DEFENCE SCIENCE & TECHNOLOGY ORGANISATION

MATERIALS RESEARCH LABORATORY

MARITIME OPERATIONS DIVISION

HIGH-FREQUENCY ACOUSTIC BOTTOM BACKSCATTER STUDIES

CSIRO
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CRUISE PROPOSAL SS2/93

FRV SOUTHERN SURVEYOR, 03 MARCH - 12 MARCH 1993

CRUISE LEADER: M. J. Bell

R & D AUTHORITY:

M.D. Frost
Chief, Maritime Operations Division
21 January 1993

POSTAL ADDRESS: Chief, Maritime Operations Division,
DSTO Sydney,
PO Box 44, Pyrmont, NSW 2009

1. INTRODUCTION

FRV SOUTHERN SURVEYOR will conduct a research cruise in and around Beagle Gulf north of Darwin. The cruise will gather scientific data on the backscattering of high-frequency acoustic energy from the sea floor and follows previous cruises conducted in HMAS Protector in the Jervis Bay and Cairns areas. This work is relevant to the performance of both mine hunting sonars currently in service with the RAN and possible systems for the proposed MHC vessels.

As well as the bottom backscattering measurements, ancillary measurements will be made to assist in interpretation and analysis of the measured backscattering. These measurements will include stereo photography, sediment sampling and sound speed profiling of the water column.

Prior to conducting backscatter experiments, sites will be surveyed by side scan sonar to identify local variations in bottom characteristics and bathymetry. It is planned to conduct these surveys at night.

2. CRUISE PROGRAMME

A. Narrative

During passage from Hobart SOUTHERN SURVEYOR will divert and berth alongside MOD Pyrmont on 6 Jan 93 to load equipment for the cruise. A stores crane lighter may be used to provide craneage in Pyrmont.

The ship will proceed north to Townsville and undertake CSIRO studies before berthing in Darwin on 12 February. Personnel involved in the cruise will travel to Darwin independently of the ship but will arrive in Darwin to install and set to work scientific equipment (including the bulky tower structure) in the week preceding the sailing date 3 March .

The deployment platform for the bottom backscattering experiments is a tower approximately 4 metres high. It is intended to deploy the tower during daylight hours although it is possible that sea state conditions may make it necessary to conduct deployments during night hours. A typical deployment of the tower will entail a period of several hours on the sea floor. It is anticipated that there will be a maximum of two deployments each day. Some deployments will repeatedly measure in the same location, while others will be at other selected locations.

Two shallow water measurement sites in Beagle Gulf close to Darwin have been nominated by the RAN. Backscatter measurements will be conduced in each area. The trials areas proposed are, in order of priority:

AREA 214	12° 15'S, 130° 05'E	12° 15'S, 130° 10'E
	12° 18'S, 130° 05'E	12° 18'S, 130° 10'E
AREA 207	12° 00'S, 130° 38'E	12° 00'S, 130° 43'E

12° 04'S, 130° 38'E 12° 04'S, 130° 43'E

A deep water site approximately 100 miles west, near 12°S, 128°30' E, may also be investigated. The water depth at this location is about 90 metres.

B. Schedule

MOD equipment will be set to work and tested at Pyrmont before the cruise. Alongside in Darwin a minimum of five working days is required to install and test equipment.

Day	Date	Event
	Wed 06 Jan	Load equipment (Pyrmont)
	Tue 23 Feb-Tue 02 Mar	Install equipment (Darwin)
01	Wed 03 Mar	SOUTHERN SURVEYOR sails from Darwin and conducts side scan survey during transit. Side scan of area 1.
02	Thu 04 Mar	First experiment area 1.
03	Fri 05 Mar-Thu 11 Mar	Backscatter measurements. Order to be determined by consultation with CO and trials personnel.
10	Fri 12 Mar	SOUTHERN SURVEYOR berths in Darwin, Unload

Initially the acoustic measurements will be made at the shallow sites, commencing in Area 214, near 12°15'S 130°05'E. The order of subsequent experiments is dependent on the successful completion of measurements at this site and will be determined by consultation with the Commanding Officer FRV SOUTHERN SURVEYOR. The timing of the measurements in the deep area will depend on the weather and on progress in the shallow areas.

