

NOTE: This is a preliminary report only. Data are yet to be fully checked and analysed.

VOYAGE REPORT OF A SURVEY OF DEEP-SEA HABITATS OF THE LOUISVILLE SEAMOUNT CHAIN (TAN1402)

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Photo caption: A mixed benthic community of stony corals, brisingid seastars, feather stars and urchins on Forde Guyot

Project report VMES133

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Project code: VMES133

Vessel: R.V. *Tangaroa*

Area: Central Louisville Seamount Chain

Period: 31 January – 6 March 2014

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BACKGROUND

Vulnerable marine ecosystems (VMEs) are ecosystems that are considered to be highly vulnerable to one or more kinds of human activity such as fishing. VMEs are identified by the vulnerability of their species, communities, and/or habitats to disturbance. There are concerns that VMEs are threatened by fishing in areas of the ocean beyond national jurisdiction ('high seas'). The United Nations, international conservation organisations, and fisheries management agencies all wish to implement management strategies to protect VMEs, and thereby preserve ecosystem function in the deep sea. New Zealand fishing fleets operate in the high seas region of the South Pacific, and New Zealand is currently leading initiatives to improve fisheries management in the region through the South Pacific Regional Fisheries Management Organization (SPRFMO).

There is currently limited information about the distribution or characteristics of VMEs in the South Pacific, which is hampering the design of management measures. Recent studies have demonstrated that habitat suitability models can predict the occurrence of seabed animals that indicate the presence of VMEs. Various international bodies have called for the development of such models and for their use in designing effective management plans for fishing on the high seas.

The VME Project aims to produce predictive models for VMEs in the South Pacific - specifically the SPRFMO area and the New Zealand EEZ. The effectiveness of potential management and conservation scenarios to protect VMEs will be evaluated using these models. The project has to date collated all available biological and environmental data for building two types of preliminary habitat suitability model (Maximum Entropy "MaxEnt" and Boosted Regression Tree "BRT") for a number of VME indicator taxa (e.g. stony corals, sponges). The performance of the preliminary habitat suitability models has been evaluated by internal cross-

validation. However, model predictions should ideally be ground-truthed to give end-users (e.g., the SPRFMO Scientific Committee) confidence in their application for management purposes. Thus a critical component of the VME project is to design and implement a survey to evaluate the reliability of the VME models. The Louisville Seamount Chain has been identified and agreed amongst the project team and its Stakeholder Advisory Group as a suitable area, where the models are expected to be most relevant for managing fishing activity and conserving VMEs in the SPRFMO region. This seamount chain is currently important to New Zealand fisheries, known to host VME species and subject to interim protection measures. Part of the Louisville Seamount Chain has also been identified recently as an Ecologically or Biologically Significant Area (although this is a designation without management implications under the Convention on Biological Diversity).

Voyage objectives:

Project objectives

- (1) To collect environmental and biological data suitable for
 - (a) the validation and/or improvement of preliminary large-scale, habitat suitability models for VME indicator taxa; and
 - (b) the development of small-scale, habitat suitability models for VME indicator taxa.
- (2) To collect specimens of VME indicator taxa (e.g. corals, sponges) for studies of genetic connectivity, and taxonomy and systematics.

Secondary objectives

- (3) To collect live specimens of coral for shore-based laboratory observation.
- (4) To observe marine mammals and seabirds to validate and/or improve existing habitat suitability models for these megafauna.

METHODS

Survey area

The sampling encompassed 6 seamounts along the Louisville Seamount Chain (Figure 1). They were originally distributed in three regions which reflected a general gradient in fishing from North to South, and although this gradient was maintained, the actual seamounts surveyed changed based on a review of which were the most suitable to test the final model results.

The six seamounts were:

Forde Guyot

“CenSeam Guyot”

“Anvil Seamount”

“39South Seamount”

“Ghost Seamount”

Valerie Guyot

A single station was on “JCM Guyot”

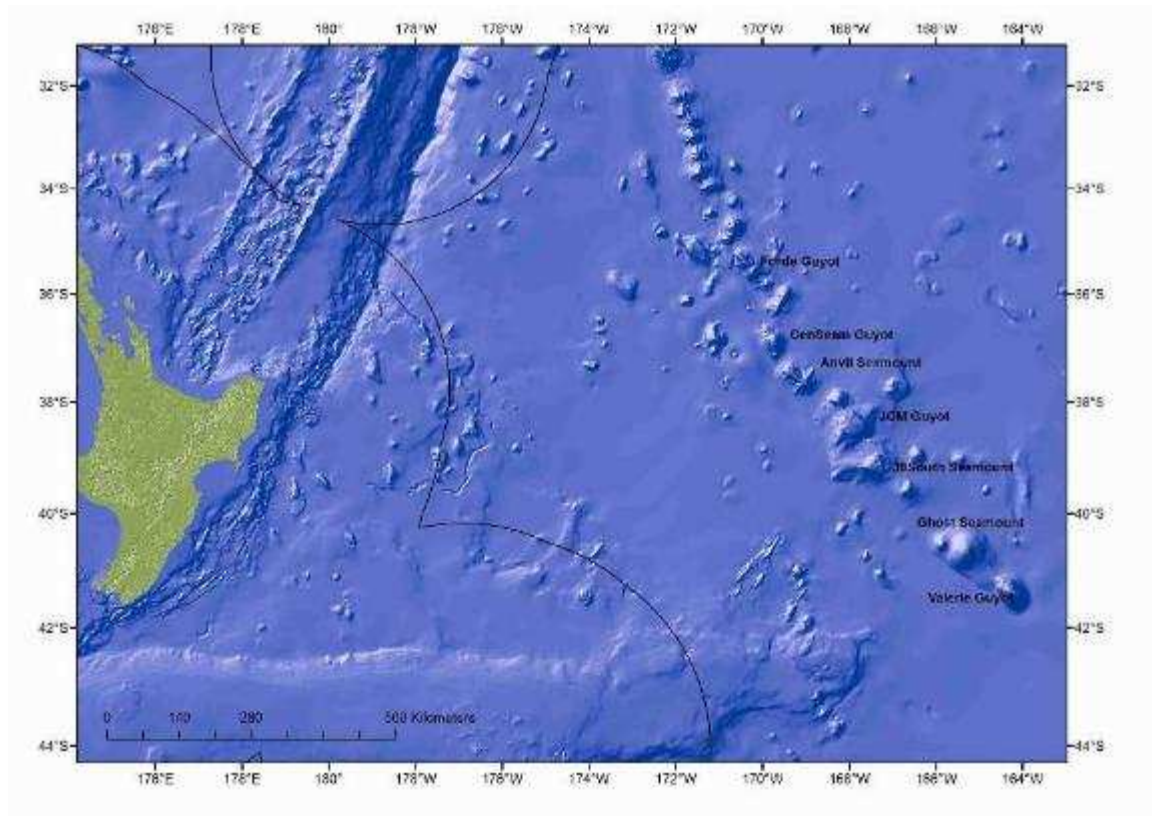


Figure 1: The general survey area on the Louisville Seamount Chain, showing the selected seamounts along the chain.

Survey stratification

Survey design was based upon sampling a range of habitat suitability model options, in order to test the accuracy and reliability of the predictions. There were 5 main “strata”, each one relating to specific model characteristics:

Stratum	Colour	Conditions
0001	Green	High probability of coral occurrence, both BRT and Maxent , unfished
0002	Pink	Low probability of coral occurrence, both BRT and Maxent, unfished
0003	Blue	Different probability between models (one high, one low), unfished
0004	Grey	Intermediate probability of coral occurrence (neither high nor low), BRT model, unfished
0005	Red	High probability of coral occurrence, both BRT and Maxent, fished.

Model results were produced at a scale of 0.5 by 0.5 n.miles, and the grid was used to structure sampling. Cells were selected at random, 6 for stratum 1 (which was deemed the most important), and 4 for each of the other strata (see Figure 2). Some seamounts typically deep) had no, or few, cells of some strata (usually 0002, which were typically deeper than 1500 m, or 0005 where northern seamounts had less fishing).

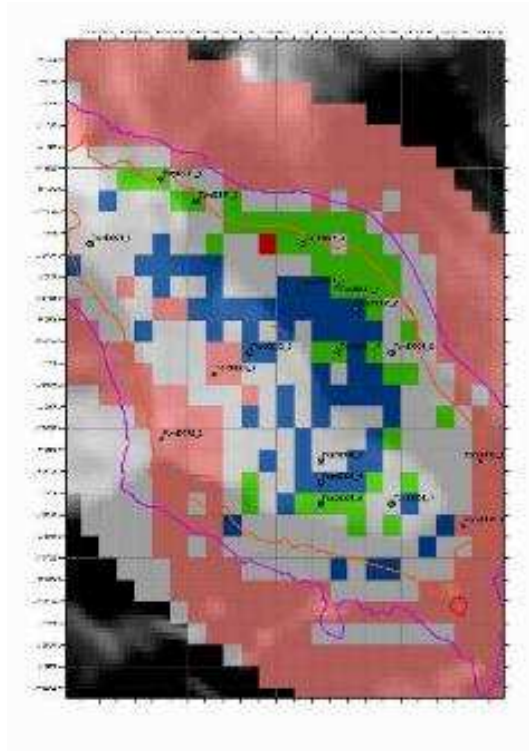


Figure 2: Example of a survey design planning map, with cell colour depicting stratification, and labels showing the cells selected for sampling.

Single cells were not selected, as the length of a DTIS tow was generally about 1 n.mile. Hence two cells were required for a tow to remain within the boundaries of a stratum. Direction of tow, and also which cells could be sampled, was affected by weather, with the vessel operation best with the wind on the starboard bow.

The random approach was complemented by some selected transect lines, based on three qualifications:

- Depth: The modeling was based on SRTM bathymetry. Once the MBES surveys were completed, and true bathymetry was known, it was clear that many of the cells were in depth ranges that would not be suitable for stony corals. Cells were then replaced by ones at shallower depth.
- Experience of the staff onboard. This was especially valuable as the survey progressed and it became clear that the distribution of corals was patchy and localised. The tops of the guyots were very consistent in that the substrate comprised sand, with few corals. Hence, in order to gain more information in the limited time available, additional cells were selected where topography and backscatter indicated from experience a greater chance that corals may be abundant.
- Cell selection was also influenced by the specific location of trawling, based on several interviews with previous fishing skippers, and their fishing maps. This gave more precise positional information than the MPI catch records, where vessel position is used, and rounded to the nearest minute of latitude and longitude.

Sampling operations

Multibeam mapping

High quality multibeam data were not available for any of the seamounts, although transit lines of 12kHz bathymetric data, and good coverage of one seamount, from several voyages by the German RV Sonne were helpful. On five of the 6 seamounts it was necessary to run multibeam transects (using the *Tangaroa's* Kongsberg EM302) across large areas of the seamount before sampling could commence.

Mapping was generally run along the axis of each seamount, typically in a NW-SE orientation. Speed depended on the weather conditions at the time, and was between 6 and 9 knots. Forde was mapped in one continuous survey, but it was planned that the other seamounts being larger were surveyed in 2 blocks, each about 12 hours in duration.

Photographic sampling

The main sampling tool was NIWAs Deep Towed Imaging System (DTIS). This is a towed camera frame system designed to survey epifauna, demersal fish and substrate type (Figure 3).

DTIS is fitted with Sony 1080 50i HD video and Canon 10 megapixel SLR still image cameras. DTIS was deployed along transects of 1 h duration at speeds of 0.5-1 kt. Seabed video was monitored in real time and spatially referenced observations of substrate type and benthic megafauna were logged using Ocean Floor Observation Protocol software (OFOP). DTIS was tracked in real time against the appropriate multibeam sonar terrain map using the *Tangaroa's* Simrad HiPAP system, with the officer of the watch using the OFOP repeater screen on the bridge for precise positioning of the camera in relation to seabed features.

DTIS video tapes were rendered as uncompressed high definition (1080 50i HDV) *.m2t files using non-linear video editing software and saved to a dedicated hard disc drive for backup. Still images were downloaded from DTIS immediately on recovery of the vehicle and filenames and metadata were written using the batch edit facilities in ACDSee Pro. All images were then saved to the OFOP PC data drive and backed up to the DTIS video hard drive. OFOP log files were checked for completeness and consistency after each deployment and backed up to the ship's server. Ashore, all video, image, and log files were uploaded to secure servers at Greta Point, Wellington. Video tape originals (miniDV format) were archived in the Brodie building map room at Greta Point.

Direct faunal sampling

Samples of the invertebrate epifauna, as well as rocks, were obtained using an epibenthic sled-NIWAs "Seamount Sled" (SEL) (see Figure 3). The sled has a 1m wide and 0.3m high mouth opening, with a 25mm mesh liner inside a 100mm chafing net outer. The sled was used to target sites where corals, representative fauna, or unusual species were observed on DTIS. Tows varied in length depending upon the distribution of targets along the DTIS transect, and the likely catch of rocks or coral rubble associated with the track. The sled was deployed from the port trawl winch. On a number tows, a transponder beacon was attached, so the position of the sled could be monitored during the tow.

The whole sample was photographed on the trawl deck and then transferred to bins for weighing. Depending on catch volume, either the whole sample or a subsample was sorted for fauna on the 5 mm mesh sorting table. All specimens were preserved appropriately (ethanol or formalin depending on taxon). All preserved and discarded samples, together with total catch weights, were recorded in the *Specify* database and, once ashore, all faunal samples were lodged at the NIWA Invertebrate Collection, Greta Point, Wellington.

Several types of coring/grab equipment were also taken in the event that conditions and time allowed sampling of soft sediment sites. However, these were not used given the focus on maximizing the time during the survey for the epibenthic objectives.

Water sampling

A small Conductivity-Temperature-Depth (CTD) unit was attached to DTIS, and data recorded for every camera transect.

Once on each seamount, a 12 bottle CTD unit (Figure 3) was deployed in the vicinity of live coral colonies. Samples were collected at standard depths of 10, ~50-100 (approx. depth of mixed layer), 250, 500, 750, 1000, 1100, 1200, 1300, 1400, 1500 m, etc. Duplicate samples were taken when possible at bottom depths where live scleractinian corals were found and / or where live corals were sampled. Samples were taken for alkalinity (1 Litre bottles) and dissolved inorganic carbon (DIC) (250 ml bottles). Bottom temperature and dissolved oxygen (DO) was recorded at each sample depth on CTD log sheets. Photographs were made of CTD log sheets as well as hard copy print outs. The CTD log sheets have a record of where possible contamination occurred by bottle. Record sheets (depth, bottle number, station, etc) of each CTD were placed in water sample bins.

Deployment of all gear was planned with direct reference to multibeam maps and observations from the DTIS video transects. Full data on the times and positions of each deployment were logged in *Tangaroa's* Trawl Coordinator system, and transferred once ashore to the appropriate databases.

Coral aquarium

Live scleractinian corals were collected from several seamounts along the Louisville Ridge. For each epibenthic sled haul, a chilled ~5.5°C seawater slurry bin was readied so corals collected by the sled could be placed back in seawater with temperatures close to where they were collected. The slurry bins with live corals were then taken to the wetlab area for processing where coral colonies of sufficient size (~125 cm³ or larger) were selected to meet voyage objectives.

The colonies were removed from the chilled water one at a time, attached to a small piece of plastic mesh with a label, weighed, photographed, then placed into one of 12 bins in *Tangaroa's* flow-through, temperature controlled aquarium system. This system was setup with a high flow rate (~50 l/hr) and temperature of ~ 5°C to reproduce conditions found in the areas from which they were collected. *Specify* no, lot no, weight, and date were recorded on the catch form and label. This label was placed in a zip lock bag and attached with a small cable tie, to each coral colony and the mesh. A written record was made of where each coral colony was placed in the aquarium system, both on paper and on a whiteboard in the lab.



Figure 3: The sampling gear used for the survey: DTIS (top), the Seamount sled (lower right), and 12 bottle CTD (lower left).

RESULTS

Voyage timetable and narrative

The voyage track is shown in Figure 4 and a summary of the daily work schedule is given in Table 1.

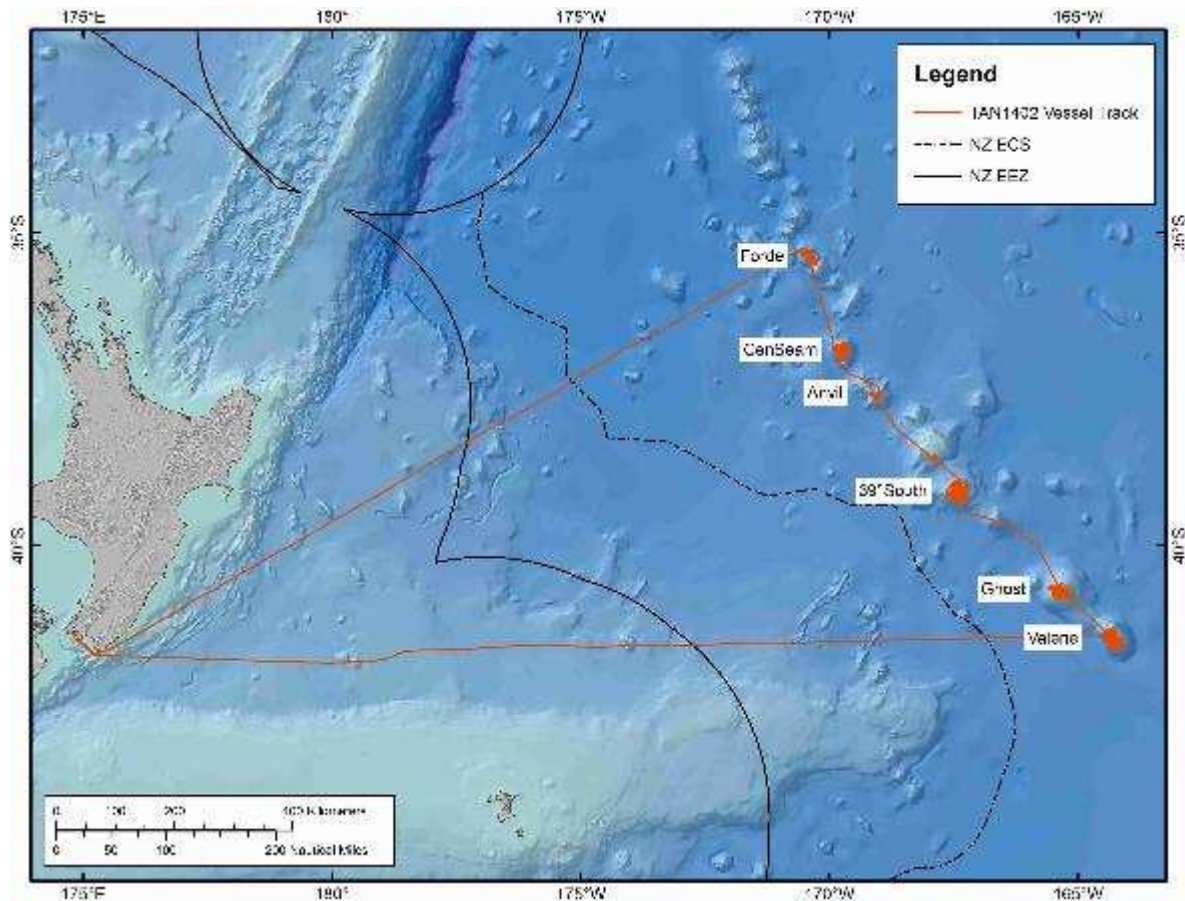


Figure 4: Track of RV Tangaroa during voyage TAN1402.

Table 1. TAN1402 voyage timetable and summary of activities.

Date	Activity
31 Jan	Mobilisation completed. Sail from Wellington 1800. Test DTIS in harbour. Autopilot problem, return to port.
1-3 Feb	In port, Wellington, checking fault, awaiting replacement.
4-6 Feb	Transit to Louisville Seamount Chain, northern site.
7 Feb	Forde Guyot. Arrive 0930, SVP prior to MBES survey. MBES finished 2300.
8 Feb	Forde Guyot: 7 DTIS, 3 sleds
9 Feb	Forde Guyot: 2 DTIS, 1 fast for some time and damage, swap to spare DTIS. 3 sleds. 3 DTIS once changed over.
10 Feb	Forde Guyot: Straight run of 8 DTIS.
11 Feb	Forde Guyot. Hipap problem when underway system leaks. CTD on VME site, a sled. 1200 transit to CenSeam Guyot. SVP, and commence MBES survey 1930.
12 Feb	CenSeam Guyot: 7 MBES lines, finish 1100. 5 DTIS.
13 Feb	CenSeam Guyot: 8 DTIS.
14 Feb	CenSeam Guyot: 2 sleds, 9 DTIS.
15 Feb	CenSeam Guyot. 2 DTIS, 2 sleds, 1 CTD cast. Complete 1 MBES line on western side. Steam for Anvil Seamount. No MBES survey as have previous Sonne data.
16 Feb	Anvil Seamount: 8 DTIS, 1 sled.

Date	Activity
17 Feb	Anvil Seamount. 4 DTIS, 1 sled. Complete CTD 1340. Head for 39South, via southern flank of JCM Guyot. JCM Guyot Two short MBES lines on southern flank. DTIS from ridge down flank.
18 Feb	Complete DTIS at JCM. Continue to 39south guyot. 39south guyot: SVP. MBES survey of eastern sector 1900. 2 DTIS.
19 Feb	39south guyot. 9 DTIS. Weather good, excellent progress.
20 Feb	39South guyot. 2 DTIS to complete east side. Sled on small cone. SVP, MBES survey of western side, 7 lines.
21 Feb	39South guyot. 4 DTIS, one sled, a CTD to 2000m. 1630 begin transit to Ghost, MBES while in transit, over several reported seamount peaks.
22 Feb	Ghost Seamount: Arrive 0430. SVP and commence MBES survey of NE sector. 1700 start DTIS operations. 3 tows working DTIS.
23 Feb	Ghost Seamount. Continue DTIS tows (7), and 2 sled tows.
24 Feb	Ghost Seamount: 3 DTIS. SVP prior to MBES survey of SW sector of seamount. Short squall delays ops slightly. 2 DTIS in evening.
25 Feb	Ghost seamount: 8 DTIS, 1 sled.
26 Feb	Ghost Seamount: NW corner region. 5 DTIS, 2 sleds (1 poor), 1 CTD. 2100 transit towards Valerie, via Mt Whales, multibeam en route.
27 Feb	Valerie Guyot. SVP. Begin MBES lines 0500. Complete SW half at 1730, but weather too rough for DTIS, so continue MBES.
28 Feb	Valerie Guyot: Complete MBES 0650. 2 sleds on southern spur. 5 DTIS.
1 Mar	Valerie Guyot: 8 DTIS, working western side primarily.
2 Mar	Valerie Guyot: 3 DTIS. One fast after 35 mins on eastern flank. CTD. 2 sleds. 1515 finish operations, begin steam for Wellington.
3-5 Mar	In transit to Wellington – multibeam en route.
6 Mar	08:00 – alongside, Aotea wharf, Wellington, Clear Customs 10:00

Sampling

In total, 157 stations were completed, consisting of 119 DTIS, 25 epibenthic sled, and 6 CTD deployments (Table 2) In addition to the main sampling, 7 sound-velocity-probe casts were made to calibrate multibeam data. All station details are presented in Appendix 1 and locations are shown in greater detail in individual site descriptions below.

One sled tow was unsuccessful, with almost no catch, although two DTIS tows ended early with the gear coming fast on obstructions, and the still camera failed on three tows.

DTIS:

More than 119 hours of high definition video were recorded (1 h per DTIS station), and almost 28,000 still images were taken (240 frames per 1 h of transect) (Table 3). Image quality for both video and stills was generally high but was dependent on the altitude of DTIS above the seabed and the speed of the ship during the transect. With many camera transects undertaken on high relief volcanic substrates and on steep canyon walls, conditions were often challenging for maintaining the camera vehicle close to the seafloor at the optimum altitude for providing consistently high quality images. Thus, the total number of useable images and minutes of video will be less than the totals given above. With the excellent surface conditions through most of the survey, however, the proportion of useable images is high.

Table 2: Count of stations per site by gear type. Numbers include both strictly random sites, as well as semi-target stations, the number of the latter in parentheses). NA, stratum did not occur on the seamount.

Seamount name	Stratum	DTIS	Sled	CTD
Forde	0001	6	6	1
	0002	4		
	0003	4		
	0004	5	2	
	0005	NA		
CenSeam	0001	7	1	1
	0002	4	2	
	0003	4		
	0004	5	1	
	0005	2		
Anvil	0001	5 (2)	1	1
	0002	2	1	
	0003	2		
	0004	2		
	0005	1		
JCM	0001	1 (1)		
39South	0001	5	1	1
	0002	NA		
	0003	3		
	0004	6 (2)		
	0005	3		
Ghost	0001	8 (5)	1	
	0002	4 (4)	2	1
	0003	5 (1)		
	0004	6 (4)		
	0005	5 (2)	2	
Valerie	0001	6 (1)	1	
	0002	NA		
	0003	3 (1)		
	0004	6 (3)	3	1
	0005	1		

Table 3: Summary of image data collected during the voyage.

Seamount	Stations	Video (hours)	Video (minutes)	Still images
Forde	20	19	26	4341
Censeam	22	22	22	4758
Anvil	13	12	27	3053
JCM	1	1	02	258
39 South	17	17	39	4255
Ghost	29	30	9	7067
Valerie	16	16	20	4132
TOTAL	118	119	25	27864

Seamount sled:

In total 25 sled tows were made. All were successful except one where the catch was very small, and bottom contact may have been inadequate. Most sled tows were 10-15 minutes on the bottom, although on two occasions tows were extended to 30 minutes to cover an expanse of soft sediment where DTIS indicated sparse fauna. The sled operated very well, with

sampling a variety of terrain from flat sand substrate through to boulder lava flows. The sled came fast on several occasions, but was able to be freed and continue the tow on most occasions. All sleds except one were recovered without one or both the break-aways having released (set at about 10 t tension-one tow had one breakaway gone but retained a good catch). On several tows, an HPR beacon was placed on the sled. This enabled us to monitor the sled position accurately. Figure 5 shows the vessel and the sled positions from the beacon.

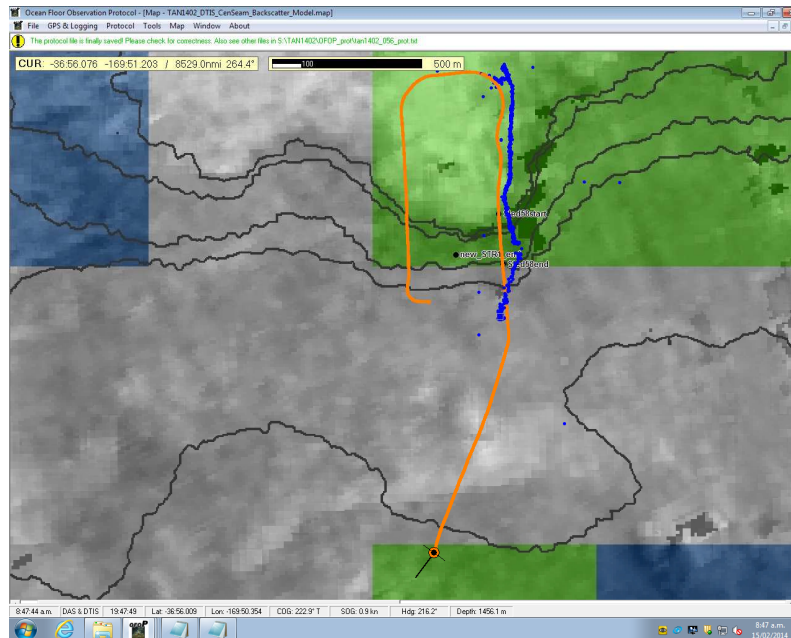


Figure 5: A trace of vessel (orange) and sled (blue) position, during a tow on CenSeam Guyot, towing southwards from the summit plateau down a section of the flank at 1300 m.

Site descriptions

Descriptions of faunal assemblages and substratum types were recorded in real time from DTIS camera transects and subsequently augmented by observations from high-resolution still images. In the next sections of the report, we document for each seamount the sampling sites, descriptions of each video transect, and selected images of the seafloor that give a representative idea of the observed communities.

Forde Guyot

Sampling sites

The location of sampling stations on Forde Guyot is shown in Figure 6.

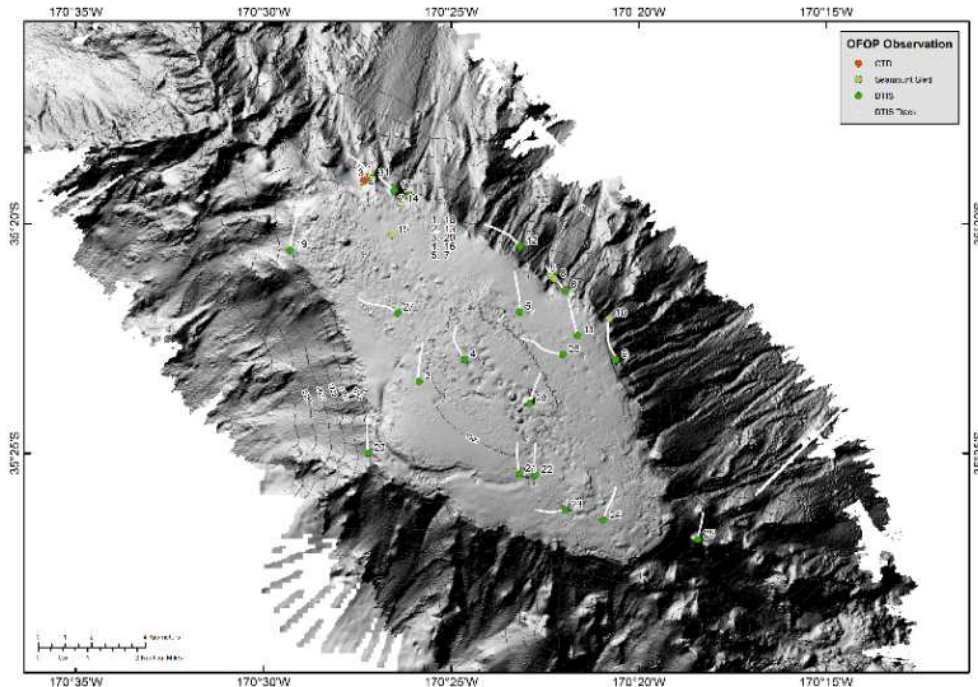


Figure 6: Forde Guyot, showing the position (with station number) of DTIS and SEL tows, and a CTD cast.

Transect descriptions

Forde: Stn 003, str0002_1.

Depth Range: 1005 – 1012 m.

Flat relief mostly sand with ripples. Gravel and coarse material in the ripples. Two areas of bedrock (lava) with overlying sand and coral rubble. Very low abundance of fauna, but occasional asteroids and two majid crabs, a few rattails.

Forde: Stn 004, str0003_3.

Depth Range: 968 – 993 m.

Overall rippled sand along most of transect, often very defined with consistent and fine grain size. Initially some gravel, with increasing bedrock (lava) and large patches of coral rubble. Frequent tracks in sand, occasional echinoids, asteroids, hydroids, sponge & scaphopods. Also chrysogorgid gorgonians (particularly *Metallogorgia*), *Etmopterus* sharks, and sponges towards end.

Forde: Stn 005, str0003_1.

Depth Range: 1004 – 1063 m.

Flat sandy bottom. Tracks common in sand, some ripples, burrows. Invertebrates included scaphopods, asteroids, Tam O'shanters, prawns. Some rattails.

Forde: Stn 006, str0001_4.

Depth Range: 1080 – 1400 m.

Mix of bedrock with sand overlay, sandy-patches with some coral rubble. Early on, live stony coral and coral rubble patches amidst bedrock. Frequent sponges (esp. stalked), gorgonians

(including *Metallogorgia*, *Iridogorgia*), black corals and crinoids. A few rattails, sharks, echinoderms on sandy bottom, some tracks and burrows.

Forde: Stn 009, str0004_2.

Depth Range: 1110 – 1172 m.

Gradual slope upwards. A mix of bedrock outcrops with sand overlay and coral rubble. Other areas of muddy sediments, gravel and coral rubble. Intact coral, with live patches around 1100m. Frequent crinoids, with gorgonians and echinoids.

Forde: Stn 011, str0003_2.

Depth Range: 1038 – 1082 m.

Downhill slope, predominantly soft sand with ripple. Occasional bedrock (lava) outcrops with coral rubble and some intact coral with brisingids and crinoids. Low abundance of invertebrates on the sand, occasional asteroids and urchins.

Forde: Stn 012, str0001_3.

Depth Range: 1280 – 1374 m.

Bedrock and boulder outcrops, sand patches, coral rubble, high rough relief. Numerous crinoids, stalked crinoids, *Bathypathes*, *Metallogorgia* and gorgonians. Few intact corals, some live at the start, some sea pens on sandy patches.

Forde: Stn 013, str0001_2.

Depth Range: 1289 – 1382 m.

Bedrock and sandy bottom substrate. Numerous crinoids (stalked & non-stalked). Large sections of coral intact/rubble, with frequent live coral heads at 1350-80 m. Gorgonians common, particularly *Metallogorgia*, with black corals, cup corals, sponges, and a Dumbo octopus. DTIS became snagged at end of tow, free after 1.5 hrs.

Forde: Stn 017, str0001_2.

Depth Range: 1154 – 1330 m.

No stills recovered due to camera problem. Started on summit with sand and coral rubble. Down slope there were bedrock outcrops with areas of intact coral, many crinoids, some chrysogorgiids and occasional *Bathypathes*. Patches of sand with coral rubble and sand overlay on bedrock. Occasional sea pens.

Forde: Stn 018, str0001_1.

Depth Range: 1163 – 1584 m.

Intact live coral on the summit at 1163 m. Sand patches with rubble and giant forams. Just off the summit at 1174 m, live intact coral, brisingids, urchins, *Anthomastus* and large numbers of crinoids. Isolated bedrock outcrops during rest of transect with live intact coral and crinoids.

Forde: Stn 019, str0004_1.

Depth Range: 1158 – 1306 m.

Intact coral with brisingids and crinoids on bedrock, some *Bathypathes*. Expansive areas of sand with varying amounts of coral rubble. Crinoids very abundant.

Forde: Stn 020, str0002_2.

Depth Range: 1195 -1298 m.

Patchy distribution of live and dead intact stony coral, crinoids, sandy areas throughout most of the transect, outcrops of rock with gorgonians. Trawl warp at 1298m.

Forde: Stn 021, str0003_4.

Depth Range: 998 – 1031 m.

Mostly sand and ripples of varying proportions, numerous tusk shells), shrimps, echinoids, asteroids. A *Platymaia* crab, basketwork eels. Sparse fauna.

Forde: Stn 022, str0004_3.

Depth Range: 1158 – 1306 m.

Generally sand, ripples and occasional boulders, some large areas of coral rubble half way into the transect. Tusk shells, tracks.

Forde: Stn 023, str001_6.

Depth Range: 1067 – 1070 m.

All rippled sand, tusk shells, tracks, shrimps, asteroids, echinoids, occasional fish.

Forde: Stn 024, str0004_4.

Depth Range: 1050 – 1060 m.

Most of the substrate was rippled sand, gradual slope upwards. Scarce fauna (asteroids, fish, giant foraminifera). A few small areas of coral rubble, intact dead coral with abundant crinoids, also on bedrock.

Forde: Stn 025, str0002_4.

Depth Range: 1350 – 1443 m.

