1974/64

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DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1974/64

STRUCTURES OF THE WESTERN MARGIN OF THE AUSTRALIAN CONTINENT

by

J.C. Branson

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FIGURES

SUMMARY

Topographic features in the western and northwestern continental slopes of Australia arose in two ways. Along the major part, bordering the Indian Ocean, extensive pre-Cretaceous block-faulting formed horsts and grabens. These were covered by a sedimentary mantle in Mesozoic and Tertiary times. In the Timor Sea, the continental slope topography developed through gentle downwarping of shallow-water deposits in the late Tertiary.

The Naturaliste Plateau was least affected by block-faulting and may have been retained at or near shelf level in the continental slope until early Tertiary time. The Wallaby Plateau and the Carnarvon Terrace (new name) were formed as Mesozoic and Tertiary sedimentary mantles over a series of linear and arcuate horst blocks. Oceanic material forms the western margin of the Wallaby Plateau; the plateau's eastern margin is almost detached from the base of the slope. The Exmouth Plateau forms an extensive area of block-faulted Triassic and Permian rocks with Cretaceous and Tertiary sedimentary cover. A northeasterly trend in the central Exmouth Plateau is truncated in the north by a dextral fault and east-west structures which isolate at least three sedimentary blocks on the northern margin. The plateau's southern margin has a northwest trend which controls some early Mesozoic deposition. The Scott Plateau contains a narrow sedimentary horst and a western region of oceanic material. On the east of the Scott Plateau, the Ashmore Terrace (new name) is formed of pre-Cretaceous horsts near the shelf break.

The Timor Trough has formed since the Pliocene with shelf structures gently downwarped into the axis of the trough. Diapiric structures (probably salt intrusions) along the trough axis are present near the line of over-thrusting of the Outer Banda Arc over the downwarped Sahul Shelf.

INTRODUCTION

The northeast Indian Ocean is flanked on the north by the Indonesian Archipelago, on the northeast by broad shelf regions of the Timor and Arafura Seas and on the east by Australia. The major ocean feature is the Wharton Basin, subdivided by ocean ridges, on its eastern side into the Perth, Cuvier, Gascoyne, and Argo Abyssal Plains. Between Indonesia and Australia, the North West and Sahul Shelves are separated from the narrow Indonesian shelf by the Timor Trough. Between the deep ocean basins and the continental shelves a complex continental slope contains the Naturaliste, Wallaby, Exmouth, and Scott Plateaus and two major slope terraces.

The Deep Sea Drilling Project carried out during 1972 by the Glomar Challenger in the Indian Ocean and in part of the Timor Trough recovered samples giving the lithologies and ages of sediments in the deep ocean basins. Oil exploration wells permitted stratigraphic correlation of data from the continental shelf. The region between the shelf and ocean basins has been surveyed by the Bureau of Mineral Resources using a systematic grid of traverses. A total of 46 000 line kilometres of data employing seismic, gravity, and magnetic methods have been recorded in the area between the southwest tip of Western Australia and the continental slope region north of Darwin (Fig. 1).

In this paper the preliminary results of this BMR marine geophysical survey are presented. General references to shelf geology, deep sea drilling, and Australian plate movements were used in the interpretation, but further work is needed to correlate shelf survey and oceanographic data with BMR's work on the continental slope.

The results of the survey show that marginal plateaus and slope terraces are mainly associated with horst blocks in a downthrown series of fault blocks. Horst blocks are the major features in the Carnarvon and Ashmore Terraces and the Exmouth and Scott Plateaus. The Naturaliste Plateau may be a Precambrian block retained as a terrace of shelf throughout the Cretaceous to become a plateau in the lower Australian continental slope during the Tertiary, when Antarctica separated southwards from Australia. The Wallaby Plateau forms a marginal feature almost separated from the present continental slope features but derived principally from the continent. The northern margin of the Sahul Shelf and North West Shelf display depositional features controlled by tension and rifting of the Indian Ocean during the Mesozoic. Late Tertiary downwarp due to the collision of the Outer Banda Arc with the broad Australian continental shelf affected deposition only in the Late Pliocene and Quaternary.

For detailed discussion of the western margin, descriptions are divided into three major regions; the southwestern region from Albany to Geraldton, the western region from Geraldton to Rowley Shoals, and the northwestern region from Rowley Shoals to Darwin. Within each margin region discussion will follow the order of the figures.

GEOLOGY

A regional geological history of the western Australian continental slope has been developed in a limited way by Beck (1972) from reconnaissance geophysical data and from the results of the Deep Sea Drilling Project (DSDP) (Luyendy K., Davies et al., 1973; Hayes, Frakes et al., 1973; Veevers, Heirtzler et al., 1973). The descriptions of shelf geology which follow make extensive use of a sedimentary basin summary by Foreman, Wyborn, Kurylowicz, Passmore & Mayne (1973).

Major sedimentary basins will be described under the appropriate region: the Perth Basin under southwest region, the Carnarvon and Canning Basins under western region, and the Browse, Bonaparte Gulf, and Money Shoals Basins under northwest region.

Generally the major sedimentary basins were separate depositional areas during the Palaeozoic and Lower Mesozoic. During the opening of the Indian Ocean existing structures partly controlled sedimentation, but Mesozoic and Tertiary basins offshore form an almost continuous belt along the entire continental slope.

Deep-sea drilling results from the Glomar Challenger Leg 27 (Veevers, Heirtzler et al., 1973) show that the earliest opening of the Indian Ocean occurred in the Late Jurassic. An extensive unconformity at the end of the Upper Cretaceous was found at all drill sites, and sedimentation appears to have recommenced in the Paleocene. The hiatus may have resulted from a change in circulation brought about by continental collision in the north or drifting apart of Australia and Antarctica in the south or by a combination of both (Veevers & Evans, 1973).

SOUTHWEST MARGIN

Topographic features in the southwest continental slope are dominated by the Naturaliste Plateau and the associated slopes and saddle region (Fig. 2). The simple form of continental slope south of Albany is not found anywhere else in the area. There, a narrow shelf is flanked by a continuous 10-degree slope which reaches the continental rise at 4000 metres depth. The continental rise off Albany narrows westwards to become a minor feature along the southern edge of the Naturaliste Plateau. The Naturaliste Plateau covers an area of 120 000 sq km; its central region lies at depths from 2200 to 2500 m and covers 46 000 sq km. The saddle that connects the inner slope to the main plateau reaches just over 2900 m depth and forms a trough which merges northwards into the continental rise. West of Perth the slope has a simple form cut by a large canyon at the mouth of the Swan River. Towards Geraldton the lower part of the slope is broken by a narrow terrace at the foot of the slope and farther north the southern part of the Carnarvon Terrace develops in the upper part of the continental slope.

Major geological features of the Perth Basin trend parallel either to the Darling Fault or to the margins of the Precambrian inliers (Fig. 3). Another sedimentary basin lies in the saddle of the Naturaliste Plateau bounded on the east by a fault scarp near the shelf, onlapping the central plateau region to the west and merging northwards into the continental rise. Near the western end of the Naturaliste Plateau a second smaller sedimentary area forms a shallow basin with the western edge opening onto the steep scarp of the outer slope.

In places the seismic sections can be correlated with deep-sea drilling sites but over most of the slope these sections provide the only evidence for estimating sedimentary rock types. Well stratified sediments are believed to be derived from land where cycles of erosion and sources of sedimentary material vary over short intervals of time. Acoustically transparent layers on the seismic records are typical of homogeneous deposits remote from land. These sediments are probably derived from a rain of pelagic animal debris and fine volcanic dust over a long time. These simple assumptions are used here but they can only be applied to sediments studied on a regional scale.

Sedimentary types in the southwest are defined from seismic records and deep-sea drilling (Fig. 4). Major deposits of sediment along the southern slope off Albany are mainly stratified and lie near the base of the slope. In the Naturaliste Plateau saddle and its western sedimentary basin the sediments appear to be stratified and may be terrigenous. On the north, acoustically transparent sediment making up the continental rise extends into the plateau's central area. To the north of the Naturaliste saddle well stratified sediments overlie acoustically transparent formations that make up the base of the slope. Northwards from Perth there is a thin cover of stratified sedimentary material near the shelf break overlying faulted and possibly folded formations. An unconformity at the top of the faulted sediments is probably post-Triassic as Deep Sea Drill Site No. 259 indicated at least an Upper Cretaceous age and Jurassic deposition may have extended from the Perth Basin over this folded and faulted zone prior to the Upper Cretaceous marine transgression.

The thickest total sedimentary section found on seismic records on the continental slope exceeds 1.5 km (Fig. 5) assuming a velocity of 2.0 km/s. It occurs in a band stretching from the saddle of the Naturaliste Plateau northwards to Geraldton. The saddle region also has over 1.5 km of sedimentary section and the western basin about 1.0 km. Deep Sea Drill Sites No. 258 and 264 recorded oozes and chalk of Lower Cretaceous age under a major Tertiary unconformity. In the centre of the plateau, deeper weak reflections with a westerly dip may indicate that this pelagic cover overlies folded sediments of pre-Cretaceous age.

The depth to the base of the crust (Moho depth) has been calculated from Bouguer anomalies by making several simple assumptions (Fig. 6). Smoothed Bouguer gravity values used in the calculations were reduced to a Moho depth assuming isostatic equilibrium, a standard continental crust 33 km thick, and densities of 2.85 and 3.30 gm/cm^3 for the crust and mantle. Crustal thickness in the range 18 to 22 km, based on this model, defines a transition zone between continental and oceanic crust. Different values for the model parameters do not substantially alter the position of the transition zone. These calculations indicate at least 20 km depth to the mantle under the Naturaliste Plateau. This is typical of crustal thicknesses beneath the continental shelf and marginal plateaus. The crust in the saddle region is also of continental thickness and hence this whole feature appears to be part of the continent.

Structural features deduced from geophysical data also follow the linear trends of the Darling Fault and the margins of the Precambrian inliers near the coast (Fig. 7). On the Naturaliste Plateau poorly defined east-west trends of gravity, magnetic, and basement features have been drawn in Figure 7, but they represent only parts of a complex pattern of anomalies. These east-west trends follow the topography and parallel the Diamantina Fracture Zone, which lies farther south. Intense magnetic anomalies suggest volcanic intrusions in the faulted slopes and thinly covered volcanic oceanic floor. West of Geraldton magnetic anomalies over the base of the slope can be directly correlated with oceanic basement features revealed on seismic records.

As will be seen later and from the evidence cited, the Naturaliste Plateau is less faulted than the other plateaus on the western margin of Australia. The lowest major unconformity overlies a midly fractured continental block. Thick sedimentary formations near the western end of this plateau also show intense magnetic anomalies. It can therefore be suggested that the western basin may contain material of volcanic origin, similar to material in the base of Deep Sea Drill Site No. 264. The saddle region formed a sedimentary basin from Lower Cretaceous or earlier time. North of the plateau a Cretaceous to Recent sedimentary mantle overlies block-faulted structures which parallel the Darling Fault.

WESTERN MARGIN

Between Geraldton and the Rowley Shoals, the continental slope is complex but contains three main topographic features: the Carnarvon Terrace, Wallaby Plateau, and Exmouth Plateau (Fig. 8). The Carnarvon Terrace is a new name proposed for an extensive terraced slope covering about 69 000 sq km between Geraldton and Barrow Island. It lies between the 600 and 1000 m isobaths and its maximum width is about 100 km near Carnarvon. The Wallaby Plateau covers 119 000 sq km and the central part, less than 3000 m deep, covers 23 000 sq km. It is connected to the slope by a deep saddle at about 4000 m. There is another plateau farther west called the West Wallaby Plateau. It was not surveyed by BMR traverses but is known to be of similar size. The Exmouth Plateau, west of Barrow Island, covers 281 000 sq km and has a central area of 77 000 sq km in water less than 2000 m deep. It reaches about 900 metres at the shallowest point and shows no evidence of reef growth. This plateau is separated from the shelf by a broad trough on which the water depth is 1200 m or more and which plunges north into the Argo Abyssal Plain. The southern margin of the plateau is a linear northwest-striking scarp, and the western and northern margins are broken and irregular. Two isolated plateaus to the north are separated from the main plateau by an east-west trough with easterly plunge.

The main geological features of the western margin are the Carnarvon Basin, the Precambrian shield, and the Canning Basin. The sedimentary basin boundaries have fault or onlap relation between Palaeozoic to Cretaceous rocks and the Precambrian (Fig. 9). Part of the Carnarvon Basin boundary zone on the northwest is the Rankin Platform, and the North Turtle Arch separates the Carnarvon Basin from the Canning Basin. In the continental slope near the southern Carnarvon Basin, structures are parallel to the arcuate form of the shelf break. Over the Exmouth Plateau structural trends are reflected in the topography. The connecting saddle and central block-faulting show northeast trends parallel to the Rankin Platform. Along the southern margin the trend is northwest, and on the northern margin there is a major east-west trend.

