2005

RV *Southern Surveyor*

program

MARINE
NATIONAL FACILITY

voyage summary SS02/2005

CSIRO

SS02/2005 (Geoscience Australia Survey 274)

The geology and tectonic evolution of the Mellish Rise off northeast Australia: a key piece in a tectonic puzzle

Itinerary

Departed Bundaberg 1030, Tuesday 25 January 2005
Arrived Cairns 0930, Sunday 20 February 2005

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Scientific objectives

The Mellish Rise is a large, geologically important, but very poorly known part of Australia's marine jurisdiction, and a key part in the tectonic jigsaw puzzle of the Southwest Pacific. The application for ship time set out the following scientific objectives.

Primary objectives were:

- To establish the nature and tectonic style of the margins of the Mellish Rise to help constrain plate tectonic hypotheses and the tectonic relationships to the nearby Louisiade, Queensland, Marion and Kenn Plateaus;
- To establish the nature and distribution of acoustic basement: is it continental and/or oceanic?

Secondary objectives were to study:

- The nature and age of the volcanic intrusions and extrusions, and their relationship to the Tasmantid volcanic chain;
- The nature of Mesozoic and Cainozoic sedimentary rocks, with emphasis on climatic and oceanographic evolution;
- The controls on the initiation and development of east Australian carbonate platforms since the middle Oligocene;
- The nature of the modern surficial sediments on this remote marginal rise and their influence on benthic habitats, as an aid to environmental management;
- The geological background bearing on the long-term resource potential of the Mellish Rise and adjacent deepwater basins.

Voyage objectives

To acquire geoscience data from the Mellish Rise to the abyssal plain

- 200-4500 m water depth
- 15 to 20∞S, 154 to 159∞E
- Highest priorities were seismic profiling and dredging
- Additional dredging on the Kenn Plateau had been scheduled to complete the dredging program from *Southern Surveyor* voyage SS5/2004
- Secondary priorities were magnetic profiling, swath mapping and coring
- Swath-mapper was to be run throughout the voyage

Voyage track

Figure 1 provides some bathymetric names, ship tracks including those on which seismic data were acquired, and station locations. It is located at the end of this document.

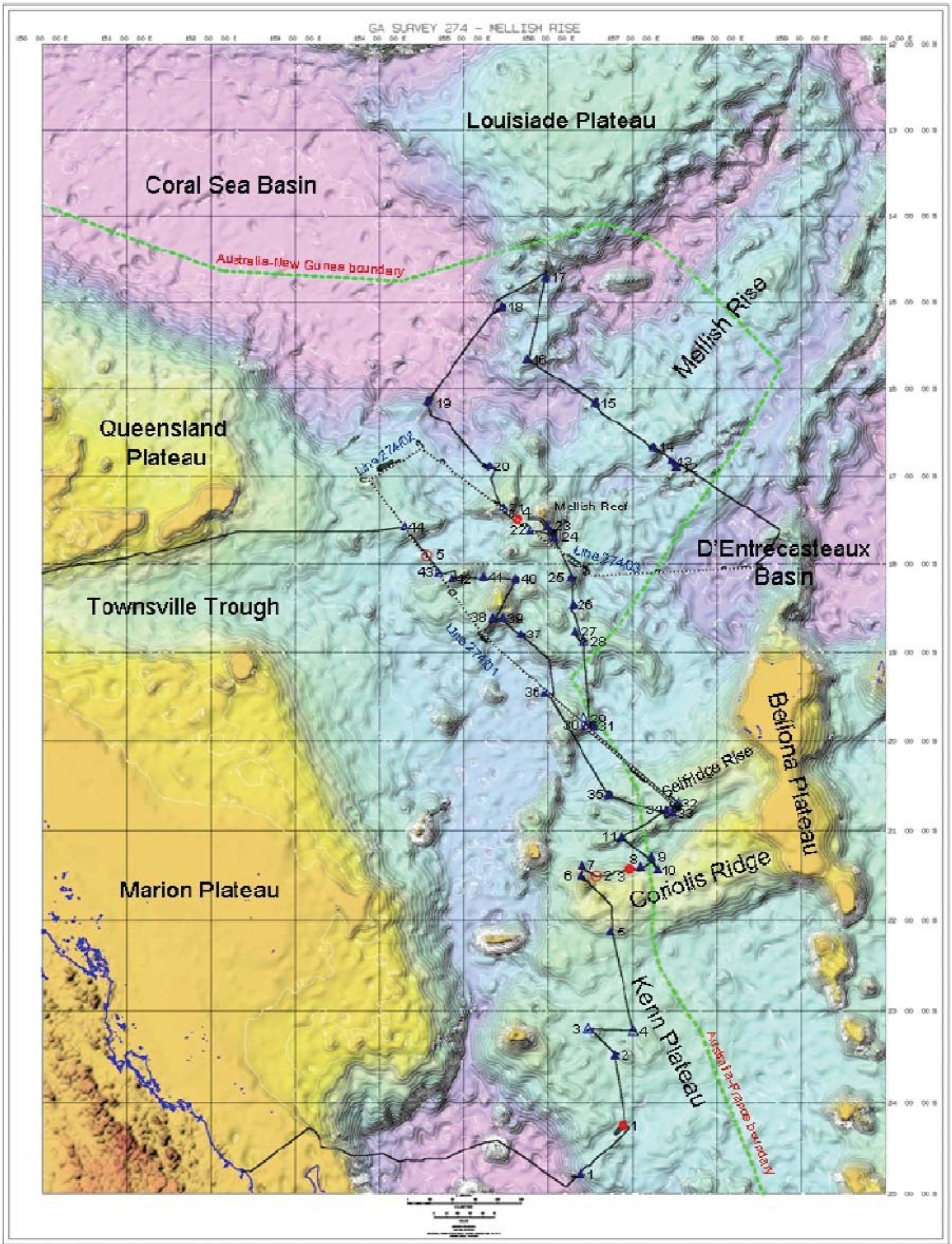

Figure 1. Location diagram of the area covered by Geoscience Australia Survey 274 over the Kenn Plateau and Mellish Rise areas. Ship tracks shown in black, dredge locations marked by blue triangles (solid are successful while hollow are unsuccessful), gravity core locations by red circles (solid are successful while hollow are unsuccessful) and seismic profiles by dotted white lines. Agreed maritime boundaries shown in red.

Geophysical results

Seismic profiling

Three seismic lines were acquired, representing the planned seismic lines 1, 2 and 3 (Figure 1, Table 1), at an average rate of 200 km/day. Line 1 is approximately 597 km long and traverses the southern extent of the Mellish Rise from the southeast to the northwest. Line 3 is about 506 km long, trending from the northwest down to the southeast before striking eastwards at a dogleg. Line 2 is some 86 km long and joins the northwestern ends of lines 1 and 3 over the southwestern tip of the Rise.

