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**1016S Cruise Report: Monitoring survey of Geikie Slide and the
Hebridean Slope NCMPA
Appendix 7: Box corer protocol**

Joey O'Connor and Ellen Last

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Appendix 7: Box corer protocol

Deployment and recovery

Please note that penetration of box corer will be visually confirmed by movement of the block and slack appearing in the deployment wire. To assist this process the cable should be marked off at suitable depth increments (including 10m from the seabed) during the initial deployment or a test deployment.

- Appropriate PPE should be worn at all times (i.e. hard hat, safety boots, coveralls, gloves and life jacket).
- Additional PPE including a harness and fall arrestor should be worn by personnel working inside areas not protected by a guard rail, or as required by individual vessel safety requirements.
- Prior to the start of a new session of work (e.g. start of job, shift change or resumption of operations), a toolbox talk should be held with all personnel involved in the deployment. This will cover all aspects of the deployment including: what is to be achieved, an overview of all safety aspects involved in the deployment and the roles of all personnel within the process.
- The condition of the equipment will be checked and confirmed by the BSL Environmental Scientist on deck. This will include mechanical condition as well as cleanliness.
- Areas to pay particular attention to include:
 - The box should be seated correctly in the lip of the main body prior to fitting the front panel;
 - The gimbals should be inspected visually and manually;
 - The overall status of bolts- ensuring tightness;
 - The condition of wire rope strops;
 - The condition of the grease-free winch wire/dyneema and splice;
 - Ensure the trigger release pin is not bent and sits in the sprung trigger hole correctly;
 - The correct setup and function of all mechanisms.
- A USBL beacon should be attached in the correct orientation and in a position which does not impede proper function of the box corer. It should be turned on directly before deployment.
- Where possible, ensure that the site has been investigated with a camera before the box corer to reduce the potential for damaging any protected or sensitive habitats or the box corer itself.
- The surveyor will direct the vessel to a predefined location, as informed by the Survey Plan. When the bridge officer and surveyor are happy with the position of the vessel, taking into account prevailing weather and current directions, permission to deploy will be given. The bridge officer must be informed when the box corer is deployed, when it reaches the seabed, and when it is safely back aboard the vessel

Deployment of box corer

Prior to any coring operations, the BSL environmental scientist will ensure:

- The box corer is clean and free from sample contamination
- The corer is reloaded/rearmed and ready for deployment
- Weather conditions are suitable to safely lower the corer to the seabed.

During deployment:

- The box corer should be positioned on deck, as close to the deployment area as possible, and directly beneath the block to avoid the load from swinging under tension.
- A clapper board should be recorded on the camera attached to the box corer detailing:
 - Date
 - Station name
 - Attempt
- The box corer should be armed ready for deployment with safety pins still in place. Ensure that the inspection door is in the open position and the trigger plate is in the correct orientation.
- Tag lines should have one end secured to a pad eye on deck while the other is passed through the box corer frame (avoiding potential snags) allowing for line recovery immediately after deployment. Tag lines should not be tied directly onto the box corer.
- All personnel should position themselves suitably on deck. Ideally this will be:
 - The non-seaward side of sampling device;
 - Not blocking winch operators line of sight;
 - Not beneath cables under tension;
 - Not in potential pinch point;
 - Not in coiled cable on deck.
- Permission must be granted from the Bridge before deployment of any equipment.
- Slack should be taken up by the winch operator: enough to lift the central gimbal mechanism but without lifting the box corer off the deck. This will allow the safety pins to be removed.
- Once the safety pins are clear and tag lines are taut, the box corer should be slowly raised and held. Simultaneously the A-frame or crane should be deployed outwards and the winch controlled to lift the device over the edge of the vessel. The box corer should be kept as close to the deck as possible during the deployment.
- The tag lines on each side must be kept taut to control the movement of the box corer.
- The system is now armed and at its most dangerous, so personnel must stand clear. If a problem occurs the reverse of the above process will be undertaken and the box corer will be placed back on deck. Only when the mechanism has been made safe (and confirmed by the BSL environmental scientist), can the problem be resolved.
DO NOT PLACE FINGERS BENEATH THE BOX OR NEAR THE LIFTING STROPS.
- When over the side and clear of the vessel, the box corer should be lowered to the water at a reasonable speed to avoid the chance of pendulum action (appropriate speed to be determined on survey). The box core should be slowed before entering the water to avoid premature triggering.
- On reaching the sea surface any tag lines should be retrieved.
- The box corer should be lowered to approximately 10m below the sea surface and it should be confirmed that the USBL beacon is being tracked (altitude above seabed to be determined on survey).
- The box corer should be lowered at full winch speed to 10m above the seabed, where it will be gently lowered to the seabed at a nominal speed of ~20m/min (*This is important as it ensures the integrity of the surface of the sample*).
- Penetration will be visually confirmed by movement of the block and slack appearing in the deployment wire. To assist this process the cable should be marked off at suitable depth increments (including 10m from the seabed) during the initial deployment or a test deployment.

