DEPARTMENT OF
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BUREAU OF MINERAL RESOURCES,
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RECORD 1975/41

STRUCTURE CONTOUR MAPS OF THE BASE OF THE ROLLING DOWNS GROUP AND THE BASE OF THE EROMANGA BASIN SEQUENCE, NORTHERN EROMANGA BASIN, 1974

by

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SUMMARY

Structure contour maps were drawn for the base of the Lower Cretaceous Rolling Downs Group and the base of the Lower Jurassic to Cretaceous Eromanga Basin sequence in the Northern Eromanga Basin, combining the results of seismic surveys, drilling, and geological mapping. The maps are more detailed and reliable in areas with seismic coverage, and less reliable between areas of seismic coverage where contours have been extrapolated over considerable distances. The base of the Rolling Downs Group has been more reliably mapped because the reflection data are generally of fair to good quality and information was available from a large number of wells and water-bores which were drilled through the horizon. The base of the Eromanga Basin sequence is less reliably mapped because the reflection data quality was generally poor for that horizon and few water-bores intersected the horizon. The deepest part of the basin is in the southwest of the area and is probably the most prospective for petroleum. This area has inadequate seismic coverage. In particular seismic work appears to be warranted to investigate the possible southwesterly extensions of the Cork Fault and the associated deep trough of sediments on the western side of the fault. The Eromanga Basin sequence is not very prospective for petroleum and most seismic surveys attempted to obtain information on the underlying Triassic and Permian sediments. This information was not examined in detail, being outside the scope of the study. However, the area south of Ooroonoo No.1 well requires additional seismic coverage to investigate a possible 5000m thick pre-Eromanga Basin sequence which was indicated on a single seismic traverse.

1. INTRODUCTION

Structure contour maps were drawn for the base of the Lower Cretaceous Rolling Downs Group and the base of the Lower Jurassic to Cretaceous Eromanga Basin sequence in the Northern Eromanga Basin. The maps were made by compiling the results from seismic surveys, drilling, and geological mapping. The study was part of a joint project by the Geological and Geophysical Branches of the Bureau of Mineral Resources (BMR) and the results will be included in a Bulletin on the geology of the Northern Eromanga Basin (Senior, Harrison, & Mond, in press.).

The Eromanga Basin in Queensland and Northern Territory has been arbitrarily divided for the purpose of reporting into northern, central, and western parts. This Record deals with the area in central Queensland between latitudes 19°30'S and 24°S and longitudes 140°30'E and 147°E.

The Eromanga Basin contains sediments of Lower Jurassic to Upper Cretaceous age. The Jurassic sequence is mainly terrestrial, the Lower Cretaceous is shallow marine and the Upper Cretaceous grades from paralic to fluvial and lacustrine. The Lower Cretaceous Rolling Downs Group conformably overlies the Jurassic Hooray Sandstone. A fairly strong seismic reflector close to the boundary between these units has been recorded on numerous seismic surveys in the area, and is referred to as the 'Blythesdale reflector', or 'Transition beds' or 'Horizon C' in petroleum exploration company reports. The Hutton Sandstone normally forms the basal unit of the Eromanga Basin sequence and overlies either Galilee Basin Permian to Triassic sediments or igneous or metamorphic basement throughout the area. The most important artesian aquifers in the area are the Hutton, Adori, and Hooray Sandstones, with the Hutton Sandstone the greatest producer (Casey, 1970). The Eromanga Basin sequence within the map area is considered to have a low petroleum potential because approximately 40 petroleum exploration wells and several thousand water-bores have shown only traces of oil or gas and any commercial petroleum which may have been contained in the widespread permeable sandstones has probably been flushed by the basin-wide movement of groundwater (Senior, Harrison, & Mond, in press).

