

RVIB *Nathaniel B Palmer* Cruise 0805, 18 April -25 May 2008
Punta Arenas, Chile – Punta Arenas, Chile

Final Report

Summary

RVIB *Nathaniel B Palmer* Cruise 0805 took place between April 18 and May starting and ending in Punta Arenas, Chile. Two science projects were involved: 1. Central Scotia Sea and the Drake Passage deep ocean gateway; Principal Investigators Ian Dalziel and Lawrence Lawver (University of Texas at Austin) and Julian Pearce (Cardiff University, UK); and 2. Glacial radiocarbon constraints from Drake Passage deep-sea corals; Principal Investigators Laura Robinson (Woods Hole Oceanographic Institution) and Rhian Waller (University of Hawaii). Ian Dalziel was appointed Chief Scientist.

The geographic separation of the principal areas of interest of the two projects, coupled with the period of time available, thirty-six days at sea, made it impossible to meet all the scientific goals proposed. The Central Scotia Sea and western Drake Passage are over 1000 nautical miles apart. By planning an outbound cruise track eastward along the North Scotia Ridge and returning by the South Scotia Ridge and Drake Passage, however, the Principal Investigators were able to address the main goals of both project, and make very significant progress towards resolution of the problems and questions set out in both proposals. In this regard they were helped by unexpectedly fine weather for the region and especially for the late autumn-early winter timing of the cruise, and also by the experience, skill and dedication of the Captain, crew and technical staff aboard *Palmer*.

The main goal of the geology and geophysics project was to understand the evolution of the long-enigmatic Central Scotia Sea, namely the portion between approximately 35 and 45 degrees west longitude, in order to refine the timing of onset of a deep ocean gateway between South America and Antarctica and hence the onset of the Antarctic Circumpolar Current. This was to be achieved mainly by resurveying the bathymetry and magnetic anomalies mapped over twenty years earlier, and by dredging and dating rock samples from the ocean floor. Although the full geographic coverage originally proposed could not be achieved for the reasons stated above, the work at sea indicated that understanding of the floor of the Central Scotia Sea needs to be drastically revised. Only a few of the east-west trending magnetic anomalies previously mapped could be confirmed. Rather than being composed of basaltic oceanic lithosphere like the eastern and western Scotia Sea, the area appears to be composed mainly of island arc material including volcanic constructs containing pyroclastic rocks of intermediate composition. Geochemical and geochronometric studies will test this shipboard hypothesis and indicate the age of the rocks. It seems clear, however, that the cruise will lead to a major reinterpretation of the tectonic evolution of the Scotia arc.

The main goal of the paleoclimate and biology project was to understand the influence of Southern Ocean water to the global climate system using deep-water corals as an archive

of past water masses. Deep-water corals are found globally from just a few meters to over 6000m deep, record vital information on past climate within their carbonate skeletons, and are found both living and fossil in Antarctic waters. The goals of this cruise were to; (a) locate deep-water coral habitats (living and fossil) using a combination of multibeam bathymetry and high resolution imaging using the WHOI TowCam system; (b) to sample these habitats for fossil corals for paired U-series dating and radiocarbon analysis to reconstruct water column radiocarbon and; (c) examine the past and present biogeography (both physical and environmental) of deep-water corals across the Drake Passage. Sample sites across the Drake Passage were limited for reasons stated above, however we were successful in collecting habitat data from 5 study areas (Burdwood Bank, Elephant Island, Shackleton Fracture Zone, 'Interim' Seamount and Sars Seamount), as well as samples of apparently old fossil *Desmophyllum dianthus* (our target species) from within the Drake Passage and numerous specimens of fossil scleractinians, stylasterids and octocorals that may also be useful for paleoclimate reconstructions. Live scleractinians were also collected from Burdwood Bank, Elephant Island and Sars seamount. Our main cruise objectives were fulfilled, demonstrating the feasibility of locating and collecting live and fossil corals from this challenging and fascinating environment in the Drake Passage. Analyses back in the US are required to exploit the full potential of both our digital (maps and images) and physical (corals, water) sample sets.

There were several areas in which the support of the science program fell short:

1. The Principal Investigators had to deal with three separate persons as 'Point of Contact' (POC) in the course of the cruise planning process and the cruise itself, and indeed the third person resigned during the cruise although he remained actively involved. There was significant and critical failure in passing information from one POC to the next in the changeovers.
2. There were significant and potentially critical failures in the process of obtaining diplomatic clearance for work planned in the Exclusive Economic Zones of the United Kingdom and Chile.
3. There were insufficient RPSC personnel available during the port call preceding the cruise, this delayed departure from Punta Arenas by several hours.
4. There was no Marine Science Technician aboard, placing an unduly heavy work load on the Marine Projects Coordinator.
5. The Electronic Technicians aboard, while skilled and dedicated, had no experience of some systems (e.g. seismic and swath mapping) critical to the science goals.
6. Some of the equipment necessary for the cruise is overdue for replacement, notably the seismic recording gear and multibeam processing and display system. While both magnetometers worked during the cruise, by the end one of them needs to be returned for refurbishment, and many spare connectors need to be ordered.

