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Vulnerable Marine Ecosystems of the Louisville Seamount Chain: voyage report of a survey to evaluate the efficacy of preliminary habitat suitability models

New Zealand Aquatic Environment and Biodiversity Report No. 149

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Vulnerable marine ecosystems (VMEs) are deep-sea ecosystems that are highly vulnerable to damage from several types of human activity such as bottom-contact fishing. The South Pacific Regional Fisheries Management Organisation (SPRFMO) Convention includes specific provisions to protect VMEs, but there are few data available on the distribution of VME indicator species or taxa in the South Pacific Ocean to use for the objective planning of spatial protection measures.

Preliminary habitat suitability models have been developed for the region that evaluate the likelihood of certain indicator taxa being present in an area, based on the inferred suitability of the habitat derived from environmental data. As part of a project funded by the New Zealand Ministry of Business, Innovation and Employment, and the Ministry for Primary Industries, a survey of seamounts along the Louisville Seamount Chain was planned to carry out active sampling of the seafloor to ground-truth the predictive habitat suitability model results.

The survey was conducted from RV *Tangaroa* in February-March 2014. The primary objectives were to collect environmental and biological data suitable for the validation and/or improvement of preliminary large-scale habitat suitability models for VME indicator taxa; and the development of smaller-scale (e.g., seamount specific) models. Six seamounts were surveyed, with sampling sites being positioned in five strata on each seamount to assess the two different preliminary model predictions. This design was structured to assess the performance of the model types in predicting suitable habitat for stony corals, and to evaluate the effect of model type, and previous fishing activity.

The main sampling tool was a towed underwater camera system, taking video and still photographs of the seafloor and benthic fauna from a height of 2–3 m. In total there were 119 camera tows, which were supported by 25 direct samples of fauna taken with a small epibenthic sled. Detailed bathymetric and topographic data were collected by multibeam echosounder surveys of five of the six seamounts, and fine-scale environmental information (conductivity-temperature-depth, CTD) was collected from each camera deployment. In addition there were six targeted CTD and rosette casts, at which water samples were taken throughout the water column. Dedicated observers were also on board to record sightings of seabird and marine mammals.

In this report descriptions are given of each seamount, the sampling distribution, an account of each photographic transect, and maps are included of the recorded distribution of VME indicator taxa on each seamount. Data are still to undergo final checking, the imagery data will be examined thoroughly, and specimen samples are yet to be formally identified. Hence the observations presented are preliminary. Nevertheless, they indicate that the key VME indicator taxon modelled for the survey, habitat-forming stony corals of the Order Scleractinia, were localised and patchy in their distribution, with substrate type and fine-scale topography being particularly important drivers of distribution. Data collected will enable a thorough evaluation of the preliminary models, and provide a strong basis for developing appropriate smaller-scale habitat suitability models for VMEs on the Louisville Seamount Chain, an important area in the SPRFMO region for New Zealand fisheries.

1. INTRODUCTION

Vulnerable marine ecosystems (VMEs) are ecosystems that are considered to be highly vulnerable to damaging impacts of human activity in the sea. Potential VMEs are identified by the vulnerability of their species, communities, and/or habitats to damage or disturbance. There are concerns that VMEs are threatened by fishing in areas of the ocean beyond national jurisdiction ('high seas'). The United Nations General Assembly (resolutions 61/105, 64/72), The Fisheries and Agricultural Organization (FAO 2009), international conservation organisations (e.g., IUCN), and fisheries management agencies are all aiming to implement management strategies to protect VMEs, and thereby conserve biodiversity and ecosystem function in the deep sea. New Zealand fishing fleets operate in the high seas region of the South Pacific Ocean, and New Zealand is currently leading initiatives to improve management of demersal fisheries and VMEs in the region through the South Pacific Regional Fisheries Management Organization (SPRFMO).

There is limited information about the distribution or characteristics of VMEs in the South Pacific, which is hampering the design of management options. However, several recent studies have demonstrated that habitat suitability models can be used to predict the possible occurrence of seabed animals in the region that could indicate the presence of VMEs (e.g., Davies & Guinotte 2011, Tracey et al. 2011). The potential application of such models was supported by a study funded by the Ministry for Primary Industries (MPI) as a prelude to the current project, investigating the development and utility of such models for estimating the distribution of a range of VME indicator taxa (in the sense of Parker et al. 2009) in New Zealand's EEZ and High Seas. This study collated over 30 000 records of ten VME taxa, and 11 environmental data layers (Rowden et al. 2013). The habitat suitability models from this pilot study predicted that large areas of the New Zealand region were potentially suitable, although this was partly due to the use of family or order taxonomic levels. The use of these types of models can be important in data-limited areas offshore and in deep water (such as the SPRFMO region), and has been recommended as part of a generic process for designing effective management plans for fishing on the high seas (Ardron et al. 2014).

The current Ministry of Business, Innovation and Employment-funded VME study aims to build on the previous MPI pilot study by including more data to produce improved habitat suitability models for VMEs in the South Pacific Ocean - specifically the SPRFMO area- and the New Zealand EEZ. 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" models) 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, which uses most of the data to develop the model, but "holds back" a proportion to test the results. However, model predictions should ideally be ground-truthed to give end-users, such as the SPRFMO Scientific Committee, an understanding of their applicability or limitations in using them for informing management options. Thus a critical component of the South Pacific VME project was to design and implement a survey to evaluate the reliability of the preliminary VME indicator taxa models. The Louisville Seamount Chain, a long chain of seamounts outside the New Zealand EEZ in the western South Pacific Ocean, was agreed as a priority area by the project team because the Chain is important to New Zealand high seas fisheries, is known to host VME indicator taxa, and is subject to interim fishing protection measures (Penney et al. 2009). Hence it is an area where the models are expected to be of high relevance for informing fisheries management and conservation of VMEs in the SPRFMO region.

In this factual report we describe the design and conduct of the survey, which was carried out from RV *Tangaroa* from 31 January to 6 March 2014. Preliminary observations are also presented, although it should be noted that data are yet to be fully checked before they are used in model evaluation and subsequent analysis.

1.1 Voyage objectives:

Primary voyage objectives
(1) To carry out surveys of seamounts to collect environmental and biological data on the composition and distribution of benthic invertebrate fauna 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. (This objective also contributes to a supporting MPI project on genetic connectivity of VME indicator taxa; ZBD2013-02)

Secondary voyage objectives
(3) To collect live specimens of coral for shore-based laboratory observation (as part of MPI project SEA2013-01, Task CORALS).
(4) To observe marine mammals and seabirds to validate and/or improve existing habitat suitability models for these megafauna.

2. METHODS

2.1 Survey area

The sampling encompassed six large seamounts along the Louisville Seamount Chain (Figure 1). All of these features have a vertical elevation of more than 1 km from the seafloor, and all of them are guyots. Guyots are a type of seamount, the peaks of which were previously above sea level but were eroded flat by wave action, and have sunk below sea level. The seamounts were originally classified 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 during the survey as new data were collected which indicated which seamounts were the most suitable to test the final model results. Details of the six seamounts are given in Table 1 (note there was only a single station on JCM Guyot).

Table 1: Summary details of the seamounts surveyed during TAN1402

Seamount	NIWA db no.	Latitude	Longitude (W)	Summit depth
Forde Guyot	216	-35.40	170.40	980
CenSeam Guyot	239	-36.92	169.73	955
Anvil Seamount	474	-37.56	169.15	1036
39 South Seamount	482	-39.10	167.40	878
Ghost Seamount	751	-40.70	165.35	620
Valerie Guyot	752	-41.45	164.25	750
JCM Guyot	477	-38.41	167.99	285

Danseur, a seamount just southeast of Forde Guyot, was originally to be surveyed. However, the actual bathymetry of this seamount was found to be very different from that which was used in the habitat suitability modelling. The latter used depth-related variables based on an estimated summit depth at about 100 m, whereas the actual summit depth was 950 m. Hence data included in the models could not reflect the actual seamount characteristics, and sampling it would have been of limited value for assessing the reliability of the model (rather than the data). Danseur Seamount was replaced by Anvil Seamount.

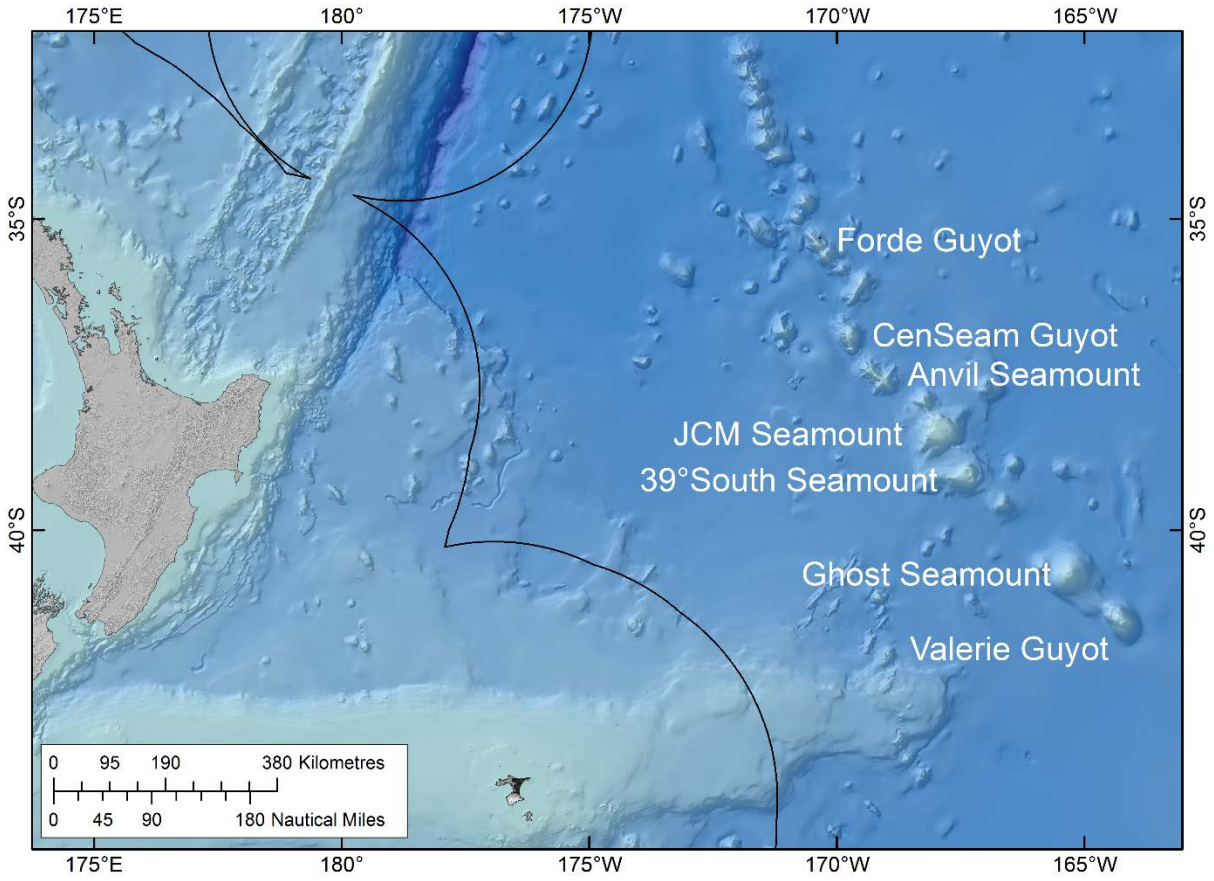

Figure 1: The general survey area on the Louisville Seamount Chain, showing the selected seamounts.

2.2 Survey design

The survey was designed, using seafloor photographic transects to sample a range of habitat suitability model predictions for the VME indicator taxon Scleractinia (including only genera that have matrix-forming colonies that could form reefs), to assess the accuracy and reliability of the preliminary models. There were five main sampling strata, each one relating to the probability of suitable habitat being found as well as whether the seamount had been fished or not (Table 2). Because fishing activity may have had impacts on benthic fauna, it is important to interpret whether model performance could be affected by fishing activity.

Table 2: Characteristics of survey strata.

Stratum	Colour	Conditions
1	Green	High probability of suitable habitat for stony corals (more than 0.8), both BRT and Maxent models, unfished
2	Pink	Low probability (less than 0.2) of suitable habitat for stony corals, both BRT and Maxent models, unfished
3	Blue	Different probability between models (one high, one low), unfished
4	Grey	Intermediate probability (0.2–0.8) of suitable habitat for stony corals (neither high nor low), BRT model, unfished
5	Red	High probability of suitable habitat for stony corals, both BRT and Maxent models, fished.

Preliminary model results were produced at a scale of 0.5 by 0.5 nautical miles (M), and the grid was used to structure sampling. Cells were selected at random, six for Stratum 1 (which was deemed the most important), and four for each of the other strata (see Figure 2). Some seamounts had no, or few,

cells of some strata (usually Stratum 2, which were typically deeper than 1500 m, or Stratum 5 where northern seamounts had less fishing).

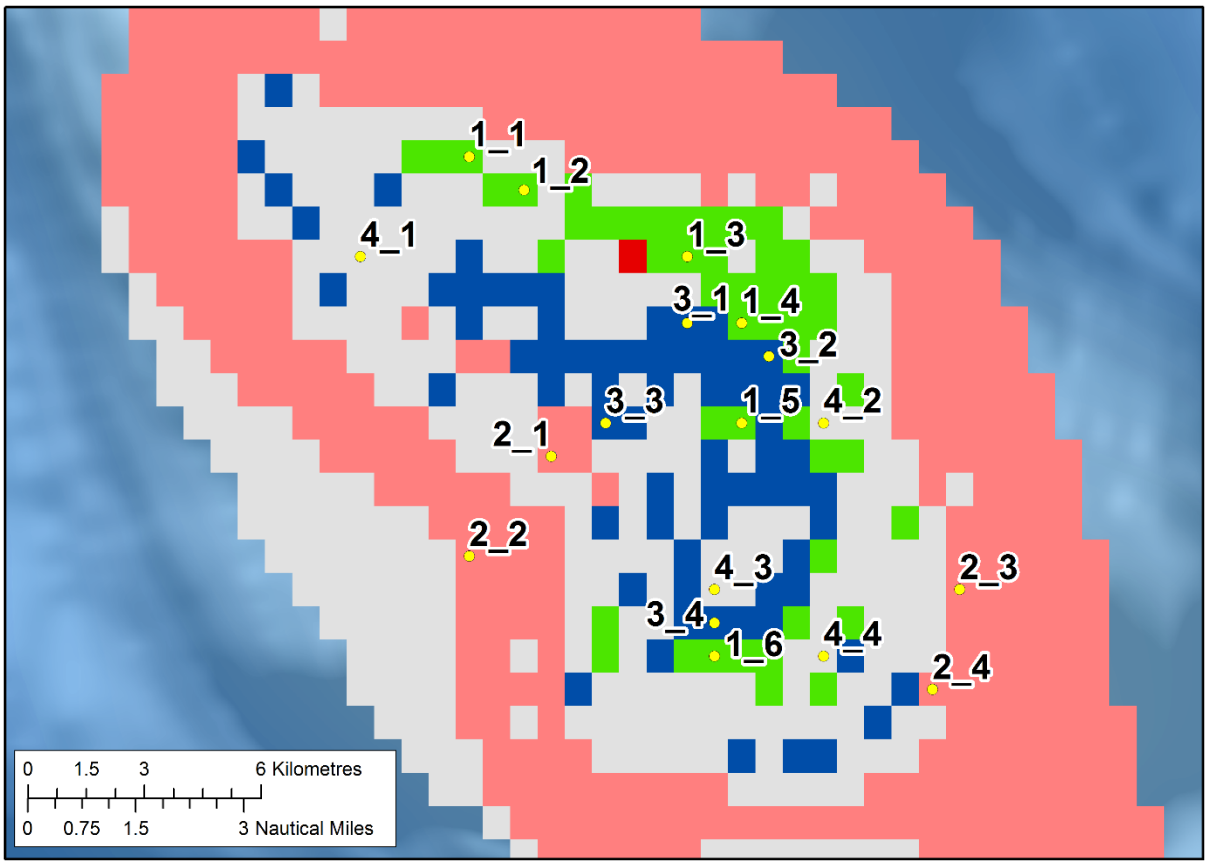

Figure 2: Example of a survey design planning map (Forde Guyot), with cell colour depicting stratification, and labels showing the cells selected for sampling (2_3 is stratum 2, 3rd station selected).

Single cells were not selected for sampling, as the length of a photographic tow was generally about 1 nautical 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. Some seamounts did not have all five strata, in particular stratum 5, if the seamount had not been trawled for orange roughy. This was the case for Forde Guyot (Figure 2) where there was only a single cell for Stratum 5 representing the recorded location of New Zealand fishing activity.

Cells were selected at random for sampling, although at times this approach was modified by three factors where applicable:

- Depth: The habitat suitability modelling used some environmental variables that were based on global Shuttle Radar Topography Mission bathymetry. In some cases, following completion of a multibeam echosounder survey (see below), during the voyage, it became clear that many of the cells were in depth ranges that would not be suitable environment for stony corals. The cells were then substituted with alternative cells in the same stratum within an environmentally suitable depth range.
- Substrate and topography: The random cell selection tended to emphasise the large flat-topped guyot summit, as this was the largest area of many of the seamounts. However, experience of coral distribution from previous seamount surveys was that corals tended to be most abundant on small peak-like features, and steep drop-off regions. 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 a greater chance that corals may be abundant. This reflected a shift in

emphasis from determining solely presence-absence, to gaining a range of abundance data to improve future model prediction

- Fishing effort: Cell selection was also influenced by the specific location of trawling (actual trawl lines rather than just fishing presence within the grid cell), based on information from interviews with previous fishing skippers, and confidential fishing maps that were available on board (Seaplot compilations). This information gave more precise data on position and density of commercial fishing tow lines than the MPI catch records which were used to first identify the fished strata. Hence photographic transects could be positioned more accurately to either avoid, or pass over, trawl locations.

2.3 Sampling operations

Multibeam mapping

High quality multibeam data were not available for any of the seamounts prior to the survey, although transit lines of 12 kHz bathymetric data, and good coverage of one seamount, from several voyages by the German RV *Sonne* in 1997 were helpful for Anvil Seamount. On five of the six seamounts it was necessary to run multibeam transects (using the RV *Tangaroa*'s Kongsberg EM302) across large areas of the seamount before benthic sampling could commence.

Multibeam transects were generally run along the axis of each seamount, typically in a NW-SE orientation. Speed varied with the weather conditions, but averaged between 6 and 9 knots.

Photographic sampling

The main sampling tool used on photographic transects was NIWA's Deep Towed Imaging System (DTIS). This is a towed camera frame system designed to survey epifauna, demersal fish and substratum type (Figure 3, top panel). 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 knots. Seabed video was monitored in real time and spatially referenced observations of substratum type and benthic mega-epifauna were logged using Ocean Floor Observation Protocol software (OFOP). DTIS was tracked in real time against an appropriate multibeam sonar terrain map using the RV *Tangaroa's* Simrad HiPAP system, with the officers on the bridge using an OFOP repeater screen for precise positioning of the camera in relation to seabed features. Data were automatically saved within OFOP, and manually saved on the HiPAP computer when required as back-up, and later merged into OFOP output files.

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 computer server. Ashore, all video, image, and log files were uploaded to secure computer servers at NIWA, Wellington. Video tape originals (miniDV format) were archived at NIWA. .

Direct faunal sampling

Samples of invertebrate epifauna, as well as rocks, were obtained using NIWA's "Seamount" epibenthic sled (see Figure 3, lower left panel). The sled has a 1 m wide and 0.3 m high mouth opening, with a 25 mm mesh liner inside an outer 100 mm chafing net. The sled was used to target sites where corals, representative fauna, or unusual species were observed on DTIS.

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

Sled tows varied in length depending upon the distribution of target fauna along the DTIS transect, and the likely catch of rocks or coral 'rubble' (mostly dead coral) associated with the tow track. On a number of tows, a transponder beacon was attached, so the position of the sled could be monitored during the tow. Figure 4 shows the vessel and the sled positions from the beacon.

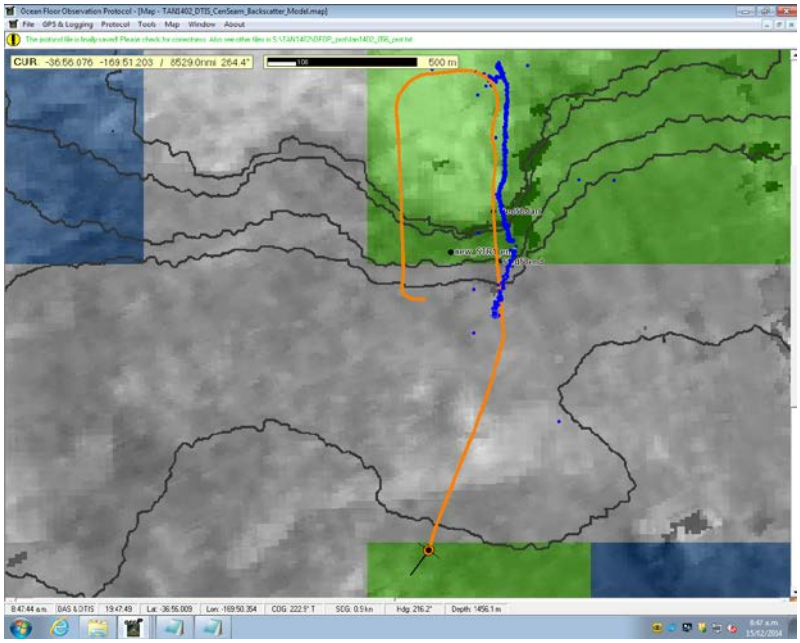

Figure 4: A trace of vessel (orange) and sled (blue) positions, during a tow on CenSeam Guyot, towing southwards from the summit plateau (top centre) down a section of the flank at 1300 m (middle centre).

The whole sample recovered by the sled was photographed on the trawl deck and then transferred to plastic fish bins for weighing. Depending on catch volume, either the whole sample or a subsample of up to six bins was sorted for fauna on a 5 mm mesh sorting table. Specimens were preserved appropriately (ethanol or formalin depending on taxon according to NIWA's collections protocol (Schiaparelli et al, in press). All preserved and discarded samples, together with total catch weights, were recorded in the *Specify* database and, once ashore, all retained faunal samples were lodged in the NIWA Invertebrate Collection, NIWA, Wellington.

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 bottom right panel) was deployed in the vicinity of live stony coral colonies. Samples were collected at standard depths of 10, about 50–100 (approximate depth of mixed layer), 250, 500, 750, 1000, 1100, 1200, 1300, 1400, and 1500 m. Duplicate samples were taken when possible at bottom depths where live stony corals were found and/or where live stony corals were sampled. Water samples were taken for alkalinity (1 litre bottles) and dissolved inorganic carbon (DIC) (250 ml bottles). Bottom temperature and dissolved oxygen (DO) were 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 there was possible contamination of a bottle (assessed by how tight the rosette canisters were upon retrieval).

Live coral collection

Live stony corals were collected from several seamounts. For each epibenthic sled haul, a bin with chilled (approximately 5.5°C) seawater was prepared so that live corals collected by the sled could be placed back in seawater at temperatures close to that where they were collected. The bins with live corals were then taken to the Wet Laboratory area for processing, where coral colonies of a size sufficient (about 125 cm^3 or larger) for shore-based laboratory studies were selected.

The selected 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 a flow-through, temperature controlled aquarium system. This system was set up with a high flow rate (about 50 l/hr) and temperature of about 5°C to reproduce *in situ* conditions. *Specify* number, lot number, 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 Wet Laboratory.

Station recording

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 RV *Tangaroa*'s Trawl Coordinator system, and transferred once ashore to the appropriate databases at NIWA, Wellington.

3. OBSERVATIONS

3.1 Voyage timetable and narrative

The voyage track is shown in Figure 5 and a summary of the daily schedule is given in Appendix 1.

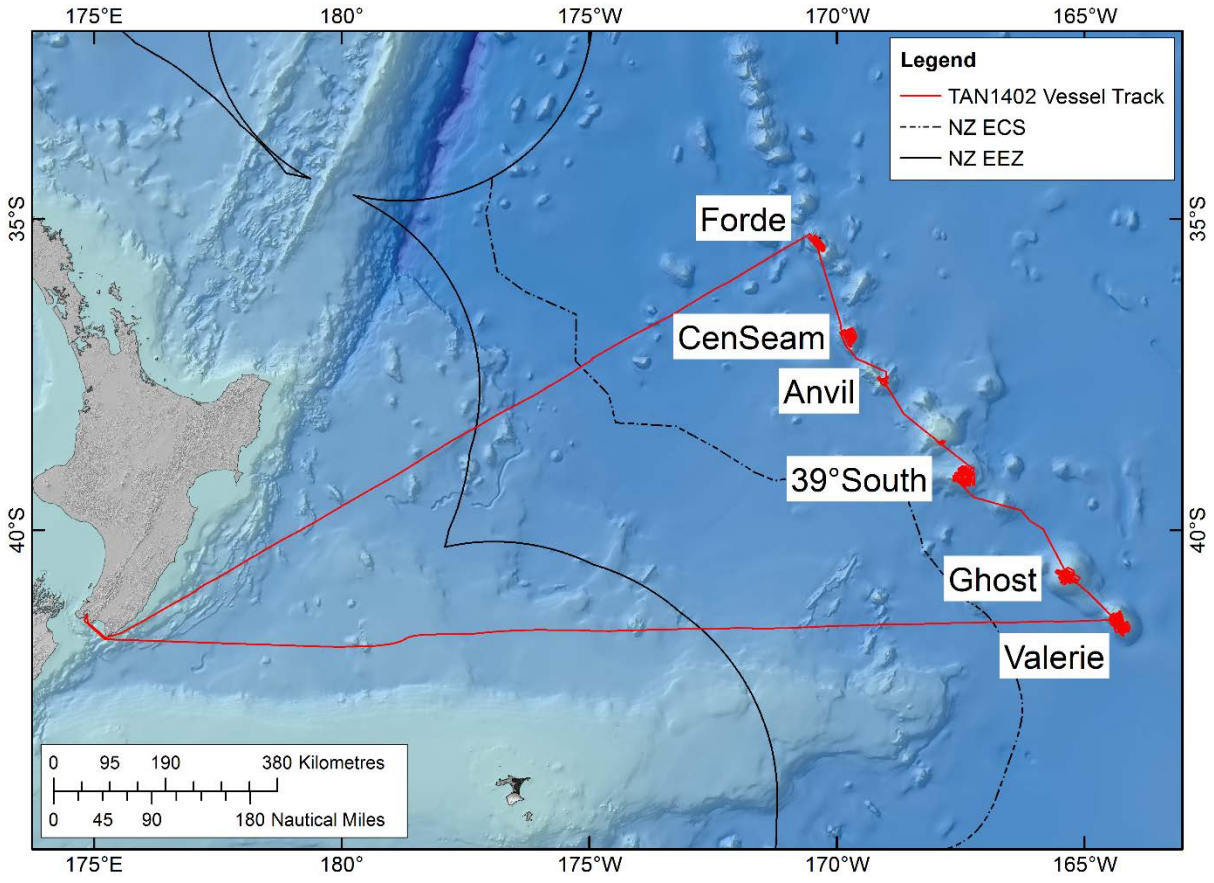

Figure 5: Track of *RV Tangaroa* during voyage TAN1402 (showing the route from Wellington to Forde Guyot, southeast along the Louisville Seamount Chain to Valerie Guyot, and return to Wellington).

3.2 Sampling

In total, 157 stations were completed, consisting of 119 DTIS, 25 epibenthic sled, and 6 CTD deployments (Table 3) In addition to the main sampling, 7 sound-velocity-probe casts were made to calibrate multibeam data. All station details are presented in Appendix 2 and locations are shown in greater detail in individual site descriptions below.

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

Photographic sampling

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 4). 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. The total number of useable images and minutes of video will be less than the totals given above, but the good weather conditions through most of the survey means that the proportion of useable images is likely to be high.

Table 3: Count of stations per seamount and stratum by gear type. Numbers include both random stations, as well as target stations, (the number of the latter in parentheses). NA, stratum did not occur on the seamount.

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

Table 4: Summary of image data collected during the voyage.

Seamount	Stations	Video (hours)	Video (minutes)	Still images
Forde	20	19	26	4 341
CenSeam	22	22	22	4 758
Anvil	13	12	27	3 053
JCM	1	1	02	258
39 South	17	17	39	4 255
Ghost	29	30	9	7 067
Valerie	16	16	20	4 132
TOTAL	118	119	25	27 864

Benthic sampling

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, sampling a variety of terrain from flat sand substrate through to boulder lava flows. The sled came fast on several occasions, but was generally able to be freed and the tow continued. All sleds except one were recovered without one or both the 'break-aways' (set at about 10 t tension) having released (one tow had one break-away gone but retained a good catch).

3.3 Preliminary site observations

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, general descriptions of the overall seamount and communities (with descriptions of each video transect as an appendix), and selected images of the seafloor that give a representative indication of the observed communities. Plots of the distribution of the main VME indicator taxa per transect are also given.

Forde Guyot

Sampling sites

The locations of sampling stations on Forde Guyot are shown in Figure 6.

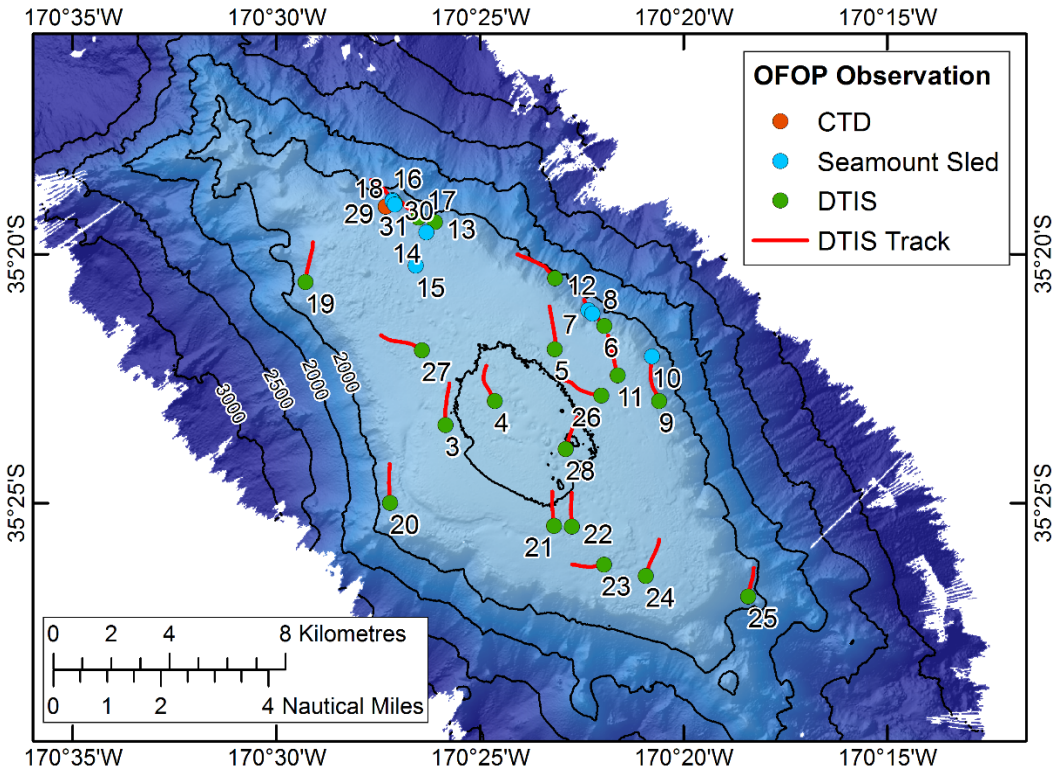

Figure 6: Forde Guyot, showing the position of DTIS and SEL tows, and a CTD cast.

