R.V. FRANKLIN

NATIONAL FACILITY

OCEANOGRAPHIC RESEARCH VESSEL

CRUISE SUMMARY

R.V. 'FRANKLIN'

FR 2/86 ('PACLARK')

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AUSTRALIA

R.V. FRANKLIN IS OWNED AND OPERATED BY CSIRO

CRUISE SUMMARY
R.V. 'FRANKLIN'
FR2/86 ('PACLARK')

Itinerary
Depart Cairns 1250 Thursday April 3, 1986
Arrive Townsville 0600 Sunday April 20, 1986

Scientific Program
Search for submarine hydrothermal vents, western Woodlark Basin

Principal Investigators

1. Dr. R.A. Binns,
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Cruise Objectives Achieved

While no active vents were photographed or dredged (this was always a slim expectation), the cruise achieved its prime objective in demonstrating that hydrothermal activity is occurring in the western Woodlark Basin and that the geological environment is unique as expected and more closely analagous to that of ancient volcanogenic massive sulfide orebodies than midocean spreading zones.

Besides numerous fresh basalts, many were dredged with ferruginous and manganiferous hydrothermal coatings. One probable low temperature metalliferous deposit, rich in Zn, Fe and Mn and showing evidence of abundant bacterial activity was sampled. Andesitic volcanics were also retrieved from a seamount and a graben-like valley on the western extension of the Woodlark spreading system near a dormant volcanoes on Fergusson, Dobu, and Sanarra Islands. Continental metamorphics were dredged from several elevated regions of the seafloor.

A previously uncharted area between Fergusson Island and the 'normal' basalt-floored eastern Woodlark axis was explored with echosounder and magnetometer. The collective results yield a detailed picture of how a seafloor spreading axis propagates into continental crust.

Further details are given in the attached 'PACLARK' cruise report. A post cruise work program was developed on board, aimed at a preliminary scientific note by September 1986 and a comprehensive publication by January 1987. A follow-up cruise (PACLARK II) will be proposed for 1988.

Cruise Narrative and Results

After proceeding across the Coral Sea and through Jomard Entrance to the Woodlark Basin, a 24 hour/day operation was conducted of echo sounding, dredging, coring, camera tows, CTD-transmissometer soundings, hydrocasts, and magnetometer profiling. See attached 'PACLARK' report for details. Stations (apart from echosounder and magnetometer tracks) are set out in Fig. 1. A preliminary handcontoured bathymetric chart of the previously unsurveyed area centred on 151°08'E and 9°43'S was prepared. Fig. 2 identifies features to which informal names, applied during the cruise, are used in the detailed 'PACLARK' report.

Scientific Personnel

Papua New Guinea
Eric J. Finlayson (PNG Geological Survey)
Australia
Ray A. Binns (CSIRO Division of Mineral Physics and Mineralogy, Co-Chief Scientist, land)
Dave J. Whitford (CSIRO Division of Mineral Physics and Mineralogy)
Dave R. Cousens (CSIRO Division of Mineral Physics and Mineralogy)
R. (Bob) J. Edwards (CSIRO Oceanography, Cruise Manager)
Alan W. Poole, (CSIRO Oceanography)
R. (Bob) V. Burne (BMR, Baas Becking Geobiological Laboratory)
Canada
Steve D. Scott (University of Toronto) (Co-Chief Scientist, sea)
Mike P. Gorton (University of Toronto)
Tim F. McConachy (University of Toronto and CRA Exploration Pty Ltd)
R. (Dick) L. Chase (University of British Columbia)
A. (Sandy) W.S. Denton (University of British Columbia)

General

Although not specifically designed for marine geoscience, RV 'Franklin' proved eminently suitable for the purpose and remains untested only with respect to seismic sounding. Laboratories were adapted to 'PACKLARK' needs as follows.

Operation Room: Magnetometer, GPS Navigation and Caesium Clock installed in racks (magnetometer cable passed through Chemistry laboratory). The 'Ops Room' was constantly manned by 2 or more scientists for navigational recording and control of over-side activities. The light table was definitely needed. For further cruises of this type it would be undesirable to replace this or rack space by additional computer terminals.

Computer Room: No modifications made. See note concerning air conditioning in port in detailed report.

Chemistry Laboratory: Used primarily to study and curate rock and sediment samples and filtered particulates from hydrocasts. After removing or covering other apparatus, microcopes were screwed onto the port bench and the central bench was used for laying-out. Our intention to conduct Mn analysis of water and filtered particulates at sea was abandoned at the last minute, but had we pursued this there would have been a space problem.

Wet Laboratory: Used essentially full time to subsample and filter seawater either directly from Niskin bottles or from storage carboys, as well as for preparation of CTD rosette for launching. Space tight but sufficient.

After-deck: There was plenty of space for dredge, corer, and camera activities. Addition of a container laboratory would be feasible and desirable if future geoscientific cruises were to include on-board chemical analysis.

General Purpose Laboratory: Set up exclusively for camera maintenance and colour film development (8 steps not requiring total darkness and preheating of chemicals). Lashing down included use of G-clamps, particle board templates, cords. A supply of angle brackets for use on bench sockets and wall channels was acquired in Cairns and left aboard.

Darkroom: After removal and stowage of the auto-printer (never used?) this was set up for camera loading, spooling of film (30 m rolls) onto processing spiral, and the four processing steps requiring total darkness. Space very tight, but despite initial trepidation colour film development at sea proved relatively easy. The darkroom leaks light and it was necessary to darken and seal off the adjacent GP Laboratory during camera loading and film processing.

Drawing Office: Used for drafting, word processing, and video camera preparation/stowage. Uncomfortable at sea and initially affected by engine-room fumes.

Ship's equipment generally functioned well and always adequately with the exception of the main towing winch, which could not be used after the fifth day on station (see detailed report). The Master, officers and crew were most helpful and attentive throughout and contributed greatly to the successs of the cruise.

R.A. Binns

R.A. Binns
Co-Chief Scientist

R.J. Edwards
Cruise Manager

PACLARK CRUISE REPORT

WESTERN WOODLARK BASIN

APRIL 3-20, 1986

VESSEL: RV FRANKLIN (cruise FR2/86)

OBJECTIVES

1. To locate evidence of present-day hydrothermal activity and deposits in the Western Woodlark Basin.

2. To map the submarine geology and understand the tectonics of ocean ridge propagation into the adjacent craton.

PERSONNEL

R.A. Binns (Co-chief Scientist, on land) CSIRO
S.D. Scott (Co-chief Scientist, at sea) University of Toronto
R.V. Burne (sediments) BMR-BBL
R.L. Chase (basalts, tectonics) University of British Columbia
D.R. Cousens (computing) CSIRO
A.W.S. Denton (sediments) University of British Columbia
R.J. Edwards (Cruise Manager) CSIRO
E.J. Finlayson (regional geology) PNG Geological Survey
M.P. Gorton (electronics, petrology) University of Toronto
T.F. McConachy (hydrothermal plumes) University of Toronto
A.W. Poole (CTD, electronics) CSIRO
D.J. Whitford (geochemistry, petrology) CSIRO

SUMMARY

PACLARK was an unqualified success in achieving its objectives despite the adverse effect of losing the main towing winch on the fifth day of operations. We have come away from the Western Woodlark Basin with a firm understanding of its geology and tectonics but with a need to learn more. We have found good evidence for present-day hydrothermal activity and have dredged a probable low temperature iron+manganese oxide deposit anomalous in zinc and arsenic. Excellent targets have been defined for further investigation. Western Woodlark Basin is perhaps the best place in the world to study the effects of ocean ridge propagation into a continental margin and the implications that this has for the generation of submarine massive sulfide deposits. We have identified a transition from normal seafloor spreading with young basaltic volcanism to a regime within the continental margin of apparently short-lived failed and active rifts of limited strike length and floored by andesite. Both regimes appear to be presently hydrothermally active.

