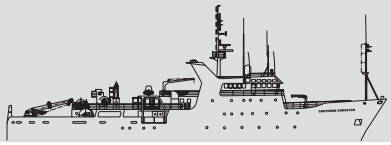

MARINE
NATIONAL FACILITY

2005 program

RV *Southern Surveyor*

CSIRO

research charter

voyage summary SS08/2005

SS08/2005

Characterising benthic habitats and sedimentary processes of southwest Australian margin, including developing an understanding of the petroleum potential of the East Mentelle Basin

Itinerary

Departed: Fremantle 1330 hrs, Wednesday 28th September 2005
Arrived: Fremantle 0900hrs, Thursday 20th October 2005

Principal Investigators

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Scientific Objectives

The scientific objectives of the survey (GA Survey 293) were to:

1. develop an understanding of deep-water sedimentary processes and benthic biota and habitats in "blind" submarine canyons on the southwest Australian margin;
2. document the geological and biological transitions between shelf, slope and offshore platform seabed environments; and
3. investigate the stratigraphy and geology of the Mentelle Basin and assess its implications for petroleum potential.

Voyage Objectives

The main survey objectives were to address existing knowledge gaps regarding deep-water temperate benthic marine habitats on the outer shelf, slope and offshore platform environments on the southwest Australian margin. A further objective of the survey was to assess the petroleum potential of the Mentelle Basin.

Voyage Track

The survey concentrated on the SW margin of Australia south of the Perth Canyon, located on the NE margin of the Mentelle Basin and Naturaliste Plateau (Fig. 1).

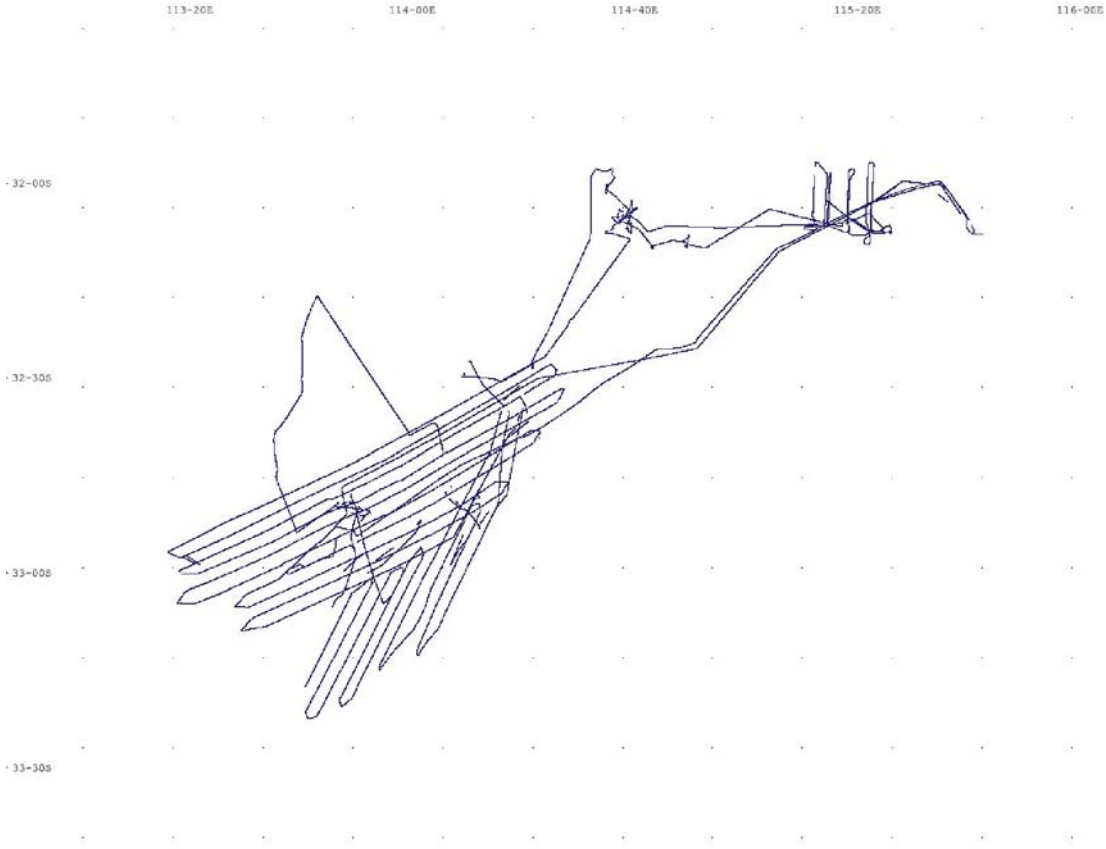

Figure 1

Results

The survey was divided into two major components: 1) a geophysical surveying program (~9 days), and 2) a physical sampling program of key seabed environments (~11 days). These environments included: canyon flanks/walls, canyon floors, interfluves, headwalls and the surrounding continental slope.

The geophysical survey component collected:
- >6,480 km^2 of swath sonar data;
- >3,280 line-km of sub-bottom profiler data; and
- >250 line-km of dual frequency side-scan sonar data.