Transect descriptions are detailed in Appendix 3. Selected still images from DTIS covering representative taxa from this seamount are given in Figure 7.

Forde Guyot summary

Forde is an elongated guyot, oriented northwest-southeast. The full multibeam survey revealed the summit plateau to be a large flat area at depths of 1000–1100 m, dropping steeply away from 1150 m. The flanks are deeply incised with gullies and ridges.

The seamount has been relatively lightly trawled, with about 250 tows over the history of the fishery reported, largely in the central part of the guyot.

The summit region is predominantly sandy substratum, with scaphapods, gastropods, and scattered echinoderms. At the plateau edge, and down the upper flanks, there was exposed bedrock with sand, and intact stony coral. Most stony coral 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 stony coral cover, more frequent live clumps, with abundant associated crinoids and brisingid seastars. Gorgonians (in particular *Metallogorgia*) were also common, although not abundant. Echinoids (*Caenopedina*) were dense in some areas, especially the northern flanks, in association with the intact stony corals.

Two of the northern sites would be likely to meet criteria for VME habitat, based on the proportion of cover of corals in DTIS images.

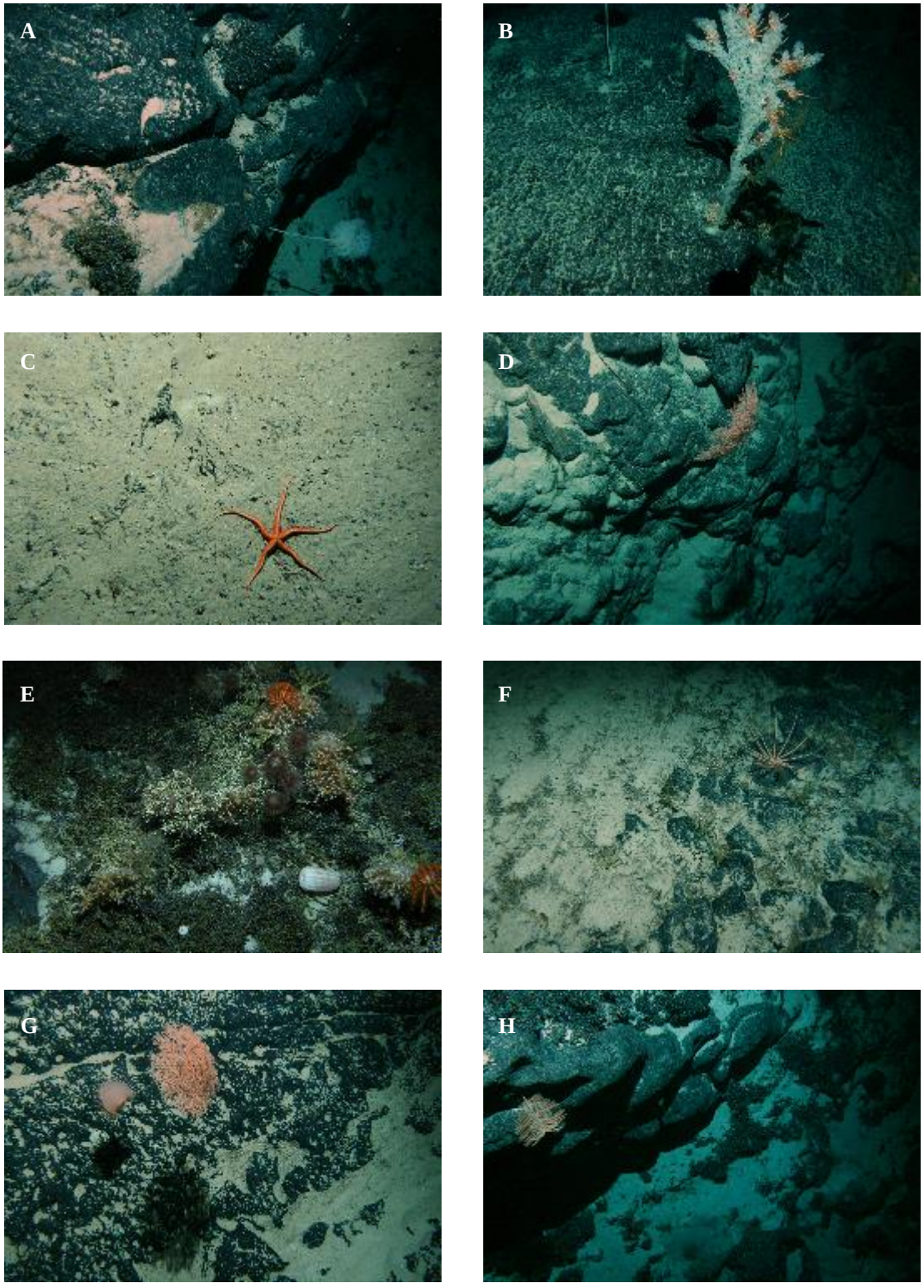

Figure 7: Forde Guyot. A, stalked sponge at 1268 m; B, hexactinellid sponge, ophiuroids, and crinoids at 1265 m; C, sea star (*Zoroaster* sp.) at 1108 m; D, chrysogorgiid coral at 1462 m; E, stony coral and echinoderms at 1175 m; F, brisingid sea star and crinoids at 1365 m; G, chrysogorgiid coral with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

VME indicator taxa distribution

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

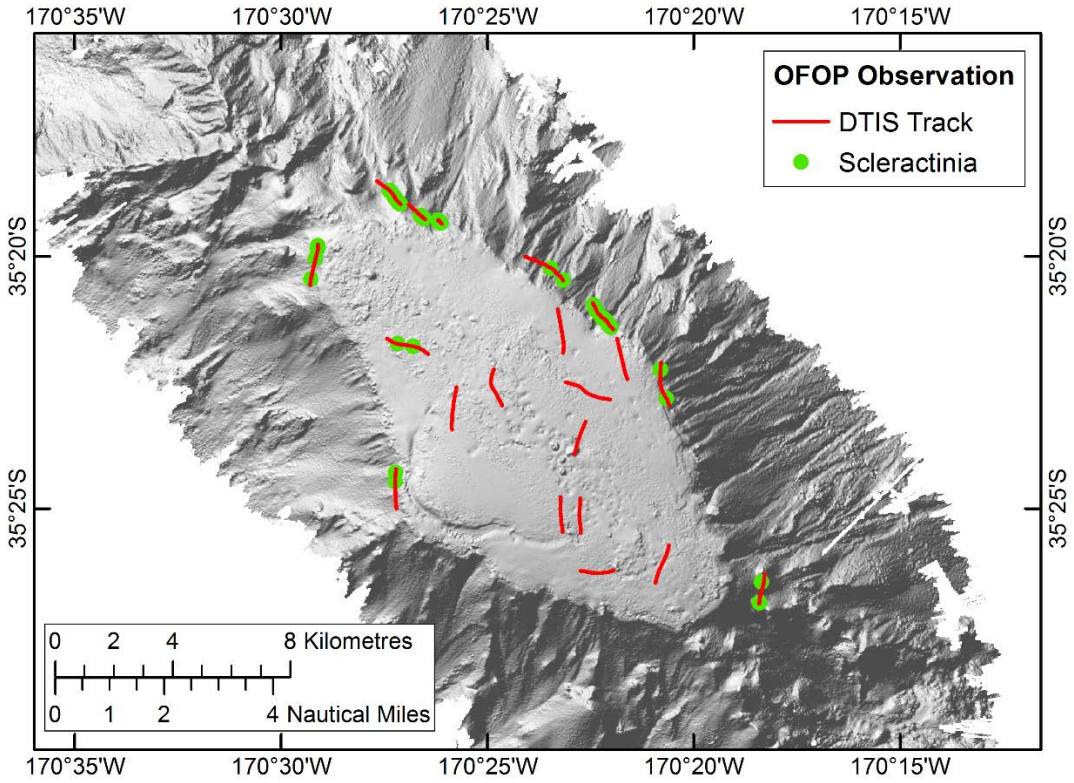

Figure 8: The distribution of scleractinian (stony) corals on Forde Guyot (OFOP data).

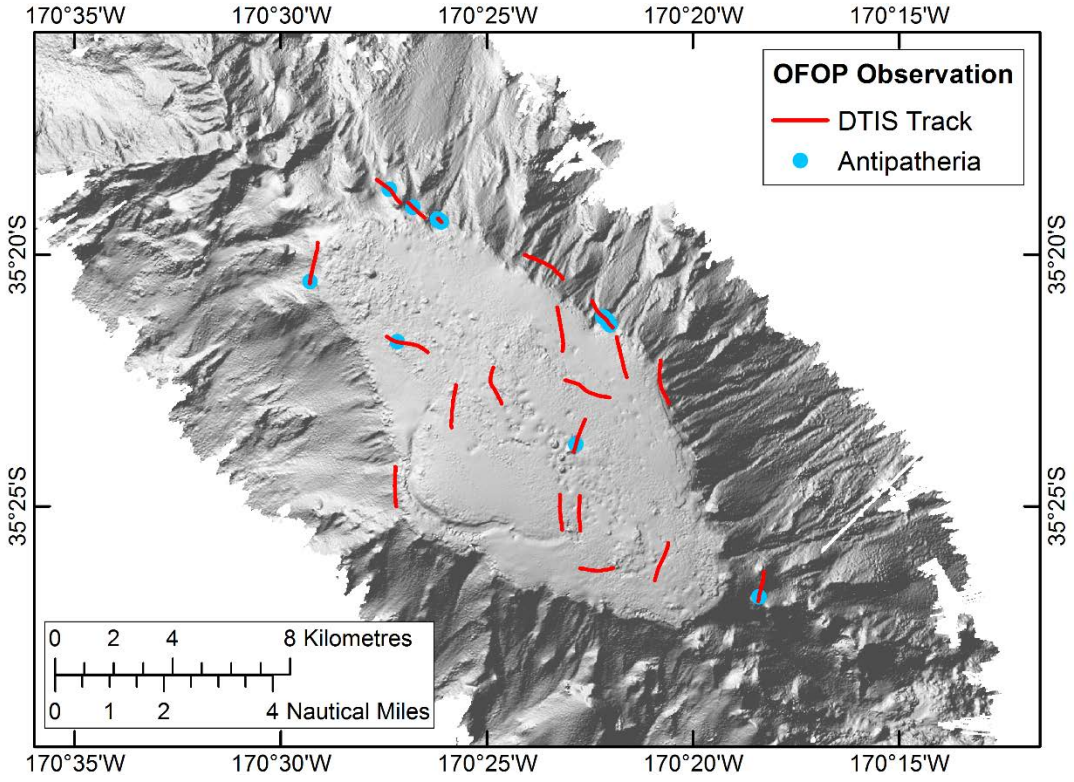

Figure 9: The distribution of antipatherian (black) corals on Forde Guyot (OFOP data).

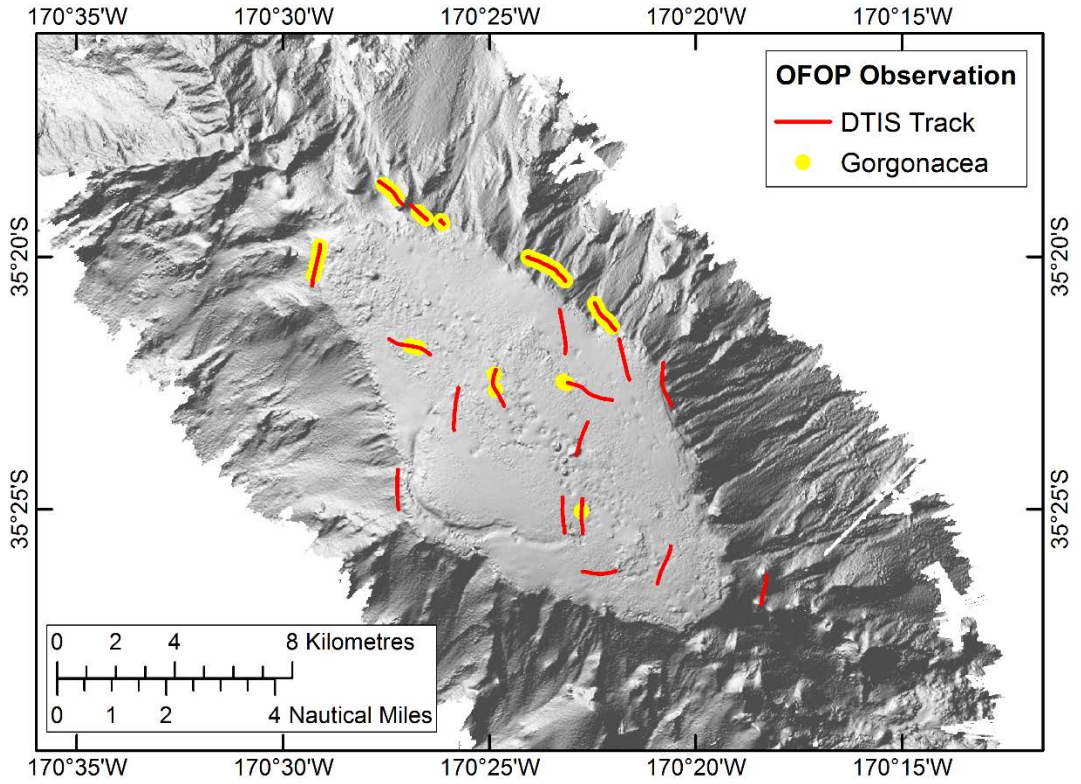

Figure 10: The distribution of gorgonian corals on Forde Guyot (OFOP data).

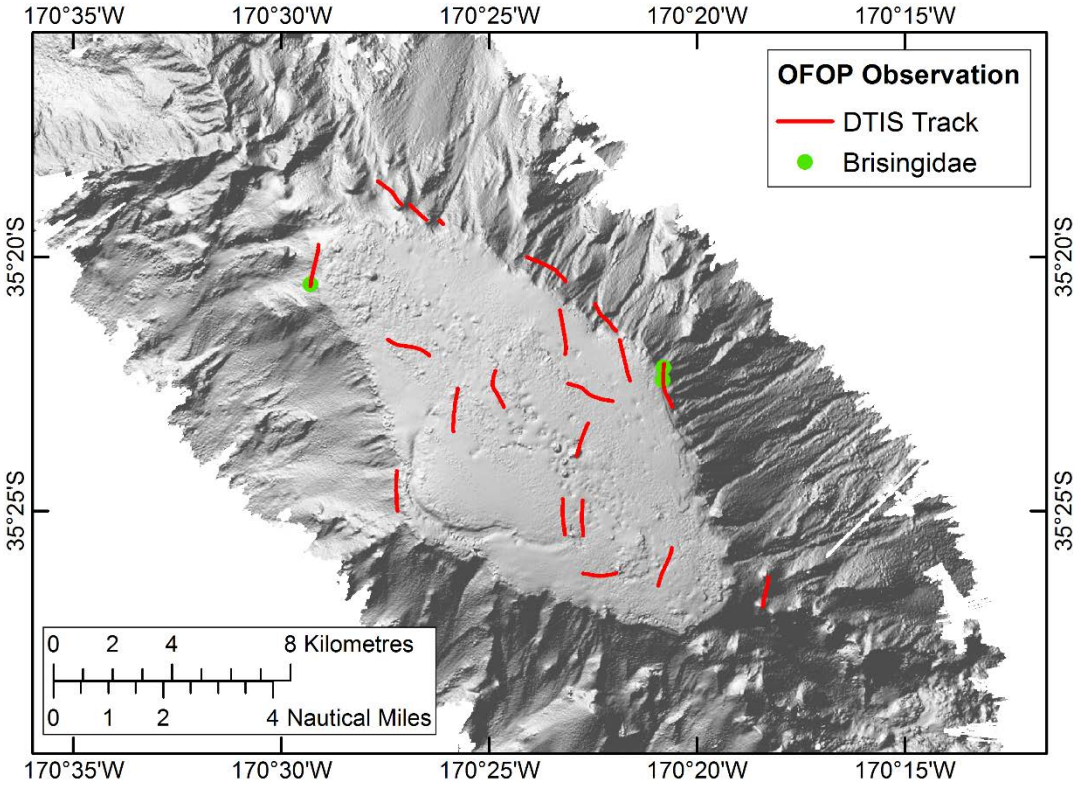

Figure 11: The distribution of brisingid seastars on Forde Guyot (OFOP data).

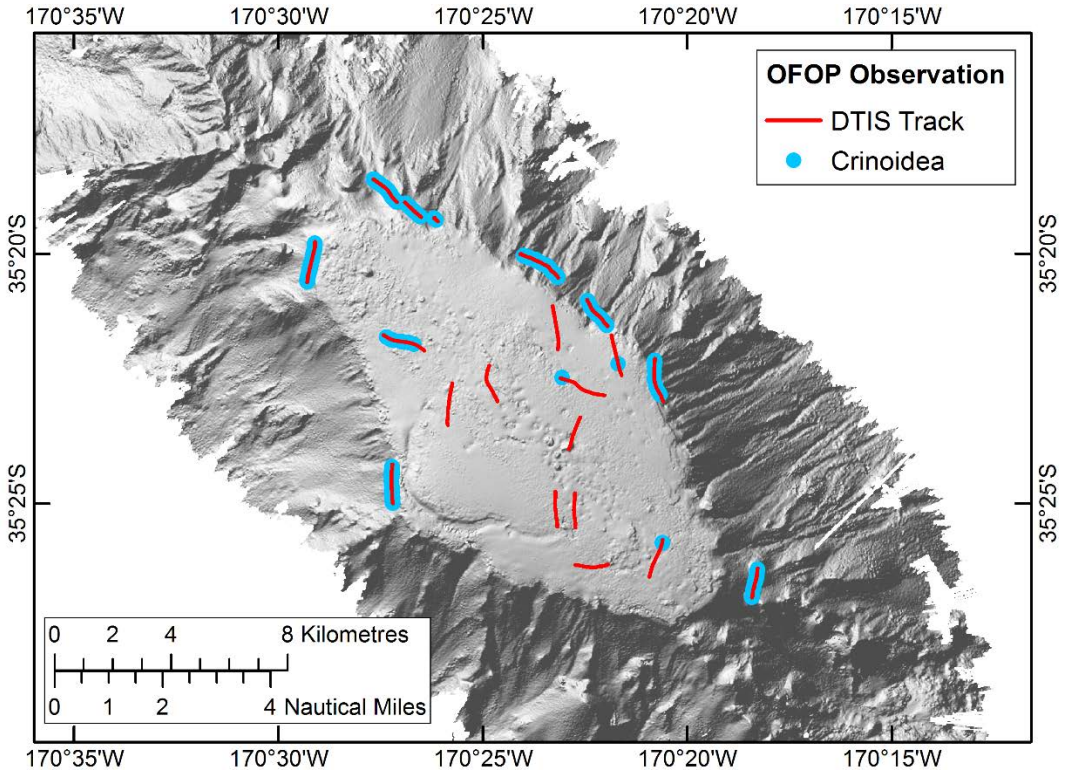

Figure 12: The distribution of crinoids (featherstars) on Forde Guyot (OFOP data).

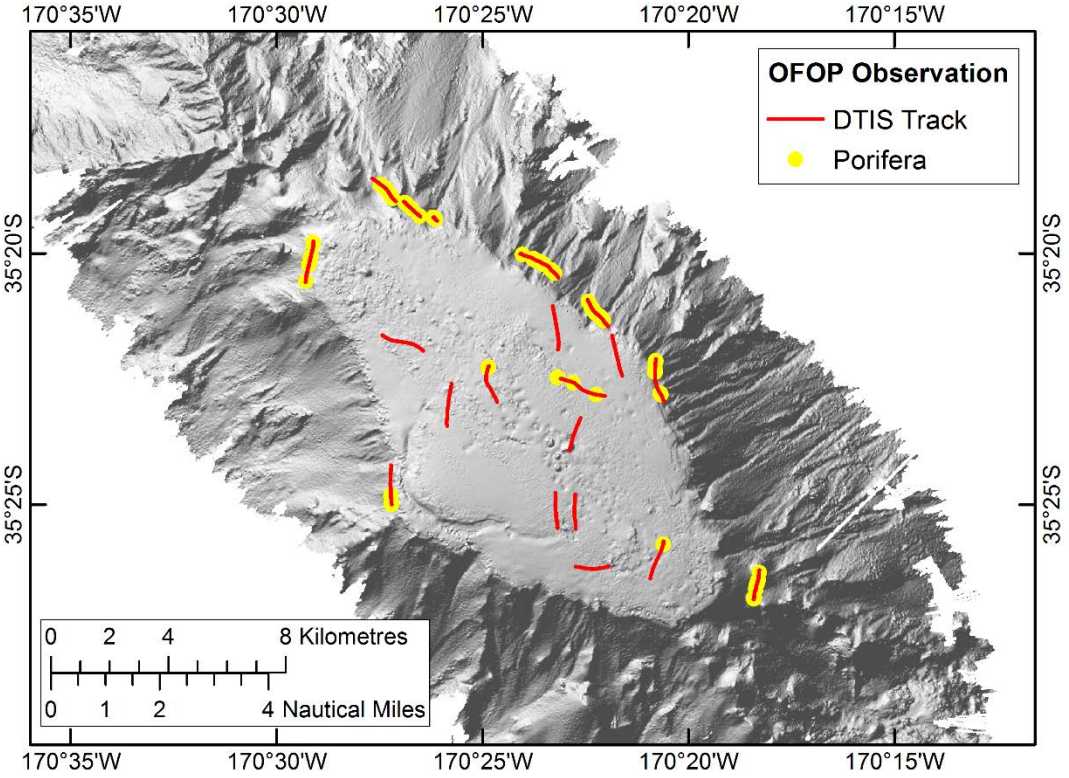

Figure 13: The distribution of Porifera (sponges) on Forde Guyot (OFOP data).

CenSeam Guyot

Sampling sites

The locations of sampling stations on CenSeam Guyot are shown in Figure 14.

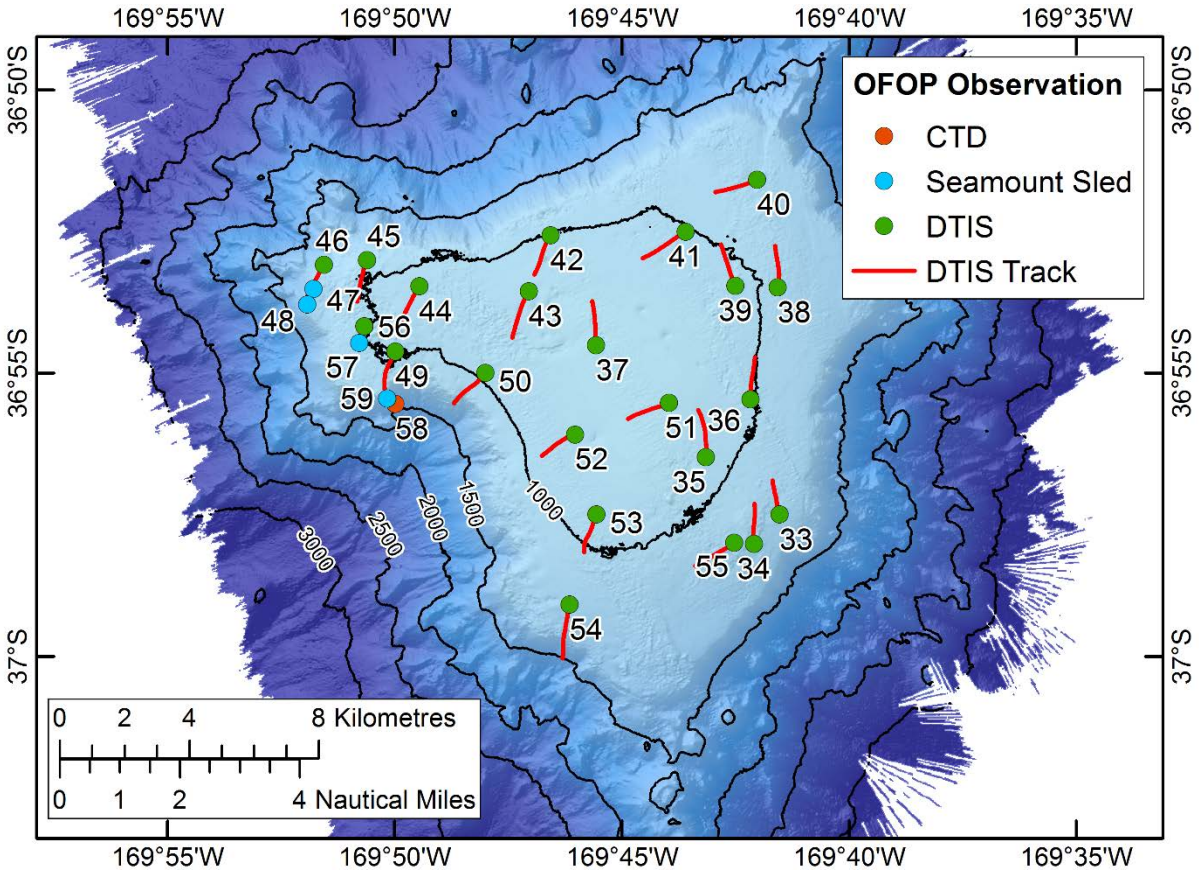

Figure 14: CenSeam Guyot, showing the position of DTIS and SEL tows, and a CTD cast.

Transect descriptions are detailed in Appendix 4.

Selected still images from DTIS covering representative taxa from this seamount are given in Figure 15.

CenSeam Guyot summary

This guyot 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.

A full multibeam survey of this guyot was conducted, as there was little bathymetric coverage prior to this voyage.

The main plateau of this guyot is at 950–1050 m depth. From 1100 m it drops steeply away, with numerous gullies and ridges down its flanks. Most sampling effort was on the plateau itself, where the substratum 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 stony coral were found. The northwestern corner of the guyot had more life, with intact stony coral, live stony coral patches, and a high density of echinoids.

The seamount has been fished, with about 250 tows recorded, mainly on the southeastern side. Few signs of trawl marks were observed.

There were several transects with appreciable expanses of intact dead stony coral, but only isolated clumps of live stony coral, and none exceeded the 15% image cover definition used onboard for VME classification (see above for source of definition).

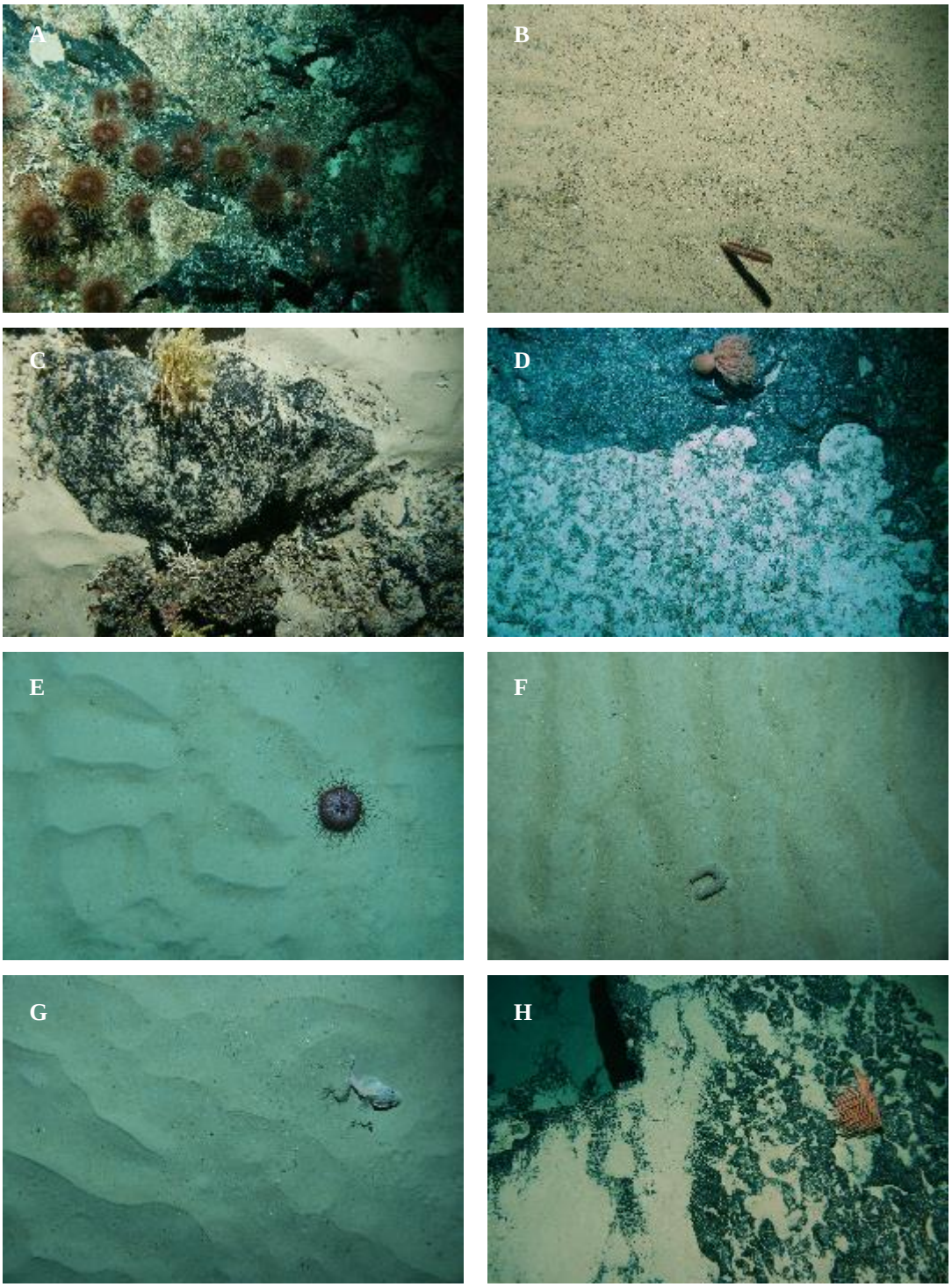

Figure 15: CenSeam Guyot. A, echinoids (urchins) (*Caenopedina porphyrogigas*) at 1059 m; B, pennatulaceans (sea pens) at 1032 m; C, crinoids and stony corals at 1031 m; D, alcyonaceans (soft coral) at 969 m; E, echinothurioid sea urchin at 950 m; F, holothuroid (sea cucumber) at 1009 m; G, scorpionfish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

VME indicator taxa distribution

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

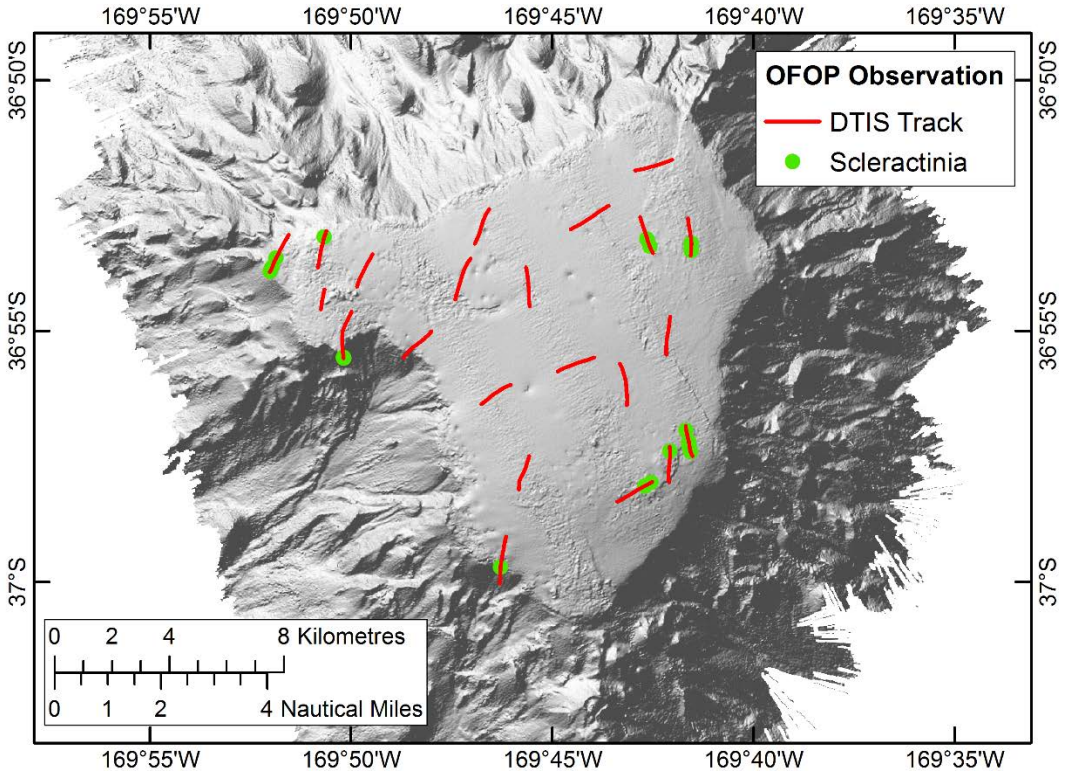

Figure 16: The distribution of scleractinian (stony) corals on CenSeam Guyot (OFOP data).