Altogether, PACLARK completed about 400 n.mi. (740 km) of bathymetric profiling and 225 n.mi. (400 km) of magnetometer surveys, including 186 sq. n.mi. (about 600 sq. km) in a previously uncharted area where we found the andesites; 13 dredge and 10 gravity core lowerings with mixed success affected

by the loss of the towing winch; 3 near-bottom camera tows which were curtailed by loss of the main winch; and 11 CTD rosette hydrocasts with an attached transmissometer.

Our principal recommendations are that a second PACLARK cruise be planned for when RV FRANKLIN is next in eastern ports in 1988 and that the ship acquire a new, reliable main towing winch.

NARRATIVE (See map for locations.)

Day 1 (April 3): Departed Cairns 1250. Scheduled departure at 0600 delayed by repairs to ship's electrical system. Rough passage.

Day 2 (April 4): In transit. Rough seas from southeast.

Day 3 (April 5): Arrived Jomard Entrance at 1300. Began watches 4 hours on and 8 hours off: 12-4 Burne (captain), Edwards, Whitford; 4-8 Chase (captain), Binns, Cousens; 8-12 McConachy (captain), Finlayson, Gorton; Floaters Denton (camera), Poole (CTD), Scott (Chief Scientist). Located large seamount at 9° 48'S 151° 35'E which we have informally named "Moresby Seamount". Deployed radar reflector buoy over Moresby Seamount in 180m of water.

Day 4 (April 6): Sediment core S-1 taken in deep basin on northeast side of Moresby Seamount (informally named "East Basin"). Recovered a small amount of pelagic mud, several pieces of fresh basalt glass and one piece of altered basalt veined by goethite (former iron sulfide?). Dredge D-1 on north slope of Moresby Seamount recovered many small pieces of old continental material, predominantly metasediments. Echo sounding survey of East Basin revealed a prominent E-W ridge which is believed to be the spreading axis of a pull-apart basin. Camera tow C-1 of East Basin aborted because of problems of compatibility between the 110 dB O.R.E. pinger and Simrad recorder. YEOKAL CTD on camera sled leaked. Added larger reflector to radar buoy. Camera tow C-1A of East Basin was successful. Used 93 dB Benthos pinger which gave a very weak signal at times; severe problems navigating by range and bearing from radar reflector. Photos show thin (a few centimetres) sediment on sheet and lobate flows.

Day 5 (April 7): Sediment core S-2 in East Basin recovered about 1 metre of khaki-brown pelagic mud. Ran several echo sounding lines over prominent E-W valleys and ridges near 9° 55'S 151° 55'E and a deep basin at 9° 52'S 151° 50'E. CTD hydrocast H-1 of suspected spreading basin at 9° 52'S 151° 49.5'E. No temperature or transmissometer anomaly. Took five 10 liter Niskin samples from 2751m to 1119m as reference standards. The CTD malfunctioned towards the end of the upcast and the last three bottles were not fired. Dredge D-2 of southwestern lobe of seamount near 9° 48'S 151° 48.5'E recovered a large haul of fresh, highly vesicular basalt, felsic pumice (exotic from SW Pacific Island arcs) and two worms about 6 cm long with "leathery" epitheca.

Day 6 (April 8): Dredge D-3 in East Basin near 9° 48'S 151° 40'E recovered a good haul of very young, glassy basalts, some with large plagioclase phenocrysts, and pelagic mud. Tubules, 2 diameter, made of soft, white, coarse crystalline material (barite?) on one basalt upper surface are of probable hydrothermal origin. Camera tow C-2 from east flank of seamount centred on 9° 54.5'S 151° 50'E (informally named Franklin Seamount) eastward into prominent E-W valley suspected on basis of bathymetry and BMR magnetics to be the spreading axis. Photos show bioturbated sediment covering lobate and sheet lavas as well as relatively unsedimented talus. Dredge D-4 on west flank of Franklin Seamount near 9° 54.5'S 151° 18.5'E returned approximately 1.5 tonnes of old basalt of several types and a large quantity of bright red iron- and manganese-rich oxide crusts which look very much like ochre and umber. The crusts are clearly hydrothermal in origin but whether they are low-temperature precipitates (more likely) or are an oxidation product of sulfides is uncertain. The iron-rich ochre contains siliceous tubules which appear to have been deposited around filamentous bacteria as has been found around several hydrothermal vent sites in the Eastern Pacific and in cherts associated with ancient massive sulfide ores. One crust has grown around what appears by comparison tests under a microscope to be a piece of nylon rope which, if the identification of the rope is correct, dates the sample at no more than 40 or 50 years and probably much less. The deposit was named "Beaujolais".

Day 7 (April 9): Attempted dredge D-5 of seamount at 9° 51.5'S 151° 55'E aborted as soon as dredge touched bottom because of bad sea state. Sediment tubes in dredge returned mud with a few small grains and a 2 cm long tubular shell. Grains are felsic volcanic but may be from exotic pumice. Echo sounding surveys of deep basins to the immediate N of Moresby Seamount centered at 9° 42'S 151° 34'E (informally named "West Basin") and 9° 45'S 151° 38.5'E (informally named "Middle Basin") revealed E-W ridges 50 to 75 m high which we interpret to be spreading axes. CTD hydrocast H-2 over the E-W ridge at the east side of West Basin near 9° 43'S 151° 36'E gave no evidence of hydrothermal activity in the temperature or transmissometer records; water samples taken anyway. Camera tow C-3 over this same ridge revealed virtually 100% bioturbated sediment. Peculiar spiral patterns about 50 cm in diameter produced by benthic animals.

Day 8 (April 10): Dredge D-6 on west side of West Basin near 9° 44'S 151° 36'E recovered a large haul of mud. Dredge D-7 in Middle Basin near 9° 45'S 151° 37'E returned another large haul of mud from which was sieved basalt chips, pumice (exotic) and small pieces of wood. DISASTER STRUCK!! Main towing winch with only about 200 total hours of use went out of commission because the motor and drum had separated and could not be repaired at sea. We were restricted to using the 6 mm hydrowire on the starboard winch so could no longer use our camera, large dredge and large corer, all of which had been returning good data. CTD hydrocast H-3 in East Basin near 9° 48'S 151° 40'E gave no transmissometer or temperature anomalies; took water samples anyway.

Day 9 (April 11): N-S echo sounding and magnetometer lines centred at 9° 40'S 151° 18'E. Magnetic high (Brunhes Anomaly 1?) and prominent E-W ridge (spreading axis?) in basin centered at 9° 38.5'S 151° 19'E (informally named "Norwest Basin"). Commenced program of echo sounding and magnetometer lines in uncharted area to the west at 151° 10'E and 151° 05'E. CTD hydrocast H-4 in E-W valley near 9° 43'S 151° 26'E where Harmon Craig had dredged mud just prior to PACLARK. An extremely weak transmissometer anomaly was recorded between 2100 and 2325m. Took water samples.

Day 10 (April 12): Two attempts to get hydrowire minidredge (constructed from spare sediment traps for the main dredge) onto the bottom without a pinger failed. Continued echo sounding and magnetometer survey of uncharted area starting at 151° 00'E and continuing eastward at one mile spacing. Submarine volcano (informally named "Dobu Seamount") within Anomaly 1(?) at 9° 47'S 151° 00'E. Made a short (~1 m) sediment corer for use on the hydrowire by removing barrel from the gravity corer and adding two 25 kg lead weights. We expected this corer to recover rock fragments from talus. Sediment core S-3 in Norwest Basin at 9° 38.5'S 151° 17.5'E returned 15 cm of pelagic mud. CTD hydrocast H-5 E-W traverse near 9° 37'S 151° 18'E encountered a weak (<0.5%) transmissometer anomaly from 1700 to 1850 m. Took water samples.