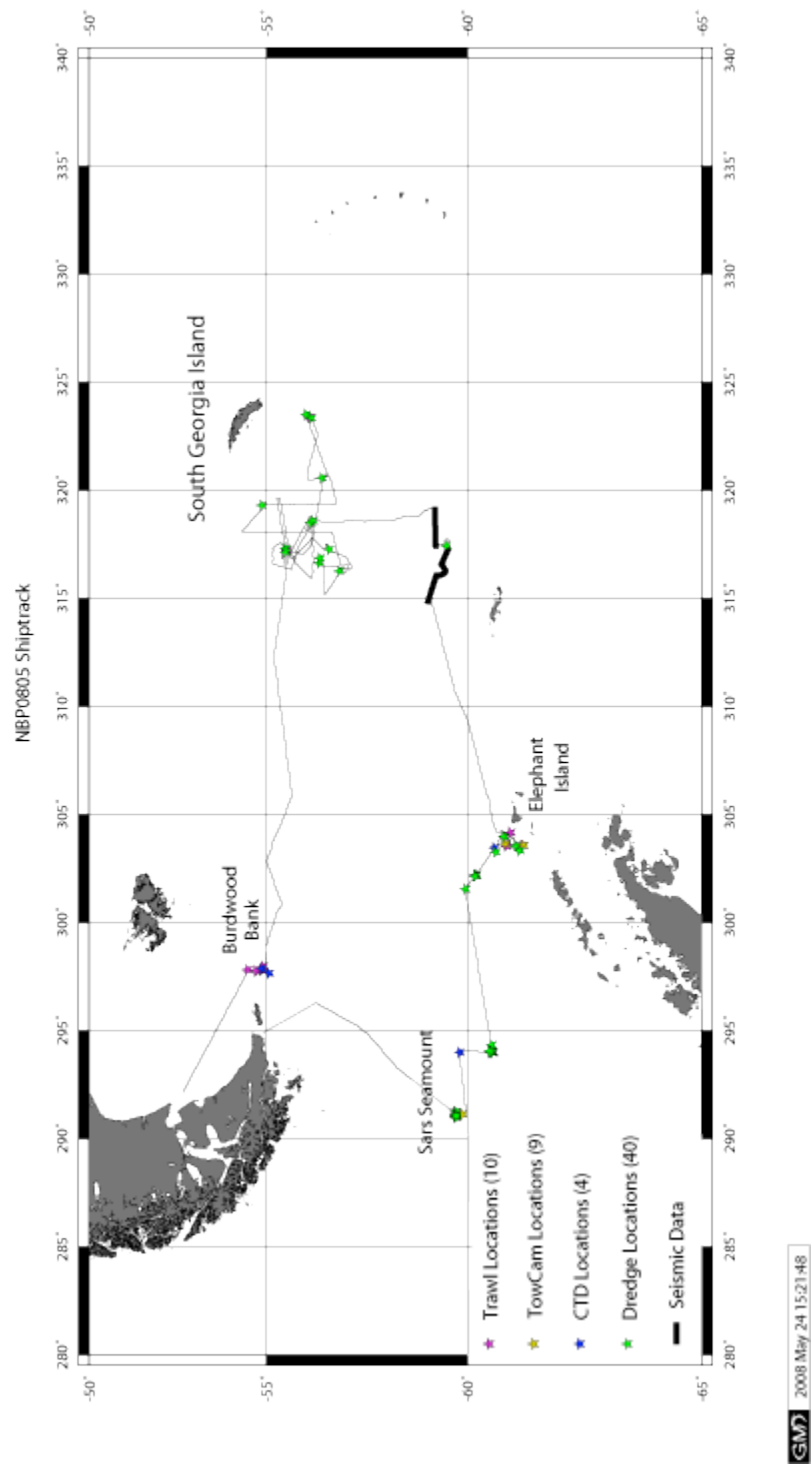
Science Goals

Central Scotia Sea and the Drake Passage deep ocean gateway, Dalziel and Lawver (US), Pearce (UK)

Despite its importance to oceanic circulation, global climate, biological evolution and hence the Earth system as a whole, the sequence of events leading to the formation of the Drake Passage gateway is poorly known. Indeed, even the time at which a deep water connection between the the southern Pacific and Atlantic oceans was initiated is speculative. The key to this problem lies in the enigmatic Central Scotia Sea floor between South Georgia and the South Orkney Islands on the North and South Scotia ridges respectively. As magnetic anomaly data are inconclusive, the only way to determine crustal age is by direct sampling and radiometric dating, thereby calibrating the spreading history of the Central Scotia Sea and constraining models. The samples obtained will also be used to test the model of mantle return flow from the opening Pacific to the closing Atlantic ocean basin.

Glacial radiocarbon constraints from Drake Passage deep-sea corals, Robinson & Waller

The Southern Ocean is an important part of the climate system, but our knowledge of its history is limited by a scarcity of well-dated records. The skeletons of deep-sea corals record vital information on past climate, and are found both living, and as fossils in Antarctic waters. Our cruise plan was to locate and collect deep-sea corals across the Drake Passage suited to reconstructing the history of the ocean circulation in the Drake Passage on time scales of tens of thousands of years. The images taken during the cruise provide the first direct observations of deep-water coral habitats within the Drake Passage and the samples are the first collections targeted towards documenting coral dispersal across the Antarctic Circumpolar Current. Ongoing laboratory work will produce precise radiometric ages for the corals using U-series techniques coupled with other geochemical measurements to reconstruct the water column properties in the Southern Ocean. This work will be important in interpreting existing paleoclimate records, including radiocarbon data from the deep North Atlantic.



