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1979/78

EASTERN GALILEE BASIN SEISMIC SURVEY, QUEENSLAND 1976

by

J. Pinchin, D.L. Schmidt and W. Anfiloff

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CONTENTS

SUMMARY

The structural relationships of the Galilee Basin and the underlying Drummond and Adavale Basins have an important bearing on the hydrocarbon potential of the area; gas has been discovered in the Adavale Basin and there have been gas and oil shows within the Galilee Basin. In addition, Permian coal measures of the Galilee Basin subcrop along the eastern margin and their depth and extent are of economic interest.

In 1976, BMR shot four six-fold CDP seismic reflection traverses covering 219 km across, and close to, the eastern margin of the Galilee Basin in areas where there had been no previous seismic coverage. The first two traverses were to investigate the structure of the basin's northeastern margin with relevance to the extent of the coal measures, and the second two were to investigate the underlying Adavale and Drummond Basins.

The results from the first and second traverses show that the basin's northeast margin was originally formed by normal sedimentary onlap, but was modified by faulting as recently as the Tertiary. Traverse 1 crossed a fault-bounded possible anticline with trend probably parallel to the basin margin. In the vicinity of Prairie and Torrens Creek, the sediments are relatively undisturbed with a southerly dip of about half a degree; 2000 m of Galilee Basin sedimentary rocks overlie 700 m of Drummond Basin rocks which are now seen to extend further to the northwest than was previously thought.

The 1971 BMR seismic traverse east of Lake Galilee 1 well was extended further east to the outcrop of the Anakie Metamorphics; results show that the Mount Hall and Telemon Formations of the Drummond Basin extend westwards below the Galilee Basin to Lake Galilee well. This is confirmed by results from the fourth traverse, near Alpha, where the Mount Hall and Telemon Formations extend westwards from the Drummond Basin outcrops towards Jericho 1 well. Hence the eastern margin of the Galilee Basin is seen to be underlain by the Drummond Basin, and the Adavale Basin is restricted to the south. The Donnybrook Gravity High, east of Lake Galilee 1, is now thought to be caused by a dense intra-basement block rather than basement uplift. An alternative explanation for the

gravity high, involving a reverse density contrast of dense sediments over less dense volcanics, is considered possible.

The conclusion is that both coal and oil exploration in this area will be difficult. The steep and faulted northeast margin of the Galilee Basin provides only a narrow strip where coal is likely to be found at mineable depths, and the pre-Galilee sediments below the basin's eastern margin look unprospective for petroleum because of their fluviatile origin. However, an area between Traverse 1 and Traverse 3, known as the Koburra Trough, contains a thick sequence of Permo-Carboniferous sediments, and its eastern margin is probably bounded by structures such as that crossed by Traverse 1; these structures could provide petroleum traps, and it is on this area that exploration should now concentrate.

INTRODUCTION

During August to early December 1976 the Bureau of Mineral Resources (BMR) conducted a reconnaissance seismic survey over the eastern margin of the Galilee Basin.

The Galilee Basin is a broad sedimentary downwarp of Permo-Triassic age. The Koburra Trough is the deepest part of the basin; it trends north-northwest near the eastern margin of the Galilee Basin, and sedimentary rocks within the trough attain a thickness of at least 6200 m, of which 2800 m belongs to the Galilee Basin. The northwest and northeast margins of the trough may be steep, and if so will affect the distribution of the Permian coal measures and the hydrocarbon potential of the area.

The eastern margin of the Galilee Basin overlies the western margin of the Devonian-Carboniferous Drummond Basin. Below the southern part of the Galilee Basin lies the Devonian Adavale Basin. The northward extent of the Adavale Basin and its relation to the Drummond Basin are unknown. These factors could be of economic importance because of the occurrence of a small gas field within the Adavale Basin at Gilmore and oil and gas shows in Lake Galilee 1 well.

Most of the eastern part of the Galilee Basin has been extensively covered by seismic surveys, but there are few over the basin's eastern margin. In 1971 BMR conducted a seismic survey eastwards from Lake Galilee 1 well towards the Drummond Basin outcrops with the objective of defining the structure of the eastern margin of the Galilee Basin and its relation to the Drummond Basin (Harrison, Anfiloff & Moss, 1975). Harrison, Anfiloff and Moss concluded that the margins of the two basins simply overlap, but the results did not provide any direct evidence as to whether the rocks at the base of Lake Galilee 1 belong to the Adavale or the Drummond Basin.

The 1976 BMR Galilee Basin seismic survey completed four six-fold common depth point (CDP) reflection traverses covering a total distance of 219 km. Detailed gravity readings were taken along all four traverses. The first two traverses were across the northeast and northwest margins of the Koburra Trough, and the second two were to the east and south of Lake Galilee 1 to investigate the underlying Adavale and Drummond Basins.

Operational reports on the survey (Brassil & Anfiloff, 1977; Schmidt, Nelson, & Anfiloff, 1977) provide details of staff, equipment, operations, and preliminary results. The final results and interpretation were presented earlier by Pinchin (1978), but this Record provides a fuller account.

GEOLOGY

Regional setting

The regional tectonic setting of the area is shown in Figure 1, and more detailed geology in Figure 2. The Lolworth-Ravenswood Block and Anakie Inlier are the main basement outcrops in the area and consist of Lower Palaeozoic metasediments and granites. Sedimentary rocks belonging to sedimentary basins of four separate ages - the Adavale, Drummond, Galilee, and Eromanga Basins - occupy the area to the south and west of these basement highs.

Rocks of the Early to Mid Devonian Adavale Basin do not crop out anywhere, and the basin is known entirely from drill-hole and seismic information.

The Late Devonian to Mid Carboniferous Drummond Basin lies south of the Lolworth-Ravenswood Block and mainly to the west of the Anakie Inlier. The outcrop area of this basin is confined to a narrow belt immediately to the west of the Anakie Inlier and to sparse, scattered outcrops to the east of the Inlier.

Late Carboniferous to Triassic sedimentation in the area was widespread; the sediments were deposited in three separate neighbouring basins: the Galilee, Cooper, and Bowen Basins. Although the Canaway Ridge is taken as the boundary between the Galilee and Cooper Basins and the Nebine Ridge is considered as the boundary between the Galilee and Bowen Basins, Permo-Triassic sedimentary rocks are continuous across both of these ridges (Senior, 1971; Vine, 1976).

9

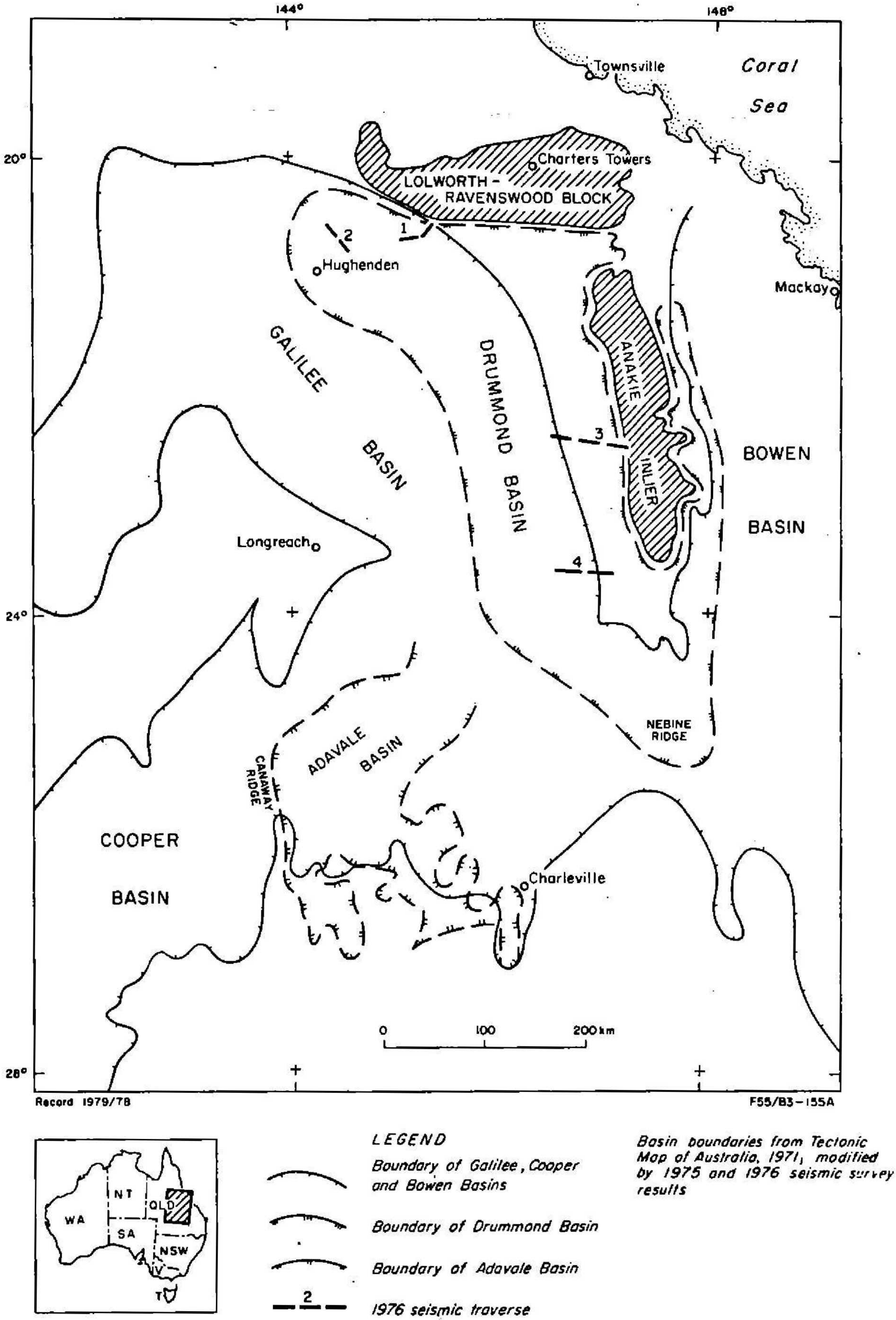


FIG. 1 Pre – Eromanga geological framework and location of survey

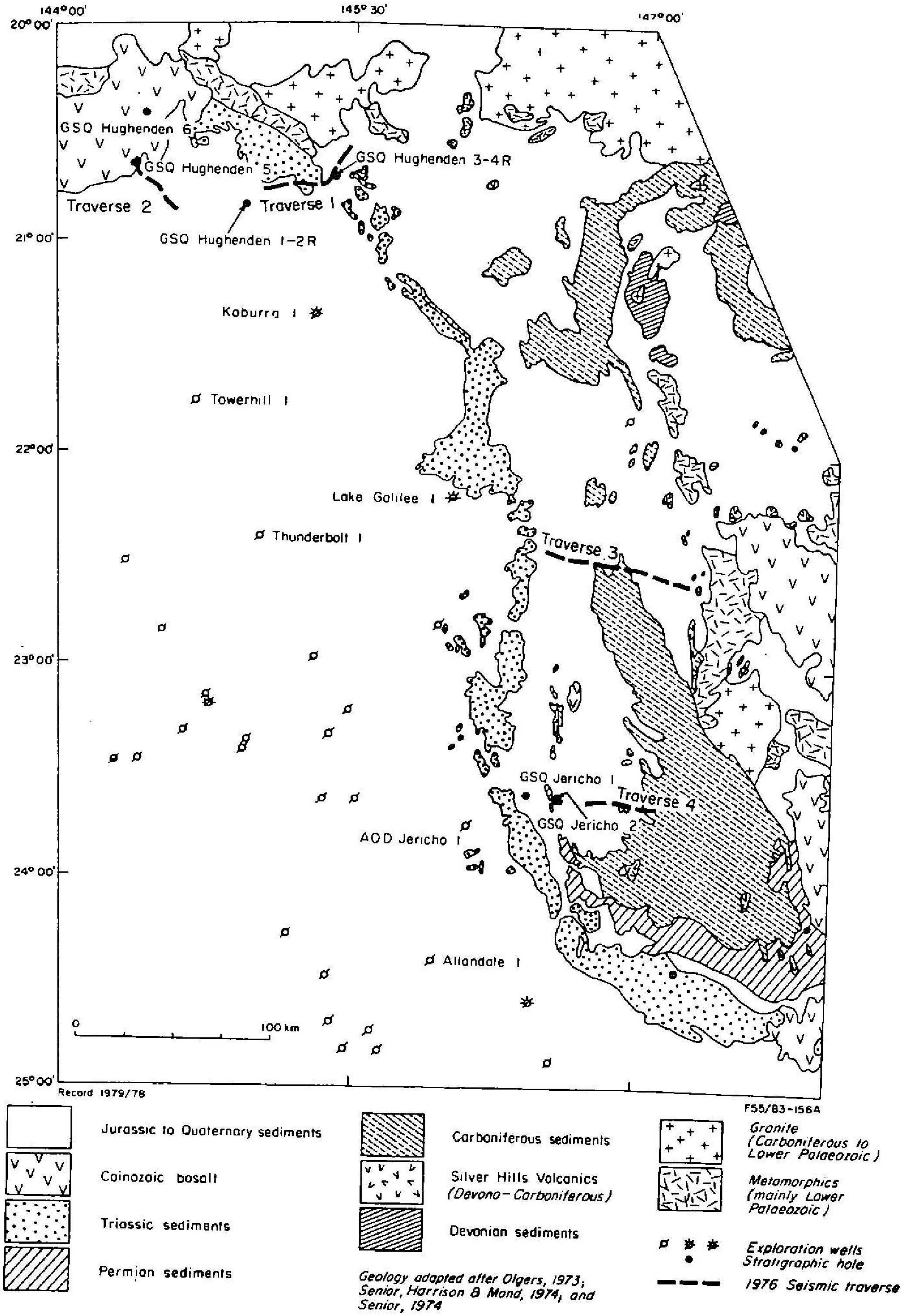


Fig. 2 Geology and well locations

Table 2. Generalised stratigraphy of the eastern area of the Galilee Basin

BASIN	Era	Period	Epoch/Age	GROUP	FORMATION	Lithology and comments	Depositional environment	Thickness (maximum) average (m)	Source of information
	Cainozoic	Quaternary to Tertiary				Alluvium; soil; sand; sandstone; mudstone; duricrust; basalt	Various terrestrial environments	(100)	
UNCONFORMITY									
Eromanga	Mesozoic	Cretaceous	Cenomanian	Rolling Downs Group	Winton Formation	Labile sandstone; siltstone; mudstone; coal	Streams, swamps and lakes	(1100),500	Exon and Senior, 1976
			Aptian to Albian		Mackunda Formation	Labile sandstone; siltstone; mudstone	Paralic during marine regression	(200),60	
					Allaru Mudstone	Mudstone; siltstone; minor sandstone	Shallow marine	(770),200	
					Toolebuc Formation	Limestone; calcareous shale; siltstone	Shallow marine	(75),15	
					Wallumbilla Formation	Mudstone; siltstone; sandstone	Shallow marine	(760),550	
					Hooray Sandstone / Gilbert River Formation	Quartzose, sub-labile sandstone	Fluvial to shallow marine	(200),150	Exon, 1966
		Jurassic		Injune Creek Group	Westbourne Fm, Adori Sandstone and Birkhead Fm	Mudstone; siltstone; sandstone	Fluvial-deltaic with minor marine incursions	(380),220	
					Hutton Sandstone	Quartz sandstone	Fluvial	120	
UNCONFORMITY									
Galilee		Triassic			Moolayember Formation	Mudstone; siltstone; sandstone	Lacustrine, fluvial	(300)	Vine and Doutch, 1972
					Clematis Sandstone (Warang Sandstone)	Quartzose sandstone; minor conglomerate and siltstone	Fluvial	(230)	
					Dunda Beds (Warang Sandstone)	Sandstone; siltstone and mudstone	Fluvial	(100)	
					Rewan Formation	Mudstone and siltstone; minor sandstone	Fluvial	(330)	
	Palaeozoic	Permian	Late		Betts Creek Beds and Boonderoo Beds, Unnamed coal measures	Labile sandstone; siltstone; coal	Fluvial, paludal	100	Vine, 1976
					Colinlea Sandstone	Sandstone; conglomerate; Evans' palynological stage 5	Fluvial	(200),150	
DISCONFORMITY									
		Permian	Early	Joe Joe Group	Aramac Coal Measures	Coal; sandstone; siltstone; mudstone Evans' palynological stage 3	Deltaic, paludal	(100),50	
					Jochmus Formation	Sandstone; mudstone; siltstone; conglomerate; tuff. Evans' palynological stages 2 and 3	Lacustrine, contemporaneous vulcanism	(130),115	Gray and Swarbrick, 1975
					Jericho Formation	Mudstone, sandstone, siltstone, Evans' palynological stages 1 and 2	Fluvio-lacustrine with a glacial influence	(770),700	Hawkins, 1977
		Carboniferous	Late		Lake Galilee Sandstone	Silicified sandstone; minor mudstone	Fluvial	(260),100	
UNCONFORMITY (Kanimblan Orogeny)									
Drummond			Early		Ducabrook Formation and Natal Formation	Sandstone; mudstone; tuff; minor conglomerate and limestone	Fluvial, lacustrine	(2100)	Olgers, 1972
					Star of Hope Formation	Sandstone; tuff; pebble conglomerate	Fluvial, contemporaneous vulcanism		
					Raymond Formation	Quartz, sandstone; mudstone	Fluvial	(3000),1000	
					Mount Hall Formation	Sandstone and pebbly conglomerate	Fluvial	(1650),600	
					Telemon Formation	Sandstone and mudstone; minor limestone and minor tuff	Fluvial, minor shallow marine incursions	(2100),600	
		Devonian	Late		Silver Hills Volcanics / Mt Wyatt Formation	Acid volcanics / Siltstone, shale, sandstone, tuff	Terrestrial volcanism / Shallow marine, paralic, volcanism	(1500) / at least 1500	
UNCONFORMITY (Tabberabberan Orogeny)									
Adavale			Middle		Buckabie Formation	Red sandstone; siltstone; shale. Extends into the Early Carboniferous	Shallow marine; continental	(3000)	Vine, 1972
					Etonvale Formation	Red-grey siltstone; shale; dolomite; anhydrite	Shallow marine, paralic lagoonal	(1000)	Tanner, 1966
					Cooladdi Dolomite (Bury Limestone)	Dolomite, Algal limestone (Bury Limestone: Limestone, oolitic grainstone, calcareous shale. Rich marine fauna)	Shallow marine (Bury Limestone: Restricted to high energy shallow marine)	(99) (total 400)	
					Lissoy Sandstone (Bury Limestone)	Quartzose, feldspathic & conglomeratic set	Continental to marginal marine	(172)	
					Log Creek Formation	Sandstone, dolomite, limestone, shale	Shallow marine	(850)	Paten, 1977
					Eastwood Beds	Interbedded shale and sandstone; grey-green, carbonaceous	Fluviatile to lacustrine	(875)	
			Early		Gumbardo Formation	Acid volcanics; arkose	Terrestrial vulcanism	(800)	Auchincloss, 1976
UNCONFORMITY									
		Silurian Ordovician Cambrian			Basement Rocks including Anakie Metamorphics, etc.	Low-grade metamorphics, granites and acid volcanics			

The Early Jurassic to Late Cretaceous Eromanga Basin overlies earlier sedimentary basins in the west of the survey area, and the entire region is capped with patches of duricrust and covered with areas of Cainozoic sands, gravels, and scattered basalt flows.

Basement

The basement rocks which crop out in the Lolworth-Ravenswood Block and Anakie Inlier consist of Lower Palaeozoic low-grade metasediments, granites, and acid volcanics. Towerhill 1 and Thunderbolt 1 wells are the only exploration wells in the eastern Galilee Basin to reach sedimentary basement (see Table 1, and see Figure 2 for location); both wells bottomed in Palaeozoic volcanics which can be correlated either with the Mount Windsor Volcanics of the Anakie High or with the Devonian-Carboniferous Silver Hills Volcanics (Olgers, 1972).

Table 1. Deepest rocks in exploration wells.

Well	Total depth (m)	Deepest rock type
Koburra 1	3260	pre-Upper Carboniferous sandstone, shale, siltstone
Towerhill 1	1481	pre-Upper Carboniferous acid volcanics
Thunderbolt 1	1608	pre-Upper Carboniferous acid volcanics
Lake Galilee 1	3406	Middle or Upper Devonian sandstone and shale
Jericho 1	2786	pre-Devonian conglomerate with igneous affinities
Allandale 1	3006	Lower Devonian acid volcanics, possibly Gumbardo Formation

Stratigraphy

The generalised stratigraphy of the area is given in Table 2.

The Adavale Basin contains mainly shallow marine sediments deposited over a mobile platform region (Paten, 1977). Overlying the acid and andesitic volcanics of the Gumbardo Formation is a transgressive sequence of shallow marine sediments including salt and dolomite in the Log Creek and Etonvale Formations. A small gas field was discovered in the Middle Devonian Log Creek Formation at Gilmore, but because of the field's size and distance from market it has not been brought into production.

The terrestrial sediments of the Drummond Basin were deposited from Late Devonian to Early Carboniferous times in an intermontane trough. Olgers (1972) reports that up to 12 000 m of fluviatile sediments were deposited by generally north-flowing rivers.

Both the initial and final stages of deposition in the basin were accompanied by acid volcanism; the Silver Hills Volcanics form a 1500 m-thick sequence of tuff and rhyolite at the base of the Drummond Basin, and both the Star of Hope and Ducabrook Formations near the top of the basin contain interbedded tuff and sandstone.

Sedimentation in the Galilee Basin was also mainly fluviatile and continued with minor breaks from the Late Carboniferous until the Late Triassic. There is evidence of glacial conditions in the Late Carboniferous and again in the Early Permian. During the Permian, several distributary river systems flowed southwards into swamps, producing the widespread coal measures. These deposits also have the best source-rock potential within the Galilee Basin (Hawkins, 1977).

During the Jurassic and Cretaceous, the fluvial and shallow marine sediments of the Eromanga Basin were deposited in a broad, regional downwarp, covering the area with up to 1800 m of mudstone, sandstone, and minor limestone.

Structure

The main geological structures are shown in Figure 3. The Late Carboniferous and younger sediments are only gently folded, and occupy broad downwarps in the underlying strata. However, the Devonian to Carboniferous sediments of the Adavale and Drummond Basins are folded into a series of generally north-northeast to north-northwest-trending folds which become tighter towards the east. Structures in the Drummond Basin were formed during the Mid-Carboniferous Kanimblan Orogeny as a result of compression from the east (Olgers, 1972). Olgers considered that large-scale shearing occurred along northwest-trending and northeast-trending fault zones; he also postulated several megashears across the Drummond Basin and Anakie Inlier, and a décollement at the base of the Drummond Basin sequence. The St Anns Fault and Chinaman Fault are high-angle reverse oblique-slip faults and form parts of these megashears.

The Koburra Trough is a major structural depression within the northeastern Galilee Basin. Although its boundaries have not been precisely defined, it is known to extend about 300 km along its northwest axis and 100 km across (Allen, 1974). It contains the greatest known thickness of Galilee Basin sediments - 2820 m, in Koburra 1 well. The presence of a thick continuous sequence of shallow-water Permian sediments in the Trough indicates that subsidence occurred penecontemporaneously with deposition (Benstead, 1973).

The Mingobar Monocline forms part of the eastern margin of the Koburra Trough. This monocline in the outcropping Triassic and Permian sediments extends in the subsurface further northwest and southeast of its mapped position (Fig. 3), and appears on the several seismic sections that cross it to be an anticline at depth.

Vine (1972) gave the name Belyando Feature to a lineament that includes the White Mountains Structure, the Mingobar Monocline, and part of the course of the Belyando River. He suggested that it comprises a major basement fracture zone and that it marks the western limit of the Drummond Basin. Harrison, Anfiloff & Moss (1975) considered the Drummond Basin sediments to extend 20 km westwards of the Belyando Feature which appeared to coincide with a shear zone as interpreted from seismic data. This shear zone was postulated to be an extension of the Chinaman Fault.

Geological evolution

The tectonic framework of the area at the beginning of the Devonian consisted of a broad mobile platform of continental crust, related to the last stages of stabilisation of the Lachlan Geosyncline, bordered to the east by the marginal seas and volcanic island arcs of the New England Geosyncline, further to the east of which lay a subduction zone (Marsden, 1972).

During the Devonian, shallow marine sediments of the Adavale Basin were deposited across the mobile platform. Towards the end of the Devonian this basin was gradually uplifted following the Tabberabberan Orogeny, and sedimentation in the basin became terrestrial and then ceased.

Volcanism and granitic intrusions accompanied the Tabberabberan Orogeny, and the resulting uplift of the Anakie Inlier produced the intermontane trough into which Drummond Basin sediments were deposited. Continued subduction to the east of the Drummond Basin produced the mid-Carboniferous Kanimblan Orogeny which thrusted and uplifted the basin sediments, terminated sedimentation, and produced a source of sediments for the Galilee and Bowen Basins. The modern Drummond Basin is now only an erosional remnant of the once widespread Devonian-Carboniferous sediments.