The major scientific outcomes of the geophysical surveying program were:

- Swath data cover a completely new area of the seabed that revealed the true extents of the blind submarine canyons in SW Australia including two previously unknown canyons (Fig. 2a), a previously unknown 75 km^2 slump block at the head of Geographe Canyon (Fig. 2b, and numerous tributary canyons on the mid-slope (Fig. 2a);

- The swath data also completed coverage of the Perth Canyon to fill in remaining gaps (Fig. 2a). The Perth Canyon is now 100% covered by high-resolution swath bathymetry data;

- The most comprehensive shallow seismic dataset ever collected for the SW margin. The data revealed the sediment thickness and sub-surface architecture of the study area, including rocky substrates in the narrow, steep-sided tributary canyons and extensive sedimented areas containing sediment drapes (Figs. 3a-b).

Sampling program:
- 24 Gravity cores – 0.1 – 5.36 m long; Total = 48.33 m
- 6 CTD casts – 0 – 2,600 m water depth
- 1 Box Core
- 14 Camera Stations – 121 still images of the seabed.
- 12 Rock Dredges
- 2 Benthic Sleds
- 3 Grabs

The major scientific outcomes of the physical sampling program were:

- Obtained history of deep-water sediment deposition in the canyons and surrounding margin from the cores. The cores contain spiculitic nanno-fossil ooze;

- Recognised four major water masses throughout the region (Fig. 4). These water masses are: 1) well-mixed surface layer (0-100 m), 2) stratified oxygen-rich water (100-600 m), 3) stratified oxygen-poor water (600-1200 m), and 4) stratified cold bottom water (>1200 m);

- Obtained first rocks ever to be collected from the Mentelle Basin (terrigenous mudstones) (Fig. 5);
- Obtained basement rocks (metamorphosed granite) close to the surface indicating the extent of the Mentelle Basin sequence along its northern margin;
- Obtained the first ever images of the seabed below 2,000 m from this margin (Figs 6a-c). The seabed images revealed that the deep sea is mostly covered with spiculitic ooze with sub-cropping rocks restricted to steep flanks and incised canyons. The benthic biota are sparse, but the photographic evidence indicates that there is an abundant and active infauna, with many new species.

Voyage Narrative

Wednesday 28/09/2005: Tested Geoscience Australia's deep-water video camera while alongside. Everything was in working order. Geoscience Australia officers in Fremantle to support mobilisation went ashore and the RV Southern Surveyor departed Fremantle Harbour for Survey 08/2005 at 0425 UTC. Transited to the ADCP mooring site. Successfully deployed the ADCP frame in 27 m of water at 0921 UTC (location: -32° 02.713, 115° 26.795). Transited to Area 1 to conduct sampling of the southern flank of the Perth Canyon. Along the way gaps in the existing swath coverage for the canyon were filled. The canyon has now almost 100% swath coverage. Most science crew are finding their sea legs. The ship's computer technician can not network any of Geoscience Australia's computers due to restrictions on the set up. This is a continuing issue that must be resolved. It is simply unacceptable that we can not network the laptops for file transfer and analysis of data it is compromising the scientific results.

Thursday 29/09/2005: Transited to Area 1 and completed a CTD at 1651 UTC in 1,450 m water depth at the first dredge station. The underwater video camera was then deployed. However, camera connector broke at 250 m due to heavy swell. The cable was re-potted at 2100 UTC and will be left to cure for 24 hours. It was decided to continue with CTD's and dredges and undertake the cameras together before transiting to Area 2. Commenced dredge on southern flank of Perth Canyon at 2356 UTC in 2,672 m at -32° 01.367, 114° 41.360. Upon retrieving the dredge it became apparent that the spooling gear on the port trawl winch was out of sync with the cable. This meant that the spooling gear had to be physically moved across the drum while hauling in the cable. This caused a delay of ~5 hours before the dredge came aboard. When finally aboard, the shear pin had sheared and the dredge chain bag was empty, probably due to the extended period of time it was dragging across the seabed. We obtained approximately 25 kg of spiculitic nanno-fossil ooze from the pipe dredge and a small piece of vesicular basalt. The problem with the spooling gear has come about because the sockets were replaced the day before we departed and the wire had not been laid out with the new sockets during the sea

trials. This means that the crew will need to lay out the cable while at sea to fix the problem. It was decided to abandon sampling of Area 1 and move on to Area 2 to undertake swath mapping to give the crew time to fix the spooling problem. Sites in Area 1 will be occupied on the way back to Fremantle. Transited to Area 2 and commenced swath mapping. Some science crew are still finding their sea legs.

Friday 30/09/2005: Continued swath mapping of the blind submarine canyons in Area 2. Due to heavy weather no repairs could be made to the spooling gear of the winch drum. We are experiencing swells of up to 5 m and seas of 1.5-2 m with winds of 40 knots ahead of a cold front. The Captain has ordered that no-one is allowed on the outside decks.

Saturday 01/10/2005: Heavy weather continues in the last 24 hours with swells of up to 6 m and winds up to 35 knots, gusting to 60 knots. Swath mapping continues. An intriguing picture of the blind canyons is beginning to emerge. The lower regions of the canyons in water depths of 3,500-4,000 m are flat-bottomed and gently sloping indicating that these lower sections are not presently active. The shape and profiles of the canyons are similar to those of the Albany canyons. In terms of seabed habitats and environments, these blind canyons will make an interesting contrast to the Albany canyons and the near-by Perth Canyon. We continue to monitor the weather situation. I am becoming concerned about one science party member who is still not well and does not seem to be getting over her seasickness. We are hoping that the break in the weather over the next 24-48 hours will help.