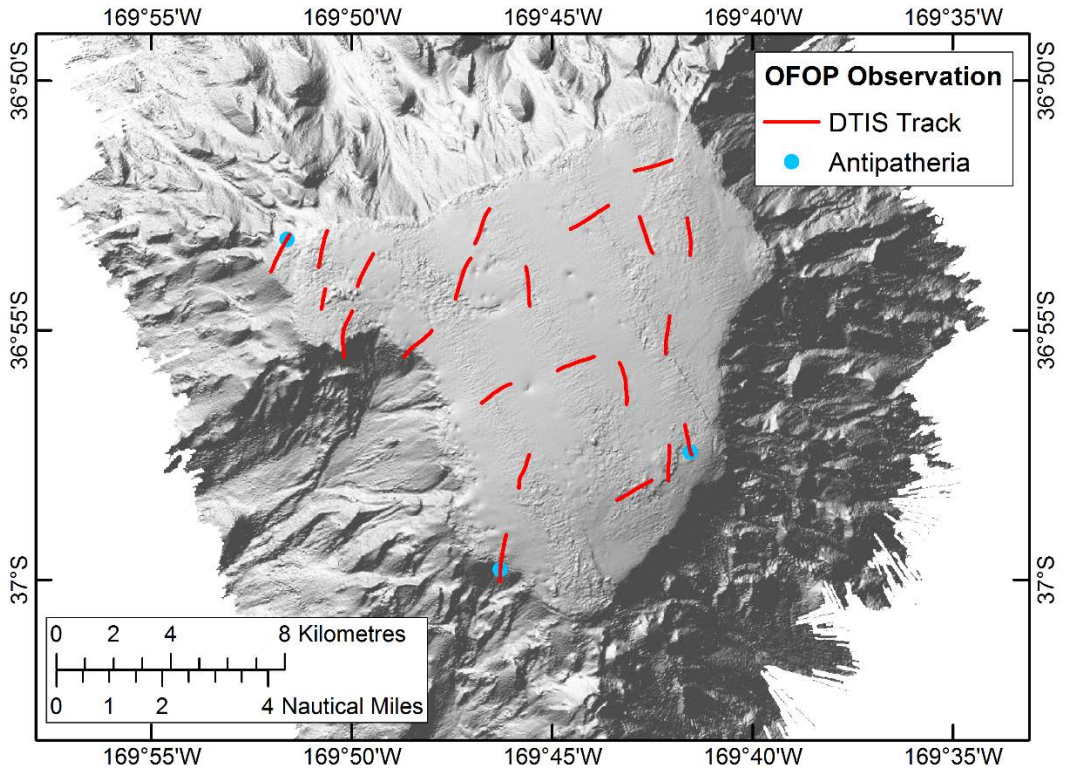

Figure 17: The distribution of antipatherian (black) corals on CenSeam Guyot (OFOP data).

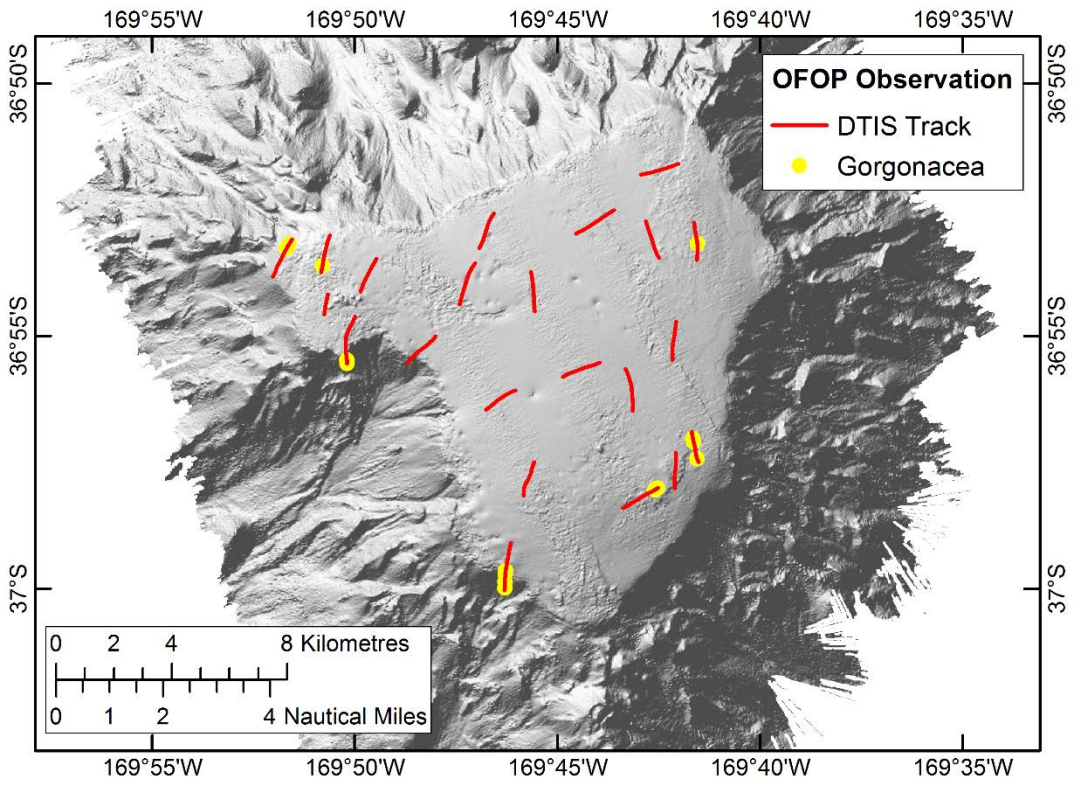

Figure 18: The distribution of gorgonian corals on CenSeam Guyot (OFOP data).

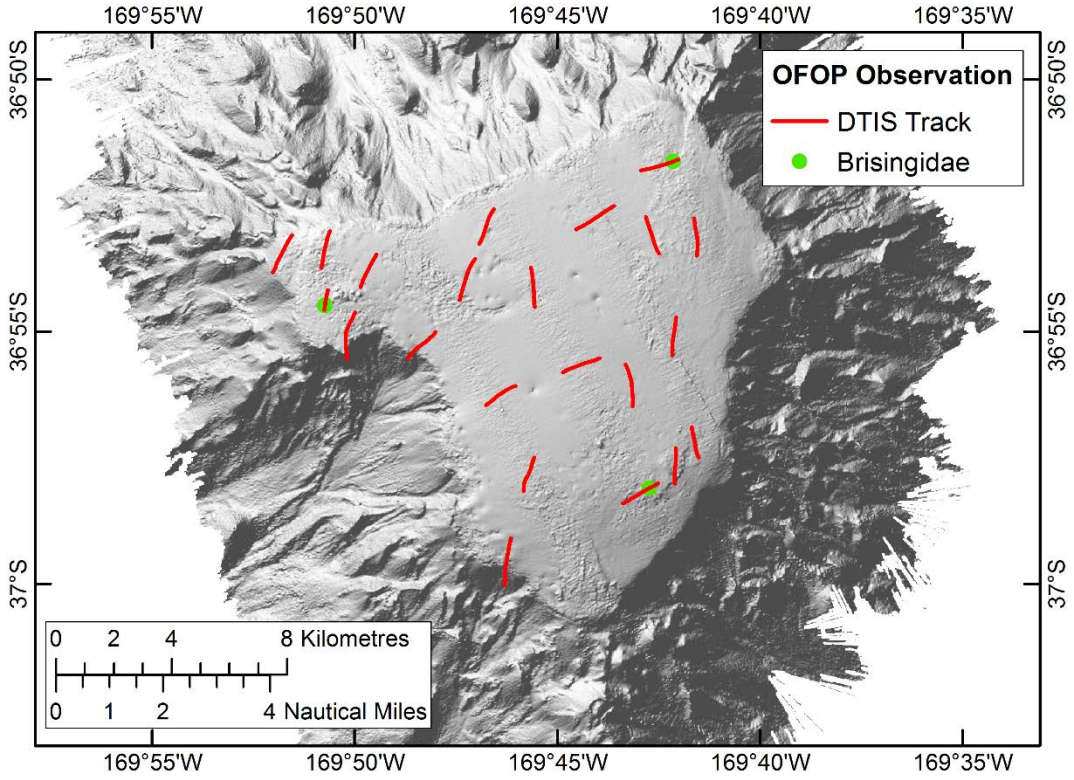

Figure 19: The distribution of brisingid seastars on CenSeam Guyot (OFOP data).

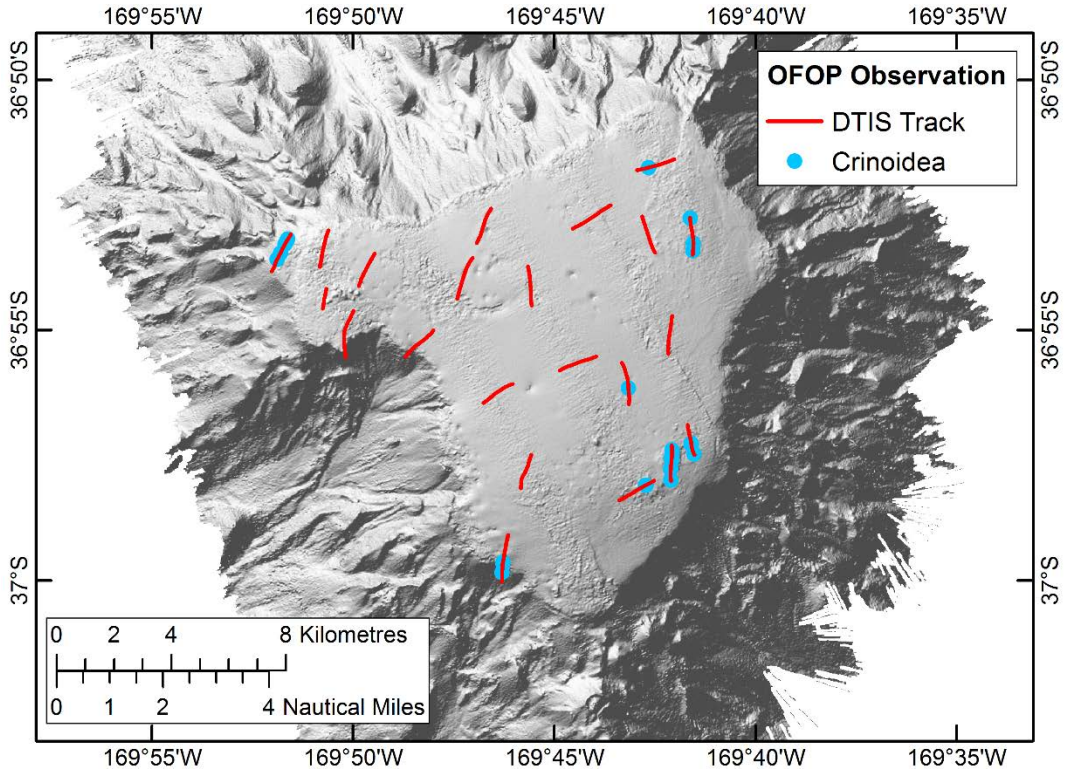

Figure 20: The distribution of crinoids (featherstars) on CenSeam Guyot (OFOP data).

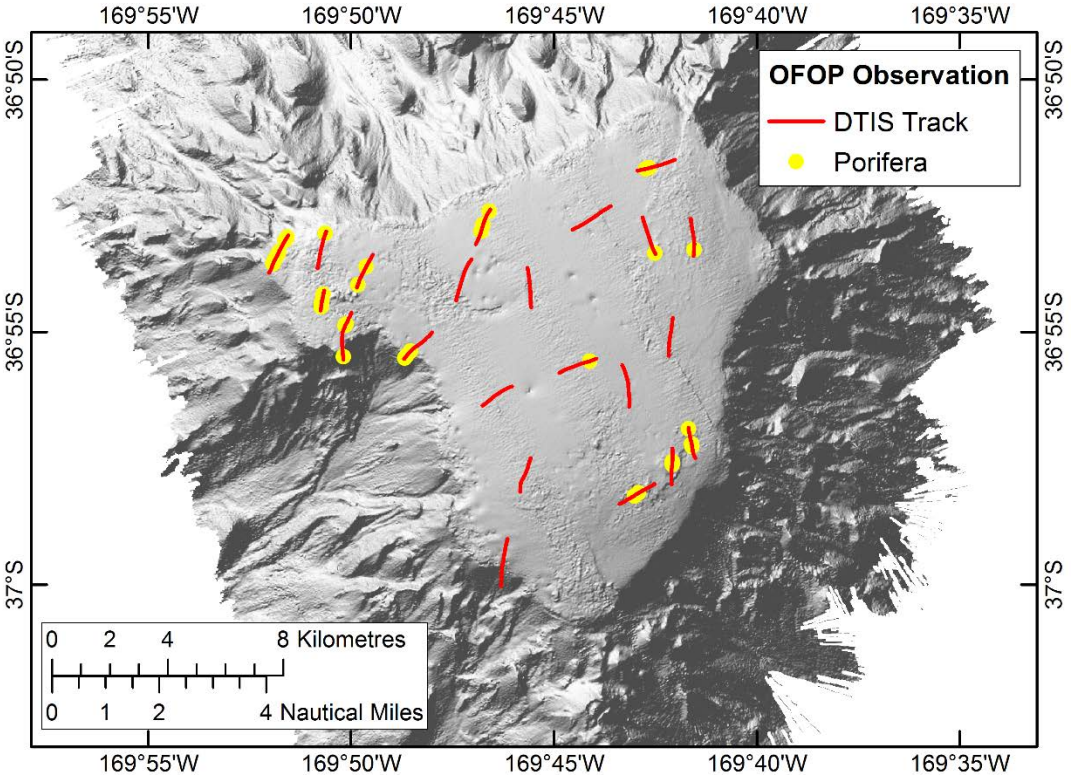

Figure 21: The distribution of Porifera (sponges) on CenSeam Guyot (OFOP data).

Anvil Seamount

Sampling sites

The locations of sampling stations on Anvil Seamount are shown in Figure 22.

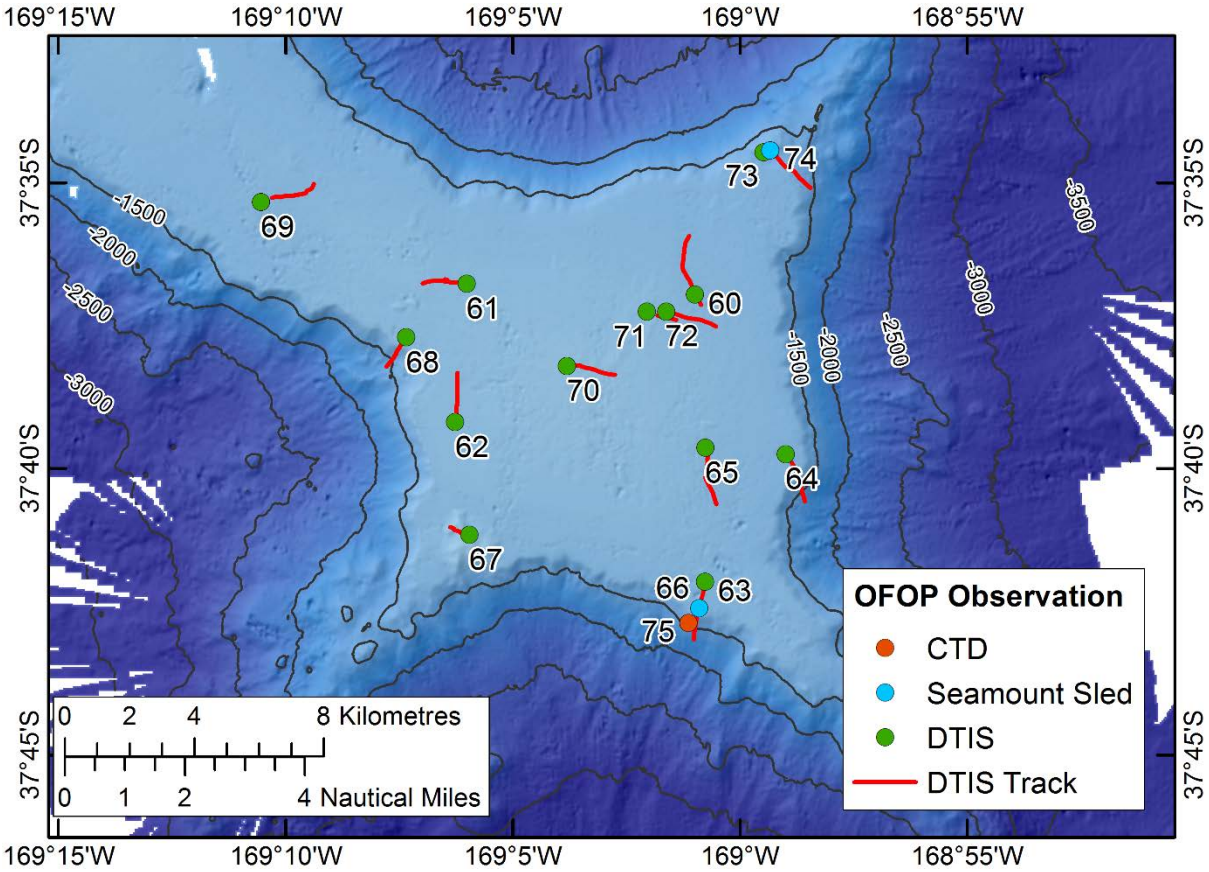

Figure 22: Anvil Seamount, showing the position of DTIS and SEL tows, and CTD cast.

Transect descriptions are detailed in Appendix 5. Selected still images from DTIS covering representative taxa from 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 RV *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 of the seamount and lack of time to sample both.

The summit of the southern feature is relatively flat-topped, with a gradual shallowing from the flank edge at 1250 m up to 1100 m. The flat top is largely sandy substratum, 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) stony coral, as well as scattered live clumps of stony coral.

Densities of stony coral, as well as most invertebrate taxa, were generally low, and no areas of VME were identified.

The seamount has only been lightly trawled, with some tows in the south-western sector.

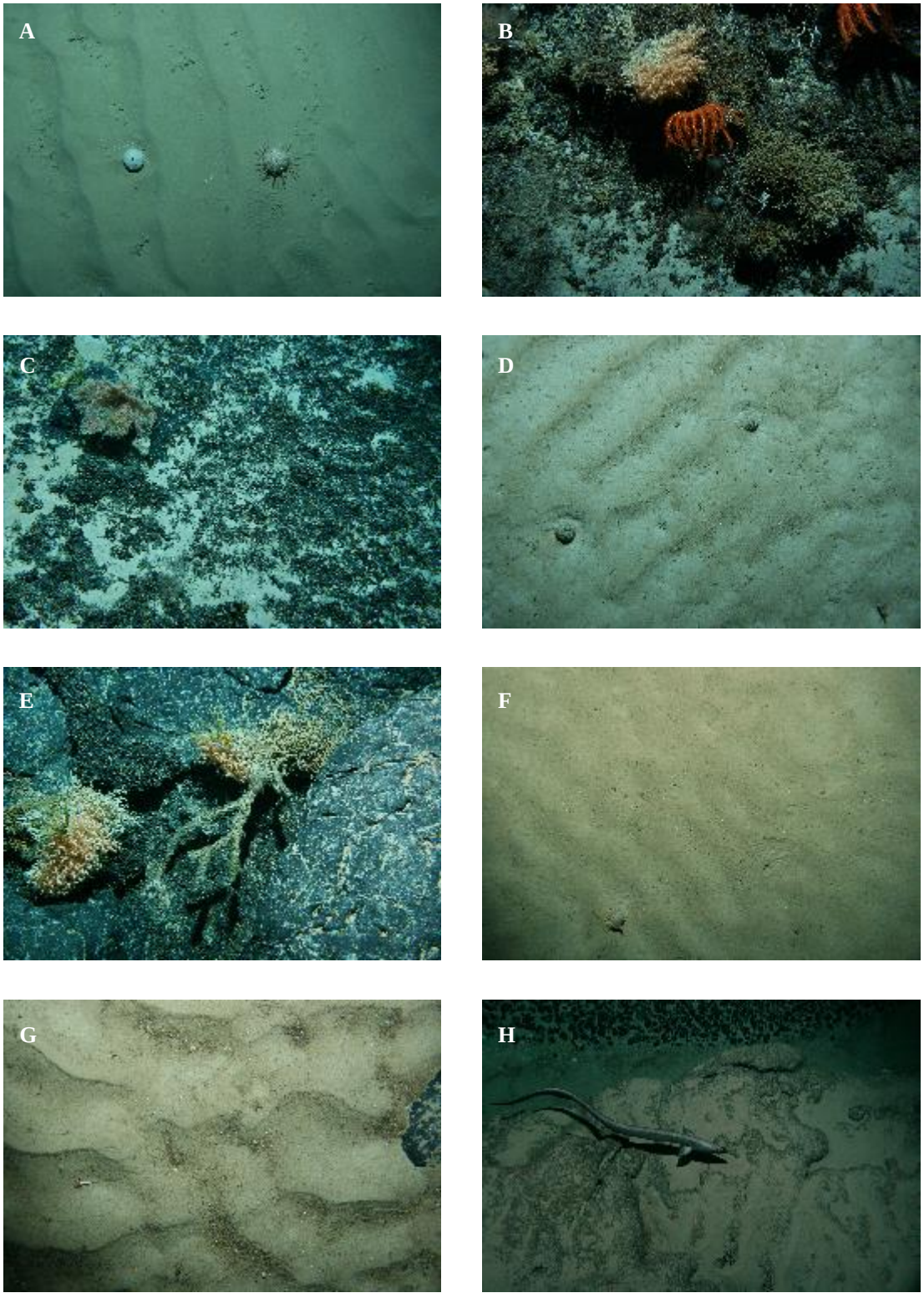

Figure 23: Anvil seamount. A, live and dead sea echinoids (*Gracilechinus multidentatus*) at 1149 m; B, brisingid asteroids amongst stony coral matrix (*Solenosmila variabilis*) at 1259 m; C, plexaurid coral with crinoids and ophiuroids at 1267 m; D, xenophyophores at 1182 m; E, hexactinellid sponge, stony 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 (*Diastobranchus capensis*) at 1387 m.

VME indicator taxa distribution

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

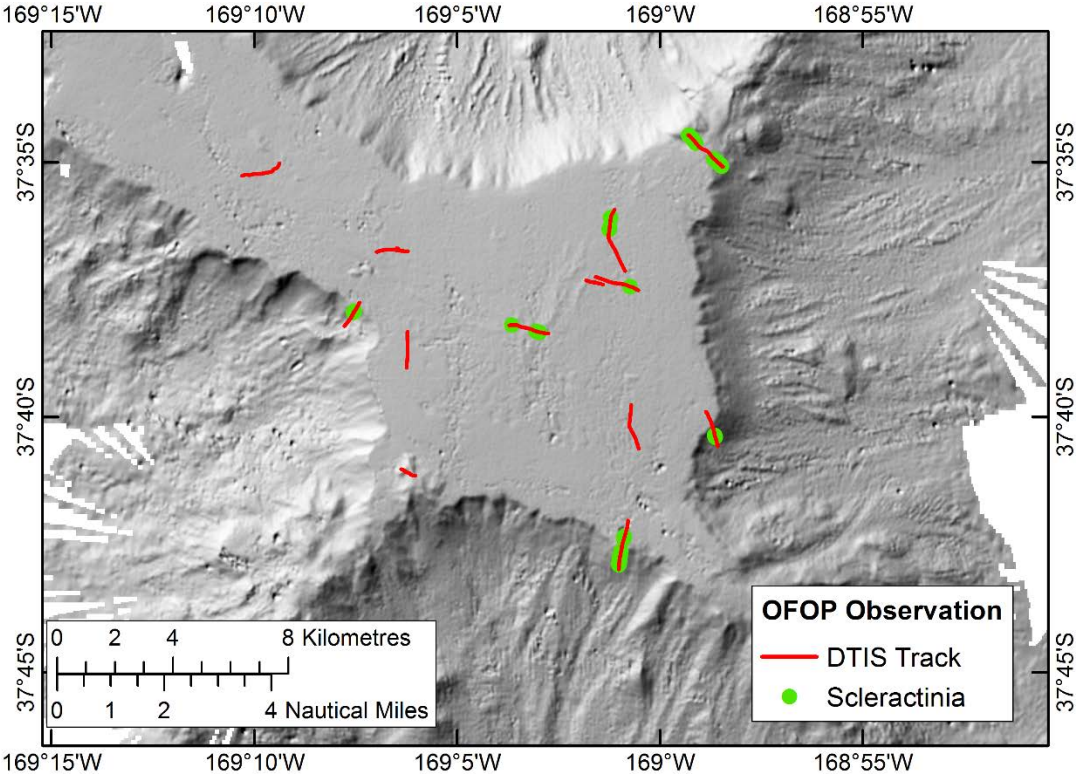

Figure 24: The distribution of scleractinian (stony) corals on Anvil Seamount (OFOP data).

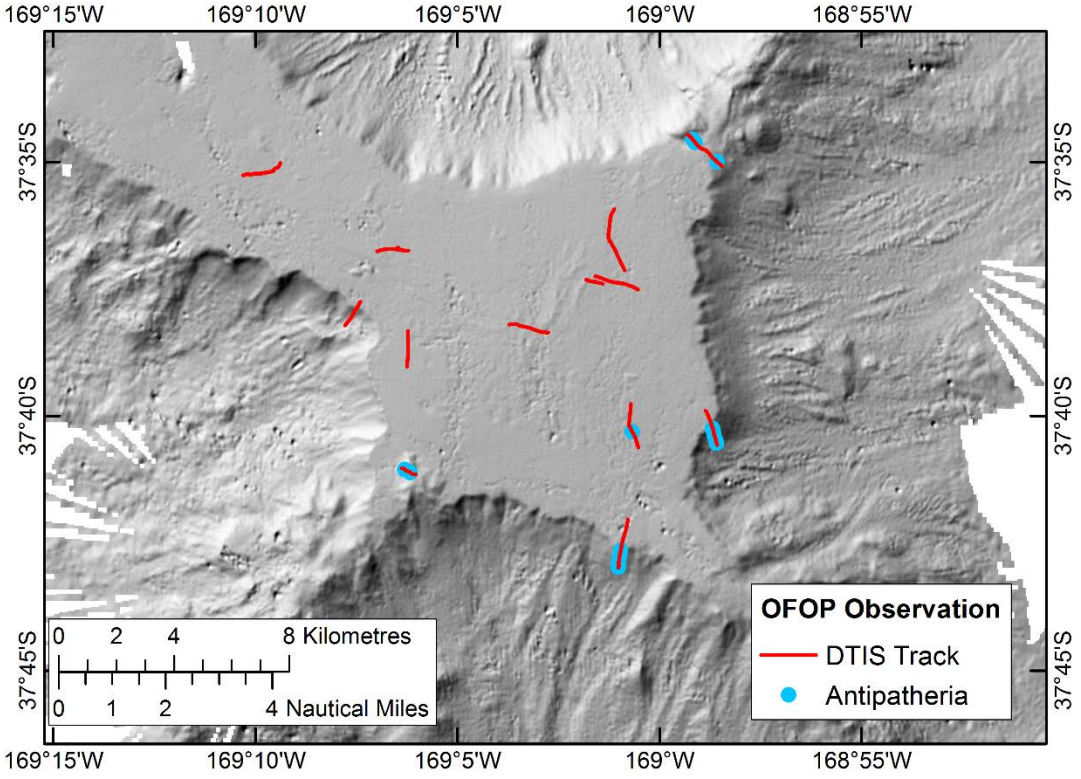

Figure 25: The distribution of antipatherian (black) corals on Anvil Seamount (OFOP data).

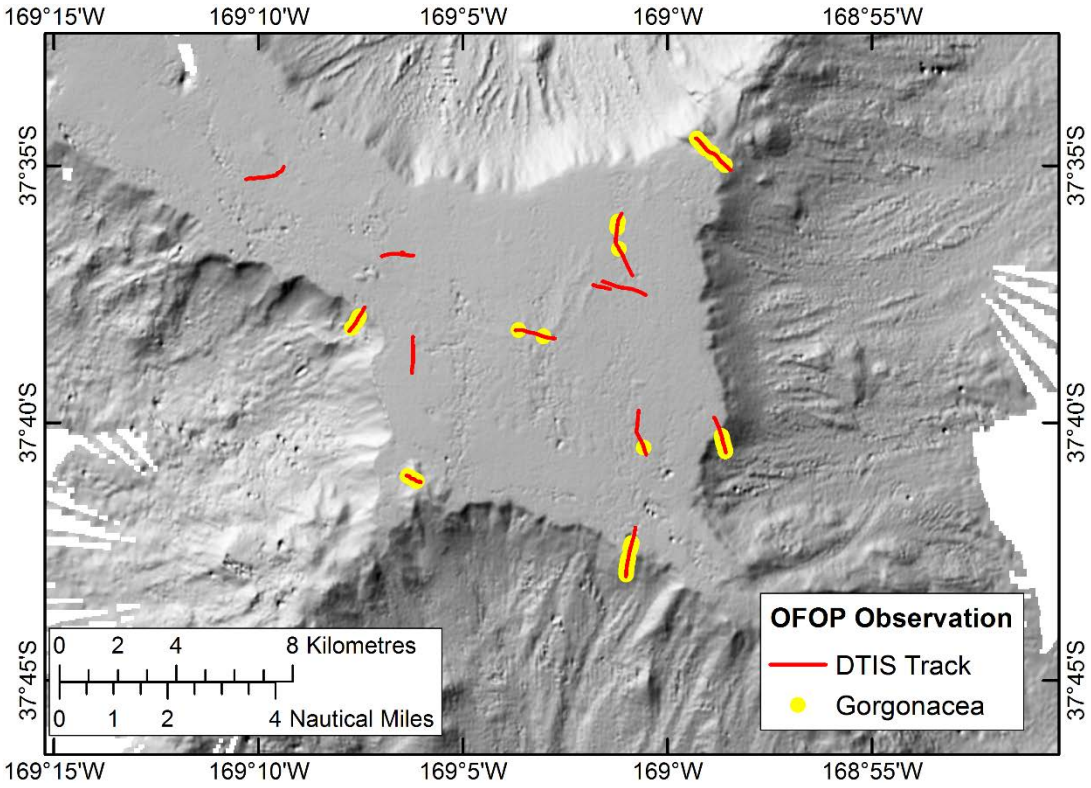

Figure 26: The distribution of gorgonian corals on Anvil Seamount (OFOP data).