The sedimentary types and thicknesses (Figs. 10 & 11) are obtained from seismic records. From Geraldton northwards to Carnarvon a continuous region of large-scale foreset bedding (megaforesets) occurs at the shelf break. North of Carnarvon, bedding tends to be subhorizontal and drapes over block-faulted structures without extensive regions of foresets. In the upper slope sedimentary cover is usually less than 0.5 km thick, but it thickens down the slope to 1.0 km of stratified and poorly stratified sediments which may suggest both land and marine sources. Beneath this subhorizontal cover folded and faulted sedimentary formations over 1.0 km thick show a predominant east dip. At the foot of the slope, homogeneous and poorly stratified sediments are usually less than 0.5 km thick but thicken in the Cuvier Abyssal Plain, northeast of the Wallaby Plateau. The Wallaby Plateau itself has a thin covering of poorly stratified sediments except in central grabens, where stratification is more prominent. Beneath the general subhorizontal sedimentary cover on the northeast side there are indications of east dip. Farther north the broad trough separating the Exmouth Plateau from the continental shelf is filled with over 2.5 km of stratified sediments. Within this sequence a major unconformity has been established by correlation with the Egret Well on the Rankin Platform. This unconformity separates the Upper Triassic from the Lower Cretaceous. The central area of the plateau is covered by 1.0 km of Cretaceous to Recent formations over east-dipping block-faulted Upper Triassic rocks. Blocks are downthrown to the west but form horsts in the centre of the plateau. The central block-faulted region covers about 200 000 sq km and the two separate areas on the northern margin cover a further 22 000 sq km. On the southern margin a sedimentary wedge is evident between the unconformity and the Upper Triassic faulted blocks. This sedimentary wedge displays prograded bedding over a vertical thickness of about 0.5 km and appears to have a southern source. It was possibly produced by strong longshore currents in Jurassic times.

Again using the Bouguer gravity values to extrapolate from a standard crust 33 km thick, the crust thins westwards from a maximum of 30 km under the continent to 22 km at the outer edge of the Carnarvon Terrace and Exmouth Plateau (Fig. 12). Thereafter thinning to about 18 km is rapid except under the Wallaby Plateau and the northwest corner of the Exmouth Plateau. In the former case, crust gradually thins under the saddle that connects the Wallaby Plateau to the Carnarvon Terrace, thickens again under the plateau itself, and finally thins towards the western edge of the plateau, where it is only about 18 km thick. This points to a separation of the Wallaby Plateau from the main continental mass. However, seismic evidence suggests that terrigenous sediment lies over and within the plateau. Therefore it seems possible that the separation took place during an episode of Indian Ocean rifting.

Magnetic and gravity trends parallel the shelf break except at the southern margin of the Exmouth Plateau (Fig. 13). A northwest gravity trend in that region may arise from the sedimentary wedge mentioned before, overlying block-faulted Triassic. Intense magnetic anomalies with short wavelength coincide with partly exposed oceanic basement in the south. On the northern margin of the Exmouth Plateau broad anomalies coincide with fault blocks detached from the main plateau by an east-west trough. The form of these anomalies indicates that deep magnetic basement is involved in this block-faulting.

In summary the structural relations along the western margin may be related to the major topographic features. The Carnarvon Terrace is a broad region of faulted pre-Jurassic rocks with a thin cover of Cretaceous to Recent sediments. The Wallaby Plateau to the west contains sedimentary structures on the northeastern side and oceanic basement features on the west, giving the appearance of a hybrid feature of continental and oceanic material. The Exmouth Plateau like the Carnarvon Terrace has substantial thicknesses of block faulted sedimentary formations. The northern Exmouth Plateau comprises several fault blocks separated from the main plateau by an east-west trough. Magnetic anomalies suggest this faulting also involves magnetic basement.

NORTHWEST MARGIN

A broad continental shelf extends from the northern margin of the Exmouth Plateau to the region north of Darwin. This shelf merges without a distinct shelf break into a broad convex slope (Fig. 14). The slope is interrupted north of the Rowley Shoals by a terrace in water depths greater than 2500 m. A shallower terrace to the northeast of this, between Scott and Ashmore Reefs, has been given the new name Ashmore Terrace. It covers 43 000 sq km in waters between 300 and 1000 m deep and maintains an almost uniform width of 100 km. West of Ashmore Terrace lies the Scott Plateau, separated from the slope by a saddle 2500 m deep. Scott Plateau has an irregular outline covering 65 000 sq km with a central area of 20 000 sq km shallower than 2500 m. Its southern margin is bounded by a series of canyons and its western margin by an irregular slope formed by ridges on the Argo Abyssal Plain. Its northern margin slopes into the Savu Basin, which was not traversed by BMR surveys. The northern end of Ashmore Terrace merges into the convex continental slope which plunges northwest from the Sahul Shelf into the Timor Trough. This trough is deepest near the eastern end of Timor, where it reaches 3400 m. Near the western end of Timor it shallows to 2000 m and north of Darwin to 1800 m. Its axis trends northeast near Timor but turns easterly farther east. The floor itself reaches a maximum width of 15 km.

Geological structures on the continental shelf divide the region into the Canning, Browse, Bonaparte Gulf, and Money Shoals sedimentary basins. These basins extend into the continental slope in this region (Fig. 15). Near the Rowley Shoals an axis of deposition lies close to the shelf break. In the Browse Basin the fault-bounded Buccaneer Nose forms a NNE-trending arch along the western margin of the Ashmore Terrace. The Ashmore-Sahul Block, Cartier Trough, and Sahul Ridge are shelf structures which reach the continental slope although there is little evidence that they form major continental slope features. The trace of a major thrust plane lies along the axis of the Timor Trough. It has been deduced from seismic and drilling evidence that the fault plane dips northwest under Timor, the Timor plate being overthrust onto the Australian plate. However, there is little present activity along this fault. Igneous and earthquake activity farther northwest suggest that the active tectonic zone now lies along the Inner Banda Arc.

Seismic evidence shows that all sedimentary formations that can be identified on the continental slope are well stratified except near the abyssal plain (Fig. 16). Only a minimum estimated thickness can be given from seismic reflection results because water-bottom multiples obliterate later arrivals (Fig. 17). The thickest sedimentary formations are recorded near the Rowley Shoals in the Canning and Browse Basins. Megaforeset bedding in rocks described by Mollan, Craig & Lofting (1969) as prograded carbonates is recognized on the western margin of the Ashmore Terrace. Apparent diapiric structures in the sedimentary column in the Ashmore Terrace may be Pliocene reef structures; Mollan, et al. (1969) suggest that reefs grew on Upper Miocene surfaces. Local thickening is observed at several places along the southern side of the Timor Trough. Deep Sea Drill Site No. 262 (Veevers, Heirtzler et al., 1973) in the axis of the trough found Pliocene shallow-water sediments beneath Pliocene and Pleistocene pelagic ooze. This suggests that the Australian continental margin was gently downwarped during the Pliocene, apparently as a result of overthrusting by the Indonesian crustal plate or underthrusting by the Australian continental shelf. Structures in various parts of the trough floor appear from the analysis of the drill core to be salt diapirs.

Reliable crustal thicknesses based on the gravity and bathymetry using the model described earlier are difficult to derive because the Timor area is not in isostatic equilibrium (Fig. 18). The depth of 30 km to the base of the crust beneath the Sahul Shelf is typical of continental crustal thickness. It appears to increase northwards to an equivalent crustal thickness of over 40 km under the eastern end of the island of Timor. However, a dynamic model is required for this region.

Structures in the northwestern margin follow the shelf trend, which is predominantly northeast. East-west trends at the southwest of Timor and north of Darwin reflect deep faulting of basement (Fig. 19). Magnetic anomalies along the margin of the Argo Abyssal Plain correspond to thin oceanic sediment cover over igneous rocks. The Money Shoals Hinge is further delineated on the continental slope by a northeast-trending gravity high.

In summary, block-faulted structures covered by a Cretaceous to Recent sedimentary mantle continue across the northwest continental shelf and slopes. The Ashmore Terrace and Scott Plateau are similar to continental slope features farther south. They were created by horsts in the block-faulted slope. Shelf structures that continue down to the base of the Timor Trough provide evidence of overthrusting of the Australian continental slope by the Outer Banda Arc.

DISCUSSION

Naturaliste Plateau

Structures in the Naturaliste Plateau indicate that this plateau is not a simple series of sedimentary horst blocks like the Exmouth and Scott Plateaus. The age and lithologies of sedimentary formations show that the central plateau existed as such during the Lower Cretaceous. The block-faulting typical of the western Australian margin ceased abruptly north of the saddle. Separation of Australia and Antarctica commenced in the Tertiary, and the Naturaliste Plateau received both detrital and pelagic sediment before this separation. The age of the central mass is unknown but is probably Precambrian. The Naturaliste and Yilgarn Blocks on the east and the Antarctic Continent on the south formed one continent during the Mesozoic. In the margin of this continent the Naturaliste Plateau may have been sheltered from block-faulting during Indian Ocean rifting.

Carnarvon Terrace

Pre-Cretaceous rifting of the continental margin north of Perth created block-faulting of Triassic and Permian formations. Lower Cretaceous pelagic deposits onlap the foot of the continental slope and on the upper slope there is a major unconformity between fault blocks and the overlying sediments. Where blocks subsided unevenly, a ridge of horsts created a terrace formed by Mesozoic and Tertiary fill in a landward graben. Off Carnarvon a second line of horst blocks creates two regions of Mesozoic and Tertiary sedimentary fill, the thicker one in deep water.

Wallaby Plateau

The eastern side of the Wallaby Plateau is formed of stratified fault blocks similar to those found in the western margin of the adjacent Carnarvon Terrace. The western side is block-faulted igneous material, its upper surface resembling the ocean floor. The plateau may have formed from blocks rifted away from the continent during the initial stages in the opening of the Indian Ocean. Crustal thickness in the saddle region of the plateau suggests that it is almost detached from the main continental mass.

Exmouth Plateau

This plateau is more complex than others on the west coast. Extensive Cretaceous and Tertiary sedimentary deposition was controlled by horst and graben structures in the central and southern area. A linear scarp at the southern margin follows the projected axis of the Proterozoic Bangemall Basin onshore. Jurassic formations may occur in this plateau in the wedge of unidentified strata near the southern scarp. They pinch-out northwards under Cretaceous to Recent subhorizontal cover. The saddle region is a northeast-trending sedimentary trough filled with Cretaceous and Tertiary deposits. The northern part of the plateau appears to be displaced about 100 km to the east by a zone of dextral faulting. The zone forms an east-west trough, partly filled with Tertiary sediments, which separates the northern region of massive sedimentary blocks from the southern region of finely faulted sedimentary blocks. The strata that form the fault blocks in the south may be correlated with Permian to Upper Triassic rocks in wells on the Rankin Platform, but those in the northern horsts are of unknown age. Oceanic basement ridges in the western and northern margins of the plateau extend into the Gascoyne and Argo Abyssal Plains.

The history of the plateau began with sedimentation in a marine or possibly a shelf environment during the Permian and Triassic. During subsequent rifting of the whole of the region the northern margin broke away in large blocks. Horsts were raised parallel to the Rankin Platform, and the southern margin rifted along a line of Precambrian origin. The Wallaby Plateau may have become detached from the continental mass, with associated volcanism, leaving in its place the Cuvier Abyssal Plain. Strong longshore currents during the Jurassic may have deposited the megaforeset beds along the southern margin over the Upper Triassic fault blocks. Subsequent Lower Cretaceous and Tertiary sedimentation extended over the whole of the plateau and continental shelf, and thicker Tertiary sediment accumulated in the saddle and the northern grabens.

Northwest slopes and Ashmore Terrace

Pre-Cretaceous horst and graben features underlie the northwest slopes. Their distribution caused minor damming of later sedimentation and resulted in a broad convex slope. The Ashmore Terrace was created by the damming effect of an upper slope horst which traverses the slope with a north-northeast trend.

Scott Plateau

A small region of horsts near the middle of the continental slope forms the Scott Plateau. To the north and south the level of the horst blocks is less marked and the slopes are controlled by the canyons which drain the Sahul and North West Shelf regions. The Ashmore-Sahul Block deflects drainage around the southern margin of the Scott Plateau via these canyons. Sedimentary thicknesses in the saddle are similar to those of Tertiary accumulations on the shelf. The surface form and increased magnetic activity of the plateau's western slopes suggest igneous formations of oceanic composition. Tertiary sediment accumulated in ponds and formed a mantle over this surface.

Timor Trough

There are several structural features of the Sahul Shelf which extend without disruption down into the southern slope of this trough. For example, both the axis and the southern, faulted margin of the Cartier Trough and the thickening of sedimentary formations at the Money Shoals Hinge are evident in the continental slope. In addition, all but the youngest Tertiary formations present on the shelf are also present down the slope. These circumstances indicate that the Sahul Shelf was not deformed until late Upper Tertiary, when collision between the shelf and the Outer Banda Arc produced the Timor Trough.

