FRANKLIN

National Facility
Oceanographic Research Vessel
CRUISE SUMMARY

CRUISE FR 3/98

Sailed Hobart	0800 hrs	Thursday 19th March 1998
Sailed Portland	1145 hrs	Saturday 21st March 1998
Docked Outer Harbour	0700 hrs	Tuesday 7th April 1998

Cool-Water Carbonate Sedimentation, Bonney and Lacepede Shelves and Eastern Great Australian Bight

Chief Scientist

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Principal Investigators

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CSIRO RV *FRANKLIN*

RESEARCH SUMMARY FR 03/98

1. Itinerary

The cruise officially commenced from Hobart on Thursday 19th March, 1998. Scientists were taken aboard in Portland on Saturday 21st March 1998. The vessel departed Portland at 1145 hrs, (local time). The cruise ended with the vessel docking at Outer Harbour, at 0745 hrs on Tuesday, 7th April, 1998 (local time).

2. Scientific Program

The specific objectives of this research cruise were to:-

(1) close the only gap in a survey of the temperate-environment continental shelf, break and slope, from Portland to Ningaloo

(2) collect sediment samples to help characterise the Holocene sedimentary facies

(3) analyse the sea-floor waters, in terms of temperature, salinity, oxygen and nutrient levels, pH and transmissivity, and once on shore, composition, age and stable isotopes

(4) document the nature of the morphology of the shelf and shelf margin

(5) collect data to ascertain controls governing the distribution of warmer-water large foraminifers, corals, coralline algae and other warm-water biota in the eastern GAB

(6) to collect material to allow the documentation of the systematics of the bryozoans, molluscs, foraminifers, sponges, ostracods, crustaceans and corals present

(7) to document the distribution, food-source and other parameters governing the distribution of the king Crab, *Pseudocarcinus gigas*

(8) collect biota and mud for screening for active metabolites

(9) ascertain water current parameters across the shelf and down the slope margin

The cruise was multi disciplinary, but with the emphasis on geoscientific aspects. It utilised a number of different techniques, including precision depth profiling; rock, sediment and biota sampling by means of pipe dredging, epibenthic sled dredging and Smith-McIntyre grabbing; water sampling and analysis by means of CTD and flow-through fluorometry; sea-floor photography and real-time underwater video.

This is the sixth cruise, by these scientists, investigating such parameters along Australia's southern and south-western margin.

3. Principal Investigators

Dr Yvonne Bone, Dept. of Geology and Geophysics, University of Adelaide, SA, Dr Noel P. James, Dept. of Geological Sciences, Queens University, Kingston, Canada and Dr. Lindsay Collins, Dept. of Applied Geology, Curtin University, Perth have all had considerable marine experience, and up to six cruises aboard the RV *Franklin*, so that were able to maximise the scientific returns from this opportunity of time allotted to their work. Their research is funded by the Australian Research Council and the Natural Sciences and Engineering Research Council of Canada. On consultation with the Cruise Manager, Dr T. Kurtis Kyser was also designated a Principal Investigator, and took control of the hydrology aspects of the research. His research is funded by the Natural Sciences and Engineering Research Council of Canada.

4. Personnel

Scientific

Yvonne Bone	(University of Adelaide - Chief Scientist)
Noel James	(Queens University, Canada - 2IC, sediments)
Lindsay Collins	(Curtin University - sediments)
Kurt Kyser	(Queens University, Canada - geochemist)
Kirsty Brown	(University of Adelaide - biota, oceanography)
Samantha Ryan	(University of Adelaide - rhodoliths)
Rolf Schmidt	(University of Adelaide - bryozoans)
Andrew Levings	(Deakin University - crustaceans)
Paul Gammon	(Queens University, Canada - forams)
Dave Vaudrey	(CSIRO - Cruise Manager)
Erik Madsen	(CSIRO - Electronics)
Ron Plaschke	(CSIRO - Hydrochemist)

A. Levings' research is funded by Fisheries Research and Development Corporation.

Crew

Neil Cheshire	Master
Arthur Staron	Chief Officer
Allan MacCarthy	Mate
Ernie Watkins	Chief Engineer
Martyn Loffman	First Engineer.
Andrew McLagan	Electrical Engineer
Jannick Hansen	Bosun
Norm Marsh	AB
Wayne Browning	AB
Peter Bushnell	AB
Phil French	Greaser
Ron Culliney	Chief Steward
Gary Hall	Chief Cook
Tom Condon	2nd Cook.