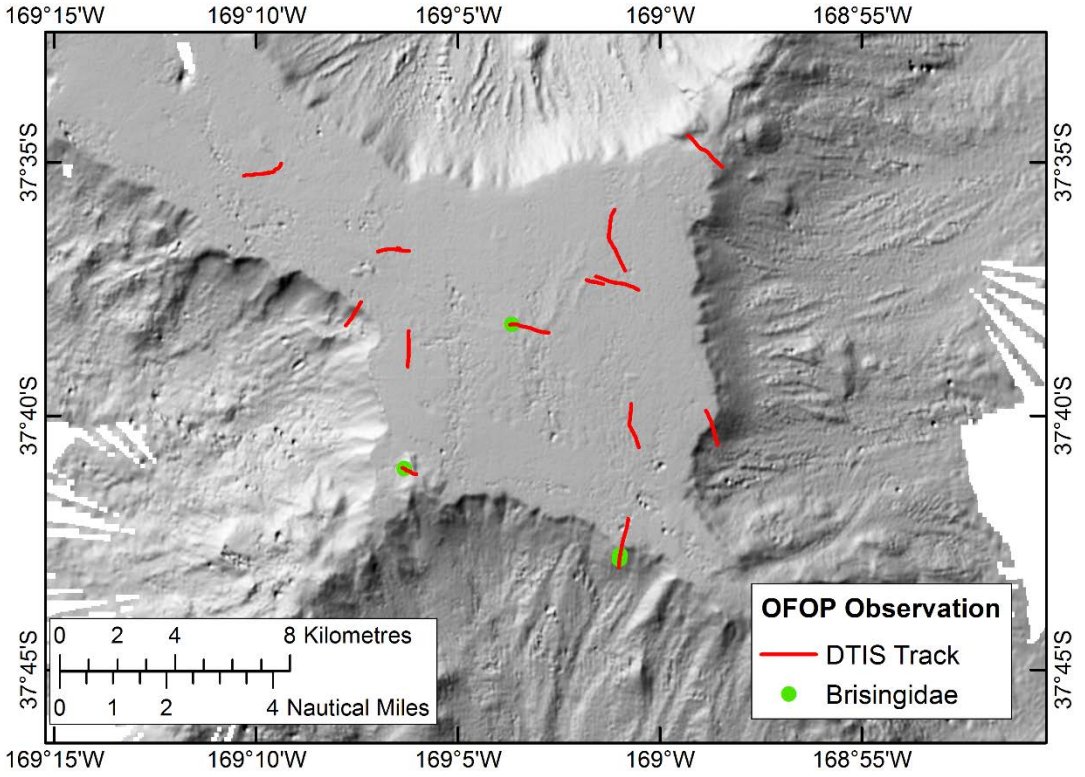

Figure 27: The distribution of brisingid seastars on Anvil Seamount (OFOP data).

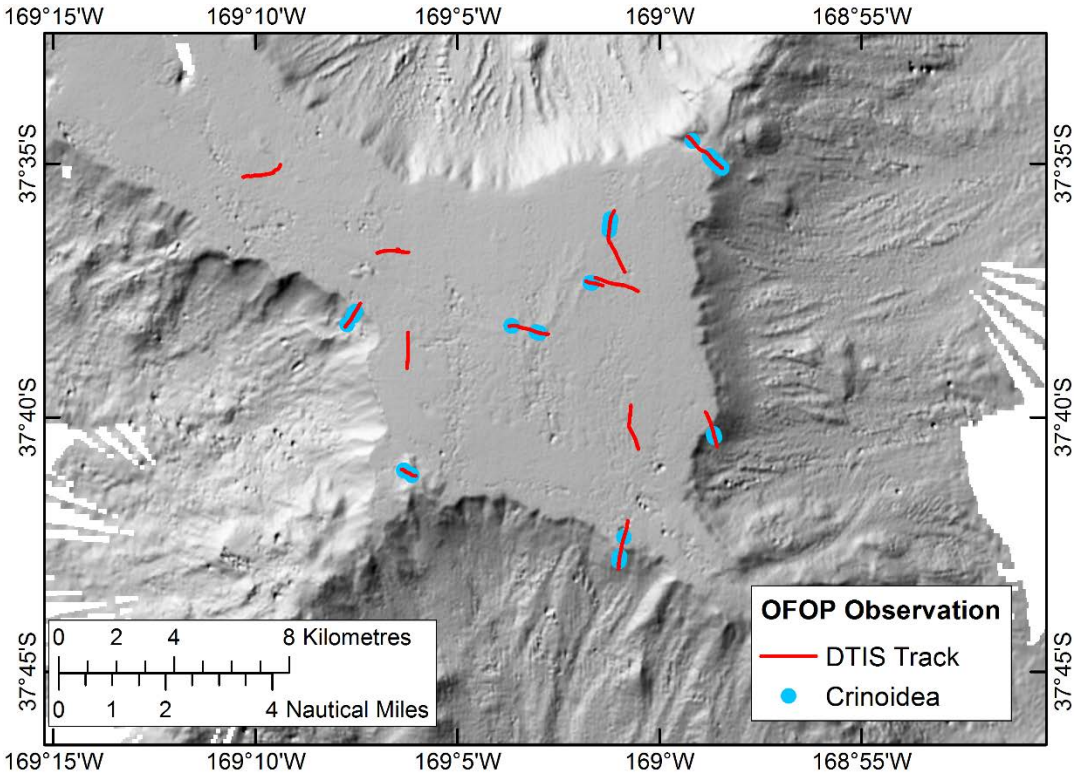

Figure 28: The distribution of crinoids (featherstars) on Anvil Seamount (OFOP data).

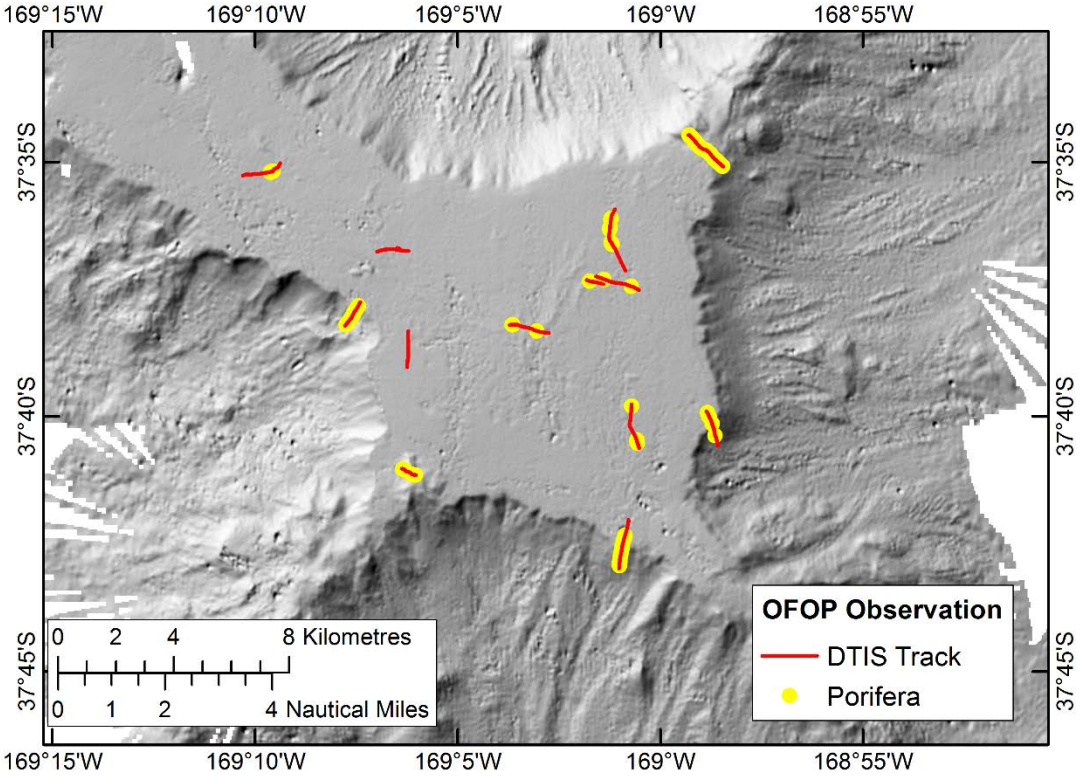

Figure 29: The distribution of Porifera (sponges) on Anvil Seamount (OFOP data).

39 South Seamount

Sampling sites

The locations of sampling stations on 39 South Seamount are shown in Figure 30.

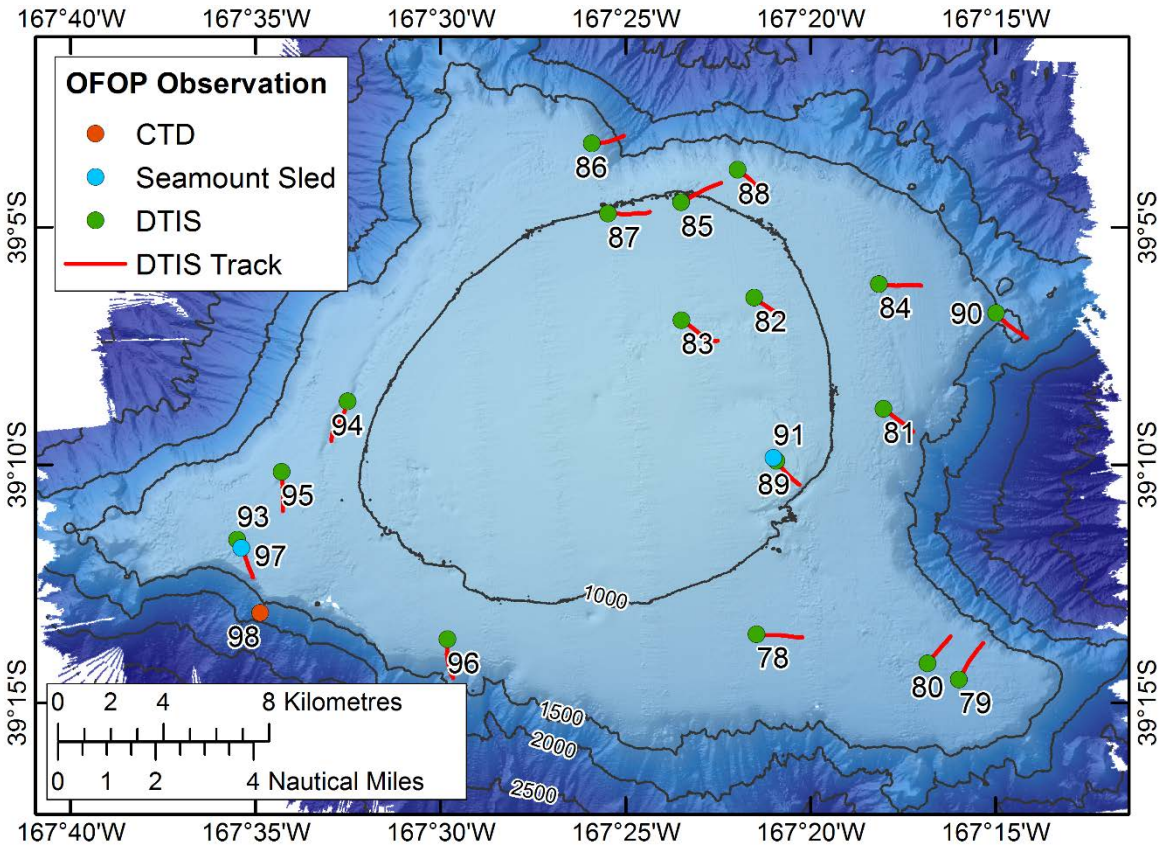

Figure 30: 39 South Seamount, showing the position of DTIS and SEL tows, and a CTD cast.

Transect descriptions are detailed in Appendix 6.

Selected still images from DTIS which show representative fauna from this seamount are given in Figure 31.

39 South Seamount summary

39 South is similar to CenSeam Guyot in its general shape, although it is shallower. It is flat-topped, with the summit at about 880 m. The top rolls over sharply at 1100–1150 m. The guyot has been trawled with about 200 tows recorded on the summit region and northern flanks.

The summit area was typically soft sediment, with observations comprising mainly burrows, animal tracks, gastropods, scaphopods, worms, xenophyophores, and scattered echinoids. There was more exposed bedrock and boulders on transects extending down the flanks of the seamount, but typically only small clumps of live stony coral. The densest patches were on the northwestern side, along a valley-feature at about 1050 m. These stony corals had the usual associates of crinoids and brisingids, with gorgonian and black corals and glass sponges. Tow 94 was the only one where stony coral clumps were defined as reaching densities that would define them as VMEs.

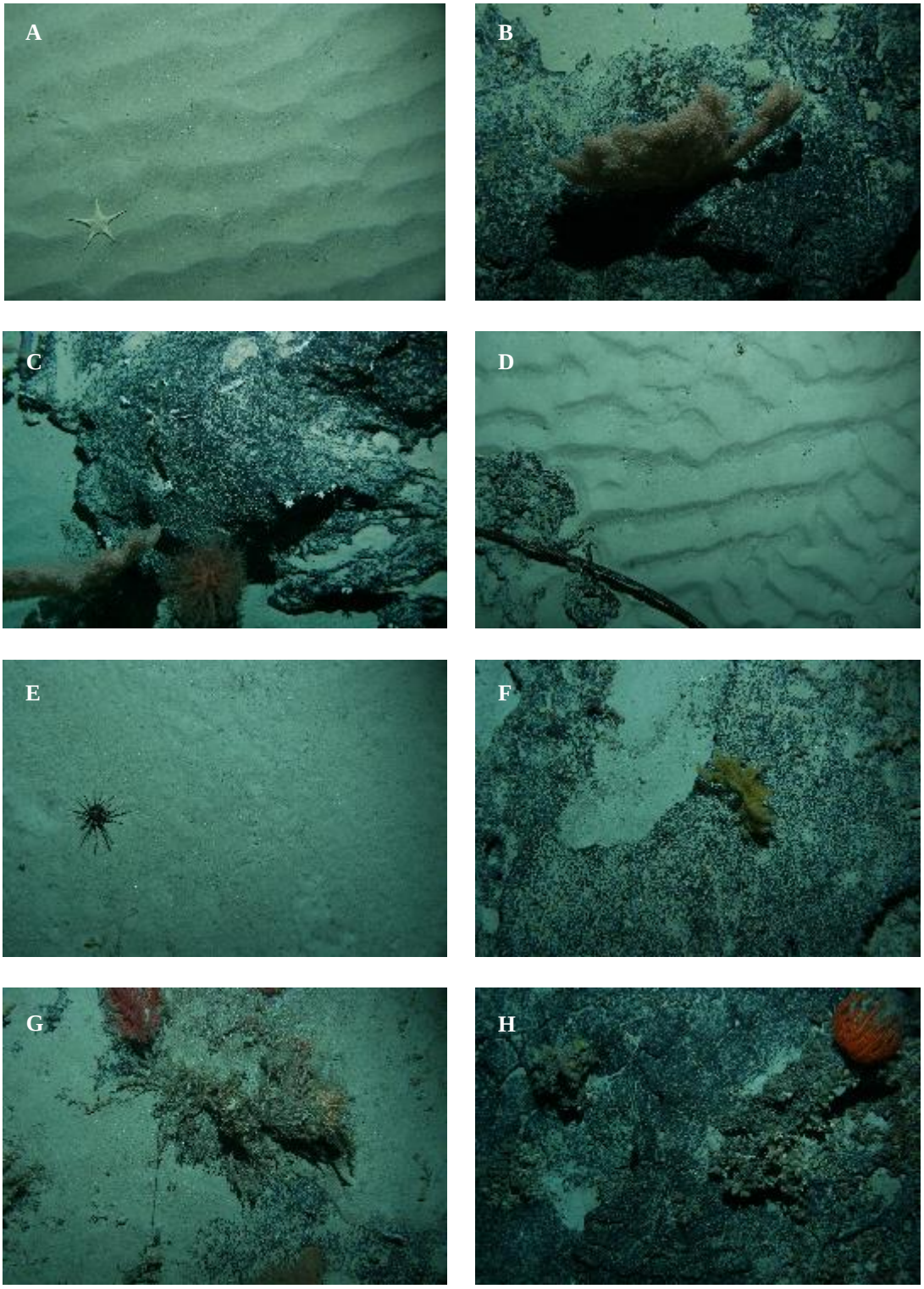

Figure 31: 39 South Seamount. A, goniasterid asteroid at 959 m; B, primnoid gorgonian coral at 920 m; C, primnoid gorgonian coral, alcyonacean soft coral, and stylasterid hydro corals at 905 m; D, trawl warp at 1071 m; E, cidarid echinoid (*Poriocidaris purpurata*) at 901 m; F, gorgonian coral at 900 m; G, assemblage of organisms including a gastropod mollusc, plexaurid, stony corals, and soft corals at 901 m; H, brisingid asteroid and small corals including stony cup corals at 904 m.

VME indicator taxa distribution

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

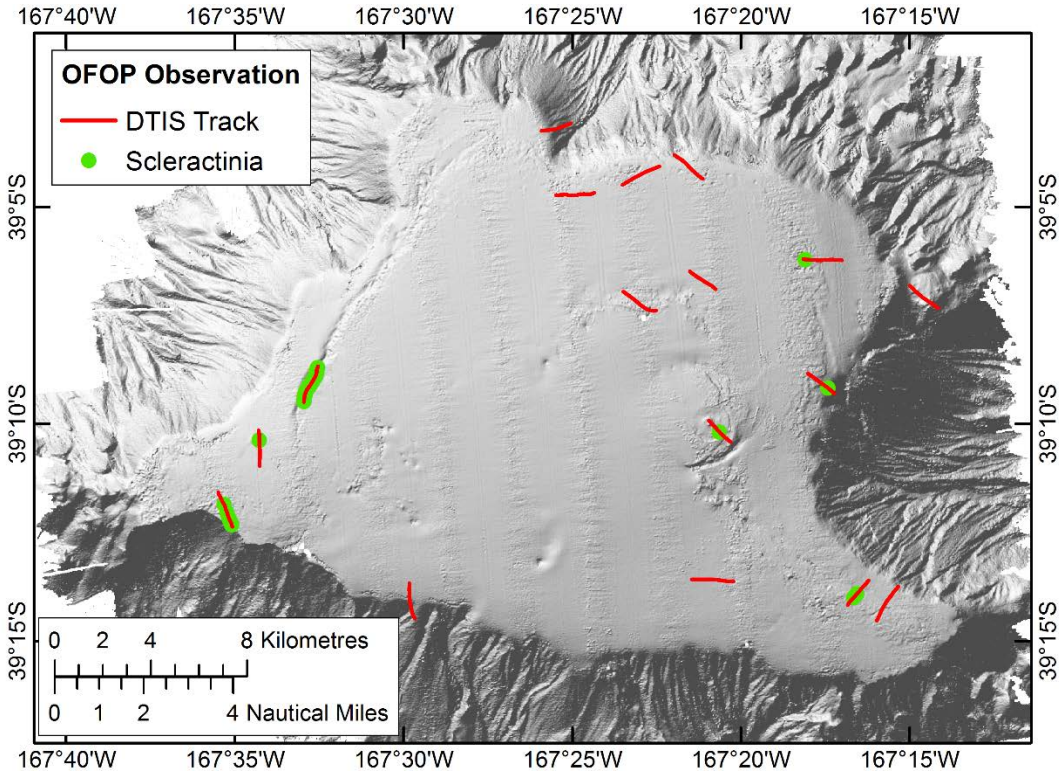

Figure 32: The distribution of scleractinian (stony) corals on 39 South Seamount (OFOP data).

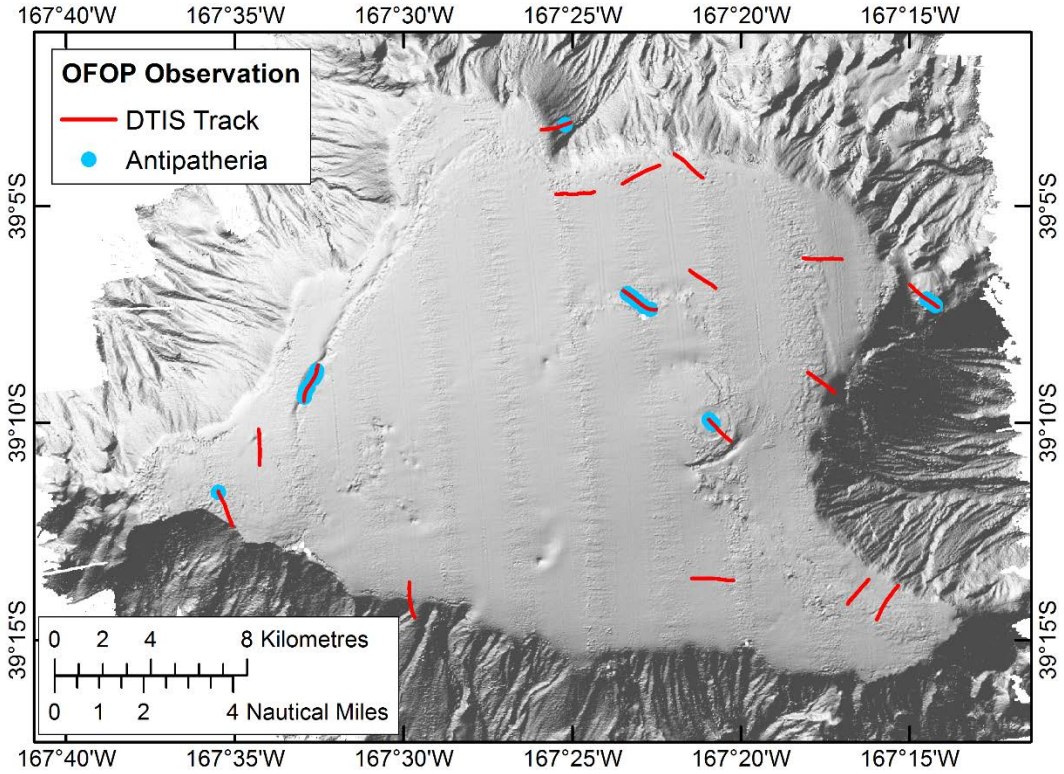

Figure 33: The distribution of antipatherian (black) corals on 39 South Seamount (OFOP data).

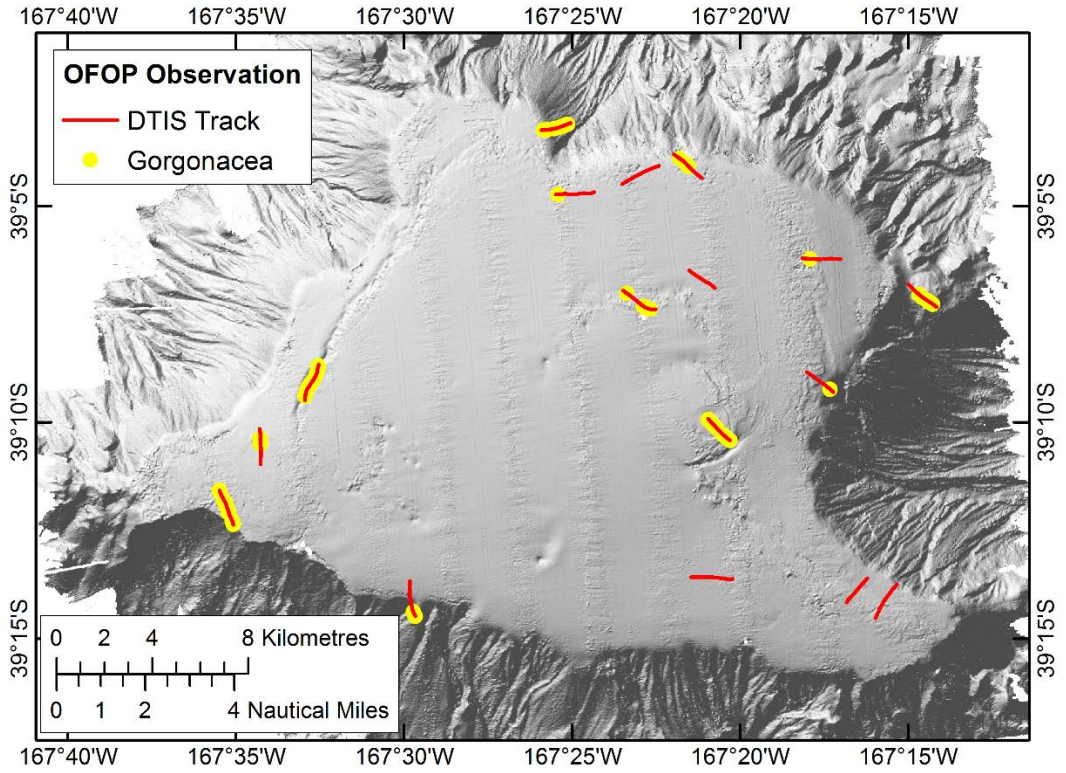

Figure 34: The distribution of gorgonian corals on 39 South Seamount (OFOP data).

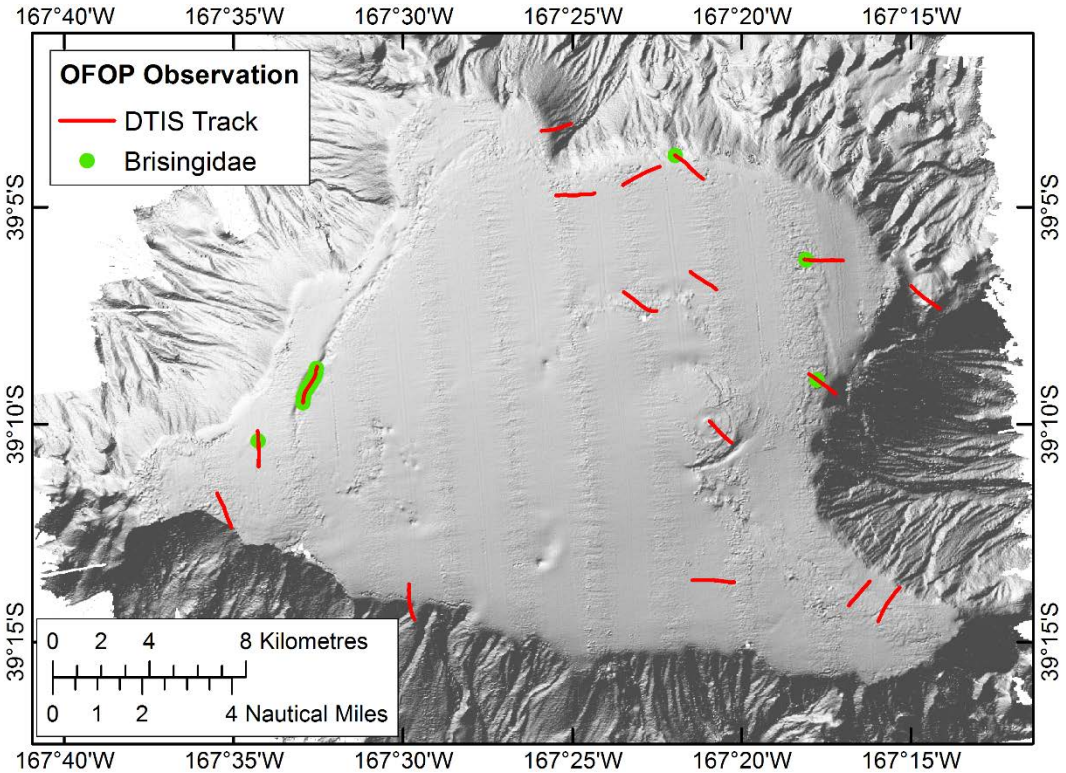

Figure 35: The distribution of brisingid seastars on 39 South Seamount (OFOP data).

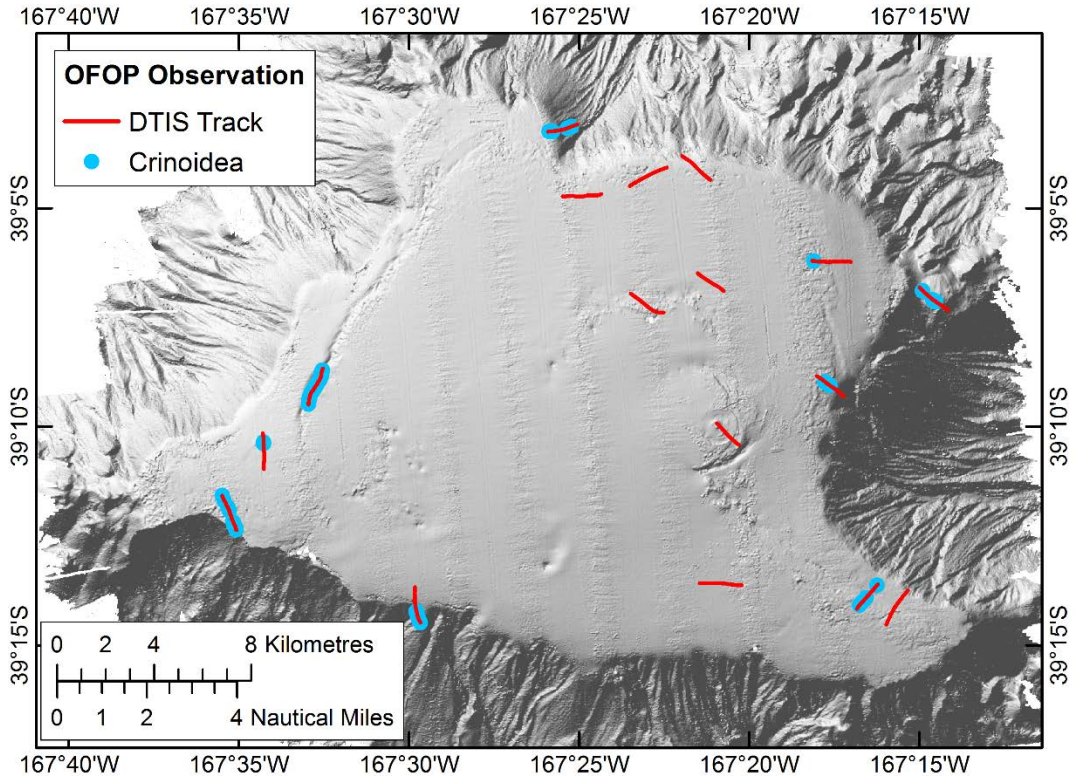

Figure 36: The distribution of crinoids (featherstars) on 39 South Seamount (OFOP data).

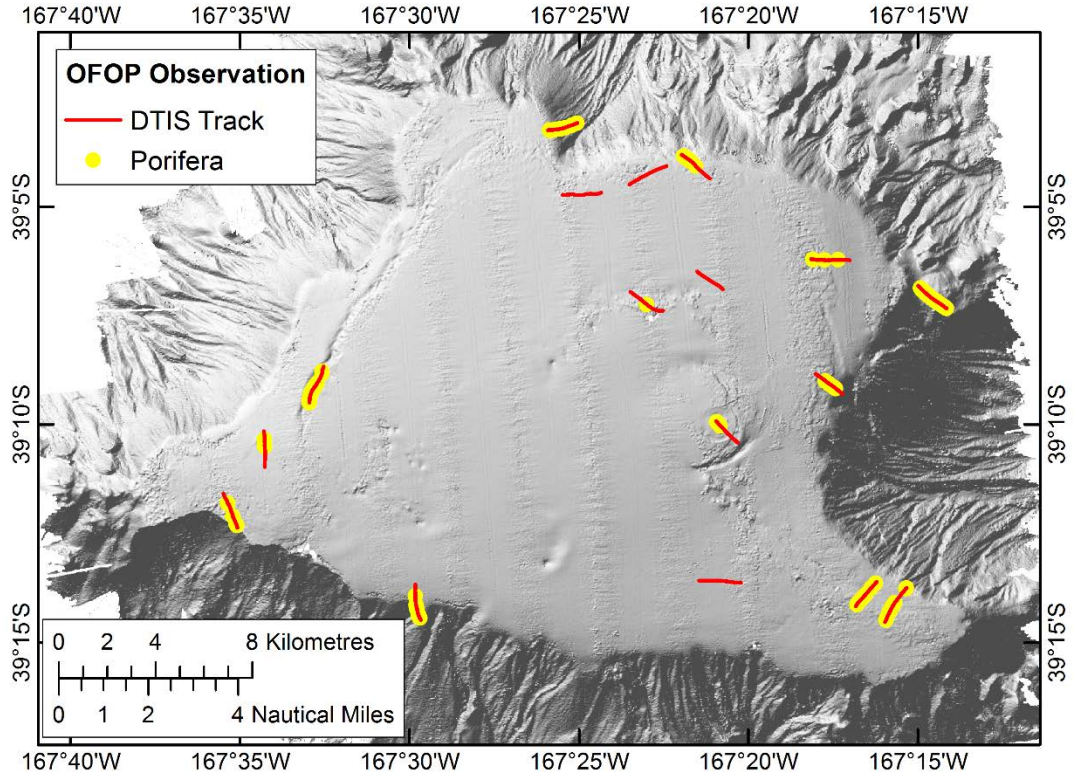

Figure 37: The distribution of Porifera (sponges) on 39 South Seamount (OFOP data).

