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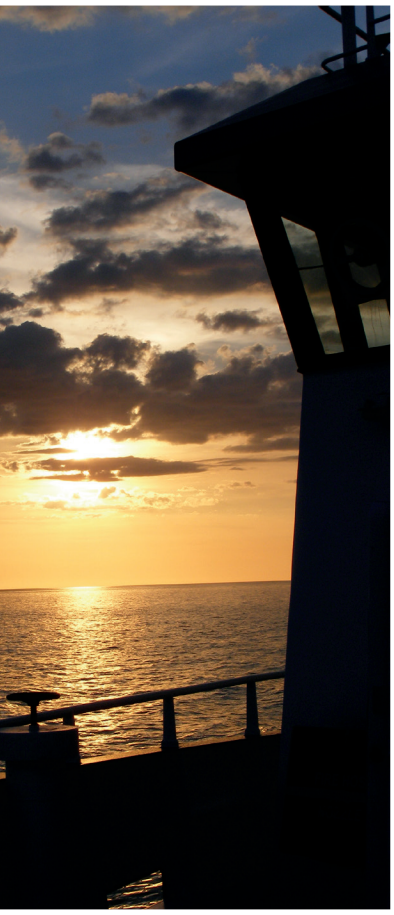

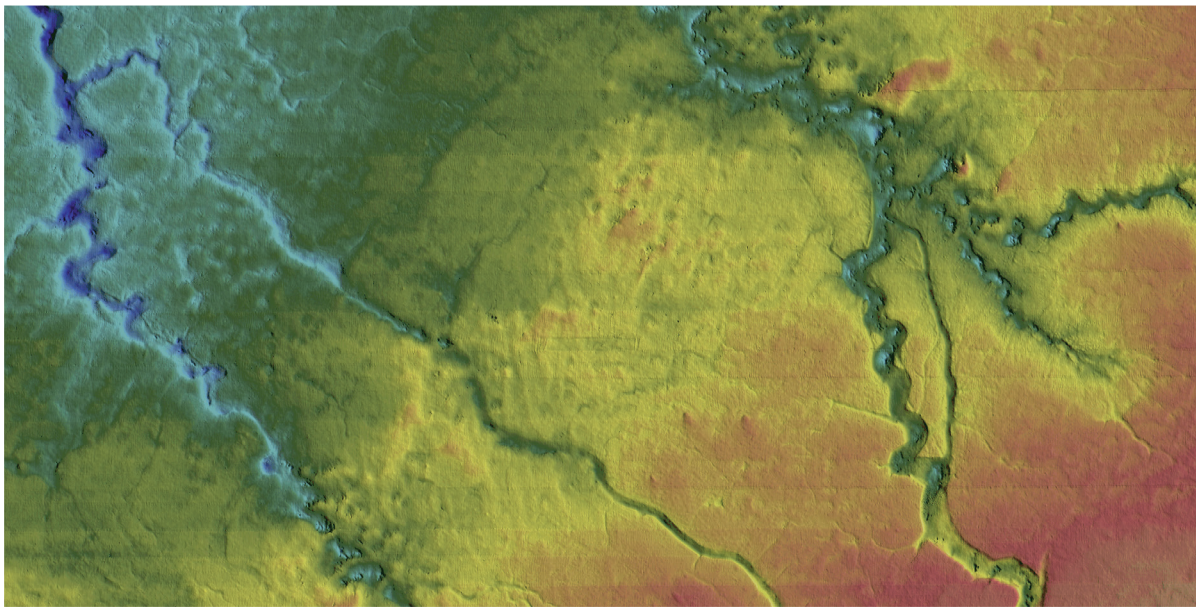

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Seabed Environments and Shallow Geology of the Petrel Sub-basin, Northern Australia:

SOL5463 (GA0335) – Post Survey Report

Carroll, A.G., Jorgensen, D.C., Siwabessy, P.J.W., Jones, L.E.A., Sexton, M.J., Tran, M., Nicholas, W.A., Radke, L.C., Carey, M.P., Howard, F.J.F., Stowar, M.J., Heyward, A.J., Potter, A. and Shipboard Party

Australian Institute of Marine Science

Seabed Environments and Shallow Geology of the Petrel Sub-basin, Northern Australia

SOL5463 (GA0335) – Post Survey Report

GEOSCIENCE AUSTRALIA
RECORD 2012/66

by

Carroll, A.G.[1], Jorgensen, D.C.[1], Siwabessy, P.J.W.[1], Jones, L.E.A.[1], Sexton, M.J.[1], Tran, M.[1], Nicholas, W.A.[1], Radke, L.C.[1], Carey, M.P.[1], Howard, F.J.F.[1], Stowar, M.J.[2], Heyward, A.J.[2], Potter, A.[1] and Shipboard Party[1]

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Executive Summary

In May 2012, Geoscience Australia, in collaboration with the Australian Institute of Marine Science (AIMS), carried out a seabed mapping survey (SOL5463/GA0335) of the Petrel Sub-basin, northern Australia. The purpose of the survey was to gather pre-competitive geophysical and biophysical data on seabed environments and the shallow geology within targeted areas of the Petrel Sub-basin to facilitate an assessment of the basin's CO_2 storage potential. This survey formed the marine component of concurrent Geoscience Australia marine and seismic surveys (GA0336) and was undertaken as part of the Australian Government's National Low Emission Coal Initiative. This initiative aims to accelerate the development and deployment of low-emission coal technologies involving carbon capture and storage and complements work Geoscience Australia is also undertaking under the National CO_2 Infrastructure Plan.

The survey mapped two targeted areas of the Petrel-Sub-basin located within the Ptrl-01 2009 Greenhouse Gas acreage release area (now closed). Data acquired onboard the AIMS research vessel, *Solander* included multibeam sonar bathymetry (471.2 km^2 in Area 1 and 181.1 km^2 in Area 2) to enable geomorphic mapping, and multi-channel sub-bottom profiles (558 line-kilometres in Area 1 and 97 line-kilometres in Area 2) to investigate possible fluid pathways in the shallow subsurface geology. Sampling sites covering a range of seabed features were identified from the preliminary analysis of multibeam bathymetry and shallow seismic reflection data. Sampling equipment deployed during the survey included surface sediment grabs, vibrocores, towed underwater video, conductivity-temperature-depth (CTD) profilers and ocean moorings. A total of 14 stations were examined in Area 1 (the priority study area) and one station in Area 2.

Multibeam sonar mapping revealed that the southern survey area (Area 1) is characterised by palaeo-channels, plains, low-relief ridges and pockmark fields, whereas the northern study area (Area 2) is characterised by three steep- to vertically-sided flat-topped banks, which stand approximately 30-40 m above the surrounding seabed. Preliminary analysis of sediment samples indicate that the plains are comprised of fine- to medium-grained sands and muds, whereas palaeo-channels comprise coarse- to very coarse-grained sands. Large areas (~380 km^2) of the seabed in Area 1 contain pockmarks (small shallow depressions in the seabed); those on the plains and in valleys are up to three metres deep and 30 m in diameter. Of these, larger pockmarks (>10 m in diameter) generally occur in fields ranging between 10-100 km^2 and cover ~80% of the southern study area, while smaller pockmarks (<10 m diameter) typically occur in closely spaced clusters within the fields of larger pockmarks. Comparatively fewer pockmarks are present in Area 2 where they occur primarily as clusters on the margins of banks and ridges. The benthic ecology component of the survey involved seabed characterisation from towed-video observations and infaunal collections from grabs. Habitats included soft barren sediments, bioturbated soft sediments and mixed patches of octocorals and sponges, distributed over shallow water depth ranges (82 – 96 m in Area 1; 45 – 52 m in Area 2). Preliminary analyses indicate that infaunal assemblages are dominated by crustaceans and polychaetes and to a lesser extent echinoderms and molluscs.

This report provides a comprehensive overview of the survey activities and preliminary results from survey SOL5463. Detailed analyses and interpretation of the data acquired during the survey will be integrated with new and existing seismic data. This new information will support the regional assessment of CO_2 storage prospectivity in the Petrel Sub-basin and contribute to the nation's knowledge of its marine environmental assets.

Acknowledgements

The authors wish to thank the Master and crew of the RV *Solander* and scientific staff at the Australian Institute of Marine Science for their support in conducting the survey. We also thank the Field and Engineering Support staff at Geoscience Australia (GA) and staff at Pearl Marine Engineering Pty Ltd in Darwin for their logistical support. Thanks to Mark Matthews and Dean Forrest (IXSURVEY) for their assistance with multibeam data acquisition during Leg 1 and Ian Atkinson (GA) for his support with the multibeam system. We thank staff at the Museum and Art Gallery, Northern Territory and Museum Victoria for agreeing to archive biological survey specimens, and Rachel Przeslawski (GA) for initial infaunal specimen identifications. We gratefully acknowledge Tanya Whiteway, Scott Nichol, Rachel Przeslawski and Chris Consoli at GA for their valuable reviews of the original draft of this report. Front cover photographs courtesy of L.E.A. Jones. This record is published with the permission of the Chief Executive Officer of Geoscience Australia and the Australian Institute of Marine Science.

1. Introduction

This report provides details of the activities undertaken during the conjoint Geoscience Australia (GA) and Australian Institute of Marine Science (AIMS) seabed mapping survey SOL5463 (GA0335) of the Petrel Sub-basin, northern Australia (Figure 1.1). The purpose of the survey was to acquire pre-competitive geophysical and biophysical data on shallow (<100 m water depth) seabed environments within two targeted areas of the Petrel Sub-basin to facilitate an assessment of the CO_2 storage potential in these areas. The survey was conducted on two legs between 3 and 31 May 2012 onboard the AIMS research vessel (RV) *Solander* and included scientists and technical staff from GA, AIMS and IXSURVEY (Appendix A). This report provides the context to the survey activities, describes the methods for geophysical data acquisition and processing, and techniques used for sedimentological, geochemical and biological seabed sampling. It also outlines some preliminary observations on the seabed characteristics of the two study areas.

1.1. BACKGROUND AND SCIENTIFIC RATIONALE

The Petrel Sub-basin, located beneath the Joseph Bonaparte Gulf, northern Australia, was identified in the 2009 Carbon Storage Taskforce Report as potentially suitable for geological storage of CO_2 because of its favourable geological setting and proximity to offshore gas and petroleum resources. Infrastructure development by Australia's offshore petroleum industry in particular will therefore require improved knowledge of seabed habitats within this region. GA is currently focused on delivering pre-competitive data and information to support the regional assessment of CO_2 storage prospectivity in the Petrel Sub-basin, as part of the Australian Government's National Low Emission Coal Initiative (NLECI). This two year program will compile and reinterpret existing data, and acquire, process and interpret new pre-competitive data to address key knowledge gaps in the Petrel Sub-basin.

Collection and analysis of seabed data (consisting of geophysical, geochemical and biological information) is essential for determining the distribution and representativeness of marine habitats and their associated ecological communities, and assessing and evaluating the potential for fluid seepage from the seafloor. In particular, bathymetric data informs on the presence or absence of physical seabed features that may be associated with seepage, while sub-bottom profiles enable investigation of the link between the seabed and the deeper subsurface geology. This survey was designed to complement new and existing seismic data for assessing seepage in two targeted areas of the Petrel Sub-basin. The survey aimed to acquire geophysical and biophysical data to characterise seabed habitats and support the investigation of critical geoscience issues affecting the CO_2 geological storage prospectivity of the region. This involved documenting and sampling features indicative of fluid seepage that may be related to poor sealing capabilities which may impact on the effective long-term geological storage of CO_2. Seepage-related features include pockmarks, scarps and banks, with associated sub-surface structures (e.g. gas chimneys, faults) and biological communities.

Survey SOL5463 formed the marine component of concurrent marine and seismic (GA0336) surveys conducted by GA in the Petrel Sub-basin. The latter survey involved the collection of approximately 4,091 line-kilometres of commercial 2D seismic data during the period 3 May 2012 to 24 June 2012, using CGG Veritas's marine seismic vessel MV *Duke*. Data collected during these surveys and the results of subsequent sample analyses and interpretation will contribute to a comprehensive interdisciplinary assessment of seal integrity and CO_2 storage potential in the Petrel Sub-basin.

1.2. SURVEY AIM AND OBJECTIVES

The principal aim of this survey was to acquire geophysical and biophysical data on shallow (<100 m water depth) seabed environments within targeted areas of the Petrel Sub-basin to facilitate an assessment of the CO_2 storage potential in these areas. Specific objectives of the survey were to:

1. Determine the location of small reefal structures on the seabed that may affect seismic data and their interpretation (i.e. pull-up effects);
2. Determine the location of fault/fracture systems that may affect the regional seal and that may have a surface expression on the seabed;
3. Characterise the seabed and associated biota across the CO_2 supercritical seal boundary (seal of CO_2 sequestrated at 800 m below the seafloor), particularly for banks, ridges and pockmark fields that may be associated with natural hydrocarbon leakage indicating a poor quality regional seal; and,
4. Determine the location and internal stratigraphy of paleochannel systems in the vicinity of the supercritical boundary that may provide migration pathways for a CO_2 plume in the study area.

1.3. STUDY AREAS

The Petrel Sub-basin is an asymmetric, northwest-southeast trending Paleozoic rift that primarily contains Paleozoic and Mesozoic sediments in the central and southeastern portion of the Bonaparte Basin (Kennard et al. 2002). It is a proven hydrocarbon sub-basin, as evidenced by the Petrel gas and oil fields. The Petrel Sub-basin sits within the Joseph Bonaparte Gulf, which occupies a pericratonic setting, and is flanked by the Proterozoic Kimberley Basin to the southwest and the Cambrian Ord and Proterozoic Victoria River basins to the south and southeast (Colwell and Kennard 1996).

The stratigraphy and structural elements of the Petrel Sub-basin show repeated marine transgressions followed by uplift and denudation (Van Andel and Veevers 1967) (Figure 1.2); these phases are related to tectonic events and glacial/interglacial sea level cycles (Kennard et al. 2002). The oldest sediments in the Petrel Sub-basin are Cambrian in age and are underlain by Proterozoic crystalline basement and sediments of the Proterozoic Kimberley Basin (Colwell and Kennard 1996). The eastern and western boundary faults of the Petrel Sub-basin converge onshore to form the southern termination of the sub-basin (Kennard et al. 2002). Stratigraphic units of interest for hydrocarbon-related studies range from the Late Devonian Bonaparte Formation to the Late Cretaceous Wangarlu Formation.

Geological reservoirs of interest for CO_2 storage in the Petrel Sub-basin include the Jurassic Plover Formation and the Early Cretaceous Sandpiper Sandstone (Figure 1.2 and Figure 1.3). The Frigate Formation overlies and seals the Plover Formation but is not as extensive as the Bathurst Island Group, which forms the regional seal for sequestration and overlies the Early Cretaceous Sandpiper Formation (Figure 1.3). The margins of the regional seal in the south and east are at shallower depths (<800 m) than at the centre of the Petrel Sub-basin (>800 to ~ 2,500 m below seabed). This is a result of the northwest plunge of the Petrel Sub-basin syncline, which gives rise to exposure of Lower Paleozoic sediments in the onshore, southeastern margin of the sub-basin.

SOL5463 targeted two areas (Figure 1.1): Area 1 was selected for its location across the CO_2 super-critical seal boundary within the Petrel Sub-basin. It covers approximately 16 x 30 km and is located in relatively shallow (<100 m) water depths. Area 2 is located above large faults within the Petrel Sub-basin and incorporates several banks (including the southern edge of Flat Top bank) that rise to 30 m water depth and occur in basal seabed depths of up to 75 m. This area is approximately 10 x 17 km and was selected to test for current-day migration and seafloor seepage of fluids up and along this fault system.

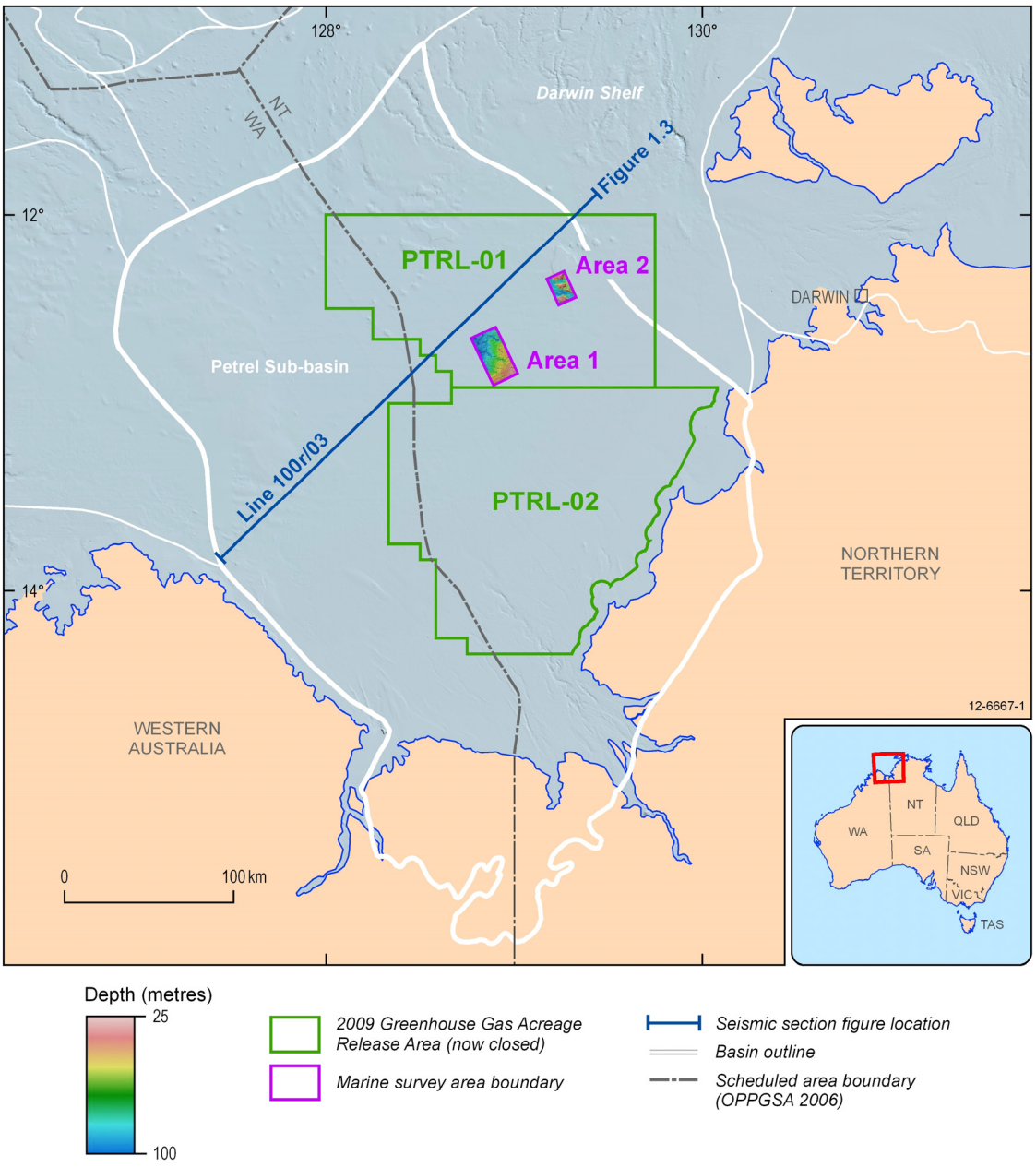

Figure 1.1: *Bathymetric map showing the location of study Areas 1 and 2 in the Petrel Sub-basin, northern Australia. Map also shows the location of the 2009 Greenhouse Gas storage assessment acreage release areas Ptrl-01 and Ptrl-02 (now closed) and Geoscience Australia seismic line 100r/03 across area Ptrl-01 (see Figure 1.3).*

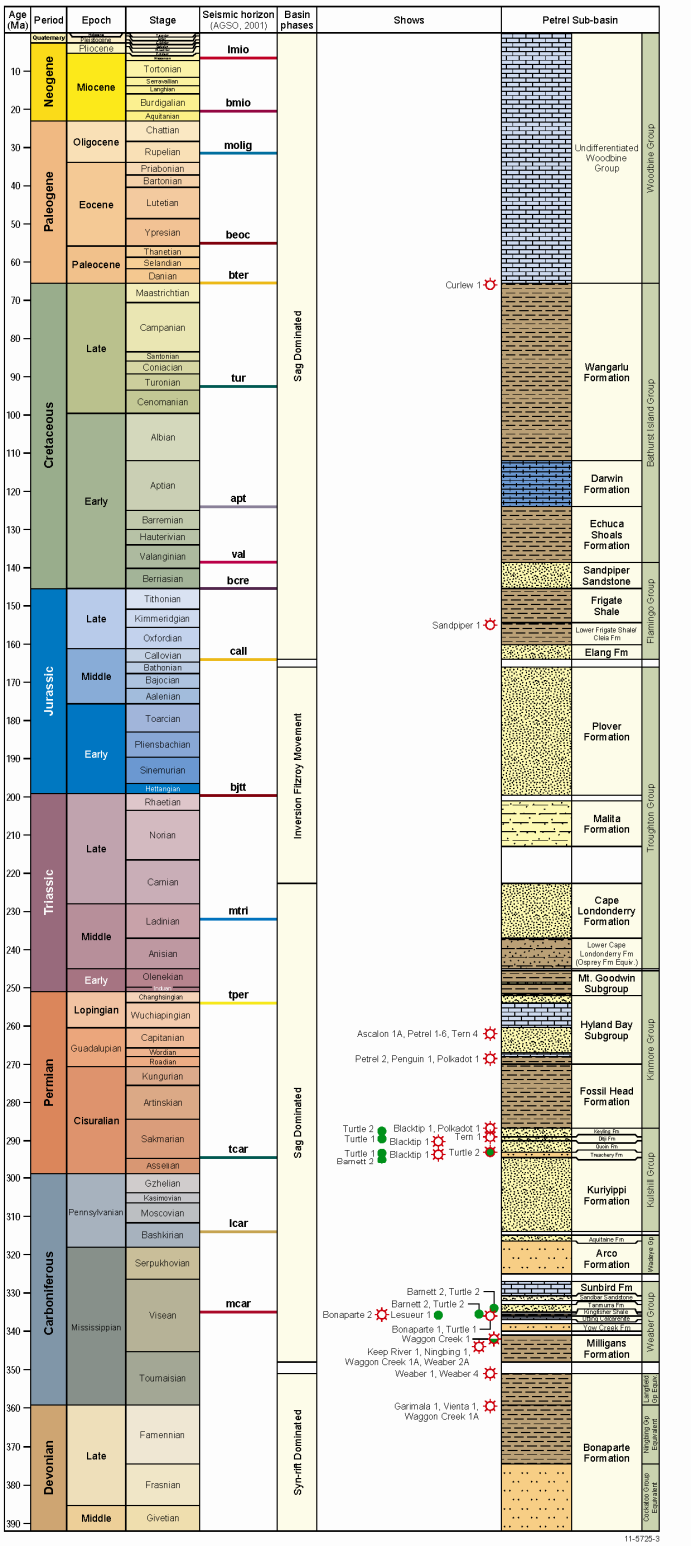

Figure 1.2: *Stratigraphy of the offshore Petrel Sub-basin based on the Bonaparte Basin Biozonation and Stratigraphy Chart (Nicoll et al. 2009). Basin phases specific to the Petrel Sub-basin after Colwell and Kennard (1996). Accumulations in Paleozoic sediments and hydrocarbon shows in Mesozoic sediments are also shown.*

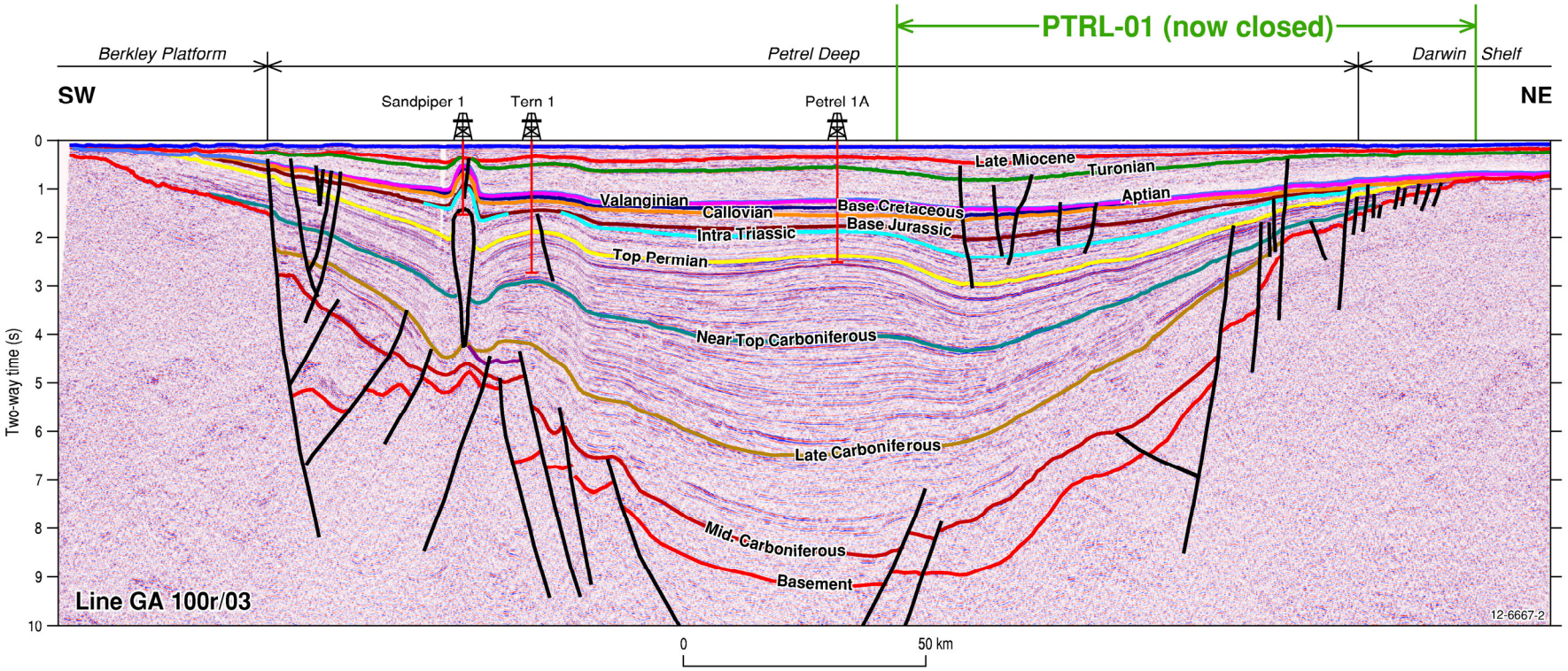

Figure 1.3: *Geoscience Australia seismic line 100r/03 across 2009 GHG release area Ptrl-01 (now closed) demonstrating the extent of the geological reservoirs of interest for CO_2 storage in the Petrel Sub-basin, including the Jurassic Plover Formation (above Base Jurassic seismic horizon) and the Early Cretaceous Sandpiper Sandstone (above Base Cretaceous seismic horizon). Regional seismic horizons are shown in Figure 1.2.*

2. Methods

Survey SOL5463 (GA0335) was divided into two operational legs: Leg 1 (3-18 May 2012) involved geophysical data acquisition, deployment of oceanographic instrument moorings and conductivity, temperature and depth (CTD) casts; Leg 2 (18-31 May 2012) involved geophysical data acquisition, seabed sampling, CTD casts and recovery of moorings. It was necessary to divide the survey into two legs in order to accommodate the teams of scientists and technicians associated with the multibeam swath system and sampling techniques within the berths available on the RV *Solander*. Daily operational reports that include geophysical and biophysical sampling operations are contained in Appendix B.

The principal methods used to acquire pre-competitive data comprised full coverage multibeam sonar mapping of the seabed to enable geomorphic mapping of each survey area, multi-channel sub-bottom profiling to investigate potential fluid pathways to the surface in shallow subsurface geology, and bio-/geochemical and sedimentological seabed sampling at 13 locations to characterise the seabed environment and identify possible seep signatures. CTD measurements and samples of the water column were also collected at 11 locations to characterise the vertical structure of the water column. Finally, measurements of waves, tides and ocean currents were acquired using current meters moored on the seabed (one within each survey area) to assist the characterisation of regional oceanographic processes.

Sampling stations were selected based on shipboard observations and preliminary interpretations of geophysical datasets as they were acquired (Appendix C). Features of interest included potential fault scarps, vents, carbonate hardgrounds and rock exposures. Seven sampling days were originally planned for physical sampling during Leg 2 of the survey and included the use of underwater Baited Remote Underwater Video (BRUV) units to characterise fish communities associated with bank features. However, the actual sampling program undertaken was limited due to delays experienced with bad weather conditions, a return to Darwin port for a medical evacuation and interruptions to data acquisition associated with the multibeam sonar system (Appendix B). The deployment of the BRUV units was not carried out due to these delays. A total of 15 stations were sampled to characterise the bio-physical properties of the seabed, and comprised 14 stations in Area 1 (the priority study area) and one station in Area 2.

A range of sampling operations were completed at each station and included a combination of CTD casts, towed underwater video and stills photography, vibrocores and sediment grabs. The combination of operations at each sampling station was determined on a station-by-station basis and depended on the nature of the seabed environment being sampled and prevailing weather conditions (Appendix B). The acquisition and processing parameters of different datasets recorded during the survey are outlined below.

2.1. GEOPHYSICAL DATA ACQUISITION AND PROCESSING

2.1.1. Multibeam Bathymetry

High-resolution (2 m horizontal resolution) multibeam bathymetry data were collected over the two study areas using GA's Simrad EM3002D multibeam sonar system, mounted in the moon pool of the RV *Solander*. The multibeam bathymetry data were processed using Caris HIPS/SIPS v7.1 SP1 software, and included: i) applying algorithms that corrected for tide and vessel pitch, roll and heave, and; ii) software filters and visual inspection of each swath line to remove any remaining artefacts and noisy data (e.g. nadir noise and data outliers). Final bathymetry surfaces were created within Caris and then exported as a surface grid (bathymetric map) for display and analysis. Final processing to correct for tidal variations was completed post-survey using a modified GPS tide in Caris.

2.1.2. Multibeam Backscatter

The Simrad EM3002D multibeam system also collected multibeam backscatter data. These data were processed using the multibeam backscatter *CMST-GA MB Process* v12.05.07.0 (×64) toolbox software co-developed by the Centre for Marine Science and Technology (CMST) at Curtin University of Technology and GA (described in Gavrilov et al. 2005; Parnum and Gavrilov 2011). The fully processed backscatter strengths were corrected for transmission loss, insonification area and local slope. The process within the toolbox also involved removal of the system transmission loss, removal of the system model, calculation of the incidence angle, correction of the beam pattern, calculation of the angular backscatter response within a sliding window of 100 pings with a 50% overlap in a 1° bin, removal of the angular dependence and restoration to the backscatter strength at an angle of 25° (Daniell et al. 2010). The final processed backscatter data were then gridded to 2 m horizontal resolution and exported for display and analysis.

2.1.3. Multibeam Water Column Return

Multibeam water column data was collected using the Simrad EM3002D multibeam system. The returns were analysed using Caris HIPS/SIPS v7.1 SP1 software. This new tool in Caris applied a simplified assumption. It assumed a constant speed of sound of 1,500 ms^{-1} in the seawater and applied a straight line ray tracing. The tool allows for stacking a user-defined number of cross sections. It also allows for selection of a desired water column backscatter range. A manual process was conducted to analyse a stack of predefined 200 pings of water column cross sections within a water column backscatter range between -55 and -15 dB.

2.1.4. Sub-bottom Profiling

Shallow sub-surface sediment data were collected using an Applied Acoustics Squid 2000 “Sparker” sub-bottom profiler (powered by a CSP-D generator on a Hi 10 setting of 2000 joules) (Figure 2.1a-c) towed at a speed of 5-7 knots (9-13 km hr^{-1}) in calm to slight seas. Use of a 24 channel Geometrics Geoeel (Figure 2.1d-e) with a group interval of 3.125 m and a 6.25 m shot interval resulted in six fold Common Depth Point (CDP) stacked data. The source was offset from the streamer by 20 m in-line and 10 m laterally and was itself towed 20 m behind the stern of the vessel. Source depth was a nominal 0.5 m and streamer depth a nominal 2.5 m (“average” of Star Oddi pressure sensor readings in very variable sea conditions). During acquisition, data quality was monitored on the data acquisition PC via a display of each successive shot record and a progressive near (second) trace gather. Shot records were output on disk in SEG-Y format with 0.5 second record length and 0.25 millisecond sample interval. Navigation log files contained GPS position and UTC time for each field record. Only times, not coordinates, were input into the SEG-Y trace headers.

During the survey, multichannel seismic reflection processing was conducted with Paradigm Geophysical’s Disco/Focus software. Processing included geometry definition with correction to actual source-receiver offsets, mute of leaked timing pulse, band pass filtering, and surface related multiple elimination on shot records. Following CDP sort, interactive velocity analysis was carried out on the first line in order to determine a representative stacking velocity function for Area 1. Observation of the relative motion of the sparker and streamer led to the idea of using non-surface consistent trim statics to align reflections prior to stack, which improved the data, particularly in the rougher seas. Migration was necessary for sharper delineation of small channels, which appeared as classic “bow-ties” on the stack section. Processed data were output as SEG-Y files and loaded into Kingdom software. These SED-Y files were subsequently used for selection of sampling sites (see Appendix C).

Figure 2.1: *(a-c) Preparation and deployment of the Applied Acoustics Squid 2000 "Sparker" sub-bottom profiler and (d-e) 24 channel Geometrics Geoeel.*

Final processing was completed post-survey at Geoscience Australia to improve the data by tailoring statics gates and velocity functions to digitised water bottom. However, the most significant improvement came with the recognition of latent high frequencies in the data above 1,000 Hz and the use of minimum entropy deconvolution not only to enhance the high frequency content but also to collapse the source wavelet and remove a substantial component of ghosting. Figure 2.2 illustrates the difference between seismic data processed onboard the RV *Solander* and final processed seismic data. Statics corrections were applied to adjust to mean sea level, correcting for the source and streamer depth and the effect of tides (interpolated from GPS elevations).

Final SEG-Y files of the migrated data were produced with relevant trace headers populated and a full EBCDIC header with metadata on acquisition and processing (see Appendix D for an example). However, it must be noted that it is impossible to completely compensate for acquisition limitations by digital multi-channel processing, and thus the quality of the final product ranges from poor to excellent. The final processed sub-bottom profile data were imported into the computer software package GeoFrame for interpretation and analysis. Only preliminary interpretations of the data have currently been completed. These interpretations will be reported fully in a subsequent publication.

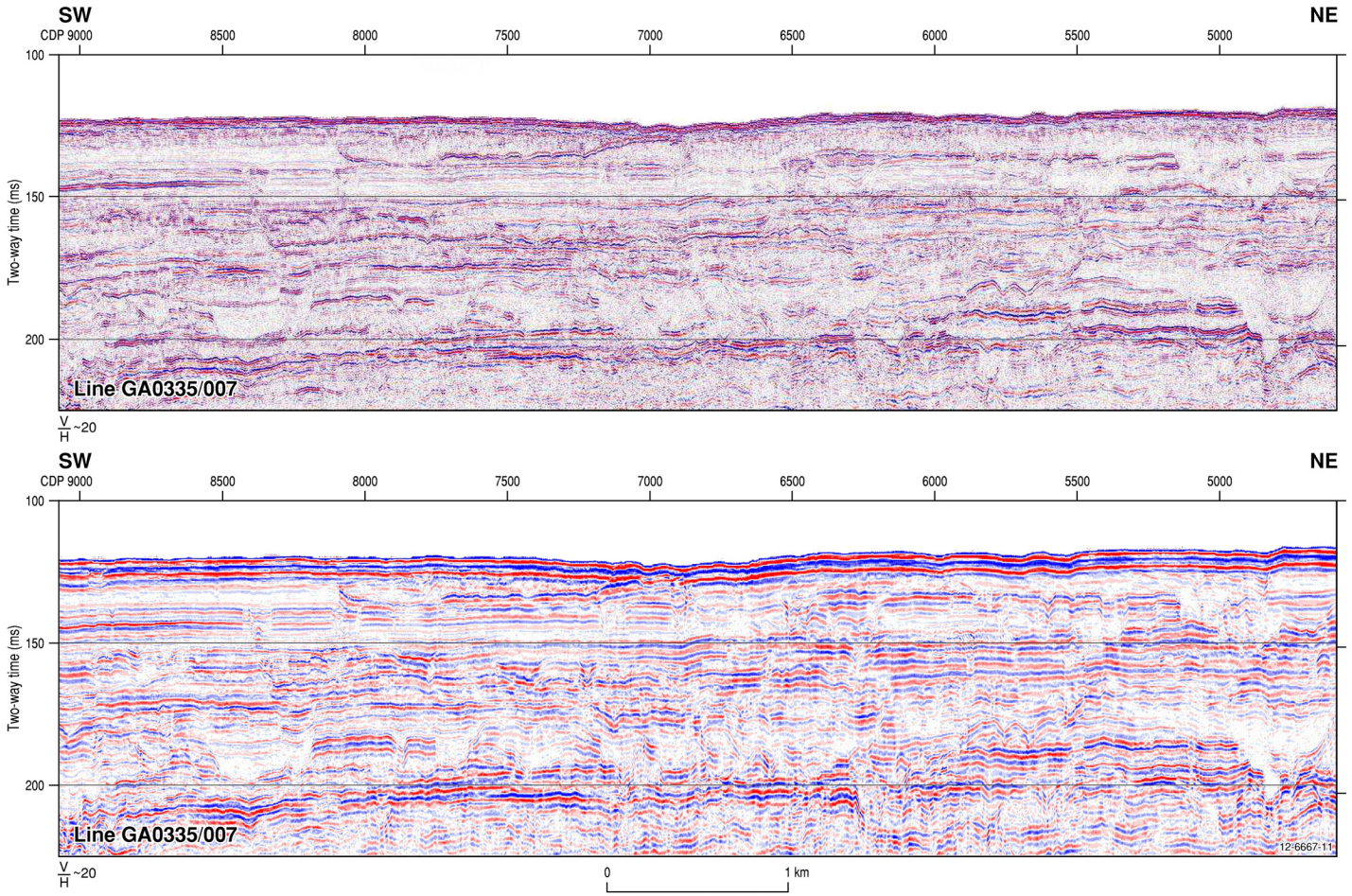

Figure 2.2: *Migrated section for western half of sub-bottom profile line GA0335/007 (up to 100 m of sediment has been penetrated by this sub-bottom profile). Top image: Seismic data processed onboard. Bottom image: Final processed seismic showing the result of applying deconvolution to the data. The higher frequency content in the latter allows for improved resolution of stratigraphy and structure in the top 100 m of sediment.*

2.2. WATER COLUMN MEASUREMENTS AND SAMPLING

Conductivity, temperature and depth (CTD) casts were completed at 11 stations (Appendix D) with a live-wire Seabird 911 deployed using a hydrographic wire from the starboard side of the RV *Solander* (Figure 2.3). This system comprised additional fluorometer, transmissometer, altimeter, and surface PAR sensors. At some stations where the CTD casts were taken, surface water, mid-water and/or bottom water (within 5 m of seabed) samples were collected using a Seabird SBE32 water sampling carousel that houses 12 remotely controlled 10L niskin bottles (Figure 2.3). Two niskin bottles were fired at each depth to collect the required water samples. Water sample analysis will include analysis for gas content in the bottom water samples. In addition, temperature, conductivity (≈salinity), fluorescence and turbidity readings of the surface water (<5 m below the sea surface) were recorded at 10 second intervals using the ship's Seabird Electronics SBE-21 thermosalinograph in conjunction with a WetLabs ECO FLNTU meter.