2. INFORMATION COMPILED

Seismic information. Thirty-five subsidized seismic surveys and three seismic surveys by BMR were made in the area up to March 1974. Unsubsidized seismic surveys have been made but no information from them was available for this project. Structure contour maps or cross-sections of the horizons were copied from the company reports and were modified where necessary, using geological information from wells and water-bores, and seismic information from nearby or intersecting seismic lines. The large number of seismic record sections was not re-interpreted as it was not considered to be necessary and would have required a large effort for little extra return.

The locations of all known seismic traverses in the Northern Eromanga Basin, together with an index of the seismic surveys, are shown in Plate 1. The surveys from which information was used in compiling the structure contour maps and the general quality of the seismic reflection information are listed in Appendix 1. The available seismic information consisted of contour maps and some cross-sections showing reflection times or depths relative to various datum planes. Most information came from reflection recording but refraction data from the Fermoy and Vergemont surveys (Pl.1) provided some useful depth profiles.

Drilling information. Many wells and water-bores intersected the base of the Rolling Downs Group and provided a large number of control points for the final contouring. The oil exploration wells and only a few water-bores intersected the base of the Eromanga Basin sequence and thus there are few control points for this horizon. The water-bores which did not drill through the base of the Bromanga Basin sequence were often deep and gave minimum thicknesses of the sequence which were useful constraints in drawing the contours for this horizon. The wells and water-bores which provided information useful for the contouring have their locations and names or numbers shown in Plate 1. Only those wells or water-bores which contributed to the particular horizon have their locations marked on the individual maps (Pls. 2 and 3). The depths to the horizons in the wells and water-bores and the minimum thicknesses are given by Senior, Harrison, & Mond, (1974, in press).

Geological mapping information. Geological mapping by BMR and by the Geological Survey of Queensland has been reported in the explanatory notes for the 1:250 000 Sheet areas. A summary of published and unpublished material is given by Senior, Harrison, & Mond (1974, in press).

3. CONTOUR MAPS

The following were the main steps in preparing the structure contour maps:

- The seismic reflection time or depth contours were converted to depth in metres relative to mean sea level, using either the reflection times and velocity functions or the depths relative to particular data given in the reports.

- Where a well or water-bore was located on or very close to a seismic traverse, a reflector was correlated to a geological boundary in the well provided that the depths were reasonably close and that the vertical velocity calculated from the reflection time and the depth in the well was within the range of vertical velocities found within the map area. The maximum difference in depth between a reflector and a horizon in a well to which it was correlated was about 200m or about 20%.

- Where only one well or water-bore was on or close to a seismic traverse the seismic contours were all adjusted up or down by the same value, the difference between the reflector and well depth.

- Where several wells or water-bores lay on or close to the seismic traverses, or where different survey lines were very close or intersected, the seismic data were adjusted and contours were drawn to be consistent with all the seismic and drilling information. Occasionally significant velocity variations occurred between two wells and the contours were adjusted up or down by values which were varied smoothly between the wells.
- Structure contours of the base of the Rolling Downs Group and the base of the Eromanga Basin sequence in the Northern Eromanga Basin were drawn from the seismic information modified to incorporate faults seen on the surface and information from drilling.

Each survey had at least one well-tie. The contouring accuracy was poorer away from wells because of possible variations of vertical velocities in the section, and in places because of faults and poor record quality which made it difficult to follow the same phases of reflection events. Correlations of reflections with geological boundaries in wells and water-bores were uncertain because of uncertainties in the reflection times and vertical velocities. Reflection times were uncertain where the reflections were weak or there was interference. Vertical velocities may have varied over the area, and there was usually insufficient control, as well as probable errors in the velocity measurements. The uncertainty of correlation may be reduced by using other information such as the character of a reflection associated with a given horizon, characteristic groups of reflectors, and correlations with adjacent surveys.

The reflection data associated with the base of the Rolling Downs Group was generally of fair quality and the mapped boundary is considered to be fairly reliable where there is seismic control. Generally deeper reflections were discontinuous and of poor quality and the base of the Eromanga Sequence is considered to be less reliable.