Ghost Seamount

Sampling sites

The locations of sampling stations on Ghost Seamount are shown in Figure 38.

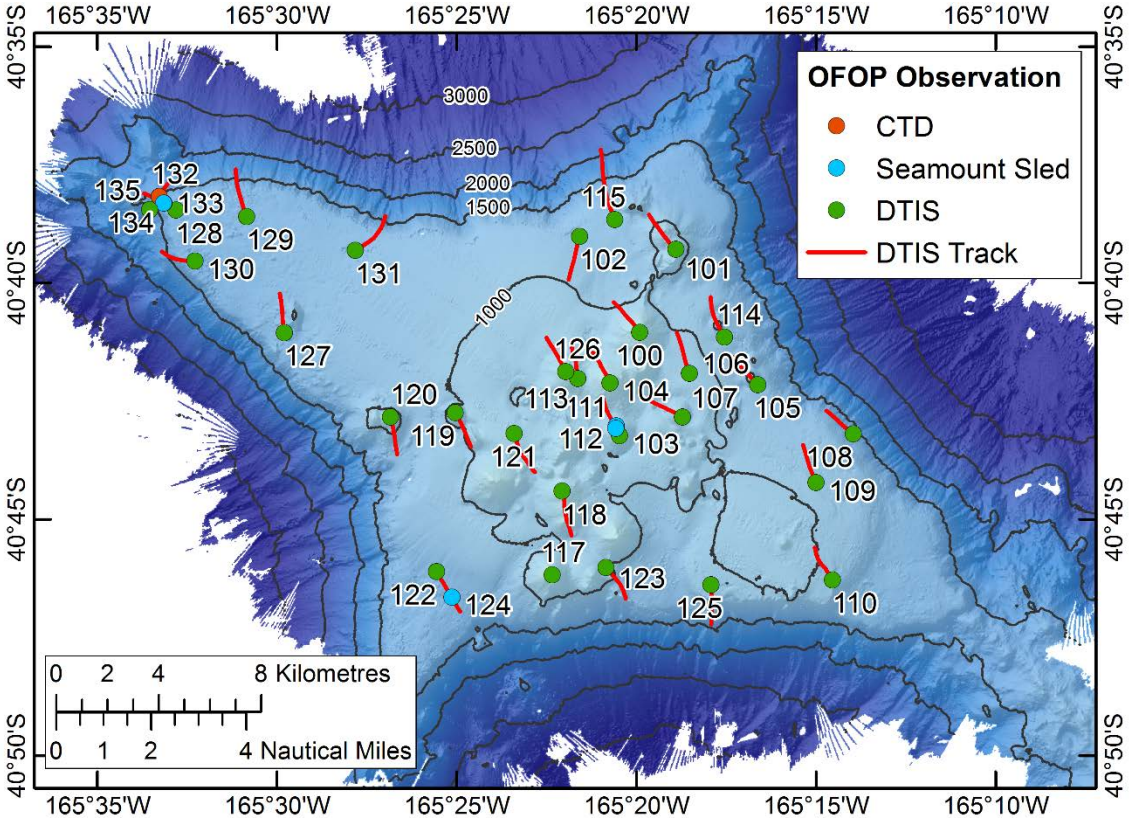

Figure 38: Ghost Seamount, showing the position of DTIS and SEL tows, and CTD cast.

Transect descriptions are detailed in Appendix 7. Selected still images from DTIS which include representative taxa and habitat of this seamount are given in Figure 39.

Ghost Seamount summary

Ghost seamount has a very different structure to the more northern seamounts and guyots. A full multibeam survey revealed a complex structure on the plateau and flanks. 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, with over 2000 bottom trawls recorded.

The hill features generally comprised exposed bedrock, with stony coral rubble. There were isolated patches of intact (dead) stony coral, with brisingids, gorgonian and black corals. Trawl marks were often seen, which is 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 xenophyophores. 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 live stony coral were found, and two stations were classified as having densities consistent with a VME. 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.

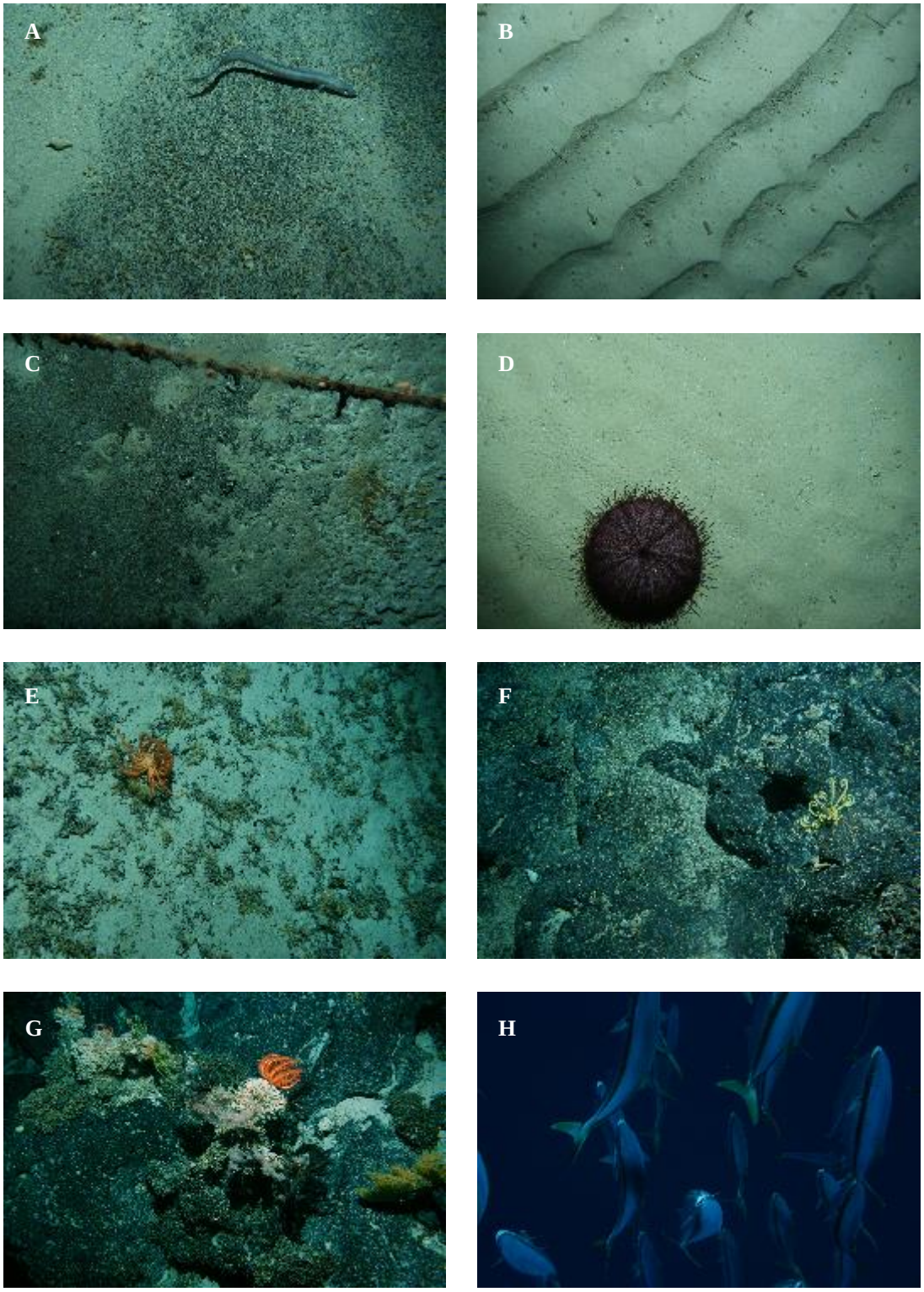

Figure 39: Ghost Seamount. A, conger eel (*Bassanago* sp.) and zoanthid cnidarians at 664 m; B, tube-worms and holothurians (sea cucumbers) at 1100 m; C, trawl warp with attached stony cup corals at 632 m; D, echinothurioid sea urchin (*Sperosoma* sp.) at 984 m; E, brisingid asteroid and zoanthids at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

VME indicator taxa distribution

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

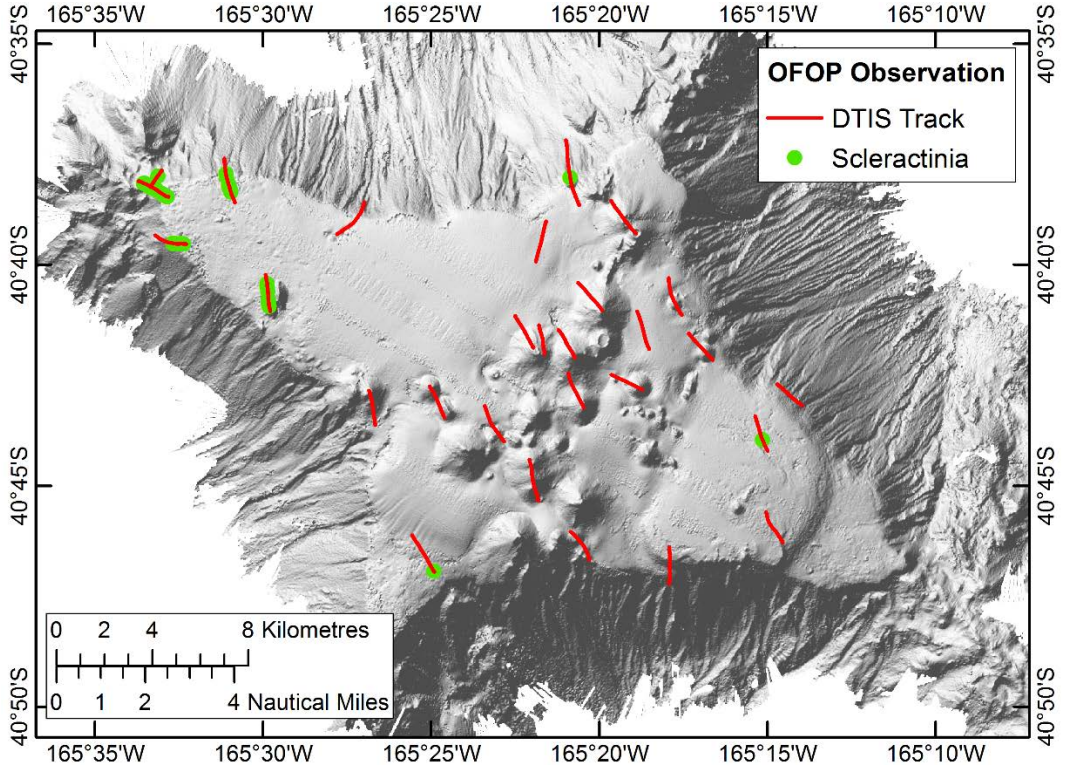

Figure 40: The distribution of scleractinian (stony) corals on Ghost Seamount (OFOP data).

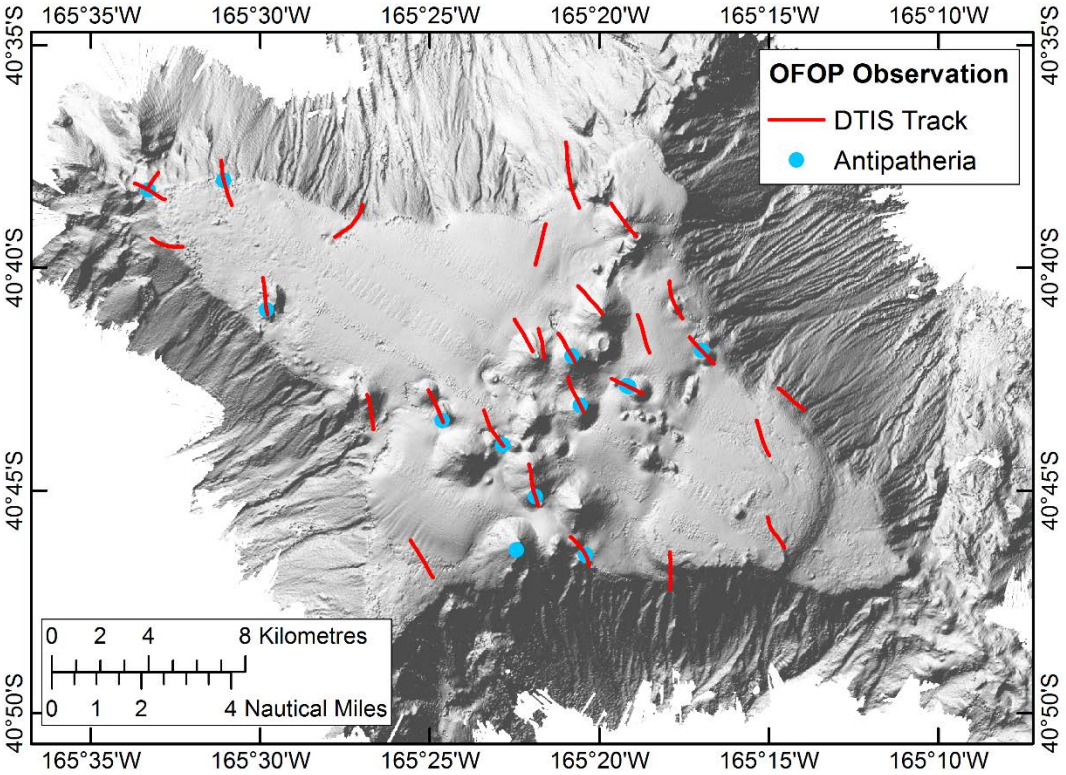

Figure 41: The distribution of antipatherian (black) corals on Ghost Seamount (OFOP data).

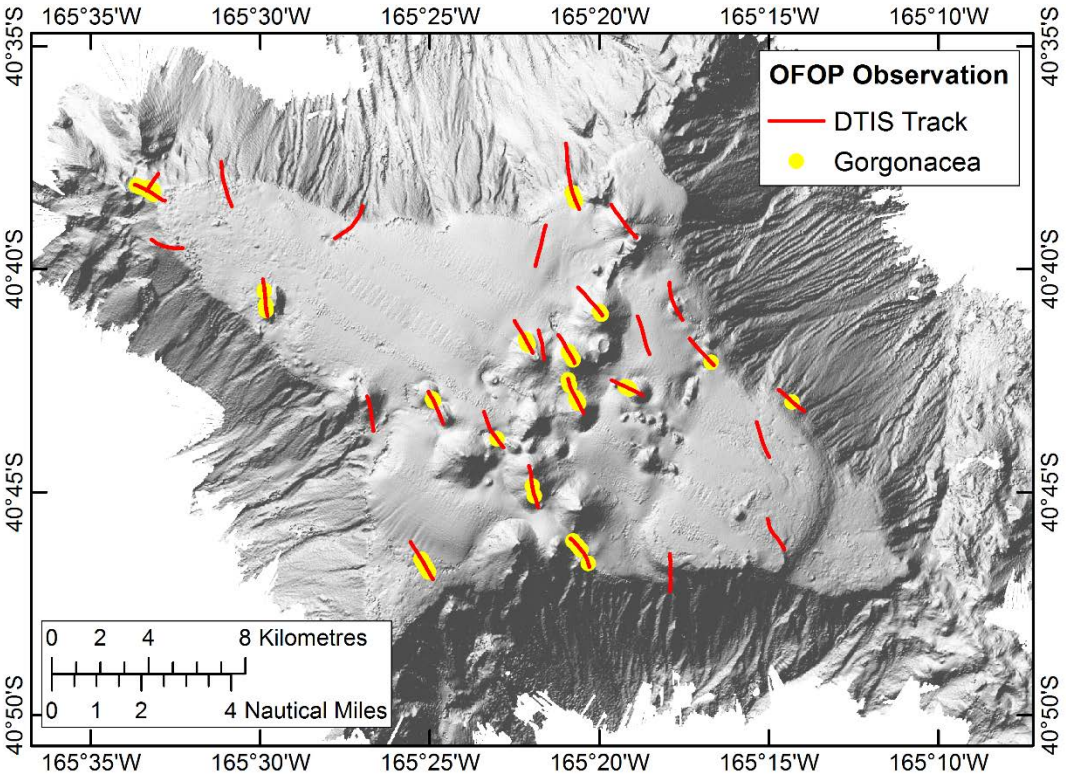

Figure 42: The distribution of gorgonian corals on Ghost Seamount (OFOP data).

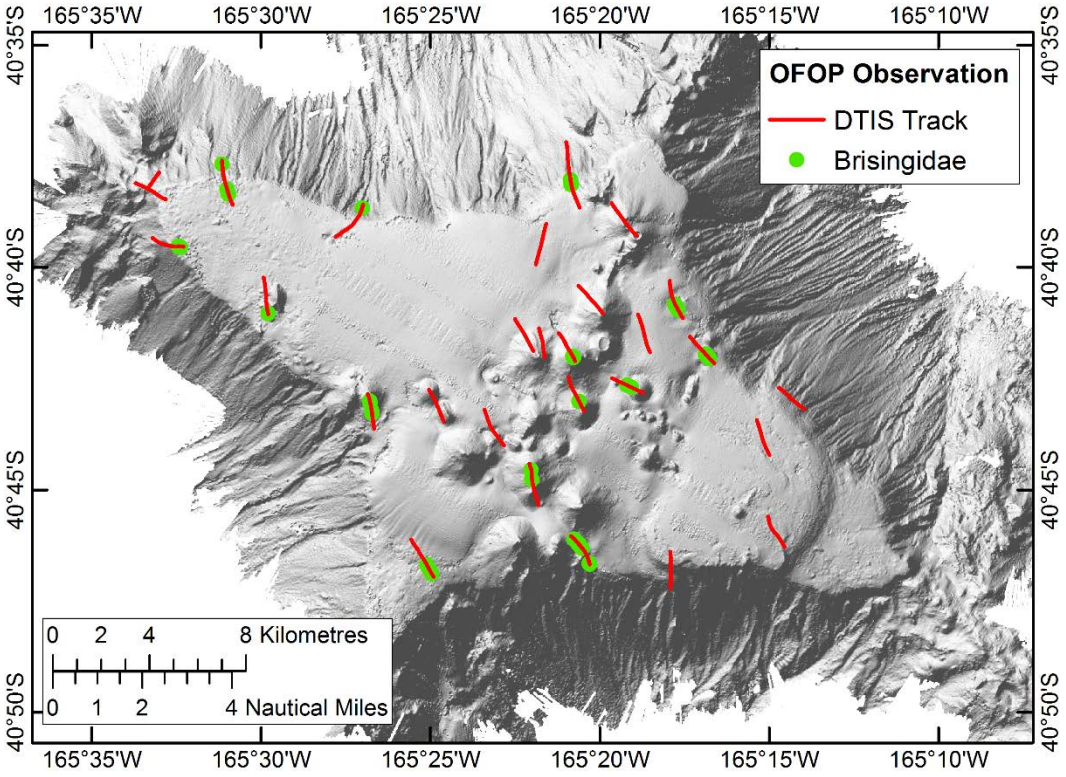

Figure 43: The distribution of brisingid seastars on Ghost Seamount (OFOP data).

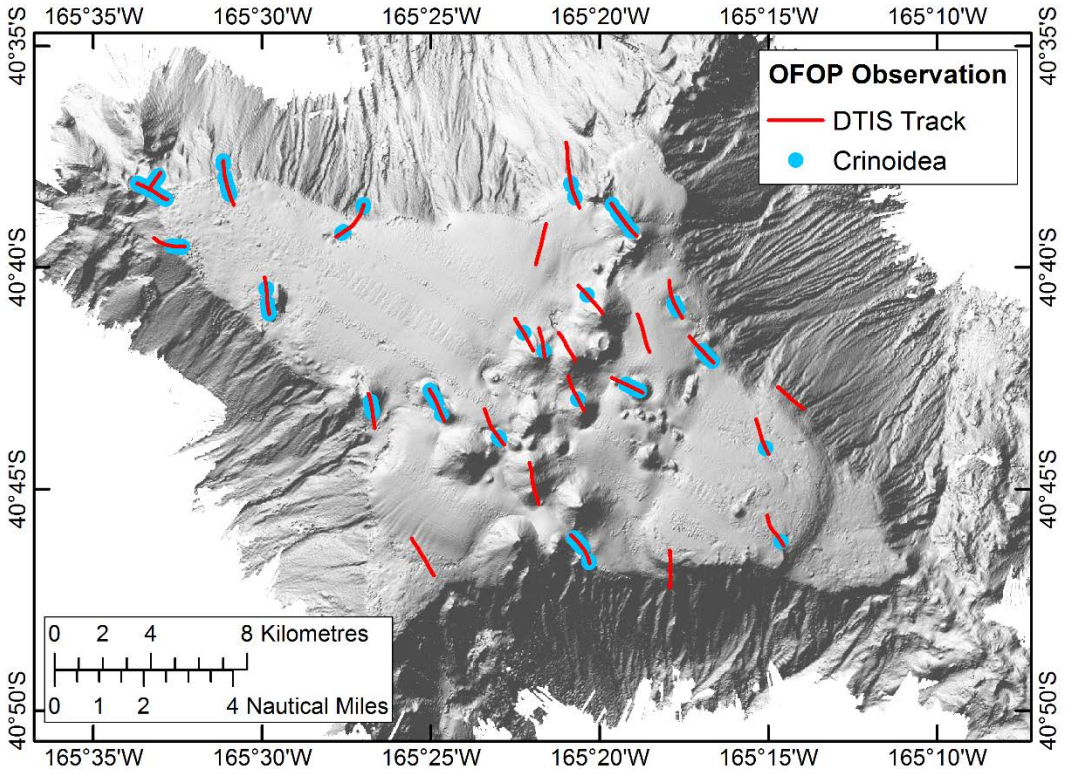

Figure 44: The distribution of crinoids (featherstars) on Ghost Seamount (OFOP data).

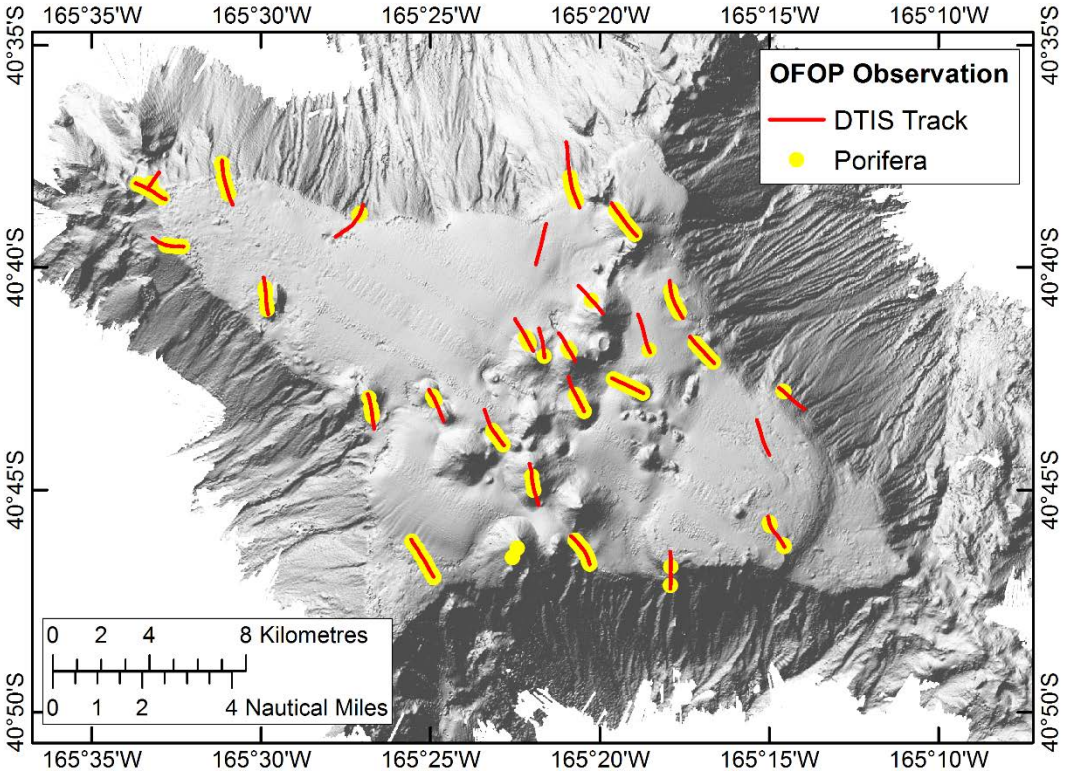

Figure 45: The distribution of Porifera (sponges) on Ghost Seamount (OFOP data).

Valerie Guyot

Sampling sites

The locations of sampling stations on Valerie Guyot are shown in Figure 46.

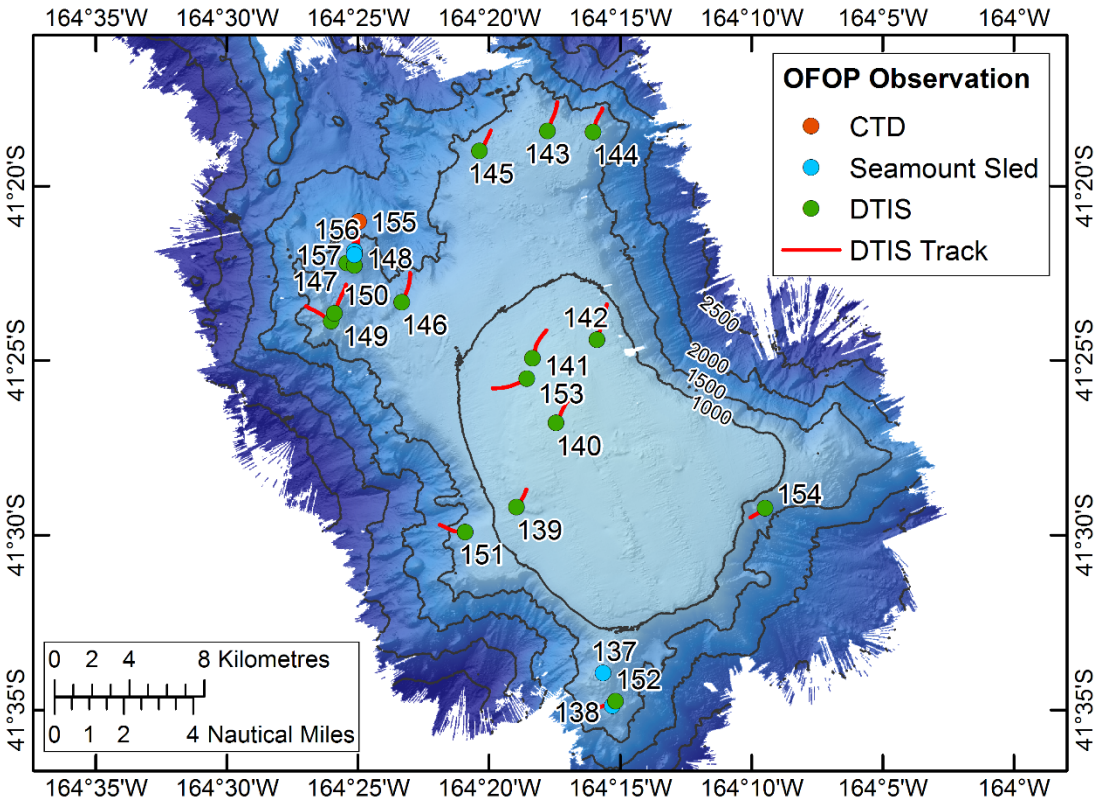

Figure 46: Valerie Guyot, showing the position of DTIS and SEL tows, and a CTD cast.

Transect descriptions are detailed in Appendix 8. Selected still images from DTIS which represent the main taxa of this seamount are given in Figure 47.

Valerie Guyot summary

Valerie Guyot was one of the first of the Louisville Seamount Chain seamounts to be discovered, and was named after the wife of one of the scientific expedition leaders in 1961. It has been trawled with at least 100 tows recorded by New Zealand vessels fishing for orange roughy.

It was fully covered by a multibeam survey which revealed a complex bathymetry. Valerie 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 substratum, with in places large numbers of ophiuroids, and often with pagurids. More of the sampling effort on this seamount was directed at the margins of the summit, and the upper flanks. Live stony coral clumps were observed in many transects, and reached densities consistent with a VME on two small hill features in the northwestern region. Primnoid corals were also dense at one site. Sponges, and crinoids were usually associated with the intact, and live, stony coral. The dense stony coral matrix occurred near the summit of the small hills, varying in depth between 1200 m and 1350 m. The distribution of these corals 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.

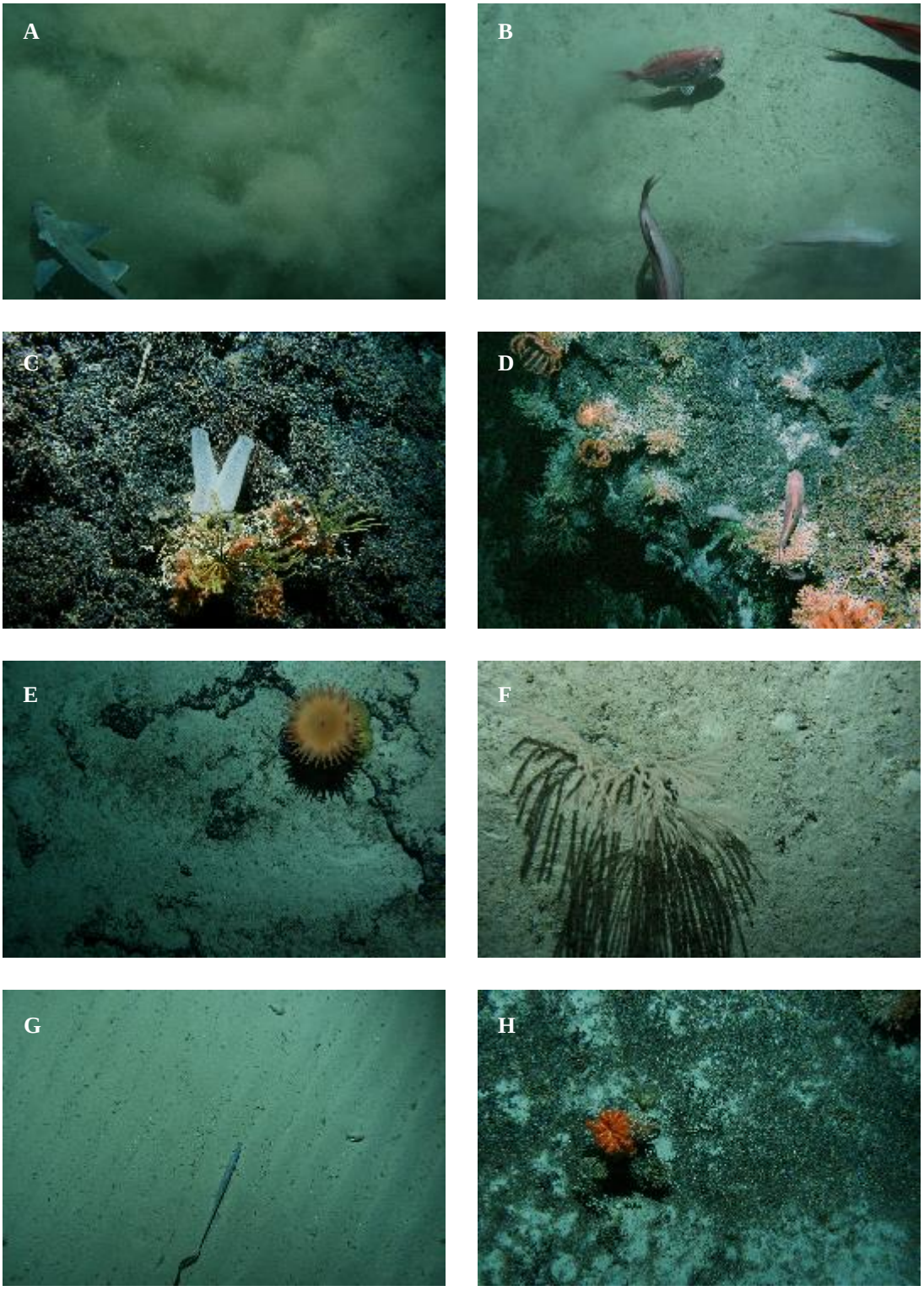

Figure 47: Valerie Guyot. A, giant chimaera (*Chimaera lignaria*) at 858 m; B, orange roughy (*Hoplostethus atlanticus*) at 1106 m; C, sponge, coral, and echinoderms at 1395 m; D, sponges, corals, echinoderms, and orange roughy at 1211 m; E, anemone at 1171 m; F, gorgonian coral at 1254 m; G, common halosaur (*Halosaurus pectoralis*) and ophiuroids (brittle stars) at 887 m; H, brisingid sea-star and crinoids on *Solenosmilia variabilis* coral at 1136 m.