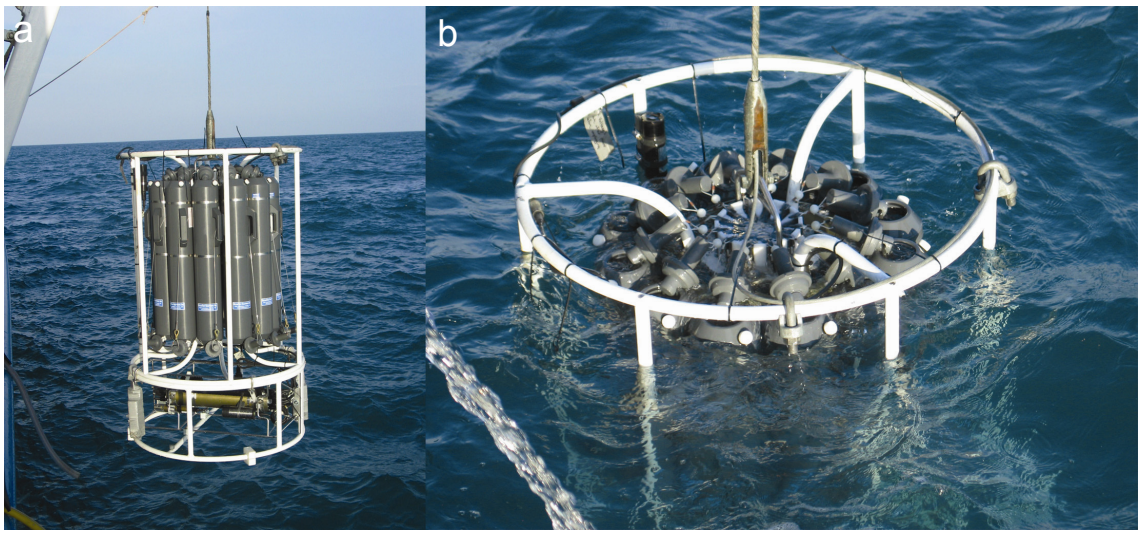

Figure 2.3: *(a) Deployment of the Seabird Electronics 911plus Livewire CTD from the starboard side of the RV Solander; (b) twelve-bottle rosette with niskin bottles open ready for water collection.*

2.3. OCEANOGRAPHIC DATA ACQUISITION

Wave, tide and ocean currents were recorded using two oceanographic moorings deployed in survey Areas 1 and 2 for a period of 25 and 23 days, respectively (Table 2.1). Positioning of the moorings was designed to be representative of sediment transport processes across areas of interest within the Petrel Sub-basin. The moorings consisted of an RD Instruments Acoustic Doppler Current Profiler (ADCP) deployed in Area 1, and a Sontek Acoustic Doppler Velocimeter (ADV) and Sontek Phase-Coherent Acoustic Doppler Profiler (PC-ADP) deployed together in Area 2. Each mooring was fitted with an acoustic release device to facilitate equipment recovery. The ADCP was deployed upward-looking (Figure 2.4) and measured the mean current velocity at 1 m bin intervals through the entire water column. Measurements were made at 15 second intervals and the vector-average stored every 10 minutes. The PC-ADP was deployed downward-looking, and measured the current velocity at 0.05 m bin intervals in the first 1 m above the bed. Measurements were made of waves and time-averaged current velocity at one Hertz (Hz) for a burst period of 17 minutes every six hours.

Table 2.1: Summary details of oceanographic moorings deployed during survey SOL5463.

INSTRUMENT	LATUDE	LONGITUDE	DEPTH (M)	DATE/TIME OF DEPLOYMENT	DATE/TIME OF RECOVERY
ADV & PC-ADP	-12.4479	129.2496	31	05/05/2012 24:56	29/05/2012 16:00
ADCP	-12.8358	128.9693	85	07/05/2012 09:18	30/05/2012 11:00

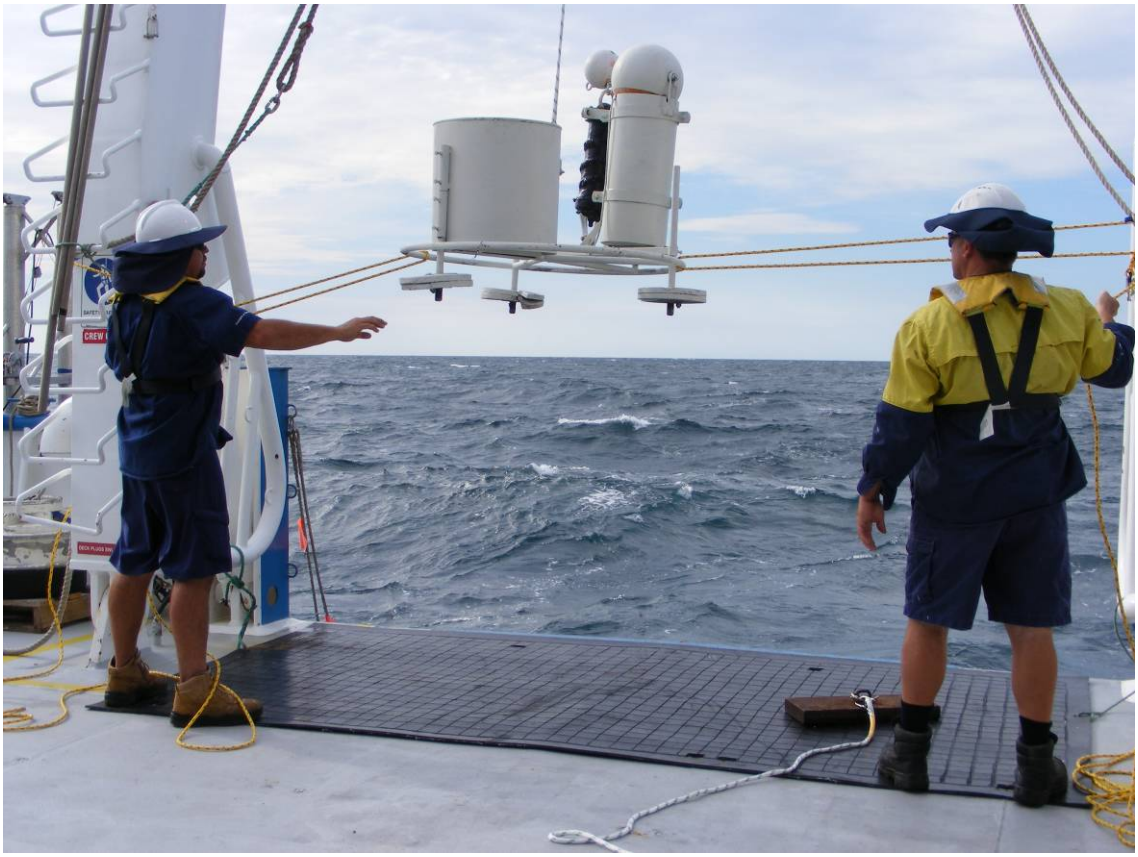

Figure 2.4: *Deployment of the ADCP mooring in Area 1.*

The ADV was deployed to measure the current velocity at a single point located 1 m above the seabed. Measurements were made at three different sampling rates, burst durations and burst intervals to capture turbulence, waves and tides. Turbulence sampling was at 10 Hz, for ten minutes every two hours. Wave sampling was at two Hz for 17 minutes every hour. Tide sampling was at 0.2 Hz for 120 seconds every 30 minutes. A preliminary visual inspection of the data indicates that the ADV and ADCP instruments recorded data of good quality, suitable for standard analysis for extraction of wave-, tide- and ocean-induced currents. The PC-ADP instrument failed shortly after deployment in Area 2.

2.4. SEABED SAMPLES

Seabed samples were acquired for sedimentological, geochemical and biological analyses. This information will be used to provide general descriptions of benthic habitats and to identify unique, rare and/or potentially vulnerable biological communities, specifically those found in association with geophysical indicators of fluid seepage.

2.4.1. Smith-McIntyre Grab Samples

Unconsolidated surface (seabed) sediments were collected at 11 stations using a Smith-McIntyre (SM) grab (10L, 0.1 m^2 opening) deployed from the starboard side winch of the RV *Solander*. The SM grab is mounted on a sturdy, weighted, steel frame, with springs to force the two-jaw bucket into the sediment substrate when released (Figure 2.5a). Tripping pads, positioned below the square-based frame on which the bucket is suspended, make first contact with the seabed and are pushed upward to release two latches holding the spring-loaded bucket jaws. Rewinding the deployment wire exerts tension on cables connected to the end of each bucket-jaw arm causing the jaws to pivot tightly shut.

In the majority of cases, three SM grabs were taken at each station. Generally, the first grab was sub-sampled for sedimentology and infauna, and the second and third grabs were sub-sampled for infauna and geochemistry, respectively.

2.4.1.1 Sedimentology Samples

Up to 250g of bulk sediment was sub-sampled from the surface (~0-2 cm) of the SM grabs (indicated in Appendix D) for texture and composition analysis, including measurement of gravel, sand and mud content by sieve separation, and particle size distributions (including mean, median, standard deviation, skewness and kurtosis indices) by laser diffraction. Separate sample splits of sub-sampled sediments were also taken for measurement of carbonate content using the carbonate bomb method.

2.4.1.2 Infaunal Samples

The sediments captured in relevant SM grabs (including those that remained after the sedimentology sub-sampling; Appendix D) were released into a 52 litre nally bin (Figure 2.5b). Excess water was passed through a 500 µm sieve, and the samples were weighed (including nally bin). The sediments were then sampled for infauna by elutriating for approximately five minutes through a 500 µm sieve. Following elutriation, excess water was passed through the sieve to collect animals lighter than the sediments. The elutriated material was carefully removed from the sieve and preserved in ethanol to be sent to GA for sorting. In order to account for heavier animals such as molluscs, which may not be collected during elutriation, the coarse fraction was sorted by hand. Elutriated samples were preserved in ethanol (most taxa) or formalin (polychaete worms) for laboratory processing of microscopic animals. In addition, ~ 25 ml of un-sieved sediment was retained to confirm that elutriation did not fail to collect significant numbers of heavy-bodied organisms (e.g. molluscs, hermit crabs).

In the laboratory, elutriated samples and sub-sampled whole fractions were examined under a dissecting microscope in the marine ecology laboratory at GA, and all intact animals were separated. Animals are currently being identified to operational taxonomic unit (OTU) by GA ecologists, with voucher specimens photographed and separated in a reference library. Polychaetes and echinoderms will be lodged at the Museum of Victoria where taxonomists will archive and identify the specimens to species level. All other taxa will be sent to appropriate institutions pending agreements.

Figure 2.5: *(a) Smith McIntyre grab used to collect seabed samples (b) for sediment grain-size analyses, geochemistry and infauna.*

2.4.1.3 Geochemistry Samples

The grabs designated for geochemistry (typically the third SM grab deployed at each station) were sub-sampled into eight separate containers for the parameters shown in Appendix D. An account of the shipboard processing, and the laboratory pre-processing and analytic techniques to be undertaken in GA laboratories on these samples is provided in Table 2.2. The chlorin, chlorophyll, sediment oxygen demand and CO_2 production rate data will be used to estimate the levels of reactive matter that support biodiversity in the region. The elemental data, including Total Organic Carbon (TOC) and Total Nitrogen (TN) and their isotopic ratios, will be used in conjunction with the organic matter abundance/reactivity indicators in a multi-variate analysis to deduce the major geochemical gradients in the region (e.g. Radke et al. 2011). A sample for organic geochemistry (biomarker analysis) was also taken (extension C_E2, Table 2.2). These samples will be used to determine if hydrocarbons are seeping into the surface sediment, and will provide other environmental information (e.g. organic matter sources).

Table 2.2: Details of shipboard/laboratory processing and analytical techniques used to prepare and analyse the geochemistry sub-samples. The sub-sample codes (C_B1 etc) correspond to the file extension assigned to the sub-sample types in the MARS database (e.g. SOL5463/014GR029C_B1).

SUB-SAMPLE	SHIPBOARD PROCESSING	PARAMETERS MEASURED	LABORATORY PRE-PROCESSING	ANALYTIC PROCEDURES AND SAMPLE POST PROCESSING
C_B1 **(CHLORINS POROSITY (0-2CM) MINERALOGY)**	7.5 ml samples of surface sediment (0-2 cm) were syringed into plastic container wrapped in aluminium foil. The samples were frozen.	Porosity and wet/dry bulk densities (0.0-2.0 cm)	Freeze-dry	Weight difference after drying and after correction for seawater salts (porosity) and normalisation to wet/dry volumes (bulk density).
		Total chlorins and chlorin indices	Triple extraction in 100% acetone after freeze-drying and grinding (in dark).	Fluorometry
		Mineralogy	10% zinc oxide added to dried samples	X-Ray diffraction
C_B2 **(CHLOROPHYLL ABC)**	4 ml samples of surface sediment (0-0.5 cm) were syringed into plastic bags. The samples were wrapped in aluminium foil and frozen.	Chlorophyll a,b,c and phaeophytin	Thaw in refrigerator and then extracted in 90% acetone	Extracts analysed by spectrophotometry (630, 647, 664 and 750 nm). Individual pigments quantified by trichometric equations and expressed on a per gram dry weight (g dry wt) basis utilising data from C_B3.
C_B3 **(POROSITY (0-0.5 CM)**	4 ml samples of surface sediment (0-0.5 cm) were syringed into plastic bags. Samples were frozen.	Porosity and wet/dry bulk densities (0-0.5cm)	Freeze-dry	Weight difference after drying and after correction for seawater salts (porosity) and normalisation to wet/dry volumes (bulk density).
C_C1 **(SEDIMENT OXYGEN DEMAND)**	Bulk sub-sample (6.5 ml) of surface sediment (0-2 cm) incubated in BOD bottles for ~24 hrs in the dark at SST. Dissolved oxygen concentrations (and saturation values) were measured at the start and finish of each incubation.	Sediment oxygen demand	N/A	Results expressed on a per g dwt basis utilising C_B1 results.
C_C2 **(DISSOLVED**	Salinity, temperature and pH were measured on pore waters extracted from sub-samples C_D1. These	CO_2 production rates	Samples brought to room temperature in	1. Dissolved inorganic carbon (DIC) determined using a DIC analyser and

SUB-SAMPLE	SHIPBOARD PROCESSING	PARAMETERS MEASURED	LABORATORY PRE-PROCESSING	ANALYTIC PROCEDURES AND SAMPLE POST PROCESSING
INORGANIC CARBON FLUX)	pore waters were then filtered (0.45 µm) into 3 ml gas-tight vials (pre-charged with 0.025 $HgCl_2$) within 1 hr of collection (T=0). The procedure was repeated on pore waters from an additional bulk sample collected as per C_D1 and incubated for ~24 hrs at SST (T=1). All samples were refrigerated prior to laboratory analysis.		dark.	infrared-based CO_2 detector. (Geoscience Australia) 2. CO_2 production rates calculated by concentration differences (T=1 – T=0) over the incubation period, after correction for $CaCO_3$ fluxes. Results expressed on a per g dwt basis utilising C_B1 data.
C_D1 **(ELEMENTS CARBONATE SURFACE AREA)**	Surface sediment (0-2 cm) was syringed into acid-washed falcon vials. Pore waters were removed within 1 hr of collection. Residual sediment was frozen for transport to the laboratory.	Major, minor, trace and rare earth elements	1. Freeze-dry 2. Grind in agate mill	X-Ray Fluorescence and ICP AES (Geoscience Australia)
		Bulk carbonate	1. Freeze-dry 2. Grind	Carbonate Bomb (Geoscience Australia)
		Particle surface area	1. Freeze dry. 2. Slow heating to 350^{o}C (12 hours).	5-point BET (Geoscience Australia)
		TOC, TN and C & N isotopes	1. Freeze-dry 2. Grind 3. Acid treatment	Mass spectrometry
C_E1 **(SURFACE SEDIMENT)**	Surface sediment (~0-2 cm) was scooped into plastic bag. Samples were immediately frozen.	N/A	N/A	N/A
C_E2 **(BIOMARKER)**	Surface sediment (~0-2 cm) was scooped into metal tin using a metal spoon. The tin was filled with sediment to ~1/3. The tins were sealed and immediately frozen.	Biomarkers	1. Freeze-dry 2. Hand-grind 3. Solvent extraction	Gas chromatography And Mass Spectrometry

2.4.2. Vibrocores

Sediment cores for sedimentology and geochemistry were collected using a vibrocorer fitted with an aluminium core barrel. A six metre core barrel was used, giving variable penetration depending on substrate type, with very limited penetration in sandy sediments. Corers were deployed and retrieved from the RV *Solander* stern A-frame, with GA's hydraulically-operated JADIN vibrocore winch and SEA's 450 vibrocorer (head and tower) (Figure 2.6). The 136 kg vibrocore head was vibrated for one minute at each deployment.

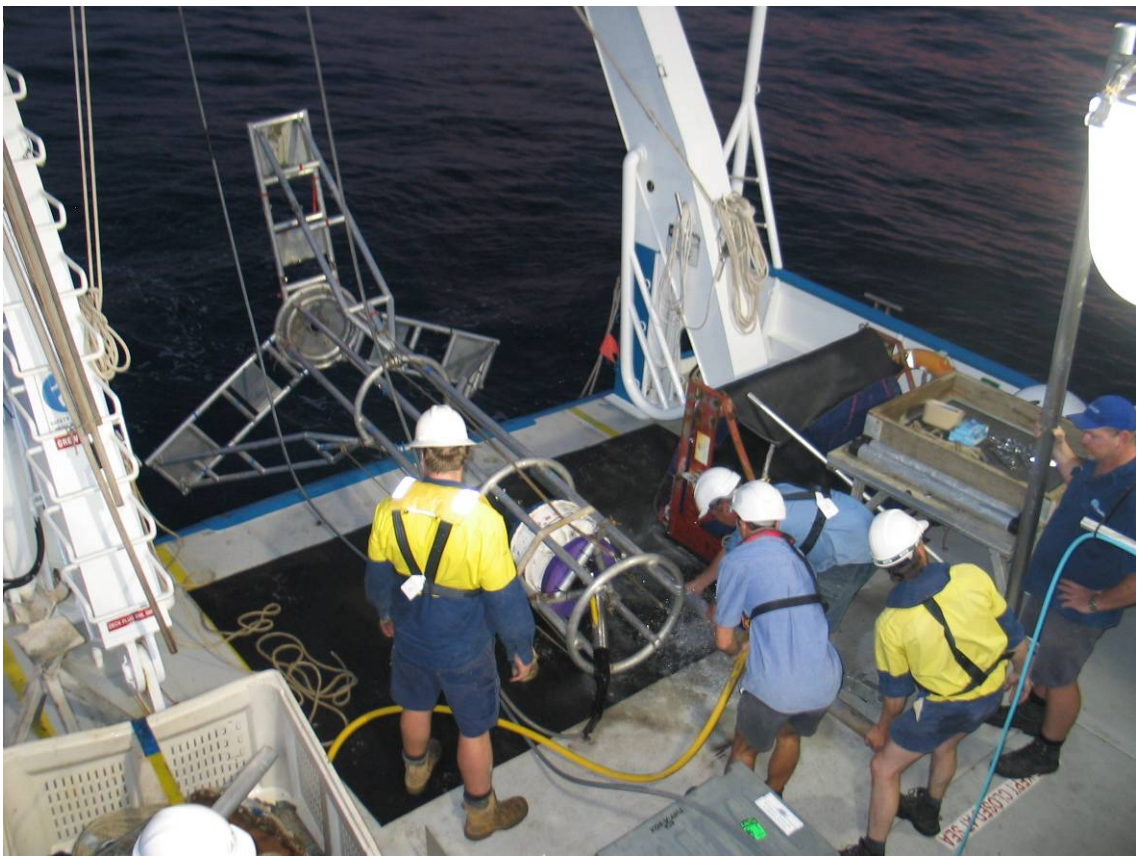

Figure 2.6: *Deployment of the vibrocorer from the stern of the RV Solander.*

2.4.2.1 Stratigraphic Core Samples

The stratigraphic cores were cut into one metre sections starting at the base of the core, once the core barrel was secure on deck. Each section was sealed with PVC end caps, labelled and stored vertically at 4 °C. In the laboratory, physical properties of wet bulk density (WBD), fractional porosity (FP), and the sediment colour spectrum (RGB) were determined at 0.01 m intervals using a GEOTEK™ MS2 multi-sensor core logger. Cores were split and will be logged visually to identify major facies and intervals that denote characteristic features. All split sedimentological cores are stored at GA's core repository in Canberra.

2.4.2.2 Geochemical Core Samples

The cores designated for geochemistry were cut into one metre sections starting at the base of the core and immediately sub-sampled into six separate containers per metre core for the parameters shown in Appendix D. An account of the shipboard processing, and the laboratory pre-processing and analytic techniques to be undertaken in laboratories on these samples is provided in Table 2.3. The head space gas data will be used to detect the migration of thermogenic gas and the generation of carbon dioxide and bacterial methane within the shallow sediments. However, the detection of a thermogenic signal in low concentration seepage areas was shown to require a minimum core penetration depth of 6 m (Abrams et al. 2001). The maximum depth of cores recovered during the survey was 3.7 m; hence the likelihood of detecting a thermogenic signal is low. The high-molecular weight hydrocarbon analysis will be used to indicate thermogenic hydrocarbons as well as archaeal and bacterial biomarkers related to the anaerobic oxidation of methane.

Table 2.3: Details of shipboard/laboratory processing techniques used to prepare the geochemistry core sub-samples. The sub-sample codes (B1, T1, etc) correspond to the file extension assigned to the sub-sample types in the MARS database (e.g. SOL5463/13VC08_1C_D1_220-240).

SUB-SAMPLE	SHIPBOARD PROCESSING	PARAMETERS MEASURED
G **(GEOCHEMISTRY)**	Sediment was scooped into 500 ml tin using a metal spatula. The tin was filled with sediment to ~1/3. The tins were sealed and immediately frozen. Transport frozen.	High-molecular weight hydrocarbons; GA's laboratory
B1, T1, T2, D1 **(HEAD SPACE GAS)**	Using a metal spatula, 165 ml samples of sediment were scooped into: 500 ml glass bottle (B1); 500 ml tin (T1); 500 ml tin (T2); 500 ml distrupter (D1). 165 ml of filtered seawater poisoned with sodium azide was added to each container and degassed by bubbling with chemical-grade nitrogen. The head space of each container was flushed with nitrogen and each container was sealed. Each container is shaken and placed upside down in the -20 °C blast freezer. Transport frozen and upside down.	C_1-C_5 hydrocarbons and CO_2 ;GA's laboratory (B1, T2, D1) and TDI-Brooks, College Station, Texas, USA (T1)
I1 **(PORE WATER ISOTOPE)**	Using a metal spatula, samples of sediment were scooped into vials. The vials were run through the centrifuge machine for 10 minutes to separate out any pore water.	Pore water isotope; GA's laboratory

2.5. TOWED UNDERWATER IMAGERY

Seabed habitats and associated benthic macro-organisms were surveyed using the AIMS towed-camera system (Figure 2.7a). This system was fitted with a single forward-facing video camera (Watec colour D250 model, 4 mm lens) and two high-resolution still cameras (Sea&Sea DX2G 12 mega pixel: one forward-facing and one downward-facing) and their associated lights. At each station, a 500 m long video transect (approximately 10-15 minute duration), along with high-resolution (12 megapixel) still photographs captured every 5 seconds, was surveyed. The camera system was deployed from the stern of the RV *Solander*, and towed at approximately 0.5 to 1.5 knots at an altitude of 0.5-2 m above the seabed. To accurately correlate the position of seabed video and images with physical features in the multibeam maps, the position of the towed-camera system was tracked using a USBL (Ultra-short Baseline) acoustic tracking system. This system failed early in the survey period; hence geo-location of video transects and stills could only be linked to RV *Solander*'s ship navigation. Video footage was transmitted in real-time to the surface via a coaxial cable to enable operators to characterise the seabed environment and allow the winch operator to

regulate the altitude of the towed-camera system. Live video feed to the surface was monitored and broadly characterised according to AIMS's classification scheme (Figure 2.7b). Upon retrieval of the camera system, video and still images were downloaded and renamed by station and a sequential image number. Images of representative habitat and biota were identified for further analysis and description.

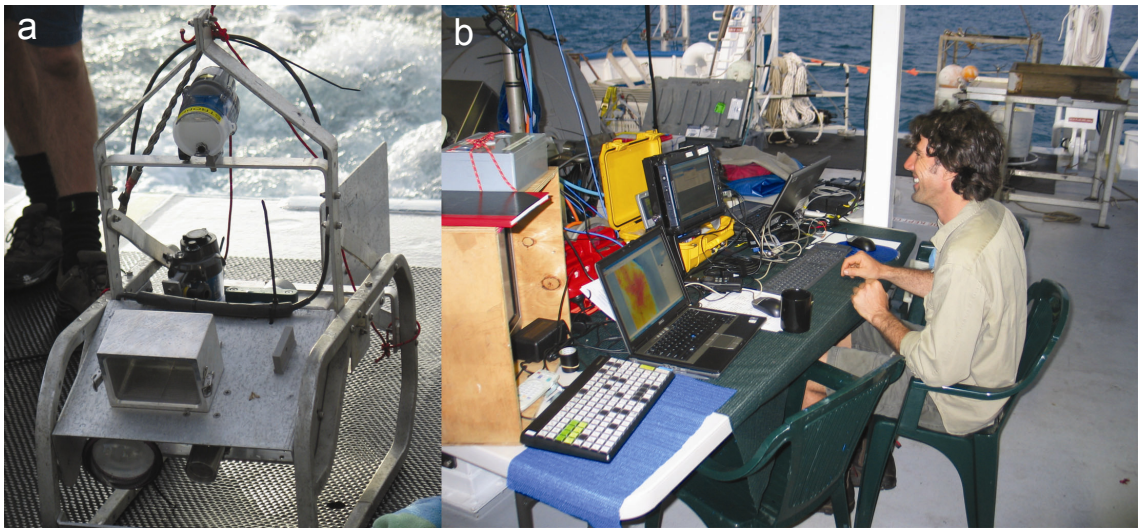

Figure 2.7: *(a) AIMS towed-video camera system and (b) characterisation equipment.*

3. Preliminary Results

The results provided herein are preliminary and reflect initial observations of data gathered during the survey. These broad observations represent both the current state of knowledge gathered on the survey and the degree to which the data have been processed and analysed. They are included here to provide a general overview of the physical, chemical and biological seabed characteristics of the two study areas.

3.1. SEABED CHARACTERISTICS AREA 1

Area 1 was surveyed by 471.2 km^2 of multibeam sonar (including bathymetry, backscatter and water column data) and 558 line-kilometres of sub-bottom profiles (Figure 3.1 and Figure 3.2). The area was sampled at 14 stations, at which 31 grabs, 11 towed-video transects, nine vibrocores, and ten CTD casts (including 7 CTD casts with water samples) were completed (Figure 3.1 and Figure 3.3; Appendix D). One oceanographic mooring was deployed and successfully retrieved in Area 1.

The multibeam swath data acquired during the survey indicate that the seafloor in Area 1 is relatively flat, deepening from 78 m water depth in the southeast to 102 m in the northwest (Figure 3.1). Principal geomorphic features include palaeo-channels (valleys) (Figure 3.4 and Figure 3.5a) and plains that are superimposed by other geomorphic features including low-relief ridges (Figure 3.4 and Figure 3.5b), pockmarks (Figure 3.4 and Figure 3.5c, d) and depressions. The palaeo-channels are typical of low gradient, coastal settings, such as those presently occurring in the southern Gulf of Carpentaria region. Meandering palaeo-channels are generally disconnected in the north and connected in the central and southern sections of Area 1 (Figure 3.1 and Figure 3.4), where they cut across gently sloping plains. A few positive relief ridges (<5 m relief) in the central eastern and northern regions of Area 1 were also mapped in the multibeam data (Figure 3.1, Figure 3.4 and Figure 3.5b).

Pockmarks are widely distributed across large areas (~380 km^2) of the seabed in the southern section of Area 1 (Figure 3.5c, d). Pockmarks are known to form from a variety of mechanisms, including the seepage of hydrocarbon fluid or gas (Judd and Hovland, 2007), pore water release due to compaction (Harrington 1985; Soter 1999; Gay et al. 2003; Judd and Hovland 2007), and groundwater seepage (Whiticar 2002; Judd and Hovland 2007). Pockmarks on the plains and in the palaeo-channels are up to 3 m deep and 30 m in diameter. Larger pockmarks (>10 m in diameter) generally occur in fields ranging between 10-100 km^2, and cover ~80% of Area 1, while smaller pockmarks (<10 m diameter) typically occur in closely spaced clusters within the fields of larger pockmarks. Many of the larger pockmarks have an ‘ejecta-like’ morphology with a raised central rim surrounding a depressed central cone. Outside the central rim area, the flanks slope firstly down then up again to the outer margin. The central cones in these larger pockmarks are typically 2-3 m deep, and the rim up to 1 m high. These geomorphological features may be associated with single ejections of fluidised material from the subsurface. Conversely, many of the smaller pockmark clusters which lack this clear ‘ejecta-like’ profile are likely to be related to the spacing of individual pockmarks, volume of material ejected and perhaps time at which each cone of depression (pockmark) was formed in the semi- to unconsolidated surficial sediments. The clustering of small pockmarks may be related to repeated fluid expulsion to the surface at a particular location over longer time-scales than those required to form the larger features.

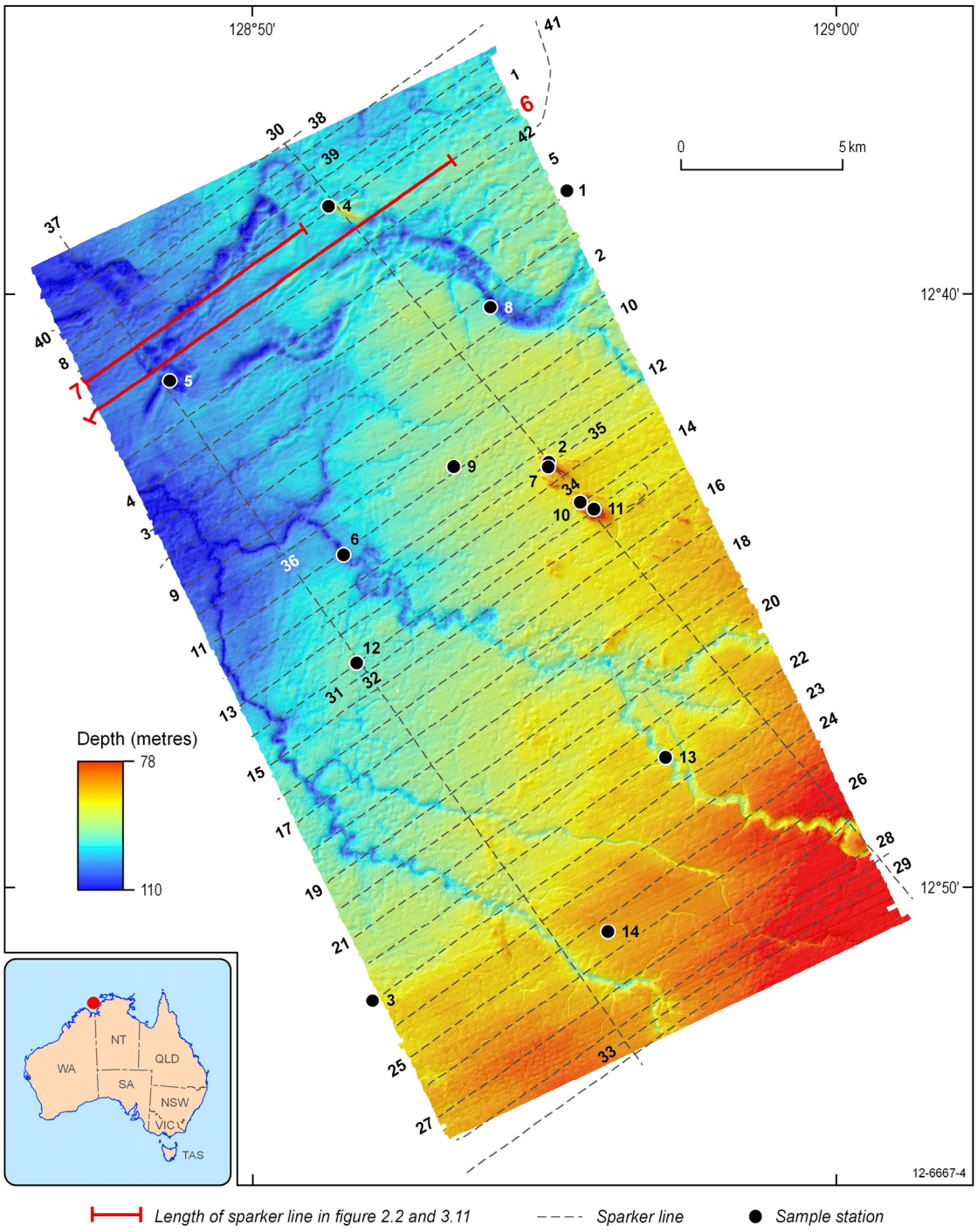

Figure 3.1: *False colour bathymetry image of Area 1 overlayed with sparker lines and sampling stations. Red lines indicate the sparker lines GA0335/007and GA0335/006 used in Figures 2.2 and 3.11, respectively.*

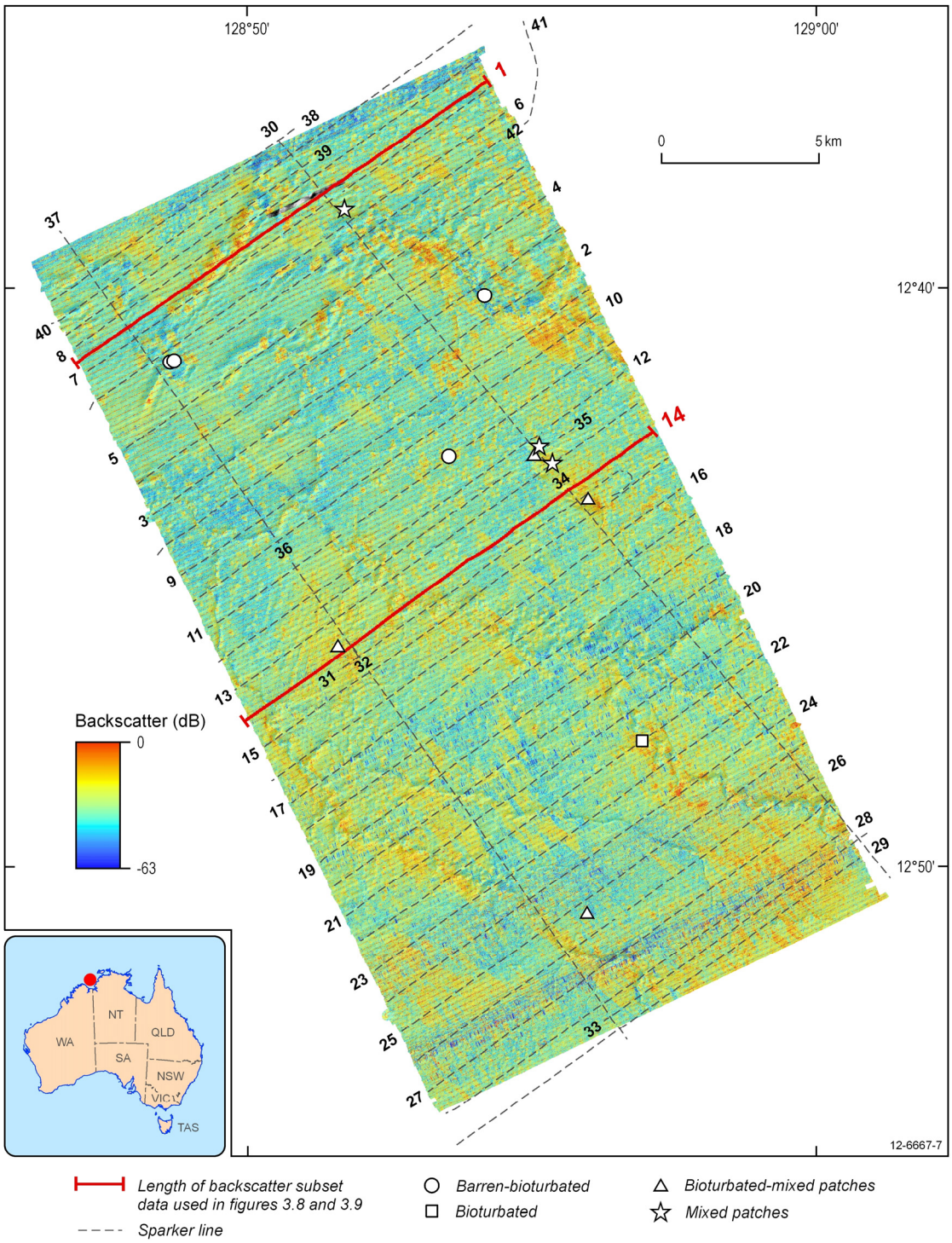

Figure 3.2: *False colour backscatter image of Area 1 overlayed with sparker lines and video-derived classes at sampling stations. Red lines indicate the location of backscatter subset data used to produce depth/backscatter profiles in Figures 3.8 (line 14) and 3.9 (line 1), respectively.*

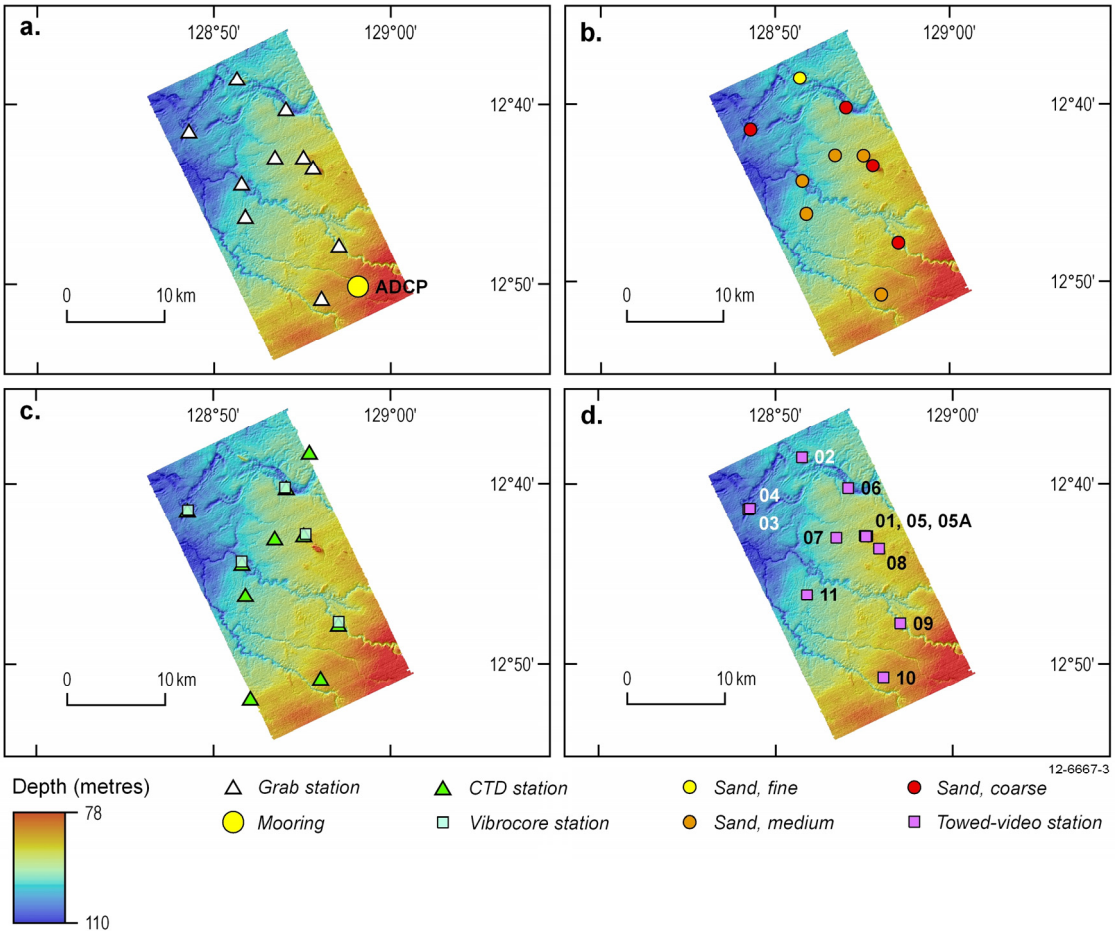

Figure 3.3: *False colour bathymetry images of Area 1 showing sampling station locations and types, including: (a) Smith-McIntyre grab stations and mooring site; (b) sediment grain size classifications; (c) CTD and vibrocore stations, and (d) towed underwater video stations (numbers refer to CAM number, see Appendix D).*

