreement with those obtained from t:Δ t analysis of reflections on the central part of Traverse A.

Traverse B, correlation of reflection and refraction results. In order to correlate the reflection and refraction results the refraction results were displayed in a variable-area cross-section form similar to the presentation of the reflection results. From the refraction section it appears that the 6030 m/s refractor may be associated with the reflection event recorded at approximately 1.2 s. This correlation would suggest that

the average refraction velocity in the section overlying the 6030 m/s refraction is about 10 percent higher than that suggested by the refraction results. The refraction method in this area would appear to be insensitive to gradual increases in velocity with depth of sediments.

Traverse G, refraction probe. A short refraction traverse was surveyed across Traverse A at SP1621 to record the velocity on an outcrop of dolomite tentatively identified as Mount Doreen Formation. An attempted correlation with the main strong reflector/refractor found on Traverse A and Traverse B was unsuccessful because of the inconclusive velocities measured in the dolomite, which was interspersed with shale. Velocities over a range from 4500 m/s to 6700 m/s were recorded instead of one discrete velocity.

Traverse E, reflection profiling, expanded spread and refraction probe. Traverse E was shot mainly as a refraction probe, but about 5 km of reflection profiles was shot about Traverse E at SP2350 where the traverse crossed the northern part of Traverse A at SP1611 (Plate 21). The reflection work was shot to assist in the interpretation of the refraction data. Three main primary reflections were recorded on Traverse E. These are conformable and approximately horizontal. Average velocities to each of the reflecting horizons were calculated from the results of an expanded spread shot about SP2350 (Plate 22). The depths calculated to the reflecting horizons are indicated in Table 4.

Three refractors were recorded on the refraction probe between SP2338 and SP2362 on Traverse E (Plate 23). The velocities and depths of the refractors are also indicated in Table 4. There is no apparent correlation between the reflection horizons and the refractions, from the calculated depths. However, the results from an offset reflection/refraction traverse shot on Traverse E between SP2342 and SP2358 (Plate 24) suggested that the intermediate reflection event originated from close to the level of a 5680 m/s refractor. It is postulated that the two originate from the same stratigraphic unit but it is most likely that the reflection event is from layering below the refracting surface.

Traverse H, reflection profiling. Reflection split-spreads were shot along Traverse H from the eastern end of Traverse E southeastward towards an outcrop of Lower Palaeozoic and Upper Proterozoic rocks (Plate 25). The two shallower horizons of the three followed along Traverse E remain conformable from SP3001 to SP3007, after which the shallowest horizon becomes too shallow to be recorded by normal reflection shooting. On this part of Traverse H, the two horizons dip to the northwest at about 8° and are at depths of approximately 360 m and 940 m respectively at

SP3007. Assuming that the dip indicated persists, then the shallowest reflecting horizon should crop out near SP3012. Mount Eclipse Sandstone is mapped on the surface to SP3015; therefore it is highly probable that the shallowest strong reflection recorded on Traverses H and E and the discontinuous shallow reflection recorded on Traverse A at its intersection with Traverse E originate from layering within the Mount Eclipse Sandstone.

The continuity of the intermediate reflecting horizon is disturbed between SP3009 and SP3010, most probably by faulting in the section. From SP3010 to SP3015 this horizon dips apparently to the west at about 15° and it is at a depth of about 480 m at SP3015. Beyond SP3015 record quality deteriorates and the horizon cannot be followed with certainty. However, assuming that the dip persists the horizon would crop out between SP3018 and SP3019, placing the reflecting horizon below the Ordovician sequence and within the Mount Doreen Formation. The horizon, with a 5700 m/s refractor measured on Traverse E, may be associated with a dolomite sequence near the top of this formation. The Walbiri Dolomite of Cambrian age does not crop out in this area, but if it is in the section it would alternatively, although less likely, correlate with the intermediate reflecting horizon.

The interval between the intermediate and deeper horizons thins from SP3008 to SP3012 by about 450 m. The record quality across this zone is poor and the deeper horizon appears to be faulted between SP3009 and SP3010. Further evidence of faulting can be seen on the deeper horizon near SP3003. Projection of the deeper reflection event to the surface suggests that it may be associated with the Vaughan Springs Quartzite or crystalline basement; in either case it would be the effective basement of the sedimentary section.

The tentative identifications of the main reflection events recorded on Traverses E and H are shown in Table 4.

TABLE 4. REFLECTION AND REFRACTION DATA FROM TRAVERSE E

Reflection				Refraction		
Reflection time (s)	Average velocity (m/s)	Interval velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Formation
		4400		4520		(subweathering)
0.410	4400		760	5130	450	Mount Eclipse Sandstone
		- 5350 -				
0.630	4900		1520	5680	1070	Mount Doreen Formation
		- 5750 -				
0.955	5200		2400	-	-	Vaughan Springs Quartzite

Traverse O, reflection profiling. Traverse O was surveyed for 32 km, southeast from Traverse H at SP3013 to intersect Line 2 shot by P.A.O.C. Continuous reflection profiling between SP6000 and SP6058 (Plate 26) indicated reflections of fair to good quality with a general northwesterly dip component and with a dip reversal in the section near SP6043. Southeast from SP6046, reflection events are discontinuous because of faulting, which is apparent under SP6047, between SP6052 and SP6054, and under SP6057. In this region only one main reflector, tentatively identified with the Vaughan Springs Quartzite, can be followed with any certainty. The shallower, less persistent events may be associated with the Mount Eclipse Sandstone.

Correlation of reflection events between Traverse O and Traverses H and E is difficult because of major faulting apparent at the northwestern end of Traverse O. A composite reflection cross-section, from Traverse H between SP3001 and SP3013 and from Traverse O between SP6000 and SP6015 shown in Plate 27, illustrates the extent of major low-angle thrusting. Overthrusting is apparently from the north; the apparent vertical displacement is about 2600 m while the apparent horizontal displacement is about 6.5 km. A steeply dipping event at 1.9 s reflection time on Traverse H at SP3004 and at 1.0 s at SP3001 is most probably a reflection from the thrust plane. The fault plane appears to extend almost to the surface at SP6015.

Traverse F, offset reflection/refraction probe, reflection profiling, and expanded spread. Initially an offset reflection/refraction traverse was shot on Traverse F between SP2742 and SP2758 (Plate 28). Traverse F intersects Traverse A at SP1552, where three strong reflection events can be seen. However, these events are not clear on the offset records.

Reflection profiles on Traverse F were shot eastwards from SP2750 to SP2798 (Plate 29) to join P.A.O.C.'s Line 2 at its western extremity to close a loop formed by Traverses A, E, H, O, and F. The three main reflection events, which on the basis of correlations made earlier are identified with layering in the Mount Eclipse Sandstone, the Mount Doreen Formation and the Vaughan Springs Quartzite respectively, are of distinctive character and can be traced eastwards from the intersection with Traverse A to about SP2756, where the quality of the shallowest event deteriorates. From SP2750 to SP2780 the reflection events show apparent westerly dip components except from SP2756 to SP2758, where there is a slight dip reversal.

Several faults are apparent in the section, and reflected refractions and diffraction events confuse the picture. Some faults extend through the entire sedimentary sequence while others appear to affect only the pre-Mount Eclipse Sandstone section. The most prominent of these faults are at SP2766, SP2780, SP2785, and SP2796. The downthrown blocks are generally to the east of the faults except at SP2766, where the downthrown block lies to the west of the fault.

The relatively thin faulted section in the centre of this traverse is atypical of most sections of the central part of the basin. The reflection events are of a less distinctive character than those recorded in the deeper parts of the basin. Immediately to the south of the section, from SP2766 to SP2780, there are exposures of Vaughan Springs Quartzite and Treuer Member; thus there is a possibility of a substantial thickness of Lower Proterozoic rocks in this part of the section.

The expanded spread which was shot centred at SP2789 is shown in Plate 30. Reflection quality was generally poor. The results were incorporated in the composite velocity determination.

Waite Creek

Traverse J, reflection profiling. A north-south traverse, 24 km long, was surveyed in the western part of the basin where outcrops had indicated a thin sedimentary section. Reflection profiling along Traverse J, however, indicated a thick sedimentary section (Plate 31).

Reflection quality in the section varies from fair to good north from SP3492. The reflections show apparent northerly dip of about 10°, with no obvious dip reversals, into a syncline about SP3518. The section shows apparent thinning of all intervals, towards the south. Minor faulting is apparent on the deepest continuous reflection event at SP3501 and SP3506, but there is no evidence of an extension of faulting higher in the section at these locations. Vaughan Springs Quartzite and granites crop out north of SP3520. The presence of reflections from below these outcrops suggests apparent large-scale overthrust faulting.

Attempts were made to identify the main reflecting horizons in the section.

Stratigraphic hole BMR Mount Doreen No. 9 (Evans et al., 1970) was drilled at SP3485, where the good quality reflection horizon at approximately 1.2 s at SP3508 was predicted to project to subcrop. This event was tentatively identified with the Mount Doreen Formation when dolomitic limestone of this formation was found in the stratigraphic hole at 212 m.

The deepest continuous event at 1.75 s at SP3508 may be extrapolated through the poor reflection zone south of SP3492 and projected to outcrop about 7 km south of SP3482. Despite possible faulting at the southern end of the traverse, which may affect the projection, the event is tentatively identified with the Vaughan Springs Quartzite. The Vaughan Springs Quartzite crops out in the area, at Mount Stanley.

The strong reflection event at 0.82 s at SP3508 shows similar character to the event identified with the dolomite in the Mount Doreen Formation on Traverse A, and is distinctly different in character from lower-amplitude, higher-frequency reflection events, recognized elsewhere in the basin, from within the Mount Eclipse Sandstone. The event is tentatively identified as a reflection from the Walbiri Dolomite although there is no confirmation from outcrops in the area. The character of the event changes as it gets shallower to the south, suggesting a change in the thickness of the reflector or a change in its composition.

Low-amplitude, high-frequency, somewhat discontinuous shallower reflection events are probably from siltstone beds within the Mount Eclipse Sandstone.

Traverse K, reflection profiling. Traverse K was surveyed originally as a short cross-traverse on Traverse J at SP3508 to provide dip information. It was later extended to the northwest across the thrust fault in a normal direction to the fault plane. Previous experience of reflection profiling in the basin had shown that where seismic reflection lines crossed or passed close to outcrops, reflection quality deteriorated markedly. Reflection profiling on Traverse K resulted in several reflection events of excellent quality being recorded up to and under the surface expression of the fault plane. Sediments of the Ngalia Basin sequence are present to a depth of about 5000 m and persist under the thrust fault with the same vertical displacement for a distance of 11.5 km. Analogue and digital reflection cross-sections from Traverse K are shown in Plates 32 and 33.

A GSI Migration Stack digital section (Plate 34) was produced for the reflection profiles from SP3780 to SP3796 in an attempt to clarify the interpretation of the structure under the thrust plane. The structure of the sedimentary reflection events between SP3793 and SP3785 on the analogue and unmigrated digital sections (Plates 32 and 33) appears to be anticlinal, but the events have the smooth curvature typical of diffractions. The events are synclinal on the migrated section, suggesting that they are diffractions from points outside the plane of the section, with a lower velocity to the point sources than their times on the sections indicate. A reflection from the fault plane can be seen clearly on all sections from Traverse K.

Traverse K, interpretation of Gravity profile.*
The gravity results on Traverse K were interpreted in an attempt to further clarify the structural picture. A generalized structural section based on the seismic reflection data and observed and computed gravity profiles are shown in Plate 35. For simplification the section shown neglects any possible anticlinal or other structures within the sedimentary section under the thrust fault, as the gravity effects produced from an uplift would give mutually cancelling positive and negative anomalies. The theoretical gravity effect computed for the simplified model is indicated by Curve 1 in Plate 35. The obvious disparity between this curve and the observed anomaly profile, Curve 2 in Plate 35, indicates that the structure and thickness of the sediments in the basin cannot explain the higher anomaly observed. An additional affect, a regional gradient of about 1.2 mGal/km increasing to the south, is necessary to raise the theoretical values to a level shown by Curve 3, which is in better agreement with the observed values. This positive gravity gradient to the south forms a part of the regional gravity gradient between the Yuendumu Regional Gravity Low and the Papunya Gravity Ridge, and implies the presence of a denser mass in the basement closer to the basement surface in the south.

Traverse K, expanded spread. The spread was centred at SP3800 (Plate 36). Information derived by BMR from the expanded spread and the tentative identifications of the main reflection events are summarized in Table 5, which also shows velocity information derived digitally by GSI using Moveout Scans at SP3780, at SP3787, and from SP3792 to SP3796. The velocity information derived by BMR from the expanded spread is in fair agreement with that derived by GSI from the Moveout Scan from SP3792 to SP3796.

Traverse N, reflection profiling. A short reflection traverse was surveyed through Traverse J at SP3494 to determine the true dip of the deepest reflector recorded at the southern end of Traverse J. The quality of the reflection events was good (Plate 37); the deepest reflector dips at 14° west of north compared with 24° west of north at SP3508. The general shallowing of the section to the south with the evidence of the northeast overthrust fault on Traverses J and K suggests fault closure of the western part of the basin in the Waite Creek area.

* Interpretation by S.P. Mathur

TABLE 5. VELOCITY DATA FROM TRAVERSE K

Reflection time (s)	Average velocity (m/s)	Interval velocity (m/s)	Depth (m)	Tentative identification
Expanded Spread SP3800 (BMR)				
		3752±17		
0.811	3752±17		1524±5	Walbiri Dolomite (?)
		- 4984±97 -		
1.152	4117±17		2372±6	Mount Doreen Formation
		- 6066±252 -		
1.430	4496±36		3220±21	Vaughan Springs Quartzite
		- 6087±381 -		
1.758	4792±42		4200±33	Vaughan Springs Quartzite
Moveout Scan, SP3780 (GSI)				
0.000	5276		0	
		- 5276 -		
1.600	5276		4221	
		- 5780 -		
2.000	5381		5377	
Moveout Scan, SP3787 (GSI)				
0.000	5276		0	
		- 5276 -		
0.850	5276		2242	
		- 4926 -		
1.300	5158		3351	
		- 5318 -		
1.500	5180		3883	
		- 5769 -		
1.900	5309		5036	
Moveout Scan, SP3792-3796 (GSI)				
0.000	2821		0	
		- 3793 -		
0.900	3794		1707	
		- 4926 -		
1.200	4106		2446	
		- 5318 -		
1.600	4440		3509	
		- 5769 -		
1.950	4706		4519	

Napperby Creek

Traverses C and D, reflection profiling. Traverse C was surveyed along Napperby Creek for 24 km north from the Stuart Bluff Range. Reflection results were poor generally except between SP498 and SP506 (Plate 38). The seismic results indicate about 2400 m of section in this part of the traverse, which is in fair agreement with the estimated depth to magnetic basement. There is evidence of minor faulting in the deepest horizon; diffraction patterns are weak.

No continuous reflection events are apparent in the section to the north of SP506, where the deepest reflection is recorded at a time of approximately 1.2 s. Vaughan Springs Quartzite crops out near SP517. A normal fault with a downthrow of about 2000 m to the south may be present at SP506. Although reflection quality is very poor to the south of SP499 it would appear from the reflection dip segments seen on the section that the sediments dip gently northwards from the southernmost shot-point into the deepest part of the basin. The deepest reflection event would project to the south to outcrop near exposures of Vaughan Springs Quartzite in the Stuart Bluff Range.

There would appear to be little velocity contrast in the sedimentary section. Reflections are of low amplitude and high apparent frequency. The character of the shallow events is consistent with that found for reflections in the Mount Eclipse Sandstone in other parts of the basin. No reflection events recorded are characteristic of the event from the Mount Doreen Formation found in the central and western parts of the basin. The Mount Doreen Formation has not been found in outcrop in the area; therefore it is reasonable to assume that the Mount Eclipse Sandstone probably lies directly on the Vaughan Springs Quartzite.

Traverse D was surveyed for 11 km west from Traverse C at SP501, mainly for a refraction probe. However a short reflection profile (Plate 39) was shot on Traverse D between SP1047 and SP1053. The shallow and deep reflection events are unconformable. The results suggest that the Mount Eclipse Sandstone dips gently westwards whereas the Vaughan Springs Quartzite is flat-lying. Slight west dips are seen in outcrops of the Mount Eclipse Sandstone in the area.

Traverse D, refraction probe. The refraction results on the probe between SP1040 and SP1060 were inconclusive because of the poor first breaks obtained when shooting from SP1040. The results included in Table 6 show reasonable consistency with the reflection information in the Mount Eclipse Sandstone.

TABLE 6. REFRACTION DATA FROM TRAVERSE D

Refractor velocity (m/s)	Average overburden velocity (m/s)	Depth (m)
4020	2740	150
5150	3690	760
5580	4140	1190

Mount Allan

Traverse L, reflection profiling. A reflection profile was shot on Traverse L (Plate 40) in a southwesterly direction from outcropping Vaughan Springs Quartzite near Mount Allan through an area of south-dipping Mount Eclipse Sandstone outcrops and then southward to cross the eastern end of P.A.O.C. Line 2.

Two main suites of fair- to good-quality reflections recorded are separated by an apparent unconformity; these events are continuous only in the section from SP4486 to SP4497. The results indicate a syncline with its axis through SP4490 for the shallow suite of reflection events which extend to a maximum depth of about 2700 m, and through SP4492 for the deeper suite which extends down to about 5400 m.

Experimental reflection shooting was carried out at SP4504 using several shot-hole and geophone patterns (Plate 15) to determine whether increasing the number of holes and geophones and arranging the geophones in an areal pattern would attenuate random and organized transverse noise and thus improve reflection quality. A slight improvement in record quality was achieved at SP4504 using 36 shallow shot-holes and 32 geophones per trace, but no marked improvement was noted when the same patterns were used for profiling between SP4504 and SP4506. It was concluded that, in the vicinity of the outcrops at the northern end of Traverse L, optimum reflection results could be achieved only by experimental shooting at most shot-points.

North of SP4506 reflection quality is extremely poor but the discontinuous reflection segments present can be seen to dip to the south at about 10°. By extrapolation of these events at the northern end of Traverse L it is evident that the shallower suite of reflections is from layering in the Mount Eclipse Sandstone while the deeper events may be from the Vaughan Springs Quartzite. The event at 1.245 s at SP4490 and at 1.180 s at SP4495 cannot be followed on the section to the north but it may be associated with the Kerridy Sandstone which crops out in the

northern part of the traverse. A minor fault can be seen from first-break and reflection evidence at SP4515. Vaughan Springs Quartzite is present north of the fault, which appears to be downthrown to the south.

A fault is apparent on the section at SP4486. First-break velocities change abruptly from high velocities in the north to lower velocities to the south. The quality of the reflection events deteriorated abruptly to the south of the fault, and reflection events are difficult to follow. Events which are recorded over short segments of the traverse south of SP4485 have similar character to those found in the Mount Eclipse Sandstone. It is thus suggested that the section to the south of SP4485 is probably a thick section of Mount Eclipse Sandstone resting directly on Vaughan Springs Quartzite. The lack of events with the distinctive character of the Vaughan Springs Quartzite reflection events may suggest that the Vaughan Springs Quartzite is thin in this area.

Traverse M, reflection profiling and expanded spread. Good-quality reflection events were recorded with slight east dip on the short cross-traverse on Traverse L at SP4491 (Plate 41), confirming true dip in a north-northwesterly direction.

Fair- to good-quality reflections were recorded on the expanded spread centred at SP5002 (Plate 42). Information from the expanded spread is summarized in Table 7.

TABLE 7. VELOCITY DATA FROM TRAVERSE M

Reflection time (s)	Average velocity (m/s)	Interval velocity (m/s)	Depth (m)	Tentative identification
		3800		
0.830	3800		1600	Mount Eclipse Sandstone
		- 3800 -		
0.960	3800		1900	" " "
		- 5700 -		
1.260	4300		2700	Kerridy Sandstone(?)
		- 5500 -		
1.680	4600		3700	?
		- 4700 -		
1.910	4600		4300	Vaughan Springs Quartzite
		- 5600 -		
2.100	4700		4900	" " "

P.A.O.C. lines, reflection profiling

Seismic reflection cross-sections from the P.A.O.C. lines, played back using a filter passband of 25 to 78 Hz as for the BMR reflection cross-sections are included in Plates 43 to 48. The seismic results on these lines are discussed briefly by Hudson & Campbell (1965) and were interpreted to produce a depth contour map on a 'Lower Palaeozoic' horizon which is shown in Plate 49. Little was known of the geology of the basin when this map was produced, and Hudson & Campbell indicated that as additional knowledge was obtained in the basin the interpretation could vary from that given. Migrated dip sections were produced from the P.A.O.C. seismic results by BMR (Wells et al., 1968), but no attempt was made at the time to reinterpret the data.

The quality of the reflection results and structure deduced from the seismic cross-sections are discussed briefly here, mainly in relation to the ties to the Gum Creek Traverses O and F, and Mount Allan Traverse L.

Line 2. The main east-west P.A.O.C. reflection traverse, Line 2 (Plate 43), extends for 57 km over the central part and into the eastern part of the Ngalia Basin. It is the tie-line between the BMR reflection traverses in the Gum Creek and Mount Allan areas. The reflection quality varies from poor to fair, and only a deep reflection horizon tentatively identified with the Vaughan Springs Quartzite, effective basement in the basin, is continuous along most of the line. The sedimentary section becomes shallower from the west and is thinnest at SP341. Several faults are apparent at SP374, SP368, and SP358 with their downthrown side apparently to the west. Minor faulting is again apparent at the intersection point with Line 4 at SP244, where the section deepens to the east towards SP161; it shallows to SP144 and deepens again to the eastern end of the line at SP132. Minor faulting is seen at SP105, with the downthrown block apparently to the east. Shallow, fairly continuous events exhibit similar general dips to the deepest reflection horizon, but faulting on the deep horizon does not appear to extend into the shallower part of the section in most cases.

Line 6. This north-south reflection traverse (Plate 44) is the farthest west of five cross-traverses shot by P.A.O.C. Reflection quality is generally poor except to the north of SP392 where several north-dipping events of fair quality, though somewhat discontinuous, can be seen. Faulting is apparent at SP382 and at SP391, with the downthrown blocks to the north. No continuous event can be seen on the section south of the intersection point with Line 2 at SP344, but discontinuous reflection events in the shallow part of the section, especially from SP414 to SP419, suggest that the shallow sedimentary formations in that part of the line dip gently southwards.

Line 4. The reflection quality on Line 4 is poor also (Plate 45). The traverse crosses Line 2 at SP244 east of the thinnest section on Line 2. The reflection quality at the intersection point is better than elsewhere on the line, but two faults are evident immediately to the north and south of Line 2 at SP265 and SP247. At SP268 the downthrown block is to the north while at SP247 the downthrown block is to the south. The general dip of the section is to the north with the deepest part at the northern end. A fault is also evident at SP261, where first break velocities for shot-points to the south are higher than those to the north and the quality of the reflections in the north deteriorates abruptly.

Line 3. This traverse crosses Line 2 at SP161. Reflection quality (Plate 46) is poor generally with the best-quality reflections at the intersection of the two traverses and at the northern end of the line. The section thickens generally northwards, but faulting is apparent in a number of areas including SP215, SP209, SP171, SP178 and SP195. The faults appear to extend into the shallower section at SP171 and SP178.

Line 1. This is the longest cross-traverse on Line 2 and crosses Line 2 at SP53. Reflection quality is poor (Plate 47) except about the intersection of the two lines, where the quality is fair. The section also thickens generally northwards. Low-angle thrusting from the north can be seen in the deepest events at SP47 to SP50 and at SP60 to SP61. Reflection quality deteriorates from SP37 to the south as the section becomes thinner and from SP64 to the north. The reflection events from SP81 to the northern end of the line at SP100 are confused by diffractions from faults at SP81 and at the northern end of the line.

Line 5. Reflection profiling was carried out only on the southern part of the line (Plate 48) from its intersection with Line 2 at SP132. Reflection quality varied from fair to poor with a deterioration in reflection quality at both the northern and southern ends of the line. The deepest reflection event is the most continuous event in the section.

Structural interpretation from correlation of seismic results

Acoustic basement in the basin - i.e. the deepest continuous reflection horizon - is considered to be from the Vaughan Springs Quartzite; it was timed on all BMR seismic reflection cross-sections and repicked on the P.A.O.C. seismic reflection cross-sections. The event timed is marked E on the sections. Only a time contour map was produced for this horizon (Plate 50), because of the uncertainties involved in attempting to incorporate the many variations in velocities in the section in different parts of the basin. Estimates of depths to basement may be made

by reference to the composite average velocity, time, and depth curves (Plate 16) or to the more particular velocity information available from expanded-spread analyses in some parts of the basin. No attempt was made to interpolate the contours between the Waite Creek and central part of the basin or from there to the Napperby area.

Numerous faults, some of which can be traced over considerable distances, are shown in the contour map. Some are considered to be normal faults but others are interpreted as low-angle thrusts in the main part of the basin, and as high-angle thrusts in places near the northern margin. The most prominent overthrust fault is that in the Waite Creek area. The structural interpretation of the deepest event in the central part of the area differs slightly from the interpretation proposed by P.A.O.C. in Plate 49. This is mainly because of the additional information that the BMR traverses provide on either side of the area covered by P.A.O.C. in the Gum Creek and Mount Allan areas. The P.A.O.C. interpretation shows as the dominant structural feature a series of east-trending thrust sheets with overthrusting from the north. Normal faulting with downthrown blocks to the northwest was evident in the western part of the area covered by the P.A.O.C. work. The integrated interpretation shows two systems of faults affecting the basement structure. One is a system of northeast-trending faults while the other faults trend north-northwest, roughly parallel to the strike of outcropping formations at the northern margin in the area.

The reinterpretation confirms the existence of a basement high at the intersection of P.A.O.C.'s Lines 2 and 6 in the central part of the basin with the basin deepening on either side of the high. The basin generally deepens to the north with its deepest part near the structurally complex northern margin.

The seismic work confirmed the existence of a thick sedimentary pile in both the eastern and western lobes, as indicated by the magnetic interpretation (Hartman, 1963). Seismic work in the Waite Creek area indicated a substantial thickness of sediments, not apparent from surface geological work, with the sediments extending for a distance of 11.5 km under a major overthrust fault with a throw of about5000 m. Although no seismic traverses were surveyed between the Waite Creek and Gum Creek areas it is reasonable to suggest from the seismic results in the two areas, from the magnetic results, and from the relatively featureless regional gravity field, that a substantial thickness of sediments with only gentle folding and faulting rather than major faulting exists throughout the western lobe of the basin. In the eastern lobe the deepest part of the basin is seen to be in the Mount Allan area. The basin as defined by surface geological mapping narrows to the east of Mount Allan, and it appears likely that the fault-bounded trough of sediments found there narrows and shallows to the east towards and beyond Napperby Creek.

Identification of reflectors and refractors in the basin, by attempting to correlate or extrapolate seismic horizons to outcropping formations, proved to be difficult, mainly because of faulting, and gave inconclusive results. However, tentative identifications of the main reflecting horizons in most areas were made using shallow stratigraphic hole data and from studies of seismic reflection characteristics and seismic velocities. The absence of a thick Lower Palaeozoic sequence along the northern margin in the western part of the basin does not preclude the possibility of a thick Lower Palaeozoic sequence being present in the deeper part of the basin.

Magellan carried out a seismic survey in 1971 using digital seismic equipment (Krieg, 1972) to further define structural leads established from the previous work and to further investigate the structure in the western lobe of the basin. The locations of the lines surveyed are indicated in the reports of Krieg (1972) and Wells et al. (1972). The record quality, using single-fold coverage as for previous work and six-fold CDP coverage in structurally complex, poor-reflection areas, was generally poor to fair in the central area but better in the western area, where faulting is less severe. Two horizons were mapped: the base of the Mount Doreen Formation or top of the Vaughan Springs Quartzite, and the probable base of the Mount Eclipse Sandstone. The survey defined several closed structures along faults, anticlinal structures developed above the sole thrust on low-angle thrust faults, and a number of leads to other structures which may be closed. Gravity control from previous semi-detailed surveys (Hickey, 1969 and Sabitay, 1971) appeared to be an excellent means of following major fault patterns in the section. Additional gravity control was recommended to assist in tracing individual faults, and more seismic work was suggested to find and define all prospective traps in the mapped area. However, it was concluded that sufficient control had been obtained for locating several exploratory test wells (Krieg, 1972).

7. CONCLUSIONS

Seismic reflection results of good to poor quality were obtained using single-coverage continuous profiling techniques on the BMR seismic surveys in the Ngalia Basin. The reflection quality was generally best in the deeper parts of the basin with Quaternary cover, and deteriorated on most traverses near the margins of the basin and in areas of outcropping Palaeozoic and Proterozoic rocks. Refraction profiling, attempted in some areas to define marker horizons, was successful in finding high-velocity refractors, up to 6030 m/s, but the interpretation of the refraction results was inconclusive.

The north-south reflection traverses in the west, in the central area, and in the east, with ties to the P.A.O.C. lines provided seismic information to delineate the configuration of the basin. The basin was shown to consist of two main lobes, as predicted from the magnetic results, with the maximum thickness of sediments roughly 5000 m near the northern margins in each lobe. The eastern lobe is graben-shaped, the central area is a highly complex faulted zone about longitude 131°30', and the western lobe is bounded by a major northeast-trending overthrust fault with a vertical displacement of 5000 m and horizontal displacement of about 11.5 km.

Other faults are evident throughout the basin; some faults, mainly normal faults, extend only through the pre-Carboniferous sediments, with the Carboniferous sediments draped over the eroded fault blocks; others, associated with the second period of diastrophism in the basin, affect the entire section. These are generally high- or low-angle thrusts.

The extent of Lower Palaeozoic sedimentation was not defined by the seismic surveys, mainly because of difficulties in correlating reflectors with outcropping Lower Palaeozoic formations. The tentative identification made suggests that the bulk of the sedimentary sequence consists of Mount Eclipse Sandstone and Vaughan Springs Quartzite. In some areas in the east the sandstone is known to overlie the quartzite directly. However, the seismic results suggest that Lower Palaeozoic rocks could be present, in the deeper troughs, beneath unconformities, in both the eastern and western lobes of the basin, with less complex faulting in the western lobe than the eastern lobe. Lower Palaeozoic sedimentation in the Ngalia Basin could thus be more widespread than was previously thought.

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APPENDIX 1

STAFF AND EQUIPMENT

Staff	1967	1968	1969
Supervisor	C.S. Robertson	C.S. Robertson (Part time) F.J. Moss (Part time)	F.J. Moss
Party Leader	P. Jones	P. Jones	P. Jones
Geophysicist	D. Tucker	D. Tucker	D.G. Townsend
Surveyor (from the then Department of the Interior)	P. Simms	M. Downing	M. Downing
Observer	R. Krege	G. Jennings	G.L. Abbs
Assistant Observer	-	-	L.E. Hemphill
Shooter	H. Pelz	H. Pelz	H. Pelz
Toolpusher	B. Findlay	B. Findlay (Part time) E.H. Cherry (Part time)	E.H. Cherry
Drill Staff	A. Zoska K. Reine	L. Keast K. McKie T. Shanahan K. Reine (Part time) L. Blunder (Part time)	A. Zoska E. Lodwick T. Shanahan (Part time)
Mechanic	E. McIntosh	E. McIntosh	E. McIntosh
Clerk	B.C. Beaman	B.C. Beaman	E. Fryk
Field Hands	16 on all surveys including cooks, assistant mechanic, drill and field helpers.		

Equipment	1967	1968	1969
Seismic Aplifiers	TI 8000	SIE PT-700	SIE PT-700
Oscillograph	SIE VT-6	SIE TRO-6	SIE TRO-6
Magnetic Recorder	ETL DS7-7	SIE PMR-20	SIE PMR-20

Geophones	ETL EVS-2B, 20 Hz. ETL EVS-8V, 4.5 Hz	ETL EVS-2B, 20 Hz ETL EVS-8V 4.5 Hz	HS-J, 14 Hz EVS-8V, 4.5 Hz
Drilling Rigs	Mayhew 1000 Carey	Mayhew 1000(2) Fox Mobile	Mayhew 1000(2) Fox Mobile
Water tankers	Bedford RLHC3 (3)	Bedford RLHC3 (3)	Bedford RLHC3 (2)
Shooting Truck	" (1)	" (1)	" (1)
Workshop Truck	" (1)	" (1)	" (1)
Flat Tops	" (2)	" (2)	" (2)
Cable Vehicles	Land Rovers, L.W.B. (3)	Land Rovers, L.W.B. (3)	Land Rovers, L.W.B. (3)
Personnel Carriers	Land Rovers S.W.B. (2)	Land Rovers, S.W.B. (2)	Land Rovers, S.W.B. (2)
Recording Truck	Inter. AB120	Inter. C1300	Bedford RLHC 3
General Purpose Vehicle	" "	" "	Inter. C1300

Office, Kitchen and Ablutions caravans and Explosives, Workshop, Generator, and General-Purpose trailers completed the party's mobile equipment.

APPENDIX 2

OPERATIONAL STATISTICS

General

Sedimentary Basin	Ngalia Basin
Survey area	Mt Doreen & Napperby 1:250 000 Sheets
Survey periods	1967 14 Sept-10 Nov Vaughan Springs 1968 20 May-27 June Napperby Creek 27 June-19 Sept Vaughan Springs 19 Sept-21 Oct Waite Creek 22 Oct-28 Nov Mt Allan 1969 27 Aug-18 Sept Waite Creek 18 Sept-6 Nov Gum Creek
Topographic survey control	Division of National Mapping 4- mile series Department of the Interior benchmarks
Datum level for survey	609.6 m
Kilometres surveyed	285
Total depth drilled in metres	56,213
Total number of holes drilled	1789
Explosives used	81915 kg Geophex 2494 kg Ammonium nitrate

Reflection information

Shot-point interval	549 m
Geophone station interval	46 m
Normal geophone pattern	24/trace, 3.8 or 6.1 m apart in line
Normal shot-hole pattern	Single, 3 or 5 holes, 15.2 m apart in line
Normal hole depth	36.5 m
Normal charge size	22.7 kg
Normal recording filter	L20-K135
Normal playback filter	L25-K78
Weathering velocity	762-914 m/s

Sub-weathering velocity	2438-2743 m/s
Method for weathering corrections	Uphole times checked by first break analysis
Normal moveout corrections	t:Δt analysis and expanded spreads on Traverses B, E, F, K and M

Refraction information

Geophone station interval	92 m
Geophone pattern	4/trace, 6.7 m apart in line, perp. to traverse
Charge sizes	4 to 540 kg
Maximum offset	19.3 km
Normal recording filter	O-K72
Normal playback filter	O-K72

Distances and depths were measured in feet and weights were measured in pounds, during the survey. Conversions to the metric system, rounding-off figures wherever convenient, were made later.

APPENDIX 3

GRAVITY MEASUREMENTS ALONG SEISMIC TRAVERSES

Gravity stations at all shot-points on the BMR 1967 and 1968 seismic traverses were read by G.A.I. for Magellan (Hickey, 1969). Readings were made at shot-points of the BMR 1969 seismic survey, by the party geophysicists, concurrently with the seismic operations in the following areas:

Waite Creek. A base station was established at the seismic camp and its observed gravity value was found by repeated ties to the Vaughan Spring Isogal station (Barlow, 1970). The observed gravity value at base station 69210000 was 595.20±0.05 mGal. The camp base was used for determining observed gravity along Traverse K, by reading at shot-points in drift-controlled loops and including the camp base in a number of the interconnected loops. G.A.I. gravity station PM6832 at SP3800 was reread for checking purposes.

