AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Record Number

1992/94

Marine Geoscience and Petroleum Geology Program

DEEP STRUCTURE OF THE EAST MALITA GRABEN REGION - WESTERN ARAFURA AND NORTHERN TIMOR SEAS

CRUISE PROPOSAL

Project 121.39

C J Pigram

AGSO

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DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

Minister for Resources: The Hon. Alan Griffiths
Secretary: Geoff Miller

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION
(formerly BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS)

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EXECUTIVE SUMMARY

The East Malita cruise is part of a program designed to determine the structural architecture of the northwestern margin of Australia and the influence of structuring on the location of, migration and trapping of hydrocarbons in the region. The major objectives of the East Malita Graben project are:

1) determine the regional structural framework of the eastern Timor Sea region by examining the boundaries between the major structural elements along a series of transects;
2) provide modern regional seismic tie lines through the wells in the region to facilitate province wide correlations;
3) determine the deep crustal structure of the Malita and Calder Grabens;
4) examine the effects of the deep crustal structure and its reactivation on the location of the known petroleum accumulations.

To examine these problems it is proposed that the R V *Rig Seismic* be used to collect a total of approximately 3000 km of deep crustal multichannel seismic and other geophysical data along 17 lines in the East Malita Graben region. The proposed lines tie all 8 wells in the region plus Tuatara-1 and Kulka -1 to the east. The lines are designed to examine the major structural relationships in the region. Where possible the lines are orthogonal to the principal trends in the region. Some strike lines are included to create regional ties between wells.

Lines 1 - 6 These lines are oriented perpendicular to the axis of the Malita Graben. They extend from the Sahul Platform across the Malita Graben and onto the Bathurst Terrace of the Darwin Platform. They are designed to examine the deep structure of each of the elements and to image the deeper parts of the Malita Graben. Line 5 ties Evans Shoals-1 to Beluga -1.

Line 7 - 8 These lines are oriented ESE-WNW and extend from the Malita Graben to the east across the Lynedoch Bank Fault System and onto the Money Shoals Platform. Along with Line 5, they are designed to examine the nature of the Lynedoch Bank Fault system.

Line 9 This line is located along the axis of the Calder Graben.

Line 10 A strike line across the Sahul Platform and the northern end of the Calder Graben. Will also examine the Lynedoch Bank Fault system and western end of the Goulburn Graben. This line ties lines 2-4, 8 and 11-13 on the Sahul Platform.

Lines 11-13 North - south lines designed to examine the northern edge of the Sahul platform and the change in bathymetric trend in the Timor Trough in this region as well as the Malita Graben.

Line 14 Tie Line from Tuatara to Kulka -1 in the Goulburn Graben.

Line 15 A tie line between Evans Shoals - 1 and Tuatara -1. Also crosses Lynedoch Bank Fault.

Line 16 Strike line along the axis of the Malita Graben. Ties 1-5 and 13.

The program suggested here will occupy a 30 day cruise with contingency for bad weather and system maintenance.

INTRODUCTION

The Marine Geoscience and Petroleum Geology Program (MGPG) began a program of deep seismic acquisition (up to 16 sec records) along the northwestern margin of Australia in 1990 with a view to having a complete regional data set that covered the region from North West Cape to the western Arafura Sea by 1993/94. This portion of the margin was seen to be the most prospective region outside of the Bass Strait Basins and the likely source of Australia's future hydrocarbon supplies. Portions of this margin have been explored in detail since the 1960's but there has little recent analysis of the regional structural framework using either modern extensional tectonic concepts for the formation of the margin (eg Lister et al., 1991) or modern collisional tectonic concepts (eg Beaumont, 1980; Allen and Homewood, 1986) for the deformation of parts of this margin.

The MG&PG program on the northwest margin of Australia is designed to establish the gross architecture of the margin by imaging the margin forming structures and examining their reactivation histories through time. This information will be critical in developing new exploration strategies, and will assist future basin framework and resource studies of the region.

To address the margin structural framework problems of this region the following cruises have been undertaken or are planned:

1) Vulcan Graben - 1900 km of deep seismic data - acquisition completed December 1990 (O'Brien and Williamson, 1990).

2) Bonaparte Basin (Petrel Sub-basin) - 2200 km of deep seismic data - acquisition completed May 1991 (Willcox & Ramsay, 1991).

3) North Carnarvon Basin I - 1654 km of km of deep seismic data - acquisition completed June 1991 (Stagg & others, 1991)

4) North Carnarvon Basin II - 2868 km of deep seismic data - acquisition completed July 1992 (Stagg 1992)

5) Malita Graben - 3000 km proposed - acquisition during early 1993 (this proposal)

6) Browse Basin - 2500 km proposed - acquisition during mid 1993

7) Scott Plateau- Roti Basin - 2500 km proposed - acquisition during mid 1993

8) Offshore Canning - 2500 km proposed - acquisition during late 1994

In addition there is a proposal by Nopec Australia Pty. Ltd. to collect approximately 3000 km of deep crustal seismic in and around the Joint Development Zone during early 1993.
On completion of this program of data acquisition there will be a network of over 20 000 km of deep crustal seismic data (including the Nopec data) that links all the major structural elements of the northwestern margin.
The Malita Graben cruise is the most northerly of the cruises in this schedule and will gather data from the north eastern Timor Sea and western Arafura Sea region. The cruise will cover the region to the east of the Joint Development Zone to approximately 131°E with a tie line extending further east to either Tuatara 1 or Kulka -1 in the Goulburn Graben (Fig. 1).

EXPLORATION HISTORY

Exploration began in the East Malita Graben region during the 1960's when Shell collected an region seismic data and aeromagnetics in the eastern part of the region and Woodside and Arco lead consortia collected regional seismic data in the western part. Woodside and Arco collected over 9000 km of regional data from 1969 to 1974. This led to the drilling of several wells. In 1971 Arco drilled Heron - 1 on the northern flank of the Malita Graben. The well had gas shows at several levels but was not tested. In 1973, Shell drilled Lynedoch - 1 also on the northern flank of the graben. It was plugged and abandoned after recording gas shows. Arco drilled a dry hole at Shearwater - 1 in 1974 and a Woodside lead consortium made gas and condensate discoveries at Sunrise - 1 and Troubadour - 1 located on the Sahul Platform. These hydrocarbons are reservoired in the Middle Jurassic Plover Formation. During the mid 1980's Western Mining Corporation (WMC) collected 2500 km of seismic data (Durrant and Young 1988) leading to the drilling of Evans Shoals - 1 by BHP Petroleum (BHPP) in 1988. Evans Shoals discovered gas in Mesozoic sands. During the late 1980's, BHPP collected regional aeromagnetics and seismic data in permit NT/P41 and further east. In 1990 they drilled Tuatara -1 in the western part of the area and Beluga-1 on the southern flank of the graben in 1991. Beluga had gas shows but Tuatara was dry.