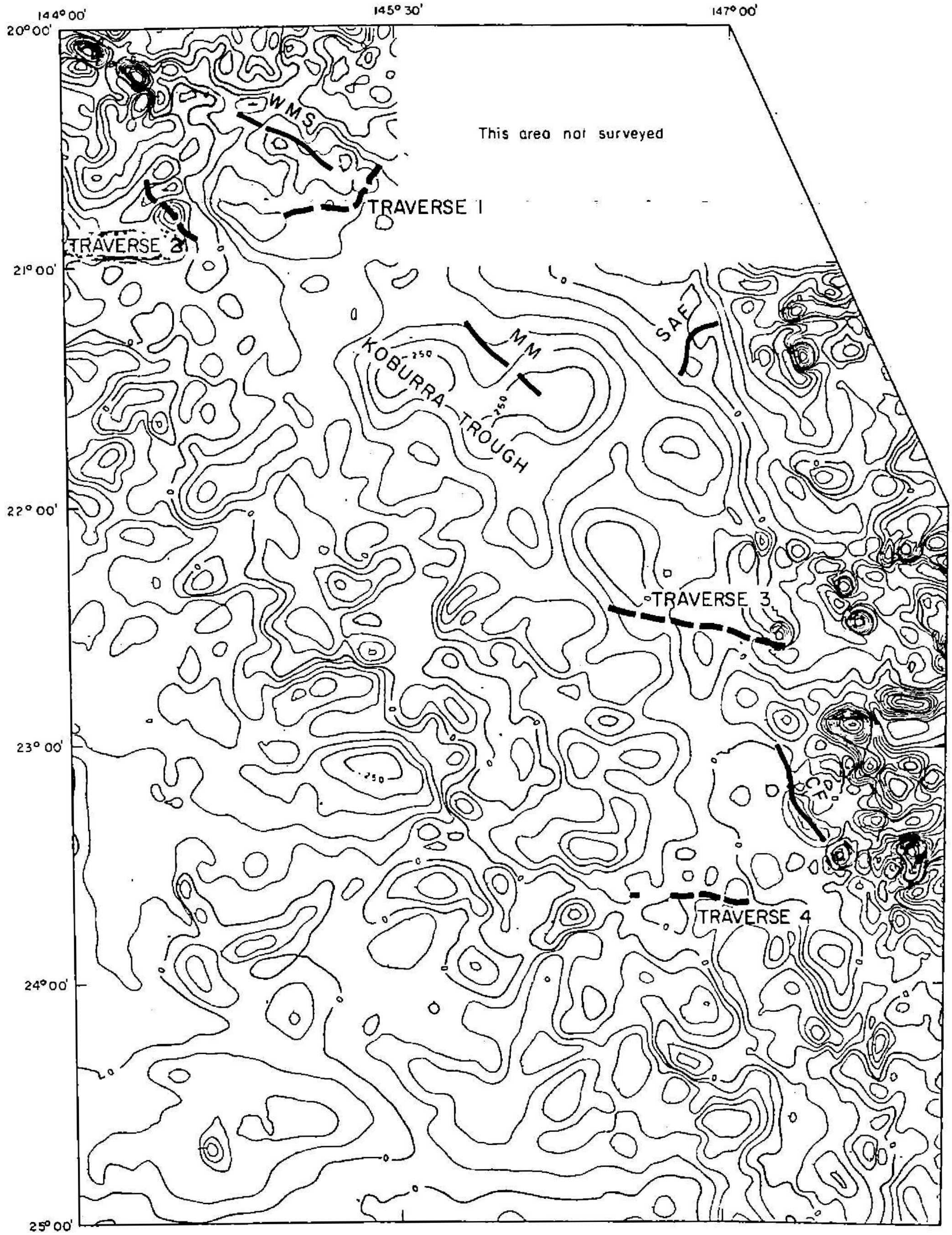
From Late Carboniferous to Late Triassic times the Galilee Basin developed as a broad intracratonic downwarp. The source areas for the mainly fluvial sedimentation were the Anakie Inlier to the east and the Ravenswood Block to the north. Widespread swamp environments towards the end of Permian times produced the extensive Late Permian coal measures. Mild folding and uplift at the end of the Triassic terminated Galilee Basin sedimentation.

Regional downwarping recommenced in the Early Jurassic, and the widespread sediments of the Eromanga Basin were deposited.

PREVIOUS GEOPHYSICAL INVESTIGATIONS

Magnetic surveys

Aeromagnetic surveys have been carried out in the area by BMR (Jewell, 1960; Waller, 1968), and by private companies (Exoil, 1962). Hsu (1974) interpreted the survey results, and produced a map showing depth to magnetic basement for the northern Eromanga Basin.

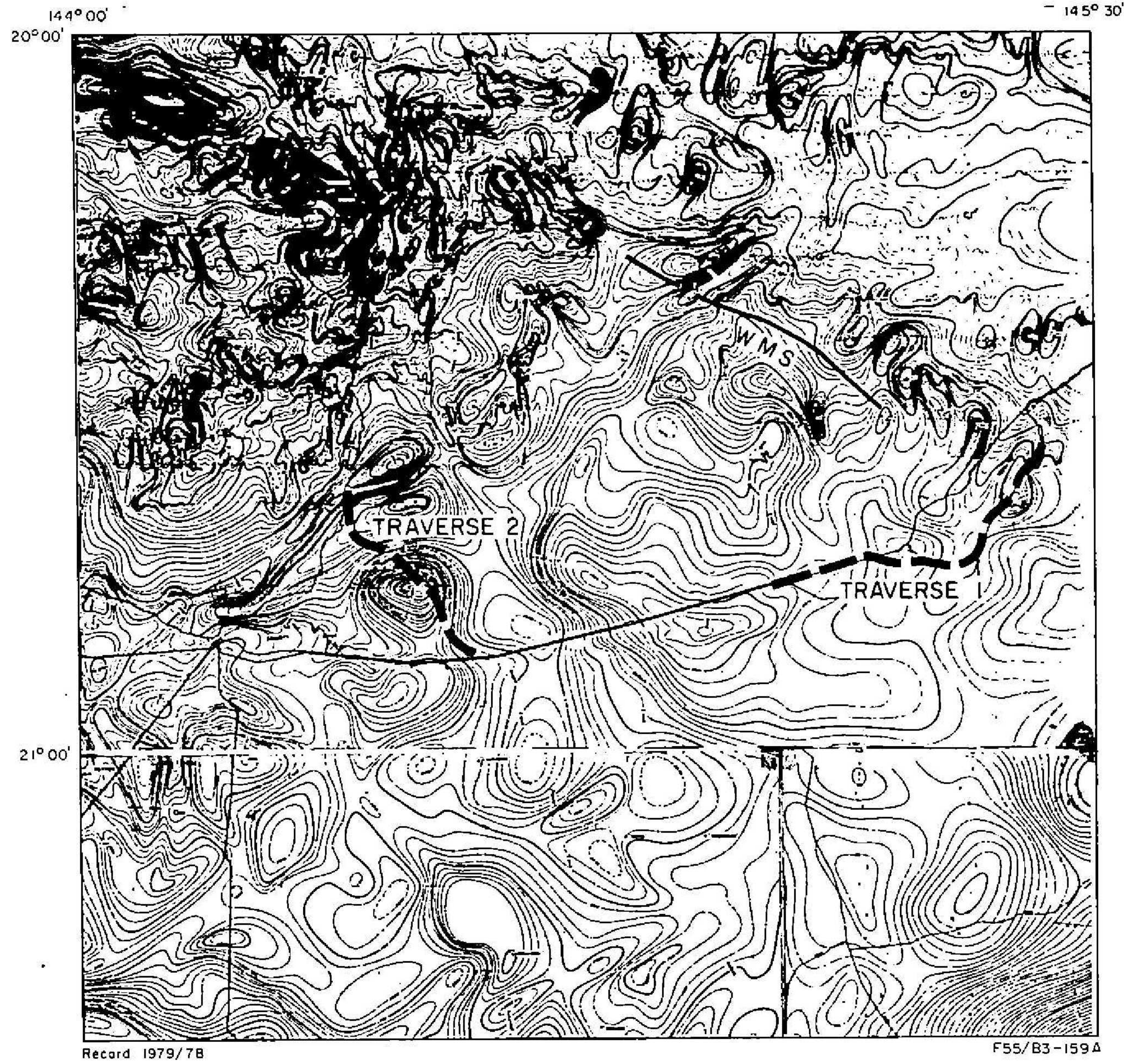


WMS *White Mountains Structure*　　SAF *St Anns Fault*

MM *Mingobar Monocline*　　CF *Chinaman Fault*　　*1976 Seismic traverse*

Extracted from Magnetic maps of Australia, 1976
Magnetic intensity contour interval 50nT

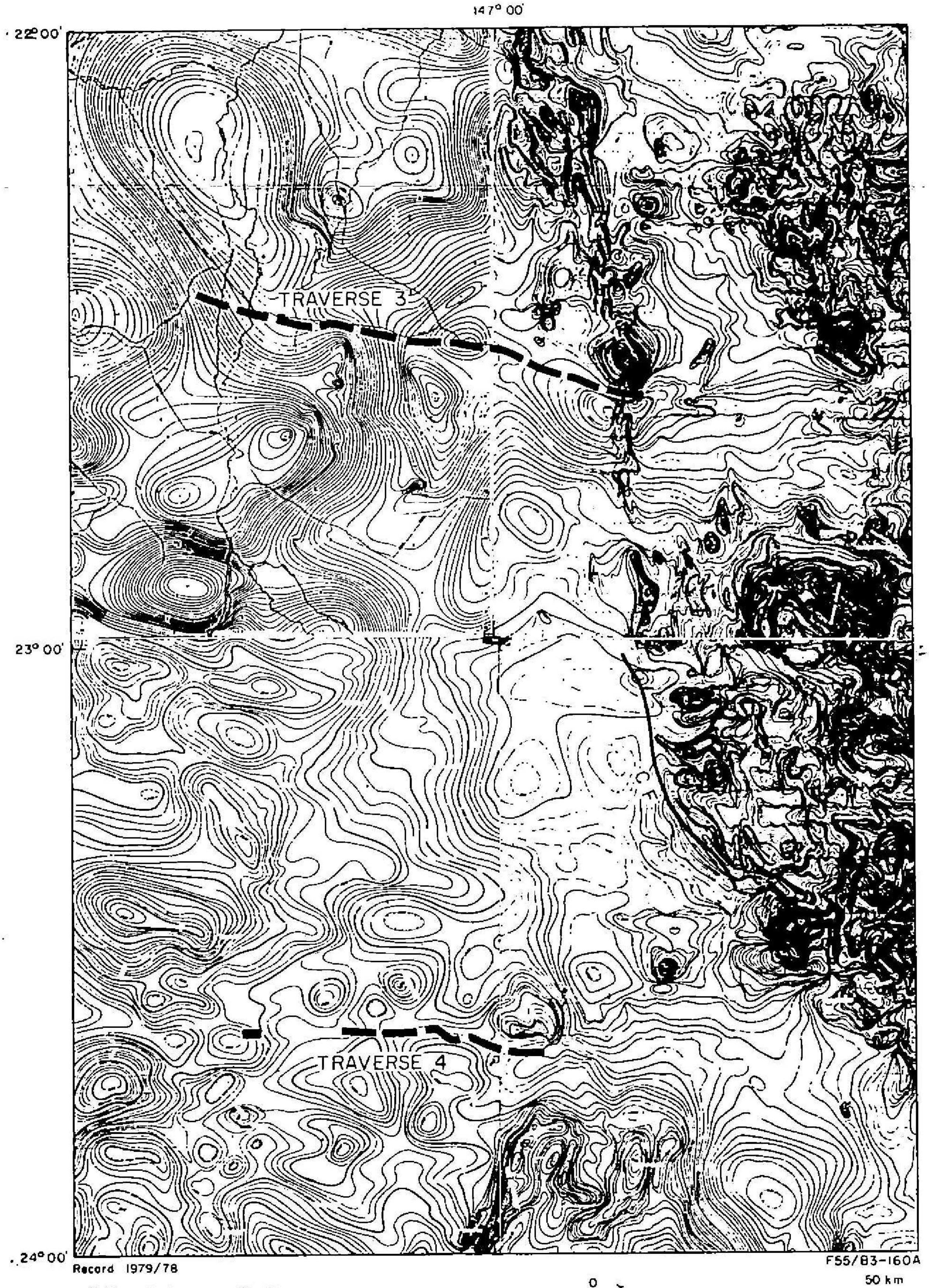
Record 1979/78　　**Fig. 4 Regional total magnetic intensity**　　F55/B3-158A



W M S *White Mountains Structure*

Magnetic intensity contour interval 10nT

Fig 5 Total magnetic intesity – traverse 1 & 2



C F *Chinaman Fault*

Magnetic intensity contour interval 10nT

Fig.6 Total magnetic intensity – traverse 3 & 4

The regional total magnetic intensity contours are shown in Figure 4, and detailed total magnetic intensity contours in the vicinity of the 1976 seismic traverses are shown in Figures 5 and 6.

A zone of relatively low-amplitude magnetic anomalies coincides with the Koburra Trough (Fig. 4); Hsu (1974) interpreted magnetic basement depths to be 3000 m to 6000 m in this region. In the north of the Koburra Trough an abrupt increase in magnetic intensity correlates with the White Mountains Structure (Figs. 4 and 5) and probably delineates the northeast margin of the Trough. The northeast-trending magnetic lineation that crosses the northern end of Traverse 2 (Fig. 5) was suggested by Hsu to represent a steep rise in magnetic basement at the northwestern end of the Koburra Trough. It should be noted that the short-wavelength, high-amplitude anomalies in the northwestern corner of Figure 5 are due to surficial Cainozoic basalt.

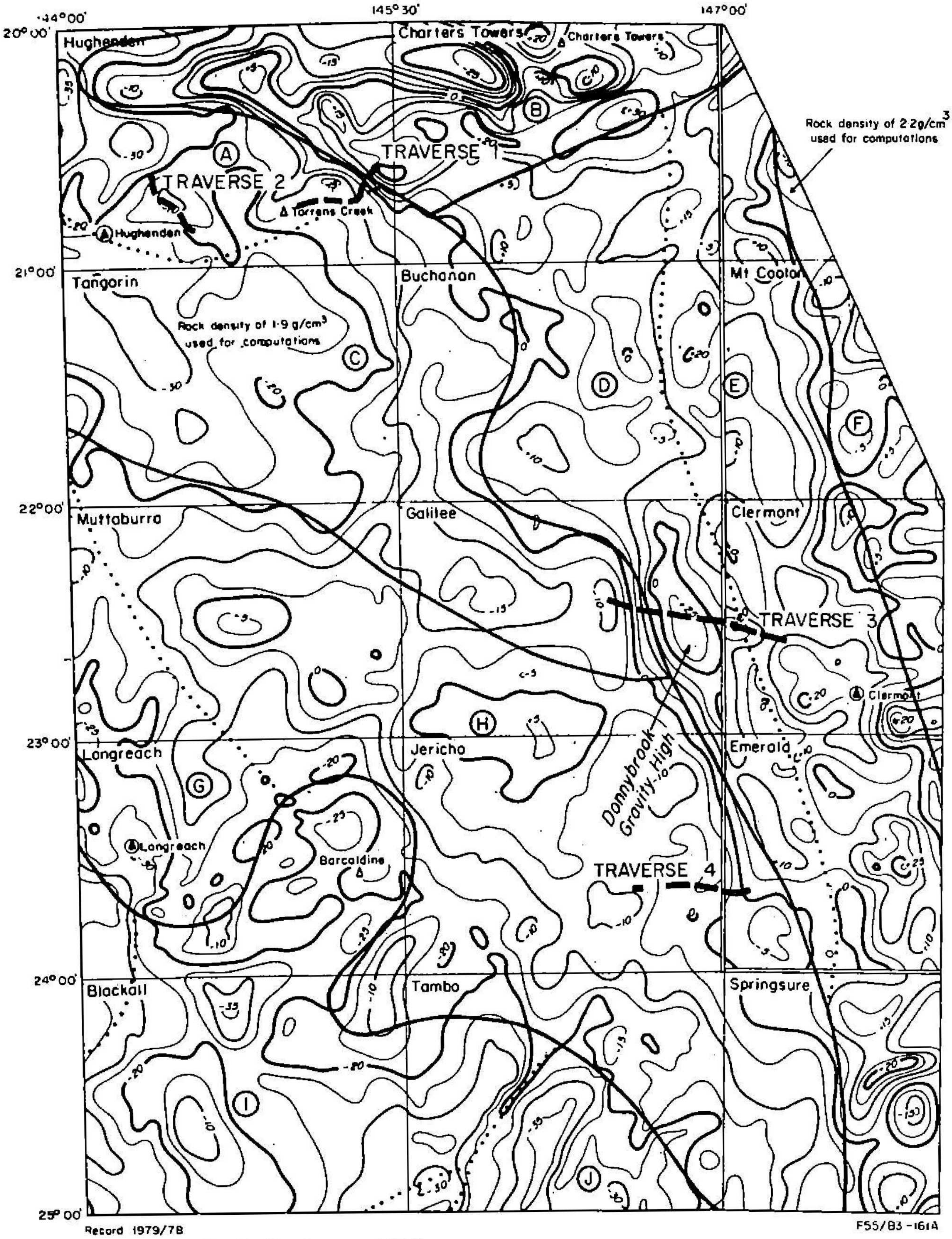
In the eastern half of Figure 6 the NNW-trending line of higher-amplitude anomalies just east of the Chinaman Fault marks the outcrop of the Silver Hills Volcanics; and to the east of this the magnetic anomalies reflect the outcrop of the Anakie Metamorphics, although here, also, Cainozoic volcanics create an overlying short-wavelength pattern.

The NNE-trending magnetic anomalies just southeast of Traverse 4 are probably caused by uplifted Silver Hills Volcanics in the core of the Mount Beaufort and other parallel anticlines.

Gravity surveys

BMR reconnaissance gravity surveys from 1959 to 1963 covered most of the Galilee Basin (Gibb, 1968). Detailed gravity surveys have also been conducted over small areas (Farmout Drillers, 1964; Harrison & others, 1975; Watts & Brown, 1976).

The regional Bouguer anomaly contours and the gravity provinces of Fraser & others (1977) are shown in Figure 7. A prominent feature of the gravity map is the linear gravity gradient that runs from the northwest corner of the map to the southeast corner, and separates the areas of lower Bouguer anomaly, i.e. Richmond Gravity Shelf, Tangorin



Gravity Provinces and Units

(A) *Richmond gravity shelf*	(F) *Emerald gravity shelf*
(B) *Charters Towers gravity complex*	(G) *Longreach gravity spur*
(C) *Tangorin gravity depression*	(H) *Aramac gravity platform*
(D) *Drummond gravity shelf* } *Anakie Regional Gravity Ridge*	(I) *Blackall gravity platform*
(E) *Clermont gravity ridge* }	(J) *Charleville gravity platform*

0 — 100 km

▬ ▬ ▬ *1976 Seismic traverse*

——— *Boundary of gravity provinces*

······ *Unit boundary*

Fig.7 Regional Bouguer anomaly contours

Gravity Depression, and Aramac Gravity Platform, from the areas of higher anomaly values, i.e. Charters Towers Gravity Complex and Anakie Regional Gravity Ridge. This gradient corresponds in the north with the White Mountains Structure (Gibb, 1968), and, in the central part of the map area, with the Belyando Feature (Vine, 1972). To the west of the gradient the Koburra Trough correlates with the Tangorin Gravity Depression; and to the east of the gradient the Anakie Inlier and Drummond Basin correlate with the Anakie Regional Gravity High.

The gravity high within the Drummond Gravity Shelf that lies athwart Traverse 3 was attributed by Harrison, Anfiloff & Moss (1975) to a 2000 m basement uplift, flanked on the west by deep-lying granite; however, those authors considered that an alternative cause could be a reverse density contrast at depth.

Seismic surveys

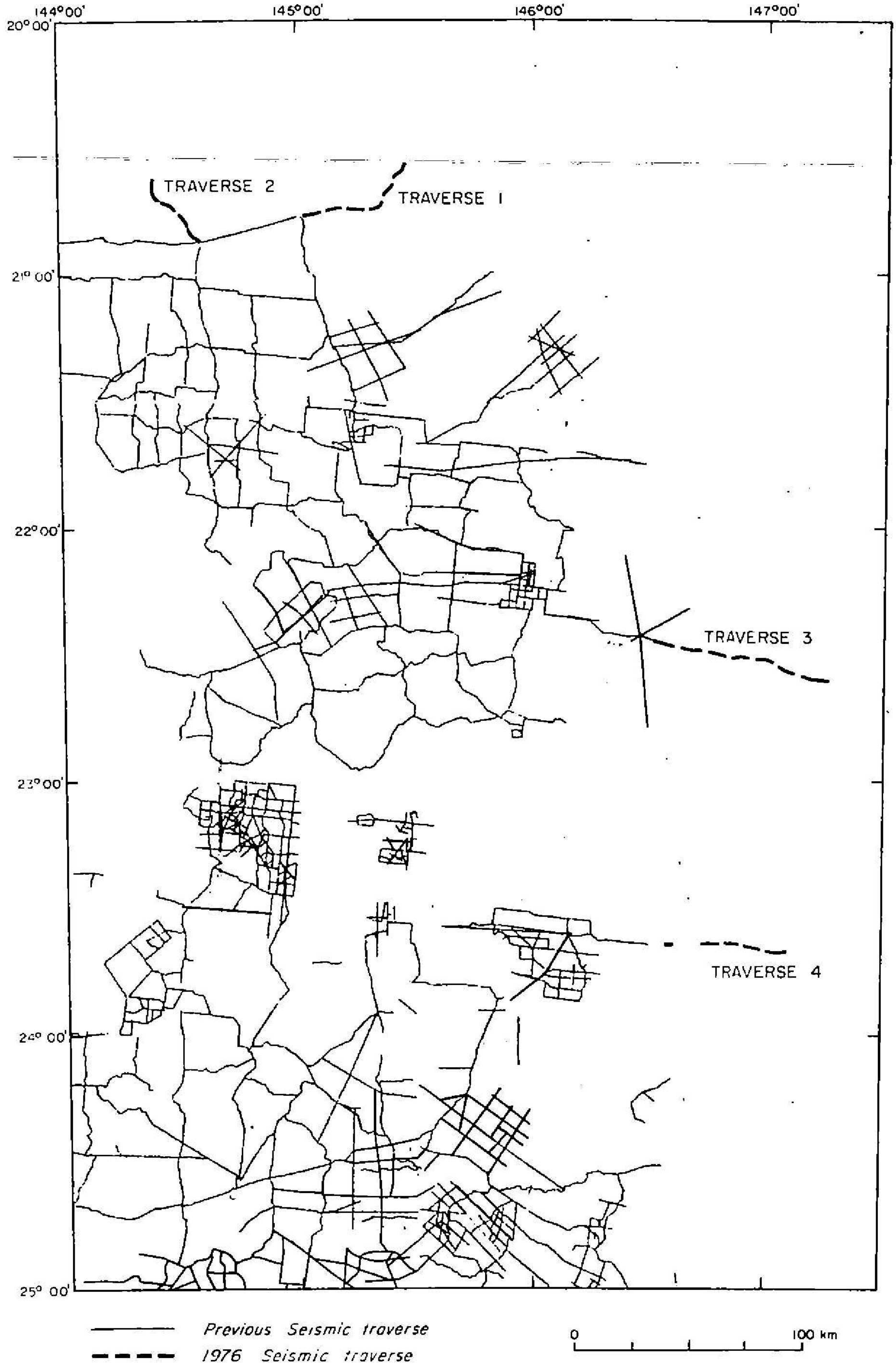
Numerous seismic surveys have been conducted in the Galilee Basin; the locations of all seismic traverses are shown in Figure 8, and the major surveys are listed in Table 3.

Most surveys obtained good reflections from the top Permian coal measures, the "P horizon"; but the only surveys to record any deeper reflections were the Towerhill, East Lynne, Galilee Basin 1971, Belyando, and Albro surveys; all used multiple-fold CDP recording. The Towerhill survey, with its "Thumper" energy source, long-offset spreads, and 12-fold coverage recorded the best deep reflections.

In 1971, BMR recorded a seismic traverse east of Lake Galilee 1 well to investigate the structure of the eastern margin of the Galilee Basin and its relation to the Drummond Basin (Harrison, Anfiloff & Moss, 1975). Their conclusion was that the eastern margin of the Galilee Basin is underlain by Middle to Upper Devonian, possibly Adavale Basin sediments. However, the interpretation was based on scanty palynological evidence for the age of these sediments at the bottom of Lake Galilee 1 (Playford, Appendix 1a in Pemberton, 1965), and recent examination of the cores from this well and from other wells in the Galilee Basin throws further doubt on this identification (Hawkins, pers. comm).