The geophysical equipment used is summarised in Appendix 1, with a summary of the data acquired given in Table 1. The three new seismic profiles were acquired at an average speed of 7 - 7.5 knots (i.e. shot spacing of 50 m) with a 550 m streamer (300 m active section of 24 channels). They were processed on board and are of good quality, with penetration into a sedimentary graben of over 2 s two-way-time (i.e. about 3 km). A total of 1189 km of seismic data were acquired in 7 days, about a third of the planned 3130 km. The reduction was caused by the complete failure of the compressor, resulting in the abandonment of the seismic program.

Shipboard analysis of the seismic profiles, which largely overlie the southern half of the Mellish Rise, confirms the initial impression provided by predicted bathymetry that the rise comprises several large-scale, basement-controlled horst blocks. The steeply-dipping block boundaries are interpreted to be largely fault-controlled. The Mellish Rise has undergone regional events including those forming a dissected pattern of rifts with possible limited seafloor spreading (at its margins), deposition of rift-valley sequences, widespread volcanism and late-stage plateau subsidence. The profiles will be figured and discussed in the planned Geoscience Australia Cruise Record, but a brief preliminary description is given below.

Seismic profile 274/01 is characterised by the presence of four large (50-100 km across), relatively evenly-spaced elevated blocks, which are separated by large deep graben filled by several sedimentary sequences. The blocks culminate at between 2.5 and 3 s TWT (two-way time), while the valley floors lie at about 4 s TWT. The blocks are covered by a 0.5 s TWT thick sequence characterised by low amplitude and discontinuous reflectors. Basement over the blocks is heavily faulted and variable in form, volcanism being dominant in parts. The central graben is some 100 km wide and contains the thickest succession of sediments. This succession comprises (from youngest to oldest):

- Seismic Unit 1a, a sequence of some 300 ms TWT (~300 m thick) made up largely of high amplitude and moderately continuous reflectors.

- Seismic Unit 2a, a sequence averaging 500 ms TWT (~600 m) thickness made up of moderate amplitude and weakly continuous reflectors. Stronger amplitude reflectors at its base and along the graben flanks may represent lava flows.

- Seismic Unit 3a, a sequence over 1.2 s TWT thick (~1500 m) made up of low amplitude and weakly continuous reflectors. Zones of high amplitude reflectors in the lower half indicate the presence of flanking lava flows. Basement, and so the probable base of this sequence, is not clearly imaged.

Seismic profile 274/03 traverses the central Mellish Rise and ends to the east over the deep D'Entrecasteaux Basin. The Mellish Rise is highly structured, with two central elevated blocks (each < 50 km across) separated by a broad deep graben whose flanks appear to be fault-controlled. Basement to the east is defined by high relief and partly rotated fault blocks descending down to basement underlying the D'Entrecasteaux Basin. Basement throughout is probably characterised by stacked lava flows. Two major sequences cover much of the rise, with a third and younger sequence present in the basin. This succession comprises (from youngest to oldest):

- Seismic Unit 1b, a sequence averaging 400 ms TWT (~400 m) thickness made up of low-moderate amplitude continuous reflectors. This is found only in the D'Entrecasteaux Basin.

- Seismic Unit 2b, a sequence of 100 - 500 ms TWT (~100-600 m) thickness extending from the D'Entrecasteaux Basin over the Mellish Rise. It is made up largely of low amplitude and discontinuous reflectors excepting at its base, which is characterised by several reflectors of very strong amplitude and high continuity.

- Seismic Unit 3b, a sequence of variable thickness at the base of the D'Entrecasteaux Basin and making up much of the graben fill over the Mellish Rise. It comprises reflectors of low amplitude and weak continuity. Stronger and more continuous reflectors at its base may represent lava flows rather than basement.

Normal faulting throughout, and particularly over the Mellish Rise on line 274/03, suggests the dominance of extension, with associated rotation of faulted basement blocks. The extension of several faults through to the sea floor indicates continued re-activation and/or differential compaction effects.

Swath-mapping

The Simrad EM300 on the R/V *Southern Surveyor* is a 30 kHz multibeam system with 135 1° beams. Survey speed during the seismic operations was 7-7.5 knots, and the remainder of the survey was conducted at speeds between 9 and 10.5 knots. Weather conditions were generally very good, with only a few days of seas around 2m. Swath data were acquired throughout the voyage and were used to image potential dredge sites. The design of the survey did not allow for an overall bathymetric model to be acquired, and only small patches were adequately imaged, mostly to locate suitable dredge targets. Generally, noise levels in the data were greater at depths approaching 3000 m, and were much greater at higher survey speeds. Across-track coverage for the survey was reasonable, given the water depths, with the best coverage being achieved over areas of outcrop, and generally in water depths ~500m to 2000m.

The topography varied from flat sea bed covered in calcareous ooze in the deeper sections, to seamounts and plateaus with outcrops, which were generally weathered volcanics often with a manganese crust. Water depths ranged from 500 to 4300 metres.

Other data

The magnetometer was deployed on the seismic lines, and on most of the run back to Cairns, a total of about 2000 kilometres. The data were very noisy and it is unclear whether processing will make them useable. The 12 KHz echosounder functioned well throughout. The sub-bottom profiler interfered severely with the swath-mapper, so was only used at several core stations, where penetration of 30-50 m was obtained.

Geological results

Sample locations are shown in Figure 1. The dredge used was a standard Geoscience Australia chain bag dredge, with two small pipe dredges attached behind to recover softer rocks and sediments. A weak link of 7.5 or 9 tonnes was used and sheared once, resulting in the dredge being recovered backward from the safety strop. Of the 44 dredges attempted, 37 produced valuable results (Table 3). Water depths varied from 400 m to 3800 m, and the average time a dredge was in the water was about 3.5 hours. Five cores were attempted and three were successful (Table 2).

Plutonic Rocks

Variable rocks of the dolerite-gabbro-quartz diorite suite are phaneritic, medium to coarse-grained, mafic plutonic rocks. In most cases, they are unusually rich in quartz. Dolerite and gabbro from the eastern Mellish Rise near the D'Entrecasteaux Basin (DR13 and DR14) are intrusive, and texturally distinct from basaltic lithologies (see below) with abundant plagioclase and hornblende, and pyroxene in some cases. Dredges 41 and 22, southwest of the Mellish Reef, yielded quartz-bearing gabbro, which in some samples (DR22) appeared gradational with basalt. The gabbro may form coarse-grained centres of larger basaltic flows or feeder dykes. One sample of quartz diorite (or tonalite) was retrieved from the Selfridge Rise (new name), wherein quartz has been subjected to recrystallisation.

Volcanic Rocks (basalt, dacite, rhyolite, hyaloclastite, pyroclastic)

Basalt is the most abundant volcanic rock type found on the Mellish Rise (but not Kenn Plateau), obtained from 14 dredges. It varies in composition from fine-grained and homogeneous with lath-shaped plagioclase phenocrysts to a highly vesicular rock. Fresh surfaces are dark grey to black. Vesicular end members are often amygdaloidal, with waxy zeolite and other black or emerald green mineral infillings. The basalt is often altered, weathered, stained or ferruginised to dark browns and oranges. Brecciation and thermally erosive surfaces occur between what are probably flow contacts.