VME indicator taxa distribution

The distribution of some VME indicator taxa along DTIS transects is shown in Figures 48 to 53.

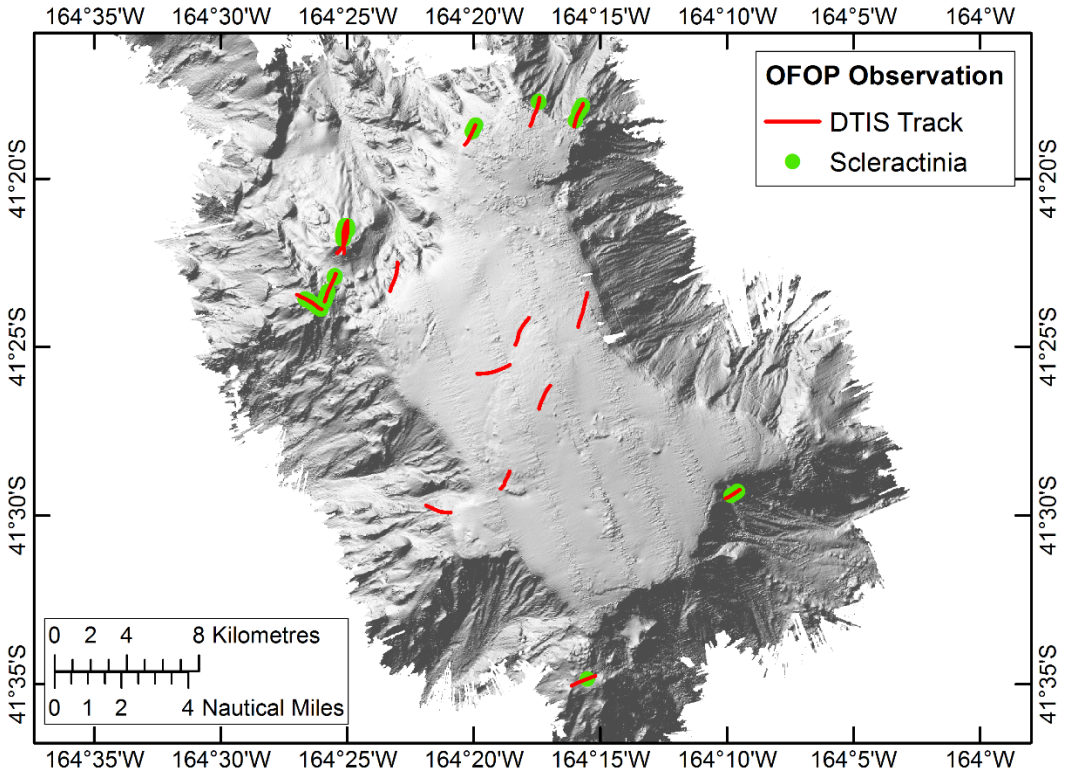

Figure 48: The distribution of scleractinian (stony) corals on Valerie Guyot (OFOP data).

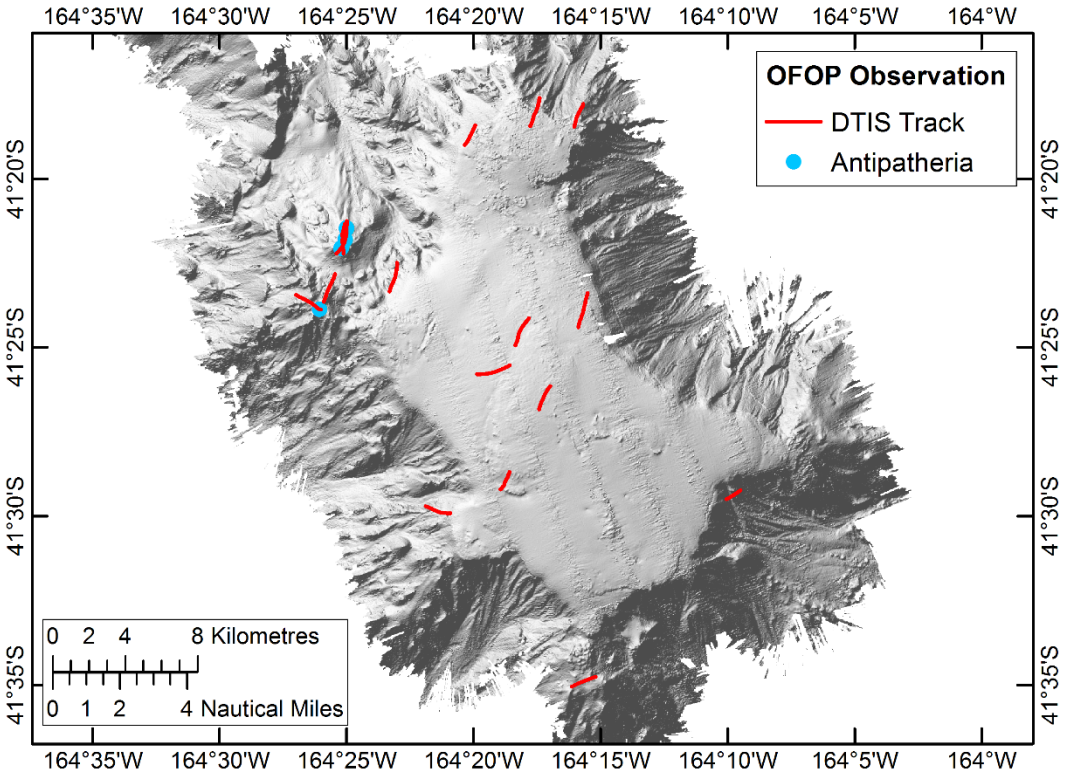

Figure 49: The distribution of antipatherian (black) corals on Valerie Guyot (OFOP data).

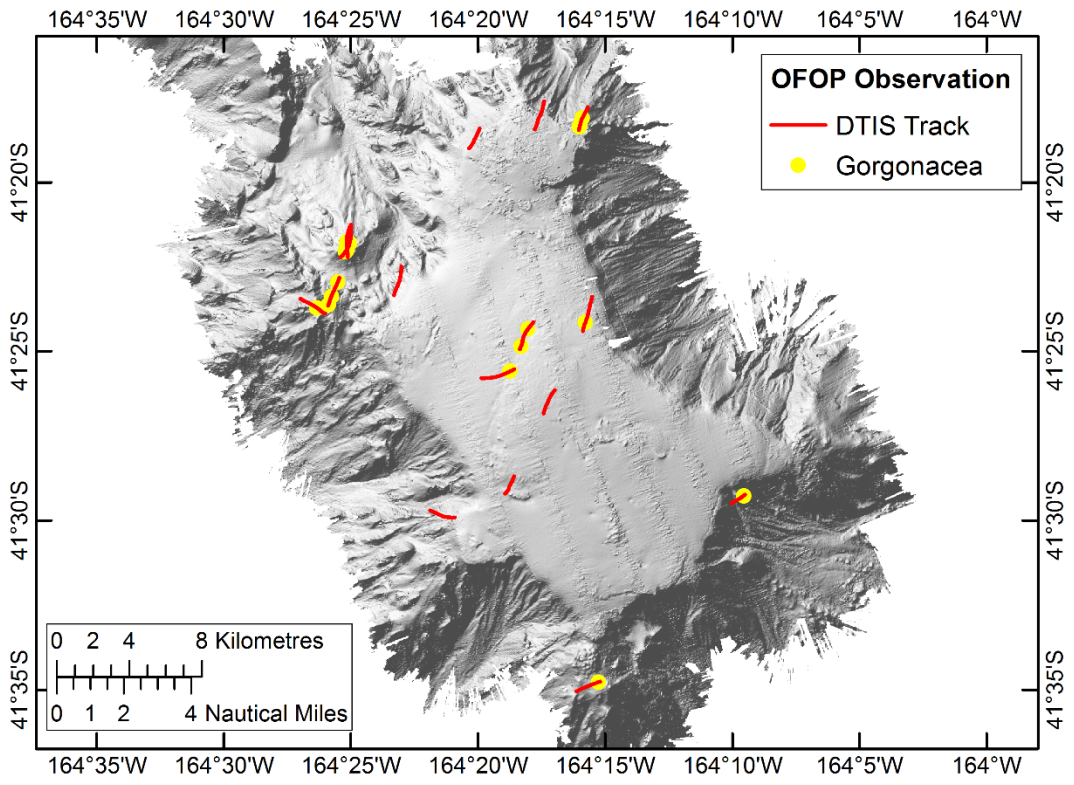

Figure 50: The distribution of gorgonian corals on Valerie Guyot (OFOP data).

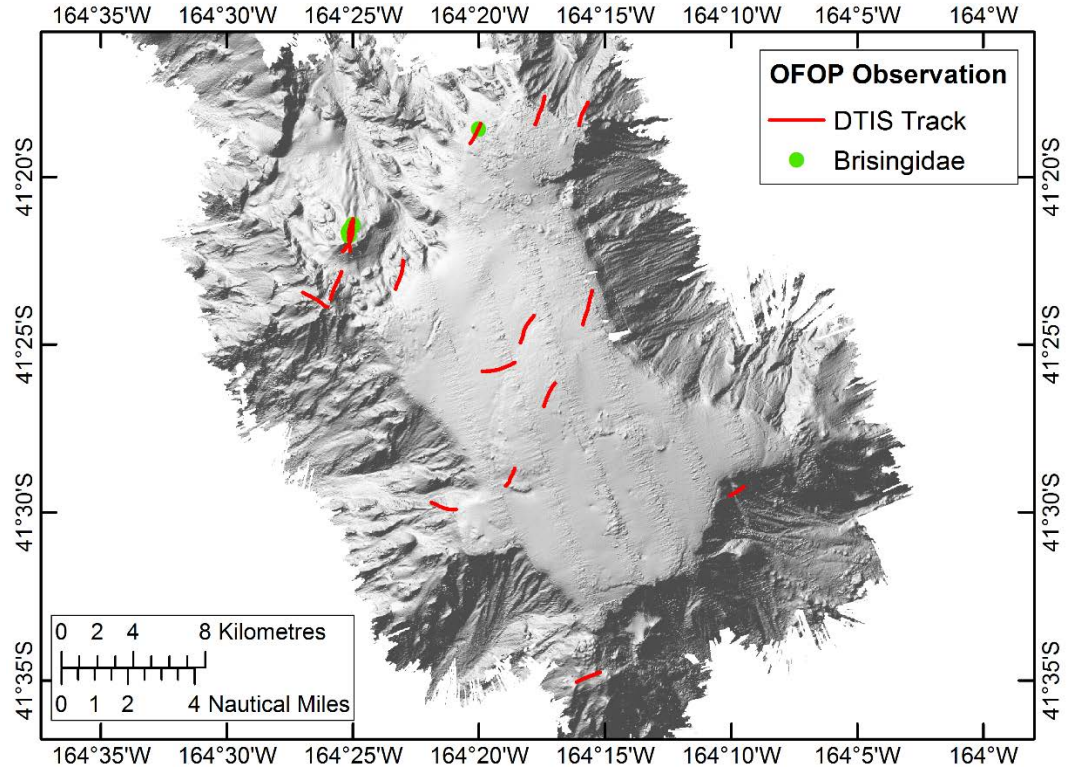

Figure 51: The distribution of brisingid seastars on Valerie Guyot (OFOP data).

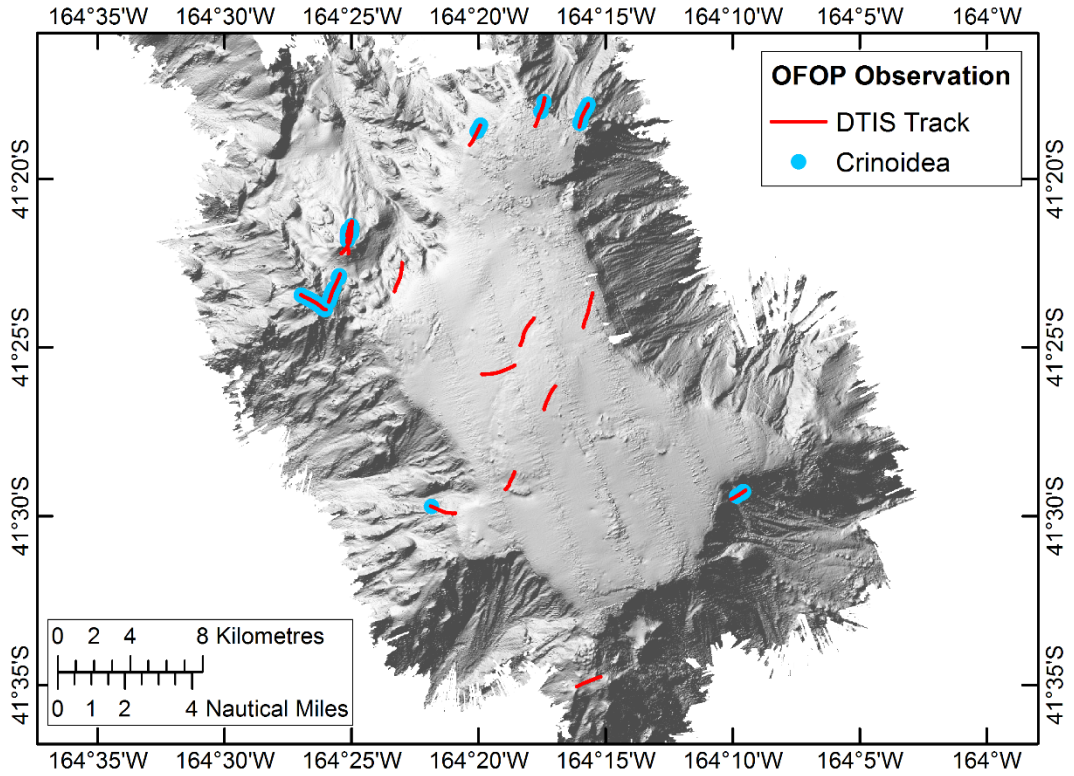

Figure 52: The distribution of crinoids (featherstars) on Valerie Guyot (OFOP data).

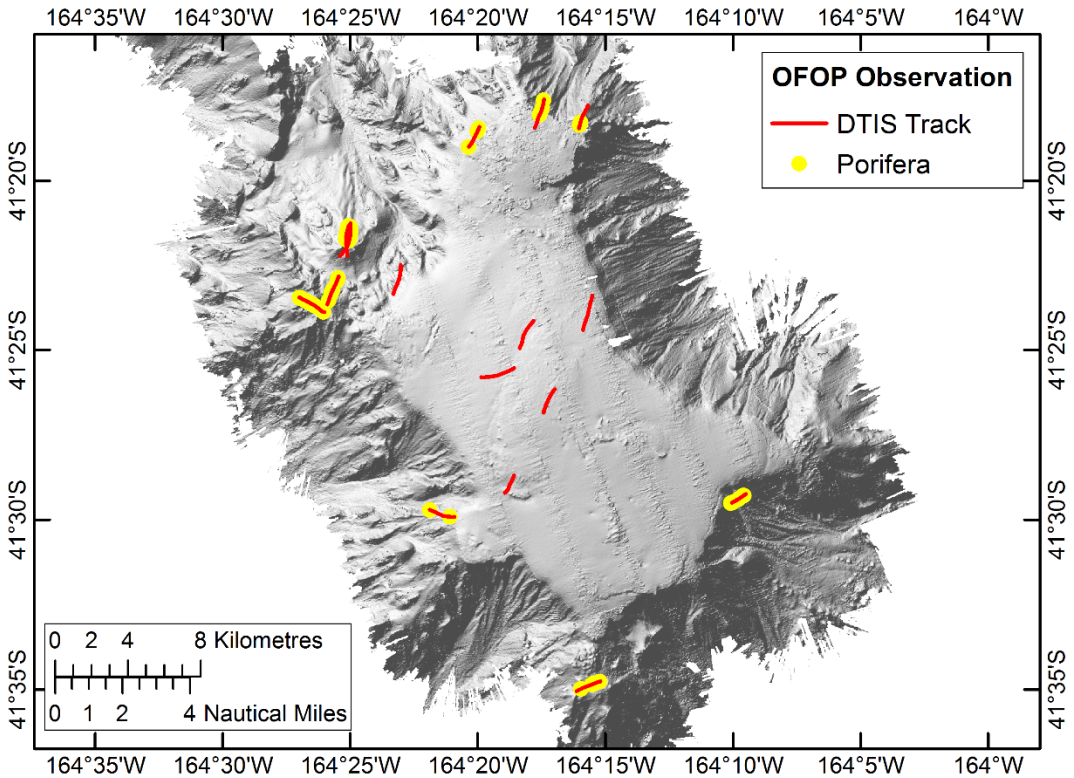

Figure 53: The distribution of Porifera (sponges) on Valerie Guyot (OFOP data).

3.4 Stony coral distribution

The distribution of individual VME indicator taxa have been shown in the sections for each seamount. The main taxon of interest was the Scleractinia or stony corals (only genera with matrix-forming colonies), on which the survey design was based. Small clumps of live stony coral were frequently observed on DTIS transects, but high densities (reaching 15% of image cover, which defines a coral reef/thicket under the EEZ and Continental Shelf (Environmental Effects) Act regulations) were not often recorded (Table 5).

Table 5: Number of DTIS transects, and those on which stony corals were observed and were classified as reaching a density consistent with a coral reef/thicket VME, on each seamount.

Seamount	No. transects	No. transects on which stony corals observed	No. of transects on which coral reef/thicket VMEs observed
Forde	19	11	2
CenSeam	22	6	0
Anvil	12	7	0
39 South	18	6	1
Ghost	28	7	2
Valerie	16	12	2

Preliminary data based on the depth of live stony corals recorded on OFOP show differences among seamounts (Figure 54).

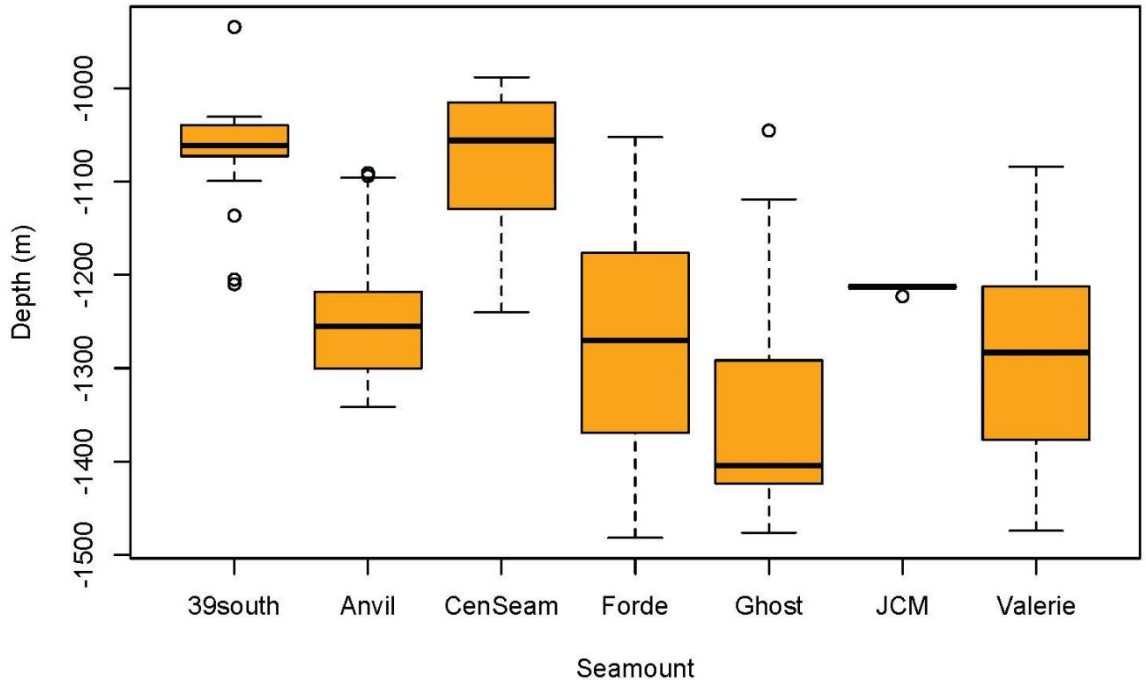

Figure 54: Depth distribution of live scleractinian (stony) corals on the surveyed seamounts. The plot shows the median (bar), upper and lower quartiles (box), and total range (circles).

3.5 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 6, grouped by seamount.

Table 6: List of taxa and number of specimens collected from epibenthic sled and beam trawls during TAN1402. See methods section for site codes. VME indicator taxa are emphasised in bold.

Phylum	Class	Order	Taxon name	39 South	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**

Phylum	Class	Order	Taxon name	39 South	Anvil	CenSeam	Forde	Ghost	Valerie	Grand Total
			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
		Brisingida	**Brisingida**	**1**						**1**
			Brisingidae		**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	*Poriocidaris purpurata*			1				1

Phylum	Class	Order	Taxon name	39 South	Anvil	CenSeam	Forde	Ghost	Valerie	Grand Total
		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 processed at NIWA and elsewhere. Many specimens will require formal identification/confirmation from specialist taxonomists, but below are some observations for selected taxa.

Deep-sea corals

A diverse array of deep-sea corals are found throughout the New Zealand region, most of which are VME indicator taxa. The 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 *Pennatula* spp. The smaller stylasterid hydro corals were observed on bedrock and overhangs. Zoanthids coated some octocorals or were seen in clusters on sandy sediment.

Colonies of live scleractinian coral *Goniocorella dumosa* and *Solenosmilia variabilis* form a branching matrix that is an important habitat for many deep-sea organisms, and provide a refuge for several invertebrate groups and sometimes fish. Colonies were observed growing on bedrock and patches of hard bottom. Multiple colonies extended for hundreds of metres in some areas, in other instances there were only a few small localised patches. Samples of these stony corals were collected for identification, aquaria experiments, genetics, and reproductive studies. The species were difficult to discriminate on board but 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.) This conclusion is corroborated by preliminary results of subsequent genetic analysis (Cong Zeng, Jonathan Gardner, Victoria University of Wellington).

On several seamounts, extensive intact but dead stony coral matrix was observed down the flanks, as well as occasionally on the summits on sandy bottom (Figure 55). In the northern region of the study area it was particularly noticeable that the matrix was covered with a ferro-manganese coating. Such coating takes a long time to form, and this observation suggests that the intact dead coral matrix we observed has been dead for a very long time, perhaps thousands 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 immediately clear what could have caused the coral's demise across such large depth gradients (hundreds of metres) and across the entire study area (hundreds of kilometres), and this question will be the subject of future investigation.

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 (refer Figure 54).

Gorgonian corals are also an important VME indicator taxon. They were variably distributed on the seamounts and guyots of the Louisville Ridge between about 650 and 1500 m depth. From north to south, the species composition varied from the dominance of Chrysogorgiidae (e.g., *Metallogorgia melanotrichos*, *Chrysogorgia* spp., and *Iridogorgia* spp.) to Primnoidae (e.g., *Thouarella* spp., and *Calyptrophora* spp.). The distributions ranged by species, from *Chrysogorgia* spp. occurring on each seamount, *M. melanotrichos* predominantly in the north, and *Iridogorgia* spp., observed up to and including 39 South Seamount. 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 stony 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.

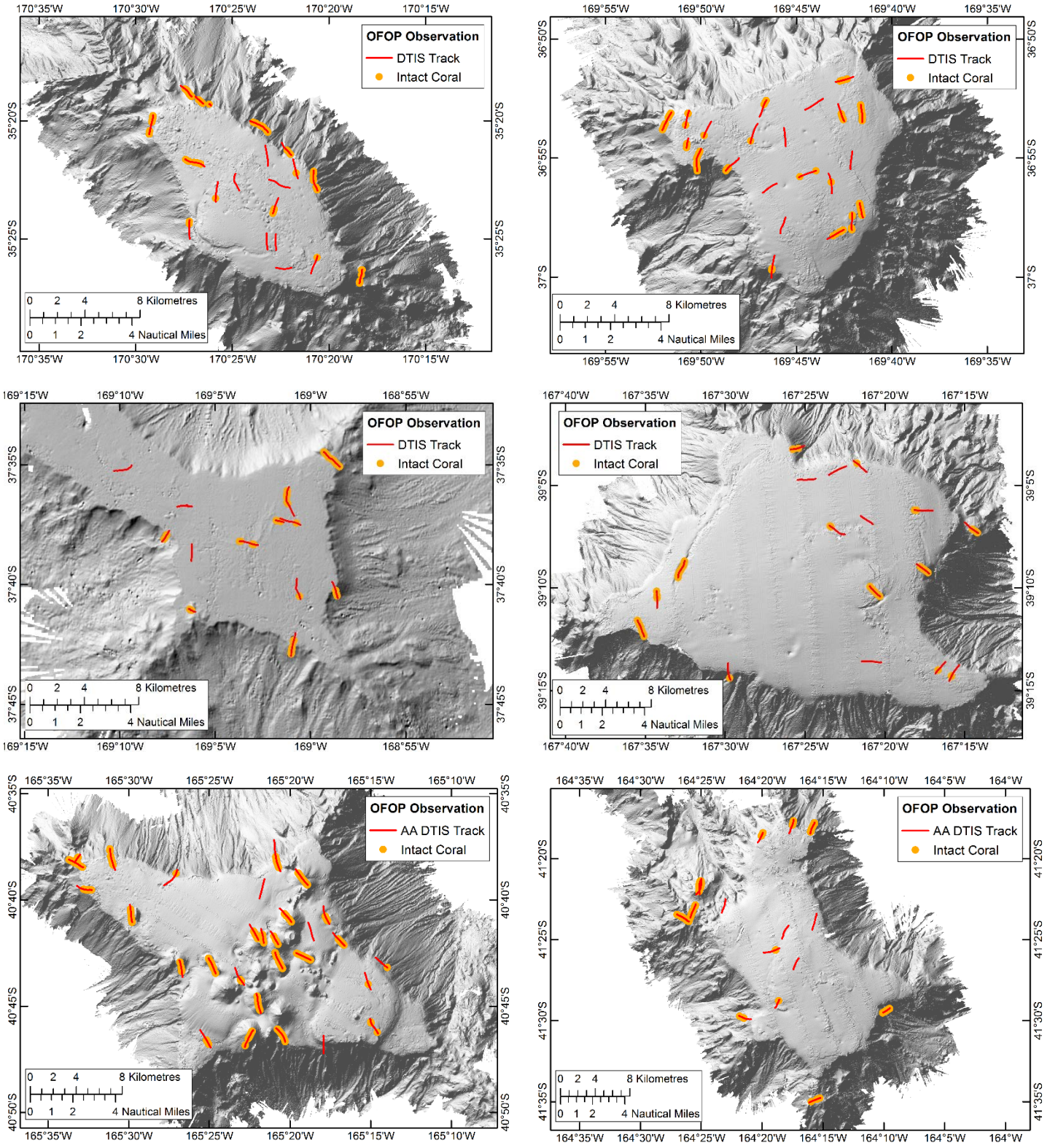

Figure 55: The distribution of intact (but dead) stony coral matrix on the 6 seamounts: Left to right; Forde, CenSeam (top), Anvil, 39 South (middle), Ghost, Valerie (bottom).

A total of 55 specimens of gorgonian corals were collected from the sled tows, with at least one *Chrysogorgia* sp. which may be new to science. Classical and phylogenetic analyses will be carried out to ascertain the taxonomic

status of this specimen, particularly in relation to other Chrysogorgiidae members collected on the seamounts during this voyage, and at other locations.

A bioluminescent bamboo coral *Keratoisis* sp. was discovered at Ghost seamount (Figure 56). Bioluminescence in bamboo corals is a phenomenon first documented in the Hawaiian bamboo coral *Lepidisis olapa* (Muzik 1978). The reasons for its bioluminescence as well as its source (associate microbial communities or host) are as yet uncertain. Sub-samples were preserved specifically for metagenomic and metatranscriptomic analyses to be carried out in collaboration with the Earth Microbiome Project (Argonne, USA and Bishop Museum, USA).

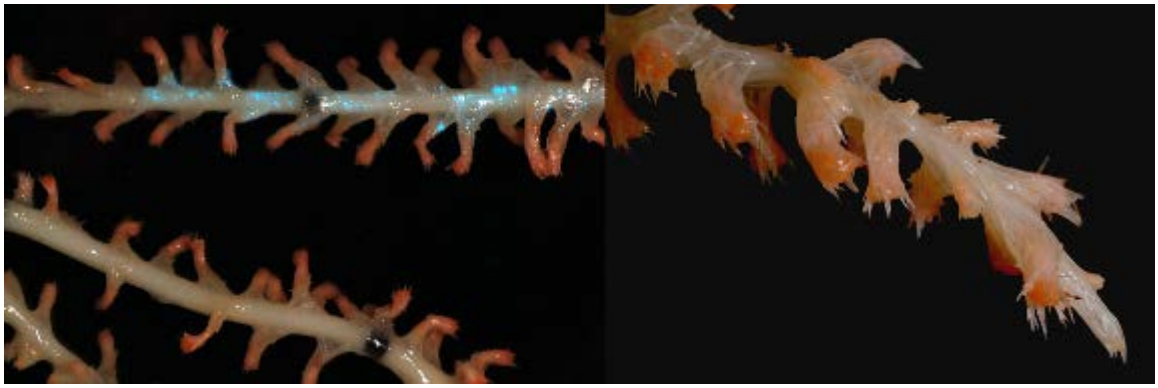

Figure 56. Bioluminescent *Keratoisis* sp., from Ghost Seamount at about 814 m depth

A small, purple soft coral most probably within the family Anthothelidae, was particularly abundant at 39° South Seamount, encrusting both dead intact stony coral matrices and benthic substratum (Figure 57). A similar specimen has also been observed from the North Western Hawaiian Islands, and hence further comparative taxonomic investigations are planned.