- The BSL Environment Scientist shall then confirm a fix with the Surveyor and recovery can commence while all relevant station metadata (position, time, depth etc) is logged.
- Once the fix has been confirmed the winch operator should slowly recover the lifting wire and box corer; ensuring smooth and steady bucket closure. Once the box corer is clear of the seabed it can be recovered at full winch speed to the surface.

Recovery procedure

- The box corer can be recovered through the water column at the maximum winch speed, however slow the rate of recovery to ~0.5m/s prior to the equipment breaking the surface.
- Once at the surface tag lines should be attached to the box corer using grappling hooks. It is important to get tag lines attached before recovering the box corer to control any pendulum action.
- Once tag lines are securely attached, the box corer should be simultaneously hauled in and gently brought inboard, maintaining control with the tag lines at all times.
- Once the box corer is completely above the deck it should be lowered onto a pallet truck positioned below the spade and box and secured with chocks.
- The pallet truck should then be jacked up to allow the safety pins to be inserted.
- The box core should be secured before processing should begin.

Prior to and during deployment/recovery of the box corer, the following shall be carried out or taken into account as appropriate:

- The corer arming mechanism has been reset. Once armed, the safety pin should be inserted to prevent it triggering prior to deployment. Once the weight is taken on the cable, while lifting the corer over the side, this pin should be removed. Care must be taken when arming, both during deployment of the corer from the landing table and when removing the pin over the vessel side. There should be two people, one either side, steadying the corer during the deployment and recovery process
- When recovering the corer to the landing table, care must be taken to avoid the equipment striking the ship's hull, both to minimise disturbance of the sediment and prevent damage to either box corer or hull
- Upon completion of all work at a particular site, the corer and deck area must be thoroughly washed down and cleared so that there is no danger of slipping or tripping when it comes to the next deployment. Corer cleanliness is important both to avoid jamming and also for avoidance of sample contamination

Sample acceptance and pre-processing

- A sample will be rejected if there is any evidence of contamination or insufficient volume (see conditions below) has been obtained, evidence of disturbance caused during recovery, or if it is not representative of the intended target seafloor based upon acoustic/video representation.
- The inspection doors should be opened as soon as practical after recovery of the box corer and the contents inspected for sample quality and acceptability by the senior environmentalist.
- The spade retention bolts and front plate should be removed, freeing the sample from the main box corer structure.
- The sample is considered to be acceptable if all of the following conditions are met:
 - Water above sample is undisturbed;
 - Box corer spade and box are sealed together (no sediment washout);