5. Results

Sea-floor sediment and biota samples were obtained from 110 sites, ranging from nearshore (depths of ~30 m) to downslope depths of 1000 m. These were obtained by:-

epibenthic sled	89	samples
pipe (Bleys Dredge)	20	samples
Smith-McIntyre grab	1	sample

Water samples were obtained from 56 sites, from sediment sampling sites. These were obtained by CTD.

These samples were augmented by the deployment of the underwater camera at 20 sites and the real-time underwater video system at 17 sites.

Flow-through fluorometry recordings were made at regular intervals.

Bathymetric depth profiling was continuously recorded, along with surface temperature and surface salinity recordings. Bottom water temperature and bottom salinity data were recorded at all the CTD stations.

6. Cruise Narrative

The following narrative and all cruise records data were recorded in local Eastern Standard Time for both times and dates.

The cruise officially commenced from Hobart on Thursday 19th March, 1998. The scientists were taken aboard in Portland on Saturday 21st March 1998. This latter date is referred to as Day 1.

DAY 1 (Sat. 21st March) Departed Portland at 11.45 hr. Scientists and remaining equipment were loaded. This equipment included a still camera system, with the pressure housings and flash unit from the Dept. of Geology, James Cook University and a Pentax MX camera from Adelaide University. The system was re-built during the week, into a new frame and trigger release system, by Ingo Dorfstatter, of Professional Divers International, Portland. A real-time underwater video system had also been built by Ingo, with a maximum cost ceiling of $10K and a time frame of 4 weeks! This was a scaled-down version of the design he had produced for a system that would do everything that anybody could ever need for shelf and slope type work, e.g. tilt and pan, sample collector, temp., salinity, pH, O_2 level, etc. The cost of this system would be in the vicinity of $120K.

Everyone immediately sat down to lunch once we had cleared the dock. This was followed by an introduction by the Master and the Cruise Manager. Site prefix of ACM xxx was chosen. The planned talk by Yvonne on procedures, goals and activities was not discussed as this was interrupted by a fire-drill. We were on the first station immediately following the fire drill. This station, 12 nm from Portland, became Way Pt A/Site ACM 001. The epibenthic sled was deployed, returning a small sample of benthic biota and sediment, by which time more than half the scientists were suffering from sea-sickness.

The underwater real-time video camera system was taken apart so that Erik could ascertain how it operated, and check for any potential problems. There had been no time for a test run of the equipment by Ingo prior to sailing. Erik made a few minor modifications. A monitor and recorder were set up in the ops. room.

The still camera system, borrowed from James Cook University, was also dismantled after testing, as the flash was not operating reliably.

The ADCP had broken down during the leg from Hobart to Portland. Spare parts were flown in, and Eric got it up and running for a few hours, after which it irretrievably broke down. This meant the abandonment of this aspect of the cruise, which was a bitter blow.

A log was set up in which to record : Station no; day/date; time/GMT; depth; lat.; long.; action; surface salinity; bottom salinity; surface temp.; bottom temp.; sed. colour; grain size; shape; sorting; mineralogy; relict %; clasts; comments/ description/biota; photography/video and CTD. Kirsty and Rolf were designated as log recorders.

A further 3 stations were occupied.

DAY 2 (Sun. 22nd March) Some of the scientists still sea-sick to varying degree. Decision taken to change watches to 12 hr on and 12 hr off. This would allow the water chemists to concentrate on their analytical work instead of being involved in sediment sampling. The camera system was deployed, returning only 17 exposures from a 36 exposure film. The real-time video system was tested for the first time, and returned with all water-tight sections dry. 10 sites sampled.