Day 11 (April 13): Sediment core S-4 aborted when pinger trace was lost. Continued echo sounding and magnetometer lines in the uncharted area at 151° 02'E and 151° 06'E. CTD hydrocast H-6 N-S traverse across prominent ridge near 9° 41'S 151° 16.5'E and into west end of Norwest Basin. Weak transmissometry anomaly on both north and south side of the seamount.

Day 12 (April 14): CTD hydrocast H-7 on southwest side of Norwest Basin detected a weak transmissometer anomaly between 1725 and 1850m. Continued echo sounding and magnetometer survey of the uncharted area along lines at 151° 12', 08' and 07'E. Sediment core S-4A on top of ridge at 9° 40'S 151° 16.5'E recovered a small amount of mud with granules of metamorphic rock suggesting that this seamount is old basement. Sediment core S-5 on east side of the seamount was aborted when the pinger trace was lost.

Day 13 (April 15): Sediment core S-6 at 9° 44.8'S 151° 26.2'E on the east flank of a ridge recovered ~15 cm of pelagic mud and several 2 cm angular fragments of fine grained metamorphic rock. Therefore, this ridge on the south side of a prominent (spreading?) valley is basement. Continued echo sounding and magnetometer lines in the uncharted area at 151° 14', 13' and 11'E. The bathymetry and magnetics of the uncharted area reveal two steep-sided and deep E-W valleys (rifts) separated by 9 minutes of latitude. The southern valley centred along 9° 40.57'S is informally named "South Valley"; the other centred along 9° 49'S is "North Valley". North Valley is about on strike with Norwest Basin. Sediment core S-7 from the top of Dobu Seamount at 9° 47.3'S 151° 59.7'E taken in ~620m of water recovered small (~0.5 cm) angular pieces of red vesicular andesite (55-58% SiO_2 by refractive index). One andesite fragment contains an inclusion of black vesicular lava. There was no sediment. Sediment core S-8 on the southeast flank of Dobu Seamount at 9° 48'S 151° 00.4'E recovered a few small chips of basaltic andesite or olivine basalt. Sediment core S-9 on the floor of South Valley southeast of Dobu Seamount at 9° 48.5' S 151° 00.6' E recovered small fragments of vesicular andesite glass (56-58% SiO_2). South Valley is clearly a nascent rift. CTD hydrocast H-8 traverse in South Valley between 151° 01' and 03'E intersected a weak transmissometer anomaly (hydrothermal plume?) from 15m (deepest lowering) to about 135m off bottom.

Day 14 (April 16): Sediment core S-10 in west end of South Valley at 9° 48'S 151° 02.7'E recovered small pieces of andesite glass (56-58% SiO_2) with very little sediment. The sediment corer was lost on the next lowering; the cotter pin appeared to have come out of the swivel. Dredge D-10 with the minidredge on the hydrowire lowered at the east end of South Valley at 9° 46'S 151° 08.5'E recovered mud containing terrigenous detritus of quartz and metamorphic minerals. Completed echo sounding and magnetometer survey of the uncharted area with lines at 151° 10', 09' and 04'E and, in order to define the western side of Dobu Seamount, at 150° 59' and 58'E. CTD hydrocast H-9 on the southern flank of Dobu Seamount near 9° 48.5'S 151° 05'E found no anomalies. Water samples taken from 860m and up. New dredge for hydrowire made by Pete Noble, Chief Engineer, from 3" pipe. Used rope as a weak link. Dredge D-11 in South Valley near 9° 48.5'S 151° 05'E returned only loose brown mud. CTD hydrocast H-10 in South Valley near 9° 48.5'S 151° 06.7'E found a weak transmissometer anomaly 250 to 300m off bottom. Took water samples.

Day 15 (April 17): Dredge D-12 in North Valley near 9° 40'S 151° 09'E recovered a small amount of brown mud. Dredge D-13 also in North Valley near 9° 39.4'S 151° 10'E recovered mud, some of which is indurated. CTD hydrocast H-11 in the deepest part of North Valley near 9° 40.6'S 151° 09.3'E encountered a weak transmissometer anomaly from 20m (deepest lowering) to 340m off bottom. Took water samples. Recovered what was left of our radar buoy over Moresby Seamount. Anchor buoy was still there; reflector buoy was suspected to have been taken by a fishing boat which was seen leaving the area with a yellow object in tow as we approached. Departed for Townsville via Jomard Entrance at 1315.

Day 16 (April 18): In transit. Moderate swell and wind from southeast.

Day 17 (April 19): In transit with rough seas on our beam.

Day 18 (April 20): Berthed at Townsville 0600.

SHIP'S OPERATION

RV FRANKLIN is well suited for marine geological work with her large afterdeck, 12 ton A-frame, TAC propulsion system for holding station and low-speed manoeuvering, and good sight lines from the winch control on the bridge. We used all of her equipment during the PACLARK cruise and encountered some problems, one very serious and the others a minor nuisance.

The serious problem was the complete mechanical failure of the main towing winch during the early morning of our fifth day on station in the Western Woodlark Basin. The winch is a hybrid of unusual design. The motor and drum are joined by dogs that are not bolted together. The bolts attaching the inner dog to the drum appear to have stretched or sheared with the result that the spline began to separate with a loud grinding noise as the drum sagged. The winch had had only about 200 total hours of use from all cruise and was not unduly stressed during PACLARK. The cause of the failure appears to have been premature wearing resulting from a faulty design. With the towing winch out of commission, we were no longer able to deploy our deep-tow camera, large dredge and large sediment corer which we had been using with great success.

Minor inconveniences included (1) a baulky side A-frame that had to be started manually; (2) bad spooling of the hydrowinch and CTD winch; (3) a break in the outer sheathing of the CTD conducting cable inflicted in port by N.Q.E.A. which limited us to 3110m of wire out; (4) problems of registering pinger traces on the fastest scale (0 to 250m) of the Simrad echo sounder as is needed for flying the camera system 3m off bottom; (5) the Simrad recorder having a 1.2 second repetition rate instead of the usual 1.0 seconds; (6) no calibration of the tensiometer on the large General Oceanics sheave on the stern A-frame; (7) dirty fresh water supply, especially in the chemistry laboratory; and, (8) intermittent failures of the TAC manoeuvering system.

Computer difficulties limited attempts to develop computer acquisition of magnetic and navigation data. Corrosion on the backplane pins of one faulty DRV-11 points to possible problems of condensation due to lack of dehumidification while the ship is in port. Further failures are likely even if the computers are not in operation under humid conditions.

The officers and crew of the FRANKLIN performed admirably, adapting to exacting tasks such as camera flying which they had not done before.

NAVIGATION

Navigation for scientific purposes was by GPS using a Trimble 4000A receiver with Hewlett Packard 5061A Cesium Beam Frequency Standard, ship's SATNAV system and radar ranging.

GPS with 3 or 4 satellites in sight gave superb fixes but was available only from about 0400 until, variably, 1200 to 1400 hours. Attempts to stretch the GPS window by using 2 satellites and the cesium clock were unsuccessful. The addition of the IPPS output option on the GPS would have allowed the use of a suitable frequency counter to correct the setting of the frequency offset of the cesium clock. A high precision counter is necessary for this operation. Computer acquisition of navigational and magnetic data was not achieved. The GPS communications interface does not behave as per the manual and all attempts to communicate succeeded only in locking the keyboard. These attempts were abandoned in favour of laborious manual acquisition when the first station was reached.

SATNAV fixes commonly disagreed with GPS by 1/2 n.mi. The disagreement invariably became worse after dead reckoning for a few tens of minutes to as much as 6 hours. Only actual satellite fixes were used and even these with scepticism.

Out of GPS time, radar ranges and bearings on prominent points of nearby islands (3 to 15 n.mi. range) or on a radar reflector which we anchored in about 180m of water over Moresby Seamount were used. Under good conditions, the reflector was visible to radar at 7 n.mi. Our experience was that radar fixes from land were commonly off by about 1/2 mile relative to GPS and that radar fixes varied by as much as 1/2 mile between operators. Some islands are clearly as much as 1/2 n.mi. out of position on the Admiralty charts relative to GPS.