CONCLUSIONS

The present topographic form of the western and northwestern continental slopes is governed by the underlying fault blocks apparently created during the rifting and opening of the Indian Ocean in Mesozoic time. Four marginal plateaus display a variety of forms of rifting and faulting. The Naturaliste Plateau in the south was least faulted by the Indian Ocean opening; the age of its central mass is unknown but may be Precambrian. The Carnarvon Terrace was formed by a line of horst rocks parallel to the shelf break. The Wallaby Plateau is made up of pre-Cretaceous continental sedimentary blocks and oceanic basement. The Exmouth Plateau represents an extensive area of faulted Permian and Triassic rocks partly overlain by a pre-Cretaceous sedimentary wedge and a thin sedimentary cover of Cretaceous to Recent age. Predominantly northeast-striking faults are present in the Exmouth Plateau except in the northern region, where the structures strike east-west. A displaced western margin and an east-west trough indicate a dextral fault zone near the north of the Plateau. Maximum Mesozoic and Tertiary accumulations occur in the northeast-trending saddle and the east-west trough near the Plateau's northern margin. The Scott Plateau is formed by horst blocks in a small region half way down the continental slope. Similarly, Ashmore Terrace is formed by a much larger series of horst blocks near the top of the slope. Features common to the Sahul Shelf and the Timor Trough indicate late Upper Tertiary development of the Trough by overthrusting of the Outer Banda Arc.

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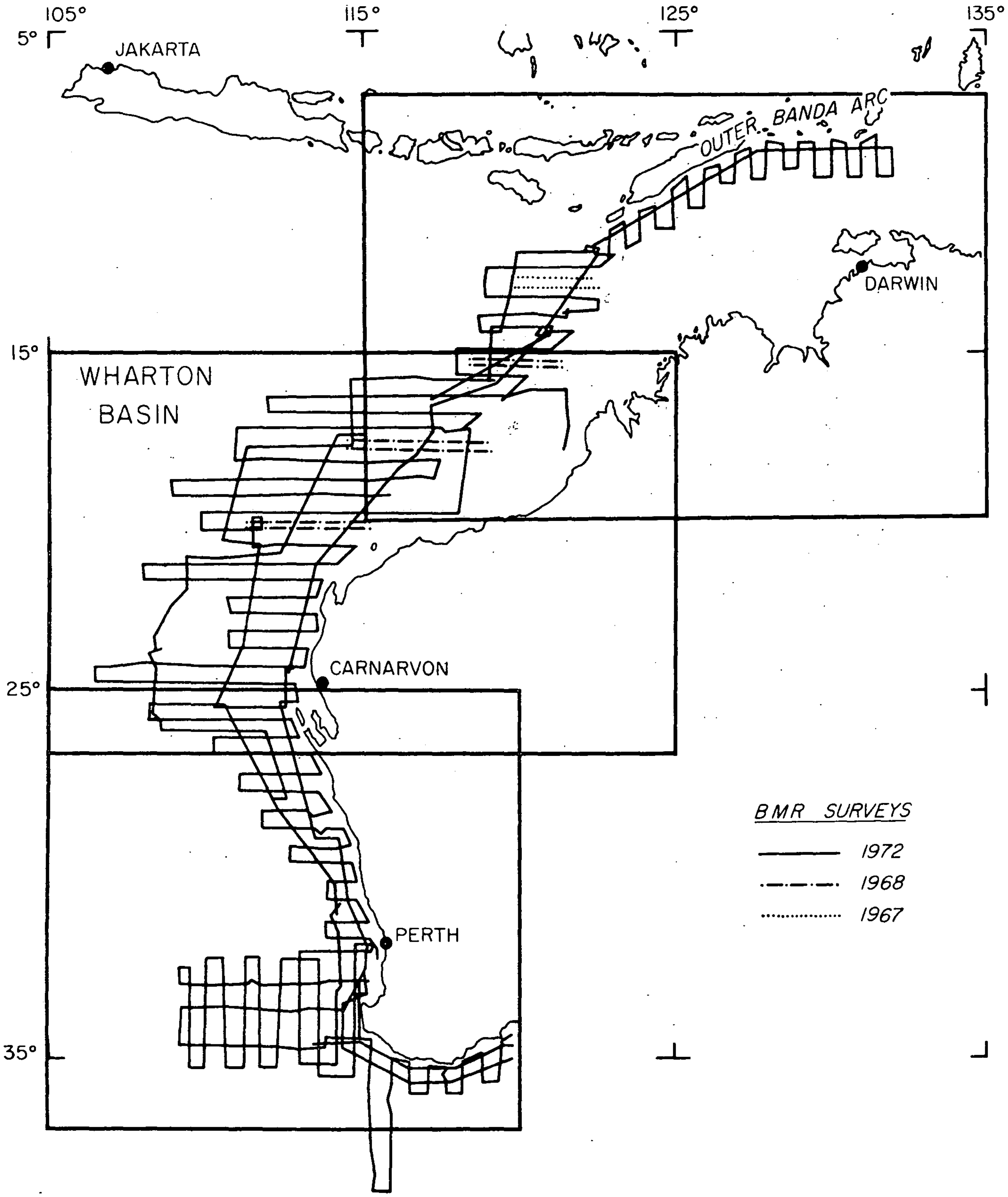