Sunday 02/10/2005: A rough night last night with swells up to 6 m and winds up to 35 knots, gusting to 55 knots. Swath mapping continues with another 200 line-km completed. The submarine canyons in the northeast of the study area have terminated in 1,500-1,700 m water depth. They show well-developed cirques, slump scarps and terraces, indicating that there is some erosion occurring and their morphology is not simply reflecting the morphology of the underlying basement. Some flanks have near vertical sides and have been noted for dredging sites. The weather has moderated and we expect easing conditions for the next 24-36 hours before a freshening of the wind again. The crew have begun repairing the spooling gear on the port trawl winch and 7 stations have been provided the bridge to occupy while it is relatively calm. We are aware that sampling will be in short periods of relatively good (but not ideal) conditions between several days of rough to severe weather. We hope to commence sampling about 0600 UTC.

Monday 03/10/2005: Commenced sampling at station 3 (-32° 49.966; 113° 54.063). A CTD was successfully completed in 2,450 m water depth. We then deployed GA's underwater camera at 1107 UTC (-32° 49.879; 113° 54.019). The camera was lowered to 1,000 m water depth and then lost all communications. Upon retrieval the wire jumped violently at 500 m water depth. When it came to the surface we realised that the camera had parted from the wire and was lost. This is extremely disappointing

for all concerned given the amount of effort put into designing and constructing the camera. It appears that the kelems grip had failed due to excess strain put on it because of the swell. The last known position of the camera was -32° 52.164; 113° 52.375 in a water depth of 2,398 m. We will now use the back-up benthos camera for under-water video shots. During the day I had become more concerned about the science party member who was not getting over her sea sickness. In consultation with the Les Morrow (Skipper), Ron Plaschke (CSIRO), Drew Mills (Voyage Manager), Peter Wilkes (P&O) and Peter Harris (GA), I decided to abandon sampling after the camera failure and transit back to Fremantle to drop her off. The transfer was successfully completed at 0330 UTC and she was received by a CSIRO representative (Peter Dunn) and relatives in Perth. Jane Blevin (watch leader) and myself both advised her to seek medical attention immediately after returning to shore. In the shelter of Fremantle Harbour we trialled the benthos camera which worked perfectly. We departed for the study area at 0715 UTC and arrived back at the study site at 1600 UTC. The weather had worsened by this stage and we recommenced swath mapping of the study area.

Tuesday 04/10/2005: Continued swath mapping of the study area. We collected approximately 150 line-km of swath and sub-bottom profiler data. The good news is that the weather has eased and is becoming more conducive for sampling. A discussion was held on the bridge at 0800 UTC to determine whether conditions were suitable for coring. Conditions were marginal so I decided to postpone an attempt at coring until first light and continue swath mapping.

Wednesday 05/10/2005: The weather was suitable today to commence a coring program in Busselton Canyon, a well-developed blind submarine canyon in the northeast of the study area. A 2.3 m gravity core VC01 containing grey-while spiculitic nanno-fossil ooze was collected from 1,630 m water depth at 00:31 UTC (-32° 36.427, 114° 20.239). At station 5, VC02 was collected from 1,708 m at 04:46 UTC (-32° 35.241, 114° 21.763) and comprised 4.10 m. At station 6, VC03 was collected from 2,386 m at 06:50 UTC (-32° 34.569, 114° 21.377) and comprised 0.42 m. At station 7, VC04 was collected from 2,719 m at 09:21 UTC (-32° 31.701, 114° 18.444) and comprised 0.30 m. The surface of this core was partially cemented and bored by numerous worm tubes. All of the cores collected from Busselton Canyon terminated in stiff grey-white spiculitic nanno-fossil ooze. We deployed the back-up benthos camera at station 7. The camera reached the bottom at >2,500 m water depth and captured a relatively smooth seafloor comprising nanno-fossil ooze containing worm trails and what appears to be a sponge. The camera became stuck in the seabed and required some skilful manoeuvring of the ship to come free. Geoscience Australia's winch had trouble retrieving the camera from that water depth and recovery was slow. After the camera was aboard we attempted a CTD at the site. Approximately 200 m below the water surface the CTD wire jumped out of the sheave and caused the winch to jam. Approximately 250 m of wire was lost and the CTD wire will need to be re-terminated. The next 6 hours were lost while the crew retrieved the CTD and tried to fix the winch.

Thursday 06/10/2005: While fine, the conditions have become unsuitable for sampling with winds of 25 knots, gusting to 30 knots associated with an approaching high pressure system from the west. We have re-commenced swath mapping of the study area until conditions become favourable for the crew to fix the trawl winch and now also the CTD winch. We have been forced to resume swath mapping on an oblique course to our original survey plan due to confused swell and sea conditions. The swath has revealed a series of relatively shallow and straight NW-trending tributary canyons on the upper- to mid-slope that feed the deeper and much broader blind canyons on the mid- to lower slope. The cirques of the canyons are well defined at the ends of the tributary canyons. Some even have morphologies of "plunge-pools" found at the base of waterfalls. The cirques of these canyons could represent underwater knick-points that are migrating up slope. The weather forecast is good for the next 2 days with a high pressure system moving towards us. This will allow the crew to make the necessary repairs to the winches and we will then recommence sampling in a large un-named blind canyon in the SW of the study area.