ECHO SOUNDING

Despite the problems with the Simrad recorder mentioned above, the system was easy to use, was virtually trouble-free and gave good records. Altogether, we ran about 400 n.mi. (740 km) of echo sounding lines, most of these in mapping the bathymetry of an uncharted 186 squ. n.mi. area from about 9° 35'S to 9° 52'S and 151° 00'E to 151° 15'E at 1 n.mi. spacing. This mapping revealed a prominent seamount (Dobu Seamount) centered at 9° 47'S 151° 00'E shoaling to about 620m, and two deep and relatively flat-floored E-W valleys (South Valley and North Valley) separated about 9 n.mi. from each other by a high ridge that is contiguous eastward with the ridge that has Moresby Seamount on its eastern end. The southeast edge of a possible uncharted shoal was encountered at 9° 33.6'S 151° 12.4'E (we diverted course at a depth of 350m).

MAGNETICS

A Geometrics proton precession Marine Magnetometer was deployed during systematic echo sounding traverses of the westernmost, previously uncharted, portion of the Woodlark Basin. The sensor was towed 120m astern at speeds from 6 to 12 knots. This functioned very efficiently and detected significant variations in total field intensity. Efforts to digitize output for real time computer plotting were unsuccessful. Some profiles from chart records were plotted on board but much data remains to be evaluated and modelled later.

Substantial dipole anomalies (maximum 44 nT at 151° 00'E) occurred over "South Valley" and just south of "North Valley", provisionally interpreted as Anomaly 1. Lesser lows and highs occured over flanking areas, probably continental.

DREDGING

A large Lister dredge with a 1/2 ton lead weight in front, a fish net sewn inside the chain bag and four sediment traps (pipes with end caps bolted to the inside of the dredge collar) was deployed on 13 mm wire from the main towing winch until the winch broke down. The sediment traps were generally sucessful. Recoveries were excellent but two hauls returned only sediment. After the main winch was out of commission, a short version of the gravity corer was used successfully to recover small rock fragments until it was lost (see section on SEDIMENT CORING). Two designs of mini-dredge for use on the 6 mm hydrowire (breaking strength 2.5 tonnes) and made from available materials were tried with poor results.

Dredge D-1: southwest flank of Moresby Seamount near 9° 44.5'S 151° 36.5'E: 1-2 kg of rock chips consisting of low grade metamorphic (greenschist) basement.

Dredge D-2: southwest lobe of seamount near 9° 48'S 151° 40'E: large 20 kg chunk of vesicular basalt with a ropey surface and drain-back features plus many smaller pieces with considerable glass and thin manganese coatings; 10 of 2 x 1 cm pumice fragments (probably exotic); 2 leathery worms 10 cm long.

Dredge D-3: East Basin near 9° 48'S 151° 40'E: 2 kg of very fresh porphyritic (plagioclase phenocrysts) basalt with glass surfaces and little or no manganese coating; one sample, broken into two pieces, has 2 mm diameter tubules of soft, white, coarse crystalline hydrothermal precipitate (barite?) on its upper glassy surface; some pelagic mud.

Dredge D-4: west flank of Franklin Seamount near 9° 54.5'S 151° 18.5'E: approximately 1.5 tonne haul, dredge bag 2/3 full of basalt and iron + manganese-rich crusts; 2 very large (70 & 50 cm) blocks and scores of smaller pieces of basalt; most have 1-2 mm manganese coating but some are more fresh and glassy; several types of basalt and a wide array of typical seafloor basalt textural features (ropey surfaces of sheet flows, pillow fragments, vesicles, lava tubes, crusts of drained lava lakes); several round pumice cobbles (probably exotic); 2 kg of orange-red ochre/umber consisting of interlaminated iron-rich (ochre) and manganese-rich layers; iron-rich layers contain filaments which are probably of bacterial origin; one piece has strands of what appears, on microscopic comparative examination, to be nylon which dates the sample at no more 50 years old and, more likely, 30 years when nylon came into common use; deposit named "Beaujolais"; Beaujolais is either a submarine weathered sulfide deposit or a low-temperature hydrothermal precipitate.

Dredge D-5: seamount near 9° 51.5'S 151° 55'E: aborted as soon as dredge touched bottom because of rising wind and seas; sediment traps returned a few small felsic volcanic grains (bedrock or exotic pumice?) and a 2 cm long tubular shell.

Dredge D-6: west side of West Basin near 9° 44'S 151° 36'E: large haul of mud containing a small amount of pumice (exotic?) and wood when cleaned in the prop wash of the ship.

Dredge D-7: Middle Basin near 9° 45'S 151° 37'E: large haul of mud from which was sieved basalt chips, pumice (exotic?), small pieces of wood and a mutilated worm.

Dredges D-8 and D-9: minidredge constructed from sediment traps for the main dredge preceeded by two 25 kg weights and used on the hydrowire (breaking strength 2.5 tonnes, certified) with a stainless steel yachting shackle (1.3 tonnes "ultimate strength, certified); no pinger on the wire: dredge failed to reach bottom both tries; a pinger is necessary.

Dredge D-10: minidredge on hydrowire with pinger in South Valley near 9° 48.6'S 151° 08.5'E: recovered a small amount of mud containing terrigenous detritus of quartz, muscovite, chlorite, biotite, hornblende (rare) and lithic fragments (one greenstone); clearly detritus from continental basement.

Dredge D-11: new minidredge fabricated from 3" pipe and preceeded by two 25 kg weights for use on hydrowire with pinger; dredged South Valley near 9° 48.5'S 151° 05'E: recovered 8 cm of loose brown mud.

Dredge D-12: North Valley near 9° 40'S 151° 09'E: recovered small amount of brown mud.

Dredge D-13: North Valley near 9° 39.5'S 151° 10'E: recovered mud, some indurated.

CAMERA TOWS

We used the University of British Columbia's deep-tow camera system consisting of an EG&G 35 mm camera, EG&G strobe, O.R.E. 110 dB 12 kHz pinger modified internally to the nonstandard 1.2015 second repetition rate of the ship's Simrad echo sounding recorder, battery pack consisting of three rechargeable 2 volt 25 ampere-hour cells, all housed in a rugged hydrodynamic cage. The film was a new Fujichrome 1600 ASA Professional D colour reversable in 30.5m rolls which could be push-processed to 4800 ASA. E6 processing, requiring 12 steps of which two had stringent temperature controls of +/- 0.3 degrees, was done successfully onboard ship requiring both the darkroom and the adjacent General Purpose Laboratory. Temperatures of the two developers were controlled by specially constructed thermostatted water baths. Other solutions were pre-heated in a controlled temperature cabinet. The films were dried in a specially constructed cabinet fitted with a blow drier.

Three camera tows were successfully completed before breakdown of the main towing winch made further camera lowerings impossible. Results are as follows:

Camera C-1: Aborted when the O.R.E. pinger record faded and then precessed rapidly across the page; latter problem thought due to a slight difference in the repetition rate of the specially shaved crystal in the pinger from the 1.2015 seconds required by the nonstandard Simrad recorder.

Camera C-1A: NW to SE transect over ridge axis in East Basin from 9^{o} 47'S 151^{o} 40.5'E to 9^{o} 15'S 151^{o} 15'E; flown mostly at 5 to 7m off bottom; film developed at 4800 ASA: sedimented sheet and lobate flows; sediment cover 50 to 100 % but only a few cm thick in most places; not much bioturbation.

Camera C-2: E to W transect from the east flank of Franklin Seamount at 9^{o} 53'S 151^{o} 51'E into prominent graben terminating tow at 9^{o} 54.5'S 151^{o} 53.5'E; flown 3 to 5m; film processed at 3200 ASA: sedimented sheet and lobate flows and much coarse talus; sediment cover 50 to 100 %; sediment thicker and more bioturbated than in C-1A.