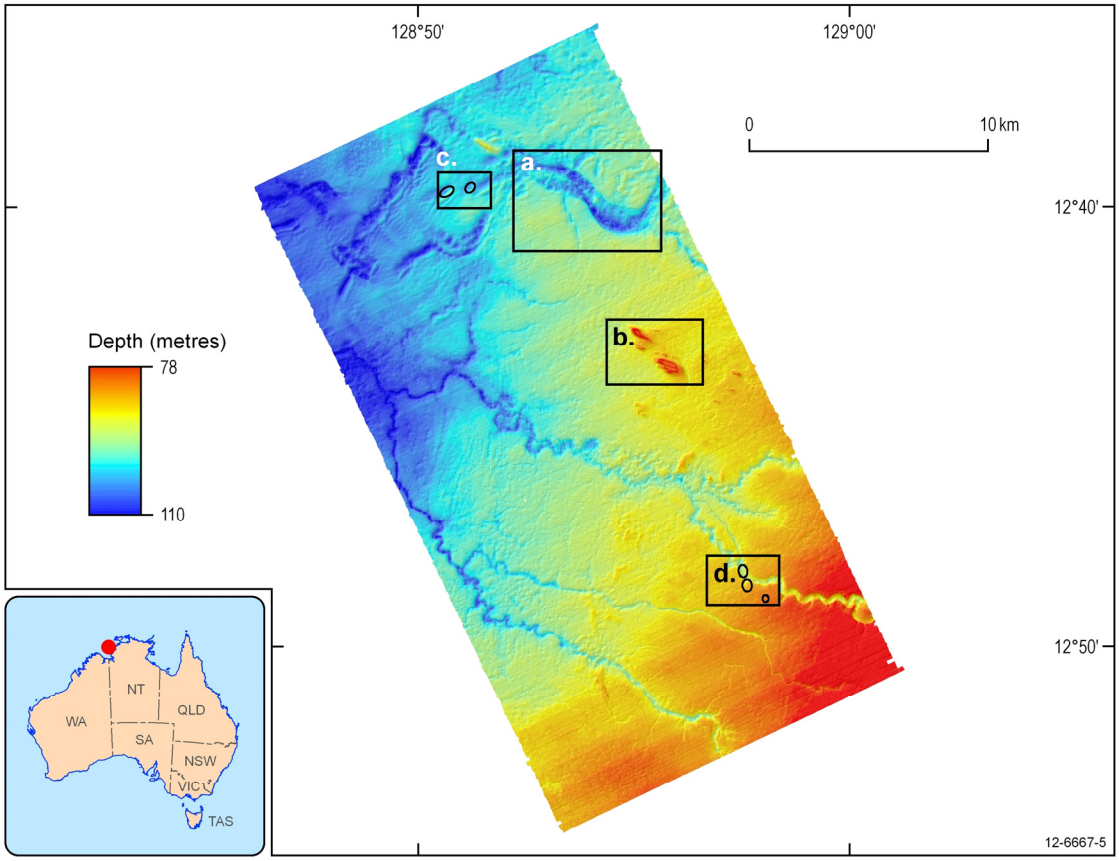

Figure 3.4: *False colour bathymetry image of Area 1 showing location of key geomorphic features (a-d) shown in Figure 3.5.*

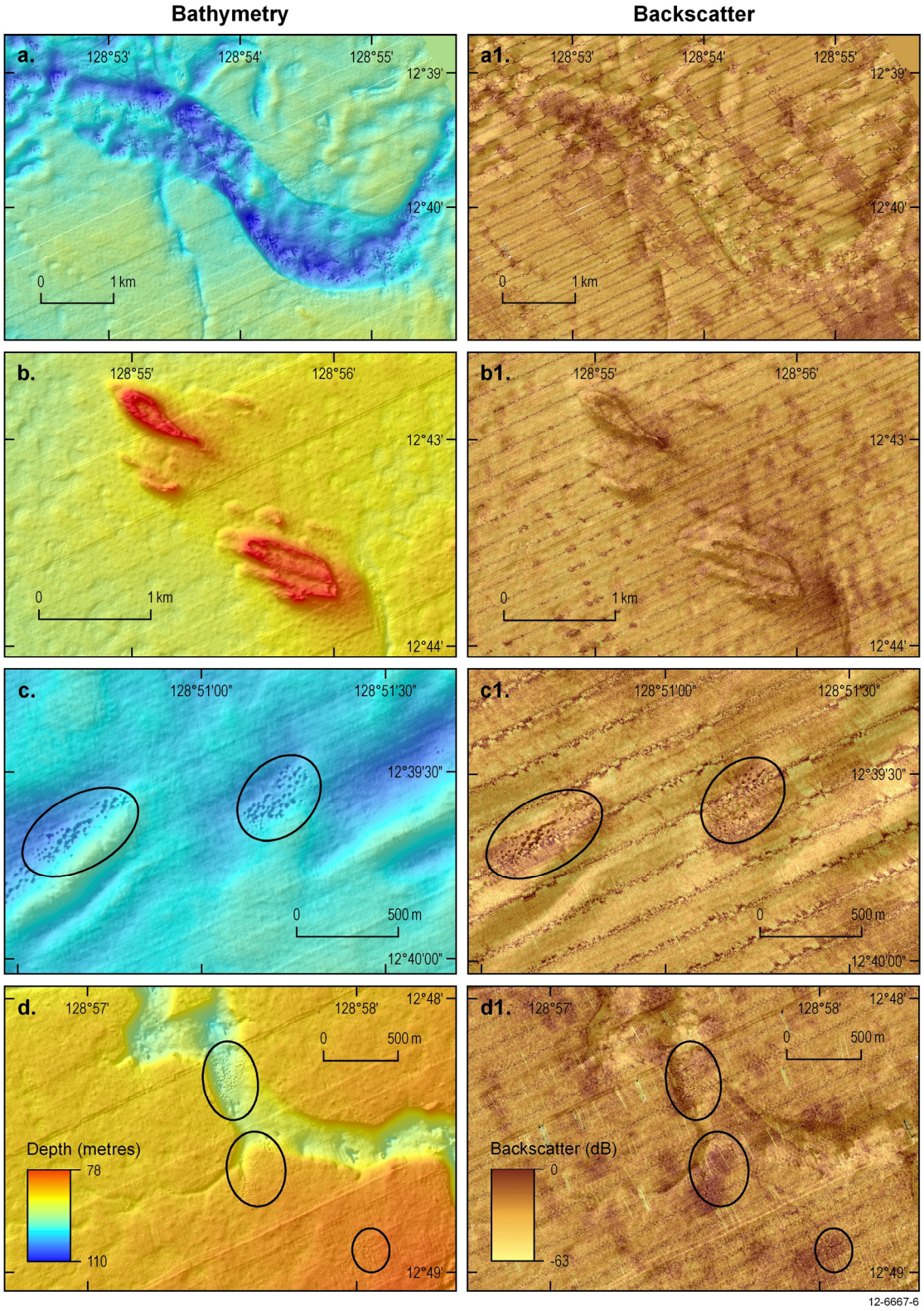

Figure 3.5: *False colour bathymetry (a-d) and backscatter (a1-d1) images of Area 1 showing key geomorphic features, including: (a & a1) palaeo-channels (valleys); (b & b1) low-lying ridges; (c & c1) pockmarks occurring in clusters within bedform fields on plains, and (d & d1) pockmarks occurring in clusters on the floors and margins of valleys and plains.*

Area 1 generally exhibited a relatively narrow range of backscatter values (Figure 3.6), corresponding to small variations in substratum types across the study area. The varying backscatter values are associated with soft and hard sediments on low-lying ridges, plains and palaeo-channel features (Figure 3.2 and Figure 3.5a1-d1). The range of backscatter values for some channels (mean –29.45 dB; Figure 3.2, Figure 3.5a1, Figure 3.6; Figure 3.7; Appendix D) reflect a mix of hard and soft substrate, accentuated by pockmarks (Figure 3.5c1, d1, Figure 3.8 and Figure 3.9). Preliminary analysis of selected multibeam water column data above pockmarks in Area 1 identified features associated with aquatic life (e.g. pelagic and demersal schools of fish, Figure 3.10a-b) and some seep-like acoustic scattering in the water column (Figure 3.10c-d).

The sub-bottom profiler data penetrated up to 140 ms two-way-time (TWT) below the seafloor, providing a good resolution image of the shallow sub-surface, which shows truncating channels, channel-fill strata and beds of sediment deposits (Figure 3.11). Some pockmark features are located above wipe-out/acoustic blanking, chimney features and possible shallow faults.

Thirty-one grab samples were collected at ten stations within Area 1 (Figure 3.3a; Appendix D). Preliminary observations of the sediment samples indicate that the plains are characterised by muddy fine- to medium-grained sand (Figure 3.3b). In contract, sediments within the palaeo-channels are comprised of coarse- to very coarse-grained sand (Figure 3.3b) that commonly include a large proportion of disarticulated shells (up to 1 cm) and shell fragments (generally less than 0.5 cm). Vibrocore deployments at five stations were successful (Figure 3.3c), with core recovery in the nine cores ranging from 0.3 m to 3.7 m (Appendix D). Ten CTD profiles were successfully recovered from ten stations (Figure 3.3c), seven of which recovered water samples (Appendix D).

Benthic habitats in the Petrel Sub-basin were broadly classified based on video observations into three main categories (see Przeslawski et al. 2011):

1. *Barren sediments:* Sediment is flat with little evidence of infaunal (bioturbation) or epifaunal activity (<20 individual epifauna over the entire transect).
2. *Bioturbated sediments:* Sediment shows at least a moderate level of infaunal and epifaunal activity with characteristic trails and burrows (*lebensspurren*) and low cover of epifauna (>20 individuals over the transect; up to 15 individuals per 15 seconds estimated over the course of the video).
3. *Mixed patches (octocorals and sponges):* Patchy rocky outcrops supporting locally abundant patches of octocorals and sponges (that occupy a proportion of at least 20% of the transect - up to 25 individuals per 15 seconds), interspersed with areas of soft sediment and low epifaunal cover. Rocky outcrops may be covered with a thin veneer of sediment; however epibenthic growth of sessile organisms indicates that a hard substratum is present.

Relatively diverse patches of mixed octocorals and sponges (e.g. soft corals, gorgonians, whips) were recorded from video observations at stations 2, 4 and 7 at depths ranging between 82 m and 89 m (Figure 3.12). These patches were often interspersed with areas of soft sediment and found in low densities on relatively flat seabed. Bioturbated sediments with *lebensspurren*, which included pits, burrows, mounds, and craters, were observed at stations 5-9, 11 and 14 at depths ranging between 82 – 96 m (Figure 3.12). Few epifauna (including octocorals, sponges and hydroids) were recorded at these locations. Relatively flat expanses of barren sediment with little bioturbation and few epifauna (<10 individuals) were observed at station 5.

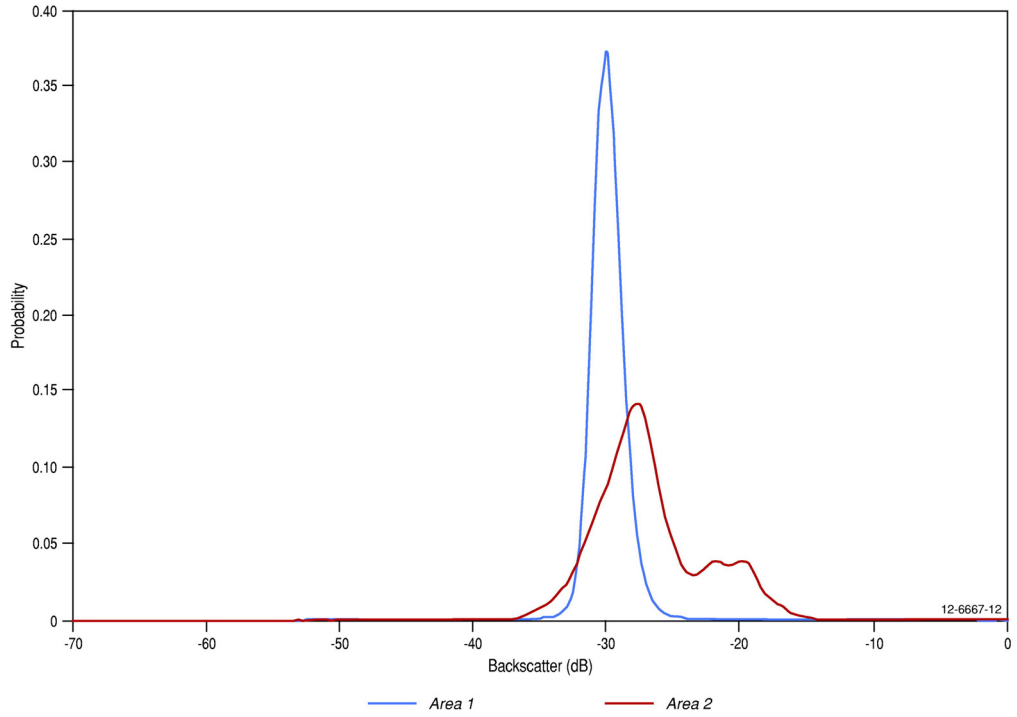

Figure 3.6: *Histogram of backscatter values for Areas 1 and 2 in the Petrel Sub-basin.*

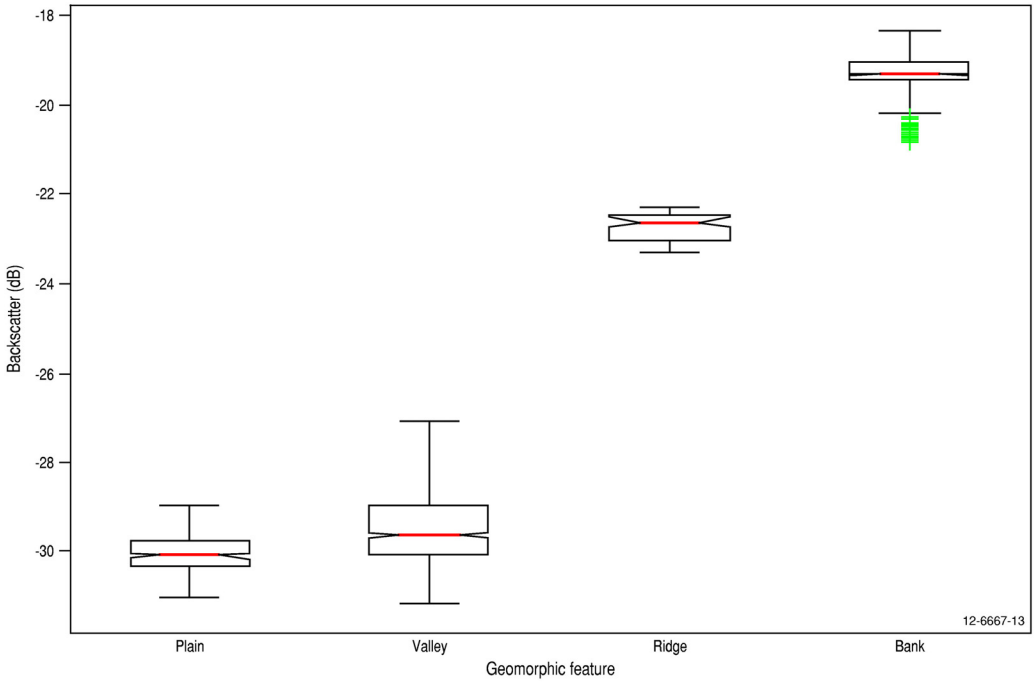

Figure 3.7: *Boxplot of backscatter summary statistics for main geomorphic features based on representative subsets of data in Areas 1 and 2. Red line within the box indicates the median; upper and lower boundaries of the box represent the 75th and 25th percentiles, respectively; whiskers correspond to ± 2.7σ (99.3 coverage). Green lines represent outliers.*

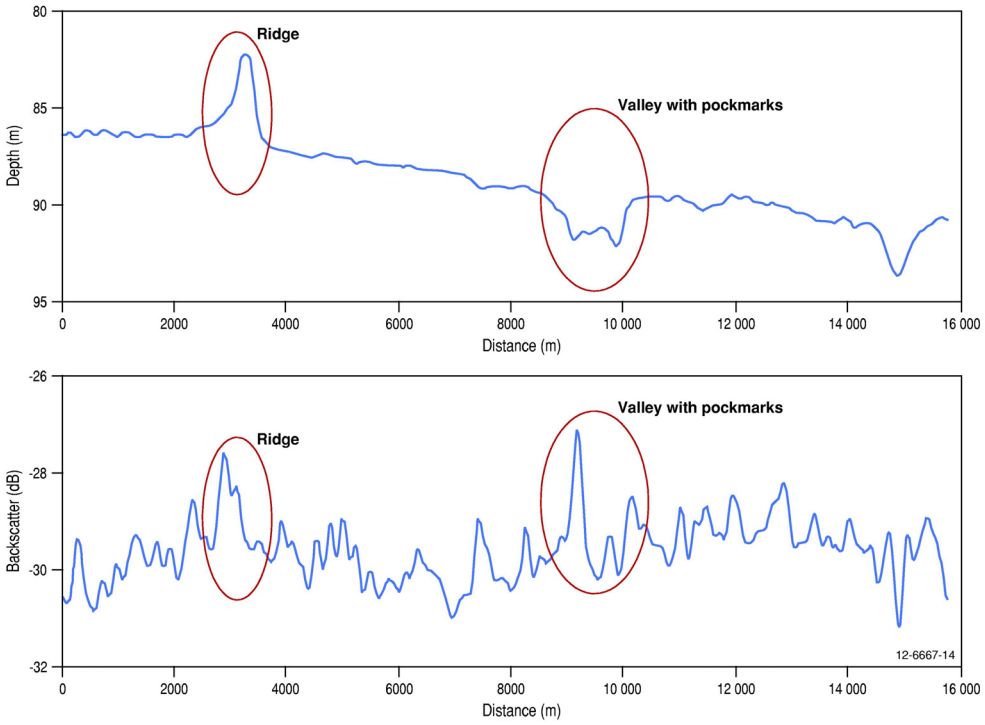

Figure 3.8: *Depth (top) and backscatter (bottom) profiles showing the variable backscatter ranges across line 14 in Area 1 (see Figure 3.2).*

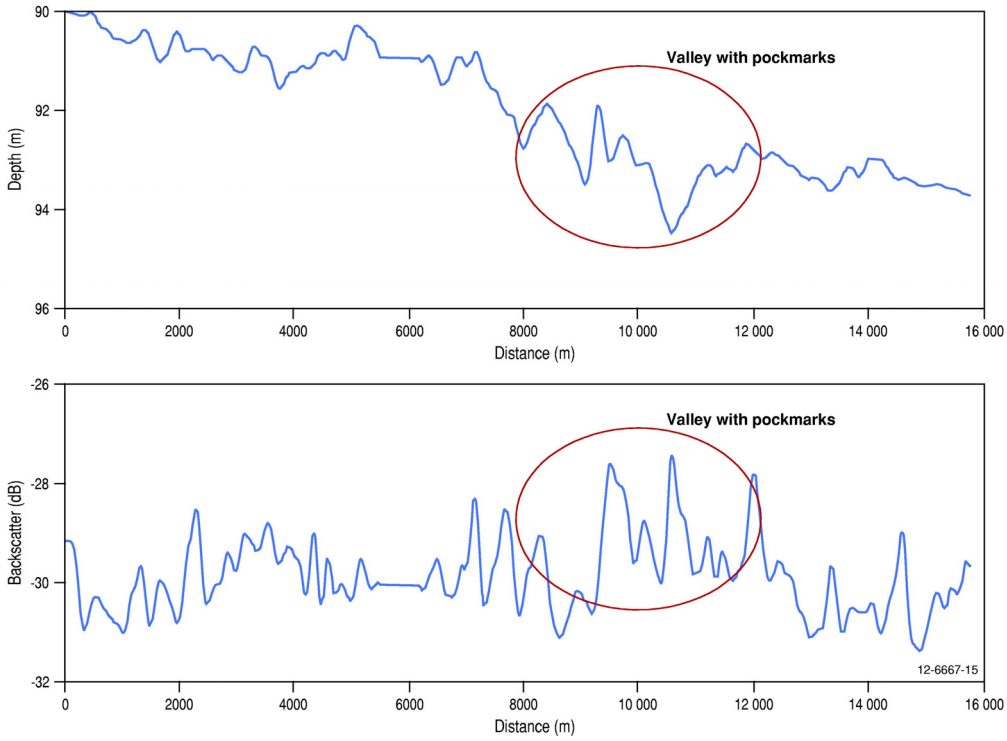

Figure 3.9: *Depth (top) and backscatter (bottom) profiles showing the variable backscatter ranges across valleys with pockmarks (see Figure 3.2 line 1) in Area 1.*

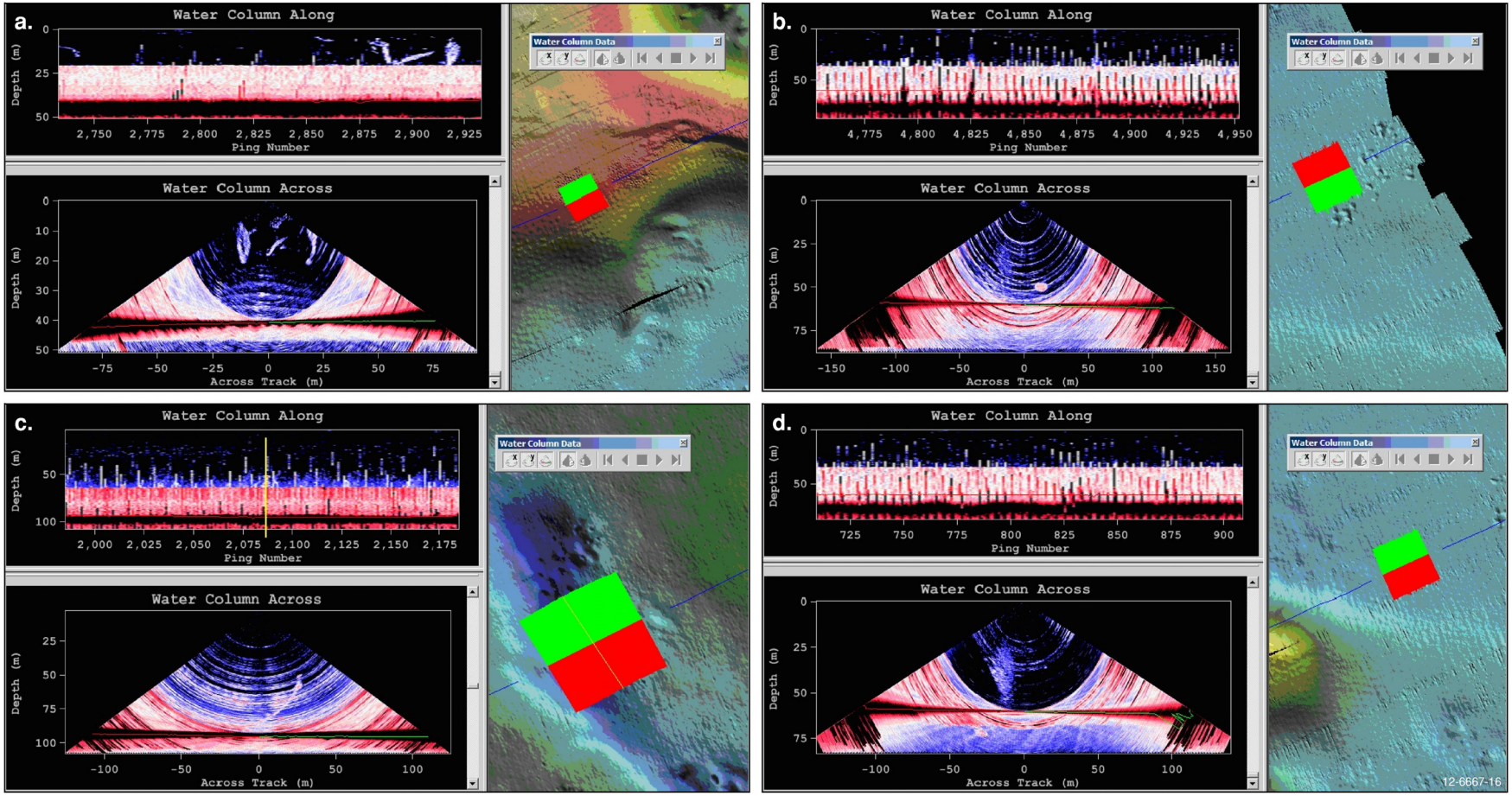

Figure 3.10: *Screen captures from the multibeam water column data software showing examples of features observed, including: (a) pelagic school; (b) demersal school; (c & d) possible seep-like objects*

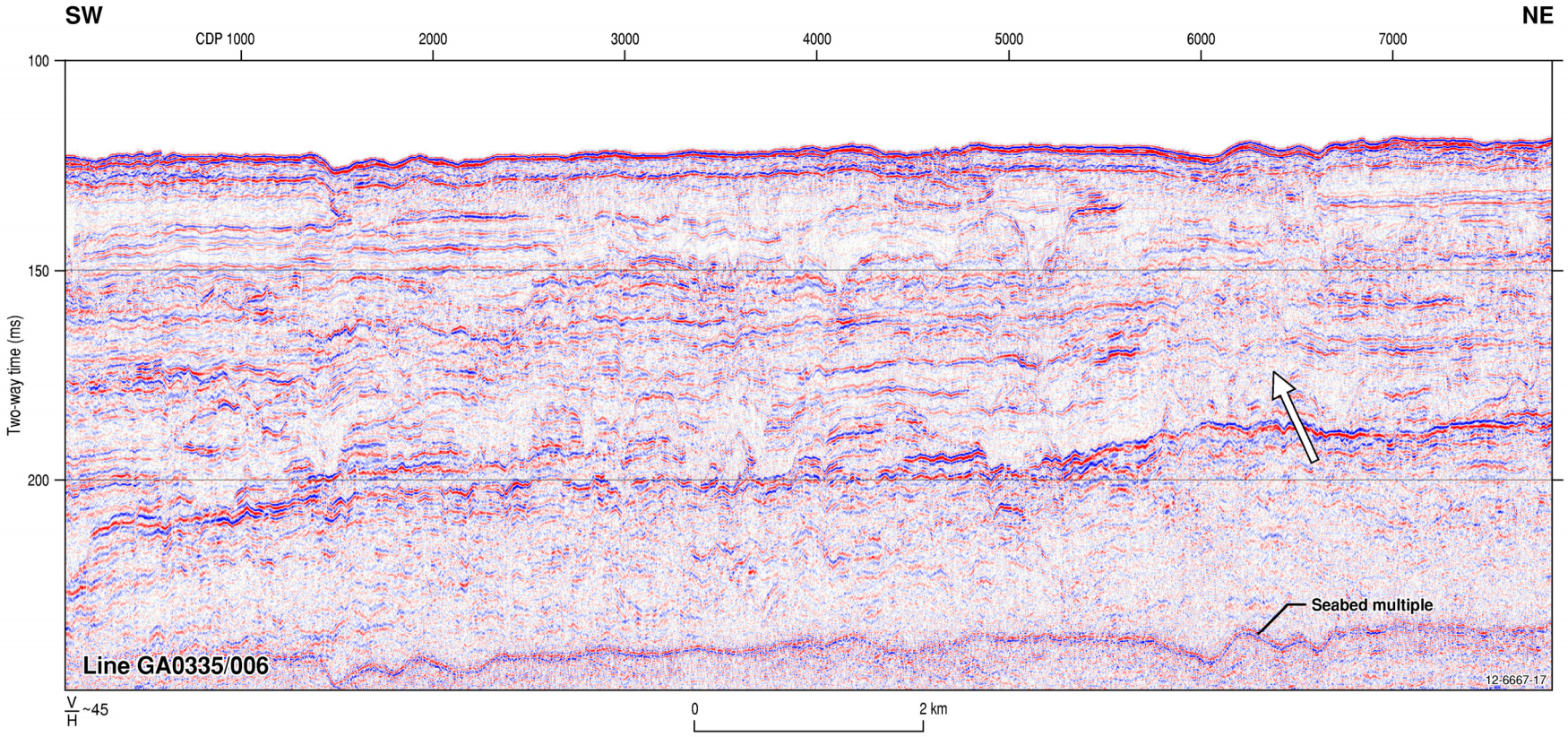

Figure 3.11: *Final processed image of sub-bottom profiler line GA0335/006 from Area 1 (approximately 100 m of sediment has been penetrated by this sub-bottom profile). The continuous and semi-continuous seismic reflectors show the build-up of sediment in the shallow subsurface including multiple channel cut-and-fill features. The seismic anomalies (vertically distorted reflectors indicated by arrow) may represent fluid movement through the strata and/or a distortion from the hardened seafloor.*

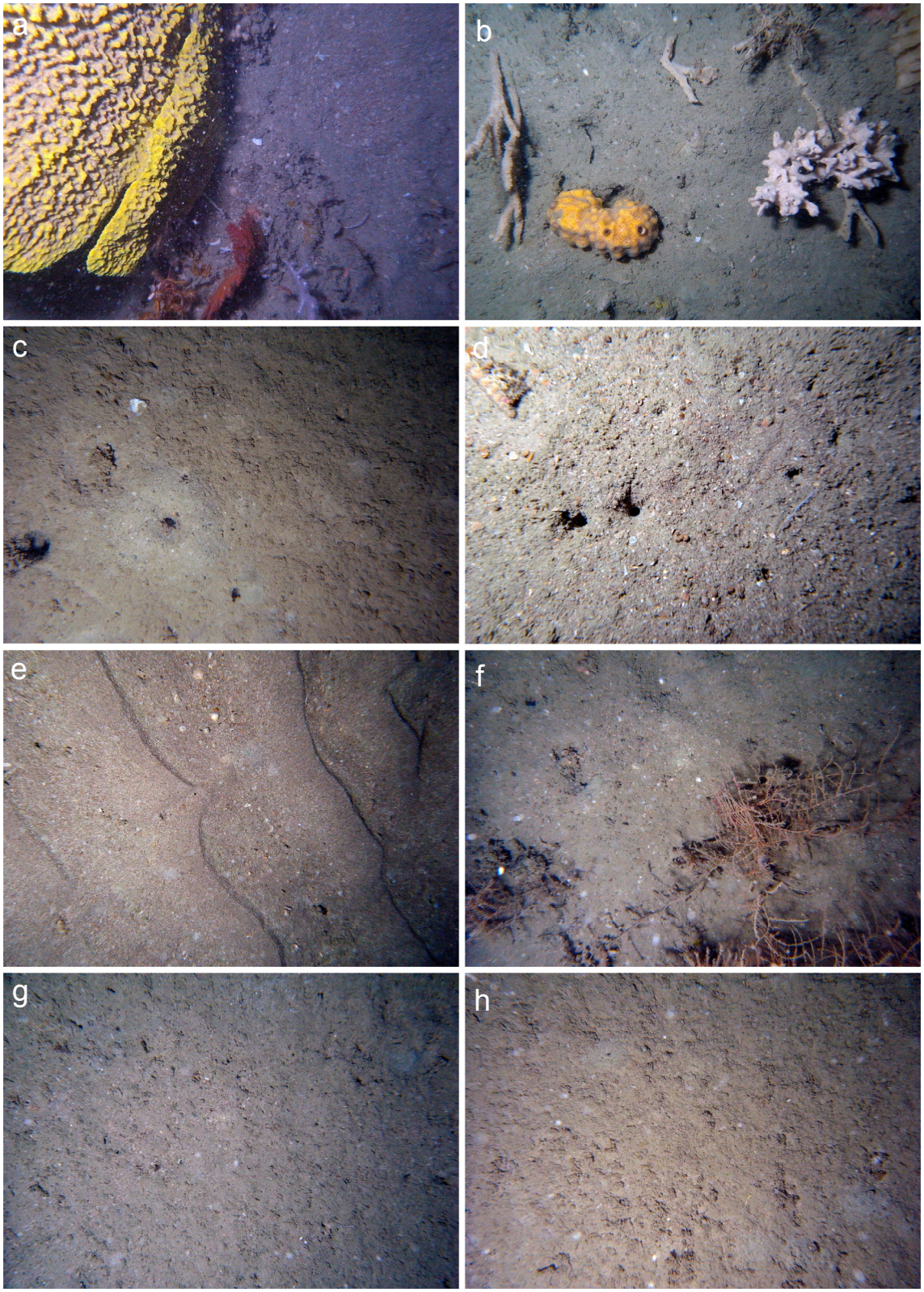

Figure 3.12: *Still photographs from the Petrel Sub-basin: (a-b) sponge and octocoral environments (a-STN15cam12, b-STN15cam12); (c-d) bioturbated sediments (c-STN15cam13, d-STN06cam11); (e) rippled sediments (STN13cam09); (f) hydroids on soft sediments (STN15cam12); (g-h) barren sediments (g-STN11cam08, h- STN15cam13); also see Figure 3.3d and Figure 3.16d .*

Preliminary sorting of infaunal specimens indicate that infaunal assemblages are dominated by crustaceans and polychaetes, and to a lesser extent echinoderms and molluscs (Figure 3.13), similar to infaunal assemblages in other areas of the Bonaparte Basin (e.g. Przeslawski et al. 2011). Species overlap was high (~90%) between crustaceans collected in 6 grabs from the central Petrel basin (current survey) and those collected in the northeastern Petrel (SOL4934 and SOL5117). No large species indicative of gas or fluid seeps have currently been recorded from the collection.

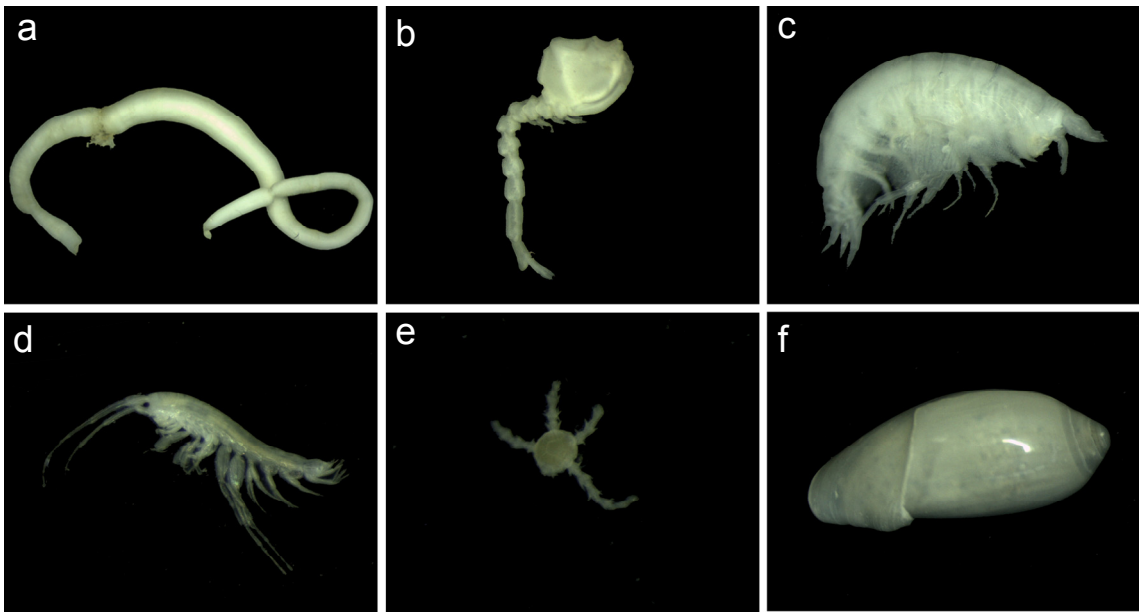

Figure 3.13: *Representative infaunal communities from grab sample 09GR17: (a) polychaete worm; (b) bototriid sp. 3; (c) gammarid sp. 22; (d) gammarid sp. 9; (e) ophiuroid sp., and (f) mollusc sp. Refer to Przeslawski et al. (2011) for species nomenclature.*

Further analysis will include investigation of the relationships between environmental factors and infauna, particularly in relation to gas or fluid seeps. Towed video transects will be used to describe and quantify the benthic habitats and epibenthos present across the various seabed environments. In addition, the species matrix generated by the current collection will contribute to a broader understanding of biodiversity patterns at a regional and national scale.

3.2. SEABED CHARACTERISTICS AREA 2

Area 2 was surveyed by 181.1 km^2 of multibeam sonar (including bathymetry, backscatter and water column data) and 97 line-kilometres of sub-bottom profiles (Figure 3.14 and Figure 3.15). Two grab samples, two video transects and two CTD casts were collected at one station on the eastern bank in Area 2 (Figure 3.16).