Friday 07/10/2005: Completed approximately 250 line-km of swath mapping on a course oblique to our original survey lines. The conditions have become suitable for sampling and I have put together a series of sampling sites targeting the tributary canyons in the east of our study area. At station 8, GC05 was collected from 2,546 m water depth at 20:45 UTC (-32° 33.267, 114° 19.394) and comprised 3.35 m. The core had a distinct and strong smell of ammonia. At station 9, GC06 was collected from 1,308 m at 06:00 UTC (-32° 53.516, 114° 12.548) and comprised 2.12 m. This core terminated in grey-white spiculitic nanno-fossil ooze. GC07 was collected at 07:09 UTC from the same station (-32° 53.546, 114° 12.514) and sampled for geochemistry. CAM03 was collected at station 09 from 09:50 UTC to 11:16 UTC using the benthos underwater stills camera. More than 15 photographs were taken along a 400 m transect. The photographs showed the seabed to be smooth and sedimented. At station 10, GC08 was collected at 14:12 UTC from 1,872 m (-32° 47.796, 114° 09.929) and comprised 3.7 m. This core terminated in grey-white spiculitic ooze. GC09 was collected at 15:35 UTC from the same site (-32° 47.817, 114° 09.967) and sampled for geochemistry. We then abandoned sampling to transit to a way-point to the north of our study area in 4.5 km of water to stream out the port trawl wire in order to fix the spooling problem. The crew began to fix the wire at 22:00 UTC.

Saturday 08/10/2005: Completed repairs to spooling gear on the port trawl winch and transited back to the study area to re-commence sampling in western region of Area 2. I have asked for a written report from Roger Thomas (Chief Engineer) on the cause of the problem and the repairs he has made. At station 11, GC10 was collected from 3,138 m at 1318 UTC (-32° 48.350, 113° 48.288) and comprised 0.40 m. The core terminated in very stiff de-watered brown clay containing large organic fragments. The clay resembles a well-developed soil horizon. Back at station 03, GC12 was collected from 2,475 m at 15:57 UTC (-32° 49.836, 113° 54.048) and comprised 1.95 m. The core

terminated in white-tan spiculitic nanno-fossil ooze. On the floor of the blind "Mentelle Canyon", GC13 was collected from 2,600 m at 18:24 UTC (-32° 49.537, 113° 51.383) and comprised 3.0 m. The core terminated in white-grey spiculitic nanno-fossil ooze. A CTD was then completed at 20:26 UTC (-32° 49.494, 113° 51.267) followed by a camera run at 23:37 UTC (-32° 49.410, 113° 51.454 to -32° 49.753, 113° 51.215). A total of 12 photographs showed that the seabed of the canyon to be comprised of nanno-fossil ooze. A sea cucumber and lobster (sp unknown) were captured in the photographs, although burrows and ejecta were common implying a relatively abundant infauna.

Sunday 09/10/2005: The camera at station 12 was completed and recovered from the seabed. By this time the weather had deteriorated and we were experiencing 20-30 knot winds and swells rising to 4 m. The deck crew and engineers did not want to risk deploying the benthic sled in case there was trouble getting the wire back on board. This outcome is very frustrating for all on board given that we lost 20 hours of perfect weather yesterday to fix the trawl wire. Consequently, we recommenced swath mapping of the study area. We have almost completed 100% of the study area and will also spend some time filling in the gaps. We continue to monitor the weather and will re-commence sampling as soon as conditions allow it. At approximately, 03:30 UTC the swath system crashed with a serious error causing it to lose the entire project to date. Fortunately, all of the data are backed up on the ship's network. Conditions had abated slightly at this time, so we steamed back to station 12 to commence the benthic sled.

Monday 10/10/2005: The swath system was brought back on line during the transit to the benthic sled site. BS02 was deployed in Mentelle Canyon in 2,600 m water depth at 09:46 UTC (-32° 50.294, 113° 50.508 to -32° 50.548, 113° 50.247). The sled came back with approximately 500 g of white spiculitic mud on the frame. It was apparent that the jaws of the sled did not open during the deployment. We lashed the jaws back to ensure material enters the sled next time. DR02 was then deployed on the cirque wall of Mentelle Canyon in 2,775 m water depth at 15:43 UTC (-32° 52.430, 113° 49.680 to -32° 52.926, 113° 49.277). The dredge came back 70% full of white-green spiculitic nanno-fossil ooze. Three types of ooze were recognised, namely: unconsolidated, gluggy and partially-lithified. These three types probably represent increasing age and depth. The gluggy and partially-lithified samples were greenish-grey in colour and may contain abundant glauconite. The wind has abated to <5 knots, but a 3.5-4 m swell remains with us.

Tuesday 11/10/2005: Sampling of the tributary Mentelle Canyon continues. DR03 was deployed in 2,013 m water depth at 00:07 UTC (-32° 57.940, 113° 52.400 to -32° 58.019, 113° 51.895). The dredge contained spiculitic nanno-fossil ooze in the pipe dredges. The 5T shear-pin broke on the chain bag, releasing anything inside it. DR04 was deployed in 2,150 m water depth at 06:00 UTC (-32° 57.610, 113° 52.449 to -32° 57.958, 113° 51.058). The dredge recovered spiculitic nanno-fossil ooze and a specimen of deep-water coral (Solenosmilia variabilis), indicating the presence of rock outcrops. This coral is one of the main reef-building corals on deep-sea seamounts.