Other Deep Crustal Surveys - BIRPS.

In early 1992, the British Institutions Reflection Profiling Syndicate (BIRPS) in conjunction with Marine Geoscience Institute of Indonesia (MGI) conducted a deep crustal survey (+20 sec records) across the Banda Arc to the east of Timor (Fig. 2). These lines finished on the outer shelf just within Australian waters and it is our intention to continue the lines across the shelf to give a complete margin transect.

REGIONAL STRUCTURE

The East Malita region lies within that part of the northwestern margin of Australia that now forms the foreland to the Timor collision zone. It is bound on its northern side by the Timor Trough (Fig. 1). The Timor Trough generally trends northeasterly adjacent to Timor, but changes to an ENE trend at the eastern end of Timor adjacent to the Sunrise - Troubadour region. This change in trend is clear in the 200 m bathymetric contour (Fig. 1). The southern edge of the trough again swings around to a NE trend at about 130° 20'E. These marked changes in trend suggest an underlying structural control inherited from the structuring associated with the formation of the margin.

The East Malita Graben region is regarded as the northeasterly part of the Bonaparte Basin. McLennan et al., (1990) place the boundary between the Bonaparte and Money Shoals Basin along the north-south Lynedoch Bank Fault System (Fig. 3), which is assumed to be a reactivated offshore extension of the Proterozoic Tom Turner Fault Zone (McLennan et al., 1990). The principle depocenter in the region is the Malita Graben which trends in a ENE-WSW direction except on its northern end where it swings around to a more NE trend which is referred to as the Calder Graben. The Malita Graben is asymmetric with bounding structures of the NW margin of the graben dipping south easterly (Northern Territory Geological Survey, 1990; West et al., 1992). The graben is surrounded by platforms comprising relatively shallow basement with thin Mesozoic and Cainozoic cover. The Sahul Platform occurs to the north, the Darwin Platform (also referred to as the Bathurst Terrace) to the south and the Money Shoals Platform to the east (Fig. 3). The Money Shoals Platform separates the Malita/Calder Graben from the Goulburn Graben to the east (Fig. 3).

The Malita Graben is thought to be either a Late Palaeozoic or Mesozoic structure. The timing of the initiation of the Malita Graben is controversial with Botten and Wolf (1990) and Northern Territory Geological Survey, (1990) suggesting that it was initiated during the Jurassic, whereas McLennan et al., (1990) favour a late Permian initiation. Only the flanks of the graben have been drilled and consequently the total sediment thickness is not known. It may be to be up to 10 km thick (Northern Territory Geological Survey, 1990; West et al., 1992). The basin forming structures are not imaged on conventional 5 or 6 second seismic records. It may also have a Palaeozoic structural and depositional precursor, as does the Petrel Sub-Basin to the south. The graben is thought to be the kitchen for hydrocarbon generation is this region.

STRATIGRAPHY

The stratigraphy of the region is poorly known due to the sparsity of wells and the nomenclature used is usually that applied to the Bonaparte Basin. The thickness and age of sedimentary packages varies with structural provinces. The Darwin Shelf has a thin cover of Jurassic to Cainozoic sediments overlying basement (Northern Territory Geological Survey, 1990; Mory 1991). The Sahul Platform has less than 5000m of Late Permian to Recent section and the Money

Shoals Platform is thought to be covered by a Mesozoic and younger section (Mory 1991; McLennan et al., 1990). The Malita Graben has only been drilled at Heron -1, which bottomed in mid Jurassic sediments. The major sediments groups encountered during drilling in the region of the proposed survey are: The Permian Kinmore Group; the Triassic to Jurassic Troughton Group; the Jurassic Flamingo Group; the Cretaceous Bathurst Island Group (BIG) and Cainozoic carbonate and siliciclastic sediments (Fig. 4). The oldest sediments encountered by drilling so far are Late Permian carbonates sediments in Troubadour -1. The Troughton Group was intersected in Troubadour -1 and Shearwater -1 wells. The Troughton and Flamingo Groups are separated by a Callovian unconformity which is attributed to a major tectonic event associated with the break up of the margin (Mory, 1991). The Flamingo Group varies from 867 m of mainly grey, silty, pyritic claystone in Heron 1 to 25 m of mainly siltstone in Evans Shoals -1. The Flamingo Group pinches out laterally on the Darwin Shelf and the Sahul Platform. It is less than 8 m thick in Troubadour -1 and consists of coarse sand. The Flamingo Group is separated from the overlying Bathurst Island Group by a Valanginian Unconformity. Elsewhere in the region the basal Bathurst Island Group consists of a greensand rich, condensed section. The Bathurst Island Group in the Malita Graben consists of over 2000 m of section (Botten and Wulf, 1990).
The Cainozoic sediments consist of basal sandy units that grade up into shallow water carbonate sediments. There is major hiatus during the Oligocene and probably in the Miocene but the section has not been well sampled.

HYDROCARBON DISCOVERIES AND SHOWS

Hydrocarbon shows are relatively common in the wells drilled in this region. The major discoveries however are confined to Sunrise -1 and Troubadour -1 on the Sahul Platform. Troubadour was a gas/condensate discovery that flowed 279 000 m^3 of gas and 38.8 kL of condensate per day (Northern Territory Geological Survey, 1990; Mory 1991). The flow was from sandstone in the middle Jurassic Plover Formation of the Troughton Group. Gas shows were also discovered in Heron -1, Lynedoch-1, Evans Shoal -1, and Shearwater-1. Heron -1 had gas shows in Lower Cretaceous limestone and claystone and in Jurassic sandstone but none were tested. Lynedoch-1 had a gas show in Cretaceous Limestone during a sidetrack and in Evans Shoal -1 an RFT recovered gas from a Mesozoic sandstone. Shearwater-1 had dead oil in the Middle Jurassic Plover Formation.

OBJECTIVES AND SPECIFIC PROBLEMS

The Malita survey is part of program of eight designed to determine the structural architecture of the northwestern margin of Australia. The major objectives of the Malita Graben project are:

1) determine the regional structural framework of the eastern Timor Sea region by examining the boundaries between the major structural elements along a series of transects;

2) provide modern regional seismic tie lines through the wells in the region to facilitate province wide correlations;

3) determine the deep crustal structure of the Malita and Calder Grabens;

4) examine the effects of the deep crustal structure and there various phases of reactivation on the known petroleum accumulations.

More specifically the project has been designed to examine the following problems related to the structural development of the eastern Timor Sea region.

- to examine the structural relationship of the Malita and Calder Grabens to their surrounding platforms.

- examine the structural development of the Darwin, Sahul and Money Shoals Platforms.

- determine the timing and style of reactivation of the major structures.