TABLE 3: MAJOR SEISMIC SURVEYS IN THE EASTERN GALILEE BASIN

Year	Survey Name	Company	Type of recording	Record quality	Reference or BMR subsidy report no.
1962	Lake Galilee and Lake Buchanan	Exoil	Single fold	fair to good	62/1586
1962	Alpha	Oil Development	single fold	poor to fair	62/1634
1963	Jericho	Alliance Oil Devel.	single fold	fair	63/1527
1962-63	Torrens Creek	Exoil	single fold	poor	62/1647
1963	Blackall-Mitchell	Amoseas	single fold	varied	62/1618
1963	Rodney Downs	Longreach	single fold	fair	62/1631
1965	Rodney Creek	Phillips-Sunray	single fold	fair	65/11008
1965-66	Bowen Downs	Amerada	single fold with spot correlation	poor	65/11034
1966-67	Thunderbolt	Amerada	single fold with spot correlation	good	66/11128
1966-67	Towerhill	Amerada	Thumper, 6-12 fold	good	66/11136
1966-67	Yarrowglen	Amerada	single fold with spot correlation	poor	66/11133
1969	Windeyer	Beaver	single fold	good	69/3067
1969	Koburra	Flinders	single fold	poor	69/3083
1970	East Lynne	Beaver	single to six fold	fair - good	70/458
1971	Galilee Basin	BMR	single to six fold	fair - good	Harrison et al., 1975
1972	Hexham	Exoil	single fold	good	72/2920
1972	Belyando	American Australian Energy	six fold	fair - good	72/2935
1973	Albro	American Australian Energy	six fold	good	74/218



Record 1979/78

Fig. 8 Seismic traverse location

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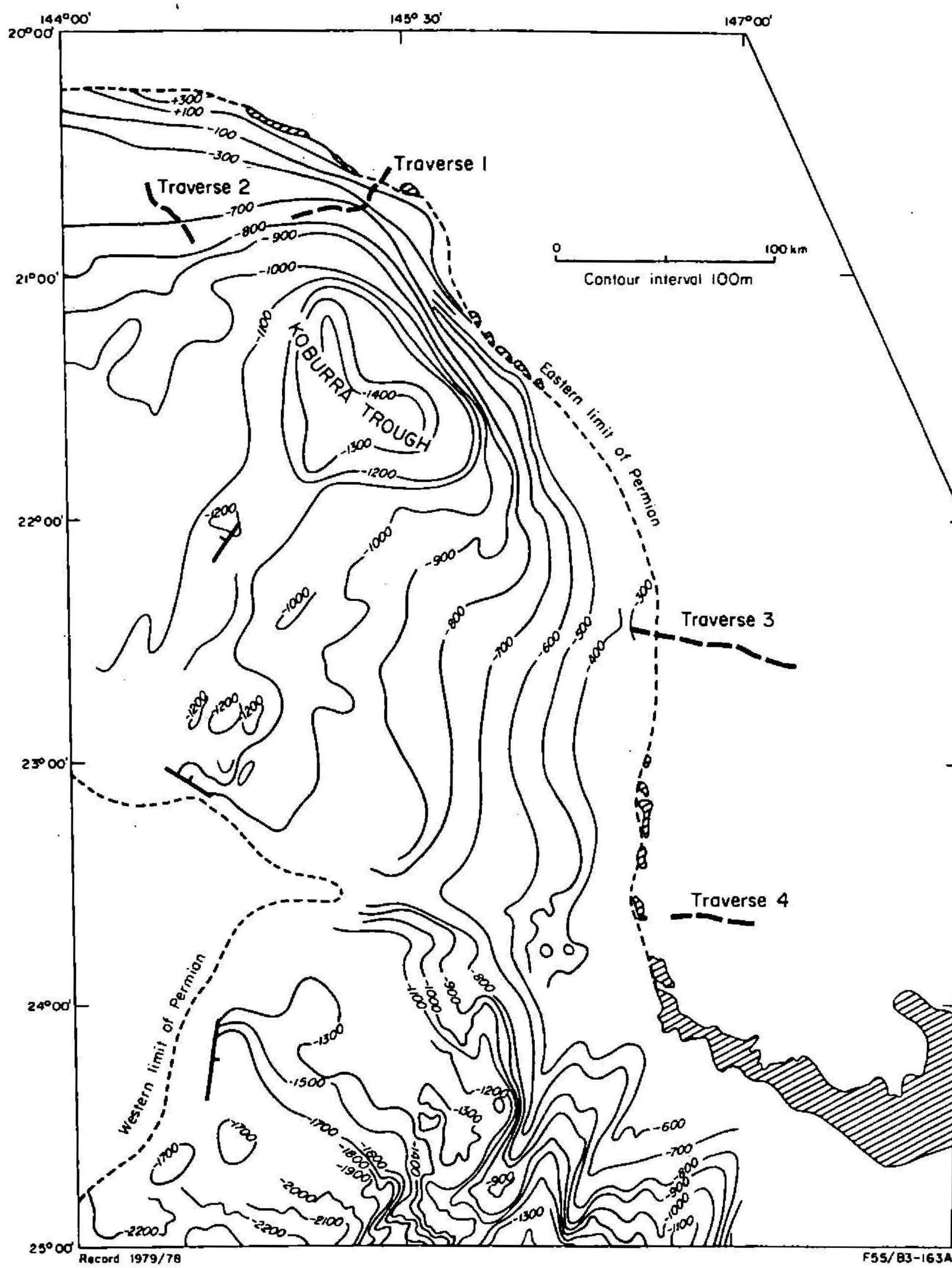
23



Permian outcrop

Fault showing direction of downthrown block.

1976 Seismic traverse

—700— Contours of depth to top of Permian (values in metres, datum +300m above M.S.L.)

Time / Depth graphs used for conversion of reflection times are given in Appendix I

Compiled by D Schmidt from data from previous seismic surveys and from Vine (1973)

Fig.9 Contours of depth to top of Permian

In 1972 and 1973, American Australian Energy Ltd followed-up the BMR 1971 survey with further seismic work (see Table 3). Their results showed that the unnamed possible Devonian sequence thickened northwards into the Koburra Trough. This suggests that both the Koburra Trough and the bottom of Lake Galilee 1 well contain either Drummond Basin sediments, or sediments of the same age as, but structurally separated from the Adavale Basin.

Figure 9 is a map of "Depth to Top of Permian" based on seismic and drilling information. This is the deepest horizon that has been regionally mapped, although Harrison & Bauer (1975) have mapped basement in the Hughenden-Koburra-Towerhill area. The structure contours of the Top of Permian show a depth of at least 1400 m in the Koburra Trough, and show the steep northeast margin of the Trough. NNE-trending anticlines at the south of the map area are also clearly visible.

OBJECTIVES AND PROGRAM

Objectives

The main objectives of the survey were to investigate the possible steep northern margins of the Koburra Trough, and the relationships and relative extents of the Adavale and Drummond Basins in the area east and south of Lake Galilee 1 well.

Traverses 1 and 2 were recorded to investigate the northeast and northwest margins of the Koburra Trough; Traverse 1 was to cross the White Mountains Structure and Traverse 2 was to cross the northeast-trending steep basement uplift that was interpreted from aeromagnetic data. The depth and extent of the Permian coal measures in this part of the Galilee Basin are of interest to the Queensland Mines Department.

It is still uncertain whether the basal sediments of Lake Galilee 1 and Jericho 1 wells belong to the Adavale or Drummond Basin; Traverses 3 and 4 were an attempt to solve this problem and to provide additional information on these two basins. Because gas has been discovered in the Adavale Basin and because the Drummond Basin contains mainly fluviatile sedimentary rocks and is non-prospective, the relative extent of these two basins is of economic significance. The original survey plan was to complete seismic links between Jericho 1 well and Allandale 1 well; between Jericho 1 well and the Drummond Basin outcrops to the east; and between Lake Galilee 1 well and basement outcrops to the east. Unfortunately, due to lack of time, only part of this proposed program, the link between Lake Galilee 1 well and basement outcrops, could be completed.

Program

Details of the seismic program are given in the operational reports by Schmidt, Nelson & Anfiloff (1976) and by Brassil and Anfiloff (1976). Four traverses were recorded using six-fold CDP recording techniques. Detailed locations of the four traverses are shown in Figures 10 to 12, and the major statistics of each traverse are summarised in Table 4. Gravity readings were taken at 0.5 km intervals along each traverse.

Table 4. Main statistics of 1976 seismic traverses.

Traverse	Length (km)	No. of shots	Date shot
1	56.5	328	6-27 August
2	35.3	217	1-14 September
3	88.7	561	23 Sept-17 Nov
4	40.0	95	22 Nov-2 Dec

Traverse 1 (Fig. 10) was sited to cross the northeast margin of the Koburra Trough and to tie to GSQ stratigraphic drill-hole Hughenden 3-4R and to lines N12 and N16 of the Bowen Downs seismic survey. Traverse 2 (Fig. 10) tied GSQ Hughenden 5 to lines N2 and N16 of the Bowen Downs seismic survey.

Traverse 3 (Fig. 11) extended from 1971 BMR seismic Traverse A eastwards across the Donnybrook Anticline and the Mistake Creek Syncline to the outcrops of the Anakie Metamorphics. Traverse 4 (Fig. 12) was shot along the Capricorn Highway near Alpha for ease of access, and tied to GSQ Jericho 2 stratigraphic hole in the west and to the Mount Beaufort Anticline within the Drummond Basin sediments in the east.

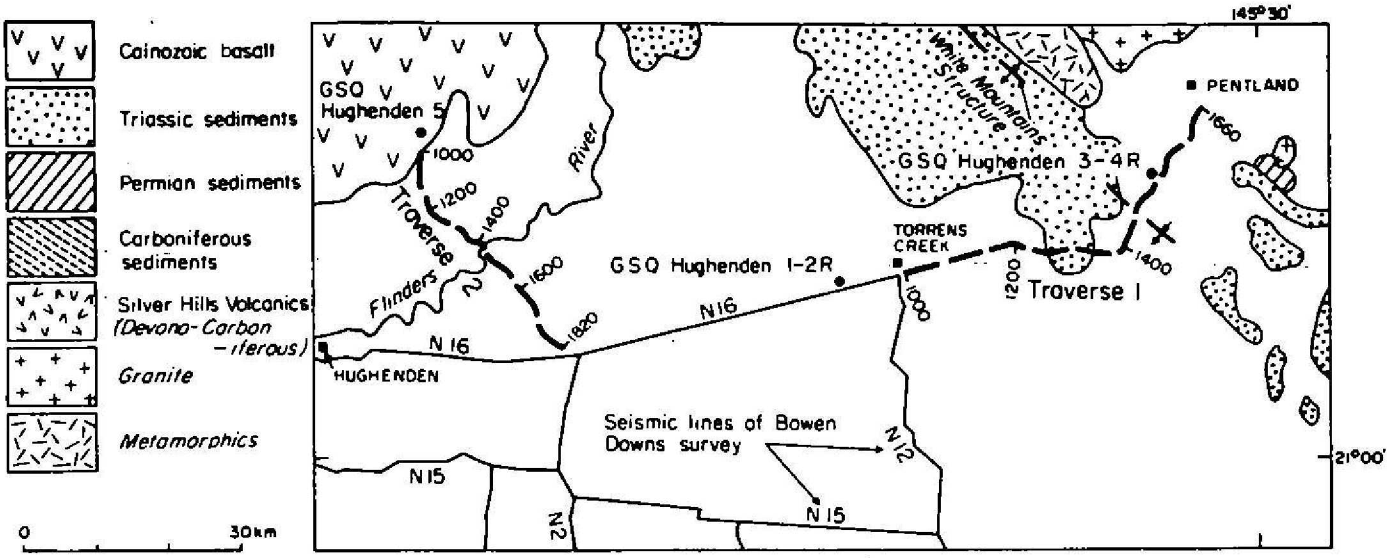


Fig.10 Location of traverses 1&2

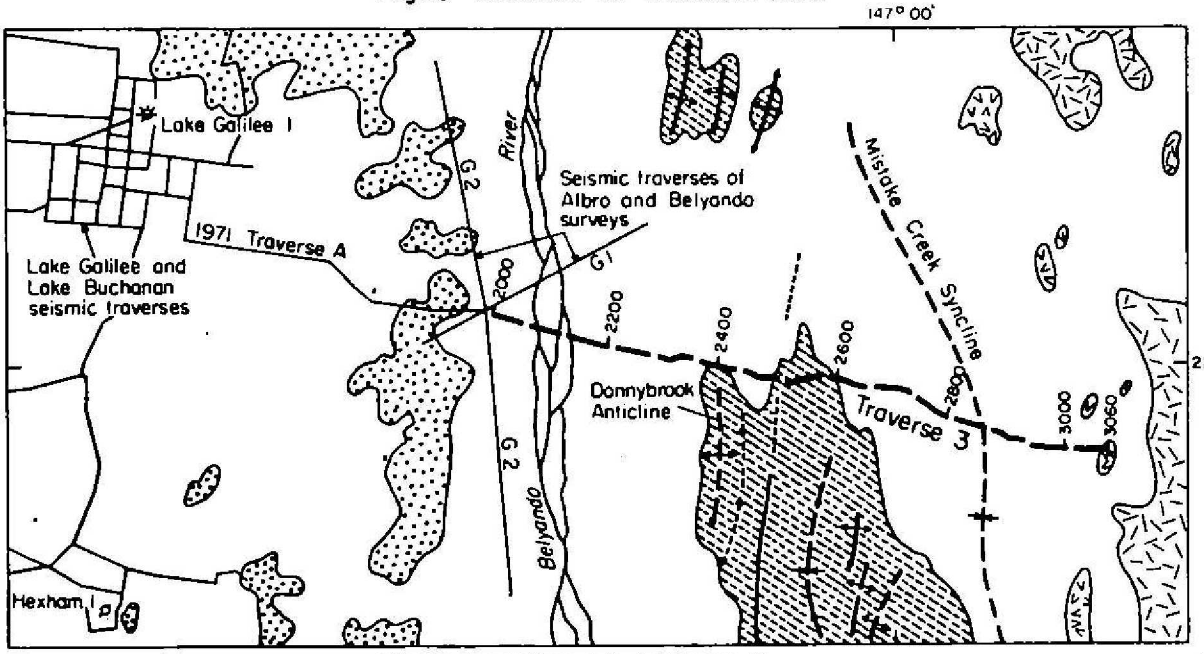
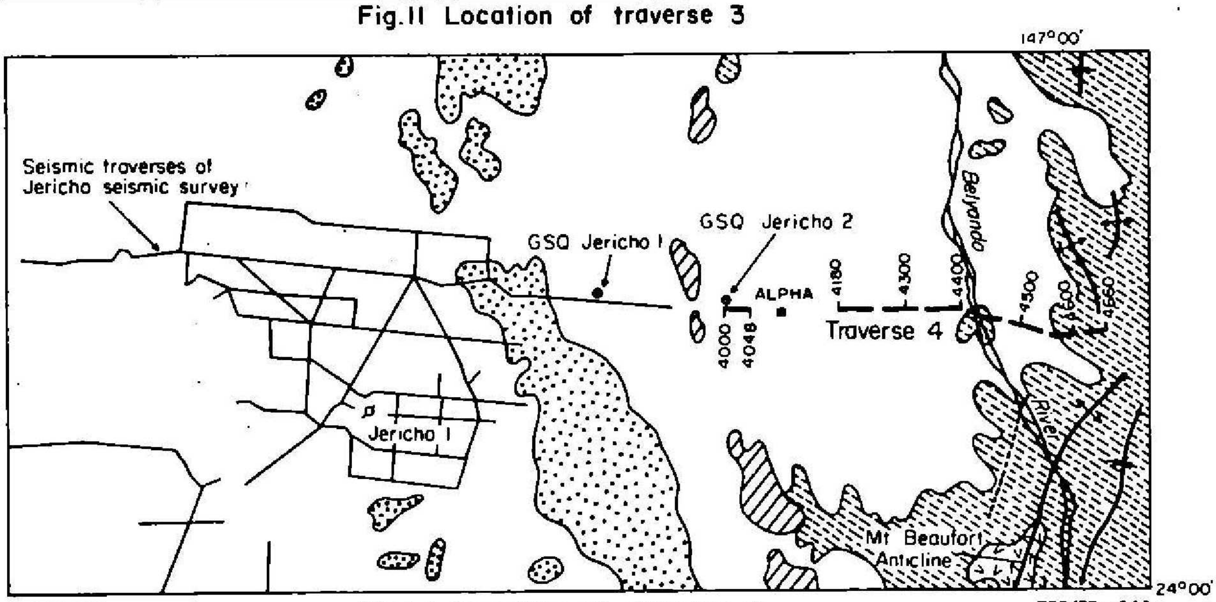


Fig.11 Location of traverse 3



Record 1979/78

Fig.12 Location of traverse 4

F55/B3-164A

Anticline (showing plunge, accurate, approximate)

Syncline (showing plunge, accurate, approximate)

Monocline (position accurate, approximate)

Structural lineament (position accurate, approximate)

Previous Seismic traverse

1976 Seismic traverse

Exploration well or stratigraphic hole

SEISMIC DATA RECORDING AND PROCESSING

Recording

Seismic data were digitally recorded using the Texas Instruments DFS IV recording system. Initial experimentation on each of the four traverses was kept to a minimum since techniques could be evaluated from the previous seismic surveys in the area. The spread configurations of 1000m-0-1000m and 0-2000m were selected as a compromise between obtaining both deep and shallow data of good quality. Single shot-holes were used except where hard drilling made a pattern of five shallow holes more efficient. The shot depth was varied along each line according to the drilling conditions and record quality. A single row of 16 geophones was connected at each geophone station as this produced good results whilst enabling moderately high production. A small part of Traverse 3, where the data were originally poor, was re-shot with deeper holes, larger charges, and 32 geophones per trace.

Most of the traverses were shot using 6-fold CDP techniques. The exception was Traverse 4 on which a mixture of 6-fold and single-fold was used alternately in an attempt to cover a large distance and at the same time obtain some high-quality data, during the last two weeks of the survey.

Only one expanded spread and one cross-traverse, both on Traverse 3, were recorded. Adequate velocity information can be generally obtained from computer velocity analysis of 6-fold CDP data; hence expanded spreads were not generally needed. On Traverse 3 an apparent velocity inversion in the shallow part of the section was noticed and the expanded spread and cross-traverse were shot to investigate whether spurious or 'side-swipe' reflections were being obtained.

Processing

The first stage in land seismic data processing is to compute the static corrections. This was done by plotting the first arrivals of all records, shooting several up-holes, and recording short weathering spreads at intervals along the traverses. Occasionally, a weathering spread was combined with an up-hole shoot, which enabled a wave-front diagram of the type originally suggested by Meissner (1961) to be plotted. An example of this is shown in Figure 13. The detailed analysis of shallow refraction results enabled an interpretation of shallow structure to be made, which in turn assisted the final interpretation of reflection results.

The seismic data were digitally processed by Geophysical Service International Ltd (G.S.I.) Sydney. The standard techniques applied to the data were:

Demultiplex
Common depth point (CDP) gather
Gain removal and true amplitude recovery
Anti-alias filter and re-sample to 4 ms
Annotation of statics as supplied by BMR
Velocity and frequency analysis
Normal moveout removal
CDP stack (6-fold)
Time-variant scaling, time-variant filtering
Trace equalisation
Application of automatic residual statics
Deconvolution

In addition to these standard processes, digital migration was applied to Traverse 3 and coherency filtering to Traverse 4.

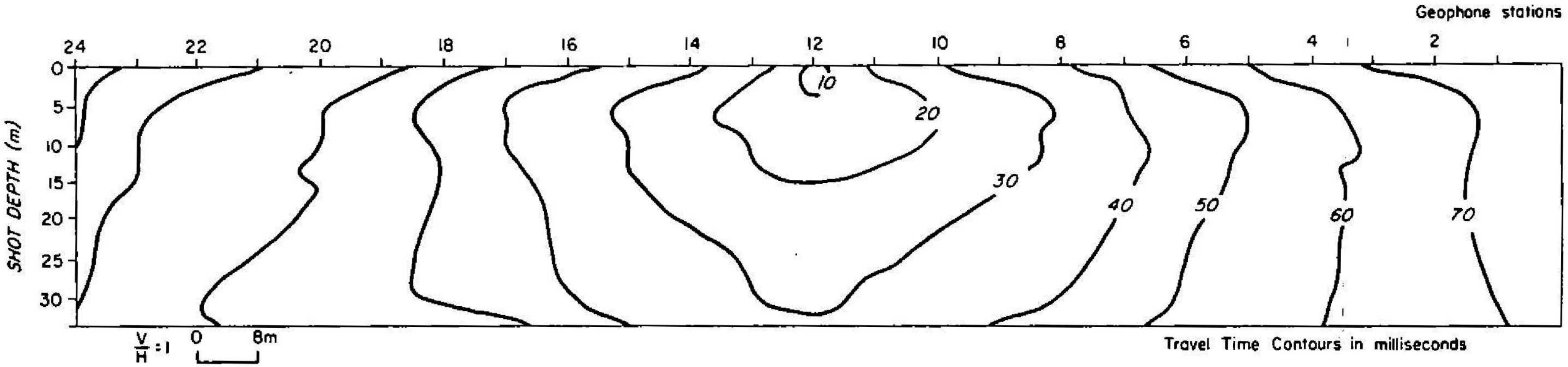
The expanded spreads and cross-traverse on Traverse 3 were not processed due to some problems in reading the field tape.

GRAVITY DATA MEASUREMENT AND REDUCTION

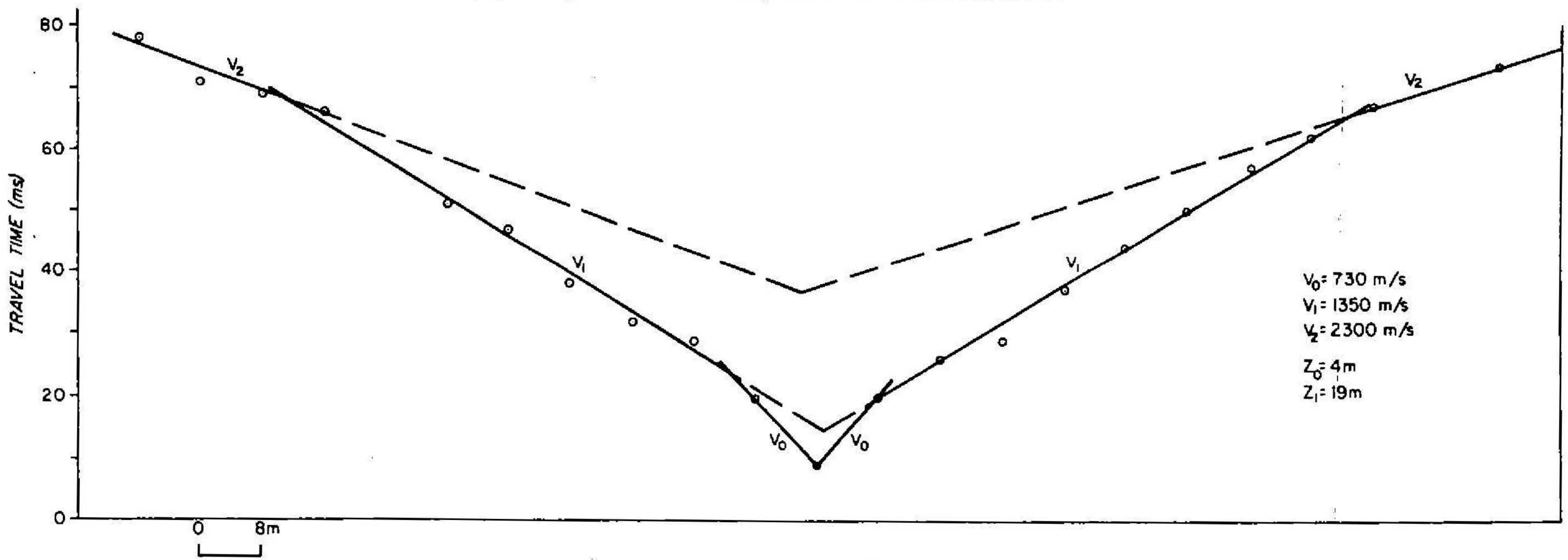
Measurement

Gravity observations were made at 0.5 km intervals along Traverses 1-4, and were tied to local benchmarks, as described in the operational reports (Brassil & Anfiloff, 1977; Schmidt, Nelson & Anfiloff, 1976). Misclosures in the observed gravity ranged from 0.02 to 0.04 mGal.