Gum Creek. Base station 69214000 with an observed gravity value of 568.05±0.05 mGal was established at the seismic camp with ties to the Vaughan Springs Isogal station as before. Recordings were made at shot-points on Traverses F and O. Drift control was measured by tying to the base and stations on the traverses in a series of loops.

Levels for the shot-points read for gravity were supplied by the seismic party surveyor; he also supplied levels for the gravity base stations. Positions were obtained by scaling latitudes and longitudes of shot-points at the ends of each straight-line segment of seismic traverses from 4 mile to one inch maps. Intermediate station positions were derived by interpolation.

Observed gravity values were computed from the field readings using the computer programs discussed by Bellamy, Lodwick & Townsend (1968). Bouguer anomalies were calculated, using heights and positioning as discussed above. A density of 2.67 g/cm was adopted for the Bouguer corrections. Fixed node values of observed gravity were used for the two base stations since the multiple ties to the base could not be dealt with adequately by the program.

The gravity meter used for the survey was Worden No. 260. A calibration factor of 0.10889 mGal/div was obtained at the Canberra calibration range prior to the survey. The calibration factors obtained on both the Alice Springs and Canberra calibration ranges immediately after the survey agreed with the earlier value.

Magellan employed a contractor to make a regional gravity survey along a number of new traverses in the basin in 1970 (Sabitay, 1971). The results from the gravity measurements along these lines and the BMR seismic traverses have been incorporated in the modified Bouguer anomaly map presented by Wells et al. (1972).

APPENDIX 4

STRATIGRAPHIC DRILLING ON SEISMIC TRAVERSES

Shallow stratigraphic drilling in the Ngalia Basin was carried out in 1968 and 1969 (Evans & Nicholas, 1970). The program was designed to supplement surface mapping and to assist in the interpretation of information on the seismic traverses. The locations of stratigraphic holes drilled on the seismic traverses are shown in Plate 50. Details of the drilling results on the seismic traverses are given by Evans & Nicholas; the most significant conclusions from the drilling and seismic information are summarized briefly as follows:

Gum Creek

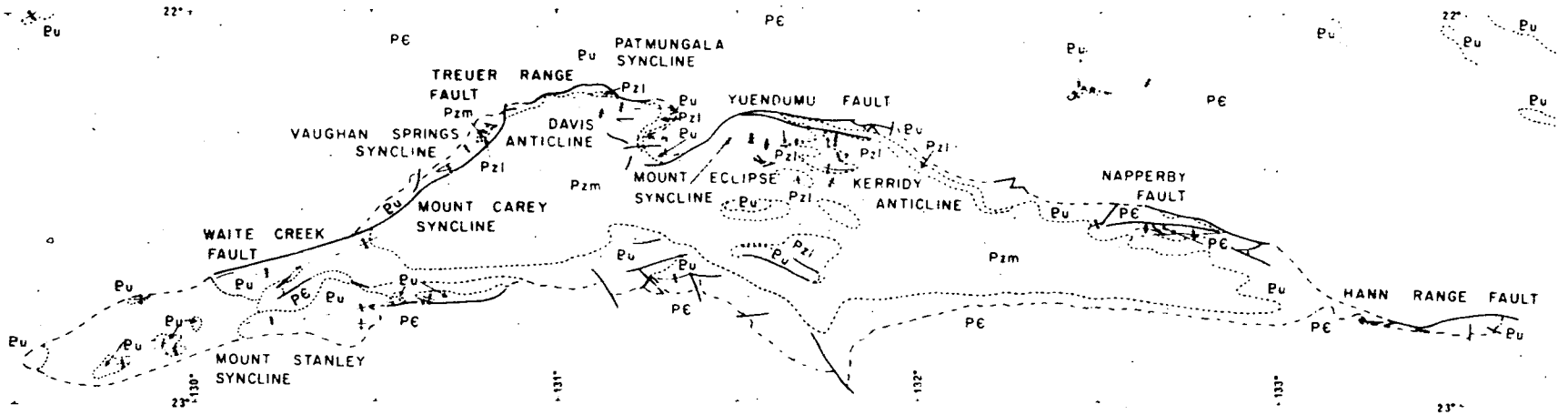
Traverse A, BMR Mount Doreen No. 7. This hole was drilled near SP1624 at the end of the seismic traverse, north of the major fault indicated on the seismic cross-section at SP1621. Siltstone in the basal part of the Mount Doreen Formation was penetrated beneath the Cainozoic cover; this would suggest that the fault at SP1621 has a downthrow to the south of approximately 2200 m, on the basis of the identification of the Mount Doreen Formation in the sections from Traverse H along Traverses E and A.

Traverse A, BMR Mount Doreen No. 8B. Mount Doreen No. 8 was abandoned at shallow depth. The stratigraphic hole, No. 8B, near SP1540 at the southern end of Traverse A penetrated dolomite at 110 m. The dolomite was considered to be Cambrian Walbiri Dolomite or dolomite at the top of the Mount Doreen Formation. The lithology is not typical of either formation but a correlation with the Mount Doreen Formation was favoured.

Waite Creek

Traverse J, BMR Mount Doreen No. 9. Dolomite penetrated at 212 m was tentatively identified as from the Mount Doreen Formation on the basis of similarities in lithology.

To accompany Record No.1974/49



REFERENCE

AGE	SYMBOL	ROCK UNIT
CARBONIFEROUS	Pzm	Mount Eclipse Sandstone
ORDOVICIAN	Pzl	Kerridy Sandstone
		Djagamara Formation
CAMBRIAN		Bloodwood Formation
		Walbiri Dolomite

AGE	SYMBOL	ROCK UNIT
ADELAIDEAN	Pu	Yuendumu Sandstone
		Mount Doreen Formation
		Vaughan Springs Quartzite
PRECAMBRIAN	Pε	Patmungala Beds, metamorphic and igneous rocks of the basement

SCALE
0 20 40 60 80 Kilometres

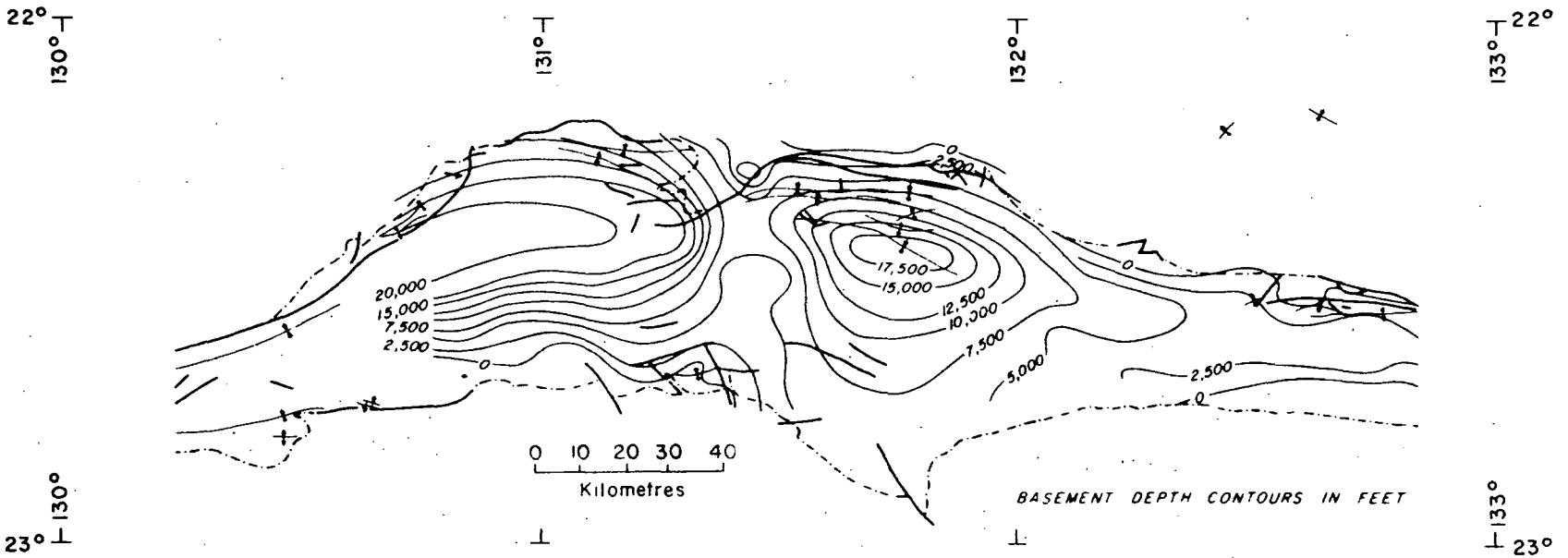
LEGEND
- Margin of basin
- Geological boundary
- Fault or thrust
- Anticline
- Syncline

STRUCTURE AND SOLID GEOLOGY — NGALIA BASIN

PLATE 1

F52/B3-74-1A

To accompany Record No. 1974/49



Based on Carter (1960) Hartman (1963)

MAGNETIC BASEMENT CONTOURS

PLATE 2

F 52/B3-72-1A

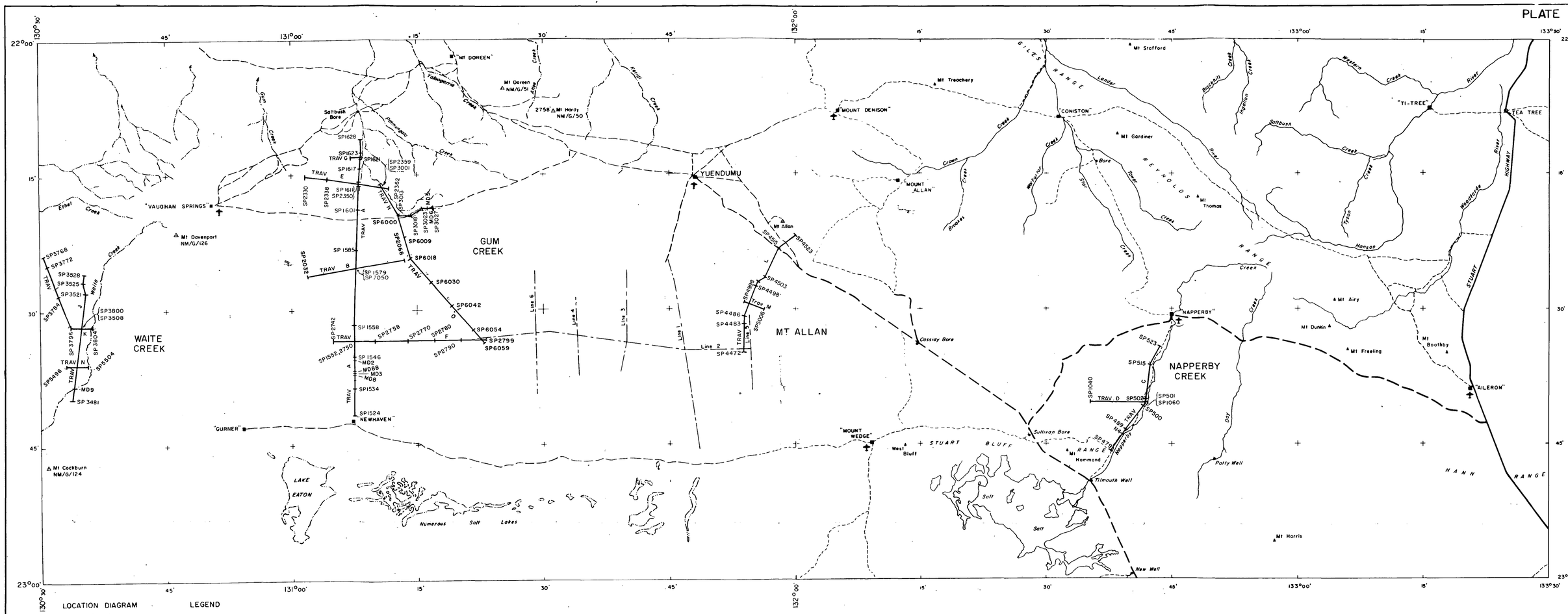
To accompany Record No.1974/49

BOUGUER ANOMALIES

PLATE 3

F 52/B3-71-1A

PLATE 4

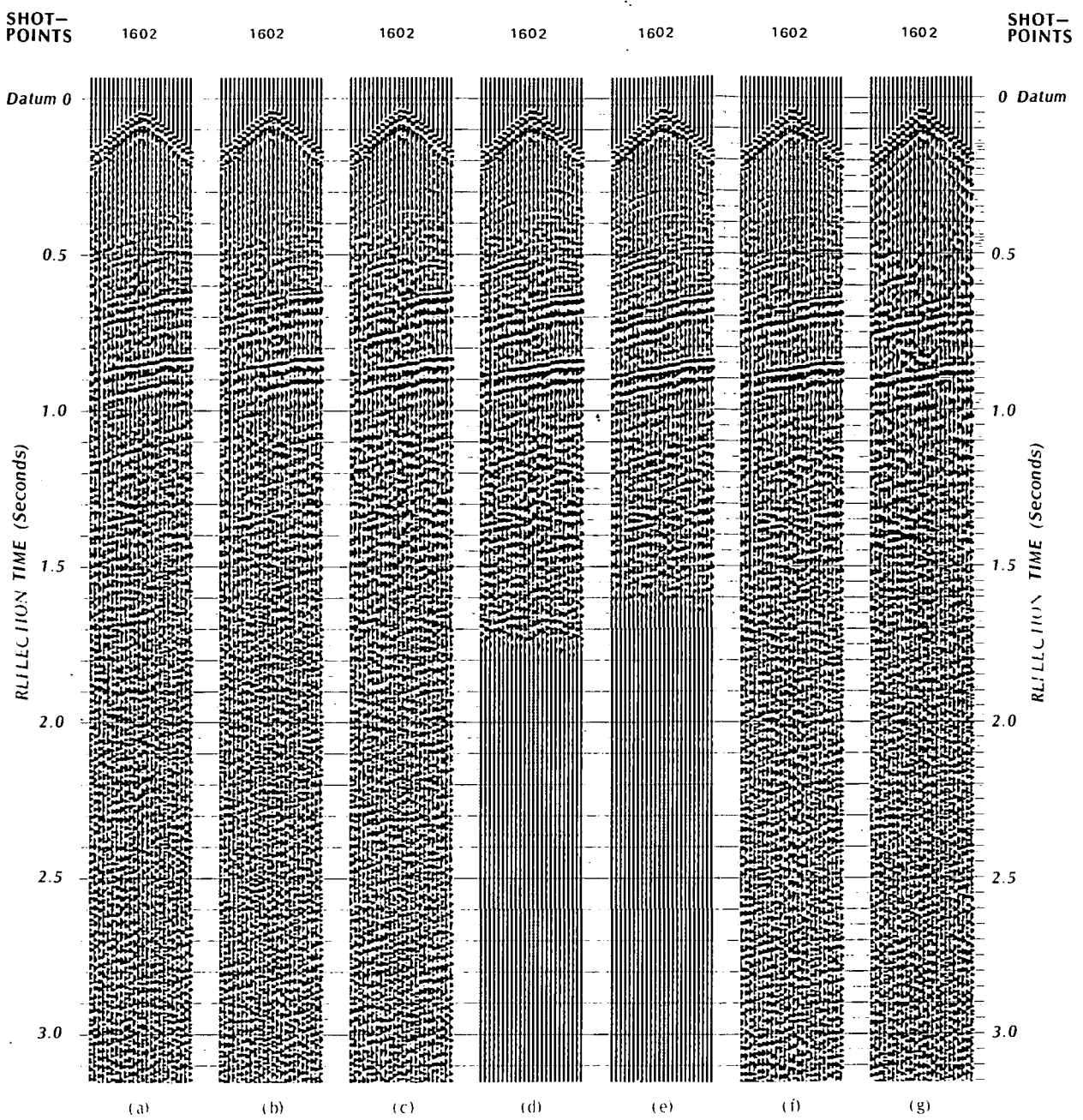


NGALIA BASIN SEISMIC SURVEY NT 1967-1969

LOCATION OF TRAVERSES

F52/B3-21-1

To accompany Record No. 1974/49



DEPTH

(a) 70.1–73.2m

(b) 57.9–61.0m

(c) 48.8–51.8m

(d) 39.6–42.6m

(e) 30.5–33.5m

(f) 21.3–25.9m

(g) 12.2–16.8m

To accompany Record No.1974/49

PLATE 5

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: DS7–7

Amplifiers : 8000 Explorer

Prefilters: –

Filters : K18 – K125

AGC : 1/1, 125

Gain Initial: –60 and –67

Final : 1 – 31

Geophones: EVS 2B–20Hz

Geophone Station Interval: 46m

Geophone Pattern:

24/trace in 2 rows of 12 in line
Rows 6.7m apart
Geophones 3.8m apart

Shot Hole Pattern:

Single
Depth as indicated
Charge 22.7kg

PLAYBACK INFORMATION

Filters: L25 – K78

AGC : Med

Gain Initial : –40

Final : –20

Trip Delay : 0.04s

Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN

SEISMIC SURVEY NT, 1967–1969

TRAVERSE A

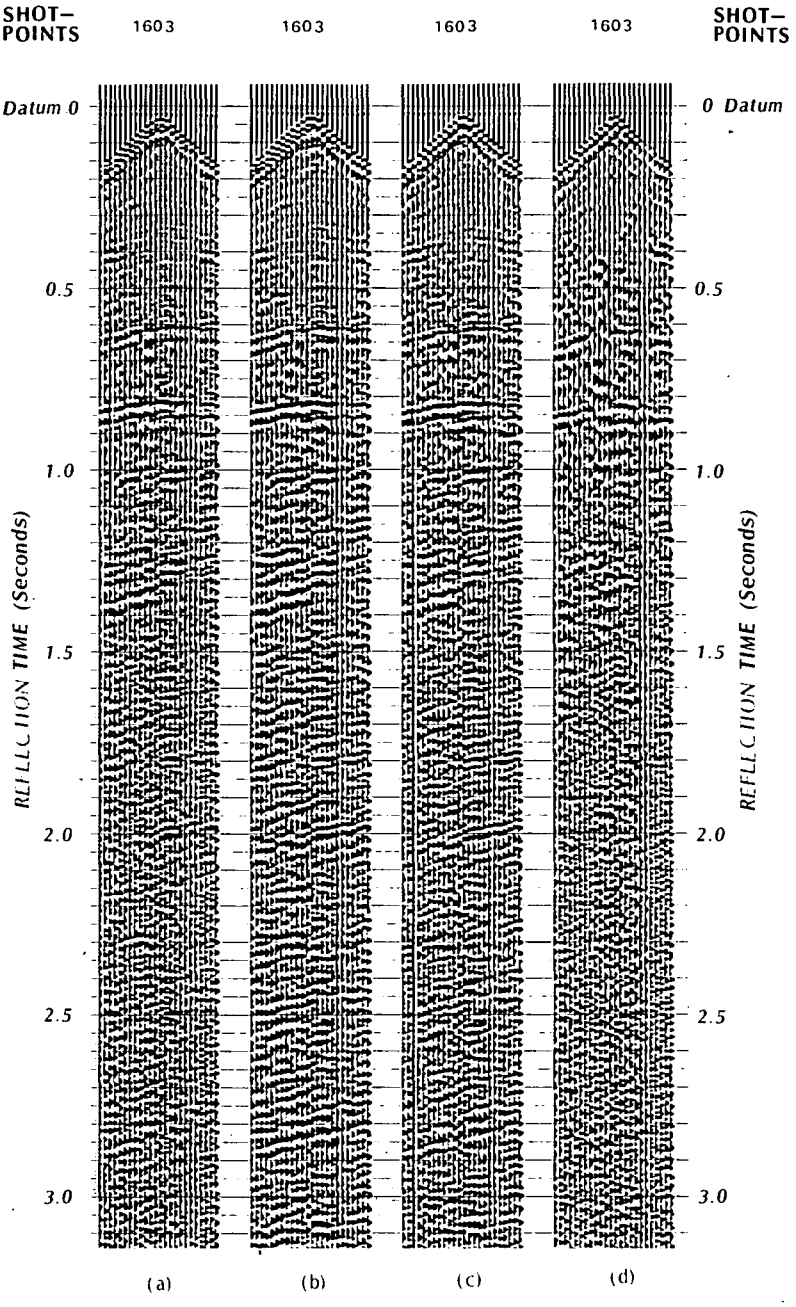
SP 1602

SHOT–HOLE DEPTH COMPARISON

RECORDED BY *Seismic Party No 1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE SIS 42*
TO ACCOMPANY RECORD No
(Based on G8S/3 115 2)

F52/83–64A

UNCORRECTED RECORD SECTION



SHOT–HOLE PATTERN

(a) 5 holes, 15.2m apart in line
Depth 36.0–36.5m
Charge 5x4.5kg

(b) 5 holes, 15.2m apart in line
Depth 27.4–29.3m
Charge 5x13.6kg

(c) 5 holes, 15.2m apart in line
Depth 21.3–21.9m
Charge 5x4.5kg

(d) 20 holes in 5 rows of 4 perpendicular to traverse
Depth 5.8–6.1m
Charge 20x1.1kg

RECORDING INFORMATION

Magnetic Recorder: DS7–7
Amplifiers : 8000 Explorer
Prefilters: –
Filters : K18 – K125
AGC : 1/1, 125
Gain Initial: –60 and –67
Final : 1 – 31
Geophones: EVS 2B – 20Hz
Geophone Station Interval: 46m
Geophone Pattern:

24/trace in 2 rows of 12 in line
Rows 6.7m apart
Geophones 3.8m apart

Shot Hole Pattern:

as indicated

PLAYBACK INFORMATION

Filters: L25 – K78
AGC : Med
Gain Initial: –40
Final : –20
Trip Delay : 0.04s
Compositing: Nil

VELOCITY INFORMATION

Nil

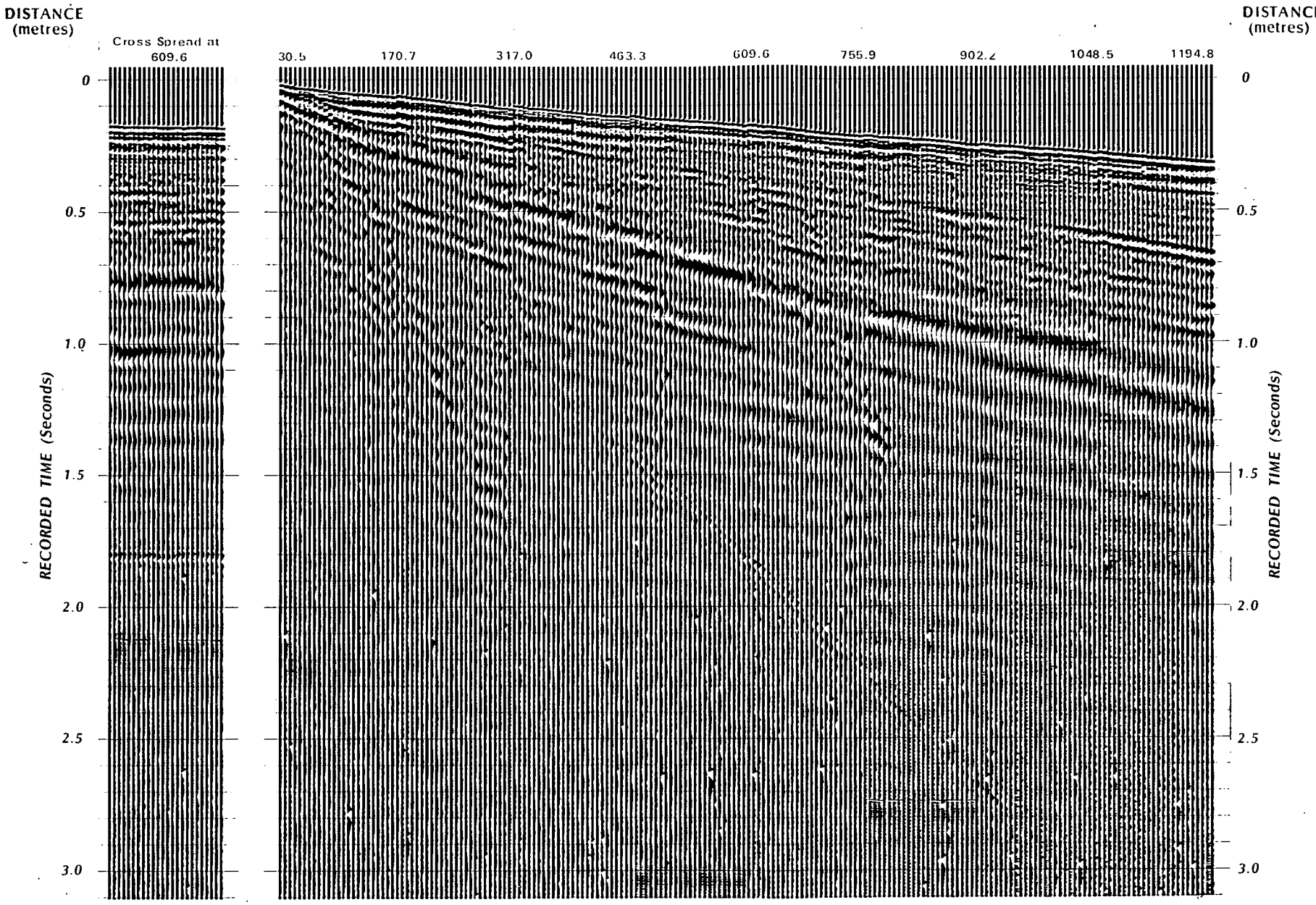
HORIZONTAL SCALE (metres)

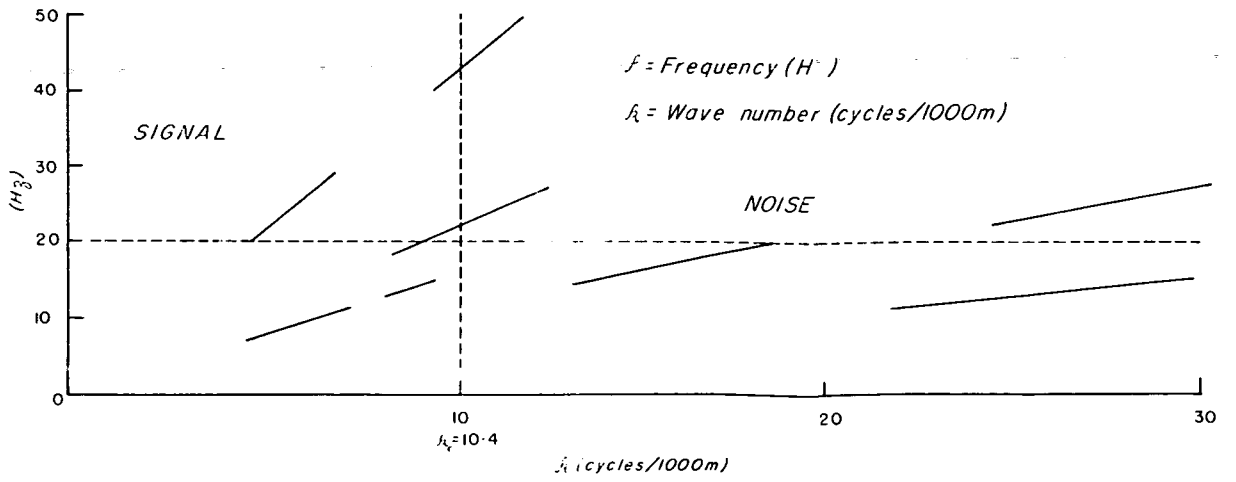
0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE A
SP 1603
SHOT–HOLE PATTERN COMPARISON

RECORDED BY *Seismic Party No 1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No (Based on G85/3–115–2)
To accompany Record No.1974/49

F52/B3–65A





FREQUENCY WAVE NUMBER GRAPH

To accompany Record No. 1974/49

UNCORRECTED RECORD SECTION

PLATE 7

RECORDING INFORMATION

Magnetic Recorder: DS7–7
Amplifiers : 8000 Explorer
Prefilters: –
Filters : 0–K125
AGC : Off
Gain Initial: Various
Final : Various
Geophones: TIC 20Hz
Geophone Station Interval: 6.1m
Geophone Pattern:

Single

Shot Hole Pattern:

Single
Depth 10.7 – 12.2m
Charge 9.1kg

PLAYBACK INFORMATION

Filters: Out
AGC : S
Gain Initial: –50
Final : –20
Trip Delay : 3.5 – 1.5s
Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE A
NOISE TEST SP 1602

RECORDED BY *Seismic Party No 1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No
(Based on GBS/3-115 2)

F52/B3–49

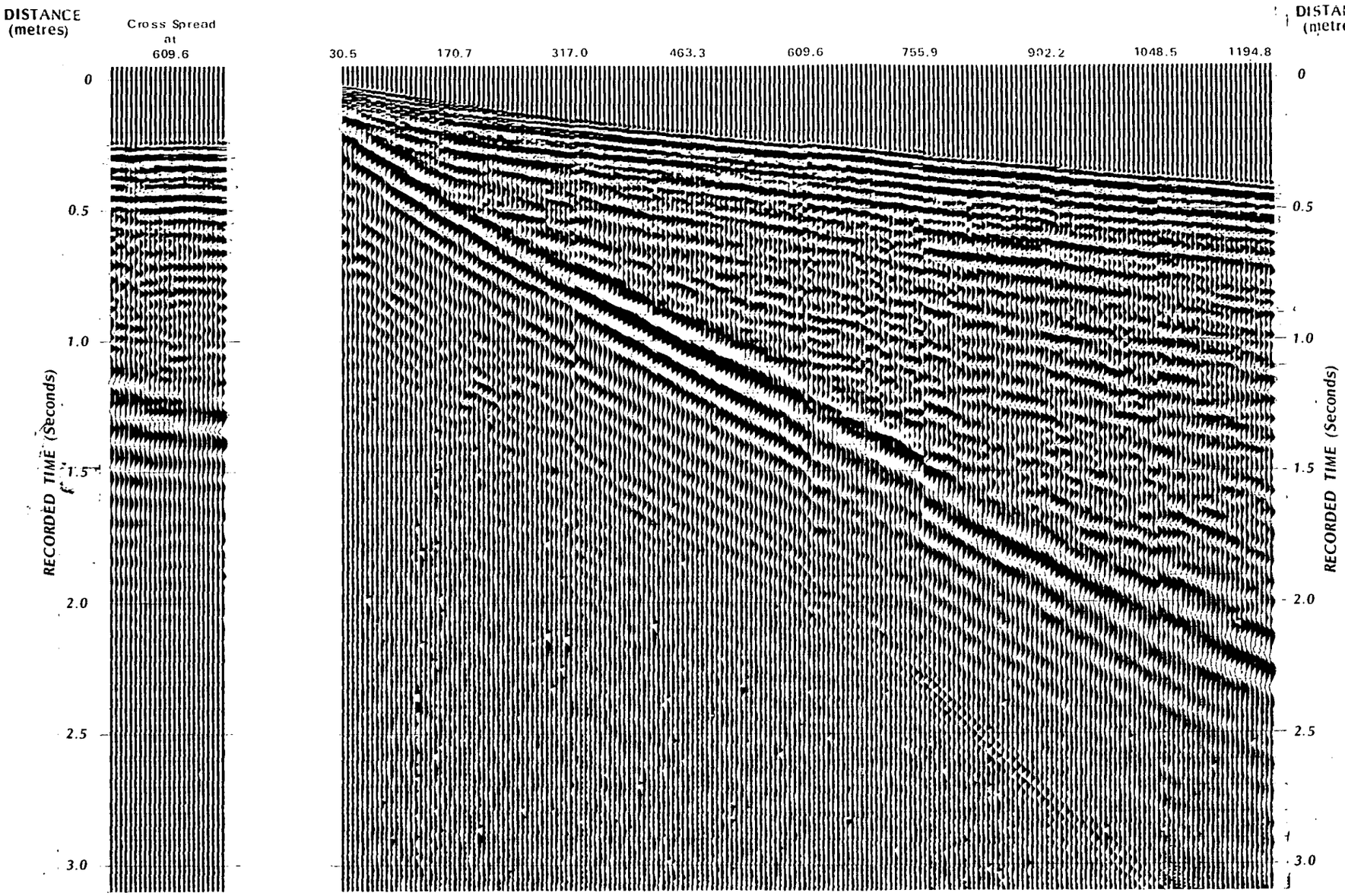


PLATE 8

UNCORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: DS7–7
Amplifiers : 8000 Explorer
Prefilters: –
Filters : 0–K125
AGC : Off
Gain Initial: Various
Final : Various
Geophones: TIC 20H z
Geophone Station Interval: 6.1m
Geophone Pattern:

Single

Shot Hole Pattern:

Single
Depth 16.5 – 18.3m
Charge 13.6kg

PLAYBACK INFORMATION

Filters: Out
AGC : S
Gain Initial: –50
Final : –20
Trip Delay: 3.5 – 1.5s
Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE A
NOISE TEST SP1566 LOW GAIN

RECORDED BY *Seismic Party No.1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No.
(Based on GS9/3–115 2)