Traversed over two conical features on the SE end of Forde. Substrate was a mix of areas of rippled sand and large areas of bare bedrock. Boulders on southern slopes had some black and gorgonian corals, and sponges. Abundant yellow crinoids. Coral rubble and dead stony coral matrix (intact) observed near summit with large aggregations of urchins.

Forde: Stn 026, str0001_5.

Depth Range: 1000 – 1022 m.

Mostly rippled sand with two isolated rocky outcrops. Sparse fauna.

Forde: Stn 027, str0002_3.

Depth Range: 1027 – 1073 m.

Area observed was mostly flat ~ 80 % rippled sand with occasional bedrock. Coral rubble near bedrock and about a dozen small clumps of living scleractinian matrix with crinoids and some gorgonians were also observed.

Forde: Stn 028, str0003_4 (Forde Summit)

Depth Range: 945 – 1000 m.

Tow was from the SW side of the top, over the summit of the small peak. Revealed a mix of dead scleractinian matrix, sand and light coloured bedrock. After reaching the base, substrate changed to rippled sand. Scarce megafauna: few fish, echinoid, and sea pens.

Selected still images from DTIS of this seamount are given in Figure 7.

Forde Guyot summary

Forde is an elongated guyot, oriented NW-SE. The summit plateau is a large flat area at depths of 1000-1100 m, dropping steeply away from 1150 m. The flanks are deeply incised with gulleys and ridges. The summit region is predominantly sandy substrate, with tusk shells, gastropods, and scattered echinoderms. At the plateau edge, and down the upper flanks, there was exposed bedrock with sand, and intact coral. Most was dead, but there were scattered live clumps (mainly thought at the time to be *Goniocorella dumosa*, but most likely *Solenosmilia variabilis*). The northern flank had areas of more extensive coral cover, more frequent live clumps, with abundant associated crinoids and brisingid seastars. Gorgonians (in particular *Metallogorgia*) were also common, although not abundant. Urchins (*Caenopedina*) were dense in some areas, especially the northern flanks, in association with the intact stony corals. The northern sites would likely meet criteria for VME habitat.

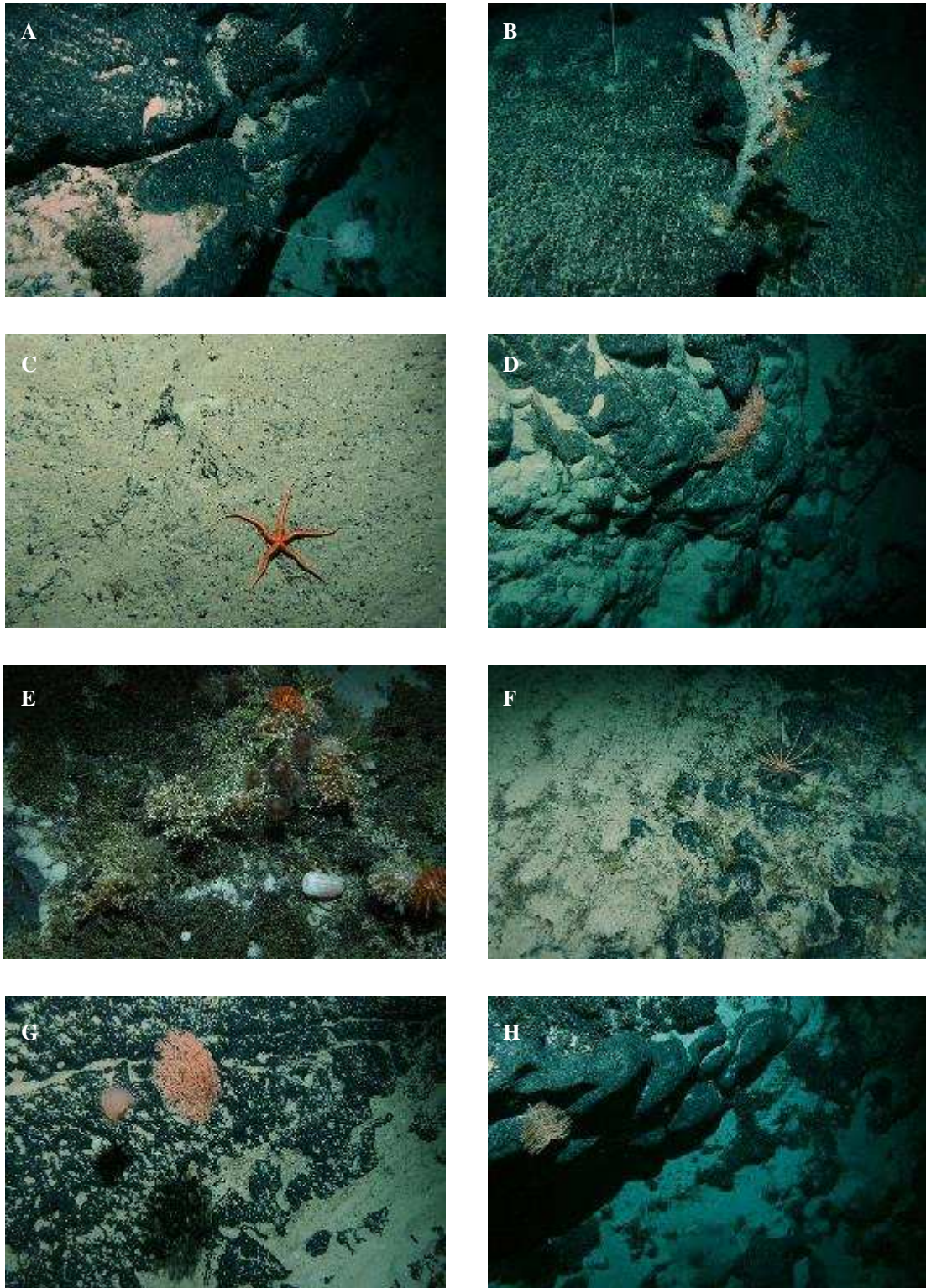


Figure 7: Forde seamount. A, stalked sponge (Porifera) at 1268 m; B, hexactinellid sponge, ophiuroids, and crinoids at 1265 m; C, sea star (*Zoroaster* sp.) at 1108 m; D, chrysogorgiid coral at 1462 m; E, coral and echinoderm complex at 1175 m; F, brisingid sea star and crinoids at 1365 m; G, chrysogorgiid coral with attached sponge at 1444 m; H, black coral (*Bathypathes* sp.) at 1426 m.

VME taxa distribution

The distribution of key VME taxa along DTIS transects is shown in Figures 8 to 13.

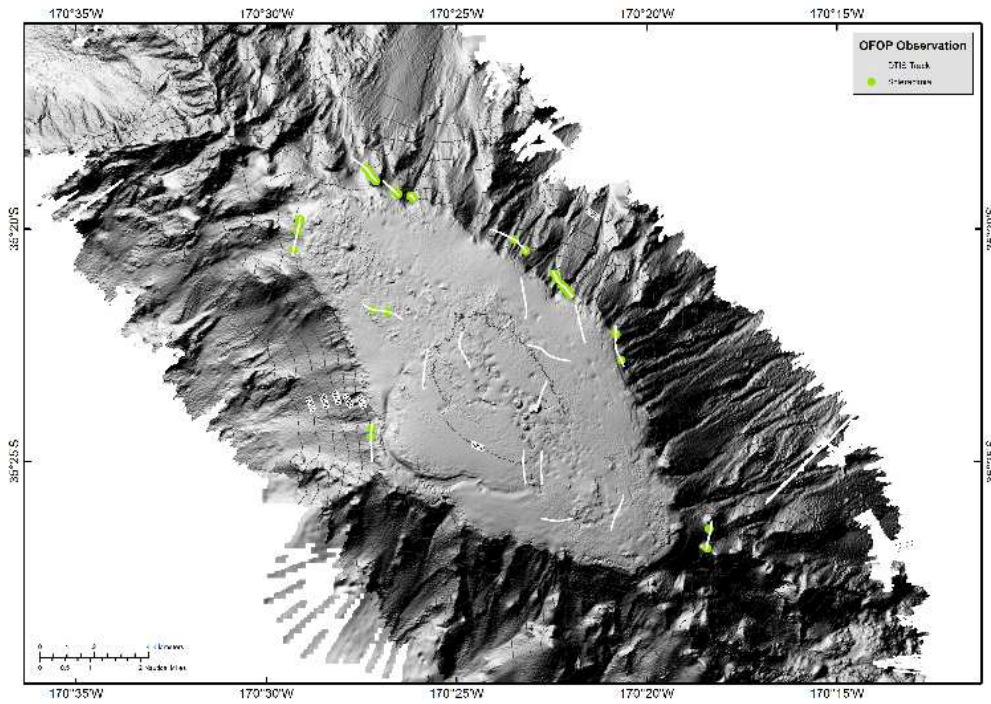


Figure 8: The distribution of Scleractinian (stony) corals on Forde Guyot (OFOP data).

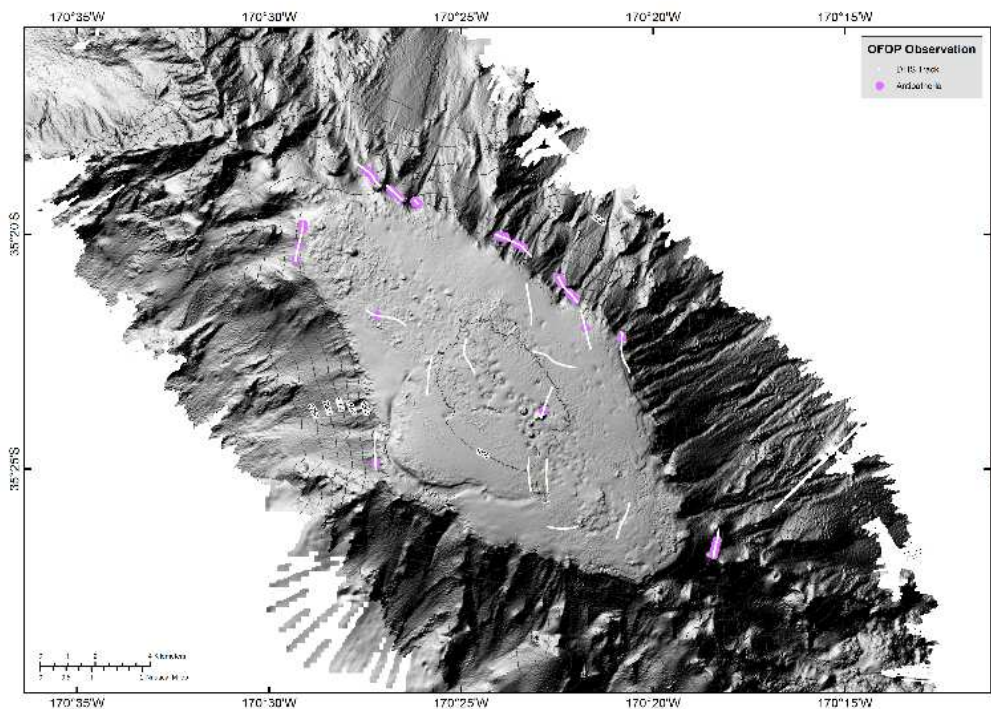


Figure 9: The distribution of Antipatherian (black) corals on Forde Guyot (OFOP data).

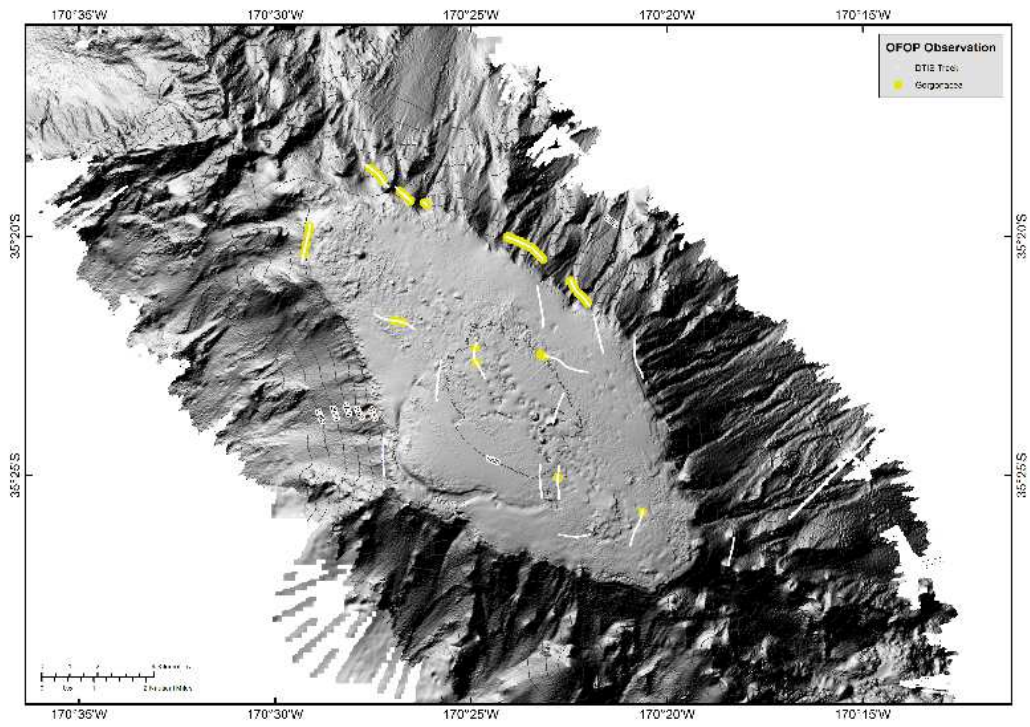


Figure 10: The distribution of Gorgonian (octo) corals on Forde Guyot (OFOP data).

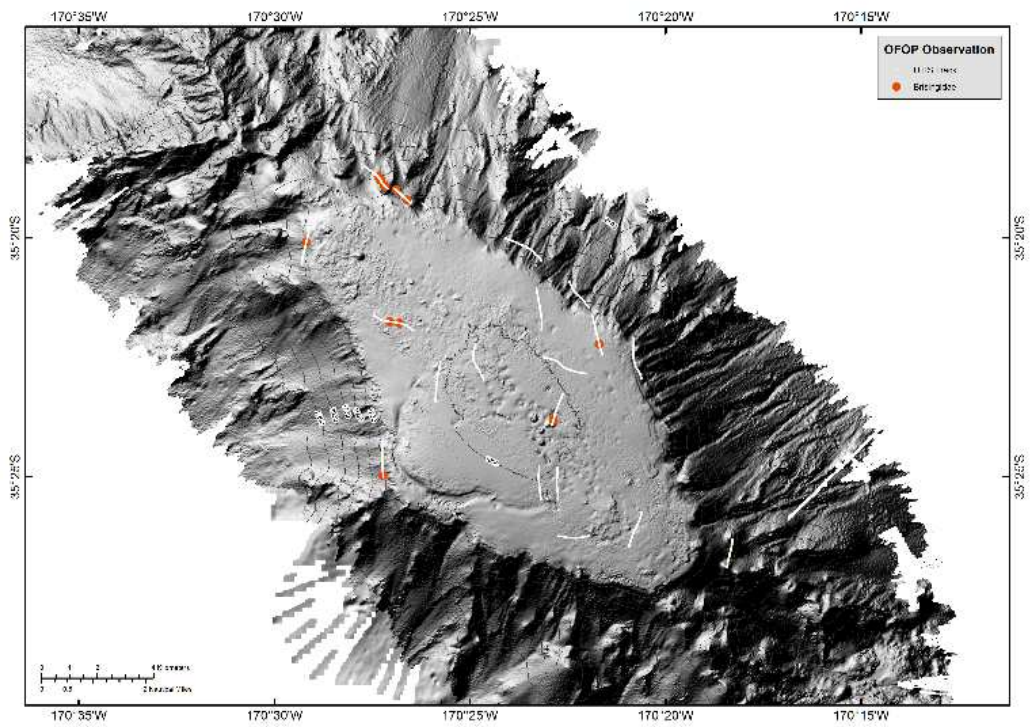


Figure 11: The distribution of brisingid seastars on Forde Guyot (OFOP data).

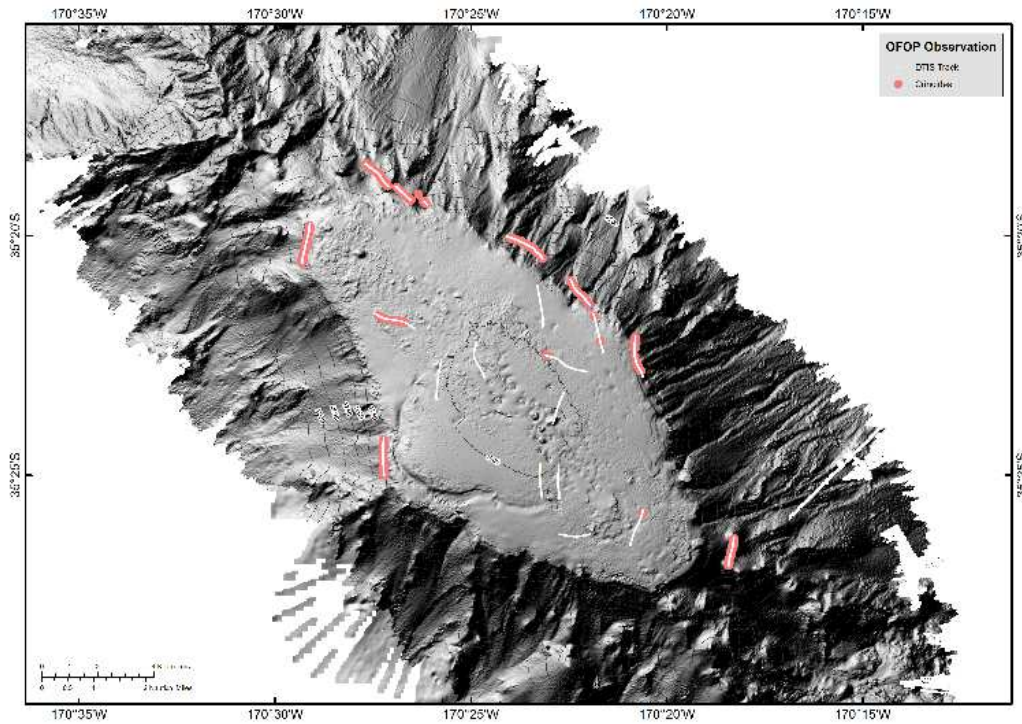


Figure 12: The distribution of crinoids (featherstars) on Forde Guyot (OFOP data).

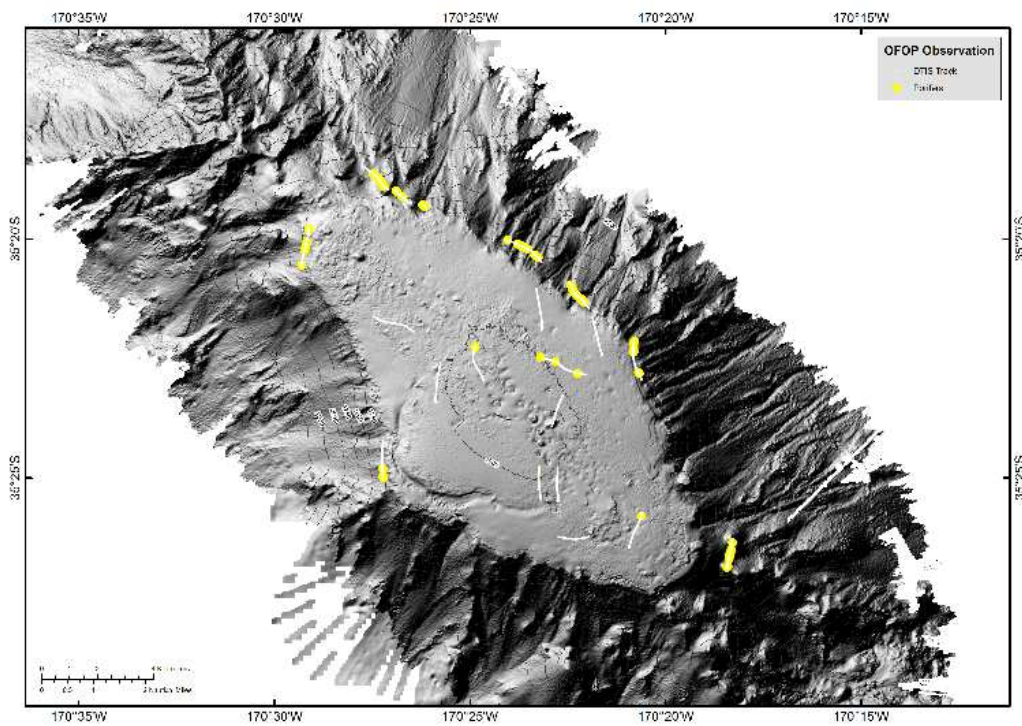


Figure 13: The distribution of Porifera (sponges) on Forde Guyot (OFOP data).

CenSeam Guyot

Sampling sites

The location of sampling stations on CenSeam Guyot is shown in Figure 14.

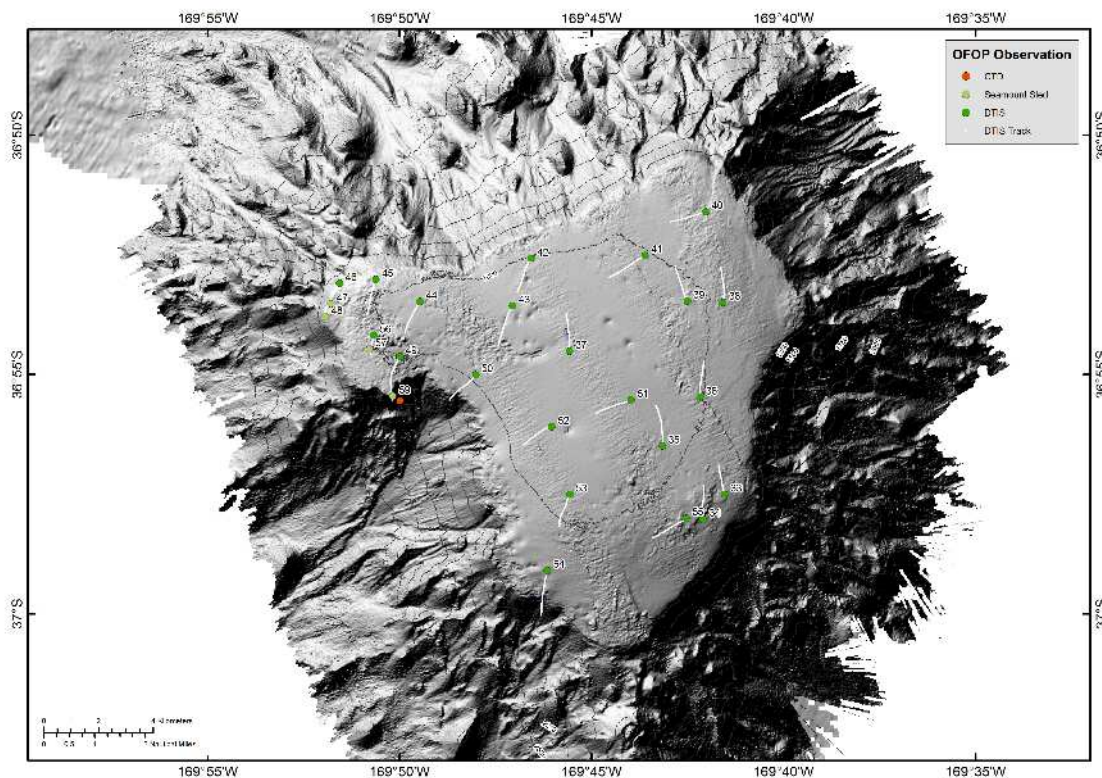


Figure 14: CenSeam Guyot, showing the position (with station number) of DTIS and SEL tows, and a CTD cast.

Transect descriptions

CenSeam, Stn 033, str0001_6

Depth Range: 1036 – 1075 m.

Patches of bedrock with sand overlay, sandy bottom with ripples, gravel – coral rubble, occasional dead intact coral. Tusk shells, echinoid tests, tracks, *Cerianthus*, with occasional intact coral on exposed rocks, small live clumps.

CenSeam, Stn 034, str0005_1.

Depth Range: 1020 – 1075 m.

Transect upwards along slope, mainly sand & ripples with some coral rubble. A few patches of intact dead coral matrix. Bedrock mostly barren with a few urchins. No apparent live corals observed.

CenSeam, Stn 035, str0004_3

Depth Range: 966 – 978 m.

95% rippled sand cover, only megafauna seen were a few asteroids, tusk shells, and a few fish. Observed a large area of dead coral rubble and matrix with no significant epifauna.

CenSeam, Stn 036, str0001_3.

Depth Range: 995 – 999 m.

100% rippled sand, very flat, very sparse fauna. Occasional asteroid, ophiuroid, tusk shell, gastropod, rattail.

CenSeam, Stn 037, str0003_3.

Depth Range: 945 – 955 m.

100% rippled sand, mostly flat with a single ~5 m deep depression. Sparse fauna, one red *Chaceon* crab, several echinoids, pagurids, sharks, and Tam O'shanter.

CenSeam, Stn 038, str0002_2.

Depth Range: 1006 – 1018 m.

Flat area, substrate predominately rippled sand plus a mix of coral rubble, bedrock outcrops and few patches of intact dead scleractinian matrix. Single live coral clump.

CenSeam, Stn 039, str0002_1.

Depth Range: 982 – 996 m.

Predominantly sand, ripples, several trawl tracks. Occasional live coral colonies on bedrock with sand overlay. Scattered typical soft benthic fauna (tusk shells, crinoids, echinoids, asteroids, burrows, tracks, gastropods, *Cerianthus*, worms).

CenSeam, Stn 040, str0004_1.

Depth Range: 1021 – 1052 m.

Flat region, bottom type changing from sand, ripples, shell hash, coral rubble, bedrock, sand overlay throughout transect. Some intact dead coral, no live. Invertebrates included asteroids, sea pens, scaphopods, urchins, gastropods. Scattered rattails, *Lepidion* and basketwork eel.

CenSeam, Stn 041, str0004_2

Depth Range: 985 – 1077 m.

Flat slope, largely rippled sand. Regular fauna of urchins, asteroids, scaphopods, cup-coral, cerianthids, gastropods. Burrows, tracks.

CenSeam, Stn 042, str0003_1.

Depth Range: 974 – 999 m.

Sandy bottom. Typical benthic fauna with tracks, burrows, echinoids (particularly Tam O'Shanter), asteroids, pagurids, sponge, scaphopods, sea pens, gastropods, sea pens, zoanthids, *Cerianthus*.

CenSeam, Stn 043, str0001_2.

Depth Range: 965 – 970 m.

Mostly on soft flat sediment. Occasional bedrock outcrops with *Anthomastus*. At the end of the transect there was some exposed bedrock and coral rubble.

CenSeam, Stn 044, str0003_2.

Depth Range: 980 – 986 m.

Mostly flat sand. Some coral rubble and intact matrix. Very sparse fauna.

CenSeam, Stn 045, str0001_1

Depth Range: 1000 – 1034 m.

Sand, ripples, rubble, with small isolated patches of bedrock with some intact coral and coral rubble. Few invertebrates, some asteroids, gastropods, Cerianthids, tusk shells. No stills taken by the DTIS

CenSeam: Stn 046, str0002_4

Depth Range: 1064 – 1154 m.

Landed 1145, tow upslope and over rise. Bedrock and sand, not a lot of epifauna. Some live stony coral (small clumps), *Metallogorgia*, sponges. Abundant coral rubble. Small numbers of crinoids, gorgonians, sponges, with a few areas of intact coral, one live.

CenSeam: Stn 049, str0001_target.

Depth Range: 994 – 1255 m.

For most of transect, sandy bottom, ripples, with bedrock patches. Typical soft sediment epifauna (tusk shells, echinoids, asteroids, tracks, burrows, tube worms, *Cerianthids*, gastropods, holothurians, eels, shark. Video was paused for 18 mins to drop off slopes. Abundant dead coral with dense *Caenopedina* urchins. Scattered primnoids, crinoids, sponges. *Metallogorgia* at very end, with expanses of dead intact coral.

CenSeam: Stn 050, str0001_4.

Depth Range: 994 – 1117 m.

Gradual slope down, sandy initially with usual tusks, urchins etc. Then bedrock with sandy overlay, coral rubble and intact coral in places. Sparse fauna.

CenSeam: Stn 051, str0002_3.

Depth Range: 945 – 957 m.

Flat rippled sandy bottom. Moved up slightly sloping seabed. gastropods common, particularly in the first half of transect. Sparse fauna otherwise.

CenSeam: Stn 052, str0003_4

Depth Range: 959 – 967 m.

100% sand, very flat and featureless seafloor. Scattered asteroids, echinoids, gastropods, but generally sparse fauna.

CenSeam: Stn 053, str0001_5.

Depth Range: 976 – 981 m.

Transect totally sandy bottom, very few animals observed.

CenSeam: Stn 054, str0004_4.

Depth Range: 1066 – 1470 m.

Southern flank of CenSeam Guyot. First half was sand, after that steep terrain, bedrock outcrops with *Bathypathes*, *Metallogorgia*, echinoids, gorgonians, crinoids.

CenSeam: Stn 055, str0005_2.

Depth Range: 1029 – 1054 m.

Bedrock with sand overlay, flat bottom. Patches of coral rubble, little intact coral, some small clumps of living scleractinia with crinoids and brisingids. One orange roughly.

CenSeam: Stn 056, str0004_Target.

Depth Range: 950 – 1009 m.

This transect targeted an unusual mark near the seafloor on the single-beam echo-sounder. Sandy substrate gives way to dominant coral rubble and intact (all dead). Tusk shells on sand at beginning, Tam O'Shanter, gastropods. Then brisingid and crinoids. Short transect.

Selected still images from DTIS of this seamount are given in Figure 15.

CenSeam Guyot summary

This guyot was fully multibeamed, as there was little coverage prior to this voyage. It was given the working name of “CenSeam Guyot” during the trip, in recognition of the Census of Marine Life on Seamounts (acronym CenSeam) that was a major international field programme under the Census of Marine Life.

The main plateau of this guyot is at 950–1050 m depth. From 1100 m it drops steeply away, like Forde with numerous gulleys and ridges down its flanks. Most sampling effort was on the plateau itself, where the substrate was predominantly rippled sand, with scaphopods and gastropods, urchins and asteroids. Bedrock patches frequently had sand overlay, and in general only small clumps of live coral were found. The northwestern corner of the guyot had more life, with intact coral, live coral patches, and a high density of urchins.

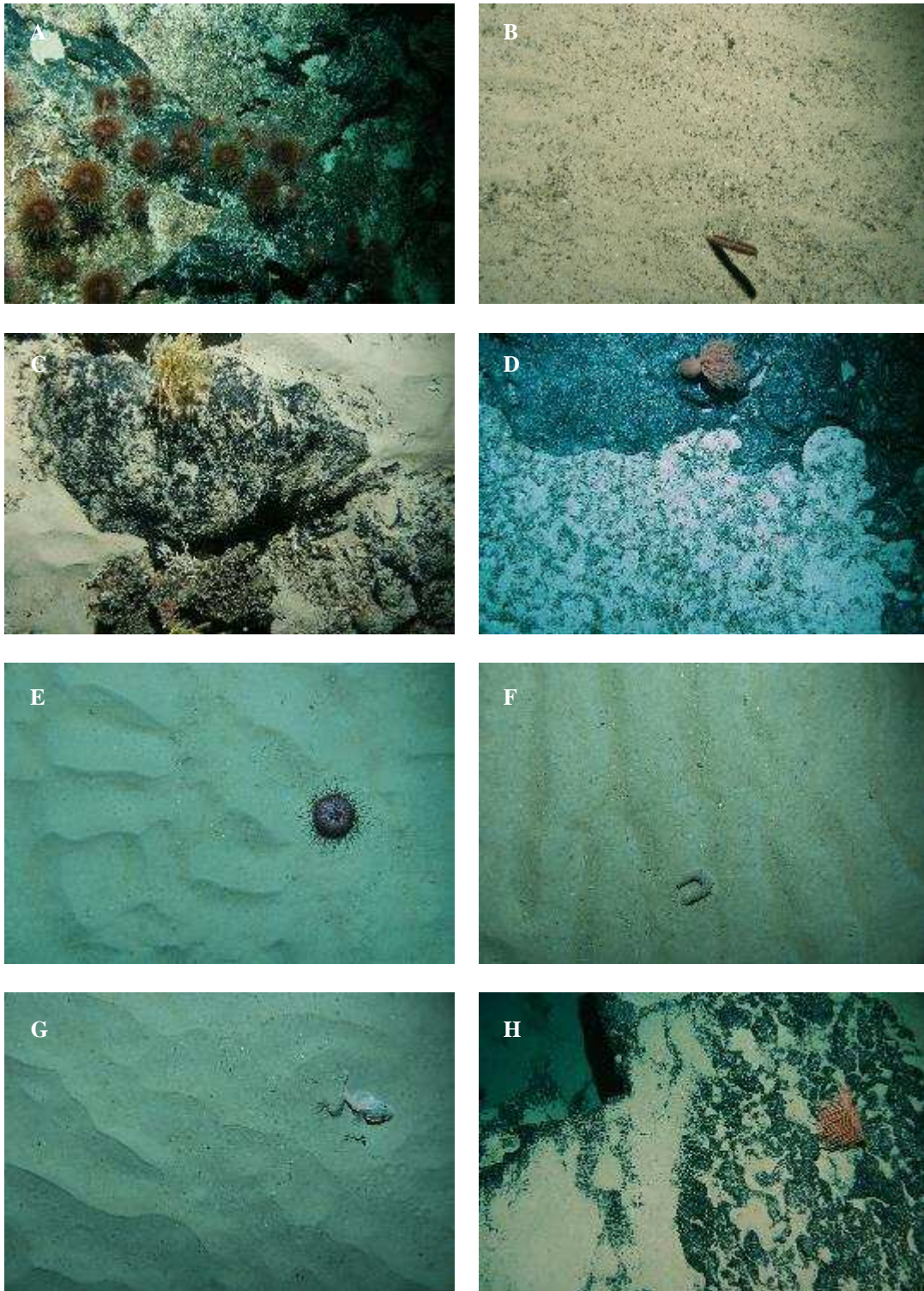


Figure 15: CenSeam Guyot. A, sea urchins (*Caenopedina porphyrogigas*) at 1059 m; B, pennatulacean sea pen at 1032 m; C, crinoids and corals at 1031 m; D, alcyonacean soft coral at 969 m; E, echinothurioid sea urchin at 950 m; F, holothuroid (sea cucumber) at 1009 m; G, scorpionfish at 950 m; H, black coral (*Bathypathes* sp.) and sea urchin (*Gracilechinus multidentatus*) at 1377 m.

VME taxa distribution

The distribution of key VME taxa along DTIS transects is shown in Figures 16 to 21.