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4. CONCLUSIONS

The structure contour maps made for the base of the Rolling Downs Group (Plate 2) and for the base of the Eromanga Basin sequence (Pl.3) in the Northern Eromanga Basin are more detailed and more reliable in areas with seismic coverage, particularly in the west-central area near Lovelle Downs No.1 well and in the southeast. Reliability is poorer in parts of the basin between areas of seismic coverage where contours have been extrapolated over considerable distances. Seismic information from 14 surveys contributed to mapping the base of the Eromanga Basin sequence and from 17 to mapping the base of the Rolling Downs Group. The base of the Eromanga Basin sequence was intersected in very few wells or water-bores so the map for this horizon is not as detailed or reliable as that for the base of the Rolling Downs Group. The two horizons generally show the same regional structural features. The horizons are deepest in an area bounded approximately by latitudes 22° and 24°S and by longitudes 142° and 144°E. This area is cut by several extensive faults all trending northeast and downthrown to the west. Elsewhere there are faults with similar trend and a number with trends between north and west. On both maps the two deepest areas are a trough trending north-northeast on the downthrown side of the Cork Fault near Lovelle Downs No.1 and Goleburra No.1 wells and a parallel trough west of Fermoy No.1 and Mayneside No. 1 wells.

Several new possible structural highs are apparent on the maps in areas without seismic coverage. On the map of the base of the Rolling Downs Group there is a high northwest of Langdale No.1 well and on the map of the base of the Eromanga Basin sequence there are highs south of Fermoy No.1 and south of Manfred No.1 wells. The highs do not appear on both contour maps.

The Eromanga Basin sequence is thickest and probably most prospective for petroleum in the southwest part of the map area. Much of this area has inadequate seismic coverage, especially that part north and west of Fermoy No.1 and Mayneside No.1 wells. The area is cut by a major fault system includin the Cork Fault which trends north-northeast and was mapped by seismic surveys

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between 22° and $23^{\circ}S$. A fault mapped at the surface east of Ooroonoo No.1 well may be part of the same fault system. Seismic work is necessary to determine whether the fault system extends to the area east and south of Ooroonoo No.1 well and whether there is a deep trough of sediments west of the fault in that area, similar to the trough found between 22° and $23^{\circ}S$. The areas of the possible new highs also warrant seismic work to confirm the structures.

Seismic surveys in the Northern Eromanga Basin were mainly concerned with the determination of the structure and thickness of sediments older than the Eromanga Basin sequence and a large quantity of seismic information has been obtained about the Permian and Triassic (Galilee Basin) sediments. This information, being beyond the scope of the study, was not examined in detail, but an area which requires further seismic coverage is south of the Ooroonoo No.1 well where there appears to be a thick sequence of pre-Eromanga Basin sediments. A line of the Binburie seismic survey runs south from the well (Pl.1). Deep events angularly unconformable with the Eromanga Basin reflectors were recorded down to 3 s indicating that of about 7000 m of sediments present there 5000 m are probably pre-Eromanga Basin sediments.