Hyaloclastite is the second most abundant volcanic rock type, found across the Mellish Rise (not Kenn Plateau), with 7 dredges yielding striking samples. The matrices of these rocks are aphanitic and in some cases obviously glass. Clasts are most often compositionally homogeneous, though there are some exceptions, and it is not straightforward at times to differentiate between compositional variation and variable weathering and/or alteration. For the most part, clasts are felsic and sometimes obviously quartz-bearing. Certain samples contain small obsidian inclusions. In one case, hyaloclastite obviously developed along a basaltic flow top. Reworking shortly after deposition has led to the development of calcareous matrices (as noted for agglomerate samples as well).

Two varieties of **felsic volcanic** rocks were found in one dredge (DR41), constituting 30% of an estimated 450 kg haul on the southern Mellish Rise. Dacite is fine-grained, leucocratic (off-white), and quartz-rich. Rhyolite is pink and not as quartz-rich, with narrow dark pink mineral bands (potash feldspar?) that are slightly coarser than the matrix, occurring in branching discontinuous layers. Larger euhedral pyroxene grains (1 mm) are obvious on fresh fractured surfaces. Volcanic structures in both dacite and rhyolite include zeolitic amygdales and 0.5cm quartz crystal aggregates - patchily evident in the overall fine-grained matrix.

South of the Mellish Rise (on the Selfridge Rise) no basalt or submarine volcanic rocks were recovered.

Pyroclastic volcanic units

Pyroclastic volcanic units constitute all volcanic rock types dredged along the Coriolis Ridge and the Selfridge Rise, and two dredges on the Mellish Rise yielded small amounts of tuffaceous volcanic rocks (not taking into account possible laterised equivalents). Silicic tuffs contain numerous clastic fragments of various compositions set in a fine-grained silicic matrix, which varies in colour from red and purple to various shades of green. The green shades may reflect varying degrees of alteration and/or metasomatism on compositionally heterogeneous layering. Clasts are of various colours including dark green, dark red, orange, grey, and white – probably representing a variety of rock types including basalt and mudstone or shale. Most fragments are smaller than 1 cm, with few larger than 1.5 cm. Phenocrysts are rare, and where present plagioclase is sometimes recrystallised to quartz. Small, rare, ~1mm, dark green crystals, possibly pyroxene, are present. Rare calcium carbonate fragments up to 1.5 cm long were noted (possibly coral). Welded textures are developed locally, and have occasionally been observed as banding and stretching of clasts defining a heterogenous layering. The commonly observed rounding of fragments may also be attributed to welding or perhaps reworking. Agglomerate from the Coriolis Ridge (DR8) is less clast-rich than those from the Mellish Rise, and has a very fine-grained calcareous matrix indicative of a reworked ash flow.

Siliciclastic sediments

Siliciclastic sediments, believed to be the oldest part of the succession, are quartzose sandstones and siltstones as well as red or grey mudstones. They are non-calcareous, but diagenetic calcite forms concretions or cross-cutting veins. Quartzose to sublabile sandstone and siltstone show well-rounded quartz grains with associated muscovite, plagioclase, and grey mudstone clasts. Some are very hard and very quartzose. A few bedding relationships have been observed, including laminae and transitional contacts grading from sandstone to siltstone to black mudstone. Several siltstone samples are bioturbated. Green and brown labile sandstones are composed of lithic fragments (< 1mm) and contain muscovite. A cobble of graded pisolitic sandstone (DR8) was sampled on the Kenn Plateau.

Homogeneous, highly oxidised, red bed mudstones have been recovered from both the Mellish Rise and Louisiade Plateau. The brick red colouration is common in Australia during the Triassic and Devonian, but the nearest similar rocks are Upper Cretaceous to Paleocene mudstones drilled in the Capricorn Basin. Red lateritised basalt, present in some Mellish Rise dredge hauls, might possibly be its precursor in some cases.

Angular to well rounded pebble conglomerates, consisting of a variety of lithologies such as tonalite, basalt, quartz-felspathic greywacke, quartz calcarenite, chalk and obsidian shards, represent part of the assemblage on the Mellish Rise. No similar rock types were recovered from the Louisiade and Kenn Plateaus. The conglomerates are of mixed sedimentary and volcanic origins.

Volcanogenic sediments

Volcanogenic sediments are a limited part of the assemblages. The main volcanogenic rock type, bentonitic mudstone, is characteristically pale olive green to olive brown and generally non-calcareous. It occurs on all three crustal features surveyed on this research voyage (Louisiade Plateau, Mellish Rise, Kenn Plateau).

A volcanolithic conglomerate (DR30) composed of angular to well-rounded fragments of vesicular basalt, weathered basalt and obsidian was discovered on the Mellish Rise. Fragments are up to 12 cm long, representing a high energy environment of deposition. The matrix is sand-sized lithic grains cemented by chert and calcite veins. By comparison, the labile sandstones from the Kenn Plateau (mentioned above) may well have a volcanogenic origin.

Limestones

A range of Cainozoic limestones from the Kenn Plateau, Mellish Rise and Louisiade Plateau includes algal boundstone, reef talus conglomerate and calcarenite. These limestones probably developed on submerging volcanic platforms. Calcarenites are the main limestone lithofacies, and contain bioclastic fragments including bryozoans, bivalves, echinoid spines, solitary corals, and foraminiferal tests (including larger forams). The calcarenites were beach, intertidal and shallow marine deposits. Algal boundstone from the Mellish Rise (DR22 and DR40) represents in situ reefs. Calcareous conglomerate, composed of pebble-sized clasts of calcarenite, formed as wave-worn limestone fragments, which were transported down the reef front. Their matrix is generally fine-grained bioclastic fragments, and micrite cement is common. Subsequent diagenesis and metamorphism have resulted in the recrystallisation of these carbonate rocks to a micritic limestone. Hard white bioclastic limestone (a low grade 'marble') was discovered on the Louisiade Plateau and was the only such occurrence found on this survey.

Deepwater deposits

The ubiquitous foraminiferal nannofossil ooze, foraminiferal sandstone/chalk/marl, chert, and manganese crusts and nodules, are common amongst dredge hauls from all three crustal features.

Conclusions about the sedimentary rocks

The sedimentary rocks dredged during this survey comprise a diverse assemblage of siliciclastics, reefal limestones, volcanogenic facies, and abyssal deposits, reflecting the complex geological history of the region. The presence of quartz-rich and bioturbated siliciclastics suggests that they may have accumulated as fluvial-neritic deposits originally part of continental Australia. Volcanogenic facies, especially bentonitic mudstones, record the input of ash during volcanic events accompanying rifting, seafloor spreading and perhaps plate subduction. The submergence of volcanic chains and microcontinents produced suitable substrates for reefal organisms to colonise. The settling of calcareous plankton and clay through the water column during the Cainozoic has led to the accumulation of homogeneous calcareous oozes and marls.