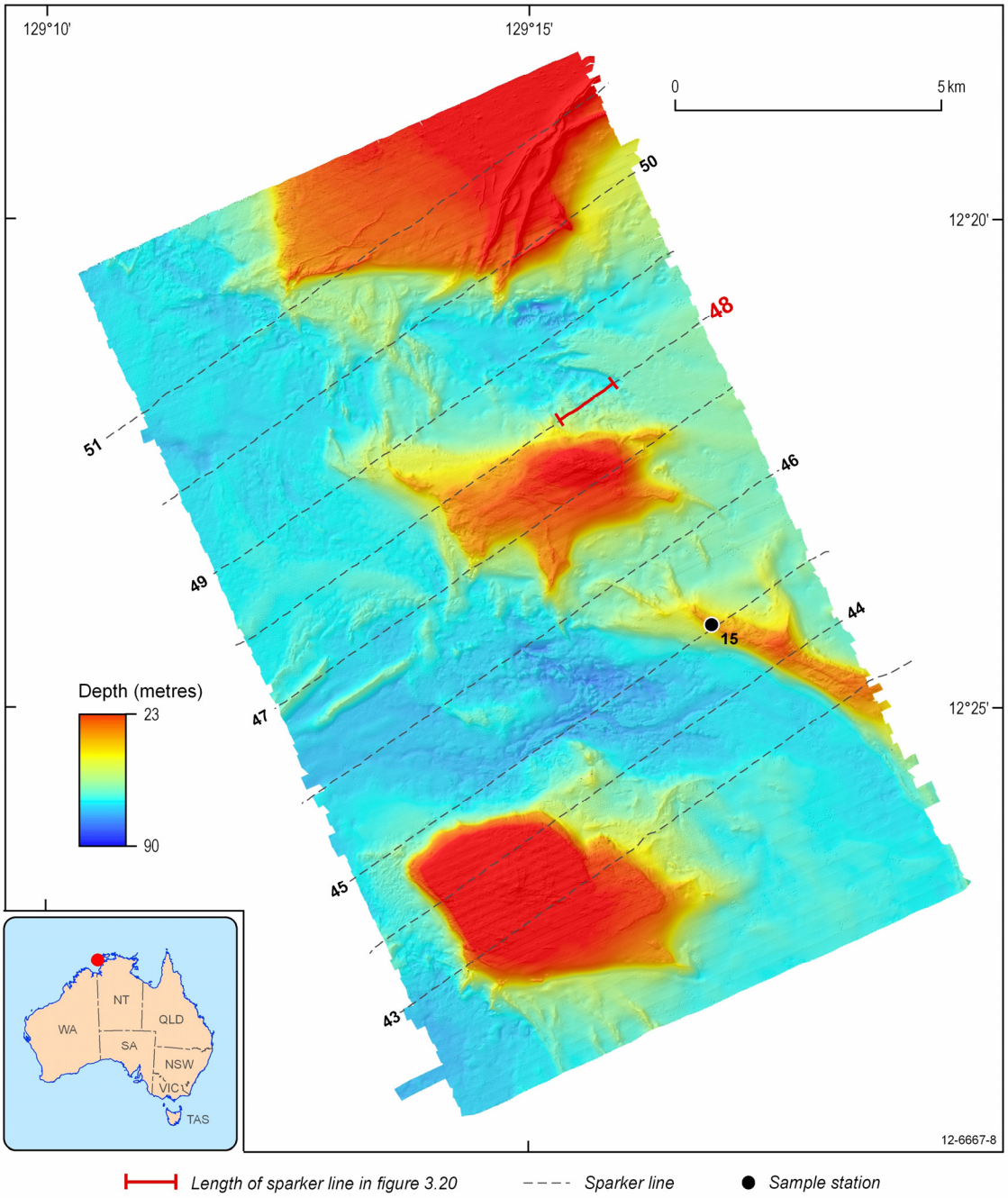

Figure 3.14: *False colour bathymetry image of Area 2 overlayed with sparker lines and sampling station. Red line indicates sparker line GA0335/048 used in Figure 3.20.*

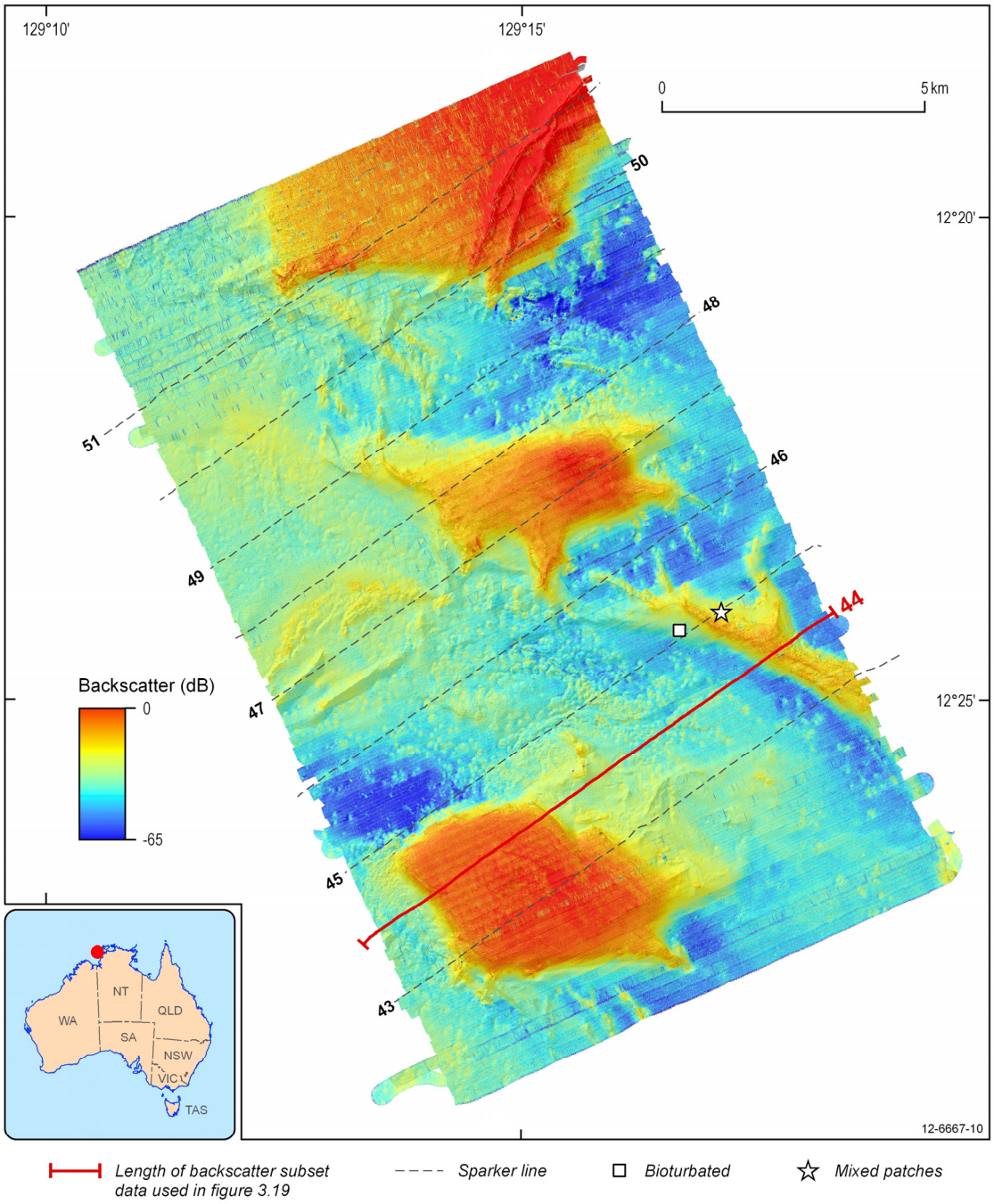

Figure 3.15: *False colour backscatter image of Area 2 overlayed with sparker lines and video-derived classes at sampling stations. Red line indicates the location of backscatter subset data used to produce depth/backscatter profiles in Figure 3.19.*

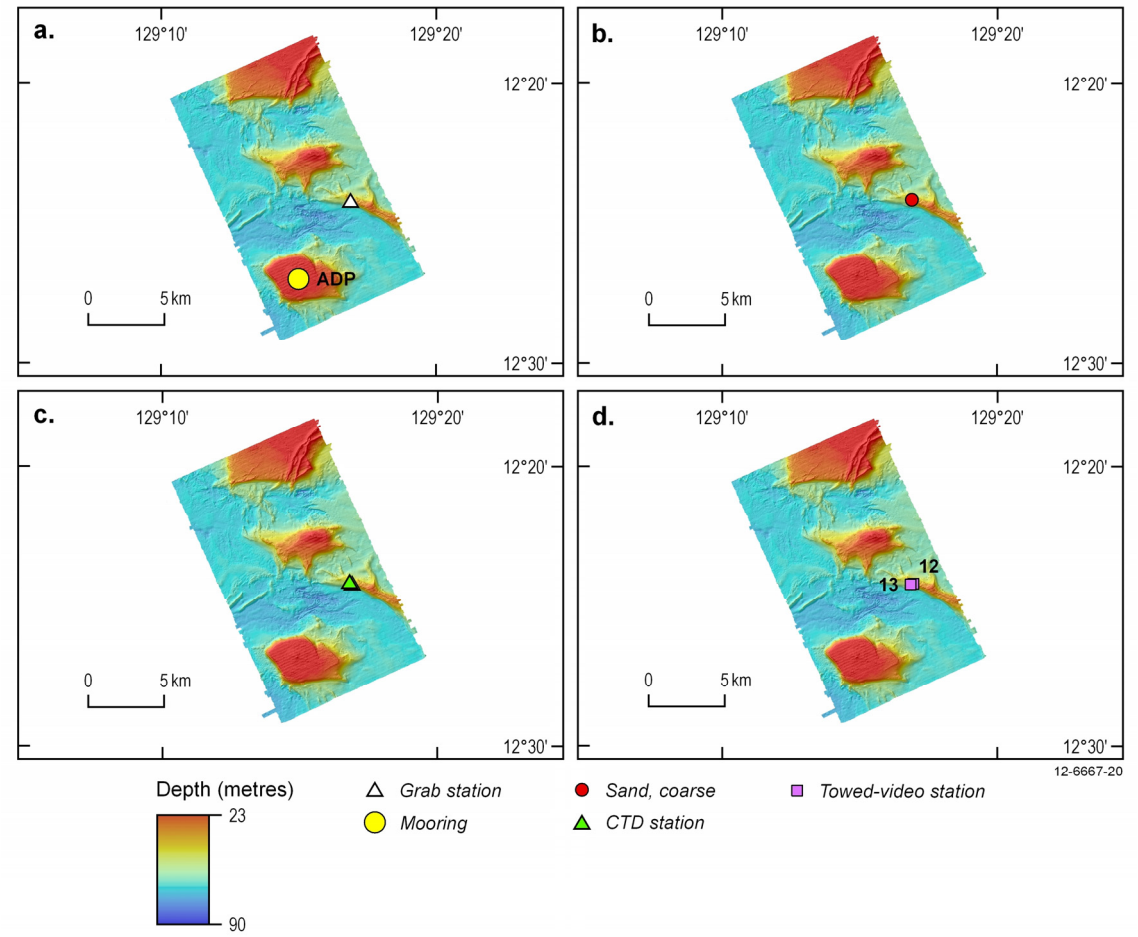

Figure 3.16: *False colour bathymetry images of Area 2 showing sampling station locations and types including: (a) Smith-McIntyre grab station and mooring site; (b) sediment grain size classification; (c) CTD station, and (d) towed underwater video stations (numbers refer to CAM number, see Appendix D).*

The multibeam swath data acquired during the survey show that the seafloor lies in water depths of 23 to 90 m (Figure 3.14). Primary geomorphic features include banks (Figure 3.14, Figure 3.17 and Figure 3.18a), ridges (Figure 3.18b) and plains with geomorphic units super-imposed on these features including pockmarks (Figure 3.18c), scarps, depressions, valley floors, and hummocks (Figure 3.18d). The area is characterised by three steeply sided, flat-topped banks (including the southern section of Flat Top bank in the northeast), which stand approximately 30-40 m above the surrounding seabed (Figure 3.14). Two linear ridges are located on the southeastern edge of Flat Top bank and tend eastward (Figure 3.14 and Figure 3.18b). Separating the central and southern banks is a northwest-southeast orientated valley, superimposed with geomorphic units including floors, scarps and irregular ridges (Figure 3.14). A narrow ridge occupies the eastern flank of the valley rising from approximately 50 m depth at its northern end, to approximately 40 m, where it meets the southeastern boundary of Area 2. Two low-lying linear ridges are located to the north of the southernmost bank, and linear to irregular ridges occupy marginal seafloor areas of all three bank features (Figure 3.14). Comparatively fewer pockmarks are present in Area 2 than in Area 1 and occur primarily as clusters on the margins of banks and ridges. Many of the larger pockmarks in Area 2 have an 'ejecta-like' morphology (Figure 3.18c), similar to those noted in Area 1, and may be associated with ejections of fluidised material from the subsurface.

Area 2 exhibits the greatest range in backscatter (seabed reflectance) values (Figure 3.6 and Figure 3.15), which coincide with the greatest variation in depth and seabed complexity. High backscatter is generally associated with banks (mean-19.28 dB, Figure 3.7, Figure 3.15, Figure 3.18a1, b1 and Figure 3.19), while low backscatter is associated with soft sediments within valley features (Figure 3.15).

Penetration by the sub-bottom profiler over the carbonate banks was poor and generally limited to the seabed reflector. The relatively high acoustic impedance of the carbonate banks weakened the sub-surface signals, resulting in very little insight into the shallow stratigraphy under the carbonate banks. Relatively more penetration (up to 90 ms TWT below the seafloor) was achieved with the sub-bottom profiler in between the carbonate banks. The shallow sub-surface shows faulting and potential fluid movement (chimney features) through the strata along with sediment deposits (Figure 3.20). In future analyses, cross-lines for the sub-bottom profile data will be integrated from the shallow seismic lines acquired from the GA0336 Petrel Sub-basin CO_2 Storage Seismic Survey.

Limited sediment was recovered from one grab, however preliminary observations of video transects at station 15 show that the bank is characterised by mixed patches of octocorals and sponges (Figure 3.12a-b) and soft bioturbated sediments (Figure 3.12c-d; Appendix D).

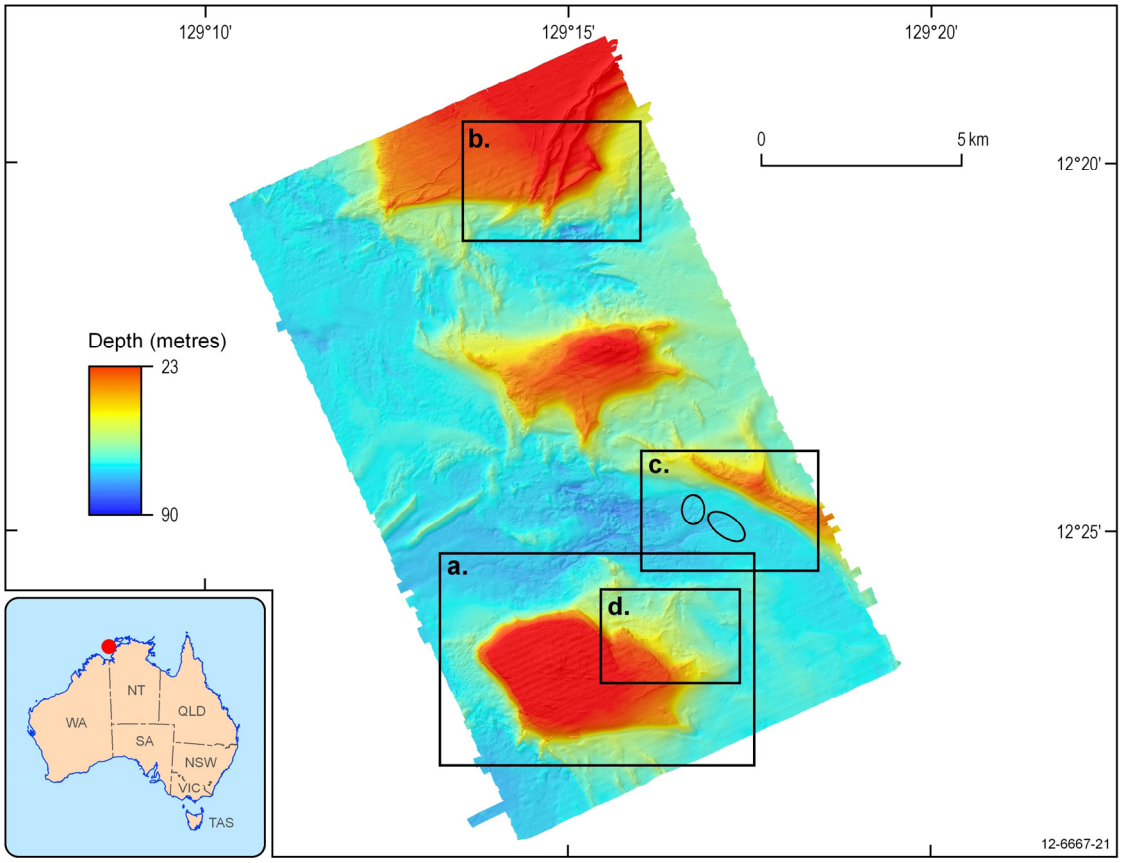

Figure 3.17: *False colour bathymetry image of Area 2 showing location of key geomorphic features (a-d) shown in Figure 3.18.*

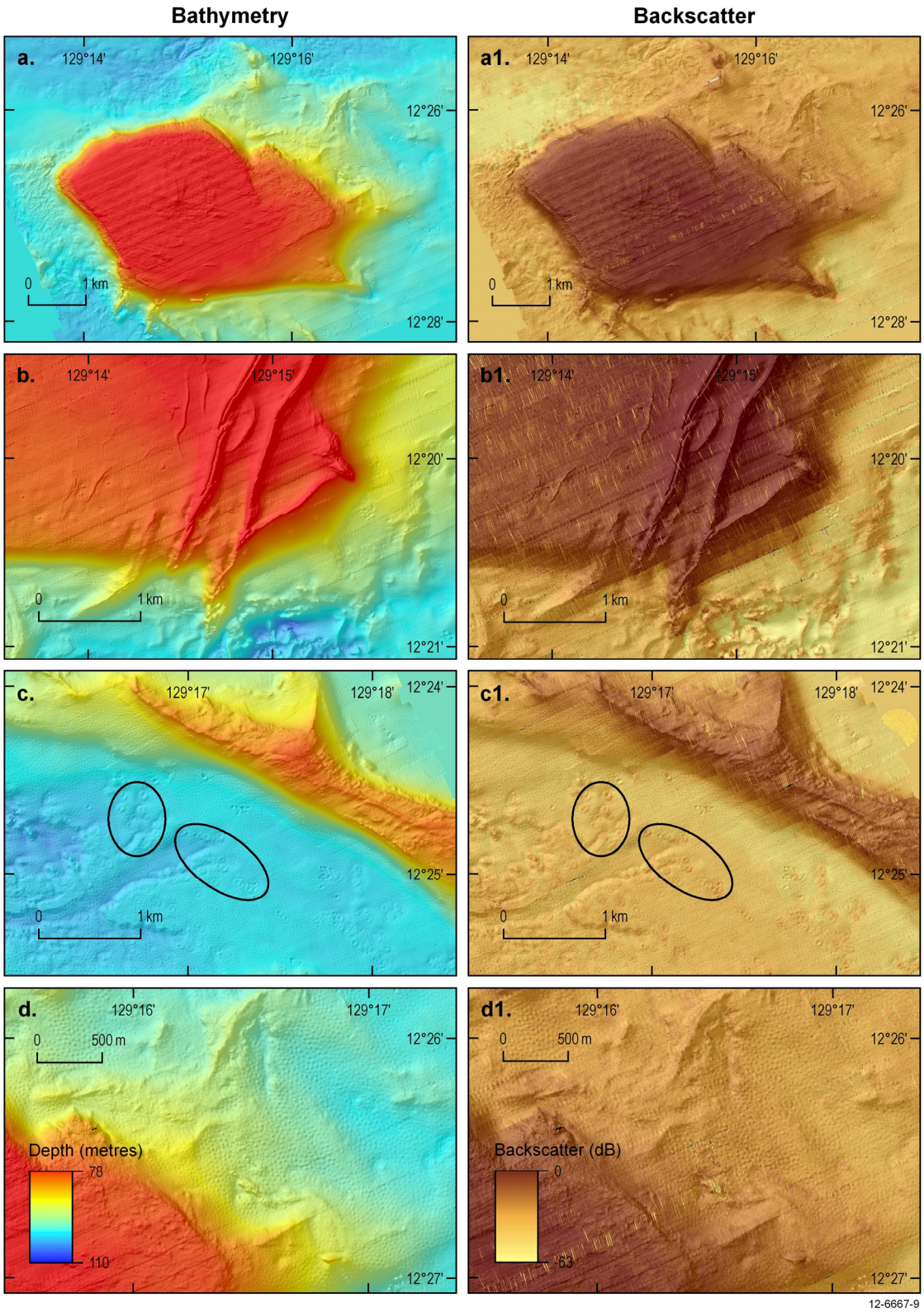

Figure 3.18: *False colour bathymetry (a-d) and backscatter (a1-d1) images of Area 2 showing key geomorphic features, including: (a & a1) bank; (b & b1) low-relief ridges; (c & c1) 'ejecta-like' pockmarks, and (d & d1) hummock field.*

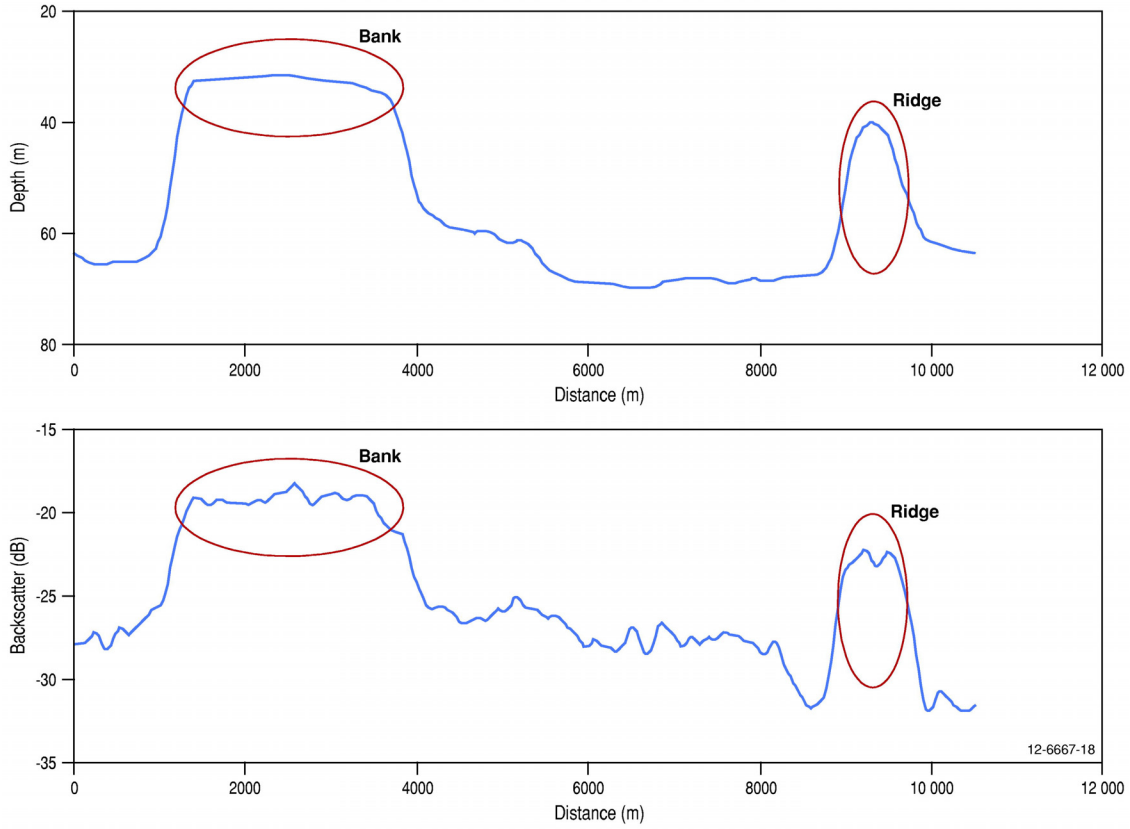

Figure 3.19: *Depth (top) and backscatter (bottom) profile across line 44 (see Figure 3.15) showing high backscatter values associated with bank and ridge features.*

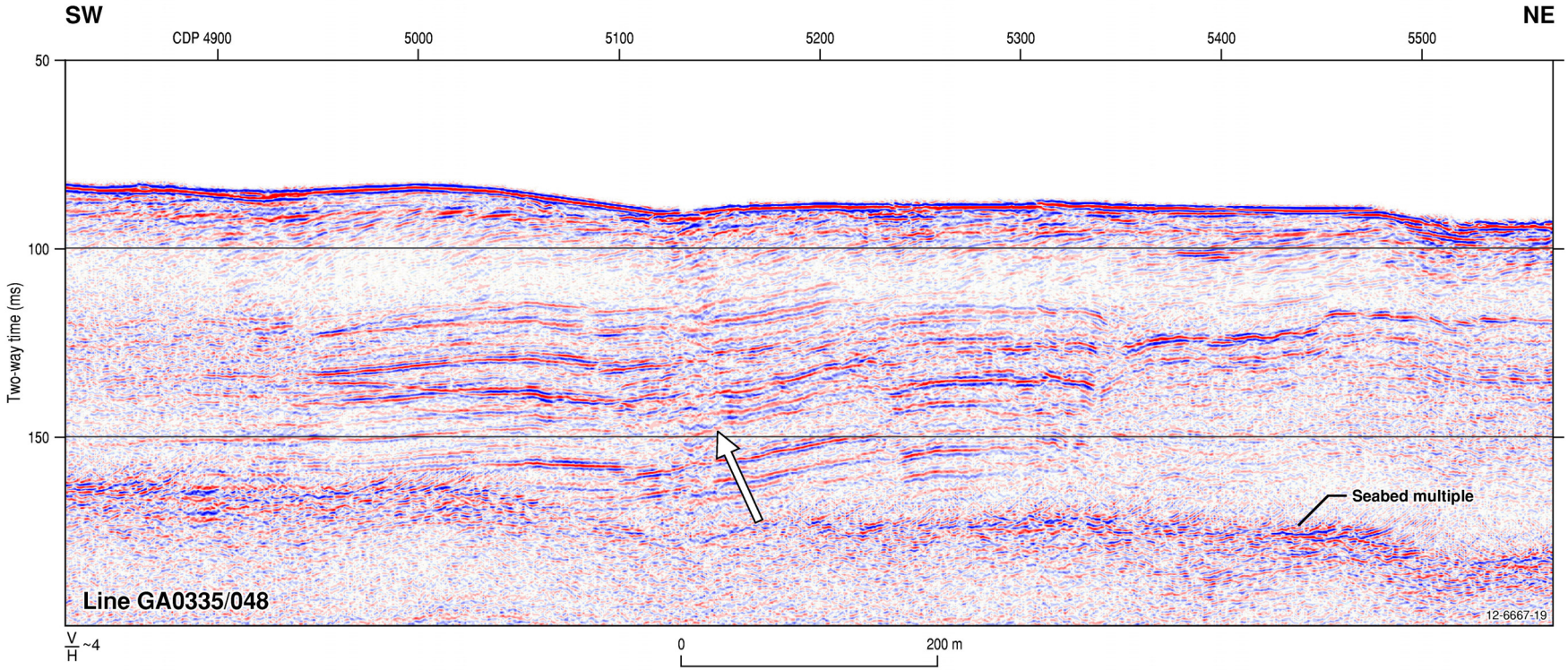

Figure 3.20: *Final processed image of sub-bottom profiler line GA0335/048 from Area 2 (up to 65 m of sediment has been penetrated by this sub-bottom profile). The continuous and semi-continuous seismic reflectors show the build-up of sediment in the shallow subsurface. The seismic anomalies (vertically distorted reflectors or chimney feature indicated by arrow) represent faults and/or potential fluid movement through the strata. These faults can potentially be aligned with large faults in the pre-existing and/or new seismic data.*

4. Concluding Remarks

The Petrel Sub-basin seabed mapping survey SOL5463 (GA0335) was designed to acquire pre-competitive geophysical and biophysical data on seabed environments within targeted areas of the Petrel Sub-basin to support an assessment of the CO_2 storage potential in these areas. The survey successfully acquired 652.3 km^2 of high-resolution multibeam sonar data (including bathymetry, backscatter and water column data) and 655 line-kilometres of sub-bottom profiles. The study areas were sampled at 15 stations that comprised 31 Smith-McIntyre grabs, 12 CTD casts (including eight CTD casts with water samples), 13 underwater towed-video transects, nine vibrocores and two oceanographic mooring stations. The pre-competitive geophysical and biophysical data acquired during the survey will be integrated with new and existing seismic data to provide a detailed overview of the seabed environments and geology of the Petrel Sub-basin. These data will be made available to industry and resource managers to provide sound scientific knowledge on the biogeophysical setting (including habitat characterisation and the identification and description of unique, rare and/or potentially vulnerable habitats and communities) and seabed stability of the Petrel Sub-basin. This information will be utilised to complete a comprehensive assessment of the Petrel Sub-basin for potential CO_2 storage and support decisions on marine zone management in northern Australia.

5. References

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6. Appendices

Appendix A. Scientific Party SOL5463/GA0335

LEG 1: FRIDAY, 4 MAY 2012 – FRIDAY, 18 MAY 2012

NAME	PRINCIPAL ROLE	RESPONSIBILITY
GA PERSONNEL ON BOARD LEG 1		
Tony Nicholas	Chief Scientist (until 5 May 2012), Sedimentologist	Science leader, geological sample acquisition and processing
Andrew Carroll	Co-chief Scientist (from 5 May 2012), Marine ecologist	Benthic ecology sample acquisition and processing, video characterisation
Diane Jorgensen	Co-chief Scientist (from 5 May 2012), Sedimentologist	Geological sample acquisition and processing
Justy Siwabessy	Multibeam operator and processor (backscatter & water column data)	Multibeam operations, processing and data management
Leonie Jones	Senior Geophysicist/Seismic Processor	Multi-channel sub-bottom data management & processing
Stephen Hodgkin	Multi-channel sub-bottom operator and multibeam support	Multi-channel sub-bottom and multibeam sonar support
Matthew Carey	Science technician and multibeam operator	Multibeam support, deploy and assist with sampling gear, lab processing of samples.
CONTRACTOR PERSONNEL FROM IXSURVEY ON BOARD LEG 1		
Mark Matthews	Multibeam processor (bathymetry)	Multibeam Data processing and management
Dean Forrest	Multibeam processor (bathymetry)	Multibeam Data processing and management
AIMS PERSONNEL ON BOARD LEG 1		
Marcus Stowar	Voyage leader	AIMS voyage leader; also responsible for operation of towed video

LEG 2: FRIDAY, 18 MAY 2012 – THURSDAY, 31 MAY 2012

NAME	PRINCIPAL ROLE	RESPONSIBILITY
GA PERSONNEL ON BOARD LEG 2		
Andrew Carroll	Co-chief Scientist, Marine ecologist	Benthic ecology sample acquisition and processing, video characterisation
Diane Jorgensen	Co-chief Scientist, Sedimentologist	Geological sample acquisition and processing
Justy Siwabessy	Multibeam operator and processor (backscatter & water column data)	Multibeam operations, processing and data management
Mike Sexton	Senior Geophysicist/Seismic processor	Multi-channel sub-bottom data management & processing
Stephen Hodgkin	Multi-channel sub-bottom operator and multibeam support	Multi-channel sub-bottom and multibeam sonar support
Howard Floyd	Sedimentologist	Geological sample acquisition and processing
Matthew Carey	Field & Engineering Support	Multibeam support, deploy and assist with sampling gear, lab processing of samples.
Andrew Hislop	Mechanical technician	Deploy and assist with sampling gear; assist with multibeam operation
AIMS PERSONNEL ON BOARD LEG 2		
Marcus Stowar	Voyage leader	AIMS voyage leader; also responsible for operation of towed video.
Paul Tinkler	Biologist	Assist with sampling, particularly towed video and BRUVs.

Appendix B. Chief Scientist Daily Log

PETREL SUB-BASIN MARINE ENVIRONMENTAL SURVEY SOL5463
PETREL SUB-BASIN, NORTHERN AUSTRALIA
CHIEF SCIENTIST DAILY LOG

Leg 1: Friday, 4 May 2012 – Friday, 18 May 2012

Chief Scientist Daily Log 1: Friday, 4 May 2012

Position at 2400 Lat: 12˚ 26'0" S Long: 129˚ 18'5" E

Departed port of Darwin on time at 13:00 hrs with all personnel in good spirits. Calibration tests of multibeam system and a VSP were conducted during transit to Mooring 1 deployment site. A direct comparison of the multibeam system results with known bathymetric features show data better than 10 cm – an excellent result. Recording of multibeam data began ~50 km from port. Some issues with the multibeam system regarding the timeliness of heading data were resolved.

Weather: Fine. Seas 1.5 m with swell 0.5 m. Winds NE 10-12 kn tending SE to ESE 14-16 kn in afternoon.

Intentions for next 24 hours: Deploy two moorings and start swath mapping in Grid 1.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
13:00	14:00	Left Port	
14:00	24:00	Transit to Mooring 1 deployment site	Swath acquired and conducted calibration tests of multibeam system

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	190	Today: 190 km transit swath
SBP	Kms	-	
CTDs	No	-	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 2: Saturday, 5 May 2012

Position at 2400 Lat: Port Darwin Long: Port Darwin

At 24:00, the ADP mooring ('Big Jim') was deployed without incident in ~30 m water depth within Grid 1. The best option for proceeding was discussed with RV *Solanders* skipper. It was agreed that we would proceed with transit to Grid 1, initiate swath mapping on northern part of Grid 1 (~4 hrs) prior to swath mapping cross shelf (a cross line) to second mooring (ADCP) deployment location (ETA ~0800-0900). Swath mapping of the northern part of Grid 1 has progressed well with 22 km long lines at 150 m line spacing. At 07:30 a decision was made to pull off the survey line and return to Darwin to seek medical attention for a GA staff member. RV *Solander* docked in Darwin at 19:30 A total of 62 km of lines were acquired in Grid 1 prior to pulling off the survey.

Swath mapping times for both grids were underestimated in original plans. Onboard calculations with ships systems and conditions estimate that filling Grid 1 (at its original size) would take 13 days (150 m line spacing, 8.5 knots) and Grid 2 (at its original size) would take 4.5 days (200 m line spacing, 8.5 knots). This differed to the original estimations of 9.5 days for Grid 1 and 3.5 days for Grid 2 (4 times water depth, 10 knots). Both grids need to be reduced to compensate for these revised acquisition times.

Weather: Fine. Seas 1.5 m with swell 0.5 m. Winds ESE 15-19 kn becoming E-NE winds 8-12 kn.

Intentions for next 24 hours: To remain in port while options for the survey are discussed.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
24:00	01:00	Mooring deployment	Deployed mooring in Grid 2
01:00	04:00	Transit to Grid 1	
04:00	07:30	Swath mapping in Grid 1	Ongoing
07:30	19:30	Transit to Darwin: Medical Evacuation	Vessel pulled off survey lines to seek medical attention for Tony Nicholas
19:30		Arrived port	Tony in ambulance to hospital

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	377	Cumulative total to date: 377 km from 315 km transit and 62 km in Grid 1
SBP	Kms	-	
CTDs	No	-	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 3: Sunday, 6 May 2012

Position at 2400 Lat: 12˚ 29.69' S Long: 129˚ 30.15' E

A phone meeting at 10:30 am occurred between Andrew Carroll, Marcus Stowar, Andrew Heyward, Anna Potter, Tony McKenna, David Mead and Jason Fowler. Following this discussion a number of decisions were made including: Leg 1 of the survey would resume with Andrew Carroll as Chief Scientist; and, the size of both grids would be reduced to compensate for lost time.

A pilot was organised and at 1600 we departed Darwin Port in transit towards Grid 1. Both grids were reduced in size to compensate for lost time (see details below). The grids were also reorientated to improve the quality of the multibeam acquired – i.e. optimum ship heading is 65 degrees (due to sea condition, wind and swell); this minimises noise and maximises ship speed. Sparker lines will still have to be acquired at a 55 degree heading to coincide with the dip of the basin. The location of the oceanographic mooring in Grid 1 has been moved slightly (see below), however it is still located directly above the 800 m seal boundary.

Weather forecast for the next few days is good. However, high winds are forecast from Friday. These high winds may effect Sparker acquisition.

A muster drill was carried out at 17:10 – 17:30 in Darwin Harbour. Procedures around abandoning ship were outlined by Jason (first mate) and deployment of an inflatable life raft was demonstrated.

Revised Grid 1: 15 km x 30 km. Total to complete = 11 days
The location of Grid 1 still covers the fault/fraction system in the NW corner and the 800 m seal boundary in the SE corner.
9.4 days of Multibeam - 150 m line spacing; 8.5 knots
1.6 days of Sparker – 19 x 15 km lines (one line overlaps old seismic line and one line overlaps new seismic line) and 2 x 30 km lines, both acquired at 5 knots. Sparker lines roughly fill in gaps from concurrent seismic survey.

Revised Bounding Coordinates of Grid 1:
128 deg 54.0087'; -12 deg 35.924617'
128 deg 46.221167'; -12 deg 39.5726'
128 deg 53.356057'; -12 deg 54.255077'
129 deg 01.149221'; -12 deg 50.608426'
Revised Mooring location in Grid 1:
128 deg 58.12825'; -12 deg 50.139533

Revised Grid 2: 11 km x 17 km. Total to complete = 4 days
The location of Grid 2 still incorporates several banks, including the southern edge of Flat Top bank.
3 days of Multibeam – 200 m line spacing; 8.5 knots
1 day of Sparker – 14 x 10 km lines and 2 x 17 km lines, both acquired at 5 knots.
Revised Bounding Coordinates of Grid 2:
129 deg 15.894547'; -12 deg 18.138058'
129 deg 10.365520'; -12 deg 20.640873'
129 deg 14.181217'; -12 deg 28.82855'
129 deg 19.700417'; -12 deg 26.343033'

Weather: Fine. Seas 1.5 m Winds E 7 kn.

Intentions for next 24 hours: To begin swath mapping and deploy mooring in Grid 1. Further plan acquisition schedule for Leg 1 and Leg 2.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
16:00	17:00	Left Port	
17:00	24:00	Transit to Grid 1	Ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	538	Cumulative total to date: 538 km from 538 km transit and 62 km in Grid 1
SBP	Kms	-	
CTDs	No	-	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 4: Monday, 7 May 2012

Position at 2400 Lat: 12˚ 40.47' S Long: 128˚ 47.23' E

Arrived at revised Grid 1 and commenced swath mapping at 0300. The reorientated multibeam lines have improved data quality and enabled a slightly higher ship speed (i.e. 8.8 kn). Swath mapping is progressing at a rate (~165-200 line spacing; ~1 hour per line) which will allow us to slightly drop back in speed during bad weather forecast for Friday and still maintain our timetabled objectives. Used swath mapping crosslines to transit to the southern end of Grid 1, where Mooring two (ADCP) was successfully deployed in ~85m water at ~ 0915 (please see coordinates below). Another swath mapping crossline was used to transit back to the northern end of Grid 1, allowing optimum use of swath time.

The multibeam system crashed five times over a period of 12 hours. It appears that communications to the processing unit failed and caused the system to repeatedly crash. Staff have been working to locate the problem and have applied different solutions. Hopefully the problem has been isolated and no further crashes occur.

The location of the MV *Duke* (concurrent seismic survey GA0336) and the timing of seismic acquisition lines through Grid 1 are causing some concerns. Apart from an initial email from John Plummer (GA Client Rep on MV *Duke*), we have not heard from the MV *Duke* via radio or email. Emails have been sent from the RV *Solander* providing updates of our situation (i.e. moving in and out of grid 1 due to medical evacuation) and radio contact has been unsuccessful. Another email will be sent to the MV *Duke* tomorrow requesting information regarding the date they expect to be in the southern end of Grid 1.

A number of staff are showing signs of fatigue. This is mainly due to disrupted shifts and longer work hours caused by the medical evacuation to Darwin and re-planning of the survey. To allow staff time to recover from this strain, rosters have been altered slightly, naps have been allowed during shifts and certain staff are periodically relieved for breaks. Staff are generally in good heath, just slightly tired. Despite experiences some rolling seas; staff are not displaying signs of sea sickness.

Multibeam systems crash (*UTC)
Crash: 2053 Restarted 2105
Crash: 2251 Restarted 2259

Crash: 0048 Restarted 0056
Crash: 0254 Restarted 0302
Crash: 0335 Restarted 0401 (Team replaced BSP card)

Status as of 2400: system operational and being monitored

WGS84 Coordinates of Big Jim (Mooring 1) as recorded by AIMS
Deployed

-12.44797078; 129.24963934	Mooring 1	Depth: 31.4m	Local time: 12:56:14
-12.44808909; 129.25005948	weight 1	Depth: 31.8m	Local time: 12:58:30
-12.44836857; 129.25007913	weight 2	Depth: 31.9m	Local time: 12:59:30

WGS84 Coordinates of ADCP (Mooring 2) as recorded by AIMS
Deployed at 0918 07/05/2012

-12.8358063710592; 128.969253426761	Depth: 84.7m	Local time: 09:15:02
-12.8352501545117; 128.968617857631	Depth: 101.2m (bad read?)	Local time: 09:16:48
-12.8348510497524; 128.96794016092	Depth: 84.6m	Local time: 09:18:00

Weather: Slightly overcast. Seas 1.0 m Winds SE-E, 8-15 kn.

Intentions for next 24 hours: Continue swath mapping of Grid 1. Interrupt swath mapping to run one sparker line in the afternoon (~1430) to test the sparker system and processing procedures. Conduct CTD to acquire seawater samples for sampling preparations. Further plan acquisition schedule for Leg 2.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	0300	Transit to Grid 1	
0300	0900	Swath mapping Grid 1	Ongoing
0900	0930	Deployment of Mooring 2	ADCP deployed ~ 85m depth
0930	2400	Swath mapping Grid 1	Ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	862	Cumulative total to date: 862 km. Today: 65 km transit and 259 km in Grid 1
SBP	Kms	-	
CTDs	No	-	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 5: Tuesday, 8 May 2012

Position at 2400 Lat: 12˚ 40.07' S Long: 128˚ 52.56' E

Swath mapping overnight progressed at a rate of 175-200 line spacing (~1 hour per line), with calmer seas enabling a ship speed of ~9kn. The multibeam system crashed 4 times between 0400 and 1325 (diagnosis: transducer head unresponsive; please see below for diagnosis procedure). At 1415

the swath system was lost again. A decision was made to replace the suspect transducer and main cable during the scheduled deployment of the sparker at 1430. During sparker deployment (~1455) the suspect transducer 457 was replaced with transducer 543 and the main cable with spark was also replaced. The acquisition of multibeam data resumed at 1705.

