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## RESEARCH CRUISE PROPOSAL

# BONAPARTE BASIN: STRUCTURAL REACTIVATION AND HYDROCARBON MIGRATION

**PROJECT 121.22**

BMR PUBLICATIONS COMPACTUS
(LENDING SECTION)

**PRINCIPAL INVESTIGATORS:-G.W. O'BRIEN & G. BICKORD**

**ASSOCIATE INVESTIGATOR:-D.T. HEGGIE**

**SCHEDULE:- FEBRUARY-MARCH 1991**

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# PROGRAM SUMMARY

***Objective:-To understand the structural reactivation processes and the mechanisms of hydrocarbon generation, migration and entrapment within the Sahul Syncline, Malita Graben and Petrel Sub-Basin, Timor Sea, northwestern Australia.***

In order to further stimulate and assist the exploration effort in the Sahul Syncline, the Malita Graben and the Petrel Sub-Basin, the Division of Marine Geosciences and Petroleum Geology (Bureau of Mineral Resources) is, as part of its Continental Margins Program, carrying out a research program within the Timor Sea in February-March 1991 using R.V. *Rig Seismic*. This program will assist in the assessment of the area's prospectivity by integrating high resolution seismic reflection and remote sensing (direct hydrocarbon detection (DHD)) geochemical data. This will result in an improved understanding of:-

1.)The timing of structural development relative to hydrocarbon generation and migration.

2.)The relationship between structural reactivation and hydrocarbon migration and trapping mechanisms.

3.)The usefulness of underway geochemical profiling as a remote sensing tool in this area.

The survey itself can be loosely sub-divided into three areas, namely the Sahul Syncline, the Malita Graben and the Petrel Sub-Basin. The total program will consist of approximately 3600 km of simultaneously collected high resolution seismic and DHD data. The general survey area is shown in Figure 1.

**Sahul Syncline:**The work program within the Sahul Syncline has two principal focuses. The first focus is to extend the BMR high resolution seismic coverage from the Avocet/Gargarney area to the boundary of Area "A" of the Zone of Co-operation (ZOC). The data will be used to study in detail the processes of structural reactivation associated with collision and foreland basin development along the northern margin of the Australian craton. The second focus is to traverse as many of the structural leads and prospects in the area as possible while carrying out a regional DHD program. This will allow the usefulness of DHD data as a remote sensing tool in this area to be evaluated.

Ancillary objectives include:
i.)Obtaining a better understanding of the integrity of the Bathurst Island Formation seal between Avocet and the eastern margin of the Sahul Syncline. This is important because of the large residual oil columns found in several wells on the Eider Horst.
ii.)Establishing the nature (and migration pathway) of the hydrocarbon charge emanating from the Sahul Syncline at the present day. This objective may be particularly important because of the possibility of flushing oil reservoirs along the margins of the Sahul Syncline (and Malita Graben) with gas generated from source rocks which are now overmature.

**Malita Graben:** Objectives within the Malita Graben are basically similar to those for the Sahul Syncline. The DHD program may help to confirm the source potential of the Malita Graben, which has been inferred but not demonstrated.

**Petrel Sub-Basin:** The program within the Petrel Sub-Basin consists largely of a number of long, regional tie-lines which have been oriented to include a number of hydrocarbon discoveries as well as undrilled prospects. These lines include profiles between the Palaeozoic Turtle and Barnett oil discoveries in the southern Bonaparte Gulf, through the Palaeozoic gas discoveries at Petrel and Tern to the Mesozoic Malita Graben. The Petrel#1 well blew out while being drilled in 1969, and is believed to be still leaking into the water column. A DHD program over Petrel#1 will allow the geochemical composition of the light hydrocarbon gases detected within the water column to be compared to the known composition of the gases within the reservoir. In addition, the vertical and horizontal geometry of this anthropogenic seep will be determined. This presents an almost unique opportunity for "ground-truthing" the DHD method.

# 2. PROJECT OBJECTIVES AND RATIONALE

**TECHNICAL OBJECTIVES**

**i.)High Resolution Seismic Reflection Data** To acquire approximately 3600 line km of high resolution seismic reflection data with a 2.5 second record length (Figure 1).