- Penetration of the box corer was sufficient to maintain a seal at the base;
- Box corer was retrieved perfectly upright and had not been fouled in any way;
- Inspection/access doors had closed properly enclosing the sample;
- No disruption of the sample through striking the side of the vessel;
- No contamination in the sample by other sampling equipment;
- Sample was taken inside the acceptable target range (<30m);
- Sample depth was greater than 15-20cm (i.e. not less than 30% of the samplers total capacity);
- No hagfish (*Myxine glutinosa*) and/or mucus coagulants present.
- Once deemed acceptable by the senior environmentalist, the overlying supernatant should be siphoned off the sample through a 9", 250µm sieve.
- Depth of sample should be recorded on the log sheet
- A **LANDSCAPE** digital photograph of the entire sample should be taken in situ with the clapper board containing the following information:
 - Station name (i.e. 1016S_GSH_A01_S1)
 - Date
 - Fix time
 - Water depth

Sample processing

One person will be nominated as Sample Manager, to take charge of the sample processing for ALL samples collected at a particular Station. It is the sole responsibility of this person to ensure that the samples are processed according to this SOP and that ALL the relevant details are entered on the labels and Grab Logsheet for each sample from that station. This is an important part of the Quality Assurance process and the nominated person WILL sign-off the sample processing by entering their initials in the QA section of the Grab Logsheet labelled 'Completed By.' The nominated person will be accountable for rectifying any errors that subsequently come to light.

The principal aim of sample processing on board ship is to reduce the volume of the substrate in the sample whilst retaining the biological material in good condition through careful sieving and appropriate fixation. Back in the shore laboratory, the samples will be sorted by hand to pick out all the biological material. The time and cost of this final processing is significantly reduced by removing the finer particulate matter (silt, mud, and sand) during the on-board sample processing.

PSA sample processing

- Labels should be prepared for the PSA sub-sample stating:
 - Station name (i.e. 1016S_GSH_A01_S1_PSA, see 1016S Data Management Plan for further information regarding naming convention)
 - Date
- A clear 55mm diameter acrylic sampler and plunger will be used to extract a vertical suction core from the centre of the core to the same depth as the faunal layers, to provide a PSA profile to match the faunal samples (typically to 15 cm)
 - Prior to sub-sampling, the sampler should be thoroughly rinsed and cleaned
- A **PROFILE** photograph of the vertical core should be taken
- Particle size analysis (PSA) sub-samples are to be placed in a labelled container and a completed waterproof label placed in and on the outside of the container
- Samples should be immediately transferred to an onboard freezer for storage at -20°C.

Fauna sample processing

- The sample should be sub-divided using two pre-cleaned stainless steel dividers, inserted to a depth of 15cm. This will create two replicate 0.1m² samples and one 0.05m² sample.
 - Sieving of the upper 15 cm is sufficient to capture macrofauna quantitatively. However, the lower part of the sediment column should be spot-checked for large animals such as nemertines and echiurids that may live very deep in the sediment.
- A further two **LANDSCAPE** digital photographs of the replicate samples with the clapper board should be taken as above (check the photographs to ensure they are in focus, evenly exposed and any text is clearly visible)
- A preliminary sediment description should be recorded on the paper log sheet including the following:
 - Sample and site ID
 - Date and time of sample
 - Approximate sediment classification (sand, silt and gravel content)
 - Sediment colour
 - Evidence and description of layering
 - Approximate sediment volume (before sieving)
 - Odour (presence of anoxic matter)