A CTD was successfully deployed at 1430 to 82 m water depth. This was the second attempt at a CTD, as the first CTD resulted in a bad/erroneous log. Matt Carey has been busy filtering the sampled water ready for use in sampling for Leg 2.

At 1400, Stephen Hodgkin ran a safety briefing for all crew regarding the Sparker system. During the deployment of the Sparker system, a number of technical issues arose. Stephen successfully troubleshooted these issues and the Sparker was deployed. However, the system would then not start. The Sparker was pulled back onto the deck at 1730 and swath mapping resumed. Stephen has been working on getting the Sparker operational again. He has pulled open the boxed unit and checked all connections. A simple test with another squid (smaller load) was successful and the full system will be trialled tomorrow afternoon.

The MV *Duke* was contacted via email with our revised survey grids. We have also requested their current position, estimated position in 24 and 48 hours (at RV *Solander* skipper's request) and the date and ETA of when the MV *Duke* is expected to enter Grid 1 and if possible Grid 2. Anne Fleming has been in contact via email to inform that the MV *Duke* may be adjusting some of its seismic lines to tie into certain wells. When available, these revised lines will need to be assimilated into the planned Sparker lines.

The procedure put in place to alleviate staff fatigue appears to be working well. Staff are better rested and have handled an intensive "troubleshooting" day quite well. Another CARIS dongle has been requested from Anne Fleming and Anna Potter (GA) for Leg 2. An additional laptop with CARIS loaded will be coming onboard with staff on Leg 2, but another CARIS dongle is needed for its use.

The GA leader email address (galeader@aims.gov.au) does not exist. This has been confirmed with Marcus Stowar.

Multibeam systems problems summary:
0400: Transducer head non responsive, BIST Test Run fail; PU Only restarted, BIST Test Run good; Rescan applied, SIS picked up head and continued surveying
0930: Volitional restart of all system (PU & PC) during SVP at UTC data change
1052: Transducer head non responsive, confirmed, PU-PC comms ok; Restart of PU & PC and continued surveying
1325: Transducer head non responsive, SIS frozen; Restart PU & PC and continued surveying
1415: Lost Sonar and Swath system. Fixed sonar system
1455: During Sparker deployment replaced suspect transducer 457 to transducer 548 and replaced main cable with spare. Resumed surveying at 1705.
Status as of 2400: system operational and being monitored

Weather: Slightly overcast. Seas 1-1.5 m Winds ENE 8 kn.

Intentions for next 24 hours: Continue swath mapping of Grid 1. Interrupt swath mapping to run one sparker line in the afternoon to test the sparker system and processing procedures. Further plan acquisition schedule for Leg 2.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	1400	Swath Mapping Grid 1	Ongoing
1430	1435	CTD deployed	Digital log taken of water column and some water samples taken for use in Leg 2 sampling
1435	1735	Sparker deployment	Technical issue with Sparker, deployment failed; during which also had technical issue with sonar and swath system
1735	2400	Swath mapping Grid 1	Ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 566 km Transit: 593 km Total: 1,159 km	Total today: 307 km in Grid 1
SBP	Kms	-	
CTDs	No	1	4 Niskin bottles fired for seawater sampling – water filtered for use in sampling Leg 2
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 6: Wednesday, 9 May 2012

Position at 2400 Lat: 12˚ 42.86' S Long: 128˚ 50.38' E

Swath mapping has progressed at a rate of 175-200 line spacing (~1 hour per line), with 0.5-1m seas enabling a ship speed of ~8-9 kn. The multibeam system crashed 14 times over the past 24 hours (UTC 08 May 1557, 1623, 1717, 1745-change over network cable, 1918, 2125, 2225; 09 May 0334, 0601-BSP Change, 0655, 0924, 1155, 1215, 1440) (see below for standard procedure to unresponsive transducer). The restart procedure is currently completed in < 6 min which equates to the time required to come about and reorientate RV *Solander* and resume mapping. Despite this time loss swath acquisition is still progressing well.

At 1600, the Sparker system was successfully deployed and one line successfully acquired. The aim of this exercise was to test the sparker system and processing procedures, prior to initiating our full sparker acquisition plan (scheduled to begin ~ 1800 Thurs). Processing of the Sparker data has shown good penetration up to 100 m into sediments.

We received an e-mail from Roy Scholey (Party Chief) aboard the MV *Duke* providing details of their current and estimated positions in 24 and 48 hours. Roy indicated that at their present rate of acquisition they would approach the southern end of Grid 1 in ~ 4-5 days (e-mail sent at 2315 on 8th May). Given the difference in the acquisition of respective seismic lines on RV *Solander* vs. the MV *Duke* (1km spacing for sparker vs. 3km spacing, respectively) a decision was made (following discussions with RV *Solander's* skipper) to continue to acquire multibeam and sparker in our current direction (i.e. advancing towards the southern boundary of Grid 1), and allow the MV *Duke* to leapfrog our position in ~ 4 days time. All attempts will be made to maximise the distance between

the RV *Solander* and the MV *Duke* to minimise the potential interference with our acquisition lines and sparker. This may involve some transit within Grid 1.

Multibeam transducer not responding, standard procedure
- PU, BSP, SH status light turns red, indicating no communications to transducer
- Confirm SIS software functioning
- Turn off PU (Processing Unit), in dry lab
- Turn on PU
- Wait 2 min 15 sec for initialisation
- Rescan, using SIS software, to re-establish TX comms.
- Confirm acquisition settings
- Resume data logging

Staff are generally in good heath, although a few staff members are still experiencing periodic sea sickness. Staff health (including staff fatigue) is being monitored.

Weather: Cloudy (6/8) with occasional squalls. Seas 0.5-1m. Winds ENE 13 kn.

Intentions for next 24 hours: Continue swath mapping of Grid 1 for 12 hours during the day. Interrupt swath mapping at ~ 1800 to deploy and run the sparker for a period of 12 hours overnight. Further plan acquisition schedule for Leg 2.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	1550	Swath mapping Grid 1	Ongoing
1600	1815	Sparker trial	Sparker deployment successful. Aim of exercise: to test the sparker system and processing procedures
1830	2400	Swath mapping Grid 1	Ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 855 km Transit: 593 km Total: 1,448 km	Total today: 289 km in Grid 1
SBP	Kms	16 km	One line acquired as a test line
CTDs	No	1	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 7: Thursday, 10 May 2012

Position at 2400 Lat: 12˚ 39.35' S Long: 128˚ 52.79' E

Swath mapping is progressing at a rate of 170-180 line spacing (~1 hour per line), with 0.5-1m seas enabling a ship speed of ~8-9 kn. The multibeam system crashed 4 times over the 12 hour period of acquisition (UTC 9th May: 2310, 2239; UTC 10th May: 0552, 0234, 0210-restart PC) (please see below for standard procedure to unresponsive transducer).

At 1730, the Sparker system was successfully deployed and acquisition began. Three lines (each ~16 km long, ~1 km line spacing) were successfully acquired by midnight (ship speed 5-5.5 kn). Only two minor problems occurred with the Sparker overnight, with acquisition generally being very successful.

Following discussion with GA staff and Marcus Stowar, a planning schedule for Leg 2 of the survey has been drafted.

Multibeam transducer not responding, standard procedure
- PU, BSP, SH status light turns red, indicating no communications to transducer
- Confirm SIS software functioning
- Turn off PU (Processing Unit), in dry lab
- Turn on PU
- Wait 2 mn 15 sec for initialisation
- Rescan, using SIS software, to re-establish TX comms.
- Confirm acquisition settings
- Resume data logging

NB: Procedure is currently completed in <6mn, about the same time required to come about and reorientate RV *Solander* and resume mapping with some data overlap.

Staff are generally in good heath, despite slightly disrupted sleep patterns experienced by a few staff members. Naps and breaks are being recommended to these staff members. Staff health (including staff fatigue and periodic sea sickness) will be continuously monitored.

Weather: Cloudy 8/8. Seas 0.5-1m Winds NNW 2 kn.

Intentions for next 24 hours: Continue swath mapping of Grid 1 for 12 hours during the day. Interrupt swath mapping at ~ 1730 to deploy and run the sparker for a period of 12 hours overnight.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	17:00	Swath mapping Grid 1	Ongoing
17:30	24:00	Sparker acquisition Grid 1	Completed three lines; ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 1,104 km Transit: 593 km Total: 1,697 km	Total today: 249 km in Grid 1
SBP	Kms	64 km	Three lines acquired totalling 48 km
CTDs	No	1	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 8: Friday, 11 May 2012

Position at 2400 Lat: 12˚ 44.35' S Long: 128˚ 50.56' E

Overnight the Swath mapping system was turned off to allow the system to cool. At 0705 the system was turned on and swath mapping resumed progressing at a rate of 170-180 line spacing (~1 hour per line), with 0.5-1m seas enabling a ship speed of ~8-9 kn. The multibeam system crashed only once over the 13.5 hour period of acquisition (UTC 11th May: 0630-restart PC; please see previous daily records for standard procedure to unresponsive transducer). Error logs produced by the PU (Telnet files) have been emailed to Ian Atkinson (GA) for further consultation with the manufacturer.

From 24:00 to 06:45, four Sparker lines (each ~16 km long) were successfully acquired. No further problems arose with the system during the night. Processing of eight sparker lines has shown that the quality of the sparker lines is very good down to ~ 100 m. Apart from filtering; the processing has included interactive velocity analysis and trim statics. Prominent features seen on the Sparker lines include facies changes from sandy to mudier interlayered packages, channels, sediment filling channels from multiple directions and possible faults. Further processing will clear the section up further and possibly clear up the multiples in the deeper section.

At 1745, the Sparker system was unsuccessfully deployed. The geo-eel battery was low on power and caused low quality data acquisition. Acquisition ceased and two swath lines were acquired while the geo-eel battery was charged further. At 20:35 the sparker was successfully deployed and acquisition began. Two lines (each ~16 km long) were successfully acquired by midnight (one line at 5.5 kn, one line at 5 kn).

Staff are generally in good heath and in good spirits, despite slightly disrupted sleep patterns experienced by a few staff members. Naps and breaks are being recommended to these staff members. Staff health (including staff fatigue and periodic sea sickness) is being monitored.

Weather: Blue sky, partly cloudy 4/8. Seas 0.5-1m. Wind E 2 kn.

Intentions for next 24 hours: Retrieve Sparker ~ 0630. Continue swath mapping of Grid 1 for ~ 12 hours during the day. Interrupt swath mapping at ~ 1730 to deploy and run the sparker for a period of 12 hours overnight.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	06:45	Sparker acquisition Grid 1	Completed 4 lines; ongoing
07:05	17:30	Swath mapping Grid 1	Resumed line acquisition. Transit within grid 1 used to fill in data gaps. Ongoing
17:45	18:10	Sparker acquisition Grid 1	Deployment failed
18:15	20:30	Swath mapping Grid 1	Two lines acquired
20:35	24:00	Sparker acquisition Grid 1	Sparker deployment successful; ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 1,285 km Transit: 593 km Total: 1,878 km	Total today: 181 km in Grid 1
SBP	Kms	160 km	Six lines acquired totalling 96 km
CTDs	No	1	

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 9: Saturday, 12 May 2012

Position at 2400 Lat: 12˚ 43.99' S Long: 128˚ 37.77' E

Overnight the Swath mapping system was turned off to allow the system to cool. At ~0730 the system was turned on and swath mapping resumed at a rate of 170-180 line spacing (~1 hour per line), with 0.5-1m seas enabling a ship speed of ~8-9 kn. The manufacturers, via Ian Atkinson, have given advice regarding possible solutions for the next system crash. However, the multibeam system did not crash once today. We achieved 50% swath coverage over Grid 1 today, lifting the spirits of all staff.

Tide data acquired from the BOM has assisted in the multibeam processing and greatly improved the quality of swath mapping. The swath mapping has so far revealed a seafloor covered in hundreds of pockmarks that range in size from 5 to 40 m in diameter. The circular to elongated pockmarks occur singular pockmarks or in fields of pockmarks (fields ranging in size from ~80-150 m in diameter). Water depth within the grid ranges from 75-100 m. Geomorphic features of the seafloor includes shallow palaeochannels, small banks and plains. Pockmarks occur within the palaeochannels and the plains. Pockmarks within the palaeochannels (~10-15 m in diameter) appear to be larger in size than those on the plains (~6-10 m in diameter).

Processing of the water column and backscatter data is progressing well. No active seeps have been identified in the water column data processed so far. Schools of fish however, are common. The backscatter data indicates mainly soft substrate with some variability to harder substrates. This variability coincides with channel sediment and some pockmark fields.

From 00:00 to 07:30, four Sparker lines (each ~16 km long) were successfully acquired (at a ship speed of 5 kn). Following sparker retrieval the geo-eel battery was placed on charge to ensure quality data acquisition upon re-deployment at ~1800. The depth logger on the eel revealed that the eel was fluctuating in water depth from 0.8-3.2 m. As the ship was powering with the tide, the eel dropped in the water and as the ship was powering against the tide, the eel rose in the water. The fluctuating eel depth is attributed to the effect of tides and the speed of the ship in the water (as apposed to the speed of the ship over the seafloor). Four new weights were added to the eel and the ship's speed for each line will be varied (5.2 kn with the tide and 4.6 kn against the tide) to try to keep the eel at a consistent depth. At 18:00, the Sparker system was successfully deployed and some short speed tests were conducted by the skipper and Stephen Hodgkin. At 18:25 the acquisition of Sparker lines commenced. Minor problems occurred with the Sparker during the evening's acquisition. Small amounts of data were lost from the lines (~60-240 m) with the largest being ~800 m of data loss on line GA335_15. The problem has been narrowed down to a load fault, which is being investigated by Stephen Hodgkin. By midnight, three lines (each ~16 km long) were acquired (5-5.5kn).

Raw SEG-Y data backed up and QC'd for 14 sparker lines acquired so far. Processing tests carried out on line GA0335_001. Brute stack processing completed on 14 sparker lines. This includes acquisition geometry, filters, NMO correction with water velocity, CDP sort and stack. More detailed processing in progress on higher priority lines includes velocity analysis and trim statics. Analysis is ongoing on methods to reduce effects of the receiver ghost and water bottom multiples

and reverberations. Results of processing are extremely promising with good resolution of features in the top 100 m of sediment, above the first water bottom multiple. This multiple may become a problem with the move into shallower water.

All personnel are well and in good spirits after another productive day of multibeam and sub-bottom profile acquisition.

Weather: Blue sky, partly cloudy 2/8. Seas 0.5-1m. Wind 6 kn from the south.

Intentions for next 24 hours: Retrieve Sparker ~ 0630. Continue swath mapping of Grid 1 for ~ 12 hours during the day. Interrupt swath mapping at ~ 1730 to deploy and run the sparker for a period of 12 hours overnight.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	07:30	Sparker acquisition Grid 1	Completed 4 lines
07:55	17:50	Swath mapping Grid 1	Resumed line acquisition. Ongoing
18:00	24:00	Sparker acquisition Grid 1	Sparker deployment successful; ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 1,442 km Transit: 593 km Total: 2,035 km	Total today: 157 km in Grid 1
SBP	Kms	272 km	Seven lines acquired totalling 112 km
CTDs	No	1	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 10: Sunday, 13 May 2012

Position at 2400 Lat: 12˚ 53.05' S Long: 128˚ 53.41' E

At 08:10, Swath mapping resumed at a rate of 170-180 line spacing (~1 hour per line), with 0.5-1m seas enabling a ship speed of ~8-9 kn. Despite the application of several suggested solutions to address problems associated with the multibeam system, multiple system crashes were experienced today (Local time: 11:33, 11:50, 12:20, 12:37, 13:18, 14:43, 15:25). Around 80 minutes of swath acquisition over 9 hours was lost in system crashes, troubleshooting and rebooting. The system was turned off overnight to allow the system to cool. Alternatives to the PU situation are being investigated by Ian Atkinson and include somehow sourcing another PU for Leg 2.

From 24:00 until 07:45, four Sparker lines (each ~16 km long) were successfully acquired. No further problems arose with the system during the night. The geo-eel battery is charged every day to ensure it is ready for the night's acquisition. The depth of the eel during the evening's acquisition could not be checked as the depth logger on the eel malfunctioned. At 17:30, the Sparker system was successfully deployed and acquisition commenced with the ship speed over ground at 5.7 kn (with the tide) and 5.2 kn (against the tide). Four lines (each ~16 km long) were successfully acquired by midnight.

The position of the MV *Duke* over the past few days has been carefully monitored. This evening the MV *Duke* was 9.5 nm from the RV *Solander* in a parallel heading. The skipper contacted the MV *Duke* and conversed with the Party Officer to clarify timings and safe working distances for swath and sparker acquisition. The Party Officer indicated that a safe working distance was 5 km to ensure clearance of their towed cable and the optimal distance for no interference from their powerful source was 10 nm. After discussions with Leonie Jones, a decision was made to maintain the evening's Sparker acquisition and monitor the Sparker returns closely for interference. Any interference encountered is likely to be removed during processing. If this is not the case and the interference is too high, the 2.5 Sparker lines that may encounter interference from the MV *Duke* may have to be re-shot. At its closest this evening, the MV *Duke* was 8.8 nm from the RV *Solander*. The sparker returns showed minimal interference from the MV *Duke* but these will be checked in processing.

All personnel are generally well. Staff health including fatigue and periodic seasickness is being monitored.

Weather: Blue sky, partly cloudy 3/8. Seas 0.5-1m. Wind 7 kn from the south.

Intentions for next 24 hours: Continue Sparker acquisition during the morning and retrieve the Sparker ~ 0630. Continue swath mapping of Grid 1.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	07:45	Sparker acquisition Grid 1	Completed 4 lines
08:15	17:10	Swath mapping Grid 1	Resumed line acquisition. Ongoing
17:30	24:00	Sparker acquisition Grid 1	Sparker deployment successful; ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 1,570 km Transit: 593 km Total: 2,163 km	Total today: 128 km in Grid 1
SBP	Kms	400 km	Eight lines acquired totalling 128 km
CTDs	No	1	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 11: Monday, 14 May 2012

Position at 2400 Lat: 12˚ 45.39' S Long: 128˚ 56.96' E

Four Sparker lines (each ~16 km long) were successfully acquired from 00:00 to 06:15 (ship speed over ground – 6.2 kn with the tide and 5.6 kn against the tide). The depth logger affixed to the Geo-eel overnight has confirmed that a consistent depth of 2 m below sea level was maintained during acquisition. All Sparker lines planned for this leg have now been acquired. Just in time as the predicted bad weather is almost upon us (see below).

At 06:25, Swath mapping of Grid 1 resumed. Unfortunately multiple system crashes were experienced today, some at the rate of every 20 mins (Local time: 9:52, 10:20, 10:32, 11:00, 11:21,

12:19, 12:30, 13:08, 13:11, 13:20, 13:35, 14:37, 14:45, 14:54, 17:52, etc. please see below). Over 8.5 hours from 6:30 until 15:00, ~2 hours of swath mapping was lost due to system crashes, troubleshooting and restarting. This has started to seriously affect our swath acquisition and survey objectives, and may regrettably affect Leg 2 swath acquisition if an alternative hardware solution is not found (please note alternatives to the PU situation are currently being investigated by Ian Atkinson). Stephan Hodgkin contacted Ian Atkinson this afternoon via satellite phone to provide an update of the current status of the multibeam system, identify possible solutions and discuss details regarding the potential acquirement of another PU for Leg 2. From 15:00 ship speed was dropped to 6 kn and the multibeam system has only crashed a few times.

We continue to monitor the position of the MV *Duke* as multibeam data acquisition advances southward; ensuring that a safe working distance of 5 km is maintained. At its closest this morning, the MV *Duke* was ~6.6 nm from the RV *Solander* as we acquired our final scheduled sparker line. So far processing of the sparker lines has detected minimal interference from the MV *Duke*. The MV *Duke* is acquiring data to the east of Grid 1 and will back in our vicinity tomorrow morning.

Bad weather is forecast for tomorrow with 20-30 kn winds and high seas (2m swell with 3m seas) predicted. Workspaces have been secured and staff warned of hazards on board a drastically moving vessel. The high winds and seas will restrict our acquisition to only swath mapping at slower ship speeds, which interestingly appears to result in fewer system crashes. If the weather worsens to a state that swath acquisition is overly effected, the RV *Solander* will cease acquisition and essentially wait out the bad weather.

All personnel are generally well – although staff moral was affected by the frequency of multiple multibeam system crashes today. Staff health including fatigue and seasickness is being monitored.

Weather: Blue sky 2/8. Seas 2-3m. Wind ESE 20kn

Intentions for next 24 hours: Continue swath acquisition in Grid 1. Bad weather is forecast for tomorrow (20-30 kn winds), which may restrict our data acquisition to swath mapping only.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	06:15	Sparker acquisition Grid 1	Completed 4 lines
06:25	24:00	Swath mapping Grid 1	Resumed line acquisition. Ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 1,763 km Transit: 593 km Total: 2,356 km	Total today: 193 km in Grid 1
SBP	Kms	464 km	Four lines acquired totalling 64 km
CTDs	No	1	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 12: Tuesday, 15 May 2012

Position at 2400 Lat: 12˚ 48.19' S Long: 12853.81' E

High winds (20-30 kn with gusts) and seas over the past 24 hours have restricted our survey activities to multibeam data acquisition only. Ship speed has dropped to 6-8 kn in order to maintain data quality. At least one swath line does have questionable data quality. The quality of this and other lines acquired today will be assessed in processing. While fewer multibeam system failures were experienced today (UTC: 17:18, 19:00, 19:13, 23:31, 00:17, 01:07, 02:13, 03:18, 04:11, 06:37, 06:53, 08:58, 09:22, 09:37, 10:00, 10:45, 11:00, 11:39, 14:33), 19 crashes resulted in ~ 3 hours of swath mapping loss due to system failures and restarting.

The position of the MV *Duke* continues to be monitored as it enters and exists our survey area, ensuring that a safe working distance of >5km is maintained. Please note: swath mapping on the MV *Duke* is being acquired at a different frequency to multibeam data acquisition on RV *Solander*.

Bad weather is forecasted again for tomorrow with 20-30 kn winds predicted. High winds and seas will again restrict our data acquisition to swath mapping only. If the weather worsens to a state whereby multibeam acquisition is overly effected, the RV *Solander* will cease data acquirement and essentially wait out the bad weather.

Some staff are displaying signs of fatigue due to the rough weather disrupting sleep. These staff have been advised to take breaks and small naps to maintain fitness. All personnel are generally well despite the rough weather. Staff health including fatigue and seasickness is being monitored.

Weather: Blue sky, partly cloudy 4/8. Seas 2-3m with 2m swell. Wind ESE 15 kn.

Intentions for next 24 hours: Continue swath acquisition in Grid 1 (N.B. tomorrow's weather forecast (20-30 kn winds) is likely to restrict our data acquisition to swath mapping only).

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	24:00	Swath mapping Grid 1	Ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 1,987 km Transit: 593 km Total: 2,580 km	Total today: 224 km in Grid 1
SBP	Kms	464 km	
CTDs	No	1	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 13: Wednesday, 16 May 2012

Position at 2400 Lat: 12˚ 47.69' S Long: 128˚ 57.84' E

High winds (20-30kn with gusts) and seas (2-3m with 2m swell) over the past 24 hours continue to restrict our survey activities to multibeam data acquisition only. Ship speed has dropped to 5.5-8 kn in order to maximise data quality, however rough weather coupled with multiple system crashes are resulting in data loss (e.g. gaps and tearing). Multibeam system crashes appear to occur more frequently as we acquire swath data to the east, with the acquisition of one eastern line yesterday taking ~ three hours to complete due to the time spent coming about and reorientating RV *Solander* to resume swath mapping. An alternative swath acquisition method was briefly trialled today whereby RV *Solander*, following a multibeam system failure, maintained her course to the east, rather than coming about. This resulted in several data gaps within our eastern acquisition lines that were later filled by a single western swath line. While this method resulted in a more stable vessel for acquisition (due to a reduced need to come about in high seas) it did not increase overall acquisition efficiency nor did it decrease overall acquisition efficiency. Hence, this method was not adopted and RV *Solander* continues to come about following each system failure in order to resume multibeam data acquisition. Overall, 234 km of multibeam data were acquired over the past 24 hours, with 24 crashes (please see below) resulting in ~ 4 hours of swath mapping loss due to system failures and restarting.

The position of the MV *Duke* continues to be monitored as she enters and exists our survey area, ensuring that a safe working distance of > 5 km is maintained.

Some staff are displaying signs of fatigue and some periodic seasickness due to disrupted sleep and rough weather. These staff have been advised to take breaks and small naps to maintain fitness. Staff health including fatigue and seasickness is being monitored.

Weather: Blue sky 2/8. Seas 2m with 2m swell. Wind ESE 17kn. N.B. Winds are forecasted to ease over the next 24-48 hours to 10-15 kn from the east southeast.

Intentions for next 24 hours: Continue swath acquisition in Grid 1. If weather allows, slow vessel in order to test AIMS towed video system and complete comparison CTD test, prior to departing Grid 1 for Darwin Port at 1800.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	24:00	Swath mapping Grid 1	Ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,221 km Transit: 593 km Total: 2,814 km	Total today: 234 km in Grid 1
SBP	Kms	464 km	
CTDs	No	1	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	-	

Chief Scientist Daily Log 14: Thursday, 17 May 2012

Position at 2400 Lat: 12˚ 26.10' S Long: 128˚ 55.49' E

174 km of multibeam data were acquired in Grid 1 over a period of 15 ½ hours, with 20 crashes (UTC:15:43, 16:54, 17:47, 17:58, 18:27, 18:49, 19:08, 19:57, 20:10, 20:29, 22:11, 22:24, 22:47, 23:29, 00:52, 01:33-02:00, 04:07, 04:34, 04:43, 04:58) resulting in ~ 4 hours of swath mapping loss due to system failures and restarting. Multibeam data has now been acquired for 82% of Grid 1, with 40-45 hours of swath acquisition remaining. Approximately 12 hours of additional swath in Grid 1 was planned to be acquired during leg two. Unfortunately, swath delays experienced during Leg 1 will hamper complete sparker and side-scan coverage during Led 2.

At ~ 16:20 the AIMS towed video was deployed at two sample stations in Grid 1 to complete test runs and trial the USBL. Video data was successfully acquired during the first deployment but problems were encountered with the collection of still images. The second towed video deployment was unsuccessful due to network issues. Marcus Stowar has since resolved all problems and the towed video system should now be functioning normally. The USBL functioned well during both towed video deployments. Both stations will be re-visited for further sampling during Leg 2.

All personnel are well and in good spirits after a productive 2 weeks of survey. All staff have done an exceptional job including our senior geophysicist/seismic processor Leonie Jones and contract personnel Mark Matthews and Dean Forest who depart RV *Solander* at Darwin Port Friday 18 May. Mike Sexton, Andrew Hislop and Floyd Howard join us for Leg 2, departing Darwin at 1800.

Weather: Blue sky 2/8. Seas 1-1.5m. Wind SE 11kn.

Intentions for next 24 hours: Continue transit from Grid 1 to Darwin port, arriving 0600. Staff rotation (Leg 1 to Leg 2 transition). Load sampling equipment and PU. Depart Darwin Port at 1800 and commence transit to Grid 2.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	15:30	Swath mapping Grid 1	Ongoing
16:20	17:30	Towed video - test	Towed video transect acquisition - test
18:00	24:00	Swath Mapping - Transit to Darwin Port	End of Leg 1

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,395 km Transit: 706 km Total: 3,101 km	Total today: 174 km in Grid 1; 113 km in transit
SBP	Kms	464 km	
CTDs	No	2	Today: 1 CTD profile acquired
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	1	

Leg 2: Friday, 18 May 2012 – Thursday, 31 May 2012

Chief Scientist Daily Log 15: Friday, 18 May 2012

Position at 2400 Lat: 12° 22.25' S Long: 129° 54.35' E

Ian Atkinson greeted the RV *Solander* with a replacement PU as we arrived in Darwin Port at ~ 0700. The new PU was installed and tested throughout the day. During the 12 hours in port, equipment was loaded, 4 staff departed, 3 staff arrived and sampling meetings were conducted. Departing staff spent some hours with their arriving counterparts for handover of information and procedures. Leonie Jones and Ian Atkinson were both given copies of the swath data (raw and processed) to carry back to GA. Leonie Jones also has a copy of the Sparker data to carry back to GA. Approximately five palettes of survey equipment were brought onboard RV *Solander* for Leg 2, including two palettes for the BRUVs. Unfortunately, GA's new towed video camera and corresponding winch system (2 palettes) were left at Pearl Marine Engineering primarily due to the lack of deck space (N.B the winch needs to be bolted to deck) and insufficient time required to test the equipment. The towed video camera runs for this survey will rely on the AIMS camera system and GA's USBL.

A draft sampling plan for Leg 2 was discussed via teleconference (attendees: Anna Potter, Tony Nicholas, Rachel Przeslawski, Diane Jorgensen and Andrew Carroll) at ~ 12:00, with comments, advice and suggestions to be incorporated into a revised Leg 2 sampling schedule. Supplementary revisions have been made to Grid 2 (please see below) to compensate for the remaining swath time required in Grid 1 (40-45 hours of multibeam acquisition remaining due to problems with multibeam system, which is 36 hours over what was initially planned for Leg 2). The total area of Grid 2 has been further condensed by shifting the eastern boundary line westward by 1 km. The location and orientation of the grid still incorporates geomorphic features of interest including shoals and the southern edge of Flat Top bank. A face-to-face meeting was held with Andrew Heyward today on board the RV *Solander* (attendees: Andrew Heyward, Marcus Stower, Andrew Carroll and Diane Jorgensen). The BRUV sampling options for Leg 2 were discussed.

During the transit to Grid 2, the multibeam system experienced no crashes or system failures. Special thanks to Ian Atkinson and FES for working so hard getting the replacement PU to, and installed on, the RV *Solander* for Leg 2.

Newly Revised Grid 2: 10 km x 17 km. Total to complete = 3.5 days
The eastern edge of the grid has been shaved back 1km. N.B. The location of Grid 2 still incorporates several banks, including the southern edge of Flat Top bank.
2.5 days of Multibeam – 200-220 m line spacing; 9 knots
1 day of Sparker – 14 x 10 km lines and 2 x 17 km lines, all acquired at 5 knots.

Revised Bounding Coordinates of Grid 2:
129.172759; -12.344014
129.258308; -12.305289
129.322067; -12.441876
129.236354; -12.480476

All personnel are well and in good spirits as we begin Leg 2 of the survey. Staff fatigue and sea sickness will be monitored.

Weather: Fine (b2/8). Seas 0.5-1m. Wind 13kn from the south.

Intentions for next 24 hours: Begin swath mapping in Grid 2.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	06:30	Transit to Darwin Port	Swath and water column data acquired during transit; End of Leg 1
06:30	18:00	Mobilisation	Darwin Port
18:00	24:00	Transit to Grid 2	Swath and water column data acquired; Start of Leg 2

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,395 km Transit: 829 km Total: 3,224 km	Total today: 123 km in transit
SBP	Kms	464 km	
CTDs	No	2	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	1	

Chief Scientist Daily Log 16: Saturday, 16 May 2012

Position at 2400 Lat: 12˚ 24.42' S Long: 129˚ 17.30' E

Swath mapping of Grid 2 is progressing well (180-220 line spacing ~40 min per line; 0.5-1m seas enabling a ship speed of ~9 kn), with the exception of a few software glitches. There have been no system failures since the replacement PU was installed (to the relief of many).

Preparations for sampling are advancing, with further amendments being made to our sampling acquisition schedule. Matt Carey worked throughout the day setting up various work stations in wet and dry lab areas. A sampling meeting has been scheduled for Monday afternoon to run through various protocols, roles and duties, prior to the commencement of sampling in Grid 1 on Tuesday 22 May.

A muster drill was carried out today from 11:05 – 11:25. Procedures around abandoning ship were outlined by Jason Smith (first mate), and deployment of an inflatable life raft was demonstrated. Staff have been rostered into 12 hour shifts, with a number of staff taking on short shifts in swath acquisition. All staff are generally well. However, fatigue and periodic sea sickness among some personnel is being experienced.

Weather: Fine (b1/8). Seas 0.5-1m. Wind 10kn from the south.

Intentions for next 24 hours: Continue multibeam data acquisition in Grid 2. Further refine acquisition schedule for sampling.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	02:30	Transit to Grid 2	Swath and water column data acquired
02:30	24:00	Swath mapping Grid 2	Ongoing

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,395 km Grid 2: 332 km Transit: 894 km Total: 3,621 km	Total today: 332 km in grid 2, 65 in transit
SBP	Kms	464 km	
CTDs	No	2	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	1	

Chief Scientist Daily Log 17: Sunday, 20 May 2012

Position at 2400 Lat: 12˚ 20.69' S Long: 129˚ 15.37' E

Swath mapping of Grid 2 is progressing very well (200-220 line spacing ~35-40 min per line; 9-10 kn) with the record being set today for maximum number of grid kilometres (413 km). Software glitches were resolved and there have been no multibeam system failures.

The swath mapping of Grid 2 has so far revealed a seafloor with three distinctive shoals/banks. Water depth within the grid ranges from 25-70 m, with the shoals extending from the seafloor at ~60 m water depth. Geomorphic features of the seafloor include small banks and plains. Circular to elongated pockmarks occur in a few small fields upon the plains. Further processing of the multibeam data is underway.

Processing of the backscatter data for Grid 2 is progressing well. The backscatter data indicates mainly soft substrate upon the plains with variability to harder substrates upon the shoals.

All staff are generally well. However, fatigue and periodic sea sickness among some personnel is being monitored.

Weather: Fine (b2/8). Seas 0.5-1m. Wind 6kn from the southeast.

Intentions for next 24 hours: Suspend multibeam data acquisition in Grid 2 at ~ 0300. Transit to the southern area of Grid 1 and resume swath mapping. Finalise acquisition schedule for sampling.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	24:00	Swath Mapping	Multibeam data acquisition Grid 2

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,395 km Grid 2: 745 km Transit: 894 km Total: 4,034 km	Total today: 413 km in grid 2
SBP	Kms	464 km	
CTDs	No	2	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	1	

Chief Scientist Daily Log 18: Monday, 21 May 2012

Position at 2400 Lat: 12˚ 52.68' S Long: 128˚ 52.93' E

Swath mapping of Grid 2 progressed very well in the early hours of this morning. Some data gaps over the shoals were filled in before transiting to Grid 1. Some software system glitches occurred early this morning but were resolved by Stephen Hodgkin and Mike Sexton. At 6:10, swath mapping of Grid 1 resumed with 170-175 line spacing at 8.5 kn (~1 hr per line). Despite the wind and ocean picking up today, swath mapping of Grid 1 is progressing well.

The weather forecast predicts similar to stronger winds and seas for the next two days. Vibrocoring is potentially dangerous in this weather and sampling operations during these conditions will be at the discretion of the skipper (as per all sampling activities). Alternative sampling sequences have been considered if this situation eventuates.

A sampling plan for Tuesday in Grid 1 has been finalised and distributed to all staff. The first station of the day (station 4) will be used to test grab operations and techniques, while the second station (station 5) will be used to refine towed video, grab and core operations and techniques (weather permitting).

Staff convened today to discuss roles and responsibilities for each sampling technique. All personnel are well and in good spirits – mainly due to the anticipation of our first day of sampling. Staff fatigue and periodic sea sickness will be closely monitored.

Weather: Fine (b2/8). Seas 0.5-1m. Wind 18kn from the southeast.

Intentions for next 24 hours: Suspend multibeam data acquisition in Grid 1 at ~ 0600. Transit to our first sampling area and commence sampling stations within the southern area of Grid 1. Resume swath mapping in the evening.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	03:30	Swath Mapping	Multibeam data acquisition Grid 2
03:30	06:00	Swath Mapping	Transit to Grid 1
06:10	24:00	Swath Mapping	Multibeam data acquisition Grid 1

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,680 km Grid 2: 805 km Transit: 911 km Total: 4,396 km	Total today: 285 km in grid 1; 60 km in grid 2; 17 km in transit
SBP	Kms	464 km	
CTDs	No	3	Today: 1 CTD profile acquired
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	1	

Chief Scientist Daily Log 19: Tuesday, 22 May 2012

Position at 2400 Lat: 12˚ 53.15' S Long: 128˚ 55.60' E

Swath mapping of Grid 1 progressed well in the early hours of this morning, despite high winds and seas, with 170 line spacing at 8.5 kn (~1 hr per line). However, at ~ 06:00 we experienced a multibeam system failure. For six hours staff (Justy, Mike, Steve, Matt and Ian) troubleshooted the problem and by midday multibeam acquisition had re-commenced. The problem appears to be associated with the PC's port connection to the Grid Engine. Ian Atkinson has e-mailed through a number of suggestions as to how this issue might be resolved, which will be trialled early tomorrow morning following the completion of multibeam acquisition in Grid 1.

Station sampling was postponed today due to high winds (15-25 kn with 30 kn gusts) and seas (2-3 m, with 1.5-2m swell). The implication of this set-back has resulted in the loss of one full sampling day. A sampling plan for Wednesday in Grid 1 has been finalised and handed to all relevant on-board staff.

All personnel are generally well although sea sickness and fatigue were experienced by a number of staff mainly due to the rough weather and disrupted sleep patterns. Staff health will be closely monitored.

Weather: Fine (b2/8). Seas 0.5-1m. Wind 13kn from the south. The weather over the next two days may potentially compromise sampling activities with 2-2.5 m seas and high winds predicted for Thursday (SE 15-25 kn) and Friday (SE 20-30 kn).

Intentions for next 24 hours: Complete multibeam data acquisition in Grid 1 at ~ 2400. Conduct troubleshooting procedures on multibeam system while in transit to swath area. At 07:30 commence sampling. Acquire sub-bottom profile data in the evening.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	06:00	Swath Mapping	Multibeam data acquisition Grid 1
06:00	12:00	Multibeam Failure	Bad weather – no sampling
12:00	24:00	Swath Mapping	Multibeam data acquisition Grid 1

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,976 km (complete) Grid 2: 805 km Transit: 911 km Total: 4,692 km	Total today: 296 km in grid 1. Grid 1 complete.
SBP	Kms	464 km	
CTDs	No	3	
Vibro Cores	No	-	
Grabs	No	-	
Dredges	No	-	
Tow-Video	Kms	1	

Chief Scientist Daily Log 20: Wednesday, 23 May 2012

Position at 2400 Lat: 12˚ 47.56' S Long: 128˚ 52.81' E

Swath mapping in Grid 2 progressed well during the early hours of this morning, with several data holes filled across the southern survey area. At ~ 06:00 we commence our transit back to Grid 1 to initiate sampling at ~ 08:00.

The four sampling stations planned for today were completed over a period of ~10 hours. Vibrocore operations did not commence until midday, due to issues connecting equipment to the frame. Stations were located in the northern to central part of the sampling area and yielded excellent physical samples (sediments and biology). Of the seven vibrocores attempted, six recovered cores, which ranged from 0.34 m to 3.71 m in length. Sediments in the core were dominated by mud and in one case medium to coarse sand. Sedimentology samples from grabs reveal dominantly muddy sands with some fine- to coarse-grained carbonate sand fractions.

A sampling plan for Thursday 24/5 in Grid 1 was finalised and distributed to all relevant on-board staff. Due to inclement weather only our highest priority sampling sites are presently being targeted. At ~ 20:20 we commenced sub-bottom profile acquisition in Grid 1.

All personnel are generally well and in good spirits after a productive day of sampling and completing multibeam acquisition in Grid 1.