(a) MEISSNER WAVE-FRONT DIAGRAM



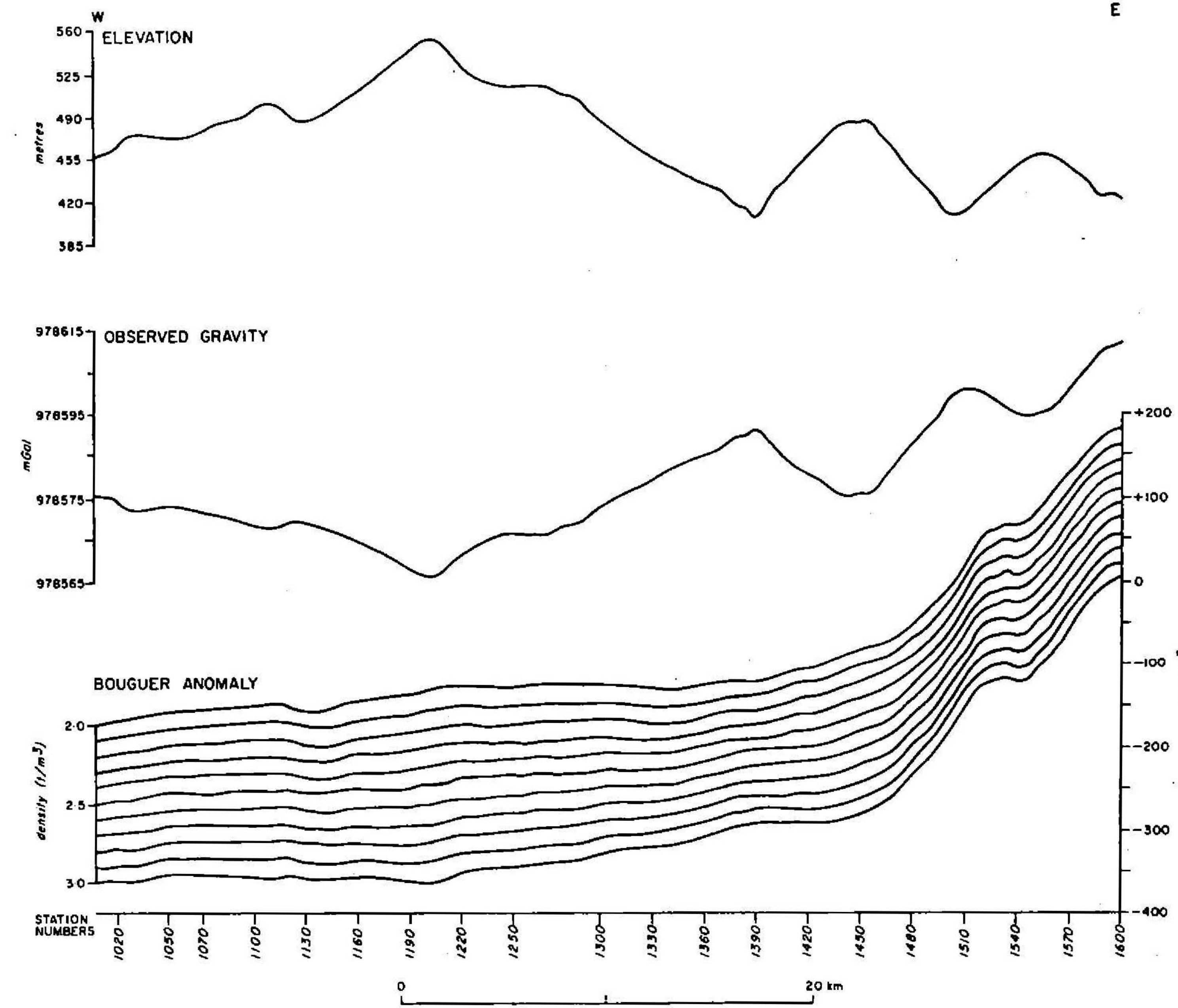
(b) FIRST BREAK PLOT, SHOT AT 2 METRES DEPTH



Record 1979/78

Fig. 13 Weathering spread plot for station 2648 traverse 3

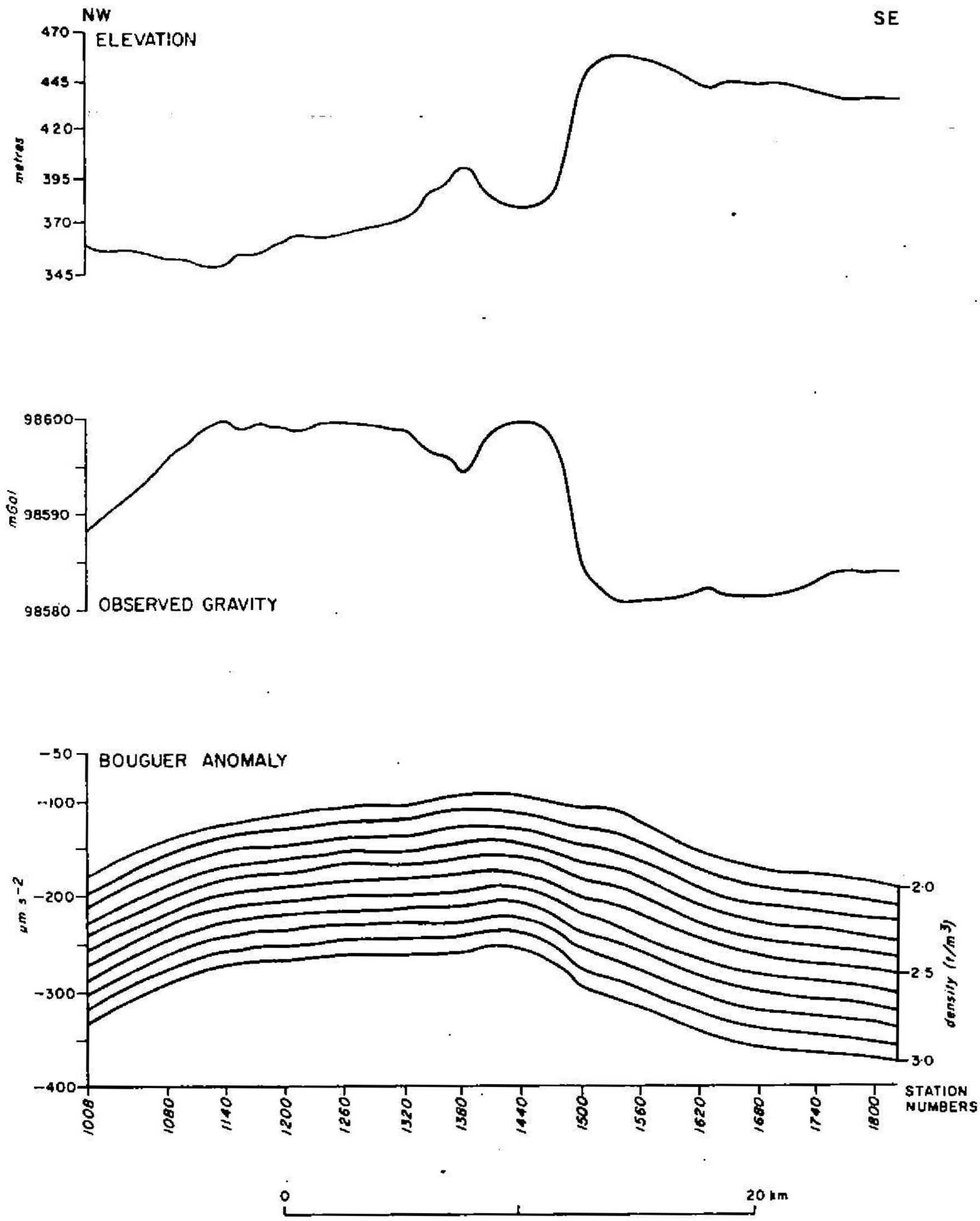
F55/B3-166A



Record 1979/78

Fig 14 Gravity and elevation profiles — traverse I

F55/B3-175A



Record 1979/78

Fig.15 Gravity and elevation profiles – traverse 2

F55/B3-176A

32

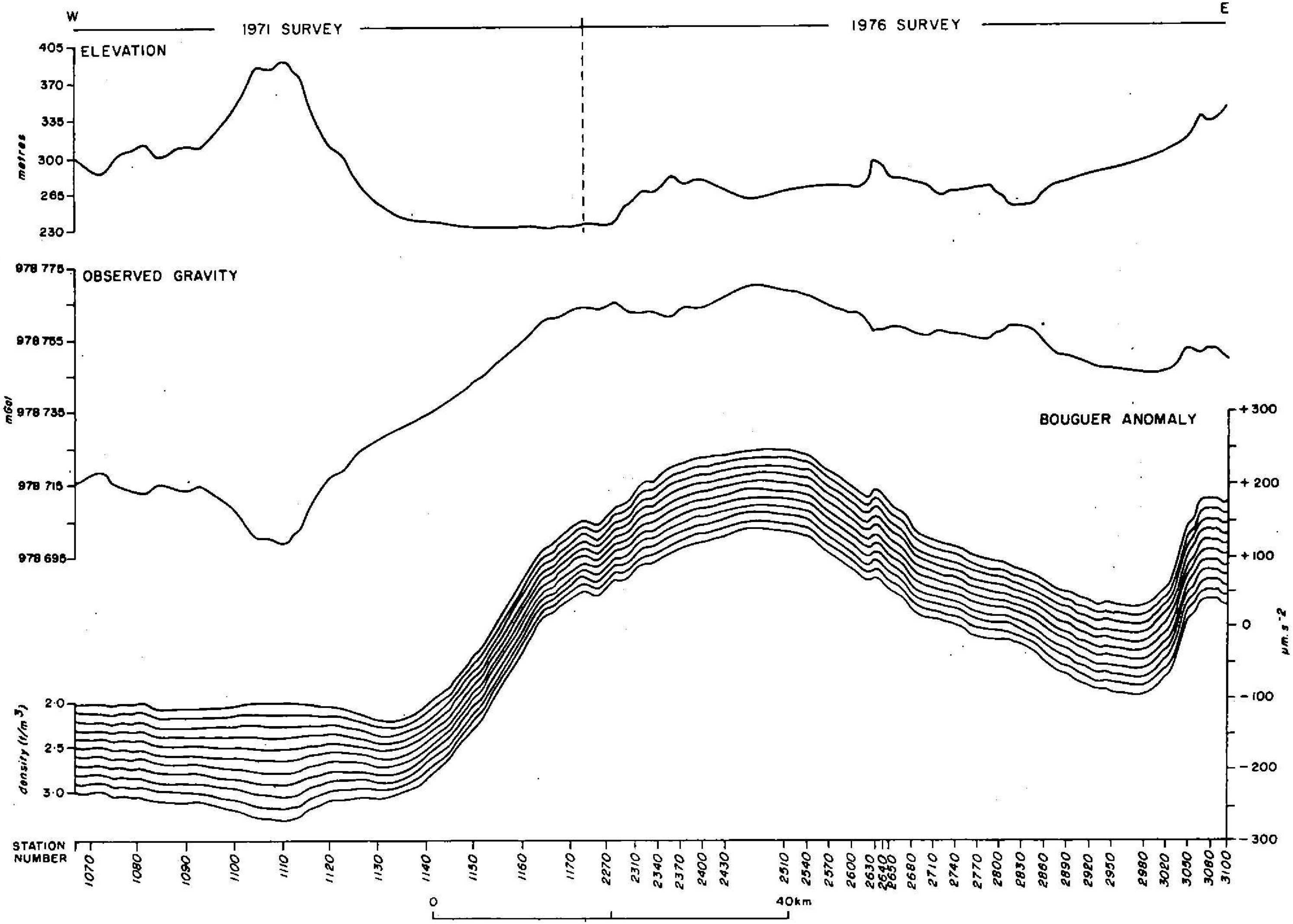
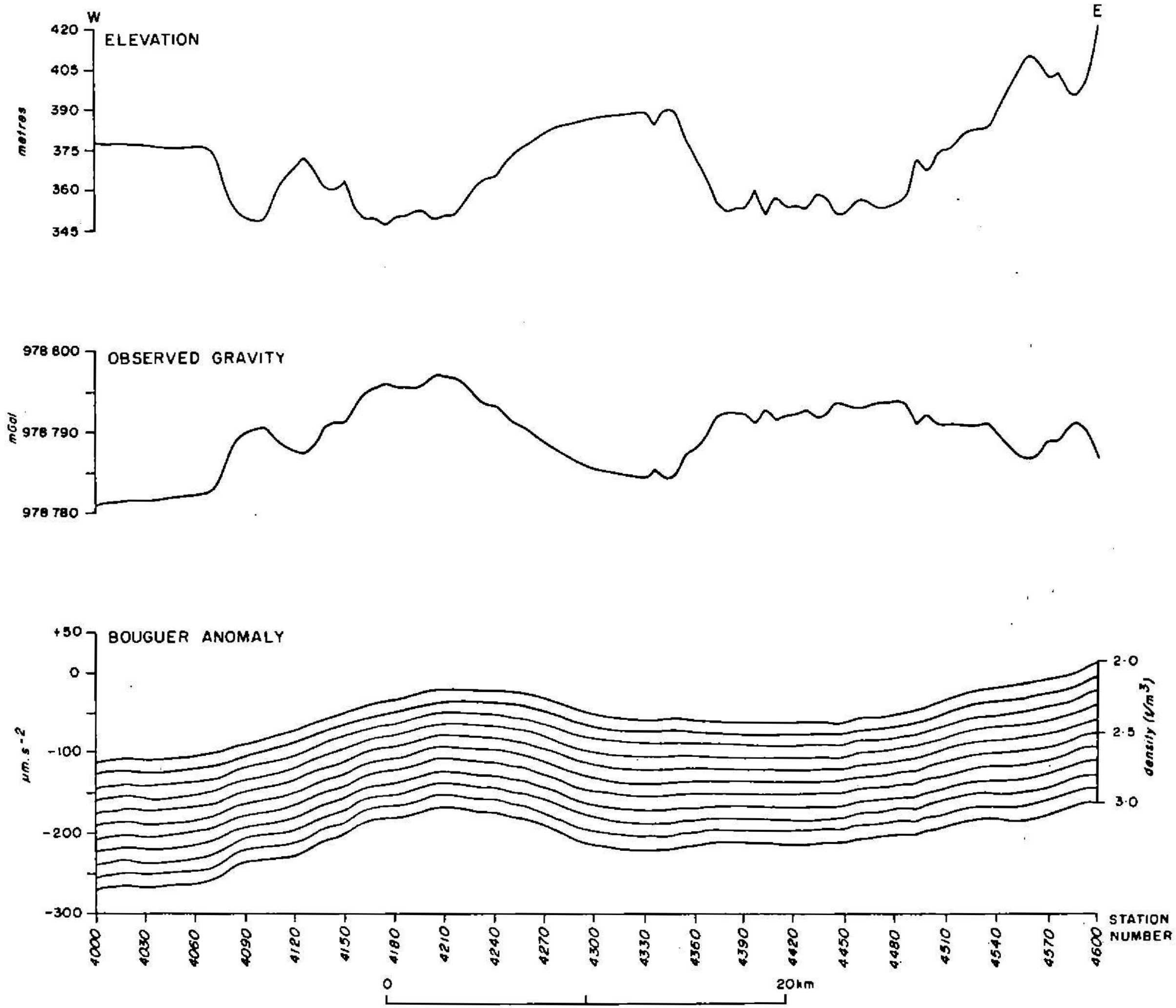


Fig.16 Gravity and elevation profiles — traverse 3

Record 1979/78

F55/83-177A



Record 1979/78

Fig.17 Gravity and elevation profiles — traverse 4

F55/B3-178A

34

Coordinates for the traverses were supplied by the Australian Survey Office, Department of Administrative Services. The complete principal facts for the four traverses are shown in Appendix 1.

Reduction

The principal facts for each traverse were reduced to Bouguer anomaly values for a range of densities between 2.0 and 3.0 tm^{-3}. The elevation, observed gravity, and Bouguer anomaly profiles for each traverse are shown in Figures 15-17. The profiles shown in Figure 15 were plotted using the combined data from the 1971 and 1976 surveys. Automatic terrain corrections using the method of Anfiloff (1977) were applied to the 2.50 tm^{-3} Bouguer profile of each traverse, but in each case, the topographic relief was insufficient to cause significant departures from the profiles obtained using the slab formula.

The Bouguer profiles invert at station 1390 on Traverse 1, indicating a surface density of about 2.50 tm^{-3} there. On Traverse 2, an inversion of profiles at the 2.20 tm^{-3} line at station 1440 shows that this is the surface density there.

On Traverse 3, the 2.20 tm^{-3} Bouguer profile is the best correction for the near-surface rocks below the hill at 1116. However, the gravity effect of this hill cannot be separated from the effect of the subsurface anomaly that causes the low at station 1135. A Bouguer reduction density cannot therefore be selected in this region, and the interpretation must be carried out by reference to the whole set of Bouguer profiles. This approach was demonstrated by Flavelle & Anfiloff (1976) in an earlier interpretation of this area.

On Traverse 4, the relief is small and has little effect on the shape of the Bouguer profiles.

SEISMIC RESULTS AND INTERPRETATION

The seismic sections for each traverse are shown in Plates 1 to 4; in addition, the near-surface profile and the interpretative geological cross-section are shown in Figures 18 and 19. The near-surface seismic profiles were produced by analysis of the first-break times which were

35

also used for weathering corrections. These shallow refraction results indicate the presence of faults on the eastern ends of Traverses 1 and 3, that were not detected by surface geology and do not show on the seismic reflection sections.

The interval velocities that are used for time-depth conversion are shown on the interpreted seismic sections. These velocities are derived from the CDP stacking velocities which were computed during data processing. The interval velocities for Traverses 1 and 2 proved to be close enough to be averaged for both lines, but the interval velocities varied considerably along Traverse 3 and have been used as shown with interpolation between discrete analysis points. It should be pointed out here that the accuracy of these velocity determinations depends upon spread length, CDP multiplicity, and reflection data quality at the analysis point; along Traverse 3 the accuracy of the interval velocities varies between ± 5% and ± 10%.

Traverse 1 - Results

The near-surface seismic refraction profile is shown in Figure 18, and the seismic reflection section in Plate 1.

Record quality on Traverse 1 is generally poor; there is a strong reflection from the top of the Permian coal measures, the P-horizon, but other reflections are discontinuous. The strong P-horizon is a major cause of the poor quality of deeper reflections in the area since it reflects a high proportion of the seismic energy and generates interfering multiples. Improved deeper reflections could have been obtained by shooting at longer offsets but at the expense of the quality of shallow reflections.

Record quality is also affected by the areas of deep weathering as can be seen by comparing Figure 18 and Plate 1. The reflection from the P-horizon almost disappears below the two buried river channels at stations 1140 and 1240. No coherent reflections are visible below the zone of deep weathering and shallow faulting between stations 1450 and 1610; this is probably also due to the presence of a major deep fault zone.

The diffraction patterns at the eastern end of the traverse appear to arise from discontinuities within the basement rocks.

Traverse 1 - Interpretation

The buried river channels interpreted from the shallow refraction data (Figure 18) could be filled with Tertiary sediments of Mid-Pliocene age. R. Coventry, a pedologist working for CSIRO, has correlated the position of these river channels with deep, red soils formed during the late Pliocene on the lower slopes of the undissected undulating plains in the area (Coventry, 1978). Deep, red loamy earths were found in the seismic shot-holes within these channels and the airphotos show traces of old river systems.

The shallow refraction data also show that the youngest sediments at the east end of the line are highly faulted. These faults were therefore active at least since the Permian and perhaps as recently as the Tertiary since the semi-weathered layer that appears to infil the river channels is also faulted.

The interpreted geological cross-section is shown in Figure 18. The three horizons shown have been traced around the network of seismic lines (see Figure 8) to Koburra 1, Towerhill 1 and Lake Galilee 1 exploration wells (see Figure 2). The horizon shown as Top Drummond Basin also ties to the stratigraphic bore GSQ Hughenden 3-4R where Gray (1977) tentatively correlates strata in the bottom of the hole with the Natal Formation. These rocks are lithologically similar to the Ducabrook and Telemon Formations which crop out in the southern Drummond Basin.

The basin margin crossed by Traverse 1 is faulted and fairly steep. The basement rises, partly by normal faulting, from 2500 m to the surface in a distance of 27 km, giving an average gradient of $5\frac{1}{2}^{\circ}$; these depth figures are in agreement with calculations of depth to magnetic basement here by Hsu (1974).

The Lower Carboniferous and especially the Permian sediments exhibit little thinning as they approach the basin margin, suggesting that the Drummond and Galilee Basins previously extended further in this direction and that later uplift or rejuvenation of the Lolworth-Ravenswood Block produced the present margin. However, the Galilee Basin could not have extended much further northeast of here because the Lolworth-Ravenswood Block was a source for sediments for the basin. The uplift of the margin occurred along a set of parallel monoclines and normal faults. The general structural trend in the area is northwest; it is therefore probable that the small horst-like block, or faulted anticline, between stations 1160 and 1250 similarly trends northwest parallel to the White Mountains Structure and to the monocline at station 1430. This monocline is probably an extension of the Mingobar Monocline which, further to the south, forms the eastern margin of the Koburra Trough. It is noticeable that seismic sections recorded during the Towerhill survey also display poor record quality in the vicinity of the Mingobar Monocline, and there is a suggestion on some of these lines of faulting and folding.

Traverse 2 - Results

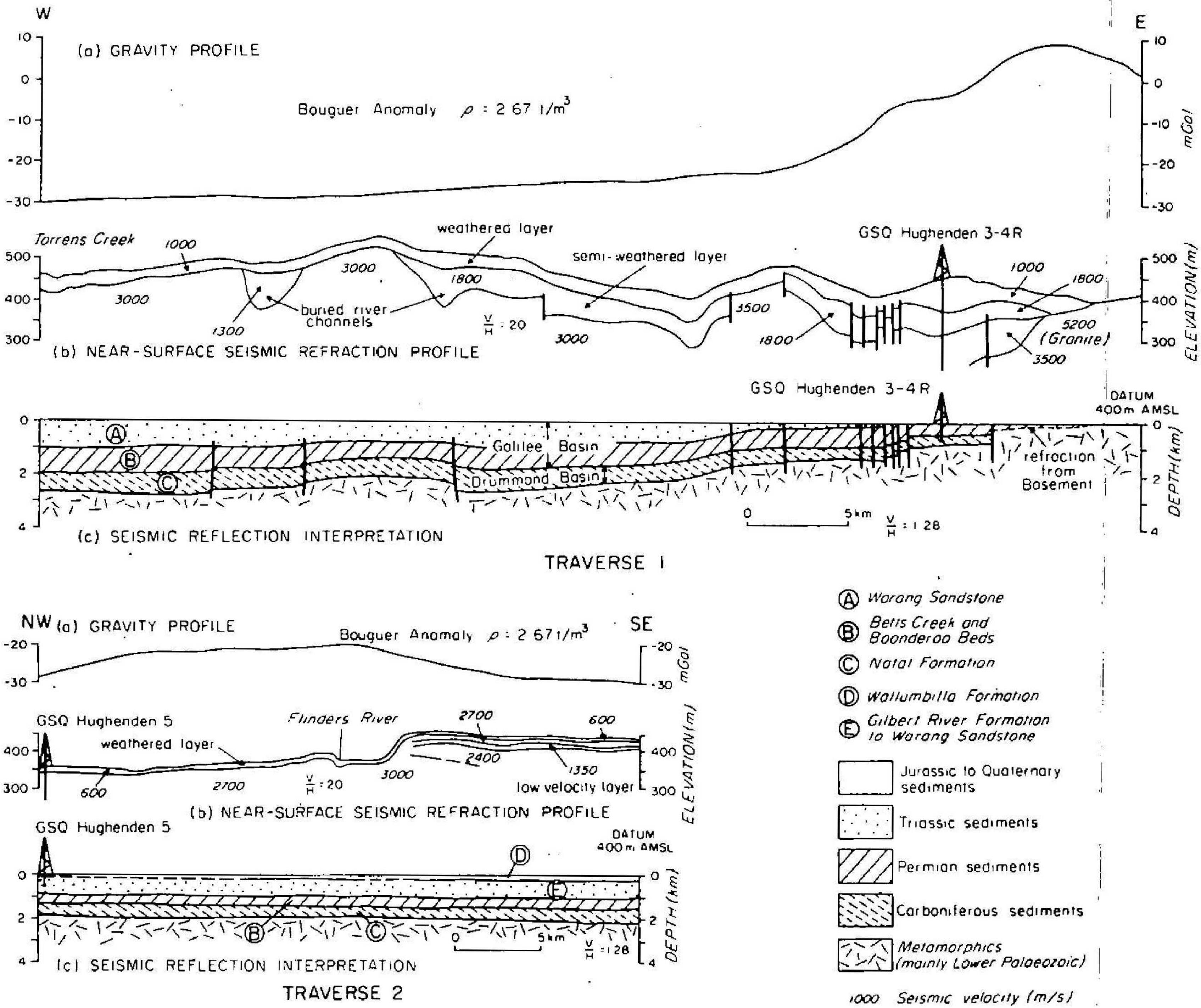
The near-surface seismic refraction profile is shown in Figure 18, and the seismic reflection section in Plate 2.

Record quality on Traverse 2 is generally better than on Traverse 1. Here, also, the P-horizon is the strongest reflection and generates several multiples. The faint suggestion of upward cusping at 1 km intervals on the P-horizon is caused by long-wavelength aliasing of the automatic residual statics program, which applies residual static corrections most effectively up to the spread length of 1 km.

The eastwards-dipping straight events in the western half of the section are probably reflected refractions from a point, possibly a fault, about 3 km off the northwestern end of the section. No fault has been mapped there, but the surface is covered by Cainozoic basalt which would obscure any older structure; the reflected refractions could arise from a vertical basalt vent.

Traverse 2 - Interpretation

The buried weathered layer interpreted from the shallow refraction data (Fig. 18) could be related to the deep weathering of the Late Cretaceous and early Tertiary, and it therefore could have been buried by later Tertiary terrestrial deposits. However, this is mainly conjecture and the buried weathered zone could be Quaternary.



Record 1979/78

Fig.18 Interpretative cross-sections, traverses 1 & 2

Based on F55/B3-173I, F55/B3-180A

The shallowest seismic reflection is identified from its extrapolation to GSQ Hughenden 5 as being from the top of the Gilbert River Formation. Sandstone at the top of the Gilbert River Formation is likely to yield a strong seismic reflection where it is overlain by mudstone of the Wallumbilla Formation. In GSQ Hughenden 7, drilled 35 km to the southwest of GSQ Hughenden 5 in 1977 (Balfe, 1979), there is a sharp change in the electric and gamma-ray logs at the boundary between the Wallumbilla and Gilbert River Formations, and one would expect a good seismic reflection from the boundary.

The other three reflections - the top of Permian, the top of Natal Formation, and basement - are tied to Traverse 1 and to the exploration wells in the area via the network of subsidised seismic lines shown in Figure 8.

As can be seen from Figure 18, the sediments are undisturbed and dip to the southeast at the slight gradient of $\frac{1}{2}^{\circ}$. There is no evidence of a steep margin of the Galilee Basin here as proposed by Vine & Paine (1974) on the basis of Hsu's (1974) data. The existence of Drummond Basin sediments this far northwest (see Fig. 1) has not been recognised before and implies that these sediments are deposited over a shelf or plain to the west of the intermontane trough that Olgers (1972) considered to be the depositional limits of the basin.

<u>Traverse 3 - Results</u>

The near-surface refraction profile is shown in Figure 19, and the seismic reflection section in Plate 3.

Record quality along Traverse 3 ranges from poor to good. At the western end of the Traverse, six-fold CDP stacking was inadequate to compensate for shot-holes that were too shallow, and the single-coverage data recorded by BMR in 1971 is better in places than the 1976 data. In zones of tighter folding and faulting, for example stations 2150-2230 and 2300-2680, the reflection quality deteriorates, and because these are the areas where the structure is more complex, interpretation of the whole section is difficult.

The expanded spreads centred at stations 2390 and 2764 were of fairly poor quality, but indicated velocities similar to those derived from CDP stacking velocity analysis. No velocity inversions occur, but the velocities are quite high. The cross-traverse at station 2858 indicated a gentle southerly dip to the main reflections, but no spurious side-swipe reflections were apparent.

The results of the digital migration on Traverse 3 were disappointing; it is thought that the poor signal-to-noise ratio and many short discontinuous seismic events led to a migrated section which looks more confusing than the unmigrated one. Further processing tests on Traverse 3 indicated that deconvolution and coherency filtering might have improved the section, but the additional expense was not warranted.

Traverse 3 - Interpretation

Interpretation of the shallow refraction data (Fig. 19) shows a weathered zone of fairly constant thickness and velocity 1000 m/s underlain by a refractor with velocity about 2000 m/s. It is not known if this 2000 m/s layer represents weathered or unweathered rock. Below this, refractor velocities gradually increase from 4000 m/s in the west to 4500 m/s in the east. A more detailed analysis of part of the traverse was possible in 1971 due to a closer station spacing and reversed refraction profiles, and these results are also presented in Figure 19.