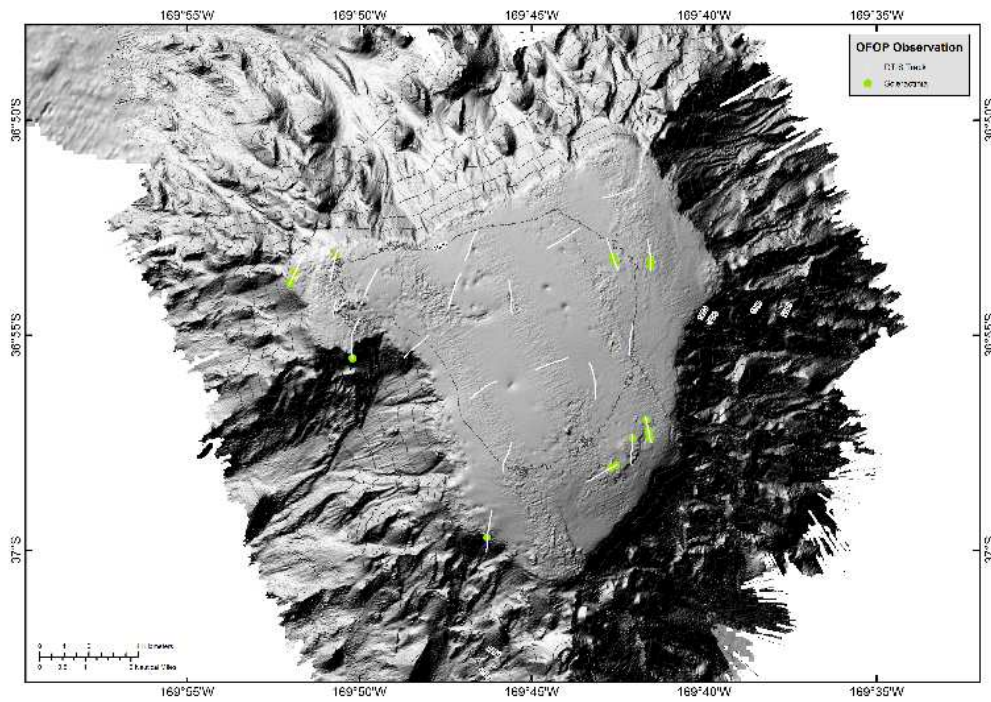


Figure 16: The distribution of Scleractinian (stony) corals on CenSeam Guyot (OFOP data).

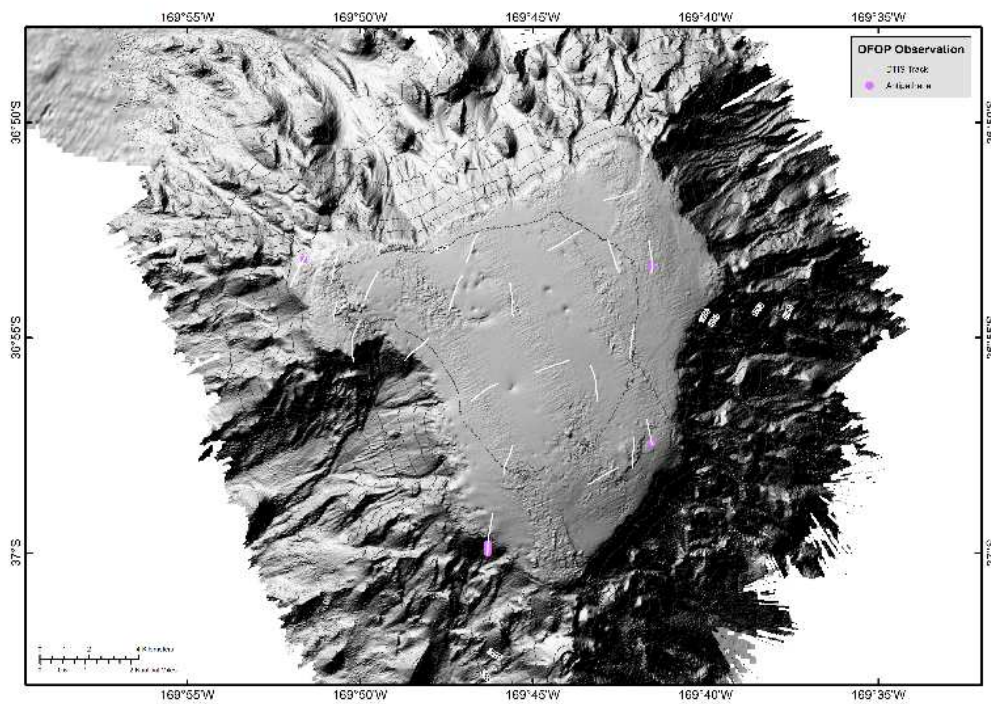


Figure 17: The distribution of Antipatherian (black) corals on CenSeam Guyot (OFOP data).

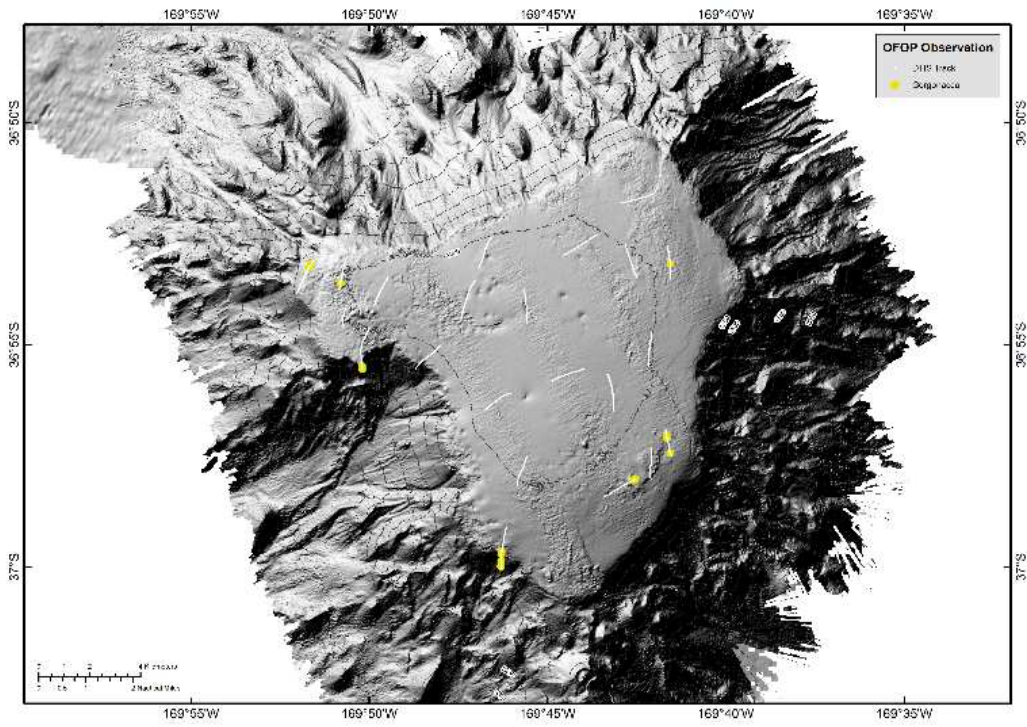


Figure 18: The distribution of Gorgonian (octo) corals on CenSeam Guyot (OFOP data).

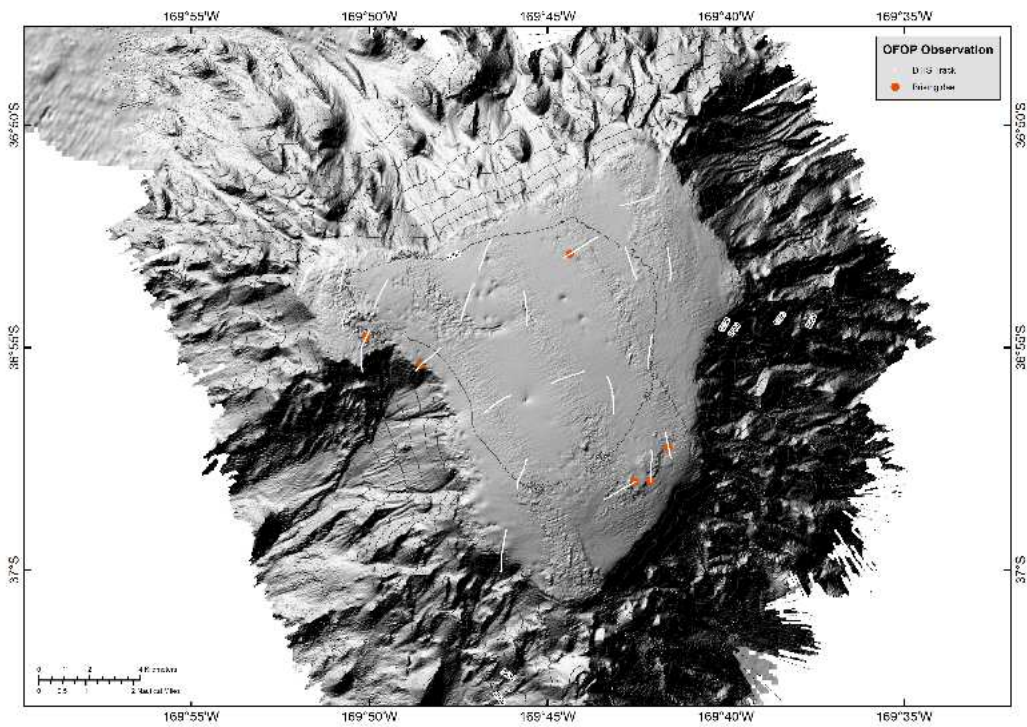


Figure 19: The distribution of brisingid seastars on CenSeam Guyot (OFOP data).

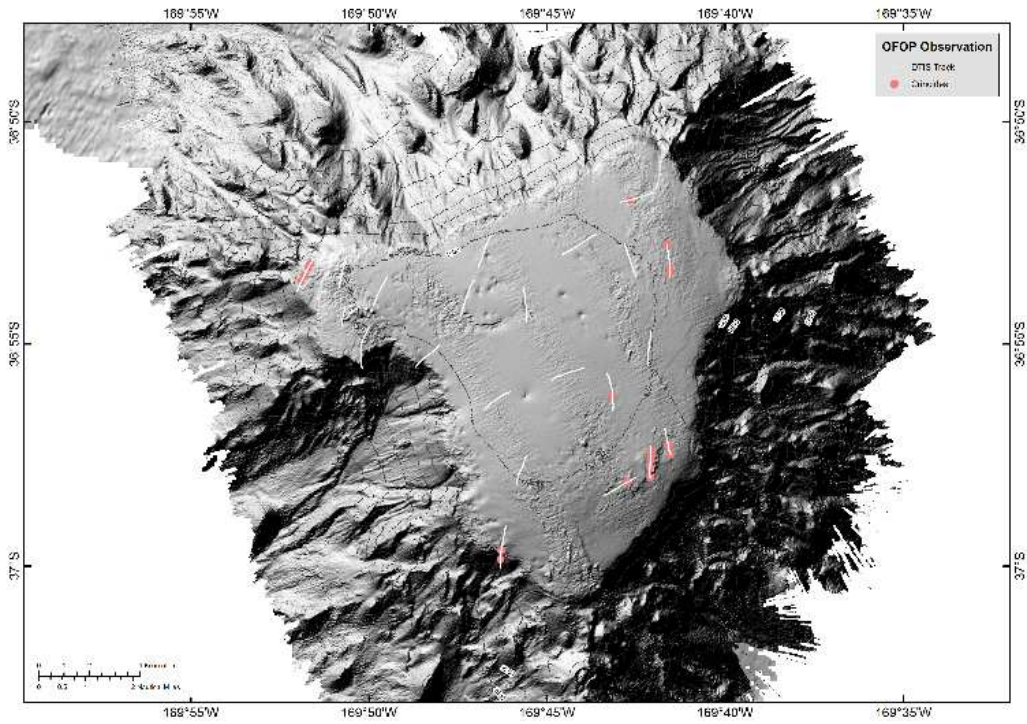


Figure 20: The distribution of crinoids (featherstars) on CenSeam Guyot (OFOP data).

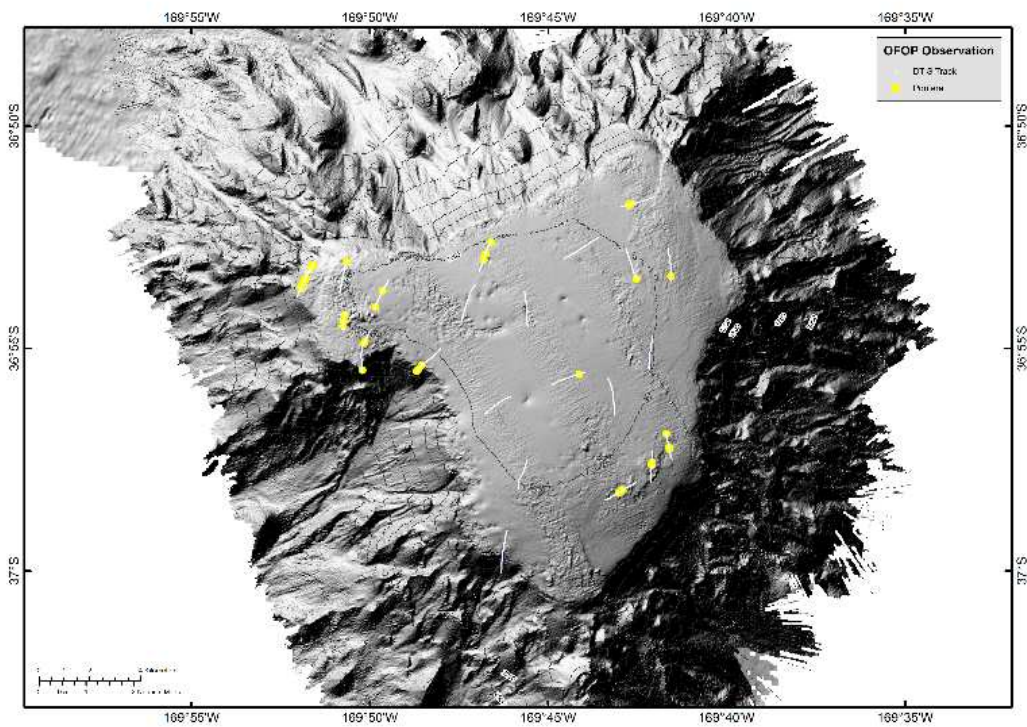


Figure 21: The distribution of Porifera (sponges) on CenSeam Guyot (OFOP data).

Anvil Seamount

Sampling sites

The location of sampling stations on Anvil Seamount is shown in Figure 22.

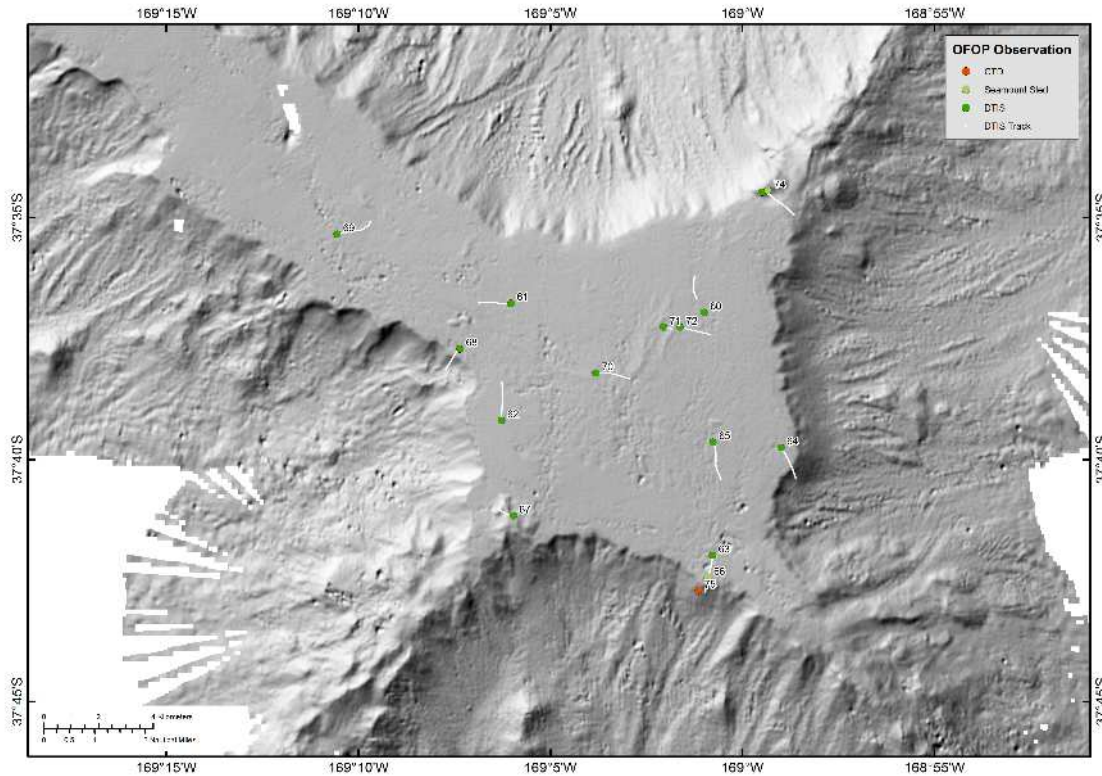


Figure 22: Anvil Seamount, showing the position (with station number) of DTIS and SEL tows, and CTD cast.

Transect descriptions

Anvil Guyot: Stn 060, str0001.

Depth Range: 1189 – 1205 m.

Gentle downhill slope, rippled sand with white cobbles. Then change to patches of exposed bedrock, coral rubble with live scleractinian matrix. Abundant urchins, crinoids and brisingids on live corals.

Anvil Guyot: Stn 061, str0001.

Depth Range: 1138 – 1152 m.

Flat, all rippled sand, low epifaunal abundance and diversity, *Gracilechinus* urchins, some asteroids, and scaphopods.

Anvil Guyot: Stn 062, str0004.

Depth Range: 1135 – 1142 m.

100% rippled sand, a few urchins and fish. Sparse fauna.

Anvil Guyot: Stn 063, str0001.

Depth Range: 1230 – 1418 m.

Initially sand, changing to bedrock, coral rubble and intact coral patches. Bedrock with stony coral clumps, with gorgonians and crinoids. Solitary gorgonians, black coral, with patches of denser sponges and echinoids. Tam O Shanter, gastropods, sea pens, sea stars on soft

sediment. No realtime OFOP position data from this station until computer problem fixed station 081.

Anvil Guyot: Stn_064, str 0001

Depth Range: 1237 – 1495 m.

First half of transect dominated by sandy bottom with many *Gracilochinus*, sea stars and sponges. Then intermittent bedrock or sand and ripples, with stony coral clumps (some live) with *Dermechinus*. Diverse scattered gorgonians, black coral, sponges, crinoids. 1300m on bedrock clumps of gorgonians (*Chrysogorgia* & cf. *Corallium*). Then drops away into dead coral zone, with urchins and scattered gorgonians. No realtime OFOP position data.

Anvil Guyot: Stn_065, str. 0003

Depth Range: 1171 – 1192 m.

Sandy fine grained bottom. Benthic fauna largely *Gracilochinus*, asteroids, some rattalis. At 1182 m bedrock, with sand overlay. Dead intact coral and rubble with some fish, tusk shells and sharks. Sandy bottom from 1200m. No realtime OFOP position data.

Anvil Guyot: Stn_067, str. 0005

Depth Range: 1047 – 1104 m.

Moved down slope over a previously fished area. Bottom comprised sand and coral rubble with several patches of exposed bedrock. Areas of low flat bedrock with sandy overlay, occasional *Bathypathes*, urchins (*Dermechinus*), gorgonians, stylasterids, crinoids, *Chaceon* crab and orange roughy. Expanses of dead coral rubble and sand between bedrock areas. No realtime OFOP position data.

Anvil Guyot: Stn_068, str.0001

Depth Range: 1162 – 1528 m.

Flat sand for the first 15 min, then bedrock with sand overlay as the drop off commenced. Steady descent for the most of the deployment with bedrock outcrops/boulders and sand patches. Small clumps of intact stony coral with crinoids, gorgonians, crinoids.

Anvil Guyot: Stn_069, str. 0002

Depth Range: 1203 – 1196 m.

Rippled sand sediment with ripples, and occasional urchin. Generally very low abundance and diversity of invertebrates.

Anvil Guyot: Stn_070, str.0004

Depth Range: 1090 – 1099 m.

Relatively flat bottom, predominantly rippled sand. Some bedrock areas with benthic fauna including stony coral (some live), gorgonians (*Iridogorgia*), brisingids, soft corals and crinoids

Anvil Guyot: Stn_071, str.0003

Depth Range: 1150 – 1153 m.

Initially sand, ripples with mixed bedrock, boulders, intact and coral rubble. Some sponges, crabs, eel, shark and rattail. After 13 minutes, DTIS gets snagged, connection lost, transect aborted

Anvil Guyot: Stn_072, str.0003

Depth Range: 1157 – 1179 m.

Continuation of previous transect (Stn_071). Sandy with gravel overlay and more prominent ripples indicative of a stronger bottom current. Urchins (*Gracilochinus*), tusk shells, natant decapods, scattered crabs and cerianthids. At 1169 m towards the end of the transect, bedrock with some live stony coral colonies. Then back to rock overlain with sand for remainder of transect, some shall hash.

Anvil Guyot: Stn_073, str.0002

Depth Range: 1285 – 1389 m.

Summit of Anvil. Start at 1285m, over top at 1280m, then drop down and rise again before dropping further to 1338m. Bottom type predominantly bedrock, sandy overlay with regions of sand, ripples, cobbles, pebbles, and gravel-like sediment. Around the summit were bedrock

outcrops, with intact stony coral (live), gorgonians, flute-like glass sponges, urchins and crinoids. From 1350m, dead intact coral, with black coral. Heading back up slope bedrock, sandy overlay, coral intact & rubble, with stony coral clumps, crinoids, urchins and sponges.

Selected still images from DTIS of this seamount are given in Figure 23.

Anvil Seamount summary

Anvil is a striking dumbbell-shaped seamount with strong lateral ridges to the east and west of the main axis. It has two definite peaks, joined by an elongated ridge. It had been swath-mapped by the *Sonne*, and this was not repeated during the survey in order to save time. We sampled only the southern peak, due to the large size if we were to try and sample both. The summit is relatively flat-topped, with a gradual shallowing from the flank edge at 1250 m up to 1100 m. The seamount has only been lightly trawled, with some tows in the southwestern sector.

The flat top is largely sandy substrate, with ripples in places indicating areas of strong current flow. The flanks drop away steeply from about 1250 m, and over the edge was hard exposed bedrock, with intact (dead) coral, as well as scattered live clumps of *Solenosmilia*. Densities were generally low, and no areas of VME were identified.

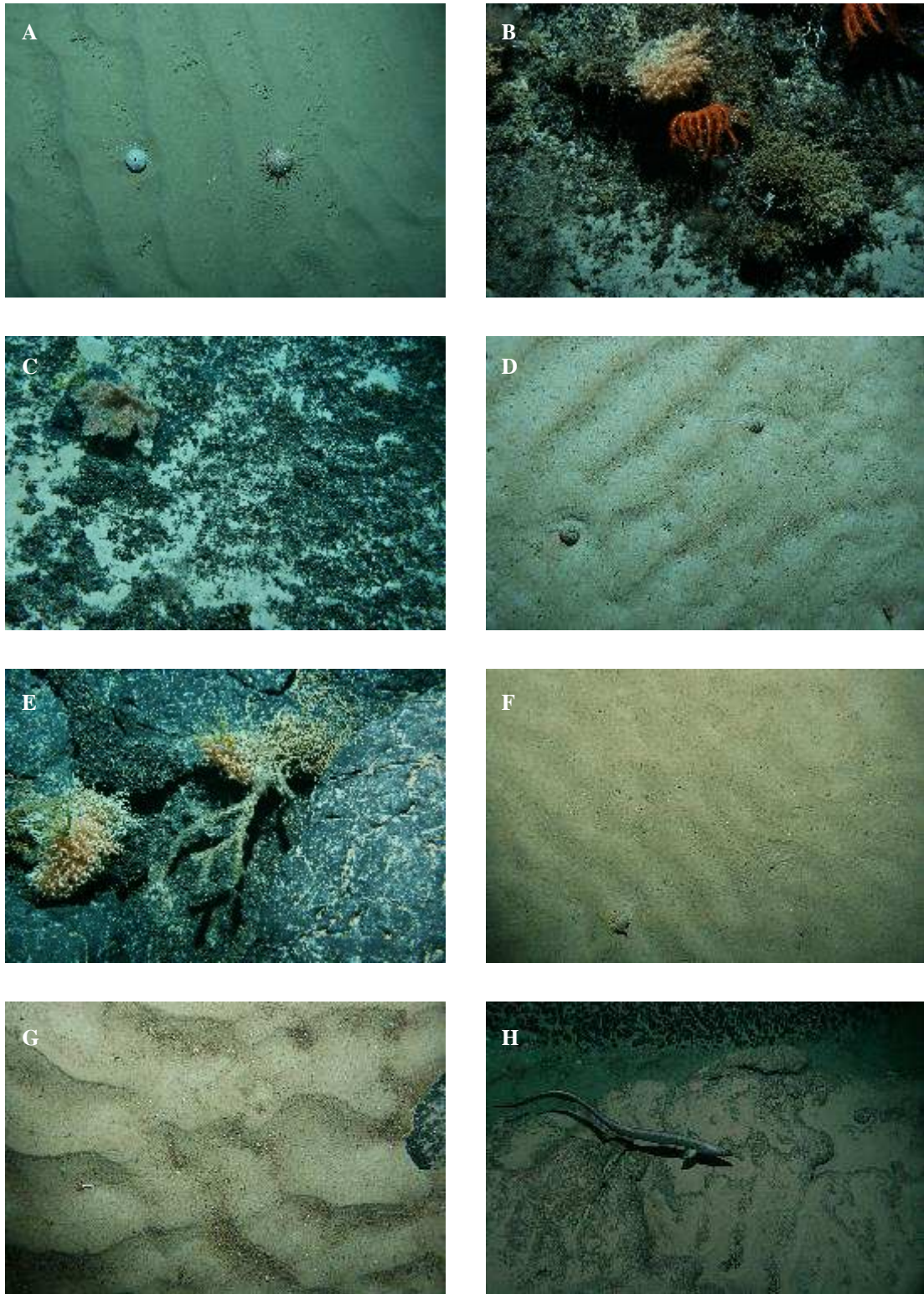


Figure 23: Anvil seamount. A, live and dead sea urchins (*Gracilechinus multidentatus*) at 1149 m; B, brisingid asteroids amongst coral matrix (*Solenosmilia variabilis*) at 1259 m; C, plexaurid coral with crinoids and ophiuroids at 1267 m; D, xenophyophores at 1182 m; E, hexactinellid sponge, scleractinian corals, and crinoids at 1200 m; F, pagurid hermit crab at 1490 m; G, scaphopod tusk shell with hermit crab at 1150 m; H, basketwork eel (*Diastobranchius capensis*) at 1387 m.

VME taxa distribution

The distribution of key VME taxa along DTIS transects is shown in Figures 24 to 29.

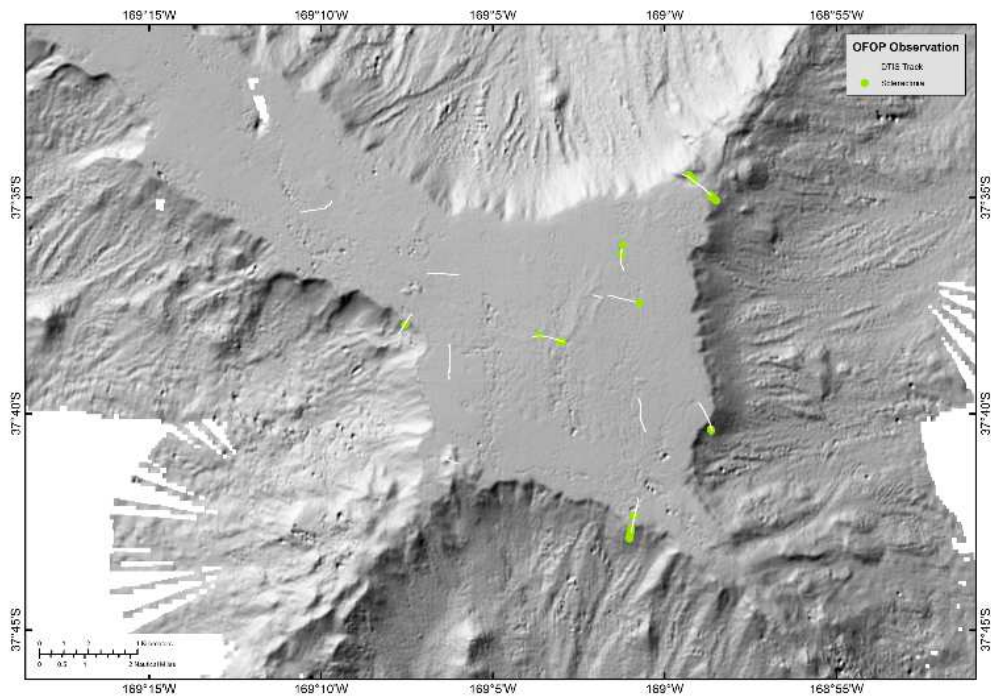


Figure 24: The distribution of Scleractinian (stony) corals on Anvil Seamount (OFOP data).

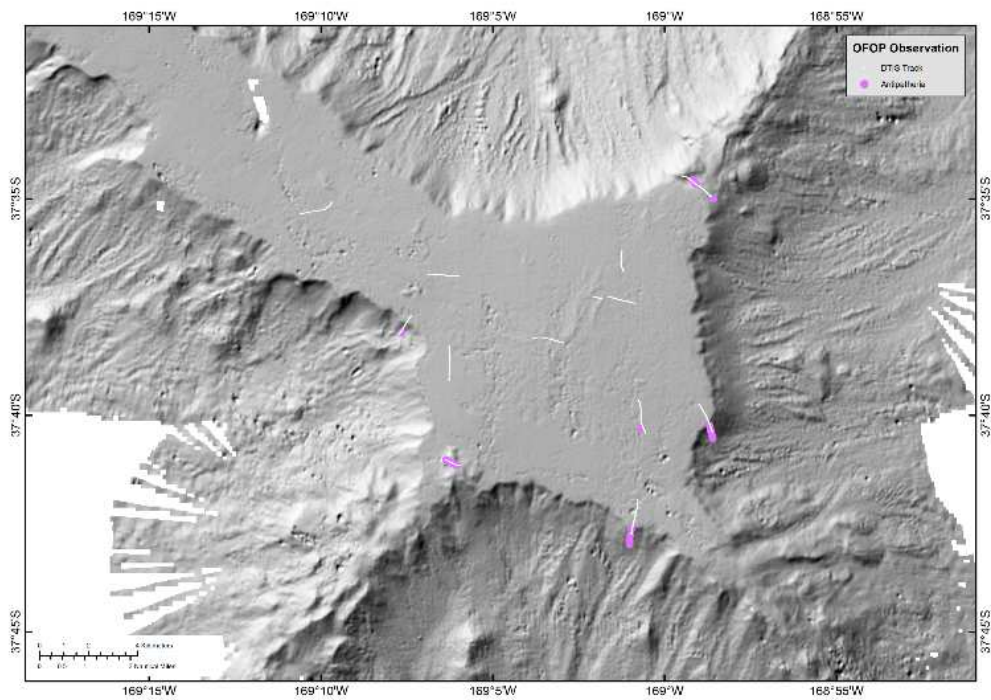


Figure 25: The distribution of Antipatharian (black) corals on Anvil Seamount (OFOP data).

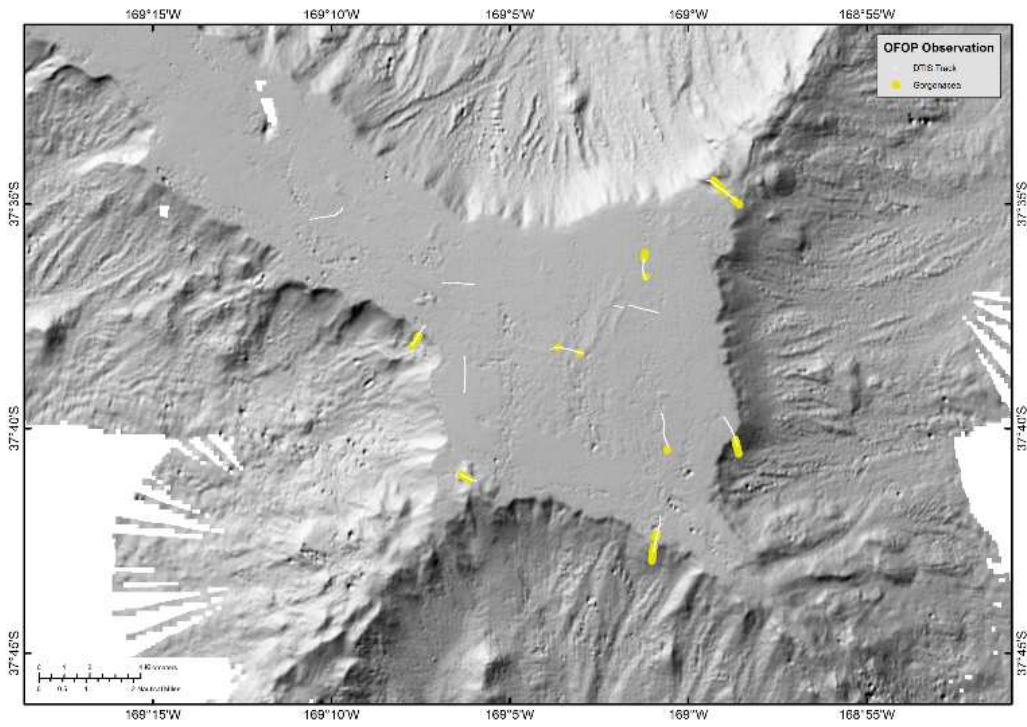


Figure 26: The distribution of Gorgonian (octo) corals on Anvil Seamount (OFOP data).

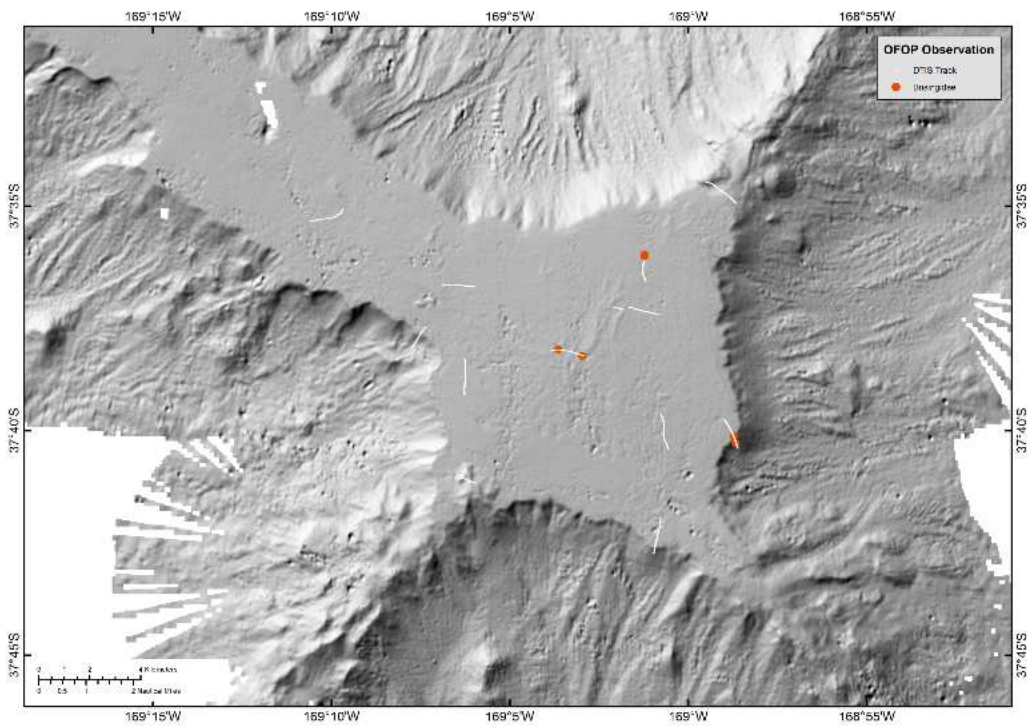


Figure 27: The distribution of brisingid seastars on Anvil Seamount (OFOP data).