Summary

Weather conditions during the survey were generally very good, with only a few days of seas of about two metres. Technically and scientifically, the balance of the program changed when the seismic program was reduced to one third of the expected kilometres because of the failure of the compressor. Despite this, two of four critical lines running WNW-ESE were acquired (Table 1). Data acquisition rates (average of 200 km/day) were tolerable and seismic data quality was good. A whale watch was kept in accord with the requirements of the Department of the Environment and Heritage, but no whales were seen.

The dredging program was increased to take advantage of the reduced seismic program, and most Mellish Rise sites were located either on the two new seismic lines or on pre-existing BMR continental margin survey seismic lines. A number of sites on the Kenn Plateau made use of seismic data from last year's *Southern Surveyor* voyage SS5/04. The need to use BMR seismic lines moved the dredging balance to the western half of the area. Of the 44 dredges attempted, 37 (85 %) produced valuable results (Table 3). The swath-mapper was invaluable in designing dredge plans. Water depths varied from 400 m to 3800 m, and the average time the dredge was in the water was about 3.5 hours. The coring program of five cores (Table 2) produced three moderately successful cores, but was disappointing overall.

The two seismic lines extend right across the Mellish Rise and reveal how the area has been affected by tension but little compression, with high blocks 30-100 km across separated by heavily sedimented graben of similar width. Satellite bathymetry and gravity maps, the total seismic data set, and the swath bathymetry, show that structural trends bounding the blocks are generally NW-SE and NE-SW. Numerous smaller horsts rise above the broad high blocks.

Dredges from the Coriolis Ridge and the Selfridge Rise, both on the northern Kenn Plateau, are dominated by silicic volcanics of continental origin, siliciclastic sediments, and shallow marine carbonates (some reefal). Basaltic volcanics are rare. The continental volcanics may be rift-related (Upper Cretaceous to early Eocene). The calcarenites may be Eocene and Oligocene in age.

Dredges from the generally deeper water (thinner crust) Mellish Rise are different, being dominated by basaltic volcanics and hyaloclastites, although silicic volcanics, siliciclastic sediments, and shallow marine carbonates (some reefal) occur. Two phases of volcanism, rift related (Upper Cretaceous to early Eocene) and hotspot related (late Eocene-Oligocene) may well be present. Three dredges from a southern protrusion of the Louisiade Plateau, which is not necessarily genetically related to that plateau, contain basaltic volcanics and hyaloclastites, silicic volcanics, siliciclastic rocks, and shallow marine carbonates in an assemblage like that of the Mellish Rise.

Until laboratory studies of the rocks are carried out, the above generalisations remain speculative. In the end, the volcanics could be related to any of three known periods of volcanism:

- The Early Cretaceous (~120-105 Ma) explosive rift-related volcanism of the Graham's Creek Formation in the Maryborough Basin: tuffs, agglomerates and volcanic breccias, overlain by trachyte and rhyolite flows, overlain by basaltic andesite and dacite.
- The Early Cretaceous (~120-105 Ma) explosive rift-related volcanism of the Whitsunday and Cumberland Islands (Whitsunday Volcanic Province): dacite, rhyolite, and andesitic ignimbrite.
- The assumed Late Cretaceous to Paleocene rift-related volcanism of the Marion Plateau (drilled in ODP Leg 194): altered basalt flows and volcaniclastic breccias and conglomerate.
- The Late Eocene to Early Oligocene hotspot volcanism of the Tasmantid chain: basalts and hyaloclastites.

Voyage narrative

The *Southern Surveyor* sailed from Bundaberg at 1025 on 25 January, and headed east into strong winds toward the first sampling site on the southeast Kenn Plateau, 420 km away. On the route we added a swath line to the southern edge of the Ron Boyd (SS1/05) data set off Fraser Island. The Topas sub-bottom profiler was tested but caused serious interference to the swath-mapper, but its use was not a critical component on this survey. The weather was bad with 3 metre waves from the east and a swell from the ESE. Winds from the east gusted to 35 knots. Progress was relatively slow, averaging 7.5 knots over the ground, and many aboard were seasick. At 0915 on 26 January we crossed Fraser Seamount (a guyot about 300 m deep) to improve the swath coverage over it.

The first dredge station (DR01) was occupied around 1830 on 26 January on the southwest margin of Kenn Plateau, and recovered only carbonate ooze at 2205 from a water depth of 3200 m at 24°49.0, 156°19.8'E. Gravity core GC01 recovered 320 cm of Quaternary calcareous ooze from 2695 m deep, further north at 24°17.03'S, 156°55.38'E at 0847 on 27 January. Dredge DR02 retrieved shelf limestone and manganese crust at 1640 from a north-trending ridge on the central plateau in a water depth of 1700 m (23°27.7'S, 156°46.8'E). Dredge DR03 was run downwind to the west up an east facing slope in a 30 knot wind and failed (probably because the dredge flew too high at 2.5 knots). The water depths were 1770-1600 m and we started at 23°12.7'S, 156°32.5'E. The dredge was recovered at 2340 on 27 January, and as this was a marginal site and time was pressing, we moved on.

Dredge DR04 was run on the central Kenn Plateau on a west-facing slope and recovered some thin manganese crust and calcareous ooze from 1700 m at 23°13.56'S, 157°00.85'E, at 0550 on 28 January. The weather was better and all hands were back in action. Dredge DR05 was located on the northern Kenn Plateau on the southern side of the Coriolis Ridge. It recovered bored chalk from a depth of 1600 m at 22°08.0'S, 156°44.65'E, at 1650. We then continued to the northern side of the Coriolis Ridge where we ran a short swath survey of the northeast corner of a large un-mapped guyot, with its top at about 280 m, before sampling up its slope. Dredge DR06 recovered shallow water limestone from 700-400 m depth at 21°30.85'S, 156°24.7'E, at 0100 on January 29.

Dredge DR07 was run on the northern flank of Coriolis Ridge, and recovered tuff and calcarenite from 1600-1500 m depth at 21°25.5'S, 156°24.45'E, at 0430 on January 29. Two attempts were made to take a core of presumed Palaeogene sediments (GC02) at 21°31.02'S, 156°34.7'E, but both failed and the location was abandoned at 2320. Dredge DR08 recovered volcanic agglomerate, felsic volcanics, pisolitic sandstone and manganese crusts from 1500-1400 m at 21°25.85'S, 157°06.8'E, at 1525. Core GC03 was designed to sample another Palaeogene target at 21°26.71'S, 157°04.83'E, and it recovered a little Miocene foram chalk at 1730. Dredge DR09 recovered a huge friable calcarenite boulder, a few waterworn volcanic pebbles, and manganese crusts, from 1800 m depth at 2200, on the middle of three scarps in French territory, at 21°21.5'S, 157°14.6'E. Dredge 10, the last sampling attempt on the northern flank of Coriolis Ridge, recovered a little calcarenite and manganese crusts from the upper scarp at a depth of 1600 m at 0330 on January 30, at 21°21.9'S, 157°14.8'E. Dredge 11, on the southern side of Selfridge Rise (formerly called Chesterfield Rise) at 21°04.5'S, 156°52.6'E, recovered metamorphic quartzite, volcanogenic greywacke, welded tuff, and rounded volcanic pebbles, and thick manganese crust, from a depth of 1800-1700 at 0700.