**ii.)Remote Sensing Geochemical Data** To acquire approximately 3600 line km of direct hydrocarbon detection ($C_1$-$C_8^+$) data (DHD) in the water column within the Sahul Syncline, the Petrel Sub-Basin and surrounding areas (Figure 1).

**iii.)Seabed Sampling For In-Situ Geochemical Data** Sediment cores will be taken in conjunction with the DHD program in selected areas, and the molecular and isotopic compositions of the light hydrocarbon gases composition of the pore waters within the sediments will be determined.

**SCIENTIFIC OBJECTIVES/RATIONALE**

The survey has two principal scientific objectives. By acquiring high resolution seismic reflection data, direct hydrocarbon detection data (DHD) and side-scan sonar data simultaneously, it is hoped that most of these objectives can be achieved concurrently. The objectives are:-

a.)To investigate the processes of structural reactivation associated with collision and foreland basin development along the northern margin of the Australian craton using high resolution seismic reflection profiling. In particular, to better understand how these processes have controlled the entrapment of hydrocarbons and, in some cases, how reactivation has resulted in the breaching of hydrocarbon reservoirs (as occurred at Avocet 1A for example [Whibley & Jacobson, 1990]). Very high resolution seismic data should allow the relationship between the shallower post-rift faults and the deeper syn- and pre-rift faults to be better delineated. Side-scan sonar data, which will be acquired in conjunction with the high resolution seismic data, should allow the seafloor expression of pockmarks and the orientation of reactivated faults to be mapped.

b.)The Direct Hydrocarbon Detection method (DHD) has not been extensively used in Australia, and the majority of surveys that have been conducted are not publicly available. Geochemical surveys conducted in the Timor Sea (by InterOcean, 1989) and Sahul Syncline (by ETI, 1989), fall into this unavailable category.

The Timor Sea appears to be a good location to test this method's usefulness as a remote sensing tool, as many of the faults extend all the way from the reservoir/source horizon to the seafloor. Its applicability in the Palaeozoic Petrel Sub-Basin, where the shallow section is much less faulted, is more difficult to predict. During the survey, DHD data will be collected over structures which cover the range of hydrocarbon-bearing and non-productive structural styles within the region. Detailed surveys will be carried out over several hydrocarbon discoveries, including Turtle, Barnett, Tern and Petrel. Data will also be collected over a number of as yet undrilled prospects.

The DHD data will be collected simultaneously with the high resolution seismic and side-scan sonar data, allowing geochemical anomalies to be related to both seafloor and sub-seafloor geology. The integration of both sediment and water column (DHD) hydrocarbon data will allow a comparison of the relative usefulness of these techniques as remote sensing tools in this area.