GC11 (collected out of sequence) was deployed in 2,131 m water depth at 12:36 UTC (-32° 56.362, 113° 52.798). The core recovered 0.10 m and terminated in very stiff, de-watered white to grey-white spiculitic nanno-fossil ooze contained in the core cutter and core catcher. GC14 was deployed in 2,072 m water depth at 14:57 UTC (-32° 56.143, 113° 53.220). The core recovered 0.90 m of stiff, de-watered grey-white spiculitic nanno-fossil ooze. This core was taken in place of a rock dredge at this site due to the inability of the ship to dredge from west to east given current weather conditions.

Wednesday 12/10/2005: Sampling of the tributary Mentelle Canyon continues. GC15 was deployed in 2,085 m water depth at 18:21 UTC (-32° 58.050, 113° 53.877). The core recovered 1.85 m of white to tan coloured spiculitic nanno-fossil ooze. GC16 was deployed in 2,170 m water depth at 21:06 UTC (-32° 59.250, 113° 53.644). The core recovered 0.30 m of semi-consolidated spiculitic nanno-fossil ooze. A CTD was attempted at 23:08 UTC at this location but had to be aborted due to software problems. A camera two was completed from 02:41 UTC to 05:05 UTC (-32° 59.226, 113° 53.649 to -33° 00.278, 113° 53.418), representing a distance of approximately 2 km. Unfortunately, a broken wire on the camera loom shorted out the strobe and no photos were obtained. During the camera deployment the problem with the CTD software was fixed and CTD04 was deployed in 2,199 m water depth at 07:57 UTC (-32° 59.204, 113° 53.641). A total of 11 water samples were collected based on changing water properties. BC01 was deployed in 2,200 m water depth at 11:15 UTC and recovered <0.05 m of semi-consolidated spiculitic nanno-fossil ooze. During the CTD and BC deployments the camera was fixed and CAM06 was deployed in 2,150 m water depth at 14:58 UTC (-32° 59.258, 113° 53.619 to -32° 59.369, 113° 53.611), representing a distance of approximately 250 m. The camera returned with 5 photographs of the seabed showing numerous burrows and a large feeding trail. Unfortunately the switch on the camera was damaged, but this is repairable.

Thursday 13/10/2005: Sampling moved to another tributary canyon to the NE of the Mentelle Canyon. DR05 was deployed in 2,025 m water depth at 19:43 UTC (-32° 56.562, 113° 58.702 to -32° 56.916, 113° 58.478). The dredge recovered a dark-brown organic-rich, micaceous terrigenous mudstone (our first rock!) and spiculitic nanno-fossil ooze. The micaceous mudstone appears heavily weathered and has a similar appearance to the material obtained in the base of GC10 from the base of the Mentelle Canyon. Sampling then moved to the interfluve between Mentelle and Geographe Canyon. GC17 was deployed at this site in 1,945 m water depth at 01:07 UTC (-32° 56.797, 113° 55.816). The core recovered 0.61 m of semi-consolidated spiculitic nanno-fossil ooze. Sampling moved to another tributary canyon of Geographe Canyon where DR06 was deployed in 2,097 m water depth at 10:41 UTC (-32° 52.744, 114° 02.866 to -32° 53.978, 114° 02.454). The dredge recovered micaceous organic-rich dark-brown terrigenous mudstone and white to grey-white spiculitic nanno-fossil ooze. The mudstone is the same as that recovered from DR05 further to the west.

Friday 14/10/2005: Sampling moved to a large straight tributary of Geographe Canyon to the head-wall of an enormous slump block. DR07 was deployed in 2,320 m water depth up the head-wall at 18:58 UTC (-32° 46.613, 114° 08.582 to -32° 47.478, 114° 09.595). In the process of dredging this steep wall the dredge stuck fast to the seabed for >2 hours but was finally freed by manoeuvring the ship directly over the dredge. The dredge recovered metamorphosed sediment (gneiss), phyllite and the seemingly ubiquitous spiculitic nanno-fossil ooze. The rocks in this dredge are the basement rocks that occur close to the surface indicating that the East-Mentelle basin sediments pinch-out on this margin. GC18 was deployed in 1,946 m water depth at 02:12 UTC (-32° 46.942, 114° 08.851) and recovered 0.12 m of solid pteropod hash and silty sand. CTD05 was deployed in 1,950 m water depth at 04:42 UTC (-32° 46.904, 114° 08.836) and 11 water samples were collected throughout the water column for suspended sediment. GC18 was deployed in 2,340 m water depth at 07:16 UTC (-32° 46.436, 114° 08.476) in the depression separating the slump block and head-wall. The core recovered 2.80 m of white unconsolidated spiculitic nanno-fossil ooze. The core was taken to sample the pelagic sediments that have accumulated in the depression since the slump to possibly determine the minimum age of the slump event. GC19 was deployed at the head of the tributary canyon in 1,562 m at 10:00 UTC (-32° 51.600, 114° 15.017). The core recovered 3.12 m of spiculitic nanno-fossil ooze. CAM07 was deployed in 1,515 m water depth at 13:32 UTC (-32° 51.427, 114° 14.949). A total of 10 photos of the seabed were obtained showing that the seabed was heavily burrowed with many feeding trails evident.