Science Party

Geology/Geophysics

University of Texas at Austin:

Ian Dalziel, Co-Principal Investigator and Chief Scientist

Lawrence Lawver, Co-Principal Investigator

Peter Barker (University of Birmingham, UK)

Marcy Davis

Lauren Greene

Kevin Johnson

Katie Peña, teacher (Zilker Elementary School, Austin Independent School District)

Cardiff University, UK:

Julian Pearce, Natural Environment Research Council Principal Investigator

Alan Hastie

Matthew Minifie

Paleoclimate and Biology

Woods Hole Oceanographic Institution:

Laura Robinson, Co-Principal Investigator

Marshall Swartz

John Swartz

University of Hawaii:

Rhian Waller, Co-Principal Investigator

Daniel Wagner

United States Geological Survey, Woods Hole:

Kathy Scanlon-Catanach

Dann Blackwood

Imperial College London, UK:

Tina Van de Flierdt

University of Oxford, UK:

Kate Hendry

University of Cambridge, UK:

Taryn Noble

Argentine Observers:

Laura Schejter, Instituto Nacional de Investigaciones y Desarrollo Pesquero

Carlos Balestrini, Servicio de Hidrografia Naval, Departamento Oceanografia

Raytheon Polar Services Company:

Jenny White, Marine Projects Coordinator

Greg Buikema, Joseph Kuenhast, Robert Zimmerman, Marine Technicians

Kevin Pedigo and Victor Shen, Electronic Technicians

Mike Coons, Dimitry Tizon, Information Technologists

Karthleen Gavahan, Multibeam specialist

Edison Chouest Offshore/RVIB *Nathaniel B. Palmer*:

Captain Mike Watson

Ice Pilot Vladimir Repin [0800-1200]

Chief Mate Rachelle Pagtalunan [2000-2400]

Second Mate Gary Talbot [0000-0400, 1200-1600]

Third Mate John Higdon [0400-0800, 1600-2000]

Time Line/Science Log

Friday April 18 2008

Departed Punta Arenas 20.15 hours local having been delayed by suppliers refueling problems and limited number of Raytheon personnel. There were no Marine Science Technicians available for the port call (or cruise), and Marine Technicians were only available for part of it. The delay did permit the official participation of last-minute Argentine Observer Carlos Balestrini

Saturday April 19 2008

Dropped pilot at eastern entrance of Straits of Magellan and steamed SE to first site for Paleoclimate party on southern edge of Burdwood Bank. Multibeam started after exiting Strait of Magellan. Underway science watchstanding began during the early morning with observations recorded at 5 minute intervals. Weather good for transit of Strait and reasonable thereafter, but rough around midnight.

Sunday April 20 2008

Arrived at Burdwood Bank site at 54°28.88'S 62°18.08'W.* Commenced detailed multibeam. Successfully tested the starboard waterfall winch to 700m wire out in preparation for camera operations. Attempted CTD but weather did not permit deployment. Blake trawl #1 was deployed to 300m on top of Burdwood Bank, coming back with good samples of corals (both fossil and live). Haul was heavily mixed with sponge spicule debris, but included good representative fauna.

Monday April 21 2008

Blake trawl #2 to 2200m depth (54°29.07S, 62°10.76W). No samples in net, most likely the result of it not reaching the bottom. The lack of a suitable pinger and the tensiometer not being sensitive enough for the light Blake Trawl frame probably contributed to the lack of a catch. Weather turned flat and calm so set up for camera tow was started. During the set up time a CTD to 2000m was deployed (54°52.732S 62°08.523W) and after some computer problems, returned with full rosette of samples for Th-Pa-Nd, carbonate chemistry, Si isotopes, nutrients and archive water samples. Towcam was then deployed but an electrical fault required it to be recovered shortly after deployment. This happened a second time, so TowCam operations were aborted and a Blake Trawl #3 was deployed to 2200m depth (54°54.344S, 62°01.642W*). Blake trawl came back with cod end open – one small rock had created a pocket in the inner bag where we did recover multiple urchins, barnacle plates and a few small fossil stylasterid corals.

** FSU Sample #2*

Tuesday April 22 2008

Blake trawl #4 was deployed at 800m depth (54°44.03S 62°12.83W). This provided a large haul mainly consisting of corals. This haul consisted of large amounts of the reef building scleractinian

Solenosmilia variabilis and it is assumed we sampled a large bank made up of a dead base and live edges. Within the trawl we also recovered solitary scleractinians *Balanophyllia malouensis* and *Flabellum curvatum* in large numbers of fossil and live, and multiple fossil samples of *Desmophyllum dianthus*. Three live samples of *Desmophyllum dianthus*, were also recovered. Other samples taken from this trawl include large quantities of stylasterid rubble and live Octocorals. These samples will provide a good complement for our target Drake Passage Samples scheduled for collection later in this cruise.

Bad weather prevented us doing further trawl, TowCam or CTD casts so it was decided to leave this area at 1245 hours and we commenced transit to Central Scotia Sea. At Transit Waypoint #6 followed escarpment along the southern margin of the Burdwood Bank that is the continuation of the Quest Fracture Zone to NW. Poor multibeam record due to heavy seas with 40+knot wind from the west. The transform fault escarpment is rectilinear in the NW, but less so to the SE. Turned NE at Transit Waypoint 7 to SE corner of Burdwood Bank to commence WNW to ESE traverse of crust in the western Scotia Sea, SE of Burdwood Bank and N of the Endurance Fracture Zone.