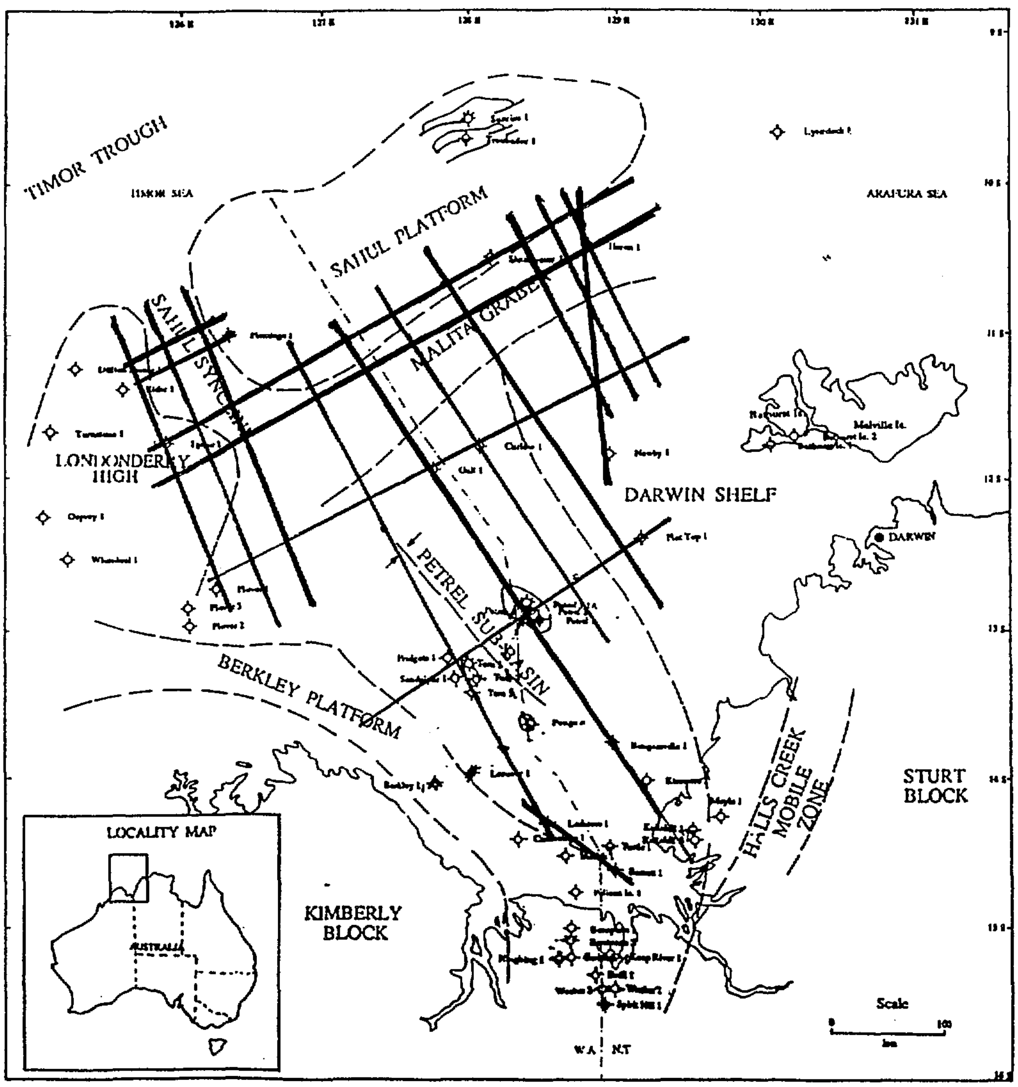


Figure 1. Proposed survey lines shown in relation to the major structural elements of the Timor Sea region. Map reproduced from Bradshaw (1990: BMR Record 1990/72).

# APPENDIX 1

## GENERAL DETAILS:-RESEARCH VESSEL RIG SEISMIC

R/V Rig Seismic is a seismic research vessel with dynamic positioning capability, chartered and equipped by BMR to carry out the Continental Margins Program. Thc 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 BMR by the Federal Department Of Transport and Communications.

| | | |
|---|---|---|
| Gross Registered Tonnage: | 1545 tonnes | |
| Length, overall: | 72.5 m | |
| Breadth: | 13.8 m | |
| Draft: | 6.0 m | |
| Engines: | Main: Norma KVMB-12 | 2640 HP/825 rpm |
| | Aux: 3x Caterpillar | 564 HP/482 KVA |
| | 1x Mercedes | 78 HP/56 KVA |
| | Shaft generator: | AVK 1000KVA; 440 V/60 Hz |
| Side Thrusters: | | 2 forward, 1 aft, each 600 HP |
| Helicopter Deck: | | 20 m diameter |
| Accommodation: | | 39 single cabins and hospital |

# APPENDIX 2

# SCIENTIFIC EQUIPMENT

## GEOPHYSICAL SCIENTIFIC EQUIPMENT

### NON-SEISMIC SYSTEMS

**General**
Raytheon echo sounders: 3.5 Khz (2 KW) and 12 Khz (2 KW)
Geometrics G801/803 magnetometer/gradiometer
Bodenseewerk Geosystem KSS-31 marine gravity meter
E.G. & G. model 990 side scan sonar

Nichiyu Giken Kogyo model NTS-11Au heatflow probe

**Navigation**
Differential GPS System
Magnavox T-set Global Positioning System
Magnavox MX 1107RS and MX 1142 transit satellite receivers
Magnavox MX 610D and Raytheon DSN 450 dual axis sonar dopplers
Arma Brown and Robertson gyro-compasses; plus Ben paddle log
Decca HIFIX-6 radio-navigation system, modified for long range operations

## SEISMIC SYSTEM CONFIGURATION FOR HIGH RESOLUTION PROGRAM: SAHUL SYNCLINE AND BONAPARTE BASIN

The anticipated recording parameters to be used on the high resolution seismic survey in the Sahul Syncline and Bonaparte Basin are as follows.