F52/B3–50

To accompany Record No.1974/49

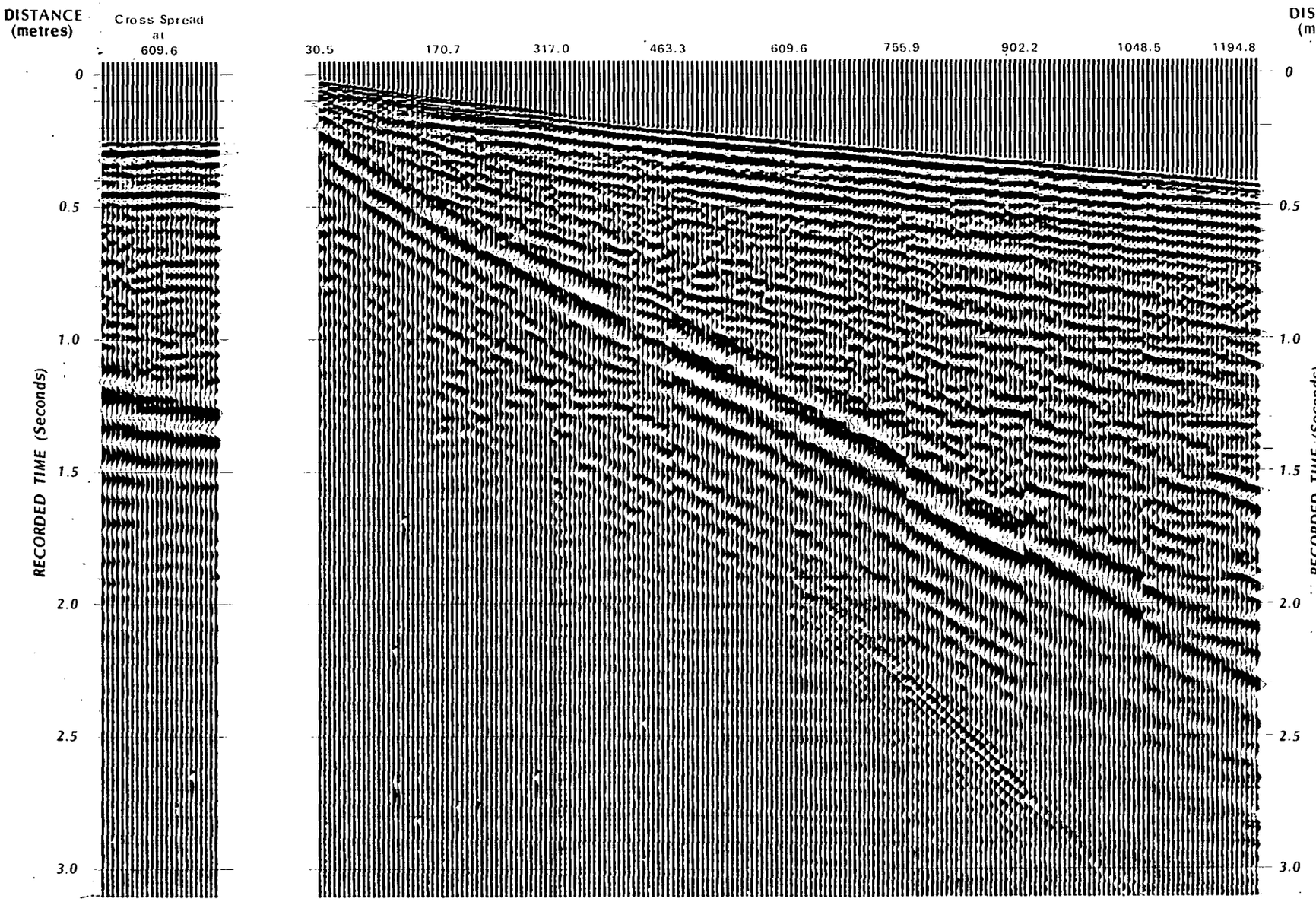


PLATE 9

UNCORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: DS7–7
Amplifiers : 8000 Explorer
Prefilters: –
Filters : 0–K125
AGC : Off
Gain Initial: Various
Final : Various
Geophones: TIC 20Hz
Geophone Station Interval: 6.1m
Geophone Pattern:

Single

Shot Hole Pattern:

Single
Depth 16.5–18.3m
Charge 13.6kg

PLAYBACK INFORMATION

Filters: Out
AGC : S
Gain Initial: –50
Final : –20
Trip Delay: 3.5–1.5
Compositing: Nil

VELOCITY INFORMATION

Nil

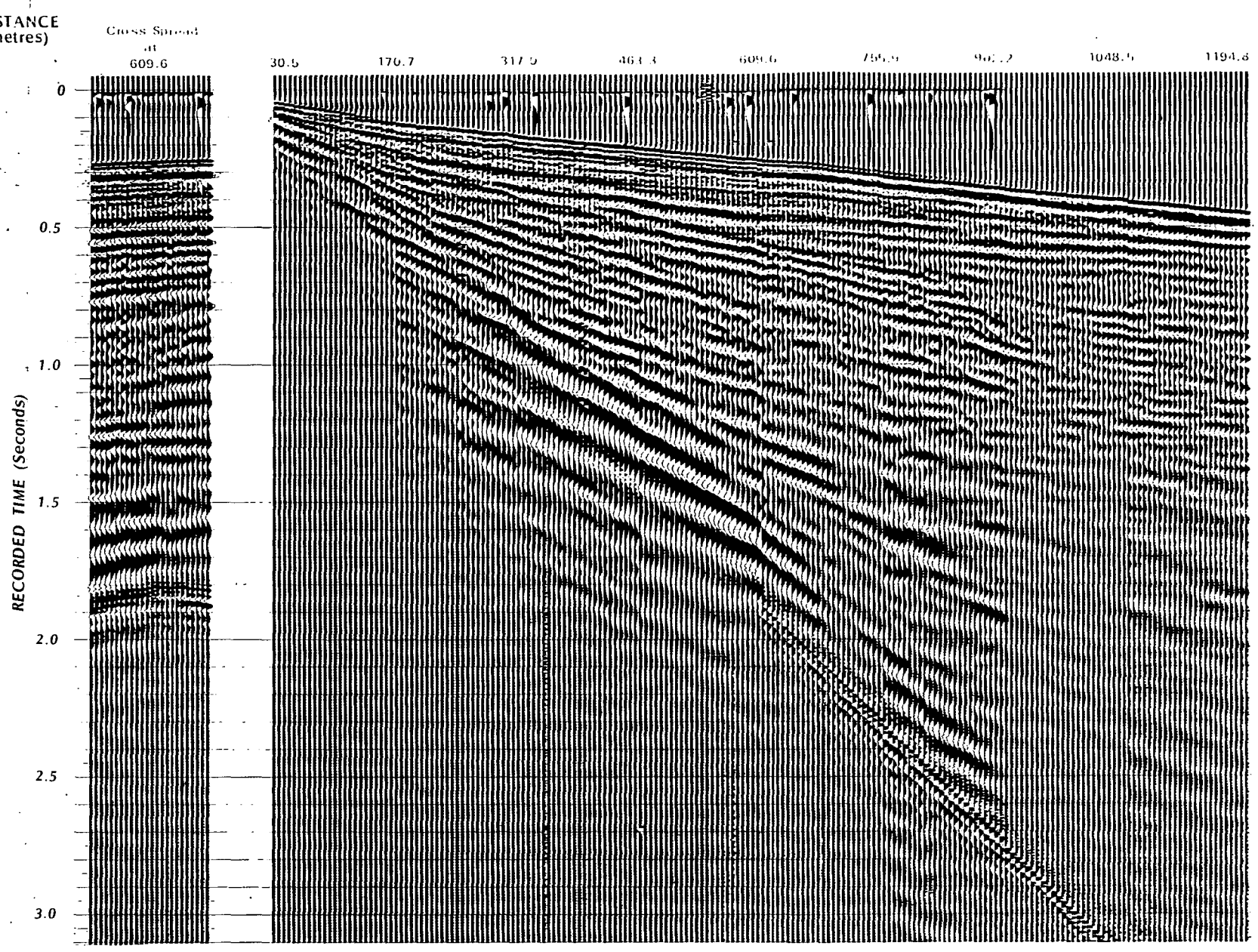
HORIZONTAL SCALE (metres)

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE A
NOISE TEST SP 1566 HIGH GAIN

RECORDED BY *Seismic Party No.1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No.
(Based on GBB/3–115–2)

F52/B3–51

To accompany Record No.1974/49



UNCORRECTED RECORD SECTION

PLATE 10

RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : 0 – K135

AGC : Off

Gain Initial: Various

Final : Various

Geophones: TIC 20Hz

Geophone Station Interval: 6.1m

Geophone Pattern:

Single

Shot Hole Pattern:

Single
Depth 11.9–13.7m
Charge 13.6kg

PLAYBACK INFORMATION

Filters: Out

AGC : S

Gain Initial : –50

Final : –40

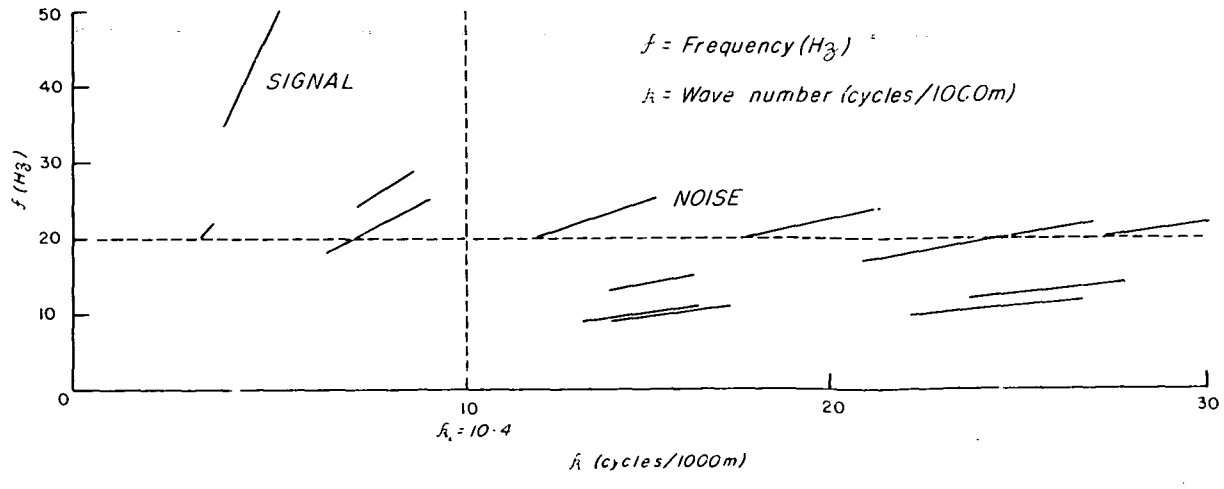
Trip Delay : .4 to .2s

Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)



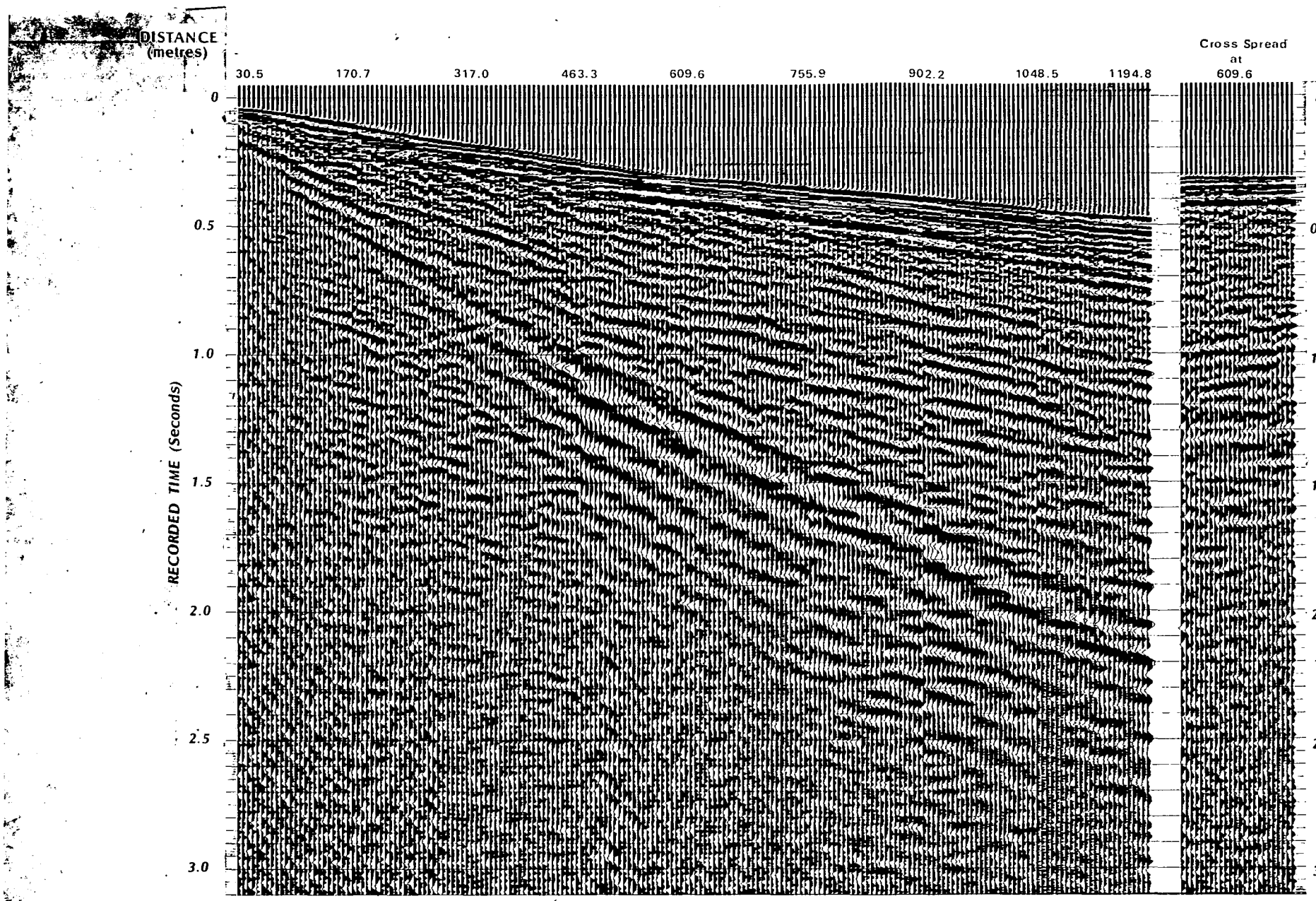
FREQUENCY WAVE NUMBER GRAPH

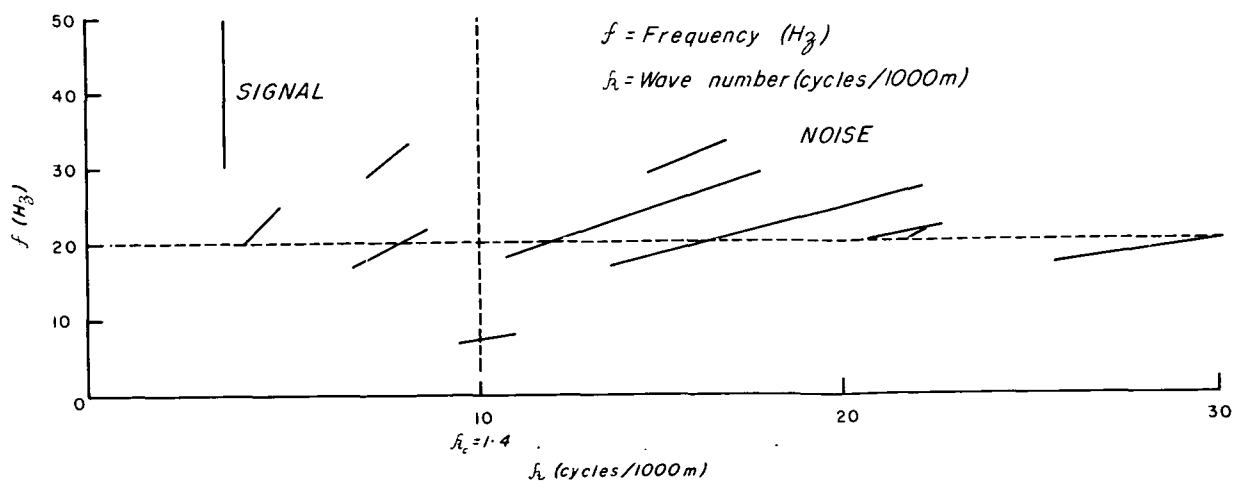
NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE C
NOISE TEST SP 502

RECORDED BY *Seismic Party No 1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No
(Based on GB5/3 115 2)

F52/B3–53

To accompany Record No. 1974/49





FREQUENCY WAVE NUMBER GRAPH

To accompany Record No 1974/49

PLATE II

UNCORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR–20
Amplifiers : PT–700
Prefilters: –
Filters : 0 – K135
AGC : Off
Gain Initial: Various
Final : Various
Geophones: TIC – 20Hz
Geophone Station Interval: 6.1m
Geophone Pattern:

Single

Shot Hole Pattern:

Single
Depth 16.5–18.3m
Charge 13.6kg

PLAYBACK INFORMATION

Filters: Out
AGC : Med
Gain Initial: –40
Final : –10
Trip Delay : Various
Compositing: Nil

VELOCITY INFORMATION

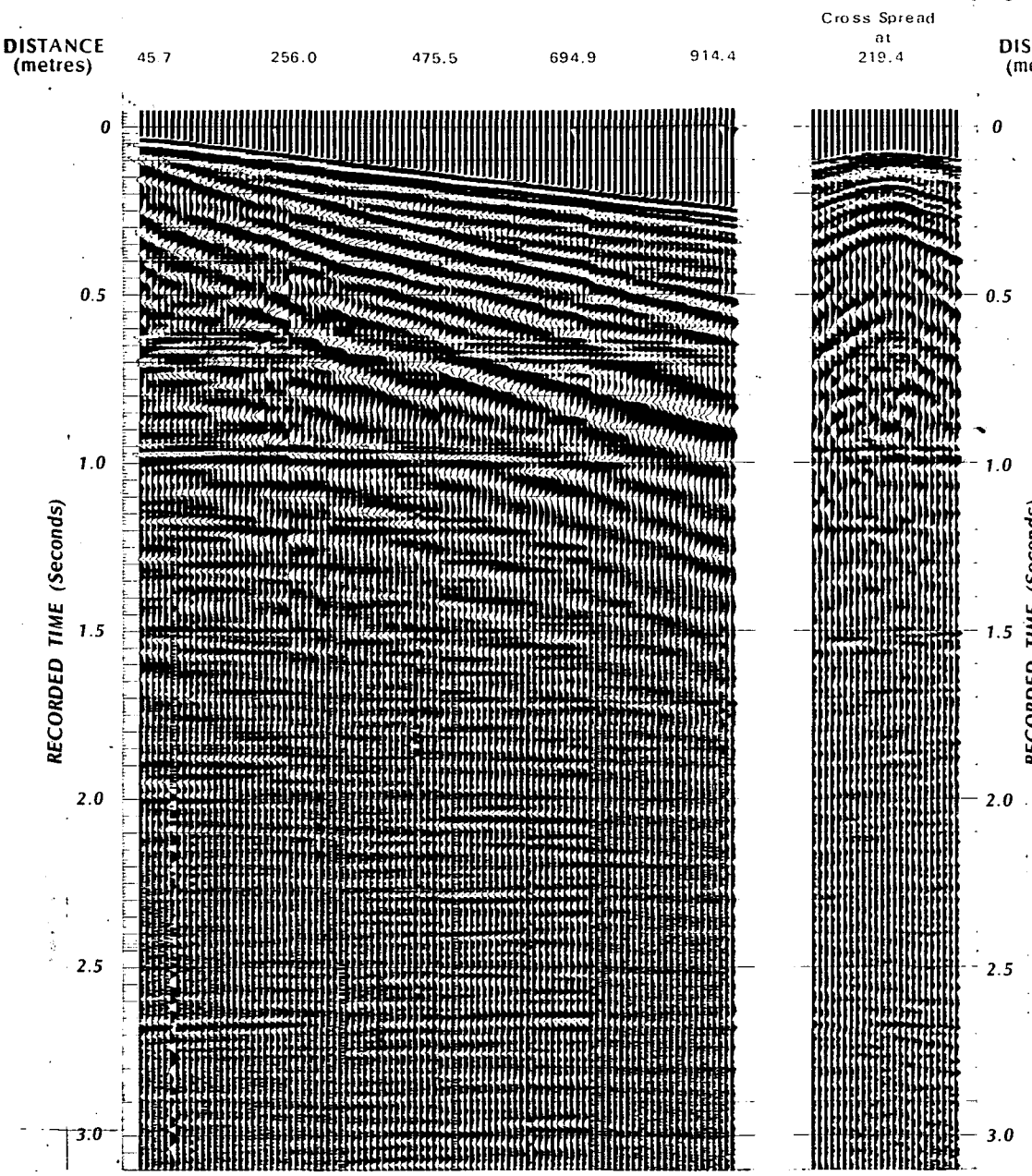
Nil

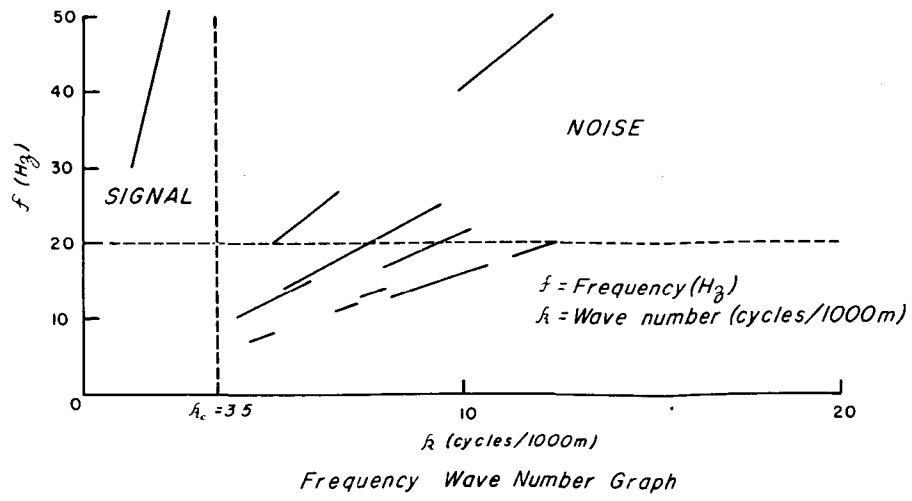
HORIZONTAL SCALE (metres)

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE C
NOISE TEST SP 508

RECORDED BY *Seismic Party No.1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No.
(Based on GBS/3–116–2)

F52/B3–52A





Frequency Wave Number Graph

To accompany Record No. 1974/49

PLATE 12

UNCORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR–20
Amplifiers : PT–700
Prefilters: –
Filters : 0–K135
AGC : Off
Gain Initial: Various
Final : Various
Geophones: HSJ – 14Hz
Geophone Station Interval: 9.1m
Geophone Pattern:

8/trace, bunched

Shot Hole Pattern:

Single
Depth 34–35.4m
Charge 9.1kg

PLAYBACK INFORMATION

Filters: Out – Out
AGC : Med
Gain Initial: –40
Final : –20
Trip Delay: Variable
Compositing: Nil

VELOCITY INFORMATION

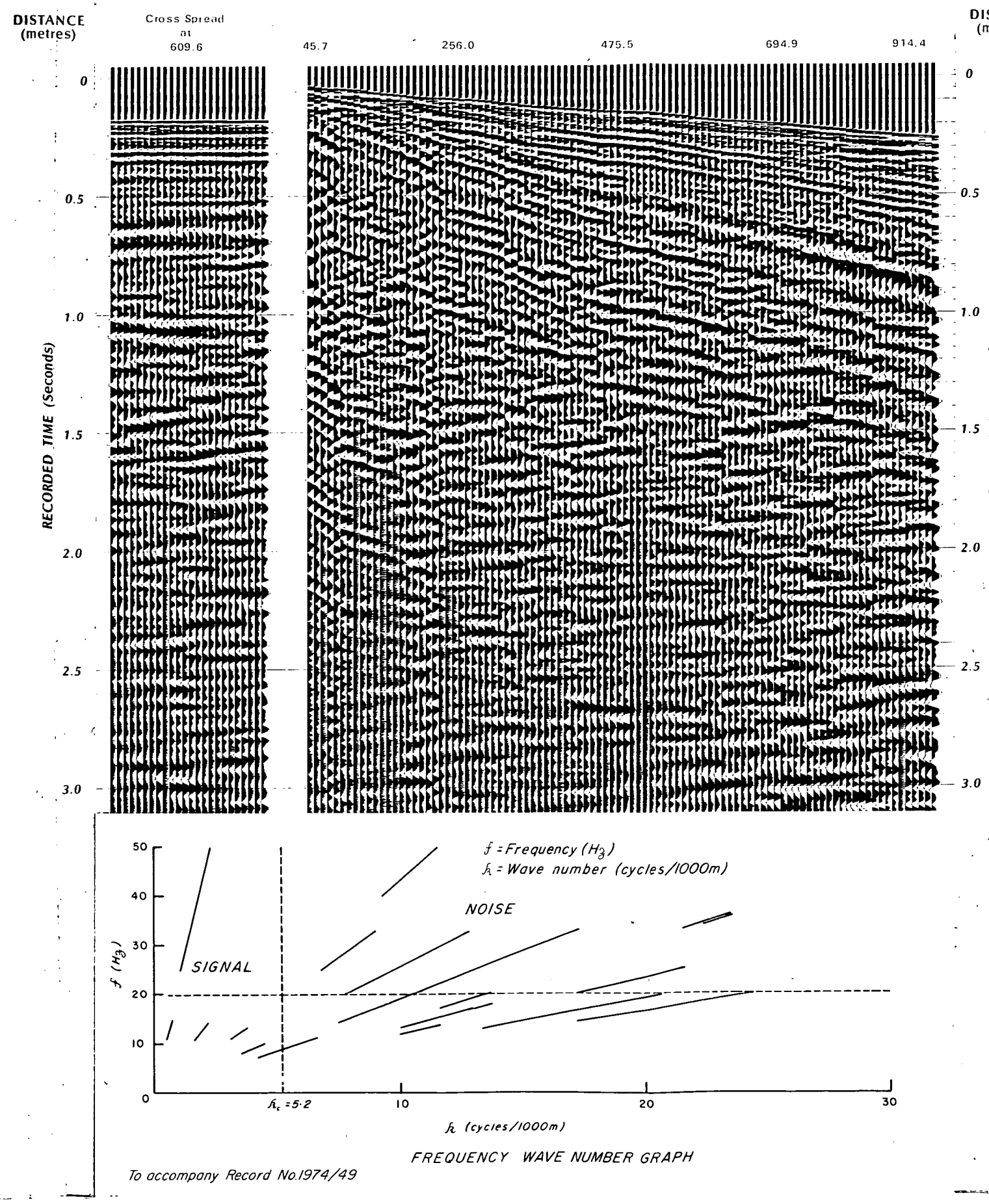
Nil

HORIZONTAL SCALE (metres)

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE E
NOISE TEST SP 2350½

RECORDED BY *Seismic Party No.1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No. (Based on GBS/3-115-2)

F52/B3–48A



FREQUENCY WAVE NUMBER GRAPH

To accompany Record No.1974/49

UNCORRECTED RECORD SECTION

PLATE 13

RECORDING INFORMATION

Magnetic Recorder: PMR–20
Amplifiers : PT–700
Prefilters: –
Filters : 0–K135
AGC : Off
Gain Initial: Various
Final : Various
Geophones: HSJ – 14Hz
Geophone Station Interval: 9.1m
Geophone Pattern:

8/trace, bunched

Shot Hole Pattern:

Single
Depth 35 – 36.5m
Charge 31.8kg

PLAYBACK INFORMATION

Filters: Out
AGC : Med
Gain Initial: –50
Final : –20
Trip Delay: Variable
Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

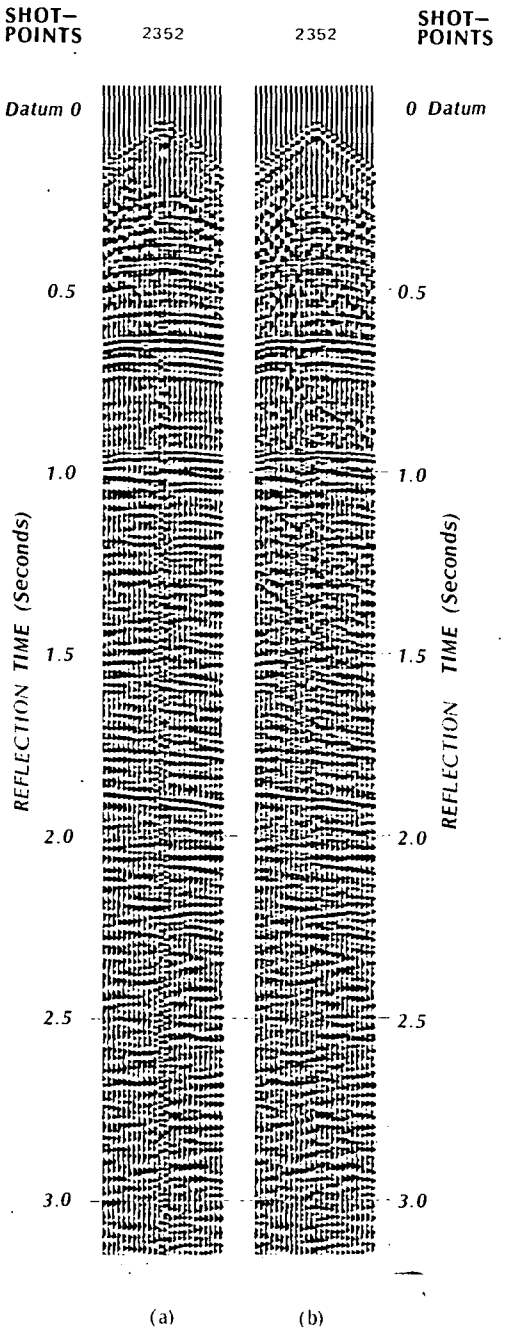
NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE L
NOISE TEST SP 4503

RECORDED BY: *Seismic Party No.1*
SECTION BY: *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No
(Based on G85/3–115–2)

F52/B3–54

PLATE 14

UNCORRECTED RECORD SECTION



RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : L20 – K135

AGC : Med

Gain Initial: –50 to –80

Final : –10

Geophones: HSJ – 14Hz

Geophone Station Interval: 46m

Geophone Pattern:

as indicated

Shot Hole Pattern:

Single
Depth 33.9–36.5m
Charge 22.7kg

PLAYBACK INFORMATION

Filters: L25 – K78

AGC : Med

Gain Initial: –40

Final : –20

Trip Delay : 0.04s

Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

GEOPHONE PATTERN

(a) 24/trace, 6.1m apart in line

(b) 24/trace in 2 rows of 12 in line
Rows 6.1m apart
Geophones 3.8m apart

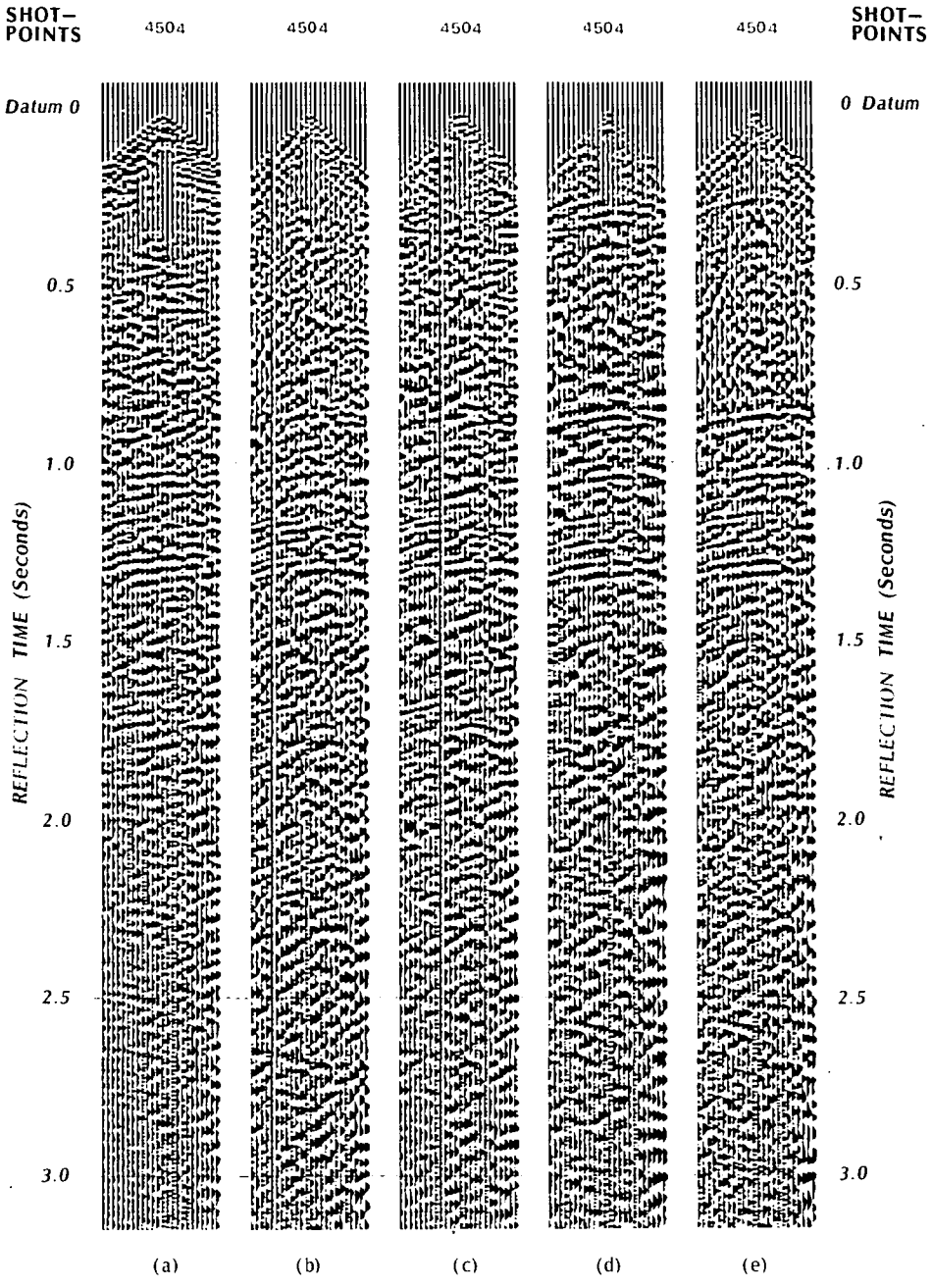
NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE E
SP 2352
GEOPHONE PATTERN COMPARISON

RECORDED BY *Seismic Party No.1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No
(Based on GBS/3–115 2)

To accompany Record No. 1974/49

F52/B3–66A

PLATE 15



	GEOPHONE PATTERN	SHOT–HOLE PATTERN
(a)	24/trace, 3.8m apart in line	Single Depth 24.4–36.5m Charge 90.7kg
(b)	32/trace in 4 rows of 8 in line Rows 9.1m apart Geophones 6.1m apart	5 holes, 15.2m apart in line Depth 34.7–36.5m Charge 5x13.6kg
(c)	32/trace in 2 rows of 16 in line Rows 9.1m apart Geophones 6.1m apart	5 holes, 15.2m apart in line Depth 34.7–36.5m Charge 5x13.6kg
(d)	32/trace in 2 rows of 16 in line Rows 9.1m apart Geophones 6.1m apart	36 holes in 6 rows of 6 in line Rows 15.2m apart Holes 12.2m apart Depth 4.0–4.6m Charge 36x2.3kg
(e)	32/trace in 4 rows of 8 in line Rows 9.1m apart Geophones 6.1m apart	36 holes in 6 rows of 6 in line Rows 12.2m apart Holes 12.2m apart Depth 4.0–4.6m Charge 36x2.3kg

To accompany Record No.1974/49

UNCORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR–20
Amplifiers : PT–700
Prefilters: –
Filters : L20–K135
AGC : Med
Gain Initial: –55 to –80
Final : –10
Geophones: HSJ – 14Hz
Geophone Station Interval: 46m
Geophone Pattern:

as indicated

Shot Hole Pattern:

as indicated

PLAYBACK INFORMATION

Filters: L25 – K78
AGC : Med
Gain Initial: –40
Final : –20
Trip Delay : 0.04s
Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