- examine the age and nature of the movement on the bounding structures of the Malita Graben. In particular, determine the nature of the northern bounding fault system. On conventional industry data sets the graben forming structures are not evident and several ages have been suggested for the formation of the graben.

- the extent and nature of any Palaeozoic underpinning to both the structural and depositional history of the graben.

- attempt to determine distribution and stratigraphic level evaporites in the Malita and Calder Grabens and their role, if any, in the structural history of the basin.

- determine the nature and movement history of the Lynedoch Bank Fault Zone. This structure appears to be the eastern boundary to the Bonaparte Basin and the eastern boundary to the Mesozoic passive margin.

- determine the pre-collisional nature of this segment of the margin in terms of its upper or lower plate affinities as described in detachment models for margin formation (Lister et al., 1990). Determining the pre-collisional nature of the margin may be essential for predicting the nature of the collision induced reactivation of the margin forming structures.

PROPOSED PROGRAM

The proposed lines for the East Malita Graben survey are shown in Figures 5 & 6. These lines total 2475 km and tie all wells in the region, plus Tuatara-1 and Kulka- 1 to the east (Appendix 1). The lines shown here are preliminary and may be changed following consultation with permit holders, designated authorities and other interested groups. The lines are designed to examine the major structural elements in the region. Where possible the lines are orthogonal to the principal trends in the region. Some strike lines are included to assist the regional ties between wells.
A summary of the lines and the specific objectives related to it follows. Way points for each line are listed in Appendix 2.

Lines 1 - 6 These lines are oriented perpendicular to the axis of the Malita Graben. They extend from the Sahul Platform across the Malita Graben and onto the Bathurst Terrace of the Darwin Platform. They are designed to examine the deep structure of each of the elements and to image the deeper parts of the Malita Graben. Line 5 ties Evans Shoals-1 to Beluga -1.

Line 7 - 8 These lines are oriented ESE-WNW and extend from the Malita Graben to the east across the Lynedoch Bank Fault System and onto the Money Shoals Platform. Along with Line 5, they are designed to examine the nature of the Lynedoch Bank Fault system.

Line 9 This line is located along the axis of the Calder Graben.

Line 10 A strike line across the Sahul Platform and the northern end of the Calder Graben. Will also examine the Lynedoch Bank Fault system and western end of the Goulburn Graben. This line ties lines 2-4, 8 and 11-13 on the Sahul Platform.

Lines 11-13 North - south lines designed to examine the northern edge of the Sahul platform and the change in bathymetric trend in the Timor Trough in this region as well as the Malita Graben.

Line 14 Tie Line from Tuatara to Kulka -1 in the Goulburn Graben.

Line 15 A tie line between Evans Shoals - 1 and Tuatara -1. Also crosses Lynedoch Bank Fault.

Line 16 Strike line along the axis of the Malita Graben. Ties 1-5 and 13.

Seismic Refraction

MGPG program is examining ways of gathering refraction data on a series of transects across the northwestern margin of Australia. To examine the suitability of the region for this type of work it is proposed to carry out seismic refraction recording concurrently with the reflection seismic program using land based stations. Between 2 and 4 seismometers will be established at onshore locations, probably on Bathurst or Melville Island to record part of the survey to test the suitablity of the gun arrays as a source in this region.

REFERENCES

Allen, P. A. and Homewood P., 1986. Foreland Basins. *International Association of Sedimentologist Special Publication* No.8. Oxford (Blackwell) 453pp.

Beaumont, C., 1981. Foreland Basins. *Geophysical Journal of the Royal Astronomical Society*, 65, 291-329.

Botten, P. and Wulff, K., 1990. Exploration potential of the Timor Gap Zone of Co-operation. *APEA Journal*, 68-90.

Durrant, J. and Young, A., 1988. A case study of seismic exploration in the Offshore Bonaparte Basin. In Purcell, P.G. and R.R. (Eds.), The North West Shelf, Australia: *Proceedings of Petroleum Exploration Society Australia Symposium*, Perth, 489 - 498.

Lister, G.S., Etheridge, M.A., and Symonds, P.A., 1991. Detachment models for the formation of passive continental margins. *Tectonics* 10, 1038-1064.

McLennan, J.M., Rasidi, J.S., Holmes, R.L. and Smith G. C., 1990. The geology and petroleum potential of the Western Arafura Sea. *APEA Journal,* 91-106.

Mory, A. J., 1991. Geology of the offshore Bonaparte Basin, North western Australia. *Geological Survey of Western Australia Report* 29, 47p.

Northern Territory Geological Survey, 1989. Petroleum Basin Study: Arafura Basin. *Northern Territory Geological Survey Report.*

Northern Territory Geological Survey, 1990. Petroleum Basin Study: Bonaparte Basin. *Northern Territory Geological Survey, Ref No. GS 90/ 010.*

O'Brien, G. W. and Williamson, P.E., 1990. Research Cruise proposal. Vulcan Graben, Timor Sea: deep crustal structure, structural reactivation, aeromagnetics, and hydrocarbon migration. *Bureau Mineral Resources, Geology and Geophysics, Australia Record,* 1990/91.

Stagg, H.M.J., 1992. Deep structure of the Southern Northwest Shelf: SNOWS-II (survey 110) Post - cruise report. *Bureau Mineral Resources, Geology and Geophysics, Australia Record,* 1992/60.

Stagg, H. M. J., Brassil, F.M., and Survey 101 Shipboard Party, 1991. Deep structure of the southern Northwest shelf - post cruise report. *Bureau Mineral Resources, Geology and Geophysics, Australia Record,* 1991/79.

West, B. G., Connolly, J.R., Blevin, J.E., Miyazaki, S., Struckmeyer, and Vuckovic, V., 1992. Petroleum Prospectivity of the East Malita Graben area, Bonaparte Basin. *Bureau Mineral Resources, Geology and Geophysics, Australia, Record,* 1992/24.

Willcox, J.B. and Ramsay, D.C., 1991. Deep structure of the Bonaparte Basin Region Petrel subbasin cruise: operational report. *Bureau Mineral Resources, Geology and Geophysics, Australia, Record,* 1991/45.