On the way to the first seismic profile, a 2000 m CTD (conductivity, temperature, depth) probe was deployed to provide water velocity information to improve the settings of the multibeam sonar and maximise its returns. After a safety meeting at 1430 on 30 January, air lines were run to the rear deck and final hydraulic adjustments made. Then the seismic cable, airguns and magnetometer were deployed, and the first shots were fired at 7 knots on the approach to Line 1. The compressor threw its belts off around 1715, because rust had accumulated on the unprotected pulleys during the previous survey. New belts were installed and the compressor was back in action by 1945. The next problem was that the DLT tape drives refused to record. At 0230 on 31 January recording started on the 597 km long Line 1 to the northwest. A computer system crash at 0630, followed by the need to tighten up a pulley on the compressor, led to a cessation of seismic data acquisition until 0944. Things went smoothly though the rest of the day and about 260 km of data had been acquired by midnight.

A major failure of the acquisition system at 0600 on 1 February necessitated a full overhaul of the *StrataVisor*, and the compressor pulley worked loose again. Only at 1430 did acquisition continue on Line 1. Another acquisition failure came at 1925, when a total of 360 km of data had been acquired. After another overhaul of the *StrataVisor* we were recording again at 2100. At 2130 we were continuing northwest along the line at 18º17'S, 154º50'E, in excellent conditions. Seismic acquisition continued uneventfully until the end of Line 1 at 1230 on 2 February, apart from an occasional apparent misfire of one airgun. The acquisition rate for the line was 190 km per day, compared to the planned 250 km per day. Parts of the line have been stacked and are of good quality.

At 1230 we went into a large butterfly turn to give us time to haul and repair the guns. The magnetometer (which has huge fluctuations in readings) was hauled in and checked to see whether power was reaching it (it was). The forward gun was pulled down. A small flake of metal from the compressor was in the generator chamber and was believed to have caused the apparent misfires. However, the apparent misfires continued so we decided to run the 86 km long Line 2 to the northeast with a single gun. At 1850 the third stage compressor valve failed, and we looped while the airgun was brought in and overhauled, and the valve replaced. The fourth stage relief valve failed at 2300 during the testing. The fourth stage compressor valve was replaced and the compressor was running again by 0130 on 3 February and we were online at 0340. Compressor problems had us offline at 0400. We were back online at 0725 and the Line 2 was completed at 1008. Production was a very poor 90 km per day.

After further compressor repairs, the 550 km Line 3 to the southeast started at 1215 on 3 February, but was broken off when the compressor shut down at 1430 for no apparent reason, starting itself again soon afterward. It appears that the apparent misfires from one gun had been symptoms of a faulty gun hydrophone, so both guns were employed. We were online again at 1545 and had recorded 130 km of data on the line when the compressor was shut down because of leaks in the second stage at 2030 at 17º21'S, 155º26'E. The weather remained perfect.

Profiling recommenced at 0145 on 4 February, and ended southeast of Mellish Reef at 1045, with 225 km recorded on the line, because of renewed problems in the second stage caused by a burnt out o-ring in a valve. Profiling recommenced at 1620 and ended at 1740 and other failures (machine turning itself off, third stage valve failure) meant that only short pieces of data were acquired until profiling resumed at 2350. Profiling to the east from 18º08'S, 156º32'E, on the modified part B of Line 3 (to the northeast rather than the east), was uneventful until 0507 on 5 February when a fourth stage valve failed. Profiling resumed at 0630 and ended at 1230, when the compressor turned itself off. The cause of this stopping may have been draining of the battery, because the alternator had not been working. Each stop necessitated a battery change. At 1330 we were under way again but at 1535 another compressor stop appears to have been caused by lack of power in the diesel. We restarted profiling at 1715, but the compressor was finally turned off at 1839 on 5 February to end Line 3 at 18º02'S, 158º31'E, meaning that we had recorded 506 km of the planned 550 km on this line. Total production was 1189 km at a rate of about 200km/day. The weather remained good.

As it was likely to take a couple of days, at least, before seismic could recommence, it was decided to go north to the proposed seismic Line 5, and swath-map and sample northwest along it until the situation was clarified. The hope was that the seismic line could be run later. The magnetometer, the seismic cable and the airguns were brought in and secured by 2050, and we brought speed up to 10 knots at 2140. At 2345 on 5 February, at 17º36'S, 158º43'E, we turned northwest onto the proposed Line 5. After an eight hour run we swath-mapped an area of steep slopes trending northeast on the northern plateau before running Dredge DR12, which recovered thick manganese crusts overlying soft claystone from the top of an escarpment in water 2500 m deep at 16º49.9'S, 157º30.9'E, at 1340 on 6 February. A little further south on the same escarpment, dredge DR13 recovered dolerite, vesicular basalt, chert, and large manganese nodules with claystone cores at 1825.

Further west, on a similar northeast trending escarpment, at 0350 on 7 February, DR14 recovered quartz gabbro (dolerite), basalt, hyaloclastite, bentonitic mudstone, glauconitic calcareous sandstone and chalk from 2900-2400 m at 16º40.6'S, 157º15.8'E. After a long transit to the northwest, DR15 was almost on the bottom at 1200 to sample another ridge, when problems with the winch control system meant that the dredge had to be brought to the surface. A pilot valve for the tension valve was replaced and the dredge commenced lowering at 1500. DR15 recovered basalt, muddy foram chalk and manganese nodules from 2630 m at 16º10.1'S, 156º34.8'E, at 1852 on 7 February. We then started a long transit to the northwest. During the day we had decided that it was not feasible to get a new injector pump for the compressor's diesel engine aboard, so no more seismic profiles could be recorded on this survey.

Dredges DR16 and 17 were taken on a southern protrusion of the Louisiade Plateau. DR16 was run up an east-west escarpment to the north, and recovered fine tuff and thick manganese crust from 2550 m at 15º39.5'S, 155º45.3'E, at 0640 on 8 February. After a long transit to the NNE, we dredged DR17 to the south on an east-west escarpment, from 3250 to 3000 m deep at 14º41.6'S, 155º52.2'E. We recovered a large and varied haul: basalt, agglomerate, pure white 'marble', redbed mudstone, grey bioturbated mudstone, green bentonitic claystone and well sorted calcarenite, at 1830 on 8 February.

After a long run to the southwest, dredge DR18 was taken to the northeast up a spur on an irregular slope in a depth of 3300-3200 m, at 15º05.5'S, 155º26.1'E. Basalt and calcareous hyaloclastite were recovered at 0650 on 9 February. We then had a very long transit to the SSW across the easternmost part of the Coral Sea Basin, during which we undertook a 3000 m CTD cast at 15º23.3'S, 155º08.1'E, starting at 1130.