The still camera was successfully deployed, but upon opening, the flash housing had water in it. This housing has always let water in, but Erik took everything apart and found that the hot-shoe wiring was completely eroded and was only firing by chance, not by design. He re-routed the wiring, eliminating the hot-shoe.

DAY 3 (Mon. 23rd March) The video camera was deployed at Station ACM 019 at 35 m, and everybody excitedly watched our first attempt at viewing the sea-floor below us. The result was pleasing, but showed that the lights and camera were slightly misaligned. Nevertheless, the 12 min of footage will supply ample material to illustrate the shallow, patchy red alga and sandy bottom. It could be readily seen that the sea-floor is constantly being swept by high velocity, strong currents.

Attempts to send material electronically to Adelaide to be downloaded on to the Internet were unsuccessful. The software for the digital camera could not be opened. E-mail request sent for further instructions. Scientists getting their sea-legs. 9 sites sampled, but ACM 022 had no recovery after two attempts, so was abandoned. A new bag was installed in the sled for Site ACM 025.

DAY 4 (Tues. 24th March) Sled got hooked up, weak link broke, but sled was retrieved, albeit with little sample. Rough-looking bottom on the sounder trace was confirmed by rocks in sample taken with pipe dredge. Continual problems with still camera, but Erik keeps on rebuilding it. 5 sites sampled.

DAY 5 (Wed. 25th March) More camera problems. Erik has now completely rebuilt the flash system. 8 sites sampled.

DAY 6 (Thurs. 26th March) Video working well at Site ACM 038, with some excellent footage showing seston in water mass near sea-floor.
More rocks. Lost pipe dredge at Site ACM 040. Fortunately, we have a spare. 6 sites sampled.

DAY 7 (Fri. 27th March) We are now well and truly in the Great Australian Bight. Ernie (C/E) modified the underwater video system frame so that the shadow of the bar does not show. He also modified the sharp corners to reduce the risk of hang-ups. 9 sites sampled.

DAY 8 (Sat. 28th March) Site 57 (90 m) returned an abundant assemblage and volume of sponges and bryozoa. This is similar to the western GAB, and unlike any

7. Summary

The anticipated loss of time through bad weather did not occur. Thus, Cruise 03/98 was highly successful, with all objectives achieved to varying degrees, apart from the ADCP facet. Follow-up work will undoubtedly provide much new information and allow increased reliability in our interpretations of the characteristics of the southern margin of Australia. It is to be hoped that the metabolite screening program reveals compounds that will benefit medical drug research. Specific topic summaries are:-

SEDIMENTOLOGY

A total of 110 sediment stations were occupied, using an epibenthic sled or pipe dredge, accompanied by CTD. 20 camera stations and 16 video sites were also selected from associated sites. Samples were obtained in depths of 30 to 500 metres. One deep station (1000m) was sampled, using a Smith-McIntyre Grab. Bathymetric profiles were run on all traverses.

Major findings were:-

- no living rhodolith pavements were found except within Spencer Gulf, where they had been anticipated:
-a drowned rhodolith zone at -100 to -150m will give important sea level history information;
-a wide, sandy shelf is characterised by an association of bryozoans, sponges and ascidians; this is frequently found as a semi-consolidated "firmground" substate, and as such it has an inhibiting effect on sediment movement, and a "binding" role;
-a sandy (rather than muddy) continental margin, where bryozoan communities are active in sediment production, often extending to -300m before slope muds are encountered;

The information collected , covering almost half the southern continental margin, is an important addition to the knowledge of the Australian continental margin sedimentation and history.