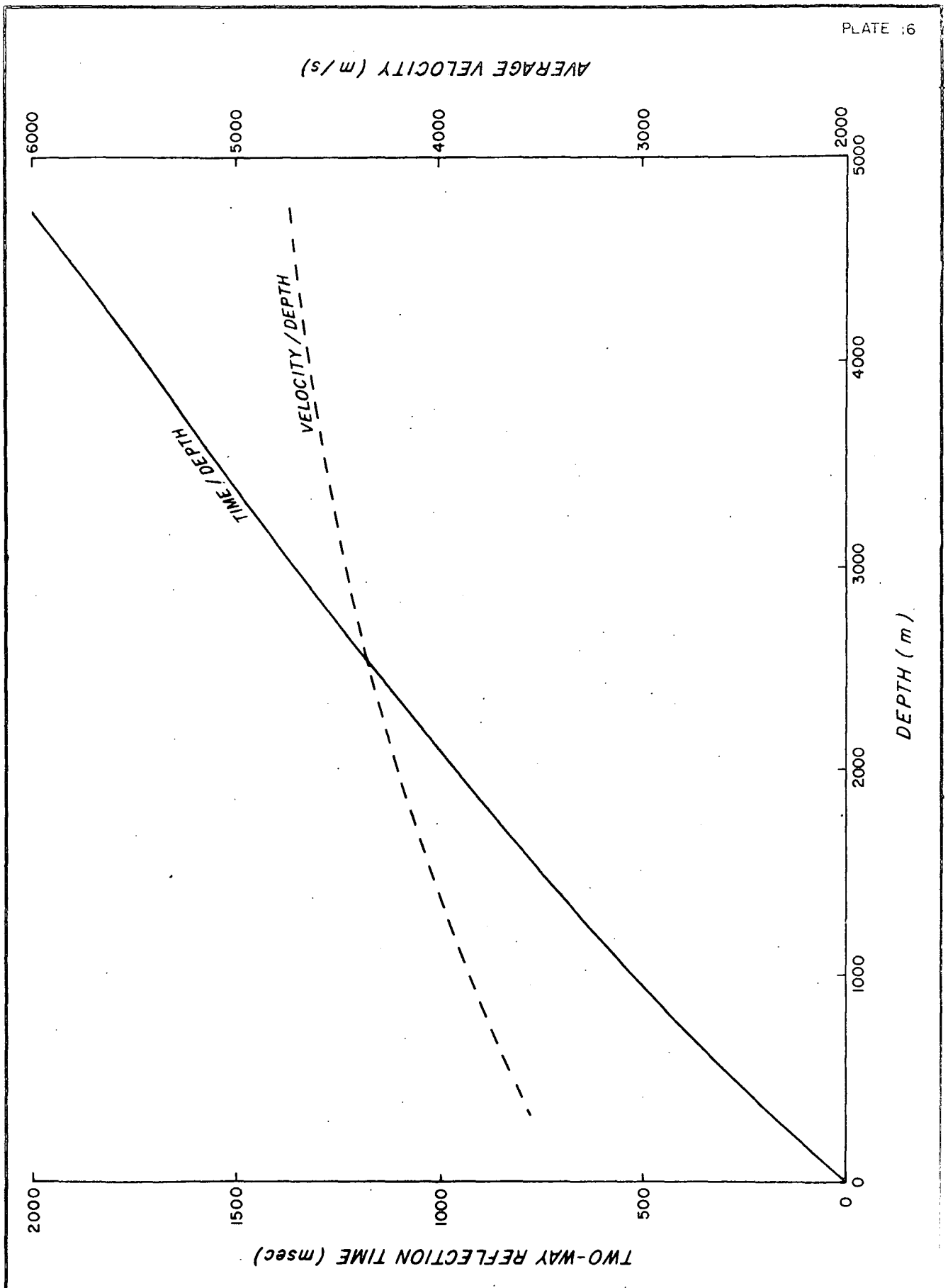
NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969

TRAVERSE L, SP4504 GEOPHONE AND SHOT–HOLE PATTERN COMPARISONS

RECORDED BY *Seismic Party No 1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No
(Based on G85/3–115 2)

F52/B3–61A

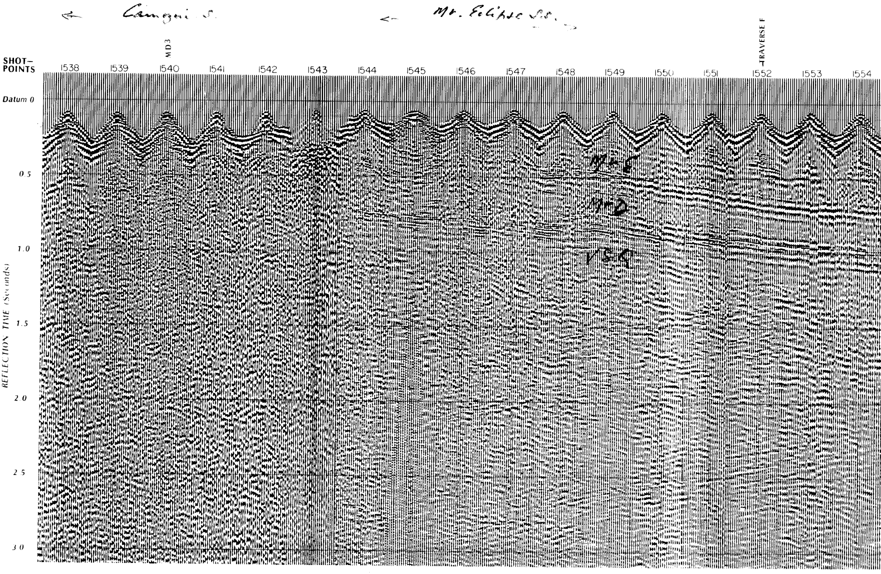
PLATE 16



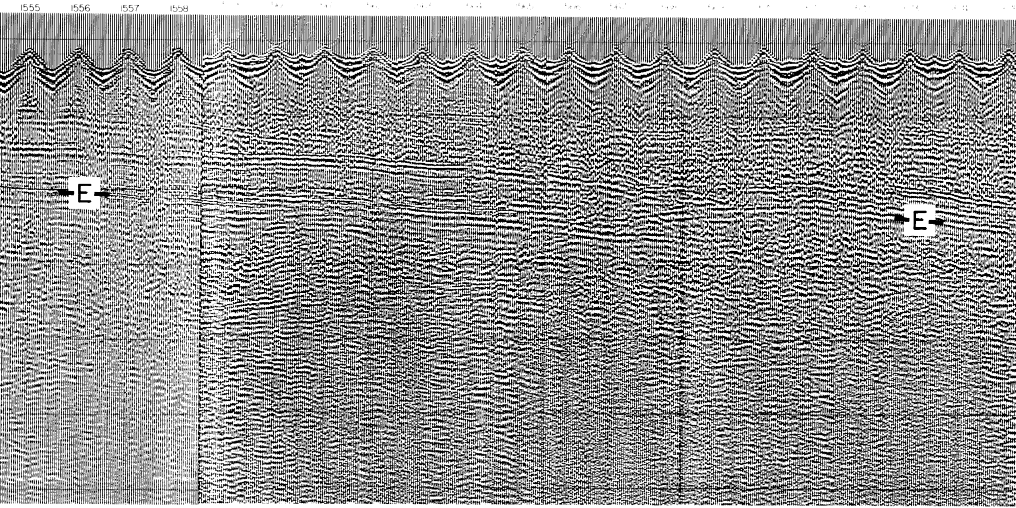
VELOCITY, TIME/DEPTH

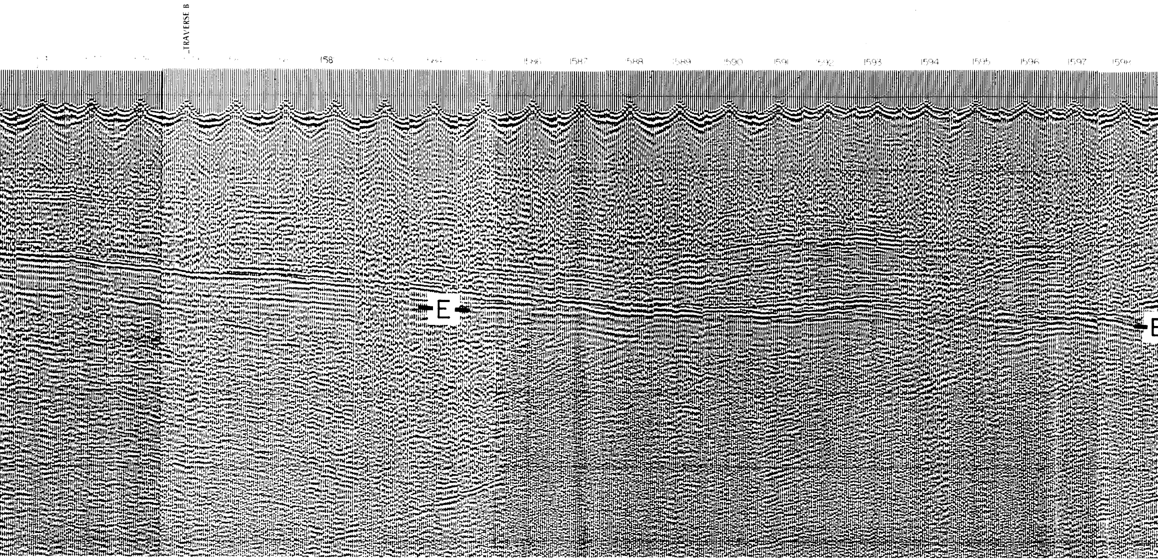
To accompany Record No. 1974/49

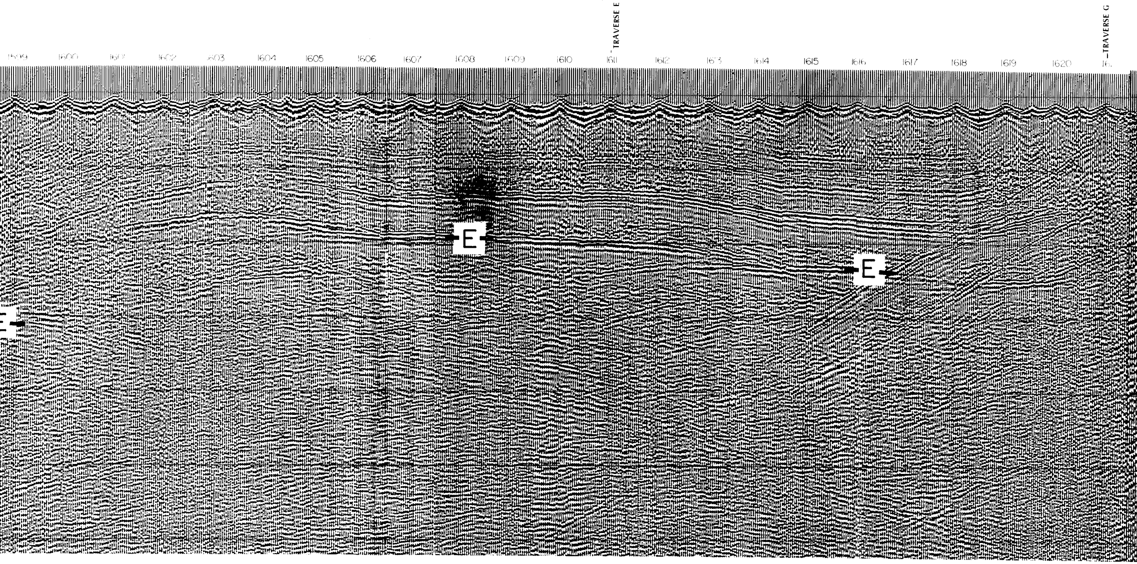
F52/B3-55A

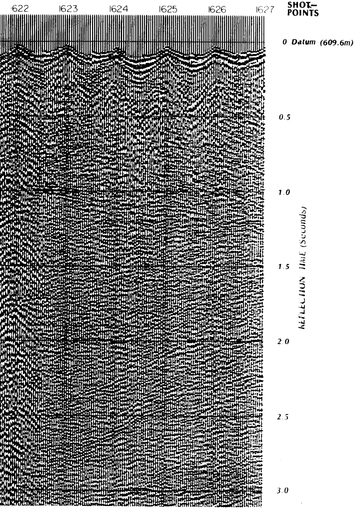


To accompany Record No.1974/49









CORRECTED RECORD SECTION

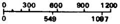
RECORDING INFORMATION	SP1538–1558, SP1622–1627		SP1559–1621
Magnetic Recorder:	PMR–20		DS7–7
Amplifiers :	PT–700		8000 Explorer
Prefilters:	–		–
Filters :	L20 – K135		K18 – K125
AGC :	Med		1/1, 125
Gain Initial:	–55 to –80		–60 and 67
Final :	–10		1 – 31
Geophones:	HSJ – 14Hz		EVS 2 B – 20Hz
Geophone Station Interval:	46m		46m
Geophone Pattern:	24/trace in 2 rows of 12 in line Rows 6.1m apart Geophones 3.8m apart		24/trace in 2 rows of 12 in line Rows 6.7m apart Geophones 3.8m apart
Shot Hole Pattern:	SP1538–1546, SP1622–1627 3 holes 15.2m apart in line Depth 34.7 – 36.5m Charge 3 x 9.1kg	SP1547–1548 5 holes 9.1m apart in line Depth 34.7 – 36.5m Charge 5 x 4.5kg	Single Depth 33.9–36.5m Charge 22.7kg

PLAYBACK INFORMATION	SP1538 – 1558	SP1622 – 1627	
Filters:	L20 – K100	L25 – K78	L25 – K78
AGC :	Med	Med	Med
Gain Initial :	–40	–40	–50
Final :	–20	–20	–20
Trip Delay :	0.1s	0.05s	0.15s
Compositing:	Nil	Nil	Nil

VELOCITY INFORMATION

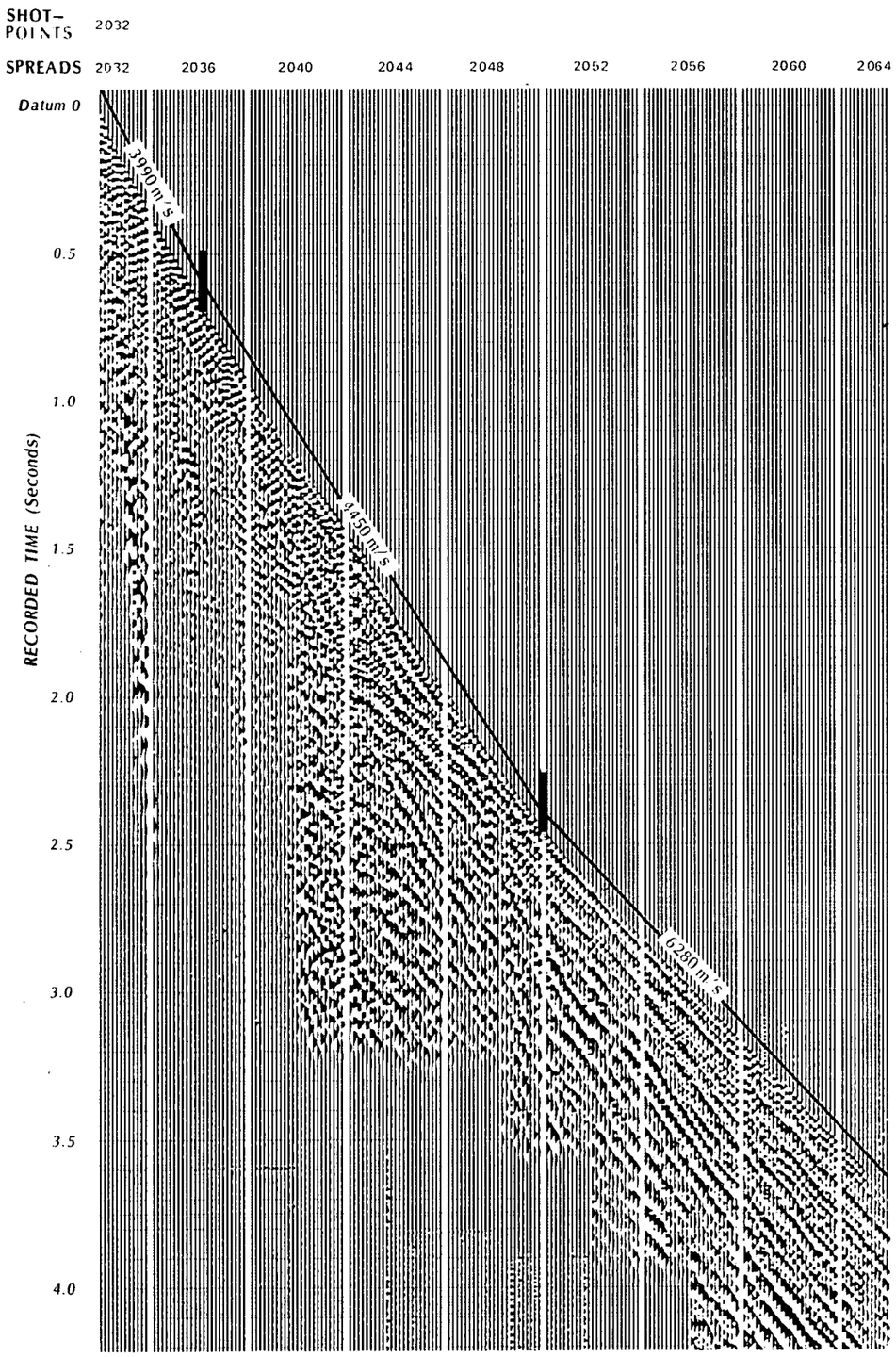
t:Δt	t:Δt	t:Δt

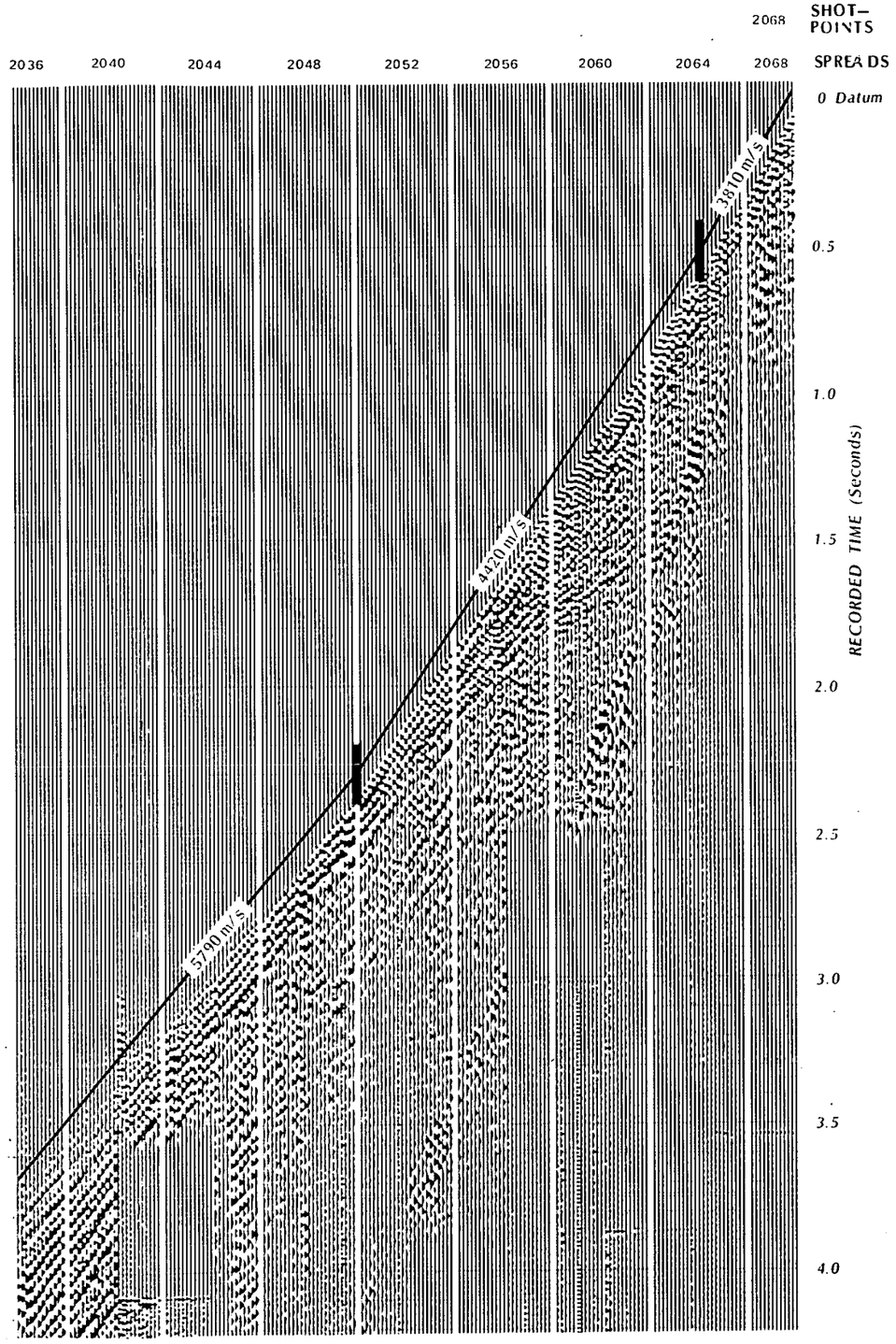
HORIZONTAL SCALE (metres)



NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE A
SP1538 – SP1627

F52/B3–11–1





To accompany Record No. 1974/49

PLATE 18

UNCORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: DS7–7

Amplifiers : 8000 Explorer

Prefilters: –

Filters : 0–K72

AGC : Off

Gain Initial: –23 to –30

Final : 1–31

Geophones: EVS–8V, 4.5Hz

Geophone Station Interval: 91.4m

Geophone Pattern:

4/trace, 6.7m apart in line perpendicular to traverse

Shot Hole Pattern:

Various

PLAYBACK INFORMATION

Filters: L25–K78

AGC : S

Gain Initial: Various

Final : –20

Trip Delay : Various

Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

0 300 600 900 1200

0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE B
REFRACTION PROFILES SP 2032, SP 2068

F52/B3-67–1

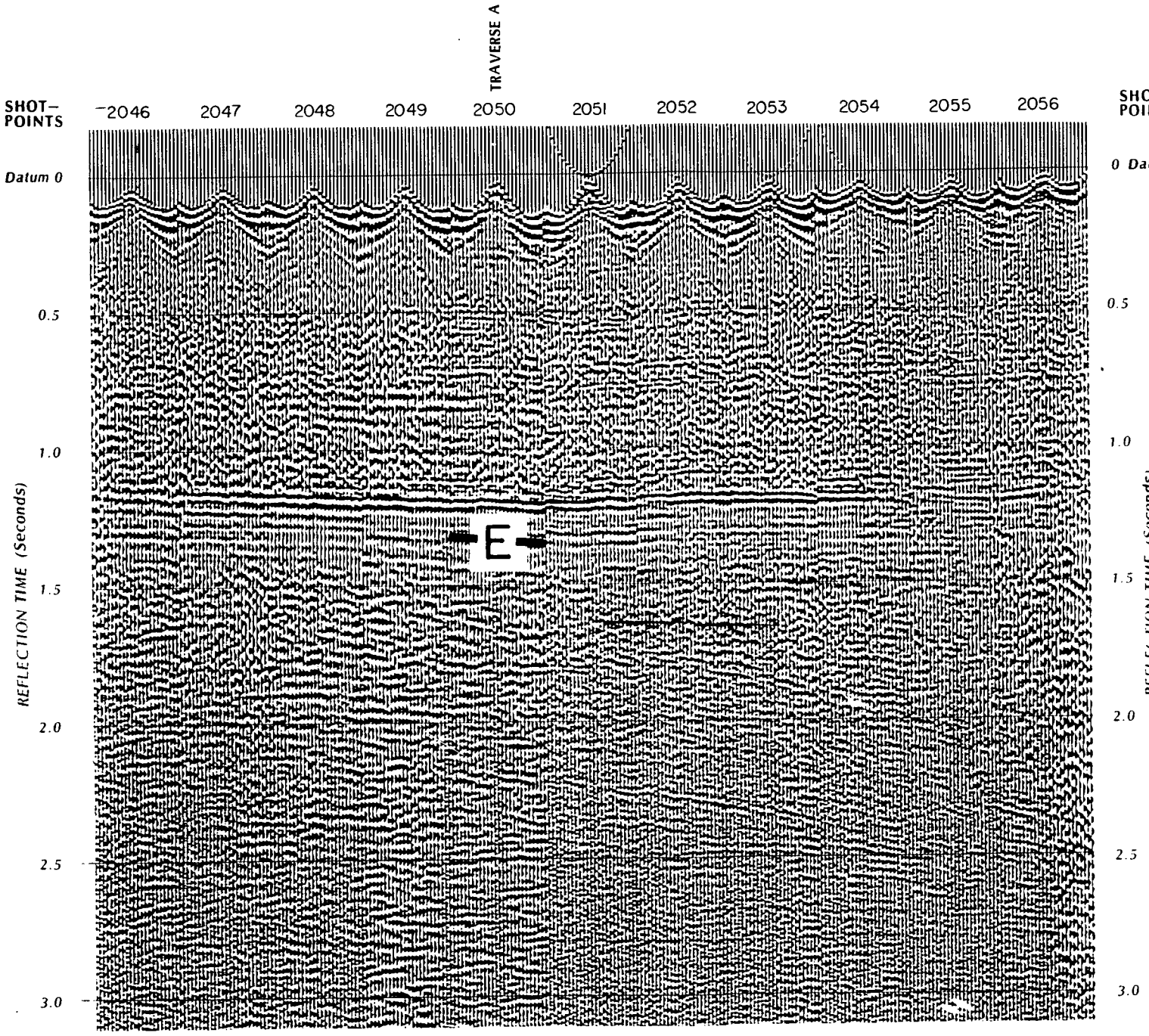


PLATE 19

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: DS7–7

Amplifiers : 8000 Explorer

Prefilters: Nil

Filters : K18 – K125

AGC : 1/1, 125

Gain Initial: –60 and –67

Final : 1 – 31

Geophones: EVS2B – 20Hz

Geophone Station Interval: 46m

Geophone Pattern:

24/trace in 2 rows of 12 in line
Rows 6.7m apart
Geophones 3.8m apart

Shot Hole Pattern:

Single
Depth 33.9–36.5m
Charge 22.7kg

PLAYBACK INFORMATION

Filters: L25 – K78

AGC : Med

Gain Initial: –50

Final : –20

Trip Delay: 0.15s

Compositing: Nil

VELOCITY INFORMATION

t: Δt and Expanded spread at SP 2050

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE B
SP 2046 – SP 2056

F52/83-12-1A

To accompany Record No. 1974/49

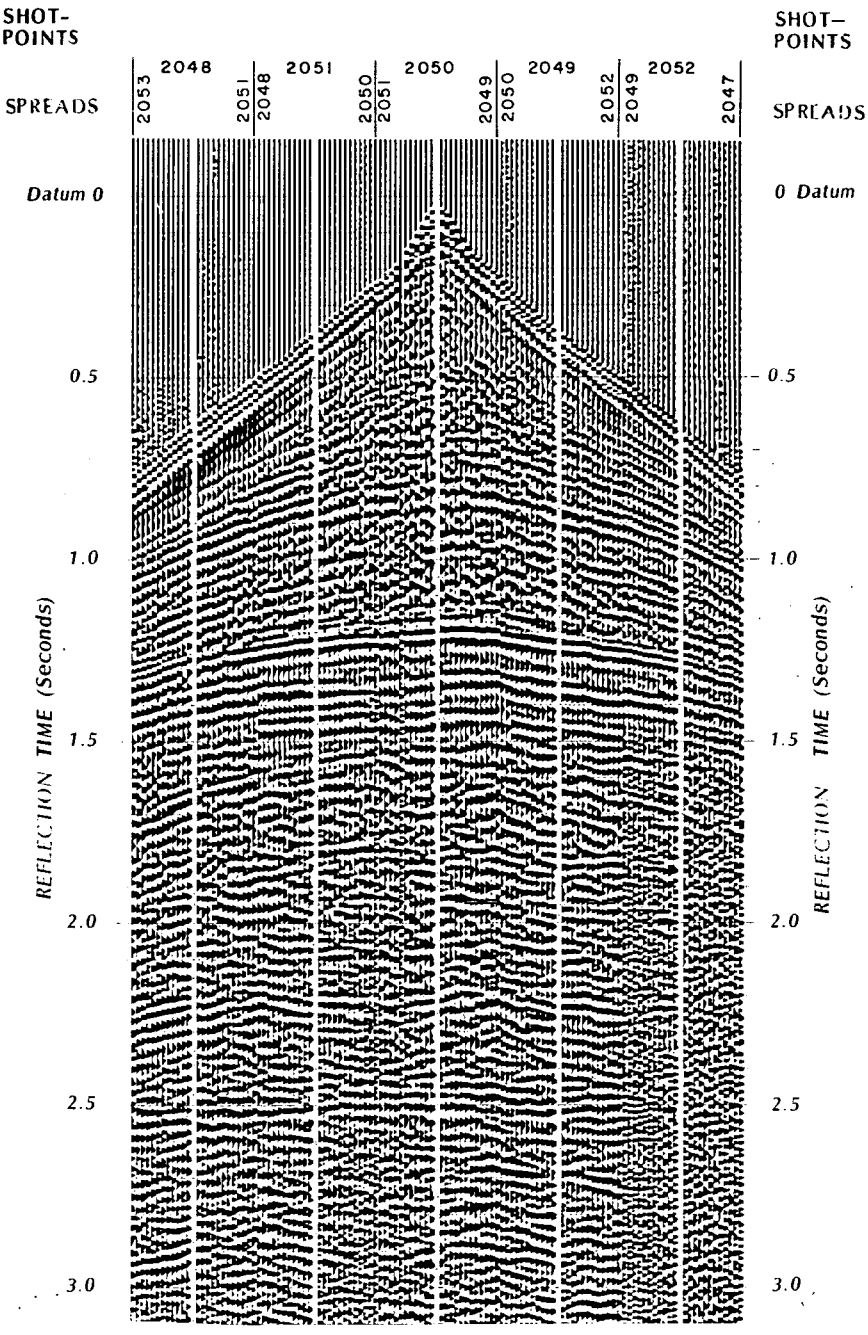


PLATE 20

CORRECTED RECORD SECTION (Weathering Corrections Only)

RECORDING INFORMATION

Magnetic Recorder: DS7–7

Amplifiers : 8000 Explorer

Prefilters: Nil

Filters : K18 – K72

AGC : 1/1, 125

Gain Initial: Various

Final : 1–31

Geophones: EVS2B – 20Hz

Geophone Station Interval: 46m

Geophone Pattern:

24/trace in 2 rows of 12 in line
Rows 6.7m apart
Geophones 3.8m apart

Shot Hole Pattern:

5 holes, 15.2m apart in line
Depth 36.5m
Charge 5x9.1kg

PLAYBACK INFORMATION

Filters: L25 – K78

AGC : Med

Gain Initial: –50

Final : –20

Trip Delay: 0.15 – 0.5s

Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE B
EXPANDED SPREAD AT SP 2050

RECORDED BY *Seismic Party No 1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No
(Based on G85/3–115 2)

F52/B3–13A

To accompany Record No.1974/49

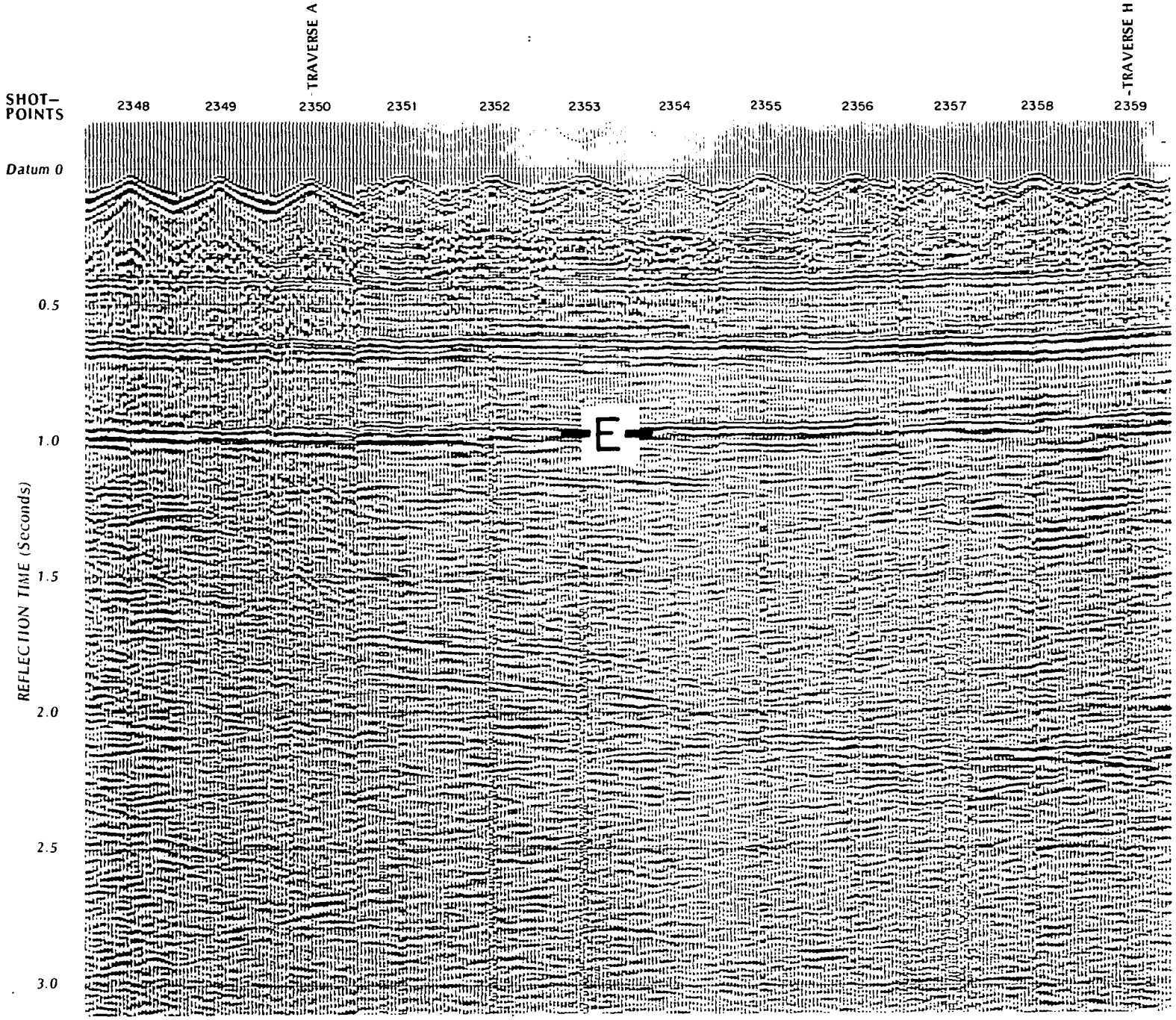


PLATE 21

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : L20 – K135

AGC : Med

Gain Initial: –55 to –80

Final : –10

Geophones: HSJ – 14Hz

Geophone Station Interval: 46m

Geophone Pattern:

SP2348–2357 : 24, trace. 6.1m apart in line
SP2358–2359 : 24, trace. 3.8m apart in line

Shot Hole Pattern:

Single
Depth 36.5m
Charge 22.7kg

PLAYBACK INFORMATION

Filters: L25 – K100

AGC : Med

Gain Initial: –40

Final : –20

Trip Delay : 0.2s

Compositing: Nil

VELOCITY INFORMATION

Expanded Spread at SP 2350

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN

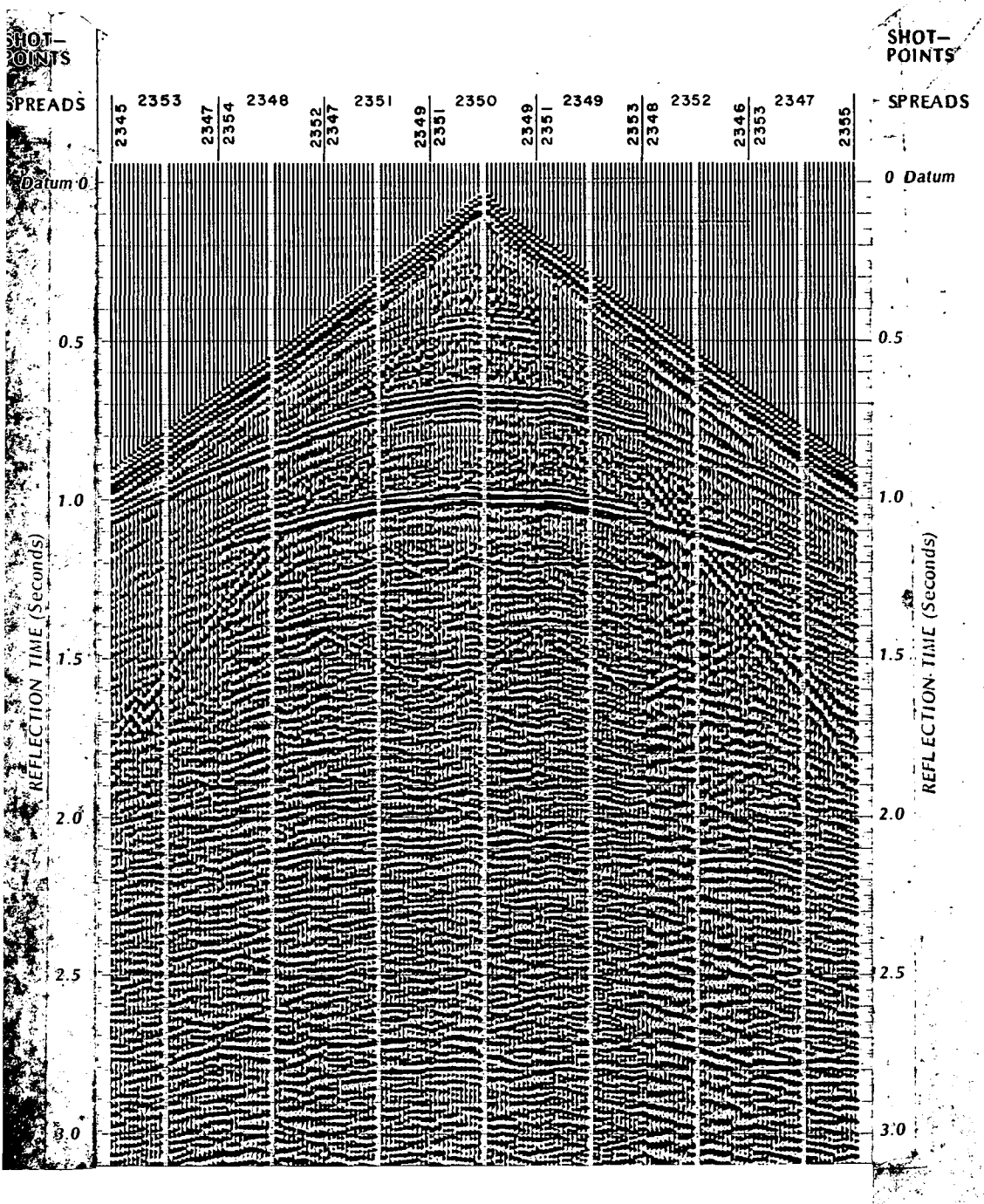
SEISMIC SURVEY NT. 1967–1969

TRAVERSE E

SP 2348 – SP 2359

To accompany Record No.1974/49

F52/83-20-1A



SHOT–POINTS
SPREADS
0 Datum
0.5
1.0
1.5
2.0
2.5
3.0
REFLECTION TIME (Seconds)

PLATE 22

CORRECTED RECORD SECTION
(Weathering Corrections Only)

RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : L20–K135

AGC : Med

Gain Initial: Various

Final : –10

Geophones: HSJ–14Hz

Geophone Station Interval: 46m

Geophone Pattern:

24/trace in 2 rows of 12 in line
Rows 6.1m apart
Geophones 3.8m apart

Shot Hole Pattern:

Single
Depth 21.3–36.5m
Charge 52.2kg

PLAYBACK INFORMATION

Filters: L25–K100

AGC : Med

Gain Initial: –40

Final : –20

Trip Delay: 0.1–0.7s

Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE E
EXPANDED SPREAD AT SP 2350

To accompany Record No. 1974/49

RECORDED BY *Seismic Party No. 1*
SECTION BY: *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD NO.
(Based on GSB/3–115–2)

F52/B3–19A

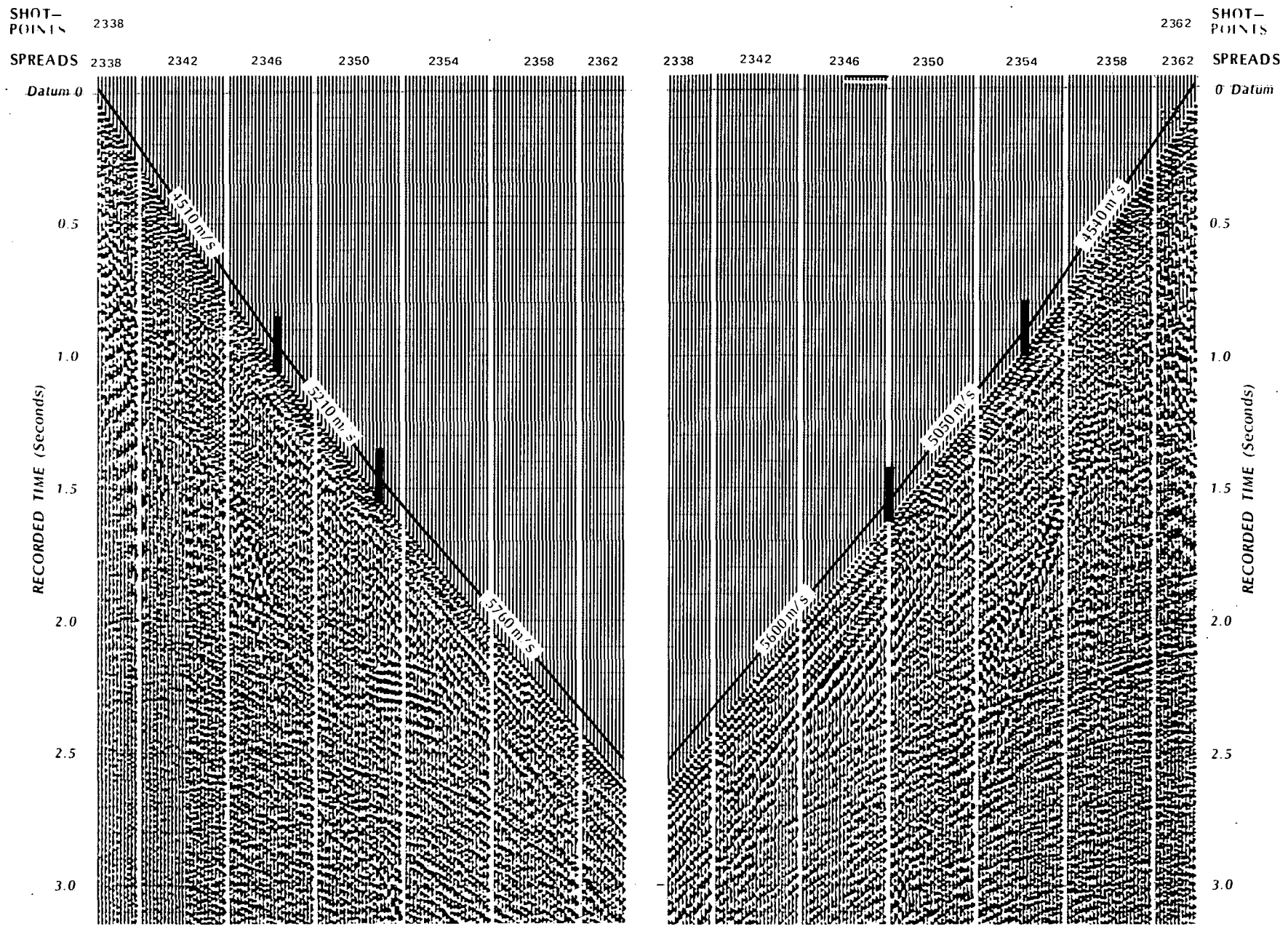


PLATE 23

UNCORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : 0 – K78

AGC : Off

Gain Initial: –

Final : –20 to –10

Geophones: EVS – 8V, 4.5Hz

Geophone Station Interval: 91.4m

Geophone Pattern:

4. trace. 6.7m apart in line. perpendicular to traverse

Shot Hole Pattern:

Varied

PLAYBACK INFORMATION

Filters: L25 – K78

AGC : S

Gain Initial: Various

Final : –20

Trip Delay : Various

Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

0 300 600 900 1200

0 548 1097

NGALIA BASIN

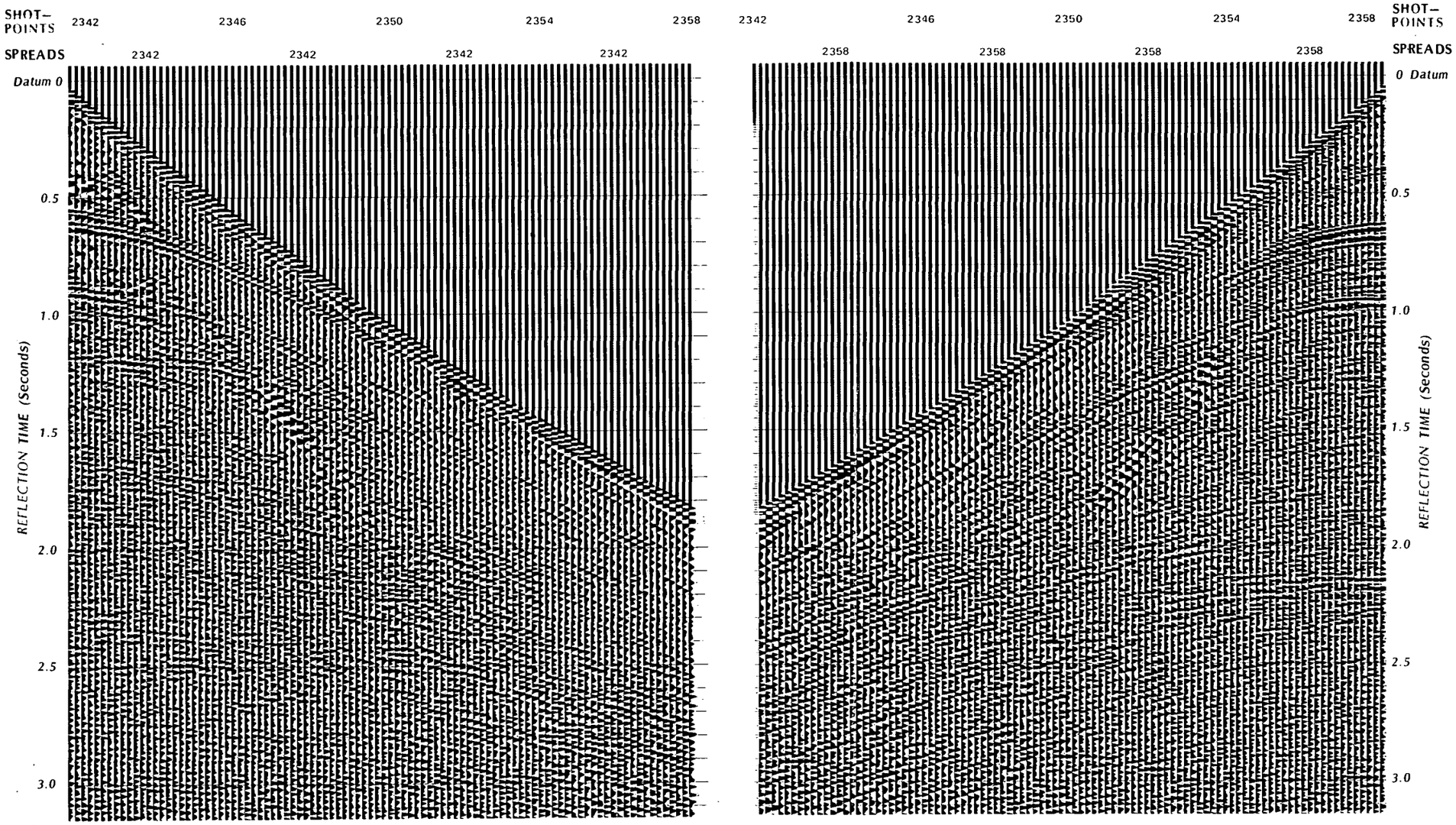
SEISMIC SURVEY NT, 1967–1969

TRAVERSE E

REFRACTION PROFILES SP 2338, SP 2362

To accompany Record No.1974/49

F52/B3–63–1



To accompany Record No.1974/49

PLATE 24

UNCORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : L20 – K135

AGC : Med

Gain Initial: Various

Final : –10

Geophones: HSJ – 14Hz

Geophone Station Interval: 91.4m

Geophone Pattern:

24/trace in 3 rows of 8 in line
Rows 6.1m apart
Geophones 3m apart

Shot Hole Pattern:

3 holes, 15.2 m apart in line
Depth 36.5m
Charge 3x9.1kg to 3x45.4kg

PLAYBACK INFORMATION

Filters: L25 – K78

AGC : Med

Gain Initial: –40

Final : –10

Trip Delay: Various

Compositing: Nil

VELOCITY INFORMATION

Nil

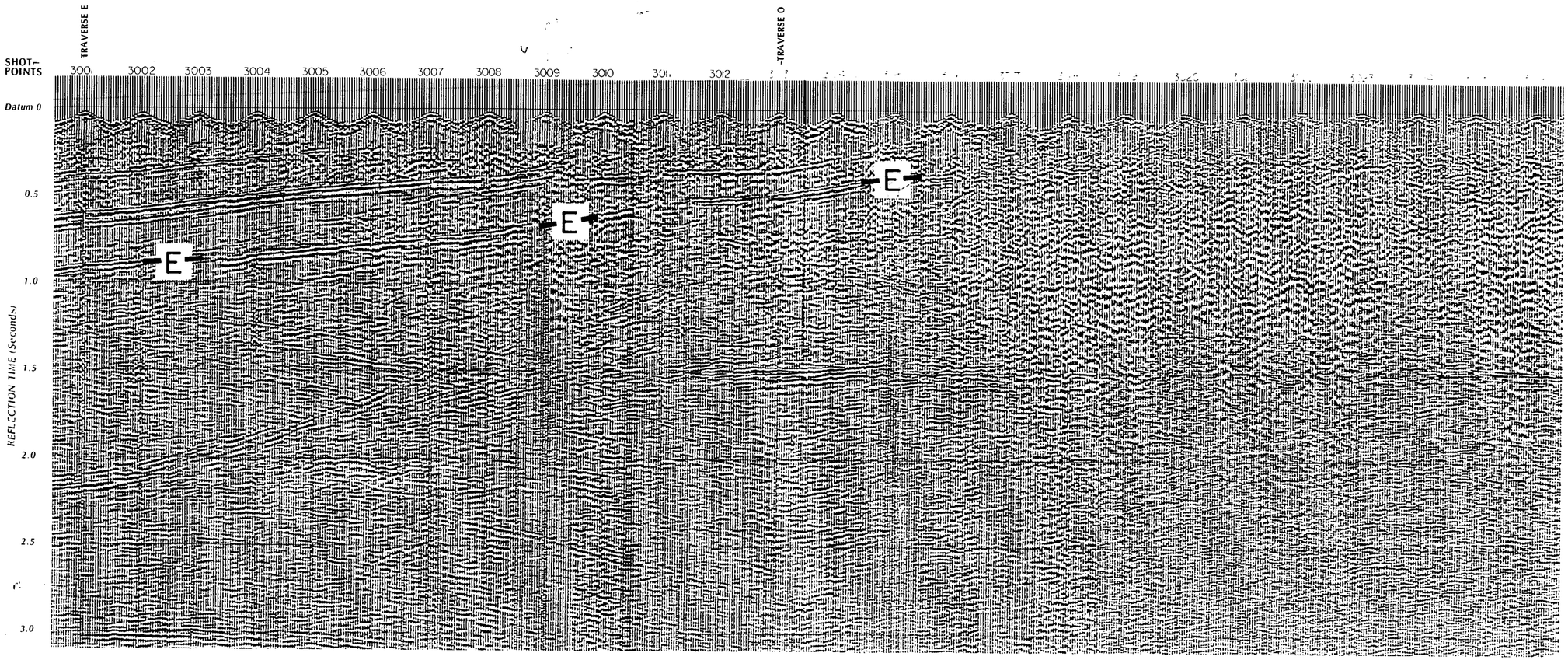
HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE E
OFFSET REFLECTION/REFRACTION
SP 2342, SP 2358

RECORDED BY *Seismic Party No.1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No
(Based on GBS/3–115 2)

F52/B3–62



SHOT-POINTS

0 Datum (609.6m)

0.5

1.0

1.5

2.0

2.5

3.0

REFLECTION TIME (Seconds)

PLATE 25

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : L20 – K135

AGC : Med

Gain Initial: –55 to –80

Final : –10

Geophones: HSJ–14Hz

Geophone Station Interval: 46m

Geophone Pattern:

24/trace, 3.8m apart in line

Shot Hole Pattern:

Single
Depth 34.7–36.5m
Charge 22.7kg

PLAYBACK INFORMATION

Filters: L25 – K100

AGC : Med

Gain Initial: –40

Final : –20

Trip Delay: 0.05s

Compositing: Nil

VELOCITY INFORMATION

t, Δt

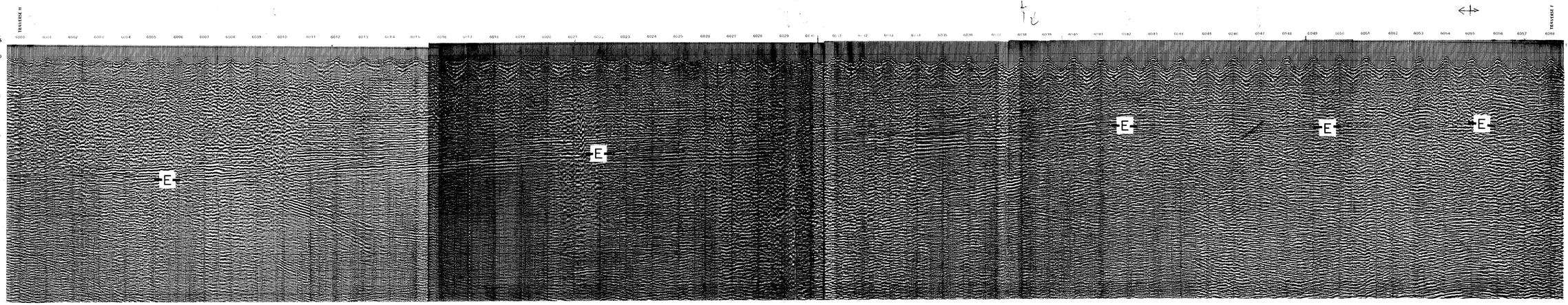
HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT. 1967–1969
TRAVERSE H
SP 3001 – SP 3026

F52/B3–17–1

To accompany Record No.1974/49



SHOT-POINTS
0 Datum (609.6m)
0.5
1.0
1.5
2.0
2.5
3.0
REFLECTION TIME (seconds)

CORRECTED RECORD SECTION

PLATE 26

RECORDING INFORMATION

Magnetic Recorder: PMR-20
Amplifiers: PT-700
Prefilters: –
Filters: L20–K135
AGC: Med
Gain Initial: +55 to +65
Final: +10
Geophones: HSJ–14Hz
Geophone Station Interval: 46m
Geophone Pattern:

24/trace, 3.8m apart in line

Shot Hole Pattern:

3 holes, 15.2m apart in line
Depth 33.9–36.5m
Charge 3x22.7kg

PLAYBACK INFORMATION

Filters: L25–K78
AGC: Med
Gain Initial: –40
Final: –20
Trip Delay: 0.25
Compositing: Nil

VELOCITY INFORMATION

t : Δt

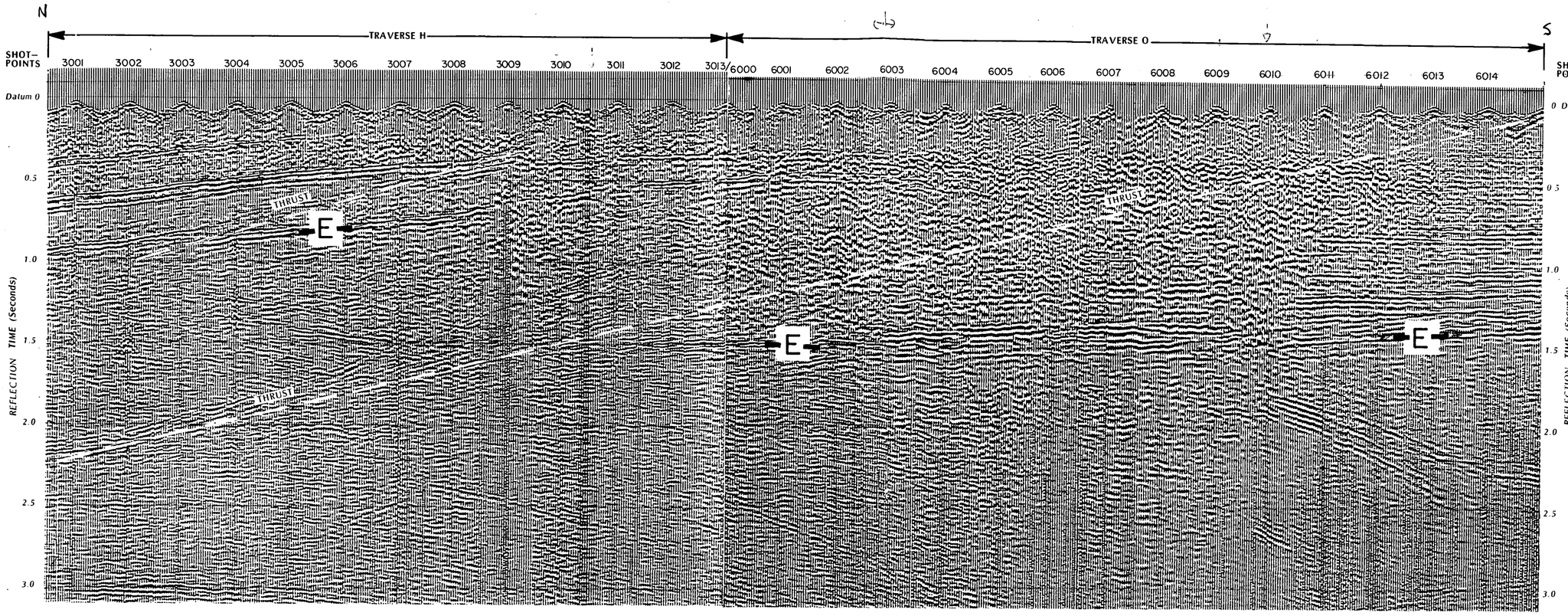
HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT. 1967–1969
TRAVERSE O
SP6000 –SP6058

F52/B3-41-1

o accompany Record No.1974/49



CORRECTED RECORD SECTION

PLATE 27

RECORDING INFORMATION

Magnetic Recorder: PMR–20
Amplifiers: PT–700
Prefilters: –
Filters: L20 – K135
AGC Med
Gain Initial: –55 to –80
Final: –10
Geophones: HSI – 14Hz
Geophone Station Interval: 46m
Geophone Pattern:

24/trace, 3.8m apart in line

Shot Hole Pattern:

SP3001 – 3013	SP6000 – 6014
Single	3 holes, 152m apart in line
Depth 34.7–36.5m	Depth 33.9–36.5m
Charge 22.7kg	Charge 3x22.7kg

PLAYBACK INFORMATION

Filters:	L25–K100	L25–K78
AGC	Med	Med
Gain Initial:	–40	–40
Final:	–20	–20
Trip Delay:	0.2s	0.05s
Compositing:	Nil	Nil

VELOCITY INFORMATION

$t:\Delta t$

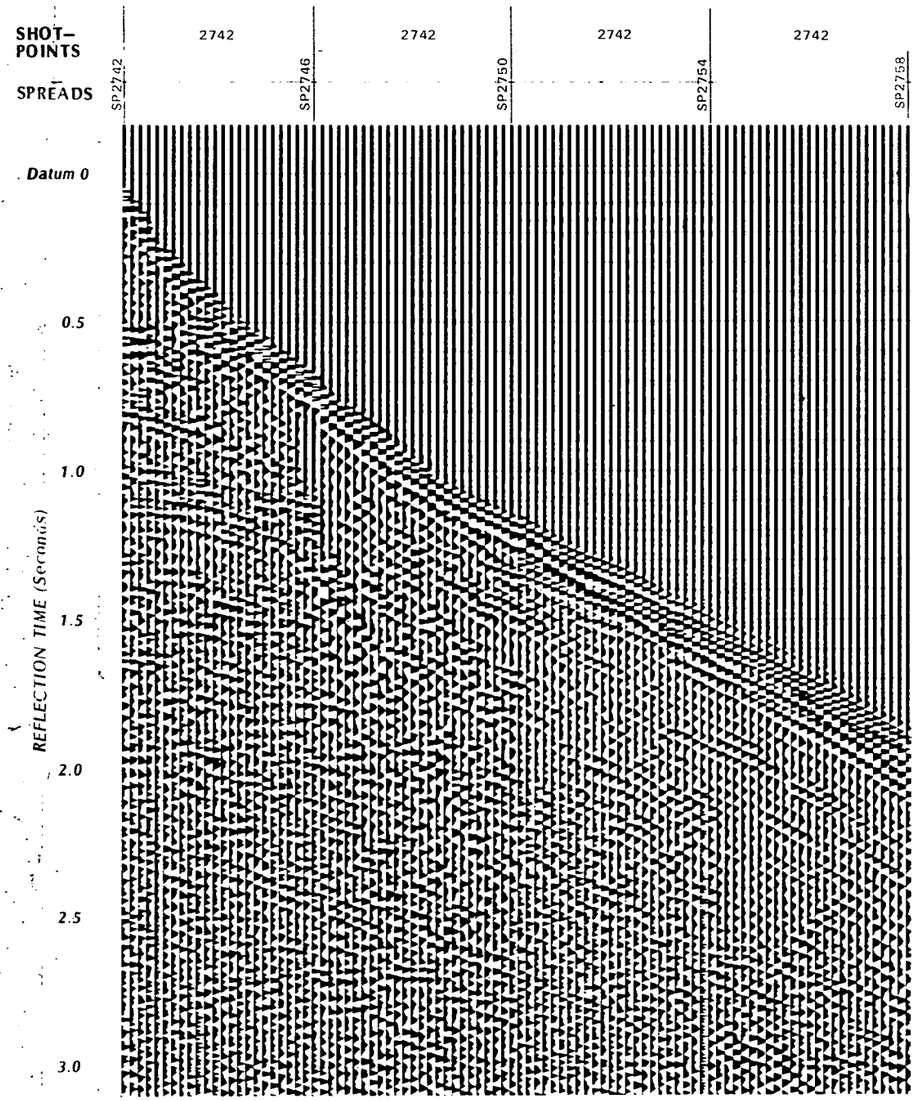
HORIZONTAL SCALE (metres)

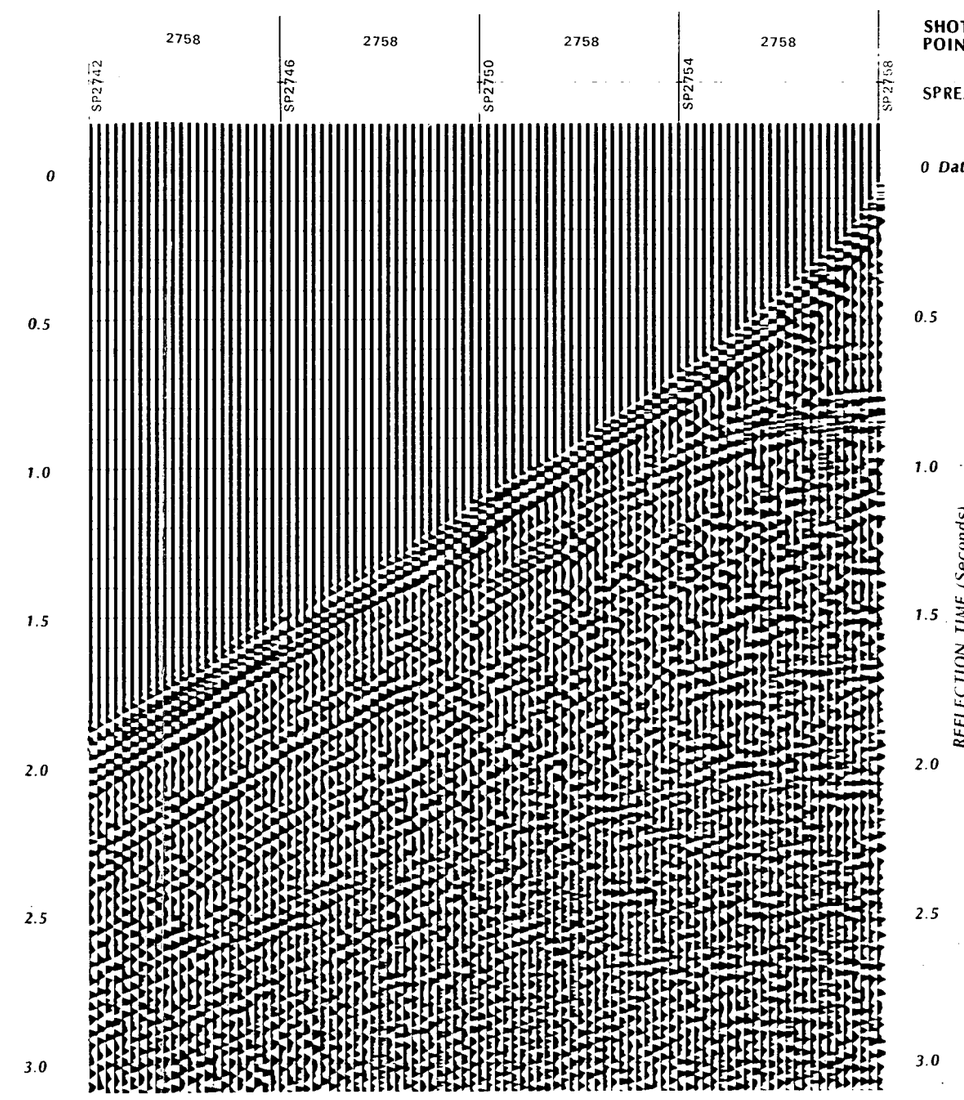
0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSES H AND O
THRUST FAULTING

To accompany Record No.1974/49

F52/B3-57-1





UNCORRECTED RECORD SECTION

PLATE 28

RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : L20 – K135

AGC : Med

Gain Initial: Various

Final : –10

Geophones: HSJ – 14Hz

Geophone Station Interval: 91.4m

Geophone Pattern:

24/trace in 3 rows of 8 in line
Rows 6.1m apart
Geophones 6.1m apart

Shot Hole Pattern:

3 holes, 15.2m apart in line
Depth 36.5m
Charge 3x2.3kg to 3x15.9kg

PLAYBACK INFORMATION

Filters: L25 – K78

AGC : Fast

Gain Initial: –40

Final : –20

Trip Delay : Various

Compositing: Nil

VELOCITY INFORMATION

Nil

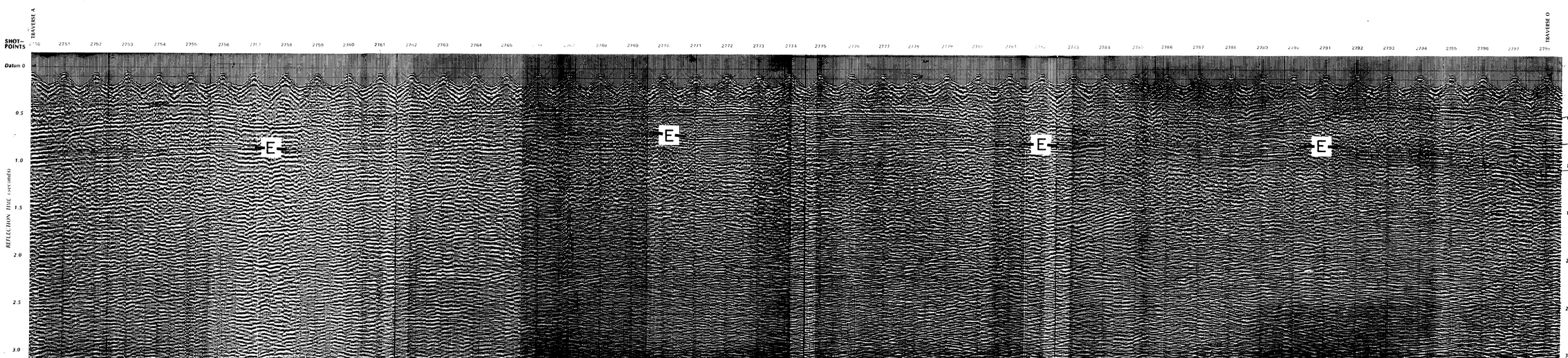
HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE F
OFFSET REFLECTION/REFRACTION
SP 2742, SP 2758

To accompany Record No. 1974/49

F52/B3–32–1



CORRECTED RECORD SECTION

PLATE 29

RECORDING INFORMATION

Magnetic Recorder: PNR–20
Amplifiers : PI–700
Prefilters: –
Filters : L20 – K135
AGC : Med
Gain Initial: –80 to –70
Final : –10
Geophones: HSJ – 14Hz
Geophone Station Interval: 46m
Geophone Pattern:

24/trace, 3,8m apart in line

Shot Hole Pattern:

3 holes, 15,2m apart in line
Depth 36,5m
Charge 3x6,8kg

PLAYBACK INFORMATION

Filters: L25 – K78
AGC : Med
Gain Initial : –40
Final : –20
Trip Delay : 0,2s
Compositing: Nil