**Source**
5 X S80 water guns
80 cu in per gun (air)
2000 psi air pressure
gun spacing 2.5 metres
gun depth 3 to 5 metres.

**Streamer**
Fjord Instruments transformerless.
10 Teledyne T-1 hydrophones per 6.25m group.
900 m cable, 144 seismic channels,
group interval 6.25 m.
depth 5m nominal.

**Field Data**
8 hz - 256 hz passband
1 ms blocked multiplexed
up to 3 sec record length
nominal 4.85 second shot rate
shot interval 12.5m for 36 fold CDP coverage
Shot-to-group 1 offset : 100 m if achievable

Seismic data supplied in SEG-Y format, special floating point format, 4 bit binary exponent, 12 bit mantissa. Conversion routinessupplied.

**Alternative Seismic System**
An alternative to the above listed seismic system which could be employed during the survey would consist of a 100 channel seismic

cable configured with a 12.5 m group interval, producing 50 fold data. The sampling rate would be 2 msec with the data demultiplexed.

**High Resolution Source Rationale**
BMR has been developing a seismic energy source specifically for use in high resolution surveys. The energy source is built around five S-80 waterguns of 80 cu.in. capacity manufactured by Seismic Systems Incorporated of Houston USA. The primary objective is to have an energy source that has a variable output energy level but an invariant power spectrum and signal waveform. By using multiple waterguns separated by more than their interaction distance, we can use from one to five guns without changing the output signal shape. It also has the advantage of a "clean" signal without bubble pulse that might obscure near-surface detail in the field. These advantages are considered to outweigh the disadvantage of a non-minimum phase energy source. Preliminary tests of the watergun array have been encouraging. Reliability and repeatability of individual gun signatures has been good.

## RIG SEISMIC SYSTEM (GENERAL)

**Seismic cable**:
Fjord Instruments, transformerless coupling
Maximum of 288 seismic channels, 12 auxiliary channels
10 Teledyne T-1 hydrophones per 6.25 metre group
Nominal sensitivity 20 Volts/Bar for standard group
Oil blocks to reduce low frequency noise
6.25, 12.5, (18.75), and 25.0 metre groups available
288 seismic channels, 12 auxiliary channels
Maximum towable length 6000 metres
3600 metres available at present (Sept 1990)

**Energy Source:**
5 x 80 cu.in. SSI S-80 watergun array
Gun depths 3 to 5 metres, spacing 2.5 metres
16 x 150 cu.in. HGS sleeve gun array (2 arrays)
16 x 160 cu.in. HGS Mod III airgun array (2 arrays)
Gun depths 5 to 15 metres, spacing 0.5 metres
Gun groups separated by 2.5 metres
Various gun groupings available
Configured as 6, 5, 3, and 2-gun groups
Usually fired as 4, 3, 2, and 1-gun groups
Compressor capacity 1200 scfm nominal at 2000 psi

**RecordingParameters:**
Low noise charge-coupled preamplifiers
Preamplifier gain from 1 to 128 in 6 dB steps
Maximum of 320 channels including seismic and auxiliaries

LC filters 4, 8, 16, and 32 Hertz at 18 dB/octave
HC filters 90, 180, 360 and 720 Hertz at 140 dB/octave
Sampling rates of 0.5, 1, 2, and 4 millisecs
Record lengths from 2 secs to 20 secs
SEG-Y recording format with extension
IFP operating at 200 khz with special floating point format
Data recorded as 4-bit binary exponent and 12-bit mantissa