APPENDIX 1

WELLS TO BE TIED DURING MALITA SURVEY

WELL	OPERATOR	DATE	TD m	OLDEST SEQUENCE	STATUS
BELUGA	BHPP	1991	3100	?JURASSIC	gas shows
EVANS SHOALS	BHPP	1988	3712	JURASSIC	gas M sst
HERON	ARCO	1971	4209	JURASSIC	gas K & J
KULKA	DIAMOND SHAMROCK	1984	3998	CARBON	oil in J and Carb sst
LYNEDOCH	SHELL	1973	3967	JURASSIC	gas in K
SHEARWATER	ARCO	1974	3177	JURASSIC	dry
SUNRISE	BOCAL	1975	2341	JURASSIC	gas/cond
TROUBADOUR	BOCAL	1974	3459	PERMIAN	gas/cond
TUATARA	BHHP	1990	3875	DEVONIAN	dry

APPENDIX 2
WAY POINTS
SPHEROID AGD 66

Linename		LATITUDE	LONGITUDE
MA01	SOL	-10.250000	128.166667
	SHEARWATER 2	-10.513611	128.310278
	EOL	-11.533000	128.925000
MA02	SOL	-9.433330	128.066670
	SUNRISE	-9.590097	128.153789
	EOL	-11.440000	129.150000
MA03	SOL	-9.433431	128.383387
	HERON	-10.440833	128.951390
	EOL	-11.000000	129.266660
MA04	SOL	-9.415000	128.750000
	EOL	-11.085000	129.650000
MA05	SOL	-10.015000	129.475000
	LYNEDOCH	-10.081523	129.531999
	BELUGA	-10.573679	129.964100
	EOL	-11.070000	130.400000
MA06	SOL	-9.710000	129.840000
	EOL	-10.716666	130.383333
MA07	SOL	-9.415000	129.500000
	EVANS SHOAL	-9.861944	130.312500
	EOL	-10.210000	130.9
MA08	SOL	-9.930000	131.250000
	EOL	-9.380000	130.450000
MA09	SOL	-10.660000	129.880000
	EOL	-9.240000	131.200000
MA10	SOL	-9.360000	131.930000
		-9.500000	129.800000
	EOL	-10.050000	128.105000
MA11	SOL	-9.385000	130.290000
	EVANS SHOAL	-9.861944	130.312500
	EOL	-10.290000	130.330000

MA12	SOL	-9.415000	129.870000
	BELUGA	-10.573679	129.964100
	EOL	-11.000000	130.010000
MA13	SOL	-9.415000	129.465000
	LYNEDOCH	-10.081523	129.531999
	EOL	-11.120000	129.630000
MA14	SOL	-9.710000	131.816666
	TUATARA	-9.734898	131.860100
	KULKA	-10.063047	132.546691
	EOL	-10.098000	132.630000
MA15	SOL	-9.870000	130.230000
	EVANS SHOAL	-9.861944	130.312500
	TUATARA	-9.734898	131.860100
	EOL	-9.725000	131.958300
MA16	SOL	-11.000000	128.510000
	EOL	-10.220000	129.780000

SOL = start of line; EOL = end of line

APPENDIX 3
LINE LENGTHS

No.	km	
1	164	SSE from JDZ through Shearwater - 1 to Bathurst Terrace
2	252	from the border SSE through Sunrise across the Sahul Platform, and Malita Graben to Bathurst Terrace - Shoot as extension of BIRPS line
3	198	from the border SSE through Heron -1 across the Sahul Platform and Malita Graben to Bathurst Terrace
4	210	SSE across the Sahul Platform and Malita Graben to Bathurst Terrace
5	154	from Evans Shoals-1 across the Malita Graben to Beluga and Bathurst Terrace
6	126	SE across Malita Graben to Money Shoals Platform
7	183	From border through Lynedoch -1 across Lynedoch Bank Fault onto Money Shoals Platform
8	107	SE from border across Calder Graben and Lynedoch Bank Fault onto Money Shoals Platform
9	190	Beliga - 1 NE along Calder Graben axis
10	430	ENE from JDZ across Sahul Platform, Calder Graben to Money Shoals Platform
11	100	S from border through Lynedoch into Calder Graben
12	176	S from border across Malita Graben to Bathurst Terrace
13	189	from the border S across Malita Graben to Bathurst Terrace
14	99	From Tuatara -1 to Kulka -1
15	190	Evans shoals -1 to Tuatara -1
16	163	Along the axis of the Malita Graben - evaporites
Total	**2954**	

Probable Shooting Sequence

starting from southern end of 1 shooting N

1 ⇒ 2 ⇒ 3 ⇒ 4 ⇒ 5 ⇒ 6 ⇒ 11 (shoot to north) ⇒ 8 ⇒ 7 ⇒ 13 ⇒ 9 (shoot to NE) ⇒ 10 ⇒ 16 (shoot to NE) ⇒ 15 ⇒ 14

APPENDIX 4

SEISMIC ACQUISITION PARAMETERS

Seismic Cable Configuration

standard	length	4800 m
	group length	25 m
	no. channels	192

Seismic Source

	airgun array capacity	50 litres (3000 cu in)
	airgun pressure	1800 psi (normal)
		1600 psi (minimum)
	shot interval	19.4 sec @ 5 knots
		21.6 sec @ 4.5 knots

Fold

	standard	4800 %

Recording Parameters

	record length	16 s
	sample interval	2 ms

two lines may be shot at 20 secs record length

APPENDIX 5
Research Vessel Rig Seismic

R.V. *Rig Seismic* is a seismic research vessel with dynamic positioning capability, chartered and equipped by AGSO to carry out the Continental Margins Program. The ship was built in Norway in 1982 and arrived in Australia to be fitted out for geoscientific research in October 1984. It is registered in Newcastle, New South Wales, and is operated for AGSO by the Australian Maritime Safety Authority.

Gross Registered Tonnage:			1545 tonnes
Length, overall:			72.5 metres
Breadth:			13.8 metres
Draft:			60 metres
Engines:	Main:	Norma KVMB-12	2640 H.P./825 r.p.m.
	Aux:	3 x Caterpillar	564 H.P./482 KVA
		1 x Mercedes	78 H.P./56 KVA
	Shaft generator:	AVK 1000 KVA; 440 V/60 Hz	
	Side Thrusters:	2 foward, 1 aft, each 600 H.P.	
	Helicopter deck:	20 metres diameter<R>	
	Accommodation:	39 single cabins and hospital	

Scientific equipment

FJORD Instruments seismic receiving array: 6.25 m, 12.5 m, 18.75 m and 25 m group lengths, up to 288 channels; up to 6000 metres active streamer length

Syntron RCL-3 cable levellers; individual remote control and depth readout

Haliburton Geophysical Service 32 x 150 cubic inch airguns in two 16 gun arrays; the normal operating array is 2 x 10 guns, giving a total of 3000 cubic inches normal operating array volume

Seismic Systems S-15 and S-80 high resolution water gun array consisting of 5 x 80 cubic inch

Air compressor system: 6 x A-300 Price compressors, each providing 300 scfm at 2000 psi (62 litres/min at 14 MPa)

Digital seismic acquisition system designed and built by AGSO running on DEC μ VAX 3500:

- 0.5msec-4msec sampling interval, 2sec-16sec record length
- Phoenix A/D converter and instantaneous floating point amplifier
- Data stored on Fujitsu 3480 cartridge tape drives
- Data in demultiplexed (modified) SEG-Y format.