Saturday 15/10/2005: BS02 was deployed in 1,430 m at 15:57 UTC (-32° 51.203, 114° 15.482) and recovered a good haul of spiculitic nanno-fossil ooze. In addition to the meio-fauna, a variety of worms were collected from the haul as well as whale ear bones. Sampling then moved to the slope environments on the interfluve of the tributary canyon. The TOPAS sub-bottom profiler showed that the sediments at this site to be very thin (<1 m) and thus the final core site was picked using the sub-bottom profile data where well-bedded sediments were 15 m thick. Despite three attempts at coring the seabed at this site, no recovery was possible, indicating that the sediments are quite hard. Also, the camera appears not to be working. A decision was made to move on to re-occupy our stations in Busselton Canyon in the far NE of the study area. The technicians are working around the clock to get it back on line. We hope that it will be fixed in time for the next station. DR08 was deployed in 1,962 m water depth at 07:51 UTC (-32° 34.887, 114° 21.270 to -32° 35.932, 114° 20.835) and recovered a full dredge containing unconsolidated spiculitic ooze, calcarenite (calcilutite), and abundant marly limestone. Other oddments included manganese crusts and octacoral covered in manganese crusts. GC20 was then deployed on the mid-slope above the canyon in 1,117 m water depth at 13:12 UTC (-32° 37.289, 114° 25.270). The core recovered 5.36 m and terminated in sticky, de-watered spiculitic nanno-fossil ooze. CAM08 was deployed at this station in 1,092 m water depth at 15:54 UTC (-32° 37.289, 114° 25.270) and collected 11 photos of the seabed. The photos showed the seabed to be heavily burrowed.

Sunday 16/10/2005: Sampling then moved to the cirque of Busselton Canyon where CAM09 was deployed in 1,665 m water depth at 19:28 UTC (-32° 35.297, 114° 21.731) and collected 8 photographs of the seabed. The photographs revealed that the seabed to comprise heavily burrowed spiculitic ooze. A gravity core was attempted in the floor of Busselton Canyon in 3,420 m water depth. While the core hit the seabed it did not return with any sample! We then transited to Perth Canyon filling in gaps in the swath bathymetry to begin a 2-day sampling program. At the first station on the southern margin of the canyon, DR09 was deployed in 2,405 m water depth at 15:47 UTC (-31° 57.877, 114° 36.473 to -31° 58.679, 114° 35.925). The dredge recovered abundant calcilutite and nanno-fossil ooze. GC21 was then deployed at the end of the dredge tow in 2,037 m water depth at 22:21 UTC (-32° 58.329, 114° 36.158) and recovered 1.31 m. The core terminated in stiff, de-watered spiculitic nanno-fossil ooze (calcilutite).

Monday 17/10/2005: Sampling then moved to reoccupy stations we had to abandon earlier in the survey due to bad weather. DR10 was deployed in 2,400 m water depth at 01:37 UTC (-32° 02.510, 114° 39.520 to -32° 02.895, 114° 38.114). The dredge recovered a full haul of calcilutite and nanno-fossil ooze at 2 phases of lithification. DR11 was then deployed in 2,108 m water depth at 07:25 UTC (-32° 03.200, 114° 38.861 to -32° 03.759, 114° 39.590). The dredge recovered a full haul of calcilutite and nanno-fossil ooze at 3 phases of lithification, as well as a specimen of deep-sea Bamboo Coral. DR12 was then deployed in 2,071 m water depth at 13:30 UTC (-32° 04.322, 114° 39.893 to -32° 04.467, 114° 40.117). The dredge recovered abundant calcilutite and some nanno-fossil ooze. In all three cases, the dredges hooked up on the seabed indicating significant rock exposure on the southern slopes of the canyon.

Tuesday 18/10/2005: Sampling continued on the southern flank of Perth Canyon with a series of gravity cores at the dredge locations. GC22 was deployed in 2,148 m water depth at 18:38 UTC (-32° 03.904, 114° 40.084) and comprised 1.85 m. The core terminated in indurated calcilutite mixed with nanno-fossil ooze. GC23 was deployed in 2,115 m water depth at 21:15 UTC (-32° 03.090, 114° 38.912) and comprised 1.19 m. The core terminated in consolidated (but not indurated) calcilutite. GC24 was deployed in 2,360 m water depth at 23:48 UTC (-32° 02.577, 114° 39.500) and comprised 0.5 m. The core terminated in consolidated calcilutite. A series of camera stations was then undertaken in a transect across the southern flank of the Perth Canyon from the interfluve to the canyon floor. CAM11 was deployed on the interfluve in 1,251 m at 03:38 UTC (-32° 03.865, 114° 38.200 to -32° 04.054, 114° 38.126). A total of 7 photos were obtained along a ~400 m long transect. All of the photos showed the seabed to be composed of spiculitic nanno-fossil ooze. The seabed also contained numerous burrows. CAM12 was deployed on a steep (>20°) slope of the canyon wall in 2,030 m water depth at 08:20 UTC (-32° 03.085, 114° 38.919 to -32° 034.084, 114° 38.916). The ship stayed on station due to the steep nature of this site. A total of 1 photo was obtained from this station and showed the

bottom to comprise spiculitic nanno-fossil ooze. Interestingly, the photo contained distinctive lineations on the seafloor, probably trawl marks. CAM13 was deployed on the canyon floor in 2,700 m water depth at 13:13 UTC (-32° 01.681, 114° 40.886 to -32° 02.050, 114° 40.803). A total of 12 photographs were obtained along a ~600 m long transect. The photos showed the canyon floor to be variable with some containing all spiculitic ooze and 1 photograph showing sub-cropping rocks interspersed with spiculitic ooze. Several sponges were seen growing on the sub-cropping rocks.