**Other:**
Reftek receiver and sonobuoys
Yaesu sonobuoy receiver and Spartan SSQ-57A sonobuoys
Raytheon echo sounders: 3.5 Khz (2 KW) and 12 Khz (2 KW)
Geometrics G801/803 magnetometer/gradiometer

## GEOLOGICAL SCIENTIFIC EQUIPMENT

Australian Winch and Haulage deep-sea winch with 10,000 m of 18 mm wire rope and a hydrographic winch with 4000 m of 6 mm wire rope
Gravity, piston, box and vibracores
Grab sampler
Pipe and rock dredges
Niskin bottle water samplers
Underwater camera

## GEOCHEMICAL SCIENTIFIC EQUIPMENT

### Sediment And Porewater Geochemistry

Flow injection analyser
UV-VIS spectophotometer
Gas chromatographs

### Water Column Geochemistry

The Direct Hydrocarbon Detection (DHD) method continuously analyzes $C_1$-$C_8$ hydrocarbons within seawater. Thermogenic hydrocarbons migrating up faults from source rocks and/or hydrocarbon reservoirs debouch into the seawater at the seafloor, producing higher concentrations of light hydrocarbons within the water column. These seep gases have molecular compositions that are distinctively different from that of the biogenically-produced hydrocarbons which are mainly produced by *in situ* processes in seawater. If the hydrocarbons are present in sufficient amounts, the molecular composition of the thermogenic hydrocarbons may be used to infer whether the primary source of the seep was oil, condensate or dry gas.

The method used on the RV 'Rig Seismic' is as follows. Seawater is continuously delivered into the geochemical laboratory onboard the ship via a submersible fish (which is towed approximately 10 m above the seafloor). The seawater is degassed in a vacuum chamber and the resulting headspace gas is injected into three gas chromatographs which sequentially sample the flowing gas stream and measure a variety of light hydrocarbons. Total hydrocarbons (THC) are measured every thirty seconds, light hydrocarbons ($C_1$-$C_4$) are measured every two minutes and $C_5$ to $C_8$ are measured every 8 minutes. These data, as well as fish altitude (above the seafloor), the depth of the fish, hydrographic (temperature and salinity) and navigation data are recorded on computer. All these data are recorded and displayed continuously so that any hydrocarbon anomalies in the water column can be quickly recognised and additional measurements can be made when appropriate. Detection sensitivity is approximately 10 parts per billion in the stripped headspace sample. At a ship speed of 4 knots, the measurement of THC is made every 70 m, $C_1$-$C_4$ every 250 m and $C_5$ to $C_8$ every 1400 m.

## APPENDIX 3

# WELLS DRILLED IN THE TIMOR SEA

| WELL NAME | LATITUDE | LONGITUDE |
|---|---|---|
| Allaru 1 | 12.093406 | 124.798173 |
| Allaru 1 ST 1 | 12.093406 | 124.798173 |
| Allaru 1 ST 2 | 12.093406 | 124.798173 |
| Anderdon 1 | 12.646416 | 124.796593 |
| Anson 1 | 12.502971 | 124.8035 |
| Arunta 1 | 11.975496 | 124.951508 |
| Ashmore Reef 1 | 12.180472 | 123.086277 |
| Asterias 1 | 13.152305 | 124.119998 |
| Augustus 1 | 11.683611 | 124.970276 |
| Avocet 1 | 11.373053 | 125.755 |
| Avocet 1A | 11.372813 | 125.755001 |
| Avocet 2 | 11.364093 | 125.757075 |