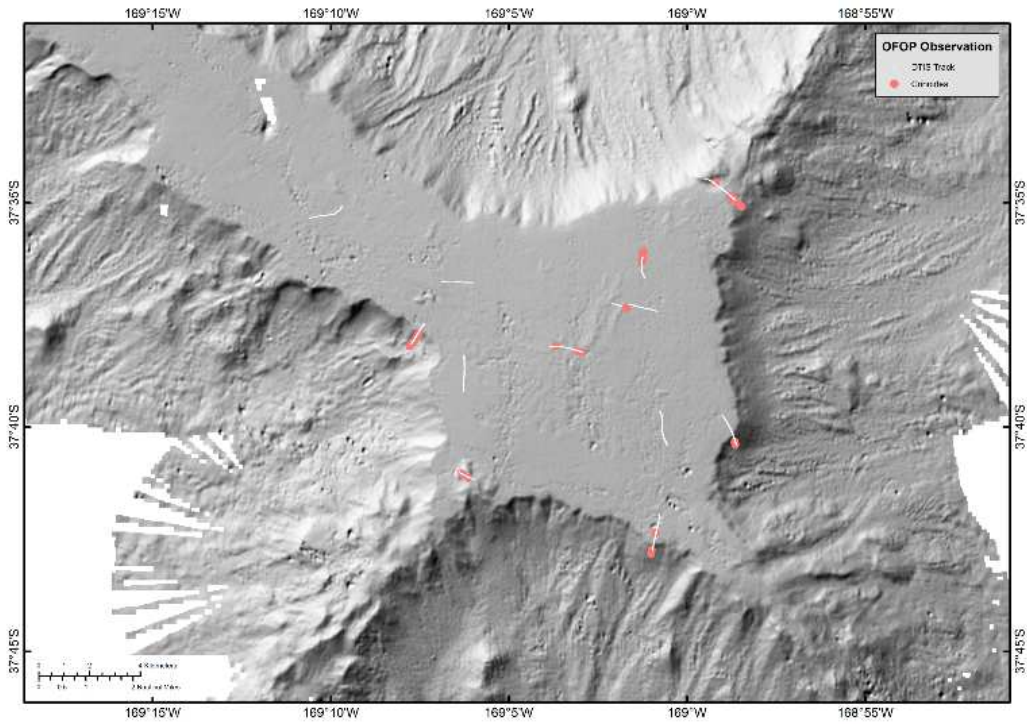


Figure 28: The distribution of crinoids (featherstars) on Anvil Seamount (OFOP data).

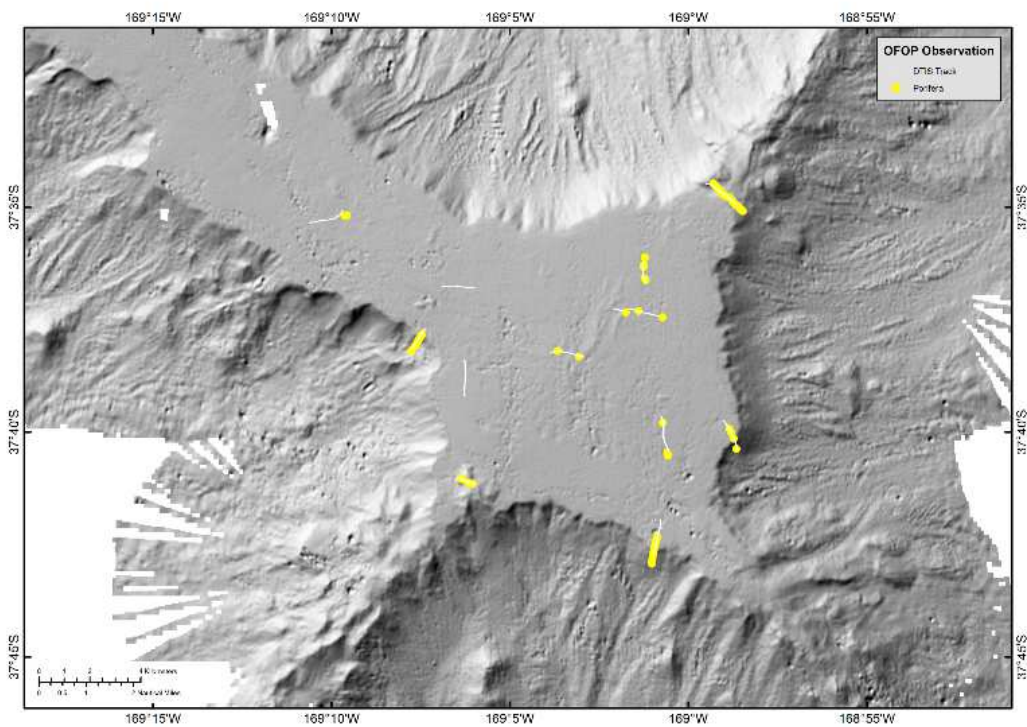


Figure 29: The distribution of Porifera (sponges) on Anvil Seamount (OFOP data).

39 South Seamount

Sampling sites

The location of sampling stations on 39South Seamount is shown in Figure 30.

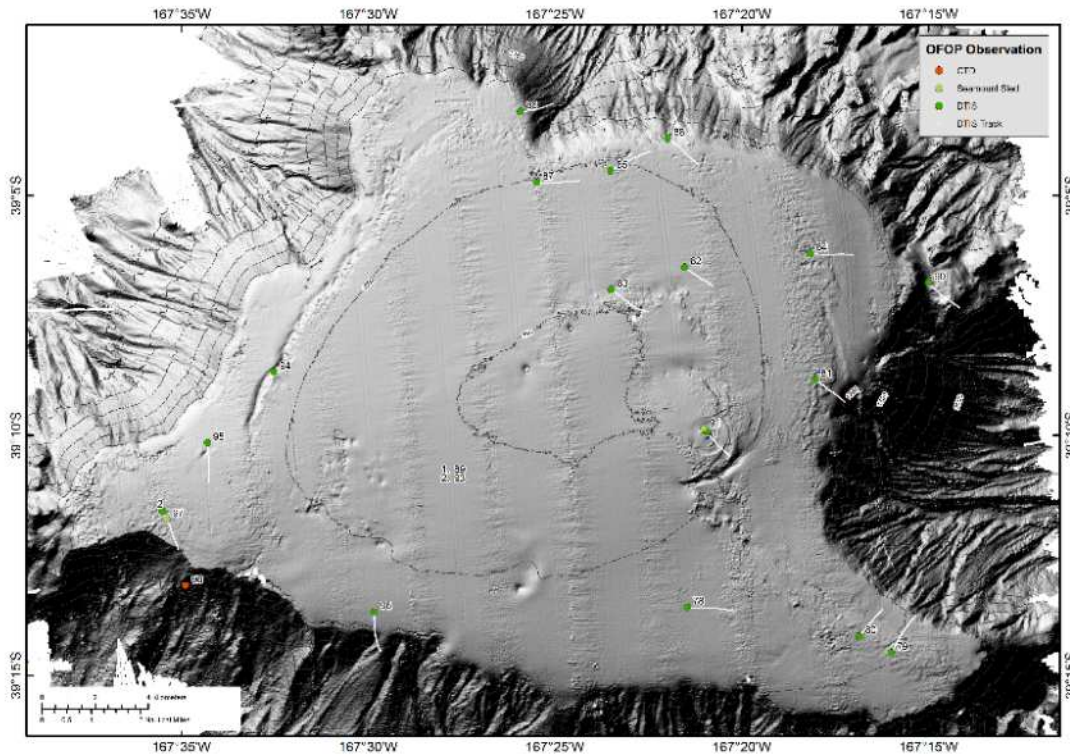


Figure 30: 39 South Seamount, showing the position (with station number) of DTIS and SEL tows, and a CTD cast.

Transect descriptions

39° South: Stn_078, str.0004

Depth Range: 1081 – 1105 m.

Flat sandy substrate with some cup corals, Cerianthids, forams and tracks.

39° South: Stn_079, str.0001

Depth Range: 1236 – 1269 m.

Predominantly sand with animal tracks, some intermittent bedrock with occasional glass sponges. Some intact dead coral on bedrock halfway through, and small amounts at end. Sparse fauna

39° South: Stn_080, str.0004

Depth Range: 1197 – 1222 m.

Gradual slope, mixed substrate types: rippled sand and bedrock outcrops. Rocks were generally barren except for a few anemones, sponges, crinoids, seastars and urchins. Two clumps of stony coral, possible live.

39° South: Stn_081, str.0001

Depth Range: 1052 – 1241 m.

Sandy bottom, intermittent bedrock with sandy overlay. Usual array of worms, tusk shells, gastropods, tracks and burrows in soft sediment. Occasional anemones, natant decapods,

seastars, sponge, forams, black corals. A basketwork eel, morid, shark, rattails. 30 minutes in at 1090m some stony coral rubble, possible a clump of live stony coral.

39° South: Stn_082, str.0003

Depth Range: 961 – 969 m.

Transect entirely sandy, with ripples. Typical epifauna including gastropods, tusk shells, small brittle stars, cerianthids, worms, Tam O Shanter urchins.

39° South: Stn_083, str.0004

Depth Range: 900 – 930 m.

Flat bottom. Sand ripples interspersed with patches of boulders, bedrock. Tracks, burrows, some worms and gastropods. Some extensive areas of coral rubble in 900-910 m. Some bedrock with large holaxonian gorgonians, black coral, soft coral and sponges. Fish over soft sediment included several halosaurs, sharks, rattails and two Chaunacidae.

39° South: Stn_084, str.0001

Depth Range: 1070 – 1158 m.

Initial area of bedrock with sand overlay, and then rippled sand, regularly changing between the two bottom types. Following a drop-off, at 1077 m was a patch of intact live stony coral and coral rubble, with sponges, crinoids, brisingids and anemones on bedrock patches. On soft sediment were frequent worms, as well as tusk shells and gastropods.

39° South: Stn_085, str.0005

Depth Range: 983 – 1012 m.

100% sandy rippled, with very occasional asteroids, cerianthids, several forams.

39° South: Stn_086, str.0005

Depth Range: 1136 – 1605 m.

Steeper slope with a 500 m steep descent, substrate was a combination of rippled sand and barren bedrock beds and outcrops. Observed a few small gorgonians, sponges and possibly a small clump of live stony coral matrix. Abundant intact dead coral as well as echinoids on bedrock. *Metallogorgia* and *Anthomastus* present.

39° South: Stn_087, str.0003

Depth Range: 983 – 995 m.

Virtually flat seafloor with sand and ripples. Very occasional asteroids, gorgonians, gastropods and forams. One *Lithodes* crab. No bedrock, rubble or coral.

39° South: Stn_088, str.0005

Depth Range: 1020 – 1092 m.

Mostly sand, many ripples, with some small intermittent bedrock areas. Possible trawl marks (23:22, 1068 m), and a trawl warp within first 10 minutes. Some brisingids, gorgonians, soft corals, but sparse fauna throughout transect. Very long sea pen.

39° South: Stn_089, str.0004

Depth Range: 899 – 950 m.

Initially sand, with some rubble and ripples, bedrock after ~5 mins with *Paragorgia*/Corallidae, black coral, fluffy gorgonians, primnoids, *Iridogorgia*. Stony corals attached to toppled/collapsed Corallidae/Paragorgiid at 901 m, 6 min). Transect mostly sand with intermittent bedrock, sand overlay, coral rubble and occasional intact dead coral. Benthic fauna include tam o shanters, stylasterids, with worms, tusk shells gastropods on soft sediment. Still shots reveal considerable quantities of cup corals and small stylasterids.

39° South: Stn_090, str.0004

Depth Range: 1467 – 1573 m.

Transect dominated by bedrock with sandy overlay, sand and ripples in between rock. Scattered gorgonians, black corals, numerous sponges (hexactinellid flute sponges). Diverse but scattered fauna elsewhere.

39° South: Stn_093, str.0001

Depth Range: 1081 – 1100 m.

Mostly rippled sand with abundant cup corals, several patches of bedrock with live stony coral matrix and brisingids, crinoids, gorgonians. Several bedrock patches with gorgonians *Thouarella*, *Iridogorgia*, large primnoids, possibly *Paramuricea*, and black corals. Steep drop-off/cliff at end of transect.

39° South: Stn_094, str.0004

Depth Range: 1030 – 1073 m.

Interesting transect. Frequent patches of coral rubble and intact coral, sand and sandy overlay on bedrock. Many stony coral colonies with crinoids, brisingids, sponges and numerous gorgonians (including *Thouarella*, Primnoids, *Paragorgia*/Corallidae) and black coral. Clumps generally small (<0.5m). Regular tiny patches of the purple soft coral (see sled 091) on coral rubble. Coral rubble often very dense. Tusk shells, sea pens, pagurids, sea stars, forams, tracks, gastropods, Farreid sponges etc on sand. Fish included *Halosauropsis*, basketwork eel, Orange roughy, Oreo, *Lepidion* and sharks.

39° South: Stn_095, str.0003

Depth Range: 1063 – 1093 m.

Brief area of bedrock early on at 1080 m, with a *Lepidion*, live stony coral, coral rubble. Also *Bathypathes*, sponges, crinoids, brisingids, gorgonians (including primnoids, *Thouarella*, *Paramuricea*). Remainder of transect predominantly sand and ripples, with worms, tusk shells, burrows, tracks, forams.

39° South: Stn_096, str.0001

Depth Range: 1066 – 1340 m.

Initially sandy bottom, with sparse fauna-worms, tusk shells, holothurians, abundant forams in places. Bedrock and sandy overlay for the latter half of the transect with steep dropoffs from 1150 – 1340 m. Sparse, but fauna included crinoids, sponges, gorgonians (particularly 1315 m), large stalked sea pen, and occasional fish.

Selected still images from DTIS of this seamount are given in Figure 31.

39 South summary

39South is similar to CenSeam Guyot in its general shape, although is shallower. It is flat-topped, the summit at about 880 m. The top rolls over sharply at 1100–1150 m. The guyot has been trawled, mainly on the northern flanks.

The summit area was typically soft sediment, with burrows, tracks, gastropods, scaphopods, worms, giant forams, and scattered tanner urchins. There was more exposed bedrock and boulders on transects extending down the flanks of the seamount, but typically only small clumps of live coral. The densest patches were on the northwestern side, along a valley-feature at about 1050 m. These corals had the usual associates of crinoids, brisingid seastars, with gorgonian and black corals and glass sponges. Tow 94 was the only one where we evaluated the coral clumps reached “VME density”.

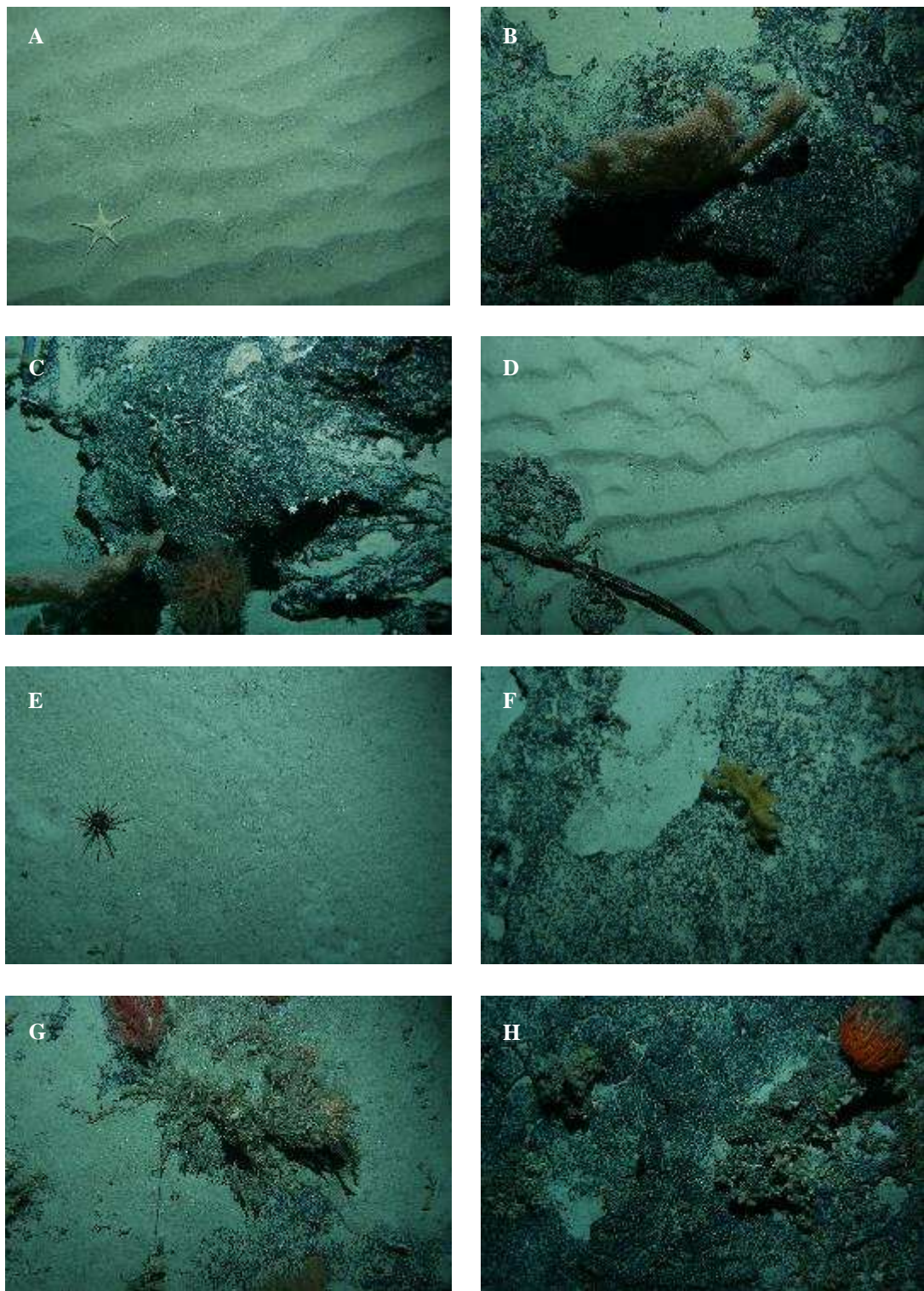


Figure 31: 39 South seamount. A, goniasterid asteroid at 959 m; B, primnoid coral at 920 m; C, primnoid gorgonian coral, alcyonacean soft coral, and stylasterid corals at 905 m; D, trawl warp at 1071 m; E, cidarid sea urchin (*Poriocidaris purpurata*) at 901 m; F, gorgonian coral at 900 m; G, species complex including a gastropod mollusc, plexaurid, scleractinian, and alcyonacean corals at 901 m; H, brisingid asteroid and small corals including scleractinian cup corals at 904 m.

VME taxa distribution

The distribution of key VME taxa along DTIS transects is shown in Figures 32 to 37.

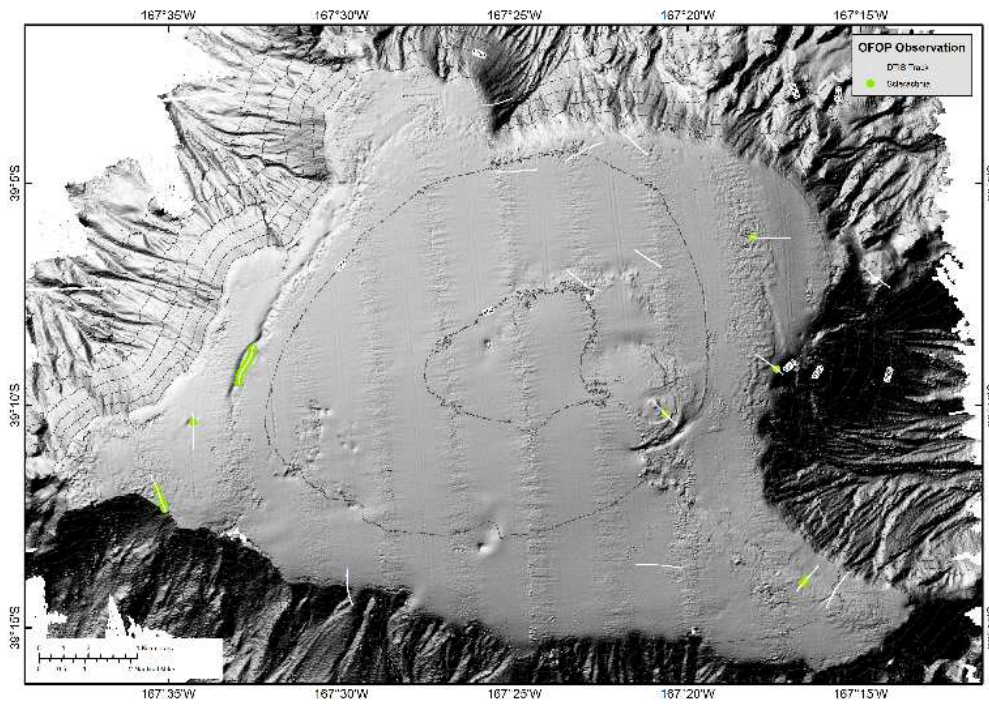


Figure 32: The distribution of Scleractinian (stony) corals on 39South Seamount (OFOP data).

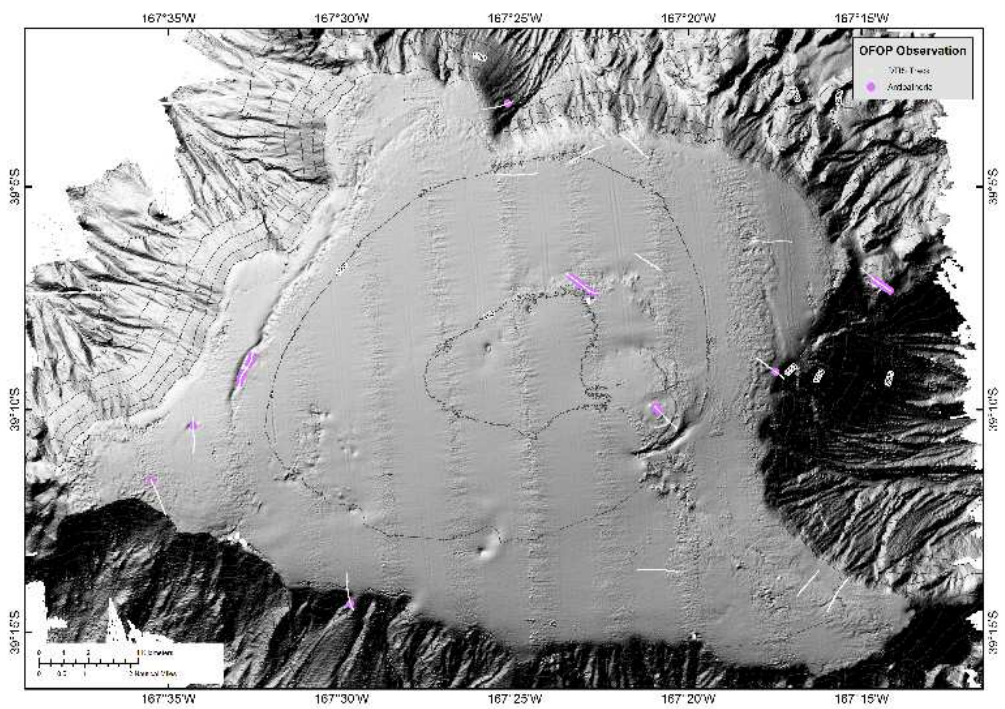


Figure 33: The distribution of Antipatherian (black) corals on 39South Seamount (OFOP data).

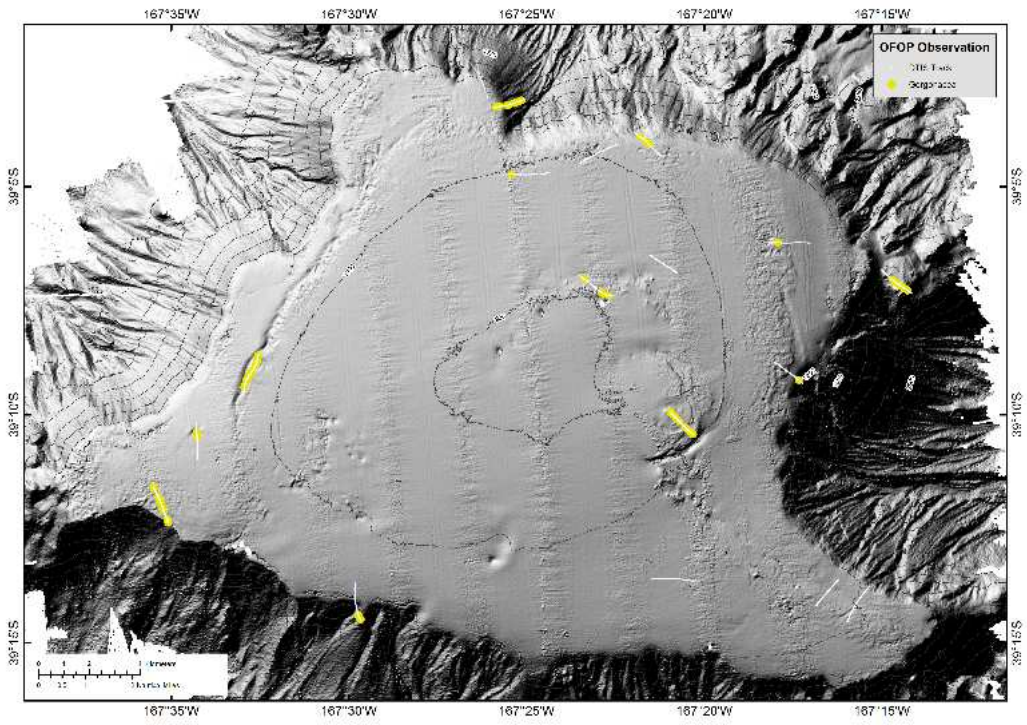


Figure 34: The distribution of Gorgonian (octo) corals on 39South Seamount (OFOP data).

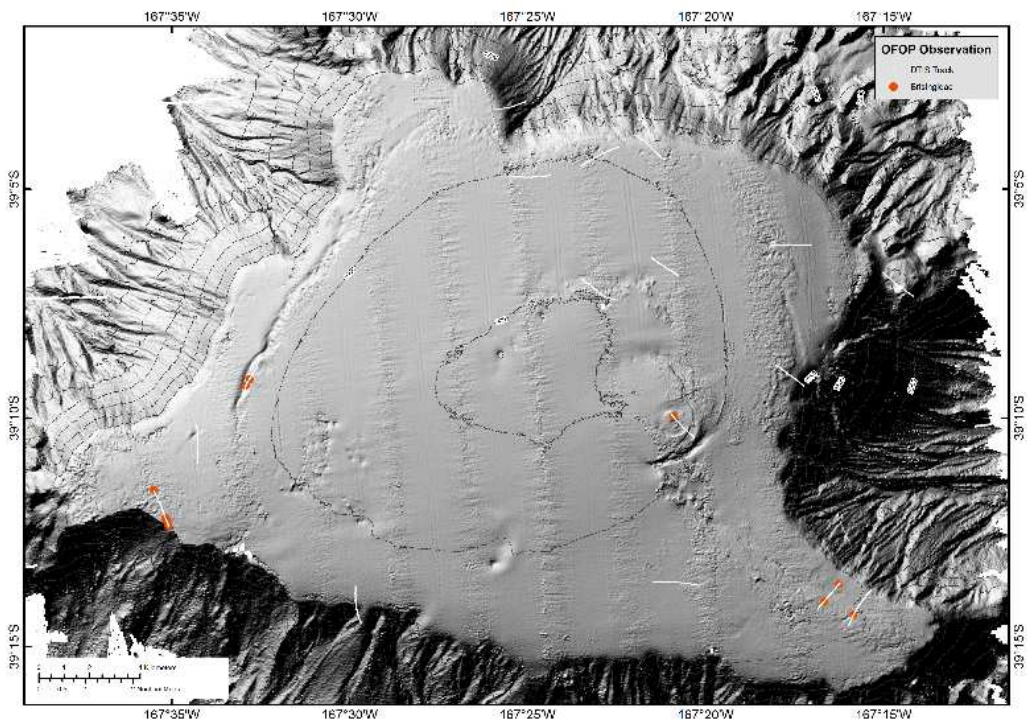


Figure 35: The distribution of brisingid seastars on 39South Seamount (OFOP data).

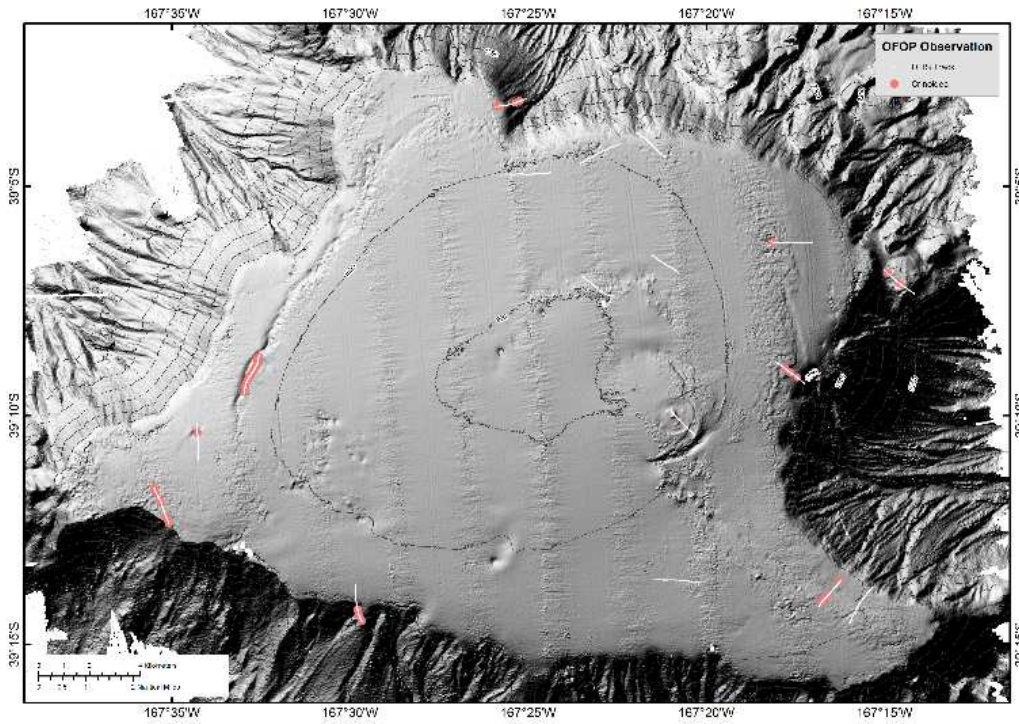


Figure 36: The distribution of crinoids (featherstars) on 39South Seamount (OFOP data).

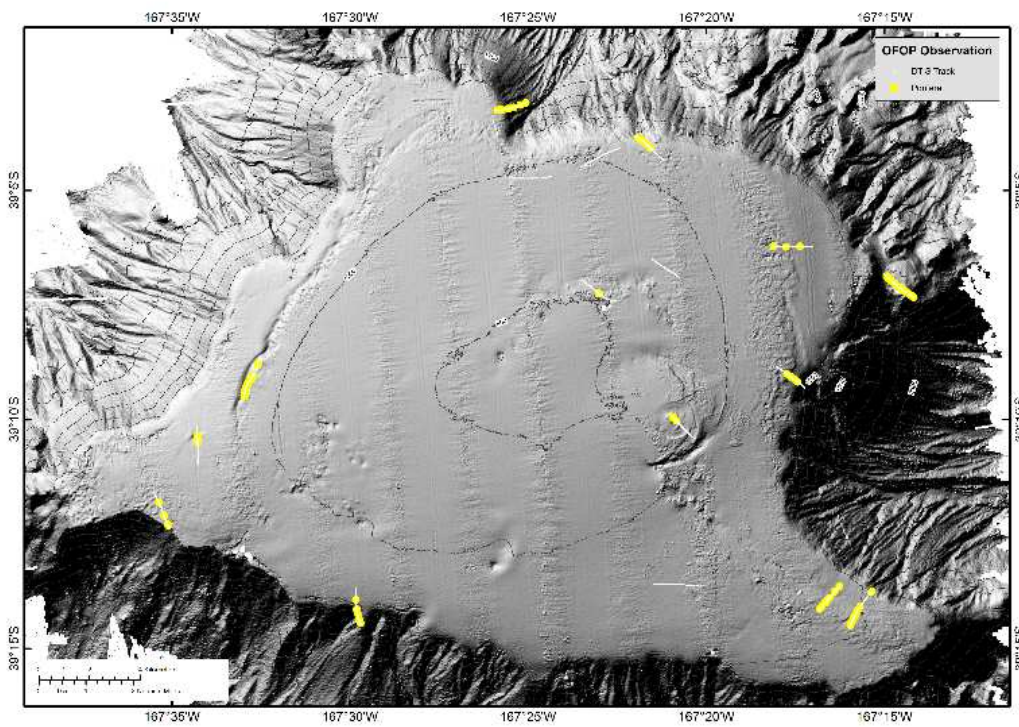


Figure 37: The distribution of Porifera (sponges) on 39South Seamount (OFOP data).

Ghost Seamount

Sampling sites

The location of sampling stations on Ghost Seamount is shown in Figure 38.

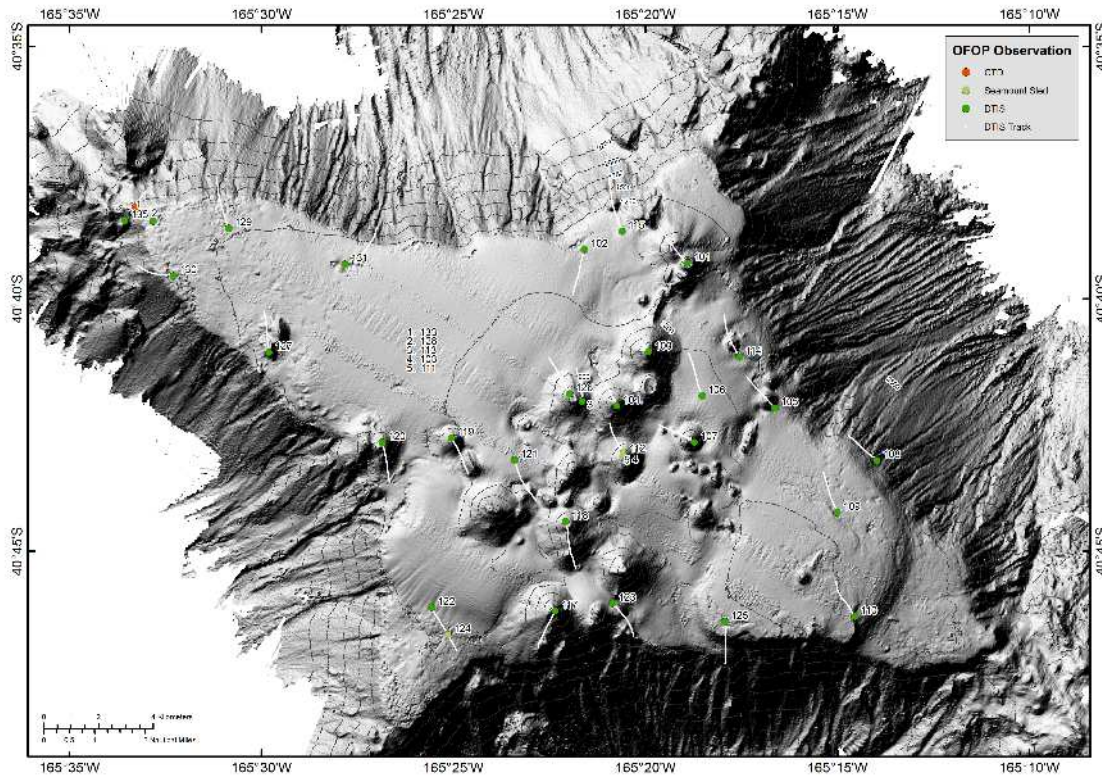


Figure 38: Ghost Seamount, showing the position (with station number) of DTIS and SEL tows, and CTD cast.