Wednesday April 23 2008

After deploying magnetometer at 0500 hrs, commenced WNW to ESE traverse of marginal western Scotia Sea crust at Transit Waypoint #8 at 0600 hrs. The crust is magnetically 'quiet.' The western part of the traverse may be on rifted continental crust, and there is no obvious sign of a history of seafloor spreading. Reached Transit Waypoint #9 at 1630 hrs and turned to more easterly heading traversing the Western Scotia Sea spreading center en route to target area of Central Scotia Sea. Along this traverse the hummocky nature of the ocean floor is particularly striking, indicating little or no sediment cover in crust ~20 million years old. On the multibeam record, the NE-SW fabric of the oceanic crust is clearly visible.

Thursday April 24, 2008

Continued eastward across seafloor spreading corridor W6 of the Western Scotia Sea towards Waypoint #10. Tested seismic system en route with 2 GI airguns. After some difficulty obtained comparatively weak signal from the ocean floor Continued generally eastward to Waypoint #10 and then across poorly known ocean floor towards Waypoint #11 at the western edge of the central Scotia Sea study zone.

Friday April 25 2008

Crossed from Western Scotia Sea spreading center to Central Scotia Sea (CSS). Commenced survey of CSS with track on ENE heading parallel to and immediately south of mapped magnetic anomaly 5c. Near 40 degrees E reversed course to parallel previous track to N with overlapping multibeam records. This will enable us to check for N-S trending magnetic anomalies.

Saturday April 26, 2008

Conducted a survey of the 'Starfish' seamount (55° 30.37'W, 42° 57.29'W). The structure and significance of the feature are not clear. An attempt was made to dredge the steepest slope of the seamount, which lies in the NE corner. This attempt had no success, the dredge ('Scripps type') was empty. The attempt was made at 55° 30'S, 42°42' W, having been moved once due to the presence of a drifting iceberg, but was frustrated by rising wind. No further attempt was made to dredge, the Chief Scientist having decided that some reassessment of dredging procedures should be undertaken first. Blake Trawl #5 was deployed at 55° 32' S, 42° 45' W at 2700m depth to attempt to collect corals on a small southerly ridge on the Starfish Seamount.

Sunday April 27 2008

Blake Trawl #5 was recovered at 0706GMT containing many glacial drop stones covered with a layer of mud. No corals were collected during this haul and the only biology being a small number of large holothurian sea cucumbers and some ophiroid brittle stars. This area may be too affected by glacial drop stones to obtain a good trawl and so we are unlikely to attempt trawling again until the Elephant Island site. Commenced SE transect of mapped magnetic anomaly #5 to seamount and potential dredge site near Waypoint #12 at 56°11'S, 41°06'W. Decided not to dredge immediately because of gentle slopes. The seamount is associated with a large positive magnetic anomaly. Turned west to Waypoint #13 at 56°11'S, 44°30'W on supposed eastern edge of West Scotia Sea spreading center, filling in multibeam survey on northern side of another seamount and prospective dredge target at ~ 56°11'S, 41°16'W. High winds and heavy seas were detrimental to the acquisition of high quality multibeam data.

Monday April 28 2008

Severe weather continued into the night, but by running before the wind we were able to acquire high quality multibeam data outlining the extent of the seamount at -56°11'S, 41°16'W. Returned to 56°18'S, 42°41'W to initiate seismic operations designed to determine the relationship of the 'seamounts' to the deeper oceanic areas. The efforts were frustrated by airgun/streamer, electronic, and air pressure difficulties, the compressor breaking down three times in the space of two hours. Finally obtained good imagery at ~1800 hrs. Commenced Dredge #2 using Scripps dredge at 56°36.6'S, 42°44'W in 2907m of water. The dredge was very successful. In addition to drop stones and manganese nodules, it yielded specimens of intermediate volcanic composition that appear to be of local origin.

Tuesday April 29 2008.

Surveyed the area to the south of Dredge Site #2, turning at ~57°11.35'S, 43°36.57'W to dredge at 56°22.9'S, 43°21.8'W (Dredge #3). This was possible because of calm weather with almost no wind. An excellent dredge haul was obtained, including not only drop stones and manganese nodules, but also apparent local bedrock consisting of intermediate composition volcanics. An attempt was made to dredge higher up the same escarpment further east at 56°23.76'S, 43°08.81'W (Dredge #4), but this was aborted due to icebergs and an increasing beam wind. Headed west south west and then west towards magnetic anomalies 7 and 8 of the West Scotia Sea spreading center in an attempt to relate that crust to the Central Scotia Sea floor.

Wednesday April 30 2008

Turned back to SE at 4°45'W to survey seamount at 56°54'S, 43°44'W for dredging. A highly successful dredge haul (Dredge #5) yielded some drop stones, but a significant amount of intermediate to acid (?dacitic) lava and pyroclastic rocks. Continued multibeam and magnetometer survey to south, east and north to fill in un-surveyed areas and reach vicinity of the previously, mapped magnetic anomalies from a possible CSS north-south spreading center for dredging and seismic survey.