5. REFERENCES

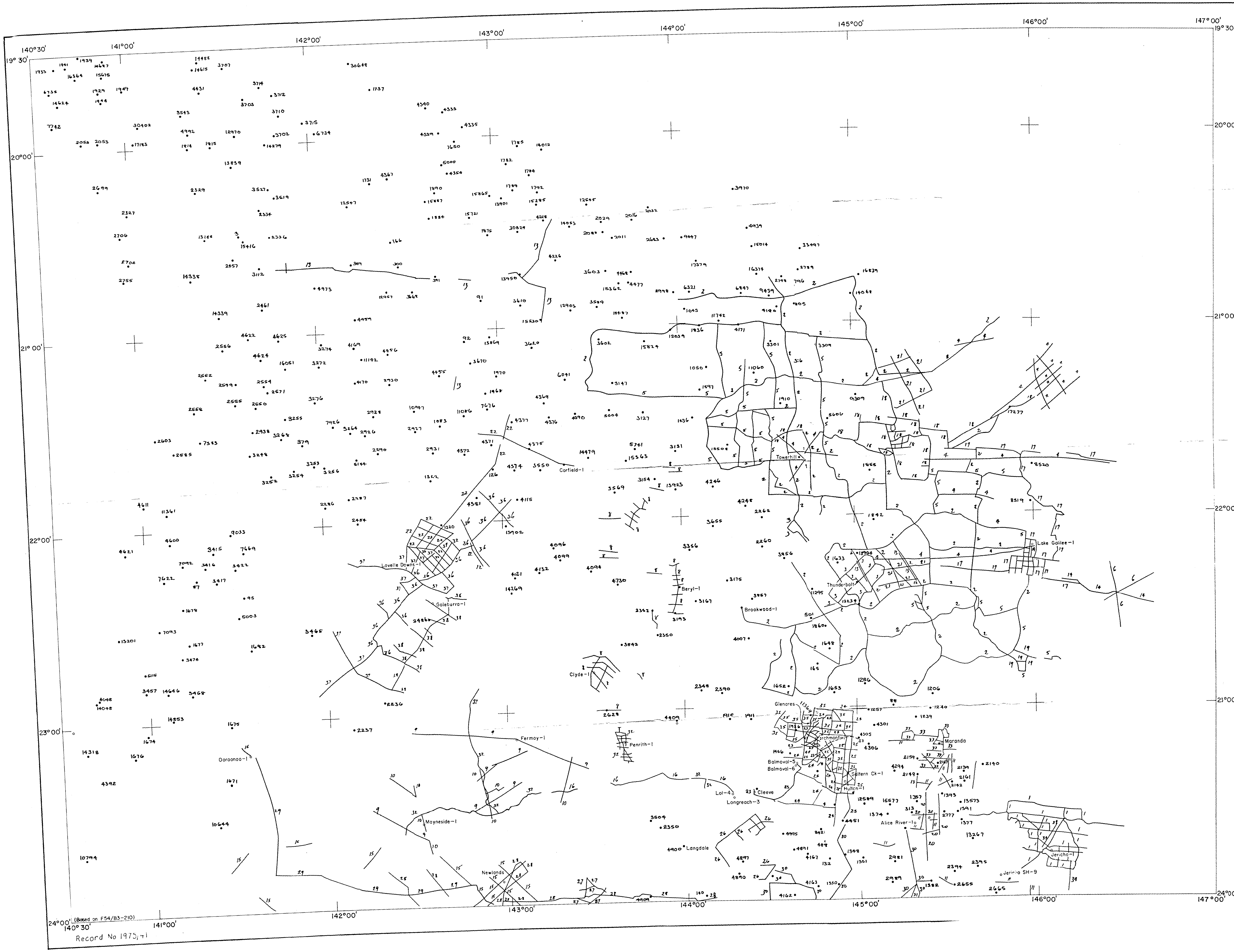
CASEY, D.J., 1970 - Northern Eromanga Basin. Geol. Surv. Qld Rep. 41.

SENIOR, B.R., HARRISON, P.L., & MOND, A., in press - Notes on the geology of the northern part of the Eromanga Basin. Bur. Miner. Resour. Aust. Bull. 167A.

APPENDIX 1

SEISMIC SURVEYS CONTRIBUTING TO STRUCTURE CONTOUR MAPS AND GENERAL DATA QUALITY.