Weather: Fine (b5/8). Seas 0.5-1.m. Wind 10kn from the south. The weather forecast predicts stronger winds and seas over the next two days.

Intentions for next 24 hours: Sparker during the early hours of Thursday morning. At 07:30 retrieve sparker and resume sampling in Grid 1. At ~ 22:00 deploy sparker for overnight sub-bottom profile data acquisition.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	06:00	Swath Mapping	Multibeam data acquisition Grid 2
06:00	08:00	Swath Mapping	Transit from Grid 2 to Grid 1
08:00	18:30	Sampling Grid 1	Four priority stations completed
20:22	24:00	Sparker	Sub-bottom profile acquisition Grid 1

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,976 km (complete) Grid 2: 839 km Transit: 1,009 km Total: 4,824 km	Total today: 34 km in Grid 2; 98 km in transit.
SBP	Kms	494 km	Acquired ~30 km today
CTDs	No	5	2 CTD's completed today (3 Niskin per STN)
Vibro Cores	No	6	6 VCs completed today
Grabs	No	12	Smith Mac; 12 grabs completed today; 3 grabs per station
Dredges	No	-	
Tow-Video	Kms	4	3 towed video's today, 500 km per STN

Chief Scientist Daily Log 21: Thursday, 24 May 2012

Position at 2400 Lat: 12˚ 38.80' S Long: 128˚ 48.64' E

Sparker acquisition in Grid 1 progressed well during the night, acquiring some longitudinal lines. Some inventive manoeuvres were deployed to circumnavigate around the MV *Duke*, who was in the southern part of Grid 1. Sparker acquisition commenced again at 21:30 hours

Over a period of 14 hours, nine sampling stations were successfully sampled today, two of which were revisited stations from yesterday. Stations were located in the central to southern part of the sampling area. Vibrocore operations commenced in the morning but were called off after two stations due to weather conditions effecting recovery rates. Only one vibrocore (0.59 m in length) was recovered in the morning, as high seas and winds kept pushing over the vibrocore on the seafloor. Despite the slightly rough weather, sampling operations continued throughout the day and into the early evening with towed video, CTD and grabs being successfully deployed and retrieved. Some equipment issues have arisen, like difficulties with the still camera and the USBL not functioning. Sedimentology samples from grabs revealed mud or sandy mud with whole shells and shell fragments. Towed video reveals a seafloor of sandy mud with sparse benthos. In the late afternoon, conditions had calmed sufficiently to deploy the vibrocore and two cores were successfully recovered (2.37 m and 1.92 m in length). Cores were muddy with coarser sand in the top 40 cm. No pore water was recovered from the sampled geochemistry core. At 21:30, sub-bottom profile acquisition commenced again in Grid 1.

The weather forecast predicts stronger winds and seas for Friday (15-25 kn) with high winds (30 kn) forecast for Saturday and Sunday. Vibrocoring is potentially dangerous in this weather and sampling operations during these conditions will be at the discretion of the skipper (as per all sampling activities). Alternative sampling sequences have been considered if this situation eventuates.

All personnel are generally well and in good spirits after another productive day of sampling and completing multibeam acquisition in Grid 1.

Weather: Fine (bC 5/8). Seas 1.5-2m. Wind 15 kn from the SSE.

Intentions for next 24 hours: Sparker during the early hours of Friday morning. At 07:30 retrieve sparker and resume sampling in Grid 1. Due to inclement weather only our highest priority sampling sites are presently being targeted. Some stations will need to be revisited due to the lack of vibrocoring today. At ~ 22:00 deploy sidescan for some overnight acquisition followed by further sub-bottom profile data acquisition.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	07:00	Sparker	Sub-bottom profile acquisition Grid 1
07:30	21:20	Sampling	9 priority stations undertaken
21:30	24:00	Sparker	Sub-bottom profile acquisition Grid 1

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,976 km (complete) Grid 2: 839 km Transit: 1,009 km Total: 4,824 km	
SBP	Kms	Grid 1: 565 km	~70 km completed today
CTDs	No	10	5 CTD's completed today (3 samples per STN)
Vibro Cores	No	9	3 VCs completed today
Grabs	No	31	Smith Mac; 19 grabs completed today; ~3 grabs per station
Dredges	No	-	Incompatible with VC on rear deck
Tow-Video	Kms	11	7 towed video's today, 500 km per STN

Chief Scientist Daily Log 22: Friday, 25 May 2012

Position at 2400 Lat: 12˚ 54.2376' S Long: 130˚ 08.3264' E

Sparker acquisition in Grid 1 progressed well during the night, acquiring the final section of longitudinal lines and some remaining latitudinal lines in the northern section of the survey area. The weather deteriorated badly during the early morning, so data quality on the last sparker line will need to be tested during processing. In the early hours of this morning, swath mapping just north of Grid 1 commenced for one line. The quality of this line is questionable however, due to the high pitch and roll experienced during its acquisition. Data quality will be assessed during processing.

Station sampling was postponed today due to high winds (25-35 kn) and seas (2-3 m, with 2m swell). After discussions with RV *Solander's* skipper this morning, a decision was made to take shelter close to the coast, until the weather improves. High winds and seas are forecast until Sunday, so the ship may be at anchor until then. The implication of this set-back has resulted in the loss of at least two, possibly three, full sampling days. Station sampling will therefore be revised again with only the highest priority sites being targeted.

All personnel are generally well although fatigue was experienced by several staff members mainly due to disrupted sleep patterns from the rough weather.

Weather: At 0900: Fine (b 1/8). Seas 2-3m with 2m swells. Wind 25-35kn from the SE. At 16:50: Cloudy (c 1/8): Wind 18kn from the SE.

Intentions for next 24 hours: Remain at anchor at Point Blaze, until the weather improves. A list of highest priority sampling sites in Grids 1 and 2 will be devised.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	06:00	Sparker	Sub-bottom profile acquisition Grid 1
06:00	07:00	Swath Mapping	Multibeam data acquisition Grid 1
07:00	08:00	Transit to Grid 2	
08:00	16:00	Transit to safe anchor	Decision made to take shelter close to coast
16:00	24:00	Anchor	Location: ~3km off Point Blaze

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,995 km (complete) Grid 2: 839 km Transit: 1,019 km Total: 4,853 km	Total today: 19 km in Grid 1, ~10 km in transit. Weather turned bad and swath acquisition ceased.
SBP	Kms	Grid 1: 625 km	~60 km completed today
CTDs	No	10	
Vibro Cores	No	9	
Grabs	No	31	
Dredges	No	-	
Tow-Video	Kms	11	

Chief Scientist Daily Log 23: Saturday, 26 May 2012

Position at 2400 Lat: 12˚ 54.2376' S Long: 130˚ 08.3264' E

Further revisions were made to our Grid 2 sampling acquisition plan, following feedback from GA headquarters. Of the 18 potential sampling stations identified within the survey area, four to seven high priority stations will be targeted (weather permitting). We have approximately 18 hours of swath mapping and 19 hours of sub-bottom profile data acquisition remaining in Grid 2. The towed video system was tested this afternoon to ascertain the problem associated with still capture. Faulty batteries appear to have been the issue and the towed video system is now functioning well. High winds and seas are forecast through to Monday 28 May. All personnel are rested, in good spirits and eager to resume survey activities.

Weather: At 1600: Fine (c 6/8). Wind 14kn from the SE.

Intentions for next 24 hours: Remain at anchor at Point Blaze, until the weather improves. Continue revising sampling plan for Grid 2. Laboratory activities; shipboard database entry; sample transportation preparation; data processing.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	24:00	Anchor	Location: ~3km off Point Blaze

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,995 km (complete) Grid 2: 839 km Transit: 1,019 km Total: 4,853 km	
SBP	Kms	Grid 1: 625 km	
CTDs	No	10	
Vibro Cores	No	9	
Grabs	No	31	
Dredges	No	-	
Tow-Video	Kms	11	

Chief Scientist Daily Log 24: Sunday, 27 May 2012

Position at 2400 Lat: 12˚ 54.2376' S Long: 130˚ 08.3264' E

Staff were kept busy today with shipboard database entry, laboratory activities and data processing. A revised sampling acquisition plan for the remaining 3 days of survey was outlined. However, the realisation of this plan is now highly dependant on prevailing weather conditions. Due to time limitations, BRUV sampling has been removed from the sampling plan, with remaining time delegated to swath/sparker acquisition, mooring recovery and sampling activities at priority stations in Grids 1 and 2.

Following discussions with RV *Solander's* skipper a decision was made to depart early Monday morning for Grid 2. Strong winds (20-30kn), are predicted to ease slightly in the afternoon (15-25kn), which will coincide with our arrival at the survey area. All personnel are rested and in good spirits and eager to resume survey activities.

Weather: At anchor Point Blaze 1600: Fine (c 6/8). Wind 6kn from the SE.

Weather forecast
Monday: SE winds 20-30kn, easing to 15-25kn in the afternoon. Seas 2-3m with 2m swell offshore
Tuesday: SE winds15-25kn. Seas 2-3m, with 2m swell offshore
Wednesday: SE winds15-25kn. Seas 2-3m, with 2m swell offshore

Intentions for next 24 hours: Depart Point Blaze at 07:30 and transit to Grid 2. Should weather allow commence sampling in Grid 2; alternatively resume multibeam acquisition.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	24:00	Anchor	Location: ~3km off Point Blaze

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,995 km (complete) Grid 2: 839 km Transit: 1,019 km Total: 4,853 km	
SBP	Kms	Grid 1: 625 km	
CTDs	No	10	
Vibro Cores	No	9	
Grabs	No	31	
Dredges	No	-	
Tow-Video	Kms	11	

Chief Scientist Daily Log 25: Monday, 28 May 2012

Position at 2400 Lat: 12˚ 20.18' S Long: 129˚ 13.98' E

At 07:30 we departed Point Blaze for Grid 2. Regrettably high winds and seas upon arrival at the survey area (~13:00) were unfavourable for sampling. Multibeam acquisition resumed at 13:20, progressing throughout the afternoon and evening (180-130 line spacing, 7-8.5 kn).

In the afternoon, problems with the vacuum toilets arose, which were compounded by the rough weather. This resulted in a foul smell throughout the accommodation deck. RV *Solander*'s crew are currently addressing the problem.

All personnel are generally well. However, rough weather has again resulted in staff fatigue and seasickness among some staff, both of which are being closely monitored. Morning tea remains highly regarded.

Weather: Fine (c 6/8). Wind 23kn from the SE. *
* Please note: this and all previous weather notations derived from RV *Solander*'s Logbook entry at 2400 each evening. A copy of the ships daily logs (including hourly weather details) have been supplied courtesy of RV *Solander*'s Master.

Weather forecast
Tuesday: SE winds 15-25kn, easing to 15kn in the afternoon. Seas 1.5-2.5m with 1.5m swell
Wednesday: SE winds 15-20kn. Seas 1.5-2.5m with 1.5m swell
Thursday: SE winds 15-20kn. Seas 1.5-2.5m with 1.5m swell
Intentions for next 24 hours: Complete multibeam acquisition in Grid 2 ~ 09:00-12:00. Should weather allow, commence sampling within Grid 2 survey area and retrieve mooring. Sparker acquisition in the evening (weather permitting).

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	07:30	Anchor	Location: ~3km off Point Blaze
07:30	13:00	Transit to Grid 2	Multibeam acquired
13:20	24:00	Swath Mapping	Multibeam acquisition Grid 2

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,995 km (complete) Grid 2: 1,034 km Transit: 1,117 km Total: 5,146 km	Total today: 98 km transit; 195 km in grid 2
SBP	Kms	Grid 1: 625 km	
CTDs	No	10	
Vibro Cores	No	9	
Grabs	No	31	
Dredges	No	-	
Tow-Video	Kms	11	

Chief Scientist Daily Log 26: Tuesday, 29 May 2012

Position at 2400 Lat: 12˚ 25.90' S Long: 129˚ 12.79' E

Multibeam acquisition progressed well overnight and into the early hours of this morning (130 line spacing, 8-9kn). Unfortunately today's weather was inappropriate for sampling (25-30kn south-easterly winds; Seas 1.5-2.5m with 1.5-2m swell) or sub-bottom profile acquisition. Hence, swath mapping of Grid 2 continued throughout the morning and early afternoon, until acquisition within the survey area was complete (~15:00).

At 16:00 'Big Jim' mooring 1 in Grid 2 was successfully retrieved. There was some concern that an unsuccessful recovery attempt could result in a potential hazard for the MV *Duke*. The MV *Duke* was contacted to confirm their position and inform them of our intension to retrieve our mooring, located in approximately 30m water depth on the south-western shoal of our survey area. The MV *Duke* has since been informed of our successful retrieval.

An additional line of multibeam along the southern boundary of Grid 2 was acquired in the late afternoon. By 19:30 winds had eased to ~ 15kn from the southeast and deemed calm enough to deploy the sparker for overnight data acquisition. There was a minor technical problem during set up, which was quickly resolved by Stephen Hodgkin. The sparker system was successfully deployed and acquisition began. Three lines (each ~10 km long; ~1.5 km spacing) were successfully acquired by midnight (ship speed 5-5.5 kn).

All personnel are generally well and in good spirits after completing swath mapping in Grid 2 and successfully retrieving Big Jim.

Weather: Cloudy (c 6/8). Wind 21kn from the SE. *
* Please note: this and all previous weather notations derived from RV *Solander'*s Logbook entry at 2400 each evening. A copy of the ships daily logs (including hourly weather details) have been supplied courtesy of RV *Solander'*s Master.

Intentions for next 24 hours: Continue sub-bottom profile acquisition in Grid 2 until ~ 09:00 Wed 30/05. Transit to Grid 1 to retrieve second mooring around slack tide (~12:00). Transit back to Grid 2 and, depending on weather and time, commence sampling and/or sparker acquisition prior to departing our survey area at 18:00 for Darwin Port (ETA Darwin ~07:00 Thurs 31 May).

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	15:00	Swath Mapping	Multibeam acquisition Grid 2 complete
15:00	17:00	Mooring retrieval – Grid 2	Big Jim successfully recovered
17:30	19:00	Swath Mapping	Extra line southern area Grid 2
19:30	24:00	Sparker	Sub-bottom profile acquisition – Grid 2

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,995 km (complete) Grid 2: 1,312 km (complete) Transit: 1,168 km Total: 5,475 km	Total today: 278 km in grid 2; grid 2 complete; 51 km in transit (includes sparker lines); Grid 2 complete
SBP	Kms	Grid 1: 625 km Grid 2: 30 km	~30 km acquired in Grid 2
CTDs	No	10	
Vibro Cores	No	9	
Grabs	No	31	
Dredges	No	-	
Tow-Video	Kms	11	

Chief Scientist Daily Log 27: Wednesday, 30 May 2012

Position at 2400 *Lat: 12˚ 21.72' S* *Long: 129˚ 58.51' E*

From 24:00 to 08:15, six Sparker lines (each ~10 km long, 1.5 km line spacing) were successfully acquired. Preliminary processing of sparker lines has shown that the penetration of the sparker over the hard banks is minimal. Further processing may clear the section up further.

At 11:00 the ACDP (mooring 2) in Grid 1 was successfully retrieved.

Sampling operations in Grid 2 did not commence until 15:45 due to transiting time to and from Grid 1. One sampling station, located on the eastern bank in Area 2, yielded minimal physical samples (sediments and biology). The sedimentology sample from the grab revealed muds with a heavy coarser fraction that included large whole shells. Towed underwater video revealed a seafloor of sandy mud with sparse benthos.

Three additional lines of multibeam along the southern boundary of Grid 2 were acquired in the early evening. Departed Grid 2 at 20:30 on time with all personnel in good spirits.

All personnel are well and in good spirits following the successful retrieval of our second mooring and the completion of Leg 2.

Weather: Fine (b 1/8). Wind 12 kn from the S.

Intentions for next 24 hours: Continue transit to Darwin Port (ETA Darwin ~06:00 Thurs 31 May). Demobilise 06:00 to late afternoon.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	08:15	Sparker	Sub-bottom profile acquisition – Grid 2
08:30	11:15	Transit to Grid 1	Swath mapping acquired
11:15	12:30	Mooring retrieval – Grid 1	ADCP successfully recovered
12:30	16:00	Transit to Grid 2	Swath mapping acquired
16:00	17:30	Sampling	1 priority station undertaken
17:30	20:30	Swath Mapping	Extra lines southern area Grid 2
20:30	24:00	Transit to Darwin Port	Swath mapping acquired. Transit to Darwin Port – End Leg 2

Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,995 km (complete) Grid 2: 1,344 km (complete) Transit: 1,423 km Total: 5,762 km	Total today: 32 km in grid 2 and 255 km in transit
SBP	Kms	Grid 1: 625 km Grid 2: 90 km	~60 km acquired in Grid 2
CTDs	No	12	2 CTDs completed today (6 niskin bottles for 1 STN)
Vibro Cores	No	9	
Grabs	No	33	Smith Mac: 2 grabs completed today (only 5% recovery)
Dredges	No	-	
Tow-Video	Kms	13	2 towed video's today, 500 km per tow

Chief Scientist Daily Log 28: Thursday, 31 May 2012

Position at 2400 Lat: Darwin Port Long: Darwin Port

Arrived at Darwin Port on time at 0600 with all personnel in good spirits. Successful demobilisation of equipment and samples completed by 1930.

Weather: Fine (b 1/8). Wind 12 kn from the S.

Intentions for next 24 hours: Most staff fly back to Canberra. Final demobilisation details to be concluded by select staff tomorrow.

Activity Log

START TIME	END TIME	ACTIVITY	COMMENT
00:00	06:00	Transit to Darwin Port	Swath mapping acquired. Transit to Darwin Port – End Leg 2
06:00	19:30	Darwin Port	Demobilisation

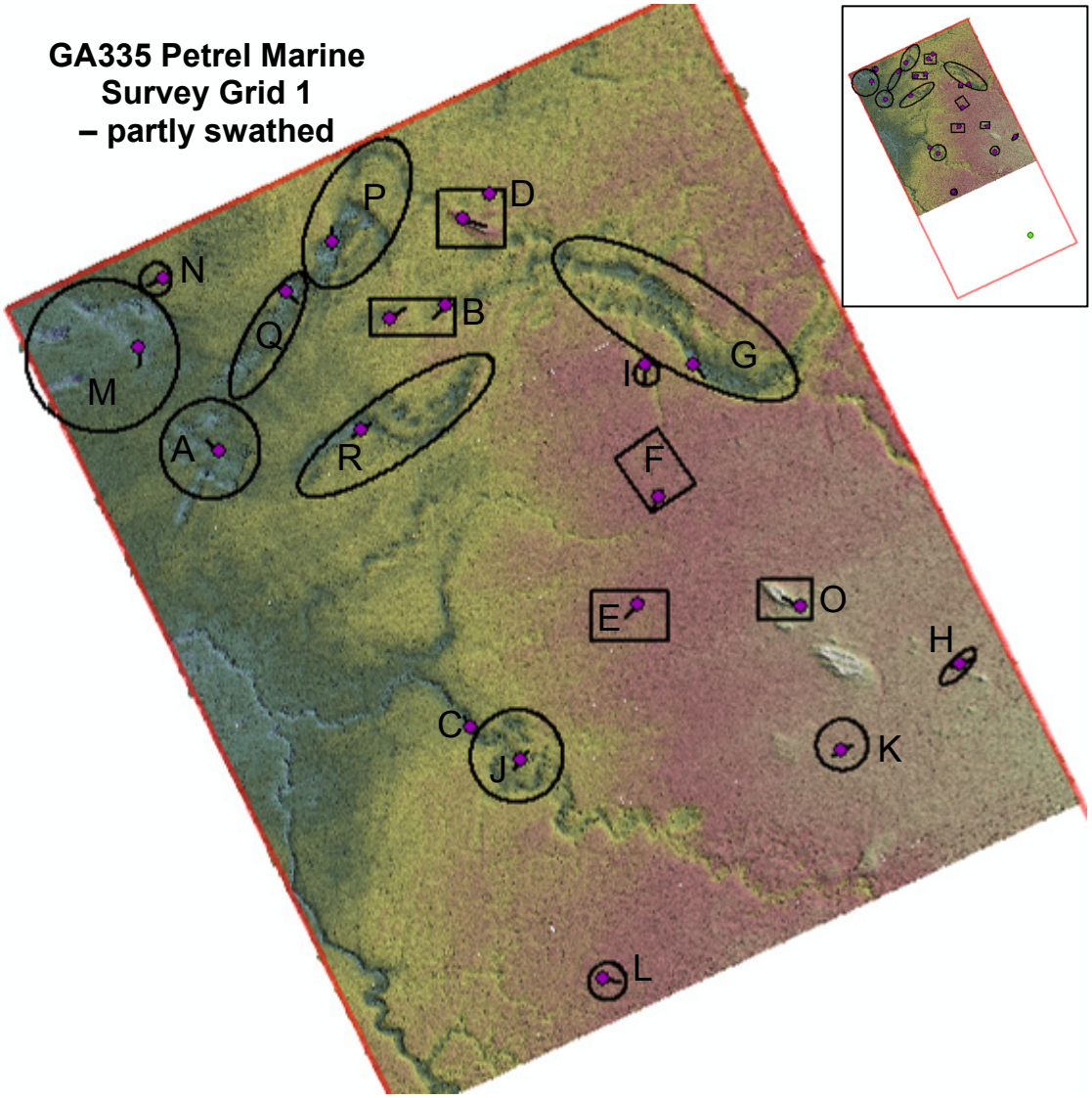
Survey Data Collection Totals at 2400

DATA TYPE	UNITS	TOTAL AMOUNT	COMMENT
Swath	Kms	Grid 1: 2,995 km (complete) Grid 2: 1,344 km (complete) Transit: 1,521 km Total: 5,860 km	Total today: 98 km in transit
SBP	Kms	Grid 1: 625 km Grid 2: 90 km	
CTDs	No	12	
Vibro Cores	No	9	
Grabs	No	33	
Dredges	No	-	
Tow-Video	Kms	13	

Appendix C. Sampling Station Selection

SAMPLE SITE SELECTION ON BOARD the PETREL SUB-BASIN MARINE ENVIRONMENTAL SURVEY SOL5463

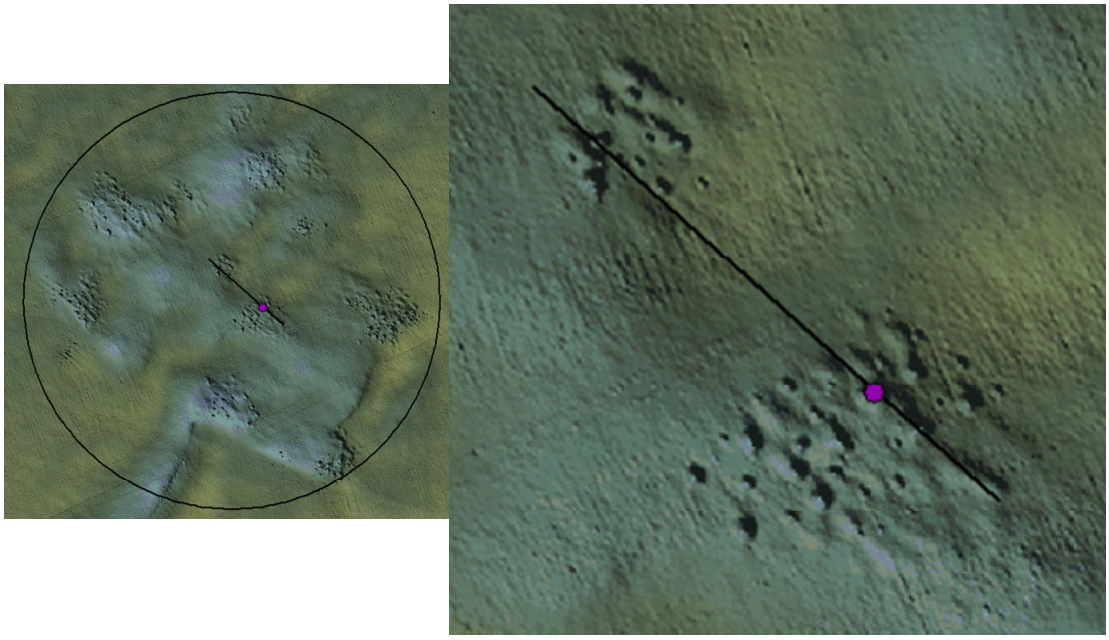
These preliminary sample site selections were prepared on-board the RV *Solander* by Diane Jorgensen and Andrew Carroll as geophysical datasets were made available to staff. Site selection and sampling activities were further refined by discussions with Tony Nicholas, Scott Nichol, Rachel Przeslawski and Anna Potter, who were located at GA headquarters in Canberra.

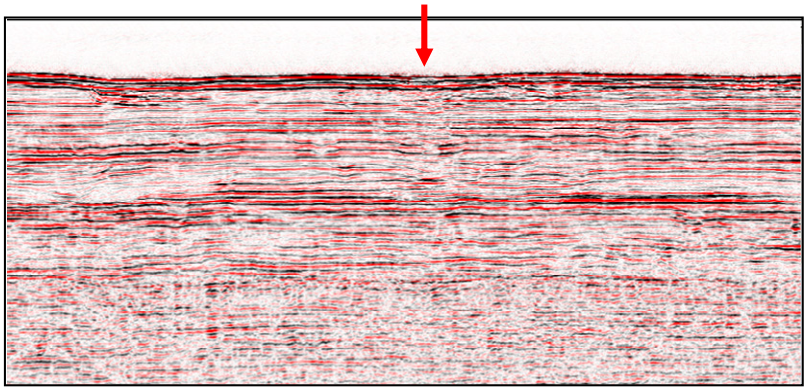


Current number of Potential Stations: 20
17 Core Stations
3 Non-Core Stations (D2, L & K)

NB: Orientation of towed camera video subject to weather, drift, current, tide, etc.

GA335 Petrel Marine Survey Grid 1 – sampling area A, 1 station





Area A

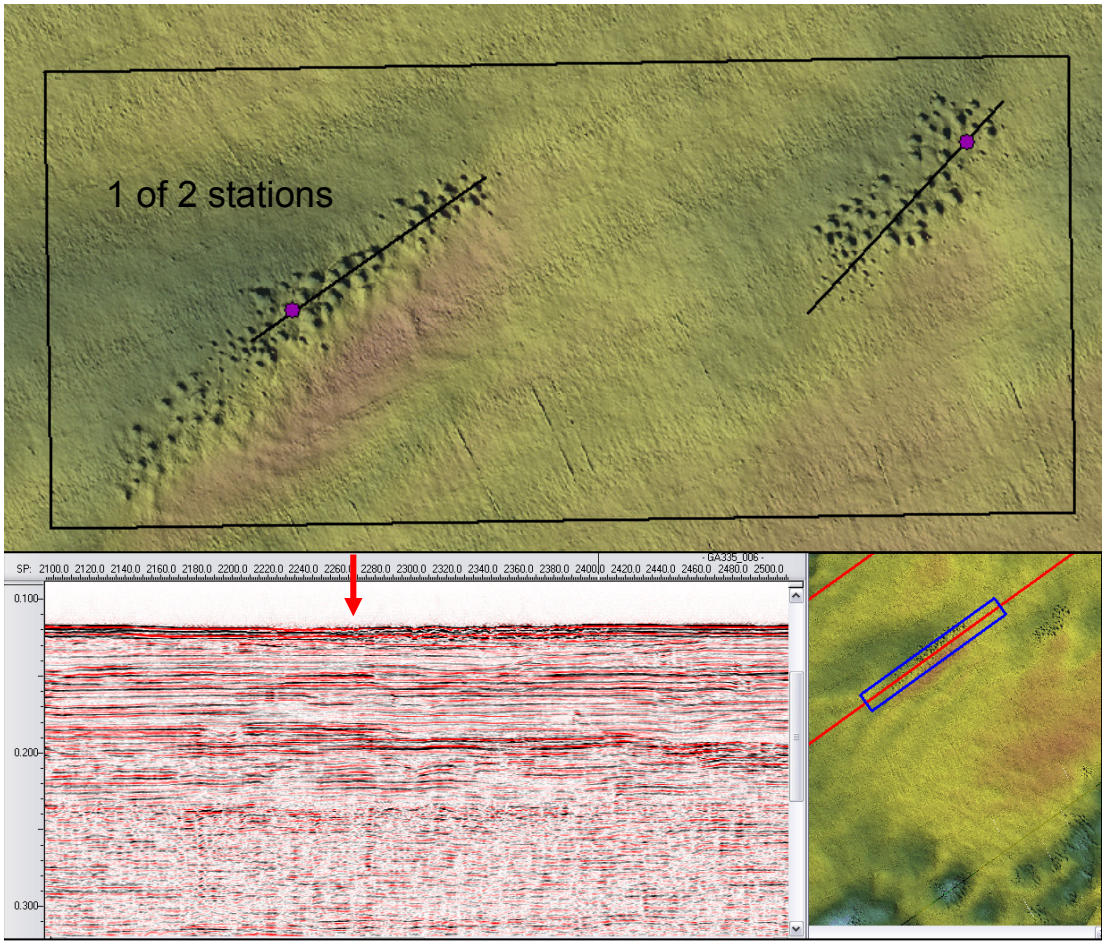
Location: Point: -12 41.21 128 48.647
Video SOL: -12 41.076 128 48.497
Video EOL: -12 41.258 128 48.702

Sparker line: GA335_006

Site rationale: highest priority, shallow seafloor depression with pockmarks. Sparker line shows potential migration pathway to seafloor.

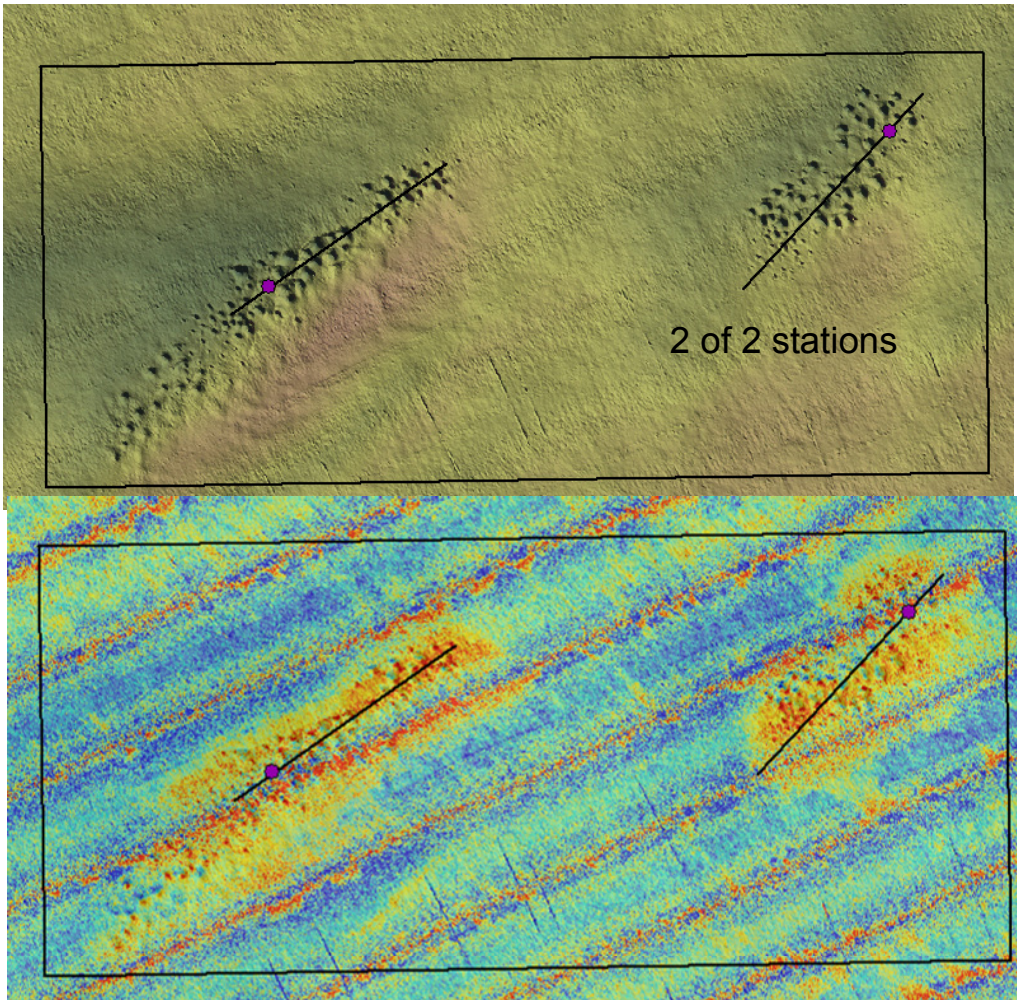
Samples: "full station"
1 x Video Tow
1-2 x Grab (biology/sediment) (# TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area B, 1 of 2 stations



Area B
Location over west pockmark field (1 station):
Point: -12 39.691 128 50.618
Video SOL: -12 39.562 128 50.802
Video EOL: -12 39.72 128 50.578
Sparker line: GA335_006
Site rationale: highest priority, linear pockmark field. Sparker line shows distortion below seafloor and potential migration pathways to pockmarks.
Samples: "full station"
1 x Video Tow
1-2 x Grab (biology/sediment) (# TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area B, 2 of 2 stations



Area B

Location over east pockmark field (1 station):

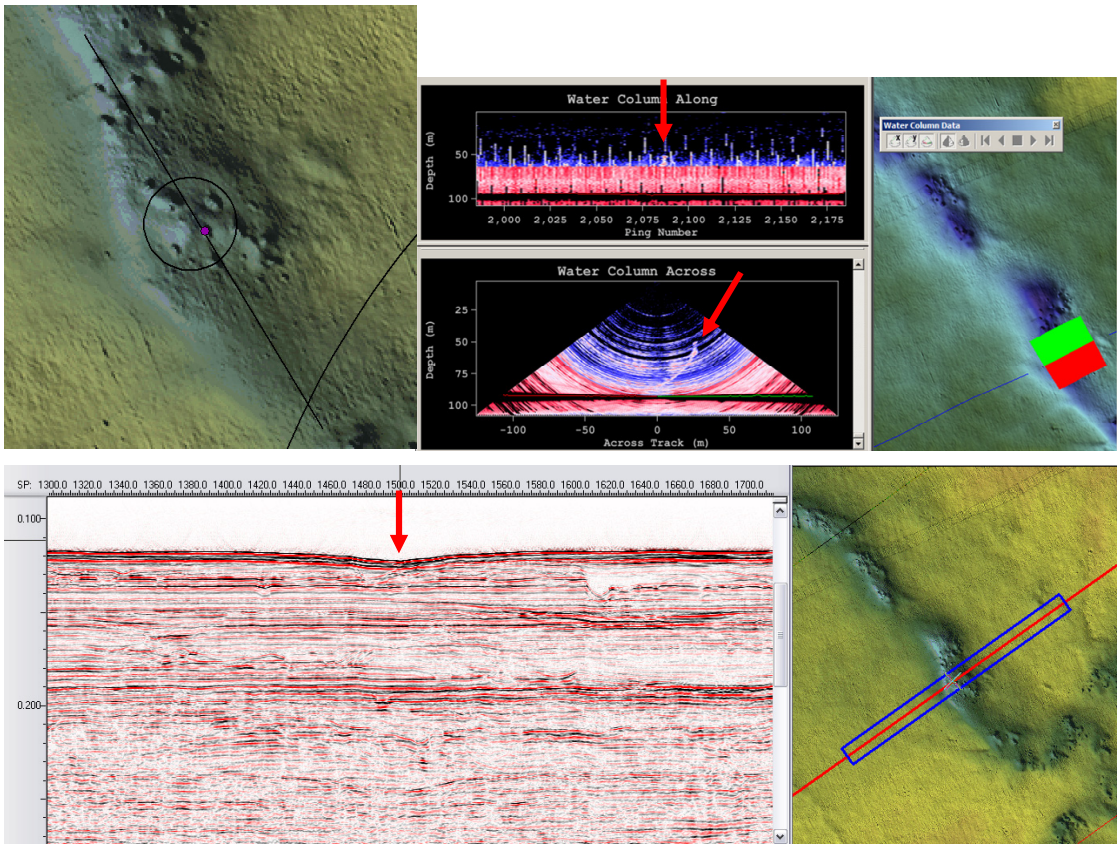
Point: -12 39.53 128 51.261
Video SOL: -12 39.491 128 51.296
Video EOL: -12 39.693 128 51.108

Site rationale: highest priority, linear pockmark field with different size pockmarks. Backscatter shows harder substrate over pockmark fields.

Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area C, 1 station



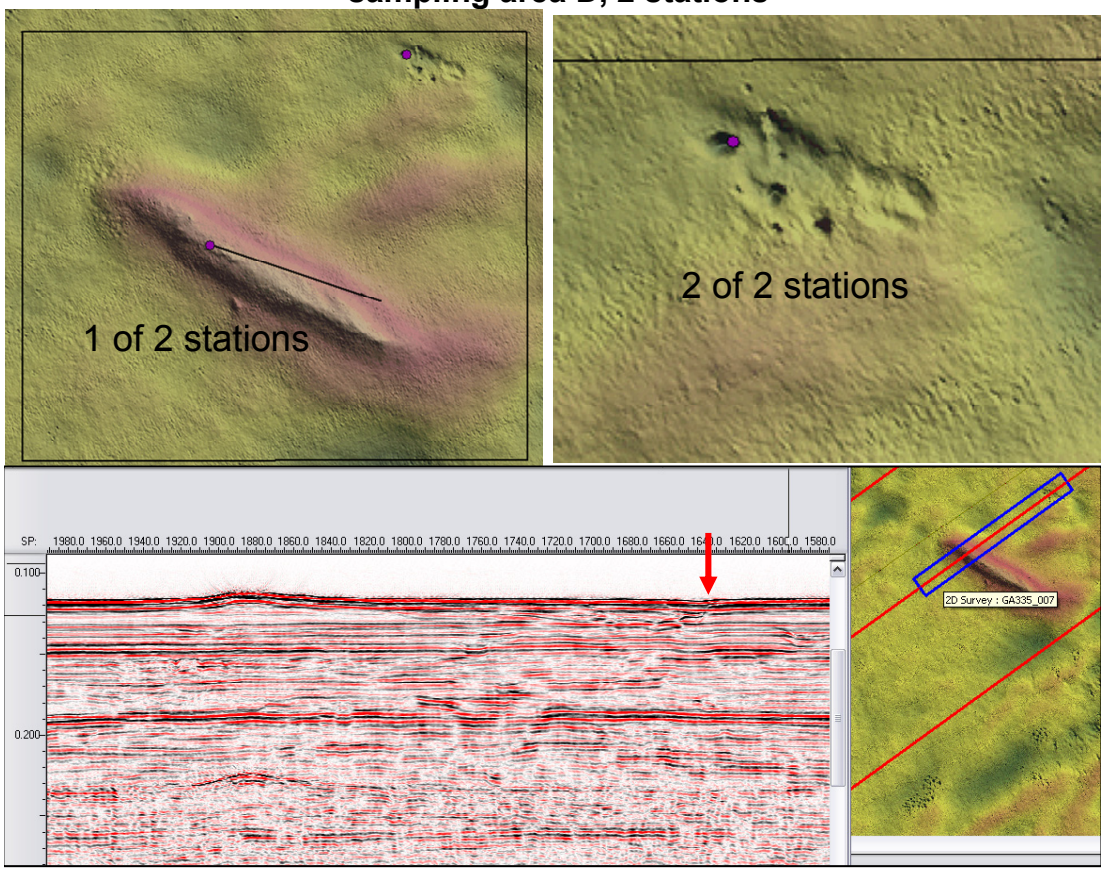
Area C
Location:

Point: -12 44.371 128 51.536
Video SOL: -12 44.492 128 51.608
Video EOL: -12 44.251 128 51.462

Sparker line: GA335_011
Site rationale: high priority, pockmark field in small channel with potential seep signature in water column data. Sparker line shows distortion below seafloor.
Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area D, 2 stations



Area D

Location over dune (1 station):

Point: -12 38.549 128 51.455
Video SOL: -12 38.547 128 51.449
Video EOL: -12 38.636 128 51.717

Location over pockmarks (1 station):

Point: -12 38.259 128 51.757

Sparker line: GA335_007

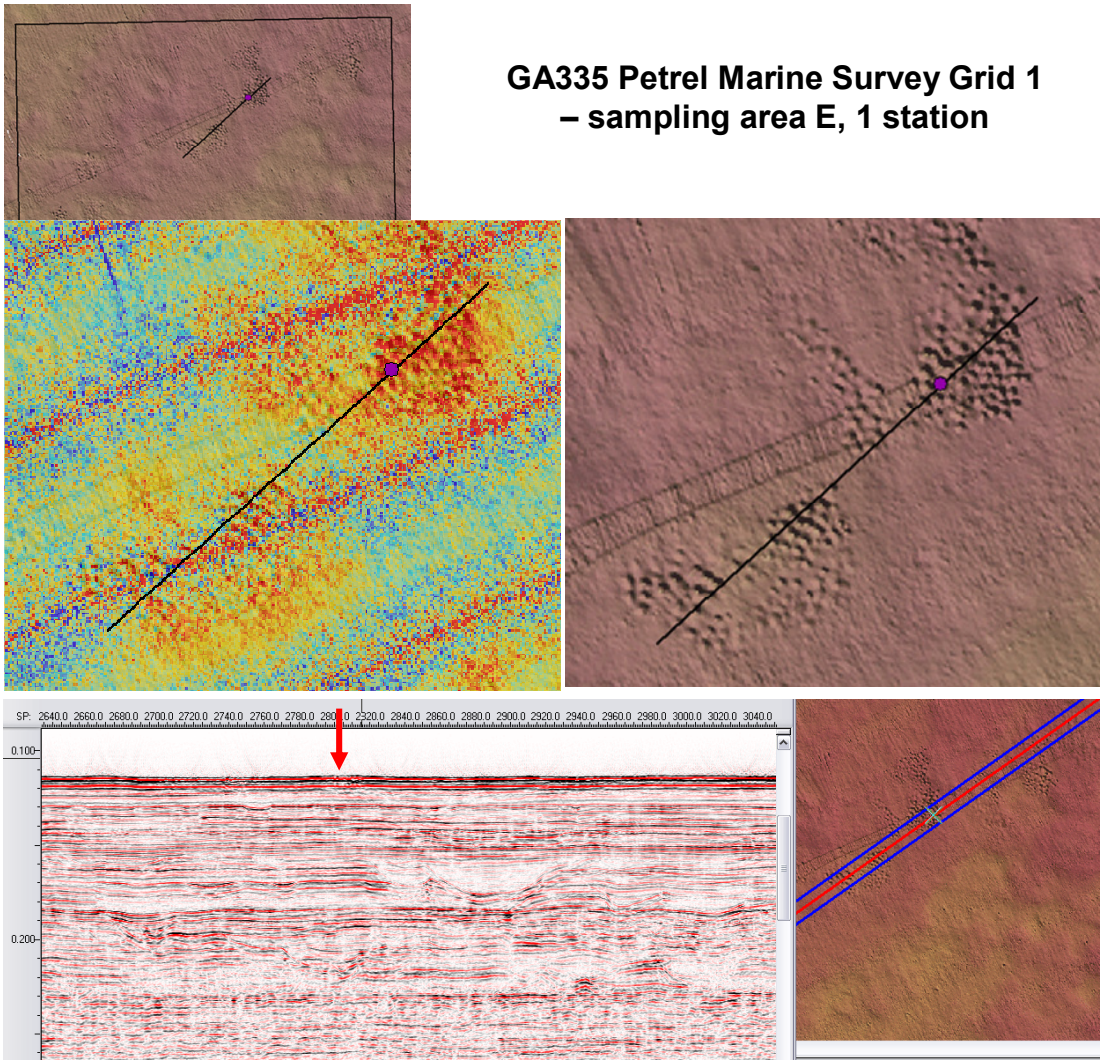
Site rationale: high priority, shallow seafloor depression with pockmarks and sand dune (~4-5 m high). Sparker line shows potential migration pathway to pockmarks.

Samples over dune:

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)

Samples over pockmarks:

1 x Grab (chemistry)
1-2 x Grab (biology/sediment) (TBC)
2 x Vibracore
1 x CTD



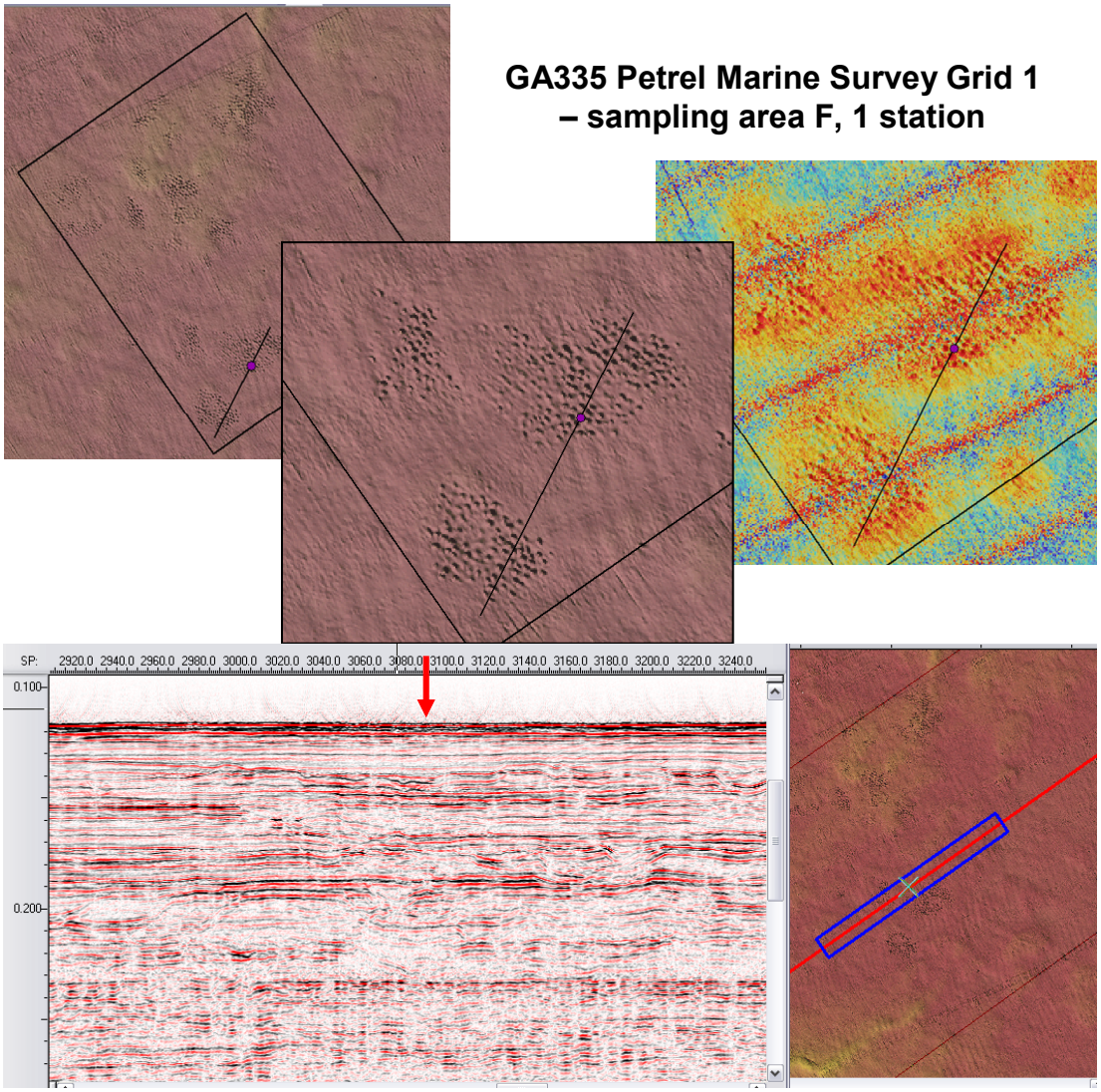
GA335 Petrel Marine Survey Grid 1 – sampling area E, 1 station

Area E
Location:

Point: -12 42.977 128 53.465
Video SOL: -12 43.1160 128 53.3130
Video EOL: -12 42.9300 128 53.5160

Sparker line: GA335_011
Site rationale: medium priority, pockmark field. Sparker line shows distortion below seafloor and potential migration pathways to pockmarks.
Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

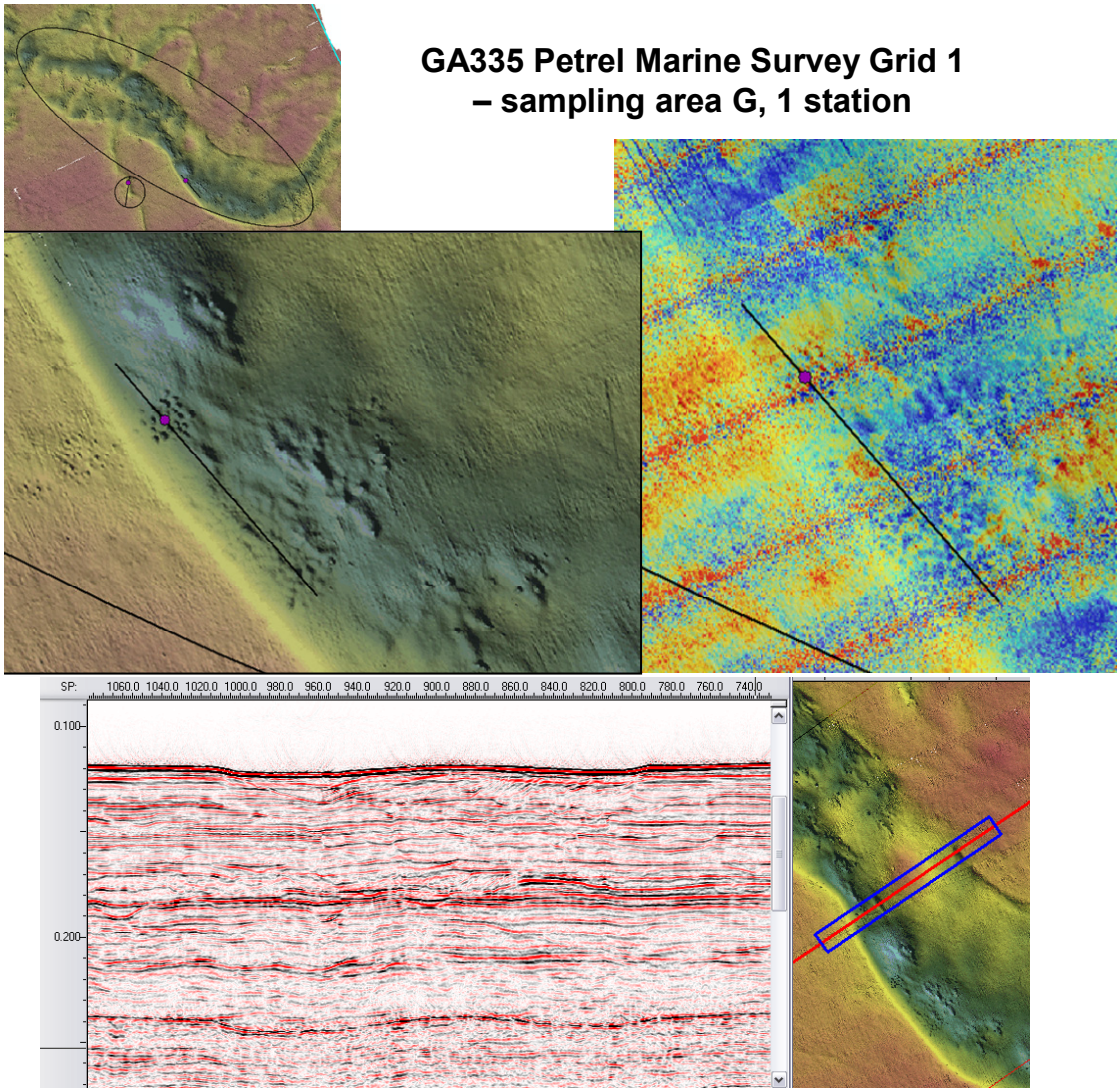


Area F
Location:

Point: -12 41.73 128 53.696
Video SOL: -12 41.6460 128 53.7380
Video EOL: -12 41.8880 128 53.6150

Sparker line: GA335_009
Site rationale: medium priority, pockmark fields. Sparker line shows distortion below seafloor and potential migration pathways to pockmarks.
Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD



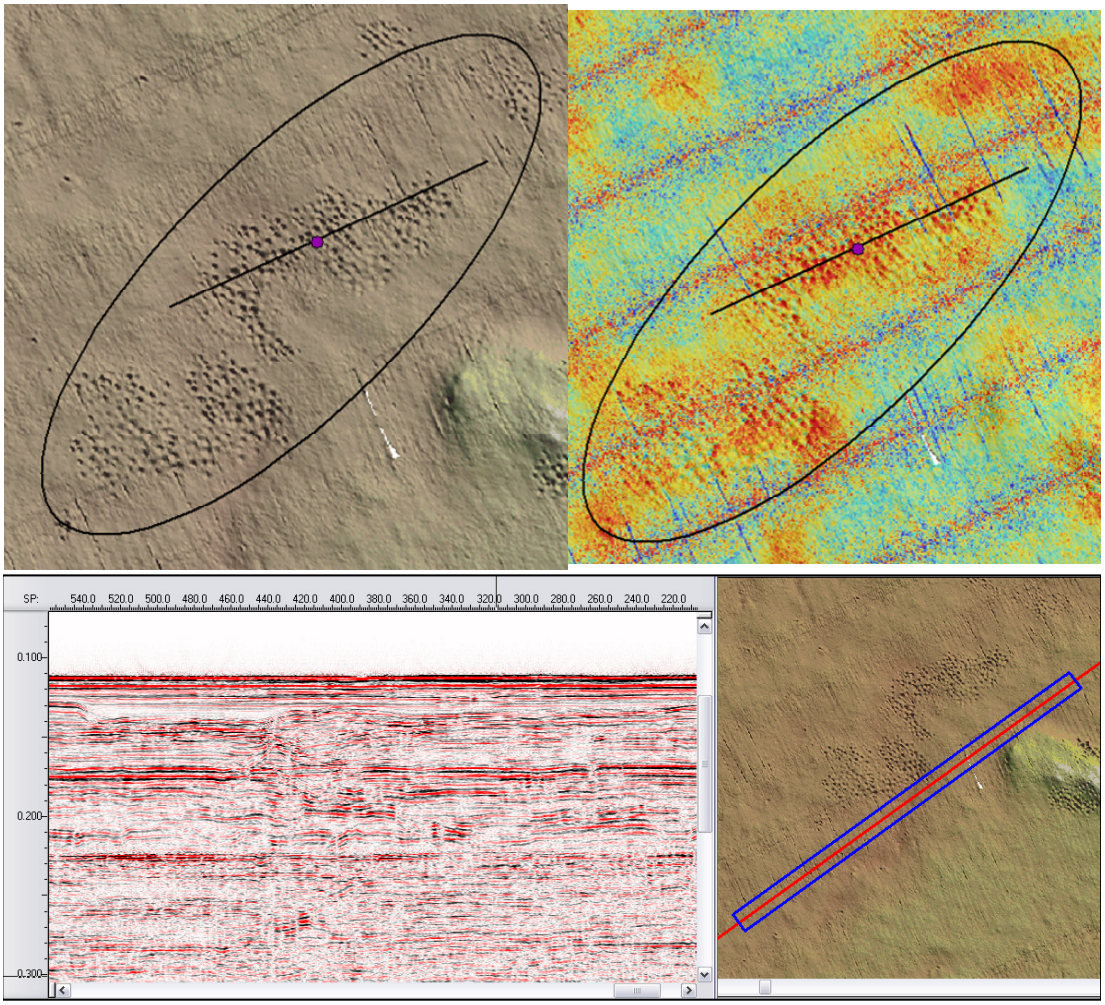
Area G
Location:

Point: -12 40.208 128 54.092
Video SOL: -12 40.156 128 54.046
Video EOL: -12 40.368 128 54.229

Sparker line: GA335_003
Site rationale: medium priority, pockmark fields in channel.
Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area H, 1 station



Area H

Location:

Point: -12 43.65 128 57.155
Video SOL: -12 43.584 128 57.293
Video EOL: -12 43.702 128 57.036

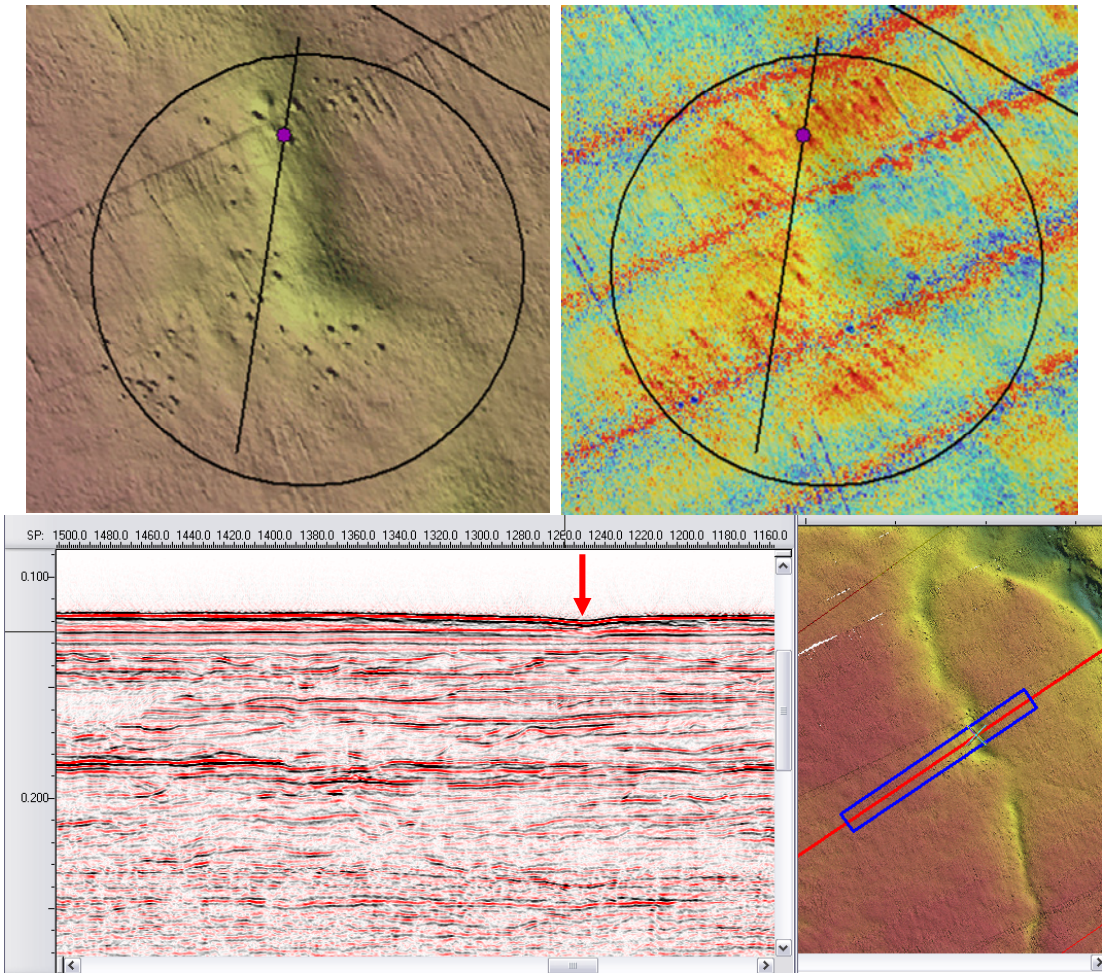
Sparker line: GA335_016

Site rationale: medium priority, pockmark fields. Sparker line shows potential migration pathways to pockmarks.

Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area I, 1 station



Area I

Location:

Point: -12 40.229 128 53.549
Video SOL: -12 40.439 128 53.518
Video EOL: -12 40.164 128 53.559

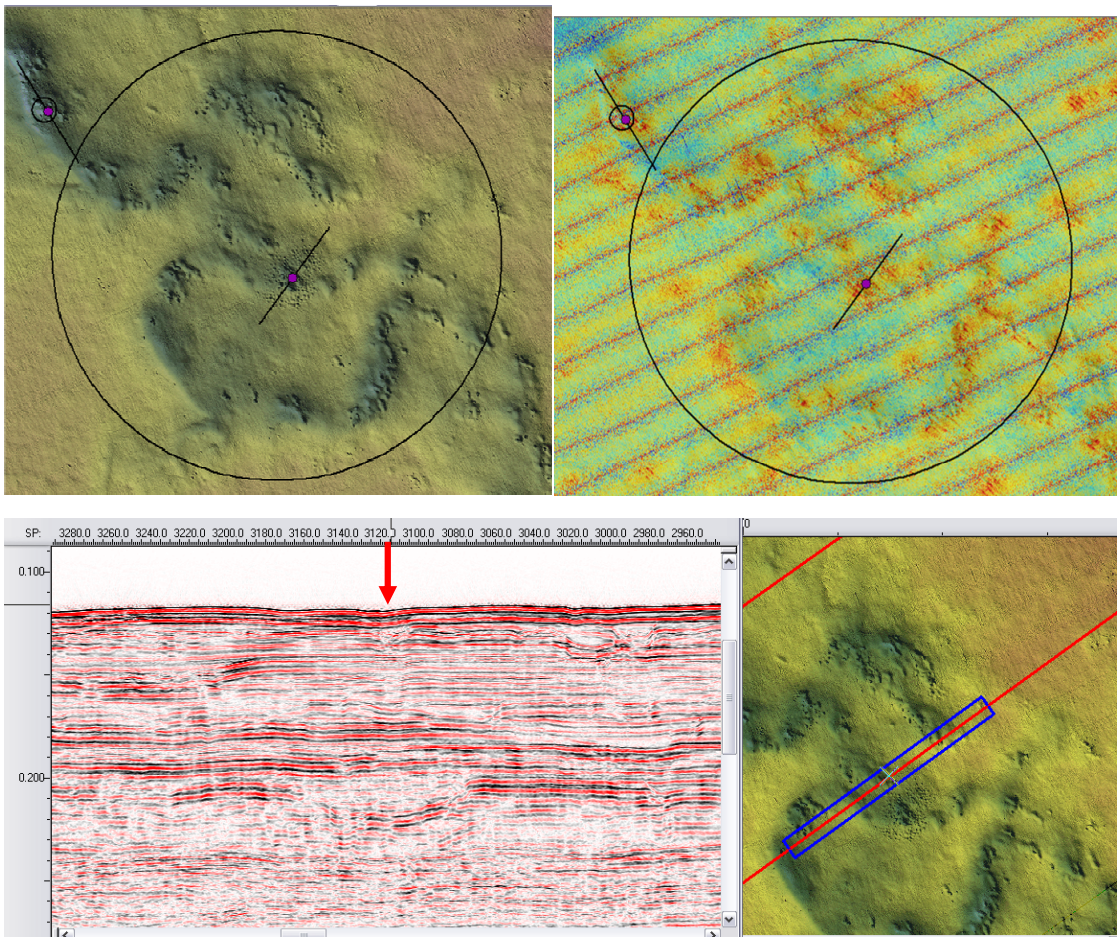
Sparker line: GA335_003

Site rationale: medium priority, pockmark fields in small channel. Sparker shows bright reflectors and possible fluid migration pathways.

Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area J, 1 station



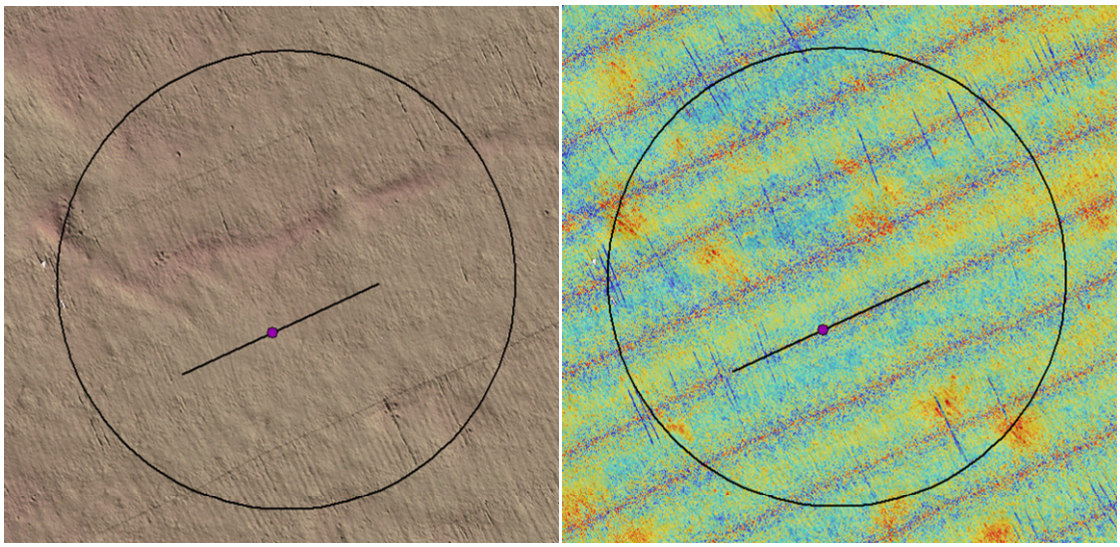
Area J
Location:

Point: -12 44.762 128 52.111
Video SOL: -12 44.643 128 52.197
Video EOL: -12 44.870 128 52.031

Sparker line: GA335_012
Site rationale: medium priority, pockmark fields in small channel. Sparker line shows distortion below seafloor and potential migration pathways to pockmarks
Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area K, 1 station



Area K
Location:

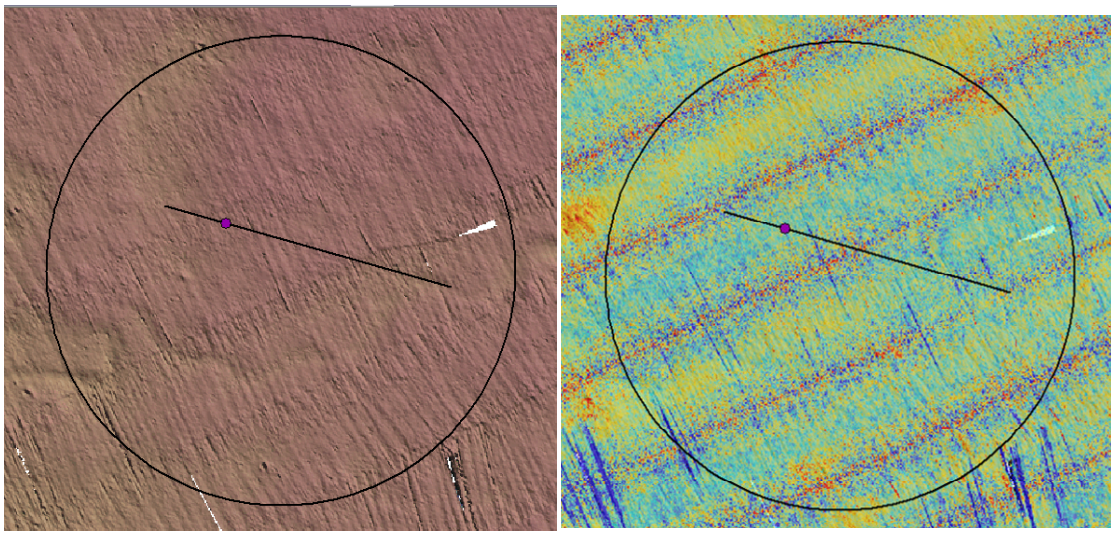
Point: -12 44.649 128 55.787
Video SOL: -12 44.703 128 55.671
Video EOL: -12 44.586 128 55.923

Site rationale: medium priority, an apparent pockmark-free area. Needed to determine if biological communities differ between seep vs non-seep habitats.

Samples: "half station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area L, 1 station



Area L
Location:

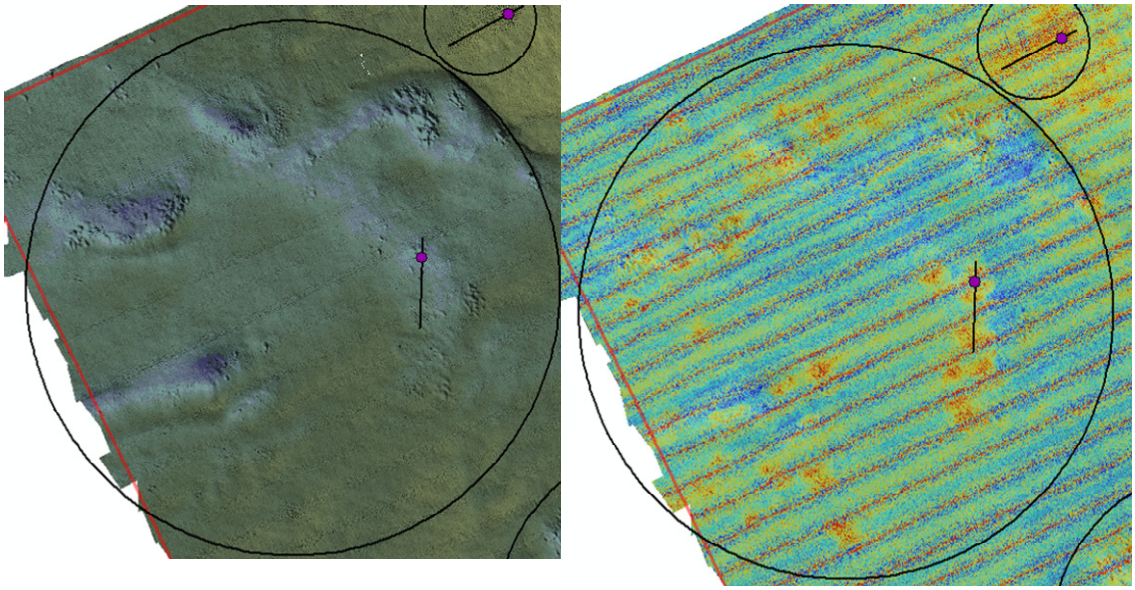
Point: -12 47.252 128 53.063
Video SOL: -12 47.237 128 53.008
Video EOL: -12 47.31 128 53.267

Site rationale: medium priority, an apparent pockmark-free area. Needed to determine if biological communities differ between seep vs non-seep habitats.

Samples: "half station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area M, 1 station



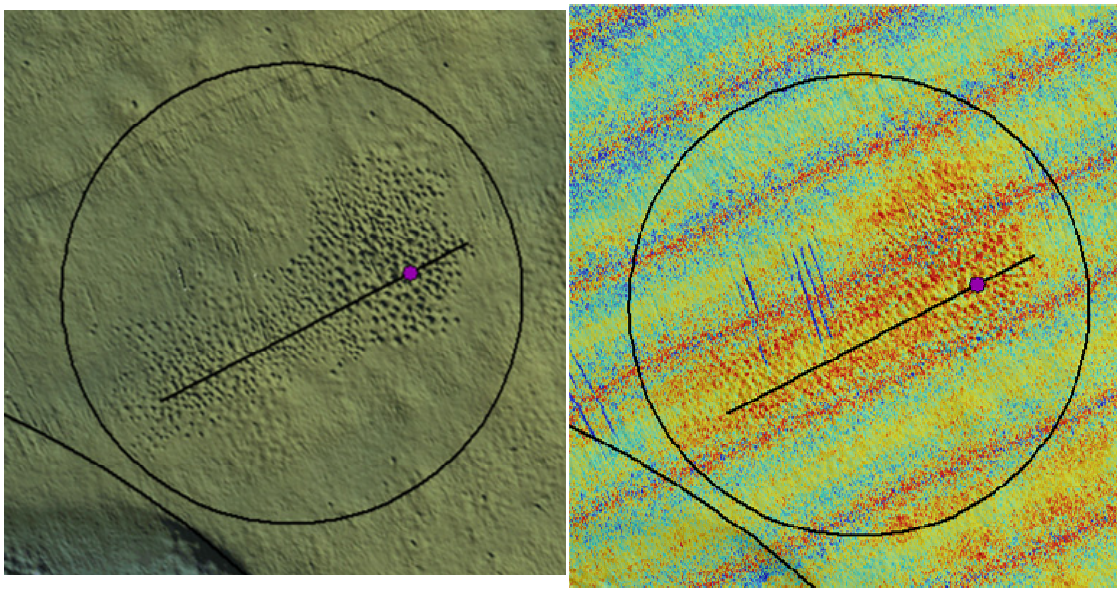
Area M
Location:

Point: -12 40.022 128 47.744
Video SOL: -12 40.251 128 47.736
Video EOL: -12 39.953 128 47.746

Site rationale: medium priority, pockmark fields in deepest part of channel.
Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area N, 1 station



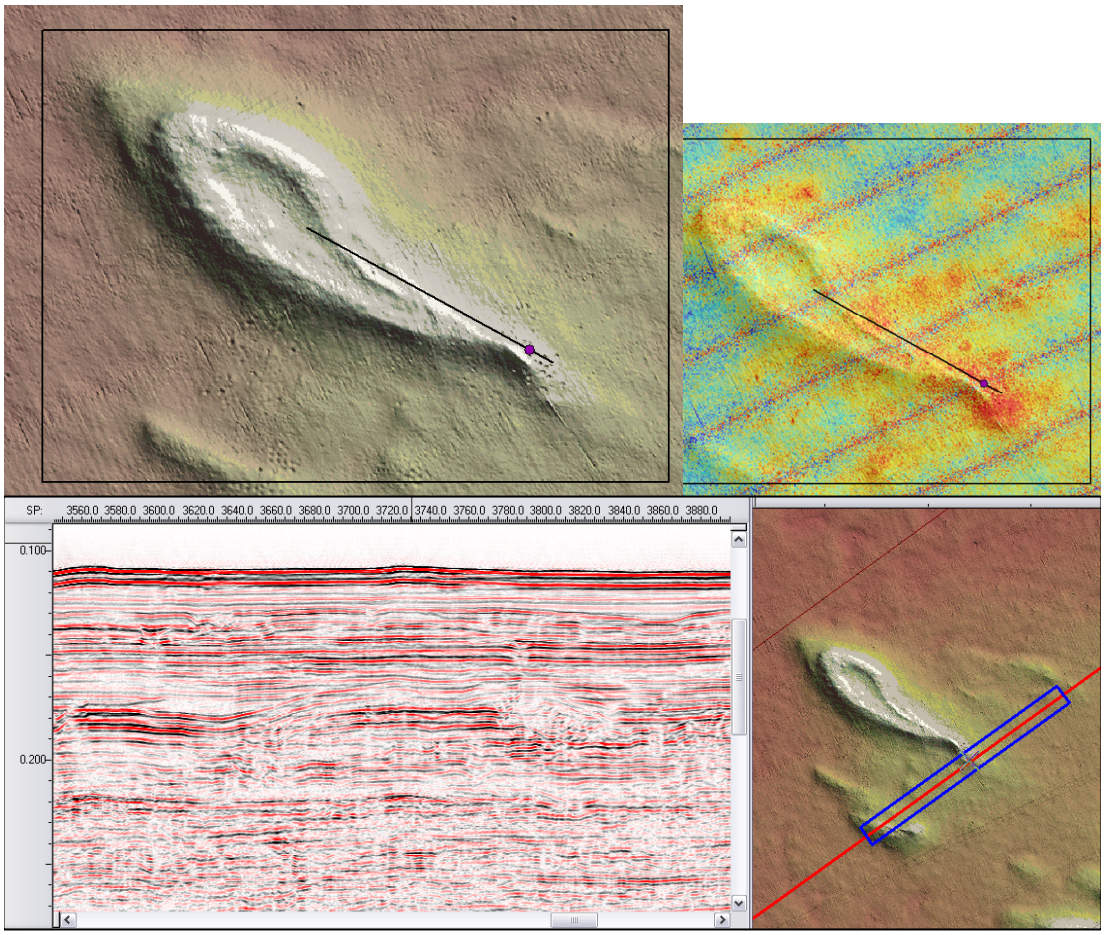
Area N
Location:

Point: -12 39.222 128 48.029
Video SOL: -12 39.197 128 48.074
Video EOL: -12 39.323 128 47.830

Site rationale: medium priority, pockmark fields in deepest part of channel.
Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1 – sampling area O, 1 station

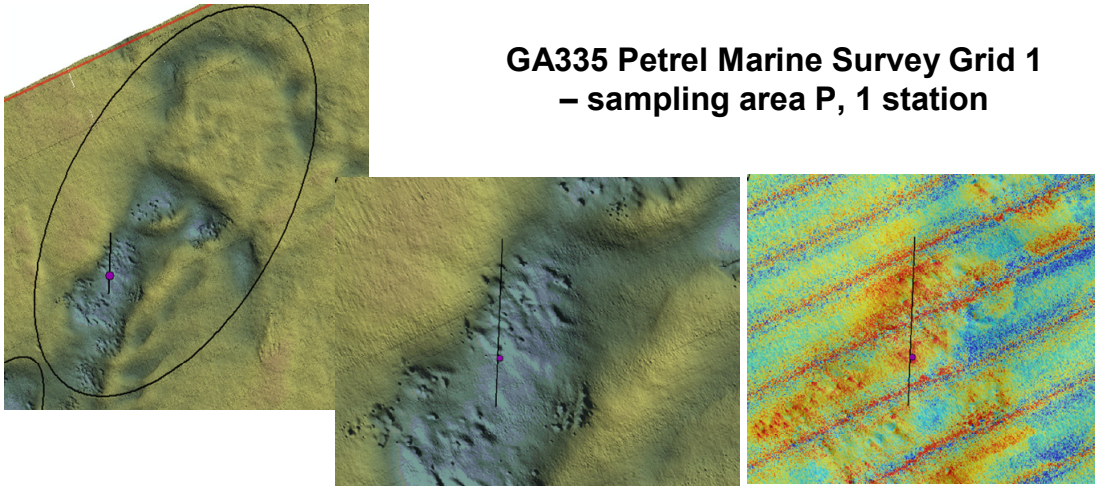


Area O
Location:

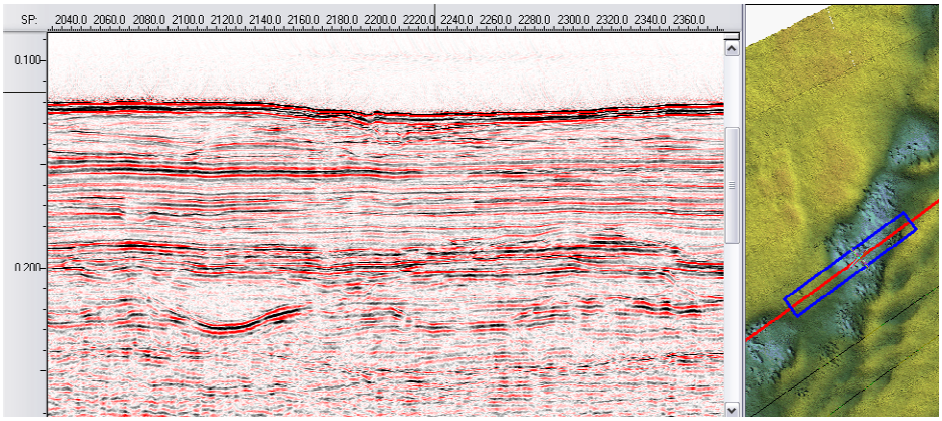
Point: -12
Video SOL: -12
Video EOL: -12

Sparker line: GA335_013
Site rationale: low priority, pockmarks in “tail” of sand dune (~4-6 m high).
Samples: “full station”