LIVING BRYOZOA

Bryozoans are the major skeletal components of the outer shelf, shelf break and upper slope carbonate sands in these cool-water settings of Southern Australia. The majority of stations sampled contained living bryozoans. Samples ranged from low to very high diversity. High diversity samples usually contain bryozoans of many different growth forms, occupying a wide range of microhabitats. Many of the Eastern GAB sites contain numerous living vagrants in quantities not seen elsewhere. *Adeona* sp. is not as common here as it is on the Western GAB, except for Site 57. The most widespread bryozoan type is the articulated zooidal form. This sediment-based observation is supported by the video footage. Upper slope samples contain fewer robust bryozoans but are a "fuzzy" low thicket of delicate cyclostomes and articulated zooidal and articulated branching cheilostomes. Slightly deeper below these sites, most of the bryozoans are dead, robust forms (e.g. arborescent, robust fenestrate, vagrant) and with approx. 50% of the sample consisting of solitary corals, of which 70% are dead and heavily abraded and 30% are living. A few, inshore sites contain only 1 or 2 species.

The prominent groups include several species of *Adeona*, *Adeonellopsis*, *Celleporaria*, many catenicellids, the vagrant forms (species of *Lunularia*,

of our previous samples. Heavy swells prevented deploying camera or video. 6 sites sampled.

DAY 9 (Sun. 29th March) Andrew's birthday - Gary made a wonderfully decorated birthday cake, complete with candles. Wish we could have found him a giant crab to put on top of it. 10 sites sampled.

DAY 10 (Mon. 30th March) 4 sites sampled.

DAY 11 (Tues. 31st March) Video system looks better without the shadow in the field of view. 7 sites sampled.

DAY 12 (Wed. 1st April) Most April's Fools' Day jokes were pathetic. Sample from Site 85 is a modern analogue for the Oligo-Miocene Gambier Limestone, but with more serpulids. 8 sites sampled.

DAY 13 (Thurs. 2nd April) Sampled first of GAB Marine Park Corridor transects. Heavy swell disallowed using the video. Most samples are sands, with minor living epifaunal biota. One site occupied at Head of Bight, sampled and CTD cast made. Video footage showed turbulent sandy bottom with no epifauna. Steamed to western corridor boundary. Video taken at 55 m showed multi-rippled sandy bottom with minimal epifauna. There is no floral component in any of the park sediments. 7 sites sampled.

DAY 14 (Fri. 3rd April) Steamed to 1000 m depth at the end of the Park Corridor transect to enable testing and calibration of new CTD equipment. Successfully deployed and retrieved Smith McIntyre at 1007 m, which contained a 5 cm thick plug of mud. A pore fluid sample obtained. Site ACM 100 saw the bag rip out of the sled, but we had a spare. 8 sites sampled.

DAY 15 (Sat. 4th April) The weather became better, enabling the deployment of the video at a number of sites. Excellent footage obtained, with Site 105 demanding running the video for 1 hour. Various ship's crew members (including the Master!) experimented with baiting the frame. Neil's ploy of tuna oil on a piece of rag gave the best results. We have to admit that the fish swimming by do add to the pictorial ("piscatorial"?) value of our video footage. 5 sites sampled.

DAY 16 (Sun. 5th April) Headed for home, via Site 57, as the sea surface was like a mill pond. Deployed the video system, and sat in the ops room enraptured. A sea-floor populated by an incredible variety of sponges, bryozoans and lesser ascidians and hydroids held the audience spell-bound. Lunch was ignored by many of the scientists whilst over an hour of video footage was filmed. Yvonne was reluctant to signal for the video to be brought back on board. No sampling done. Headed for Spencer Gulf.

DAY 17 (Mon. 6th April) The ship's boat was deployed and some of the scientists enjoyed a spin around the ship, with Jannik. A number of rolls of film were soon shot! We finally retrieved a large haul of rhodoliths for Sam, off Dangerous Reef (but didn't see any white pointers, much to Kurt's disappointment). More excellent video footage was taken of the rhodolith pavement. 4 sites sampled. Completed sampling at 4.30 pm. Cleaning up time.

DAY 18 (Tues. 7th April) Continued steaming to Outer Harbour, docking at 07.45 hrs. A euphoric feeling for all, but for varying reasons. The Chief Investigators still puzzled as to why they got a cruise with not even a single hour of down-time. All aims achieved apart from current data from ADCP.