The interpretation of the seismic data presented in Figure 19 is not definitive; other interpretations are possible. However, this interpretation matches the known geology and conforms to many of Olger's (1972) views of the structural development of the Drummond Basin. It does not provide a satisfactory model for the gravity profile, as is explained later. Interpretation is complicated by numerous diffractions and reflected refractions especially in the more intensely faulted and folded zones. The faults at the extreme eastern end of the traverse do not show up on the seismic section, but strong diffraction patterns at this end indicate major discontinuities within the basement rocks.

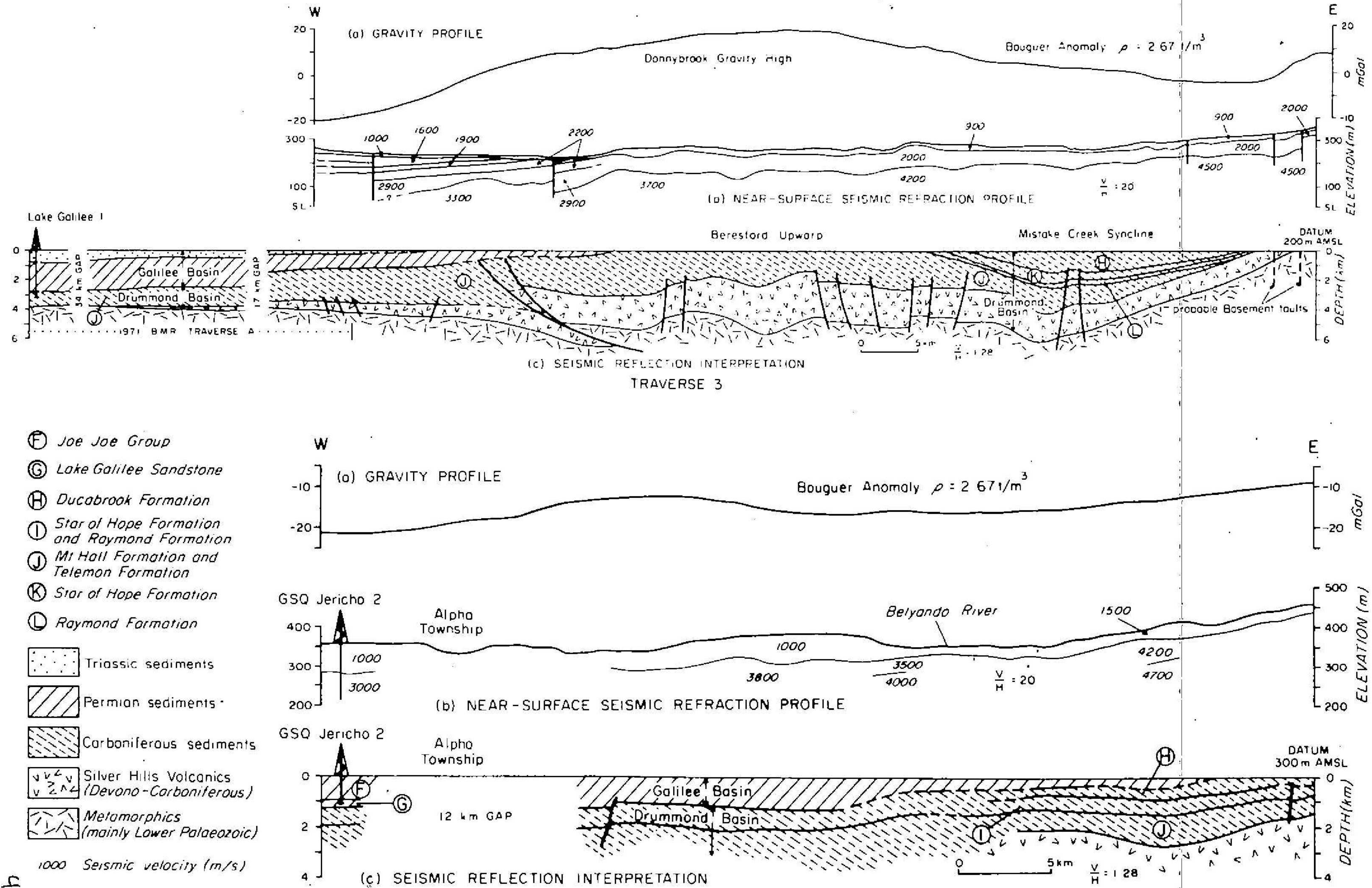


Fig.19 Interpretative cross-sections, traverses 3 & 4

(Based on F55/B3-173-174)
F55/B3-179A

The interpretation presented here differs from that presented by Harrison, Anfiloff & Moss (1975) in two ways. Firstly the thrust fault in the vicinity of stations 2160-2260 was interpreted by Harrison et al. as a shear zone, and secondly, Harrison et al. considered that Adavale Basin sediments underlay the Galilee and Drummond Basins whereas the pre-Late Carboniferous sediments are here considered to be entirely Drummond Basin.

Olgers's interpretation of the structure of the Drummond Basin supports the ideas of thrust faults and strike-slip faults. The thrust fault shown on this section is in rough alignment with the Chinaman Fault, which is a reverse oblique-slip fault, and Olgers interprets a decollement at the base of the Scartwater Salient further north. On the other hand Olgers's Chinaman Megashear passes through the fault zone on Traverse 3. It seems likely that both low-angle reverse movement and strike-slip movement have occurred here.

The interpretation placed on the thrust fault here is that it occurred during the Mid-Carboniferous Kanimblan Orogeny; hence the Drummond Basin sediments were affected, but not the Galilee Basin sediments.

Harrison et al. (1975) based their interpretation of the pre-Galilee Basin sediments on the identification of Adavale Basin sediments at the bottom of Lake Galilee 1 well whereas the age determinations of these rocks is still uncertain and Hawkins (1977) shows Drummond Basin rocks at the bottom of this well. Traverse 3, which extends the 1971 BMR Traverse A across the Drummond Basin outcrops, has here been interpreted to tie to local outcrops and structure and, as can be seen from Figure 19, this leaves no room for Adavale Basin rocks between the Drummond Basin and basement. Correlation of the seismic reflections was aided by analysis of the interval velocities. The Silver Hills Volcanics have a velocity of about 5300 m/s while the overlying Mount Hall Formation and Telemon Formation have a velocity of about 4300 m/s and the underlying basement rocks a velocity of 6000 m/s.

The interpretation here shows the younger Drummond Basin units as being restricted to the Mistake Creek Syncline and the older Mount Hall and Telemon Formation to be thicker below the Beresford Upwarp and to extend far to the west. This interpretation is in agreement with the structural development of this area as described by Vine & Doutch (1972). The Beresford Upwarp started to develop in Mount Hall time, and folding and normal faulting continued during deposition; the northern part of the Mistake Creek Syncline crossed by Traverse 3 started to develop after Star of Hope time and therefore contains thicker sequences of younger Drummond Basin rocks. The maximum thicknesses of each unit shown in Figure 19 are in general agreement with those mentioned by Olgers (1972) except for the Silver Hills Volcanics, which here attains 3000 m as opposed to the 1500 m suggested by surface mapping. The different thickness of Mount Hall and Telemon Formations across the thrust fault are due to erosion of the overthrust block prior to deposition of Galilee Basin sediments.

Traverse 4 - Results

The near-surface refraction profile is shown in Figure 19, and the seismic reflection section in Plate 4.

Along much of the traverse the weathering is deep, between 60 m and 80 m; the main cause of the fairly poor seismic reflections is that the shots were fired in the weathering. The variation in quality between the single-fold and six-fold CDP coverage is not as marked as the variation with weathering depth.

Traverse 4 - Interpretation

Identification of the seismic reflections is based on the tie to the stratigraphic bore GSQ Jericho 2, the tie to the outcrops of the Drummond Basin in the east, and comparison of the seismic section character to that within the Mistake Creek Syncline on Traverse 3. The strongest reflection, as on Traverse 3, is from near the top of the Mount Hall Formation. No basement reflection has been identified.

The Drummond Basin rocks are not as tightly folded and faulted here as on Traverse 3, but folding, as indicated by surface geology, is more intense east of the traverse.

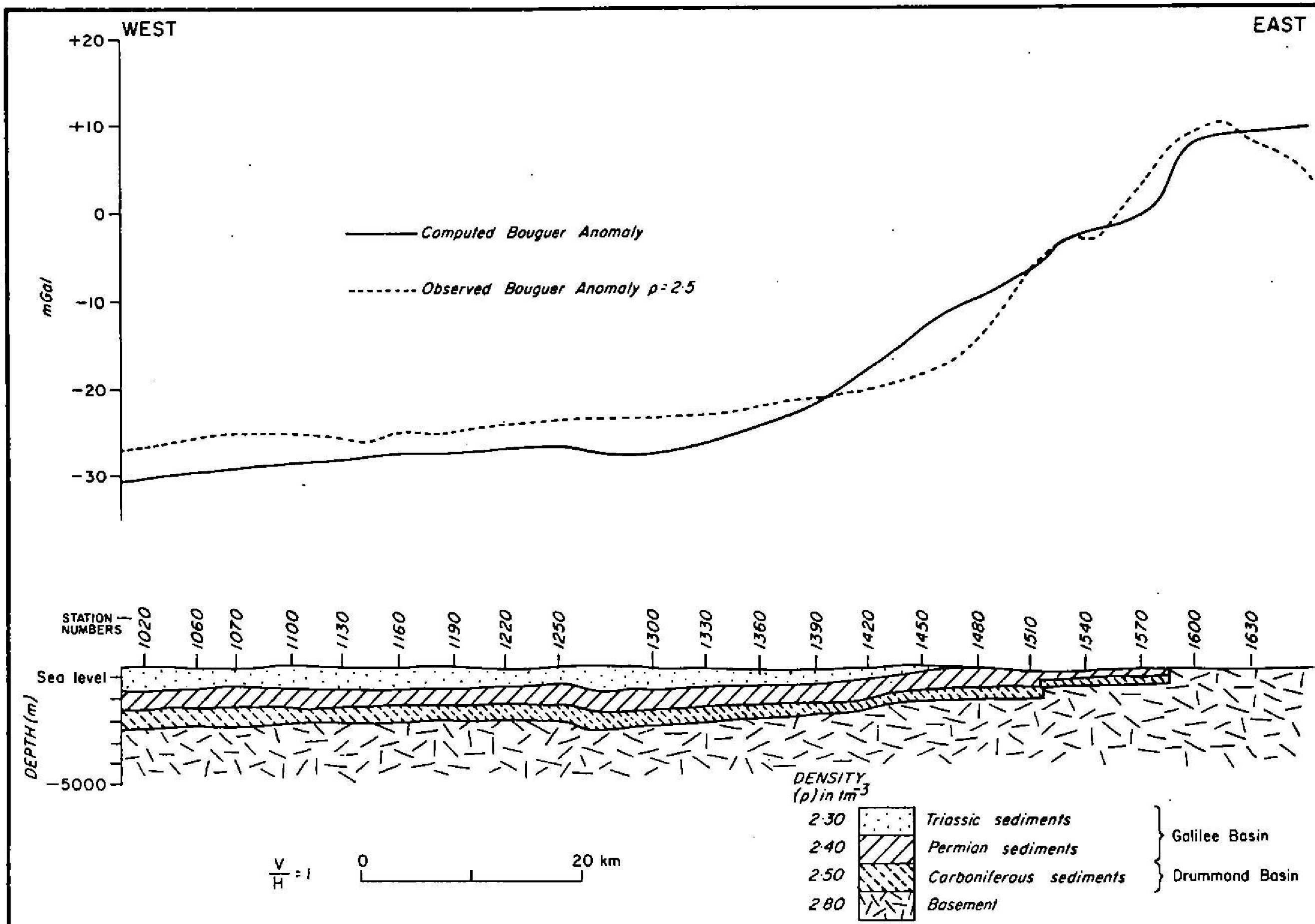


Fig.20 Two dimensional gravity model – traverse 1

Because of the gap in seismic coverage between Traverse 4 and the nearest line of the Jericho Seismic Survey (see Fig. 12), and because of the large distance to be covered, correlation of the reflections on Traverse 4 with those at Alliance Oil Development Jericho 1 well is difficult. However, the band of reflections arising from the Mount Hall and Telemon Formations can be followed westwards from Traverse 4 for a considerable distance towards Jericho 1 well. In this well, the Devonian strata consist of volcaniclastics and dacite and could be related to the Silver Hills Volcanics; Olgers (1972) considered the Drummond Basin to extend to Jericho 1, and these seismic results support his conclusions.

GRAVITY RESULTS AND INTERPRETATION

There is sufficient seismic and gravity data on Traverses 1 and 3 to enable two-dimensional gravity modelling and quantitative interpretation to be carried out. Traverses 2 and 4 are discussed qualitatively since the Bouguer profiles do not show any short-wavelength anomalies that could be modelled, and there is little correlation between gravity and seismic results.

Traverse 1

The Bouguer anomaly increases gradually from the west, and culminates in a +30 mGal anomaly at the eastern end of the traverse. This gradient coincides with the shallowing of sedimentary basement from a depth of 2600 m to the outcrop of the Lolworth-Ravenswood Block. A simple two-dimensional model of the seismic section does not exactly yield the observed profile (see Fig. 20); the differences in computed and observed gravity are probably caused by faults and density changes within the complex Cambro-Ordovician metamorphic and granitic rocks that form basement and which are not apparent on the seismic section.

Traverse 2

The traverse straddles a broad, low-amplitude gravity high. Since the seismic reflectors are almost flat-lying, the gravity high must be caused either by gradual density changes in the basement or by large, deep structures beyond each end of the traverse.

Traverse 3

Traverse 3 crosses a Bouguer anomaly high of about 40 mGal, the Donnybrook Gravity High (see Figs. 21 and 22). To the east of this high, the Bouguer anomaly drops steadily to around station 3000, at which point it abruptly rises again by about 15 mGal. At station 2020 a gravity low of only 2-3 mGal separates the Donnybrook Gravity High from the regional gravity field over the Galilee Basin. Several small, sharp bumps in the gravity profile are superimposed on the flanks of the Donnybrook Gravity High, but elsewhere the profile is fairly smooth.

The small bump in the observed gravity at station 2660 on the eastern flank of the Donnybrook Gravity High is produced by the outcrop of the Raymond Sandstone, which is a thin unit of greater density than the surrounding sediments. A similar bump at station 2240 on the western flank of the High must also be due to a small near-surface geological structure although the body that causes the anomaly has not been identified.

Possible causes of the Donnybrook Gravity High

The Donnybrook Gravity High was attributed by Harrison & others (1975) to a basement uplift, and the small adjacent low to the west was attributed to an intrabasement granite pluton. Here, the small gravity low is still attributed to a granite pluton, but the Donnybrook Gravity High is now thought to be caused either by a dense intrabasement body, as shown in the two-dimensional model, Figure 21, or by a reverse density contrast produced by low-density Silver Hills Volcanics below higher-density Drummond Basin sediments as shown in Figure 22.

Basement uplift. The seismic results rule out the possibility of a basement uplift as the cause of the Donnybrook Gravity High; in addition, an uplift large enough to produce this gravity high would cause the Silver Hills Volcanics to crop out over the uplift and this does not occur. Admittedly, the Beresford Upwarp coincides fairly well with the Donnybrook Gravity High, but this upwarp has an insignificant gravity effect and the adjacent Mistake Creek Syncline, which is a similar sized geological structure, does not correlate well with the observed gravity low. The gravity profile itself provides evidence against a basement uplift beneath the Donnybrook Gravity High. The observed gravity over the High reaches a higher level than the gravity over the Anakie Metamorphics at the eastern end of the traverse; therefore, the Donnybrook Gravity High must be caused

47

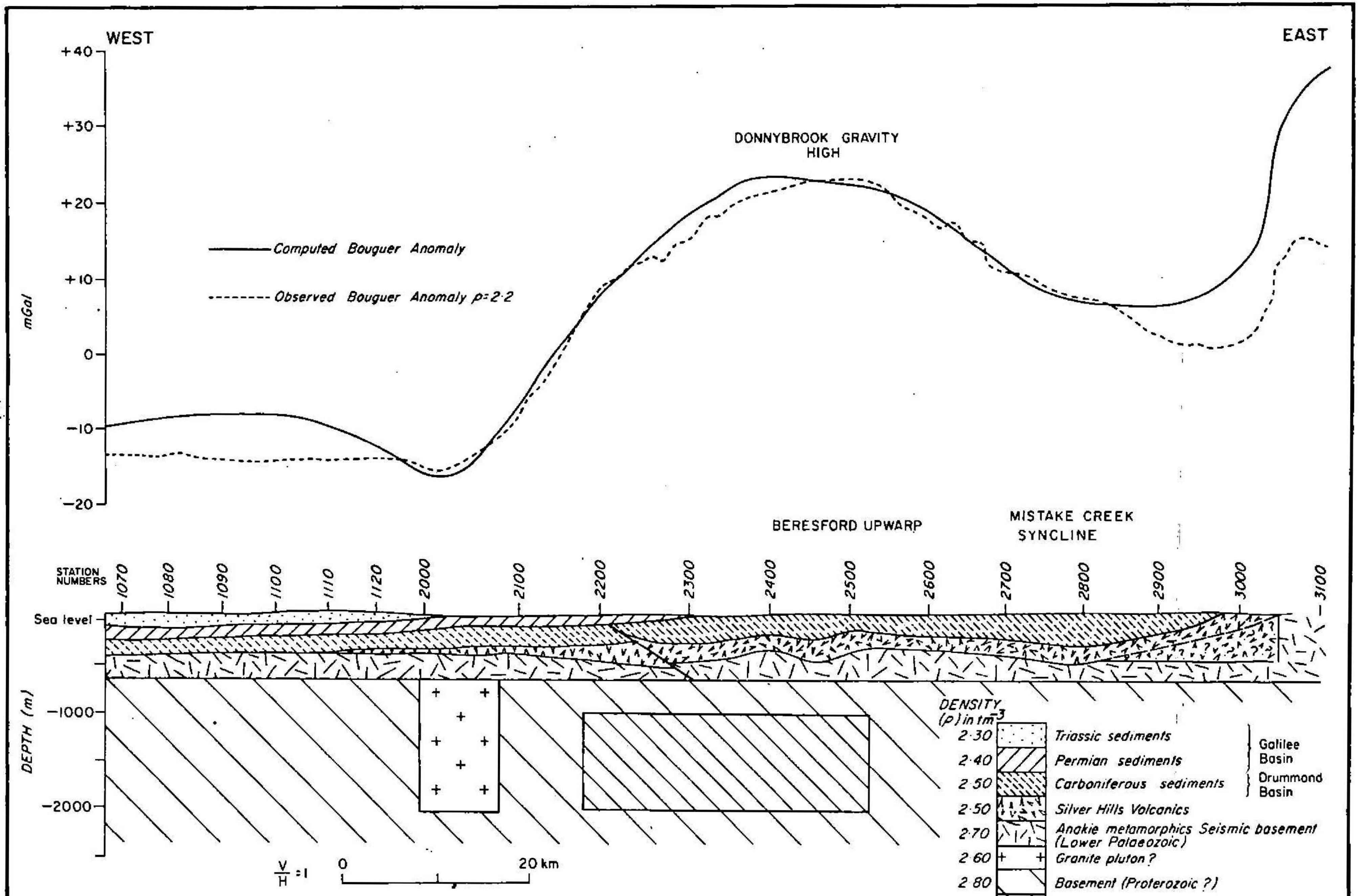


Fig. 21 Two-dimension gravity model - traverse 3

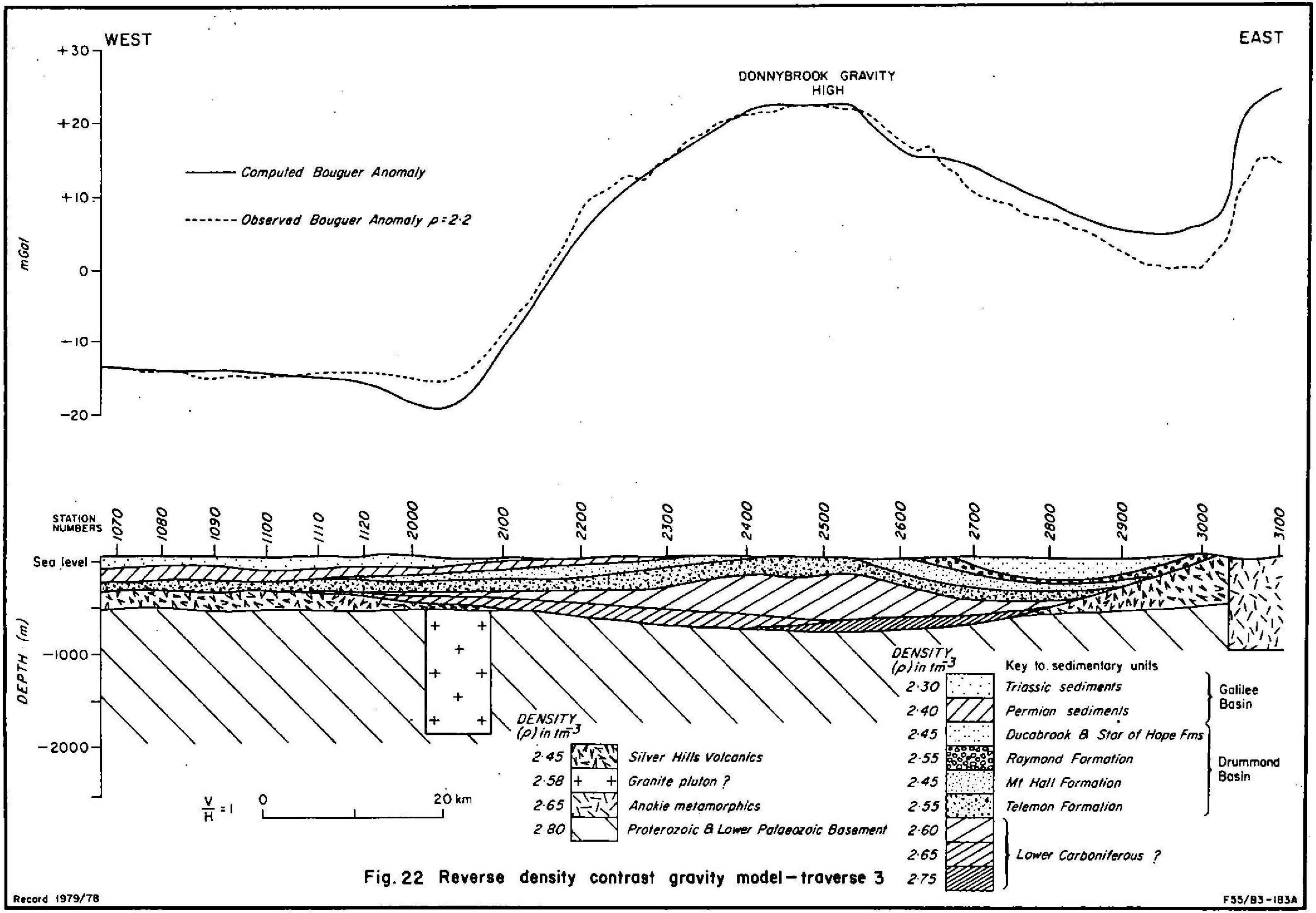


Fig. 22 Reverse density contrast gravity model – traverse 3

by an additional dense body other than just uplifted Anakie Metamorphics.

Dense intrabasement block. The gravity effect of a dense intrabasement block is modelled in Figure 21. The addition of a granite pluton to the model below station 2050 is necessary to produce the gravity low at this point, but some discrepancy between the observed and computed anomalies remains west of the granite. The largest mismatch between the observed and computed profiles is at the eastern end of the traverse, where an additional triangular body of density 2.5 tm^{-3} has been introduced to the model to account for the shape of the gravity low at station 3000 and the sharp rise in gravity at 3050. This sharp increase in gravity must be due to a density contrast across a large near-vertical fault. Seismic refraction results indicate two faults here, and strong deep seismic diffraction patterns here also probably originate from one or more faults. Therefore, although the seismic reflection data plus geological information about the relationship between the Silver Hills Volcanics and Anakie Metamorphics militate against it, there is considerable evidence that a large fault separates the Anakie Metamorphics from the adjacent rocks to the west.

Reverse density contrast. A gravity model based on the concept of low-density Silver Hills Volcanics overlain by higher-density Drummond Basin sediments is shown in Figure 22. This model produces a close match between observed and computed Bouguer anomalies, and was first proposed by Flavelle & Anfiloff (1976). On the seismic section at stations 1126-2060 there are strong, eastwards-dipping reflections at 2.0-3.0 seconds reflection time. It is postulated that the deepest of these reflections arises from an erosional top of the Silver Hills Volcanics, which are now overlain by a sequence of Drummond Basin and possibly pre-Drummond sediments to form the structure shown in Figure 22. The Silver Hills Volcanics consist largely of rhyolites and welded tuffs which are quite likely to have a lower density than overlying sediments; their extensive westward distribution suggested by this model is supported by volcanics of similar composition in Thunderbolt 1, Towerhill 1, and Jericho 1 exploration wells.

Traverse 4

The Bouguer anomaly rises gently from west to east along the traverse, and superimposed on this regional trend between stations 4100 and 4300 is a broad gravity high of only 7 mGal. The long wavelength of this gravity high indicates that it is probably caused by a structure deeper than 3000 m, but the seismic section is poor and shows no structures that could be identified as possible sources of the gravity anomaly. The steady eastward rise in Bouguer anomaly is consistent with the eastward shallowing of the Galilee Basin as shown by the seismic results.

CONCLUSIONS

The northeast margin of the Galilee Basin, adjacent to the Lolworth-Ravenswood Block, is formed by normal onlap onto basement, and is extensively modified by Tertiary faulting along previously existing northwesterly structural trends parallel to the White Mountains Structure and Mingobar Monocline. Traverse 1 crossed a gentle fault-bounded anticline, the amplitude of which increases with depth, indicating fault movement as far back as Early Carboniferous. Structures similar to this could occur further south in the Koburra Trough, where the sedimentary thickness is greater, and could provide the most attractive oil exploration targets in the area.