Camera C-3: E to W slalom over ridge axis in West Basin starting at 9^{o} 43'S 151^{o} 36.5'E and finishing at 9^{o} 43'S 151^{o} 34.5'E; terrain very difficult to fly; flown mostly at 3 to 5 meters but considerable time spent much higher off bottom; film developed at 3200 ASA: heavily sedimented lavas; 90 to 100 % sediment cover, bioturbated.

SEDIMENTS

Sediments were sampled by means of gravity corer (originally 3m barrel, later reduced to 1m when used on on the hydrowire), Lister dredge itself and its sediment traps, "minidredges" on the hydrowire and by adhesion to the camera cage during bottom photography.

Substantial sediment samples were recovered in only three dredges and one gravity core. The sediment sampling program was seriously curtailed by the failure of the main winch. Bottom photographs reveal a cover of sediment over most surfaces, including fresh basalts, and indicates sedimentation rates similar to the 1-3 cm/1000yr found by Exon et al. (1984 Cruise Report) in the Eastern Woodlark Basin. Extensive biological activity in the form of burrows and grazing trails (one type, in West Basin, in peculiar spirals) is evident in bottom photographs of West and East Valleys. These indicate oxic bottom conditions and the probability of reworking of the top 5-10 cm of the sediment. The dominant sediment type is a Globigerina ooze consisting of planktonic foraminiferal remains and hemi-pelagic clay. Pumice fragments and wood are present in minor quantities. Close to volcanic edifices, basaltic sand and pebbles form significant components of the ooze. Metasedimentary clasts were recovered in two dredge hauls through talus fans at the foot of basement ridges. Ferromanganese oxide crusts recovered in dredge D-4 exhibit an intimate association of siliceous (?) tubules (presumed to have formed around filamentous bacteria) and iron + manganese oxides.

Descriptions of the individual sediment cores follow. Further descriptions are found under DREDGING.

S-1 9° 47'S 151° 40'E. Core recovery restricted to 3 flat chips of brown/black glass and a little khaki Globigerina ooze retained in the core catcher. The glassy chips were about 2 cm across.

S-2 9° 55.5'S 151° 43.8'E. Core recovery 111 cm.

UNIT	DEPTH (cm)	DESCRIPTION
1	0-13	Bioturbated brown Globigerina ooze.
2	13-18	Mixed green, brown, & khaki ooze strongly bioturbated with 4 mm diameter cross-cutting burrows.
3	18-30	Greenish brown ooze with small pockets of 2 mm long capsule shaped fecal pellets. Gap at 26-27 cm.
4	30-93	Gradational upper contact into light olive-green ooze with 1mm diameter vertical burrows lined with black material. Vague laminations between 30 &40 cm. Lenses of grey-black sediments occur at 50-53 cm, 63-67 cm, & 76.5-78.5 cm.
5	93-111	Mixed brown/green/khaki bioturbated ooze, similar to unit 2.

S-3 9° 38.5'S 151° 17.5E. Core recovery 10 cm of khaki Globigerina ooze containing fecal pellets and pumice fragments.

S-4 coring aborted.

S-4A 9° 40'S 151° 16.5'E. Recovered 5 cm of green/khaki mud. This is dominated by Globigerina, but also contains grains of basalt and metasediments.

S-5 coring aborted.

S-6 9° 44.8'S 151° 26.2'E. Recovered 15 cm of Globigerina ooze.

UNIT	DEPTH (cm)	DESCRIPTION
1	0-3	Khaki Globigerina ooze with fine rock-fragments.
2	3-5	Similar ooze containing pebbles of siliceous metasediment up to 4 cm across.
3	5-15	Khaki Globigerina ooze.

S-7 9° 47.3'S 151° 59.7'E. Recovered fragments of pink/brown vesicular andesite. An epilithic fauna of Foraminifera and Brachiopods were attached to some fragments. Fragments were coated with khaki ooze.

S-8 9° 48'S 151° 00.4'E. Recovered chips of basaltic andesite with rare forams.

S-9 9° 48.5'S 151° 00.6'E. Recovered grains of vesicular andesitic glass and some Globigerina ooze.

S-10 9° 48'S 151° 02.7'E. Recovered small pieces of vesicular andesitic glass.

S-11 Corer was lost due to failure of the cotter-pin in the swivel.

CTD/HYDROCASTS

When hot hydrothermal solutions emanate from the seafloor, they entrain ambiént bottom water, rise until they reach density equilibrium and spread in a direction that is dependent on near bottom currents. These effluent plumes can be detected with tracers such as 3He, methane and manganese; by departures in local temperature and salininty profiles; and also with light scattering and light attenuation meters. Numerous studies on the Juan de Fuca, Explorer and mid-Atlantic Ridges, the East Pacific Rise, and the Gulf of California have shown that plumes rise to about 350 meters above bottom and spread laterally for up to 100 km. More commonly , they have relatively strong signatures within about 4 km of their source. Since their areal extent is much larger than the vent field from which they originate, they offer an excellent target for remote sensing packages deployed from a ship. Moreover, if a plume can be recognized, it provides evidence that active hydrothermal venting is occurring on the seafloor. The absence of a plume, however, does not preclude massive sulfides being present on the seafloor.

The aim of the work undertaken on PACLARK was to determine whether hydrothermal plumes are present in the Western Woodlark Basin and, if so, to trace their source. This was carried out by using the following equipment mounted on a rosette water sampler lowered over the side of RV Franklin.

Neil Brown CTD
Sea Tech Transmissometer (measures light attenuation)
altimeter
oxygen sensor
eleven ten-litre Niskin bottles
reversing thermometers

Method

Real-time measurements of temperature, salinity, dissolved oxygen, and light transmission were relayed through a conducting cable and converted to a digital readout. The sensor package was usually lowered to within 20 m above bottom and then 'yo-yoed' up and down to about 500 m above bottom to cover the position of a potential plume. Targets were basins coincident with interpreted zero-age crust. One station was completed per target, or more stations as deemed necessary. Distances between hydrocasts were therefore varied, from 2 to 11 n. miles in an arcuate zone 50 n. miles long. The Niskin bottles were fired either in pairs or singly at various positions in the water column depending on the profiles of the different parameters.

Once on deck the bottles were sampled for salinity and oxygen to check the CTD's calibration, and then, when appropriate, for helium and methane analyses, and finally for trace element chemistry. Samples for helium analysis were collected in aluminum mounted copper tubing supplied by Tom Trull at Woods Hole Oceanaographic Institution, Woods Hole, USA. Samples for analysis of dissolved methane were collected in 250 ml glass containers with teflon stopcocks at both ends.

For major and trace element studies of seawater samples, two unfiltered samples were taken; 500 ml and 250 ml. A 60 ml aliquot was then subsampled from the 500 ml sample. The 500 ml and 250 ml samples were acidified with ultrapure 6.2M HCl to a pH of approximately 2. A filter holder containing a preweighed 47 mm Nucleopore membrane was then attached to the spigot of the Niskin bottle and a further three samples(500, 250, and 60 ml) were collected and acidified. All bottles had been thoroughly acid washed and wrapped in plastic and stored in clean wooden boxes. Filter holders were removed and the remaining seawater was drained into volume-marked 20 litre carboys for final filtering. Depending on the amount of water left after sampling, and the position that the sample was taken, filtering took from 12 to 72 hours. If filters became clogged they were washed with distilled water or replaced. Filters were removed from the holder with a pair of teflon coated tweezers and placed in a petri dish which was stored in a refridgerated vacuum desiccator.

Results

Eleven hydrocasts (H1-H11) were completed. Of these one (H6) was a reconnaisance 'yo-yo' and no water samples were taken. Three (H4,7 and 9) involved collection of only unfiltered water and the remaining seven (H1,2,3,5,8,10 and 11) were sampled for unfiltered and filtered water. A total of 112 water samples was collected (35 filtered and 77 unfiltered) and a further 24 helium samples and 12 methane samples were collected from selected hydrocasts. Approximately 60 membranes captured particulates from various depths in the water column.