Fig. 1 LOCALITY MAP AND BMR TRAVERSES

To accompany Record No. 1974/64

A/B8-48A

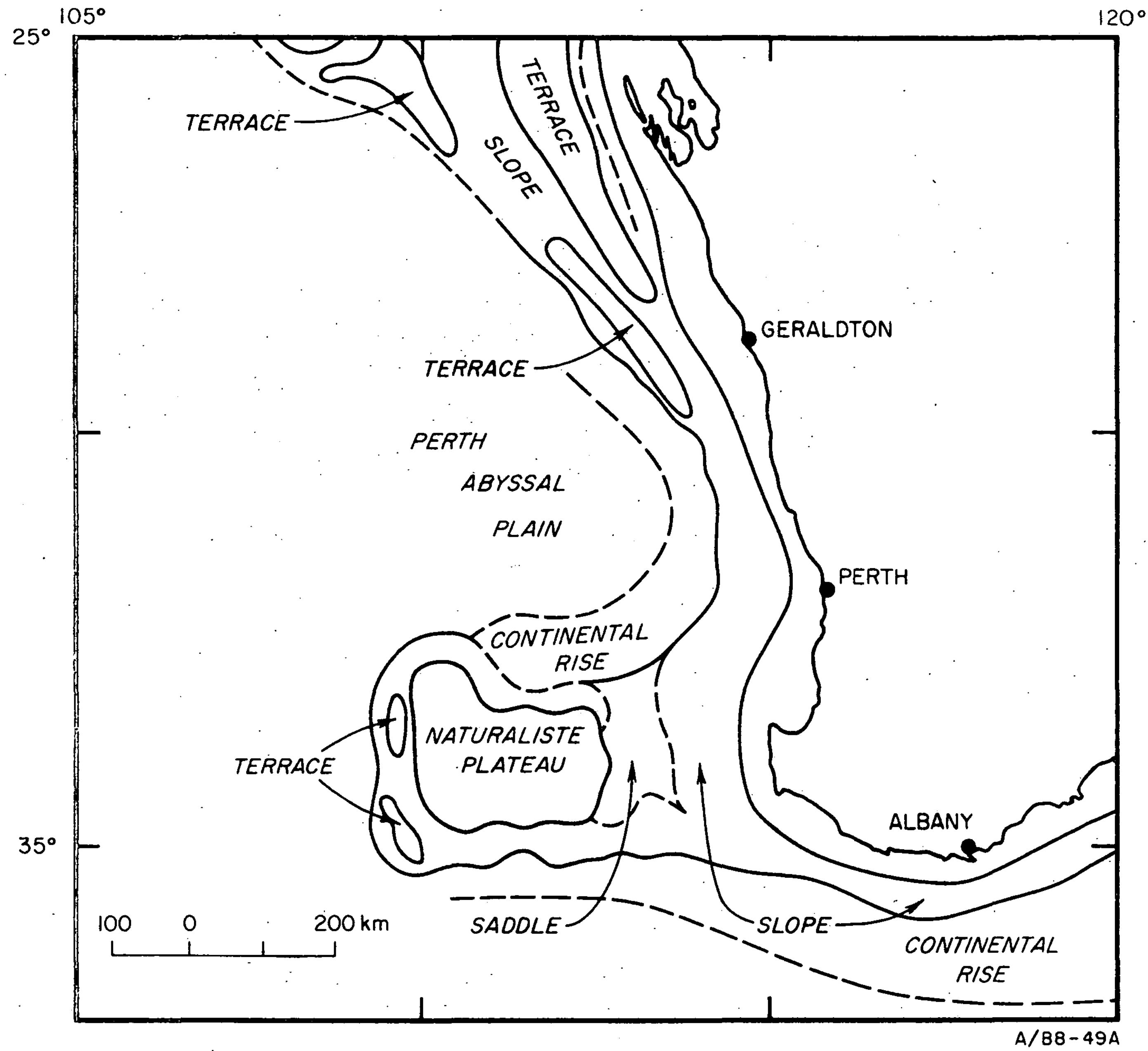


Fig. 2 SOUTHWEST MARGIN, TOPOGRAPHIC FEATURES

To accompany Record No. 1974/64

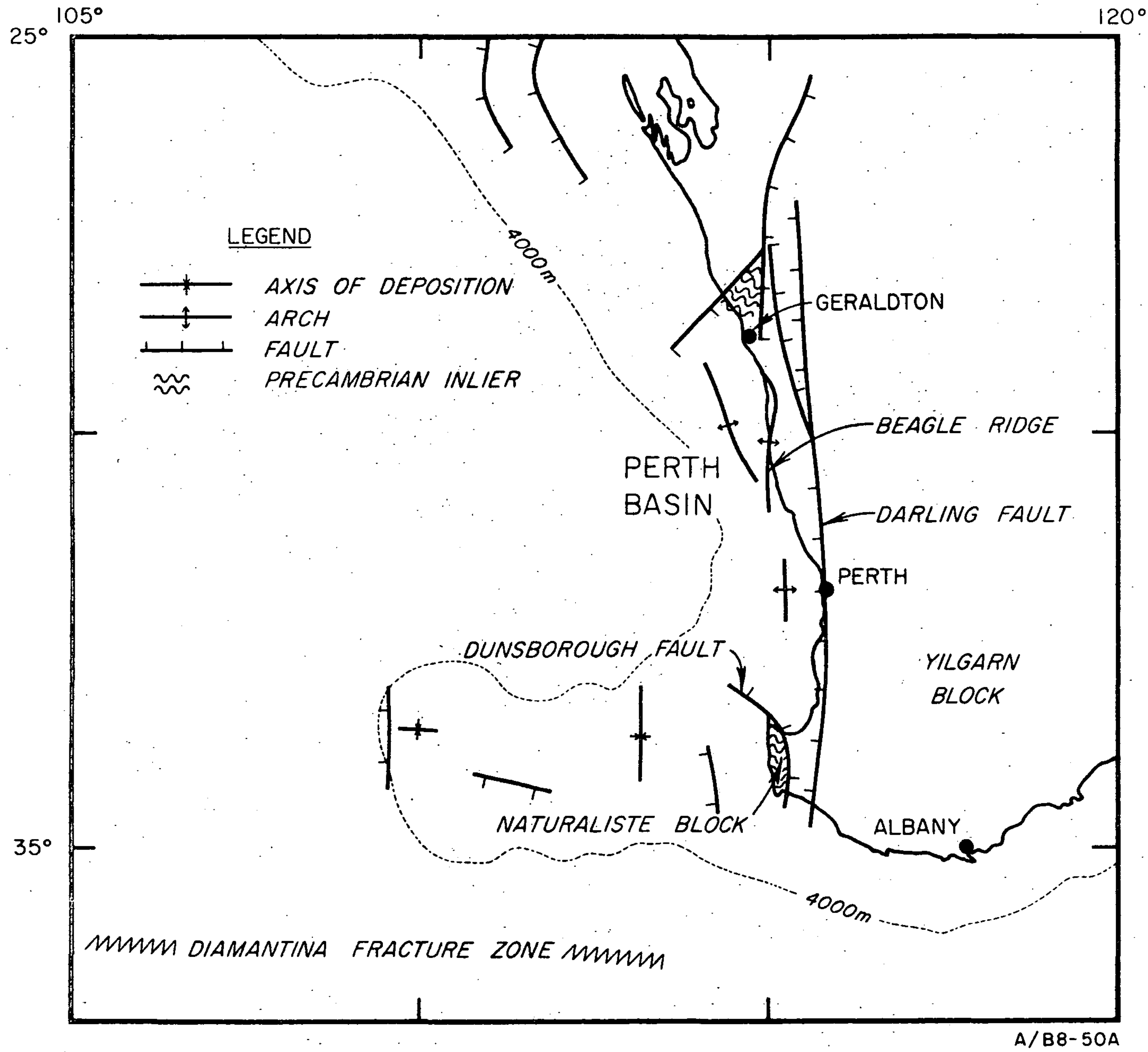


Fig. 3 SOUTHWEST MARGIN, GEOLOGICAL STRUCTURES

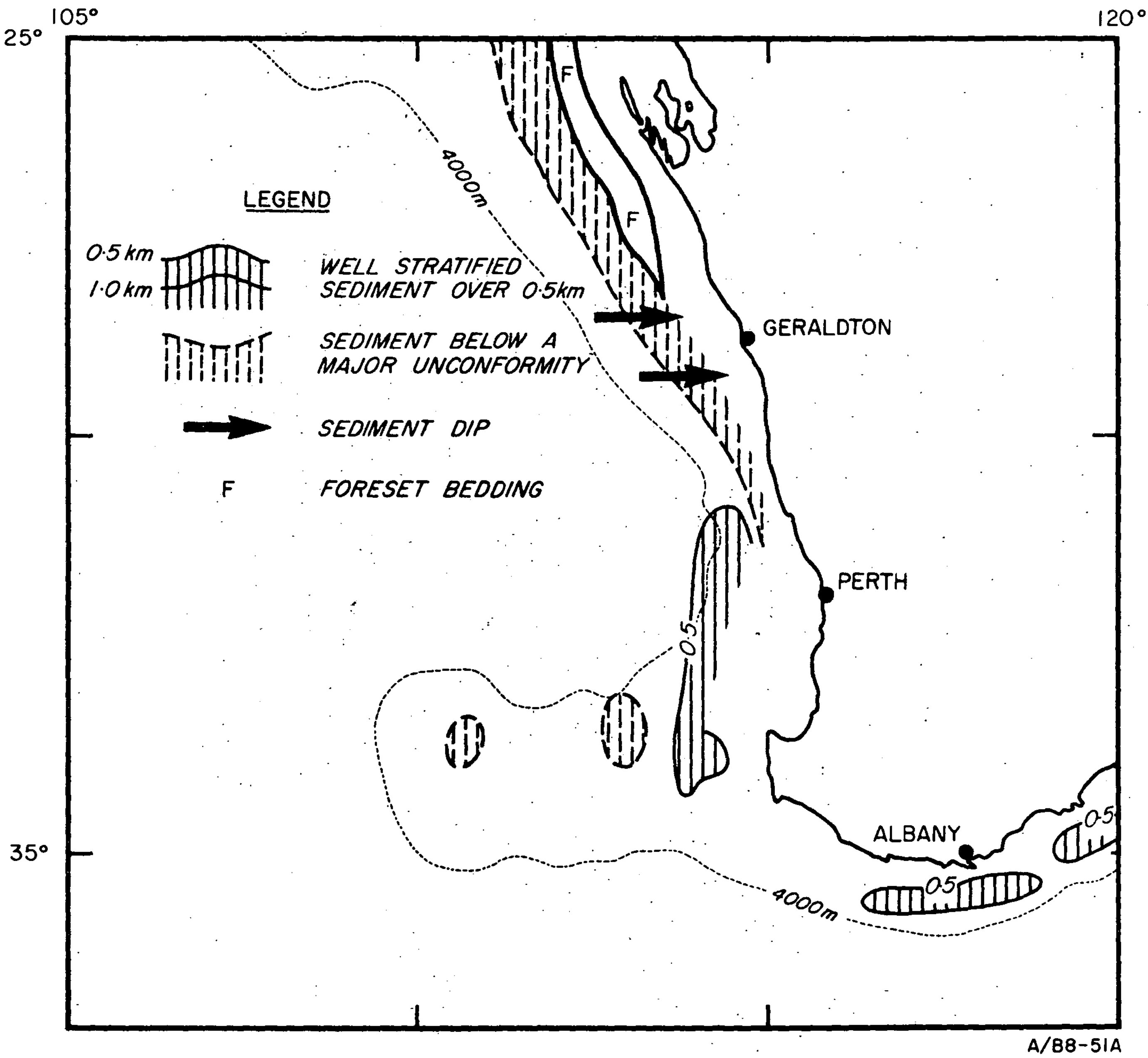