Reftek and Yaesu sonobuoy receivers

Raytheon echo sounders: 3.5 KHz (2 K.W.), 16 transducer sub bottom profiler and 12 KHz (2 K.W.)

Geometrics G801/803 magnetometer/gradiometer

Bodenseewerk Geosystem KSS-31 marine gravity meter

E.G. & G. model 990 sidescan sonar with 1000 m of cable

Nichiyu Giken Kogyo model NTS-11AU heatflow probe

Australian Winch and Haulage deepsea winch with 10 000 metres of 18 mm wire rope and hydrographic winch with 4000 m of 6 m wire rope

Coring and rock dredging systems (various) and vibracorer

Light hydrocarbon extractor and gas chromatographs for continuous DHD (direct hydrocarbon detection) in bottom water

Hydrocarbon gas analyses in sediments

Geochemical analysis equipment for environmental monitoring.

15 metre A frame with a 12.5 ton load capability, using a variety of winches, supporting towed arrays and future capability for large scale deep coring and drilling

Navigation equipment

Magnavox T-Set Global Positioning System navigator

Magnavox MX 1107RS and MX 1142 transit satellite receivers

Magnavox MX 610D and Raytheon DSN 450 dual axis sonar dopplers

Sperry, Arma Brown and Robertson gyro-compasses; plus Ben paddle log

RACAL SKYFIX differential GPS system

APPENDIX 6

PROCESSING AGREEMENT FOR SEISMIC CRUISES

PROJECT : EAST MALITA CRUISE LEADER : C J PIGRAM

PROJECT CODE : 121. 39

OBJECTIVES REQUIRED FROM SEISMIC & NON-SEISMIC DATA :

3000 km of 16 sec records; one or 2 lines of 20 sec data
192 channels, 25m groups 4800 m cable 48 fold
image deep crustal structure
DMO, migration - may be evaporites at depth
timing of recording - either Feb or March 1993
Processing windows - March -August or May October 1993
Probably compress data early in processing sequence
Look at extensive post stack enhancement of deep data

REQUIRED PROGRESS REPORTS : fortnightly

SEISMIC DATA

LINE PRIORITIES : 14 lines; priorities to be advised following consultation

PROPOSED DISPLAY SCALES : 10 cm/sec to 7 secs, 5 cm/sec to 14 secs; 2.5 cm/sec to 20 secs

PROCESSING DEADLINES : TBA

LINES				
DATE				
STAGE				
LINES				
DATE				
STAGE				

NAVIGATION AND GEOPHYSICAL PARAMETERS

UKOOA FILE	YES
WITH WATER DEPTH	YES
WITH GRAVITY	YES (drift and eotvos correction applied)
WITH MAGNETICS	YES

POSITION SAMPLE INTERVAL FOR UKOOA FILE: 500m - yes
1000m
OTHER

TIME BASED FILE WITH PARAMETERS AS ABOVE FOR WHOLE CRUISE

PLOT POTENTIAL FIELD DATA ON SEISMIC

PROCESSING DEADLINES
To be advised following consultation.

SURVEY CATEGORY

REGIONAL SEISMIC	YES
HIGH RESOLUTION SEISMIC	_____
LINES AND TRANSITS	_____

C J PIGRAM
CRUISE LEADER

for F BRASSIL
DATA PROCESSING MANAGER

13 January, 1993
DATE

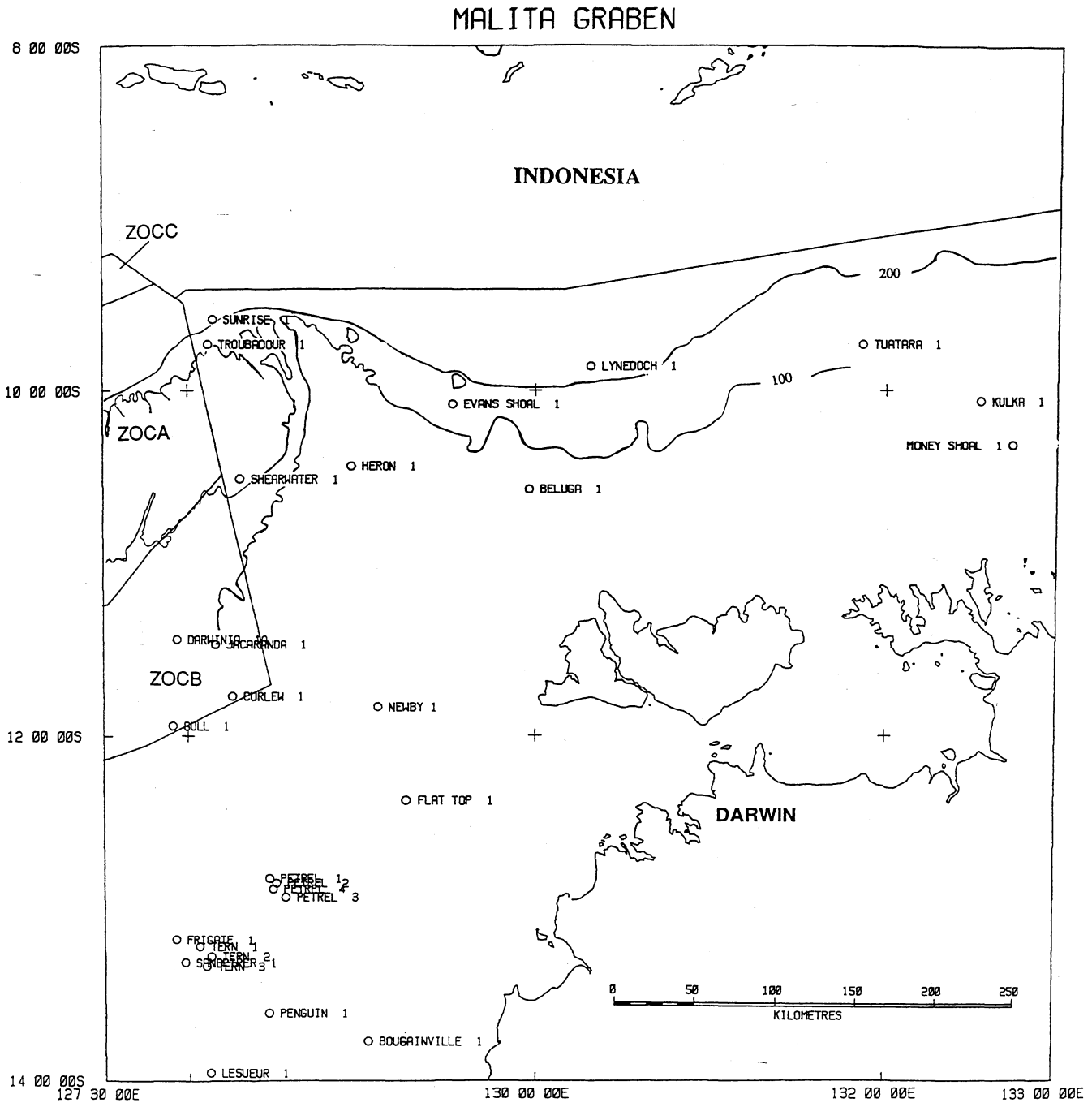

FIGURE 1: Location of the survey area. Well locations are shown.