In general, the interpretation of the results relies on visual inspection of the temperature and transmissometer vs depth traces on the flat bed plotter. As the other data need to be considered as well, the following results are considered to be preliminary and are subject to change.

H1: April 7, 1986; 9° 53.15'S, 151° 49.25'E (basin north of Franklin Seamount). No anomalies were observed but two filters contained a thin film of light brown scum.

H2: April 9, 1986; 9° 44.52'S, 151° 36.16'E (West Basin) No anomalies were observed.

H3: April 10, 1986; 9° 49.24'S, 151° 40.49'E (East Basin). An extremely weak transmissometer anomaly was detected between 2160 and 2400 m. Filters from 300-400 m above bottom clogged quickly but no discolouration was observed.

In the above three hydrocasts, transmissometer profiles were similar with marked attenuation in the photic zone ,a broad weakly attenuated zone to about 1200 m which coincides with a salinity maximum, followed by less attenation to the bottom.

H4: April 11, 1986; 9° 43.59'S, 151° 25.45'E (basin north of target 2A, west along strike from West Basin). Transmissometer trace noisier than previous stations. An extremely weak transmissometer anomaly was observed between 2100 and 2325 m, 400 to 600 m above bottom.

H5: April 12, 1986; 9° 38.90'S, 151° 16.97'E (in the west of Norwest Basin). A weak transmissometer anomaly was detected 700 to 800 m above bottom. It is stronger than the anomalies referred to above and requires a source at about 2000 to 2100 m depth. No temperature anomaly was detected with this layer. The altimeter came in quickly 100 m above bottom indicating a hard (and non sedimented) bottom. The anomaly was traced over a distance of 1.2 n.mi.

H6: April 13, 1986; 9° 41.70'S 151° 16.57'E (Norwest Basin) A weak transmissometer anomaly was found south of target 2A and traced north into Norwest Basin. It is approximately the same height as the zone detected in H5 and presumably comes from the same source.

H7: April 13, 1986; 9° 41.74'S, 151° 17.78'E (Norwest Basin). No anomalies were seen in the early stages of this station; however, on the upcast a weak transmissometer anomaly was detected between 1725 and 1850 m as the Norwest Basin was approached. The transmissometer profile was noisy, particularly near bottom on the south side of target 2A. This may be due to resuspended sediment or an artefact of winch operations maintaining a constant height above bottom.

H8: April 15, 1986; 9° 48.34'S, 151° 00.90'E (South

Valley near Dobu Seamount). A weak transmissometer and associated temperature anomaly were noted between 900 and 1000 m. A weak transmissometer anomaly was seen between 1180 and 1330 m (170 to 20 m above bottom). The transmissometer profile was notably noisy, reflecting the station's proximity to land. The profile also showed a marked attenuation with depth which is opposite to previous hydrocasts.

H9: April 16, 1986; 9° 47.75'S, 151° 00.17'E (Dobu Seamount). No anomalies were observed but the transmissometer profile had a slight negative slope, similar to but not as pronounced as that observed during H8.

H10: April 16, 1986; 9° 49.68'S, 151° 07.03'E (east part of South Valley). A weak transmissometer anomaly was observed between 1300 and 1350 m (260 to 210 m above bottom). A small temperature anomaly occurred about 950 m depth and is probably the same as detected in H8. Like the other hydrocasts completed in the area around Dobu Seamount, the transmissometer profile had a negative slope below the salinity maximum zone.

H11: April 17, 1986; 9° 40.83S, 151° 09.21'E (west part of North Valley). A weak transmissometer anomaly (0.1 to 0.3%) was observed between 1900 and 2220 m depth, 340 to 20 m above bottom. There were no temperature anomalies. The upcast trace highlights these features more than the downcast.

Some general trends are noteworthy:

1) Transmissometer profiles are noisier in the west than in the east, presumably due to an increase of land-derived detritus.

2) Although transmissometer profiles show characteristic trends in the photic and salinity maximum zones in all areas, there are differences towards the bottom of the water column in the east and west parts of the survey area. This corresponds to the observation that hydrothermal input is more apparent in the east than the west.

3) Hydrothermal activity is probably present in the Dobu Seamount area, South Valley, North Valley, Norwest Basin and possibly the basin north of Lonely Basin. However, because of variable topography in these areas and the lack of coincident temperature and transmissometer anomalies that suggest low activity-low temperature venting (except for South Valley), simple plume structures based on areas elsewhere in the worlds oceans may not be applicable here.

PETROLOGY

A zoom stereomicroscope and a petrological microscope were used in the Chemistry Laboratory to examine and identify samples during the cruise. The latter proved valuable in studying small rock chips washed from bottom sediment after failure of the towing winch prevented further use of the rock dredge. Refractive index measurements on glass and feldspar enabled preliminary classification of volcanic samples. A small rock saw was mounted on the afterdeck but was not used.

Bedrock identification as follows:-

D1 Mainly low grade metamorphics, especially foliated psammitic metasediments, with minor microdiorite, microgranodiorite, and schist. 1-2 kg.

D2 Approximately 30 kg volcanics including two large specimens (20, 6 kg). Possibly two populations. Dominant type a vesicular aphanitic basalt with glassy rinds and showing sheet, ropey and drainback structures, occasional slight weathering or faint Mn crusts. Less abundant type is very fresh and largely vitreous, with lobate flow structure; andesitic obsidian in composition?

D3 Approximately 2 kg volcanics with two populations. The first has abundant plagioclase (An 90) phenocrysts (2-3 mm) in fresh black glass; somewhat vesicular with lobate flow structures. The second is an aphyric, paler grey basalt with glassy rinds but some hydrothermal alteration and coatings.

D4 Approximately 1.5 tonnes "older" basalt with extensive Mn coating and, in several samples, yellow brown crusts. Largest specimen about 50 kg. Also about 5 kg smaller pieces (8 cm down) of red-brown "umber-ochre", with interlayered yellow brown material largely composed of siliceous coatings to filament bacteria, red-brown clay-like Fe zones, and dark grey to black Mn oxide layers and veins.

D5 Sediment traps contained sand sized particles of pale volcanic glass (same source as pumice fragments common in most samples?) plus indeterminate finely crystalline rocks requiring further study (altered basalt or metamorphics?)

D6 Sand elutriated from mud included pumice and rare basalt glass.

D7 Elutriated sand composed mainly of schistose metasediment with rare shards of basaltic glass.

D10 Elutriated sand included quartz, muscovite, biotite, chlorite, rare hornblende and metamorphic fragments (all exotic terrigenous?).

D11 Elutriate contains fragments of red-brown, vesicular glass closely resembling S9, S10.

D12, D13 No rock chips seen in elutriate.

S1 Two small pieces of fresh basalt glass (high RI, Fe rich?) and one of paler grey altered basalt with lustrous brown vein.

S2(core) No elutriate prepared.

S3 Elutriate contains glassy felsic volcanics (pumice-related?)

S4A One 6 mm fragment of red-brown quartzite. Elutriate contains siliceous metamorphics and some schist.

S6 Core contains pebble layer with indurated sandy sediment. No foliation, possibly Trobriand??

S7 3 lumps to 1.5 cm of pink-brown, vesicular, partdevitrified andesitic glass, one with breccia-like inclusion of dark grey vesicular (?) andesite. Fauna adhering indicates exposed rock.

S8 Chips of dark grey, highly vesicular variolitic basalt or basaltic andesite with pale green olivine phenocrysts.

S9 Chips of a brilliant red-brown vesicular to pumiceous glass, andesitic.

S10 Same as S9.

All samples except the extensive D4 basalt haul were catalogued and given CSIRO (e.g. 103089) and PACLARK (e.g. D/2/089) numbers during the cruise.