Transect descriptions

Ghost Seamount: Stn_100, str.0004

Depth Range: 645 – 1022 m.

Transect down slope from the summit of a conical feature on top of the seamount, NW direction. Bottom was a mix of sand and large areas of coral rubble, with patches of intact coral. Sparse benthic fauna, scattered fishes, but generally barren. Suggestive of trawling. Substrate changed to rippled sediment at base of conical feature.

Ghost Seamount: Stn_101, str.0005

Depth Range: 916 – 1088 m.

Transect passed over two distinct features (depth ~855 – 1100 m), lots of intact coral (some areas 100% cover), coral rubble and sand. Most numerous benthic organisms were pagurids and gastropods. Numerous sharks, brisingids, sponges and crinoids. Fishing gear 10 min in. Scattered fishes observed.

Ghost Seamount: Stn_102, str.0003

Depth Range: 1005 – 1107 m.

Gently ascending transect (1107 – 1005 m) across rippled sand. Very low faunal abundance but including forams, seastars, pagurids, rattails, red spider crab.

Ghost Seamount: Stn_103, str.0005

Depth Range: 730 – 918 m.

Started on side of the mound, went up and over continuing on to the base. Substrate predominantly rubble with large areas of intact coral (dead). Some frequent gorgonians, and brisingids Other fauna scattered and typically sparse.

Ghost Seamount: Stn_104, str.0004

Depth Range: 632 – 930 m.

Initially coral rubble, on bedrock, increasing sandy-gravel patches with intermittent bedrock.. Possible trawl scours on bedrock, occasional trawl track and line. Lots of oreos, stripy rattail, morids. Benthic epifauna comprised some isidid gorgonians, initially numerous cup corals, patches of anemones, and generally abundant gastropods.

Ghost Seamount: Stn_105, str.0003

Depth Range: 910 – 1117 m.

Transect starts at 1117 m up the slope to the top of the hill at 910 m, then heads down slope in NW direction to 1100 m, then up to ~1000 m. The south side of the hill consisted of bedrock with sand, coral rubble and intact coral. Very dense low coral matrix. Brisingids and crinoids common towards the top of the knoll, with frequent gastropods and demosponges. Beyond the knoll intact coral and coral rubble dominated as headed NW. After dropping to 1100 m substrate dominated by sand, with pagurids, demosponges, tusk shells, seastars, anemones, worms, with some rattails.

Ghost Seamount: Stn_106, str.0003

Depth Range: 958 – 992 m.

Flat sandy bottom, ripples, some gravel. Epibenthic fauna comprised gastropods, pagurids, seastars, brittle stars. Some tracks and burrows. Sparse fish, including flatfish

Ghost Seamount: Stn_107, str.0003

Depth Range: 761 – 980 m.

Transect line over hill, 831 – 980 m. Top of hill 766 m. Initially on bedrock then a dominance of coral rubble, some coral intact and sand, but mostly very dense rubble up the slope. After coming over the top, more coral that persisted along most of the transect. Southern and northern flanks had demosponges, brisingids, crinoids, cup corals and primnoids associated with rocky outcrops. Sandy regions had gastropods, worms, tusk shells, tam o shanter, pagurids

Ghost Seamount: Stn_108, str.0003

Depth Range: 1299 – 1393 m.

Substrate was sand with occasional ripples and more muddy sediment with tracks. Occasional small regions of bedrock, mostly with a heavy sand overlay and little fauna. Sandy habitat had low numbers of asteroids, natant decapods, and forams.

Ghost Seamount: Stn_109, str.0004

Depth Range: 1041 – 1067 m.

Fairly flat transect, mostly rippled sand. Some individual boulders, with brisingids, some anemones, crinoids, possible live coral clump at 1045 m. Low abundance of fauna. Several straight depressions in the sand noted, possibly trawl marks.

Ghost Seamount: Stn_110, str.0001

Depth Range: 940 – 1050 m.

Majority of transect rippled sand with tracks. Small area of intact coral towards end with sponges. Low faunal abundance, scattered brisingid and crinoids on bedrock boulders. Typical sand fauna comprised forams, pagurids, gastropods, seastars, shrimps and cerianthids. Fish mostly rattails.

Ghost Seamount: Stn_113, str.0004

Depth Range: 730 – 915 m.

This deployment targeted a depth of 730 m on the eastern flank of a cone feature. It traversed across in a northerly direction and down slope to a depth of 915 m. Initially; substrate was a mix of craggy broken pale bedrock, intact coral and coral rubble, with scattered brisingids. Lower down slope there was evidence of trawl marks in areas of coral rubble and sand.

Towards the base of the feature substrate was sand with pagurids and gastropods (many dead shells).

Ghost Seamount: Stn_114, str.0001

Depth Range: 922 – 1092 m.

Initially sandy gravel, then substantial increase in coral rubble and intact coral. Large numbers of crinoids and brisingids on dead intact coral, some orange roughly and occasional rattails. From 1050 m sandy substrate, with high density of worms, with forams, cerianthids, tam o shanters, pagurids, gastropods, tusk shells, tracks and burrows.

Ghost Seamount: Stn_115, str.0001

Depth Range: 1056 – 1385 m.

Transect started with sand and ripples with an abundance of worms and burrows, occasional gastropods, shrimps, forams and cerianthids. Gradual ascent with bedrock, coral rubble and gorgonians, primarily *Thouarella*. Intact corals with brisingids and crinoids. From 1300 m substrate predominantly sand with a few worms and tusk shells, with fish including orange roughly.

Ghost Seamount: Stn_117, str.0005

Depth Range: 1067 – 1276 m.

Start at the side of the hill, up into the crater, out and down the other side (701 – 1067 m). Mostly sand/rubble. Several areas of intact coral and some bedrock. Low faunal abundance, predominantly fish: lots of rattails, shark and cardinal fish

Ghost Seamount: Stn_118, str.0005

Depth Range: 687 – 955 m.

Went over 3 mounds, a complex transect predominantly rubble, bedrock and/or boulders, some intact coral. First half of the transect had many zoanthids and epizoanthids. Abundant brisingids and some black coral (including *Leiopathes*)

Ghost Seamount: Stn_119, str.0003

Depth Range: 873 – 963 m.

Transect over the summit of the hill and down, along the side of the adjacent hill (~814-1005 m). Started with mixed substrate of rubble (some intact), cobbles, sand and bedrock then moved into rubble and sand, then finally ended on hard bedrock for last 10 min. Scattered gorgonians, brisingids and crinoids on the hard substrate, gastropods on soft sediment.

Ghost Seamount: Stn_120, str.0001

Depth Range: 873 – 1151 m.

Sandy bottom initially, then rapid change to dense patches of coral rubble, some intact coral in places. A dense school of cardinal fish, *Epigonus telescopus* at 881 m, some orange roughly, The latter third of the transect was mainly rippled sand, with occasional bedrock and sand overlay. Diverse fauna, primarily pagurids and gastropods on soft sediment, with crinoids and brisingids on the coral rubble.

Ghost Seamount: Stn_121, str.0004

Depth Range: 900 – 956 m.

Ran up slope to 900 m then dropped over the side of the knoll to 956 m. Most of the line comprised sand, faunal tracks, some rubble. Gastropods and pagurids common, with some seastars, sponges, shrimps, rattails. Close to end of the transect some intact coral but mainly rubble.

Ghost Seamount: Stn_122, str.0001

Depth Range: 1202 – 1254 m.

Sand, few ripples initially with many small forams along with scattered gastropods, asteroids, sponges, shrimps, tusk shells, cerianthids, tracks and burrows. Areas of coral rubble and gravel with the occasional tam o shanter. Striking sections of bedrock-sand ripples/waves in the last 10 mins. Bedrock/boulders hosted gorgonians, brisingids, sponges, a single clump of live coral at 1254 m.

Ghost Seamount: Stn_123, str.0005

Depth Range: 955 – 1104 m.

Mixed substrate types: sand, ripples, bedrock with a sandy overlay and some intact coral. Patches of dense coral rubble also. Soft sediment taxa mainly gastropods, forams, shrimps. Sponges, gastropods, pagurids, crinoids, brisingids, holothurians on hard substrate/rubble, and numerous orange roughy.

Ghost Seamount: Stn_125, str.0001

Depth Range: 1011 – 1375 m.

Transect started flat with rippled sand, then small patches of bedrock, as the slope increased down to 1375 m. Fauna included glass sponges, asteroids and tamarisks, cerianthids, anemones, orange roughy and rattails.

Ghost Seamount: Stn_126, str.0004

Depth Range: 718 – 945

Transect down side of a hill and continued along the flat (718 – 945 m). First half predominantly rubble/sand with some areas of bedrock. Gastropods abundant on soft sediment. Intact coral and one patch of Isididae (905 m) and some crinoids and demosponges.

Ghost Seamount: Stn_127, str.0001

Depth Range: 1104 – 1195 m.

Moved along the western slope of the ridge, with exposed bedrock, intact dead coral, several live stony coral with brisingids and crinoids. Giant lepidion at start. Scattered primnoid corals, black corals, glass sponges. Clumps of live stony coral at intervals throughout. Rippled sand at end of transect with forams, gastropods etc.

Ghost Seamount: Stn_128, str.0002

Depth Range: 1321 – 1544 m.

Transect along ridge on the northwestern edge of the seamount. Substratum was dominated by dense dead stony coral matrix and some rubble. High abundances of clumps of live scleractinians (VME) with crinoids, echinoids and sponges. Last stony coral observation at 1470 m. Transect continued down to (~1544 m) and intact dead coral continued on deeper.

Ghost Seamount: Stn_129, str.0002

Depth Range: 1252 – 1509 m.

Initial sand, with numerous cerianthids. Intermittent sand, bedrock with sandy overlay, boulders with coral intact and rubble. Numerous live stony coral colonies between 1279 – 1356 m with crinoids, some *Dermechinus*. Intact coral (though dead) down to 1505 m.

Ghost Seamount: Stn_130, str.0002

Depth Range: 1305 – 1575 m.

Initially bedrock, sandy overlay, coral rubble and intact coral. Fauna included sponges, asteroids, cerianthids, forams and gastropods. In bedrock areas, especially last 20 mins, crinoids and brisingids associated with the patches of intact and live stony coral.

Ghost Seamount: Stn_131, str.0001

Depth Range: 11:79 – 1618 m.

Transect run under DP. DTIS lowered to seafloor and recording started once movement detected. Initially very flat sandy bottom with distinct ripples and occasional worms, asteroids, rattails. Not much action, so video paused twice for several minutes to extend the run. At 1250 m moved on to bedrock with sand overlay and dropped steadily down to 1618 m over 20 min with scattered rattails, tusk shells, some crinoids and brisingids.

Ghost Seamount: Stn_135, str.0002

Depth Range: 1407–1602 m.

Landed at 1519 m on ridge to SW of spur, towing upslope to the northeast. Bedrock with sand overlay, until depth of 1487m, when some intact coral, with boulders/bedrock and sand interspaces. Scattered gorgonians. Extensive area of intact coral with live scleractinian heads from 1462 m up to the top of the ridge at 1407 m, and on northern side to 1422 m. Then bedrock,

some coral rubble, occasional sponges and crinoids, more bedrock with sand overlay. A small patch of intact coral clumps at 1508 m, then rippled sand. Stalked crinoid towards end of run at 1574 m.

Selected still images from DTIS of this seamount are given in Figure 39.

Ghost Seamount summary

Ghost seamount is named after a small peak on its southern end. It has a very different structure to the more northern seamounts and guyots. The top is generally a flat plateau at 1050–1100 m, but has about 13 small volcanic plug-like hills rising from it. These are typically about 200 m high. They have been extensively fished.

The hill features generally comprised exposed bedrock, with coral rubble. There were isolated patches of intact (dead) coral, with brisingid seastars, gorgonian and black corals. Trawl marks were often seen, which is only to be expected given the fishing history of this seamount. The flat and sloping areas of the summit plateau generally comprised soft sediment, with variable fauna. In places there were dense patches of worms, and giant forams. In some flank areas there were patches of scattered live clumps of stony coral, but the northwestern corner was the main site where extensive areas of intact coral were found. The narrow tongue-like extension drops from about 1300 m down to 1500 m with a cover of low but intact stony coral, with many live heads near the peak of the ridge. These extended down to 1470 m.

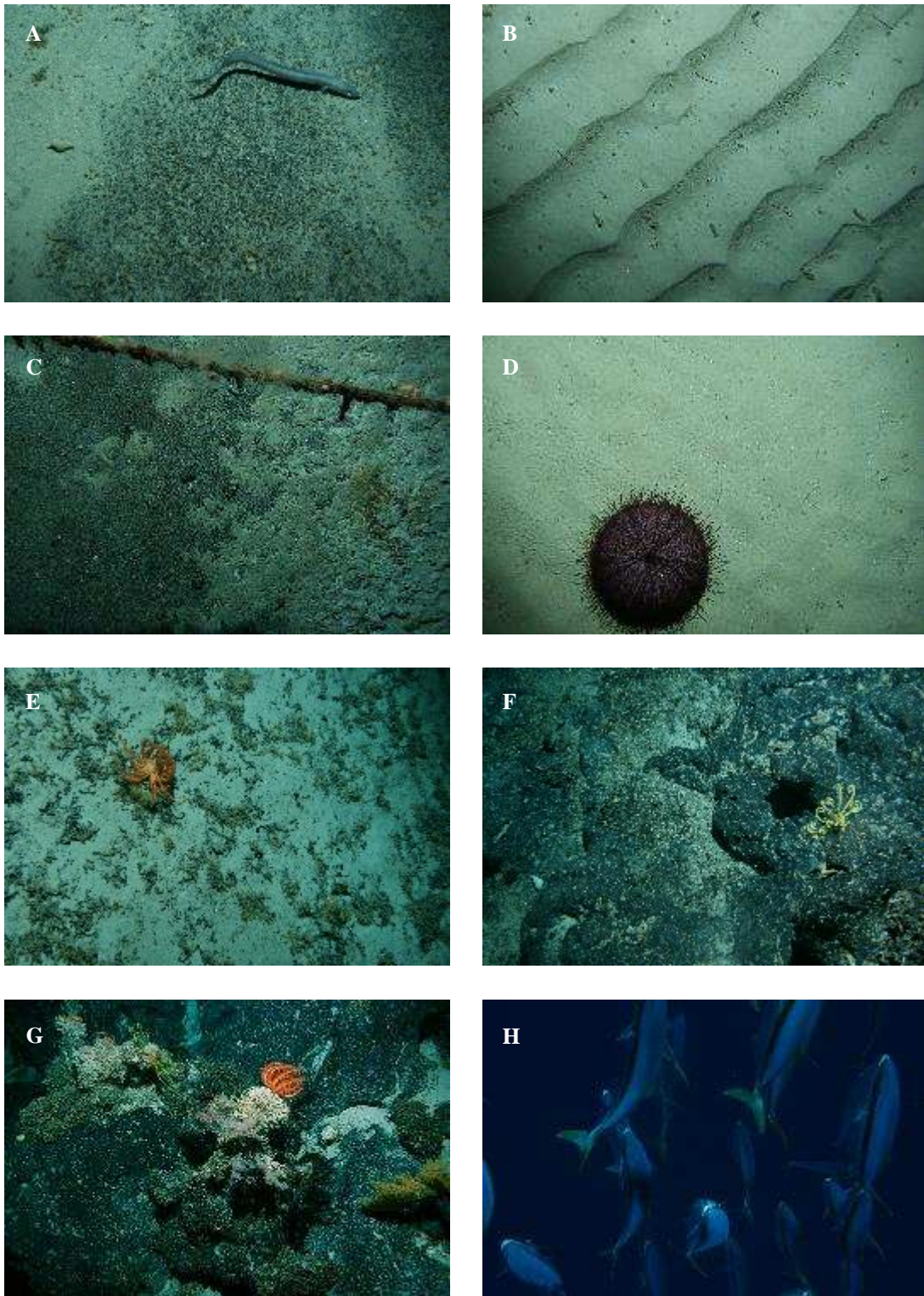


Figure 39: Ghost seamount. A, conger eel (*Bassanago* sp.) and zoanthid cnidarians at 664 m; B, tube-worms and sea cucumbers (holothuroids) at 1100 m; C, trawl warp with attached cup corals at 632 m; D, echinothurioid sea urchin (*Sperosoma* sp.) at 984 m; E, brisingid sea-star and zoanthids at 671 m; F, crinoid and gastropod at 1068 m; G, coral and echinoderm species complex at 1119 m; H, yellowtail kingfish (*Seriola lalandi lalandi*) at 20 m.

VME taxa distribution

The distribution of key VME taxa along DTIS transects is shown in Figures 40 to 45.

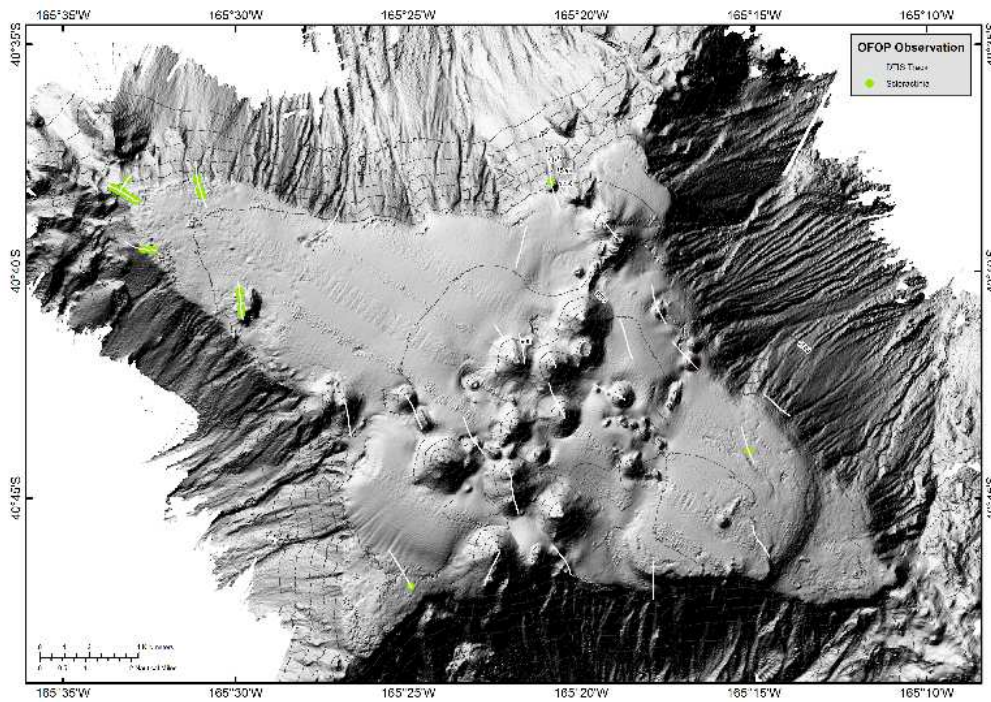


Figure 40: The distribution of Scleractinian (stony) corals on Ghost Seamount (OFOP data).

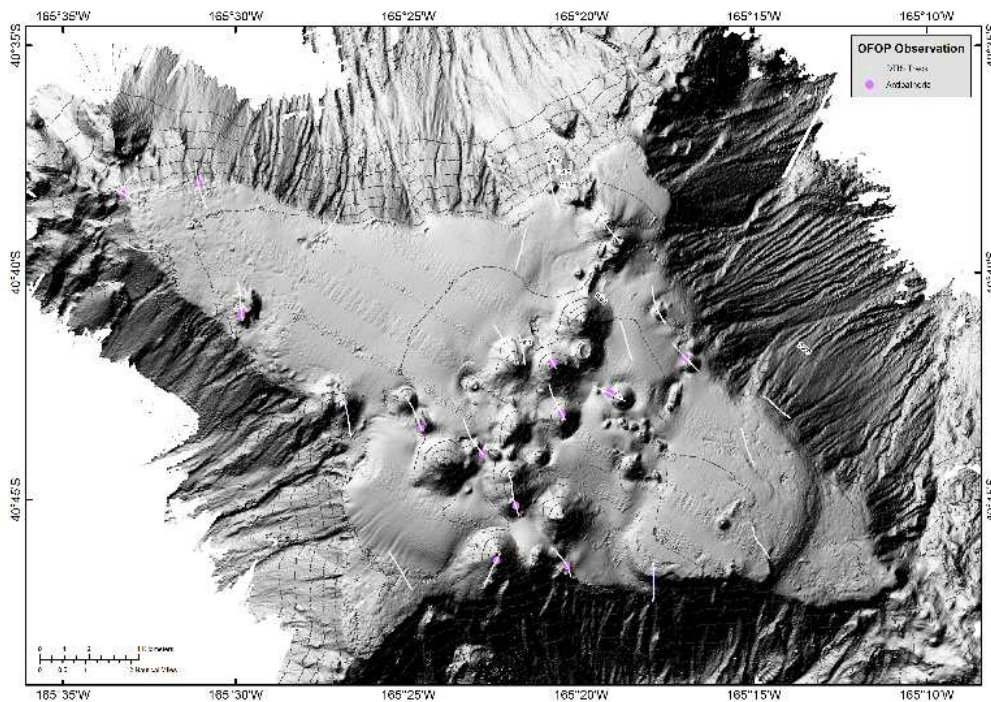


Figure 41: The distribution of Antipatherian (black) corals on Ghost Seamount (OFOP data).

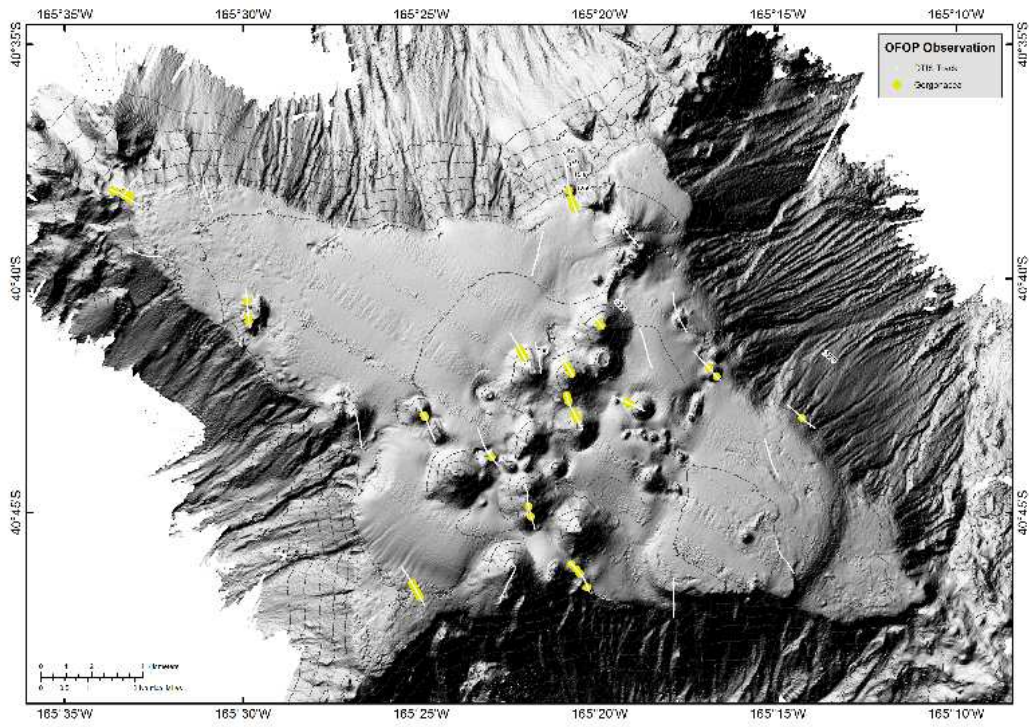


Figure 42: The distribution of Gorgonian (octo) corals on Ghost Seamount (OFOP data).

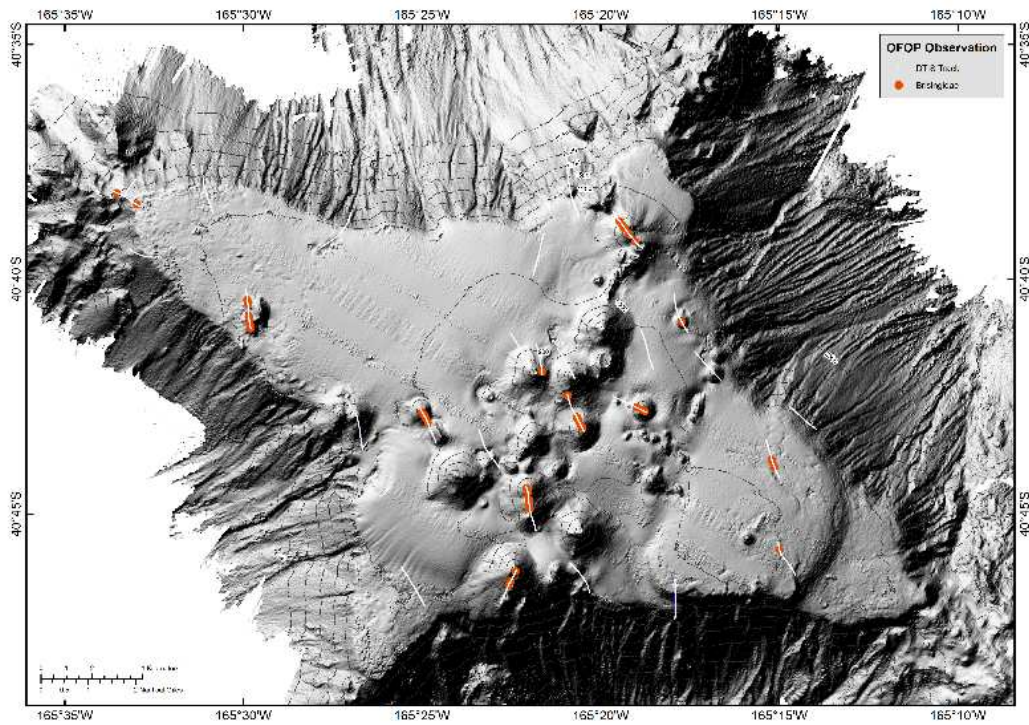


Figure 43: The distribution of brisingid seastars on Ghost Seamount (OFOP data).

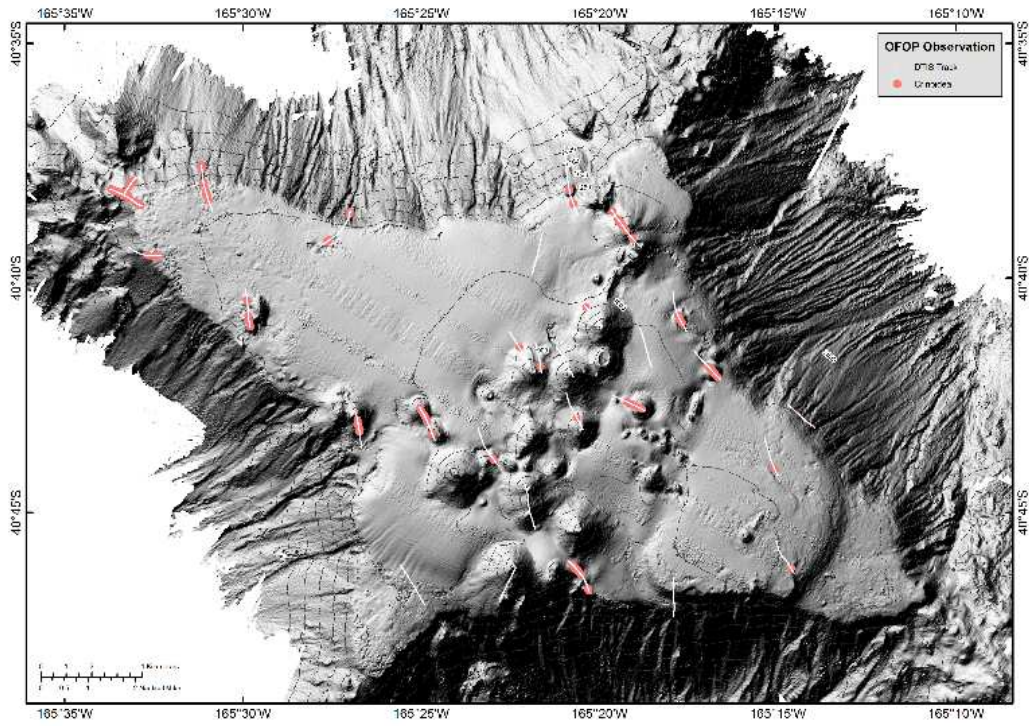


Figure 44: The distribution of crinoids (featherstars) on Ghost Seamount (OFOP data).

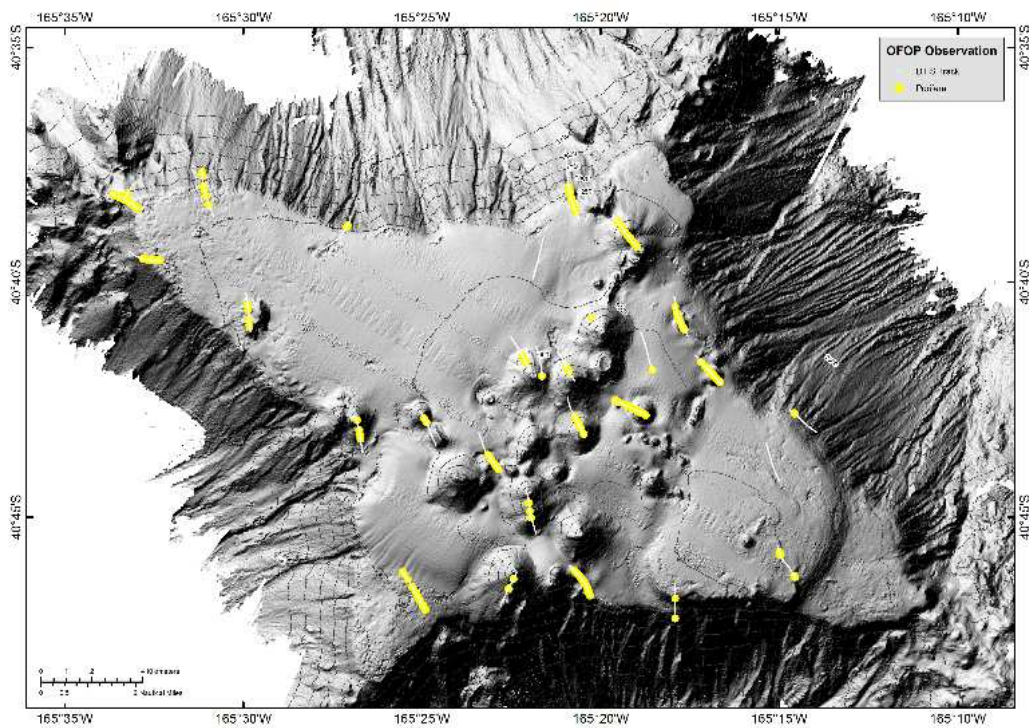


Figure 45: The distribution of Porifera (sponges) on Ghost Seamount (OFOP data).

Valerie Guyot

Sampling sites

The location of sampling stations on Valerie Guyot is shown in Figure 46.

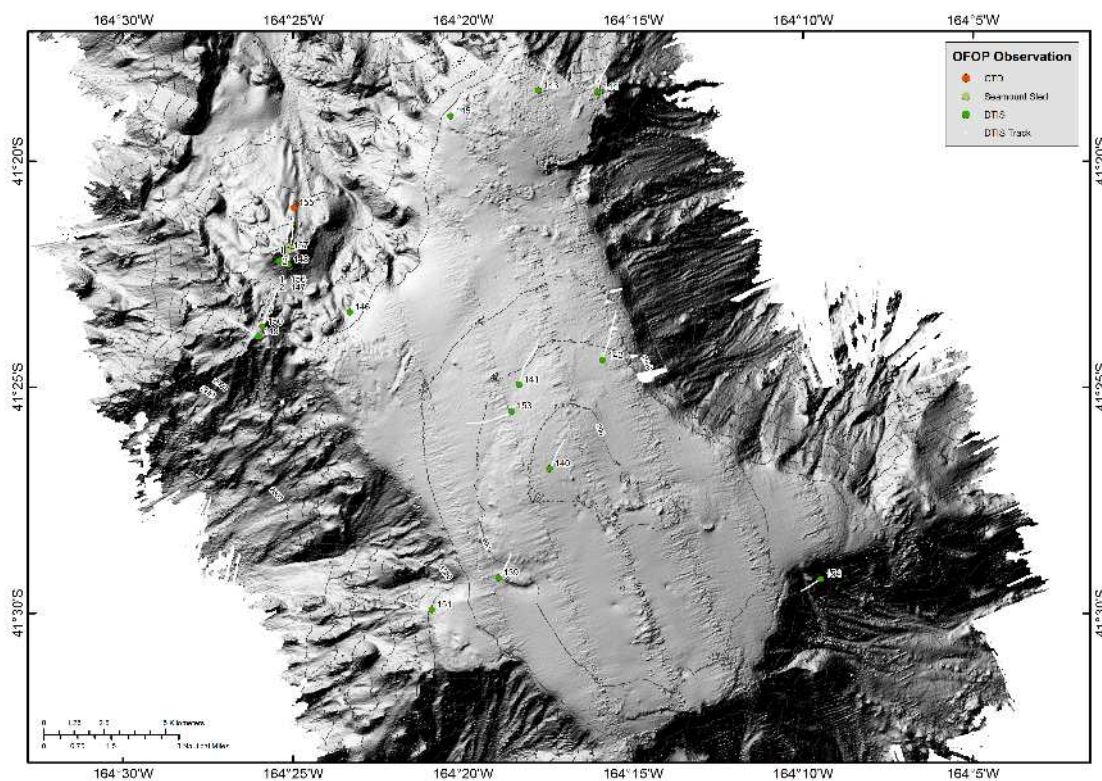


Figure 46: Valerie Guyot, showing the position (with station number) of DTIS and SEL tows, and a CTD cast.

Transect descriptions

Valerie Guyot: Stn139, str.0003

Depth Range: 862 – 926 m.

Predominantly sandy and some ripples with occasional gravel, cobbles, boulders and bedrock with sandy overlay. Ophiuroids were dominant, with pagurids, gastropods, shrimps, asteroisds and tam o shanters, some forams, rattails. Numerous burrows and tracks.

Valerie Guyot: Stn140, str.0005

Depth Range: 769 – 787 m.

Relatively flat transect. Sand with some gravel, ophiuroids blanketing the bottom and numerous tracks. A few halosaurs. Scattered other fauna, diverse but not numerous.

Valerie Guyot: Stn141, str.0004

Depth Range: 880 – 902 m.

Most of the transect was over flat terrain, rippled sand with pebbles and a patch of coral rubble. Very sparse megafauna, some eels and small sharks.