The steep, faulted nature of the northeast margin probably provides only a narrow strip where coal is likely to be found at shallow depths, and a detailed exploration program would be required to locate any commercial seams.

Rocks of the Drummond Basin are seen to extend further northwest than was previously thought. This raises the questions of the depositional environment west of the intermontane Drummond Basin trough, and the limits of deposition of these Upper Devonian and Lower Carboniferous strata. The Drummond Basin in the outcrop area is considered to be generally fluviatile and non-prospective for petroleum, but its extension to the west below the Galilee Basin could be of a different facies.

In the Mistake Creek Syncline and Beresford Upwarp (Traverse 3), the Drummond Basin rocks, including a thick sequence of Silver Hills Volcanics, are extensively folded and faulted. This folding ends in the east at a low-angle thrust fault below the Belyando River, west of which there is only gentle folding. The Silver Hills Volcanics are 3000 m thick below the Beresford Upwarp, and thin westwards to pinch out 30 km southeast of Lake Galilee No. 1.

It is thought unlikely that the Adavale Basin extends as far north as Jericho 1 well; seismic reflections from the Mount Hall and Telemon Formations can be followed westwards below the Galilee Basin from the Drummond Basin outcrop area to both Lake Galilee No. 1 and Jericho 1 exploration wells. Thus it seems likely that the volcaniclastics and dacite in the bottom of Jericho 1 are related to the Silver Hills Volcanics. Towerhill 1 and Thunderbolt 1 wells also bottomed in acid volcanics; if these are also equivalent to the Silver Hills Volcanics, then volcanics accumulated over a wide area, and it is possible that subsequent Drummond Basin sediments were similarly widespread. There is still not enough knowledge about the sediments that underlie the eastern margin of the Galilee Basin to determine the petroleum prospectivity of the area.

The Koburra Trough contains at least 2800 m of Galilee Basin sediments plus 3200 m of pre-Galilee strata, and it may be bounded by anticlinal structures similar to that crossed by Traverse 1. The Koburra Trough looks, at present, to be the most favourable place for petroleum exploration within the Galilee Basin, and its structural history and stratigraphy should be investigated in detail as the next step in the exploration of the basin.

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GALILEE BASIN 1978/03/06

7611.001 GALILEE BASIN SURVEY - TRAVERSE 1 DATUM = *DM MD 1978/03/06

BMR STATION NUMBER.	LATITUDE SOUTH. (DEGREES)	LONGITUDE EAST. (DEGREES)	METER ELEVATION (METRES)	OBSERVED GRAVITY. (MGAL)	GROUND ELEVATION (METRES)	TERRAIN CORRECTION FOR 2.67	FREE AIR ANOMALY. (MGAL)	BOUGUER ANOMALY. FOR 2.67	INFORMAL STATION NAME, NUMBER,BENCHMARK,ETC.	* LAST DATE STATION UPDATED
7611.1008	20.7702	145.0303	457.70	978575.50	457.70	*********	19.84	-31.37		1978/03/06
7611.1012	20.7693	145.0333	460.30	978574.92	460.30	*********	20.11	-31.39		..
7611.1020	20.7677	145.0395	462.00	978574.84	462.00	*********	20.65	-31.03		..
7611.1026	20.7665	145.0442	473.70	978572.40	473.70	*********	21.89	-31.10		..
7611.1032	20.7653	145.0488	476.00	978571.87	476.00	*********	22.14	-31.11		..
7611.1050	20.7618	145.0627	473.50	978573.02	473.50	*********	22.73	-30.24		..
7611.1058	20.7602	145.0690	475.20	978572.52	475.20	*********	22.09	-30.31		..
7611.1064	20.7590	145.0735	477.30	978572.09	477.30	*********	23.14	-30.26		..
7611.1070	20.7578	145.0782	479.60	978571.62	479.60	*********	23.45	-30.20		..
7611.1076	20.7567	145.0828	482.40	978570.85	482.40	*********	23.61	-30.35		..
7611.1082	20.7555	145.0875	485.10	978570.42	485.10	*********	24.09	-30.18		..
7611.1088	20.7543	145.0922	487.40	978569.91	487.40	*********	24.36	-30.17		..
7611.1094	20.7532	145.0967	490.40	978569.31	490.40	*********	24.75	-30.11		..
7611.1100	20.7520	145.1013	495.40	978568.19	495.40	*********	25.24	-30.18		..
7611.1106	20.7508	145.1060	499.20	978567.24	499.20	*********	25.54	-30.31		..
7611.1112	20.7497	145.1107	499.30	978567.15	499.30	*********	25.55	-30.31		..
7611.1118	20.7485	145.1153	492.80	978568.58	492.80	*********	25.04	-30.09		..
7611.1124	20.7472	145.1198	487.40	978569.27	487.40	*********	24.14	-30.38		..
7611.1130	20.7460	145.1245	486.20	978569.11	486.20	*********	23.68	-30.71		..
7611.1136	20.7448	145.1292	488.40	978568.66	488.40	*********	23.98	-30.66		..
7611.1142	20.7437	145.1338	492.10	978567.68	492.10	*********	24.21	-30.84		..
7611.1148	20.7425	145.1385	496.80	978566.91	496.80	*********	24.96	-30.62		..
7611.1154	20.7413	145.1430	502.20	978566.07	502.20	*********	25.66	-30.52		..
7611.1160	20.7402	145.1477	508.40	978564.97	508.40	*********	26.74	-30.13		..
7611.1166	20.7390	145.1523	514.10	978563.65	514.10	*********	27.25	-30.26		..
7611.1172	20.7378	145.1570	520.30	978562.36	520.30	*********	27.90	-30.26		..
7611.1178	20.7367	145.1617	526.90	978560.91	526.90	*********	28.60	-30.35		..
7611.1184	20.7355	145.1662	533.10	978559.63	533.10	*********	29.30	-30.34		..
7611.1190	20.7342	145.1708	540.20	978558.02	540.20	*********	29.96	-30.47		..
7611.1196	20.7330	145.1755	547.70	978556.74	547.70	*********	31.07	-30.21		..
7611.1202	20.7318	145.1802	553.90	978555.48	553.90	*********	31.79	-30.18		..
7611.1208	20.7322	145.1847	550.50	978556.43	550.50	*********	31.67	-29.92		..
7611.1214	20.7340	145.1892	541.10	978558.79	541.10	*********	31.02	-29.51		..
7611.1220	20.7358	145.1935	532.20	978561.05	532.20	*********	30.43	-29.11		..
7611.1226	20.7382	145.1975	524.60	978562.60	524.60	*********	29.49	-29.20		..
7611.1232	20.7397	145.2020	519.40	978563.84	519.40	*********	29.04	-29.07		..
7611.1238	20.7402	145.2067	514.20	978564.93	514.20	*********	28.49	-29.03		..
7611.1244	20.7408	145.2115	512.30	978565.51	512.30	*********	28.45	-28.87		..
7611.1250	20.7417	145.2162	511.80	978565.77	511.80	*********	28.50	-28.75		..
7611.1256	20.7423	145.2210	512.70	978565.50	512.70	*********	28.47	-28.89		..
7611.1262	20.7428	145.2258	514.50	978565.54	514.50	*********	29.04	-28.52		..
7611.1268	20.7432	145.2305	514.40	978565.58	514.40	*********	29.02	-28.52		..
7611.1276	20.7435	145.2370	508.90	978566.74	508.90	*********	28.47	-28.46		..
7611.1282	20.7437	145.2417	504.50	978567.67	504.50	*********	28.03	-28.41		..
7611.1288	20.7432	145.2465	504.20	978567.81	504.20	*********	28.11	-28.30		..
7611.1294	20.7430	145.2513	493.80	978570.09	493.80	*********	27.19	-28.06		..
7611.1300	20.7428	145.2560	487.10	978571.59	487.10	*********	26.63	-27.86		..
7611.1306	20.7427	145.2600	480.00	978573.26	480.00	*********	26.12	-27.58		..
7611.1312	20.7425	145.2657	473.30	978574.58	473.30	*********	25.38	-27.57		..
7611.1318	20.7423	145.2705	466.70	978575.69	466.70	*********	24.66	-27.55		..

GALILEE BASIN   1978/03/06

7611.001 GALILEE BASIN SURVEY - TRAVERSE 1   DATUM * ADM HU   1978/03/06

BMR STATION NUMBER.	LATITUDE SOUTH. (DEGREES)	LONGITUDE EAST. (DEGREES)	METER ELEVATION (METRES)	OBSERVED GRAVITY. (MGAL)	GROUND ELEVATION (METRES)	TERRAIN CORRECTION FOR 2.67	FREE AIR ANOMALY. (MGAL)	BOUGUER ANOMALY. FOR 2.67	INFORMAL STATION NAME, NUMBER, BENCHMARK, ETC.	* LAST DATE STATION UPDATED
7611.1324	20.7422	145.2753	460.10	978577.23	460.10	*********	23.98	-27.58		1978/03/06
7611.1330	20.7420	145.2802	453.10	978576.68	453.10	*********	23.28	-27.41		..
7611.1336	20.7432	145.2847	446.60	978580.12	446.60	*********	22.64	-27.32		..
7611.1342	20.7453	145.2888	443.70	978580.68	443.70	*********	22.38	-27.26		..
7611.1348	20.7453	145.2937	439.00	978582.16	439.00	*********	22.21	-26.90		..
7611.1354	20.7452	145.2985	435.50	978583.09	435.50	*********	22.07	-26.65		..
7611.1360	20.7450	145.3033	433.00	978583.91	433.00	*********	22.13	-26.32		..
7611.1366	20.7448	145.3080	429.60	978584.92	429.60	*********	22.10	-25.96		..
7611.1372	20.7447	145.3126	426.10	978585.98	426.10	*********	22.05	-25.62		..
7611.1378	20.7435	145.3173	416.90	978588.19	416.90	*********	21.53	-25.11		..
7611.1384	20.7412	145.3215	413.30	978588.77	413.30	*********	21.13	-25.10		..
7611.1390	20.7388	145.3255	404.60	978590.63	404.60	*********	20.45	-24.81		..
7611.1396	20.7353	145.3285	410.20	978589.43	410.20	*********	21.19	-24.70		..
7611.1402	20.7312	145.3302	427.00	978585.86	427.00	*********	23.05	-24.72		..
7611.1408	20.7268	145.3315	435.10	978583.96	435.10	*********	23.91	-24.77		..
7611.1414	20.7225	145.3330	445.60	978582.01	445.60	*********	25.45	-24.40		..
7611.1420	20.7182	145.3345	452.70	978580.30	452.70	*********	26.19	-24.45		..
7611.1426	20.7140	145.3358	460.70	978578.46	460.70	*********	27.07	-24.47		..
7611.1432	20.7102	145.3373	469.30	978576.59	469.30	*********	28.08	-24.42		..
7611.1438	20.7053	145.3387	479.50	978574.76	479.50	*********	29.69	-23.95		..
7611.1444	20.7010	145.3402	483.90	978573.84	483.90	*********	30.38	-23.75		..
7611.1450	20.6968	145.3417	478.20	978575.44	478.20	*********	30.47	-23.02		..
7611.1456	20.6925	145.3430	483.00	978574.62	483.00	*********	31.40	-22.63		..
7611.1462	20.6880	145.3445	469.30	978577.71	469.30	*********	30.52	-21.98		..
7611.1468	20.6837	145.3460	459.40	978580.14	459.40	*********	30.15	-21.24		..
7611.1474	20.6800	145.3487	449.40	978582.99	449.40	*********	30.14	-20.14		..
7611.1480	20.6768	145.3522	440.30	978586.00	440.30	*********	30.53	-18.73		..
7611.1486	20.6738	145.3557	431.70	978588.54	431.70	*********	30.59	-17.71		..
7611.1492	20.6708	145.3592	423.80	978591.31	423.80	*********	31.10	-16.31		..
7611.1498	20.6677	145.3627	408.60	978595.97	408.60	*********	31.26	-14.45		..
7611.1504	20.6647	145.3662	403.90	978598.23	403.90	*********	32.25	-12.94		..
7611.1510	20.6615	145.3697	405.60	978599.71	405.60	*********	34.44	-10.94		..
7611.1516	20.6575	145.3718	416.80	978599.26	416.80	*********	37.68	-8.95		..
7611.1522	20.6535	145.3742	423.50	978596.85	423.50	*********	39.58	-7.80		..
7611.1528	20.6495	145.3763	430.00	978597.55	430.00	*********	40.52	-7.58		..
7611.1534	20.6455	145.3787	439.90	978595.88	439.90	*********	42.14	-7.07		..
7611.1540	20.6413	145.3803	444.80	978594.01	444.80	*********	42.03	-7.73		..
7611.1546	20.6372	145.3816	450.10	978593.20	450.10	*********	43.11	-7.25		..
7611.1552	20.6328	145.3833	452.00	978594.11	452.00	*********	44.86	-5.71		..
7611.1558	20.6285	145.3848	455.10	978594.28	455.10	*********	46.24	-4.67		..
7611.1564	20.6247	145.3870	452.50	978596.03	452.50	*********	47.42	-3.20		..
7611.1570	20.6218	145.3907	445.50	978599.38	445.50	*********	48.78	-1.06		..
7611.1576	20.6190	145.3945	439.80	978601.84	439.80	*********	49.65	.44		..
7611.1582	20.6162	145.3982	432.30	978604.92	432.30	*********	50.58	2.22		..
7611.1588	20.6133	145.4020	419.20	978608.79	419.20	*********	50.57	3.68		..
7611.1594	20.6105	145.4058	422.60	978608.78	422.60	*********	51.78	4.50		..
7611.1600	20.6078	145.4095	415.80	978610.37	415.80	*********	51.43	4.91		..
7611.1606	20.6048	145.4132	408.00	978612.52	408.00	*********	51.35	5.71		..
7611.1612	20.6015	145.4163	405.40	978613.50	405.40	*********	51.73	6.37		..
7611.1618	20.5978	145.4190	405.50	978612.56	405.50	*********	51.04	5.67		..

GALILEE BASIN   1978/03/06

7611.A01 GALILEE BASIN SURVEY - TRAVERSE 1   DATUM = BUM HU   1978/03/06

BMR STATION NUMBER.	LATITUDE SOUTH. (DEGREES)	LONGITUDE EAST. (DEGREES)	METER ELEVATION (METRES)	OBSERVED GRAVITY. (MGAL)	GROUND ELEVATION (METRES)	TERRAIN CORRECTION FOR 2.67	FREE AIR ANOMALY. (MGAL)	BOUGUER ANOMALY. FOR 2.67	INFORMAL STATION NAME, NUMBER,BENCHMARK,ETC.	* LAST DATE STATION UPDATED
7611.1624	20.5937	145.4206	403.30	978612.10	403.30	********	50.14	5.02		1978/03/06
7611.1630	20.5892	145.4215	390.90	978613.65	390.90	********	48.13	4.40		..
7611.1636	20.5847	145.4220	365.20	978613.68	365.20	********	46.87	3.78		..
7611.1642	20.5802	145.4225	365.90	978613.13	365.90	********	46.60	3.43		..
7611.1648	20.5757	145.4225	390.20	978611.28	390.20	********	46.35	2.69		..
7611.1652	20.5730	145.4237	389.30	978610.78	389.30	********	45.73	2.17		..
7611.1658	20.5688	145.4257	394.10	978608.58	394.10	********	45.26	1.17		..
7611.1664	20.5647	145.4275	399.60	978606.00	399.60	********	44.62	-.09		..

* END-FILE *

GALILEE BASIN

1978/03/06

7612.001 GALILEE BASIN SURVEY - TRAVERSE 2

DATUM = BDM MU

1978/03/06

BMR STATION NUMBER.	LATITUDE SOUTH. (DEGREES)	LONGITUDE EAST. (DEGREES)	METER ELEVATION (METRES)	OBSERVED GRAVITY. (MGAL)	GROUND ELEVATION (METRES)	TERRAIN CORRECTION FOR 2.67	FREE AIR ANOMALY. (MGAL)	BOUGUER ANOMALY. FOR 2.67	INFORMAL STATION NAME, NUMBER,BENCHMARK,ETC.	* LAST DATE STATION UPDATED
7612.1000	20.6267	144.3982	361.30	978588.02	361.30	*********	11.15	-29.27		1978/03/06
7612.1012	20.6308	144.3966	358.20	978589.43	358.20	*********	11.35	-28.72		..
7612.1024	20.6353	144.3958	357.60	978590.48	357.60	*********	11.95	-28.06		..
7612.1036	20.6398	144.3952	357.40	978591.43	357.40	*********	12.57	-27.41		..
7612.1048	20.6443	144.3945	357.90	978592.27	357.90	*********	13.30	-26.74		..
7612.1064	20.6503	144.3948	356.10	978593.79	356.10	*********	13.91	-25.93		..
7612.1080	20.6563	144.3943	353.10	978595.43	353.10	*********	14.26	-25.24		..
7612.1092	20.6608	144.3938	351.20	978596.72	351.20	*********	14.70	-24.59		..
7612.1104	20.6648	144.3950	352.90	978597.05	352.90	*********	15.32	-24.16		..
7612.1116	20.6685	144.3976	348.00	978598.73	348.00	*********	15.27	-23.66		..
7612.1128	20.6723	144.4005	349.00	978599.11	349.00	*********	15.73	-23.32		..
7612.1140	20.6768	144.4012	348.50	978599.77	348.50	*********	15.97	-23.02		..
7612.1152	20.6813	144.4016	355.60	978598.64	355.60	*********	16.76	-23.02		..
7612.1164	20.6853	144.4040	355.50	978599.13	355.50	*********	16.98	-22.79		..
7612.1176	20.6893	144.4062	354.50	978599.73	354.50	*********	17.04	-22.62		..
7612.1188	20.6933	144.4083	359.70	978598.80	359.70	*********	17.51	-22.73		..
7612.1200	20.6975	144.4105	361.50	978596.93	361.50	*********	17.91	-22.53		..
7612.1212	20.7015	144.4125	365.80	978598.49	365.80	*********	18.56	-22.36		..
7612.1224	20.7040	144.4165	364.30	978599.06	364.30	*********	18.52	-22.24		..
7612.1236	20.7062	144.4207	363.20	978599.56	363.20	*********	18.55	-22.08		..
7612.1248	20.7082	144.4248	363.60	978599.78	363.60	*********	18.77	-21.90		..
7612.1260	20.7103	144.4292	366.20	978599.48	366.20	*********	19.15	-21.62		..
7612.1272	20.7125	144.4333	367.10	978599.52	367.10	*********	19.33	-21.73		..
7612.1284	20.7147	144.4375	369.20	978599.14	369.20	*********	19.47	-21.83		..
7612.1296	20.7168	144.4416	369.70	978599.09	369.70	*********	19.45	-21.91		..
7612.1308	20.7188	144.4460	372.40	978598.64	372.40	*********	19.71	-21.95		..
7612.1320	20.7210	144.4503	372.70	978598.81	372.70	*********	19.85	-21.85		..
7612.1332	20.7232	144.4545	378.30	978597.07	378.30	*********	20.51	-21.62		..
7612.1344	20.7253	144.4587	384.90	978596.84	384.90	*********	21.38	-21.68		..
7612.1356	20.7283	144.4622	389.40	978596.22	389.40	*********	21.97	-21.59		..
7612.1368	20.7317	144.4653	392.10	978596.04	392.10	*********	22.43	-21.44		..
7612.1380	20.7343	144.4690	401.40	978594.29	401.40	*********	23.39	-21.52		..
7612.1392	20.7348	144.4738	397.60	978595.28	397.60	*********	23.18	-21.30		..
7612.1404	20.7365	144.4782	386.40	978597.97	386.40	*********	22.31	-20.92		..
7612.1416	20.7392	144.4820	382.20	978599.02	382.20	*********	21.91	-20.85		..
7612.1428	20.7435	144.4833	388.40	978599.50	388.40	*********	21.61	-20.94		..
7612.1440	20.7477	144.4850	380.20	978599.68	380.20	*********	21.40	-21.09		..
7612.1452	20.7518	144.4866	380.60	978599.41	380.60	*********	21.05	-21.53		..
7612.1464	20.7562	144.4885	381.10	978599.30	381.10	*********	20.91	-21.72		..
7612.1476	20.7598	144.4908	388.60	978597.54	388.60	*********	21.17	-22.30		..
7612.1488	20.7620	144.4950	410.50	978592.51	410.50	*********	22.77	-23.16		..
7612.1500	20.7645	144.4992	446.80	978584.30	446.80	*********	25.61	-24.37		..
7612.1512	20.7655	144.5035	453.20	978582.95	453.20	*********	26.18	-24.52		..
7612.1524	20.7670	144.5080	456.80	978582.02	456.80	*********	26.27	-24.64		..
7612.1536	20.7685	144.5125	460.30	978580.92	460.30	*********	26.16	-25.34		..
7612.1548	20.7720	144.5155	458.50	978581.06	458.50	*********	25.53	-25.76		..
7612.1560	20.7757	144.5183	456.70	978581.19	456.70	*********	24.89	-26.20		..
7612.1572	20.7793	144.5210	455.00	978581.15	455.00	*********	24.11	-26.80		..
7612.1584	20.7830	144.5236	452.70	978581.25	452.70	*********	23.28	-27.37		..
7612.1596	20.7868	144.5265	450.70	978581.39	450.70	*********	22.57	-27.85		..

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GALILEE BASIN 1978/03/06

7612.001 GALILEE BASIN SURVEY - TRAVERSE 2 DATUM * HUM HU 1978/03/06

BMR STATION NUMBER.	LATITUDE SOUTH. (DEGREES)	LONGITUDE EAST. (DEGREES)	METER ELEVATION (METRES)	OBSERVED GRAVITY. (MGAL)	GROUND ELEVATION (METRES)	TERRAIN CORRECTION FOR 2.67	FREE AIR ANOMALY. (MGAL)	BOUGUER ANOMALY. FOR 2.67	INFORMAL STATION NAME, NUMBER, BENCHMARK, ETC.	* LAST DATE STATION UPDATED
7612.1620	20.7942	144.5320	444.80	978582.07	444.80	********	20.99	-28.77		1978/03/06
7612.1632	20.7978	144.5346	440.80	978582.61	440.80	********	20.08	-29.25		..
7612.1644	20.8015	144.5375	445.30	978581.44	445.30	********	20.08	-29.74		..
7612.1656	20.8055	144.5400	445.60	978581.29	445.60	********	19.78	-30.07		..
7612.1668	20.8095	144.5423	444.10	978581.51	444.10	********	19.30	-30.38		..
7612.1680	20.8135	144.5445	444.10	978581.45	444.10	********	19.00	-30.68		..
7612.1692	20.8175	144.5465	444.50	978581.58	444.50	********	19.02	-30.71		..
7612.1704	20.8220	144.5467	444.10	978581.73	444.10	********	18.77	-30.91		..
7612.1716	20.8263	144.5478	443.50	978581.92	443.50	********	18.52	-31.10		..
7612.1728	20.8305	144.5497	441.70	978582.33	441.70	********	18.13	-31.29		..
7612.1740	20.8347	144.5515	439.60	978583.05	439.60	********	17.95	-31.23		..
7612.1752	20.8388	144.5533	437.40	978583.70	437.40	********	17.71	-31.22		..
7612.1764	20.8432	144.5552	436.20	978583.96	436.20	********	17.30	-31.50		..
7612.1776	20.8467	144.5580	435.60	978584.32	435.60	********	17.27	-31.47		..
7612.1788	20.8508	144.5612	437.20	978583.95	437.20	********	17.19	-31.72		..
7612.1800	20.8533	144.5643	437.40	978584.04	437.40	********	17.14	-31.79		..
7612.1812	20.8567	144.5677	436.50	978584.04	436.50	********	16.66	-32.17		..
7612.1824	20.8598	144.5710	436.20	978584.13	436.20	********	16.47	-32.33		..