Thursday May 1 2008

Surveyed and dredged seamount at 56°09'S, 41°29'W. Dredge #06 was only partly successful. Disappointingly, only one possible local rock specimen was obtained despite several 'spikes' in tension on the wire and indeed having the vessel 'anchored' for 1.5 hours when the dredge became stuck. We were unable to pursue the original plan of conducting a seismic survey of the area between the mapped anomaly 5 locations due to the fact that permission had not been sought from the British authorities for such activity within the South Georgia and South Sandwich Islands Maritime Zone. That being the case NBP steamed north along 41°55'W longitude to cross the mapped magnetic anomaly sequence in the northern CSS and onto the edge of the North

Scotia Ridge at 54°20'S, 41°55'W, before heading SE towards another seamount at 54°40'S, 40°45'W for surveying and possible dredging.

Friday May 2 2008

Dredged seamount at 54° 90'S, 40° 69'W. Dredge (Dredge #7) was very successful, obtaining a small number of specimens but of high quality intermediate-acid volcanic rocks, highly vesicular indicating comparatively low pressure/depth of formation. Proceeded due south along 40°38' longitude to 56°50' latitude to investigate magnetic anomalies and conduct multibeam survey of area to the east of the previously mapped CSS magnetic anomaly sequences. Then turned east to seamount 'Y' near the South Georgia microcontinent at 56°05'S, 36°45'W to initiate survey and dredging of seamounts in the eastern part of the CSS.

Saturday May 3 2008

Continued multibeam and magnetometer survey east to seamount 'Y.' Surveyed crest and eastern flank of this guyot-like seamount. Dredged lower flank of seamount from ~2600m-2100m at 56° 02.18'S, 36° 29.12'W . Dredge haul (#8) included dark colored volcanoclastic rocks with slightly rounded edges. Hence decided to dredge higher up slope. Surveyed round north and western sides and selected site in south to dredge into the fresh (30 knot) northerly wind. From Dredge site at 56° 10.68'S, 36°39.21W in 1567m of water we dredged upslope to the north to the 900m contour and obtained a very large dredge haul (# 9) containing both angular and rounded clasts. The haul was large, but it appeared that most of the material is ice rafted, including many fragments of slaty and phyllitic interlayered greywacke and shale. These looked identical in hand specimen to the Cumberland Bay Formation on South Georgia. These clasts were not noted from drop stone collections at other sites, and probably reflect the debris carried by South Georgia glaciers to the edge of the continental shelf during the last glacial maximum.

At the end of the evening a Blake trawl was started across the almost flat top of the seamount from the south in a NNW direction into the wind.

Sunday May 4 2008

Unfortunately the Blake trawl was lost at the very end of the trawl, severing at the bridle. The vessel proceeded in rough weather towards the site of former Dredge #06 (56° 08.92', 41° 28.63'W) to make a second attempt to dredge what is regarded as an important target. Some deviation was made to the south to acquire more magnetic data over previously recognized anomalies. At ~ 1500 hrs a major deviation was made to the south to dredge the eastern escarpment of the CSS central 'horst' at ~ 56° 35.5'S, 39.14.5'W. Conducted a brief survey of the escarpment and selected a location of 56° 29.61S, 39° 24.58' W for the dredge to the SW into the wind. Dredge #10 contained mainly glacial dropstones.

Monday May 5, 2008

Proceeded NE to complete survey of outer perimeter of the 'starfish' seamount at 55° 30.37'W, 42° 57.29'W and re-dredge site of unsuccessful DR #01 at 55° 30'S, 42°42' W.

Tuesday May 6 2008

Successfully completed dredge (#11) at 55° 30'S, 42°42' W . It contained some apparently local rocks as well as drop stones. Proceeded SE to complete survey of the setting of the 'starfish' seamount and re-dredge the seamount previously dredged (DR #06) at 56°09'S, 41°29'W. The new dredge site (DR #12) is at 56° 12.3'S, 41° 24.0' W. After several hours of dredging with encouraging tension 'spikes' the dredge was returned to deck empty. The inner bag was inverted. Either this happened early in the procedure and kept any material out of the dredge, or it happened late as part of the process of freeing the dredge from some obstruction. There was no time to repeat the dredge, so proceeded due south to 58° 00'S, 41° 24.0' W.

Wednesday May 7 2008

Turned SSE at 58° 00'S, 41° 24.0' W, proceeding towards 59° 15'S, 40° 42.0' W to commence seismic traverse westward across eastern half of basin between Bruce and Pirie banks. Deployed airguns and seismic streamer before dark at 1300 hrs local time with marine mammal watch in place. Ceased firing briefly on reports of a whale in the vicinity which changed course to approach the airguns from astern. The guns were shut down and the whale departed astern. Following standard procedures the guns were restarted and the vessel continued SSE at 5 knots prior to turning west and deploying the magnetometer. The day finished with seismic profiling of the basin west of Bruce Bank. Loss of resolution in the seismic record caused a temporary problem. This was due to loss of air pressure to the guns.

Thursday May 8 2008

Proceeded west recording seismic data across 'skinny' seamount/ridge in the center of the Bruce Bank-Pirie Bank basin to 56° 15'S, 42° 42'W. Brought in seismic gear and returned to the seamount/ridge at 59° 20'S, 42° 29'W. Surveyed south along the crest of the seamount/ridge, and returned northwards to dredge at 59° 29'S, 42° 33'W. After dredging the seismic gear was redeployed and the vessel proceeded east, before turning west towards Pirie Bank, in an attempt to cross an unnamed ridge apparent on the satellite altimetry derived predicated topography map. This was unsuccessful, and we concluded that the 'ridge' is probably an artifact in the satellite data. A major deviation had to be made to avoid a large iceberg (~26x20 nm).