Valerie Guyot: Stn142, str.0001

Depth Range: 869 – 968 m.

Sand substrate with some gravel, blanketed with ophiuroids, tracks abundant. Trawl gear (warp) at start. Halosaurs most abundant fish, but also rattails, eels, scorpionfish,

Valerie Guyot: Stn143, str.0001

Depth Range: 1085 – 1373 m.

Initially rippled sand, with abundant forams, ophiuroids, tusk shells. Frequent bedrock patches, coral rubble and intact coral in places. Some live stony coral clumps on rocky outcrops at 1248 m to 1285 m. Sponges, brisingids.

Valerie Guyot: Stn144, str.0001

Depth Range: 1081 – 1357 m.

Mixed substrate along this transect, downslope was exposed bedrock with sand interspaces, with intact coral, and an orange roughly aggregation from ~1098 – 1195 m. Downslope further from 1200 m had clumps of live stony coral matrix, with brisingids and crinoids.

Valerie Guyot: Stn145, str.0001

Depth Range: 1164 – 1360 m.

No depth change for the first half an hour, with sand substrate. Epibenthic fauna consisted of forams, cerianthids, seastars, shrimps and urchins. From 1190 m, increasing bedrock and sandy overlay, small stony coral clumps with usual brisingids and crinoids.

Valerie Guyot: Stn146, str.0003

Depth Range: 1351 – 1405 m.

Sandy substrate throughout, mainly cerianthids and worms, with rattails the most common fish. Several extensive patches of dense small holothurians (almost transparent, clear in stills).

Valerie Guyot: Stn147, str.0004

Depth Range: 1255 – 1544 m.

Shallowest depth 1255 m at the top of the hill. Initially sand then bedrock around the summit. Large colonies of primnoid gorgonians on the summit. Bedrock with sandy overlay down to 1376 m then extensive intact dead coral and live stony coral clumps down to 1460 m. Dense patches of VME-like stony coral, with brisingids, crinoids, echinoids (*Dermechinus*), and sponges.

Valerie Guyot: Stn148, str.0004

Depth Range: 1155 – 1515 m.

Landed straight on a field of primnoids. Intermittent sandy bottom, with bedrock and sandy overlay. Towed upslope towards peak of hill, with scattered fauna. Approaching the summit were abundant live stony coral clumps, most frequent around summit, but patchy down to 1370 m. Video finished, but continued with stills

Valerie Guyot: Stn149, str.0004

Depth Range: 1124 – 1474 m.

Interesting transect, mixed substrate with sand, patches of intact coral and rubble, bedrock and boulders typically with live stony coral. Associated with crinoids and brisingids. Some orange roughly. Mixed other fauna including echinoids, ophiuroids, sponges.

Valerie Guyot: Stn150, str.0004

Depth Range: 1135 – 1400 m.

First part of the transect was predominantly rubble/sand/bedrock with areas of intact coral and patches of live scleractinia with brisingids and crinoids. Mid-transect was sandy with cerianthids and rattails. Then back into bedrock outcrops with intact coral, live stony coral, brisingids and crinoids.

Valerie Guyot: Stn151, str.0001

Depth Range: 1210 – 1623 m.

Steep transect (1210 – 1623 m), predominantly sandy substrate, with some smaller areas of sand/bedrock. Cerianthids were the most abundant invertebrate, other fauna sparse but diverse.

Valerie Guyot: Stn152, str.0004

Depth Range: 1245 – 1281 m.

Along line of sled tow 138.

Mostly flat, sandy slope with frequent patches of exposed bedrock. Sparse fauna, some gorgonians, small patch of live stony coral.

Valerie Guyot: Stn153, str.0003

Depth Range: 861 – 922 m.

Sandy bottom, with occasional bedrock, cobbles and the odd boulder with impressive primnoids. Abundant pagurids, gastropods, ophiuroids, asteroids, cerianthids, forams on the sandy bottom. Numerous halosaurids, rattails, morids.

Valerie Guyot: Stn154, str.0001

Depth Range: 1133 – 1336 m.

Towing upslope. Initially intact dead coral with some gorgonians, changing to more extensive bedrock with scattered live stony coral from 1195 – 1133 m. Frequent patches of coral rubble, with lamp shell hash. Lots of pagurids, with normal soft sediment fauna, with tracks and burrows. Anemones and stylasterids on rocky outcrops as well. DTIS snagged on overhang at 1221m, fast for 50 mins.

Selected still images from DTIS of this seamount are given in Figure 46.

Valerie Guyot summary

Valerie Guyot was one of the first of the Louisville seamounts to be discovered, and was named after the wife of one of the scientific expedition leaders in 1961. It is a large guyot, with the summit peak at about 770 m. From 1100 m it drops steeply away, but is irregular on its flanks, with areas of ridge-like extensions to the east and west, and a complex area of deep hills in the northwest.

The summit plateau region comprised mainly sandy substrate, with in places large numbers of brittle stars, and often with pagurids. More of the effort on this seamount was directed at the margins of the summit, and the upper flanks. Live coral clumps were observed in many transects. They reached VME densities on two small hill features in the northwestern region. Primnoid corals were also dense at one site. Brisingids, sponges, and crinoids were usually associated with the intact and live coral. The dense coral matrix occurred near the summit of the small hills, varying in depth between 1200 m and 1350 m. Their distribution was somewhat shallower than on some of the other seamounts. An orange roughy school was observed on the northeastern corner close to a drop-off.

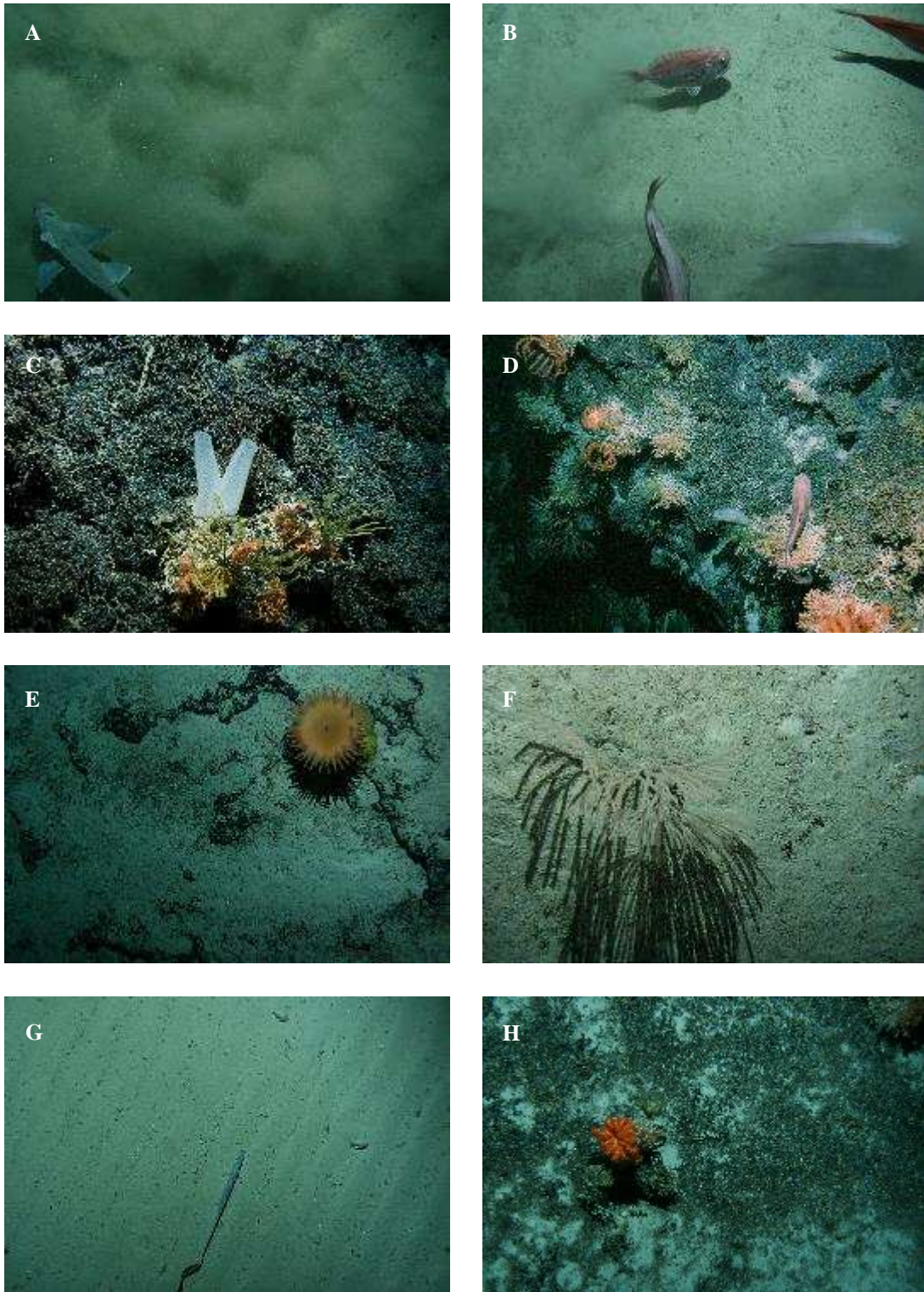


Figure 46: Valerie seamount. A, giant chimaera (*Chimaera lignaria*) at 858 m; B, orange roughy (*Hoplostethus atlanticus*) at 1106 m; C, sponge, coral, and echinoderm complex at 1395 m; D, sponges, corals, echinoderms, and orange roughy at 1211 m; E, anenome at 1171 m; F, ?primnoid gorgonian coral at 1254 m; G, common halosaur (*Halosaurus pectoralis*) and ophiuroids (brittle stars) at 887 m; H, brisingid sea-star and crinoids on *Solenosmilia variabilis* coral at 1136 m.

VME taxa distribution

The distribution of key VME taxa along DTIS transects is shown in Figures 47 to 52.

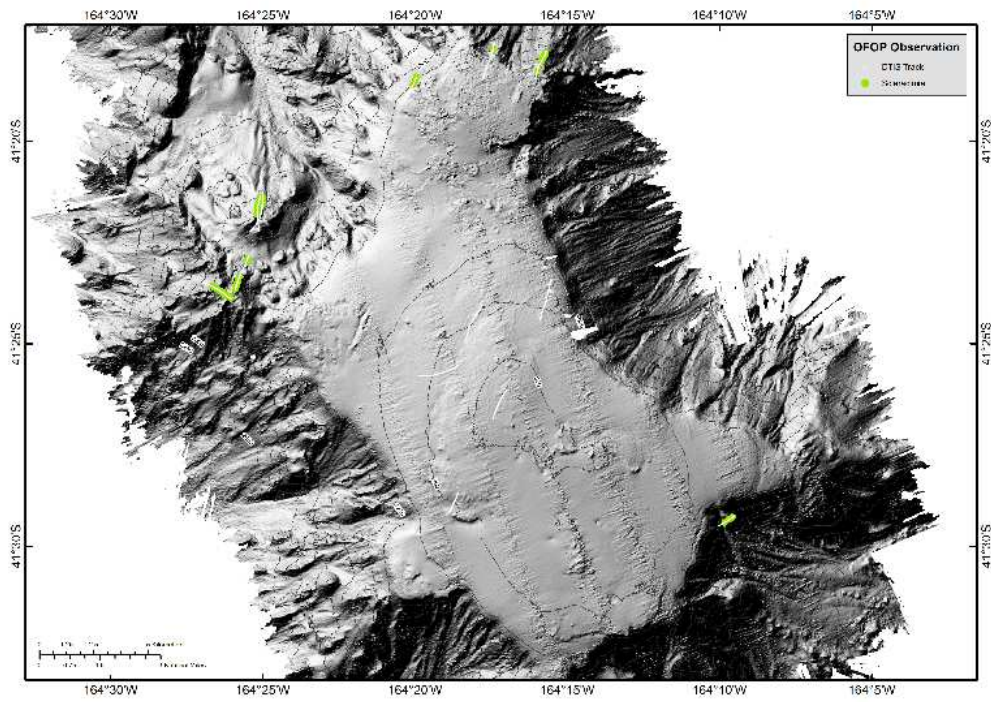


Figure 47: The distribution of Scleractinian (stony) corals on Valerie Guyot (OFOP data).

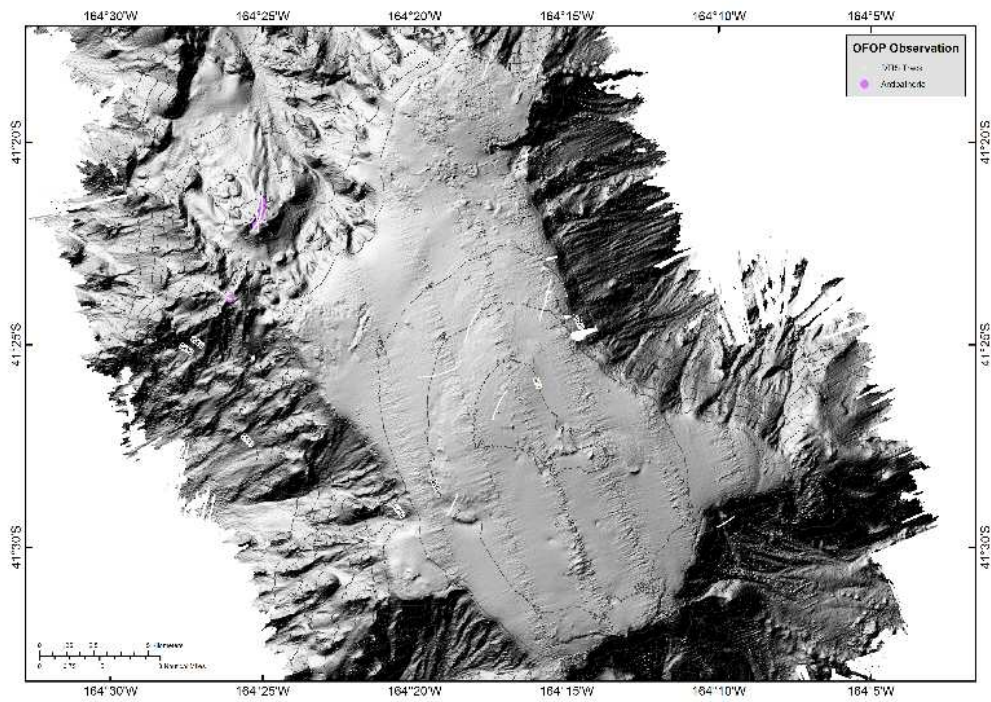


Figure 48: The distribution of Antipatherian (black) corals on Valerie Guyot (OFOP data).

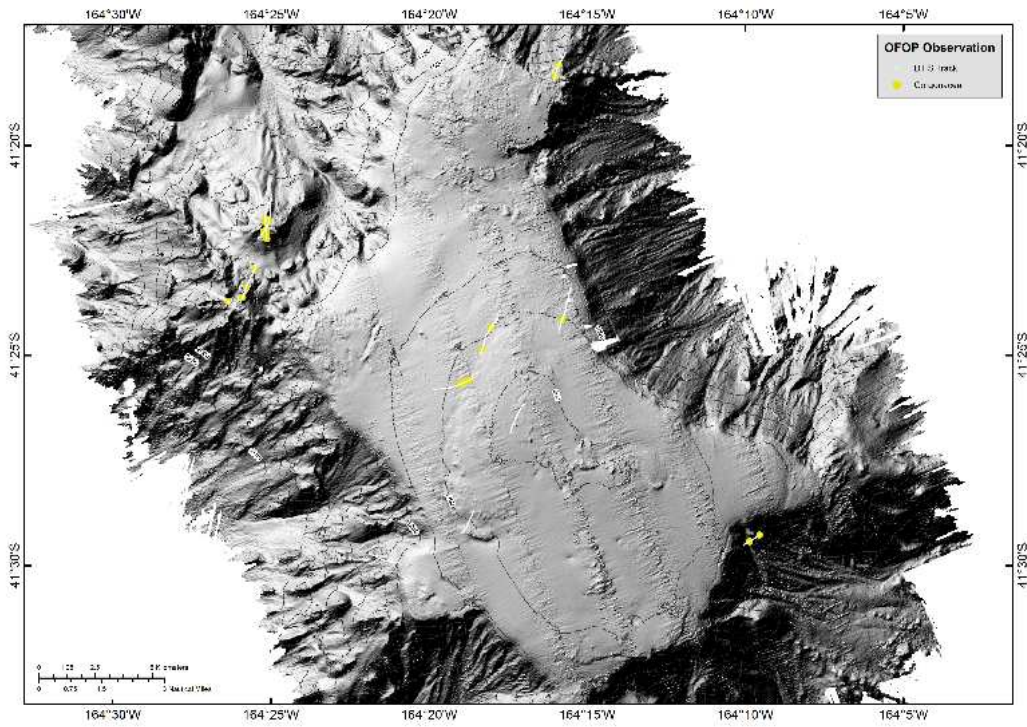


Figure 49: The distribution of Gorgonian (octo) corals on Valerie Guyot (OFOP data).

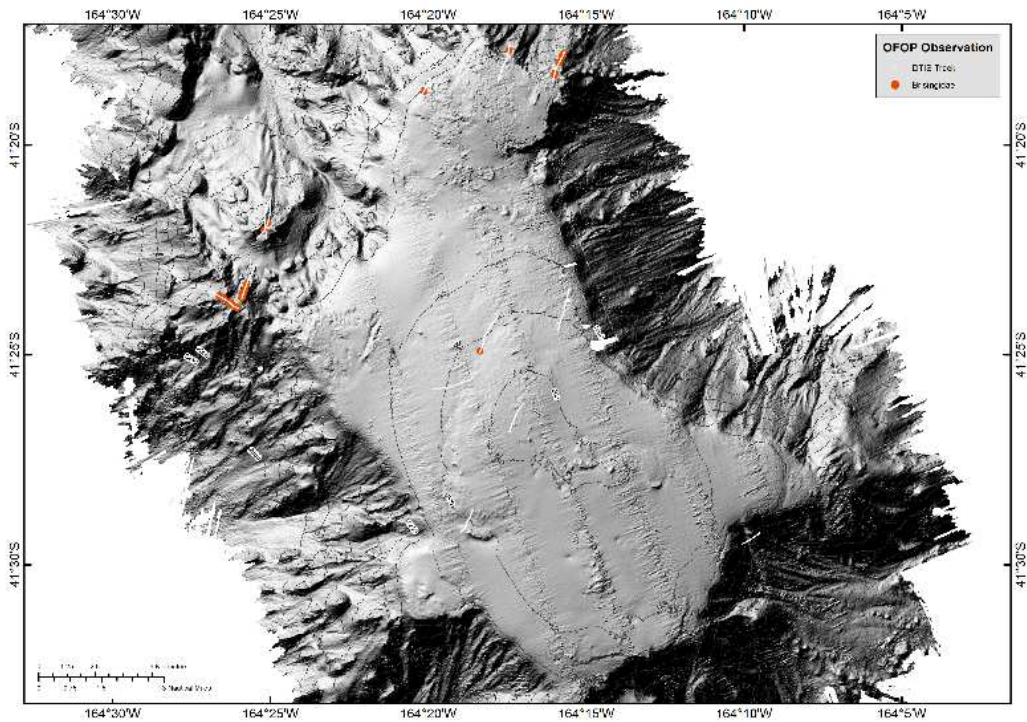


Figure 50: The distribution of brisingid seastars on Valerie Guyot (OFOP data).

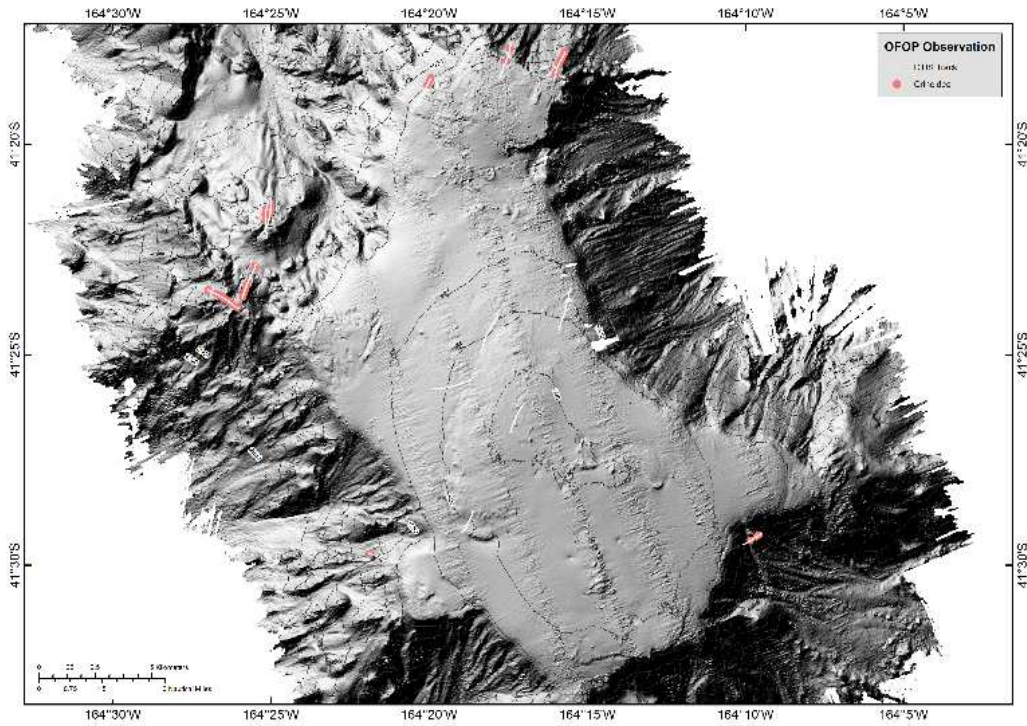


Figure 51: The distribution of crinoids (featherstars) on Valerie Guyot (OFOP data).

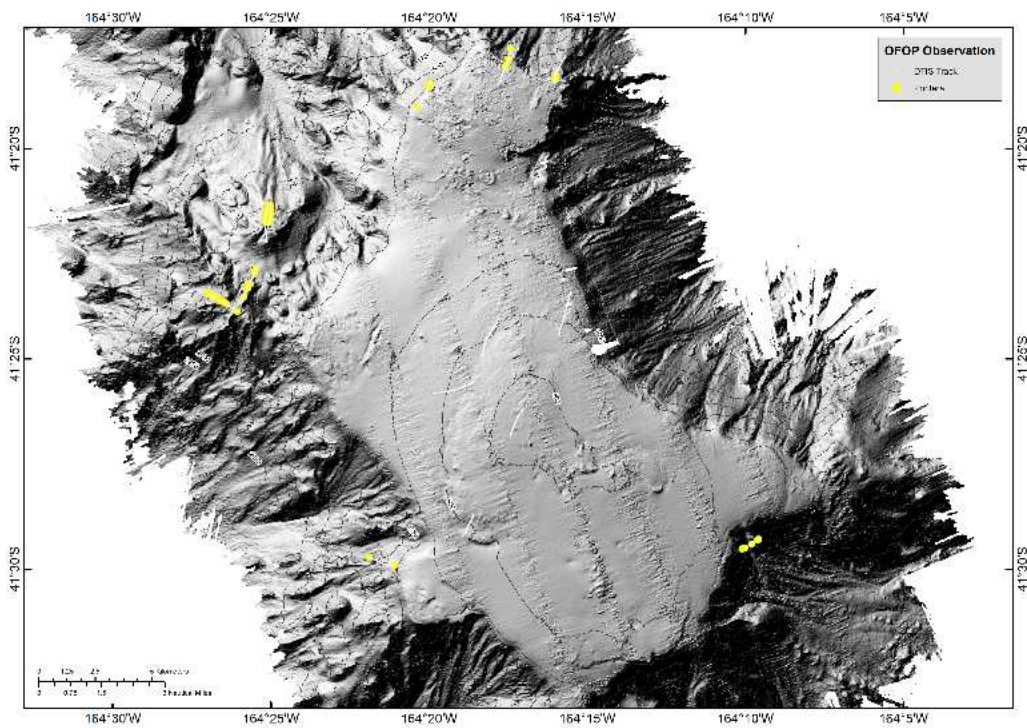


Figure 52: The distribution of Porifera (sponges) on Valerie Guyot (OFOP data).

Stony coral distribution

The distribution of individual VME taxa have been shown under the sections for each seamount. The main taxon of interest was the Scleractinia, (the stony corals), on which the survey design was based. Small clumps of live coral were frequently observed on DTIS transects, but high densities were not often recorded (Table 4).

Table 4: Summary of stony coral and VME-density records from DTIS transects.

Seamount	No. DTIS	No. Stony coral	No. VME
Forde	19	11	2
CenSeam	22	6	0
Anvil	12	7	0
39South	18	6	1
Ghost	28	7	2
Valerie	16	12	2

Preliminary data based on the depth of live Scleractinia recorded on OFOP show interesting differences between seamounts, and between the depth distributions of the taxa in New Zealand waters (Figure 53).

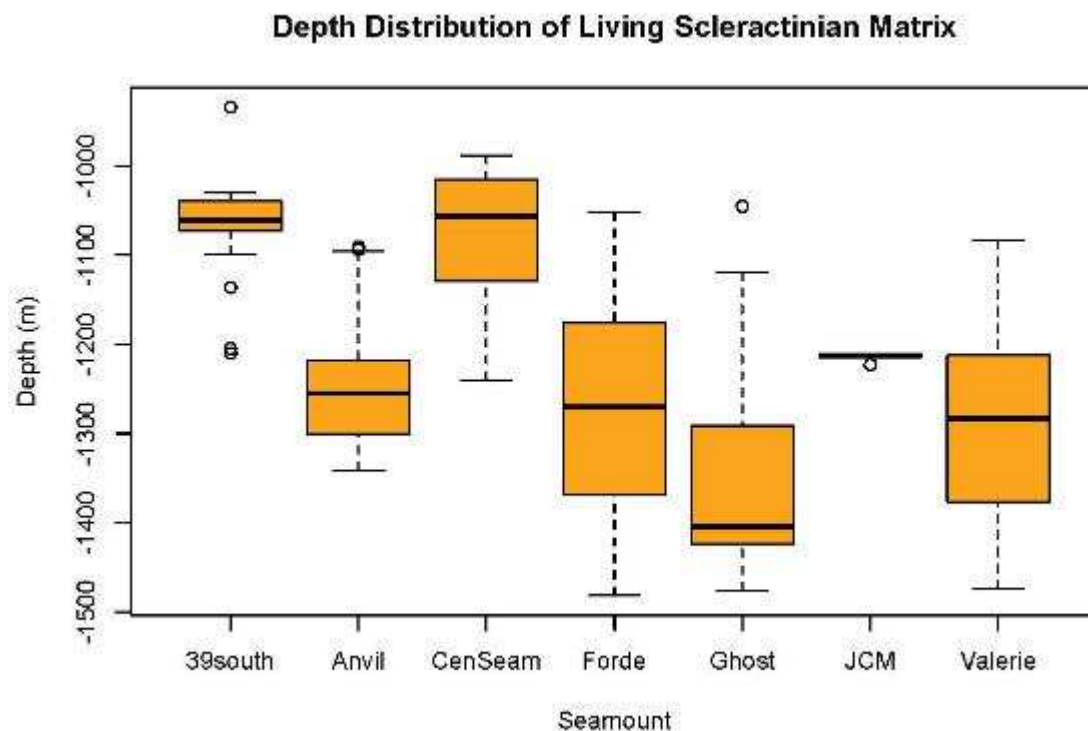


Figure 53: Depth distribution of live scleractinian corals on the surveyed seamounts. The plot shows the median (bar), upper and lower quartiles (box), and total range (circles).

Specimen collection

A total of 667 invertebrate and 7 fish specimen “lots” were catalogued during the survey, representing 73 invertebrate taxa from 10 phyla, and 5 fish species. The numbers of specimens per taxon are summarized in Table 5, grouped by seamount.

Table 5: List of taxa and number of specimens collected from epibenthic sled and beam trawls during TAN1402. See methods section for site codes.

Phylum	Class	Order	O.T.U.	39south	Anvil	Censeam	Forde	Ghost	Valerie	Grand Total
Annelida			Annelida				1			1
	Oligochaeta	Euhirudinea	Hirudinidae						1	1
	Polychaeta		Polychaeta	106	7	1	21	6	40	181
Arthropoda			Crustacea				1			1
	Malacostraca	Amphipoda	Amphipoda				2			2
		Decapoda	Brachyura	11	1	7	2	35	26	82
			Decapoda		1	2	4	6	5	18
			Galatheidae	11	1	17	11	47	83	170
			Galatheoidea	10			2	1		13
			Paguridae	9	3	2	3	11	8	36
			Polycheles			1	2	1	3	7
		Isopoda	Isopoda						2	2
	Maxillopoda		Cirripedia	1						1
Brachiopoda			Brachiopoda			4	3			7
Bryozoa			Bryozoa			7			1	8
Chordata	Ascidiacea (Tunicates)		Ascidiacea (Tunicates)	2	2	3	7	1	2	17
	Thaliacea (Salps)		Thaliacea (Salps)			1	1	5	1	8
Cnidaria	Anthozoa	Actiniaria	Actiniaria	11	1		5	11	17	45
		Alcyonacea	Alcyonacea	531	3	1	10			545
			Anthothela		1					1
		Antipatharia	Antipatharia	2			2			4
		Gorgonacea	Acanthogorgia		1		2			3

			Acanthogorgiidae				1			1
			Calyptrophora						1	1
			Chrysogorgiidae	1	1		5	1	1	9
			Corallium			1	1			2
			Gorgonacea	1		2	5	1		9
			Hemicorallium	3						3
			Isididae		1	1	6	1	1	10
			Keratoisis					1		1
			Metallogorgia				7			7
			Paracalyptrophora	1						1
			Plexauridae		3		2			5
			Primnoidae	7	2	1		1		11
			Thouarella	1						1
		Pennatulacea	Pennatulacea				1			1
		Scleractinia	Caryophyllia				1			1
			Caryophylliidae	3	4	8	121	14	13	163
			Desmophyllum				8			8
			Desmophyllum dianthus	100			1		7	108
			Eguchipsammia				4			4
			Goniocorella dumosa	17	2		10	14	9	52
			Scleractinia	7	12	29	22	5	7	82
			Solenosmilia variabilis				13	1		14
		Zoantharia	Zoanthidae					1		1
	Hydrozoa		Hydrozoa	5		3	2	20		30
			Siphonophora			1				1
		Anthoathecata	Stylasteridae	2	1		1	3	6	13
Echinodermata	Asteroidea		Asteroidea	5	1	3	10	3	19	41
		Brsingida	Brsingida	1						1
			Brsingidae		1		3		1	5

		Paxillosida	Psilaster				1			1
		Valvatida	Pillsburiaster				2			2
	Crinoidea		Crinoidea	11	2	3	198	20	19	253
		Articulata	Thaumatometra alternata				8			8
	Echinoidea		Echinoidea	3	1	7	10	10	17	48
		Cidaroida	Poriocidararis purpurata				1			1
		Echinoida	Dermechinus horridus				2			2
			Gracilechinus multidentatus		2					2
		Echinothurioida	Echinothuriidae	1						1
		Pedinoida	Caenopedina		1	5	1			7
			Caenopedina otagoensis				1			1
			Caenopedina porphyrogigas				2			2
	Holothuroidea		Holothuroidea		1		3			4
	Ophiuroidea		Ophiuroidea	318	65	120	239	360	947	2049
Mollusca			Mollusca				4		1	5
	Bivalvia		Bivalvia			1		3		4
	Gastropoda		Gastropoda	8		2	1	17	3	31
	Scaphopoda		Scaphopoda	1			12			13
Porifera			Porifera	29	21	50	17	15	20	152
	Hexactinellida		Hexactinellida	2	1		3		6	12
		Hexactinosida	Farreidae			2	1			3
Sipuncula			Sipuncula					1		1
Grand Total				1221	143	287	807	616	1267	4341

Notes on selected taxa

The voyage collected a lot of data and samples that will be further checked, identified, and processed at NIWA. Many specimens will require formal identification/confirmation from specialist taxonomists, but below are some impressions for selected taxa from several scientists onboard.

Deepsea corals

A diverse array of deepsea corals are found throughout the New Zealand region and the current survey has been valuable in extending knowledge of their known distributions. Groups represented include the scleractinian cup and branching 3-D matrix forming species, black corals, various gorgonian octocorals, and the occasional sea pen resembling *Pennatulula* spp. The smaller stylasterid hydrocorals were observed on bedrock and overhangs. Zoanthids coated some octocorals or were seen in clusters on sandy sediment.

Scleractinian stony corals: Colonies of live scleractinian coral *Goniocorella dumosa* and *Solenosmilia variabilis* form a branching matrix that is an important habitat for many deepsea organisms and provides a platform or refuge for several invertebrate groups. Both species were observed with colonies growing on bedrock and patches of hard bottom. These extended for 100s of metres in some areas, in other instances there were only a few small localised patches. Specimen samples were collected for identification, aquaria experiments, genetics, and reproductive studies. The species have been difficult to discriminate as the colonies appear to be growing on each other and/or together. Corallites on the branches of one specimen appeared to be characteristic of both species as both extratentacular and intratentacular budding was visible. Often the distinctive bridges were not apparent on *G. dumosa*. This proved confusing onboard, although it is not unusual for the matrix forming corals to display the intertwined growth pattern or for one to grow on the matrix of another.

Since the voyage, photographs have been sent to taxonomic experts, and after considerable discussion, they have concluded that most are *Solenosmilia variabilis* (S Cairns, Smithsonian Institute, USA, Marcelo Kitahara, Universidade Federal de São Paulo, Brazil), pers. comm.

On several seamounts, extensive intact but dead stony coral matrix was observed down the flanks, as well as on the top on sandy bottom (Figure 54). In the northern region it was particularly noticeable that the matrix was coated in ferro-manganese. This may indicate the intact coral matrix we observed has been dead for a very long time, perhaps 1000s of years. The dead matrix was seen in areas where little or no fishing had occurred as well as on seamounts where fishing activity has been significant. It is not clear what could have caused the corals demise across such large depth gradients (100s of m) and across the entire study area (100s of km). Possibilities include that there may have been a climatic event, possibly a change in the oxygen levels where they usually thrive; sandy sediment swept up by localised currents or human disturbance may have smothered their bottom habitat and clogged their feeding ability; or the corals may have been dead for centuries, sinking with the seamounts below their preferred environment. Live branching stony corals were found at the limits of their preferred depth distribution. *G. dumosa* and *S. variabilis* are most commonly found in New Zealand waters at depths of 800-1000m. However the living corals we observed occurred deeper on the Louisville Ridge in 1200-1350 m depths. This is not outside their documented range, but it is at the lowest end.