SCIENTIFIC ACCOMPLISHMENTS

1. Established the regional geology/tectonics of Western Woodlark Basin. Collation of previous bathymetric, seismic and magnetic data produced an accurate 1:300,000 scale map. Additional bathymetric and magnetic surveys during PACLARK of a previously uncharted 186 sq. n.mi. (636 sq. km) area to the west towards Fergusson Island greatly added to our knowledge and confirmed our tectonic interpretations. Moresby Seamount was found to be an outlier of continental crust, not a volcano.

2. Confirmed that seafloor spreading extends from Woodlark Basin into the continental crust and provides a superb, easily accessible example of ocean ridge propagation into a continent. This regime is characterized by closely spaced (a few km), active and failed spreading segments 10-25 km long offset from one another by transform (?) segments 10-20 km long. Slopes are extremely steep, e.g. 3100m over a distance of 10 km. The tectonic picture is one of general confusion as propagation fails in one area and succeeds in another.

3. Recent basaltic volcanism representing nascent ocean floor occupies the offset series of deep (2500 to 3200m) rift basins in the eastern portion of the study area. Several of the basins have median ridges. The relatively shoaled (700 to 1500m) South Valley and Dobu Seamount, in the Western sector, are made of fresh andesite suggesting that they may be floored by thinned continental or island arc crust. Alternatively, the intermediate volcanism may characterize the onset of spreading, a topic for future study. The transition from andesitic to basaltic volcanism probably takes place between 151° 10' and 151° 15'E.

4. Although no hydrothermal vents or sulfide deposits were found, there is abundant evidence of present and former hydrothermal activity in the form of altered, hydrothermally coated and veined basalt; the Beaujolais ferromanganese oxide deposit with filamentous bacteria; weak transmissometer anomalies; and clogged, discoloured filters from deep Niskin water samples. Potential sites for actively-forming or extinct deposits include: andesites at the west end of South Valley including Dobu Seamount; rocks of unknown volcanic type in North Valley and Norwest Basin; basalts of West Basin, East Basin, Franklin Seamount and a seamount at 9° 47'S 151° 49'E. Finding a sulfide deposit in andesite would be a "first" and would be more

highly relevant to important ancient ore-forming environments than are those in basalts. Terrigenous sediments are filling some spreading regions of high potential for hydrothermal activity (e.g. South Valley), forming an environment which also has important implications for studying ore-forming processes.

5. A start, curtailed by the loss of the main winch, was made in understanding deep-sea sedimentation in young spreading basins in a rifted continental margin.

6. Evidence of bacterial modification of hydrothermal activity was found in dredged ferromanganese oxide crusts from the Beaujolais deposit on Franklin Seamount. Filaments in these samples, deduced to be of bacterial origin, appear to be the same as those found in vent sites in the eastern Pacific Ocean and in iron+silica-rich caps on some ancient massive sulfide ores.

7. Many samples of rock, sediments and water have been collected for laboratory study. These will further elucidate geological processes and hydrothermal activity in the Western Woodlark Basin. Some biological specimens were collected.

TECHNICAL ACCOMPLISHMENTS

1. We demonstrated that RV FRANKLIN is a suitable ship for a multi-facetted deep marine geological program. FRANKLIN's main towing winch, however, is inadequate and unsafe. Furthermore, its tensiometer must be calibrated.

2. With careful planning, a cruise of the complexity and magnitude of PACLARK can be organized and expedited from afar. Until two weeks before the cruise, Co-chief Scientist Scott was in France and Canada and Binns was in Sydney).

3. We demonstated the value of GPS navigation for detailed survey work. Radar navigation was inadequate.

4. The transmissometer on CSIRO's CTD rosette was demonstrated to be a very useful tool for locating zones of increased particulate concentration which are interpreted to be hydrothermal in origin.

5. The new Fuji 1600 ASA colour reversal film was demonstrated to be very versatile because of its high speed and capability of being push-processed to 4800 ASA. The film was processed at sea and , although requiring great care and many steps, is not much more difficult to do than black and white. Graininess was high but quite acceptable. Colours, which tended to favour blue, were not as realistic as Kodak Ektachrome 400 ASA which can be push-processed to 1600 ASA.

6. The sediment traps attached to the Lister dredge proved a sucessful innovation.

7. The ship's company, four CSIRO scientists, one BMR scientist and a PNG geologist were introduced by the Canadians to the marine geological techniques for locating hydrothermal vents. They will form a nucleus for future endeavours of this type.

RECOMMENDATIONS

1. PACLARK II cruise in 1988 to test the areas of highest potential for hydrothermal activity and sulfide deposits, to dredge areas of high potential for felsic volcanics and to photograph (and video?) these areas. The cruise should also include an examination of Goodenough Bay, further to the west, where there is evidence of spreading. PACLARK II should lead to submersible studies of selected targets with a Japanese, French or American vehicle (maximum required depth 3200m).

2. Try to get a SEABEAM and SEAMARK I survey done of the Western Woodlark Basin and Goodenough Bay.

3. If 2 is not likely before early 1988, ask SOPAC to do a bathymetric (and magnetic?) survey of Goodenough Bay.

4. The history of uplift and subsidence of Western Woodlark Basin and the D'Entrecasteaux Islands may test McKenzie's (1978) hypothesis of basin evolution. Land work on raised terraces, together with the results from PACLARK, may provide answers.

5. Seismic profiling of the western sector of Western Woodlark Basin may reveal targets for ODP drilling to test the uplift theory. This would be more likely to happen if Australia were to quit dithering and join ODP in partnership with Canada.

6. Replace FRANKLIN's main towing winch with one of safe, reliable design and construction.

7. If 24 hour GPS is not available for PACLARK II, put radar beacons or, better, transponders, on nearby islands.

8. Real-time computer plotting of navigational data is possible with the ship's VAX system and is required in order to free scientists from the inordinate amount of time spent on manual plotting.

9. Consider doing ship-board methane, Mn and Fe analyses for rapid testing of transmissometer anomalies. We are presently doing these (and 3He) on shore which does not permit following up on anomalies. A geochemistry container to be carried on FRANKLIN's afterdeck in place of the biological container should be considered for PACLARK II.

10. Tow the CTD at a faster rate in order to cover a larger area in the search for hydrothermal plumes (as others do).

11. CSIRO should consider purchasing a deep-tow camera system and recording video system which could be used by both geologists and biologists.

ACKNOWLEDGEMENTS

Captain Neil Cheshire, his officers and crew of RV FRANKLIN for their unstinting service, knowledgeable advice, encouragement when things were looking bad for us and for their comraderie.

The Royal Australian Navy Research Laboratories for the loan of their gravity sediment corer (which we lost), a backup pinger and auxiliary equipment.

The Ocean Sciences Institute of Sydney University, RAN Research Laboratories, Canberra Deep Space Communications Centre, NSW Geological Survey and NSW Department of Public Works for the loan of equipment.

The RAAF for flying much of our equipment from Sydney to Cairns and Townsville and back, and the Australian Army who also helped with transport.

Joan Scott who laboriously hand contoured our 1:300,000 bathymetric base map at 100m intervals.

CRA Exploration Pty. Limited for moral and financial support including McConachy's expenses from Toronto to take part in PACLARK.

The Natural Sciences and Engineering Research Council of Canada for a research grant to Scott and Chase to enable the Canadians to participate in PACLARK.

NOTE: Coordinates and other information in this report may differ slightly from those cited in Table 1. The table takes account of post-cruise checks, corrections to on-board plots, and initial laboratory study of samples.