- Reference to deck or other photographs taken
- Surface description (burrows, tubes, casts, bioturbation, uneven etc.)
- Conspicuous fauna
- Vertical structure (obvious horizons, depth of loose surface layer etc.)
- Presence of reef and venting gas indicators (*Sabellaria spinulosa* tubes, *Lophelia pertusa*, mussels, *Beggiatoa*, MDAC, serpulids)
- Presence of anthropogenics such as oil contamination or cuttings.
- Other factors/comments relating to quality of sample including reasons for failed samples, weather conditions etc.
- All failed samples should be photographed and recorded, with reasons for failure recorded where known.
- Care should be taken throughout the entire sample processing to avoid loss of sample material and cross contamination between samples.
- Once a sample has been deemed acceptable, photographed and described following the above criteria, each faunal subsample should be gently emptied to a depth of approximately 15cm (this depth depends to a large degree on surface sediment consolidation) into separate sample trays.
- A small, waterproof internal label should be completed and placed in each deck tray to remain with the sample throughout the rest of the processing procedure (this is particularly important when dealing with two samples simultaneously).
- Megafauna, large macrofauna, nodules and stones are to be picked by tweezer
- The sample should be transferred from the sample tray to the Wilson AutoSiever (WAS) – if each sub-sample is large, this should be a gradual process to avoid overburdening the autosiever.
 - Macrofauna sub samples collected will be sieved using the Wilson Autosiever in ideally <4 °C seawater through sieves of mesh size 0.25mm and 0.5mm, with both fractions retained separately in suitable containers.
 - Should the sample contain a large amount of cohesive clays, approximately 1 teaspoon of sodium hexametaphosphate per 1L of solution should be added to induce separation (note that details of this chemical are to be provided to the SIC for filing in COSHH folder).
 - To achieve this fractions will be processed as follows:
 - *A 0.5mm mesh sieve will be placed on the WAS with a 0.25mm mesh sieve placed to capture run off from the collection chute/exhaust for further sieving*
 - *Please note that this method may present some issue with controlling the outwash volumes passing over the 250µm to prevent from clogging up, and preventing loss of the fines inside the WAS, which would need to be washed down thoroughly between samples.*
 - *Once configured onboard survey staff will decide how practical this approach is in the field.*
 - OR
 - *A 0.25mm mesh sieve will be placed on the WAS*
 - *The 0.25 and 0.5mm fractions will be separated through pooling on completion of sieving*
 - *Please note the effectiveness of the WAS at 0.25mm will be dictated by water pressures supplied by the vessel and the particle size distribution and cohesion of the sediments being processed.*
- WAS operations will be led by the BSL environmental scientist
- Once suitably sieved down, the sieve should be removed from the WAS and the sediment should be pooled to one edge of the sieve and photographed in **LANDSCAPE** with the deck slate.

- The sample should be carefully transferred to a labelled sample container together with the internal label. Any fauna retained from siphoning of the supernatant should be gently sieved through both the 0.5mm and 0.25mm sieves
- Where a sample is split between multiple containers (e.g. large samples, many stones, different size classes) these should be labelled appropriately (e.g. 1 of 2 or 2 of 2). Do not overfill sample containers (samples should be filled not more than 60-70% of the container volume to ensure proper fixation of samples).
- Complete the metadata logsheet entering the remaining sample information
- All faunal samples are labelled with:
 - Date
 - Site name
 - Sample name
 - Sample equipment type (e.g. BC for box corer)
 - Depth range (e.g. 0-10, 0-15)
 - Sieve size class (i.e. 0.25mm or 0.5mm)
- Samples should be fixed in 4% buffered formalin saline solution
- A fixative to seawater ratio of approximately 1 to 4 should be used to ensure the sample is sufficiently preserved.
- The lid should be secured and the sample gently inverted to ensure adequate mixing of the fixative through the whole sample.
- Faunal samples will be stored upright at ambient temperature.
- All equipment should then be washed before further deployments are carried out.

Causes of Deployment Failure

- Complete failure with no sediment in the box indicate that the Box Corer was dragged horizontally over the ground and did not land upright on its frame (there may be some sediment on the frame), pre tripping of the spade or hard (impenetrable) substrate. If the lower edges of the box are bent a rock may have been hit
 - Reason: Ship speed too fast, substrate impenetrable
- Failure with some sediment remnants due to the spade and the box closing indicates pre-tripping of the instrument; in this case the closed legs have penetrated into the bottom and the lower lids grabbed some sediment while the corer was pulled out.
 - Reason: vibrations, wave movements.
- Failure without any sample, with the box open indicates that the hook of the release mechanism on top did not slide out. The release-hook should be well greased so that it can slide out easily, and the siding should be controlled when the release mechanism is prepared before lowering.
 - Reason: the hook on top did not slide out

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