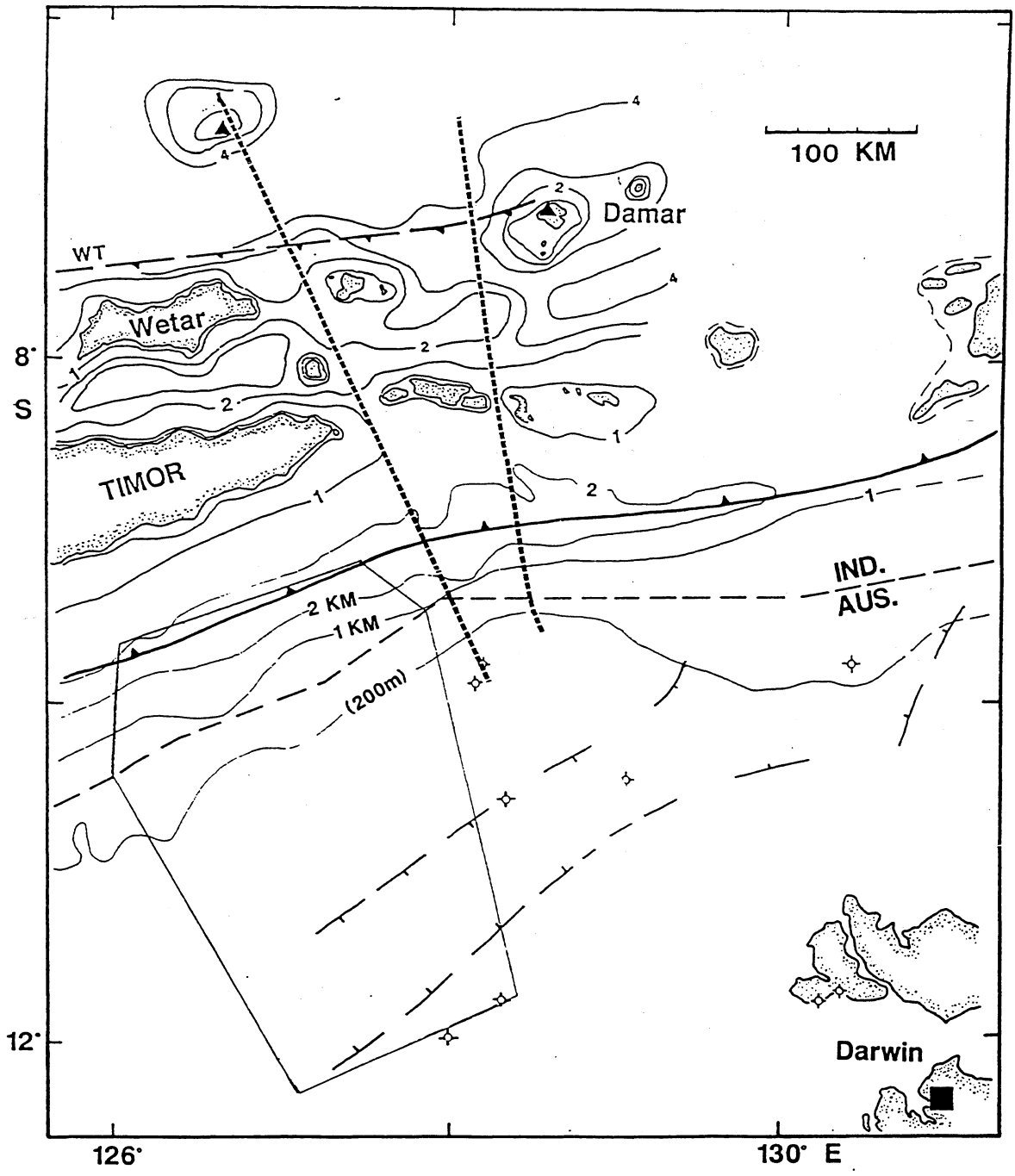

FIGURE 2: Map showing the approximate location of of the deep crustal lines shot across the Banda Arc by BIRPS in 1992.