Friday May 9 2008

Traversed Pirie Bank with seismic gear operational from the east to potential site for ocean drilling to determine the timing of opening of a deep-sea gateway for the Antarctic Circumpolar Current between South America and the Antarctic Peninsula. Seismic reflection profiles were obtained across the western Pirie-Bruce basin and over Pirie Bank. The shipboard system was adequate to image up to 2 km of sediment on the first survey, but caused problems in imaging less than 1 km of sediment during the second. For long periods the 2 guns would not synchronize, and there was 60Hz interference that could not be removed. In trying to remove this interference the limitations of the recording system were exposed. May 8-9 over eastern Bruce-Pirie Basin and eastern Pirie Bank was the first time the system had been deployed during the cruise (except for brief initial trials), and its performance and unreliability caused concern.

Brought seismic streamer and airguns aboard, and left central Pirie Bank at 1930 local time to transit to Elephant Island vicinity towing magnetometer.

Saturday May 10 2008

Transited across western Pirie Bank and eastern Protector Basin *en route* to Elephant Island vicinity. Change course about noon to head for 60° 00'S, 50° 40'W on northern branch of western South Scotia Ridge west of the South Orkney Islands, then to waypoint NW of Elephant Island at 60° 40'S, 55° 50.4'W. *en route* to trawl site west of the island. Entered Antarctic Treaty area south of 60° 00' south latitude at ~ 1600 hrs local time.

Sunday May 11 2008

En route to trawling site west of Elephant Island. Pulled in magnetometer at ~0930 hrs local on Elephant Island shelf. Trawl site 60° 59.05'S, 55° 50.8'W ~ 200 m water depth. Blake Trawl lost while on bottom. Unclear why the trawl was lost as standard procedures were followed and Knudsen 3.5KHz survey shows flat bottom suited to Blake Trawl deployment. Additional seabeam survey was undertaken to determine deeper areas suited to coral sampling given winds from the NW. Rock Dredge deployed at 0104 GMT, 60° 50.95'S, 56° 01.39'W, ~1600m on ~25

degree slope on Elephant Nose. Small haul of mud coated rocks, primnoid and bamboo corals acquired..

Monday May 12 2008

Continued seabeam surveying and trawling in western Elephant Island area. TowCam was launched but malfunctioned. Manufacturing engineers contacted to determine how to resolve the problem. Box Dredge deployed at 0718 GMT 60° 49.99'S, 56° 21.49 'W, ~1800 m water depth. Box dredge returned empty, but evidence of scraping on bottom suggesting it hit the bottom at least once. It was decided that with the weight of wire on the Palmer, additional weights should be added to help keep the dredge on the seafloor at the correct angle. A plateau at 450m was subject to an intense 3.5KHz survey in preparation for an Otter Trawl deployment. All agreed that the selected site was well suited, flat with sediment. Otter trawl deployed at 1939 GMT, 61° 19.07'S, 56° 25.16'W. Pinger was attached at 100m wire out and proved useful for determining when Otter Trawl was on bottom. Trawl was left on seafloor for 10 minutes. Otter contained scleractinian and stylasterid corals, large and small rocks and other biological specimens including multiple fish and echinoderms. At 2321 GMT a rock dredge was deployed on a 10 degree slope at 61° 05.86'S, 56° 26.17'W, ~1000m water depth. Rocks covered in coral holdfasts (most likely stylasterid corals) small stylasterid corals and a few other biological specimens were recovered. 0352 GMT TowCam launched at 61° 17.04'S, 56° 25.49'W, near to site of Otter Trawl. Smooth deployment, successful run, including 1600 images and five 5 liter water samples recovered. Rocks were all drop stones.

Tuesday May 13 2008

TowCam continued into 13 May. Continued seabeam surveying and trawling in western Elephant Island area. Attempted second Box dredge at 1031 GMT, 60° 11.10'S, 56° 39.71'W in ~1200m water depth. Dredge came up with a few loose pebbles. Discussions of how to improve dredge include welding steel plates to top and bottom surfaces. Transit to 2000m water depth to deploy TowCam at 60° 52.25'S, 55° 20.84'W. 3.5KHz survey showed smooth sedimented terrain. TowCam deployed successfully collecting over 1600 images and five 5 liter water samples. Images showed a highly sedimented bottom with numerous solitary corals, so the Otter trawl was deployed on the same track line.

Wednesday May 14 2008

Otter Trawl was successfully recovered at 1046 GMT and brought back a large haul of shrimp and fish, with some small solitary scleractinian corals and other invertebrate fauna. Transited to CTD station in deep-water by the Shackleton Fracture Zone. However the CTD malfunctioned due to a corroded connector and was unable to be deployed. Transited to Dredge #18 site at 60° 38.70'S, 56° 43.78'W and deployed in 2500, of water. Dredge came back with many rocks, sandy sediment and a few scleractinian and coral stylasterid coral bases. CTD was repaired, and deployed at 2244 GMT to 4221m at 60° 37.027'S, 56° 32.138'W. Water was collected from 12 depths for carbonate chemistry, nutrient analysis, silicon isotopes, physical property measurements, neodymium and thorium isotopes. A small sediment sampler was added to the bottom of the CTD and retrieved dark brown mud in a core ~2inches long. Rocks were all drop stones.