METABOLITE SCREENING

Samples of macrobenthic fauna, predominantly sponges, were collected during the cruise for Dr Rob Capon and the Marine Natural Product Research Group, Department of Chemistry, University of Melbourne, whose main interests are the discovery of new organic chemical compounds occurring naturally in marine life forms. Research conducted by the group is directed to assessing the antibiotic activity of the extracts from these organisms.

Mud samples were also collected for a new research program looking at marine bacteria, with similar aims to those for the macrobenthic fauna project.

Material was collected by the epibenthic sled (1m x 0.25m gape) as part of the sediment collecting program. The sponges were frozen and the mud samples refrigerated, ready for transport to Melbourne, in order to preserve the nature of the chemistry.

8. Follow-up Laboratory Work (brief outline)

(a) Bulk sediment samples: These will be cleaned and dried, and a qualitative analysis of the composition of the bulk sample and the coarse fraction from each sample will be made by Bone and James. They will produce a facies map, based on sediment composition. Selected samples will be dated, to enable sea-level history interpretation. This aspect will be under the leadership of Collins.

(b) Bryozoa: The living bryozoans have been separated aboard and will be further taxonomically identified by Bone. Many of them will feature in the semi-pictorial publication, "Bryozoans of Southern Australia - A field and laboratory Guide", which is currently in preparation by Bone, Bock, Hageman, Cook and Campbell. All living species collected on this cruise will be photographed for inclusion. Bone will continue comparative studies with other modern areas and she and Schmidt will compare these to the fossil bryozoans in onshore Tertiary basins. Brown will determine which bryozoan species are epiphytic carbonate producers. Bone will continue her geochemical studies.

(c) Brachiopods: Kyser, Bone and James will continue their geochemical studies, testing the brachiopod analysed results against those measured in their ambient sea-water. Living and relict brachiopods from the same site will be compared, as will different species from the same site.

Dr L. Cohen, Dept. of Molecular Biology, Glasgow University, will be analysing the genetic sequencing of the unattached brachiopod, *Anakinetica cumingi.*

(d) Corals: Similar studies will be done on the corals as those done on the brachiopods.

(e) Water Samples: Kyser will analyse samples for stable isotopes, age and selected trace elements. These results will be integrated with work on phytoplankton productivity, and then overall integration with studies on both sediments and biota.

(f) Other Biota:

(i) Sponges: (a) Sponges will be screened for active metabolites by Dr Rob Capon, Dept. of Organic Chemistry, Melbourne University. (b) Sponges will be macerated and their hard parts studied (i.e. their siliceous spicules) by Bone and her group as part of a new project looking at the silt to fine sand-size components in carbonate sediments.

Selenaria and *Otionella*), *Sphaeropora*, *Parmularia*, and the fenestrate colonies of phidoloporid bryozoans. A large number of colonies occur encrusting rocks, shells, sponges, and other bryozoans. Many of these will not add significant amounts to the calcareous sediment as they are single sheet encrusters with a colony diameter of <1 cm. In addition, several other weakly calcified colonies are present which have no preservation potential. These include species of *Bugula*, *Flustra* and *Amathia*.

Because of the dominant role bryozoans play in the ecology of the Great Australian Bight, a detailed analysis of their habitats and distributions will aid in the understanding of this ecosystem as a whole. In addition, information about these Bryozoa will provide valuable insights for paleoenvironmental analysis of carbonate rocks from related settings throughout the Cenozoic of Australia.

WATER SAMPLING

Water samples from the deepest portions of all of the 56 CTD casts were collected for stable isotope analysis, nutrient contents, dissolved oxygen, and trace metal contents. In addition, 15 sites were sampled more extensively to augment the temperature and salinity data from the CTD, which were used to characterise distinct water masses.

Data from the CTD in conjunction with the nutrient contents measured on board clearly indicate that there are no fewer than 12 distinct water masses in the area covered by the transects. Although these data represent those waters present during this season, CTD and nutrient data collected from previous cruises can be compared with our extensive set to trace the seasonal extents of the various masses we identified. Among the more pronounced water masses that we will further charcterize with stable isotope and trace metal analysis are:
--High salinity and temperature waters originating from the Great Australian Bight
--Low nutrient shelf waters that make up the bottom waters of the Great Australian Bight
--Low salinity, relatively high temperature waters above these bottom waters that contain a component of the Leeuwen Current water
--Upwelling waters along the eastern margin of the great Australian Bight
-- Highly saline, high-temperature waters from Spencer Gulf
--Significant upwelled waters along most of the shelf margin southeast of Spencer Gulf.