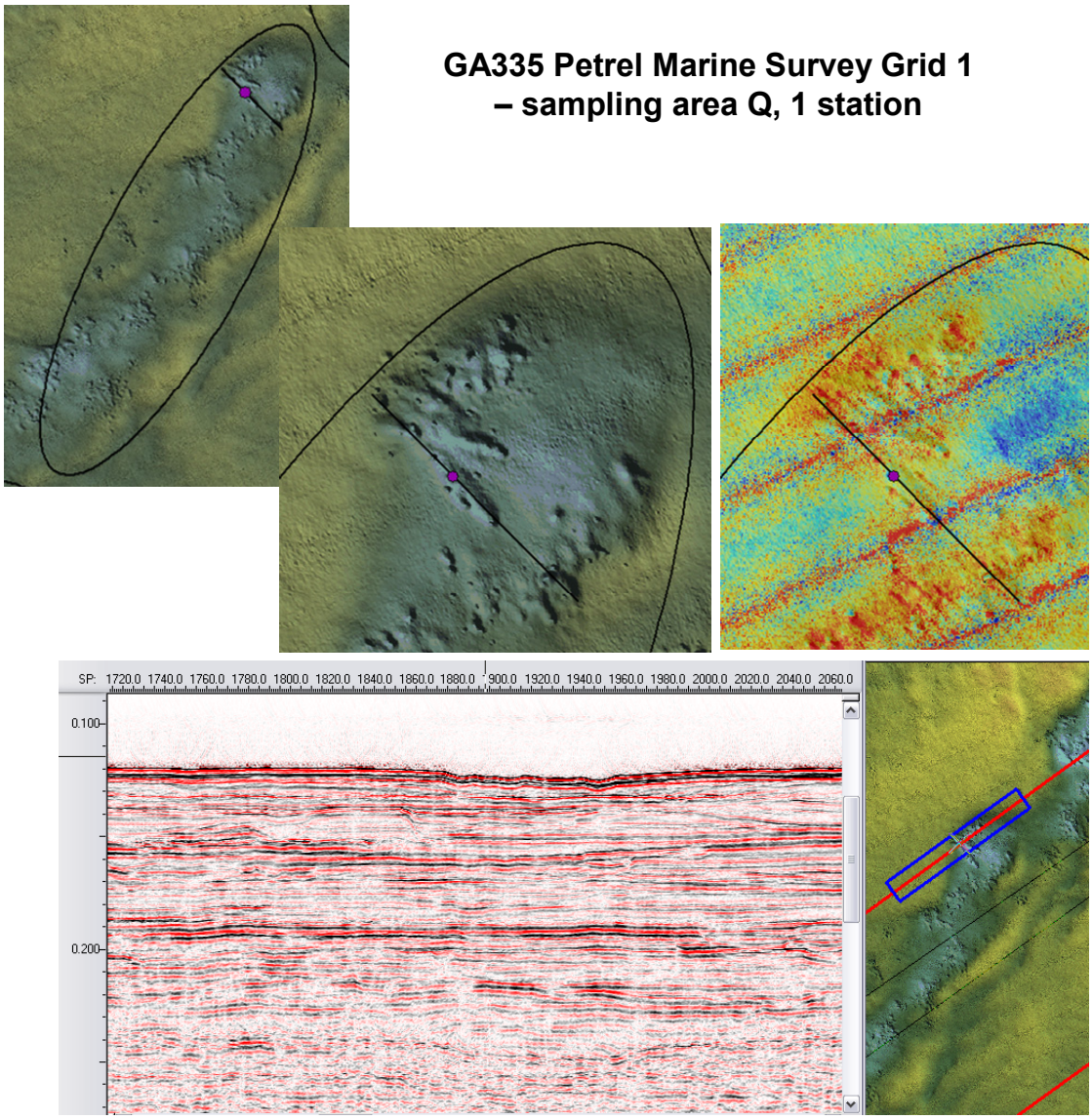
1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD



GA335 Petrel Marine Survey Grid 1 – sampling area P, 1 station



Area P
Location:
Point: -12 38.813 128 49.953
Video SOL: -12 38.623 128 49.956
Video EOL: -12 38.89 128 49.946
Sparker line: GA335_008
Site rationale: low priority, pockmark fields in channel.
Samples: "full station"
1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

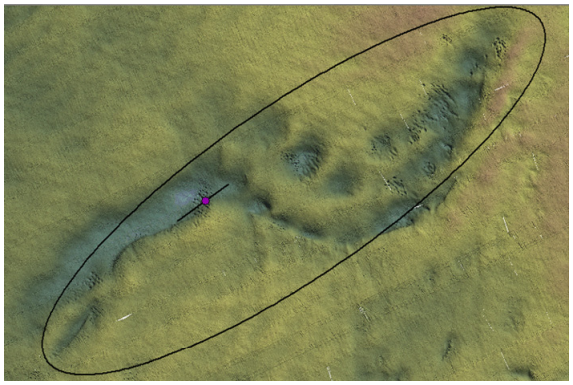


Area Q
Location:

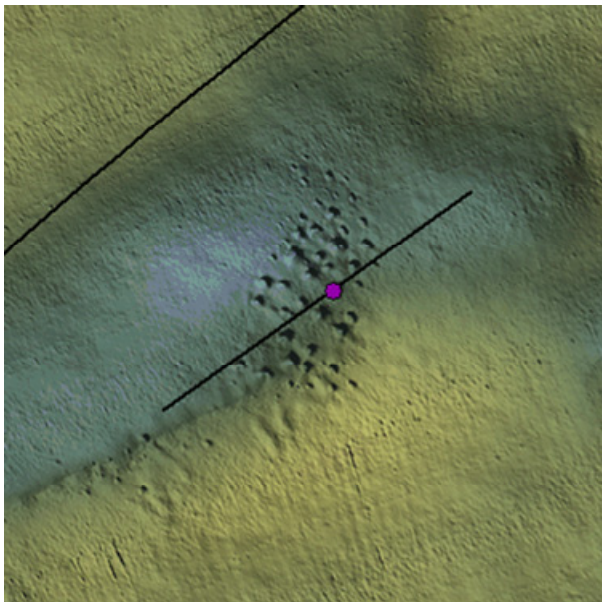
Point: -12 39.388 128 49.434
Video SOL: -12 39.311 128 49.357
Video EOL: -12 39.506 128 49.552

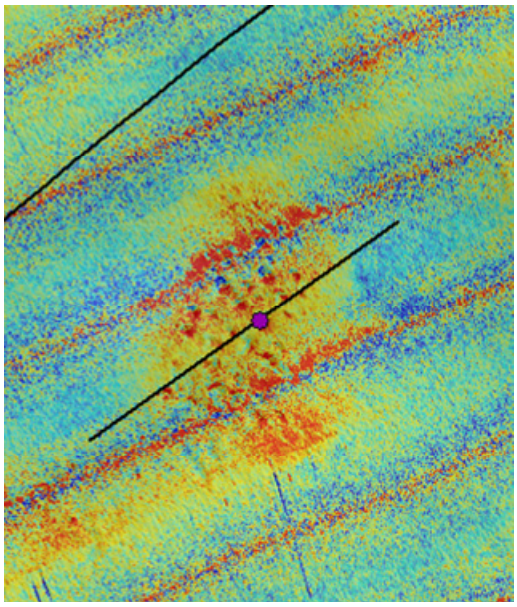
Sparker line: GA335_008
Site rationale: low priority, pockmark fields in channel.
Samples: "full station"

1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD



GA335 Petrel Marine Survey
Grid 1
– sampling area R,
1 station



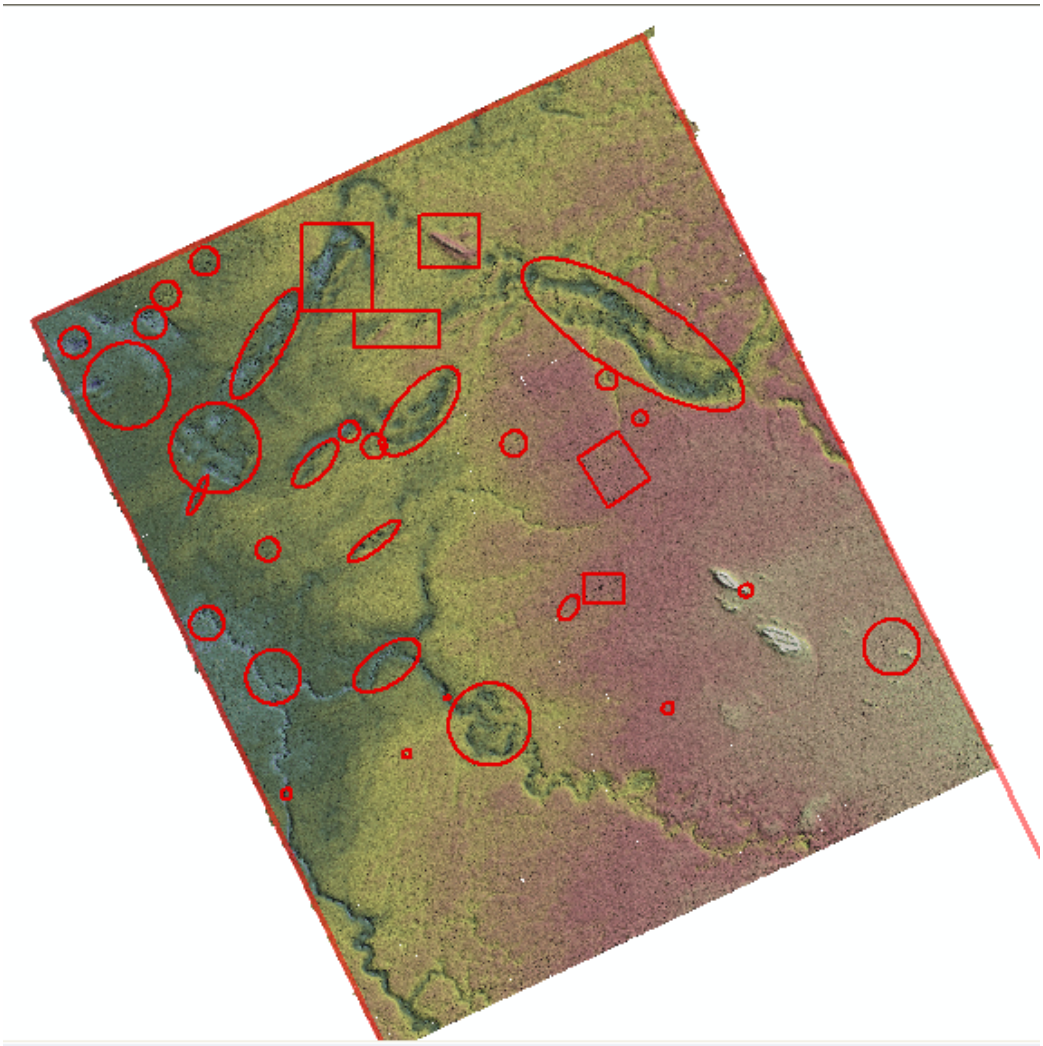


Area R
Location:

Point: -12 40.962 128 50.296
Video SOL: -12 40.888 128 50.397
Video EOL: -12 41.05 128 50.17

Site rationale: low priority, pockmark fields in channel.
Samples: "full station"
1 x Video Tow
1-2 x Grab (biology/sediment) (TBC)
1 x Grab (chemistry)
2 x Vibracore
1 x CTD

GA335 Petrel Marine Survey Grid 1
– partly swathed
All potential sites identified….



Appendix D. Data Acquisition

EXAMPLE OF AN EBCDIC HEADER FOR FINAL PROCESSED MIGRATED SUB-BOTTOM PROFILE DATA ACQUIRED DURING SURVEY SOL5463

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C1  FINAL SUB-BOTTOM PROFILER DATA PROCESSED BY GEOSCIENCE AUSTRALIA AUGUST 2012
C2  DATA ACQUIRED BY GEOSCIENCE AUSTRALIA ON AIMS RESEARCH VESSEL SOLANDER
C3  SURVEY NO.    : GA0335              SURVEY NAME    : PETREL SUB BASIN MARINE
C4  LINE NO.      : GA0335_007          GPS HEADING    : 235 DEGREES
C5    RECORDING PARAMETERS
C6  SYSTEM        : GEOMETRICS MARINE   DATE RECORDED  : MAY 2012
C7  RECORDING GAIN: CHAN 1-12 0 DB, CHAN 17-24 12 DB
C8  RECORDING FILTERS : LOW-CUT 0 HZ, HIGH-CUT 0 HZ, NOTCH OUT
C9  SAMPLE RATE   : 0.25 MS             RECORD LENGTH  : 0.5 S
C10 NO. CHANNELS  : 24                  DATA FORMAT    : SEGY REVISION 0 ON DISK
C11 SOURCE TYPE   : SQUID 2000 SPARKER, CSP-D GENERATOR AT 2000 JOULES (HI 10)
C12 SOURCE OFFSET : 10 M PERPENDICULAR  SOURCE LAYBACK : 20 M
C13 SOURCE DEPTH  : 0.5 M (APPROX)      SP INTERVAL    : 6.25 M
C14 CABLE MODEL   : GEOMETRICS GEOEEL   GROUP INTERVAL : 3.125 M
C15 CABLE LAYBACK : 40 M                CABLE DEPTH    : 2.5 M (APPROX)
C16 NEAR CHANNEL  : 1 (APPROX 22 M)     FAR CHANNEL    : 24 (APPROX 92 M)
C17 CMP SPACING   : 1.5625 METRES       COVERAGE       : 6 FOLD
C18   FINAL PROCESSING SEQUENCE : MIGRATION 0.5 S, 0.25 MS
C19  1: DUMMY LINE GEOM (CDP INT 1.5625 M)
C20  2: SEGY TO 'DISCO' INTERNAL FORMAT
C21  3: MUTE OF LEAKED TIMING PULSE AND FIRST ARRIVALS
C22  4: BAND PASS FILTER 160/24 TO 1500/72 (HZ/DB PER OCTAVE)
C23  5: WHOLE TRACE AMPLITUDE BALANCE
C24  6: SURFACE RELATED MULTIPLE ELIMINATION
C25  7: COMMON MIDPOINT SORT
C26  8: NMO CORRECTION (10% STRETCH MUTE), WITH CALCULATED VELOCITY FUNCTION
C27  9: NON SURFACE CONSISTENT TRIM STATICS USING 20 MS GATE AROUND WATER BOTTOM
C28 10: AGC (50 MS GATE)
C29 11: COMMON MID POINT STACK
C30 12: MINIMUM ENTROPY DECONVOLUTION
C31 13: FINITE DIFFERENCE TIME MIGRATION USING 100% STACKING VELOCITY FUNCTION
C32 14: BAND PASS FILTER 160/24 TO 1500/72 (HZ/DB PER OCTAVE)
C33 15: TAILORED WATER BOTTOM MUTE (BYTES 111-112)
C34 16: APPLICATION STATIC FOR S & R DEPTH AND TIDE RELATIVE TO MSL
C35 17: TRACE AMPLITUDE SCALING AND SEG-Y (REVISION 1) OUTPUT
C36
C37  TIDES FROM INTERPOLATED GPS ELEVATIONS FROM CNAV (M SEXTON R PARUMS)
C38  CDP COORDINATES IN SEPARATE P190 FILE (M SEXTON)
C39  GEOPHYSICIST LEONIE JONES; COPYRIGHT COMMONWEALTH OF AUSTRALIA (GEOSCIENCE
C40  AUSTRALIA) 2012, CREATIVE COMMONS ATTRIBUTE 3.0 AUSTRALIA LICENCE
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SAMPLE LIST – CTDS

SAMPLEID	START LONGITUDE	START LATITUDE	END LONGITUDE	END LATITUDE	WATER DEPTH (M)	ACQUISITION DATE	COMMENTS	NUMBER OF WATER SAMPLES
SOL5463/01CTD01	128.92311	-12.637732	128.923085	-12.637852	85.7	8/5/2012	CTD profile	0
SOL5463/02CTD02	128.917923	-12.714027	128.917878	-12.71418	80.5	17/5/2012	CTD profile	0
SOL5463/03CTD03	128.867573	-12.865261	128.867204	-12.86513	84.0	21/5/2012	CTD profile	0
SOL5463/05CTD04	128.808283	-12.691083	128.807587	-12.690637	94.3	23/5/2012	CTD profile and water samples taken (near water bottom)	3
SOL5463/06CTD05	128.859607	-12.740278	128.859832	-12.740663	90.2	23/5/2012	CTD profile and water samples taken (near water bottom)	3
SOL5463/08CTD06	128.901417	-12.670052	128.90105	-12.669727	92.2	24/5/2012	CTD profile and water samples taken (near water bottom)	3
SOL5463/09CTD07	128.890637	-12.716883	128.890372	-12.716707	85.7	24/5/2012	CTD profile and water samples taken (near water bottom)	3
SOL5463/12CTD08	128.862762	-12.769738	128.862957	-12.76994	86.6	24/5/2012	CTD profile and water samples taken (near mid-way)	3
SOL5463/13CTD09	128.9503	-12.797067	128.950828	-12.797033	85.8	24/5/2012	CTD profile and water samples taken (near mid-way)	3
SOL5463/14CTD10	128.933612	-12.846295	128.93344	-12.845888	83.4	24/5/2012	CTD profile and water samples taken (near mid-way)	3
SOL5463/15CTD11	129.281505	-12.402918	129.281288	-12.402803	42.5	30/5/2012	CTD profile	0
SOL5463/15CTD12	129.280087	-12.402063	129.279957	-12.401972	43.4	30/5/2012	CTD profile and water samples taken (near water bottom and near mid-way)	6

SAMPLE LIST – GRABS

SAMPLE NO	SAMPLE ID	LONGITUDE	LATITUDE	WATER DEPTH (M)	ACQUISITION DATE	COMMENTS
2132173	SOL5463/04GR01	128.855145	-12.642118	88.4	23/5/2012	Biology grab
2132174	SOL5463/04GR02	128.856895	-12.642402	85.5	23/5/2012	Sedimentology and Biology grab
2132177	SOL5463/04GR03	128.856867	-12.642052	84.8	23/5/2012	Geochemistry grab
2132193	SOL5463/05GR04	128.809787	-12.691025	93.1	23/5/2012	Sedimentology and Biology grab
2132196	SOL5463/05GR05	128.809007	-12.690928	93.8	23/5/2012	Biology grab
2132197	SOL5463/05GR06	128.808547	-12.691302	94.2	23/5/2012	Geochemistry grab
2132231	SOL5463/06GR07	128.859362	-12.740028	96.14	23/5/2012	Sedimentology and Biology grab
2132234	SOL5463/06GR08	128.858628	-12.740253	91.7	23/5/2012	Biology grab
2132235	SOL5463/06GR09	128.859928	-12.740313	90.0	23/5/2012	Geochemistry grab
2132260	SOL5463/07GR10	128.917793	-12.715467	80.4	23/5/2012	Sedimentology and Biology grab
2132263	SOL5463/07GR11	128.917307	-12.715682	82.6	23/5/2012	Biology grab
2132264	SOL5463/07GR12	128.916847	-12.715858	84.1	23/5/2012	Geochemistry grab
2132282	SOL5463/08GR13	128.901245	-12.670458	90.3	24/5/2012	Sedimentology and Biology grab
2132285	SOL5463/08GR14	128.901487	-12.670583	90.4	24/5/2012	Biology grab
2132286	SOL5463/08GR15	128.901163	-12.670253	90.6	24/5/2012	Geochemistry grab
2132302	SOL5463/09GR16	128.890775	-12.715365	85.7	24/5/2012	Sedimentology and Biology grab
2132305	SOL5463/09GR17	128.890893	-12.716523	85.3	24/5/2012	Biology grab
2132306	SOL5463/09GR18	128.890512	-12.716725	85.8	24/5/2012	Geochemistry grab
2132314	SOL5463/10GR19	128.926882	-12.725287	77.6	24/5/2012	Sedimentology and Biology grab
2132317	SOL5463/10GR20	128.926762	-12.725567	79.0	24/5/2012	Biology grab
2132318	SOL5463/10GR21	128.92597	-12.724818	79.8	24/5/2012	Geochemistry grab
2132327	SOL5463/10GR22	128.926365	-12.72557	77.6	24/5/2012	Biology grab
2132333	SOL5463/12GR23	128.863042	-12.770392	86.4	24/5/2012	Sedimentology and Biology grab
2132336	SOL5463/12GR24	128.863993	-12.754275	87.0	24/5/2012	Biology grab
2132337	SOL5463/12GR25	128.86465	-12.770242	87.0	24/5/2012	Geochemistry grab
2132351	SOL5463/13GR26	128.951232	-12.796933	85.4	24/5/2012	Sedimentology and Biology grab
2132354	SOL5463/13GR27	128.951307	-12.796503	85.0	24/5/2012	Biology grab
2132355	SOL5463/13GR28	128.949998	-12.797068	85.9	24/5/2012	Geochemistry grab

SAMPLE NO	SAMPLE ID	LONGITUDE	LATITUDE	WATER DEPTH (M)	ACQUISITION DATE	COMMENTS
2132389	SOL5463/14GR29	128.93479	-12.845997	83.2	24/5/2012	Sedimentology and Biology grab
2132392	SOL5463/14GR30	128.93341	-12.84535	83.3	24/5/2012	Biology grab
2132393	SOL5463/14GR31	128.934845	-12.845836	83.3	24/5/2012	Geochemistry grab
2132412	SOL5463/15GR32	129.281608	-12.402612	40.7	30/5/2012	Sedimentology and Biology grab; not enough sediment was recovered to elutriate but specimens were recovered.
2132415	SOL5463/15GR33	129.281917	-12.40307	42.1	30/5/2012	Biology grab; not enough sediment was recovered to elutriate but specimens were recovered.

SAMPLE LIST – GRAB SUBSAMPLES

Sub-samples from the Smith McIntyre grab deployments. The grab numbers are shown in columns under the measured parameters. The letters/numbers in brackets (e.g. C_B1) correspond to the file extensions assigned to the sub-sample types in the MARS database (e.g. SOL5463/014GR029C_B1).

STATION NUMBER	SEDIMENTOLOGY: GEOLOGY CARBONATE P-FRACTIONS (A)	BIOLOGY (B)	GEOCHEMISTRY							
			CHLORINS POROSITY (0-2CM) MINERALOGY (C_B1)	CHLOROPHYLL ABC (C_B2)	POROSITY (0-0.5 CM) (C_B3)	SOD (C_C1)	DIC FLUX (C_C2)	ELEMENTS CARBONATE SURFACE AREA (C_D1)	SEDIMENT (C_E1)	BIOMARKER (C_E2)
04	02	01, 02	03	03	03	03	03	03	03	03
05	04	04,05	06	06	06	06	06	06	06	06
06	07	07,08	09	09	09	09	09+	09	09	09
07	10	10,11	12	12	12	12	12	12	12	12
08	13	13,14	15	15	15	15	15	15	15	15
09	16	16,17	18	18	18	18	18	18	18	18
10	19	19,20,22	21	21	21	21	21	21	21	21
12	23	23,24	25	25	25	25	25	25	25	25
13	26	26,27	28	28	28	28	28	28	28	28
14	29	29,30	31	31	31	31	31	31	31	31
15	32	32,33								

+ (Initial sample only (T=0) due to bad weather)

BRIEF DESCRIPTIONS OF GRAB SAMPLES

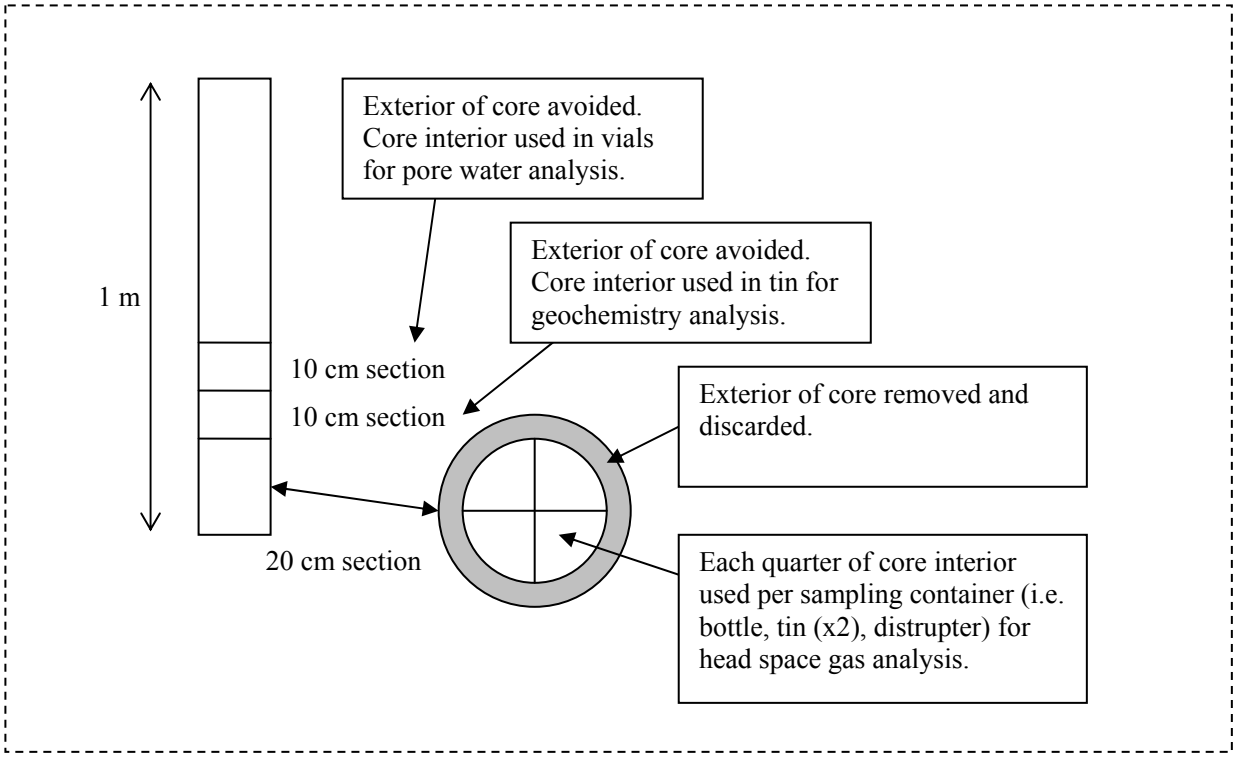
SAMPLE ID	BRIEF DESCRIPTION
SOL5463/04GR02	Muddy fine sand, some few disarticulated small Anadara bivalve molluscs, numerous rounded to sub-angular black silt size grains
SOL5463/05GR04	Coarse quartz sand, rounded and sub-rounded quartz grains, shell pieces, numerous disarticulated *Mactra* sp.? bivalve shells, numerous silt sized black grains sub angular to sub-rounded
SOL5463/06GR07	Poorly sorted shelly sandy mud, some single valves of *Mactra* sp.? (disarticulated), numerous fine rounded silt sized black grains
SOL5463/07GR10	Shelly muddy sand, many silt sized black rounded grains, few larger shell pieces, numerous relict/stained yellow-brown grains- fine sand to silt
SOL5463/08GR13	Gritty muddy coarse sand, angular granules (gravel) and brown pellets, shell fragments, forams, and many small rounded and angular black silt sized grains
SOL5463/09GR16	Medium muddy shelly sand, many silt sized black rounded grains
SOL5463/10GR19	Coarse grained shelly sand with numerous black grains - either mineral? or organic?, and some elphiid forams
SOL5463/12GR23	Medium muddy shelly sand, mixture of recent and relict (stained yellow) grains, numerous small black rounded silt sized grains
SOL5463/13GR26	Coarse shelly sand, comparatively little mud, numerous silt sized rounded black grains
SOL5463/14GR29	Sticky muddy medium sand, with shell fragments and grits, numerous sub-rounded to sub-angular silt sized black grains
SOL5463/15GR33	Very coarse sand sized shell debris in mud, very wet, - shell pieces, bryozoans, brown pellets - material is either fresh and angular with no discolouration, or discoloured browns and yellows and rounded somewhat - i.e. modern and relict grains

SAMPLE LIST – CORES

SAMPLE NO	SAMPLE ID	LONGITUDE	LATITUDE	CORE LENGTH (M)	WATER DEPTH (M)	ACQUISITON DATE	COMMENTS
2132206	SOL5463/05VC01	128.808933	-12.691048	2.9	94.1	23/5/2012	Geochemistry core
2132222	SOL5463/05VC02	128.809238	-12.69182	2.9	92.8	23/5/2012	Sedimentology core
2132244	SOL5463/06VC03	128.859513	-12.738868	3.7	90.4	23/5/2012	Geochemistry core
2132256	SOL5463/06VC04	128.859192	-12.740438	2.07	91.3	23/5/2012	Sedimentology core
2132273	SOL5463/07VC05	128.919552	-12.713702	3.57	82.7	23/5/2012	Attempted to sample for geochemistry unsuccessfully; retained top section as sedimentology core
2132275	SOL5463/07VC06	128.918208	-12.713555	0.34	81.1	23/5/2012	Sedimentology core
2132295	SOL5463/08VC07	128.9003	-12.669967	0.59	80.1	24/5/2012	Sedimentology core
2132364	SOL5463/13VC08	128.950613	-12.796497	2.4	86.1	24/5/2012	Geochemistry core
2132381	SOL5463/13VC09	128.950753	-12.795267	1.92	85.3	24/5/2012	Sedimentology core

ILLUSTRATION OF SAMPLES TAKEN FROM ONE METRE VIBROCORE CORE SECTION. THE UPPER 70 CM OF EACH CORE SECTION WAS DISCARDED AFTER SAMPLING

Once the core barrel was secure on deck, the geochemical cores were cut into one metre sections starting at the base of the core and were then immediately sub-sampled in the on-board laboratory as per the scheme shown in figure below. Since samples were collected starting from the base of each core, and the total recovered length varied from core to core, the sub-seabed depth of samples also varies from core to core. Remaining un-sampled portions of the geochemistry cores were discarded.



During sampling, care was taken to remove mud that had been in contact with the aluminium core barrel, to avoid organic contamination, and only the interior portion of the core was collected for analyses. In the lower 10 cm section of core, the core exterior was avoided and the core interior was placed in a 500 ml tin, labelled and stored in the -20 °C blast freezer. The upper 10 cm section of core was sampled for pore water isotope analysis. The core interior was placed in

eight vials and run through the centrifuge machine for 10 minutes to separate out any pore water. Pore water sampling was not done on all geochemistry cores and the separation technique resulted in no recovery to minimal pore water samples.

The lower 20 cm of each 1 m core section was extruded from the core barrel by pushing a metal cutting device up through a 20 cm section of core barrel. The cutting device has four metal plates that divided the extruded core into quarters. After extrusion, the exterior of the core was trimmed with a metal spatula to remove mud that had been in contact with the core liner. Each quarter was then removed from the cutter and placed in either: 1) a 500 ml tin (tins provided by TDI-Brooks); 2) a 500 ml tin (duplicate sample); 3) a 500 ml plastic disrupter canister (disrupters provided by EGI); or 4) a 500 ml glass bottle.

One quarter of a 20 cm section of core filled a container (i.e. tin, bottle or disrupter) to around one-third full. This was the volume of mud required for head-space gas analysis. Once the mud was placed inside a container, a further one-third of the volume (165 mL, using a graduated measuring cylinder) was then filled with filtered sea water which had been poisoned with sodium azide and degassed by bubbling with chemical-grade nitrogen. The head space of the container was then flushed with nitrogen and the container was sealed. Once sealed, the container was shaken and placed upside down in the -20 °C blast freezer. Samples collected for headspace gas analysis will be analysed by GA's laboratory and TDI-Brooks, College Station, Texas, USA.

SAMPLE LIST – UNDERWATER CAMERA/VIDEO TRACK

SAMPLE NO	SAMPLE ID	START LONGITUDE	START LATITUDE	START WATER DEPTH (M)	END LONGITUDE	END LATITUDE	END WATER DEPTH (M)	ACQUISITION DATE	COMMENTS
2132169	SOL5463/02CAM01	128.92311	-12.715777	81.4	128.92387	-12.717698	84.0	17/5/2012	Video acquired
2132172	SOL5463/04CAM02	128.858428	-12.64279	85.3	128.862078	-12.644013	87.0	23/5/2012	Video acquired
2132187	SOL5463/05CAM03	128.808953	-12.691477	94.3	128.809737	-12.6908	93.5	23/5/2012	Video acquired
2132188	SOL5463/05CAM04	128.809482	-12.689337	91.0	128.811993	-12.6879	91.2	23/5/2012	Video and camera stills acquired
2132226	SOL5463/06CAM11	128.861783	-12.770033	87.4	128.858917	-12.76925	87.3	24/5/2012	Video and camera stills acquired
2132259	SOL5463/07CAM05	128.918408	-12.715522	78.8	128.918975	-12.71217	83.5	24/5/2012	Video acquired
2132277	SOL5463/08CAM06	128.901665	-12.670333	92.3	128.903623	-12.668043	90.4	24/5/2012	Video and camera stills acquired
2132297	SOL5463/09CAM07	128.890587	-12.716978	85.6	128.893615	-12.715282	85.2	24/5/2012	Video and camera stills acquired
2132328	SOL5463/11CAM08	128.930795	-12.727203	79.4	128.934343	-12.727552	80.6	24/5/2012	Video and camera stills acquired
2132346	SOL5463/13CAM09	128.95063	-12.796422	85.9	128.947145	-12.787092	83.9	24/5/2012	Video and camera stills acquired
2132384	SOL5463/14CAM10	128.934783	-12.84598	83.2	128.931397	-12.847032	83.5	24/5/2012	Video and camera stills acquired
2132402	SOL5463/15CAM12	129.2826	-12.403473	42.5	129.285817	-12.401065	49.3	30/5/2012	Video and camera stills acquired
2132403	SOL5463/15CAM13	129.28064	-12.403817	48.6	129.276752	-12.405015	57.3	30/5/2012	Video and camera stills acquired

SEABED DESCRIPTIONS FROM TOWED VIDEO AND STILL CAMERA IMAGES

Start and end metadata for latitude, longitude and depths are based on the preliminary towed-video tracks from the RV *Solander* navigation files as finalized location files were not available at the time of video analysis

STN	CAMERA NUMBER	START LATITUDE	START LONGITUDE	END LATITUDE	END LONGITUDE	START DEPTH (M)	END DEPTH (M)	TRANSECT DURATION (MINS)[1]	TRANSECT LENGTH (M)	NO. STILLS[2]	SEABED DESCRIPTION
02	CAM01	-12.715717	128.91955	-12.71715	128.92275	81.9	83.8	14:00	385	0	Bioturbation, individual patches of sponges and octocorals interspersed with sediment
04	CAM02	-12.642783	128.858417	-12.643967	128.861867	86.8	88.5	10:18	400	0	Bioturbation, individual patches of sponges and octocorals interspersed with sediment
05	CAM03	-12.69052	128.809	-12.690833	128.809617	96.3	96.4	15:30	330	0	Some bioturbation, few (<5) individuals
05	CAM04	-12.689567	128.809367	-12.6879	128.811967	94.2	94.7	12:38	380	114 (51)	Barren, some bioturbation, few individuals, ripples, pockmark
06	CAM11A	-12.77	128.86295	-12.769317	128.85911	89.6	89.9	11:02	425	103 (61)	Bioturbation, individual patches of sponges and octocorals interspersed with sediment

STN	CAMERA NUMBER	START LATITUDE	START LONGITUDE	END LATITUDE	END LONGITUDE	START DEPTH (M)	END DEPTH (M)	TRANSECT DURATION (MINS)[1]	TRANSECT LENGTH (M)	NO. STILLS[2]	SEABED DESCRIPTION
06	CAM11B[3]	-12.77	128.86295	-12.76965	128.85994	89.6	89.9	11:02	425	0	Bioturbation, individual patches of sponges and octocorals
07	CAM05	-12.715333	128.917317	-12.714667	128.917433	83.5	81.8	02:20	75	0	Bioturbation, individual patches of sponges and octocorals interspersed with sediment, flat
07	CAM05A	-12.715733	128.9183	-12.7122	128.91895	82.5	86.7	13:14	400	0	Mixed patches of sponges and octocorals interspersed with sediment, flat
08	CAM06	-12.670583	128.9016	-12.668067	128.9036	92.8	92.5	14:18	355	126 (114)	Some bioturbation, very few individuals (<10), ripples
09	CAM07A	-12.716933	128.8906	-12.715283	128.893567	88.8	88.8	10:22	380	86 (55)	Some bioturbation, very few individuals (<10), ripples
09	CAM07B[3]	-12.717933	128.8906	-12.715283	128.893567	88.8	88.8	10:22	380	0	Some bioturbation, very few individuals (<10), ripples
11	CAM08A	-12.727233	128.93085	-12.727517	128.934217	82.6	83.8	10:05	375	80 (54)	Mixed patches of sponges and octocorals interspersed with sediments, flat

STN	CAMERA NUMBER	START LATITUDE	START LONGITUDE	END LATITUDE	END LONGITUDE	START DEPTH (M)	END DEPTH (M)	TRANSECT DURATION (MINS)[1]	TRANSECT LENGTH (M)	NO. STILLS[2]	SEABED DESCRIPTION
11	CAM08B[3]	-12.727233	128.93085	-12.727517	128.934217	82.6	83.8	10:05	375	79 (67)	Mixed patches of sponges and octocorals interspersed with sediments, flat
13	CAM09A	-12.796467	128.9506	-12.797883	128.948067	88.5	86.2	14:38	320	0	Bioturbated, few individuals, rippled/flat
13	CAM09B[3]	-12.796467	128.9506	-12.797883	128.948067	88.5	86.2	14:38	320	121 (107)	Bioturbated, few individuals, rippled/flat
14	CAM10A	-12.84595	128.934917	-12.847	128.931517	85.0	85.1	12:09	385	0	Bioturbation, few individuals, flat
14	CAM10B[3]	-12.84595	128.934917	-12.847	128.931517	85.0	85.1	12:09	385	80 (71)	Bioturbation, few individuals, flat
15	CAM12A	-12.403517	129.2825	-12.4011	129.2857	45.8	51.4	11:56	440	120 (76)	Mixed patches of sponges and octocorals interspersed with sediment
15	CAM12B[3]	-12.403517	129.28193	-12.40143	129.28502	45.8	51.4	11:56	440	105 (85)	Mixed patches of sponges and octocorals interspersed with sediment
15	CAM13A	-12.403817	129.28085	-12.404983	129.276833	51.6	60	09:15	455	80 (60)	Heavy bioturbation with very few organisms

STN	CAMERA NUMBER	START LATITUDE	START LONGITUDE	END LATITUDE	END LONGITUDE	START DEPTH (M)	END DEPTH (M)	TRANSECT DURATION (MINS)[1]	TRANSECT LENGTH (M)	NO. STILLS[2]	SEABED DESCRIPTION
15	CAM13B[3]	-12.40366	129.28154	-12.40464	129.27766	51.6	60	09:15	455	65 (53)	Heavy bioturbation with very few organisms

[1] Transect duration is in minutes:seconds.
[2] The number of still images collected from one camera: the first number represents the total number of stills collected while those in brackets represent images that are usable (e.g. not overexposed, under-exposed, blurry, turbid and unfocused).
[3] Metadata are replicated for these transects as there were two still cameras attached to the camera tow body.

PRELIMINARY BIOLOGY, GEOMORPHOLOGY VS BACKSCATTER OBSERVATIONS

BIOLOGY CATEGORY	SAMPLE ID	DEPTH [M]	GEOMORPHIC FEATURE	BACKSCATTER [DB]	MEAN BACKSCATTER [DB]
Mixed Patches	02cam01	81.95	Ridge	-27.37	-27.28
	04cam02	87	Ridge	-30.35	
	07cam05A	82.48	Ridge	-29.41	
	15cam12	48.82	Ridge	-22	
Bioturbated	05cam04	94.23	Valley	-28.69	-28.55
	07cam05	83.33	Ridge	-29.72	
	08cam06	90.36	Valley	-28.25	
	09cam07	88.92	Plain	-27.16	
	11cam08	82.66	Ridge	-30.37	
	13cam09	86.73	Valley	-30.42	
	14cam10	84.85	Plain	-30.15	
	06cam11	90.08	Plain	-27.22	
	15cam13	48.9	Ridge	-25	
Barren	05cam03	96.49	Valley	-29.99	-29.99