* END-FILE *

GALILEE BASIN

1978/03/06

7613.001 GALILEE BASIN SURVEY - TRAVERSE 3

DATUM * ADM MU

1978/03/06

BMR STATION NUMBER.	LATITUDE SOUTH. (DEGREES)	LONGITUDE EAST. (DEGREES)	METER ELEVATION (METRES)	OBSERVED GRAVITY. (MGAL)	GROUND ELEVATION (METRES)	TERRAIN CORRECTION FOR 2.67	FREE AIR ANOMALY. (MGAL)	BOUGUER ANOMALY. FOR 2.67	INFORMAL STATION NAME, NUMBER, BENCHMARK, ETC.	* LAST DATE STATION UPDATED
7613.2258	22.4805	146.6490	235.90	978762.94	235.90	********	33.40	7.01		1978/03/06
7613.2270	22.4827	146.6585	235.90	978764.11	235.90	********	34.43	8.04		..
7613.2276	22.4838	146.6632	237.10	978764.61	237.10	********	35.23	8.70		..
7613.2282	22.4850	146.6676	237.90	978765.55	237.90	********	36.34	9.72		..
7613.2286	22.4858	146.6710	243.30	978764.38	243.30	********	36.78	9.56		..
7613.2292	22.4870	146.6757	249.50	978763.19	249.50	********	37.43	9.52		..
7613.2298	22.4883	146.6802	256.20	978762.22	256.20	********	38.40	9.78		..
7613.2304	22.4895	146.6850	257.00	978762.53	257.00	********	38.93	10.17		..
7613.2310	22.4873	146.6892	261.70	978762.32	261.70	********	40.30	11.03		..
7613.2316	22.4867	146.6938	263.50	978762.52	263.50	********	41.10	11.62		..
7613.2322	22.4868	146.6987	269.50	978761.97	269.50	********	42.39	12.24		..
7613.2328	22.4857	146.7033	265.40	978762.70	265.40	********	41.93	12.24		..
7613.2334	22.4850	146.7082	264.50	978762.68	264.50	********	41.68	12.09		..
7613.2340	22.4847	146.7130	270.80	978762.06	270.80	********	42.77	12.57		..
7613.2346	22.4862	146.7175	273.60	978761.73	273.60	********	43.46	12.85		..
7613.2352	22.4877	146.7222	279.20	978761.18	279.20	********	44.46	13.23		..
7613.2358	22.4892	146.7260	282.50	978760.99	282.50	********	45.28	13.67		..
7613.2364	22.4905	146.7313	281.70	978761.59	281.70	********	45.54	14.03		..
7613.2370	22.4913	146.7362	274.30	978763.40	274.30	********	45.02	14.33		..
7613.2376	22.4920	146.7410	273.40	978763.77	273.40	********	45.07	14.48		..
7613.2382	22.4925	146.7458	275.00	978763.80	275.00	********	45.56	14.79		..
7613.2388	22.4932	146.7507	278.70	978763.27	278.70	********	46.13	14.95		..
7613.2394	22.4938	146.7553	277.90	978763.83	277.90	********	46.40	15.31		..
7613.2400	22.4945	146.7602	277.80	978763.80	277.80	********	46.38	15.30		..
7613.2406	22.4952	146.7650	275.90	978764.25	275.90	********	46.12	15.25		..
7613.2412	22.4957	146.7698	273.80	978764.94	273.80	********	46.13	15.50		..
7613.2418	22.4970	146.7745	271.50	978765.74	271.50	********	46.13	15.76		..
7613.2424	22.4988	146.7788	269.10	978766.31	269.10	********	45.85	15.74		..
7613.2430	22.5007	146.7833	268.30	978766.76	268.30	********	45.93	15.92		..
7613.2436	22.5017	146.7880	266.50	978767.33	266.50	********	45.88	16.07		..
7613.2442	22.5018	146.7928	264.70	978767.97	264.70	********	45.96	16.34		..
7613.2448	22.5020	146.7977	262.10	978768.68	262.10	********	45.85	16.53		..
7613.2454	22.5040	146.8020	260.00	978769.35	260.00	********	45.75	16.66		..
7613.2462	22.5065	146.8080	259.10	978769.60	259.10	********	45.64	16.66		..
7613.2468	22.5077	146.8127	258.70	978770.00	258.70	********	45.76	16.82		..
7613.2474	22.5090	146.8172	260.10	978769.69	260.10	********	46.00	16.90		..
7613.2486	22.5115	146.8267	264.00	978769.20	264.00	********	46.36	16.82		..
7613.2492	22.5120	146.8307	265.10	978768.98	265.10	********	46.44	16.79		..
7613.2498	22.5120	146.8362	265.80	978768.62	265.80	********	46.30	16.56		..
7613.2504	22.5112	146.8408	266.90	978768.37	266.90	********	46.44	16.58		..
7613.2510	22.5117	146.8457	267.90	978768.10	267.90	********	46.45	16.48		..
7613.2516	22.5130	146.8503	269.20	978767.91	269.20	********	46.58	16.46		..
7613.2522	22.5147	146.8548	269.50	978767.91	269.50	********	46.56	16.41		..
7613.2528	22.5147	146.8595	270.20	978767.70	270.20	********	46.57	16.34		..
7613.2534	22.5130	146.8640	271.20	978767.11	271.20	********	46.39	16.05		..
7613.2540	22.5115	146.8685	271.50	978766.99	271.50	********	46.46	16.09		..
7613.2546	22.5098	146.8730	272.50	978766.40	272.50	********	46.37	15.88		..
7613.2552	22.5095	146.8778	272.50	978765.93	272.50	********	45.84	15.35		..
7613.2558	22.5092	146.8827	272.80	978765.14	272.80	********	45.16	14.64		..
7613.2564	22.5082	146.8875	273.40	978764.39	273.40	********	44.66	14.07		..

GALILEE BASIN   1978/03/06

7613.001 GALILEE BASIN SURVEY - TRAVERSE 3   DATUM = @DM MO   1978/03/06

BMR STATION NUMBER.	LATITUDE SOUTH. (DEGREES)	LONGITUDE EAST. (DEGREES)	METER ELEVATION (METRES)	OBSERVED GRAVITY. (MGAL)	GROUND ELEVATION (METRES)	TERRAIN CORRECTION FOR 2.67	FREE AIR ANOMALY. (MGAL)	BOUGUER ANOMALY. FOR 2.67	INFORMAL STATION NAME, NUMBER, BENCHMARK, ETC.	* LAST DATE STATION UPDATED
7613.2570	22.5082	146.8923	273.60	978763.97	273.60	********	44.30	13.69		1978/03/06
7613.2576	22.5082	146.8972	274.00	978763.46	274.00	********	43.91	13.26		..
7613.2582	22.5082	146.9020	273.60	978763.13	273.60	********	43.46	12.85		..
7613.2588	22.5080	146.9070	272.20	978763.08	272.20	********	42.99	12.54		..
7613.2594	22.5075	146.9118	273.40	978762.18	273.40	********	42.49	11.91		..
7613.2600	22.5080	146.9165	272.80	978761.94	272.80	********	42.03	11.52		..
7613.2606	22.5097	146.9210	269.30	978762.52	269.30	********	41.43	11.30		..
7613.2612	22.5112	146.9255	270.80	978761.54	270.80	********	40.82	10.52		..
7613.2618	22.5128	146.9300	274.60	978760.37	274.60	********	40.71	9.99		..
7613.2624	22.5145	146.9345	281.10	978758.86	281.10	********	41.10	9.65		..
7613.2630	22.5161	146.9391	296.00	978756.78	296.00	********	43.52	10.40		..
7613.2636	22.5178	146.9435	292.70	978757.68	292.70	********	43.29	10.54		..
7613.2640	22.5187	146.9467	291.40	978757.57	291.40	********	42.72	10.13		..
7613.2644	22.5192	146.9498	289.30	978757.48	289.30	********	41.96	9.59		..
7613.2650	22.5208	146.9543	281.00	978758.45	281.00	********	40.26	8.82		..
7613.2656	22.5225	146.9588	278.40	978758.50	278.40	********	39.48	8.25		..
7613.2662	22.5240	146.9633	277.60	978758.58	277.60	********	39.14	8.08		..
7613.2668	22.5250	146.9682	277.60	978758.20	277.60	********	38.69	7.64		..
7613.2674	22.5235	146.9726	276.20	978757.88	276.20	********	37.96	7.06		..
7613.2680	22.5228	146.9777	275.00	978756.97	275.00	********	36.88	6.03		..
7613.2686	22.5228	146.9825	273.90	978756.31	273.90	********	35.80	5.16		..
7613.2692	22.5235	146.9873	273.40	978756.13	273.40	********	35.42	4.84		..
7613.2698	22.5240	146.9922	272.30	978756.09	272.30	********	35.01	4.55		..
7613.2704	22.5243	146.9970	270.70	978756.14	270.70	********	34.55	4.26		..
7613.2710	22.5247	147.0018	267.90	978756.62	267.90	********	34.14	4.17		..
7613.2716	22.5252	147.0067	262.80	978757.59	262.80	********	33.51	4.10		..
7613.2722	22.5278	147.0105	264.60	978757.16	264.60	********	33.46	3.86		..
7613.2728	22.5305	147.0145	266.60	978756.58	266.60	********	33.33	3.50		..
7613.2734	22.5332	147.0183	267.80	978756.55	267.80	********	33.50	3.54		..
7613.2740	22.5358	147.0223	266.70	978756.69	266.70	********	33.13	3.29		..
7613.2746	22.5385	147.0262	267.70	978756.48	267.70	********	33.06	3.11		..
7613.2752	22.5412	147.0302	268.80	978756.23	268.80	********	32.98	2.91		..
7613.2758	22.5440	147.0340	269.50	978755.60	269.50	********	32.38	2.23		..
7613.2764	22.5467	147.0380	270.50	978755.36	270.50	********	32.28	2.02		..
7613.2770	22.5500	147.0412	271.00	978755.07	271.00	********	32.18	1.77		..
7613.2776	22.5532	147.0447	272.00	978755.02	272.00	********	31.99	1.56		..
7613.2782	22.5562	147.0482	272.20	978755.02	272.20	********	31.86	1.41		..
7613.2788	22.5593	147.0517	270.80	978755.35	270.80	********	31.56	1.26		..
7613.2794	22.5608	147.0562	263.80	978756.83	263.80	********	30.78	1.27		..
7613.2800	22.5618	147.0610	263.00	978757.09	263.00	********	30.73	1.31		..
7613.2806	22.5627	147.0657	262.20	978757.27	262.20	********	30.61	1.28		..
7613.2812	22.5637	147.0705	253.40	978758.89	253.40	********	29.45	1.10		..
7613.2818	22.5647	147.0752	253.40	978758.51	253.40	********	29.01	.66		..
7613.2824	22.5657	147.0800	253.70	978758.45	253.70	********	28.98	.59		..
7613.2830	22.5670	147.0847	254.00	978758.17	254.00	********	28.70	.29		..
7613.2836	22.5687	147.0892	254.70	978757.82	254.70	********	28.46	-.03		..
7613.2842	22.5702	147.0937	254.60	978757.62	254.60	********	28.14	-.35		..
7613.2848	22.5717	147.0983	256.40	978757.18	256.40	********	28.16	-.53		..
7613.2854	22.5732	147.1028	264.60	978755.10	264.60	********	28.51	-1.09		..
7613.2860	22.5752	147.1073	269.40	978753.60	269.40	********	28.44	-1.69		..

GALILEE BASIN   1978/03/06

7613.001 GALILEE BASIN SURVEY - TRAVERSE 3   DATUM = 0UM HO   1978/03/06

BMR STATION NUMBER.	LATITUDE SOUTH. (DEGREES)	LONGITUDE EAST. (DEGREES)	METER ELEVATION (METRES)	OBSERVED GRAVITY. (MGAL)	GROUND ELEVATION (METRES)	TERRAIN CORRECTION FOR 2.67	FREE AIR ANOMALY. (MGAL)	BOUGUER ANOMALY. FOR 2.67	INFORMAL STATION NAME, NUMBER, BENCHMARK, ETC.	* LAST DATE STATION UPDATED
7613.2866	22.5770	147.1117	272.10	978752.61	272.10	********	28.29	-2.15		1978/03/06
7613.2872	22.5785	147.1162	274.80	978751.92	274.80	********	28.14	-2.60		..
7613.2878	22.5795	147.1210	275.90	978751.30	275.90	********	27.79	-3.07		..
7613.2884	22.5803	147.1258	275.70	978751.08	275.70	********	27.46	-3.38		..
7613.2890	22.5812	147.1305	277.00	978750.81	277.00	********	27.50	-3.45		..
7613.2896	22.5828	147.1350	280.00	978750.07	280.00	********	27.62	-3.71		..
7613.2902	22.5845	147.1397	280.90	978749.31	280.90	********	27.03	-4.40		..
7613.2908	22.5863	147.1440	282.60	978748.91	282.60	********	27.04	-4.58		..
7613.2914	22.5885	147.1483	284.20	978748.57	284.20	********	27.05	-4.74		..
7613.2920	22.5905	147.1527	284.70	978748.07	284.70	********	26.58	-5.27		..
7613.2926	22.5917	147.1573	285.70	978747.69	285.70	********	26.43	-5.53		..
7613.2932	22.5927	147.1622	287.40	978747.22	287.40	********	26.42	-5.73		..
7613.2938	22.5942	147.1667	288.50	978747.60	288.50	********	27.05	-5.23		..
7613.2944	22.5958	147.1713	288.90	978747.21	288.90	********	26.67	-5.65		..
7613.2950	22.5973	147.1756	290.10	978747.04	290.10	********	26.78	-5.68		..
7613.2956	22.5988	147.1803	290.50	978747.01	290.50	********	26.78	-5.72		..
7613.2962	22.5998	147.1852	291.50	978746.82	291.50	********	26.83	-5.78		..
7613.2968	22.6007	147.1898	292.80	978746.44	292.80	********	26.60	-5.96		..
7613.2972	22.6013	147.1930	293.40	978746.26	293.40	********	26.76	-6.06		..
7613.2978	22.6018	147.1978	294.30	978746.04	294.30	********	26.79	-6.14		..
7613.2984	22.6020	147.2028	295.30	978745.97	295.30	********	27.01	-6.02		..
7613.2990	22.6022	147.2077	296.40	978745.85	296.40	********	27.22	-5.94		..
7613.2996	22.6022	147.2125	298.20	978745.65	298.20	********	27.58	-5.78		..
7613.3002	22.6023	147.2173	299.80	978746.01	299.80	********	28.42	-5.12		..
7613.3008	22.6025	147.2222	301.90	978745.99	301.90	********	29.04	-4.73		..
7613.3014	22.6027	147.2270	304.00	978746.53	304.00	********	30.22	-3.79		..
7613.3020	22.6027	147.2318	305.90	978746.60	305.90	********	30.07	-3.35		..
7613.3026	22.6028	147.2366	309.00	978747.09	309.00	********	32.31	-2.26		..
7613.3032	22.6037	147.2415	311.20	978748.29	311.20	********	34.13	-.68		..
7613.3038	22.6043	147.2463	313.70	978750.13	313.70	********	36.70	1.61		..
7613.3044	22.6047	147.2512	315.80	978752.39	315.80	********	39.59	4.26		..
7613.3050	22.6047	147.2560	317.90	978752.83	317.90	********	40.68	5.11		..
7613.3056	22.6047	147.2610	323.40	978752.16	323.40	********	41.71	5.53		..
7613.3062	22.6048	147.2657	335.20	978751.43	335.20	********	44.61	7.11		..
7613.3068	22.6049	147.2707	339.30	978751.34	339.30	********	45.18	7.82		..
7613.3074	22.6049	147.2756	332.50	978752.99	332.50	********	45.33	8.13		..
7613.3080	22.6049	147.2804	334.70	978752.19	334.70	********	45.21	7.77		..
7613.3086	22.6050	147.2853	335.10	978752.44	335.10	********	45.50	8.09		..
7613.3092	22.6054	147.2901	338.80	978750.79	338.80	********	45.04	7.14		..
7613.3100	22.6059	147.2966	347.20	978749.22	347.20	********	46.03	7.19		..
7613.3509	22.5090	146.8172	260.10	978769.89	260.10	********	46.00	16.90		..

* END-FILE *

GALILEE BASIN

7614.001 GALILEE BASIN SURVEY - TRAVERSE 4

DATUM = ADM HU

1978/03/06

BMR STATION NUMBER.	LATITUDE SOUTH. (DEGREES)	LONGITUDE EAST. (DEGREES)	METER ELEVATION (METRES)	OBSERVED GRAVITY. (MGAL)	GROUND ELEVATION (METRES)	TERRAIN CORRECTION FOR 2.67	FREE AIR ANOMALY. (MGAL)	BOUGUER ANOMALY. FOR 2.67	INFORMAL STATION NAME, NUMBER, BENCHMARK, ETC.	* LAST DATE STATION UPDATED
7614.4000	23.6447	146.5642	377.60	978780.84	377.60	********	19.50	-22.74		1978/03/06
7614.4006	23.6451	146.5691	377.50	978781.12	377.50	********	19.73	-22.50		..
7614.4012	23.6454	146.5739	377.60	978781.13	377.60	********	19.75	-22.50		..
7614.4018	23.6458	146.5788	377.80	978781.41	377.80	********	20.06	-22.20		..
7614.4024	23.6461	146.5837	377.30	978781.47	377.30	********	19.95	-22.26		..
7614.4030	23.6465	146.5886	376.90	978781.39	376.90	********	19.72	-22.45		..
7614.4036	23.6469	146.5935	376.20	978781.46	376.20	********	19.55	-22.54		..
7614.4042	23.6472	146.5984	376.20	978781.76	376.20	********	19.83	-22.26		..
7614.4048	23.6476	146.6033	376.50	978781.77	376.50	********	19.90	-22.22		..
7614.4054	23.6479	146.6081	376.50	978781.97	376.50	********	20.08	-22.04		..
7614.4060	23.6483	146.6130	376.60	978782.08	376.60	********	20.20	-21.93		..
7614.4066	23.6486	146.6179	376.40	978782.44	376.40	********	20.47	-21.60		..
7614.4072	23.6494	146.6226	373.70	978783.19	373.70	********	20.33	-21.48		..
7614.4078	23.6511	146.6273	362.20	978786.18	362.20	********	19.67	-20.85		..
7614.4084	23.6513	146.6321	353.30	978788.75	353.30	********	19.46	-20.06		..
7614.4090	23.6513	146.6371	349.20	978789.47	349.20	********	19.43	-19.63		..
7614.4096	23.6514	146.6419	349.10	978790.27	349.10	********	19.70	-19.36		..
7614.4102	23.6526	146.6466	348.60	978790.70	348.60	********	19.89	-19.11		..
7614.4108	23.6542	146.6512	358.40	978789.02	358.40	********	21.13	-18.97		..
7614.4114	23.6558	146.6557	364.50	978788.11	364.50	********	22.08	-18.78		..
7614.4120	23.6563	146.6605	368.00	978787.68	368.00	********	22.54	-18.63		..
7614.4126	23.6559	146.6654	372.50	978787.27	372.50	********	23.62	-18.05		..
7614.4132	23.6555	146.6703	368.00	978788.63	368.00	********	23.62	-17.55		..
7614.4138	23.6551	146.6752	361.00	978790.78	361.00	********	23.55	-16.83		..
7614.4144	23.6548	146.6801	360.50	978791.21	360.50	********	23.93	-16.40		..
7614.4150	23.6541	146.6849	363.00	978791.00	363.00	********	24.54	-16.07		..
7614.4156	23.6527	146.6896	353.50	978793.36	353.50	********	24.06	-15.49		..
7614.4162	23.6519	146.6943	349.00	978794.85	349.00	********	24.22	-14.83		..
7614.4168	23.6519	146.6992	349.40	978795.17	349.40	********	24.65	-14.43		..
7614.4174	23.6520	146.7041	346.70	978795.99	346.70	********	24.64	-14.15		..
7614.4180	23.6520	146.7090	349.60	978795.32	349.60	********	24.86	-14.25		..
7614.4186	23.6521	146.7139	350.00	978795.60	350.00	********	25.26	-13.90		..
7614.4192	23.6521	146.7188	352.40	978795.40	352.40	********	25.80	-13.63		..
7614.4198	23.6522	146.7237	351.40	978795.97	351.40	********	26.05	-13.26		..
7614.4204	23.6522	146.7286	348.50	978797.05	348.50	********	26.24	-12.75		..
7614.4210	23.6513	146.7334	350.30	978796.62	350.30	********	26.43	-12.76		..
7614.4216	23.6508	146.7382	350.10	978796.60	350.10	********	26.38	-12.79		..
7614.4222	23.6508	146.7431	354.50	978795.69	354.50	********	26.62	-12.84		..
7614.4228	23.6509	146.7480	360.60	978794.28	360.60	********	27.29	-13.05		..
7614.4234	23.6509	146.7529	364.20	978793.28	364.20	********	27.48	-13.35		..
7614.4240	23.6518	146.7578	364.00	978793.41	364.00	********	27.46	-13.26		..
7614.4246	23.6511	146.7627	369.30	978792.06	369.30	********	27.74	-13.57		..
7614.4252	23.6511	146.7676	373.80	978790.88	373.80	********	27.95	-13.87		..
7614.4258	23.6512	146.7725	375.70	978790.48	375.70	********	28.13	-13.90		..
7614.4264	23.6513	146.7774	378.50	978789.47	378.50	********	27.98	-14.36		..
7614.4270	23.6513	146.7823	381.20	978788.50	381.20	********	27.84	-14.81		..
7614.4276	23.6514	146.7872	383.00	978787.81	383.00	********	27.70	-15.15		..
7614.4282	23.6514	146.7921	383.60	978787.09	383.60	********	27.16	-15.75		..
7614.4288	23.6515	146.7970	384.80	978786.32	384.80	********	26.76	-16.29		..
7614.4294	23.6515	146.8019	385.90	978785.78	385.90	********	26.55	-16.62		..

GALILEE BASIN   1978/03/06

7614.001 GALILEE BASIN SURVEY - TRAVERSE 4   DATUM = BOM 00   1978/03/06

BMR STATION NUMBER.	LATITUDE SOUTH. (DEGREES)	LONGITUDE EAST. (DEGREES)	METER ELEVATION (METRES)	OBSERVED GRAVITY. (MGAL)	GROUND ELEVATION (METRES)	TERRAIN CORRECTION FOR 2.67	FREE AIR ANOMALY. (MGAL)	BOUGUER ANOMALY. FOR 2.67	INFORMAL STATION NAME, NUMBER, BENCHMARK, ETC.	* LAST DATE STATION UPDATED
7614.4300	23.6516	146.8066	366.40	978785.34	366.40	********	26.27	-16.96		1978/03/06
7614.4306	23.6516	146.8117	366.80	978785.19	366.80	********	26.23	-17.04		..
7614.4312	23.6517	146.8166	367.30	978784.81	367.30	********	26.01	-17.32		..
7614.4318	23.6518	146.8215	367.50	978784.56	367.50	********	25.61	-17.54		..
7614.4324	23.6518	146.8264	368.80	978784.39	368.80	********	26.04	-17.46		..
7614.4330	23.6519	146.8313	368.90	978784.24	368.90	********	25.92	-17.59		..
7614.4336	23.6519	146.8362	363.40	978785.35	363.40	********	25.33	-17.57		..
7614.4342	23.6520	146.8411	369.40	978784.07	369.40	********	25.89	-17.67		..
7614.4348	23.6521	146.8460	368.90	978784.40	368.90	********	26.06	-17.44		..
7614.4354	23.6521	146.8509	377.20	978786.97	377.20	********	25.02	-17.18		..
7614.4360	23.6522	146.8558	372.20	978787.79	372.20	********	24.29	-17.35		..
7614.4366	23.6523	146.8607	364.70	978789.57	364.70	********	23.75	-17.05		..
7614.4372	23.6523	146.8656	354.40	978791.72	354.40	********	22.72	-16.93		..
7614.4378	23.6524	146.8705	351.60	978792.17	351.60	********	22.30	-17.03		..
7614.4384	23.6524	146.8754	353.10	978791.99	353.10	********	22.58	-16.92		..
7614.4390	23.6525	146.8803	351.80	978792.24	351.80	********	22.43	-16.93		..
7614.4396	23.6526	146.8852	359.00	978790.69	359.00	********	23.10	-17.07		..
7614.4402	23.6526	146.8901	349.60	978792.65	349.60	********	22.15	-16.96		..
7614.4408	23.6527	146.8950	356.30	978791.14	356.30	********	22.70	-17.16		..
7614.4414	23.6543	146.8995	352.70	978791.88	352.70	********	22.22	-17.23		..
7614.4420	23.6566	146.9038	353.30	978792.03	353.30	********	22.41	-17.11		..
7614.4426	23.6588	146.9080	351.40	978792.61	351.40	********	22.26	-17.05		..
7614.4432	23.6610	146.9123	357.90	978791.42	357.90	********	22.93	-17.11		..
7614.4438	23.6627	146.9168	355.80	978792.17	355.80	********	22.92	-16.89		..
7614.4444	23.6632	146.9217	349.80	978793.27	349.80	********	22.13	-17.00		..
7614.4450	23.6634	146.9266	350.80	978793.10	350.80	********	22.25	-16.99		..
7614.4456	23.6637	146.9315	355.40	978792.71	355.40	********	23.27	-16.49		..
7614.4462	23.6640	146.9364	355.20	978792.80	355.20	********	23.36	-16.38		..
7614.4468	23.6648	146.9412	352.40	978793.49	352.40	********	23.05	-16.37		..
7614.4474	23.6655	146.9460	353.40	978793.46	353.40	********	23.28	-16.26		..
7614.4480	23.6660	146.9509	354.00	978793.67	354.00	********	23.64	-15.96		..
7614.4486	23.6664	146.9558	357.20	978793.23	357.20	********	24.16	-15.80		..
7614.4492	23.6669	146.9606	370.40	978790.49	370.40	********	25.46	-15.97		..
7614.4498	23.6673	146.9655	366.10	978791.95	366.10	********	25.57	-15.39		..
7614.4504	23.6678	146.9704	373.40	978790.70	373.40	********	26.54	-15.23		..
7614.4510	23.6685	146.9752	374.40	978790.92	374.40	********	27.02	-14.86		..
7614.4522	23.6712	146.9846	380.70	978790.56	380.70	********	28.43	-14.16		..
7614.4528	23.6725	146.9893	382.10	978790.67	382.10	********	28.68	-13.86		..
7614.4534	23.6739	146.9939	382.00	978790.85	382.00	********	28.94	-13.80		..
7614.4540	23.6760	146.9983	390.80	978789.19	390.80	********	29.86	-13.86		..
7614.4546	23.6782	147.0026	397.30	978788.09	397.30	********	30.62	-13.63		..
7614.4552	23.6804	147.0066	403.40	978786.99	403.40	********	31.26	-13.87		..
7614.4558	23.6826	147.0111	408.60	978786.37	408.60	********	32.10	-13.62		..
7614.4564	23.6842	147.0196	406.60	978787.00	406.60	********	32.00	-13.49		..
7614.4570	23.6851	147.0204	400.60	978788.60	400.60	********	31.69	-13.13		..
7614.4576	23.6849	147.0253	402.20	978788.51	402.20	********	32.10	-12.69		..
7614.4582	23.6845	147.0302	394.70	978790.46	394.70	********	31.77	-12.39		..
7614.4588	23.6840	147.0351	394.00	978790.85	394.00	********	31.98	-12.10		..
7614.4594	23.6836	147.0399	402.00	978789.79	402.00	********	33.41	-11.56		..
7614.4600	23.6831	147.0448	418.80	978786.40	418.80	********	35.32	-11.53		..