VELOCITY INFORMATION

1:Δt and Expanded Spread at SP2789

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE F
SP 2750 – SP 2798

F52/B3–43–1

any Record No.1974/A9

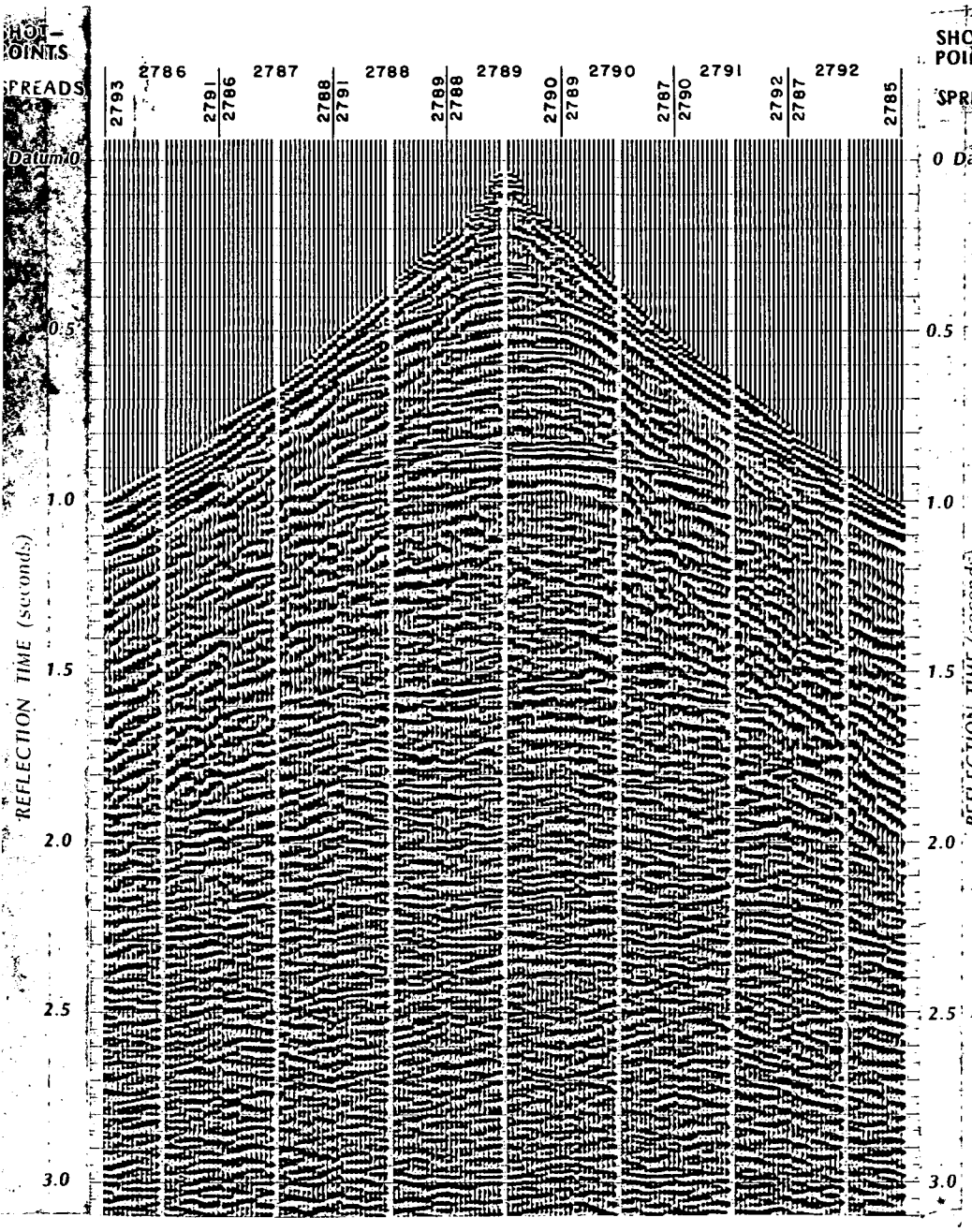


PLATE 30

UNCORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR-20
Amplifiers: PT-700
Prefilters: –
Filters: L20–K135
AGC: Med
Gain Initial: –40
Final: –10
Geophones: HSJ–14Hz
Geophone Station Interval: 46m
Geophone Pattern:

24/trace, 3.8m apart in line

Shot Hole Pattern:

3 holes, 15.2m apart in line
Depth 36.5m
Charge 3x13.6kg

PLAYBACK INFORMATION

Filters: L25–K78
AGC: Med
Gain Initial: –40
Final: –20
Trip Delay: Various
Compositing: Nil

VELOCITY INFORMATION

HORIZONTAL SCALE (metres)

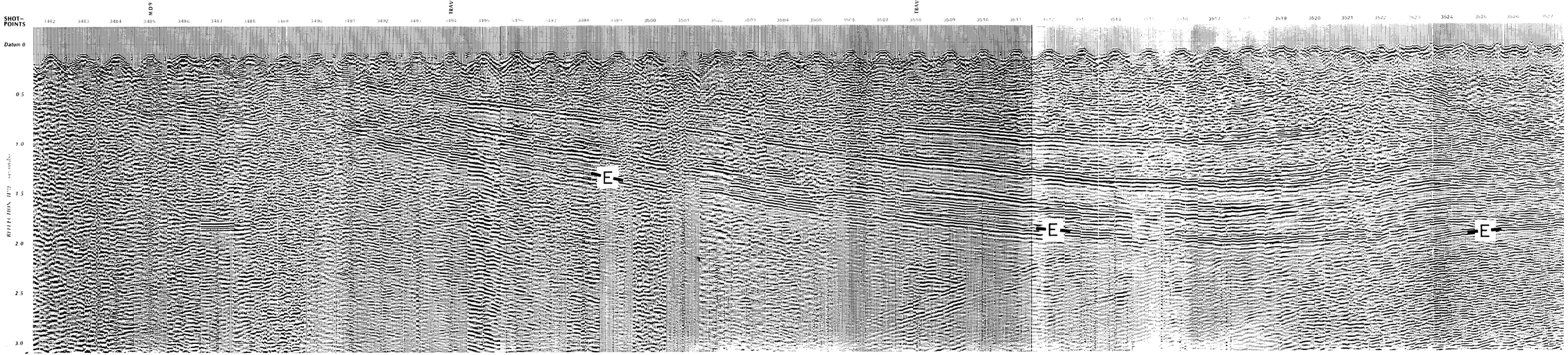
0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE F
EXPANDED SPREAD AT SP 2789

RECORDED BY: *Seismic Party No.1*
SECTION BY: *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No
(Based on GBS/3-115-2)

F52/B3-45A

To accompany Record No.1974/49



SHOT-POINTS
0 Datum (609.6m)
0.5
1.0
1.5
2.0
2.5
3.0
REFLECTION TIME - seconds

PLATE 3

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR-20
Amplifiers : PT-700
Prefilters: -
Filters : L20-K135
AGC : Med
Gain Initial: Various
Final : -10 to -20
Geophones: HSJ-14Hz
Geophone Station Interval: 46m
Geophone Pattern:

24 trace 6.1m apart in line

Shot Hole Pattern:

3 holes 15.2m apart in line
Depth 36.5m
Charge 3x11.3kg to 3x15.9kg

PLAYBACK INFORMATION

Filters: L25-K78
AGC : Med
Gain Initial : -40
Final : -20
Trip Delay : 0.2s
Compositing: Nil

VELOCITY INFORMATION

t:X1

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 548 1097

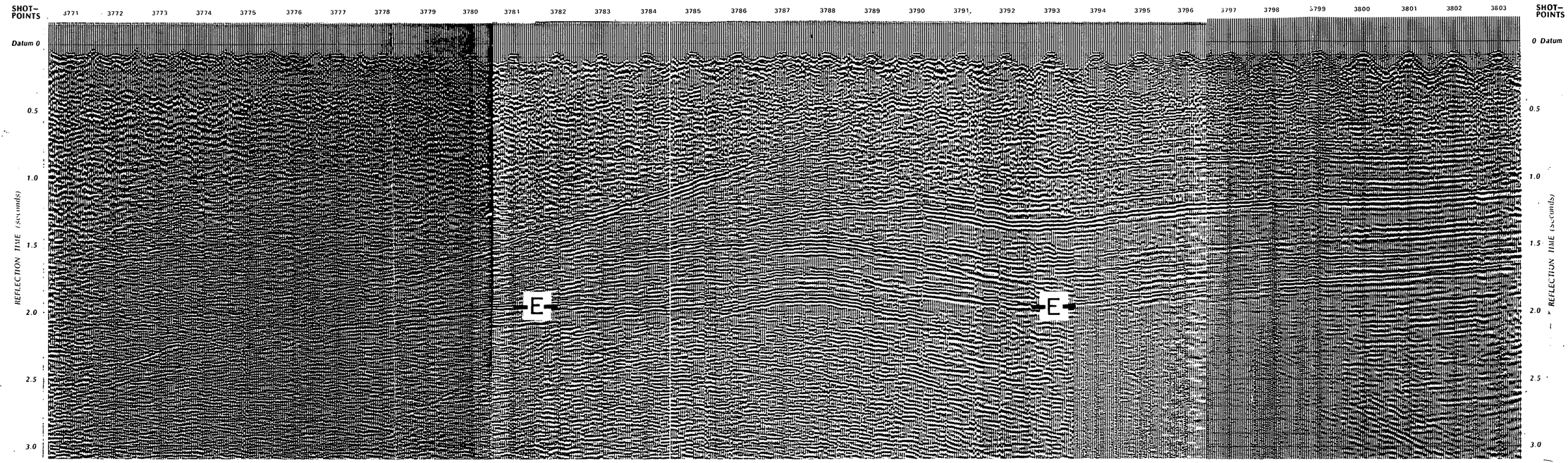
NGALIA BASIN
SEISMIC SURVEY NT, 1967-1969
TRAVERSE J
SP 3482 - SP 3527

F52/83-23-1

To accompany Record No 1974/49

TRAVERSE J

PLATE 32



CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR–20
Amplifiers : PT–700
Prefilters: –
Filters : L20 – K135
AGC : Med
Gain Initial: Various
Final : 0 to –10
Geophones: HSJ – 14Hz
Geophone Station Interval: 46m
Geophone Pattern:

24/trace, 6.1m apart in line

Shot Hole Pattern:

3 holes, 15.2m apart in line
Depth 36.5m
Charge 3x13.6kg to 3x22.7kg

PLAYBACK INFORMATION

Filters: L25 – K78
AGC : Med
Gain Initial : –40
Final : –20
Trip Delay : 0.15s – 0.3s
Compositing: Nil

VELOCITY INFORMATION

t : Δt and Expanded Spread at SP 3800

HORIZONTAL SCALE (metres)

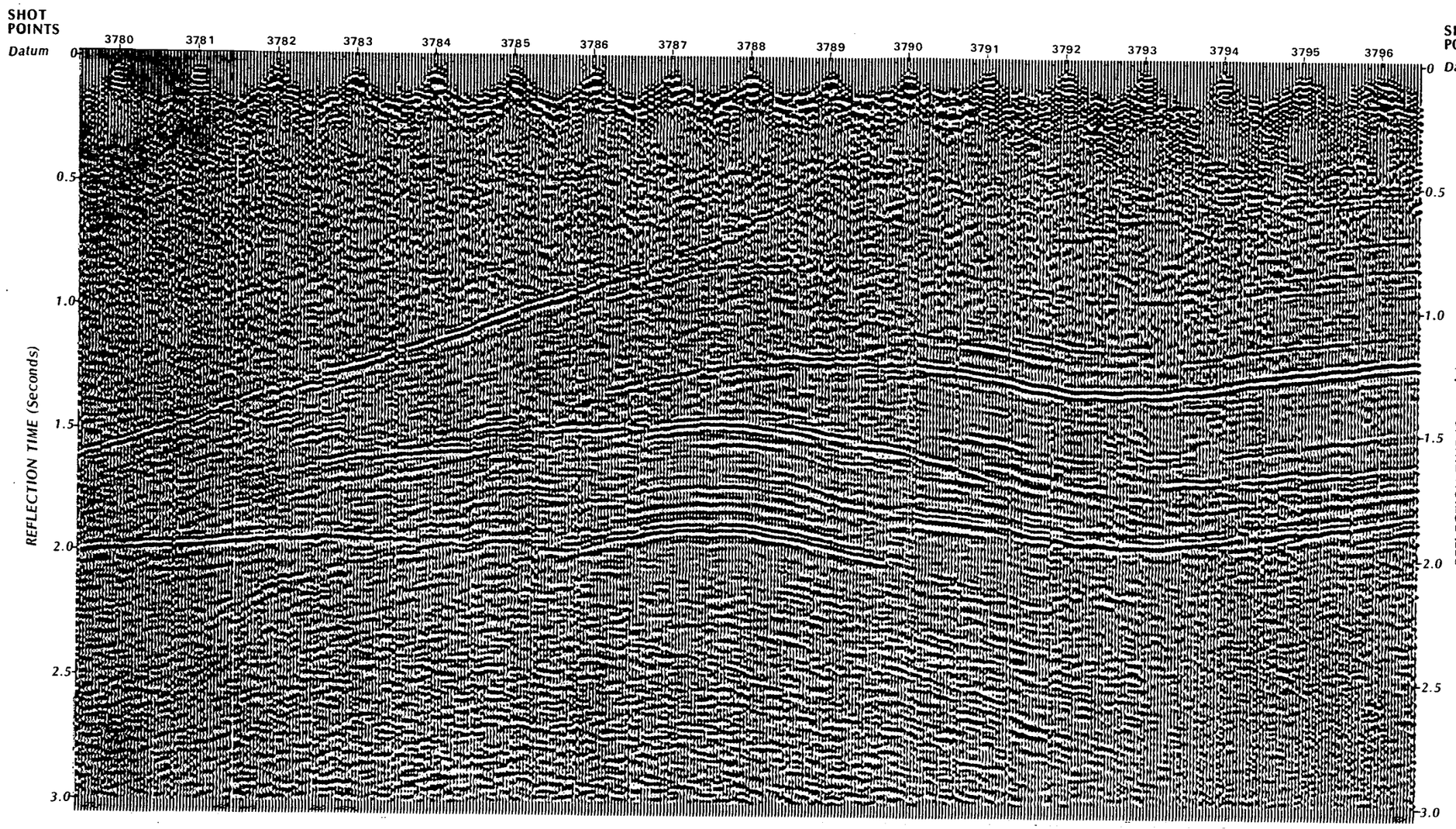
0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE K
SP 3771 – SP 3803

F52/B3–42–1

To accompany Record No.1974/49

PLATE 33



1-FOLD DYNAMITE	
Cable length	3600 ft
Group interval	150 ft
Shot Point interval	3750 ft
Recording length	5.0 s

ANALOG – DIGITAL TRANSCRIPTION

3 s 4 ms

STATIC CORRECTION (DATUM STATICS)

TIME VARYING DECONVOLUTION

Total Gate	0.3–2.9 s
Number of Gates	4
Number of Filter Points	24

NMO AND STATIC CORRECTION (SMOOTHING STATICS)

DISPLAY

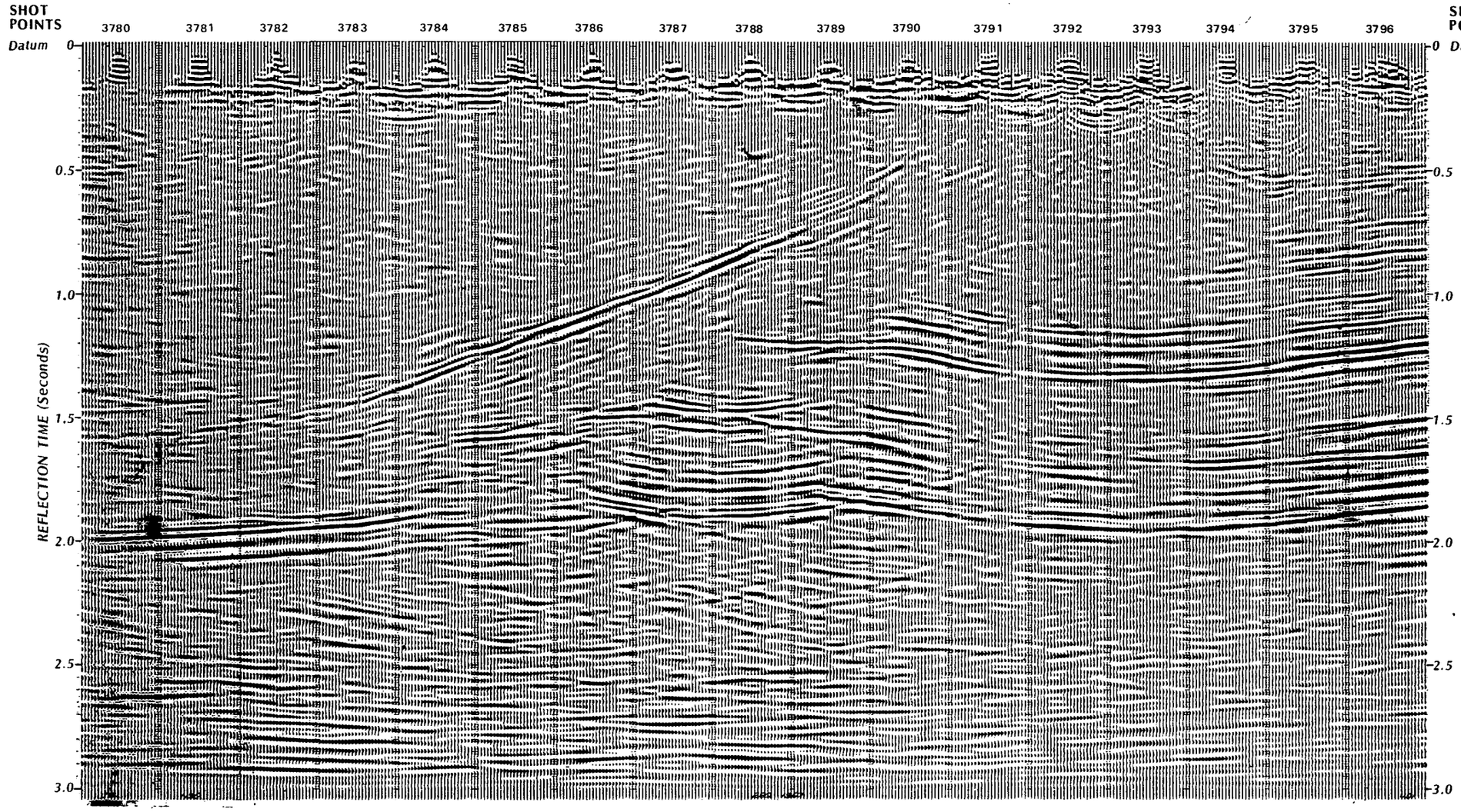
Filter: 15–50Hz

NGALIA BASIN
SEISMIC SURVEY N T , 1967–1969
TRAVERSE K
SP 3780 – SP 3796

To accompany Record No. 1974/49

F52/B3-77

PLATE 34



1-FOLD DYNAMITE	
Cable length	3600 ft
Group interval	150 ft
Shot Point interval	3750 ft
Recording length	5.0 s

ANALOG – DIGITAL TRANSCRIPTION

3 s 4 ms

STATIC CORRECTION (DATUM STATICS)

TIME VARYING DECONVOLUTION

Total Gate	0.3–2.9 s
Number of Gates	4
Number of Filter Points	24

NMO AND STATIC CORRECTION (SMOOTHING STATICS)

MIGRATION STACK

Digital Filter	10–60 Hz
Aperture	204 Traces
Inversity Scaling	

DISPLAY

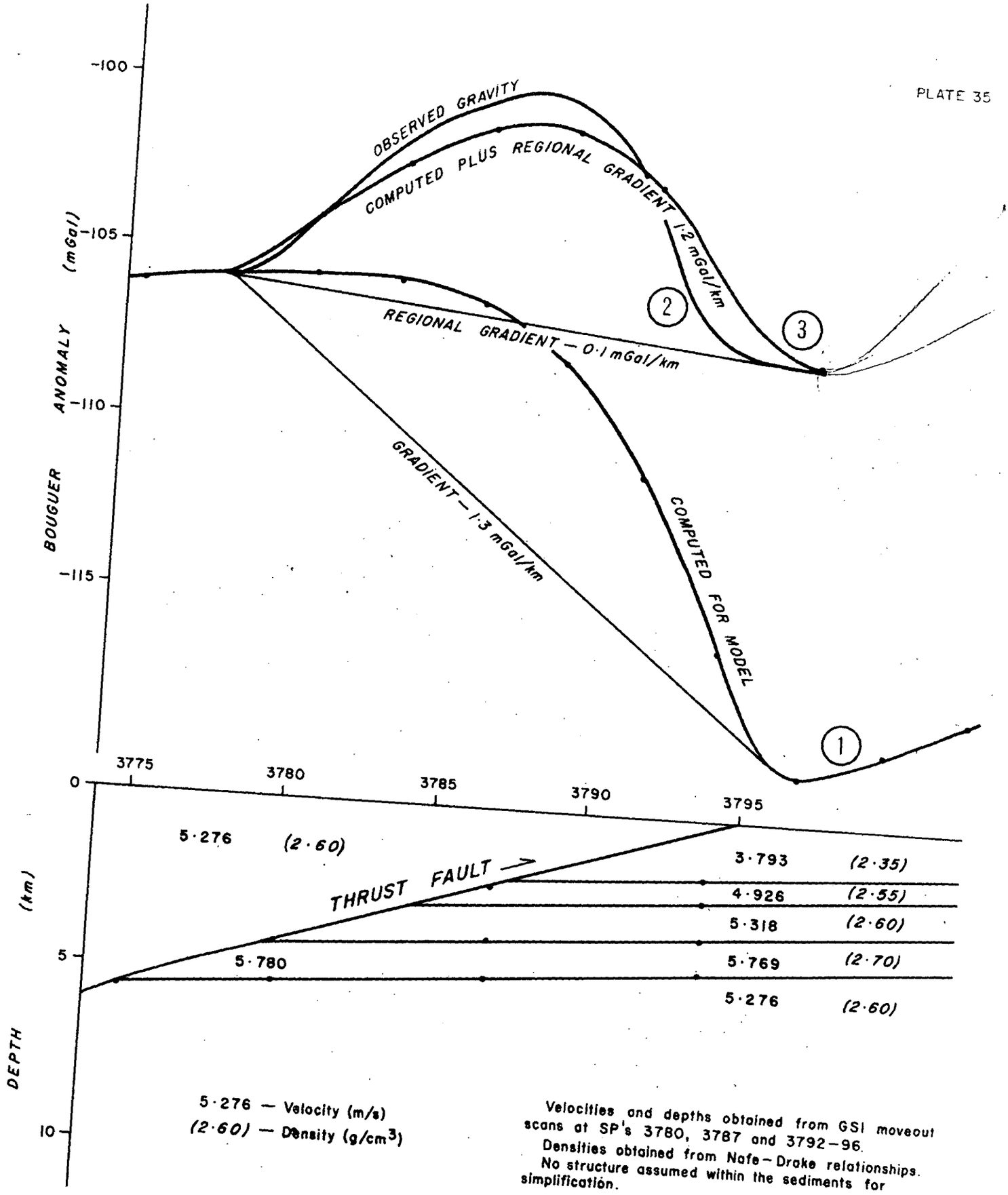
Filter: 15–50 Hz

NGALIA BASIN
SEISMIC SURVER N T , 1967–1969
TRAVERSE K
SP 3780 – SP 3796

F52/B3-78

To accompany Record No.1974/49

PLATE 35



Velocities and depths obtained from GSI moveout scans at SP's 3780, 3787 and 3792–96.
Densities obtained from Nafe–Drake relationships.
No structure assumed within the sediments for simplification.

TRAVERSE K
BOUGUER ANOMALY PROFILE AND SEISMIC MODEL

To accompany Record No. 1974/49

F52/B2-56 A

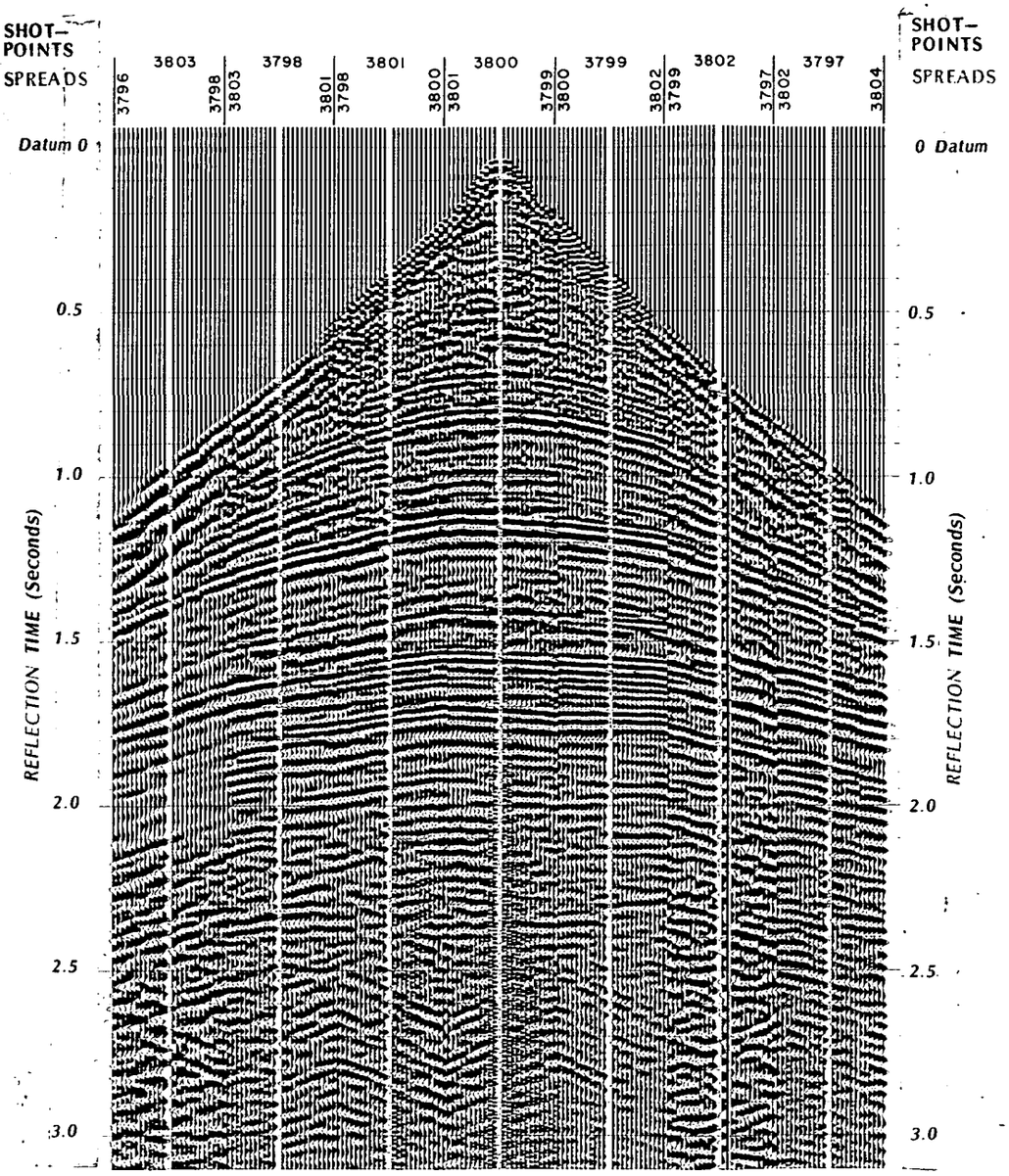


PLATE 36

CORRECTED RECORD SECTION (Weathering Corrections Only)

RECORDING INFORMATION

Magnetic Recorder: PMR–20
Amplifiers : PT–700
Prefilters: –
Filters : L20 –K135
AGC : Med
Gain Initial: Various
Final : 0 to –10
Geophones: HSJ – 14Hz
Geophone Station Interval: 46m
Geophone Pattern:

24/trace, 6.1m apart in line

Shot Hole Pattern:

3 holes, 15.2m apart in line
Depth 36.5m
Charge 3x18.1kg to 36.3kg

PLAYBACK INFORMATION

Filters: L25 – K78
AGC : Med
Gain Initial: –40
Final : –20
Trip Delay: Various
Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE K
EXPANDED SPREAD AT SP 3800

RECORDED BY *Seismic Party No 1*
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD No
(Based on GBS/3–115 2)

F52/B3–27

To accompany Record No. 1974/49

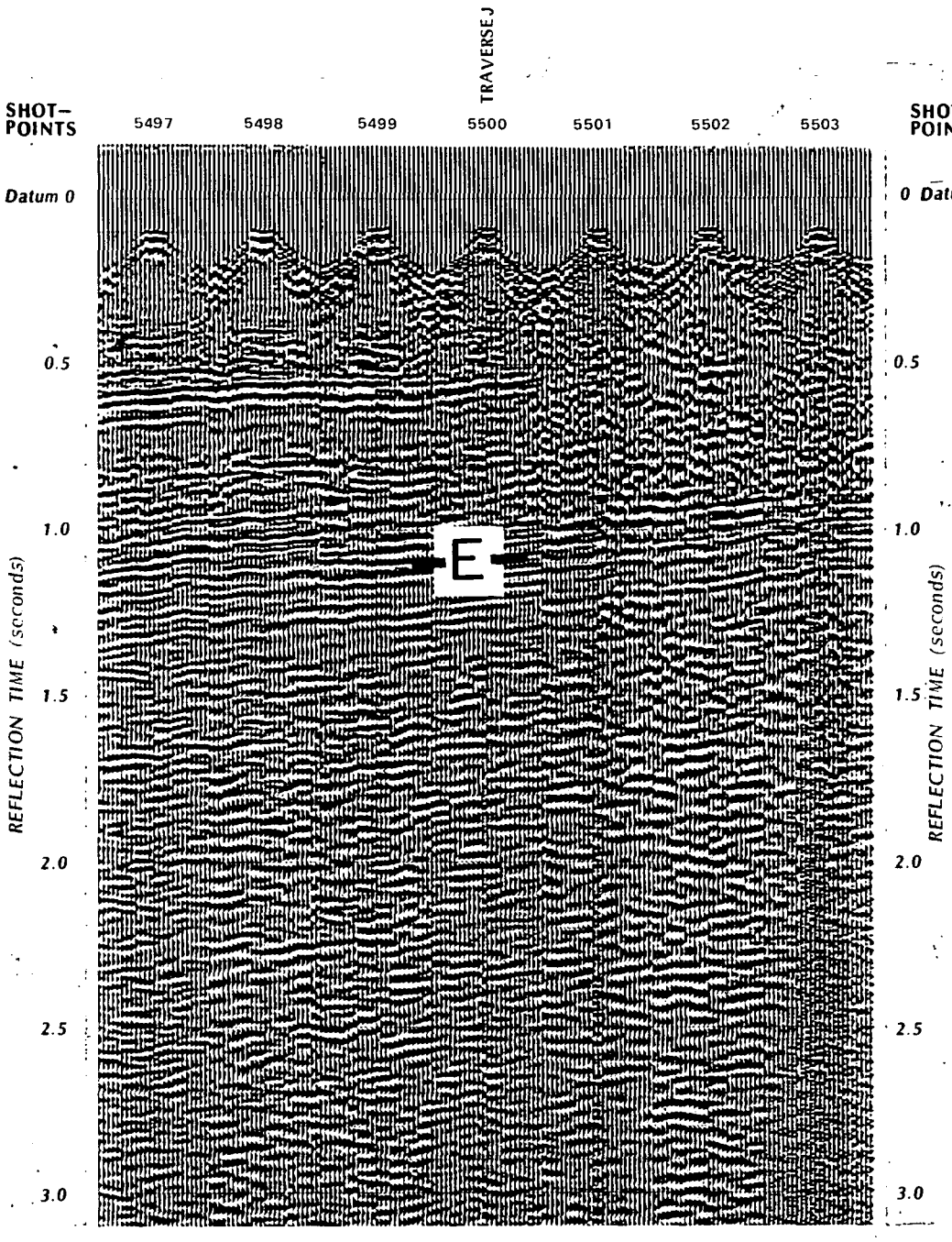


PLATE 3

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR–20
Amplifiers : PT–700
Prefilters: –
Filters : L20 – K135
AGC : Med
Gain Initial: –80 to –55
Final : –10
Geophones: HSJ – 14Hz
Geophone Station Interval: 46m
Geophone Pattern:

24/trace, 6.1m apart in line

Shot Hole Pattern:

3 holes, 15.2m apart in line
Depth 36.5m
Charge 3x13.6kg

PLAYBACK INFORMATION

Filters: L25 – K78
AGC : Med
Gain Initial: –40
Final : –20
Trip Delay: 0.3s
Compositing: Nil

VELOCITY INFORMATION

t : Δt

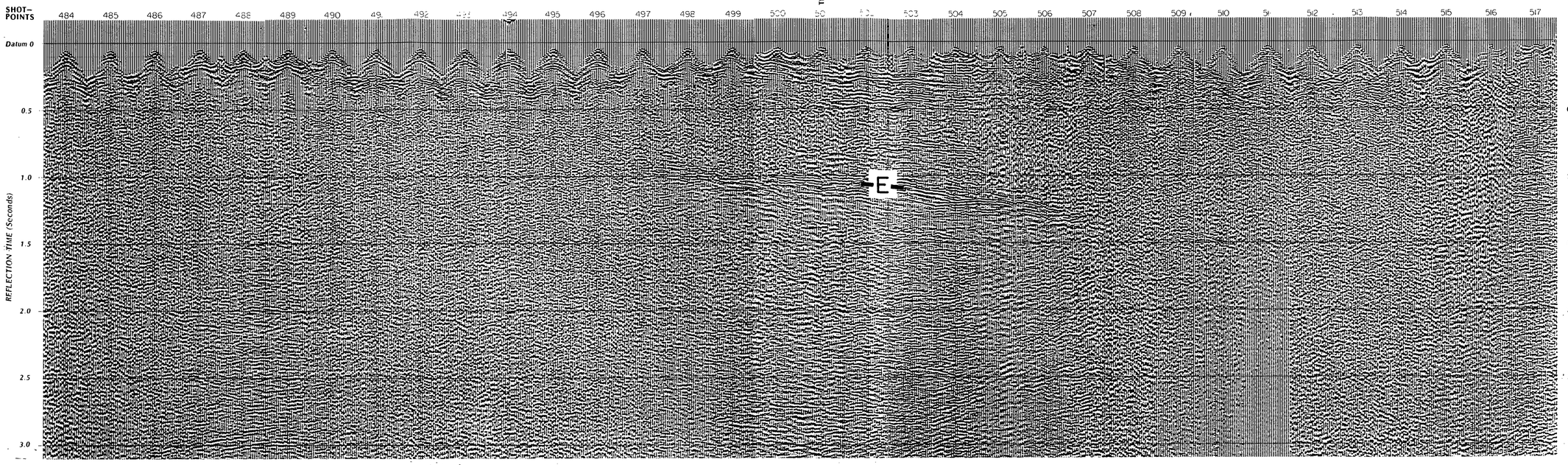
HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE N
SP 5497 – SP 5503

F52/B3-44-1A

To accompany Record No. 1974/49



SHOT-POINTS

0 Datum (609.6m)

0.5

1.0

1.5

2.0

2.5

3.0

REFLECTION TIME (Seconds)

PLATE 38

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR-20

Amplifiers : PT-700

Prefilters: –

Filters : L20 – K135

AGC : Med

Gain Initial: Various

Final : –10

Geophones: HSJ – 14Hz

Geophone Station Interval: 46m

Geophone Pattern:

24/trace in 2 rows of 12 in line
Rows 6,1m apart
Geophones 3,8m apart

Shot Hole Pattern:

SP484–493, 507–517	SP493–499	SP500–506
5 holes,	3 holes,	5 holes,
9,1m apart in line	15,2m apart in line	15,2m apart in line
Depth 34,7–36,5m	Depth 34,7–36,5m	Depth 34,7–36,5m
Charge 5x4,5kg	Charge 3x9,1kg	Charge 5x4,5kg