| | | |
|---|---|---|
| Barcoo 1 (Woodside) | 15.343611 | 120.636721 |
| Barita 1 | 11.443318 | 125.728054 |
| Barnett 1 | 14.530556 | 129.0611 |
| Barnett 2 | 14.532361 | 129.052138 |
| Barnett 3 | 14.534238 | 129.050336 |
| Barossa 1 | 12.020833 | 124.261111 |
| Bassett 1 | 13.31111 | 123.42667 |
| Bassett 1A | 13.311583 | 123.425222 |
| Bedout 1 | 18.244444 | 119.389611 |
| Berkley 1 | 14.004721 | 127.831111 |
| Berri 1 | 11.486111 | 124.563888 |
| Bilyara 1 | 12.684654 | 124.505886 |
| Bilyara 1 ST 1 | 12.684654 | 124.505886 |
| Birch 1 | 12.460841 | 124.495348 |
| Bougainville 1 | 13.773583 | 129.04181 |
| Brecknock 1 | 14.436964 | 121.6725 |
| Brewster 1 | 13.91361 | 123.2595 |
| Brewster 1A | 13.913706 | 123.259511 |
| Brown Gannet 1 | 12.108056 | 123.856111 |
| Buccaneer 1 | 13.616666 | 124.016666 |
| Buffon 1 | 13.393869 | 122.183228 |
| Cambridge 1 | 14.290431 | 128.432639 |
| Cartier 1 | 12.244166 | 123.940276 |
| Cassini 1 | 12.146501 | 124.968138 |
| Cassini 1 ST 1 | 12.146498 | 124.968136 |
| Cassini 2 | 12.148551 | 124.949416 |
| Casuarina 1 | 12.052446 | 125.098658 |
| Caswell 1 | 14.241306 | 122.4675 |
| Caswell 2 | 14.242528 | 122.469522 |
| Challis 1 | 12.123753 | 125.00446 |
| Challis 2 | 12.121666 | 125.018333 |
| Challis 2A | 12.121286 | 125.018568 |
| Challis 3 | 12.115125 | 125.022888 |
| Challis 4 | 12.129268 | 124.995086 |
| Challis 5 | 12.122263 | 124.996666 |
| Challis 6 | 12.109661 | 125.034593 |
| Challis 7 | 12.105366 | 125.040561 |
| Challis 8 | 12.102161 | 125.047823 |
| Challis 9 | 12.1091 | 125.035398 |
| Challis 10 | 12.126736 | 125.017348 |
| Challis 11 | 12.099143 | 125.054613 |
| Champagny 1 | 12.487223 | 124.312601 |
| Champagny 1 ST 1 | 12.487223 | 124.312601 |
| Cockell 1 | 11.667278 | 125.039228 |
| Cockell 1 ST 1 | 11.667278 | 125.039228 |
| Coonawarra 1 | 12.080554 | 124.353333 |
| Crane 1 | 12.125766 | 125.628168 |
| Curlew 1 | 11.770556 | 128.263888 |
| Cygnet 1 | 11.896124 | 125.939031 |
| Darwinia 1 | 11.441854 | 127.934766 |
| Darwinia 1A | 11.442118 | 127.934921 |
| Delamere 1 | 12.000475 | 125.304193 |
| Delta 1 | 12.649066 | 123.970348 |