Those waters that reside on the bottom of the shelf have salinities, temperatures, and nutrient contents that appear to correlate with distinct assemblages of biota. Consequently, there is a direct connection between water character and the biota present, which includes the calcareous biota that are producing the sediments presently being deposited along the shelf.

KING CRAB - *PSEUDOCARCINUS GIGAS*

The water characteristics, substrate types, food resources and species able to predate on juvenile benthic stages of *Pseudocarcinus gigas* were documented. This will allow the synthesis, using the whole ecosystem approach, of the fisheries biology of this valuable commercial species.

(ii) **Ascidians:** Ascidians will also be part of the silt to fine-sand-size components project of Bone et al.

(iii) **Crustacea et al.**: Levings will continue on his documentation of the factors that affect the distribution and abundance of the Giant crab *Pseudocarcinus gigas.* All crustacean samples will be given to Dr Gary Poore, Museum of Victoria, for identification.

(iv) **Foraminifera**: Dr Li Qianyu, Dept. of Geology and Geophysics, University of Adelaide, will analyse distribution of modern and relict specimens of both benthic and planktic species in all samples, and determine Holocene environments. Honours student, Samantha Burgess, will study 4 transects from the 4 different basins, and will compare them with transects taken at different times of the year in the case of the GAB and Lincoln Shelf.

(v) **Rhodoliths:** Ryan will assess the distribution of living and dead rhodoliths, their associations with other biota, their substrates, sea-floor temperature and salinity data and the factors that control their shape, density and size.

(vi) **Epiphytes:** Brown will use the epiphytes collected as the first pass collection for her PhD study on "Epiphytes as Carbonate Producers in Temperate environments".

(g) **Mud:** (a) Bone will determine the physical components, including complete and fragments or elements of biota, within the silt to fine sand-size fraction. (b) Capon will be assessing the living bacterial components.