* END-FILE *

APPENDIX I

* DESCRIPTION OF THIS TAPE *

RECORD TYPE - BUFFERED BINARY WITH 512 60-BIT WORDS/RECORD

DATUM USED -

1.	STATION NUMBER -	8 DIGIT FLOATING POINT	*
2.	POSITION UNITS -	DECIMAL DEGREES	D
3.	ELEVATION UNITS -	METRES ABOVE M.S.L.	M
4.	ELEVATION DATUM -	DATUM UNDEFINED	
5.	GRAVITY UNITS -	MILLIGALS	M
6.	GRAVITY DATUM -	OLD POTSDAM DATUM	O

Record 1979/78

F55/B3-189A

* 1978/03/06 *

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GALILEE BASIN                                                                    DATUM = *DM MU      1978/03/06

7611,RR1  GALILEE BASIN SURVEY - TRAVERSE 1                  108 STATIONS.          *DM MO      1978/03/06
7612,RR1  GALILEE BASIN SURVEY - TRAVERSE 2                   68 STATIONS.          *DM MU      1978/03/06
7613,R01  GALILEE BASIN SURVEY - TRAVERSE 3                  141 STATIONS.          *DM MU      1978/03/06
7614,R01  GALILEE BASIN SURVEY - TRAVERSE 4                  100 STATIONS.          *DM MU      1978/03/06

ENDFILE                                     TAPE CONTAINS    417 STATIONS.

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

        LISTAPE COMPLETED            18.06.28                    JOB TIME IS         .9 SECONDS

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
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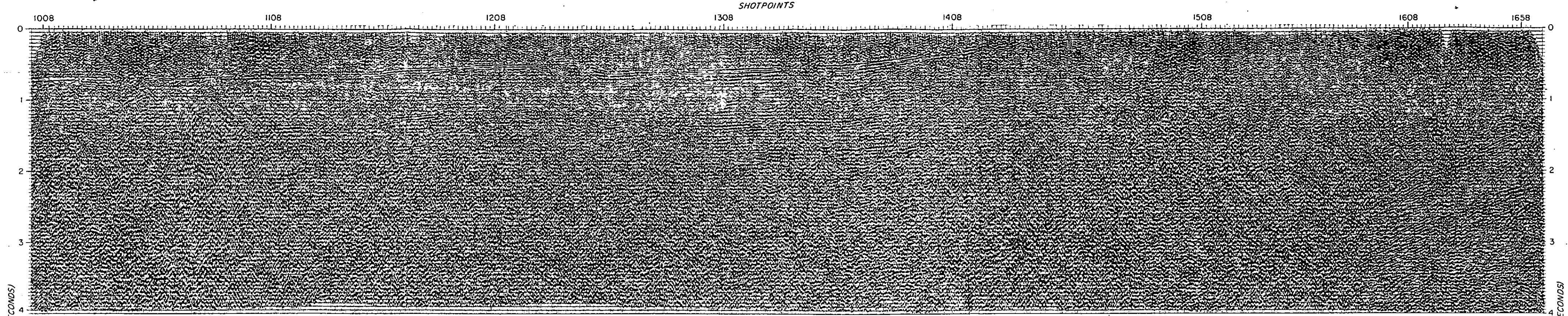
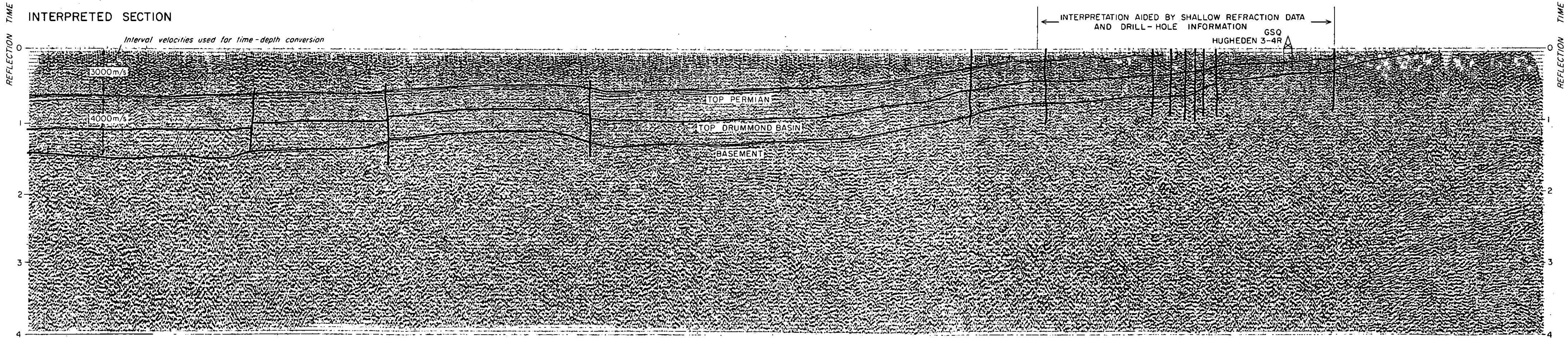
UNINTERPRETED SECTION



INTERPRETED SECTION



RECORDING PARAMETERS

1. DFS IV 9 TRACK SEG B
2. 24 TR 6 FOLD OFF-END
3. 16 GEOPHONES-TRACE GROUP INT 83·3m
4. 2ms RECORDING SAMPLE RATE
5. FILTER 12Hz - 124 Hz
6. RECORD BY BMR 1976

PROCESSING SEQUENCE

1. TRUE AMPLITUDE RECOVERY
2. 2ms - 4ms RESAMPLE
3. STATIC CORRECTIONS AND EDIT
4. CROOKED LINE CDP GATHER
5. TIME VARIANT SCALING
6. VELOCITY ANALYSIS
7. NMO CORRECTIONS
8. 6 FOLD CDP STACK
9. RESIDUAL STATIC CORRECTIONS
10. TIME VARIANT FILTER
11. TIME VARIANT SCALING

PROCESSED BY GEOPHYSICAL SERVICE INT. 1977
DATUM +400m A.H.D
REPLACEMENT VELOCITY Ve = 2600 ms^{-1}

FILTER

TIME	BANDPASS
0·750	15-45 Hz
2·000	7-30 Hz

NO AUTOSTATICS SP1422-1662

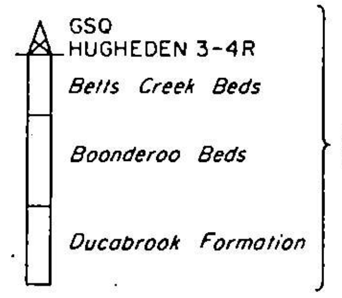
SP 1000	
TIME ms	RMS VEL m/s
0	1800
600	3060
1250	3100
2000	3700
4000	4400

SP 1172	
TIME ms	RMS VEL m/s
0	1800
600	3050
1250	3100
2000	3700
4000	4400

SP 1320	
TIME ms	RMS VEL m/s
0	2000
600	2800
1300	3500
2000	3700
4000	4400

SP 1466	
TIME ms	RMS VEL m/s
0	2000
500	3100
960	3400
1500	3900
4000	5000

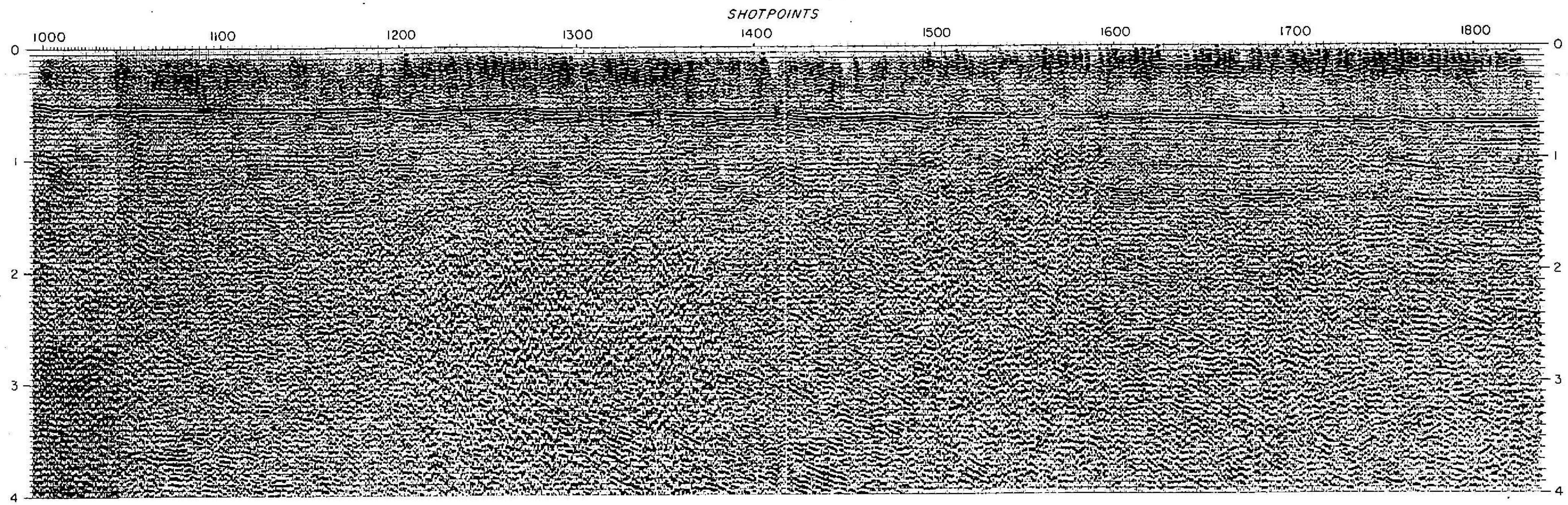
Two-way time below datum	Depth below surface
0·075s	163m
0·220s	416m
0·307s	568m



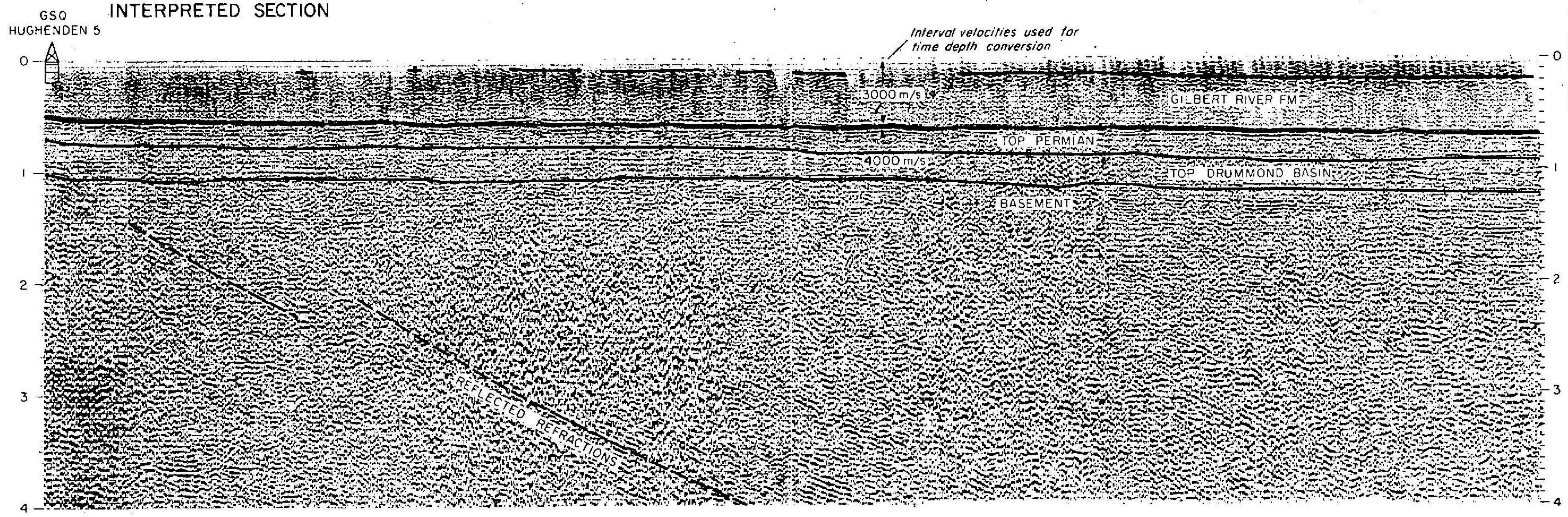
0 5 10 km

TRAVERSE I SEISMIC SECTION

UNINTERPRETED SECTION



INTERPRETED SECTION



RECORDING PARAMETERS

1. DFS IV 9 TRACK SEG B
2. 24 TR 6 FOLD OFF-END
3. 16 GEOPHONES-TRACE GROUP INT 83·3m
4. 2 ms - 4ms RECORDING SAMPLE RATE
5. FILTER 12 Hz - 124Hz
6. RECORDED BY BMR 1976

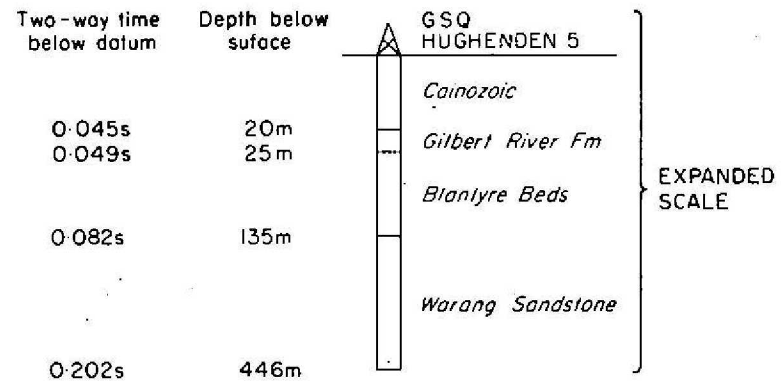
PROCESSING SEQUENCE

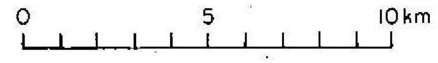
1. TRUE AMPLITUDE RECOVERY
2. 2ms - 4ms RESAMPLE
3. STATIC CORRECTIONS AND EDIT
4. CROOKED LINE CDP GATHER
5. TIME VARIANT SCALING
6. VELOCITY ANALYSIS
7. NMO CORRECTIONS
8. 6 FOLD CDP STACK
9. RESIDUAL STATIC CORRECTIONS
10. TIME VARIANT FILTER
11. TIME VARIANT SCALING

PROCESSED BY GEOPHYSICAL SERVICE INT. 1977
DATUM +400m AHD
REPLACEMENT VELOCITY $Ve = 2600 ms^{-1}$

SP 1000	
TIME ms	RMS VEL m/s
0	2200
350	2860
500	3260
1400	3900
4000	4760

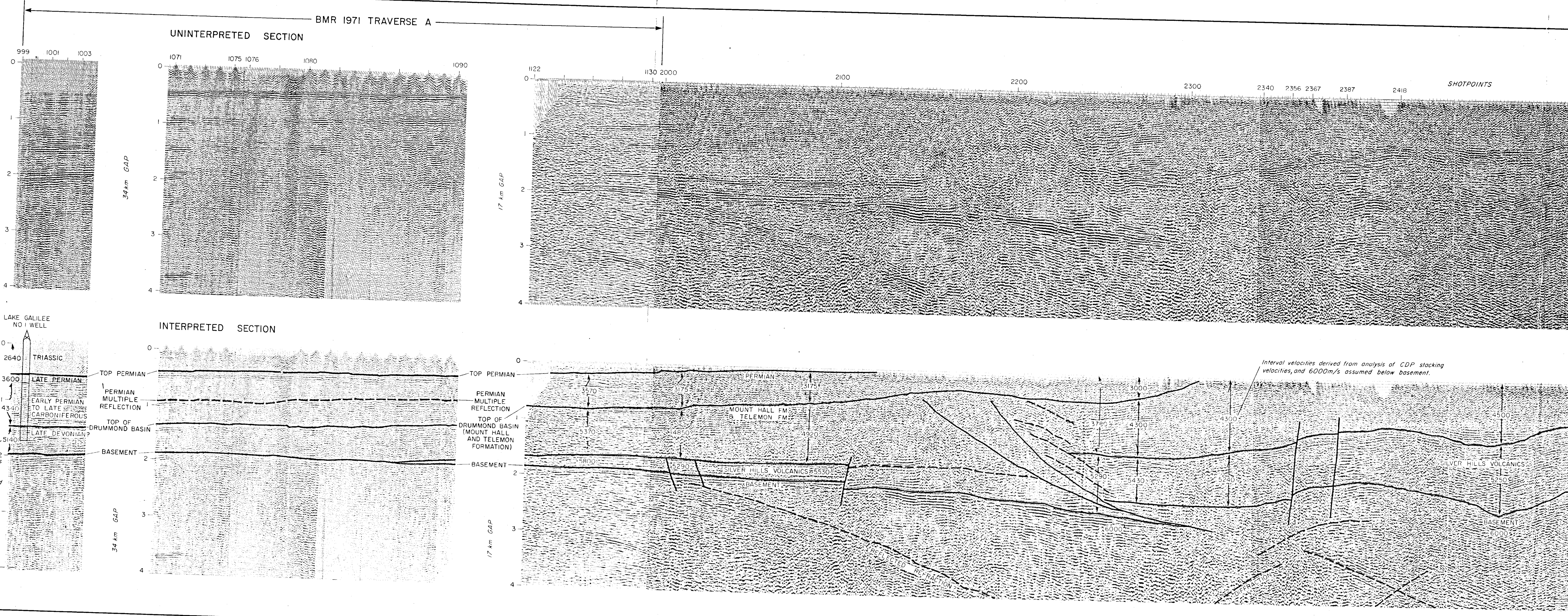
SP 1820	
TIME ms	RMS VEL m/s
0	2200
460	2960
700	3200
1520	3820
4000	4760





TRAVERSE 2 SEISMIC SECTION

F55/B3-185



TRAVERSE 3 SEISMIC SECTION

Record 1979/78

RECORDING PARAMETERS

1. DFS IV 9 TRACK SEG B
2. 24 TR 6 FOLD OFF-END
3. 16 GEOPHONES-TRACE GROUP INT 83·3m
4. 2ms RECORDING SAMPLE RATE
5. FILTER 12Hz – 124Hz
6. RECORDED BY BMR 1976

PROCESSING SEQUENCE

1. TRUE AMPLITUDE RECOVERY
2. 2ms – 4ms RESAMPLE
3. STATIC CORRECTIONS AND EDIT
4. CROOKED LINE CDP GATHER
5. TIME VARIANT SCALING
6. VELOCITY ANALYSIS
7. NMO CORRECTIONS
8. 6 FOLD CDP STACK
9. RESIDUAL STATIC CORRECTIONS
10. TIME VARIANT FILTER
11. TIME VARIANT SCALING

PROCESSED BY GEOPHYSICAL SERVICE INT. 1977
DATUM +200m AHD
REPLACEMENT VELOCITY Ve = 2000 ms^{-1}

SP 2000

TIME ms	RMS VEL m/s
0	2300
450	2700
850	3325
1000	3700
2000	4300
6000	4600

SP 2076

TIME ms	RMS VEL m/s
0	2400
550	2900
900	3400
1150	3850
2000	4400
6000	5250

SP 2214

TIME ms	RMS VEL m/s
0	2500
575	3000
778	3350
1000	3750
2300	4600
6000	5400

SP 2276

TIME ms	RMS VEL m/s
0	2575
500	3050
800	3375
1200	3800
2000	4275
2800	5000
6000	5650

SP 2342

TIME ms	RMS VEL m/s
0	3000
500	3300
900	3900
1900	4300
6000	5750

SP 2468

TIME ms	RMS VEL m/s
0	3000
500	3500
900	3900
1500	4500
6000	5750

SP 2570

TIME ms	RMS VEL m/s
0	3000
500	3500
1000	3975
2250	4850
6000	5600

SP 2708

TIME ms	RMS VEL m/s
0	3500
700	4150
1500	4500
2500	4900
6000	5600

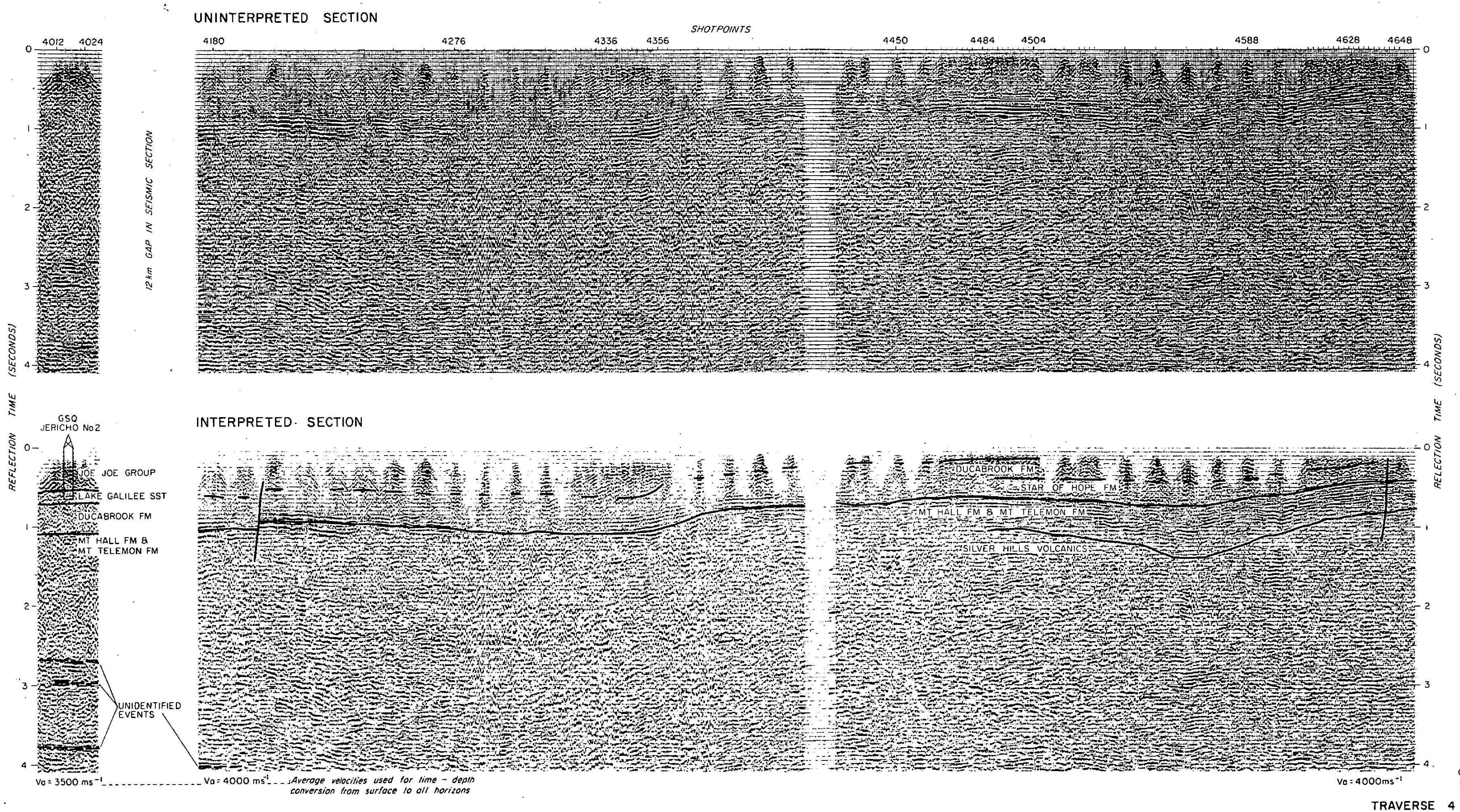
SP 2770

TIME ms	RMS VEL m/s
0	3500
700	4250
1700	4650
2200	4800
6000	5600

0 — 5km
SCALE FOR SP999–1130

0 — 5km
SCALE FOR SP 2000–3060

F55/B3-186



RECORDING PARAMETERS

1. D.F.S IV 9 TRACK SEG B
2. 24 TR 6 FOLD OFF-END
3. 16 GEOPHONES-TRACE GROUP INT 83·3m
4. 2ms RECORDING SAMPLE RATE
5. FILTER 12Hz - 124Hz
6. RECORDED BY BMR 1976

PROCESSING SEQUENCE

1. TRUE AMPLITUDE RECOVERY
2. 2ms – 4ms RESAMPLE
3. STATIC CORRECTIONS AND EDIT
4. CROOKED LINE CDP GATHER
5. TIME VARIANT SCALING
6. VELOCITY ANALYSIS
7. NMO CORRECTIONS
8. AUTOMATED RESIDUAL STATICS
9. CDP STACK VARIABLE 1-6 FOLD
10. TIME VARIANT FILTER - SEE BOX
11. TIME VARIANT SCALING
12. COHERENCY FILTERING S.P. 4180 - 4648

PROCESSED BY GEOPHYSICAL SERVICES INT. 1977
DATUM +300m AHD
REPLACEMENT VELOCITY Ve = 3500 ms⁻¹

FILTER

TIME	BANDPASS
0·750	15-45 Hz
2·000	7-30 Hz

SP4012

TIME ms	RMS VEL m/s
0	3200
1000	3600
2800	4400
4500	5400
6000	6000

SP 4026

TIME ms	RMS VEL m/s
0	3200
1000	3600
2800	4400
4500	5400
6000	6000

SP 4030

TIME ms	RMS VEL m/s
0	3200
1000	3600
2800	4400
4500	5400
6000	6000

SP4344

TIME ms	RMS VEL m/s
0	3700
600	3900
3900	5000
5000	6000
6000	6500

SP 4632

TIME ms	RMS VEL m/s
0	3750
600	4000
2000	4400
2400	4700
3000	5200
4100	5400
4800	5600
6000	5850

SP 4656

TIME ms	RMS VEL m/s
0	3750
600	4000
2000	4400
2400	4700
3000	5200
4100	5400
4800	5600
6000	5850

0 5 10km

TRAVERSE 4 SEISMIC SECTION

F55/B3-187