| | | |
|---|---|---|
| Dillon Shoals 1 | 11.239263 | 125.446997 |
| Discorbis 1 | 12.882476 | 123.812796 |
| Douglas 1 | 11.795833 | 124.946388 |
| Drake 1 | 11.285013 | 125.835554 |
| Dromana 1 | 12.274998 | 124.9125 |
| East Mermaid 1 | 17.166944 | 119.822555 |
| East Swan 1 | 12.301968 | 124.582249 |
| East Swan 2 | 12.292674 | 124.583496 |
| Echuca Shoals 1 | 13.750342 | 123.723617 |
| Eclipse 1 | 12.271388 | 124.618609 |
| Eclipse 2 | 12.238423 | 124.643611 |
| Eider 1 | 11.389167 | 125.746389 |
| Evans Shoal 1 | 10.081523 | 129.531999 |
| Fagin 1 | 11.571388 | 125.137776 |
| Flamingo 1 | 11.026111 | 126.481944 |
| Flat Top 1 | 12.376472 | 129.265528 |
| Frigate 1 | 13.18 | 127.923611 |
| Fulica 1 | 11.088891 | 125.875276 |
| Garganey 1 | 11.356596 | 125.916388 |
| Garganey 1 ST 1 | 11.356596 | 125.916423 |
| Grebe 1 | 12.451111 | 124.249444 |
| Gryphaea 1 | 12.810646 | 123.739321 |
| Gull 1 | 11.941389 | 127.910277 |
| Heron 1 | 10.440833 | 128.95139 |
| Heywood 1 | 13.462683 | 124.066725 |
| Ibis 1 | 12.062021 | 125.346491 |
| Jabiru 1 | 11.932181 | 125.005222 |
| Jabiru 1A | 11.933561 | 125.004081 |
| Jabiru 2 | 11.934864 | 124.988837 |
| Jabiru 3 | 11.925583 | 125.00885 |
| Jabiru 4 | 11.921625 | 125.019882 |
| Jabiru 5 | 11.940204 | 124.989593 |
| Jabiru 5A | 11.939861 | 124.990171 |
| Jabiru 6 | 11.930321 | 125.012855 |
| Jabiru 7 | 11.920548 | 125.017303 |
| Jabiru 7 ST 1 | 11.917991 | 125.017401 |
| Jabiru 8 | 11.936518 | 125.01038 |
| Jabiru 8A | 11.936526 | 125.010388 |
| Jabiru 9 | 11.951113 | 124.980398 |
| Jabiru 10 | 11.922358 | 125.026016 |
| Jabiru 11 | 11.942079 | 124.993308 |
| Jacaranda 1 | 11.470835 | 128.16388 |
| Jarrah 1 | 11.289238 | 125.70328 |
| Jarrah 1A | 11.289333 | 125.703166 |
| Kalyptea 1 | 13.032998 | 123.872388 |
| Kambara 1 | 16.743011 | 122.437578 |
| Katers 1 | 12.675416 | 124.744416 |
| Keeling 1 | 12.620538 | 124.165036 |
| Keraudren 1 | 18.907592 | 119.15423 |
| Kimberley 1 | 12.60288 | 124.383086 |
| Kinmore 1 | 14.033614 | 129.262448 |
| Kite 1 | 12.067793 | 126.436761 |
| Lacepede 1 | 17.088333 | 121.444721 |

| | | |
|---|---|---|
| Lacepede 1A | 17.088439 | 121.444822 |
| Lacrosse 1 | 14.2975 | 128.58278 |
| Lagrange 1 | 18.274361 | 119.318916 |
| Langhorne 1 | 11.979638 | 124.365721 |
| Lesueur 1 | 13.95264 | 128.125833 |
| Leveque 1 | 15.753312 | 122.004906 |
| Lombardina 1 | 15.288942 | 121.537303 |
| Londonderry 1 | 13.614769 | 124.51183 |
| Longleat 1 | 12.563693 | 124.742111 |
| Lorikeet 1 | 11.173676 | 125.617996 |
| Lucas 1 | 12.260361 | 124.133804 |
| Lynher 1 | 15.9401 | 121.083065 |
| Maple 1 | 12.019916 | 124.538716 |
| Matilda 1 | 14.454828 | 128.749747 |
| Minilya 1 | 18.32465 | 118.732426 |
| Minjin 1 | 16.802153 | 122.379092 |
| Montara 1 | 12.689346 | 124.531661 |
| Mount Ashmore 1 | 12.560276 | 123.20667 |
| Mount Ashmore 1A | 12.560276 | 123.20639 |
| Mount Ashmore 1B | 12.560081 | 123.20781 |
| Nancar 1 | 10.988741 | 125.757818 |
| Newby 1 | 11.835278 | 129.101944 |
| Nome 1 | 11.655268 | 125.221291 |
| North Hibernia 1 | 11.671953 | 123.324741 |
| North Scott Reef 1 | 13.948054 | 121.974721 |
| North Turtle 1 | 18.909806 | 118.087776 |
| Octavius 1 | 11.847221 | 124.910555 |
| Oliver 1 | 11.644801 | 125.008801 |
| Osprey 1 | 12.219167 | 125.22084 |
| Paqualin 1 | 11.980638 | 124.5069 |
| Parry 1 | 12.270646 | 124.337516 |
| Pascal 1 | 12.203 | 124.221898 |
| Pearl 1 (Home Energy) | 17.851387 | 122.02777 |
| Peewit 1 | 12.656144 | 126.020894 |
| Pengana 1 | 11.891433 | 125.029043 |
| Penguin 1 | 13.607778 | 128.468333 |
| Perindi 1 | 16.828358 | 122.26314 |
| Petrel 1 | 12.826389 | 128.47418 |
| Petrel 1A | 12.831112 | 128.47223 |
| Petrel 2 | 12.853889 | 128.51389 |
| Petrel 3 | 12.935833 | 128.569498 |
| Petrel 4 | 12.888441 | 128.494751 |
| Phoenix 1 | 18.635292 | 118.7854 |
| Phoenix 2 | 18.602193 | 118.842526 |
| Plover 1 | 12.7125 | 126.368611 |
| Plover 2 | 12.958056 | 126.174444 |
| Plover 3 | 12.818156 | 126.115833 |
| Pokolbin 1 | 11.519443 | 124.552776 |
| Pollard 1 | 11.664721 | 124.56889 |
| Prion 1 | 12.404444 | 124.151944 |
| Prudhoe 1 | 13.748819 | 123.864203 |
| Puffin 1 | 12.308333 | 124.333611 |
| Puffin 2 | 12.363056 | 124.275277 |