PLAYBACK INFORMATION

Filters: L31 – K78

AGC : Med

Gain Initial: –40

Final : –20

Trip Delay : 0,2s

Compositing: Nil

VELOCITY INFORMATION

t:Δt

HORIZONTAL SCALE (metres)

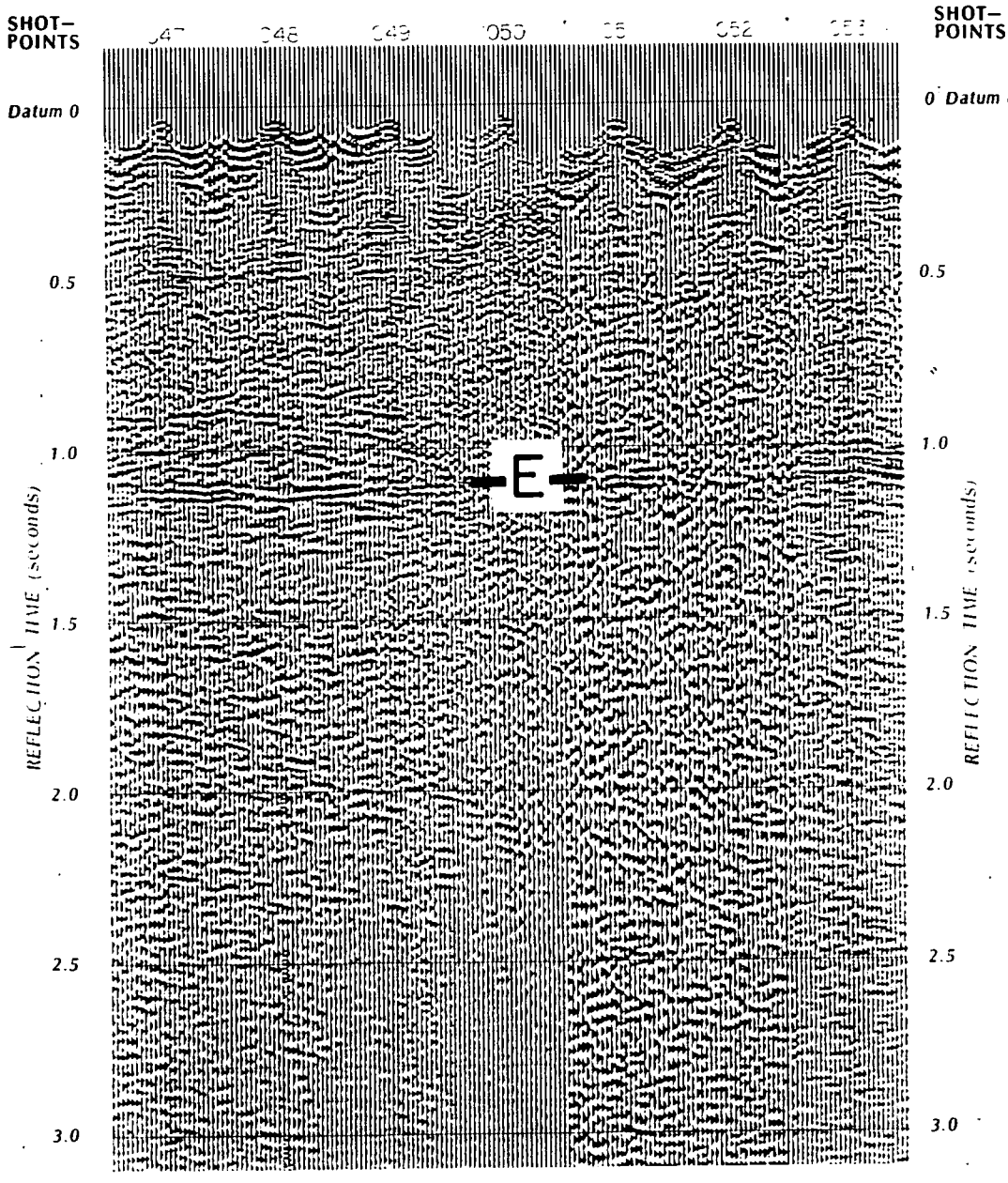
0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE C
SP 484 – SP 517

To accompany Record No.1974/49

F52/B3-18-1

CORRECTED RECORD SECTION



RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : L20 – K135

AGC : Med

Gain Initial: –50

Final : –10

Geophones: HSJ – 14Hz

Geophone Station Interval: 46m

Geophone Pattern:

24/trace in 2 rows of 12 in line
Rows 6.1m apart
Geophones 3.8m apart

Shot Hole Pattern:

5 holes. 9.1m apart in line
Depth 36.5m
Charge 5x4.5kg

PLAYBACK INFORMATION

Filters: L31 – K78

AGC : Med

Gain Initial: –40

Final : –20

Trip Delay: 0.1s

Compositing: Nil

VELOCITY INFORMATION

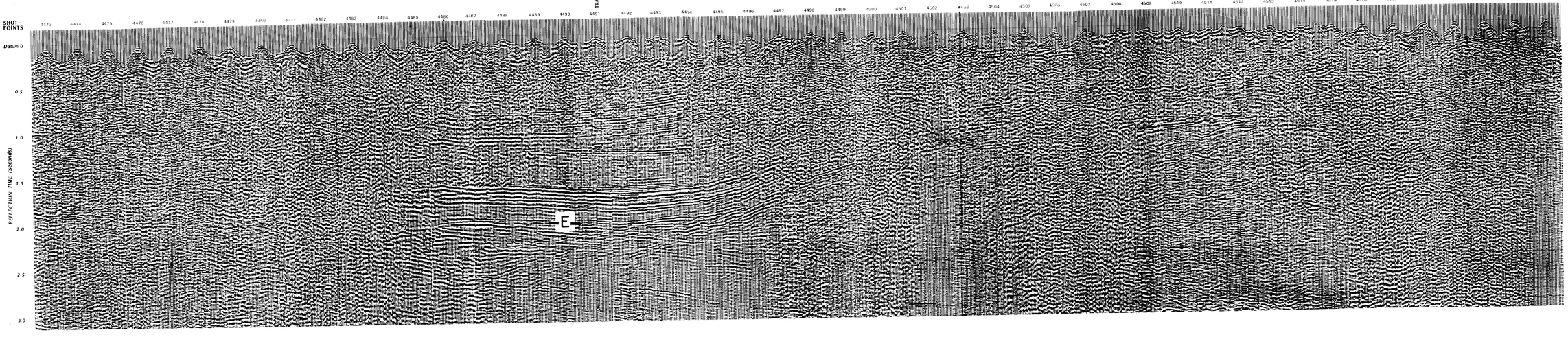
$t : \Delta t$

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE D
SP 1047 – SP 1053
F 52/B3-15-1A

To accompany Record No. 1974/49



CORRECTED RECORD SECTION

PLATE 40

RECORDING INFORMATION

Magnetic Recorder: PMR-20
Amplifiers : PT-700
Prefilters: –
Filters : L20–K135
AGC : Med
Gain Initial: Various
Final : –10
Geophones: HSJ–14Hz
Geophone Station Interval 46m
Geophone Pattern:

24/trace, 3.8m apart in line

Shot Hole Pattern:

3 holes, 15.2m apart in line
Depth 36.5m
Charge 3x0.8kg to 3x36.3kg

PLAYBACK INFORMATION

Filters : L25–K78
AGC : Med
Gain Initial : –40
Final : –20
Trip Delay : 0.15s
Compositing: Nil

VELOCITY INFORMATION

1 : X1

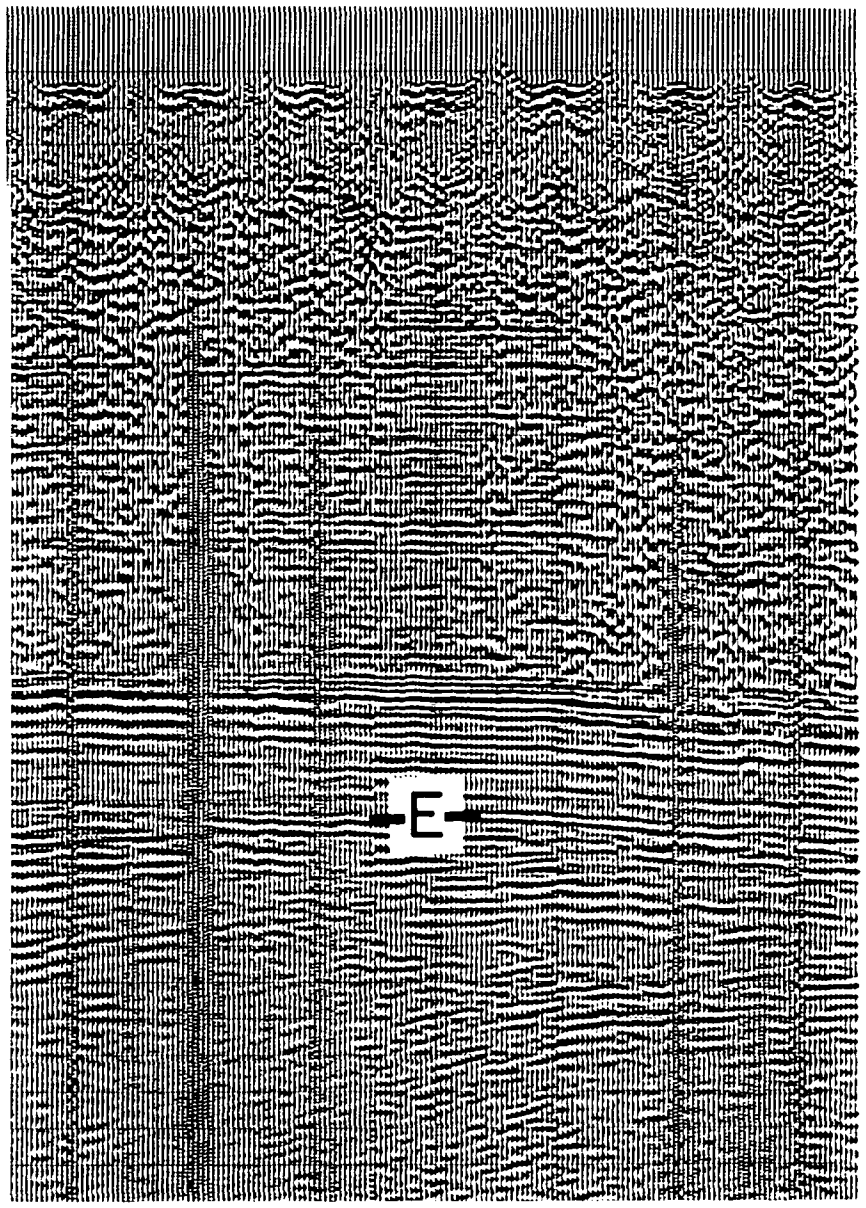
HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT. 1967–1969
TRAVERSE L
SP 4473 – SP 4522

F52/B3–25–1

To accompany Record No.1974/49



SHOT–POINTS

0 Datum (609.6m)

0.5

1.0

1.5

2.0

2.5

3.0

REFLECTION TIME (Seconds)

PLATE 41

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : L20 – K135

AGC : Med

Gain Initial: Various

Final : –10

Geophones: HSJ – 14Hz

Geophone Station Interval: 46m

Geophone Pattern:

24/trace, 38m apart in line

Shot Hole Pattern:

3 holes, 15.2m apart in line
Depth 36.5m
Charge 3 x 27.2kg to 3 x 36.3kg

PLAYBACK INFORMATION

Filters: L25 – K78

AGC : Med

Gain Initial: –40

Final : –20

Trip Delay: 0.1s

Compositing: Nil

VELOCITY INFORMATION

t : Δt and Expanded Spread at SP 5002

HORIZONTAL SCALE (metres)

0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE M
SP 4999 – SP 5005

To accompany Record No. 1974/49

F52/B3–26–1A

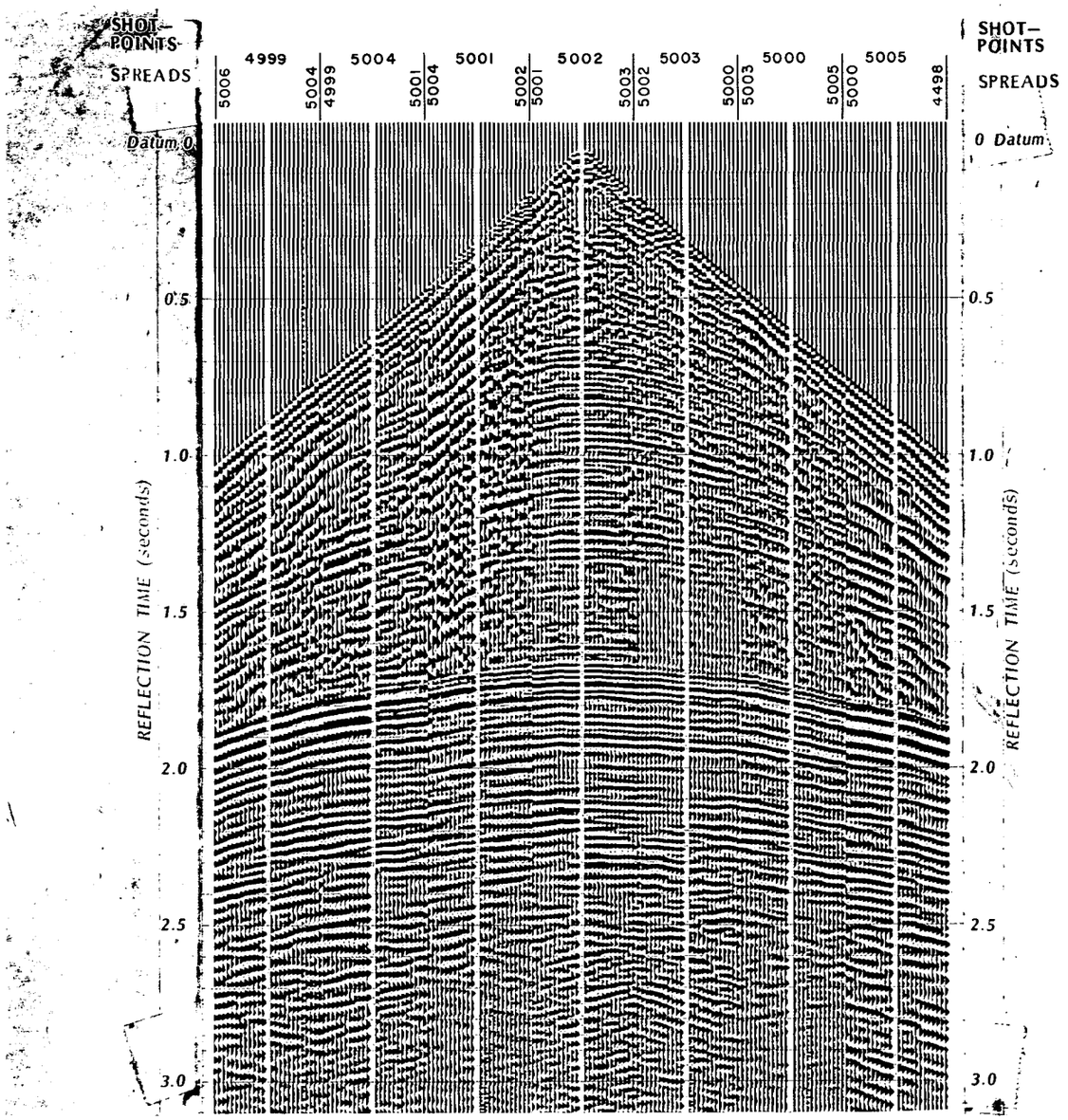


PLATE 42

CORRECTED RECORD SECTION
(Weathering Corrections Only)

RECORDING INFORMATION

Magnetic Recorder: PMR–20

Amplifiers : PT–700

Prefilters: –

Filters : L20 – K135

AGC : Med

Gain Initial: Various

Final : –10

Geophones: HSJ – 14Hz

Geophone Station Interval: 46m

Geophone Pattern:

24/trace, 3.8m apart in line

Shot Hole Pattern:

3 holes, 15.2m apart in line
Depth 36.5m
Charge 3x36.3kg to 3x77.1kg

PLAYBACK INFORMATION

Filters: L25 – K78

AGC : Med

Gain Initial: –40

Final : –20

Trip Delay : Various

Compositing: Nil

VELOCITY INFORMATION

Nil

HORIZONTAL SCALE (metres)

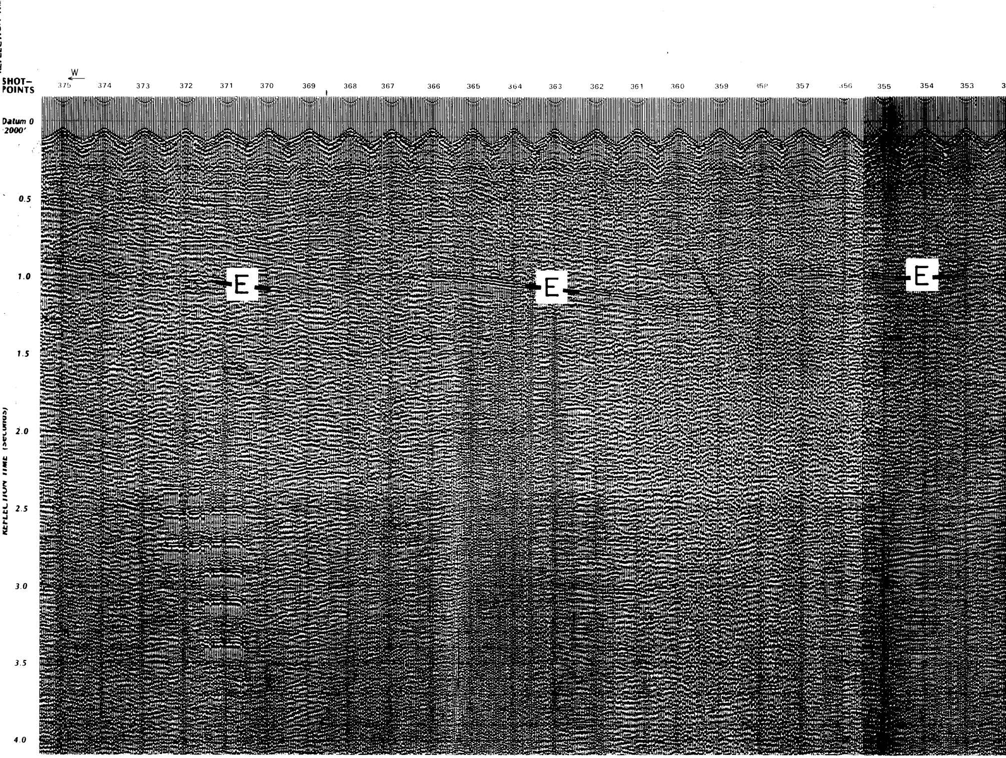
0 300 600 900 1200
0 549 1097

NGALIA BASIN
SEISMIC SURVEY NT, 1967–1969
TRAVERSE M
EXPANDED SPREAD AT SP 5002

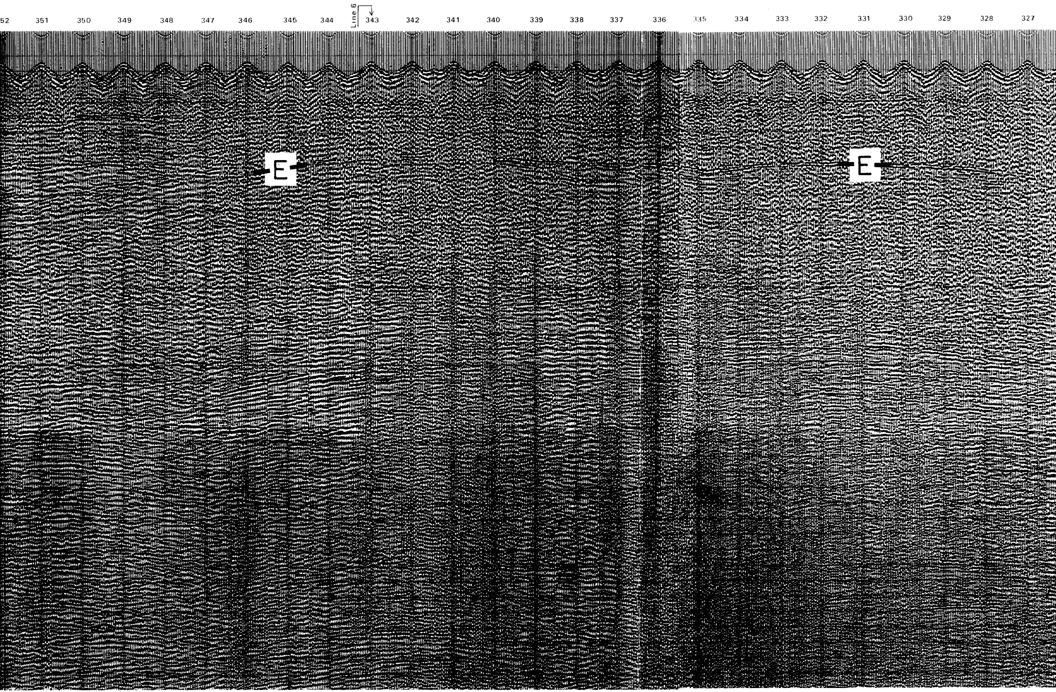
RECORDED BY: *Seismic Party No.1*
SECTION BY: *Bureau of Mineral Resources Playback Centre SIE MS 42*
TO ACCOMPANY RECORD NO.
(Based on GBS/3–118–2)

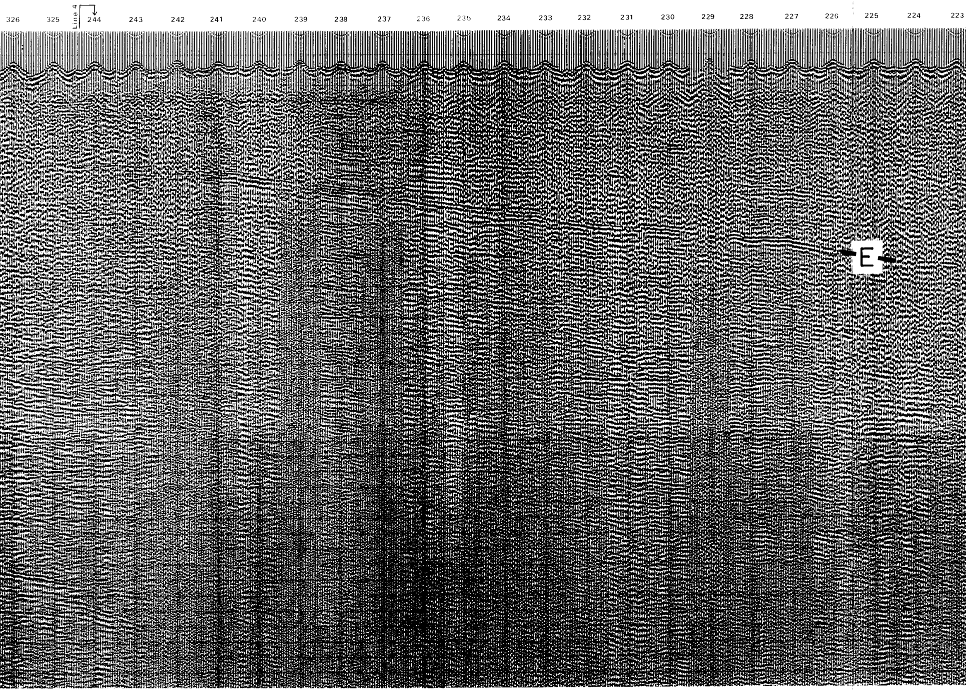
F52/B3–28

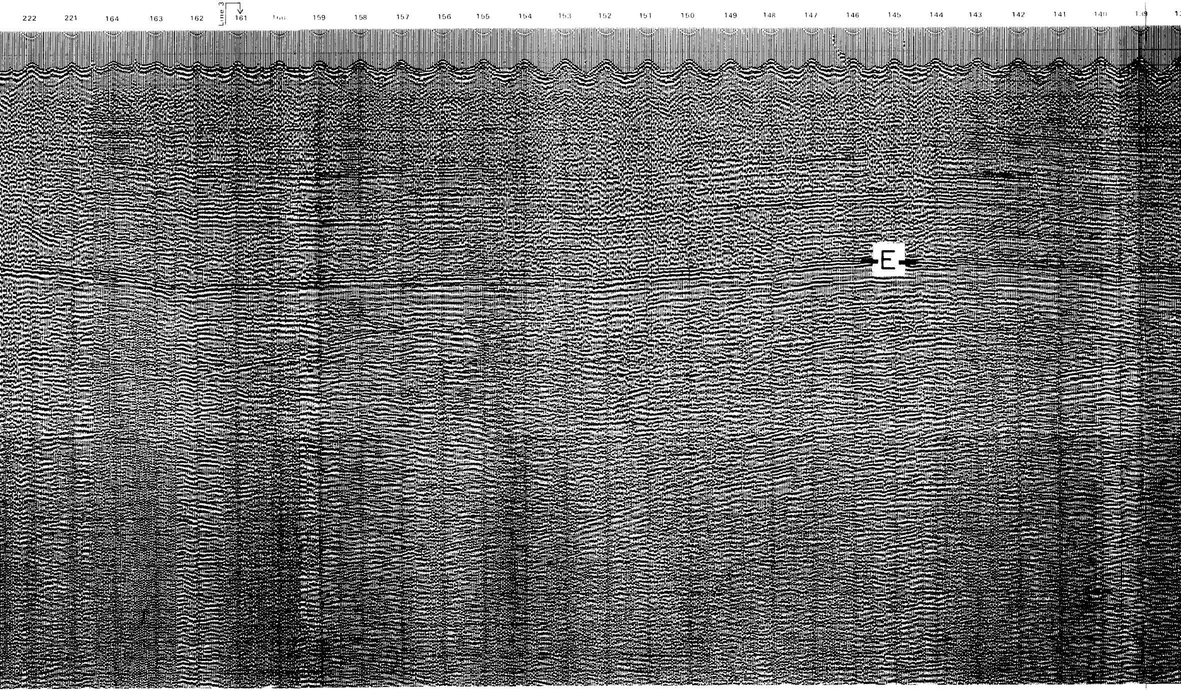
To accompany Record No.1974/49

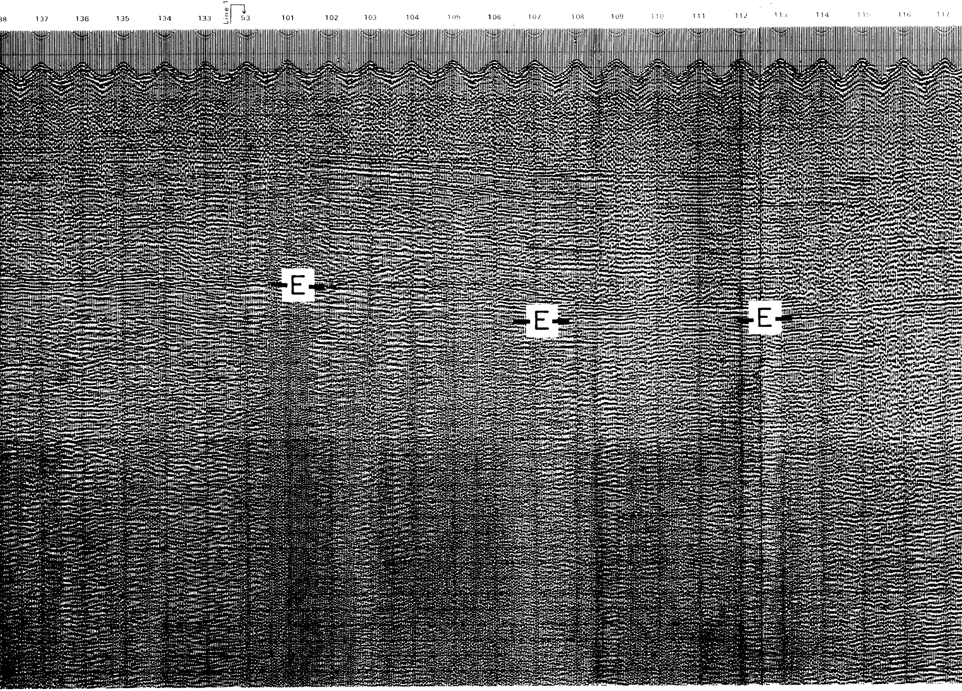


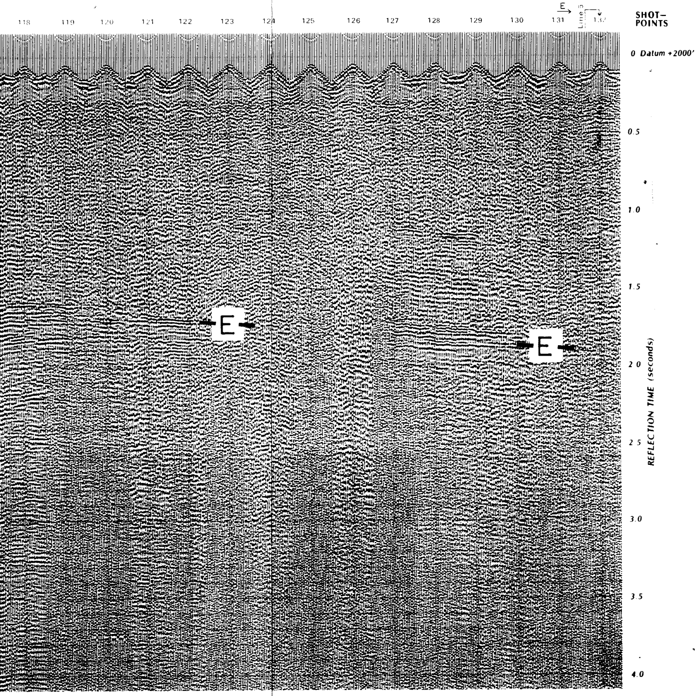
To accompany Record No.1974/49






222
221
164
163
162
Line 3
161
160
159
158
157
156
155
154
153
152
151
150
149
148
147
146
145
144
143
142
141
140
139
E





CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: SIE MR-4E
Amplifiers : SIE GA-33
Prefilters: –
Filters : 2/20 – 1/90
AGC : Fast
Gain Initial: –
Final : –
Geophones: SIE S-16
Geophone Station Interval:
Geophone Pattern:

in line

Shot Hole Pattern:

Single
Depth:
Charge:

PLAYBACK INFORMATION

Filters:
AGC : Med
Gain Initial : –40
Final : –20
Trip Delay : .2s
Compositing: Nil

VELOCITY INFORMATION

t:Δt

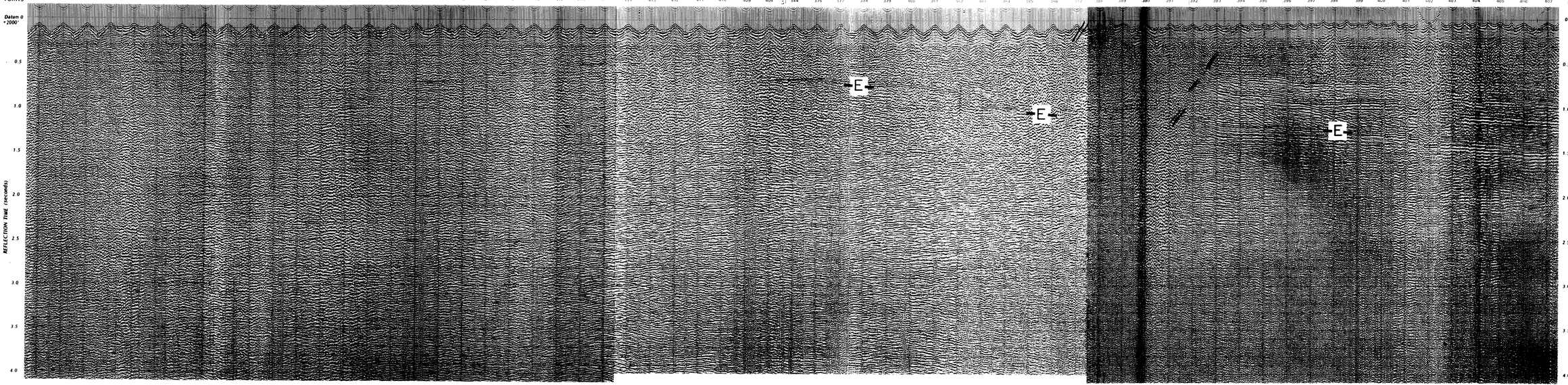
HORIZONTAL SCALE

0 500 1000
0 152.34 304.7

NAPPERBY SEISMIC SURVEY 1964
(PACIFIC AMERICAN OIL CO.)
LINE 2

RECORDED BY G. A. I.
SECTION BY *Bureau of Mineral Resources Playback Centre SIE MS 42*
[illegible] COMPANY RECORD No
Based on [illegible]

E53/B3-150-1



SHOT-POINTS

0 Datum +2000'

REFLECTION TIME (seconds)

0.5

1.0

1.5

2.0

2.5

3.0

3.5

4.0

PLATE 44

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: SIE MR–4E

Amplifiers : SIE GA–33

Prefilters: –

Filters : 2/20 – 1/90

AGC : Fast

Gain Initial: –

Final : –

Geophones: SIE S–16

Geophone Station Interval:

Geophone Pattern:

t in line

Shot Hole Pattern:

Single

Depth:

Charge:

PLAYBACK INFORMATION

Filters:

AGC : Med

Gain Initial : –40

Final : –20

Trip Delay : .2s

Compositing : Nil

VELOCITY INFORMATION

HORIZONTAL SCALE

0 100'