Wednesday 19/10/2005: The ADCP was recovered successfully at 23:30 UTC and CTD06, CAM14 and GR01, 02 and 03 completed at the site. The grabs contained rocky rubble and calcareous medium sand. We then transited to the head of the Perth Canyon to begin a digital acquisition survey with the side scan sonar and Topas sub-bottom profiler to seek evidence of a lowstand river channel extending across the shelf and feeding into the Perth Canyon. Alas, while we found many interesting features including onlapping reflectors, little incised channels and uncharted wrecks, we could not find any compelling evidence for a lowstand channel in the area that we surveyed. We found evidence of remnant marine deposits comprised of tidal sand ridges and laminated sediments (fan?) at the head of the canyon that would've been in 40-50 m of water at the LGM.

Thursday 20/10/2005: The pilot boarded the RV Southern Surveyor at 23:15 UTC and was alongside in Fremantle Harbour at 00:00 UTC. The ship was demobilised and the science and technical party departed for Canberra.

Summary

Even though we experienced bad weather and lost time due to returning crew to shore and fixing the port trawl winch in the first week, the survey has been a success. The data collected on this survey have greatly improved our understanding of the nature and processes of the seabed associated with blind submarine canyons on the SW margin of Australia and surrounding areas, as well as the geology of the East Mentelle Basin, fulfilling the scientific objectives of the survey.

Personnel

Scientific Participants

Name	Organisation	Role
Andrew Heap	Geoscience Australia	Chief Scientist
Jane Blevin	Geoscience Australia	Scientist/watch leader
Irina Borissova	Geoscience Australia	Scientist/GIS/Database
Emma Mathews	Geoscience Australia	Scientist/Database
Michele Spinoccia	Geoscience Australia	Swath processor
Cameron Mitchell	Geoscience Australia	Swath processor/GIS
Ian Atkinson	Geoscience Australia	Electronics Technician
Franz Villagran	Geoscience Australia	Electronics Technician
Colin Tindall	Geoscience Australia	Geological Technician
Petar Vujovic	Geoscience Australia	Geological Technician
Craig Wintle	Geoscience Australia	Mechanical Technician
Karen Gowlett-Holmes	CSIRO	Biologist
Julian Finn	Victoria Museum	Biologist
Drew Mills	CSIRO	Electronics (Voyage Manager)
Hiski Kippo	CSIRO	Computer support

Marine Crew

Name	Role
Les Morrow	Master
Arthur Staron	First Mate
Brent Middleton	Second Mate
Roger Thomas	Chief Engineer
John Elfstrom	1st Engineer
Chris Heap	2nd Engineer
Tony Van Rooy	Boatswain
Russell Williams	IR
Les Webster	IR
Marcus Gaffney	IR
Phil French	IR
Andy Goss	Chief Cook
Kevin Shenahan	2nd Cook
Charmayne Aylett	Chief Steward

Acknowledgments

I thank Ron Plaschke and Don McKenzie of the Marine National Facility for their invaluable assistance in setting up and planning the survey. Thanks also to Adsteam (Fremantle) for providing a vessel and crew at short notice to transfer the seasick scientific crew member ashore. I also thank Peter Dunn (CSIRO) for his assistance with the transfer. This voyage summary is published with permission of the Chief Executive Officer, Geoscience Australia.

Dr Andrew Heap
Chief Scientist

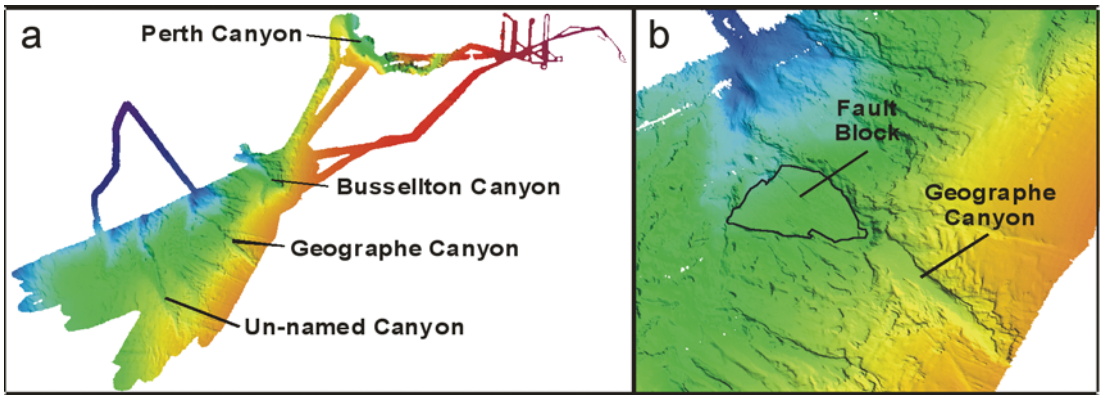

Figure 2: a) False-colour bathymetry image of high-resolution multi-beam swath sonar data collected on survey SS08/2005. Survey revealed true extents of blind submarine canyons and completed coverage for the large Perth Canyon. b) False-colour multi-beam swath bathymetry image of a large fault block in Geographe Canyon.