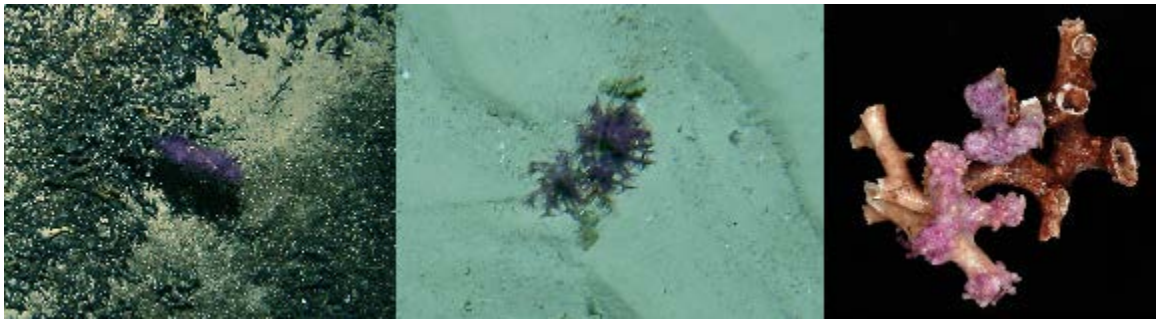

Figure 57: Soft coral located on dead coral rubble and coral matrix at 39° South Seamount, 910m

Coral Associates

VME indicator taxa often occur together, as corals can provide biogenic habitat for other species. A considerable diversity of invertebrate associates were sampled during the voyage. Polychaetes including scale worms were frequently encountered on live scleractinians and gorgonians such as *Thouarella* spp. Brisingid seastars and crinoids were frequently observed on the live scleractinian *S. variabilis.* Such live structures were invariably associated with a range of fauna including glass sponges and gorgonians, as well as certain echinoid species (*Caenopedina porphyrogigas* and *Dermechinus horridus*).

The brittle star *Ophiocreas oedipus* was consistently present on colonies of the gorgonian *Metallogorgia melanotrichos*, which is a well documented obligate association. Numerous ophiuroids were found attached to 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.

The means by which such taxa interact and provide linkages between communities is potentially important for understanding the structure and function of VMEs, and material from this voyage will be investigated further through collaboration between the University of Hawaii, the Bishop Museum, Woods Hole Oceanographic Institution (WHOI), and NIWA.

Sponges

Sponges are a VME indicator taxa, but were not seen in densities that were consistent with sponge gardens (a VME) as defined by the EEZ and Continental Shelf (Environmental Effects) Act regulations. Hexactinellid (or glass) sponges were nonetheless common in the region, and most appeared to belong to the lacey honeycomb families Farreidae and Euretidae. Small ophiuroids were often attached and entwined throughout their honeycomb-like structure (left image of Figure 58). Sponge specimens caught in the epibenthic sled also had had ophiourpids, cup, and branching stony corals in association with the dead framework of *Farrea similaris*, presumably using it as substrate to settle and grow on (right images of Figure 58).

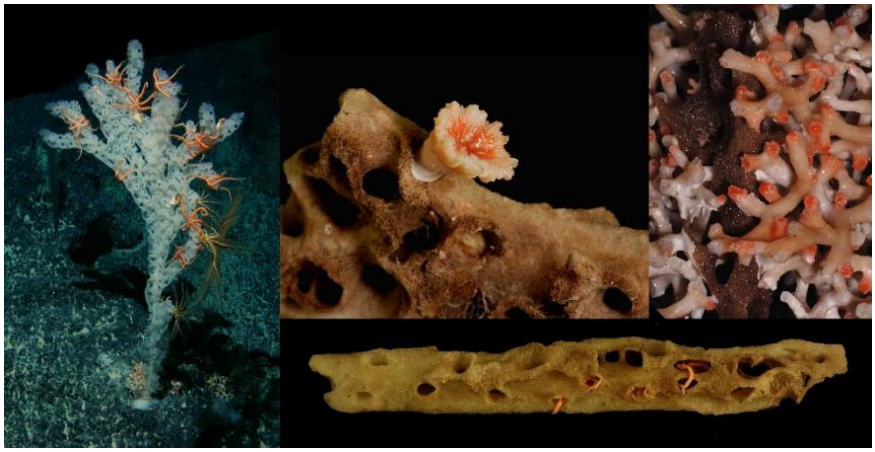

Figure 58: Lacey honeycomb glass sponges (Farreidae/ Euretidae) with associate taxa.

Echinoids

Echinoids are not VME indicator taxa, but are often in association with indicator species, or seamount habitats that the UNGA lists as a VME habitat. They were seen on most of the DTIS transects, with the most commonly observed being the flexible-test echinothurioids. 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 (two *Araeosoma*, one *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 Seamount Chain 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 Seamount Chain.

Because of the close association of these two echinoid species with the sparsely distributed colonies of live coral it is possible that they may be coral predators. 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 echinoid 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 of a range of photographs of taxa and individual specimens are given in Figure 59.

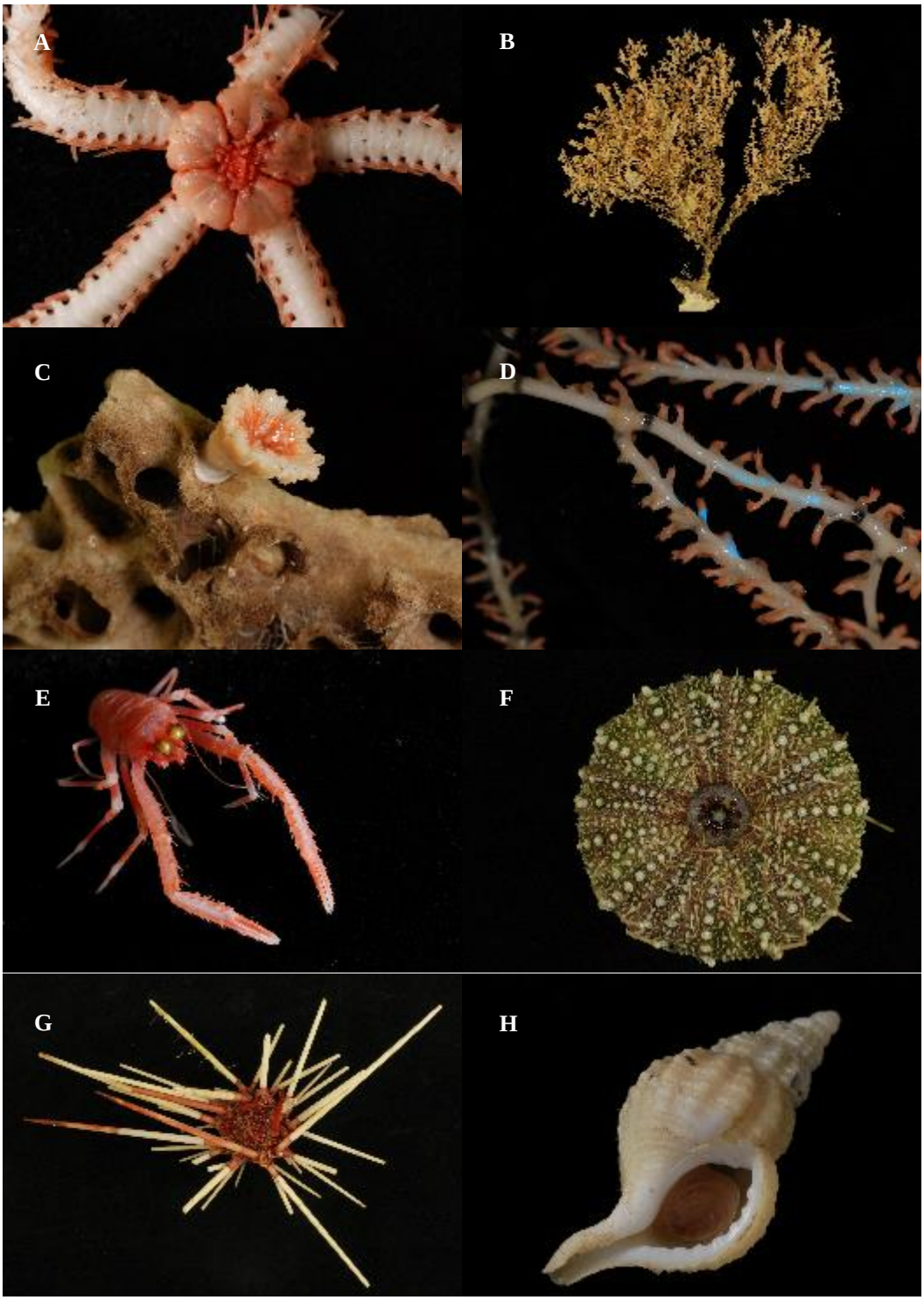

Figure 59: Specimen images. A, ophiuroid; B, gorgonian coral (Primnoidae); C, stony cup coral (*Desmophyllum dianthus*) using the dead framework of a hexactinellid sponge *Farrea similaris* as substrate to settle and grow on; D, bamboo coral *Keratoisis* spp. showing bioluminescence; E, galatheid (squat lobster); F, echinoid *(Gracilechinus multidentatus*); G, cidarid (*Poriocidaris purpuratus*); H, gastropod mollusc.

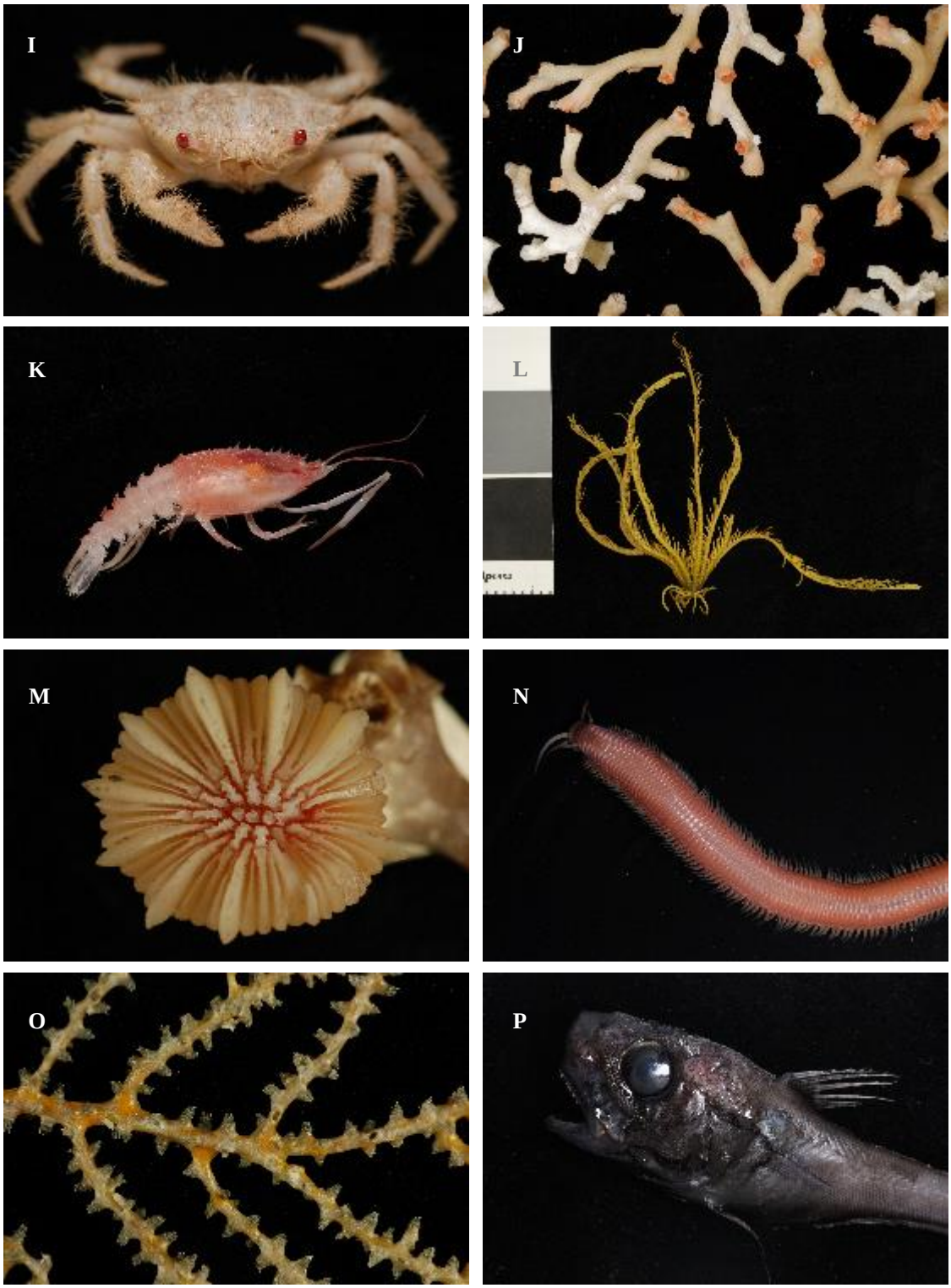

Figure 59: Specimen images—*continued*. I, unidentified crab; J, fragments of scleractinian stony coral matrix (*Goniocorella dumosa*); K, deep-sea blind lobster (*Polycheles* sp.); L, comatulid crinoid; M, carnation cup coral (*Caryophyllia* spp.); N, polychaete worm *(Eunice* sp.); O, plexaurid coral *Paramuricea*; P, globosehead rattail (*Cetonurus crassiceps*).

Live coral collection

Corals were sampled at six stations, from four seamounts: Anvil (station 66), 39 South (stations 91, 97), Ghost (stations 134, 138) and Valerie (Station 156). These were successfully kept alive on board (Figure 60) and subsequently transferred to aquaria at NIWA Greta Point (and they are still alive five months after collection).

Figure 60. Live stony branching corals and other VME related fauna (sponges and crinoids) in situ on Valerie Seamount (left), a live coral colony (centre) about to be placed in the temperature controlled aquarium system on board *Tangaroa* (right).

3.6 CTD and water sampling

Table 7 summarises the CTD station details for each seamount - depth range sampled, number of alkalinity and dissolved inorganic carbon (DIC) samples collected for each depth, and the bottom temperature (^{o}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 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 DO) 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.

Table 7: Summary of water sampling operations.

Seamount	Station no.	Depth range (m)	No. of bottles Alkalinity	DIC	Bottom temp. ^{o}C	Bottom DO ml/l
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

3.7 Seabird observations

Observation were made during 25 days over the course of the voyage, with 2481 sightings of seabirds. Raw sightings data, not standardized to observing effort, yielded a total of 25 species (Table 8).

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

NZ wandering albatross	Masked booby	Westland petrel
Snowy albatross	Southern giant petrel	Grey petrel
Northern royal albatross	Northern giant petrel	Cook's petrel
Southern royal albatross	Grey ternlet	White-necked petrel
Campbell albatross	Long tailed skua	Black winged petrel
Chatham albatross	Arctic skua	Kermadec petrel
Salvin's albatross	Wedge-tailed shearwater	White bellied storm petrel
White-capped albatross	Flesh-footed shearwater	
Southern Buller's albatross	Buller's shearwater	

The number of species differed between seamounts, with the northern seamounts having lower diversity than the more southern ones, especially Ghost (Table 9).

Table 9. Observation times and seabird species numbers by seamount.

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

These data represent a valuable addition to knowledge of regional distributions of seabirds. As an example, Figure 61 shows the distribution of the species combined into higher groups. Petrels dominated at the northern seamount, but progressing southwards, they decreased in frequency, with shearwaters and albatrosses being more common.

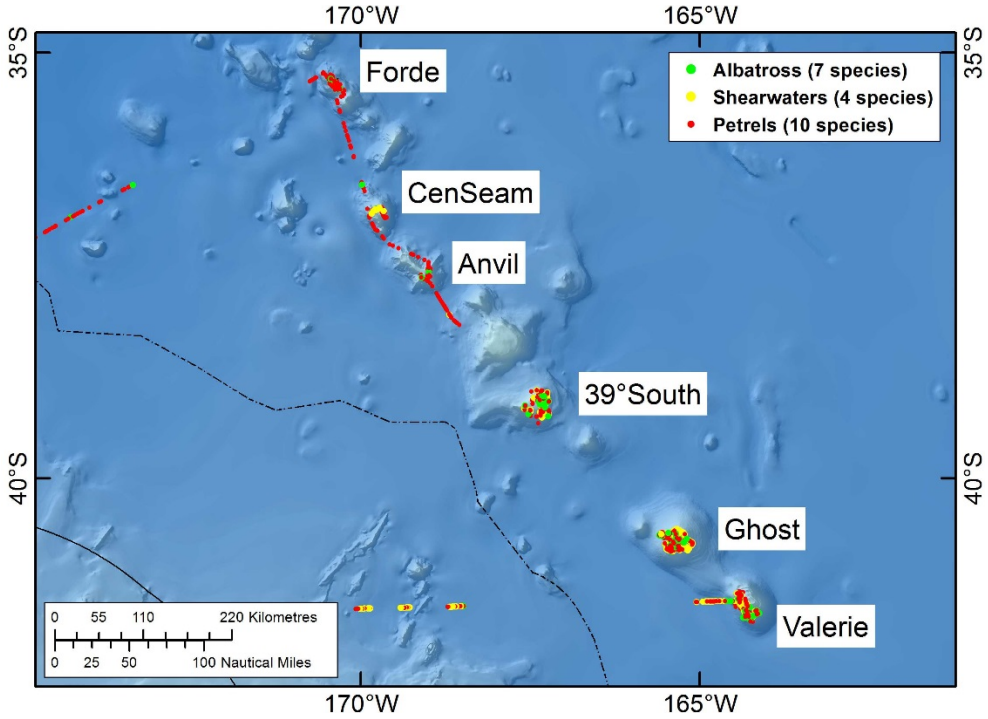

Figure 61: Distribution of observed albatross, shearwaters, and petrels.

3.8 Marine Mammal observations

A total of 10 cetacean sightings were recorded throughout the survey. Only one sighting, of a sperm whale, was recorded in the Louisville Seamount Chain survey area. The other 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 the voyage.

Common name	Scientific name	No. of sightings	No. of Animals
Common dolphins	*Delphinus delphis*	5	141
Pilot whales	*Globicephela sp*	1	12
Sperm whales	*Physeter macrocephalus*	2	2
Like sperm whales	*Physeter macrocephalus*	2	2
Total		10	157

3.9 Bathymetry

Some of the survey area had been mapped prior to the voyage, but five of the six seamounts had to be mapped in order to provide adequate data for sample planning.

During the survey, including transits, more than 10 000 km^2 of Multibeam Echo-Sounder (MBES) data were collected. Both the bathymetry and backscatter signals were processed for the seamount targets, but bathymetry only for the transit lines between seamounts. The later were run at speeds of up to 12 knots and are of moderate quality.

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 12 KHz MBES systems and as a result have horizontal resolutions of 50 m at best, usually 100 m or more. The present survey repeated some of the coverage of these surveys because the 30 KHz MBES on RV *Tangaroa* allows horizontal resolutions of 25 m. The increased detail of seafloor topography was important to the safe and successful deployment of DTIS, as well as an aid to survey design.

3.10 Voyage Web Page

At times during the voyage, blog entries posted by on-board staff were published on the NIWA website. These were not a detailed or official record of the survey, but comprised background information as well as a description of various activities and observations on board.

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

4. DISCUSSION

The survey achieved its objectives. Most strata were sampled on all targeted seamounts, and a large amount of photographic data and specimen samples were collected. These data and samples will be analysed in detail under the South Pacific VME project, and projects associated with it, during the next year.

The survey design was adapted as we learnt more about the actual bathymetry of the seamounts, and the distribution of faunal communities. This modification of the survey plan was not unexpected. Although depth itself was not a variable in either the preliminary BRT or Maxent models, data layers for other environmental factors are based on it. The depth discrepancy caused us to substitute one of the planned seamounts in the northern region,

The selection of sampling sites also changed to an extent during the survey, as we learnt more about the distribution of stony corals and other VME indicator taxa. 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 coral reefs. However, the summit areas of the large guyot structures in the Louisville Seamount Chain, 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) allowed us to 'manually' predict stony coral distribution during the survey. The relatively small spatial scale of the distribution of benthic fauna compared to the availability of data for relatively large-scale environmental predictor variables is a challenge for future modelling. However, the new multibeam and photographic data collected during the survey will be highly informative and progress the next iteration of modelling.

The survey was structured to evaluate the efficacy of habitat suitability modelling based on the presence of VME indicator taxa. However, managers are faced with the need to consider and define what constitutes a VME in absolute terms, not just whether individuals of a species or taxon are present. Whereas it is straightforward to identify the indicator taxa, there is limited guidance on what density or numbers of taxa might be appropriate for identifying a VME based on seafloor images and other biological data (see Bullimore et al. 2013 for issues related to identifying 'coral gardens'). During the survey, we used the definition of a coral reef/thicket according to Schedule 6 of the EEZ and Continental Shelf (Environmental Effects) Act regulations (2013) http://www.legislation.govt.nz/regulation/public/2013/0283/latest/DLM5270660.html). This definition states that a reef/thicket exists if a colony of a structure-forming species covers 15% or more of the seabed in a visual imaging survey of 100 m^2 or more. We interpreted the coverage as being live coral clumps (which can occur within a more extensive dead matrix). During the survey, stony coral VMEs were identified at seven stations; two were in Stratum 1 (where suitable habitat for stony corals was predicted by the preliminary models to occur with a high probability), two were in Stratum 2 (where suitable habitat was predicted to occur with a low probability), and three were in Stratum 4 (where the prediction for suitable habitat was of intermediate probability) (Table 11).

Table 11: Summary of stony coral occurrences by stratum, and number of stony coral VMEs.

Stratum	Stony coral predicted	No. DTIS tows	No. stony corals observed	No. stony coral VMEs
1	Yes	40	19	2
2	No	13	11	2
3	Yes/No	23	2	0
4	Yes/No	29	12	3
5	Yes/No	12	4	0

The greater depth at which the stony corals occurred in the survey area was unexpected. The median depth of *Solenosmilia* on the New Zealand slope and small seamounts is about 1000 m (Tracey et al. 2011), whereas on the Louisville Seamount Chain survey it was 1200–1300 m. The detailed environmental data collected during the voyage will be used to identify what factors may have contributed to this difference. 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 samples of coral taken, and enable evaluation of how this situation may have arisen. For example, a large "die off" could have coincided with a major oceanographic event; or this may be related to the natural process of seamounts slowly getting deeper with age through tectonic movement.

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Information on commercial fishing activity was derived from MPI catch-effort records, as well as from data and discussions with skippers familiar with the seamounts, Chris Healey and Halle Steffensen.

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APPENDIX 1.

TAN1402 voyage timetable and summary of activity log.

Date	Activity log
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 region.
7 Feb	Forde Guyot: Arrive 0930, SVP prior to Multibeam Echo Sounder (MBES) survey. MBES finished 2300.
8 Feb	Forde Guyot: 7 DTIS, 3 sleds
9 Feb	Forde Guyot: 2 DTIS, 1 damaged 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 stony coral 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 RV *Sonne* data.
16 Feb	Anvil Seamount: 8 DTIS, 1 sled.
17 Feb	Anvil Seamount: 4 DTIS, 1 sled. Complete CTD 1340. Head for 39 South, 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 39 South Seamount. 39 South Seamount: SVP. MBES survey of eastern sector 1900. 2 DTIS.
19 Feb	39 South Seamount: 9 DTIS. Weather good, excellent progress.
20 Feb	39 South Seamount: 2 DTIS to complete east side. Sled on small cone. SVP, MBES survey of western side, 7 lines.
21 Feb	39 South Seamount: 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, MBES 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 minutes 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

APPENDIX 2

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, stony 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 stony coral rubble, and some erect (dead). Sparse fauna, some asteroids, 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. 150 kg rock/rubble. Some dead stony coral rubble. Small sample of echinoids, 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, and 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, stony coral rubble, rock outcrops. Intact stony coral matrix in places. Ridge at end-corals, sponges, echinoids.	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, stony 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 stony 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 stony coral rubble, then rocky and dense stony corals. VME density. Need to change over DTIS.	**Y**
14	Forde	SEL	9-Feb	736	35	19.57	170	26.32	w	1137	1154	0.21	45	OK	40 kg coral rubble with some live stony corals, with polychaetes, ophiuroids, *Metallogorgia*, some sponges. 50 kg crusty rock.	
15	Forde	SEL	9-Feb	940	35	20.24	170	26.58	w	1075	1100	0.38	45	OK	15 kg stony 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	44 kg dead stony coral rubble, mainly *Solenosmilia*, 20% cup coral. 0.2 kg 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 stony 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 stony coral on summit and flanks of hill in SE corner of cell.	Y

Stn	Smt	Method	Date	Time	lat_d	lat_min	lon_d	lon_min		s_dep	f_dep	n.mile	dir	Perf	Comments	Live SIA
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 stony coral matrix and live stony coral.	Y
20	Forde	UWC	10-Feb	144	35	25	170	27.21	w	1298	1184	0.78	359	OK	Sandy with stony 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. Scaphopods. Occasional echinoids, asteroid 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, animal tracks, scaphopods. One patch of bedrock with gorgonian corals, some stony 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, scaphopods. Occasional seastars, echinoids. No stony 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 stony 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 stony coral matrix on summit of hill 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 stony 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 stony 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 stony coral (dead), tow north down slope with bedrock, rock outcrops. Some asteroids. Base at 996m with sandy gravel, occasional scaphopods and asteroids.	
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. 15 kg dead *Solenosmilia*. Some crinoids, echinoids, holothurian.	
31	Forde	SEL	11-Feb	937	35	19.01	170	27.09	w	1205	1600	0.64	326	OK	HPR on. 53 kg coral rubble. Some live stony coral. Echinoid, 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 stony coral rubble. Scattered intact stony 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 stony coral. Scattered patches of stony 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, stony coral fragments, few patches intact stony coral. Sparse fauna, scaphopods, 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 1000 m isobath. Rippled sand. Sparse fauna. Scaphopods.	
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 echinoids, gastropods.	
38	CenSeam	UWC	13-Feb	104	36	53.49	169	41.57	w	1011	1019	0.73	356	OK	Sandy-gravel bottom with stony coral rubble. Some rocky outcrops with patches of intact stony coral, mostly dead. One live clump. Scattered sparse fauna.	Y

Stn	Smt	Method	Date	Time	lat_d	lat_min	lon_d	lon_min		s_dep	f_dep	n.mile	dir	Perf	Comments	Live SIA
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 start with some live coral clumps. Scattered tusk shells, sea stars, shark, and 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) stony coral, anemones, asteroids, scaphopods, 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 stony coral rubble. Scaphopods, tracks, burrows. Several echinoids.	
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. Scaphopods, asteroids and echinoids scattered. No stony 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 stony coral 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 stony coral rubble. Sparse fauna including asteroids, gastropods, 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 stony coral rubble and exposed rock. Small heads of intact stony 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 Stratum 2_4. Bedrock and sand with stony coral rubble. On downslope at ca. 1100 m, a few heads of live stony 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. 17 kg rocks, 6 kg stony coral rubble-*Solenosmilia*.	
48	CenSeam	SEL	14-Feb	447	36	53.79	169	51.93	w	1116	1350	0.28	245	OK	18 kg stony 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, scaphopods, some asteroids. Stop recording to extend tow. Restart towards edge. Bedrock, stony coral rubble, intact (dead) coral. High densities echinoids 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. Scaphopods, echinoids, asteroids. Towards end, on upper flanks, dead intact stony coral.	
51	CenSeam	UWC	14-Feb	1256	36	55.53	169	43.96	w	957	949	0.78	248	OK	Rippled sand, scaphopods, animal 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, animal 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, stony coral rubble, and intact stony coral matrix at the plateau edge. Echinoids abundant on rock and coral matrix. Below ca. 1400 m, bare bedrock with *Bathypathes* and *Metallogorgia* corals, and one large *Iridogorgia* specimen recorded in video.	

Stn	Smt	Method	Date	Time	lat_d	lat_min	lon_d	lon_min		s_dep	f_dep	n.mile	dir	Perf	Comments	Live SIA
55	CenSeam	UWC	14-Feb	2339	36	58	169	42.53	w	1045	1054	0.80	239	OK	Tow along 1050 m isobath. Rippled sand overlaying bedrock through most of transect, exposed bedrock common. Areas of stony coral rubble, intact stony coral matrix, and a few apparently live scleractinian coral heads. One orange roughy 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) stony 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. 161 kg stony coral rubble, 40 kg crust rocks, 3 kg sponge, ophiuroids, cidarid echinoid, crab.	
58	CenSeam	CTD	15-Feb	554	36	55.55	169	49.99	w	10	1322	0.00	270	OK	CTD on target site, 1300 m 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. 46 kg stony coral rubble, 23 kg rock, 5 echinoids (*Caenopedina*), sponge, squat lobster, ophiuroids.	
60	Anvil	UWC	15-Feb	1809	37	36.96	169	0.99	w	1191	1225	0.70	342	OK	Rippled sand with white echinoids, then rock with stony coral rubble, intact stony coral matrix and possible live scleractinians. Echinoids on stony 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 stony coral, live heads, echinoids, crinoids, some gorgonians. Over "edge" more bedrock with live stony 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 stony 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. Stony coral rubble throughout, sand, then bedrock. Little intact stony 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 scaphopods. Occasional bouldery outcrops, some localised sponge and intact (?live) stony coral on rocks.	Y

Stn	Smt	Method	Date	Time	lat_d	lat_min	lon_d	lon_min		s_dep	f_dep	n.mile	dir	Perf	Comments	Live SIA
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 stony corals (some live), gorgonian corals, sponges, echinoids. Then level out with rippled sandy bottom, stony coral rubble. Then last part of transect like the beginning, intact stony coral, some live scleractinians, echinoids, sponges, crinoids. Diverse tow.	Y
74	Anvil	SEL	17-Feb	913	37	34.44	168	59.33	w	1275	1380	0.15	137	OK	95 kg rocks, crust and conglomerate. 6 kg stony 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 stony 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 stony 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 39 South.	
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, echinoids, 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, xenophyophores, then bedrock and boulder outcrops, with stony coral rubble, some intact stony coral (dead), occasional sponges and crinoids. 2 small clumps of live stony 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, animal 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, scaphopods on sand; sponge, gorgonian and soft corals, crinoids on rocks. No intact stony 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 scaphopods. Occasional bedrock outcrop, sand covered. No intact stony 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 1600 m. Rippled sand at start, increasing bedrock down slope. One small live stony coral head on sand, Generally sparse fauna but dense echinoid population on outcrop at 1275 m.	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 sea 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 echinoids. 1 live clump of stony coral.	Y

Stn	Smt	Method	Date	Time	lat_d	lat_min	lon_d	lon_min		s_dep	f_dep	n.mile	dir	Perf	Comments	Live SIA
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, echinoids (*Gracelechinus*) and glass sponges.	
91	39south	SEL	20-Feb	800	39	9.86	167	21.01	w	910	934	0.62	139	OK	53 kg rocks, 47 kg coral rubble. 5 kg live material. Diverse corals (*Corallium*, *Thouarella*, *Goniocorella*, primnoids, *Bathypathes*, purple soft corals). Sponges, echinoids, asteroids and ophiouroids, 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 39 South	
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, and 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 stony coral rubble drifts. Scattered but frequent pockets of intact stony coral, clumps of live stony coral, crinoids, 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, scaphopods and worms. Some rocky outcrops, generally bare. Some dead intact stony 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, scaphopods, asteroids, crab, xeniophyophores 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	9 kg stony coral rubble. Small catch of invertebrates, some live *Goniocorella*, gorgonian corals, ophiouroids.	
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	630 m peak. Bedrock/sand overlay, smooth. Extensive stony 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 stony coral, sparse fauna, some 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	Stony coral rubble, intact dead stony 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 613 m. Exposed rock, stony coral rubble, trawl warp and scours. Patch of anemones and brisingids. Scattered gorgonioans, intact (dead) stony 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 stony coral on SE side of hill, patches of brisingids and crinoids. 910 m at summit, stony 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.	