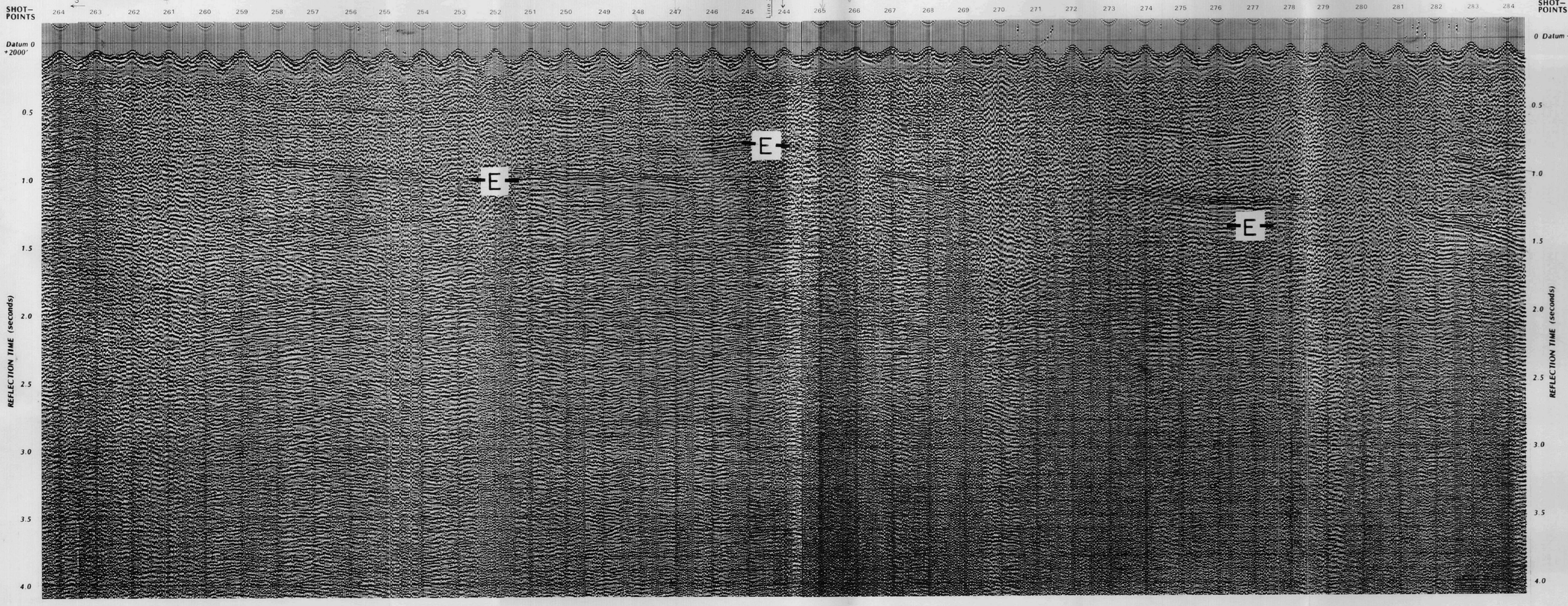
0 1/4

NAPPERBY SEISMIC SURVEY 1964
(PACIFIC AMERICAN OIL CO.)
LINE 6

To accompany Record No.1974/49

F53/83–154–1

PLATE 45



CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: SIE MR – 4E
Amplifiers : SIE GA – 33
Prefilters: –
Filters : 2/20 – 1/90
AGC : Fast
Gain Initial: –
Final : –
Geophones: SIE S – 16
Geophone Station Interval : [illegible]
Geophone Pattern:

12 Traces [illegible] apart in line

Shot Hole Pattern:

Single
Depth: [illegible]
Charge: [illegible] (Average)

PLAYBACK INFORMATION

Filters: [illegible]
AGC : Med
Gain Initial : –40
Final : –20
Trip Delay : .2s
Compositing: Nil

VELOCITY INFORMATION

t:Δt

HORIZONTAL SCALE

(inches)

0	500	1000
0	402.34	804.7

NAPPERBY SEISMIC SURVEY 1964
(PACIFIC AMERICAN OIL CO.)
LINE 4

RECORDED BY G. A. L.
SECTION BY Bureau of Mineral Resources, Playback Centre Syd. WA.
TO ACCOMPANY RECORD No.
Based on GSS 3 176 6

F53/B3-152-1

To accompany Record No. 1974/49

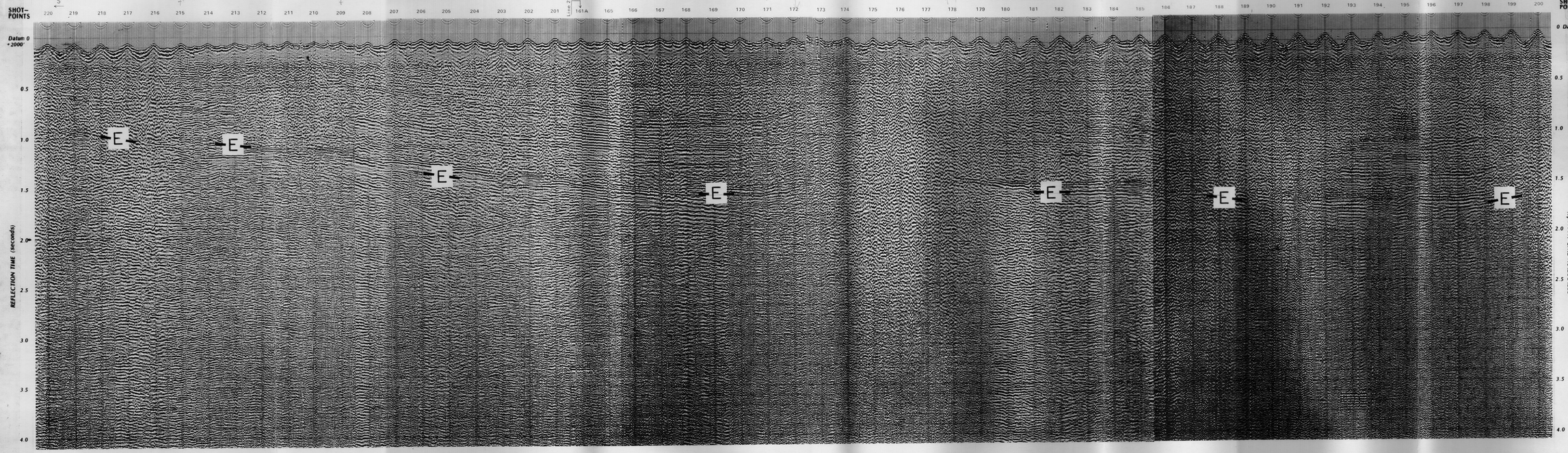


PLATE 46

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: SIE MR–4E
Amplifiers : SIE GA–33
Prefilters: –
Filters : 2/20 – 1/90
AGC : Fast
Gain Initial: –
Final : –
Geophones: SIE S–16
Geophone Station Interval: [illegible]m
Geophone Pattern:

12 traces 1.4m apart in line

Shot Hole Pattern:

Single
Depth: [illegible]m
Charge: [illegible] (Average)

PLAYBACK INFORMATION

Filters: [illegible]
AGC : Med
Gain Initial : –40
Final : –20
Trip Delay : .2s
Compositing: Nil

VELOCITY INFORMATION

1:Δt

HORIZONTAL SCALE

(metric)

0 500 1000
0 402.34 804.7

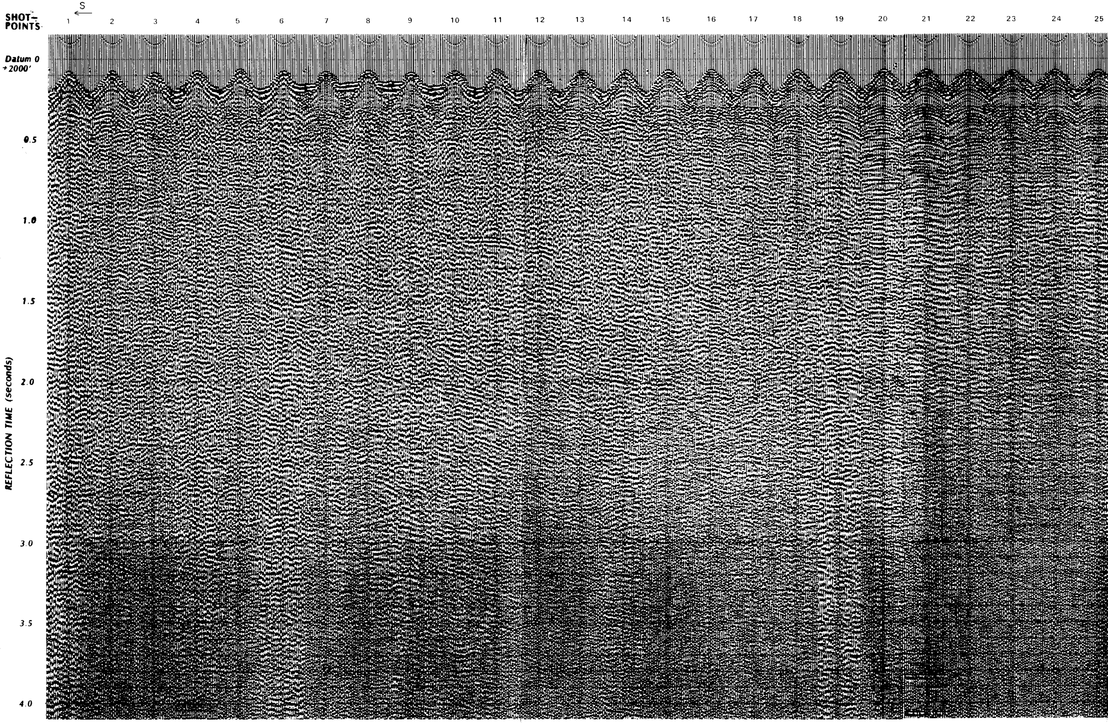
NAPPERBY SEISMIC SURVEY 1964
(PACIFIC AMERICAN OIL CO.)
LINE 3

RECORDED BY G.A.I.
SECTION BY Bureau of Mineral Resources
Geology & Geophysics Vol 46 C

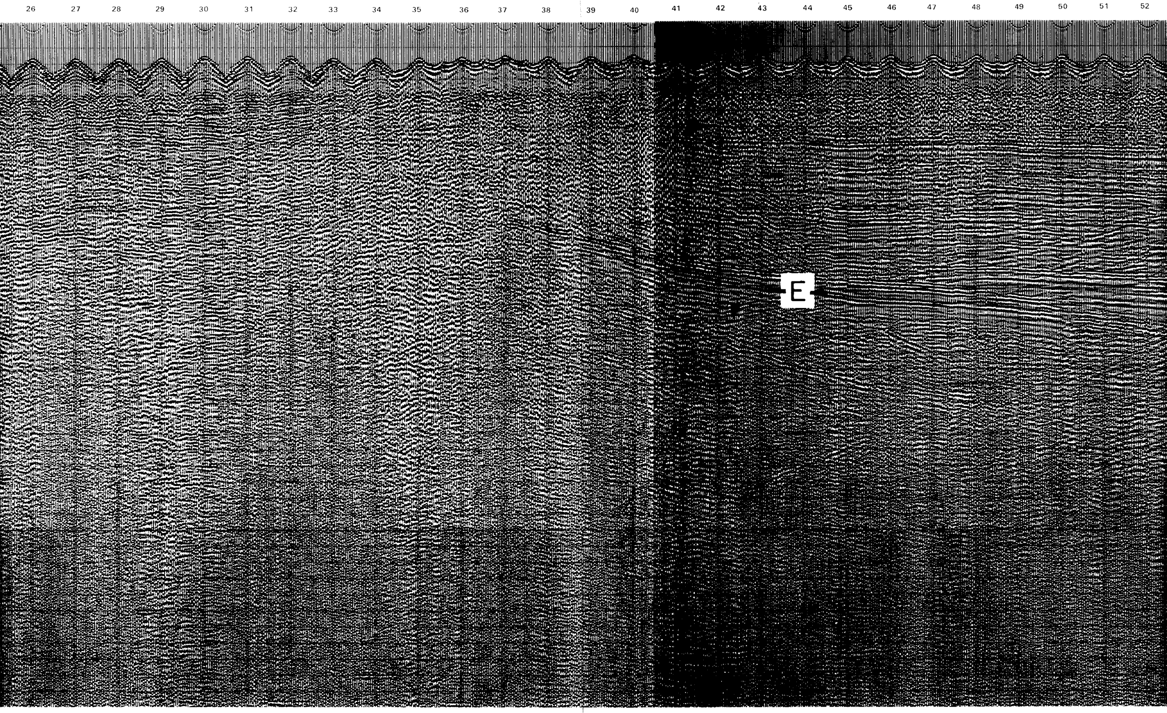
TO ACCOMPANY RECORD No.
Issued on Sept. 3 19 75

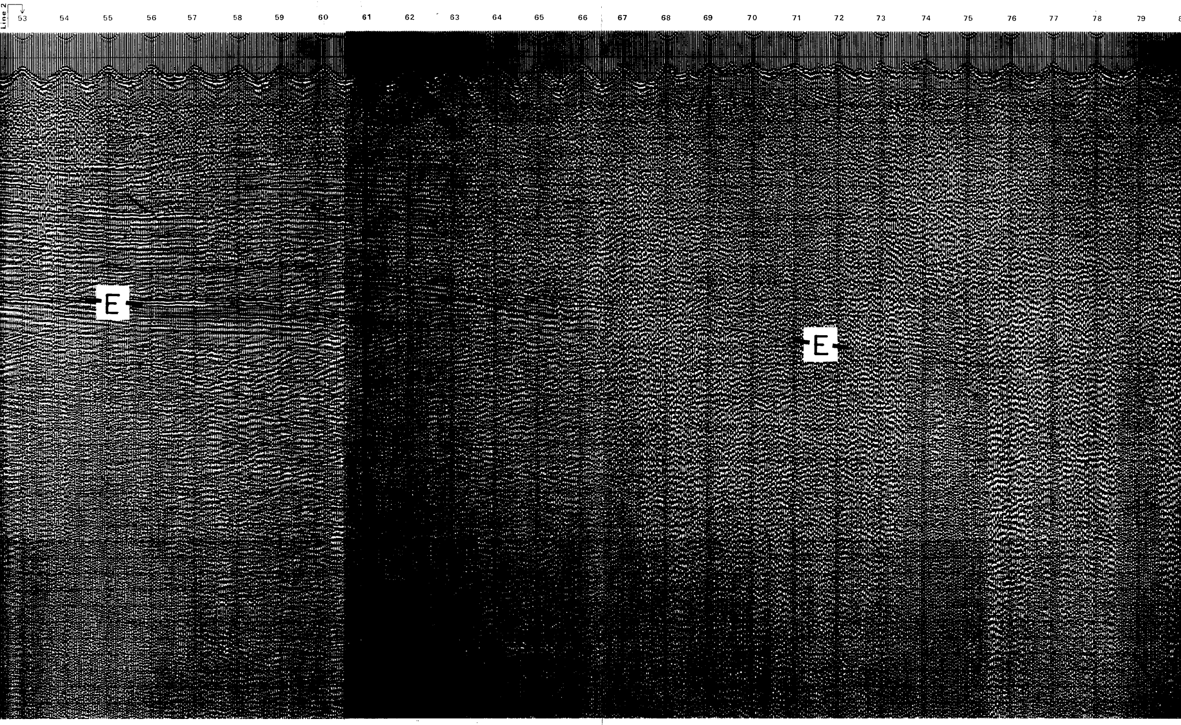
FS3/83–151–1

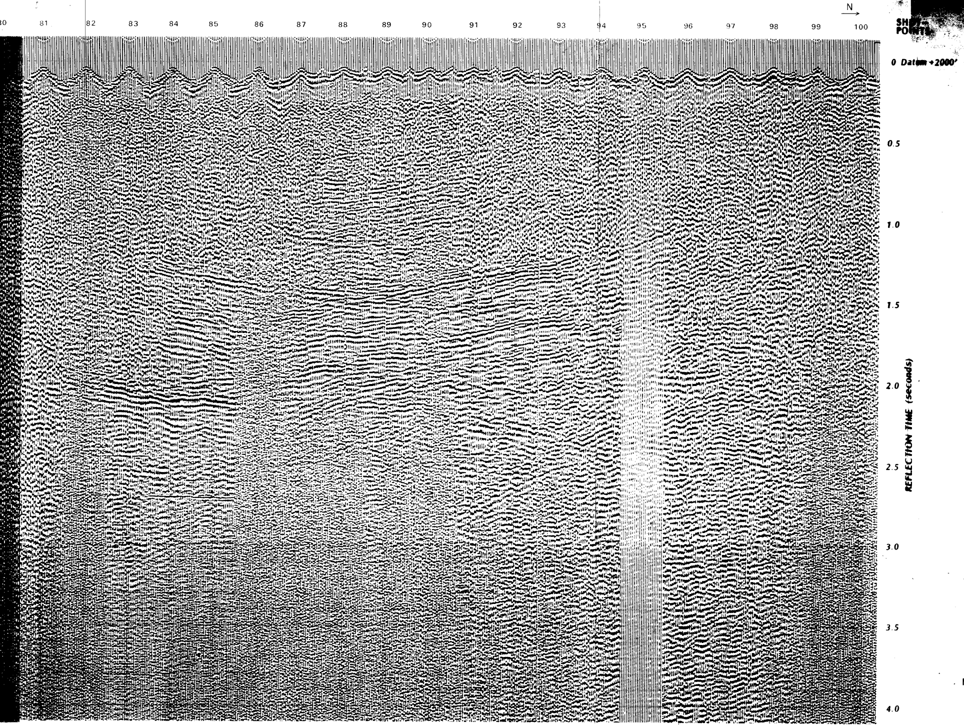
To accompany Record No.1974/49



To accompany Record No. 1974/49







CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: SIE MR–4E

Amplifiers : SIE GA–33

Prefilters: –

Filters : 2/20 – 1/90

AGC : Fast

Gain Initial: –

Final : –

Geophones: SIE S–16

Geophone Station Interval:

Geophone Pattern:

Shot Hole Pattern:

Single
Depth:
Charge:

PLAYBACK INFORMATION

Filters:

AGC : Med

Gain Initial: –40

Final : –20

Trip Delay: .2s

Compositing: Nil

VELOCITY INFORMATION

t:Δt

HORIZONTAL SCALE

(metr[illegible]

100[illegible]
0 0 402.34 804.7

NAPPERBY SEISMIC SURVEY 1964
(PACIFIC AMERICAN OIL CO.)
LINE 1

RECORDED BY G. A. I.
SECTION BY *Bureau of Mineral Resources Playback Centre Sit MS 42*
TO ACCOMPANY RECORD No
(Based on G88 3 118 0)

F53/B3–149–1

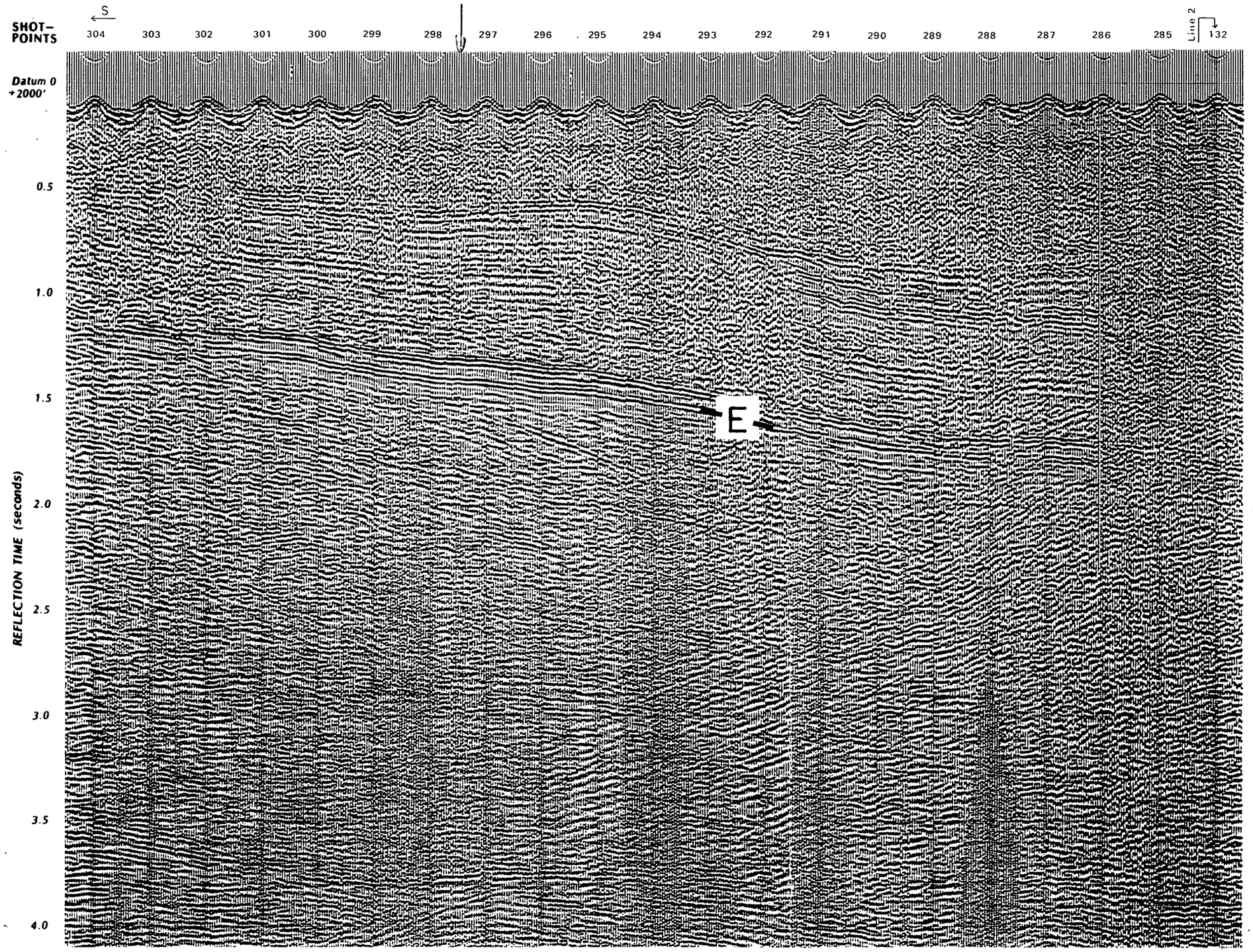


PLATE 48

CORRECTED RECORD SECTION

RECORDING INFORMATION

Magnetic Recorder: SIE MR–4E
Amplifiers : SIE GA–33
Prefilters: –
Filters : 2/20 – 1/90
AGC : Fast
Gain Initial: –
Final : –
Geophones: SIE S–16
Geophone Station Interval:
Geophone Pattern:

[illegible] apart in line.

Shot Hole Pattern:

Single
Depth:
Charge: (Average)

PLAYBACK INFORMATION

Filters:
AGC : Med
Gain Initial: –40
Final : –20
Trip Delay: .2s
Compositing: Nil

VELOCITY INFORMATION

t:Δt

HORIZONTAL SCALE

(metres)

0 500 1000
0 402.34 804.7

NAPPERBY SEISMIC SURVEY 1964
(PACIFIC AMERICAN OIL CO.)
LINE 5

To accompany Record No. 1974/49

RECORDED BY G.A.I.
SECTION BY Bureau of Mineral Resources Playback Center SIE MS 42
TO ACCOMPANY RECORD No.

F53/B3–153–1

PLATE 49

NAPPERBY SEISMIC SURVEY

Depth contours on Lower Palaeozoic horizon

131°15'

132°00'

22°20'

22°50'

LINE 2

LINE 4

LINE 3

LINE 6

LINE 5

LINE 1

HIGH

F?

KILOMETRES

5 0 5 10

Contour Interval 200 feet
Datum 1700 feet above sea level

From Hudson & Campbell, 1965

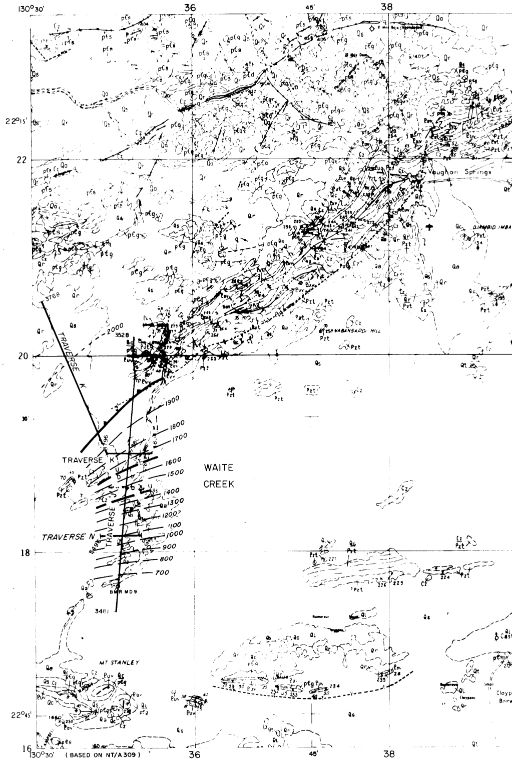
F52/B3-37

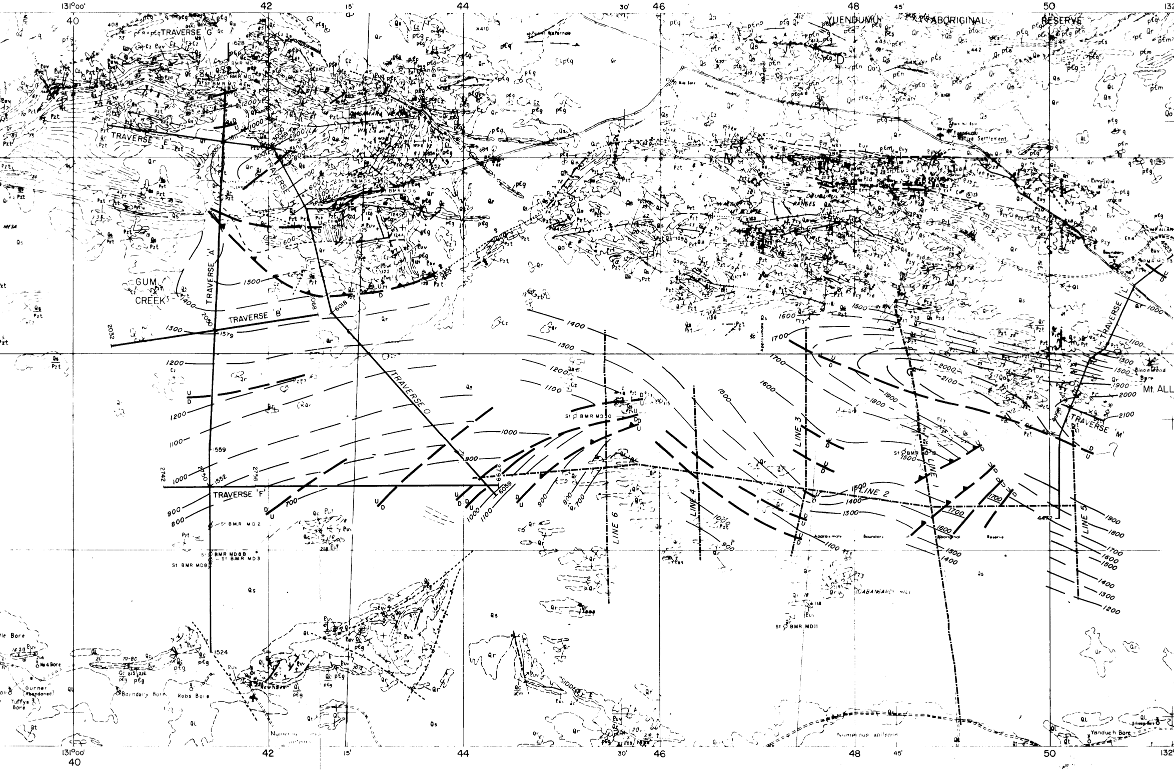
To accompany Record No. 1974/49

Reference

CAINOZOIC	QUATERNARY		Qa	*Alluvium*
			Qc	*Colluvium*
			Qs	*Aeolian sand*
			Qr	*Red soil, alluvium*
			Qt	*Evaporites*
			Ql	*Travertine*
	UNDIFFERENTIATED		Cz	*Silcrete and ferruginized (lateritized) rock*
PALAEOZOIC	CARBONIFEROUS	Mount Eclipse Sandstone	Pzt	*Coarse-grained, arkosic sandstone; subgreywacke, minor cobble conglomerate and red micaceous siltstone*
	ORDOVICIAN ?	Kerridy Sandstone	Pzy	*Red-brown, silty arkosic and calcareous sandstone; subgreywacke and interbedded siltstone*
		Djagamara Formation	Pzd	*White, well-sorted sandstone, glauconitic; abundant clay pellets. Interbedded green shale in places*
	CAMBRIAN	Bloodwood Formation	Ꞓb	*Red-brown micaceous siltstone and sandstone. Abundant trace fossils and rare macrofossils*
		Walbiri Dolomite	Ꞓw	*Dolomite, siltstone and minor stromatolitic, oolitic and glauconitic dolomite and sandstone. Abundant fragmentary marine macrofossils*
PRECAMBRIAN	PROTEROZOIC	Yuendumu Sandstone	Ᵽuy	*Red-brown sandstone, minor coarse arkose at the base*
		Mount Doreen Formation	Ᵽuq	*Green siltstone with erratics, lenses of dolomitic sandstone and pebbly sandstone; siltstone, pink laminated dolomite, red shale, Thick dolomite sequence in places*
		Vaughan Springs Quartzite	Ᵽuv	*Thick bedded qartzite, basal pebbly sandstone and pebble conglomerate*
		Treuer Member	Ᵽut	*Thick bedded sandstone, siltstone. Possibly interbedded evaporites*
		Patmungala Beds	pꞒp	*Silty sandstone, quartzite, siltstone, spotted claystone, minor stretched chert pebble conglomerate and shale*
			pꞒ	*Undifferentiated igneous and metamorphic rocks*
			pꞒg	*Granite*
			pꞒd	*Dolerite*
			pꞒs	*Schist*
			pꞒm	*Undifferentiated metamorphic rocks*
			pꞒq	*Quartzite*
			pꞒn	*Gneiss*

To accompany Record No.1974/49


130°30'
36
45'
38
22°15'
22
20
30'
18
22°45'
16
Vaughan Springs
DJAMBID IMBA
VABANSARD HILL
TRAVERSE K
TRAVERSE N
TRAVERSE
WAITE
CREEK
3768
3528
3481
BMR MD9
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
MT STANLEY
130°30'
(BASED ON NT/A309)
36
45'
38


131°00'
40
42
15'
44
30'
46
48
45'
50
YUENDUMU
ABORIGINAL
RESERVE
TRAVERSE 'G'
TRAVERSE 'E'
TRAVERSE 'A'
TRAVERSE 'B'
TRAVERSE 'C'
TRAVERSE 'D'
TRAVERSE 'F'
TRAVERSE 'L'
TRAVERSE 'M'
GUM CREEK
MESA
LINE 2
LINE 3
LINE 4
LINE 5
LINE 6
Mt. ALL
RANGES
Yuendumu Native Settlement
St BMR MD 2
St BMR MD 3
St BMR MD 6
St BMR MD 8
St BMR MD 8B
St BMR MD 10
St BMR MD 11
St BMR MD 12
Approximate Boundary of Aboriginal Reserve
Boundary Bore
Robs Bore
Gurner (Abandoned)
Tuffys Bore
Newhaven
SIDDELEY
Yanduch Bore
Mt Jabangardi Hill
Pzt
Qr
Qs
pЄg
Cz
Puv
Pzy
Pzd
Qc
Ql
pЄm
U
D
1579
1559
1552
1524
6018
6059
2742
2032
2060
2750
4472
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
131°00'
40
42
15'
44
30'
46
48
45'
50
132°

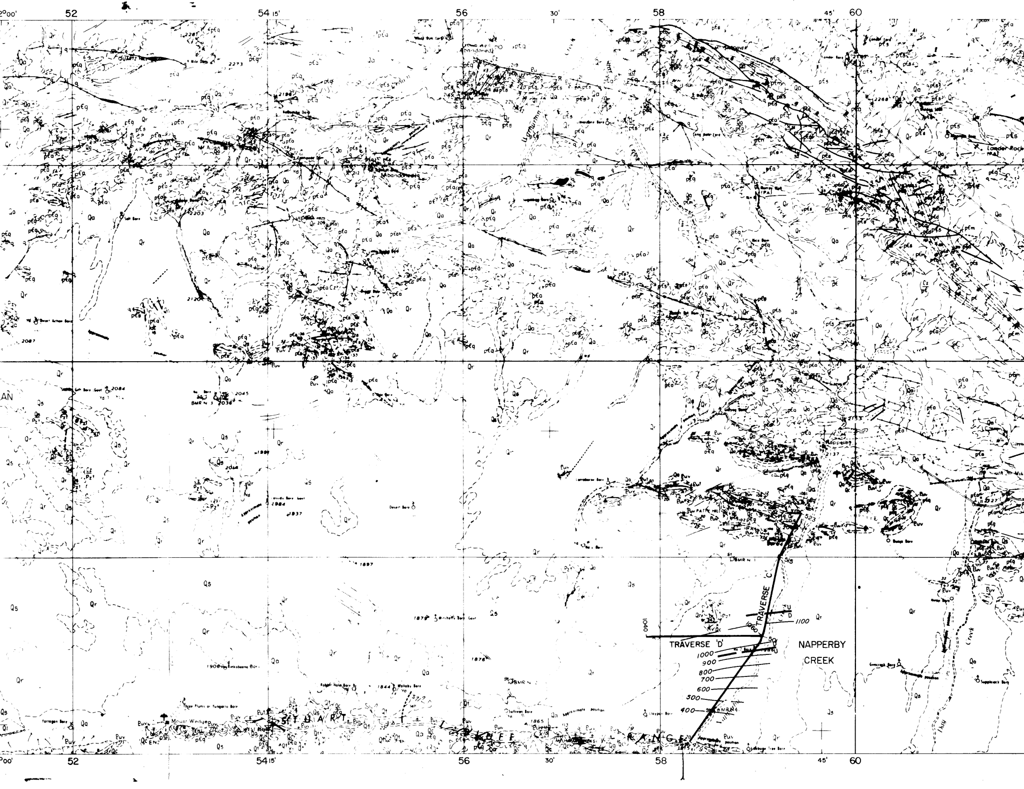
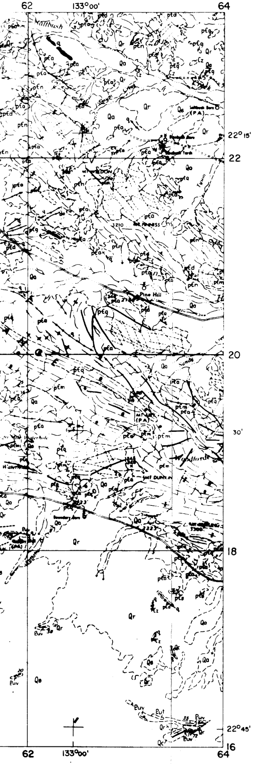
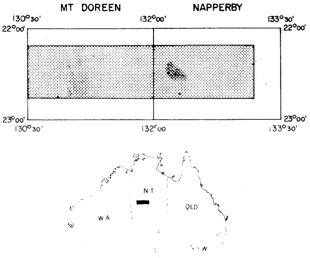

52
54 15'
56
30'
58
45'
60
NAPPERBY
CREEK
TRAVERSE 'D'
TRAVERSE 'C'
1100
1040
1060
1000
900
800
700
600
500
400
BMR N 1
BMR N 3
BMR N 4
Mount Wedge
Landor Rock
Napperby
STUART BLUFF RANGE
Approximate position
Qa
Qr
Qs
pЄq
pЄa
pЄs
pЄm
Puv
Cz

PLATE 5



62
133°00'
64
22°15'
22
Qa
Qr
pЄa
pЄn
pЄg
pЄm
Pine Hall
MT DUNKIN
Boundary Bore
20
30'
18
Puv
22°45'
62
133°00'
64
16



MT DOREEN
NAPPERBY
130°30'
132°00'
133°30'
22°00'
22°00'
23°00'
23°00'
130°30'
132°00
133°30'
N T
W A
QLD

2068 BMR Seismic Traverses

PAOC Seismic Lines

Normal Fault

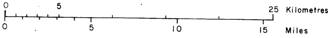
Thrust Fault

Time Contour in Milliseconds (Unmigrated)

St ∅ Stratigraphic hole: BMR Mt Doreen (MD) and Napperby (N): Position approximate

Contour under Thrust Fault

REFLECTION TIME TO HORIZON E, VAUGHAN SPRINGS QUARTZITE



0
5
25 Kilometres
0
5
10
15
Miles

TO ACCOMPANY RECORD No.

F52/B3-76