Fig. 4 SOUTHWEST MARGIN, SEDIMENTARY TYPES

To accompany Record No. 1974/64

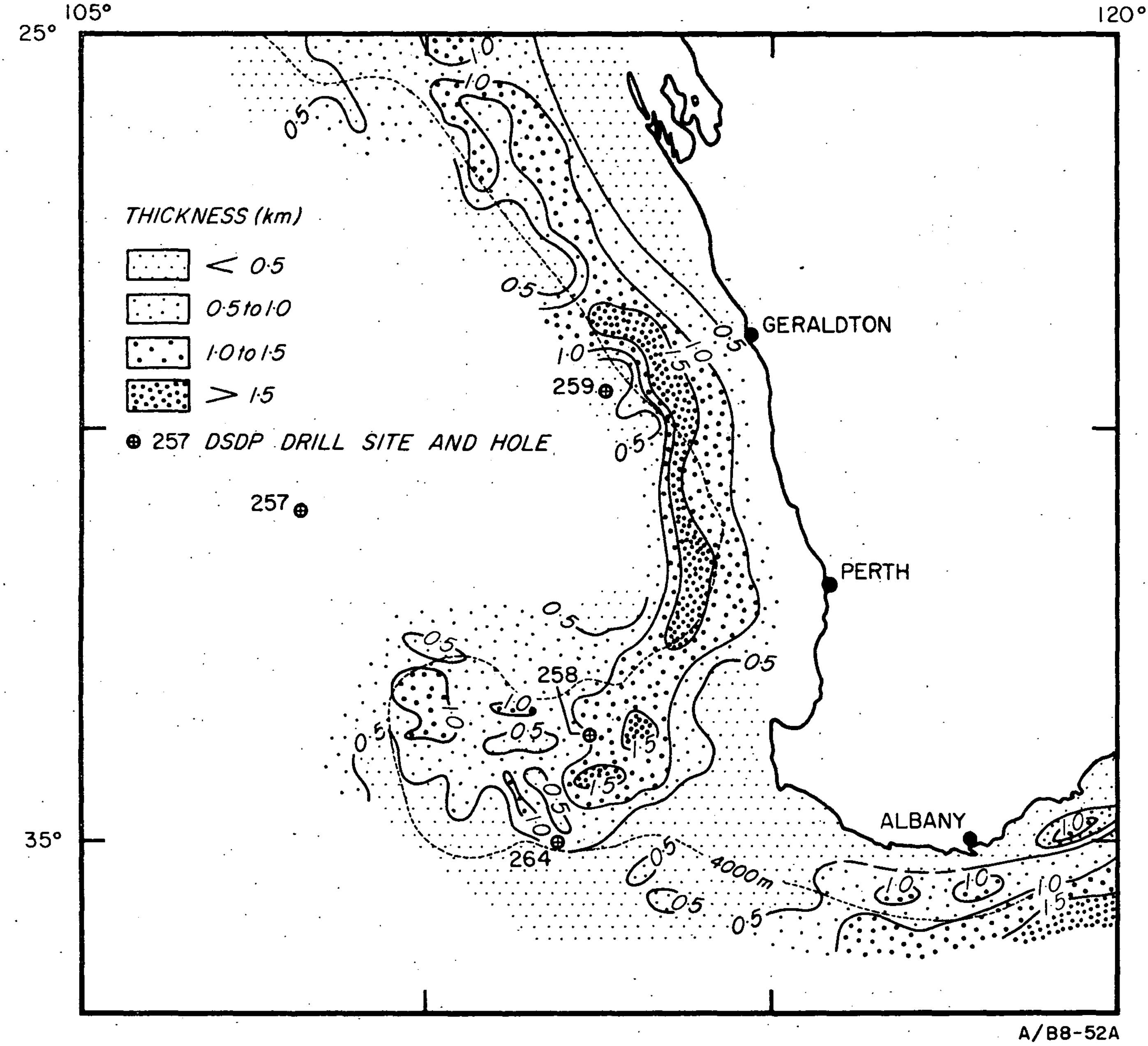


Fig. 5 SOUTHWEST MARGIN, SEDIMENTARY THICKNESS AND DSDP SITES

To accompany Record No. 1974/64

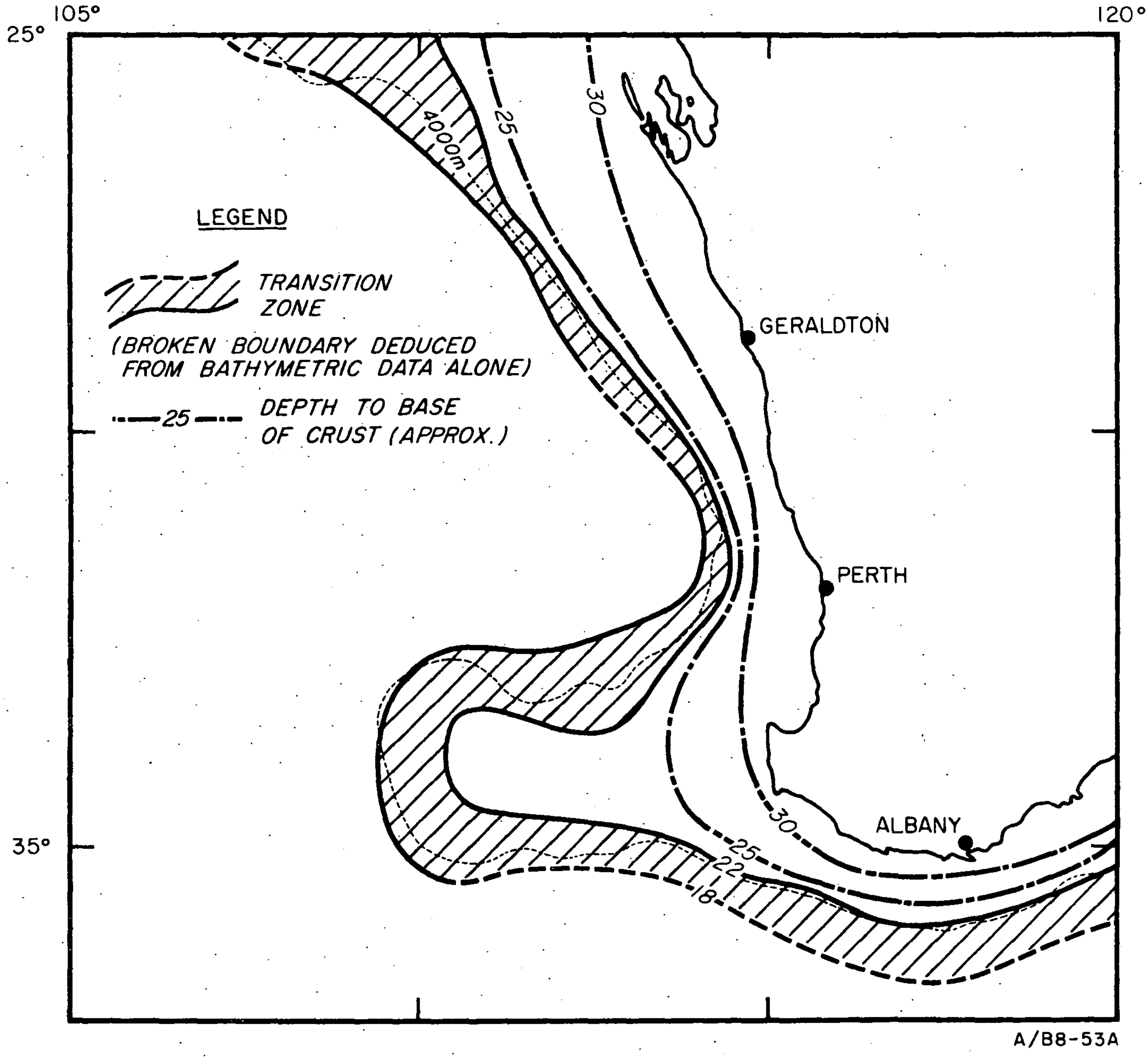
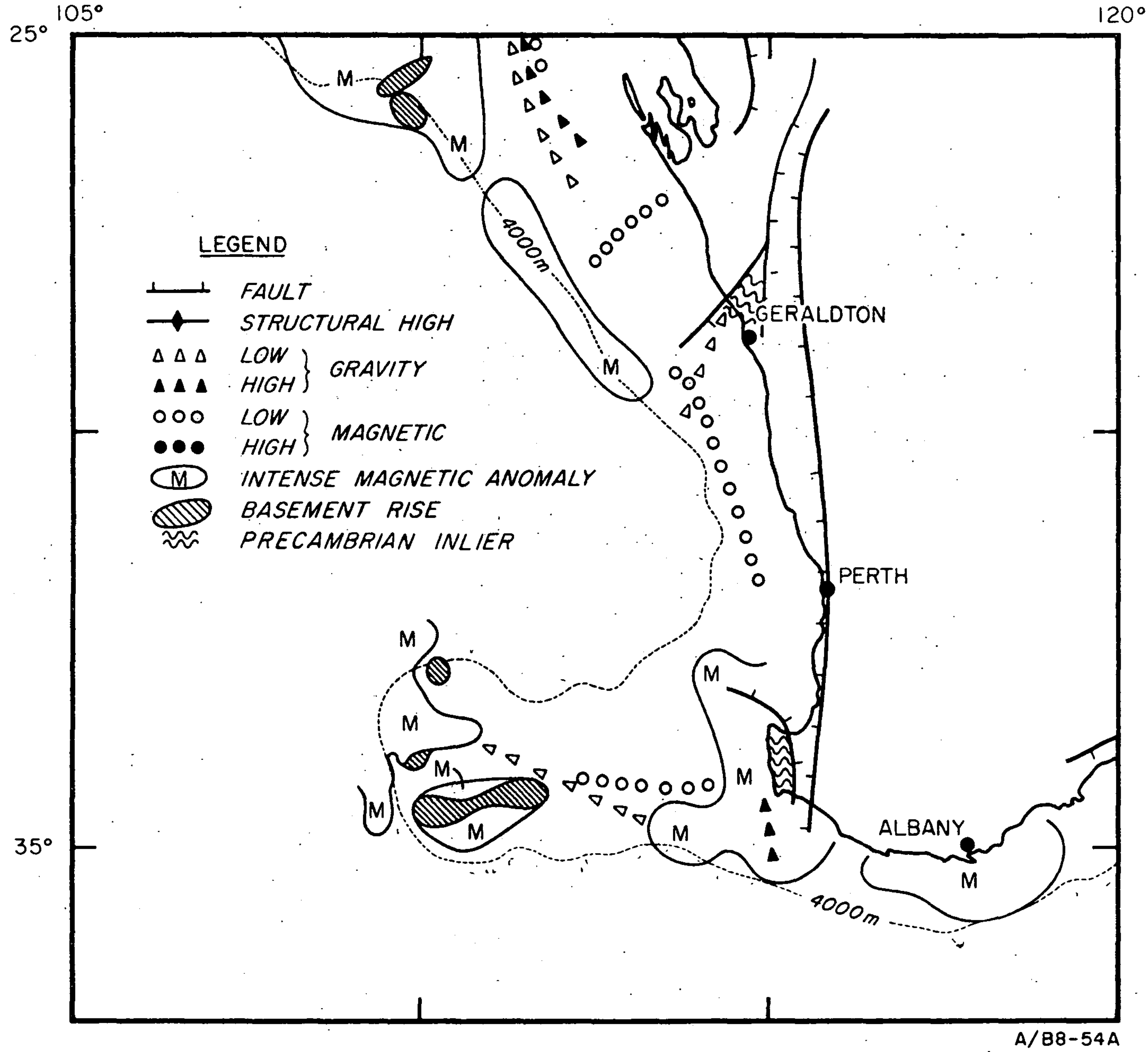