Survey	Survey No. on locality map	Base of Rolling Downs Group	Base of Eromanga Basin sequence
Cairnhope-Rimbanda	8	good	good
Fermoy	9	good	fair (refraction data)
Vergemont	10	good	fair (refraction data)
Mayne	15	fair	fair
Longreach-Silsoe	16	fair	fair
Wokingham Creek	22	good	not mapped
Balmoral	23	fair	not mapped
Rodney Downs	24	fair	fair-poor
Brixton	25	poor	fair-poor
Wellshot Creek	26	fair	poor
Thomson River	27	fair	poor
Ruthven	28	good-poor	good-poor
Binburie	29	good-poor	good-poor
Barcoo	30	fair	not mapped
West Blackall	31	good-fair	not mapped
Maneroo	32	good	fair-poor
Rodney Creek	35	not mapped	good-poor
Williams Creek	38	good-fair	good-fair

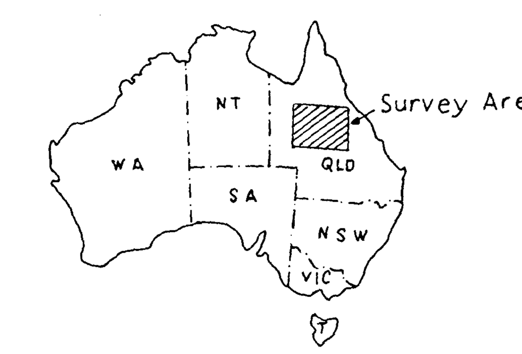


INDEX OF SEISMIC SURVEYS

	No	Operator	Year(s)	Name of Survey
	1	Alliance Oil Development Australia N.T.	1963	Jericho
	2	Amerada Petroleum Corporation	1965–66	Bowen Downs
	3	" " "	1966–67	Thunderboult
	4	" " "	1966–67	Towerhill
	5	" " "	1966–67	Yarrowglen
	6	American Australian Energy	1972	Belyando
	7	American Overseas Petroleum Ltd.	1962–63	Blackall – Mitchell
	8	Associated Australian Oilfields N.L.	1963	Cairnhope – Rimbanda
	9	Australian Aquitaine Petroleum Pty. Ltd.	1963	Fermoy
	10	" " " " "	1964	Vergemont
	11	Beaver Exploration Australia N.L.	1969	Windeyer
	12	Bureau of Mineral Resources	1960	Winton
	13	" " " "	1966	Flinders River
	14	" " " "	1972	Galilee Basin
	15	Conorada Petroleum Corporation	1961	Mayne
	16	Cree Oil of Canada Ltd.	1960	Longreach – Silsoe
	17	Exoil N.L.	1962	Lake Galilee and Lake Buchanan
	18	" "	1962–63	Torrens Creek
	19	" "	1972	Hexham
	20	Farmout Drillers N.L.	1962	Lagoon Creek
	21	Flinders Petroleum N.L.	1969	Koburra
	22	Hematite Petroleum Pty. Ltd.	1973	Wokingham Creek
	23	Longreach Oil Ltd.	1961–62	Balmoral
	24	" " "	1962–63	Rodney Downs
	25	" " "	1963	Brixton
	26	" " "	1965	Wellshot Creek
	27	" " "	1969	Thomson River
	28	Marathon Petroleum Australia Ltd.	1963	Ruthven
	29	" " " "	1964	Binburie
	30	" " " "	1965	Barcoo
	31	" " " "	1966–67	West Blackall
	32	Mines Administration	1962	Maneroo
	33	Oil Development N.L.	1961	Coreena
	34	" " "	1962	Alpha
*	35	Phillips Petroleum Co. and Sunray Mid-Continent Oil Co.	1965	Rodney Creek
*	36	" " " " " "	1966	Collingwood
*	37	" " " " " "	1967–68	Western River
	38	U.S. Natural Resources Aust. Ltd.	1971	Williams Creed

* Later Phillips Australian Oil Co. and Sunray DX Oil Co.

Note: 35 Seismic surveys were subsidized by the Australian Government and three were made by BMR



LEGEND

Petroleum exploration well name and position.

Water-bore number and position.

Seismic traverse survey number and location.

Note: Positions of wells and water-bores are only shown for those which contributed to either of the structure contour maps (Plates 2, 3).