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107	Ghost	UWC	23-Feb	1023	40	42.84	165	18.72	w	837	980	0.78	296	OK	Land on eastern side of hill, tow up towards summit with heavy stony coral rubble, some intact stony coral, and 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 stony coral and stony 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. 59 kg stony 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. 68 kg stony 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 stony 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. Stony coral rubble on flanks, intact stony 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 1090 m with stony coral rubble, intact stony 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 south-western 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 stony coral matrix on friable, pale bedrock at start, becoming stony coral rubble and sand, then dark, smooth bedrock at transect end. Sparse fauna; brisingid stars, asteroids, an echinoid, 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 stony coral matrix, boulders, smooth dark bedrock, sand overlay. Brisingid sea 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 stony coral, stony coral rubble, sand patches. Crinoids, some echinoids, 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. Stony 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 880 m. 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, xenophyophores abundant. Then sparse fauna on hard substrate, bedrock with sandy overlay, occasional sponges, brisingids, one clump of live stony coral.	Y

Stn	Smt	Method	Date	Time	lat_d	lat_min	lon_d	lon_min		s_dep	f_dep	n.mile	dir	Perf	Comments	Live SIA
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 stony 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; echinoids, cerianthids, shrimps, orange roughy, 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. Stony coral rubble at start, intact stony coral on bedrock deeper, with patch of bamboo corals at ~900 m. 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 stony coral matrix and live scleractinian heads in several places. Also *Bathypathes*, 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 stony coral "reef", many live heads along the length of the transect. Interspersed with sand and bedrock, but dominated by stony 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 stony coral, some live heads. Ridge with blocky lava, extensive intact stony 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	Landed on bouldery seafloor, with intact stony 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 stony 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: 81.67 kg stony coral matrix and rock with numerous live stony 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 stony 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 south-western sector of Valerie Guyot	
137	Valerie	SEL	28-Feb	731	41	33.95	164	15.66	w	1060	1061	0.25	76	OK	78 kg stony coral rubble, some sponge, ophiuroids, galatheids. Small amount live stony 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 ophiuroids, galatheids, crabs, sponges. 54 kg rocks.	Y

Stn	Smt	Method	Date	Time	lat_d	lat_min	lon_d	lon_min		s_dep	f_dep	n.mile	dir	Perf	Comments	Live SIA
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, and asteroids. 3-4 m swell, several 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, several 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, several 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 stony coral, some live. Bedrock and sand mix, dense orange roughy at times near drop-off, live stony 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 stony 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 stony coral, live heads, crinoids, brisingids. Quiet again offridge, but on north side 1365-1450 intact stony 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 stony coral and live coral. Gets denser as deepen on north side, extensive 1300-1450m, then fewer 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 stony coral rubble and areas of bedrock. Intact stony coral in places with some live colonies, brisingids and sponges to ~1350m, then sand, bedrock, stony 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 stony coral matrix and some live colonies, brisingids and sponges along west side. Massive outcrop of bedrock at end of transect with extensive intact stony coral and abundant live colonies. Awkward swell, several 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 stony coral matrix at ca. 1450 m. 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 stony coral rubble, some sign of live scleractinia.	Y

Stn	Smt	Method	Date	Time	lat_d	lat_min	lon_d	lon_min		s_dep	f_dep	n.mile	dir	Perf	Comments	Live SIA
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 corals. Sand has frequent gastropods, pagurids, ophiuroids, with asteroids, cerianthids, xenophyophores. 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 stony coral, shell hash. Between 1195 and 1133 at top of ridge, pockets of live stony 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 stony coral patch for species id. 288 kg stony coral rubble, including live Scleractinia, with ophiuroids, crinoids, crabs, sponges, polychaetes. 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, 5 kg. Primnoid coral, a few ophiuroids, asteroids, crustaceans.	

APPENDIX 3:

Individual transect descriptions of Forde Guyot.

Forde: Station 3, Stratum 2
Depth Range: 1005 – 1012 m.
Flat relief mostly sand with ripples. Gravel and course material in the ripples. Two areas of bedrock (lava) with overlying sand and stony coral rubble. Very low abundance of fauna, but occasional asteroids and two majid crabs, and a few rattails.

Forde: Station 4, Stratum 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 stony coral rubble. Frequent animal tracks in sand, occasional echinoids, asteroids, hydroids, sponge and scaphopods. Also chrysogorgid gorgonians (particularly *Metallogorgia*), *Etmopterus* sharks, and sponges towards end.

Forde: Station 5, Stratum 3
Depth Range: 1004 – 1063 m.
Flat sandy bottom. Animal tracks common in sand, some ripples, and burrows. Invertebrates included scaphopods, asteroids, echnoids, and prawns. Some rattails.

Forde: Station 6, Stratum 1
Depth Range: 1080 – 1400 m.
Mix of bedrock with sand overlay, sandy-patches with some coral rubble. Early on, live stony coral and stony coral rubble patches amidst bedrock. Frequent sponges (especially stalked), gorgonians (including *Metallogorgia, Iridogorgia*), black corals and crinoids. A few rattails, sharks, echinoderms on sandy bottom, some faunal tracks and burrows.

Forde: Station 9, Stratum 4
Depth Range: 1110 – 1172 m.
Gradual slope upwards. A mix of bedrock outcrops with sand overlay and stony coral rubble. Other areas of muddy sediments, gravel and stony coral rubble. 'Intact' coral (where colony matrix is extant), with live stony coral patches around 1100m. Frequent crinoids, with gorgonians and echinoids.

Forde: Station 11, Stratum 3
Depth Range: 1038 – 1082 m.
Downhill slope, predominantly soft sand with ripple. Occasional bedrock (lava) outcrops with stony coral rubble and some intact stony coral with brisingids and crinoids. Low abundance of invertebrates on the sand, occasional asteroids and echinoids.

Forde: Station 12, Stratum 1
Depth Range: 1280 – 1374 m.
Bedrock and boulder outcrops, sand patches, stony coral rubble, high rough relief. Numerous crinoids, stalked crinoids, *Bathypathes, Metallogorgia* and gorgonians. Few intact stony corals, some live at the start, some sea pens on sandy patches.

Forde: Station 13, Stratum 1
Depth Range: 1289 – 1382 m.
Bedrock and sandy bottom substrate. Numerous crinoids (stalked and non-stalked). Large sections of stony coral intact/rubble, with frequent live stony coral 'heads' at 1350–80 m. Gorgonians common, particularly *Metallogorgia*, with black corals, stony cup corals, sponges, and a Dumbo octopus. DTIS became snagged at end of tow, free after 1.5 hrs.

Forde: Station 17, Stratum 1
Depth Range: 1154 – 1330 m.
No stills recovered due to camera problem. Summit with sand and coral rubble. Down slope there were bedrock outcrops with areas of intact stony coral, many crinoids, some chrysogorgiids and occasional *Bathypathes*. Patches of sand with stony coral rubble and sand overlay on bedrock. Occasional sea pens.

Forde: Station 18, Stratum 1
Depth Range: 1163 – 1584 m.

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

Forde: Station 19, Stratum 4

Depth Range: 1158 – 1306 m.

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

Forde: Station 20, Stratum 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 1298 m.

Forde: Station 21, Stratum 3

Depth Range: 998 – 1031 m.

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

Forde: Station 22, Stratum 4

Depth Range: 1158 – 1306 m.

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

Forde: Station 23, Stratum 1

Depth Range: 1067 – 1070 m.

All rippled sand, scaphopods, animal tracks, shrimps, asteroids, echinoids, and occasional fish.

Forde: Station 24, Stratum 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 stony coral rubble, intact dead stony coral with abundant crinoids, also on bedrock.

Forde: Station 25, Stratum 2

Depth Range: 1350 – 1443 m.

Traversed over two conical features on the southeast 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. Stony coral rubble and dead stony coral matrix (intact) observed near summit with large aggregations of urchins.

Forde: Station 26, Stratum 1

Depth Range: 1000 – 1022 m.

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

Forde: Station 27, Stratum 2

Depth Range: 1027 – 1073 m.

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

Forde: Station 28, Stratum 3

Depth Range: 945 – 1000 m.

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

APPENDIX 4:

Individual transect descriptions of CenSeam Guyot.

CenSeam: Station 33, Stratum 1
Depth Range: 1036 – 1075 m.
Patches of bedrock with sand overlay, sandy bottom with ripples, gravel – stony coral rubble, occasional dead intact stony coral. Scaphopods, echinoid tests, animal tracks, *Cerianthus*, with occasional intact stony coral on exposed rocks, small live clumps.

CenSeam: Station 34, Stratum 5
Depth Range: 1020 – 1075 m.
Transect upwards along slope, mainly sand and ripples with some stony coral rubble. A few patches of intact dead stony coral matrix. Bedrock mostly barren with a few urchins. No apparent live stony corals observed.

CenSeam: Station 35, Stratum 4
Depth Range: 966 – 978 m.
95% rippled sand cover, only megafauna seen were a few asteroids, scaphopods, and a few fish. Observed a large area of dead stony coral rubble and matrix with no significant epifauna.

CenSeam: Station 36, Stratum 1
Depth Range: 995 – 999 m.
100% rippled sand, very flat, very sparse fauna. Occasional asteroid, ophiuroid, scaphopod, gastropod, rattail.

CenSeam: Station 37, Stratum 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 echinoids.

CenSeam: Station 38, Stratum 2
Depth Range: 1006 – 1018 m.
Flat area, substrate predominately rippled sand plus a mix of stony coral rubble, bedrock outcrops and few patches of intact dead stony coral matrix. A single live stony coral clump.

CenSeam: Station 39, Stratum 2
Depth Range: 982 – 996 m.
Predominantly sand, ripples, several trawl tracks. Occasional live stony coral colonies on bedrock with sand overlay. Scattered typical soft benthic fauna (scaphopods, crinoids, echinoids asteroids, burrows, animal tracks, gastropods, *Cerianthus*, worms.

CenSeam: Station 40, Stratum 4
Depth Range: 1021 – 1052 m.
Flat region, bottom type changing from sand, ripples, shell hash, stony coral rubble, bedrock, sand overlay throughout transect. Some intact dead stony coral, no live. Invertebrates included asteroids, sea pens, scaphopods, urchins, gastropods. Scattered rattails, *Lepidion* and basketwork eel.

CenSeam: Station 41, Stratum 4
Depth Range: 985 – 1077 m.
Flat slope, largely rippled sand. Regular fauna of urchins, asteroids, scaphopods, stony cup-coral, cerianthids, gastropods. Burrows, animal tracks.

CenSeam: Station 42, Stratum 3
Depth Range: 974 – 999 m.
Sandy bottom. Typical benthic soft habitat with animal tracks, burrows, echinoids, asteroids, pagurids, sponge, scaphopods, sea pens, gastropods, zoanthids, *Cerianthus*.

CenSeam: Station 43, Stratum 1
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 stony coral rubble.

CenSeam: Station 44, Stratum 3
Depth Range: 980 – 986 m.

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

CenSeam: Station 45, Stratum 1

Depth Range: 1000 – 1034 m.

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

CenSeam: Station 46, Stratum 2

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 stony coral rubble. Small numbers of crinoids, gorgonians, sponges, with a few areas of intact stony coral, one live clump.

CenSeam: Station 49, Stratum 1

Depth Range: 994 – 1255 m.

For most of transect, sandy bottom, ripples, with bedrock patches. Typical soft sediment epifauna (scaphopods, echinoids, asteroids, animal tracks, burrows, tube worms, cerianthids, gastropods, holothurians, eels, shark. Video was paused for 18 minutes to reach the edge of the plateau. Abundant dead stony coral with dense *Caenopedina* urchins. Scattered primnoids, crinoids, sponges. *Metallogorgia* at very end, with expanses of dead intact stony coral.

CenSeam: Station 50, Stratum 1

Depth Range: 994 – 1117 m.

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

CenSeam: Station 51, Stratum 2

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: Station 52, Stratum 3

Depth Range: 959 – 967 m.

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

CenSeam: Station 53, Stratum 1

Depth Range: 976 – 981 m.

Transect totally sandy bottom, very few animals observed.

CenSeam: Station 54, Stratum 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: Station 55, Stratum 5

Depth Range: 1029 – 1054 m.

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

CenSeam: Station 56, Stratum 4

Depth Range: 950 – 1009 m.

This transect targeted an unusual mark near the seafloor on the single-beam echo-sounder. Sandy substratum initially, changing to dominant stony coral rubble and intact (all dead). Scaphopods on sand at beginning, echinoids, gastropods. Then brisingid and crinoids. Short transect.

APPENDIX 5:

Individual transect descriptions of Anvil Seamount.

Anvil: Station 60, Stratum 1
Depth Range: 1189 – 1205 m.
Gentle downhill slope, rippled sand with white cobbles. Then change to patches of exposed bedrock, stony coral rubble with live stony coral matrix. Abundant echinoids, crinoids and brisingids on live stony corals.

Anvil: Station 61, Stratum 1
Depth Range: 1138 – 1152 m.
Flat, all rippled sand, low epifaunal abundance and diversity, *Gracilechinus* echinoids, some asteroids, and scaphopods.

Anvil: Station 62, Stratum 4
Depth Range: 1135 – 1142 m.
100% rippled sand, a few echinoids and fish. Sparse fauna.

Anvil: Station 63, Stratum 1
Depth Range: 1230 – 1418 m.
Initially sand, changing to bedrock, stony coral rubble and intact stony coral patches. Bedrock with stony coral clumps, with gorgonians and crinoids. Solitary gorgonians, black coral, with patches of denser sponges and echinoids. Echinoids, gastropods, sea pens, asteroids on soft sediment. No real-time OFOP position data from this station until computer problem fixed station 81.

Anvil: Station 64, Stratum 1
Depth Range: 1237 – 1495 m.
First half of transect dominated by sandy bottom with many echinoids (*Gracilechinus)*, asteroids and sponges. Then intermittent bedrock or sand and ripples, with stony coral clumps (some live) with echinoids (*Dermechinus)*. Diverse scattered gorgonians, black coral, sponges, crinoids. 1300 m on bedrock clumps of gorgonians (*Chrysogorgia* and cf. *Corallium*). Then drops away into dead stony coral zone, with echinoids and scattered gorgonians. No real-time OFOP position data.

Anvil: Station 65, Stratum 3
Depth Range: 1171 – 1192 m.
Sandy fine grained bottom. Benthic fauna largely echinoid *Gracilechinus*, asteroids, some rattalis. At 1182 m bedrock, with sand overlay. Dead intact stony coral and rubble with some fish, scaphopods and sharks. Sandy bottom from 1200m. No real-time OFOP position data.

Anvil: Station 67, Stratum 5
Depth Range: 1047 – 1104 m.
Moved down slope over a previously fished area. Bottom comprised sand and stony coral rubble with several patches of exposed bedrock. Areas of low flat bedrock with sandy overlay, occasional black coral (*Bathypathes)*, echinoids (*Dermechinus*), gorgonians, stylasterids, crinoids, *Chaceon* crab and orange roughy. Expanses of dead stony coral rubble and sand between bedrock areas. No real-time OFOP position data.

Anvil: Station 68, Stratum 1
Depth Range: 1162 – 1528 m.
Flat sand for the first 15 minutes, 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: Station 69, Stratum 2
Depth Range: 1203 – 1196 m.
Rippled sand sediment with ripples, and occasional echinoid. Generally very low abundance and diversity of invertebrates.

Anvil: Station 70, Stratum4
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: Station 71, Stratum 3
Depth Range: 1150 – 1153 m.
Initially sand, ripples with mixed bedrock, boulders, intact and stony coral rubble. Some sponges, crabs, eel, shark and rattail. After 13 minutes, DTIS gets snagged, connection lost, transect aborted.
Anvil: Station 72, Stratum 3
Depth Range: 1157 – 1179 m.
Continuation of previous transect (Station71). Sandy with gravel overlay and more prominent ripples indicative of a stronger bottom current. Echinoids (*Gracilechinus*), scaphopods, 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 shell 'hash' (dead shells).
Anvil: Station 73, Stratum 2
Depth Range: 1285 – 1389 m.
Summit of Anvil. Start at 1285 m, over top at 1280 m, with bedrock outcrops, and intact stony coral (live), gorgonians, flute-like glass sponges, echinoids and crinoids. Undulating bottom with regions of sand, ripples, cobbles, pebbles, and gravel-like sediment. From 1350 m, dead intact stony coral, with black coral. Heading back up slope bedrock, sandy overlay, intact stony coral and rubble, with stony coral clumps, crinoids, echinoids and sponges.

APPENDIX 6:

Individual transect descriptions of 39 South Seamount.

39º South: Station 78, Stratum 4
Depth Range: 1081 – 1105 m.
Flat sandy substratum with some stony cup corals, cerianthids, xenophyophores and animal tracks.
39º South: Station 79, Stratum 1
Depth Range: 1236 – 1269 m.
Predominantly sand with animal tracks, some intermittent bedrock with occasional glass sponges. Some intact dead stony coral on bedrock halfway through, and small amounts at end. Sparse fauna.
39º South: Station 80, Stratum 4
Depth Range: 1197 – 1222 m.
Gradual slope, mixed substratum types: rippled sand and bedrock outcrops. Rocks were generally barren except for a few anemones, sponges, crinoids, asteroids and echinoids. Two clumps of stony coral, possibly live.
39º South: Station 81, Stratum 1
Depth Range: 1052 – 1241 m.
Sandy bottom, intermittent bedrock with sandy overlay. Usual array of worms, scaphopods, gastropods, animal tracks and burrows in soft sediment. Occasional anemones, natant decapods, asteroids, sponge, xenophyophores, black corals. Scattered fishes, a basketwork eel, morid, shark, and rattails. Some stony coral rubble, and a clump of live stony coral at about 1100 m.
39º South: Station 82, Stratum 3
Depth Range: 961 – 969 m.
Transect entirely sandy, with ripples. Typical epifauna including gastropods, scaphopods, small ophiouroids, cerianthids, worms, echinoids.
39º South: Station 83, Stratum 4
Depth Range: 900 – 930 m.
Flat bottom. Sand ripples interspersed with patches of boulders, bedrock. Animal tracks, burrows, some worms and gastropods. Some extensive areas of stony 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 fish belonging to the Chaunacidae.
39º South: Station 84, Stratum 1
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 scaphopods and gastropods.
39º South: Station 85, Stratum 5
Depth Range: 983 – 1012 m.
100% sandy rippled, with very occasional asteroids, cerianthids, several xenophiophores.
39º South: Station 86, Stratum 5
Depth Range: 1136 – 1605 m.
Steeper slope with a 500 m descent, substratum was a combination of rippled sand and barren bedrock beds and outcrops. Observed a few small gorgonians, sponges and a small clump of live stony coral matrix. Abundant intact dead stony coral as well as echinoids on bedrock. Gorgonian corals (*Metallogorgia)* and soft corals (*Anthomastus)* present.
39º South: Station 87, Stratum 3
Depth Range: 983 – 995 m.
Virtually flat seafloor with sand and ripples. Very occasional asteroids, gorgonians, gastropods and xenophyophores. One *Lithodes* crab. No bedrock, stony coral rubble or stony coral.
39º South: Station 88, Stratum 5
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.

39º South: Station 89, Stratum 4

Depth Range: 899 – 950 m.

Initially sand, with some rubble and ripples, then bedrock with gorgonian coral (*Paragorgia*, primnoids, *Iridogorgia*), black coral, stony cup corals, Stony corals attached to toppled/collapsed Paragorgia). Transect mostly sand with intermittent bedrock, sand overlay, stony coral rubble and occasional intact dead stony coral. On soft sediment, benthic fauna include echnioids, stylasterids, worms, scaphopods, and gastropods.

39º South: Station 90, stratum 4

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.

39º South: Station 93, Stratum 1

Depth Range: 1081 – 1100 m.

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

39º South: Station 94, Stratum 4

Depth Range: 1030 – 1073 m.

Frequent patches of stony coral rubble and intact stony coral, sand and sandy overlay on bedrock. Many stony coral colonies with crinoids, brisingids, sponges and numerous gorgonians (including *Thouarella*, Primnoids, *Paragorgia*) and black coral. Stony coral clumps generally small (<0.5 m). Regular tiny patches of the purple soft coral (see sled 091) on sometimes dense stony coral rubble. Scaphopods, sea pens, pagurids, asteroids, xenophyophores, animal tracks, gastropods, Farreid sponges on sand. Fish included *Halosauropsis*, basketwork eel, orange roughy, oreo, *Lepidion* and sharks.

39º South: Station 95, Stratum 3

Depth Range: 1063 – 1093 m.

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

39º South: Station 96, Stratum 1

Depth Range: 1066 – 1340 m.

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

APPENDIX 7:

Individual transect descriptions of Ghost Seamount.

Ghost: Station 100, Stratum 4
Depth Range: 645 – 1022 m.
Transect down slope from the summit of a conical hill on top of the seamount, NW direction. Bottom was a mix of sand and large areas of stony coral rubble, with patches of intact stony coral. Sparse benthic fauna, scattered fishes. Substratum changed to rippled sediment at base of conical feature.

Ghost: Station 101, Stratum 5
Depth Range: 916 – 1088 m.
Transect passed over two distinct features (depth about 855 – 1100 m), lots of intact stony coral (some areas 100% cover), stony coral rubble and sand. Most numerous benthic organisms were pagurids and gastropods. Numerous sharks, brisingids, sponges and crinoids. Scattered fishes observed.

Ghost: Station 102, Stratum 3
Depth Range: 1005 – 1107 m.
Gently ascending transect (1107 – 1005 m) across rippled sand. Very low faunal abundance but including xenophyophores, asteroids, pagurids, rattails, and red spider crab.

Ghost: Station 103, Stratum 5
Depth Range: 730 – 918 m.
Started on side of the hill, went up and over continuing on to the base. Substratum predominantly stony coral rubble with large areas of intact stony coral (dead). Some frequent gorgonians, and brisingids. Other fauna scattered and typically sparse.

Ghost: Station 104, Stratum 4
Depth Range: 632 – 930 m.
Initially stony coral rubble, on bedrock, increasing sandy-gravel patches with intermittent bedrock. Possible trawl scours on bedrock, occasional trawl track and lost line. Frequent oreos, rattails, morids. Benthic epifauna comprised some isidid gorgonians, initially numerous stony cup corals, patches of anemones, and generally abundant gastropods.

Ghost: Station 105, Stratum 3
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 about 1000 m. The south side of the hill consisted of bedrock with sand, stony coral rubble and intact stony coral. Very dense low stony coral matrix. Brisingids and crinoids common towards the top of the knoll, with frequent gastropods and demosponges. Beyond the knoll intact stony coral and stony coral rubble dominated as headed NW. After dropping to 1100 m substratum dominated by sand, with pagurids, demosponges, scaphopods, asteroids, anemones, worms, with some rattails.

Ghost: Station 106, Stratum 3
Depth Range: 958 – 992 m.
Flat sandy bottom, ripples, some gravel. Epibenthic fauna comprised gastropods, pagurids, asteroids, ophiuroids. Some animal tracks and burrows. Sparse fish.

Ghost: Station 107, Stratum 3
Depth Range: 761 – 980 m.
Transect line over hill, 831 – 980 m. Top of hill 766 m. Initially on bedrock then a dominance of stony coral rubble, some stony coral intact and sand, but mostly very dense rubble up the slope. After the summit, more stony coral that persisted along most of the transect. Southern and northern flanks had demosponges, brisingids, crinoids, stony cup corals and primnoids associated with rocky outcrops. Sandy regions had gastropods, worms, scaphopods, echinoids, pagurids

Ghost: Station 108, Stratum 3
Depth Range: 1299 – 1393 m.
Substratum 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 xenophyophores.

Ghost: Station 109, Stratum 4

Depth Range: 1041 – 1067 m.
Fairly flat transect, mostly rippled sand. Some individual boulders, with brisingids, some anemones, crinoids, live stony coral clump at 1045 m. Low abundance of fauna. Several straight depressions in the sand noted, possibly trawl marks.

Ghost: Station 110, Stratum 1
Depth Range: 940 – 1050 m.
Majority of transect rippled sand with animal tracks. Small area of intact stony coral towards end with sponges. Low faunal abundance, scattered brisingids and crinoids on bedrock boulders. Typical sand fauna comprised xenophyophores, pagurids, gastropods, asteroids, shrimps and cerianthids. Fish mostly rattails.

Ghost: Station 113, Stratum 4
Depth Range: 730 – 915 m.
This deployment targeted a depth of 730 m on the eastern flank of a hill 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 stony coral and stony coral rubble, with scattered brisingids. Lower down slope there was evidence of trawl marks in areas of stony coral rubble and sand. Sandy towards the base of the feature with pagurids and gastropods (many dead shells).

Ghost: Station 114, Stratum 1
Depth Range: 922 – 1092 m.
Initially sandy gravel, then substantial increase in stony coral rubble and intact stony coral. Large numbers of crinoids and brisingids on dead intact stony coral, some orange roughy and occasional rattails. From 1050 m sandy substratum, with high density of worms, with xenophyophores, cerianthids, echinoids, pagurids, gastropods, scaphopods, animal tracks and burrows.

Ghost: Station 115, Stratum 1
Depth Range: 1056 – 1385 m.
Transect started with sand and ripples with an abundance of worms and burrows, occasional gastropods, shrimps, xenophyophores and cerianthids. Gradual ascent with bedrock, stony coral rubble and gorgonians, primarily *Thouarella*. Intact stony corals with brisingids and crinoids. From 1300 m substrate predominantly sand with a few worms and scaphopods, with fish including orange roughy.

Ghost: Station 117, Stratum 5
Depth Range: 701 – 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 stony coral and some bedrock. Low faunal abundance, predominantly fish: lots of rattails, sharks and black cardinal fish.

Ghost: Station 118, Stratum 5
Depth Range: 687 – 955 m.
Went over 3 hills, a complex transect predominantly rubble, bedrock and/or boulders, some intact stony coral. First half of the transect had many zoanthids and epizoanthids. Abundant brisingids and some black coral (including *Leiopathes*)

Ghost: Station 119, Stratum 3
Depth Range: 873 – 963 m.
Transect over the summit of the hill and down, along the side of the adjacent hill (about 814–1005 m). Started with mixed substratum 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: Station 120, Stratum 1
Depth Range: 873 – 1151 m.
Sandy bottom initially, then rapid change to dense patches of stony coral rubble, some intact stony coral in places. A dense school of cardinal fish, *Epigonus telescopus* at 881 m, some orange roughy, 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 stony coral rubble.

Ghost: Station 121, Stratum 4
Depth Range: 900 – 956 m.

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

Ghost: Station 122, Stratum 1

Depth Range: 1202 – 1254 m.

Sand, few ripples initially with many small xenophyophores along with scattered gastropods, asteroids, sponges, shrimps, scaphopods, cerianthids, animal tracks and burrows. Areas of stony coral rubble and gravel with the occasional echinoid. Striking sections of bedrock-sand ripples/waves in the last 10 minutes. Bedrock/boulders hosted gorgonians, brisingids, sponges, and a single clump of live stony coral at 1254 m.

Ghost: Station 123, Stratum 5

Depth Range: 955 – 1104 m.

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

Ghost: Station 125, Stratum 1

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 echinoids, cerianthids, anemones, orange roughy and rattails.

Ghost: Station 126, Stratum 4

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 stony coral and one patch of bamboo corals (905 m), some crinoids and demosponges.

Ghost: Station 127, Stratum 1

Depth Range: 1104 – 1195 m.

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

Ghost: Station 128, Stratum 2

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 stony coral with crinoids, echinoids and sponges. Last stony coral observation at 1470 m. Transect continued down to (about 1544 m) and intact dead stony coral continued on deeper.

Ghost: Station 129, Stratum 2

Depth Range: 1252 – 1509 m.

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

Ghost: Station 130, Stratum 2

Depth Range: 1305 – 1575 m.

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

Ghost: Station 131, Stratum 1

Depth Range: 11:79 – 1618 m.

Transect run under Dynamic Positioning. DTIS lowered to seafloor and recording started once movement detected. Initially very flat sandy bottom with distinct ripples and occasional worms, asteroids, rattails. 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 with scattered rattails, scaphopods, some crinoids and brisingids.

Ghost: Station 135, Stratum 2
Depth Range: 1407–1602 m.
Landed at 1519 m on ridge to SW of spur, towing upslope to the northeast. Bedrock with sand overlay, at depth of 1487 m intact stony coral, with boulders/bedrock and sand interspaces. Scattered gorgonians. Extensive area of intact stony coral with live stony coral heads from 1462 m up to the top of the ridge at 1407 m, and on northern side to 1422 m. Then bedrock, some stony coral rubble, occasional sponges and crinoids, more bedrock with sand overlay. A small patch of intact stony coral clumps at 1508 m, then rippled sand. Stalked crinoid towards end of run at 1574 m.

APPENDIX 8:

Individual transect descriptions of Valerie Guyot.

Valerie: Station 139, Stratum 3
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, asteroids and echinoids, some xenophyophores, rattails. Numerous burrows and animal tracks.

Valerie: Station 140, Stratum 5
Depth Range: 769 – 787 m.
Relatively flat transect. Sand with some gravel, ophiuroids blanketing the bottom and numerous animal tracks. A few halosaurs. Scattered other fauna, diverse but not numerous.

Valerie: Station 141, Stratum 4
Depth Range: 880 – 902 m.
Most of the transect was over flat terrain, rippled sand with pebbles and a patch of stony coral rubble. Very sparse megafauna, some eels and small sharks.

Valerie: Station 142, Stratum 1
Depth Range: 869 – 968 m.
Sand substratum with some gravel, blanketed with ophiuroids, animal tracks abundant. Trawl gear (warp) at start. Halosaurs most abundant fish, but also rattails, eels, scorpionfish,

Valerie: Station 143, stratum 1
Depth Range: 1085 – 1373 m.
Initially rippled sand, with abundant xenophyophores, ophiuroids, scaphopods. Frequent bedrock patches, stony coral rubble and intact stony coral in places. Some live stony coral clumps on rocky outcrops at 1248 m to 1285 m. Sponges, brisingids.

Valerie: Station 144, Stratum 1
Depth Range: 1081 – 1357 m.
Mixed substratum along this transect, downslope was exposed bedrock with sand interspaces, with intact stony coral, and an orange roughy aggregation from about 1098 – 1195 m. Downslope further from 1200 m had clumps of live stony coral matrix, with brisingids and crinoids.

Valerie: Station 145, Stratum 1
Depth Range: 1164 – 1360 m.
No depth change for the first half an hour, with sand substratum. Epibenthic fauna consisted of xenophyophores, cerianthids, asteroids, shrimps and echinoids. From 1190 m, increasing bedrock and sandy overlay, small stony coral clumps with brisingids and crinoids.

Valerie: Station 146, Stratum 3
Depth Range: 1351 – 1405 m.
Sandy substratum throughout, fauna mainly cerianthids and worms, with rattails the most common fish. Several extensive patches of dense small holothurians (almost transparent, obvious in still images).

Valerie: Station 147, Stratum 4
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 stony coral and live stony coral clumps down to 1460 m. Dense patches of stony coral, with brisingids, crinoids, echinoids (*Dermechinus*), and sponges.

Valerie: Station 148, Stratum 4
Depth Range: 1155 – 1515 m.
Landed straight on dense area 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. Transect extended after video finished, with still camera recording deeper distributions.

Valerie: Station 149, stratum 4
Depth Range: 1124 – 1474 m.

Mixed substratum with sand, patches of intact stony coral and rubble, bedrock and boulders typically with live stony coral. Dense areas of stony corals with crinoids and brisingids. Some orange roughy. Mixed other fauna including echinoids, ophiuroids, and sponges.

Valerie: Station 150, Stratum 4

Depth Range: 1135 – 1400 m.

First part of the transect was predominantly rubble/sand/bedrock with areas of intact stony 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: Station 151, Stratum 1

Depth Range: 1210 – 1623 m.

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

Valerie: Station 152, Stratum 4

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: Station 153, Stratum 3

Depth Range: 861 – 922 m.

Sandy bottom, with occasional bedrock, cobbles and the occasional boulder with dense patches of primnoids. Abundant pagurids, gastropods, ophiuroids, asteroids, cerianthids, xenophyophores on the sandy bottom. Numerous halosaurs, rattails, morids.

Valerie: Station 154, Stratum 1

Depth Range: 1133 – 1336 m.

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