Fig. 6 SOUTHWEST MARGIN, DEPTH TO BASE OF CRUST

To accompany Record No. 1974/64



SOUTHWEST MARGIN,
Fig. 7 GEOPHYSICAL FEATURES AND TRENDS

To accompany Record No. 1974/64

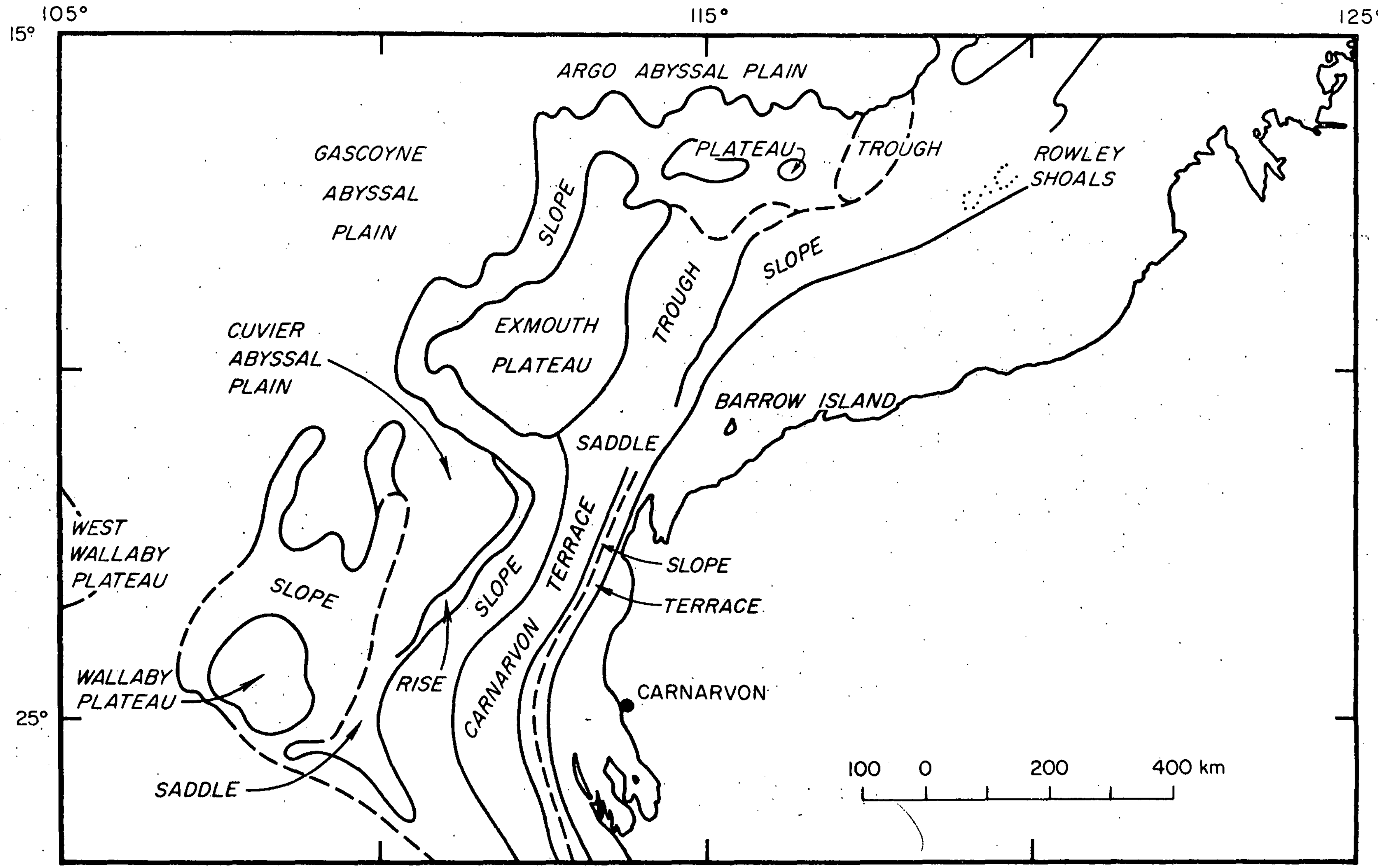


Fig. 8 WESTERN MARGIN, TOPOGRAPHIC FEATURES

A/B8-55A

To accompany Record No. 1974/64

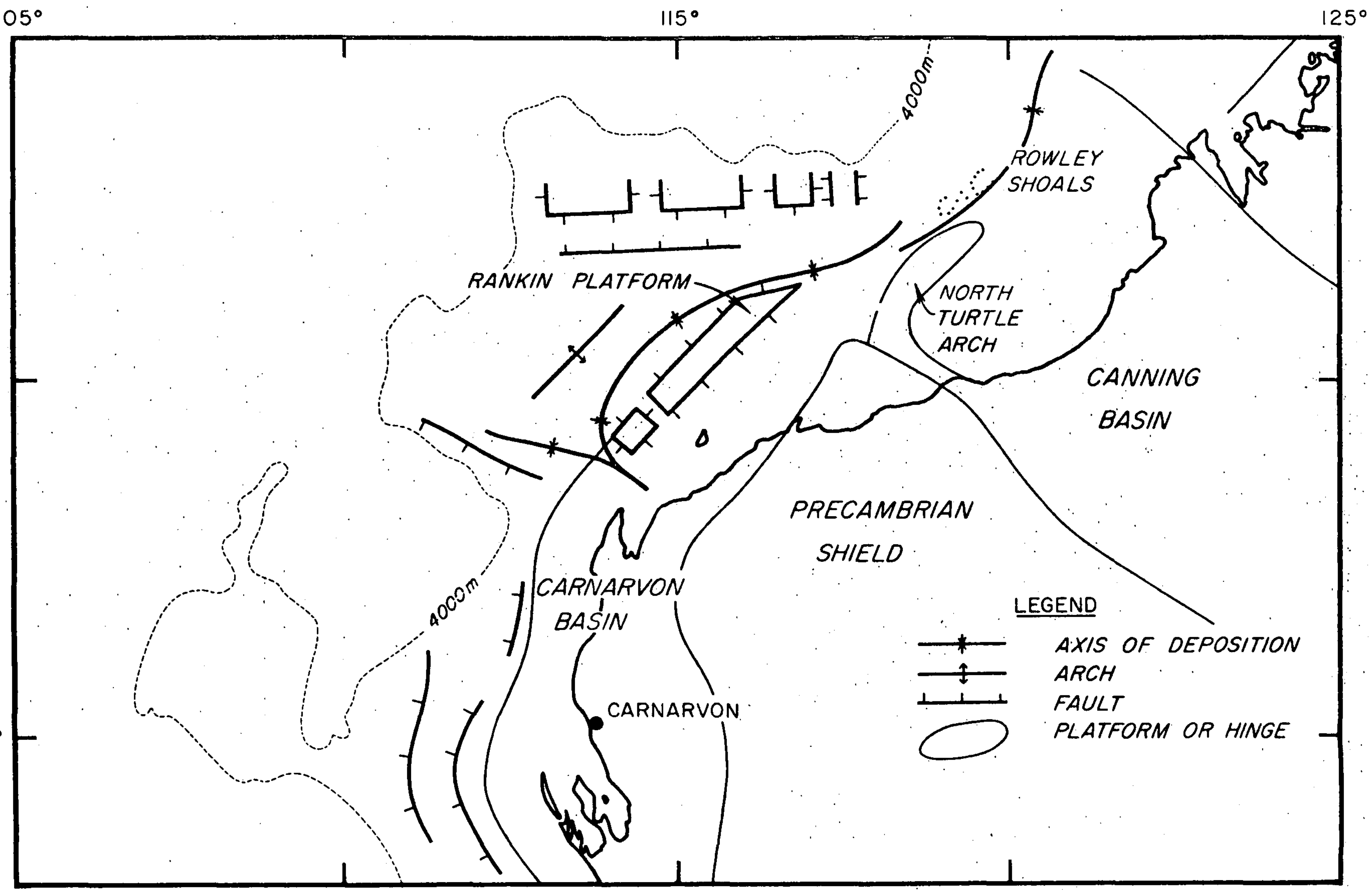


Fig. 9 WESTERN MARGIN, GEOPHYSICAL STRUCTURES

To accompany Record No. 1974/64

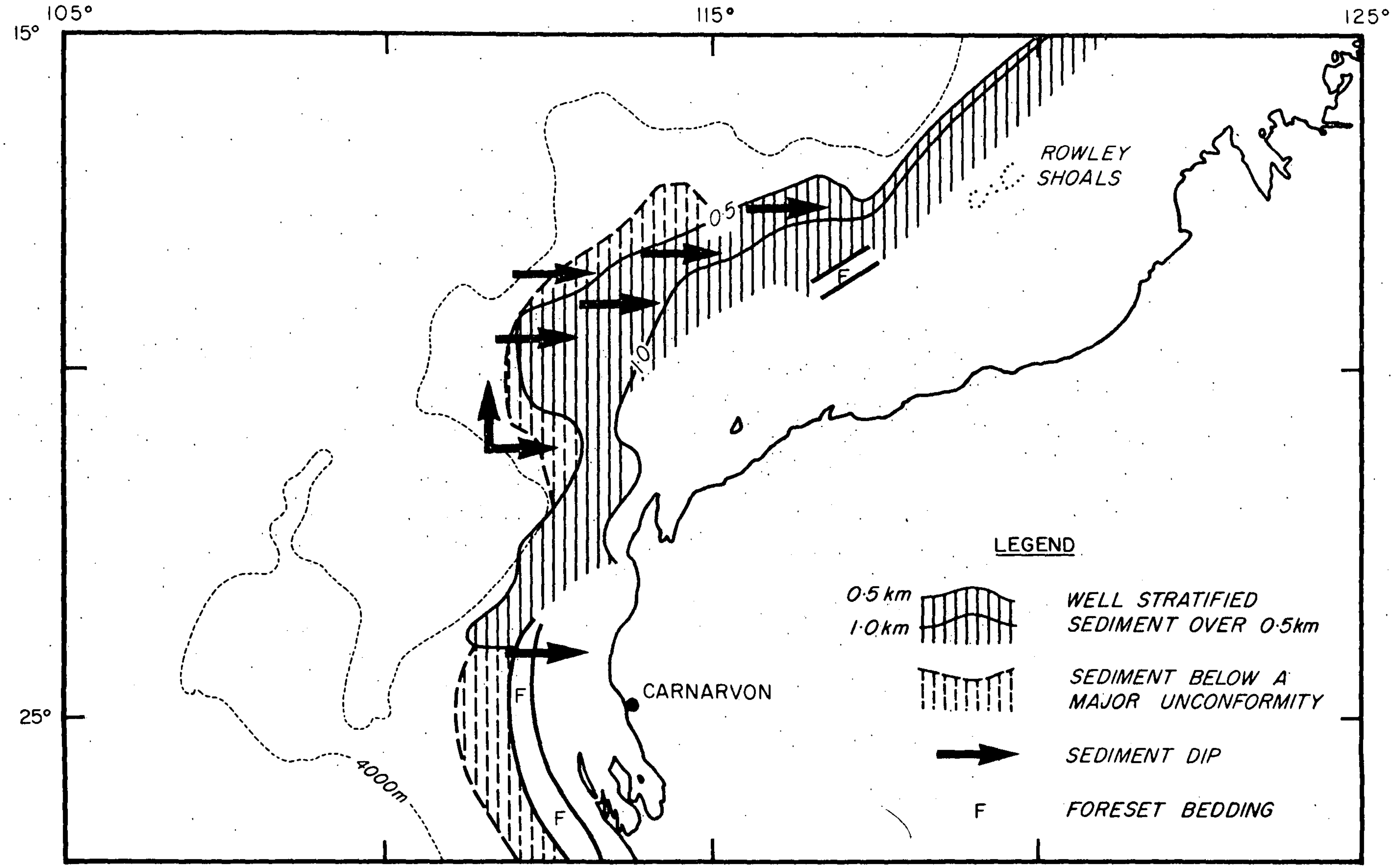


Fig. 10 WESTERN MARGIN, SEDIMENTARY TYPES

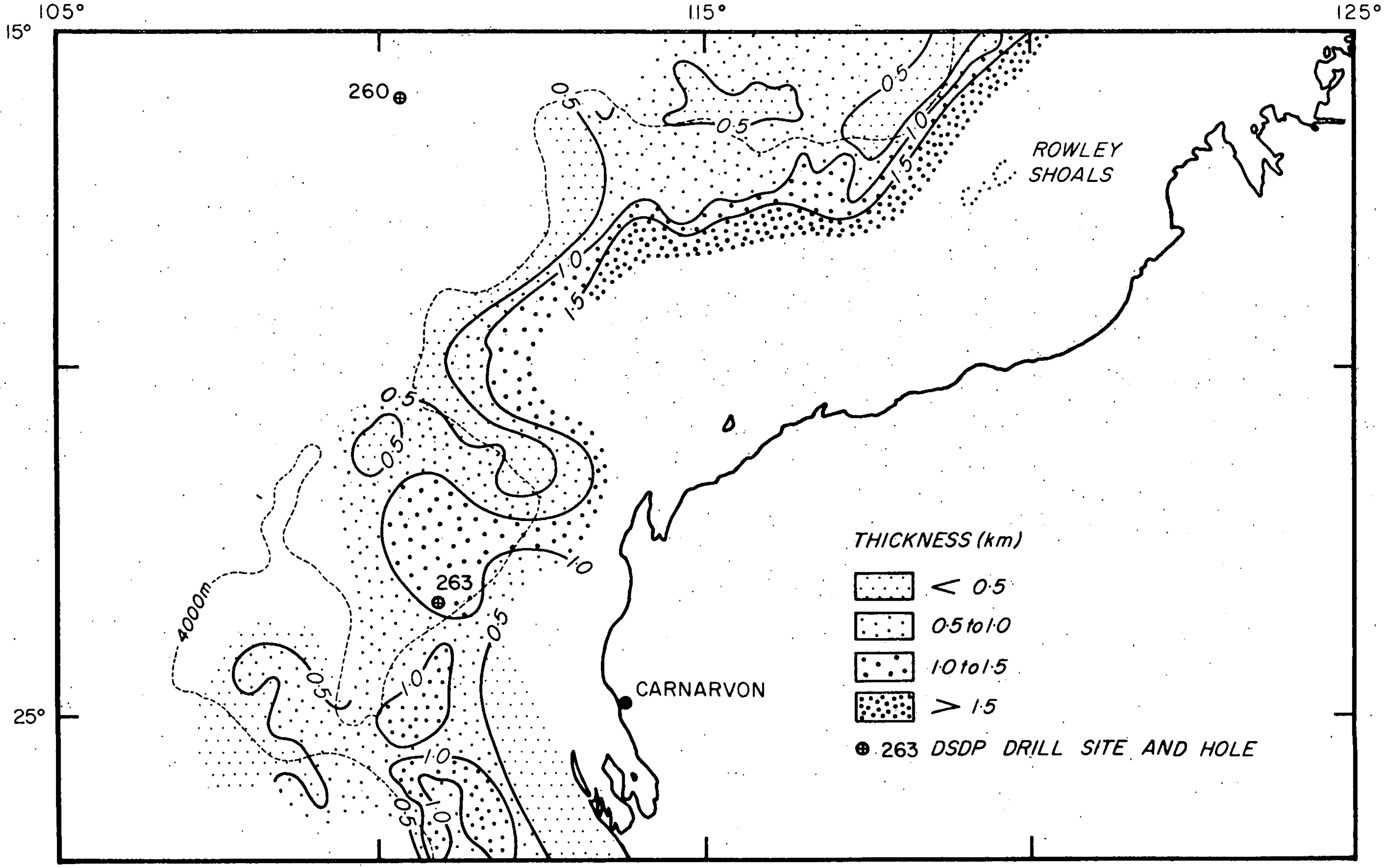