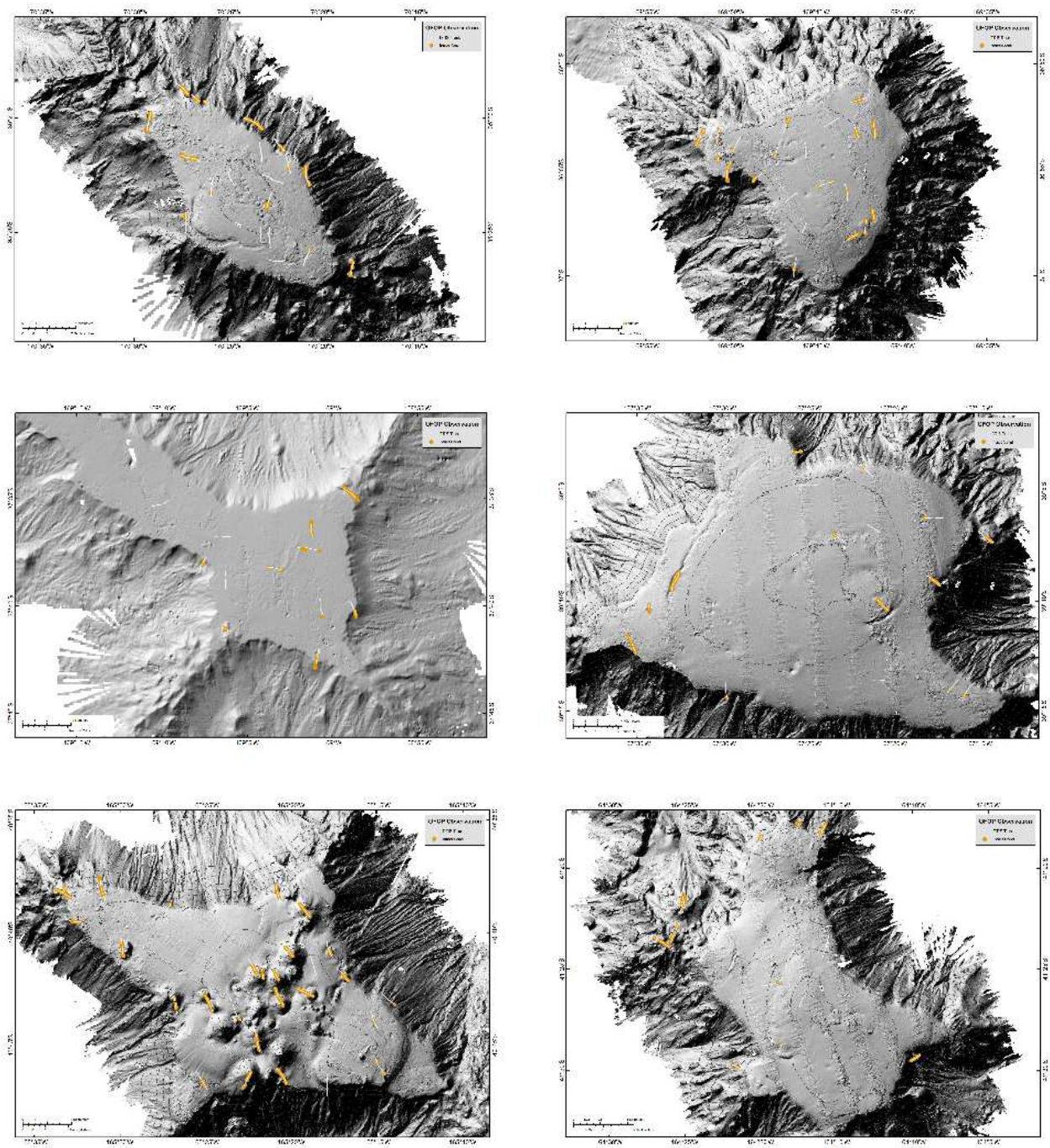


Figure 54: The distribution of intact (but dead) stony coral matrix on the 6 seamounts: Left to right; Forde, CenSeam (top), Anvil, 39 South (middle), Ghost, Valerie (bottom).

Gorgonian distribution

Gorgonian corals were variably distributed on the seamounts and guyots of the Louisville Ridge between ~650 – 1500 m depth. From north to south, the species composition varied along a gradient of Chrysogorgiidae (e.g., *Metallogorgia melanotrichos*, *Chrysogorgia* spp., and *Iridogorgia* spp.) to Primnoidae (e.g., *Thouarella* spp., & *Calyptrophora* spp.). Other taxa include *Hemicorallium*, *Paragorgia*, and *Paramuricea*, as well as *Acanthogorgia* and members of the Isididae (e.g., *Keratoisis* spp.). Most notably was the presence of *Chrysogorgia* spp. on each seamount, *M. melanotrichos* predominantly in the north, and *Iridogorgia* spp., observed up to and including 39° South. Primnoids increased in abundance with *Thouarella* spp., dominant within the gorgonians present at Ghost, and small fields of the lyrate *Calyptrophora* at Valerie. All gorgonian taxa were observed on hard substratum such as exposed bedrock, with sandy overlay, or boulders and dead hard coral rubble.

Overall diversity and abundance of gorgonians appeared low relative to areas inside the New Zealand EEZ, such as on the Kermadec Ridge and Chatham Rise, as well as off Tasmania.

Of the 24 sleds, 55 specimens were collected with at least one *Chrysogorgia* sp. likely new to science. Members of the *Chrysogorgia* genus are characteristic of the deep ocean, present on hard substratum in all ocean basins between 100 – 4492 m depth. Classical and phylogenetic analyses are underway to ascertain the taxonomic status of this specimen, particularly in relation to other Chrysogorgiidae members collected on the seamounts during this voyage, and other locations.

The discovery of the bioluminescent bamboo coral *Keratoisis* sp. (Figure 55), is a phenomena first documented in the Hawaiian bamboo coral *Lepidisis olapa*, and further adds to the body of knowledge for this controversial taxonomic group. The reasons for its bioluminescence as well as its source (associate microbial communities or host) are as yet uncertain, however such research would inevitably yield invaluable results with sub-samples preserved specifically for metagenomic and metatranscriptomic analyses in collaboration with the Earth Microbiome Project (Argonne, USA & Bishop Museum, USA).

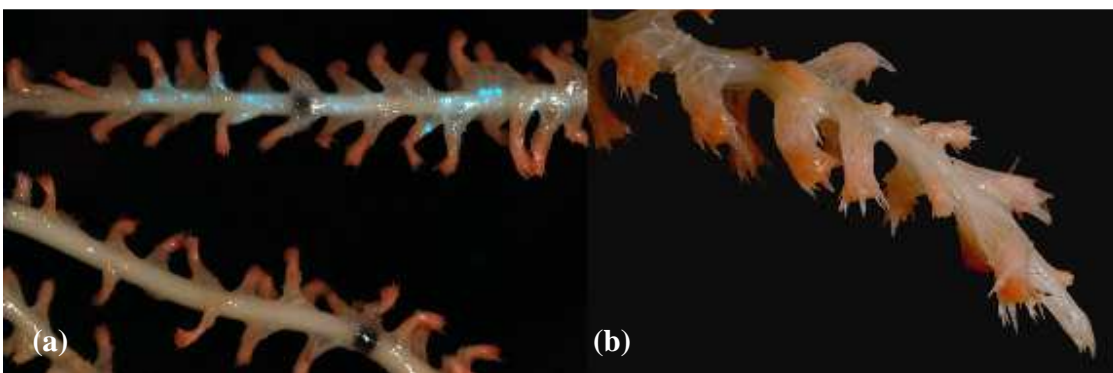


Figure 55. (a) Bioluminescent and, (b) a close up image of *Keratoisis* sp., from Ghost Seamount at ~ 814 m depth from predominantly dead coral rubble substratum.

Interestingly, a small, purple soft coral most probably within the family Anthothelidae, was particularly abundant at the 39° South Seamount encrusting both dead intact coral matrices and benthic substratum (Figure 56). A similar specimen has also been observed from the North Western Hawaiian Islands, and hence further comparative taxonomic investigations are planned.

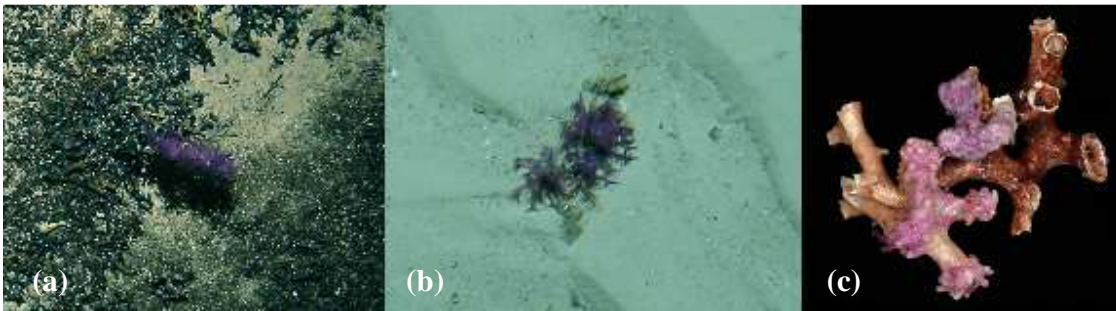


Figure 56 Soft coral located on (a, b) dead coral rubble and (c) coral matrix at the 39° South Seamount, 910m

Associates

A considerable diversity of invertebrate associates were sampled during the voyage inhabiting various sessile megafauna. Polychaetes including scale worms were frequently encountered on live scleractinia and gorgonians such as *Thouarella* spp. Ophiuroids were probably the most ubiquitous associate taxa. *Ophiocreas oedipus* was consistently present on colonies of the gorgonian *Metallogorgia melanotrichos*, which is a well documented obligate association. Numerous ophiuroids were found clinging onto gorgonian, scleractinian and sponge taxa, the latter particularly on individuals within the glass sponge family Farreidae. Crustaceans such as galatheids and shrimps (e.g., *Uroptychus* sp. and *Bathypalaemonella* sp. respectively) were also commonly associated with gorgonian colonies, as were anemones on *Thouarella* spp., and stylasterids on the base of bamboo corals. Brisingid seastars and crinoids were frequently observed on the live scleractinian *S. variabilis*. Such live structures invariably attracted a plethora of life including glass sponges and gorgonians in some cases, as well as certain echinoid species (*Caenopedina porphyrogigas* and *Dermechinus horridus*). How such taxa interact and provide linkages between communities will be investigated through collaboration between the University of Hawaii, Bishop Museum, WHOI, and NIWA.

Sponges

Hexactinellid (or glass) sponges were common in the region, most appeared to belong to the lacey honeycomb glass sponges (Family Farreidae/ Euretidae). Small brittlestars were often attached and entwined throughout their honeycomb-like structure (left image of Figure 57). On the right, images of specimens caught in the epibenthic sled show brittle stars, cup, and branching stony corals using the dead framework of *Farrea similaris* as substrate to settle and grow on.



Figure 57: Lacey honeycomb glass sponges (Farreidae/ Euretidae).

Echinoids

Echinoids were seen on most of the DTIS transects, with the most commonly observed being the flexible-test echinothurioids (Tam O'Shanter's). Two genera (*Hygrosoma* and *Sperosoma*) were present on soft-bottom transects, and a further genus (*Araeosoma*) was occasionally observed on hard substrates. Three specimens were obtained from seamount sleds (2 *Araeosoma*, 1 *Sperosoma*) – these being the first confirmed records for these genera from the Louisville Seamount Chain.

Two rigid-test species were frequently seen on hard substrates, usually in close association with live scleractinian corals. Individuals of the pedinid *Caenopedina porphyrogigas*, previously known from a single record on the Louisville from south of the survey area, were seen perched on live clumps of coral and nearby hard substrates in high densities (particularly on the northern seamounts Forde and CenSeam) – reminiscent of the urchin barrens more commonly seen on shallow reefs. Less common but exhibiting similar behaviour were individuals of the echinid *Dermechinus horridus*. This species is widely spread around the southern hemisphere and is well known from the New Zealand region including the Louisville. Because of the close association of these two urchin species with the sparsely distributed colonies of live coral there was speculation on board that they may be predated on them. However, there is also unpublished research suggesting that these two species are capable of filter feeding, an exceedingly rare feeding mode in echinoids, and therefore they may simply be positioning themselves in the best currents for food supply (filter-feeding crinoids were also very commonly seen perching on corals). Specimens of both urchin species were retained for analysis of stomach contents.

Several other echinoids were encountered: the cidarid *Poriocidaris purpurata*, seen on DTIS and one collected; the echinid *Gracilechinus multidentatus*, seen on the sand in moderate densities in some locations (e.g., Anvil, 39 South) with several collected; the pedinid *Caenopedina otagoensis*, seen on bedrock on DTIS and one collected; and a single unidentified temnopleurid (probably *Pseudechinus* sp.) was extracted from within a live clump of coral matrix.

Specimen photographs

Almost 500 specimen photographs of animals caught in the epibenthic sled were taken at 24 stations.

Examples are given in Figure 58.

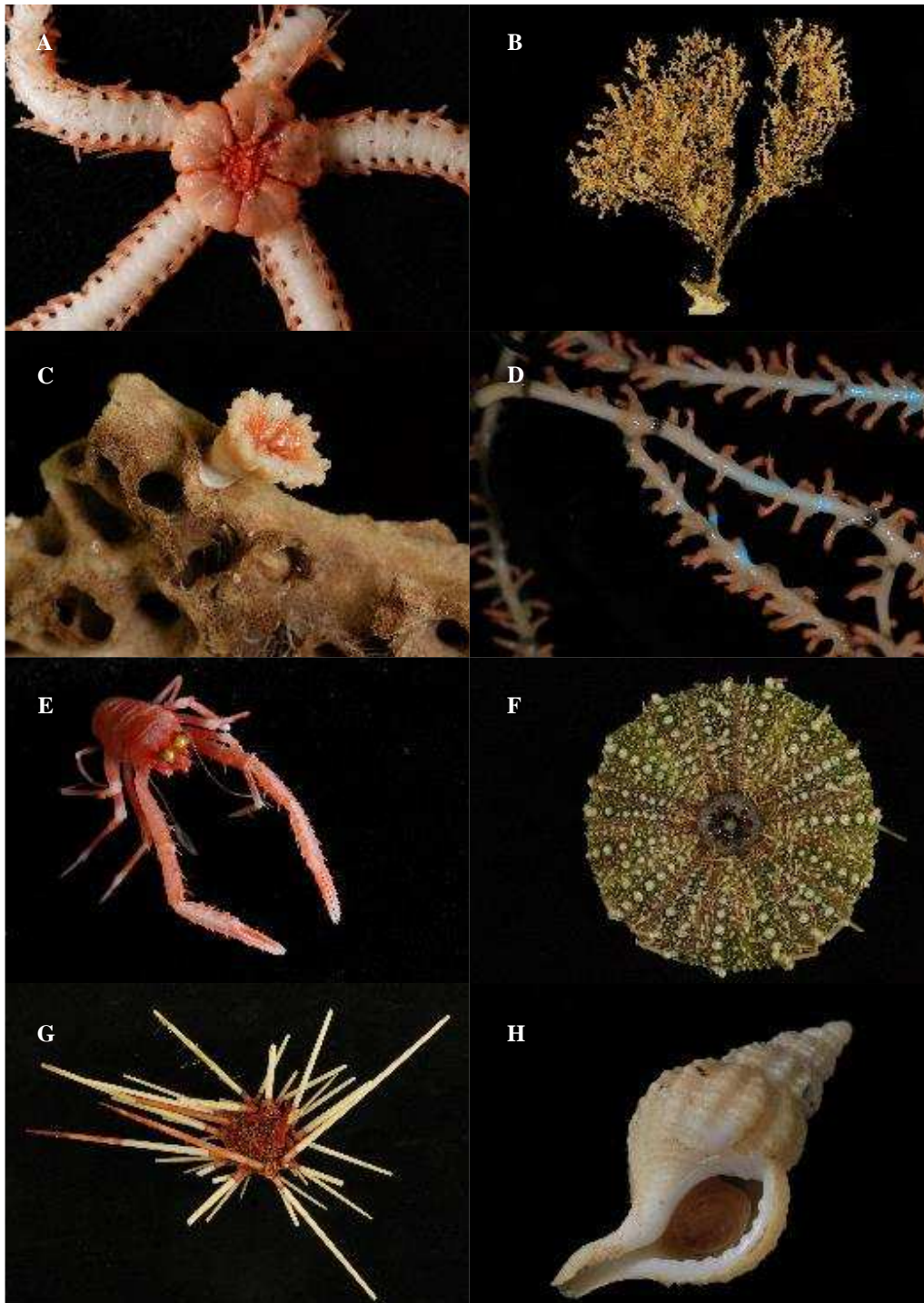


Figure 58: Specimen images. A, brittle-star ophiuroid; B, sea-fan coral (Primnoidae); C, stony cup coral (*Desmophyllum dianthus*) using the dead framework of a hexactinellid sponge *Farrea similaris* as substrate to settle and grow on; D, bamboo coral *Keratoisis* spp. showing bioluminescence; E, galatheid (squat lobster); F, echinoid (*Gracilechinus multidentatus*); G, cidarid (*Poriocidaris purpuratus*); H, gastropod mollusc.

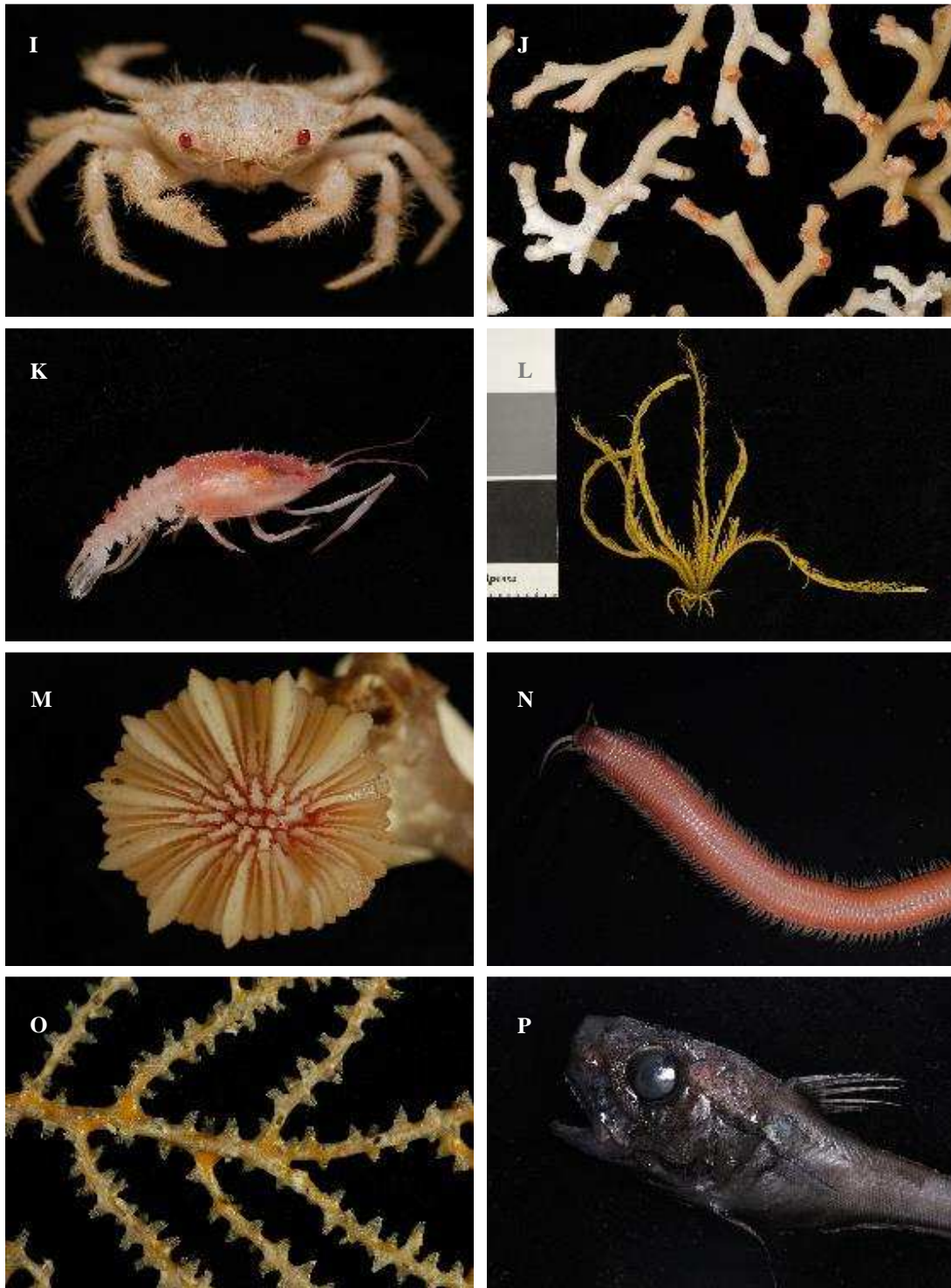


Figure 58: Specimen images—*continued*. I, unidentified crab; J, fragments of scleractinian branching stony coral matrix (*Goniocorella dumosa*); K, deep-sea blind lobster (*Polycheles* sp.); L, comatulid crinoid; M, carnation cup coral (*Caryophyllia* spp.); N, polychaete worm (*Eunice* sp.); O, plexaurid sea fan coral *Paramuricea*; P, globosehead rattail (*Cetonurus crassiceps*).

Live coral collection

Corals were sampled at 6 stations, from 4 seamounts: Anvil, 39 South, Ghost and Valerie. The 12 bin tank configuration is shown below (Table 6).

Table 6. Final aquarium tank configuration detailing station number, sample date and *Specify* number for the live corals in each of the 12 containers.

Container 1 Station 156 2/3/14 #94590	Container 4 Station 156 2/3/14 #94590	Container 7 Station 66 16/2/14 #94287	Container 10 Station 134 26/2/14 #94485
Container 2 Station 138 28/2/14 #94550	Container 5 Station 66 16/2/14 #94287	Container 8 Station 91 20/2/14 #94339	Container 11 Station 156 2/3/14 #94590
Container 3 Station 134 26/2/14 #94485	Container 6 Station 66 16/2/14 #94287	Container 9 Station 97 21/2/14 #94440	Container 12 Station 138 28/2/14 #94550

CTD and water sampling

Table 7 summarises the CTD station details for each seamount - depth range sampled, number of alkalinity and DIC samples collected for each depth, and the bottom temperature ($^{\circ}$ C) and dissolved oxygen (DO) data. The bottom depths sampled for each seamount ranged from 1271 to 1972 m. DIC and alkalinity samples will be processed by NIWA over the coming months to obtain aragonite and calcite saturation state values by depth for each seamount. CTD information from DTIS stations and from the water sampling casts (including dissolved oxygen) will also be processed to provide additional derived variables (e.g. sigma-theta), which may be useful in helping determine environmental drivers of deep-sea coral distribution. Aragonite and calcite saturation state data derived from the *in situ* water samples will help ground truth existing carbonate chemistry models for the region and aid in the development of more accurate models in the coming months.

Table 7: Summary of water sampling TAN1402

Seamount	Station_no	Depth range (m)	No. of bottles		Bottom T°C	Bottom DO ml/l
			Alkalinity	DIC		
Forde	29	10-1275	11	11	3.91	3.90
CenSeam	58	7-1321	12	12	3.34	3.70
Anvil	75	10-1408	11	11	3.42	3.55
39 South	98	10-1972	11	11	2.50	3.10
Ghost	132	10-1471	12	12	3.25	3.61
Valerie	155	11-1489	12	12	3.30	3.50

Seabird observations

Observation were made during 25 days over the course of the voyage, with 2,481 sightings of seabirds. Raw sightings data, not standardized to observing effort, yielded a total of 25 species (Table 8). The number of species differed between seamounts, with the northern seamounts having lower diversity than the more southern ones, especially Ghost (Table 9).

Table 8: List of seabird species (common name) observed during the voyage.

- | | |
|-----------------------------|----------------------------|
| NZ. Wandering Albatross | Long Tailed Skua |
| Snowy Albatross | Arctic Skua |
| Northern Royal Albatross | Wedge-tailed Shearwater |
| Southern Royal Albatross | Flesh-Footed Shearwater |
| Campbell Albatross | Buller’s Shearwater |
| Chatham Albatross | Westland Petrel |
| Salvin’s Albatross | Grey Petrel |
| White-Capped Albatross | Cook’s Petrel |
| Southern Buller’s Albatross | White-necked Petrel |
| Masked Booby | Black winged Petrel |
| Southern Giant Petrel | Kermadec Petrel |
| Northern Giant Petrel | White Bellied storm Petrel |
| Grey Ternlet | |

Table 9. Observation times and species numbers by seamount.

Seamount	Observation time (hrs)	Species count
Forde	60	13
CenSeam	42	9
Anvil	20	8
39South	37	11
Ghost	48	22
Valerie	35	16

The data represent a valuable addition to knowledge of regional distributions. As an example, Figure 59 shows the distribution on the ridge of the species combined into higher groups. Petrels dominated at the northern seamount, but as we progressed southwards, they decreased in frequency, with shearwaters and albatrosses being more common.

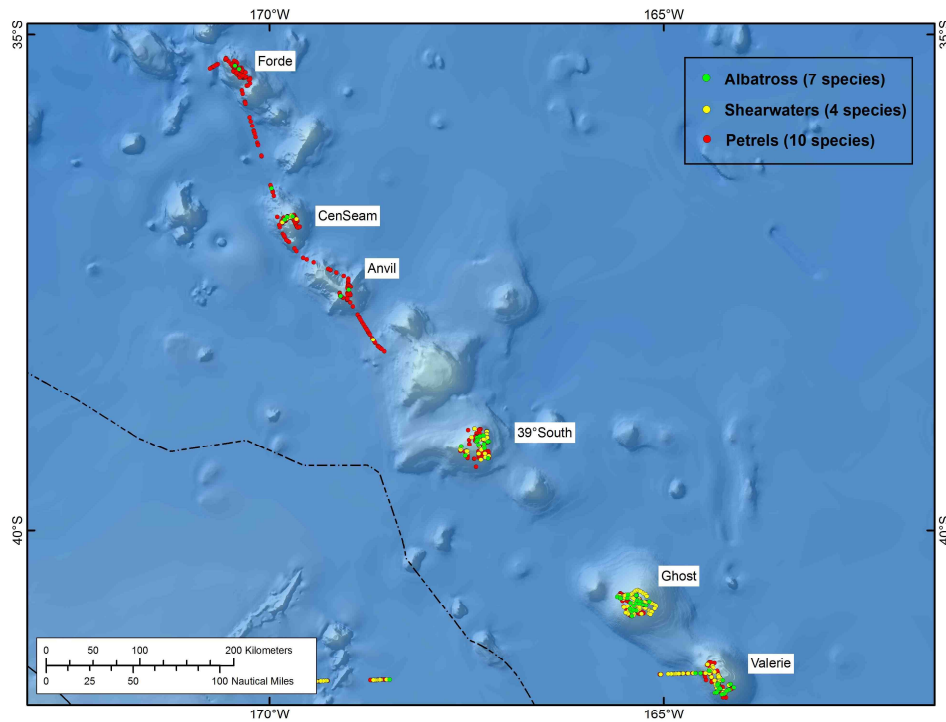


Figure 59: Distribution of observed albatross, shearwaters, and petrels.

Marine Mammal observations

A total of 10 cetacean sightings was recorded throughout the survey. Only one sighting, of a sperm whale, was recorded in the Louisville Seamount Chain survey area. The other cetacean sightings were recorded during transit to the survey area. Species recorded included common dolphins (*Delphinus delphis*), pilot whales (*Globicephala* sp.) and sperm whales (*Physeter macrocephalus*) (Table 10).

Table 10: Cetacean sightings during TAN1402

Cetacean species	Scientific name	No. of sightings	No. of Animals
Common dolphins	<i>Delphinus delphis</i>	5	141
Pilot whales	<i>Globicephala</i> sp	1	12
Sperm whales	<i>Physeter macrocephalus</i>	2	2
Like sperm whales	<i>Physeter macrocephalus</i>	2	2
Total		10	157

Bathymetry

Some of the survey area had been mapped prior to this voyage, but 5 of the 6 seamounts had to be covered before sampling.

During the survey more than 10,000 km² of Multibeam Echo-Sounder (MBES) data were collected. Both the bathymetry and backscatter signal was processed for the seamount targets, but bathymetry only for the transit lines between seamounts. The later were run at speeds of up to 12 kn and are of moderate quality, as is to be expected for that speed.

Bathymetry data were processed using CARIS HIPS 8.1.6 and backscatter data were processed using QPS FMGT 7.3. Data from both software packages were exported into ESRI compatible formats. Using ESRI ArcGIS data were then imported into File Geo Data Bases (FGDB) for generation of map exports into the OFOP software used in DTIS operations.

Previous MBES data in the survey area consisted largely of transit data from various vessels. Noteworthy is the RV *Sonne* voyage SO167 that collected data along the northern and central Louisville Seamount Chain. All of these were 12KHz MBES systems and as a result have horizontal resolutions of 50 m at best, usually 100 m or more. TAN1402 repeated some of the coverage of these surveys as the 30KHz MBES on RV *Tangaroa* allows horizontal resolutions of 25m. The gained detail of seafloor topography was important to the safe & successful deployment of DTIS, as well as an aid to survey design.

Voyage aspects Web Page

At times during the voyage, blog entries were provided to NIWA. This was not an official record of the survey, but various thoughts and observations on the activities onboard.

Blog 1: New seamount research to improve fisheries management

Blog 2: Mountains in the Sea: the Louisville Seamount Chain

Blog 3: Sampling seamounts

Blog 4: Seafloor life on the Louisville Seamounts

Blog 5: Scientists at sea

Blog 6: Measuring seawater chemistry on the Louisville Ridge

Blog 7: Homeward bound

See the webpage at: <https://www.niwa.co.nz/news-and-publications/blogs/tangaroa-voyage-blog-surveying-the-louisville-seamount-chain>

DISCUSSION

The survey achieved its objectives. The DTIS coverage and supporting sled tows were completed largely as planned. Most strata were surveyed on all features, and a large amount of photographic data and specimen samples were collected. These will form a sound basis for detailed analyses in the coming year under the programme.

The survey design was adapted as we learnt more about the actual bathymetry of the seamounts, and the distribution of faunal communities. Although depth itself was not a variable in either the BRT or Maxent models, many other environmental factors are in some way related to it. This caused us to replace one of the planned seamounts in the northern region, Danseur, because the modelling was based on conditions associated with a seamount with an estimated summit at about 100 m, whereas the actual summit depth was 950 m. Hence the data available to the model did not reflect the seamount characteristics at all, and sampling it would have been futile for checking the reliability of the model.

The greater depth at which the stony corals occurred was unexpected. The median depth of *Solenosmilia* and *Goniocorella* on the New Zealand slope and small seamounts is 900–1000 m., whereas on the Louisville seamounts it was 1200–1300 m. It is hoped that the detailed environmental data collected during the voyage will help interpret this (see stony corals section earlier in the report). Similarly, the amount of dead, but intact, coral matrix was surprising, although this has also been observed in other parts of the New Zealand EEZ, the Macquarie Ridge, and off Tasmania. Follow up work is planned to age the coral, and hence enable us to evaluate whether a large “die off” could coincide with a major oceanographic event, be related to the seamounts slowly getting deeper with age, or be an effect of high sedimentation rates on the guyot-shape seamounts.

Our previous experience with seamount, knoll and hill features in the New Zealand region had implied that the summit and upper flank areas are often the best sites for finding high density coral “reefs”. However, with the large guyot structure of the Louisville seamounts, the summit areas were plateau-like, and predominantly soft sandy sediment. Stony corals were therefore patchy in their distribution, and were often localised in areas of steep and rough topography, such as ridges or small knob-like hills on the seamounts. Knowledge of the detailed bathymetry, and also the backscatter from the multibeam (enabling soft-hard to be discriminated) were key aspects in coral distribution. The relatively small spatial scale of biological distribution compared to the relatively large-scale environmental parameter knowledge is a challenge. However, the new data collected will be highly informative and progress the next iteration of modelling.

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Appendix 1: TAN1402 sampling station summary. UWC = DTIS camera, SEL = epibenthic sled, SVP = sound velocity probe, CTD = conductivity temperature depth probe. Perf = gear performance, depths (s_dep, f_dep) in m, Time is NZST.