At 0130 on 10 February, dredge DR19 recovered hyaloclastite and manganese nodules from 3700 m depth on a north-facing scarp on the southern flank of the Coral Sea Basin, at 16º10.9'S, 154º34.1'E. Further east on a gentle west-facing scarp of a large block, dredge DR20 failed to recover rocks and probably did not reach bottom at 2850-2650 m depth at 16º54.6'S, 155º15.8'E. The dredge was recovered at 1210 on 10 February and we continued eastward to the eastern side of the block. Dredge DR21 was taken to the NNW up the slope of a plateau and recovered basalt, plus minor basaltic conglomerate and agglomerate, dark red claystone, and laminated calcareous red and grey claystone at 1900, from 1950-1500 m at 17º24.3'S, 155º29.2'E. Core GC04 was taken in a thick Quaternary sequence in a depocentre just west of the block on which Mellish Reef sits. At 1130 on 10 February, 150 cm of foram nanno ooze was recovered from 17º33.2'S, 155º42.6'E.

Dredge DR22 was recovered nearby, from 1700-1300 m depth on the western side of the Mellish Reef block, at 0800 on 11 February at 17º35.7'S, 155º44.8'E. It contained a sequence with basalt lower down and reef limestone (algal boundstone, calcirudite, calcarenite) on top. Dredge DR23 was hung up for some hours on the eastern side of the block before coming free after the shear pin on the dredge broke. The dredge was recovered at 1500 by the safety strop, but only one piece of hyaloclastite and several pieces of manganese crust came back from 2300-2000 m at 17º38.5'S, 156º03.9'E. The damaged dredge was replaced by another one. We then ran two east-west swath lines on the ridge south of Mellish Reef in the search for a shallow dredge target. The pedestal of the reef was visible on the swath data, but was considered too close to the island for straightforward dredging. We then returned to a slope close to that of DR23, in the hope of dredging both volcanics and limestones. Dredge DR24 was recovered at 2340 from 2200-2000 m depth at 17º40.0'S, 156º03.1'E. It recovered calcarenite, micritic limestone, basalt, volcanogenic conglomerate and muddy calcareous lithic sandstone from the southeast side of the Mellish block.

Dredge DR25 was recovered from southeast of the Mellish block at 0800 on 12 February from 2650-2350 m depth at 18º09.0'S, 156º17.3'E. It contained abundant calcarenite and hyaloclastite. Dredge DR26 was recovered further south at 1700, from 2100-1950 m depth at 18º29.9'S, 156º18.0'E. It contained a huge rounded boulder of basalt with a thick manganese coating, and minor coated lithic conglomerate and sandstone. Dredge DR27 was aimed at a narrow flat-topped ridge further south again, and was recovered at 2300 from 1800-1650 m depth, at 18º51.8'S, 156º23.1'E. Despite the dredge being hung up, it recovered only one piece of manganese crust, various recently alive organisms including three types of deepwater corals, and calcareous sand. The corals and sand may have come from the upper platform of the ridge.

Dredge DR28 was an attempted repeat of DR27, but never reached the bottom because of strong currents. It was recovered at 0240 on 13 February. We then headed south to Line 1, where we made three sampling attempts on the southeast side of a large block northwest of the Selfridge Rise. Dredge DR 29 was aimed at a ridge below the main plateau, and was recovered empty at 1230 from 19º49.8'S, 156º27.7'E. It too had not reached the bottom (despite having the standard 25 % more wire out than the water depth), and we decided to increase wire length in future. Dredge DR30 sampled the slope up to the plateau, and hung up for a considerable time. It recovered a small slab of hard basaltic conglomerate and some calcareous ooze at 1730, from a depth of 2400-2100 m at 19º49.7'S, 156º26.2'S. Dredge DR31 repeated DR29, sampling the small ridge in deep water at a depth of 2600-2450 m at 19º49.8'S, 156º27.6'E. A small haul, recovered at 2145, consisted of calcareous tuff, brown foram-bearing terrigenous mudstone, greenish grey, weakly lithified, nanno foram limey sandstone, calcareous ooze and manganese crust. This suggests that the basaltic plateaus are underlain by older soft sediments.

After a seven hour transit southeast along Line 1 to the Selfridge Rise, dredge DR32 was taken up a steep rise to the north on a northeast trending ridge with terraces, and hung up for some time. Only a little manganese crust was recovered at 0940 on 14 February, from a depth of 1550 m at 20º45.7'S, 157º32.1'E. Dredge DR33 was taken a little to the east on the same ridge, and it hung up for long periods. A piece of hard ferruginous bedded sandstone, containing quartz, lithic fragments and perhaps feldspar, plus a chalk fragment, was recovered at 1445 from a depth of 1800-1700 m at 20º45.9'S, 157º32.3'E. A little quartz-rich metadolerite, cut by fine quartz veins and deformed, plus manganese, was recovered in dredge DR34 from 1700 m deep at 20º50.6'S, 157º22.2'E, reinforcing the evidence that the Selfridge Rise is continental in origin. Dredge DR35 on the western Selfridge Rise was recovered at 0500 on 15 February from 2200-1950 m depth at 20º36.7'S, 156º43.5'E. It contained hard quartz-rich sandstone, ?bentonitic claystone, pebbly micritic limestone, concretionary micritic mudstone, micritic calcarenite and calcareous ooze.

Dredge DR36 was located on the western side of a block of the Mellish Rise north of the Kenn Reef block, at 2500-2150 m depth at 19º27.6'S, 155º00.3'E. It was recovered at 1715 on 15 February and contained basalt, a little foram-rich calcarenite and foram chalk, a tiny amount of bentonitic clay, and abundant thick manganese crust. Dredge DR37 was taken to the northeast on a block south of Mellish Reef. At 0300 on 16 February it recovered foram-rich chalk and thick manganese crust from 2200 m depth at 18º49.5'S, 155º41.7'E. Dredge DR38 was taken northward up a block south of Mellish Reef. It recovered a handful of basalt and pumice from 2600 m depth at 0830, at 18º38.6'S, 155º19.6'E. Dredge DR39 was taken a little east of DR38. At 1345, it recovered basaltic hyaloclastic conglomerate, containing basalt pebbles in a quartz-bearing matrix of altered glass, and minor calcareous ?tuff from 2400 m deep at 18º37.9'S, 155º23.6'E. Dredge DR40 was taken on a tilted fault block on the same high as DR39, in a depth of 2100-1850 m, at 18º10.8'S, 155º37.6'E, and recovered at 2045 on 16 February. It was a relatively long haul upslope and contained a very varied haul: calcareous conglomerate (fore-reef talus), algal boundstone, weathered calcarenite, vesicular basalt, brecciated vesicular basalt, abundant well-lithified redbed mudstone, weathered red mudstone, hard grey mudstone, greenish grey mudstone and other altered mudstone.