LOCATION OF SEISMIC TRAVERSES IN THE NORTHERN EROMANGA BASIN, QLD 1974

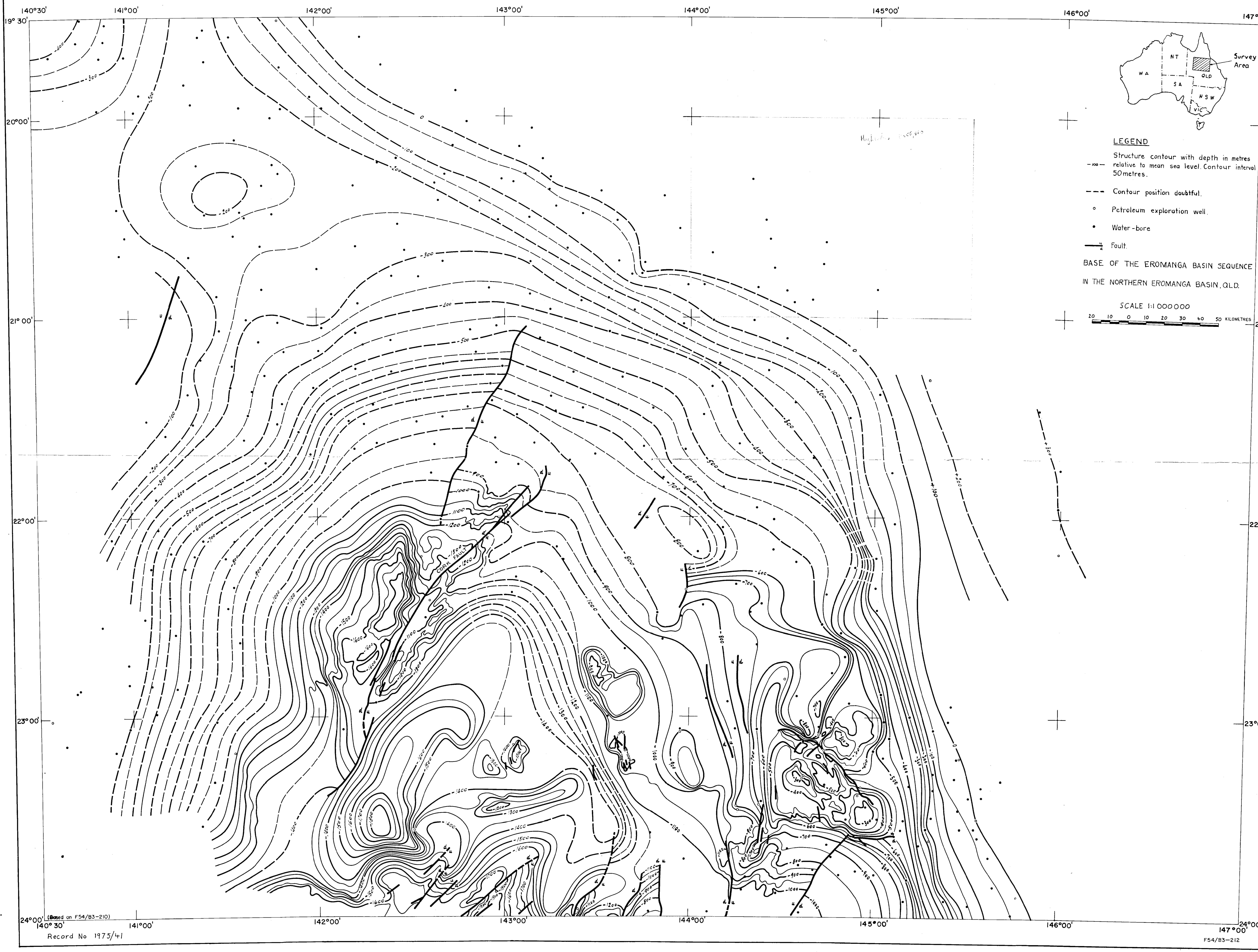
SCALE 1:1 000 000

20 10 0 10 20 30 40 50 KILOMETRES

PLATE 2

F54/B3-211

PLATE 3



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