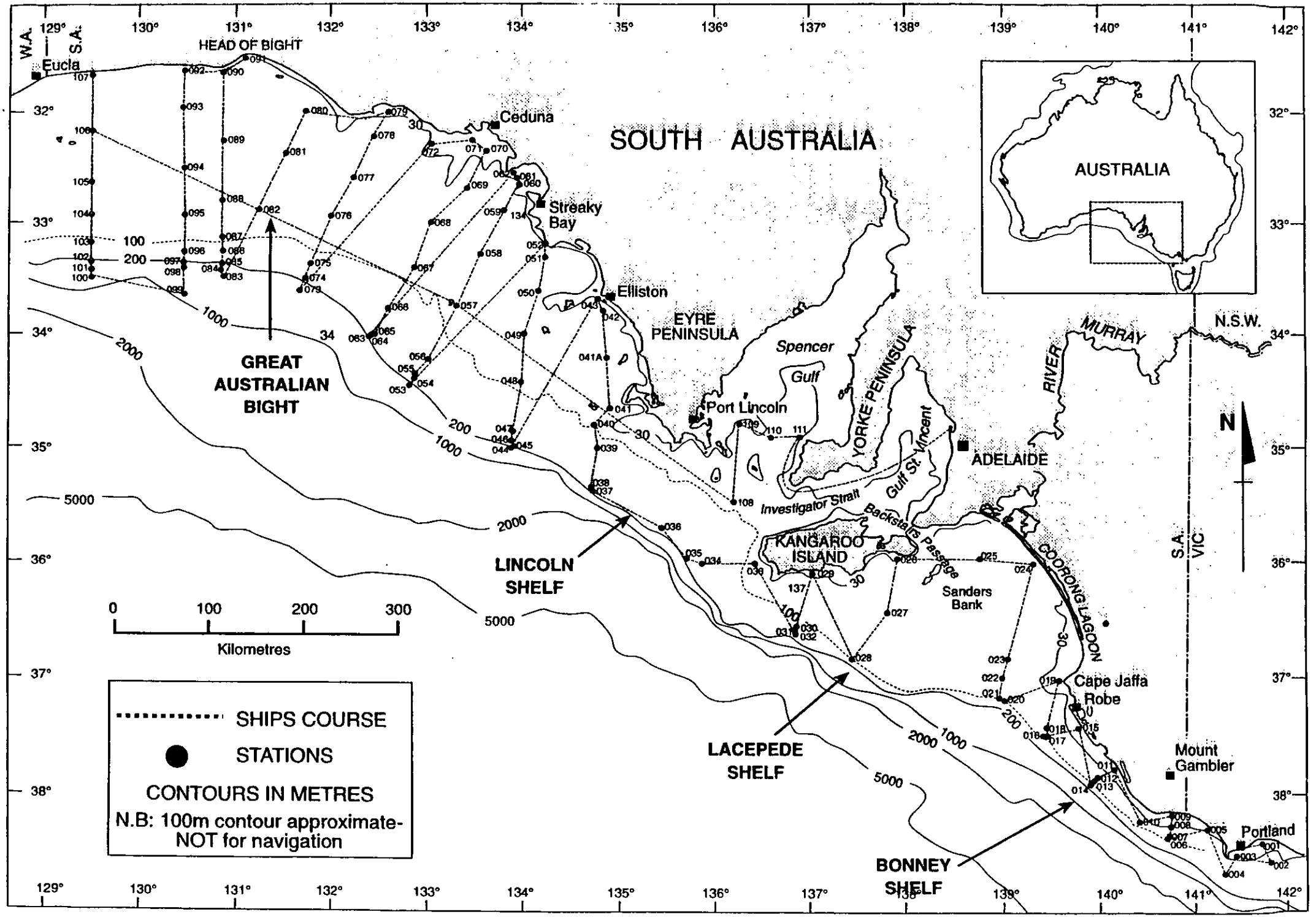
9. Acknowledgments.

The scientific party would like to acknowledge the professional expertise of Captain N. Chesire, and all officers and crew of CSIRO RV *Franklin* , and thank them for their unstinting and friendly help at all times. This is the sixth cruise in this series wherein the *Franklin* has proven itself to be an excellent research vessel, well-suited to this type of geo- and bio-scientific work. The CSIRO personnel (Cruise Manager, Dave Vaudrey, and Electronics Specialist, Erik Madsen) were thoroughly competent and co-operative. Their continuous cheerfulness and skill in all situations enabled non-stop data-gathering. Special compliments must be given to the Chefs, Gary and Tom, for their excellent culinary delights throughout the voyage.

We would also like to pay a special tribute to Ingo Dorfstatter of Professional Divers International Pty. Ltd., Portland, Vic. for his superb contribution to the success of this expedition. He designed, then built, the real-time underwater video system in less than a month, so that it went to sea with the paint on the frame still wet. He was not given time to test his model. The video footage obtained allows a major step forward in our presentation of the cool-water carbonate realm to the scientific community, and the world at large.

Dr Yvonne Bone
Chief Scientist

7th April, 1998


SOUTH AUSTRALIA
W.A.
S.A.
Eucla
HEAD OF BIGHT
Ceduna
Streaky Bay
Elliston
EYRE PENINSULA
GREAT AUSTRALIAN BIGHT
Spencer Gulf
Port Lincoln
YORKE PENINSULA
Gulf St. Vincent
ADELAIDE
Investigator Strait
Backstairs Passage
KANGAROO ISLAND
LINCOLN SHELF
LACEPEDE SHELF
BONNEY SHELF
Sanders Bank
COORONG LAGOON
Cape Jaffa
Robe
Mount Gambier
Portland
MURRAY RIVER
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SHIPS COURSE
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CONTOURS IN METRES
N.B: 100m contour approximate-
NOT for navigation