| | | |
|---|---|---|
| Puffin 3 | 12.288783 | 124.35825 |
| Puffin 4 | 12.292226 | 124.360668 |
| Rainbow 1 | 11.937958 | 124.331913 |
| Rainier 1 | 12.062463 | 125.023008 |
| Rob Roy 1 | 13.971 | 124.199194 |
| Rowan 1 | 12.498298 | 124.393698 |
| Rutherglen 1 | 11.606943 | 124.470833 |
| Sahul Shoals 1 | 11.427221 | 124.54723 |
| Sandpiper 1 | 13.314722 | 127.976388 |
| Scott Reef 1 | 14.076108 | 121.824655 |
| Scott Reef 2 | 14.101111 | 121.8575 |
| Scott Reef 2A | 14.101575 | 121.857803 |
| Shearwater 1 | 10.513611 | 128.310278 |
| Skua 1 | 12.505278 | 124.432777 |
| Skua 2 | 12.509516 | 124.404346 |
| Skua 3 | 12.506121 | 124.414663 |
| Skua 4 | 12.493136 | 124.425766 |
| Skua 5 | 12.473919 | 124.443666 |
| Skua 6 | 12.487743 | 124.438568 |
| Snowmass 1 | 11.994708 | 125.179466 |
| Stork 1 | 11.491416 | 125.792638 |
| Sunrise 1 | 9.590097 | 128.153789 |
| Swan 1 | 12.188056 | 124.492777 |
| Swan 2 | 12.194727 | 124.495677 |
| Swift 1 | 12.537356 | 124.451507 |
| Tahbilk 1 | 12.732758 | 124.503976 |
| Talbot 1 | 12.453138 | 124.881616 |
| Talbot 2 | 12.457133 | 124.870329 |
| Taltarni 1 | 12.612863 | 124.579529 |
| Tamar 1 | 11.870924 | 126.211144 |
| Tancred 1 | 11.734743 | 125.323429 |
| Tern 1 | 13.220833 | 128.064722 |
| Tern 2 | 13.2789 | 128.132789 |
| Tern 3 | 13.336026 | 128.104471 |
| Troubadour 1 | 9.734394 | 128.123753 |
| Turnstone 1 | 11.736944 | 125.295833 |
| Turtle 1 | 14.476608 | 128.94484 |
| Turtle 2 | 14.505891 | 128.945791 |
| Voltaire 1 | 11.193351 | 125.331983 |
| Vulcan 1 | 12.241993 | 124.549474 |
| Vulcan 1A | 12.242261 | 124.549964 |
| Vulcan 1B | 12.242642 | 124.550339 |
| Wamac 1 | 17.240517 | 121.491563 |
| Whimbrel 1 | 12.482778 | 125.378055 |
| Willeroo 1 | 12.027721 | 124.897891 |
| Woodbine 1 | 12.645206 | 124.147072 |
| Yampi 1 | 14.558888 | 123.276077 |
| Yarra 1 | 12.047804 | 124.360026 |
| Yering 1 | 12.612888 | 124.517098 |