Dredge DR41 was taken to the east up the scarp of a mesa, from 1900-1400 m depth and in a relatively long haul centred on 18º10.4'S, 155º15.8'E, and was recovered at 0330 on 17 February. It recovered a large haul of varied rocks: felsic volcanics (dacite, rhyolite, quartz diorite), basalt, volcanics weathered to multicoloured claystone, and the familiar redbed mudstone. Dredge DR42 was taken to the west up a ridge sitting on a plateau, and became seriously hooked up near the starting point. It recovered a moderate haul of basalt, lateritised basalt, foram chalk and grey mudstone from 1600 m deep at 18º09.2'S, 154º53.4'E at 1230. Dredge DR43 was taken to the east up the western slope of the same ridge from 2000-1850 m deep at 18º07.9'S, 154º42.0'E, and was recovered at 1650. It contained a large haul of hard quartz-rich calcareous sandstone, hard cemented calcarenite and friable calcarenite. After travelling WNW for two hours, we deployed gravity corer GC05 in the broad low between two blocks, where the water was 2860 m deep and the sea bed absolutely flat. Unfortunately, we recovered only a few centimetres of very pale brown foram-rich nannofossil ooze from 17º53.98'S, 154º32.99'E, at 2030 on 17 February, perhaps because there was current-winnowed foram sand at the surface. Dredge DR44 was taken northward up the southeastern slope of the rise connecting the Mellish Rise and Queensland Plateau from 2500-2350 m deep, at 17º38.0'S, 154º20.3'E. It was recovered at 0230 on 18 February and contained a small haul of fine grained calcarenite, bentonitic claystone, and manganese nodules and crusts.

We then set course for Cairns around the southern side of the Queensland Plateau with the swath-mapper being used. Because of a misunderstanding with the bridge, the magnetometer was not deployed until 1130 on 18 February. We berthed in Cairns at 0930 on 20 February.

Personnel

Scientific contingent

Neville Exon	GA	Chief Scientist
George Bernardel	GA	senior geophysicist
Andrea Cortese	GA	geophysicist
Kinta Hoffmann	Geological Survey of Queensland	geologist
Claire Findlay	GA	nannofossil specialist
Julie Brown	Australian National University	geologist
Emma Briggs	Sydney University	student
Jon Stratton	GA	science technician
Ian Atkinson	GA	science technician
Franz Villagran	GA	electronics technician
Craig Wintle	GA	mechanical technician
Andrew Hislop	GA	mechanical technician
Don McKenzie	CSIRO	voyage manager
Bernadette Heaney	CSIRO	National Facility computing support
Peter Dunn	CSIRO National Facility	electronics support

Ship's crew

Les Morrow	Master
Bob McManamon	Chief Mate
Brent Middleton	Second Mate
Roger Thomas	Chief Engineer
Rob Cave	First Engineer
Seamus Elder	Second Engineer
Tony Hearne	Bosun
Troy Loveridge	Integrated Rating (IR)
Russell Williams	IR
Keith Mitchell	IR
Fiona Perry	IR
Peter Williams	Chief Steward
Patrick Wainwright	Chief Cook
Ton Beerman	Second Cook

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Dr Neville Exon
Chief Scientist

Table 1: Seismic line statistics

Line	Direction shot	Start	End	Length
274/01	northwest	20 44.00S, 157 32.36E	18 49.80S, 155 14.84E	335 km
274/01	northwest	18 49.80S, 155 14.84E	17 02.76S, 153 52.80E	262 km
274/02	northeast	17 03.14S, 153 52.77E	16 40.11S, 154 31.04E	86 km
274/03	southeast	16 40.41S, 154 29.18E	08 07.98S, 156 31.31E	283 km
274/03	east	18 07.98S, 156 31.31E	18 02.37S, 158 30.95E	223 km

Note: lines 1 and 3 include a dogleg

Total seismic profiles: 1189 km

Table 2. Core sites

No.	Line: SP	Latitude (S)	Longitude (E)	Depth (m)	Description
GC01	270/7: 2600	24°17.03'	156°55.38'	2695	320 cm calcareous ooze
GC02	270/3:5860	21°31.02'	156°34.70'	1222	Two attempts at Palaeogene sediments failed; minor ooze
GC03	701: 12770	21°26.71'	157°04.84'	1306	Few cm calcareous ooze over Miocene foram chalk
GC04	274/3:7058	17°33.25'	155°42.74'	2295	160 cm foram nanno ooze
GC05	274/1	17°53.98'	154°32.99'	2860	Few cm foram nanno ooze

Table 3. Dredge sites

No.	Line: SP	Latitude (S) Longitude (E)	Depths (m) Recovery	Description
DR01	270/7: 915	24°49.0' 156°19.8'	3200	Calcareous ooze
DR02	270/14 swath	23°27.7' 156°46.8'	1700 15 kg	Thick manganese crust; late Miocene fine grained limestone with bivalves; fine grained ?metasediment
DR03	13/31 swath	23°12.7' 156°30.4'	1770-1620	No recovery. Probably did not reach bottom in rough conditions
DR04	13/31 swath	23°13.6' 157°00.8'	1700 10 kg	Thin manganese crust; calcareous ooze
DR05	N701	22°08.0' 156°44.6'	1600 30 kg	? Miocene chalk; calcareous ooze; foram sand
DR06	[13/44:45.0807]	21°30.85' 156°24.65'	700-400 10 kg	Micritic limestone; calcarenite; shell hash
DR07	[14/02:9.0455]	21°25.5' 156°24.45'	1600-1500 60 kg	Silicic tuff; calcarenite; shell hash
DR08	[701: 12820]	21°25.85' 157°06.8'	1500-1400 200 kg	Volcanic agglomerate with calcareous matrix; welded agglomerate; fine felsic volcanics; volcaniclastic sandstone; pisolitic sandstone; thick manganese crust
DR09	[270/4:1000]	21°21.5' 157°14.6'	1800 300 kg	Friable calcarenite-calcirudite; water worn volcanic pebbles; thick manganese crust
DR10	[270/4:1000]	21°21.9' 157°14.8'	1600 100 g	Calcarenite; thin manganese crust
DR11	270/3-4 intersection	21°04.5' 156°52.6'	1800-1700 50 kg	Metamorphic quartzite; volcanogenic graywacke, welded tuff; thick manganese crust
DR12	Swath	16°49.9'S 157°30.9'E	2600 30 kg	Claystone; thick manganese crust
DR13	Swath	16°51.1'S 157°29.2'E	2900-2750 100 kg	Dolerite; vesicular basalt; chert; chalk; manganese nodules
DR14	Swath	16°40.6'S 157°15.8'E	2900-2400 500kg	Quartz gabbro (dolerite); basalt; hyaloclastite; bentonitic mudstone; glauconitic calcarenite; chalk; calcareous ooze
DR15	14/35:32.0555	16°10.1'S 156°34.8'E	2630 60 kg	Basalt; muddy foram chalk; manganese nodules
DR16	14/56:55.1455	15°39.5'S 155°45.3'E	2600-2500 15 kg	Fine tuff; thick manganese nodules; calcareous ooze
DR17	14/57:52.2245	14°41.6'S 155°52.2'E	3250-3000 500 kg	Basalt; agglomerate; marble; red bed mudstone; grey bioturbated mudstone; bentonitic claystone; well sorted calcarenite
DR18	14/59:56.0640	15°05.3'S 155°26.0'E	3300-3100 20 kg	Basalt; hyaloclastite in carbonate cement
DR19	14/36:32.1820	16°10.9'S	3750-3650 154°34.1'E	400 kg Hyaloclastite; manganese nodules
DR20	14/78:92.0240	16°54.6'S 155°15.8'E	2850-2650	No recovery. Probably did not reach bottom.
DR21	274/3:2300	17°24.4'S 155°29.3'E	1950-1500 200kg	Basalt; minor basaltic conglomerate and agglomerate; dark red claystone; laminated calcareous red and grey claystone
DR22	274/3:8200	17°35.7'S 155°45.7'E	1700-1300 350 kg	Basalt; vesicular basalt; reef limestone (algal boundstone, calcirudite, calcarenite)