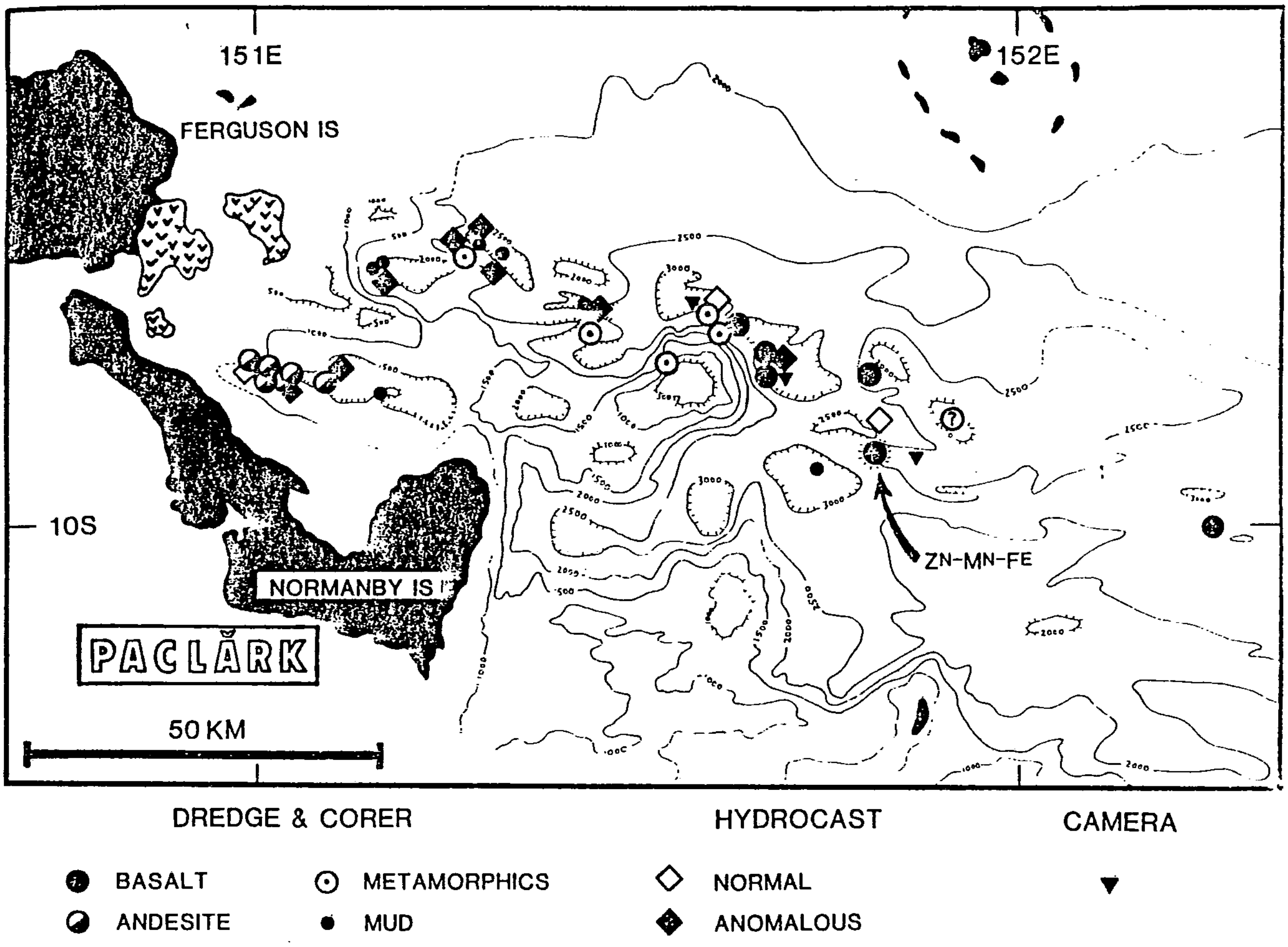
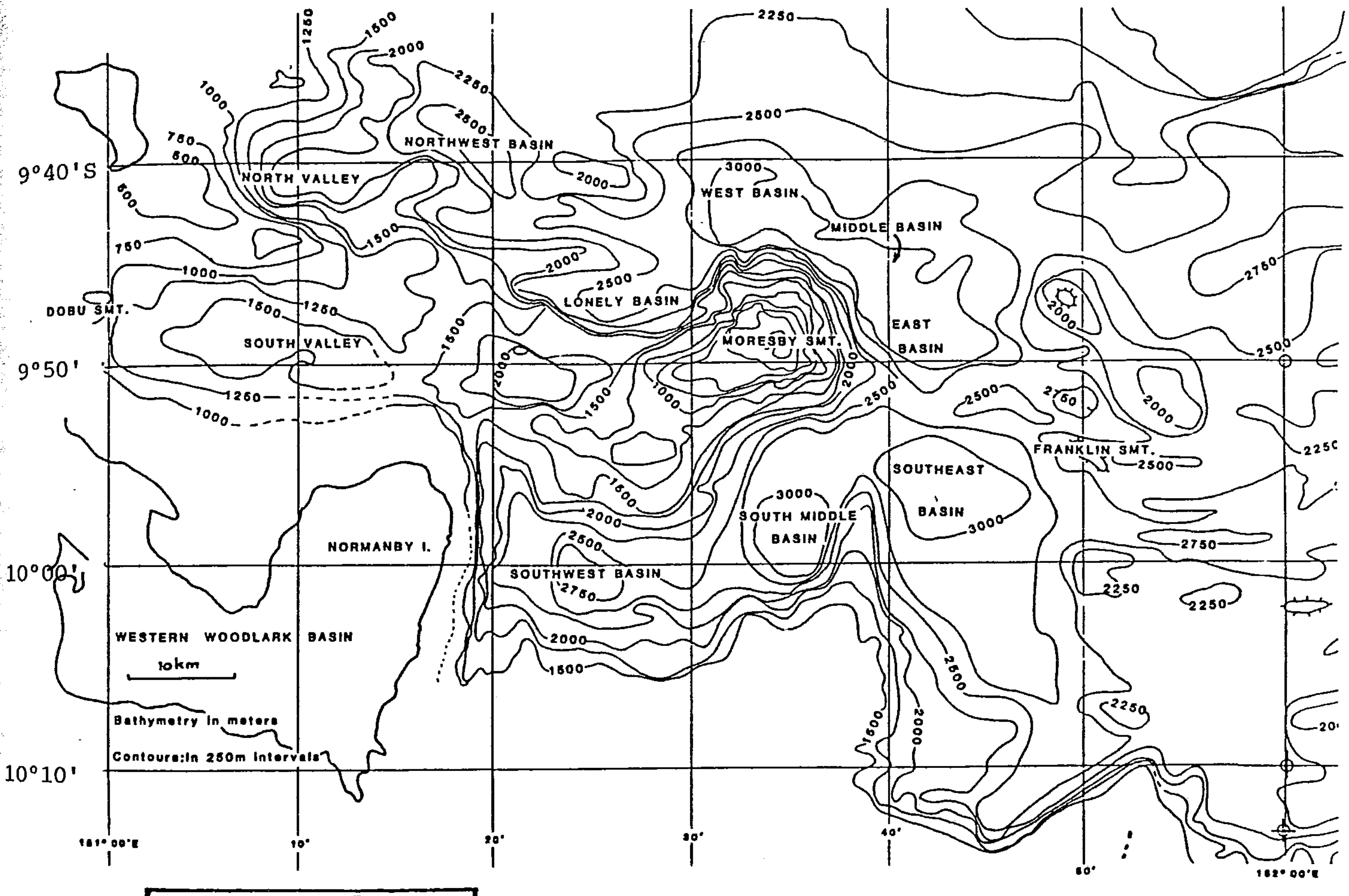


Fig. 1 PACLARK Cruise. Location of over-side operations. Echo-sounder and magnetometer traverses not shown. PAPATUA (1986) and NATSUSHIMA (1983/84) dredge sites included.



PACLĂRK

Fig. 2 Informal names applied during PACLARK Cruise. Bathymetry of previously-uncharted western sector also shown. Bathymetry of eastern sector from HMAS 'Moresby' 1968.