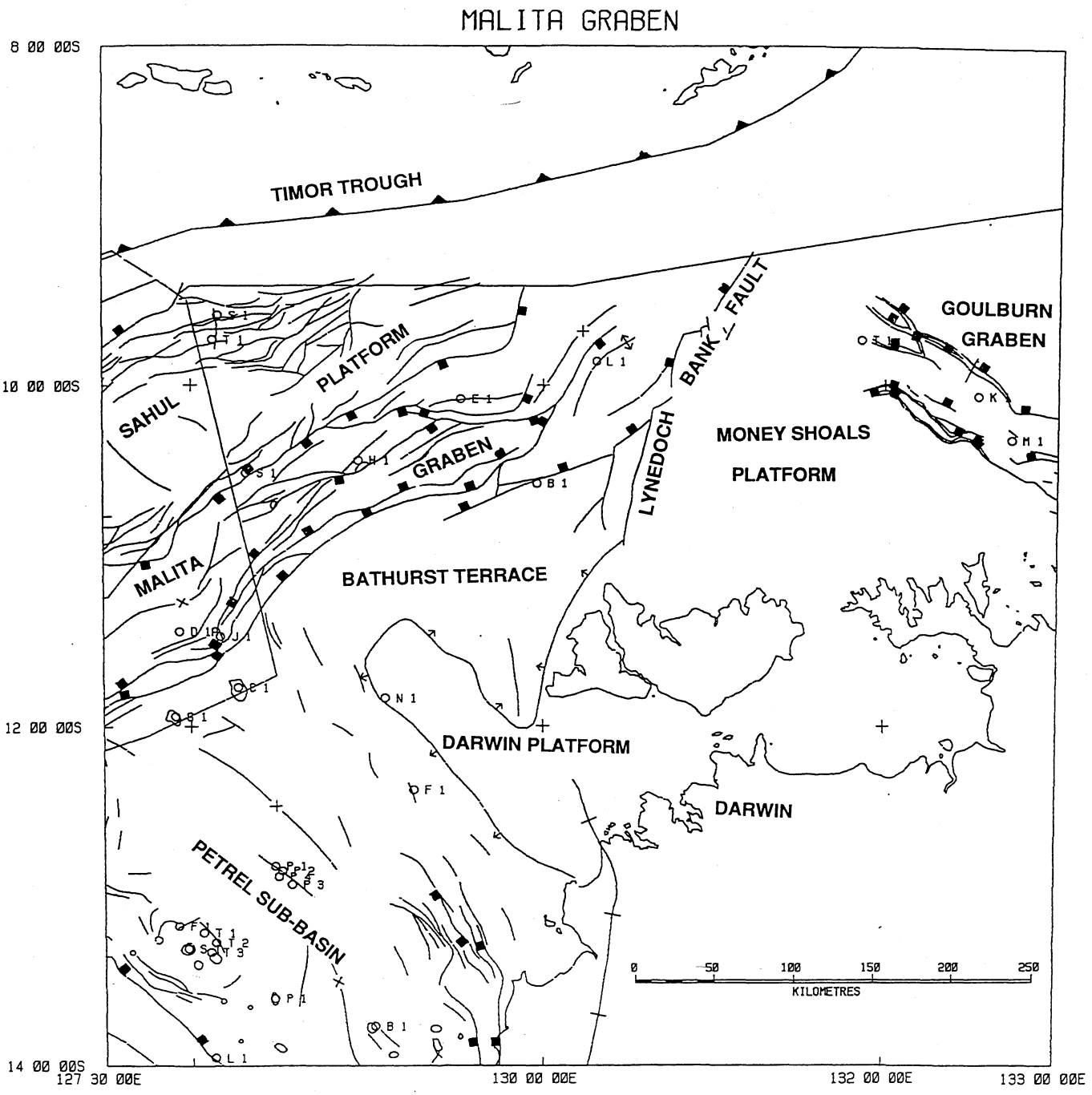

FIGURE 3: Structural framework map of the East Malita Graben region (Northern Territory Geological Survey, 1989; 1990)

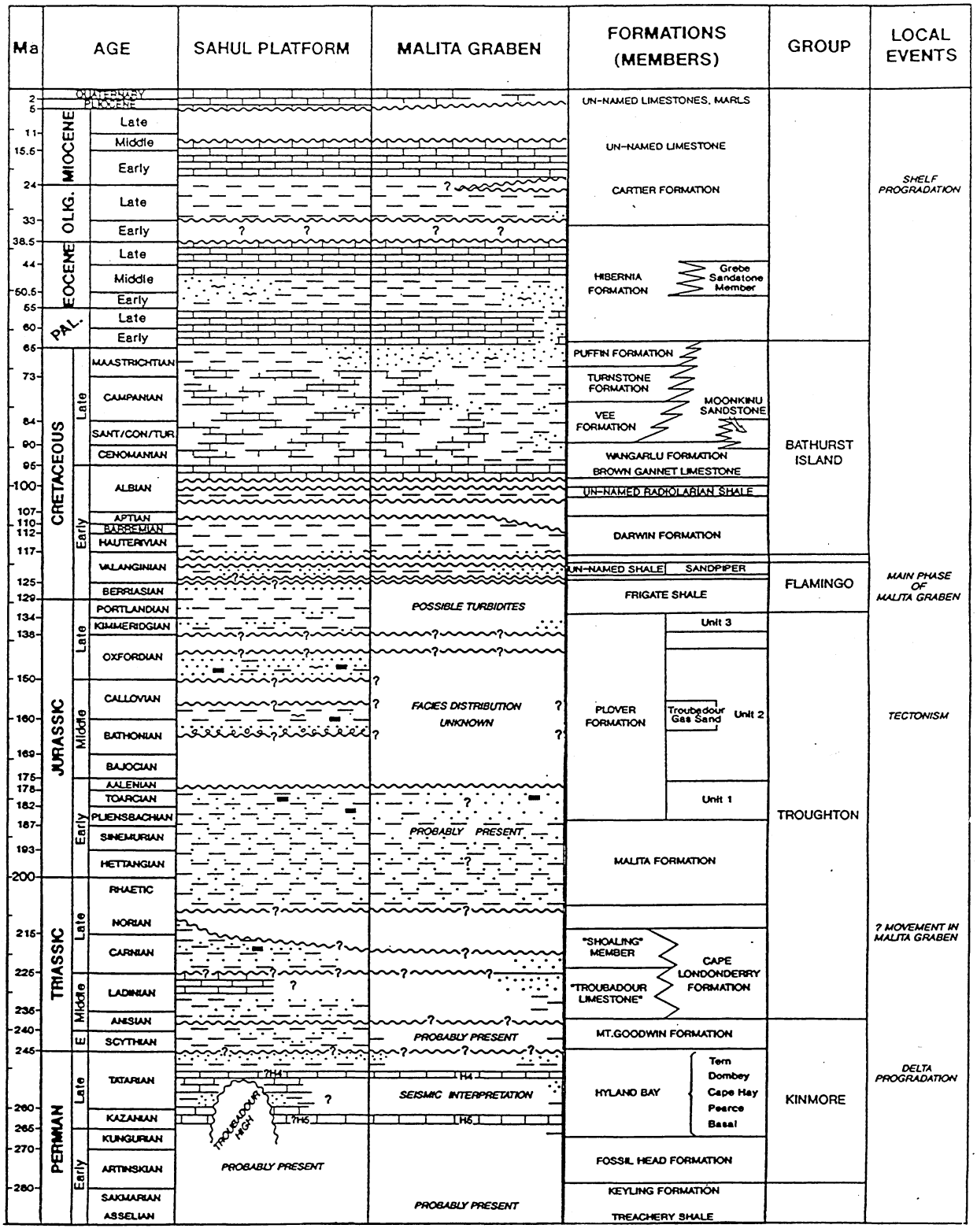

FIGURE 4: Stratigraphic column for the East Malita Graben region (Northern Territory Geological Survey, 1990)