DR23	13/72:88.2007	17°38.5'S 156°03.9'E	2300-2000 0.2 kg	Hyaloclastite; manganese crust
DR24	13/72:88.2007	17°40.2'S 156°03.2'E	2200-2000 200 kg	Calcarenite; micritic limestone; basalt; volcanogenic conglomerate; muddy calcareous lithic sandstone
DR25	13/64:72.1640	18°09.0'S 156°17.3'E	2650-2350 200 kg	Calcarenite; hyaloclastite
DR26	13/62:66.1120	18°29.9'S 156°18.0'E	2100-1950 60 kg	Rounded basalt boulder; conglomerate; calcareous lithic sandstone; thick manganese crusts
DR27	13/60:66.0723	18°51.7'S 156°23.1'E	1800-1650 0.5 kg	Conglomerate; manganese crust; deepwater corals (*Corallium*, bamboo, black)
DR28	13/60:66.0723	18°51.5'S 156°23.2'E	No recovery	Not on bottom
DR29	274/1:3340	19°49.8'S 156°27.7'E	No recovery	Not on bottom
DR30	274/1:3340	19°49.8'S 156°26.3'E	2400-2100 0.5 kg	Basaltic conglomerate; calcareous ooze
DR31	274/1:3340	19°49.9'S 156°27.6'E	2600-2450 7 kg	Calcareous tuff; brown foram-bearing mudstone; greenish grey foram mudstone; calcareous ooze
DR32	274/1:1000	20°45.7'S 157°32.1'E	1550 0.5 kg	Thick manganese crust
DR33	274/1:1000	20°45.7'S 157°32.1'E	1800-1700 0.5 kg	Ferruginised quartz-bearing sandstone; chalk; calcareous ooze
DR34	N701:14250	20°50.6'S 157°22.2'E	1700 4 kg	Quartz-rich metadolerite; thick manganese crust
DR35	13/49:0448	20°36.7'S 156°43.5'E	2200-1950 150 kg	Hard quartz-rich sandstone; ?bentonitic claystone; pebbly micritic mudstone; concretionary micritic mudstone; micritic calcarenite; calcareous ooze
DR36	274/1:4660	19°27.6'S 156°00.4'E	2500-2150 8 kg	Basalt; foram-rich calcarenite; foram chalk; bentonitic clay; thick manganese crust.
DR37	13/60:66.0321	18°49.5'S 155°41.7'E	2200 25 kg	Foram-rich chalk; thick manganese crust
DR38	274/1:7160	18°38.6'S 155°19.6'E	2600 0.1 kg	Basalt; pumice
DR39	274/1:7160	18°37.9'S 155°23.6'E	2400 12 kg	Basaltic hyaloclastic conglomerate; minor calcareous ?tuff
DR40	13/64:72.1233	18°10.8'S 155°37.6'E	2100-1850 200 kg	Calcareous conglomerate; algal boundstone; weathered calcarenite; vesicular basalt; brecciated vesicular basalt; redbed mudstone; weathered red mudstone; hard grey mudstone; greenish grey mudstone; weathered mudstone
DR41	13/64:72.1020	18°10.4'S 155°15.8'E	1900-1450 450 kg	Felsic volcanics (dacite, rhyolite, quartz diorite); basalt; volcanics weathered to multicoloured claystone; redbed mudstone
DR42	13/64:72.0808	18°09.2'S 154°53.4'E	1600 20 kg	Basalt; lateritised basalt; foram chalk; grey mudstone
DR43	274/1:8932	18°07.9'S 154°42.0'E	2000-1850 130 kg	Hard cemented calcarenite; friable calcarenite; hard quartz-rich calcareous sandstone
DR44	274/1:10330	17°38.0'S 154°20.3'E	2500-2350 10 kg	Fine grained calcarenite; bentonitic mudstone; manganese nodules and crusts

Appendix 1. Key equipment

– *Kongsberg-Simrad EM 300* multibeam sonar swath-mapper
– *Kongsberg-Simrad Topas PS 18* parametric sub-bottom profiler
– Scientific echosounder (12 kHz)
– *Charge-Air* DC330/2000 diesel compressor of 2000 psi capacity for airguns
– 2 x GI airguns, each of capacity 45/105 cubic inches
– Seismic winch
– *Stealtharray* solid seismic cable 550 m long, with 300 m active section and 24 channels
– Seismic acquisition system including *Navipak* and *Geometrics StrataVisor NX*
– Seismic processing work station
– Plotter for seismic profiles and sampling locations
– MMC *Seaspy Overhauser* magnetometer and towing winch
– Gravity corer, 1 tonne, for 4-6m cores
– Dredges, chain bag and pipe
– Ship's winches and deck machinery
– Coring cradle
– DGPS navigation

Appendix 2. Technical summary of activities over 26 days

Activity	Timing	Elapsed time	Rate of acquisition
420 km transit from Bundaberg	1030 Jan 25 to 1530 Jan 26	1 day 5 hours	7.7 knots (into high winds)
11 dredges; 3 cores	1530 Jan 25 to 0330 Jan 30	4 days 12 hours	7 hours/station including transits. 3.3 hours/dredge over side
1189 km seismic acquisition	1700 Jan 30 to 1830 Feb 5	6 days 2 hours	9.5 km/hour 200 km/day
33 dredges; 2 cores	1330 Feb 6 to 0230 Feb 18	11 days 14 hours	8 hours/station including transits 3.8 hours/dredge over side
1000 km transit to Cairns	0230 Feb 18 to 1000 Feb 20		9.6 knots (slowed as neared Cairns)
Transits between activities	0330 to 1700 Jan 30; 1830 Feb 5 to 1330 Feb 6	1 day 8 hours	
Total sampling: 44 dredges, 2 cores		16 days 2 hours	8 hours/station including transits

In summary:

1) The seismic program was reduced to one third of the expected kilometres because of the failure of the compressor. Fortunately, two of four critical lines running WNW-ESE were acquired. Data acquisition rates were tolerable and data quality was good. The Voyage Plan called for 3130 km of seismic data and we acquired 1189 km.

2) Of the 44 dredges, 40 recovered something, and 37 (85 %) produced valuable results. The Voyage Plan called for 36 dredges and we acquired 44 dredges. Water depths varied from 400 m to 3800 m. The average time for each dredge (in the water to back on deck) was 3.3-3.8 hours.

3) The coring program of 5 cores produced three moderately successful cores, but was disappointing overall. The Voyage Plan called for 10 cores and we acquired 5 cores.