Thursday May 15 2008

Winds picked up in the early morning to over 40knot gusts, so a short one hour multibeam survey to fill in data gaps on the Shackleton Fracture Zone was undertaken while waiting for the wind to reduce. Winds finally died down at around 0900 GMT and a rock dredge (DR19) was deployed to 1200m depth at 60° 12.78'S, 57° 45.89'W. Dredge came back on deck at 1233 GMT with a few

rocks, starfish and scleractinian and stylasterid bases. A box dredge (DR20) was then deployed at a shallower site (800m, at 60° 11.76'S, 57° 47.21'W) and brought back small to medium sized rocks, some brachiopods, sponges and a few scleractinian coral and stylasterid coral bases. A rock Dredge (DR21) was deployed at 1739 GMT (1140m, at 60° 11.21'S, 57° 50.66'W) . Rocks with coral holdfasts were recovered. Wind and seas dropped sufficiently to deploy TowCam (CAM05) at 750m, 60° 10.867'S, 57° 50.078'W. 1051 images were taken and showed sediment, ferromanganese pavement, scarce boulders abundant live biology and fossil corals. Recovered TowCam on May 16.

Friday 16 May 2006

Shackleton Fracture Zone. TowCam (CAM05) at 750m, 60° 10.867'S, 57° 50.078'W. 1051 images were taken and showed sediment, ferromanganese pavement, scarce boulders abundant live biology and fossil corals. Recovered TowCam on May 16 at 0104 GMT. An inner liner bag was added to the box dredge which was then deployed (DR22) at 0203 GMT the same location as the TowCam run. Dredge contained several cubic feet of fossil coral rubble, gravel, sand and starfish. Most material was smaller than the box dredge mesh, so the inner lining was deemed a successful addition. The box dredge was redeployed at 0549 GMT over the same area to collect more material (DR23). Recovered dredge, ~75% full of similar material including fossil (ferromanganese crust coated) *Caryophyllia* corals, *D. dianthus* corals and colonial scleractinian corals as well as stylasterids, brachiopods, starfish, other biological samples and gravel. Transited to NW to sample a similar plateau at ~1560m water depth 59° 56.89 S, 58° 29.18'W. Dredge (DR24) was deployed at 11:11 GMT and a few rocks with coral holdfasts were recovered. Dredge on deck at 1510 GMT. Magnetometer was deployed for the geology/geophysics group. Begin transit to west towards "Interim seamount"

Saturday 17 May 2006

Transited to 'Interim Seamount' for paleoclimate/biology studies while awaiting clearance to work in Chilean waters. Had some difficulty reconciling multibeam with existing and apparently unedited British Antarctic Survey data. Resurveyed entire seamount during course of time at Interim resulting in an elongate SW – NE trending ridge with several discrete "knolls" along the ridge crest. Surveying continued until 1534 when a suitable TowCam site was chosen at 1067m water depth, 60° 34.61 S, 66° 00.19'W. TowCam operations were successful, and showed rough terrain with exposed pillow basalts on knolls, and sediment / gravel / fossil coral areas with distributed live biology long the transect.

Sunday 18 May 2008

At 00:58 GMT DR25 (box dredge) was deployed at 60° 34.34 S, 65° 59.18'W, 884m water depth and recovered basalt pebbles, and ferromanganese coated stylasterid corals. The Scripps style rock dredge was lined with cotton to try and prevent loss of small material. At 04:15 GMT the rock dredge (DR26) was deployed on a steeper slope at 896m water depth, 60° 33.45 S, 65° 58.17'W and recovered basalt rocks, and large fossil stylasterids. The cotton aided recovery but was shredded and could not be used again. The box dredge (DR27) was redeployed at 07:53 GMT, 1113m water depth, 60° 32.83 S, 65° 56.95'W on a northern saddle. Fine coral rubble and manganese grains with basalt pebbles were recovered. An alternative porous plastic lining bag was put into the rock dredge which was then deployed (DR28) at 11:33 GMT on the shallowest pinnacle of the seamount, at 759m water depth 60° 33.80 S, 65° 58.22'W. The lining ripped, and floated up inside the dredge, but we still recovered some stylasterids, hydroids and coral holdfasts. A second TowCam run was carried out at 14:09 GMT at 1199m water depth, 60° 32.77 S, 65° 56.65'W. Pictures showed patchy areas of outcropping basalt, sediment and fossil coral gravel. At 20:29 GMT box dredge (DR29) was deployed to cross the TowCam track at 60° 33.66 S, 65° 58.11'W. Vesicular pillow basalts, live and fossil stylasterids were recovered. At

23:18 GMT Box dredge (DR30) was deployed at 1417m water depth 60° 31.579 S, 65° 56.343'W.