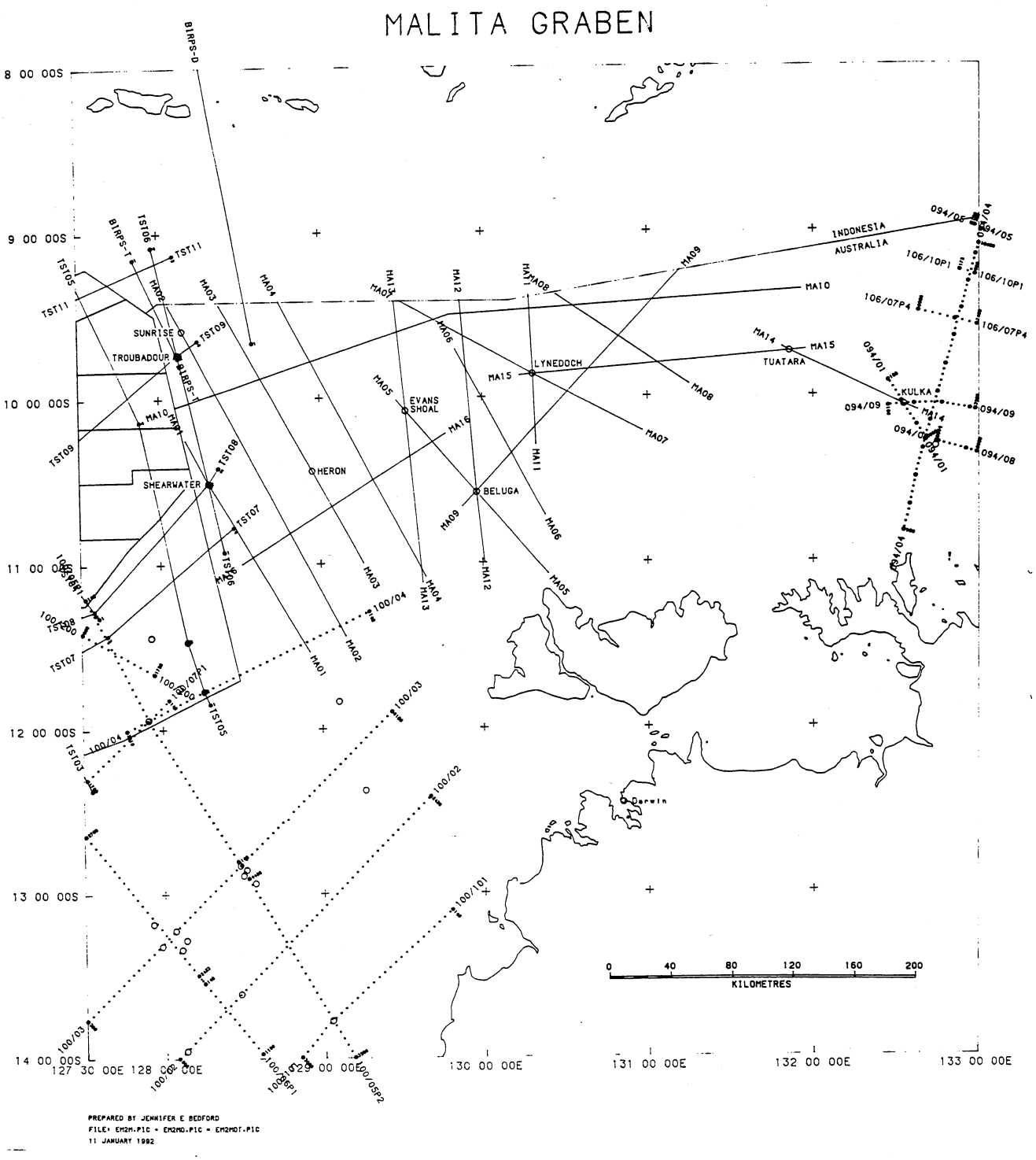

FIGURE 5: Track map of the East Malita Graben region showing proposed lines

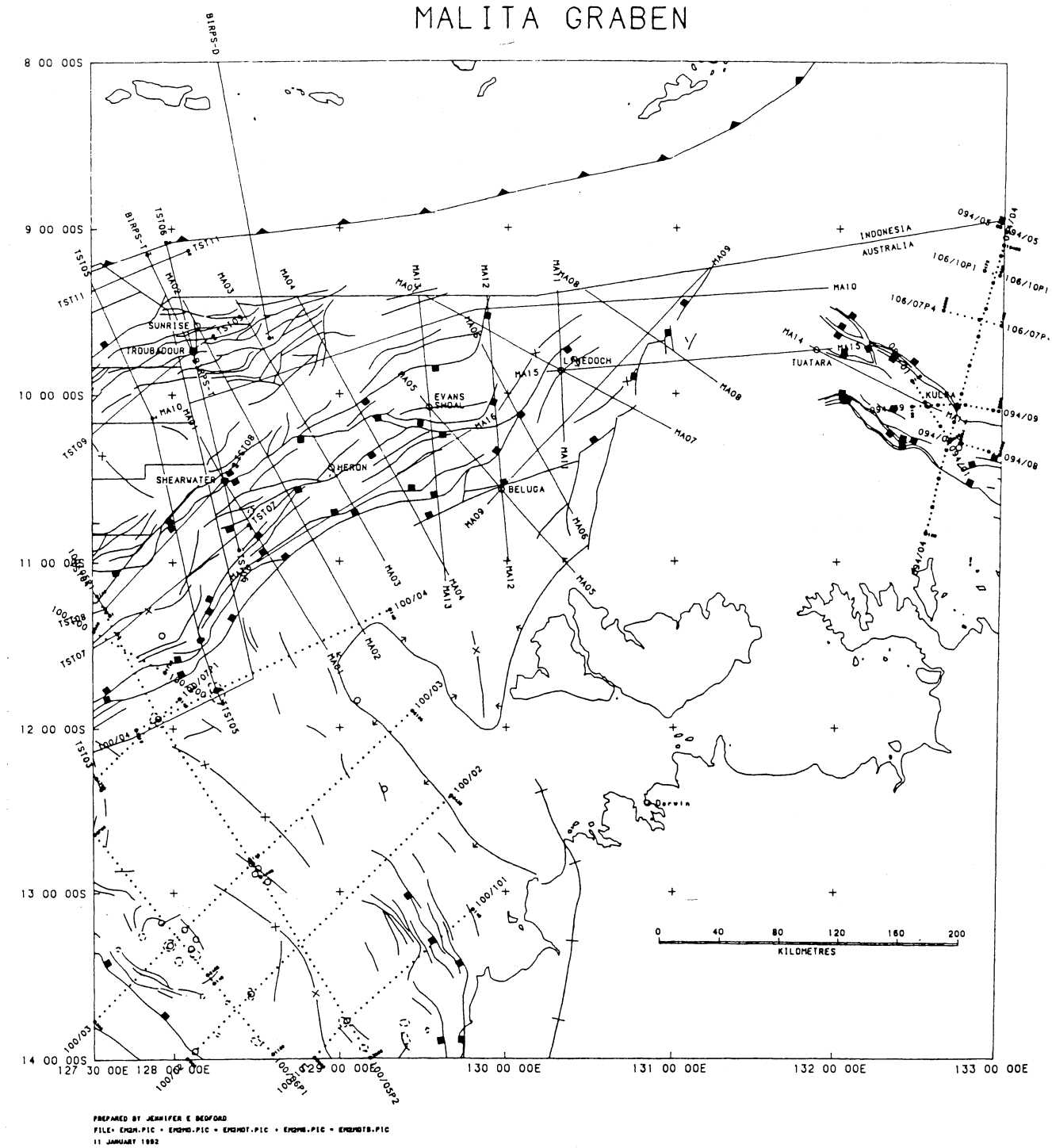

FIGURE 6. Regional structural elements with proposed tracks superimposed.