Fig. II WESTERN MARGIN, SEDIMENTARY THICKNESS AND DSDP SITES

To accompany Record No. 1974/64

To accompany Record No. 1974/64

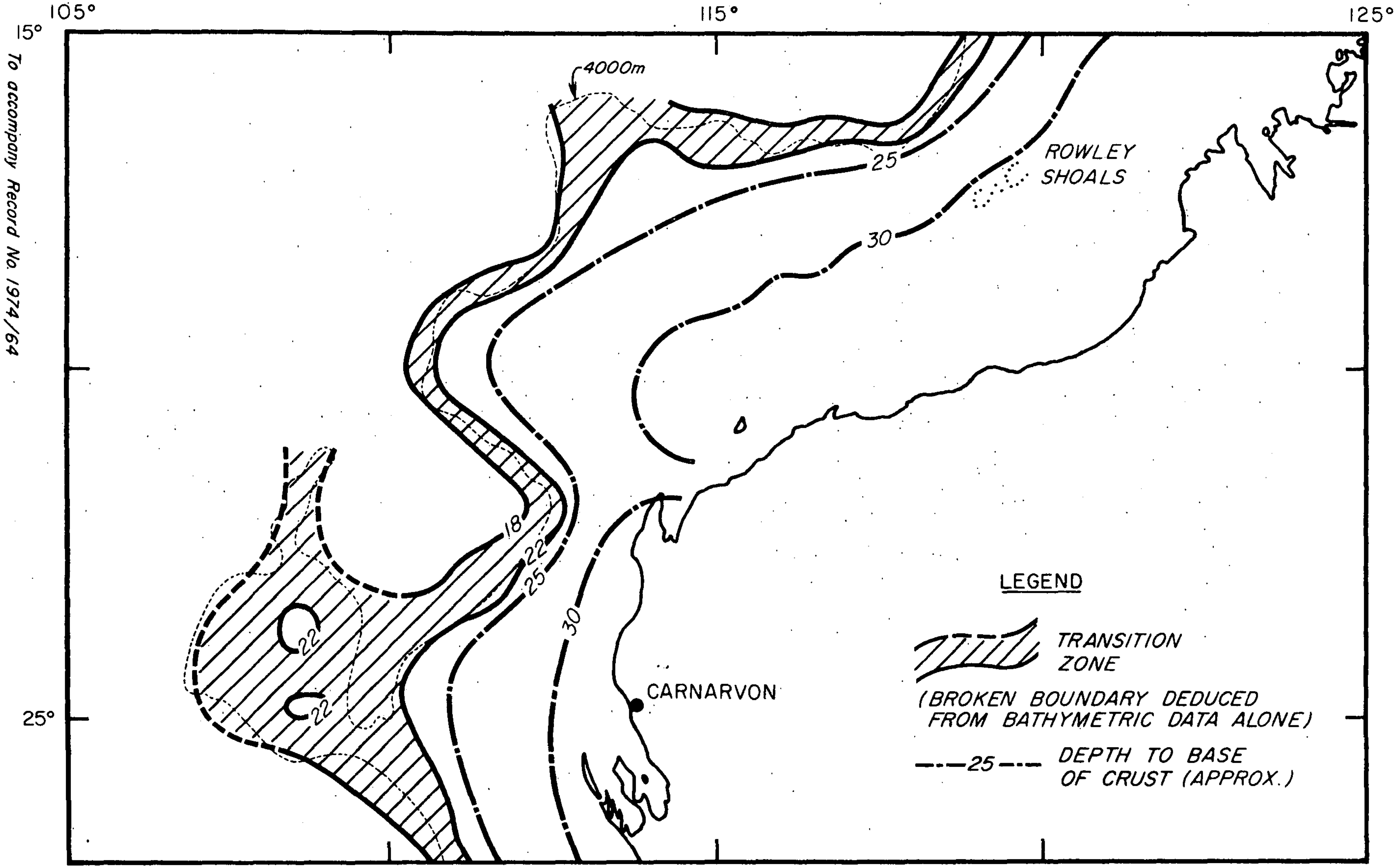


Fig. 12 WESTERN MARGIN, DEPTH TO BASE OF CRUST

A/B8-59A

To accompany Record No. 1974/64

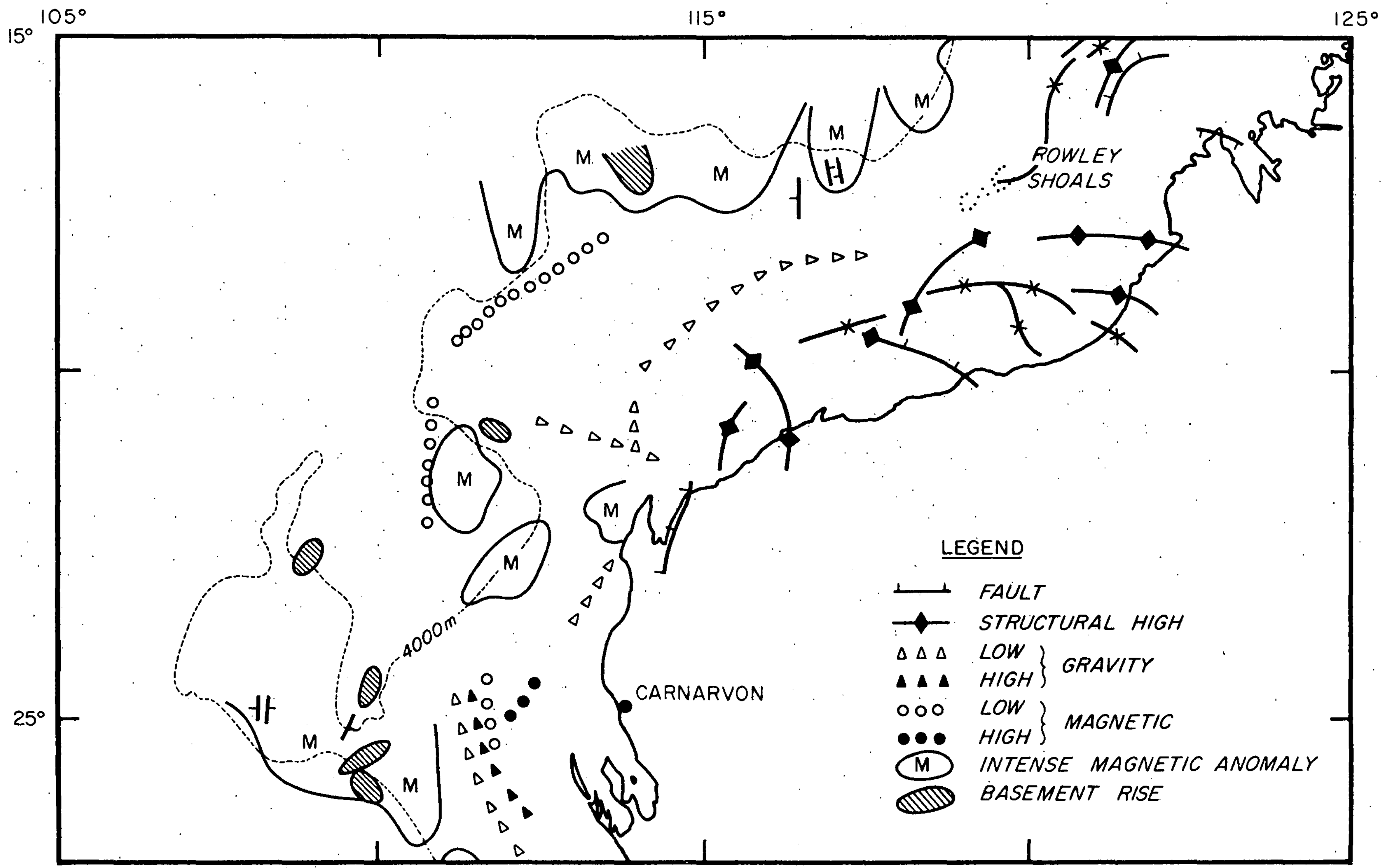


Fig. 13 WESTERN MARGIN, GEOPHYSICAL FEATURES AND TRENDS

To accompany Record No. 1974/64

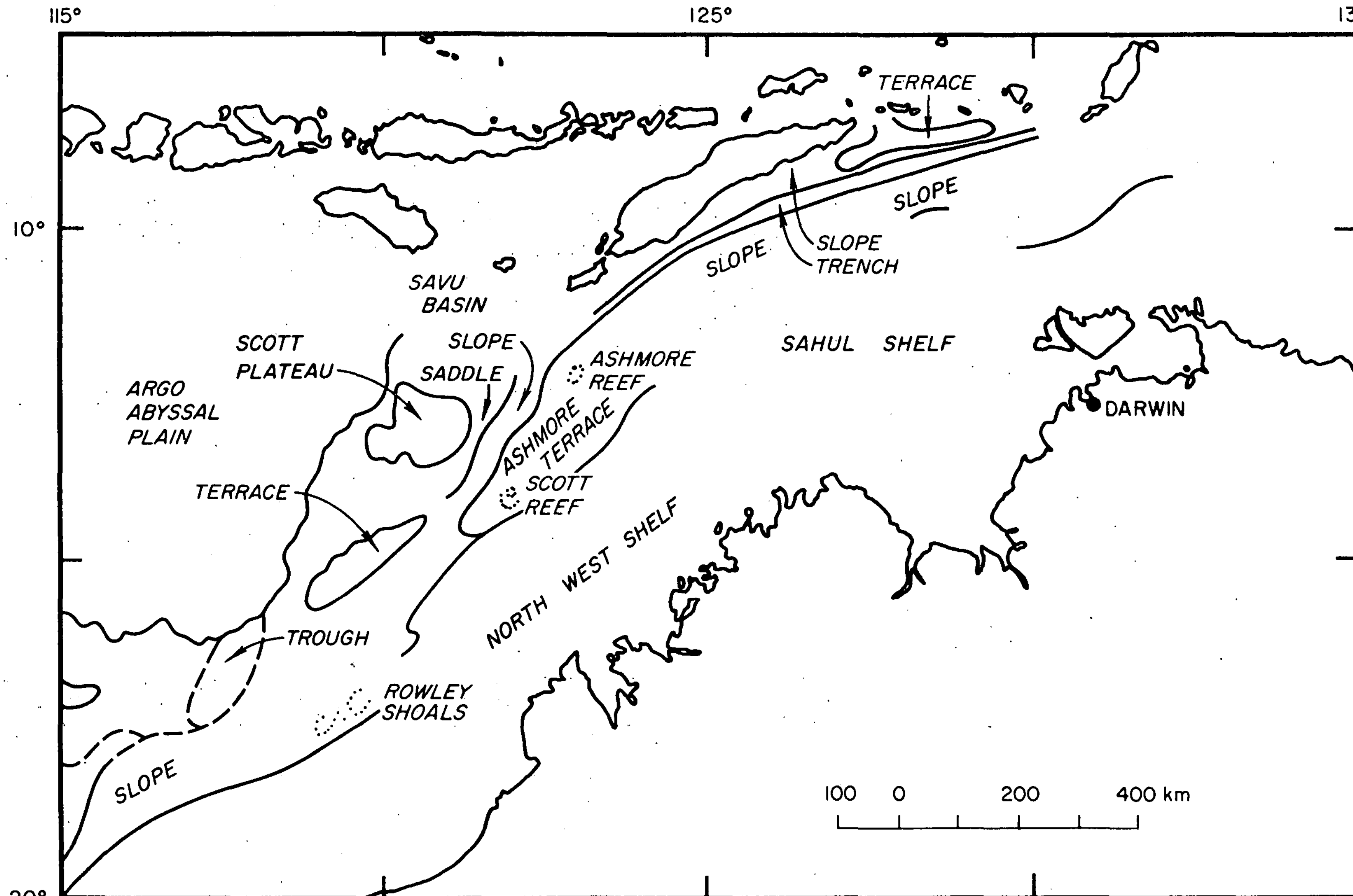


Fig. 14 NORTHWEST MARGIN , TOPOGRAPHIC FEATURES

To accompany Record No. 1974/64

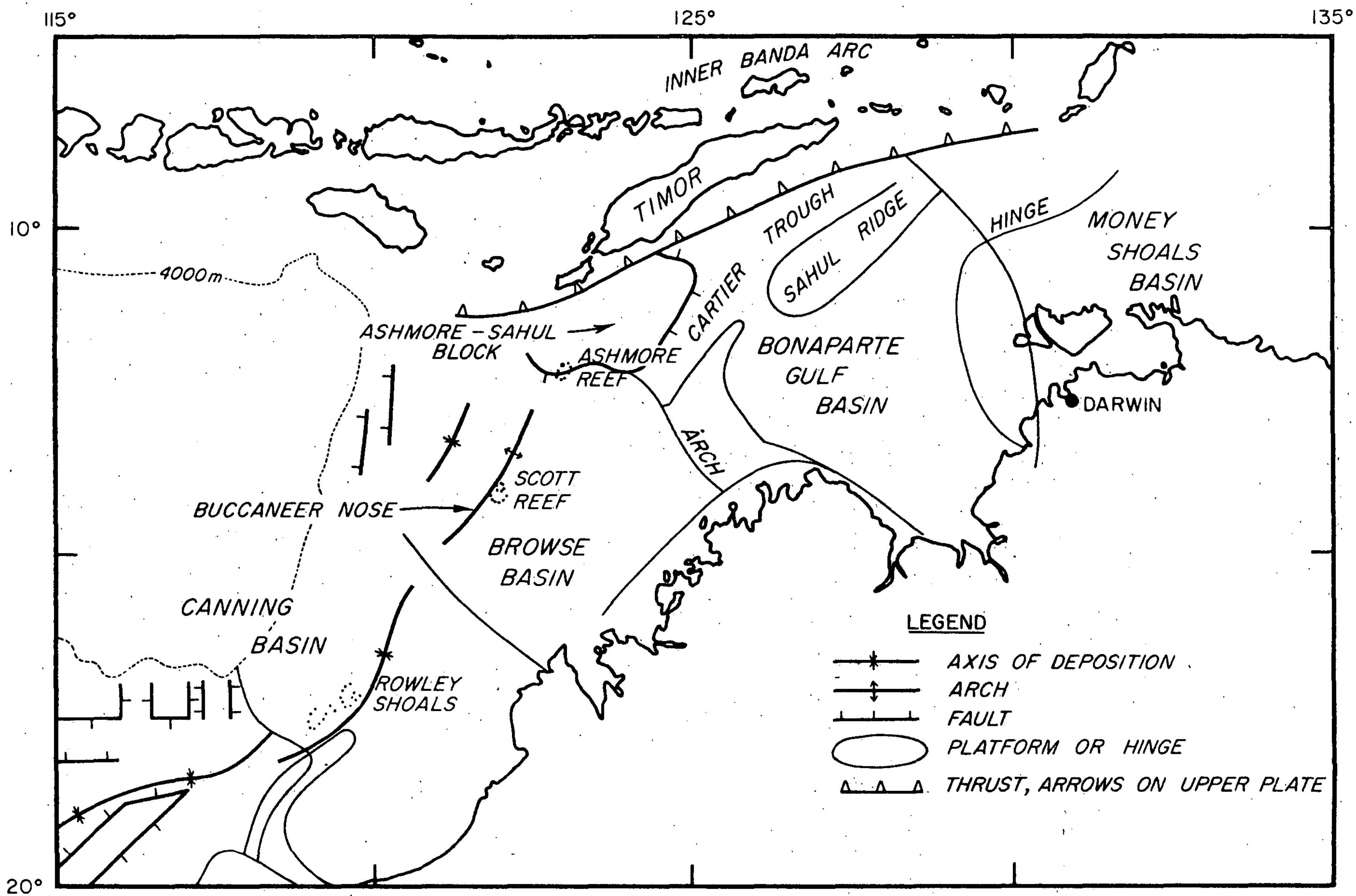


Fig. 15 NORTHWEST MARGIN, GEOPHYSICAL STRUCTURES