3. ADMINISTRATION

A. Scientific Personnel

MOD - DSTO

Mr. Michael Bell	Cruise leader
Mr. Jim Thompson	Scientist
Mr. John Shaw	Engineer
Mr. Ross Susic	Logging software
Ms. Jane Cleary	Scientist

Mr. Bill Martin	Electronics & Mechanics
Mr. Chris Halliday	Mechanics & Logistics

RAN

Two or 3 personnel to be nominated.

B. Organisation of Scientific Personnel

At the commencement of the cruise the cruise leader will allocate personnel to watches if necessary, and determine responsibilities. During the cruise the cruise leader may change these allocations and responsibilities as necessary for the conduct of the cruise.

C. Co-ordination

(i) Location: Darwin Area

(ii) Responsibility: The Cruise Leader is responsible for the initiation of experiments and location of stations within the overall time available.

(iii) Preparation: Most of the scientific equipment will be loaded on SOUTHERN SURVEYOR in Sydney. Computers and equipment not available on January 6 will be air freighted to Darwin. A minimum of five working days alongside in Darwin is required to test and install the equipment in the ship.

(iv) Unloading: The scientific equipment for this cruise will be unloaded in Darwin .

D. Security

All aspects of the cruise are unclassified.

E. Safety

The experimental programme will be suspended if the Commanding Officer considers that it is unsafe to proceed.

F. Command and Control

(i) R & D Authority:

Chief, Maritime Operations Division,
Materials Research Laboratory,
Defence Science and Technology Organization.

(ii) Task:

Mine Hunting Sonar Support, NAV 92/256.

(iii) Co-ordinator:

Mr. M. J. Bell,
Maritime Operations Division,
DSTO Sydney,
P.O. Box 44, Pyrmont 2009
Phone (02) 692 1422, Fax (02) 660 0019
DNATS 8-27 1422, Telex 127142
Located at: Wharf 17, Jones Bay Road, Pyrmont

G. Stores Requirements (FRV SOUTHERN SURVEYOR)

Nil for scientific work.

H. Tenure of Data

DSTO will retain all scientific records generated from the backscatter experiments. i.e. acoustic, side-scan sonar, CTD, sediment samples, stereo photographs and video records.

4. TECHNICAL PROCEDURES

A. Equipment Required For Cruise

(i) DSTO Equipment:

Tower (with pan & tilt)
Transducers (33 kHz, 100 kHz, 200 kHz and 300 kHz)
Underwater cable system
Deck leaders for underwater cables
Acoustic transmission, reception and recording system
- underwater electronics, including housing
- laboratory equipment & electronics to drive underwater electronics
- laboratory equipment & electronics to drive transducers from ship
- receive electronics
- data acquisition system

Stereo photography system
Laptop computer
Desktop computers for system control and logging
SDL portable CTD
Cable floats

Shipek grab
Sample bottles for sediments

(ii) RAN equipment

Route Survey Side Scan Sonar System
- control and navigation electronics
- towfish, winch and tow cable

(iii) Ship's Equipment:

Laboratory space
- computer Room
- operations Room

Fish laboratory
- bench for side scan sonar installation

Lifting equipment
- aft gantry hoist, including wire
- small towed bodies winch, including wire (for camera deployment)
- hydrographic crane

Echo sounder

B. Procedures For Scientific Measurement Programme

The tower is approximately 4 m high, with a 1.5 m wide steel base of square shape. It weighs approximately 1300 Kg. The structure is lowered to the sea floor for the bottom backscatter measurements. The tower has a pan-and-tilt mechanism to enable the acoustic transducers to ping on the sea floor at a variety of elevations and azimuths, and an on-board electronics module which is powered and controlled from the ship via electrical cable. The acoustic signals and instrument state data are transmitted to the ship via the electrical cable. Measurements are also remotely made of compass heading and of pan and tilt.