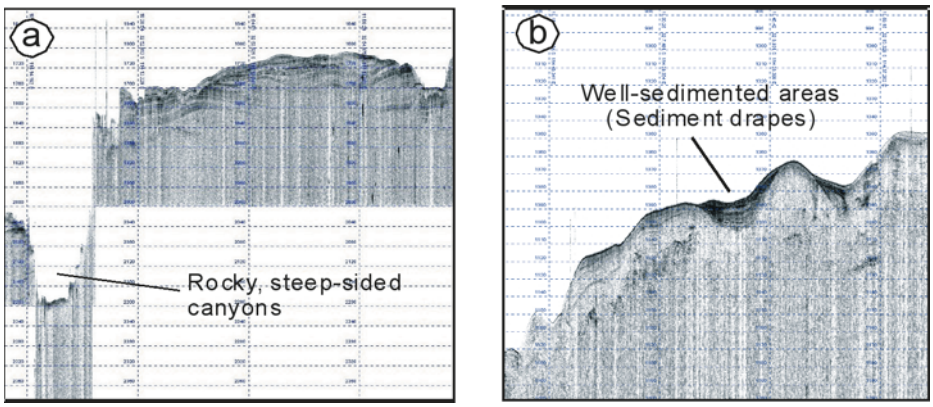

Figure 3: a-b) Examples of sub-bottom profile images showing the narrow, steep sided submarine canyons and sedimented areas. The floors of the canyons contain rock sub-crop and the surrounding slope regions are thickly sedimented with well-bedded pelagic oozes.

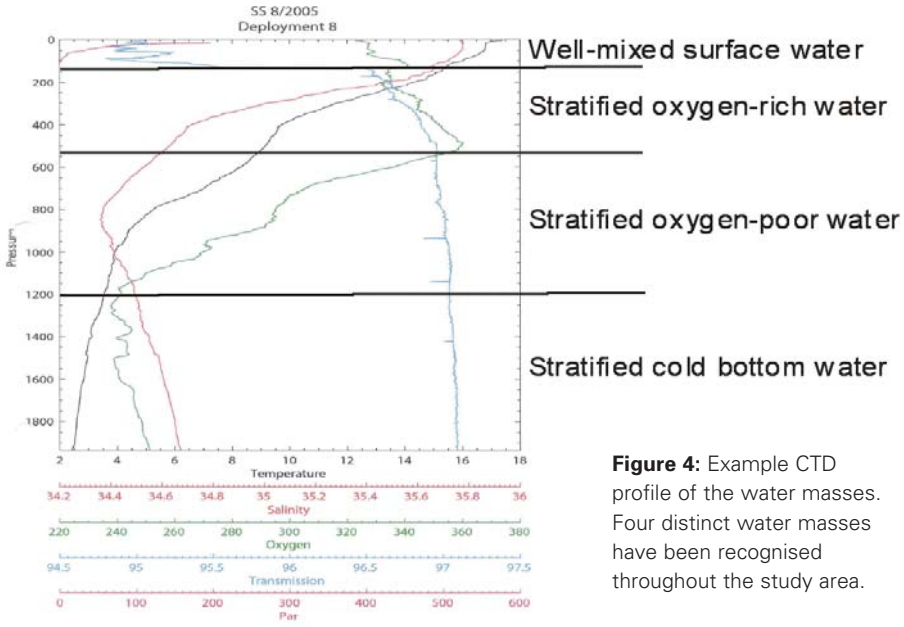

Figure 4: Example CTD profile of the water masses. Four distinct water masses have been recognised throughout the study area.

Figure 5: Digital photograph of the terrigenous mudstones recovered from the Mentelle Basin.

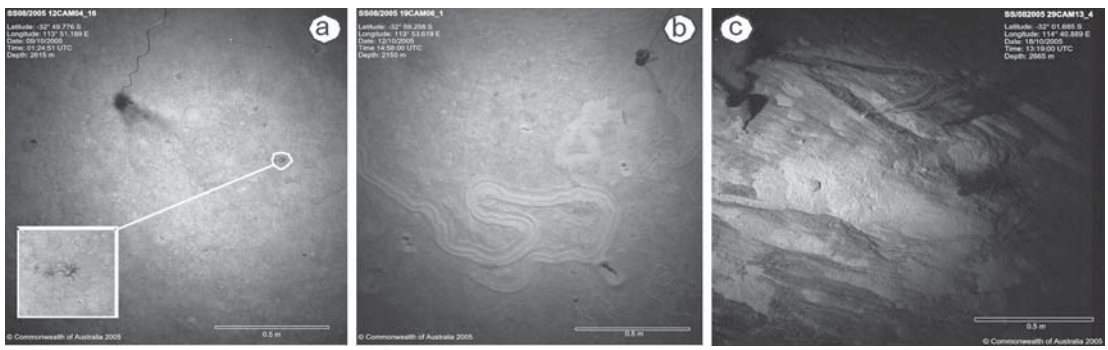

Figure 6: Examples of the seabed images collected from the canyon environments, including: a) flank/wall, b) interfluve, and c) floor.