Stn	Smt	Method	Date	Time	lat_d	lat_min	lon_d	lon_min	s_dep	f_dep	n.mile	dir	Perf	Comments	Live SIA	
1	Test	UWC	31-Jan	1734	41	15.7	174	50.11	e	20	21	0.21	305	OK	DTIS test in Wellington harbour	
2	Forde	SVP	7-Feb	840	35	15.05	170	32.68	w	0	1508	0.00	318	OK	SVP prior to multibeam survey of Forde.	
3	Forde	UWC	8-Feb	2	35	23.44	170	25.85	w	1003	1006	0.84	6	OK	Rippled sand, few outcrops, coral rubble at start. Sparse fauna. Still camera failed.	
4	Forde	UWC	8-Feb	302	35	22.96	170	24.64	w	972	984	0.74	347	OK	Sandy rippled bottom, occasional rocky outcrops, patches of coral rubble, some erect (dead). Sparse fauna, some seastars, urchins.	Y
5	Forde	UWC	8-Feb	556	35	21.92	170	23.17	w	1023	1063	0.86	352	OK	Rippled sandy bottom, burrows and tracks. Tusk shells common, some sea stars and urchins.	
6	Forde	UWC	8-Feb	856	35	21.45	170	21.95	w	1145	1390	0.67	322	OK	Soft sandy sediment and rugged bedrock outcrops, especially at base and on ridge top. Stony, gorgonian, bamboo and black corals in places. Echinoids on sandy sediment.	Y
7	Forde	SEL	8-Feb	1204	35	21.13	170	22.34	w	1226	1215	0.03	129	NO	Fast after 3 minutes. 150kg rock/rubble. Some dead coral rubble. Small sample of urchin, crinoid, sponge, amphipod.	
8	Forde	SEL	8-Feb	1329	35	21.2	170	22.24	w	1154	1270	0.15	131	OK	One weak link parted but catch good. Coral rubble, some cobbles, assortment of live coral, asteroids, sponge, ophiuroids. Good specimens.	
9	Forde	UWC	8-Feb	1500	35	22.96	170	20.6	w	1090	1090	0.86	350	OK	Along edge of plateau. Sandy, coral rubble, rock outcrops. Intact coral matrix in places. Ridge at end-corals, sponges, urchins.	Y
10	Forde	SEL	8-Feb	1956	35	22.06	170	20.78	w	1175	1280	0.20	2	OK	Along last part of DTIS #9. Small catch, 10kg coral rubble, Metallogorgia.	
11	Forde	UWC	8-Feb	2123	35	22.44	170	21.62	w	1040	1144	0.83	346	OK	Flat sandy seabed, ripples, exposed bedrock, coral rubble in places. Sparse fauna.	
12	Forde	UWC	9-Feb	32	35	20.49	170	23.16	w	1250	1258	0.88	302	OK	Steep gullies, lava flows, some coral matrix, mainly isolated gorgonian and black coral, crinoids.	Y
13	Forde	UWC	9-Feb	340	35	19.36	170	26.11	w	1288	1355	0.06	321	NO	Came fast for 1.5 hours. Slope at start with rubble, then rocky and dense stony corals. Definite VME density. Need to change over DTIS and repair.	Y
14	Forde	SEL	9-Feb	736	35	19.57	170	26.32	w	1137	1154	0.21	45	OK	40kg coral rubble with some live stony corals, with polychaetes, ophiuroids, Metallogorgia, some sponges. 50kg crusty rock.	
15	Forde	SEL	9-Feb	940	35	20.24	170	26.58	w	1075	1100	0.38	45	OK	15kg coral rubble, mainly dead, 80%SVA, 20% GDU.	
16	Forde	SEL	9-Feb	1323	35	18.92	170	27.15	w	1160	1350	0.17	0	OK	44kg dead coral rubble, mainly Solenosmilia, 20% cup coral. 0.2kg live specimens-ophiuroids, brisingid seastar, black coral.	
17	Forde	UWC	9-Feb	1639	35	19.27	170	26.51	w	1154	1335	0.44	312	OK	Continuation of DTIS#013. No stills. Hill at start has live coral matrix, VME density.	Y
18	Forde	UWC	9-Feb	1917	35	18.97	170	27.1	w	1163	1583	0.60	318	OK	Live coral on summit and flanks of hill in SE corner of cell.	Y
19	Forde	UWC	9-Feb	2243	35	20.57	170	29.29	w	1302	1189	0.79	10	OK	Sand-gravel, bedrock in places. Scattered areas of intact coral matrix and live coral.	Y

20	Forde	UWC	10-Feb	144	35	25	170	27.21	w	1298	1184	0.78	359	OK	Sandy with coral rubble. Rocky outcrops. Crinoids abundant in sandy areas.	Y
21	Forde	UWC	10-Feb	454	35	25.46	170	23.18	w	1031	988	0.69	357	OK	Gradual slope. Rippled sandy sediment. Tusk shells. Occasional urchins, seastars, shrimp, crab, rattails.	
22	Forde	UWC	10-Feb	748	35	25.48	170	22.75	w	1027	998	0.69	1	OK	Sandy sediment, gradual shallow slope. Burrows, tracks, tusk shells. One patch of bedrock with gorgonian corals, some coral rubble.	
23	Forde	UWC	10-Feb	1041	35	26.24	170	21.96	w	1071	1066	0.64	271	OK	Flat tow to west. Rippled sand, burrows, tracks, tusk shells. Occasional seastars, urchins. No coral.	
24	Forde	UWC	10-Feb	1341	35	26.47	170	20.93	w	1070	1055	0.77	20	OK	Flat sand with ripples, occasional anemones, scaphopods. At end of transect, some bedrock, intact coral (dead), bamboo coral.	
25	Forde	UWC	10-Feb	1625	35	26.88	170	18.42	w	1330	1410	0.65	11	OK	SE flank 1200-1500m. Intact dead coral matrix on summit of hill at start and upper slopes. Current scoured lava flows and sand in gully.	Y
26	Forde	UWC	10-Feb	1857	35	22.85	170	22.02	w	1022	999	0.97	292	OK	Flat rippled sand, sparse fauna. Some bedrock with coral rubble towards end of tow.	
27	Forde	UWC	10-Feb	2137	35	21.94	170	26.43	w	1038	1080	0.88	291	OK	Central area of seamount. Mostly rippled sand, occasional patches of bedrock with coral rubble.	Y
28	Forde	UWC	11-Feb	53	35	23.92	170	22.9	w	970	993	0.69	19	OK	Land on top of cone, bedrock with some intact coral (dead), tow north down slope with bedrock, rock outcrops. Some seastars. Base at 996m with sandy gravel, occasional scaphopods and sea stars.	
29	Forde	CTD	11-Feb	523	35	19.05	170	27.32	w	0	1260	0.18	31	OK	CTD over tow #18 site. 11 of 12 bottles fired.	
30	Forde	SEL	11-Feb	738	35	18.94	170	27.15	w	1160	1470	0.35	324	OK	Small catch. 15kg dead Solenosmilia. Some crinoids, urchin, holothurian.	
31	Forde	SEL	11-Feb	937	35	19.01	170	27.09	w	1205	1600	0.64	326	OK	HPR on. 53kg coral rubble. Some live stony coral. Urchin, ophiuroids, crinoids, Chrysogorgia, small sponges.	
32	CenSeam	SVP	11-Feb	1914	36	45.6	169	54.73	w	0	1500	0.20	221	OK	SVP prior to MBES survey of CenSeam Guyot	
33	CenSeam	UWC	12-Feb	1146	36	57.5	169	41.53	w	1072	1037	0.62	349	OK	Bedrock with sand overlay mostly, with rippled sand and coral rubble. Scattered intact coral, both live and dead clumps. Few other animals.	Y
34	CenSeam	UWC	12-Feb	1418	36	58.02	169	42.09	w	1075	1025	0.72	1	OK	Rippled sand seafloor, some patches of exposed rock with dead intact coral. Scattered patches of coral rubble.	Y
35	CenSeam	UWC	12-Feb	1717	36	56.49	169	43.15	w	978	967	0.85	351	OK	Mostly rippled sand, coral fragments, few patches intact coral. Sparse fauna, tusk shells, gastropods, some shrimps.	
36	CenSeam	UWC	12-Feb	1944	36	55.47	169	42.17	w	998	995	0.75	6	OK	To north along 1000m isobath. Rippled sand. Sparse fauna. Tusk shells.	
37	CenSeam	UWC	12-Feb	2213	36	54.51	169	45.57	w	945	954	0.78	355	OK	Muddy sand throughout transect. One crab, scattered urchins, gastropods.	
38	CenSeam	UWC	13-Feb	104	36	53.49	169	41.57	w	1011	1019	0.73	356	OK	Sandy-gravel bottom with coral rubble. Some rocky outcrops with patches of intact coral, mostly dead. One live clump. Scattered sparse fauna.	Y
39	CenSeam	UWC	13-Feb	403	36	53.46	169	42.5	w	985	997	0.77	341	OK	Gradual slope. Mainly rippled sand, but some bedrock near stat with some live coral clumps. Scattered tusk shells, sea stars, shark, rattail.	Y

40	CenSeam	UWC	13-Feb	702	36	51.59	169	42.02	w	1052	1024	0.76	254	OK	Rippled sand with shell hash and coral rubble, with bedrock outcrops. Some intact (dead) coral, anemones, sea stars, tusk shell, sponges. Occasional shrimps, fish.	
41	CenSeam	UWC	13-Feb	958	36	52.51	169	43.6	w	997	977	0.89	239	OK	Rippled sand over most of transect, scattered coral rubble. Scaphopods, tracks, burrows. Several tam-o-shanter urchins.	
42	CenSeam	UWC	13-Feb	1224	36	52.57	169	46.57	w	999	976	0.76	203	OK	Rippled sand substrate, with frequent tracks and burrows evident. Tusk shells, sea stars and urchins scattered. No coral.	
43	CenSeam	UWC	13-Feb	1458	36	53.56	169	47.05	w	966	968	0.87	199	OK	Sand throughout except for patches of rock and corral rubble in final ten minutes of transect.	
44	CenSeam	UWC	13-Feb	1904	36	53.47	169	49.46	w	978	980	0.72	206	OK	No DTIS still images - camera malfunction. Sand/mud substrata with some small patches of exposed rock with coral rubble. Sparse fauna including asteroids, gastropods, Tam O'shanter echinoids.	
45	CenSeam	UWC	13-Feb	2131	36	53.01	169	50.61	w	1029	1031	0.75	194	OK	No DTIS still images - camera malfunction. Sand substrata with occasional patches of coral rubble and exposed rock. Small heads of intact coral matrix in places, one soft coral recorded.	
46	CenSeam	UWC	14-Feb	14	36	53.09	169	51.56	w	1145	1147	0.83	207	OK	No DTIS still images - camera malfunction. DTIS at revised Str2_4. Bedrock and sand with coral rubble. On downslope at ca. 1100m, a few heads of live coral, large sponges, and Metallogorgia specimens.	Y
47	CenSeam	SEL	14-Feb	258	36	53.52	169	51.79	w	1098	1122	0.20	210	OK	Sled towards DTIS#046. Land short, tow 10 minutes, come fast. 17kg rocks, 6kg coral rubble-Solenosmilia.	
48	CenSeam	SEL	14-Feb	447	36	53.79	169	51.93	w	1116	1350	0.28	245	OK	18kg coral rubble. Sponge, prawnkiller, squat lobster, ophiuroids.	
49	CenSeam	UWC	14-Feb	705	36	54.62	169	49.99	w	999	1253	0.92	189	OK	Target tow south across contours, and down steep flank of spur. Flat and sandy for much of transect, tusk shells, some asteroids. Stop recording to extend tow. Restart towards edge. Bedrock, coral rubble, intact (dead) coral. High densities urchins on boulders down flanks.	
50	CenSeam	UWC	14-Feb	1020	36	55	169	48.01	w	994	1117	0.75	227	OK	Flat sandy bottom for most of the transect. Tusk shells, tam-o-shanter urchins, sea stars. Towards end, on upper flanks, dead intact coral.	
51	CenSeam	UWC	14-Feb	1256	36	55.53	169	43.96	w	957	949	0.78	248	OK	Rippled sand, scaphopods, tracks, burrows. Occasional asteroids, one octopus, one oreo.	
52	CenSeam	UWC	14-Feb	1530	36	56.09	169	46.03	w	964	982	0.70	237	OK	Flat, rippled sand, scaphopods, tracks, some asteroids.	
53	CenSeam	UWC	14-Feb	1757	36	57.5	169	45.56	w	980	1009	0.71	199	OK	Gradual down-slope tow. Sand, tracks, scaphopods, occasional asteroids.	
54	CenSeam	UWC	14-Feb	2042	36	59.09	169	46.15	w	1021	1493	0.95	186	OK	Tow south across edge of plateau. Sand with sparse fauna on plateau, giving way to boulders, bedrock, coral rubble, and intact coral matrix at the plateau edge. Urchins abundant on rock and coral matrix. Below ca. 1400m, bare bedrock with Bathypathes and Metallogorgia corals, and one large Iridogorgia specimen recorded in video.	
55	CenSeam	UWC	14-Feb	2339	36	58	169	42.53	w	1045	1054	0.80	239	OK	Tow along 1050m isobath. Rippled sand overlaying bedrock through most of transect, exposed bedrock common. Areas of coral rubble, intact coral matrix, and a few apparently live scleractinian coral heads. One orange roughly recorded.	Y

56	CenSeam	UWC	15-Feb	243	36	54.18	169	50.67	w	1005	1011	0.41	188	OK	Sandy at start, increasing coral rubble, then intact (dead) coral on bedrock on the humps. Some sponges also. After humps, back into sandy habitat.	
57	CenSeam	SEL	15-Feb	437	36	54.47	169	50.78	w	1013	1010	0.24	25	OK	Good tow line, sticky on humps. 161kg coral rubble, 40kg crust rocks, 3kg sponge, brittle stars, cidarid urchin, crab.	
58	CenSeam	CTD	15-Feb	554	36	55.55	169	49.99	w	10	1322	0.00	270	OK	CTD on target site, 1300m depth, all 12 bottles fired.	
59	CenSeam	SEL	15-Feb	737	36	55.45	169	50.17	w	1147	1400	0.31	195	OK	Tow down DTIS#49 line. Land at base. 46kg coral rubble, 23kg rock, 5 urchins (Caenopedina), sponge, squat lobster, brittle stars.	
60	Anvil	UWC	15-Feb	1809	37	36.96	169	0.99	w	1191	1225	0.70	342	OK	Rippled sand with white urchins, then rock with coral rubble, intact coral matrix and possible live scleractinia. Urchins on coral and bedrock in latter part of transect.	Y
61	Anvil	UWC	15-Feb	2126	37	36.77	169	6.02	w	1152	1138	0.65	271	OK	Flat bottom, rippled muddy sand, sparse fauna.	
62	Anvil	UWC	16-Feb	21	37	39.19	169	6.27	w	1142	1135	0.76	1	OK	Flat transect, muddy sand with few animals.	
63	Anvil	UWC	16-Feb	319	37	41.98	169	0.77	w	1230	1418	0.76	191	OK	Flat muddy sand at start. Bedrock outcrops with intact coral, live heads, urchins, crinoids, some gorgonians. Over "edge" more bedrock with live coral.	Y
64	Anvil	UWC	16-Feb	634	37	39.75	168	58.99	w	1238	1495	0.71	155	OK	Flat sandy substrate at start, then exposed bedrock at edge, and rough going down flank. Intact coral (dead) with some live heads, occasional gorgonians and black coral.	Y
65	Anvil	UWC	16-Feb	958	37	39.64	169	0.76	w	1171	1192	0.77	168	OK	Mainly rippled sand, occasional echinoid, sparse fauna. Boulders and patches of bedrock in places, no corals.	
66	Anvil	SEL	16-Feb	1229	37	42.44	169	0.9	w	1244	1370	0.31	191	OK	Tow down DTIS#063 line. Small, diverse catch, live scleractinians, gorgonians ...	
67	Anvil	UWC	16-Feb	1440	37	41.16	169	5.96	w	1047	1104	0.36	294	OK	DTIS across 'Little Pig' hill at southwest corner of south Anvil peak. Coral rubble throughout, sand, then bedrock. Little intact coral, no live scleractinia seen. Occasional black corals, gorgonians, sponges, orange roughy.	
68	Anvil	UWC	16-Feb	1722	37	37.71	169	7.35	w	1162	1528	0.53	215	OK	Tow across plateau edge and down seamount flank. Level sand at first, then bedrock and boulders down slope. Sparse fauna but isolated heads of live scleractinian coral	Y
69	Anvil	UWC	16-Feb	2009	37	35.34	169	10.55	w	1203	1196	0.82	77	OK	Sandy seabed, sparse fauna, echinoids, scaphopods, cerianthids.	
70	Anvil	UWC	16-Feb	2240	37	38.21	169	3.81	w	1090	1099	0.71	100	OK	Mostly rippled sand but two patches of exposed bedrock with a few apparently live heads of scleractinian coral.	Y
71	Anvil	UWC	17-Feb	106	37	37.26	169	2.05	w	1150	1137	0.22	109	OK	Rippled sand interspersed with bouldery outcrops. Sparse fauna. DTIS comms lost at 16 minutes following snag on rocks.	
72	Anvil	UWC	17-Feb	357	37	37.26	169	1.62	w	1157	1180	0.63	105	OK	Rippled firm sand, Gracilechinus urchins and tusk shells. Occasional bouldery outcrops, some localised sponge and intact (?live) stony coral on rocks.	Y
73	Anvil	UWC	17-Feb	644	37	34.47	168	59.48	w	1285	1338	0.81	125	OK	Rocky at start off side of small hill, intact corals (some live), gorgonian corals, sponges, urchins. Then level out with rippled sandy bottom, coral rubble. Then last part of transect like the beginning, intact coral, some live scleractinians, urchins, sponges, crinoids. Diverse tow.	Y

74	Anvil	SEL	17-Feb	913	37	34.44	168	59.33	w	1275	1380	0.15	137	OK	95kg rocks, crust and conglomerate. 6kg coral rubble. Gracellechinus, pipe coral, gorgonian coral, ophiuroids.	
75	Anvil	CTD	17-Feb	1139	37	42.7	169	1.14	w	0	1410	0.00	101	OK	CTD on site of corals and DTIS #063.	
76	JCM	UWC	17-Feb	2348	38	36.96	167	56.19	w	868	1245	0.91	123	OK	Downslope from southern edge of summit plateau: extensive intact coral matrix - none live - on plateau, bedrock and sand on flank, some live scleractinian heads on bedrock at 1210 m.	Y
77	39south	SVP	18-Feb	506	39	2.27	167	15.03	w	0	1500	0.00	9	OK	SVP prior to swath map survey of 39degS.	
78	39south	UWC	18-Feb	1918	39	13.57	167	21.46	w	1084	1104	0.94	93	OK	Flat sandy seabed, ripped in second half of transect. Sparse fauna including pagurids, Tam O'shanter urchins, eels.	
79	39south	UWC	18-Feb	2147	39	14.52	167	15.99	w	1236	1270	0.92	33	OK	Sand with some patches of exposed bedrock, becoming rugged bedrock at drop-off to seamount flank. Very sparse fauna throughout; one or two hexactinellid sponges on rocks.	
80	39south	UWC	19-Feb	14	39	14.18	167	16.84	w	1201	1222	0.75	40	OK	Flat sandy bottom, with some bedrock, boulder and gravel outcrops. Sparse fauna, occasional crab, sponge. Live scleractinian coral heads on bedrock outcrops.	Y
81	39south	UWC	19-Feb	312	39	8.83	167	18.03	w	1053	1241	0.78	128	OK	Downslope off plateau. Rippled sand for first half, worms, scaphopods, giant foraminifera, then bedrock and boulder outcrops, with coral rubble, some intact coral (dead), occasional sponges and crinoids. 2 small clumps of live coral.	Y
82	39south	UWC	19-Feb	625	39	6.49	167	21.52	w	961	979	0.72	124	OK	On flat plateau. Sandy, rippled, substrate. Gastropods, scaphopods, tracks, burrows. Sparse fauna.	
83	39south	UWC	19-Feb	859	39	6.96	167	23.49	w	930	918	0.87	119	OK	On area of fishing foul, and high reflectivity. Sandy bottom interspersed with occasional bedrock outcrops. Gastropods, tusk shells on sand; sponge, gorgonian and soft corals, crinoids on rocks. No intact coral.	
84	39south	UWC	19-Feb	1149	39	6.2	167	18.15	w	1079	1158	0.88	92	OK	Eastern side down slope. Soft sandy sediment, gastropods and tusk shells. Occasional bedrock outcrop, sand covered. No intact coral.	
85	39south	UWC	19-Feb	1533	39	4.48	167	23.5	w	988	1014	0.93	64	OK	Sand with indistinct ripples. Sparse fauna.	
86	39south	UWC	19-Feb	1821	39	3.24	167	25.92	w	1136	1605	0.69	76	OK	Tow down slope on northern flank to 1600m. Rippled sand at start, increasing bedrock down slope. One small live coral head on sand. Generally sparse fauna but dense urchin population on outcrop at 1275m.	Y
87	39south	UWC	19-Feb	2043	39	4.72	167	25.48	w	995	983	0.89	86	OK	Flat sand, sparse fauna. One lithodid crab seen.	
88	39south	UWC	19-Feb	2311	39	3.8	167	21.97	w	1095	1021	0.85	130	OK	Tow up slope. Sand and pale bedrock and boulders at start, brisingid star abandoned trawl gear, large columnar sea pen. Leveling off to rippled sand with sparse fauna. No scleractinian corals seen..	
89	39south	UWC	20-Feb	147	39	9.92	167	20.92	w	905	950	0.72	136	OK	Areas of exposed bedrock and boulders with gorgonian (Paragorgia) and black corals. Sand substrate over much of transect, with gastropods and tam-o-shanter urchins. 1 live clump of stony coral.	Y
90	39south	UWC	20-Feb	457	39	6.81	167	14.99	w	1470	1573	0.84	129	OK	Exposed bedrock along top of deep ridge on eastern flank. Sand overlay and sand drifts. Black corals, urchins (Gracellechinus) and glass sponges.	

91	39south	SEL	20-Feb	800	39	9.86	167	21.01	w	910	934	0.62	139	OK	53kg rocks, 47kg coral rubble. 5kg live material. Diverse corals (Corallium, Thouarella, Goniocorella, primnoids, Bathypathes, purple soft corals). Sponges, Tam-o-shanter, sea star and brittle stars, hermit crabs, worms, gastropods, squat lobsters.	
92	39south	SVP	20-Feb	1030	39	18.63	167	25.06	w	0	1500	0.00	42	OK	SVP prior to multibeam survey of western side of 39south	
93	39south	UWC	21-Feb	34	39	11.58	167	35.5	w	1087	1180	0.85	156	OK	Sand with bedrock. Solitary corals and anemones frequent on sand. Live stony corals, brisingids, crinoids on rocks. Sheer drop-off at end.	Y
94	39south	UWC	21-Feb	320	39	8.67	167	32.52	w	1064	1062	0.88	202	OK	Along crest of ridge. Bedrock and boulders, interspersed with sand and coral rubble drifts. Scattered but frequent pockets of intact coral, clumps of live stony coral, feather stars, brisingid sea stars, gorgonian and black coral, flute sponge.	Y
95	39south	UWC	21-Feb	556	39	10.15	167	34.3	w	1093	1063	0.83	178	OK	Rippled sandy sediment, tusk shells and worms. Some rocky outcrops, generally bare. Some dead intact coral patches towards end of transect.	
96	39south	UWC	21-Feb	934	39	13.67	167	29.82	w	1084	1340	0.82	170	OK	Sandy bottom at start, tusk shells, sea stars, crab, giant forams in places. Then bedrock with sandy overlay from 1200 crinoids, sponge, gorgonian, black corals.	
97	39south	SEL	21-Feb	1223	39	11.75	167	35.39	w	1082	1090	0.47	157	OK	9kg coral rubble. Small catch of invertebrates, some live Goniocorella, gorgonian corals, brittle stars.	
98	39south	CTD	21-Feb	1334	39	13.12	167	34.88	w	0	1965	0.24	155	OK	CTD off southern flank. 11/12 bottles fired.	
99	Ghost	SVP	22-Feb	350	40	36.25	165	24.29	w	0	1500	0.00	66	OK	SVP prior to starting multibeam survey of Ghost Seamount.	
100	Ghost	UWC	22-Feb	1607	40	41.05	165	19.91	w	645	1022	0.85	319	OK	630m peak. Bedrock/sand overlay, smooth. Extensive coral rubble, sparse fauna. Some oreo and cardinalfish.	
101	Ghost	UWC	22-Feb	1831	40	39.29	165	18.9	w	916	1101	0.93	322	OK	Northeast hill. Areas of dead intact coral, sparse fauna, sme brisingids, crinoids.	
102	Ghost	UWC	22-Feb	2114	40	39.02	165	21.58	w	1107	1005	0.94	194	OK	Rippled sandy bottom, sparse fauna.	
103	Ghost	UWC	22-Feb	2342	40	43.24	165	20.47	w	759	831	0.84	336	OK	Coral rubble, intact dead coral at top of hill. Patch of dense bamboo coral and gorgonians on the matrix mid-hill. Generally sparse fauna. Signs of gear scours.	
104	Ghost	UWC	23-Feb	218	40	42.12	165	20.74	w	661	930	0.74	330	OK	"FaceAche". Summit at 613m. Exposed rock, coral rubble, trawl warp and scours. Patch of anemones and brisingids. Scattered gorgonians, intact (dead) coral	
105	Ghost	UWC	23-Feb	500	40	42.16	165	16.62	w	1117	1070	0.81	318	OK	Transect SE to NW across hill and ridge. Extensive dead intact coral on SE side of hill, patches of brisingids and crinoids. 910m at summit, coral rubble and sand overlay. Bouldery at base and ridge.	
106	Ghost	UWC	23-Feb	743	40	41.92	165	18.52	w	960	994	0.89	342	OK	Flat bottom, rippled sand, scattered gastropods, asteroids. Sparse fauna.	
107	Ghost	UWC	23-Feb	1023	40	42.84	165	18.72	w	837	980	0.78	296	OK	Land on eastern sde of hill, tow up towards summit with heavy coral rubble, some intact coral, bedrock. Rubble and intact patches also on western side, a single patch with gorgonians, black coral, brisingids.	
108	Ghost	UWC	23-Feb	1336	40	43.2	165	13.96	w	1393	1299	0.74	310	OK	Tow on eastern flank. Mostly rippled sand with some patches of dark bedrock and boulders. Sparse fauna.	

109	Ghost	UWC	23-Feb	1608	40	44.23	165	15	w	1041	1043	0.87	339	OK	Along slope at eastern edge of plateau. Mostly sand with some patches of dark boulders and bedrock. Brisingids and anemones in places on rocks. Two small live scleractinian colonies observed in video replay.	Y
110	Ghost	UWC	23-Feb	1855	40	46.29	165	14.54	w	1050	992	0.76	330	OK	Tow across a rise on Mount Ghost. Rippled sand, bedrock outcrops with intact coral and coral rubble in places, sparse fauna.	
111	Ghost	SEL	23-Feb	2121	40	43.03	165	20.56	w	814	912	0.23	326	OK	Target line of DTIS#103. 59kg coral rubble, a large bamboo coral, several crabs, pagurids.	
112	Ghost	SEL	23-Feb	2244	40	43.08	165	20.57	w	768	913	0.23	324	OK	Repeat of tow 111. 68kg coral rubble.	
113	Ghost	UWC	24-Feb	3	40	42.03	165	21.63	w	742	917	0.67	349	OK	Tow from summit down to N. Intact old coral at top, rubble on flank. Trawl marks. Sparse fauna.	
114	Ghost	UWC	24-Feb	305	40	41.15	165	17.55	w	1077	1092	0.89	341	OK	Transect up and over small hill. Coral rubble on flanks, intact coral, rubble, and patches of abundant brisingids and crinoids. Flat areas with rippled sand, gastropods.	
115	Ghost	UWC	24-Feb	529	40	38.66	165	20.6	w	1125	1385	0.81	343	OK	Downslope, sandy at start, abundant worms. Small hill at 1090m with coral rubble, intact coral, brisingid sea stars and crinoids. Deeper, bedrock and sand, sparse fauna, orange roughy, rattails.	
116	Ghost	SVP	24-Feb	711	40	37.33	165	21	w	0	1500	0.00	187	OK	SVP prior to MBES survey of southwestern Ghost Seamount.	
117	Ghost	UWC	24-Feb	1849	40	46.18	165	22.34	w	701	1067	0.77	205	OK	Tow downslope from summit of hill. Intact coral matrix on friable, pale bedrock at start, becoming coral rubble and sand, then dark, smooth bedrock at transect end. Sparse fauna; brisingid stars, asteroids, an urchin, shrimps, rattails, sharks.	
118	Ghost	UWC	24-Feb	2132	40	44.41	165	22.07	w	687	955	0.95	168	OK	Tow across northern summit, along ridge and down flank. Heterogeneous substrata; friable pale bedrock with coral matrix, boulders, smooth dark bedrock, sand overlay. Brisingid stars, small zoanthids, oreos, cardinals, rattails.	
119	Ghost	UWC	25-Feb	1	40	42.75	165	25.04	w	872	963	0.79	155	OK	Tow southeast from summit at 796m. Bedrock with intact coral, coral rubble, sand patches. Crinoids, some urchins, scattered gorgonian and black coral.	
120	Ghost	UWC	25-Feb	244	40	42.84	165	26.85	w	886	1153	0.79	169	OK	Over summit at 860m, down SE flank onto flat. Coral rubble, occasional brisingids, crinoids. Sparse fauna. School of small cardinalfish, scattered roughy, rattails, sharks.	
121	Ghost	UWC	25-Feb	516	40	43.19	165	23.4	w	928	956	0.91	151	OK	Along flat plateau, abundant gastropods, then up flanks to ridge peak off side of a hill at 880m. Bedrock with coral rubble. Then down onto sandy plateau. Sparse fauna.	
122	Ghost	UWC	25-Feb	831	40	46.11	165	25.56	w	1202	1254	0.99	149	OK	Flat sandy bottom, giant forams abundant. Then sparse fauna on hard substrate, bedrock with sandy overlay, occasional sponges, brisingids, one clump of live stony coral.	Y
123	Ghost	UWC	25-Feb	1058	40	46.03	165	20.85	w	991	1088	0.77	146	OK	Small hill, down slope to ridge on southern side. Bedrock with sandy overlay at start. Heavy coral rubble on summit. Some sponge, brisingids, crinoids. Fish.	
124	Ghost	SEL	25-Feb	1332	40	46.65	165	25.14	w	1230	1260	0.42	151	OK	Along DTIS #122 line. Fast at end, poor sample; two rocks and a sponge.	
125	Ghost	UWC	25-Feb	1549	40	46.39	165	17.92	w	1011	1375	0.81	179	OK	Across edge of plateau. Rippled sand at start, becoming dark bedrock on steep drop-offs. Sparse fauna throughout; TAM, cerianthids, shrimps, ORH, oreos.	

126	Ghost	UWC	25-Feb	1829	40	41.88	165	21.97	w	718	945	0.82	330	OK	Same hill as #122 but 330 degrees. Coral rubble at start, intact coral on bedrock deeper, with patch of bamboo corals at ~900m. Rippled sand from base of hill onwards. Sparse fauna throughout.	
127	Ghost	UWC	25-Feb	2119	40	41.06	165	29.8	w	1104	1195	0.83	352	OK	Tow from southern crest of hill north along and down flank. Rugged dark bedrock with intact coral matrix and live scleractinian heads in several places. Also <i>Bathypathes</i> , some sponges, crinoids.	Y
128	Ghost	UWC	25-Feb	2353	40	38.46	165	32.82	w	1332	1510	0.70	298	OK	Northwestern corner. Extensive intact coral "reef", many live heads along the length of the transect. Interspersed with sand and bedrock, but dominated by coral.	Y
129	Ghost	UWC	26-Feb	251	40	38.6	165	30.85	w	1260	1509	0.84	344	OK	North flank. Sandy with rock outcrops with intact coral, some live heads. Ridge with blocky lava, extensive intact coral, some live stony coral, crinoids. No Hipap at end.	Y
130	Ghost	UWC	26-Feb	553	40	39.54	165	32.29	w	1305	1575	0.72	285	OK	Land on bouldery seafloor, with intact coral and live heads. Expanses of rippled sand, then downslope bedrock, sand overlay, sparse fauna.	Y
131	Ghost	UWC	26-Feb	858	40	39.31	165	27.82	w	1179	1618	0.95	41	OK	Sandy for much of transect, sparse fauna. Downslope with bedrock and sand overlain, very few animals, occasional fish.	
132	Ghost	CTD	26-Feb	1216	40	38.17	165	33.28	w	0	1480	0.25	301	OK	CTD on site of DTIS 128, with live corals.	
133	Ghost	SEL	26-Feb	1430	40	38.31	165	33.15	w	1360	1400	0.11	291	OK	At seabed early and came fast; small sample of rocks and sponge fragments.	
134	Ghost	SEL	26-Feb	1606	40	38.31	165	33.16	w	1370	1448	0.24	293	OK	Good sample: 81.67kg coral matrix and rock with numerous live coral fragments, crinoids, sponges, gorgonians, ophiuroids.	
135	Ghost	UWC	26-Feb	1835	40	38.45	165	33.55	w	1519	1600	0.70	34	OK	Tow perpendicular to #128, across ridge from S-N. Bare rock on southern side, high density of intact coral with live heads on ridge, then rock, boulders, rippled sand down northern side.	Y
136	Valerie	SVP	27-Feb	250	41	18.45	164	27.98	w	0	1500	0.00	324	OK	SVP prior to MBES survey of southwestern sector of Valerie Guyot	
137	Valerie	SEL	28-Feb	731	41	33.95	164	15.66	w	1060	1061	0.25	76	OK	78kg coral rubble, some sponge, brittle stars, galatheids. Small amount live coral	Y
138	Valerie	SEL	28-Feb	913	41	34.89	164	15.31	w	1223	1241	0.22	82	OK	53kg coral rubble. Good live Scleractinea, with brittle stars, galatheids, crabs, sponges. 54kg rocks.	Y
139	Valerie	UWC	28-Feb	1154	41	29.21	164	18.96	w	926	862	0.59	28	OK	Rippled sand over much of transect, some bedrock and boulder outcrops. Dense patches of small ophiuroids in places, scattered gastropods, pagurids, asteroids. 3-4 m swell, many bottom contacts.	
140	Valerie	UWC	28-Feb	1414	41	26.8	164	17.45	w	787	769	0.74	29	OK	Sand and gravel substrata with some coral rubble observed towards end of transect. High densities of small ophiuroids, frequent pagurids. 2-3 m swell, many bottom contacts.	Y
141	Valerie	UWC	28-Feb	1649	41	24.94	164	18.35	w	879	900	0.90	27	OK	Level sand with pebbles/cobbles and ripples through most of transect, coral rubble and patches of bedrock at end. Asteroids, ophiuroids, pagurids, sharks, rattails, eels.	
142	Valerie	UWC	28-Feb	1911	41	24.41	164	15.89	w	869	968	1.05	14	OK	Level sand with coral fragments. Echinothurids, ophiuroids, pagurids, asteroids, eels. 2-3 m swell, many bottom contacts.	

143	Valerie	UWC	28-Feb	2147	41	18.43	164	17.78	w	1084	1372	0.89	18	OK	Tow from plateau down slope. Sand, changing to outcrops of bedrock and coral rubble. Intact coral, some live, near end of transect.	Y
144	Valerie	UWC	1-Mar	20	41	18.46	164	16.04	w	1082	1287	0.65	21	OK	NE spur. Sand at start, patches of intact coral, some live. Bedrock and sand mix, dense orange roughly at times near drop-off, live coral patches throughout.	Y
145	Valerie	UWC	1-Mar	324	41	19	164	20.37	w	1167	1360	0.82	28	OK	NW flank. Sandy on plateau, more bedrock outcrops as go down flank. Several small clumps of live coral, with brisingids and crinoids.	Y
146	Valerie	UWC	1-Mar	621	41	23.34	164	23.33	w	1352	1405	0.88	15	OK	Sandy bottom, small holothurians and cerianthids abundant in places, otherwise scattered and sparse fauna.	
147	Valerie	UWC	1-Mar	905	41	22.21	164	25.42	w	1312	1544	1.01	19	OK	West Hill. Up ridge from SW, soft initially, then bedrock with dense fan corals. Pockets of intact coral, live heads, crinoids, brisingids. Quiet again offridge, but on north side 1365-1450 intact coral, many live heads, brisingids, crinoids.	Y
148	Valerie	UWC	1-Mar	1151	41	22.29	164	25.14	w	1263	1386	0.78	0	OK	West hill. Up ridge from south. Dense primnoids at start, and again midway up. Peak at 1205, where scattered intact coral and live coral. Gets denser as deepen on north side, extensive 1300-1450m, then less. Crinoids and brisingids.	Y
149	Valerie	UWC	1-Mar	1503	41	23.88	164	26.02	w	1122	1474	0.91	298	OK	Down weak ridge from east to west. Sand at start, then coral rubble and areas of bedrock. Intact coral in places with some live colonies, brisingids and sponges to ~1350m, then sand, bedrock, coral rubble to end of tow.	Y
150	Valerie	UWC	1-Mar	1742	41	23.66	164	25.9	w	1135	1400	0.89	22	OK	Tow N along high-backscatter ridge. Bedrock outcrops with intact coral matrix and some live colonies, brisingids and sponges along west side. Massive outcrop of bedrock at end of transect with extensive intact coral and abundant live colonies. Awkward swell, many bottom contacts.	Y
151	Valerie	UWC	1-Mar	2047	41	29.92	164	20.92	w	1210	1623	0.76	286	OK	Tow downslope to 1600m. Muddy sand then increasing bedrock outcrops. Sparse epifauna but one patch of intact coral matrix at ca. 1450m. Slickheads common.	
152	Valerie	UWC	2-Mar	13	41	34.76	164	15.19	w	1245	1281	0.75	247	OK	Site of sled 138. Rippled sand, bedrock at end, little coral rubble or sgn of live scleractinia.	Y
153	Valerie	UWC	2-Mar	312	41	25.53	164	18.57	w	861	922	0.95	253	OK	Flat, sandy bottom. Occasional bedrock and cobble patches, with primnoid crals. Sand has frequent gastropods, pagurids, ophiuroids, with asteroids, cerianthids, giant forams. Halosaurs were regularly seen.	
154	Valerie	UWC	2-Mar	618	41	29.24	164	9.48	w	1336	1220	0.53	237	OK	Sand and rubble downslope, then onto ridge before dropping into a gully. Areas of bedrock, with intact coral, shell hash. Between 1195 and 1133 at top of ridge, pockets of live coral with crinoids and sponges.	Y
155	Valerie	CTD	2-Mar	1004	41	21.03	164	24.98	w	0	1490	0.00	217	OK	CTD near DTIS148 site.	
156	Valerie	SEL	2-Mar	1236	41	21.88	164	25.14	w	1220	1250	0.20	355	OK	Target sled on SIA patch for species id. 288kg coral rubble, including live Scleractinia, with ophiuroids, crinoids, crabs, sponges, ploychaetes. Diverse catch.	
157	Valerie	SEL	2-Mar	1348	41	21.98	164	25.14	w	1247	1255	0.13	177	OK	Target sled on PRI patch for species id. Small catch, 5kg. Primnoid coral, a few ophiuroids, asteroids, crustaceans.	