A/B8-62A

To accompany Record No. 1974/64

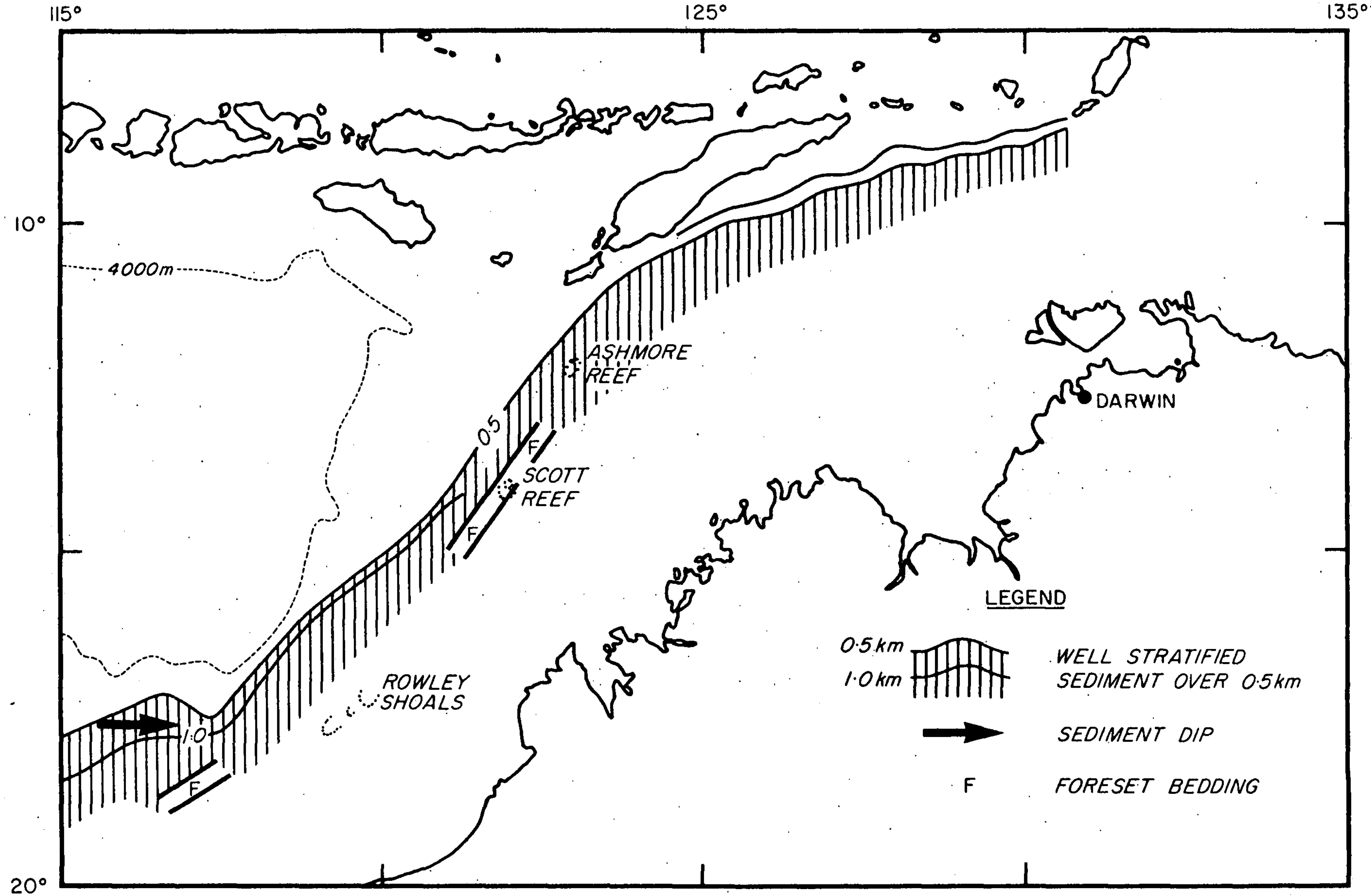


Fig. 16 NORTHWEST MARGIN, SEDIMENTARY TYPES

A/B8-63A

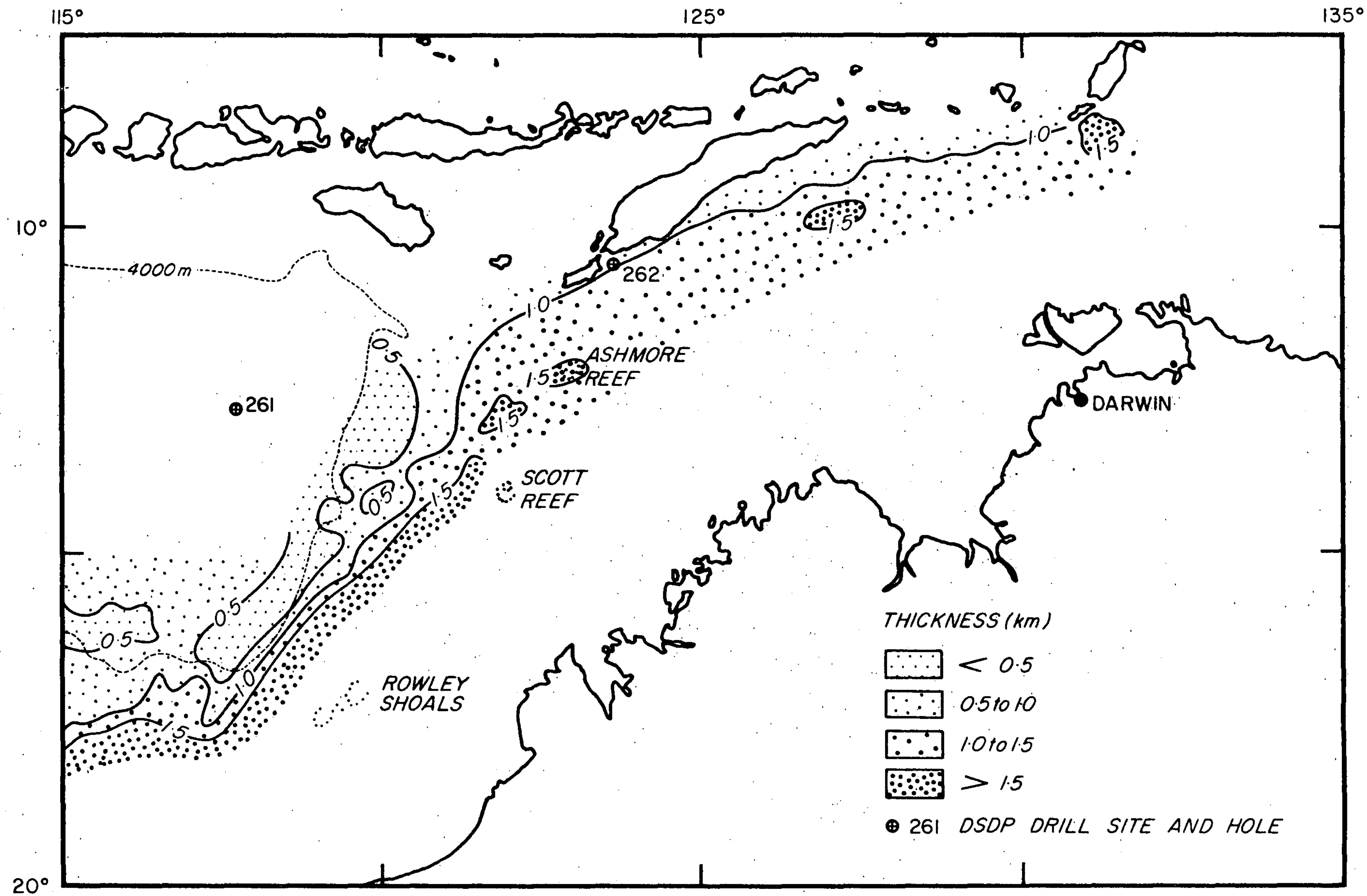


Fig. 17 NORTHWEST MARGIN, SEDIMENTARY THICKNESS AND DSDP SITES

To accompany Record No. 1974/64

A/B8-64A

To accompany Record No. 1974/64

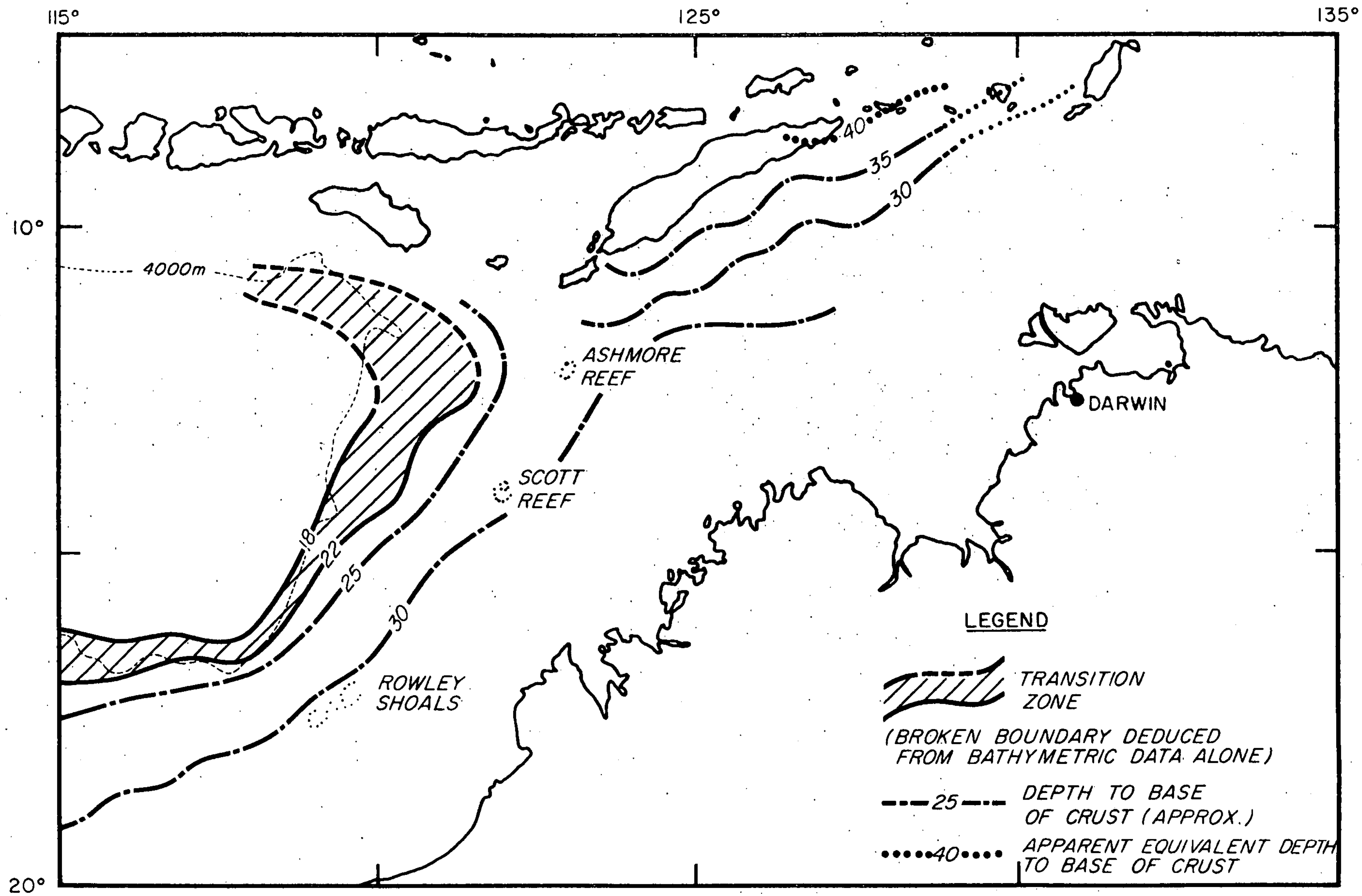


Fig. 18 WESTERN MARGIN, DEPTH TO BASE OF CRUST

A/B8-65A

To accompany Record No. 1974/64

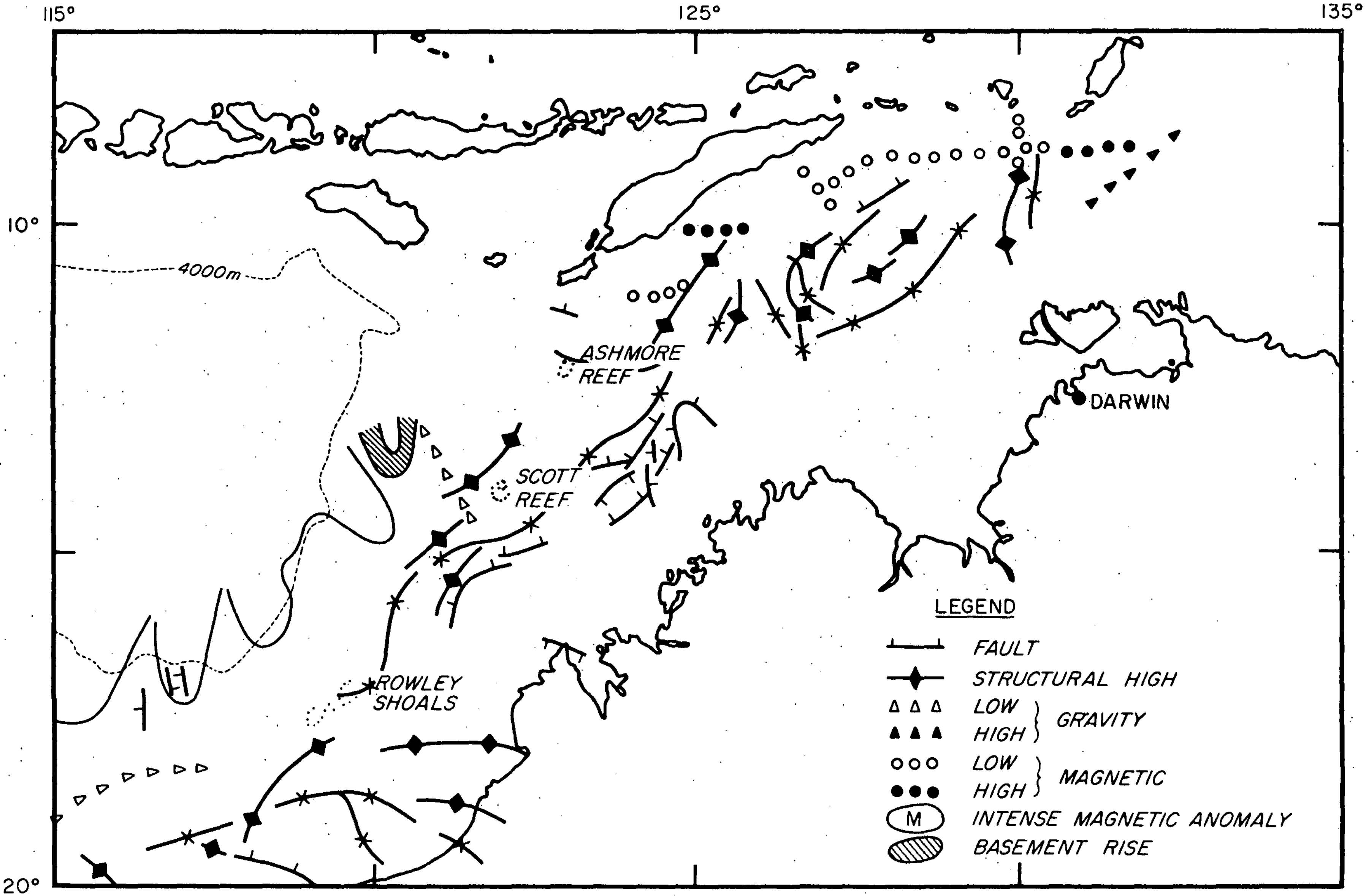


Fig. 19 NORTHWEST MARGIN, GEOPHYSICAL FEATURES AND TRENDS

A/B8-66A