Monday 19 May 2008

Box dredge DR30 was recovered at 02:27 GMT and contained basalt and live and fossil stylasterids corals. At 0309 GMT box dredge DR 31 was deployed at 1358m water depth, 60° 31.64 S, 65° 56.09'W. Corals were recovered including a complete fossil *Desmophyllum dianthus* specimen (target paleoclimate species). Box dredge (DR32) was deployed at 1938m water depth, at 60° 31.92 S, 66° 00.35'W. Tension spikes indicated that the dredge was hauled over the seafloor, but unfortunately it came up washed clean, we suspect it turned upside down during hauling. A third lining was made for the Scripps rock dredge, this time out of a number of rock bags. The rock dredge (DR32) was deployed at 11:57 GMT, 1852m at 60° 30.28 S, 65° 56.15'W. Unfortunately the bag snagged and the dredge recovered only one small bryozoan. Chilean permission to sample Sars seamount was still not obtained so it was decided to transit northward towards a deep-water CTD site situated at a similar latitude to Sars, and on route to an alternative seamount should permission not be forthcoming. CTD04 was deployed at 2014 GMT, 59° 49.413 S, 66° 0.185'W in 4403 m of water with a small sediment catcher attached to the base. A full water depth transect and a 7cm sediment core were recovered. During the CTD notification that permission should arrive on the morning on the 20th was received. Magnetometer was deployed for geology/geophysics group and transit to Sars commenced, skirting southern boundary of Chilean Exclusive Economic Zone (EEZ).

Tuesday 20 May

After some confusion over permission details it was decided to carry out a deep water (3640m) TowCam08 at 18:23 GMT at 59° 23.15 S, 68°51.83'W, well outside potential Chilean EEZ waters. Upon receiving news of permission to work at Sars, TowCam operations were ceased and we proceeded to Sars Seamount. Multibeam surveying of the bank showed a 500m plateau surrounded by knoll like features considered likely fossil coral targets.

Wednesday 21 May

Once TowCam batteries were fully charged TowCam09 was deployed at ~0244 GMT transiting from the edge of the plateau up onto the summit (~ 500m) at 59° 41.46 S, 68°46.25'W. Images showed sediment, sponges and corals. Box dredge (DR34) was deployed on a knoll below the summit at 899m water depth 59° 44.00 S, 68°44.55'W. The box dredge was filled with compacted sandy sediment (basalt and sand) that had to be pried out. Within the sand were large fossil *D. dianthus* individuals (and other species). This finding was extremely important and validated our efforts to target Sars for paleoclimate sample collection. TowCam09 pictures confirmed the feasibility of trawling the top of the seamount, so Otter Trawl TO_03 was deployed at 1305 GMT at 59° 43.31 S, 68°43.51'W. The trawl contained hundreds of intact sponges with sizes greater than a foot in diameter. Amongst the sponges were live and fossil corals including the reef building scleractinian *Solenosmilia*, and king crab, brachiopods, starfish and other biological specimens. Box dredge (DR 35) was deployed at 17:33 GMT at 59° 43.37 S, 68°52.83'W at 718m water depth. Again the box dredge came up packed with coal sand that contained multiple large fossil *D. dianthus*, live *Caryophyllia* and multiple other live and fossil corals and biology. Box dredge (DR 36) was deployed at 20:43 GMT at 59° 42.39 S, 69°00.48'W at 1718m water depth. The box dredge contained fist sized basalt pebbles, large fossil stylasterids and two intact fossil *D. dianthus*, live soft corals and crabs.

Thursday 22 May

Box dredge (DR 37) was deployed at 01:42 GMT at 59° 44.65 S, 68°59.38'W at 1952 m water depth. On commencing hauling in the wire large tension spikes were observed on the tensiometer, exacerbated by ship heave. The ship was backed down to allow safe recovery of the box dredge which was recovered, empty, at 06:16 GMT. Box dredge (DR 38) was deployed at 07:02 GMT at 59° 44.56 S, 68°53.86'W at 1038m water depth. The box dredge contained sand with fossil *D. dianthus*. Box dredge (DR 39) was deployed at 10:23 GMT at 59° 43.74 S, 68°54.04'W at 817 m water depth, below site DR34. Additional multibeam data were collected to ensure that Sars was well mapped to allow detailed habitat analysis and to aid future collections. The dredge contained coral and basalt sand with fossil *D. dianthus* and live and fossil *Caryophyllia*, as well as other biological specimens. Box dredge (DR 40) was deployed at 16:12 GMT at 59° 43.91' S, 68°55.99'W at 1294 m water depth. Dredge contained fossil *D. dianthus* and *Caryophyllia* and basalt rocks, but no sand sized fraction. Dredging operations were ceased at 19:10 GMT, the deck was secured and transit towards magnetometer site south of the Straits of La Maire commenced, filling multibeam maps as we left Sars Seamount. Multibeam system was switched off when we reached deep water.

Friday May 23 2008

Transited in heavy seas northwestward to 56 degrees 10'South, 65 degrees 35'West to run magnetometer transect across purported oldest a magnetic anomalies in the West Scotia Sea

Saturday May 24 2008

Ceased all underway geophysical measurements passing through Strait of Le Maire and stood down from underway science watches. Transited towards eastern approach to Strait of Magellan.

Sunday May 25 2008

Docked Punta Arenas, Chile

Conclusion

We were fortunate that none of the shortcomings outlined in the opening Summary of this report proved critical for the achievement of the scientific goals, and the unexpectedly good weather for the time of year helped immensely. NBP0805 can be regarded as a highly productive and successful interdisciplinary cruise. Captain Mike Watson and his crew, and MPC Jenny Watson and her staff were instrumental in making the cruise the success that it was. Their extraordinary efforts to acquire the final magnetic profile across the critical magnetic anomalies in the northwestern limit of the West Scotia Sea in bad weather and with time pressing to return to port was very much appreciated.