The stereo camera frame will be deployed to the sea floor from the starboard side small towed bodies winch. The system is self contained with flash and exposure controlled by an electronic timer installed in one of the water proof camera housings.

Water depths for deployment of the equipment vary from 20m in the shallow areas 207 and 214 to near 90 metres in the deep area. A grab will be used to obtain sediment samples at each measurement site.

CTD profiles will be taken during the measurement program.

C. Equipment Deployment

The tower structure has on several occasions been successfully deployed from HMAS Protector. The higher gantry on SOUTHERN SURVEYOR and the reduction in the height of the tower mean that a simpler procedure can be used.

The tower will sit vertically under the aft gantry. The gantry hoist will lift the tower outboard of the stern via the top lifting point. The tower will then be lowered to the sea floor using the net winch.

Cable deployment is an important aspect of the total deployment. The electrical and strength cables must be held clear of the pan and tilt mechanism at the top of the tower so as not to foul. On previous experiments this has been accomplished by tying the electrical and strength cables together over the first ten or so metres, and attaching floats to support this combined cable. The cables were then led to the ship with the electrical cable supported by a series of floats. A similar procedure is proposed for this cruise.

D. Ship Positioning

In order to make the backscatter measurements, the scientific equipment mounted on the tower is deployed on the sea floor. A multicore electrical cable (350 m length) separate to the support cable links the equipment to the ship throughout the experiment. This cable provides power and bi-directional communication between laboratory equipment and the instrumentation package. Both the electrical umbilical cable and the strength cable are connected to the ship throughout the experiment. These cables must be buoyed so that they do not drape into the structure and foul the equipment. The ship must remain in close proximity to the frame, due to the limited length of the underwater electrical cable.

Constraining the ship position is vitally important for the success of the operation. This problem will be aggravated by tidal streams in Beagle Gulf, where currents in excess of 1 knot are expected, and in deep water. While current in itself does not impose constraints on the conduct of the backscatter measurements a change in current direction which causes the ship to swing at anchor does. It is therefore desirable to anchor the ship fore and aft to restrict swinging. If this is not possible, backscatter measurements may need to be limited to flood or ebb tides.

The bottom photography should be conducted during periods of low current.

E. Side Scan Sonar Survey

The RAN will install a side scan sonar system for the cruise. This equipment will be loaded and installed in Darwin and comprises a Route Survey System with an integrated navigation equipment system (differential GPS). A winch for the cable and towfish will be installed on the shelter deck aft. Control electronics and displays will be fitted to

benches in the fish laboratory. Accurate navigation is required during the side scan surveys and some equipment displays may be mounted on the bridge to assist in this regard. The side scan sonar system will be operated by RAN personnel.

The side scan survey should be conducted at four knots with the towfish 8 metres off the bottom in the shallow areas. A depressor may be fitted to the towfish in deep water. Initial lane spacing will be 200 metres but may be changed depending on system performance. The rate of area coverage thus achieved will be 2 hours per square mile.

5. DISTRIBUTION

RAN:

Hydrographer
Director, Hydrographic Office, Sydney
Mine Hunter Coastal, Project Director
Mine Sweeper Project Director
Naval Scientific Adviser
Director of Oceanography and Meteorology

DSTO:

Chief, Maritime Operations Division
RLSSS, Maritime Operations Division
DSTO Cruise Participants, as listed in 3.A
DSTO Sydney Library
MRL Melbourne Library
DSTO Sydney Registry, File 490-1-16

CSIRO:

Chief , CSIRO Division of Fisheries
Chief , CSIRO Division of Oceanography
Library, CSIRO Hobart
C. Liron
FRV SOUTHERN SURVEYOR (3 copies)

CO-OPERATING INSTITUTION:

Ocean Technology Group, University of Sydney